

### Description

The DFS600HF14I4Q1 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

- Blocking voltage 1400V
- $R_{DS(on)} = 3.5m\Omega @ T_j = 25^\circ C, V_{GS} = 20V$
- Low thermal resistance with Si<sub>3</sub>N<sub>4</sub> AMB
- 175°C maximum junction temperature
- Thermistor inside
- Low Switching Losses

### Applications

- xEV Applications
- Motor Drives
- Vehicle Fast Chargers
- Smart-Grid/Grid-Tied Distributed Generation

### Circuit diagram

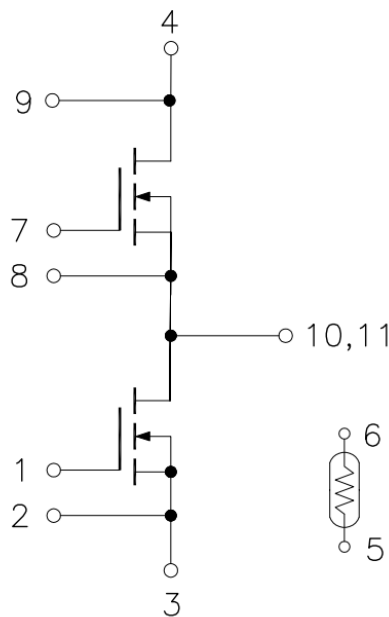


Figure 1. Out drawing & circuit diagram for DFS600HF14I4Q1

## Pin Configuration and Marking Information

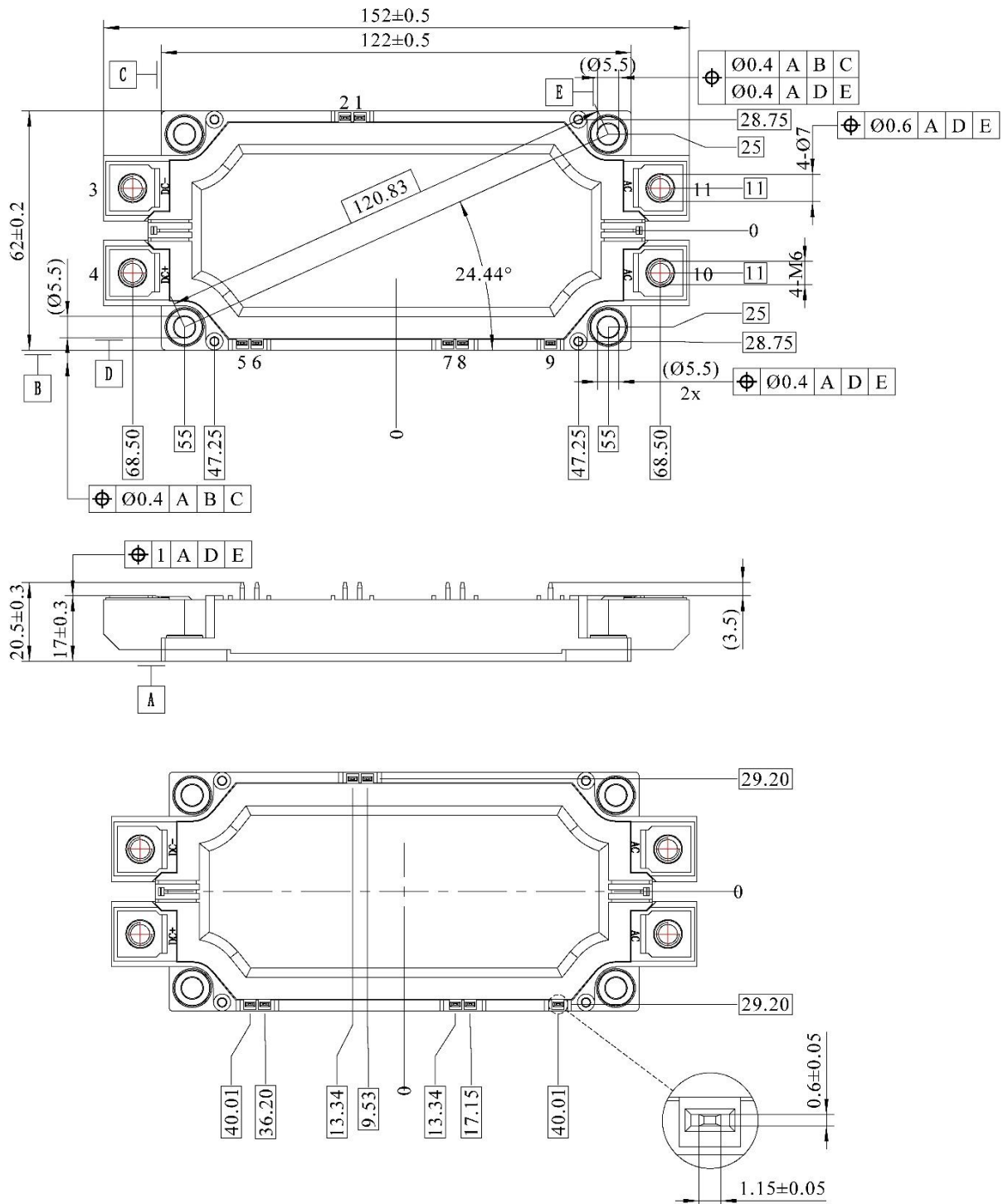


Figure 2. Pin configuration

### Module

Parameter	Conditions	Value	Unit
Isolation Voltage	RMS, f =50Hz, t =1min	4.0	KV
Material of module baseplate	-	Cu	-
Creepage distance	terminal to heatsink terminal to terminal	14.5 13	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	0.5	mΩ
