

HCS400FH170D4C2

1700V/400A Half Bridge SiC MOSFET Module

Description

The HCS400FH170D4C2 is a Half Bridge SiC MOSFET Power Module. It integrates high performance SiC MOSFET chips designed for applications such as the Motor drives and Renewable energy.



Features

- Blocking Voltage 1700V
- $R_{DS(ON)} = 5.2m\Omega @ T_J = 25^\circ C, V_{GS} = 15V$
- Low Thermal Resistance with Si_3N_4 AMB
- 175°C Maximum Junction Temperature
- Low Inductive Design
- Thermistor Inside
- Pressfit Terminal
- Copper Base Size: 79mm*62mm

Application

- Motor Drives
- Servo Drives
- UPS Systems
- Smart-Grid/Grid-Tied Distributed Generation

Circuit Diagram

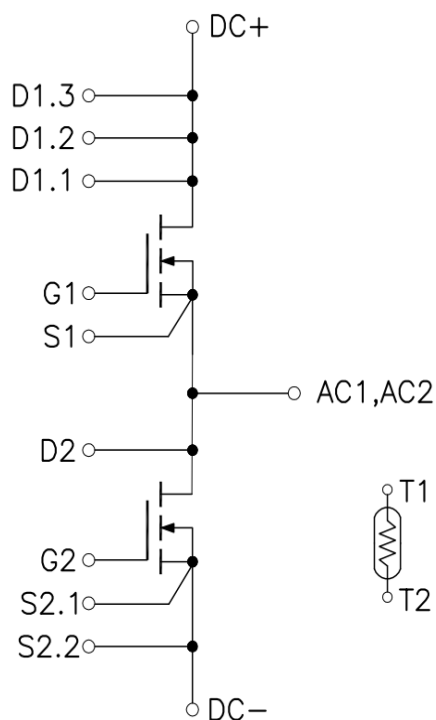


Figure 1. Out Drawing & Circuit Diagram HCS400FH170D4C2

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

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Physical Dimensions

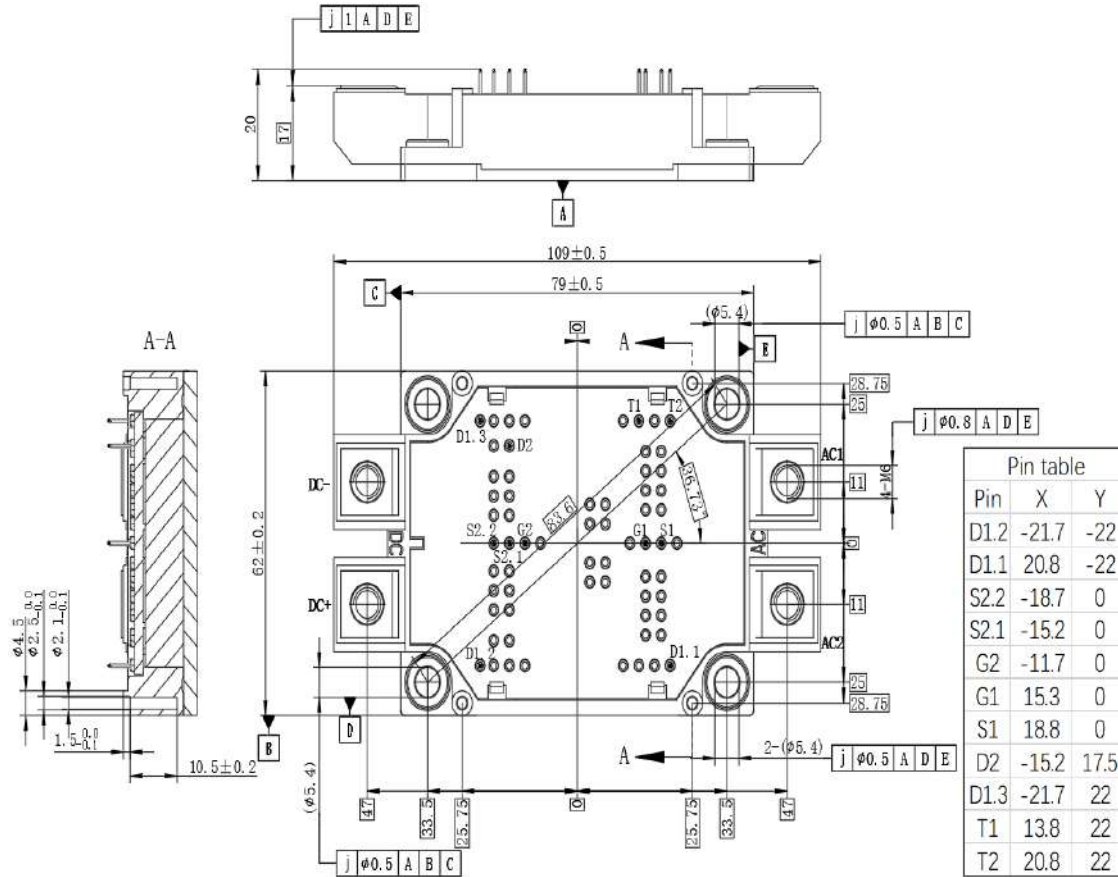


Figure 2. Physical Dimensions

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 10	mm
Clearance	terminal to heatsink terminal to terminal	12.5 10	mm
CTI	-	600	-
Module lead resistance, terminals – chip	Tc=25°C	0.5	mΩ
Mounting torque for module mounting	M5, M6	3 to 6	Nm
Weight	-	250	g

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Maximum Ratings ($T_j=25^{\circ}\text{C}$ Unless Otherwise Specified)

