

Description

The DFS400HF12I3C2 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/5.4mΩ ($V_{GS}=15V$), 4.5 mΩ ($V_{GS}=18V$)
- Low thermal resistance with Si₃N₄ 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

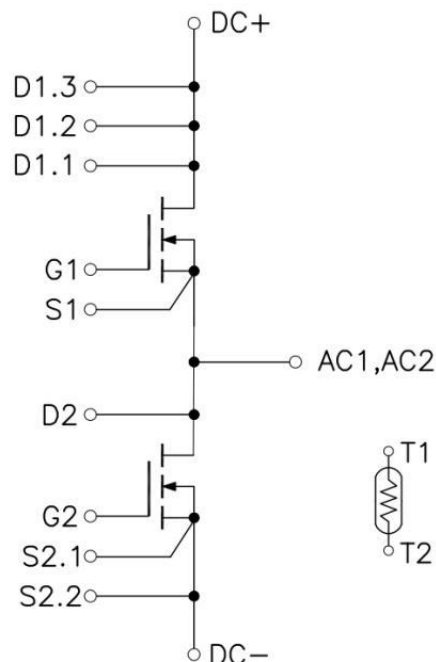


Figure 1. Out drawing & circuit diagram for DFS400HF12I3C2

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

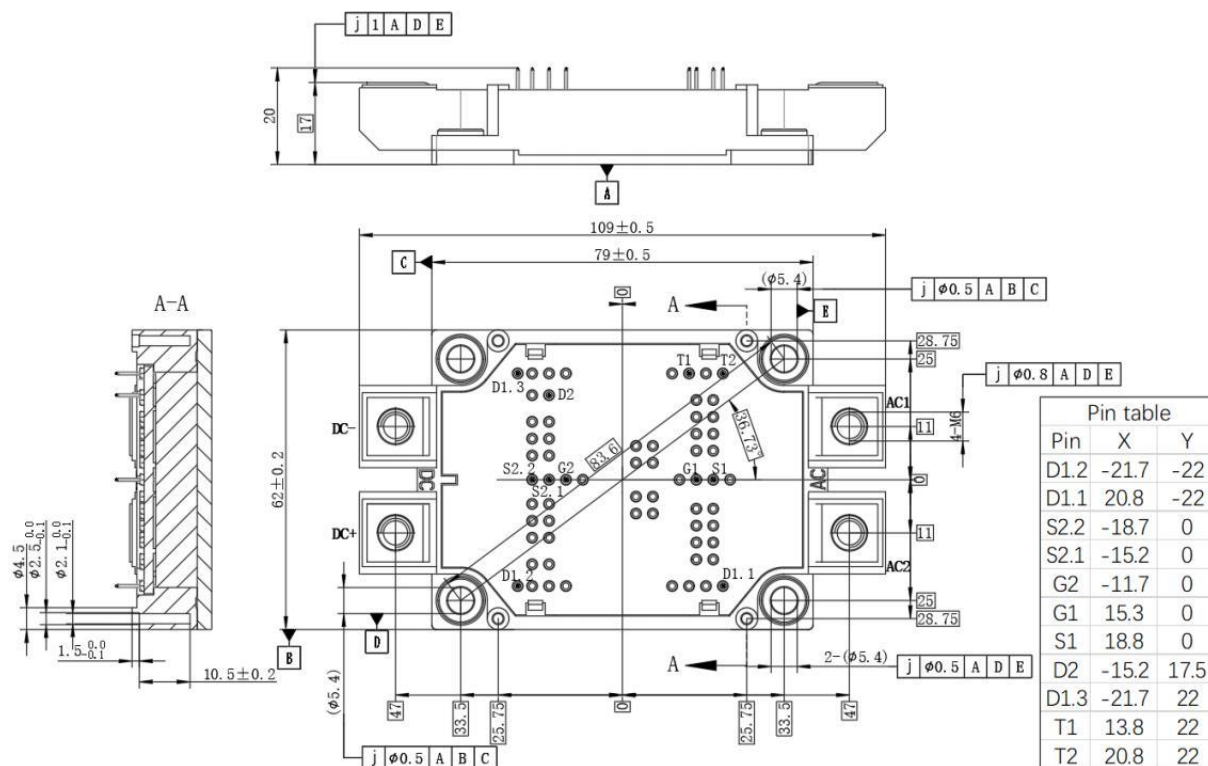


Figure 2. Pin configuration

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 _C =25°C	0.3	mΩ
Mounting torque for module mounting	M5, M6	3 to 6	Nm
Weight	-	250	g