Mounting torque for module mounting	M5, M6	3 to 6	Nm
Weight	-	340	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	1400	V
V <sub>DS nom</sub>	Continuous Operating DC Voltage	Not include surge voltage	1100	V
V <sub>GSS</sub>	Gate-Source Voltage	D-S Short, AC frequency ≥1Hz, Note1	-10 to 25	V
I <sub>DS</sub>	DC Continuous Drain Current	T <sub>c</sub> =60°C, V <sub>GS</sub> =20V	600	A
I <sub>DS</sub>	DC Continuous Drain Current	T <sub>c</sub> =100°C, V <sub>GS</sub> =20V	460	A
I <sub>SD</sub>	Source (Body diode) Current	T <sub>c</sub> =60°C, with ON signal	600	A
I <sub>SD</sub>	Source (Body diode) Current	T <sub>c</sub> =100°C, with ON signal	460	A
I <sub>DSM</sub>	Pulse Forward Current	T <sub>c</sub> =25°C, Pulse width =1ms, V <sub>GS</sub> =20V, Note2	1200	A
P <sub>tot</sub>	Total Power Dissipation	T <sub>c</sub> =25°C	2830	W
T <sub>jmax</sub>	Max Junction Temperature	-	175	°C
T <sub>stg</sub>	Storage Temperature	-	-40 to 125	°C