Symbol	Parameter	Conditions	Value	Unit
V_{DS}	Drain-Source Voltage	G-S Short	1700	V
V_{GSS}	Gate-Source Voltage(+)	D-S Short	20	V
V_{GSS}	Gate-Source Voltage(-)	D-S Short	-10	V
$V_{GSS\text{Surge}}$	G-S Voltage (tsurge• 800nsec)	D-S Short, Note1	-10 to 20	V
I_{DS}	DC Continuous Drain Current	$T_f=25^{\circ}\text{C}$, $V_{GS}=15\text{V}$	420	A
I_{DS}	DC Continuous Drain Current	$T_f=80^{\circ}\text{C}$, $V_{GS}=15\text{V}$	330	A
I_{SD}	Source (Body Diode) Current	$T_f=25^{\circ}\text{C}$, with ON signal	420	A
I_{SD}	Source (Body Diode) Current	$T_f=80^{\circ}\text{C}$, with ON signal	330	A
I_{DSM}	Pulse Forward Current	$T_c=25^{\circ}\text{C}$, Pulse width =1ms, $V_{GS}=15\text{V}$, Note2	800	A
P_{tot}	Total Power Dissipation	$T_c=25^{\circ}\text{C}$	2585	W
T_{jmax}	Max Junction Temperature	-	175	$^{\circ}\text{C}$
T_j	Junction temperature	-	-40 to 150	$^{\circ}\text{C}$
T_{slg}	Storage temperature	-	-40 to 125	$^{\circ}\text{C}$

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

Note2: Pulse width limited by maximum junction temperature

NTC Characteristics

Symbol	Parameter	Conditions	Value			Unit
			Min.	Typ.	Max.	
R25	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

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MOSFET Electrical Characteristics ($T_j=25^{\circ}\text{C}$ Unless Otherwise Specified, Chip)

