

HCS450FH220D3T1

2200V/450A Half Bridge SiC MOSFET Module

Description

The HCS450FH220D3T1 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

- 2200V/4.2mΩ
- Low thermal resistance with AIN AMB
- Low Inductive Design
- Thermistor inside

Applications

- xEV Applications
- Motor Drives
- Renewable energy

Circuit diagram

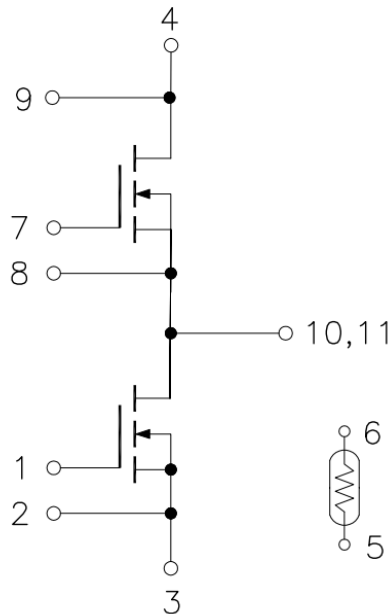


Figure 1. Out drawing & circuit diagram for HCS450FH220D3T1

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Pin Configuration and Marking Information

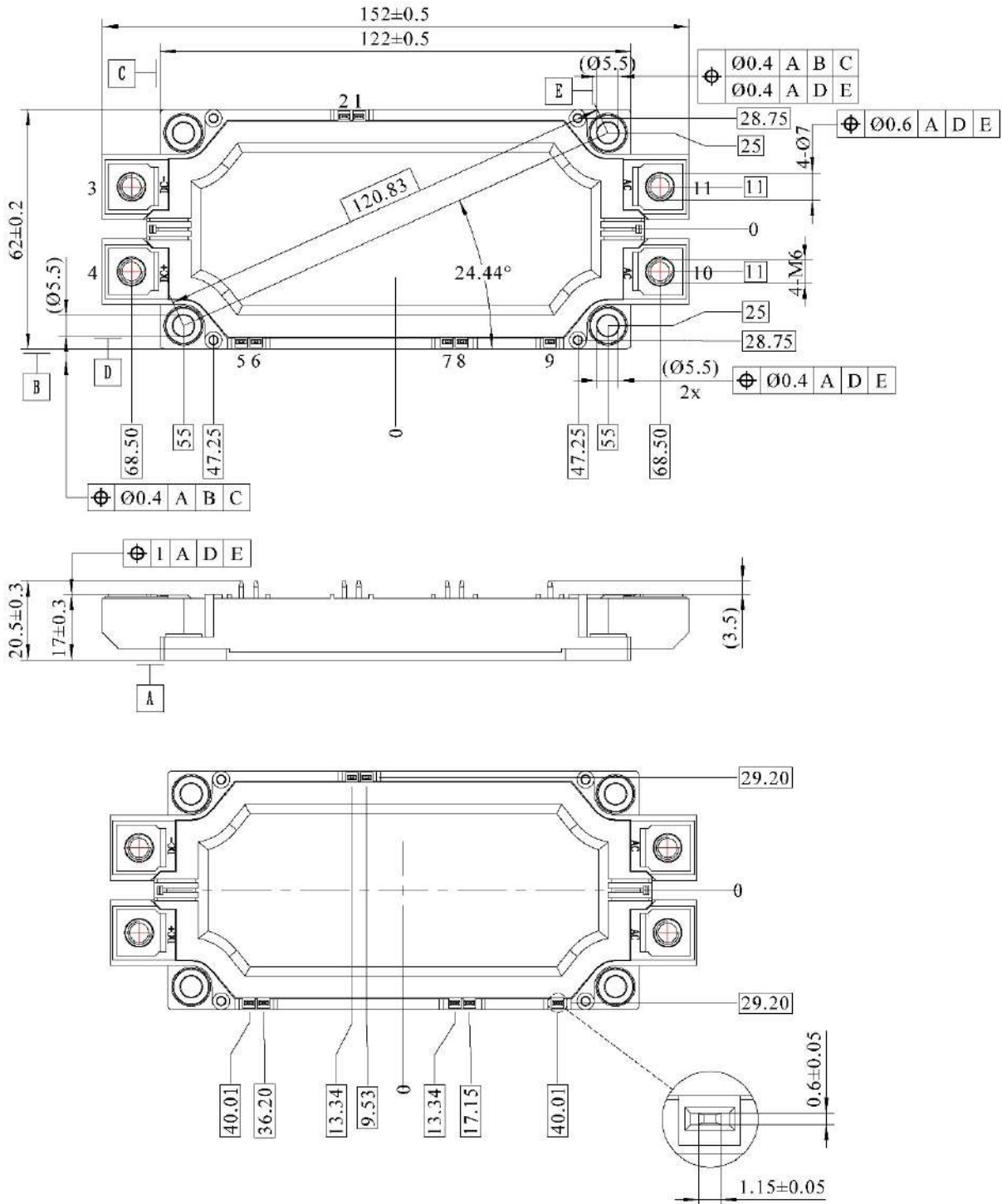


Figure 2. Pin configuration

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Module

Parameter	Condition	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	-	600	-
Module lead resistance, terminals – chip	T _c =25°C	0.5	mΩ
Mounting torque for module mounting	M5, M6	3 to 6	Nm
Weight	-	350	g

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

Symbol	Parameter	Condition	Ratings	Unit
V _{DSS}	Drain-Source Voltage	G-S Short	2200	V
V _{GSS}	Gate-Source Voltage	D-S Short, AC frequency ≥1Hz, Note1	-10 to 25	V
I _{DS}	DC Continuous Drain Current	T _C =25°C , V _{GS} =+20V	520	A
I _{DS}	DC Continuous Drain Current	T _C =60°C , V _{GS} =+20V	440	A
I _{SD}	Source (Body diode) Current	T _C =25°C, with ON signal	520	A
I _{SD}	Source (Body diode) Current	T _C =60°C, with ON signal	440	A
I _{DSM}	Pulse Drain Current	T _C =25°C, Pulse width =1ms, V _{GS} =+20V, Note2	1000	A
P _{tot}	Total Power Dissipation	T _C =25°C	2273	W
T _{Jmax}	Max Junction Temperature	-	150	°C
T _{stg}	Storage Temperature	-	-40 to 125	°C

Note1: Recommended Operating Value, +20V/-6V

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
△R/R	Deviation of R ₁₀₀	T _c =100°C, R ₁₀₀ =493 Ω	-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 ($T_j=25^\circ\text{C}$ unless otherwise specified, chip)