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

Symbol	Parameter	Conditions	Ratings	Unit
V_{DS}	Drain-Source Voltage	G-S Short	1200	V
V_{GS}	Gate-Source Voltage	D-S Short, AC frequency $\geq 1\text{Hz}$, Note1	-10 to 22	V
I_{DS}	DC Continuous Drain Current	$T_f = 25^\circ\text{C}$, $V_{GS} = +15\text{V}$	430	A
I_{DS}	DC Continuous Drain Current	$T_f = 65^\circ\text{C}$, $V_{GS} = +15\text{V}$	370	A
I_{SD}	Source (Body diode) Current	$T_f = 25^\circ\text{C}$, with ON signal	430	A
I_{SD}	Source (Body diode) Current	$T_f = 65^\circ\text{C}$, with ON signal	370	A
I_{DSM}	Pulse Drain Current	$T_c = 65^\circ\text{C}$, Pulse width = 1ms, $V_{GS} = +15\text{V}$, Note2	800	A
P_{tot}	Total Power Dissipation	$T_c = 25^\circ\text{C}$	1720	W
T_{jmax}	Max Junction Temperature	-	175	$^\circ\text{C}$
T_{stg}	Storage Temperature	-	-40 to 125	$^\circ\text{C}$

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_{25}	Resistance	$T_c = 25^\circ\text{C}$	-	5	-	k Ω
$\Delta R/R$	Deviation of R_{100}	$T_c = 100^\circ\text{C}$, $R_{100} = 493\Omega$	5	-	5	%
P_{25}	Power dissipation	$T_c = 25^\circ\text{C}$	-	-	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

Preliminary datasheet_Ver.E EN

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MOSFET Electrical characteristics (T_j=25°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 =400uA		1200	-	-	V
I _{DSS}	Zero gate voltage drain Current	V _{DS} =1200V, V _{GS} =0V		-	4	-	μA
V _{GS(th)}	Gate-source threshold Voltage	I _D =140mA, V _{DS} =V _{GS}	T _j =25°C	1.8	2.7	-	V
I _{GSS}	Gate-Source Leakage Current	V _{GS} =20V, V _{DS} =0V	T _j =25°C	-	-	400	nA
R _{DS(on)} (Chip)	Static drain-source On-state resistance	I _D =400A V _{GS} =+15V	T _j =25°C	-	5.4	8.0	mΩ
			T _j =175°C	-	7.7	-	mΩ
		I _D =400A V _{GS} =+18V	T _j =25°C	-	4.5	-	mΩ
			T _j =175°C	-	6.4	-	mΩ
V _{DS(on)} (Chip)	Static drain-source On-state Voltage	I _D =400A V _{GS} =+15V	T _j =25°C	-	2.16	3.2	V
			T _j =175°C	-	3.08	-	V
		I _D =400A V _{GS} =+18V	T _j =25°C	-	1.80	-	V
			T _j =175°C	-	2.56	-	V
C _{iss}	Input Capacitance	V _D =800V, V _{GS} =0V, f =100KHz		-	23.3	-	nF
C _{oss}	Output Capacitance			-	0.70	-	nF
C _{rss}	Reverse transfer Capacitance			-	0.057	-	nF
Q _g	Total gate charge	V _{DD} =800V, I _D =240A, V _{GS} =+15/-5V		-	720	-	nC
t _{d(on)}	Turn-on delay time	V _{DD} =600V I _D =400A V _{GS} =+15/-4V R _{gon} /R _{goff} =5.1/3.3Ω Inductive load switching operation	T _j =25°C	-	56	-	ns
			T _j =150°C	-	49	-	
t _r	Rise time		T _j =25°C	-	33	-	ns
			T _j =150°C	-	27	-	
t _{d(off)}	Turn-off delay time		T _j =25°C	-	119	-	ns
			T _j =150°C	-	131	-	
t _f	Fall time		T _j =25°C	-	19	-	ns
			T _j =150°C	-	48	-	
E _{on}	Turn-on power dissipation		T _j =25°C	-	13.64	-	mJ