Symbol	Parameter	Conditions		Value			Unit
				Min.	Typ.	Max.	
V _{(BR)DSS}	Drain-Source Breakdown Voltage	V _{GS} =0V, I _D =160μA		1700	-	-	V
I _{DSS}	Zero gate voltage drain current	V _{DS} =1700V, V _{GS} =0V		-	4	160	μA
V _{GS(Th)}	Gate-source threshold voltage	I _D =240mA, V _{DS} =V _{GS}	T _J =25°C	1.8	2.7	-	V
			T _J =175°C	-	1.90	-	V
I _{GSS}	Gate-Source Leakage Current	V _{GS} =15V, V _{DS} =0V	T _J =25°C	-	-	1000	nA
R _{DS(on)} (Chip)	Static drain-source On-state resistance	I _D =400A, V _{GS} =15V	T _J =25°C	-	5.2	7.5	mΩ
			T _J =175°C	-	11.6	-	mΩ
V _{DS(on)} (Chip)	Static drain-source On-state resistance	I _D =400A, V _{GS} =15V	T _J =25°C	-	2.08	3.0	V
			T _J =175°C	-	4.64	-	V
C _{iss}	Input capacitance	V _{DS} =1000V, V _{GS} =0V f =1MHz, V _{AC} =25mV		-	30.5	-	nF
C _{oss}	Output capacitance			-	0.82	-	nF
C _{rss}	Reverse transfer capacitance			-	0.15	-	nF
Q _g	Total gate charge	V _{DD} =1000V, I _D =300A, V _{GS} =-5/+15V		-	1022	-	nC
R _{gint}	Internal gate resistance	T _J =25°C		-	0.48	-	Ω
t _{d(on)}	Turn-on delay time	V _{DD} =900V I _D =400A V _{GS} =+15/-4V R _{G(ON)} =6.8Ω R _{G(OFF)} =6.8Ω Inductive load Switching operation	T _J =25°C	-	165	-	ns
			T _J =150°C	-	129	-	
t _r	Rise time		T _J =25°C	-	123	-	ns
			T _J =150°C	-	93	-	
t _{d(off)}	Turn-off delay time		T _J =25°C	-	515	-	ns
			T _J =150°C	-	646	-	
t _f	Fall time		T _J =25°C	-	80	-	ns
			T _J =150°C	-	102	-	
E _{on}	Turn-on power dissipation		T _J =25°C	-	48.4	-	mJ
			T _J =150°C	-	40.7	-	
E _{off}	Turn-off power dissipation		T _J =25°C	-	46.1	-	mJ
			T _J =150°C	-	49.6	-	
R _{th(j-c)}	FET Thermal Resistance	Junction to Case		-	0.058	-	K/W
R _{th(c-f)}	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.

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Body Diode Electrical Characteristics ($T_j=25^{\circ}\text{C}$ Unless Otherwise Specified, Chip)

Symbol	Parameter	Conditions		Value			Unit
				Min.	Typ.	Max.	
V _{SD}	Body Diode Forward Voltage	V _{GS} =-4V I _{SD} =400A	T _J =25°C	-	5.5	-	V
			T _J =150°C	-	5.2	-	
T _{rr}	Reverse Recovery Time	V _{RR} =900V I _D =400A V _{GS} =+15/-4V R _{G(ON)} =R _{G(OFF)} =6.8Ω Inductive loads Switching operation	T _J =25°C	-	46	-	ns
			T _J =150°C	-	147	-	
Q _{rr}	Reverse Recovery Charge		T _J =25°C	-	2.2	-	μC
			T _J =150°C	-	11.1	-	
E _{rr}	Diode Switching Power Dissipation	T _J =25°C	-	0.5	-	mJ	
		T _J =150°C	-	4.6	-		