Symbol	Item	Condition	Value			Unit	
			Min.	Typ.	Max		
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	$V_{GS}=0V, I_D=1mA$	2200	-	-	V	
I_{DSS}	Zero gate voltage drain Current	$V_{DS}=2200V, V_{GS}=0V$	-	-	200	μA	
$V_{GS(th)}$	Gate-source threshold Voltage	$I_D=170mA, V_{DS}=10V$	3.5	4.5	5.5	V	
I_{GSS}	Gate-Source Leakage Current	$V_{GS}=25V/-10V, V_{DS}=0V$	-	-	± 400	nA	
$R_{DS(on)}$ (Chip)	Static drain-source On-state resistance	$I_D=450A$ $V_{GS}=+20V$	$T_j=25^\circ\text{C}$	-	4.2	-	m Ω
			$T_j=150^\circ\text{C}$	-	8.4	11.8	m Ω
$V_{DS(on)}$ (Chip)	Static drain-source On-state Voltage	$I_D=450A$ $V_{GS}=+20V$	$T_j=25^\circ\text{C}$	-	1.89	-	V
			$T_j=150^\circ\text{C}$	-	3.78	5.31	V
R_{Gint}	Internal Gate Resistance	$T_j=25^\circ\text{C}$	-	4.1	-	Ω	
C_{iss}	Input Capacitance	$V_{DS}=1100V, V_{GS}=0V, f=10kHz$	-	36.7	-	nF	
C_{oss}	Output Capacitance		-	1.2	-	nF	
C_{rss}	Reverse transfer Capacitance		-	0.03	-	nF	
Q_g	Total gate charge	$V_{DS}=1100V, I_D=170A, V_{GS}=+20V/-6V$	-	1080	-	nC	
$t_{d(on)}$	Turn-on delay time	$V_{DD}=1100V$ $I_D=450A$ $V_{GS}=+20/-6V$ $R_{gon}/R_{goff}=0.75/3.0\Omega$ Inductive load switching operation	$T_j=25^\circ\text{C}$	-	135	-	ns
			$T_j=150^\circ\text{C}$	-	160	-	
t_r	Rise time		$T_j=25^\circ\text{C}$	-	35	-	ns
			$T_j=150^\circ\text{C}$	-	40	-	
$t_{d(off)}$	Turn-off delay time		$T_j=25^\circ\text{C}$	-	345	-	ns
			$T_j=150^\circ\text{C}$	-	300	-	
t_f	Fall time		$T_j=25^\circ\text{C}$	-	115	-	ns
			$T_j=150^\circ\text{C}$	-	60	-	
E_{on}	Turn-on power dissipation		$T_j=25^\circ\text{C}$	-	16.0	-	mJ
			$T_j=150^\circ\text{C}$	-	14.2	-	
E_{off}	Turn-off power dissipation	$T_j=25^\circ\text{C}$	-	24.8	-	mJ	
		$T_j=150^\circ\text{C}$	-	22.6	-		
$R_{th(j-c)}$	FET Thermal Resistance	Junction to Case	-	0.055	-	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 $0.9W/m \cdot K$ and thickness is 50 μm .