Note1: Recommended Operating Value, +20V/-5V ,+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 R <sub>100</sub>	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> =6mA	1400	-	-	V	
I <sub>DSS</sub>	Zero gate voltage drain Current	V <sub>DS</sub> =1400V, V <sub>GS</sub> =0V	-	6	-	μA	
V <sub>GS(th)</sub>	Gate-source threshold Voltage	I <sub>D</sub> =120mA V <sub>DS</sub> =V <sub>GS</sub>	T <sub>j</sub> =25°C	1.8	2.5	4.0	V
			T <sub>j</sub> =175°C	-	1.6	-	V
I <sub>GSS</sub>	Gate-Source Leakage Current	V <sub>GS</sub> =20V, V <sub>DS</sub> =0V, T <sub>j</sub> =25°C	-	150	1000	nA	
R <sub>DS(on)</sub> (Chip)	Static drain-source On-state resistance	I <sub>D</sub> =600A V <sub>GS</sub> =20V	T <sub>j</sub> =25°C	-	3.5	-	mΩ
			T <sub>j</sub> =175°C	-	6.3	-	mΩ
		I <sub>D</sub> =600A V <sub>GS</sub> =18V	T <sub>j</sub> =25°C	-	3.9	-	mΩ
			T <sub>j</sub> =175°C	-	6.7	-	mΩ
V <sub>DS(on)</sub> (Chip)	Static drain-source On-state Voltage	I <sub>D</sub> =600A V <sub>GS</sub> =20V	T <sub>j</sub> =25°C	-	2.0	-	V
			T <sub>j</sub> =175°C	-	3.8	-	V
		I <sub>D</sub> =600A V <sub>GS</sub> =18V	T <sub>j</sub> =25°C	-	2.3	-	V
			T <sub>j</sub> =175°C	-	4.0	-	V
C <sub>iss</sub>	Input Capacitance	V <sub>D</sub> =1000V, V <sub>GS</sub> =0V f =200kHz, V <sub>AC</sub> =25mV	-	33.5	-	nF	
C <sub>oss</sub>	Output Capacitance		-	1.57	-	nF	
C <sub>rss</sub>	Reverse transfer Capacitance		-	0.18	-	nF	
Q <sub>G</sub>	Total gate charge	V <sub>DD</sub> =800V, I <sub>D</sub> =300A, V <sub>GS</sub> =+20/-5V	-	1298	-	nC	
R <sub>Gint</sub>	Internal Gate Resistance	T <sub>j</sub> =25°C	-	1.0	-	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/-5V R <sub>G(on)</sub> =3.3Ω R <sub>G(off)</sub> =3.3Ω Inductive load switching operation	T <sub>j</sub> =25°C	-	54	-	ns
			T <sub>j</sub> =150°C	-	48	-	
t <sub>r</sub>	Rise time		T <sub>j</sub> =25°C	-	40	-	ns
			T <sub>j</sub> =150°C	-	33	-	
t <sub>d(off)</sub>	Turn-off delay time		T <sub>j</sub> =25°C	-	35	-	ns
			T <sub>j</sub> =150°C	-	49	-	
t <sub>f</sub>	Fall time		T <sub>j</sub> =25°C	-	20	-	ns
			T <sub>j</sub> =150°C	-	23	-	
E <sub>on</sub>	Turn-on power dissipation		T <sub>j</sub> =25°C	-	14.2	-	mJ
			T <sub>j</sub> =150°C	-	19.5	-	
E <sub>off</sub>	Turn-off power dissipation	T <sub>j</sub> =25°C	-	3.5	-	mJ	
		T <sub>j</sub> =150°C	-	6.1	-		
R <sub>th(j-c)</sub>	FET Thermal Resistance	Junction to Case	-	0.053	-	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	-	4.6	-	V
			T <sub>j</sub> = 150°C	-	4.0	-	
T <sub>rr</sub>	Reverse recovery time	V <sub>RR</sub> = 800V, I <sub>D</sub> = 600A MOSFET side:	T <sub>j</sub> = 25°C	-	35	-	ns
			T <sub>j</sub> = 150°C	-	38	-	
Q <sub>rr</sub>	Reverse recovery charge	V <sub>GS</sub> = +18/-5V R <sub>G(on)</sub> = R <sub>G(off)</sub> = 3.3Ω	T <sub>j</sub> = 25°C	-	2.3	-	uC
			T <sub>j</sub> = 150°C	-	5.8	-	
E <sub>rr</sub>	Diode switching power dissipation	Inductive load switching operation	T <sub>j</sub> = 25°C	-	0.8	-	mJ
			T <sub>j</sub> = 150°C	-	2.6	-	

