

HCS600FF120E3C1

1200V/600A Half Bridge SiC MOSFET Module

Description

The HCS600FF120E3C1 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 1200V
- $R_{DS(on)} = 3.2m@V_{GS} = 18V$
- Low thermal resistance with Si₃N₄ 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

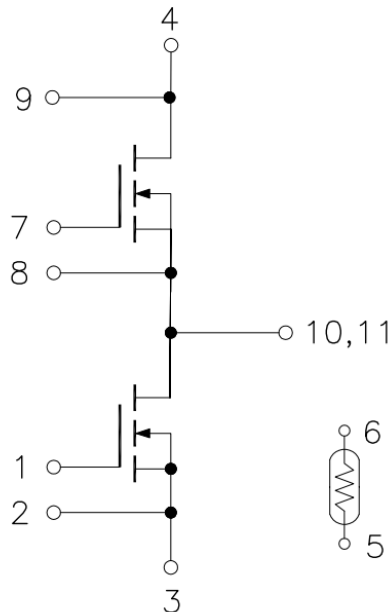


Figure 1. Out drawing & circuit diagram for HCS600FF120E3C1

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Module

Parameter	Condition	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 13	mm
Clearance	terminal to heatsink terminal to terminal	12.5 10	mm
CTI	-	>400	-
Module lead resistance, terminals–chip	T _C =25°C	0.5	mΩ
Mounting torque for module mounting	M5, M6	3 to 6	Nm
Weight	-	340	g

Maximum Ratings (T_j =25°C unless otherwise specified)

Symbol	Parameter	Condition	Ratings	Unit
V _{DSS}	Drain-Source Voltage	G-S Short	1200	V
V _{GSS}	Gate-Source Voltage	D-S Short, AC frequency ≥ 1Hz, Note1	-10 to 22	V
I _{DS}	DC Continuous Drain Current	T _C =25°C, V _{GS} =18V	710	A
I _{DS}	DC Continuous Drain Current	T _C =60°C, V _{GS} =18V	620	A
I _{SD}	Source (Body diode) Current	T _C =25°C, with ON signal	710	A
I _{SD}	Source (Body diode) Current	T _C =60°C, with ON signal	620	A
I _{DSM}	Pulse Forward Current	T _C =25°C, Pulse width =1ms, V _{GS} =20V, Note2	1200	A
P _{tot}	Total Power Dissipation	T _C =25°C	2250	W
T _{jmax}	Max Junction Temperature	-	175	°C
T _{stg}	Storage Temperature	-	-40 to 125	°C

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

Note2: Pulse width limited by maximum junction temperature

NTC characteristics

Symbol	Parameter	Condition	Value			Unit
			Min.	Typ.	Max.	
R ₂₅	Resistance	T _C =25°C	-	5	-	kΩ
ΔR/R	Deviation of R ₁₀₀	T _C =100°C, R ₁₀₀ =493Ω	-5	-	5	%
P ₂₅	Power dissipation	T _C =25°C	-	-	20	mW
B _{25/50}	B-value	R ₂ =R ₂₅ exp [B _{25/50} (1/T ₂ - 1/(298,15 K))]	-	3375	-	K
B _{25/80}	B-value	R ₂ =R ₂₅ exp [B _{25/80} (1/T ₂ - 1/(298,15 K))]	-	3411	-	K
B _{25/100}	B-value	R ₂ =R ₂₅ exp [B _{25/100} (1/T ₂ - 1/(298,15 K))]	-	3433	-	K