			$T_j = 150^{\circ}\text{C}$	-	13.42	-	
E_{off}	Turn-off power dissipation		$T_j = 25^{\circ}\text{C}$	-	5.64	-	mJ
			$T_j = 150^{\circ}\text{C}$	-	6.11	-	
$R_{\text{th(j-c)}}$	FET Thermal Resistance	Junction to Case		-	0.087	-	K/W
$R_{\text{th(c-f)}}$	Contact thermal Resistance	With thermal conductive grease, Note3		-	0.015	-	K/W

Note3: Assumes Thermal Conductivity of grease is $0.9\text{W/m} \cdot \text{K}$ and thickness is $50\mu\text{m}$.

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

Symbol	Item	Condition		Value			Unit
				Min.	Typ.	Max	
V _{SD}	Body Diode Forward Voltage	V _{GS} =-5V I _{SD} =400A	T _j =25°C	-	5.2	-	V
			T _j =175°C	-	4.3	-	
T _{rr}	Reverse recovery time	V _{DD} =600V I _D =400A	T _j =25°C	-	31	-	ns
			T _j =150°C	-	63	-	
Q _{rr}	Reverse recovery charge	V _{GS} =+15/-4V R _{gon} /R _{goff} =5.1/3.3Ω Inductive load	T _j =25°C	-	1.5	-	μC
			T _j =150°C	-	6.4	-	
E _{rr}	Diode switching power dissipation	switching operation	T _j =25°C	-	0.96	-	mJ
			T _j =150°C	-	2.37	-	