Test Conditions

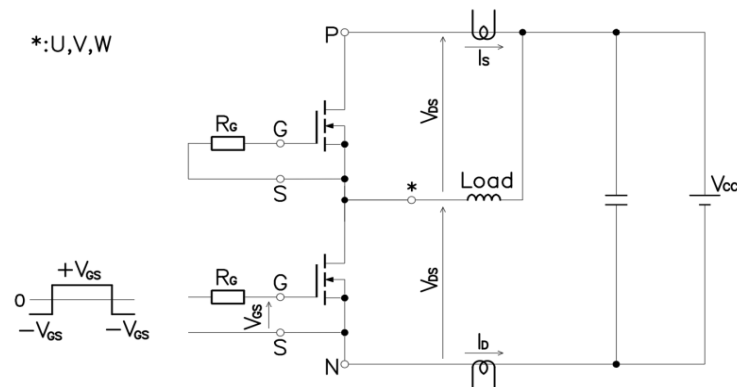


Figure 3. Switching Time Measure Circuit

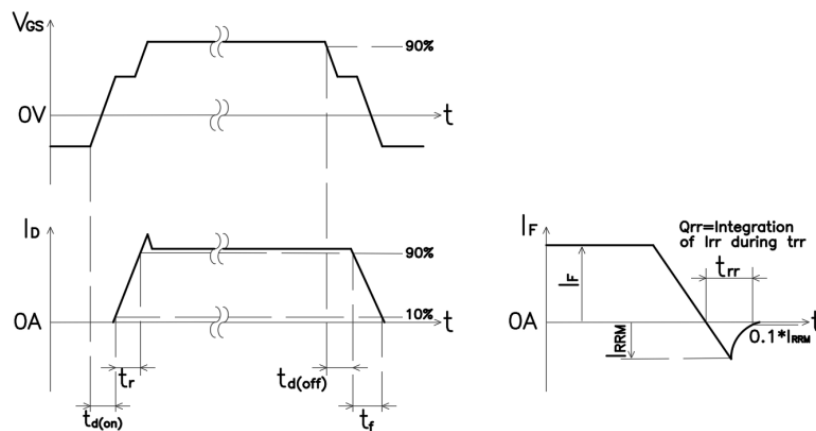


Figure 4. Switching Time Definition

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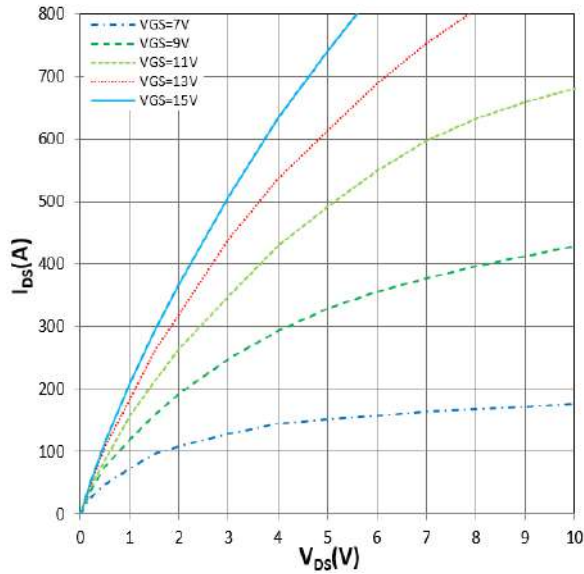


Figure 5. I_{DS} VS V_{DS}
 $T_J=25^{\circ}\text{C}$, V_{GS} Parameter

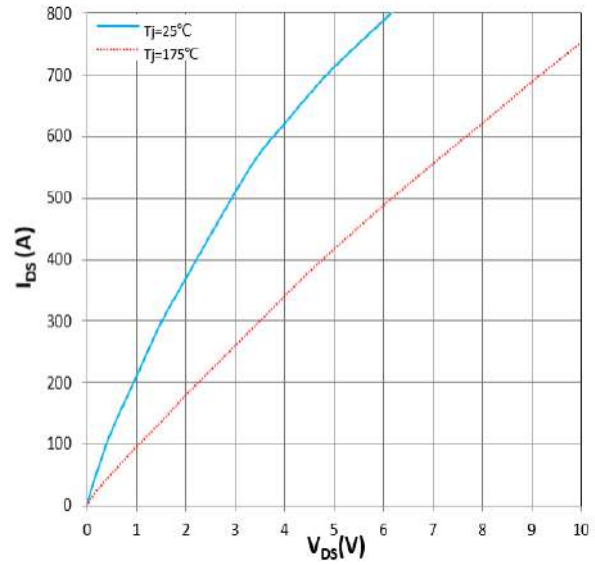


Figure 6. I_{DS} VS V_{DS}
 $V_{GS}=15\text{V}$, T_J Parameter

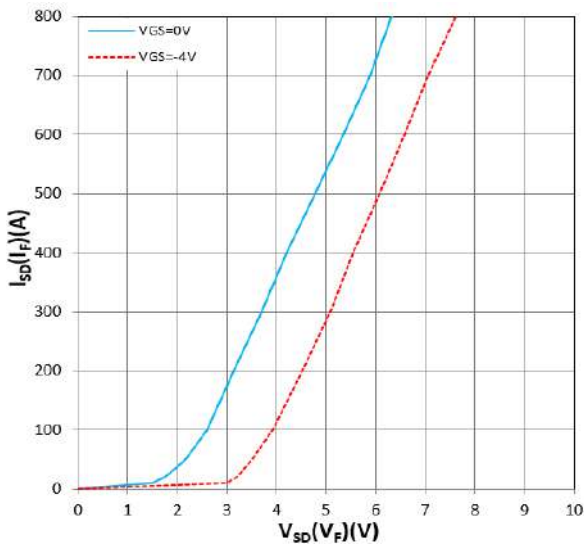


Figure 7. $I_{SD} (I_F)$ VS $V_{SD} (V_F)$
 $T_J=25^{\circ}\text{C}$, V_{GS} Parameter