### Test Conditions

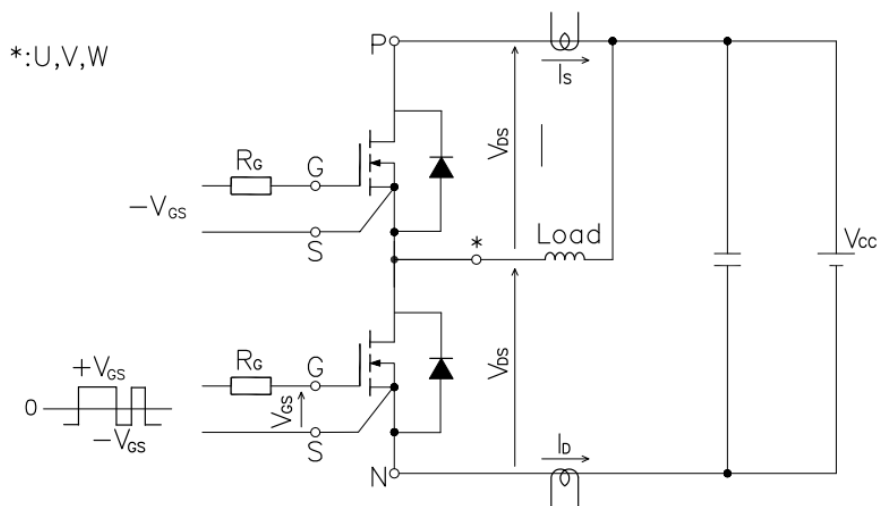


Figure 3. Switching time measure circuit

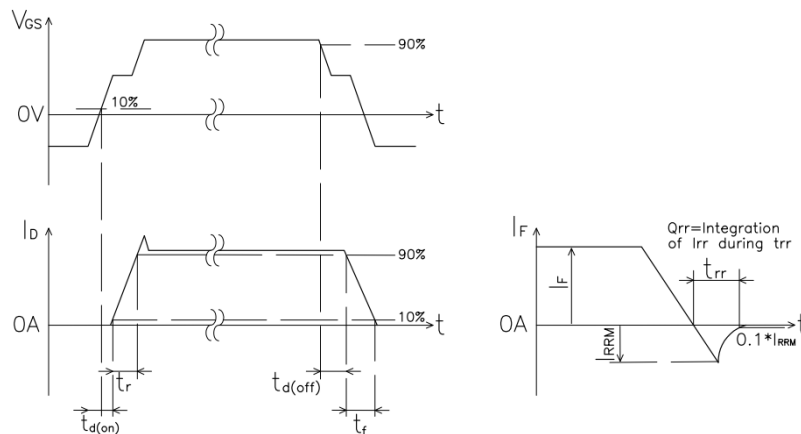


Figure 4. Switching time definition

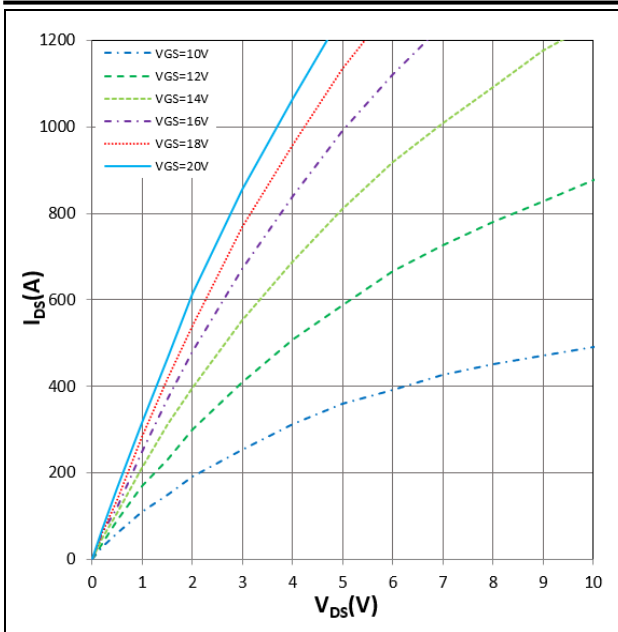


Figure 5.  $I_{DS}$  vs  $V_{DS}$   
 $T_j=25^\circ\text{C}$ ,  $V_{GS}$  parameter