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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 =600μA	1200	-	-	V	
I _{DSS}	Zero gate voltage drain Current	V _{DS} =1200V, V _{GS} =0V	-	20	-	μA	
V _{GS(th)}	Gate-source threshold Voltage	I _D =210mA T _j =25°C	1.8	2.7	-	V	
		V _{DS} =V _{GS} T _j =175°C	-	2.1	-	V	
I _{GSS}	Gate-Source Leakage Current	V _{GS} =20V, V _{DS} =0V, T _j =25°C	-	-	600	nA	
R _{DS(on)} (Chip)	Static drain-source On-state resistance	I _D =600A V _{GS} =+15V T _j =25°C	-	3.6	5.0	mΩ	
		T _j =175°C	-	5.2	-	mΩ	
		I _D =600A V _{GS} =+18V T _j =25°C	-	3.2	-	mΩ	
		T _j =175°C	-	4.4	-	mΩ	
V _{DS(on)} (Chip)	Static drain-source On-state Voltage	I _D =600A V _{GS} =+15V T _j =25°C	-	2.16	3.0	V	
		T _j =175°C	-	3.12	-	V	
		I _D =600A V _{GS} =+18V T _j =25°C	-	1.92	-	V	
		T _j =175°C	-	2.64	-	V	
C _{iss}	Input Capacitance	V _D =1000V, V _{GS} =0V f =200kHz, V _{AC} =25mV	-	34.8	-	nF	
C _{oss}	Output Capacitance		-	1.06	-	nF	
C _{rss}	Reverse transfer Capacitance		-	0.086	-	nF	
R _{Gint}	Internal gate resistor	-	-	1.1	-	Ω	
Q _G	Total gate charge	V _{DD} =800V, I _D =360A, V _{GS} =+18/-5V	-	1240	-	nC	
t _{d(on)}	Turn-on delay time	V _{DD} =600V I _D =600A V _{GS} =+18/-5V R _{gon} /R _{goff} =3.3/3.3Ω Inductive load switching operation	T _j =25°C	-	93	-	ns
			T _j =150°C	-	81	-	
t _r	Rise time		T _j =25°C	-	58	-	ns
			T _j =150°C	-	50	-	
t _{d(off)}	Turn-off delay time		T _j =25°C	-	182	-	ns
			T _j =150°C	-	221	-	
t _f	Fall time		T _j =25°C	-	13	-	ns
			T _j =150°C	-	22	-	
E _{on}	Turn-on power dissipation		T _j =25°C	-	18.68	-	mJ
			T _j =150°C	-	17.85	-	
E _{off}	Turn-off power dissipation	T _j =25°C	-	21.30	-	mJ	
		T _j =150°C	-	23.12	-		
R _{th(j-c)}	FET Thermal Resistance	Junction to Case	-	0.066	-	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	Item	Condition	Value			Unit	
			Min.	Typ.	Max.		
V_{SD}	Body Diode Forward Voltage	$V_{GS} = -5\text{V}$ $I_{SD} = 600\text{A}$	$T_j = 25^\circ\text{C}$	-	6.3	-	V
			$T_j = 175^\circ\text{C}$	-	5.6	-	
T_{rr}	Reverse recovery time	$V_{DD} = 600\text{V}$ $I_D = 600\text{A}$	$T_j = 25^\circ\text{C}$	-	33	-	ns
			$T_j = 150^\circ\text{C}$	-	47	-	
Q_{rr}	Reverse recovery charge	$V_{GS} = +18/-5\text{V}$ $R_{gon}/R_{goff} = 3.3/3.3\Omega$	$T_j = 25^\circ\text{C}$	-	1.99	-	uC
			$T_j = 150^\circ\text{C}$	-	5.87	-	
E_{rr}	Diode switching power dissipation	Inductive load switching operation	$T_j = 25^\circ\text{C}$	-	0.56	-	mJ
			$T_j = 150^\circ\text{C}$	-	1.99	-	