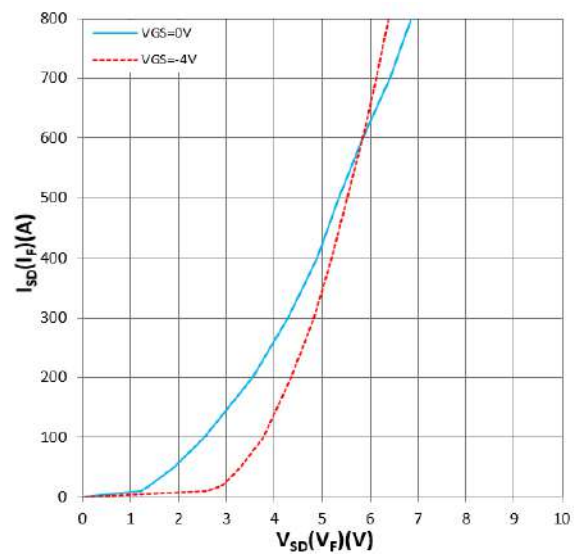


Figure 8. $I_{SD} (I_F)$ VS $V_{SD} (V_F)$
 $T_J=175^{\circ}\text{C}$, V_{GS} Parameter

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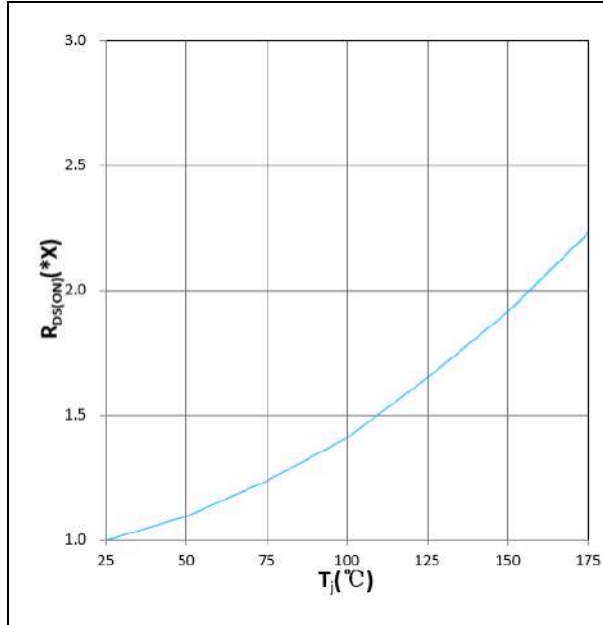


Figure 9. $R_{DS(on)}$ VS T_J
 $V_{GS}=+15V$, $I_D=400A$, 1.0X = 5.2mΩ

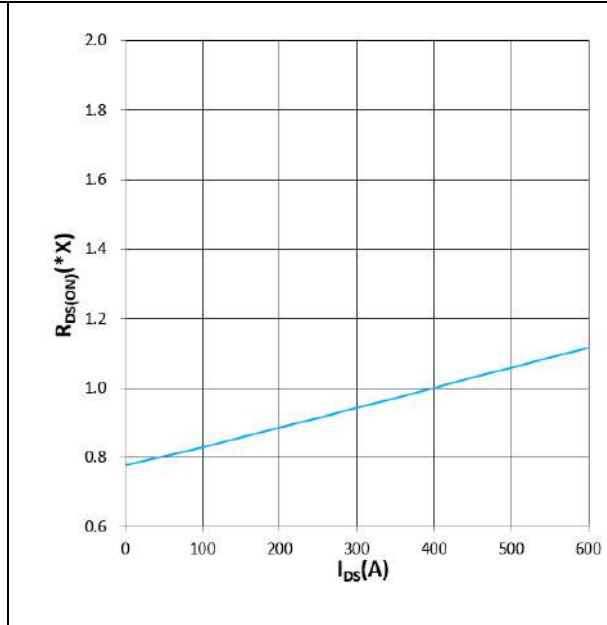


Figure 10. $R_{DS(on)}$ VS I_{DS}
 $V_{GS}=+15V$, $T_J=25^{\circ}C$, 1.0X = 5.2mΩ