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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	$V_{GS} = -6\text{V}$ $I_{SD} = 450\text{A}$	$T_j = 25^\circ\text{C}$	-	3.0	-	V
			$T_j = 150^\circ\text{C}$	-	5.0	-	
T_{rr}	Reverse recovery time	$V_{DD} = 1100\text{V}$, $I_D = 450\text{A}$ $V_{GS} = +20/-6\text{V}$,	$T_j = 25^\circ\text{C}$	-	40	-	ns
			$T_j = 150^\circ\text{C}$	-	30	-	
E_{rr}	Diode switching power dissipation	$R_{gon}/R_{goff} = 0.75/3.0\Omega$ Inductive load	$T_j = 25^\circ\text{C}$	-	1.35	-	mJ
			$T_j = 150^\circ\text{C}$	-	1.20	-	

Test Conditions

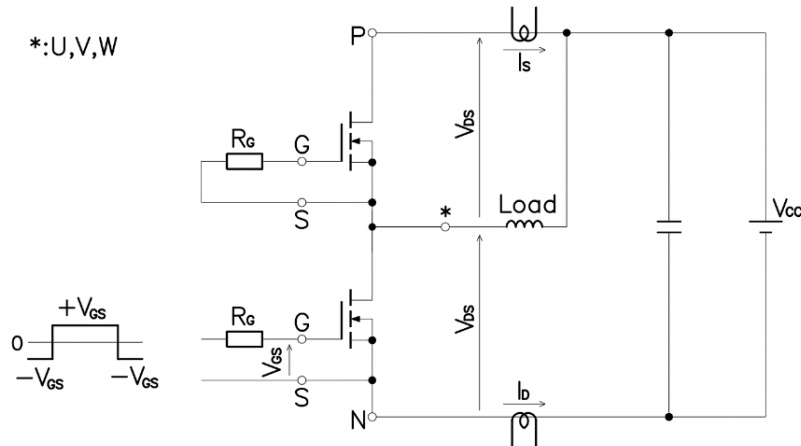


Figure 3. Switching time measure circuit

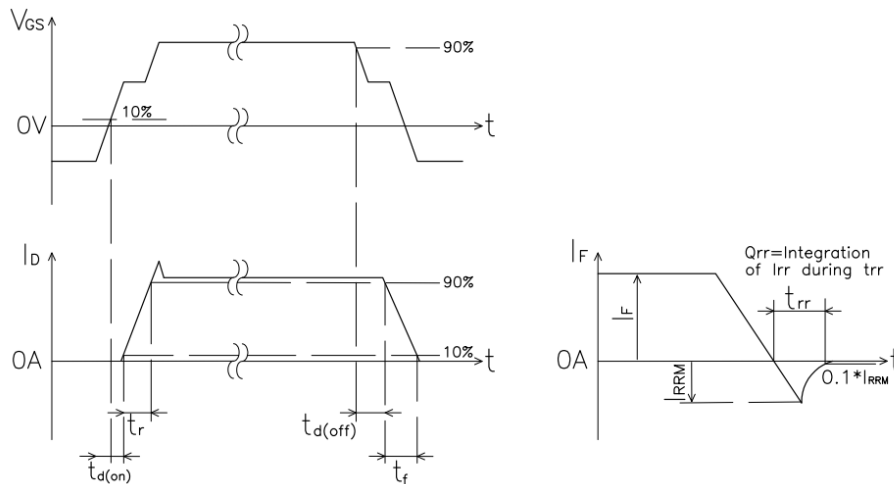


Figure 4. Switching time definition

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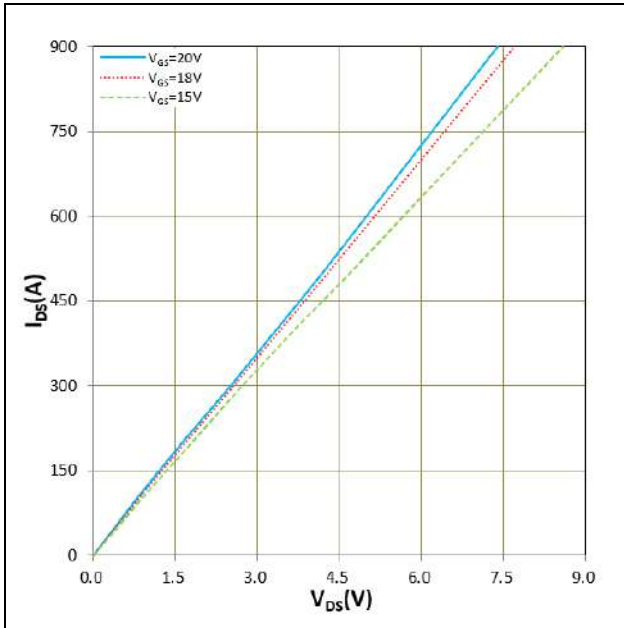