Test Conditions

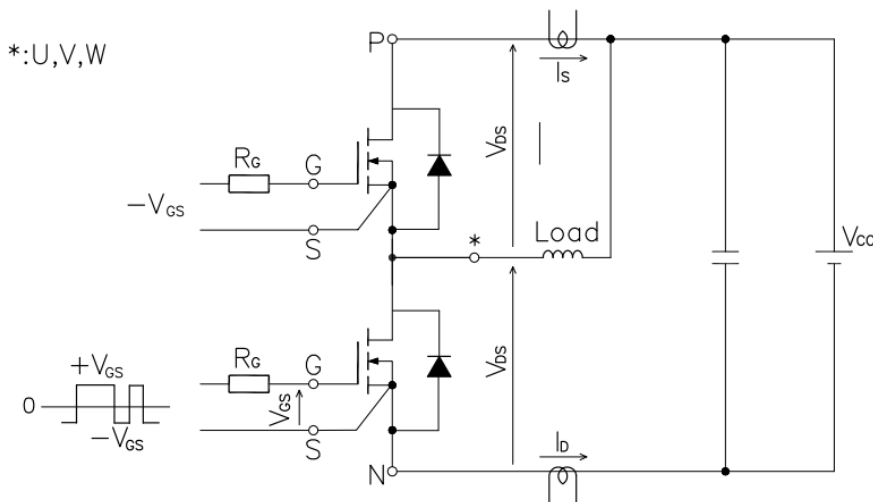


Figure 3. Switching time measure circuit

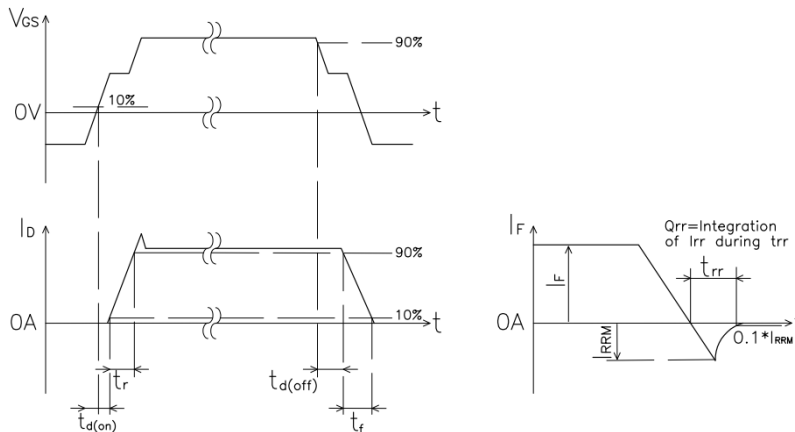


Figure 4. Switching time definition

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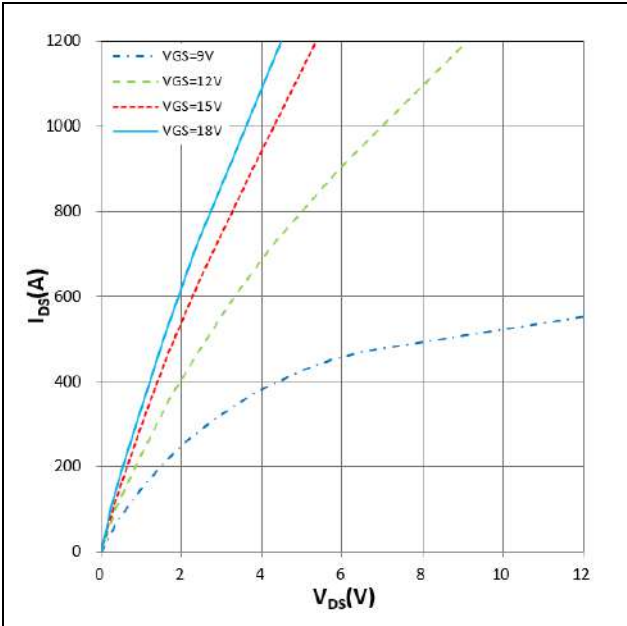