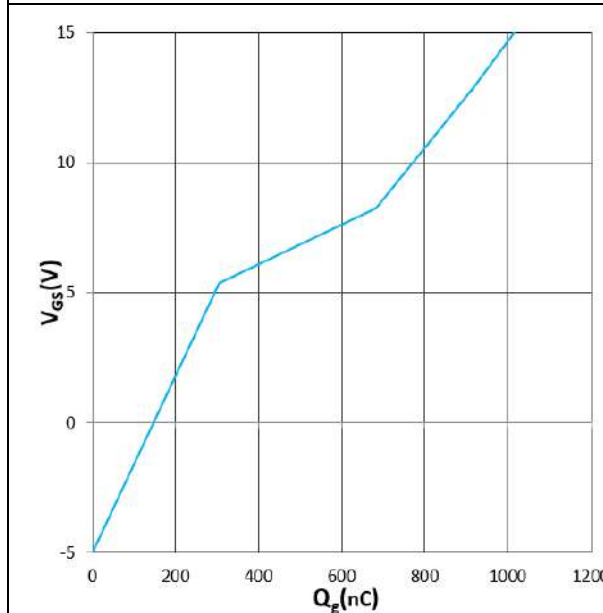


Figure 11. V_{GS} VS Q_g
 $T_J=25^{\circ}C$, $I_D=300A$, $V_{DS}=1000V$

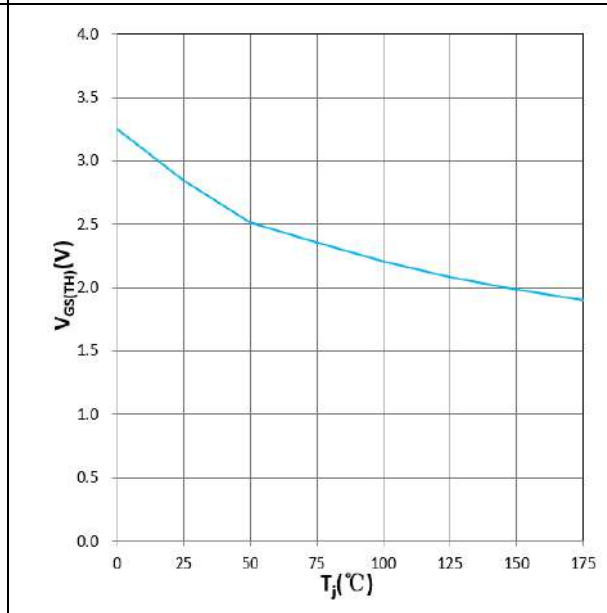


Figure 12. $V_{GS(th)}$ VS T_J
 $V_{GS}=V_{DS}$, $I_D=240mA$

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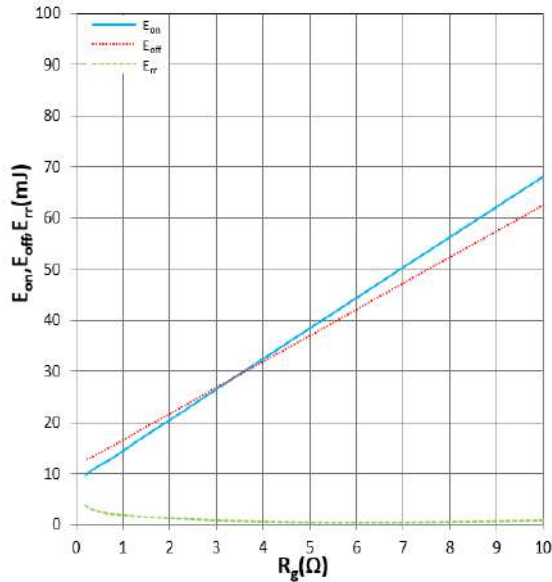