Test Conditions

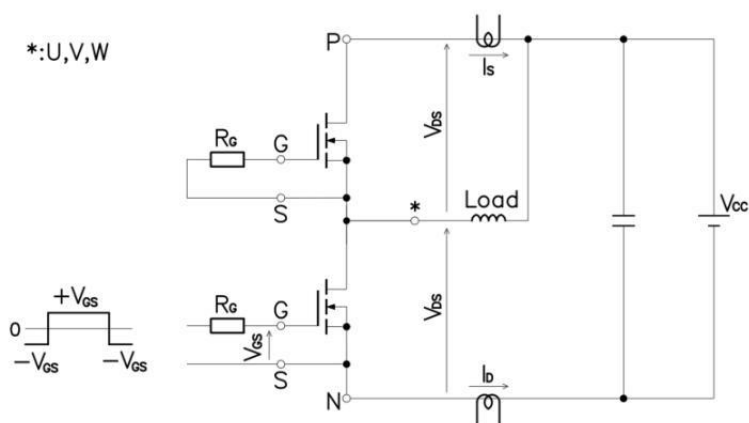


Figure 3. Switching time measure circuit

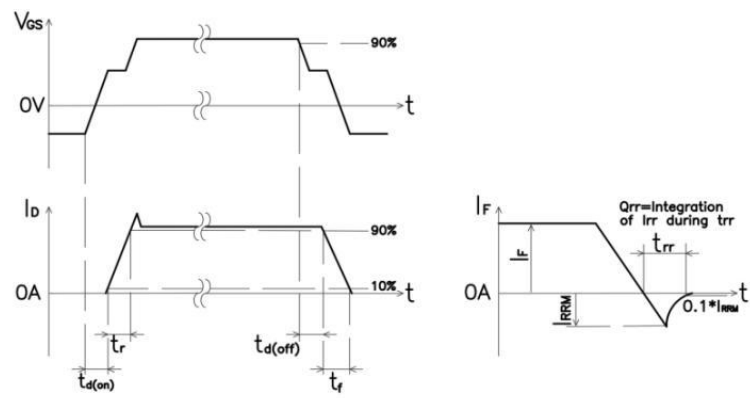


Figure 4. Switching time definition

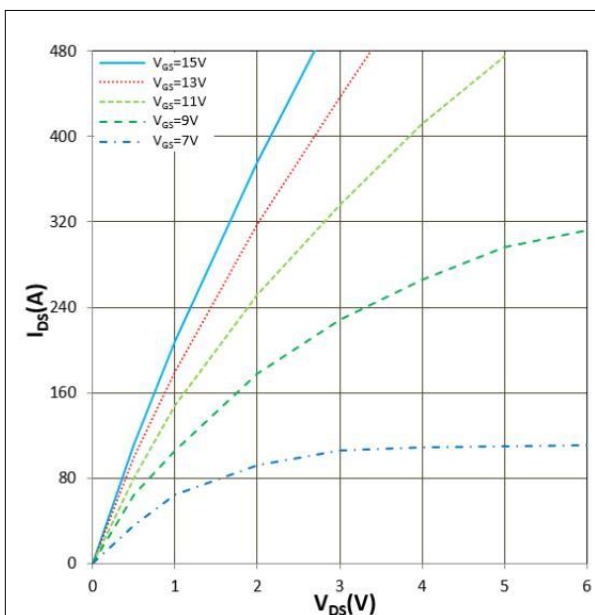


Figure 5. I_{DS} vs V_{DS}
 $T_j = 25^\circ\text{C}$

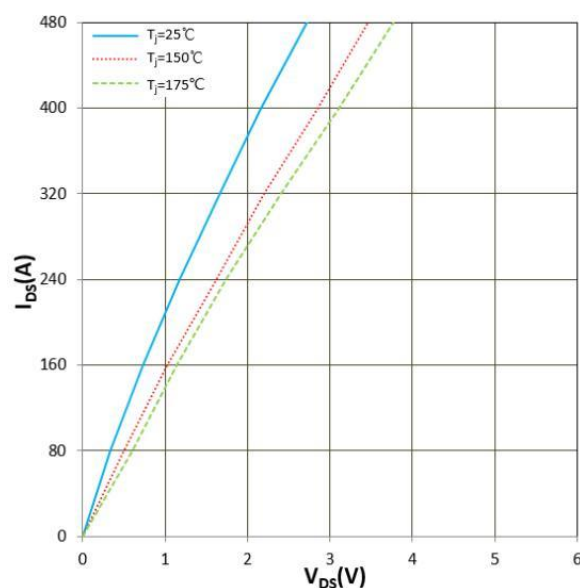


Figure 6. I_{DS} vs V_{DS}
 $V_{GS} = +15\text{V}$

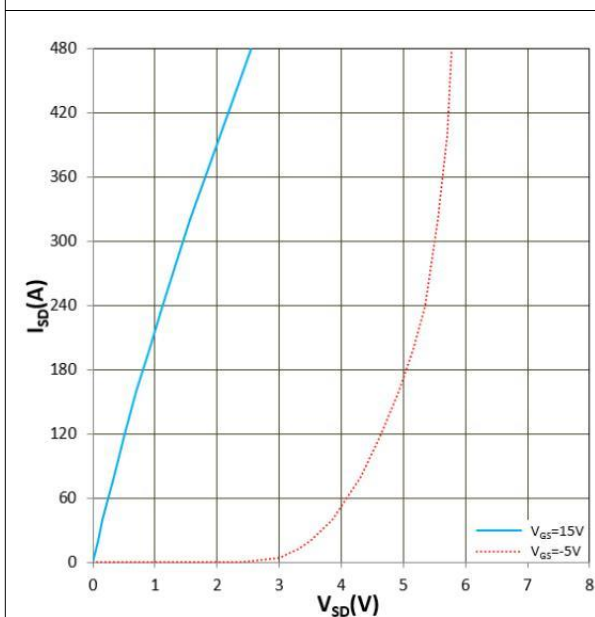


Figure 7. I_{SD} vs V_{SD} (V_F)