Figure 5. I_{DS} vs V_{DS}
 $T_j=25^\circ\text{C}$, V_{GS} parameter

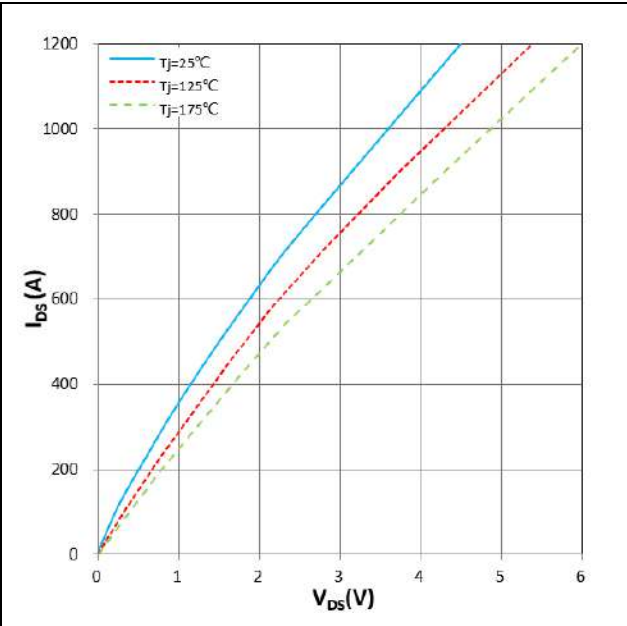


Figure 6. I_{DS} vs V_{DS}
 $V_{GS}=18V$, T_j parameter

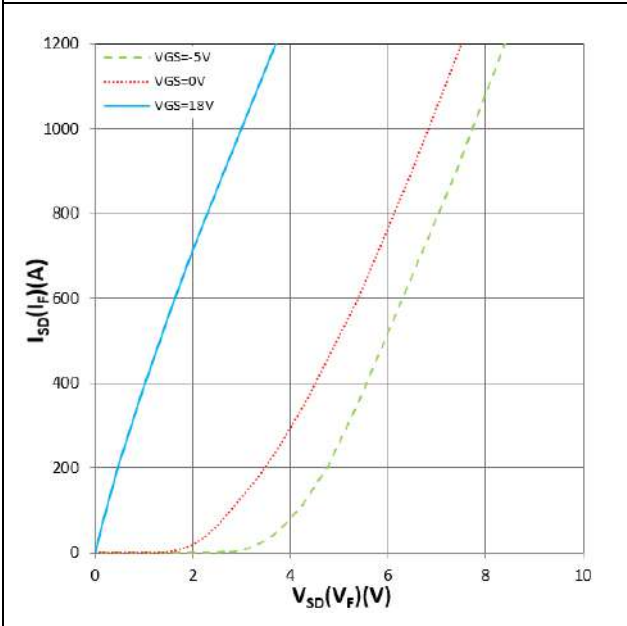


Figure 7. $I_{SD}(I_F)$ vs $V_{SD}(V_F)$
 $T_j=25^\circ\text{C}$, V_{GS} parameter

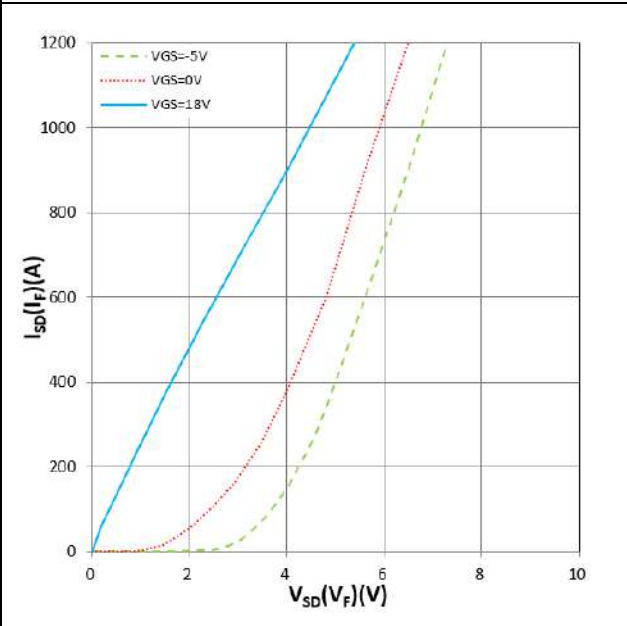


Figure 8. $I_{SD}(I_F)$ vs $V_{SD}(V_F)$
 $T_j=175^\circ\text{C}$, V_{GS} parameter

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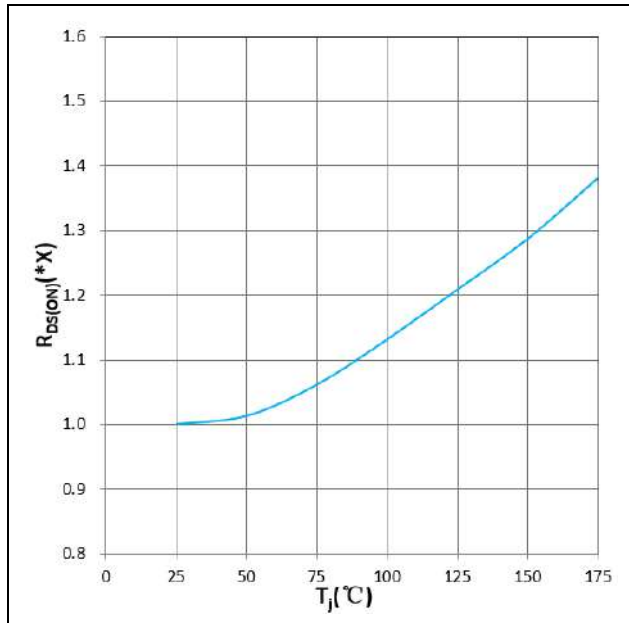