Figure 13. E_{on}, E_{off}, E_r VS R_g
T_j=25°C, V_{cc}=900V, I_D=400A, V_{GS}=+15V/-4V
Inductive Load

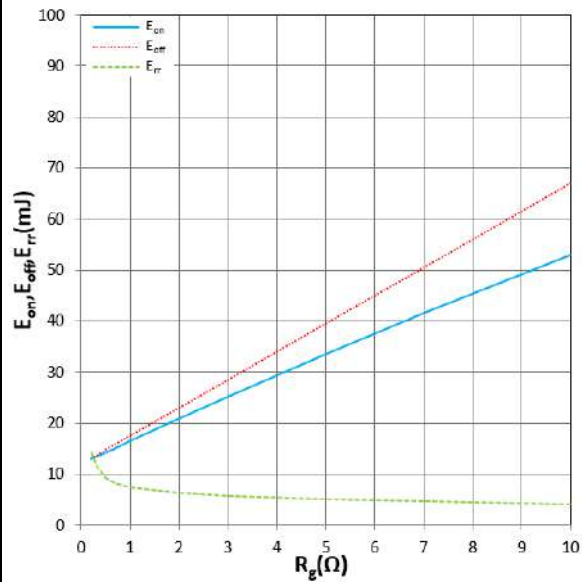


Figure 14. E_{on}, E_{off}, E_r VS R_g
T_j=150°C, V_{cc}=900V, I_D=400A, V_{GS}=+15V/-4V
Inductive Load

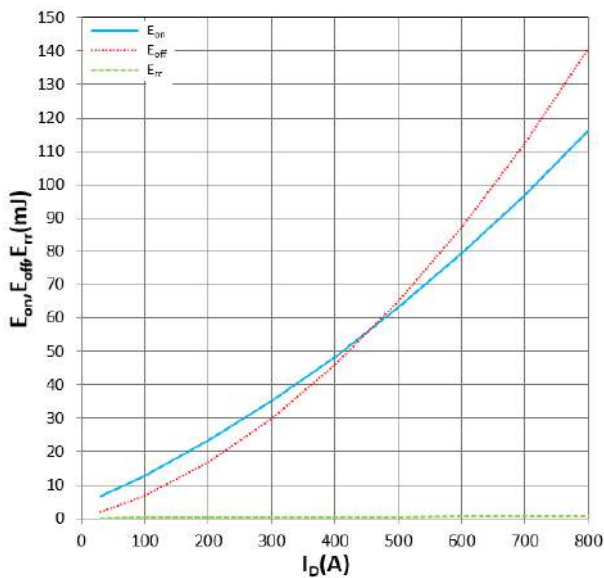


Figure 15. E_{on}, E_{off}, E_r VS I_D
T_j=25°C, V_{cc}=900V, V_{GS}=+15V/-4V, R_g=6.8Ω
Inductive Load

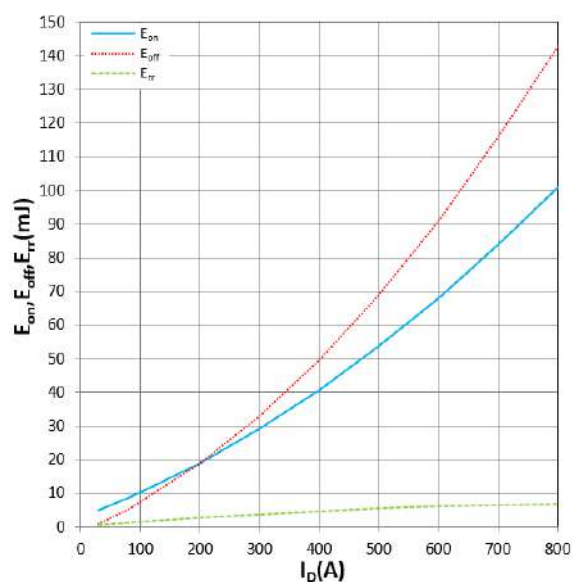


Figure 16. E_{on}, E_{off}, E_r VS I_D
T_j=150°C, V_{cc}=900V, V_{GS}=+15V/-4V, R_g=6.8Ω
Inductive Load

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Revision History

Document Version	Description of Changes
RevX.0.1	Released

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