Figure 5. I_{DS} vs V_{DS}
 $T_j = 150^\circ\text{C}$

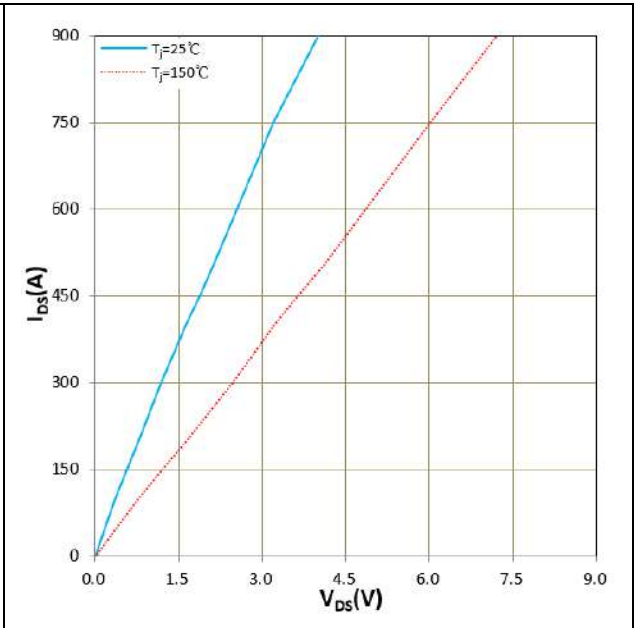


Figure 6. I_{DS} vs V_{DS}
 $V_{GS} = +20\text{V}$

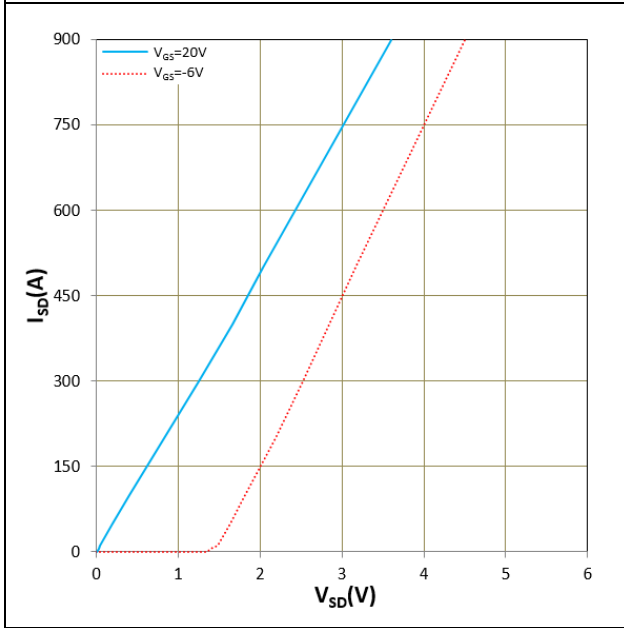


Figure 7. I_{SD} vs $V_{SD} (V_F)$
 $T_j = 25^\circ\text{C}$

