

Description

The DFS09HF12EYQ1 is a half bridge SiC MOSFET Power Module. It integrates high performance SiC MOSFET chips designed for the applications such as Solar Inverter, UPS, Fuel cell-DC/DC converter, Energy Storage Systems.



Features

- Blocking voltage:1200V
- 9.2mΩ $R_{ds(on)}$ @ $T_j=25^\circ\text{C}$
- 150A@ $T_f=75^\circ\text{C}$
- Low Switching Losses
- 175°C maximum junction temperature
- Si₃N₄ AMB
- Thermistor inside

Applications

- Solar inverter Systems
- Fuel cell-DC/DC converter
- Uninterruptible Power Supplier
- Energy Storage System

Circuit diagram

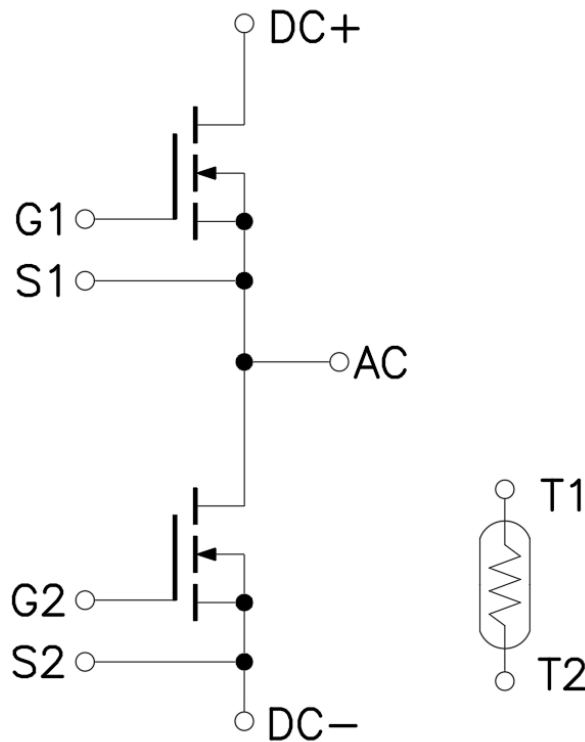


Figure 1. Out drawing & circuit diagram for DFS09HF12EYQ1

Pin Configuration and Marking Information

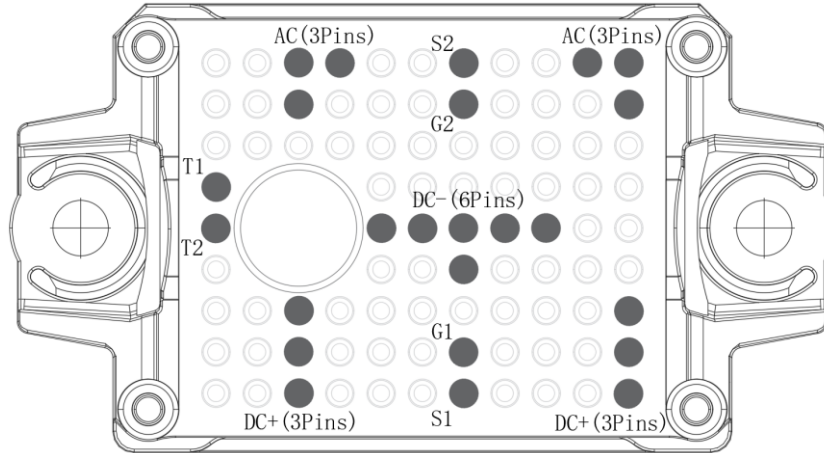


Figure 2. Pin configuration

Symbol	Description
AC	Output terminal of half bridge
S2	Low side source signal terminal
G2	Low side gate signal terminal
DC+	DC+ Bus connection
DC-	DC- Bus connection
S1	High side source signal terminal
G1	High side gate signal terminal
T1	Thermistor connection 1
T2	Thermistor connection 2

Module

Parameter	Conditions	Value	Unit
Isolation voltage	RMS, f=50Hz, t=1min	3.4	kV
Clearance	Terminal to Terminal	5	mm
	Terminal to Heatsink	10	mm
Creepage distance	Terminal to Terminal	6.3	mm
	Terminal to Heatsink	12.7	mm
Comparative Tracking Index	-	400	-
Weight	-	26	g