Figure 9. $R_{DS(ON)}$ vs T_j
 $V_{GS}=+18V$, $I_D=600A$, $1.0X=3.2m\Omega$

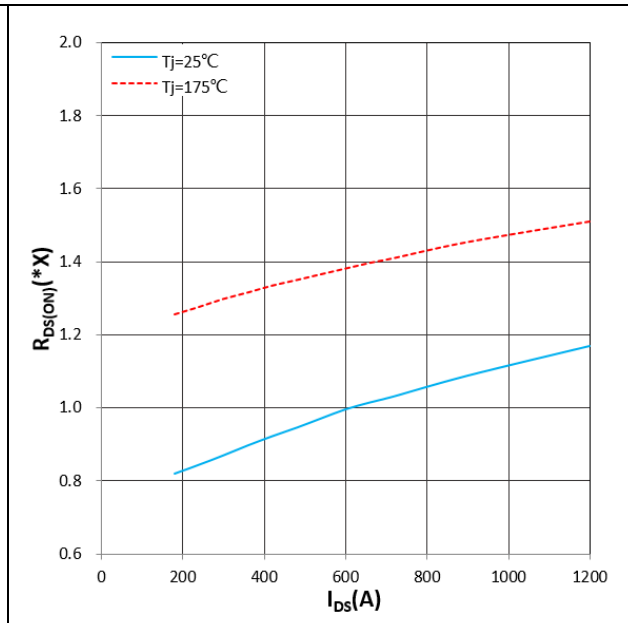


Figure 10. $R_{DS(ON)}$ vs I_{DS}
 $T_j=25/175^\circ C$, $V_{GS}=+18V$, $1.0X=3.2m\Omega$