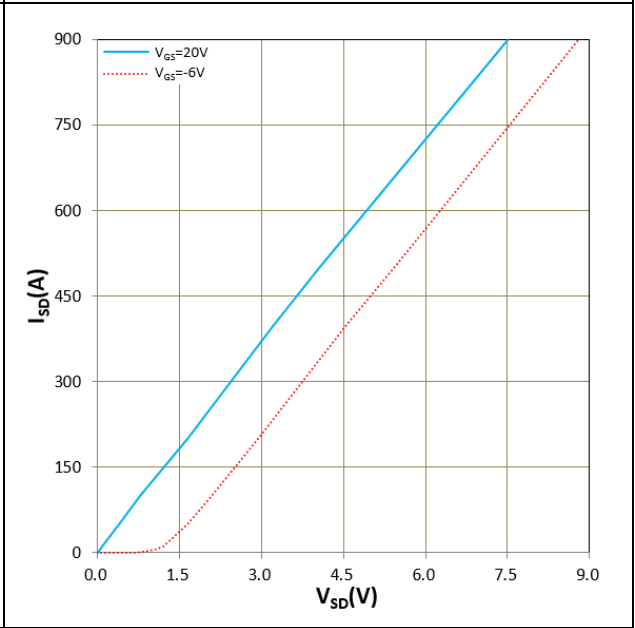


Figure 8. I_{SD} vs $V_{SD} (V_F)$
 $T_j = 150^\circ\text{C}$

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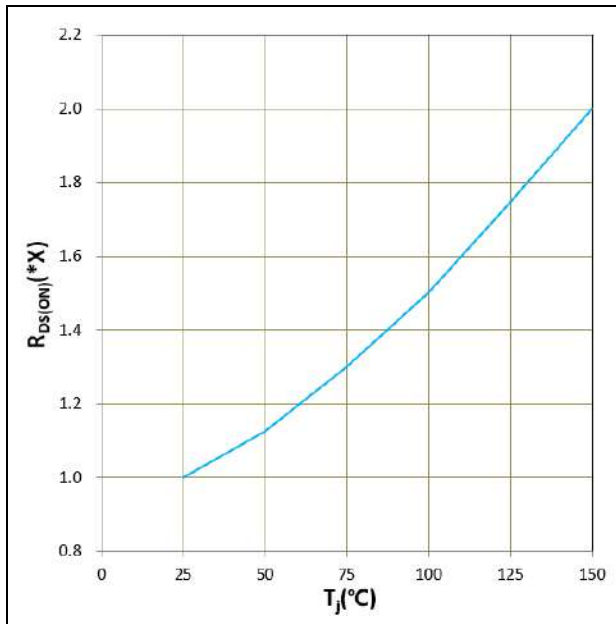


Figure 9. $R_{DS(ON)}$ vs T_j
 $V_{GS} = +20V$, $I_D = 450A$, $1.0X = 4.2m\Omega$