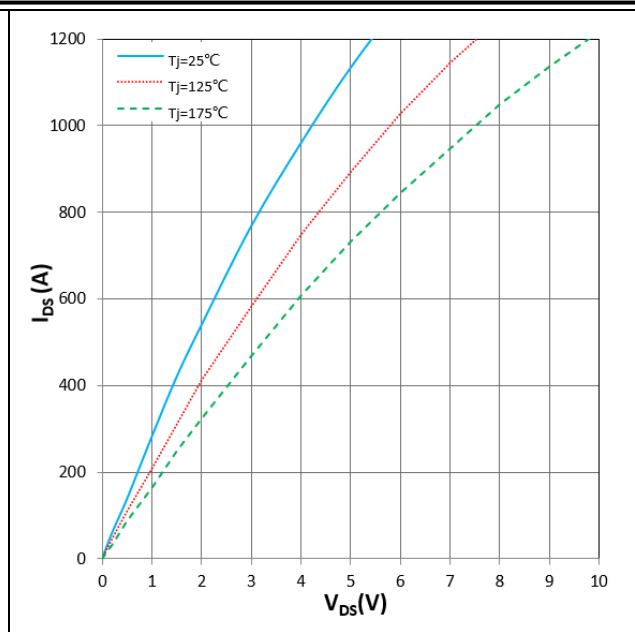


Figure 6.  $I_{DS}$  vs  $V_{DS}$   
 $V_{GS}=18\text{V}$ ,  $T_j$  parameter

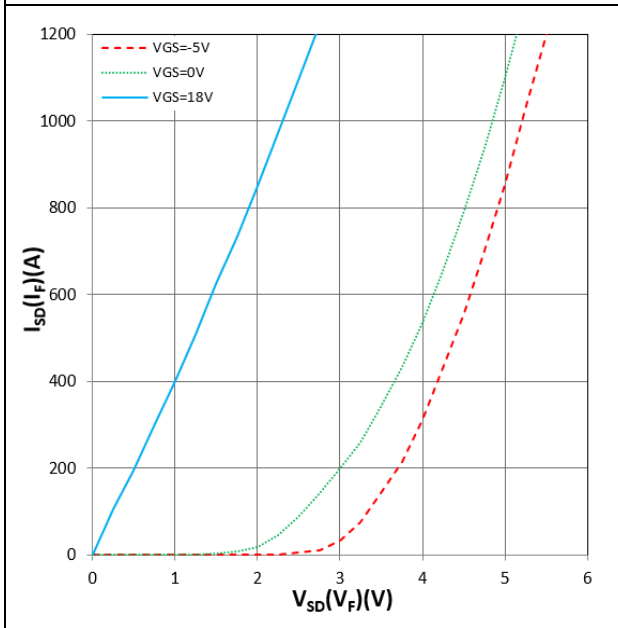


Figure 7.  $I_{SD}(I_F)$  vs  $V_{SD}(V_F)$   
 $T_j=25^\circ\text{C}$ ,  $V_{GS}$  parameter

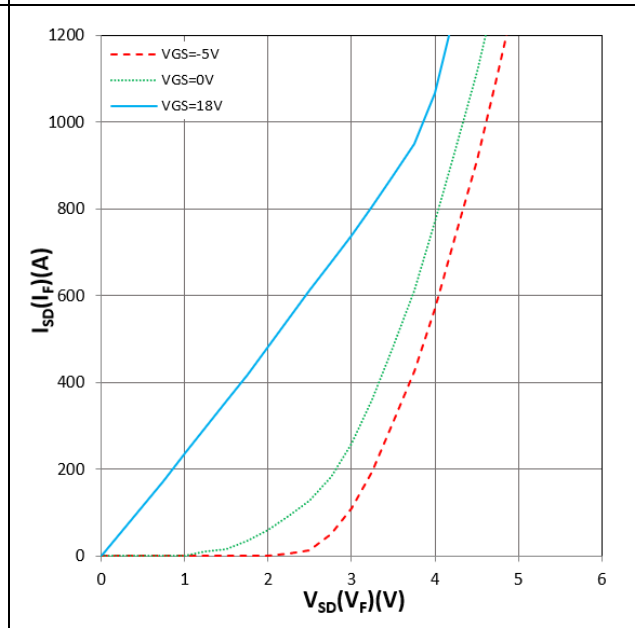


Figure 8.  $I_{SD}(I_F)$  vs  $V_{SD}(V_F)$   
 $T_j=175^\circ\text{C}$ ,  $V_{GS}$  parameter