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

Symbol	Parameter	Conditions	Ratings	Unit
V _{DSS}	Drain-Source Voltage	G-S Short	1200	V
V _{GSS}	Gate-Source Voltage(+)	D-S Short	20	V
V _{GSS}	Gate-Source Voltage(-)	D-S Short	-5	V
V _{GSSSurge}	G-S Voltage(t _{surge} <300nsec)	D-S Short, Note1	-10 to 25	V
I _{DS}	DC Continuous Drain Current	T _f =75°C, Note2	150	A
I _{SD}	Source (Body diode) Current	T _f =75°C, with ON signal	150	A
I _{DP}	Drain Pulse Current, Peak	Less than 1ms, Note3	300	A
T _j	junction temperature	-	-40 to 175	°C
T _{stg}	Storage temperature	-	-40 to 125	°C

Note1: Recommended Operating Value, +20V/-5V; +18V/-5V; +15V/-4V

Note2: Case temperature(T_c) is defined on the surface of base plate just under the chips

Note3: 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 R100	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

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	$V_{GS}=0V, I_D=4mA$	1200	-	-	V	
I_{DSS}	Zero gate voltage drain current	$V_{DS}=1200V, V_{GS}=0V$	-	0.4	4.0	μA	
$V_{GS(th)}$	Gate-source threshold voltage	$I_D=40mA, V_{DS}=V_{GS}$	2.0	2.4	4.0	V	
I_{GSS+}	Gate-Source Leakage Current	$V_{GS}=20V, V_{DS}=0V, T_j=25^\circ C$	-	-	400	nA	
I_{GSS-}		$V_{GS}=-5V, V_{DS}=0V, T_j=25^\circ C$	-	-	-400	nA	
$R_{DS(on)}$ (Chip)	Static drain-source On-state resistance	$I_D=150A, T_j=25^\circ C$	$V_{GS}=20V$	-	9.2	12.8	mΩ
		$I_D=150A$ $T_j=175^\circ C$	$V_{GS}=20V$	-	18	-	mΩ
			$V_{GS}=18V$	-	18.2	-	mΩ
$V_{DS(on)}$ (Chip)	Static drain-source On-state voltage	$I_D=150A, T_j=25^\circ C$	$V_{GS}=20V$	-	1.38	1.92	V
		$I_D=150A$ $T_j=175^\circ C$	$V_{GS}=20V$	-	2.70	-	V
			$V_{GS}=18V$	-	2.73	-	V
C_{iss}	Input capacitance	$V_{DS}=1000V, V_{GS}=0V$	-	12.77	-	nF	
C_{oss}	Output capacitance	$f=200kHz, V_{AC}=25mV$	-	0.528	-	nF	
C_{rss}	Reverse transfer capacitance		-	0.028	-	nF	
Q_G	Total gate charge	$V_{DD}=800V, I_D=80A, V_{GS}=+20/-5V$	-	472	-	nC	
R_{Gint}	Internal Gate Resistance	$T_j=25^\circ C$	-	0.475	-	Ω	
$t_{d(on)}$	Turn-on delay time	$V_{DD}=600V$ $I_D=150A$ $V_{GS}=+15/-4V$ $R_G=2.5\Omega$ Inductive load switching operation	$T_j=25^\circ C$	-	25	-	ns
			$T_j=150^\circ C$	-	22	-	
t_r	Rise time		$T_j=25^\circ C$	-	13	-	ns
			$T_j=150^\circ C$	-	9	-	
$t_{d(off)}$	Turn-off delay time		$T_j=25^\circ C$	-	33	-	ns
			$T_j=150^\circ C$	-	34	-	
t_f	Fall time		$T_j=25^\circ C$	-	18	-	ns
			$T_j=150^\circ C$	-	20	-	
E_{on}	Turn-on power dissipation		$T_j=25^\circ C$	-	1.99	-	mJ
			$T_j=150^\circ C$	-	2.35	-	
E_{off}	Turn-off power dissipation	$T_j=25^\circ C$	-	0.41	-	mJ	
		$T_j=150^\circ C$	-	0.31	-		
$R_{th(j-c)}$	FET Thermal Resistance	Junction to Case/MOSFET	-	0.09	-	K/W	
$R_{th(c-f)}$	Contact thermal resistance	With thermal conductive grease/MOSFET	-	0.15	-	K/W	

Assumes Thermal Conductivity of grease is 2.8 W/m·K and thickness is 50um.