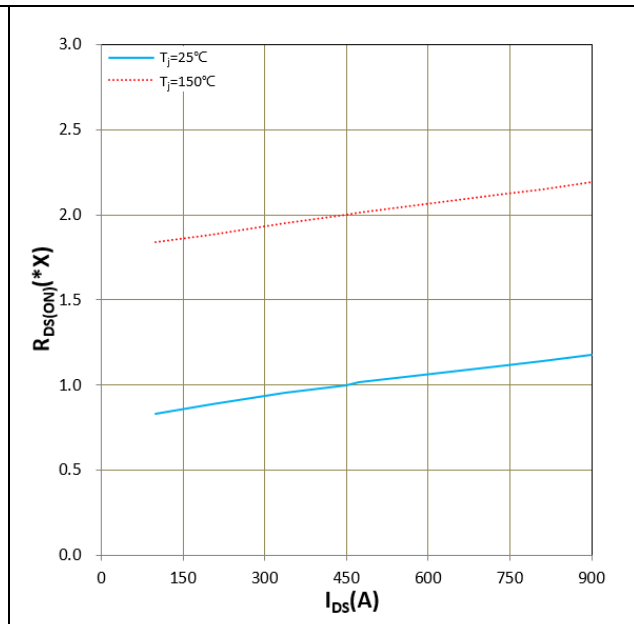


Figure 10. $R_{DS(ON)}$ vs I_{DS}
 $V_{GS} = +20V$, $1.0X = 4.2m\Omega$

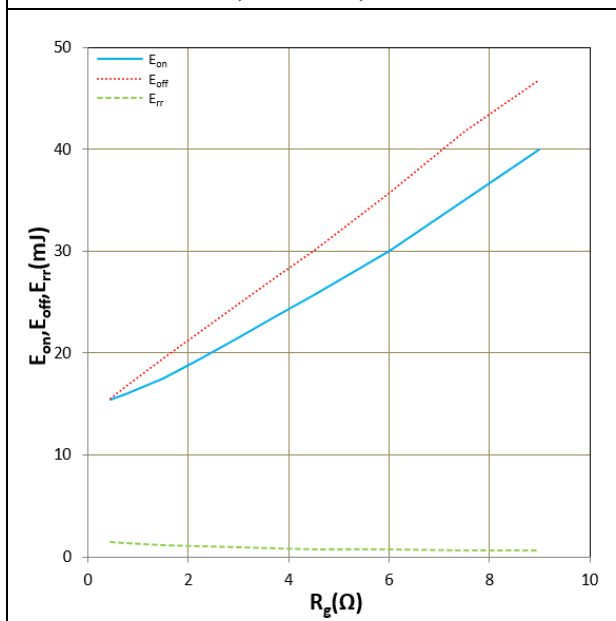


Figure 11. E_{on} , E_{off} , E_{rr} vs R_g
 $T_j = 25^\circ C$, $V_{DD} = 1100V$, $I_D = 450A$, $V_{GS} = +20V/-6V$
 Inductive Load

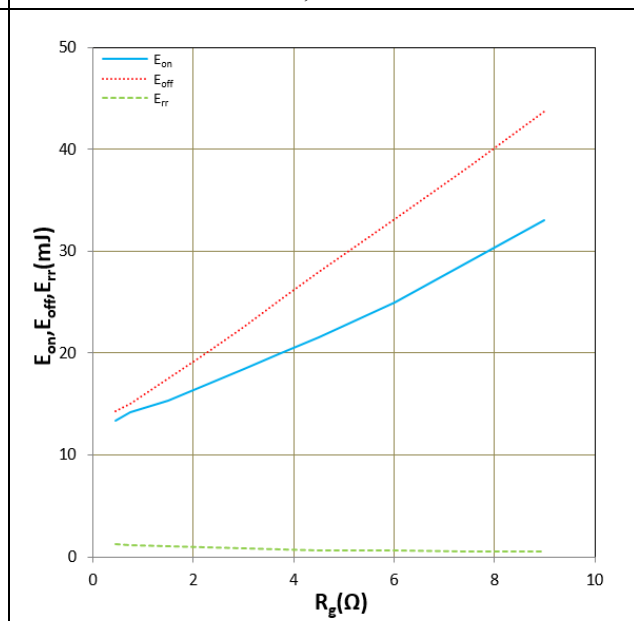


Figure 12. E_{on} , E_{off} , E_{rr} vs R_g
 $T_j = 150^\circ C$, $V_{DD} = 1100V$, $I_D = 450A$, $V_{GS} = +20V/-6V$
 Inductive Load