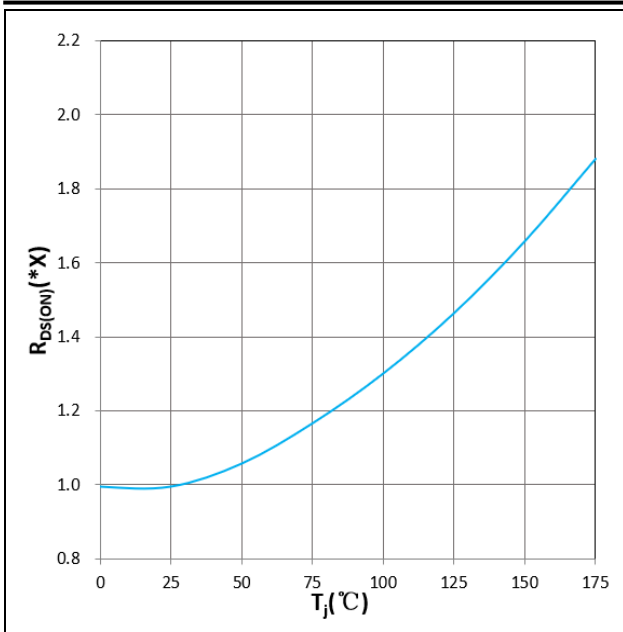


Figure 9.  $R_{DS(ON)}$  vs  $T_j$   
 $V_{GS}=+20V, I_D=600A, 1.0X=3.6m\Omega$

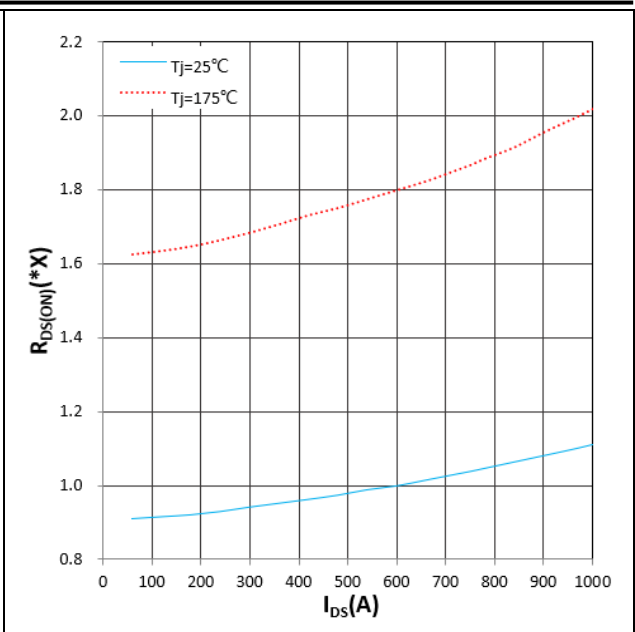


Figure 10.  $R_{DS(ON)}$  vs  $I_{DS}$   
 $T_j=25^\circ C/175^\circ C, V_{GS}=+20V, 1.0X=3.6m\Omega$