 $T_j = 25^\circ\text{C}$

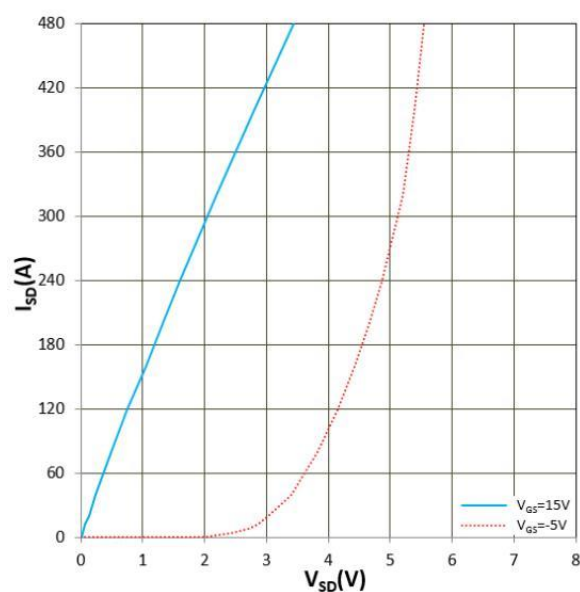


Figure 8. I_{SD} vs V_{SD} (V_F)
 $T_j = 175^\circ\text{C}$

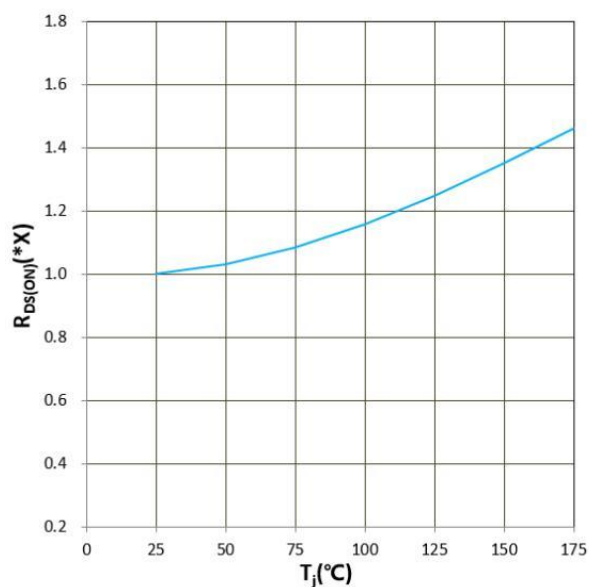


Figure 9. $R_{DS(ON)}$ vs T_J

$V_{GS} = +15\text{V}$, $I_D = 400\text{A}$, $1.0X = 5.4\text{m}\Omega$

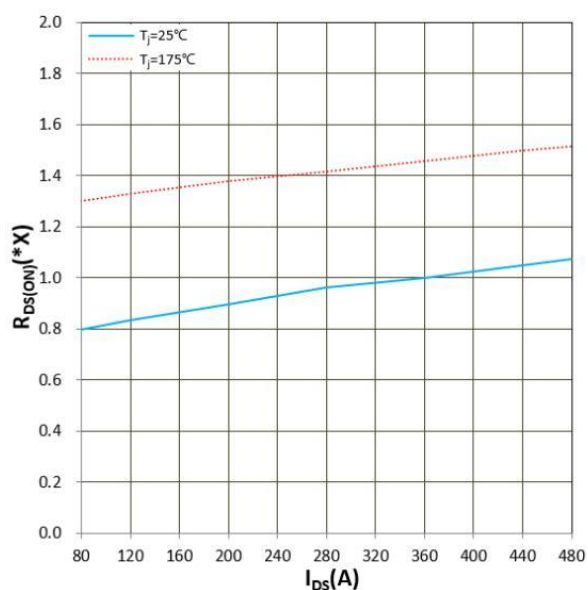


Figure 10. $R_{DS(ON)}$ vs I_{DS}

$V_{GS} = +15\text{V}$, $I_D = 400\text{A}$, $1.0X = 5.4\text{m}\Omega$