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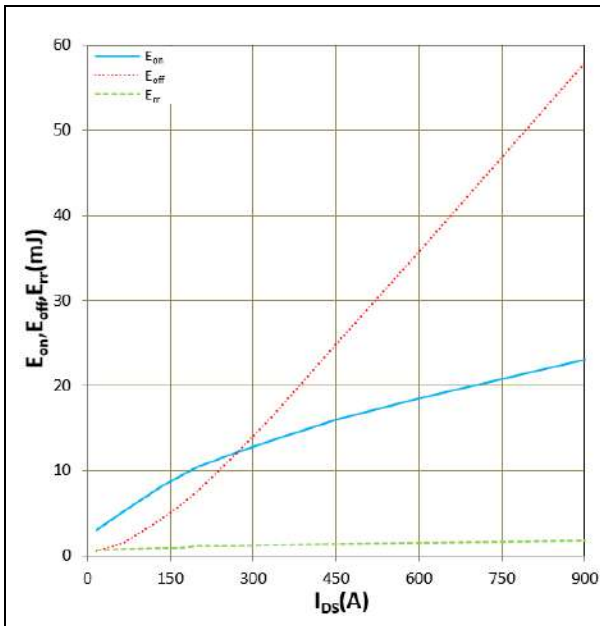


Figure 13. E_{on} , E_{off} , E_{rr} vs I_{DS}
 $T_j = 25^\circ\text{C}$, $V_{DD} = 1100\text{V}$, $R_{GON} / R_{GOFF} = 0.75/3.0 \Omega$
 $V_{GS} = +20\text{V}/-6\text{V}$, Inductive Load

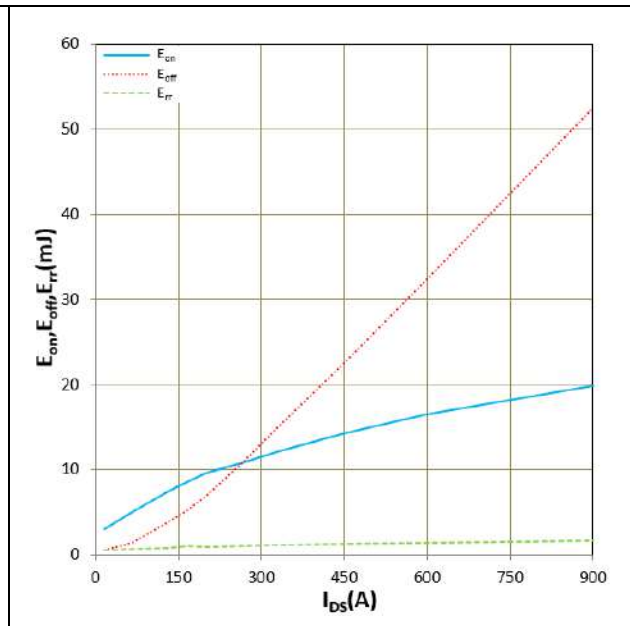


Figure 14. E_{on} , E_{off} , E_{rr} vs I_{DS}
 $T_j = 150^\circ\text{C}$, $V_{DD} = 1100\text{V}$, $R_{GON} / R_{GOFF} = 0.75/3.0 \Omega$
 $V_{GS} = +20\text{V}/-6\text{V}$, Inductive Load

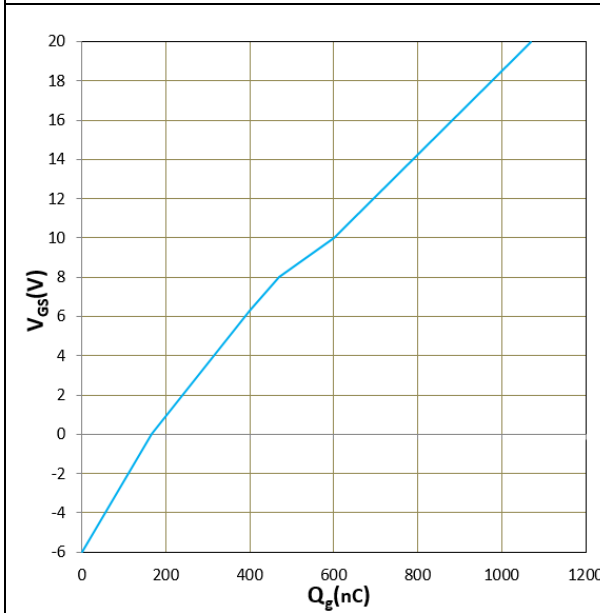


Figure 15. V_{GS} vs Q_g
 $V_{CC} = 1100\text{V}$, $I_D = 450\text{A}$, $T_j = 150^\circ\text{C}$