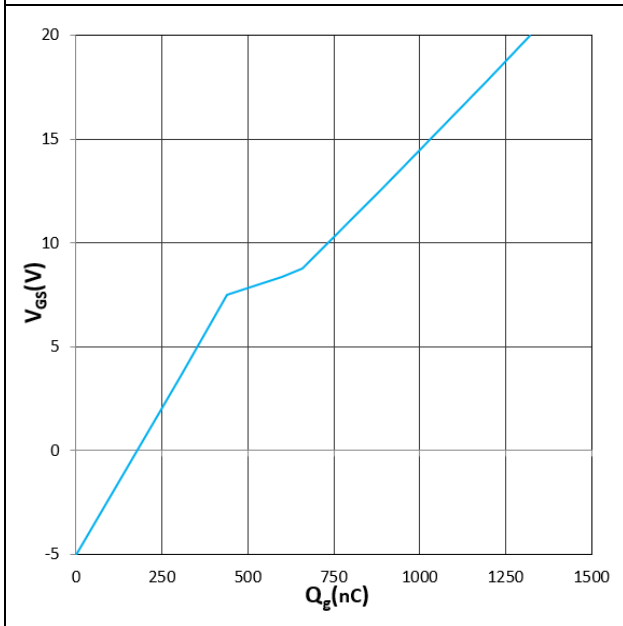


Figure 11.  $V_{GS}$  vs  $Q_g$   
 $T_j=25^\circ C, V_{DS}=800V, I_D=300A$

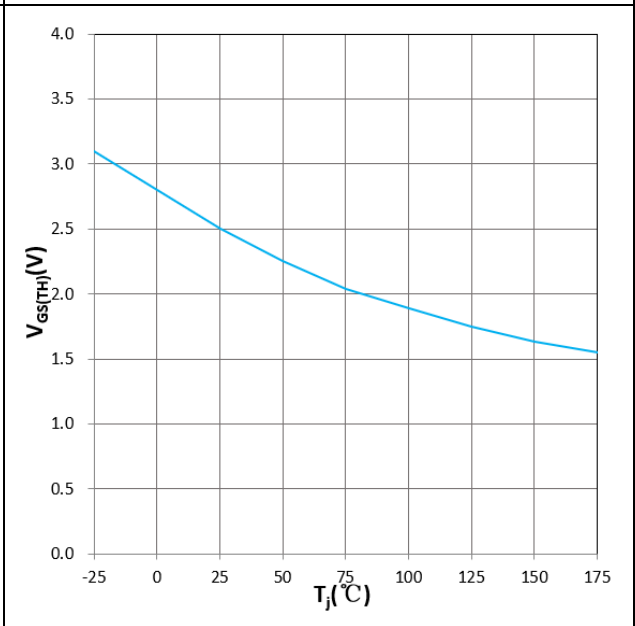


Figure 12.  $V_{GS(TH)}$  vs  $T_j$   
 $V_{GS}=V_{DS}, I_D=120mA$

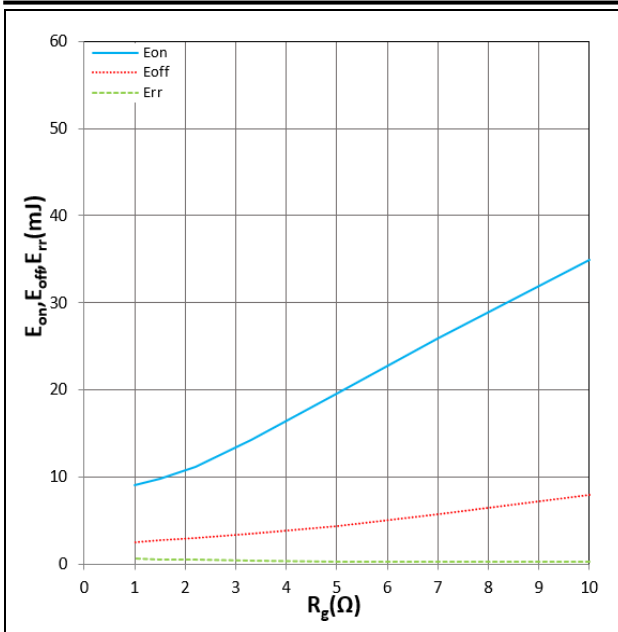


Figure 13. E<sub>on</sub>, E<sub>off</sub>, E<sub>rr</sub> vs R<sub>g</sub>  
T<sub>j</sub>=25°C, V<sub>DD</sub>=600V, V<sub>GS</sub>=+18V/-5V, I<sub>D</sub>=600A  
Inductive Load