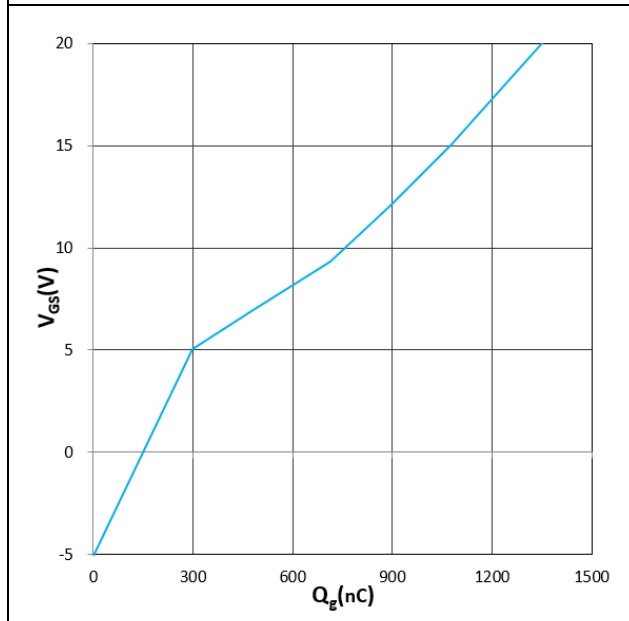


Figure 11. V_{GS} vs Q_g
 $T_j=25^\circ C$, $V_{DS}=800V$, $I_D=360A$

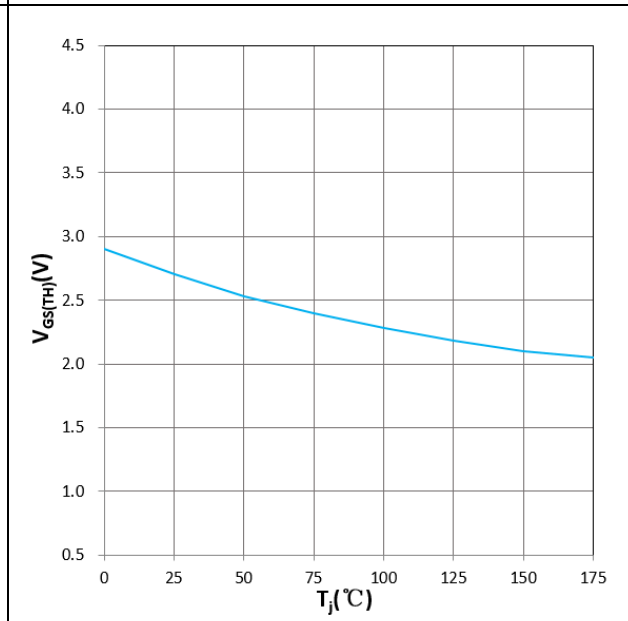
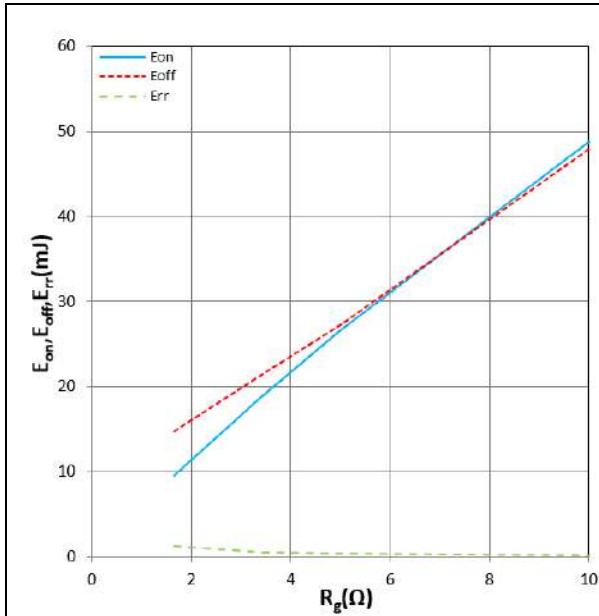


Figure 12. $V_{GS(TH)}$ vs T_j
 $V_{GS}=V_{DS}$, $I_D=210mA$

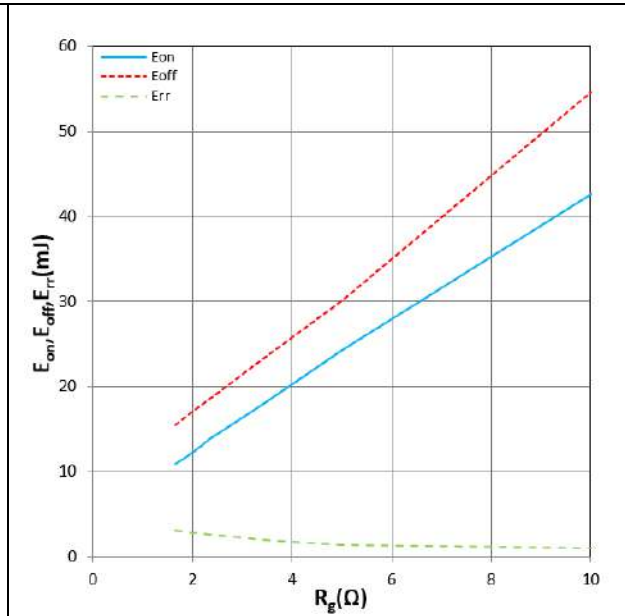
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 Figure 13. E_{on}, E_{off}, E_{rr} vs R_g

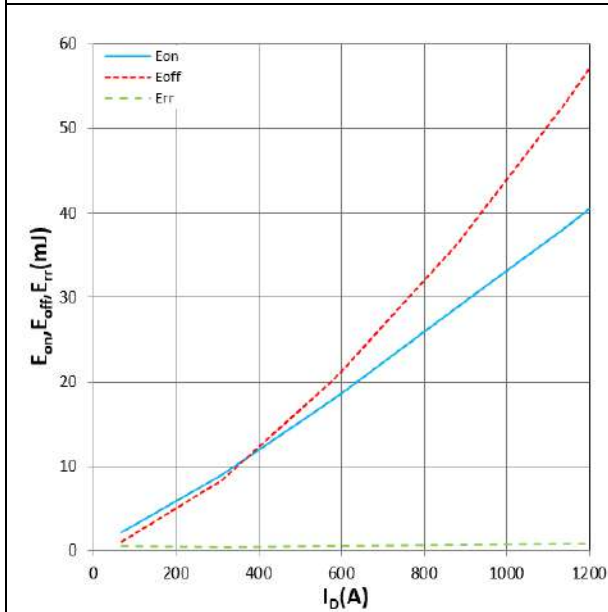
 T_j=25°C, V_{DD}=600V, V_{GS}=+18/-5V, I_D=600A