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

Symbol	Item	Condition	Value			Unit	
			Min.	Typ.	Max		
V _{SD}	Body Diode Forward Voltage	V _{GS} = 0V I _{SD} = 150A	T _j = 25°C	-	3.85	-	V
			T _j = 175°C	-	3.45	-	
T _{rr}	Reverse recovery time	V _{DD} = 600V I _D = 150A	T _j = 25°C	-	29	-	ns
			T _j = 150°C	-	31	-	
Q _{rr}	Reverse recovery charge	V _{GS} = +15/-4V R _G = 2.5Ω	T _j = 25°C	-	2.5	-	μC
			T _j = 150°C	-	7.1	-	
E _{rr}	Diode switching power dissipation	Inductive load switching operation	T _j = 25°C	-	1.07	-	mJ
			T _j = 150°C	-	2.10	-	

Test Conditions

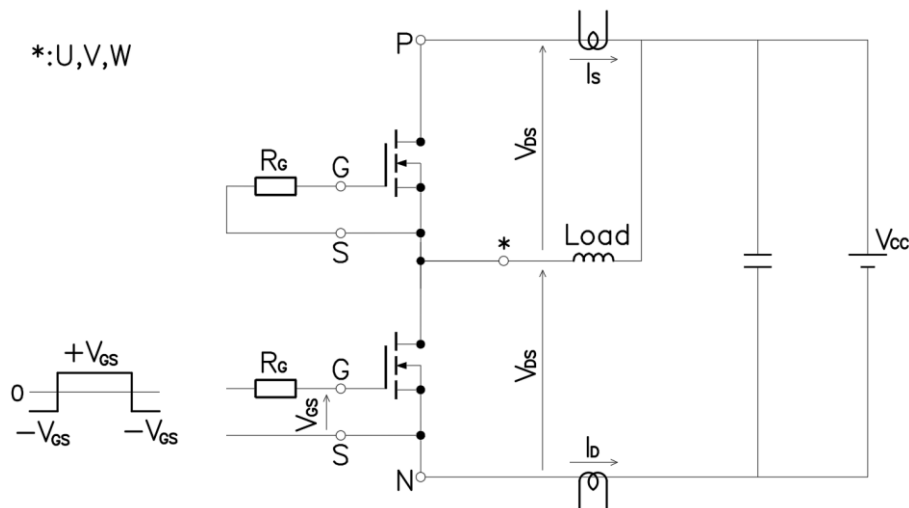