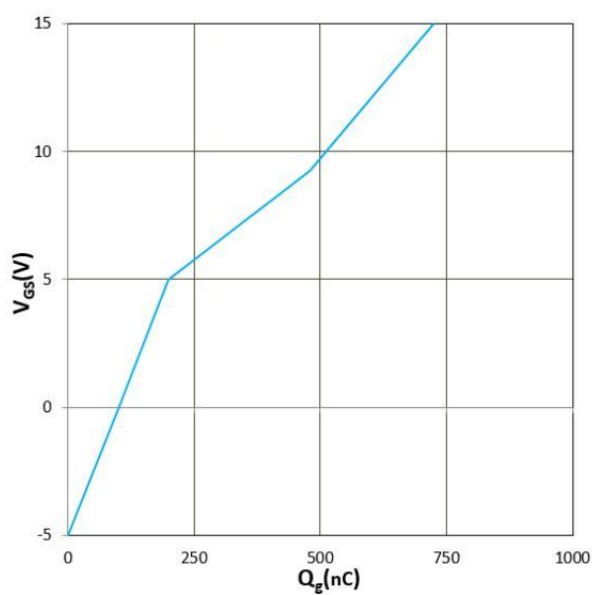


Figure 11. V_{GS} vs Q_g

$V_{DS} = 800\text{V}$, $I_D = 240\text{A}$, $T_J = 25^{\circ}\text{C}$

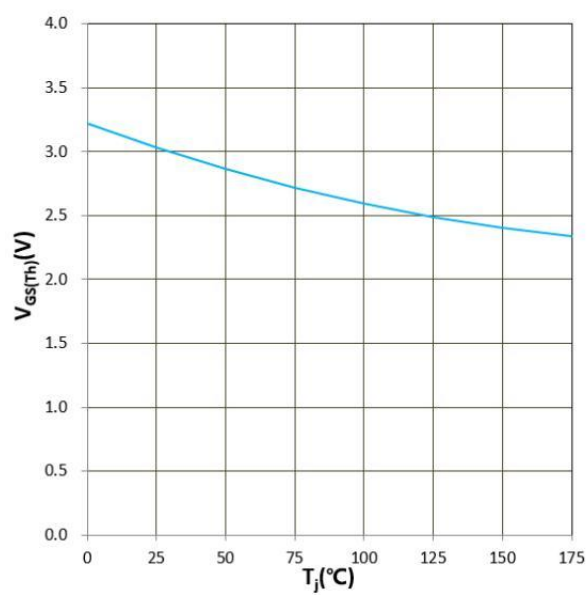


Figure 12. $V_{GS(TH)}$ vs T_J

$V_{GS} = V_{DS}$, $I_D = 140\text{mA}$

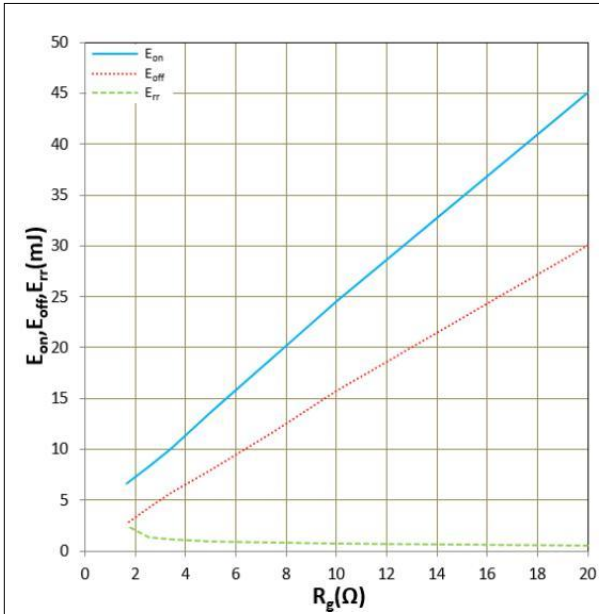


Figure 13. E_{on} , E_{off} , E_{rr} vs R_g
 $T_j = 25^\circ\text{C}$, $V_{CC} = 600\text{V}$, $V_{GS} = +15\text{V}/-4\text{V}$, $I_D = 400\text{A}$
 Inductive Load