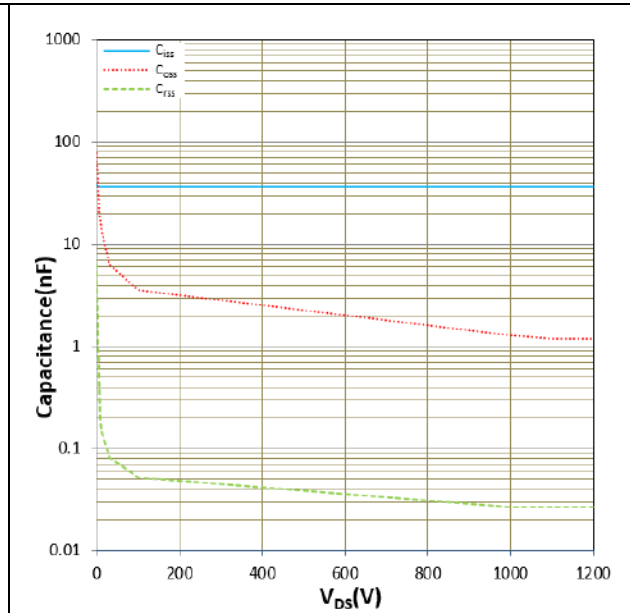
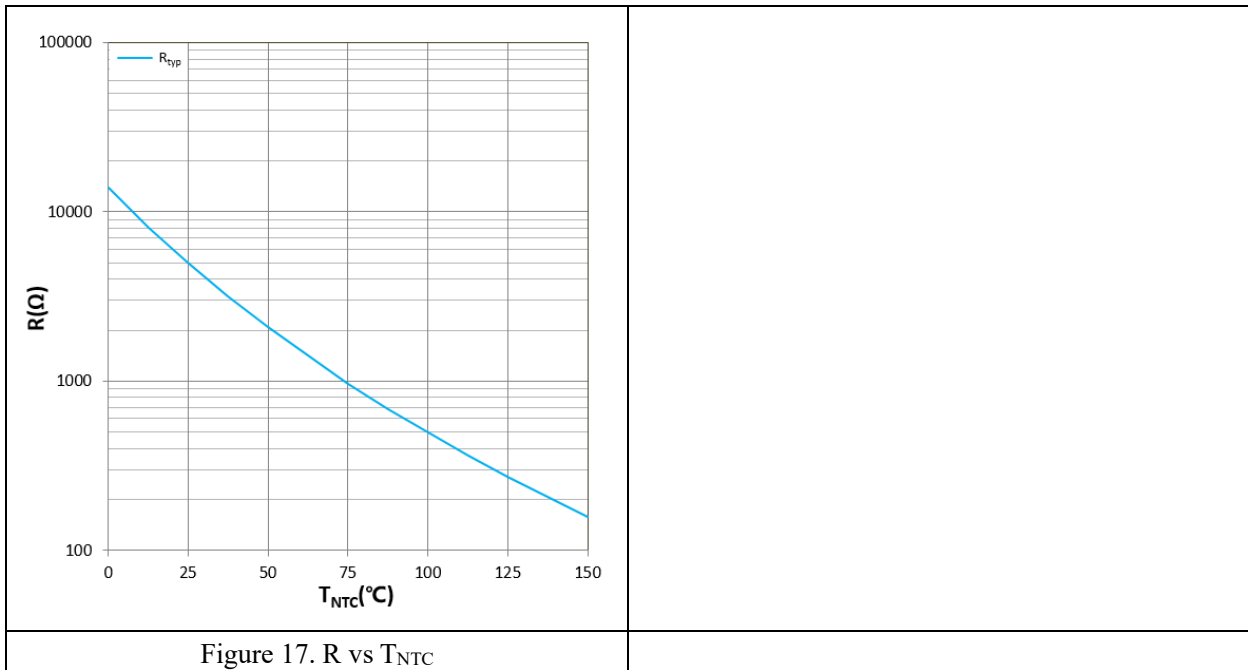


Figure 16. C_{ies} , C_{oss} , C_{rss} vs V_{DS}
 $T_j = 25^\circ\text{C}$, $V_{GS} = 0\text{V}$, $f = 10\text{kHz}$

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Changes to this product data sheet are reserved.

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Revision History

Document Version	Description of Changes
RevX.0.1	Released

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