Inductive Load

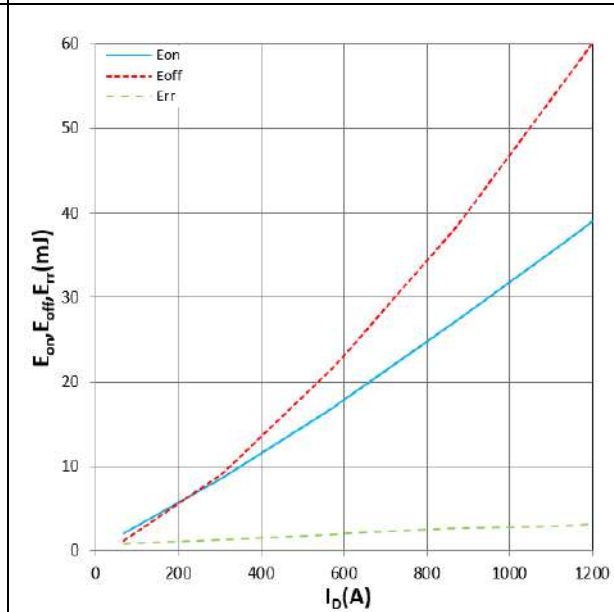

 Figure 14. E_{on}, E_{off}, E_{rr} vs R_g

 T_j=150°C, V_{DD}=600V, V_{GS}=+18/-5V, I_D=600A

Inductive Load


 Figure 15. E_{on}, E_{off}, E_{rr} vs I_D

 T_j=25°C, V_{DD}=600V, V_{GS}=+18/-5V

 R_{gon}/R_{goff}=3.3/3.3Ω, Inductive Load

 Figure 16. E_{on}, E_{off}, E_{rr} vs I_D

 T_j=150°C, V_{DD}=600V, V_{GS}=+18/-5V

 R_{gon}/R_{goff}=3.3/3.3Ω, Inductive Load

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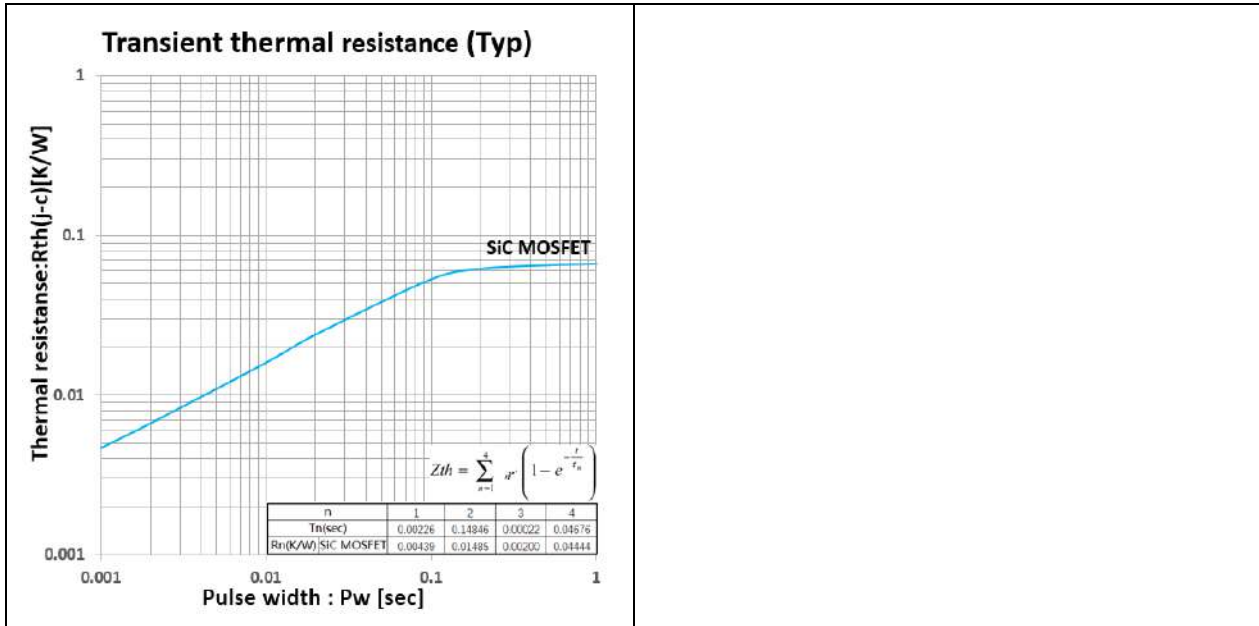


Figure 17. transient thermal impedance
SiC MOSFET

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