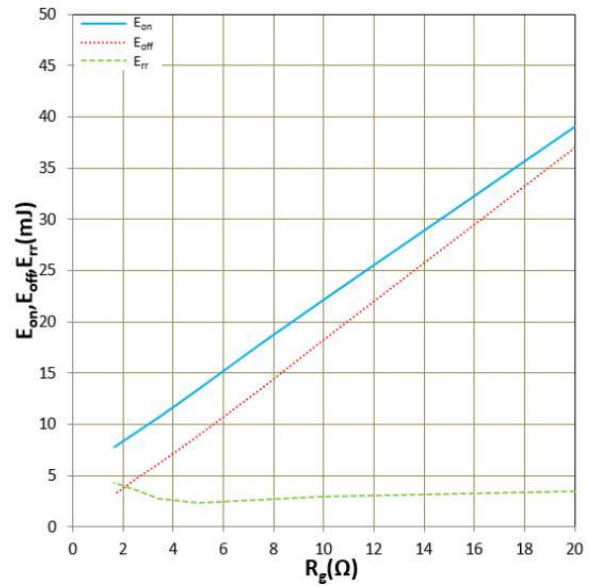


Figure 14. E_{on} , E_{off} , E_{rr} vs R_g
 $T_j = 150^\circ\text{C}$, $V_{CC} = 600\text{V}$, $V_{GS} = +15\text{V}/-4\text{V}$, $I_D = 400\text{A}$
 Inductive Load

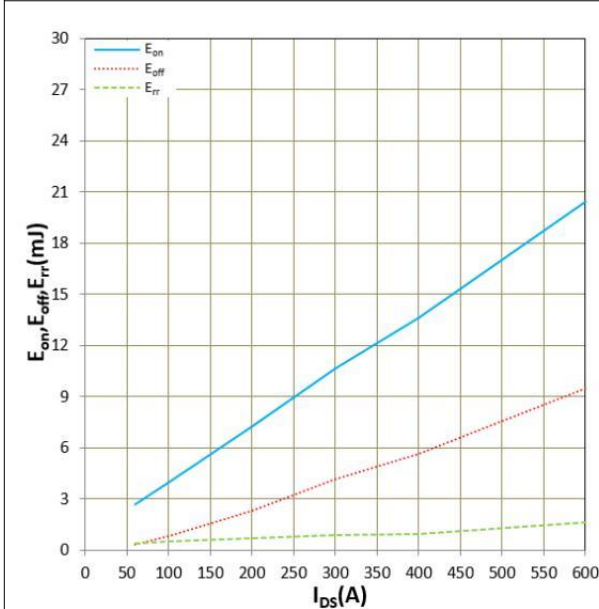


Figure 15. E_{on} , E_{off} , E_{rr} vs I_{DS}
 $T_j = 25^\circ\text{C}$, $V_{CC} = 600\text{V}$, $V_{GS} = +15\text{V}/-4\text{V}$
 $R_{gon}/R_{goff} = 5.1/3.3\Omega$, Inductive Load

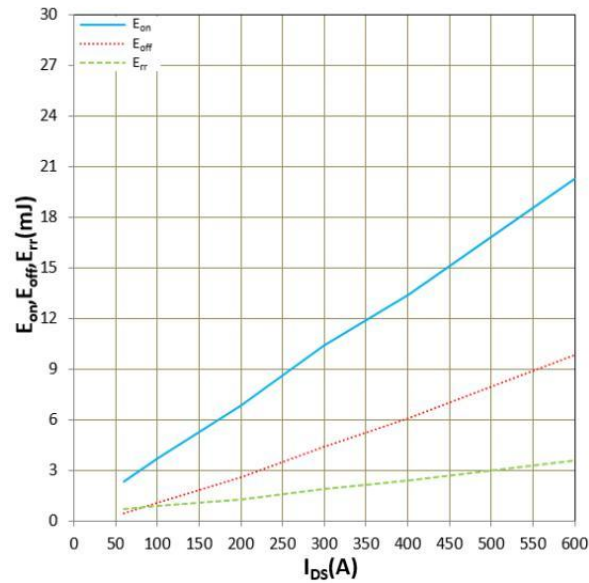


Figure 16. E_{on} , E_{off} , E_{rr} vs I_{DS}
 $T_j = 150^\circ\text{C}$, $V_{CC} = 600\text{V}$, $V_{GS} = +15\text{V}/-4\text{V}$
 $R_{gon}/R_{goff} = 5.1/3.3\Omega$, Inductive Load

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