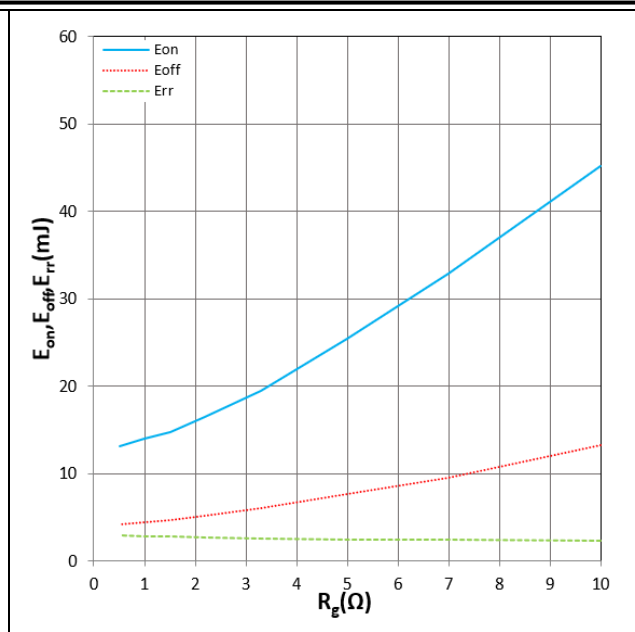


Figure 14. E<sub>on</sub>, E<sub>off</sub>, E<sub>rr</sub> vs R<sub>g</sub>  
T<sub>j</sub>=150°C, V<sub>DD</sub>=600V, V<sub>GS</sub>=+18V/-5V, I<sub>D</sub>=600A  
Inductive Load

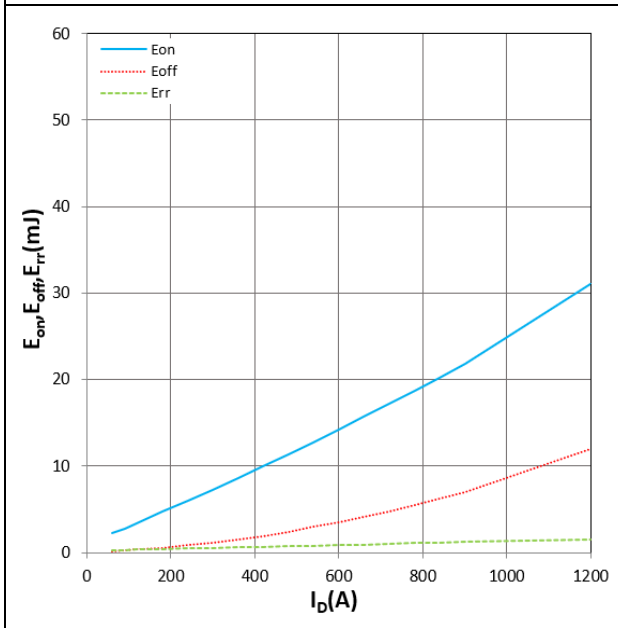


Figure 15. E<sub>on</sub>, E<sub>off</sub>, E<sub>rr</sub> vs I<sub>D</sub>  
T<sub>j</sub>=25°C, V<sub>DD</sub>=600V, V<sub>GS</sub>=+18V/-5V, R<sub>g</sub>=3.3Ω  
Inductive Load

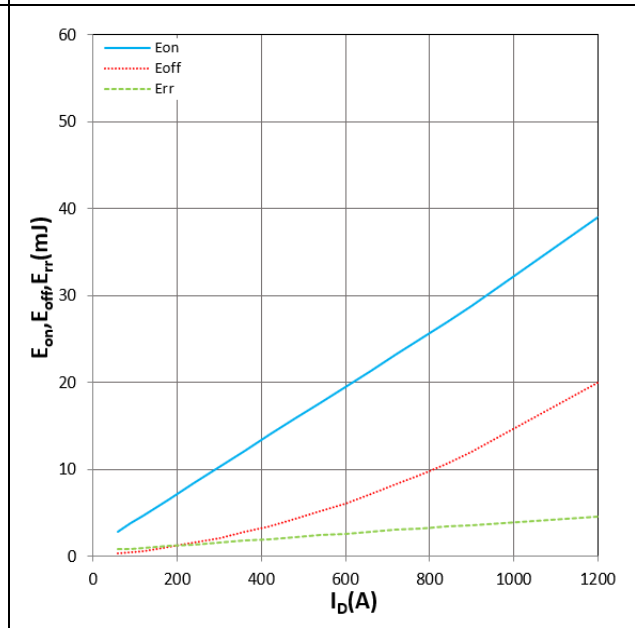


Figure 16. E<sub>on</sub>, E<sub>off</sub>, E<sub>rr</sub> vs I<sub>D</sub>  
T<sub>j</sub>=150°C, V<sub>DD</sub>=600V, V<sub>GS</sub>=+18V/-5V, R<sub>g</sub>=3.3Ω  
Inductive Load



### IMPORTANT NOTICE:

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