Figure 3. Switching time measure circuit

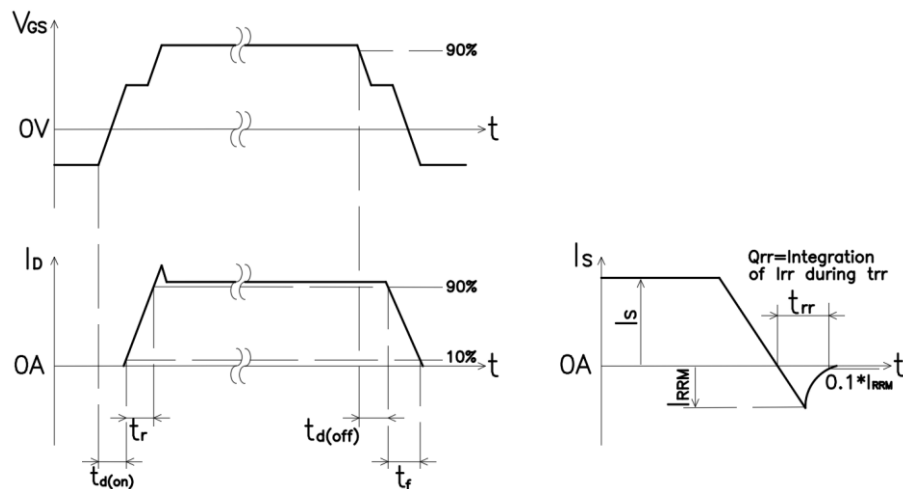


Figure 4. Switching time definition

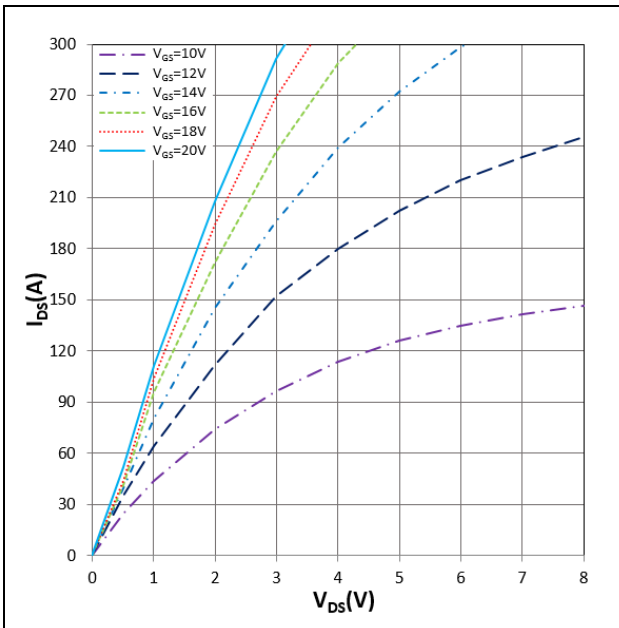


Figure 5. I_{D_S} vs V_{D_S}
 $T_j = 25^\circ\text{C}$, V_{G_S} parameter

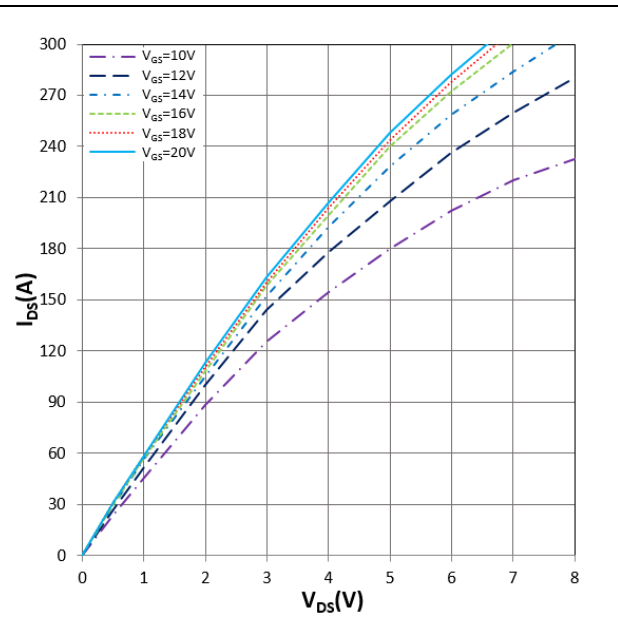


Figure 6. I_{D_S} vs V_{D_S}
 $T_j = 175^\circ\text{C}$, V_{G_S} parameter

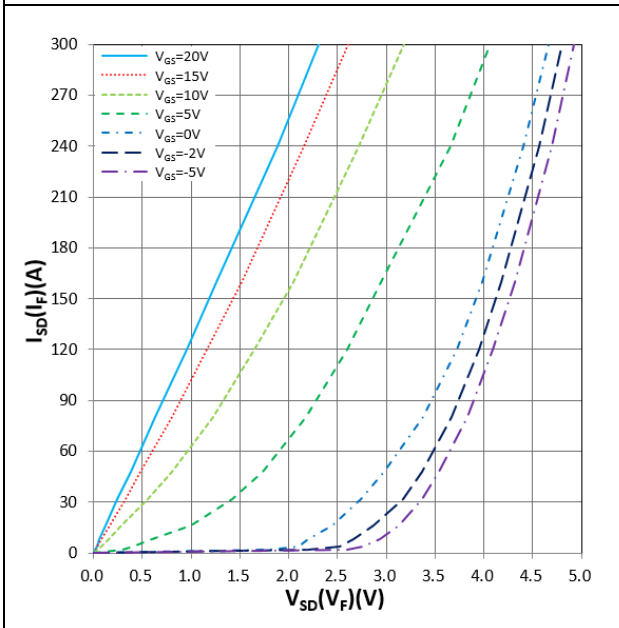


Figure 7. $I_{S_D}(I_P)$ vs $V_{S_D}(V_F)$
 $T_j = 25^\circ\text{C}$, V_{G_S} parameter

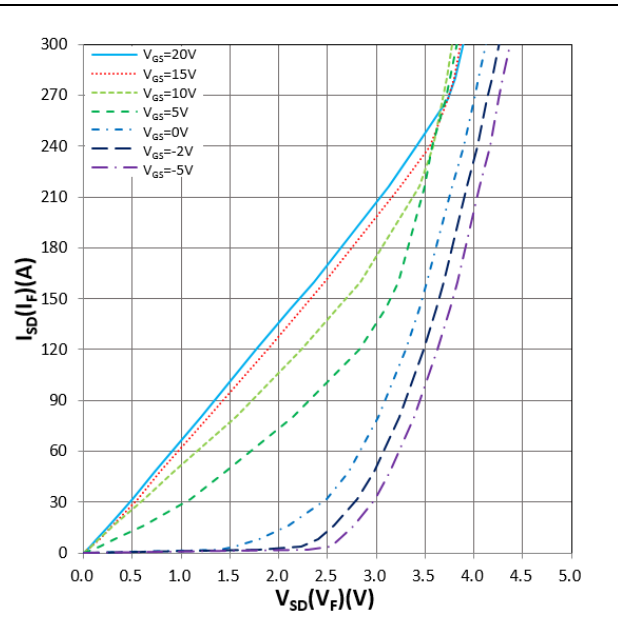


Figure 8. $I_{S_D}(I_P)$ vs $V_{S_D}(V_F)$
 $T_j = 175^\circ\text{C}$, V_{G_S} parameter

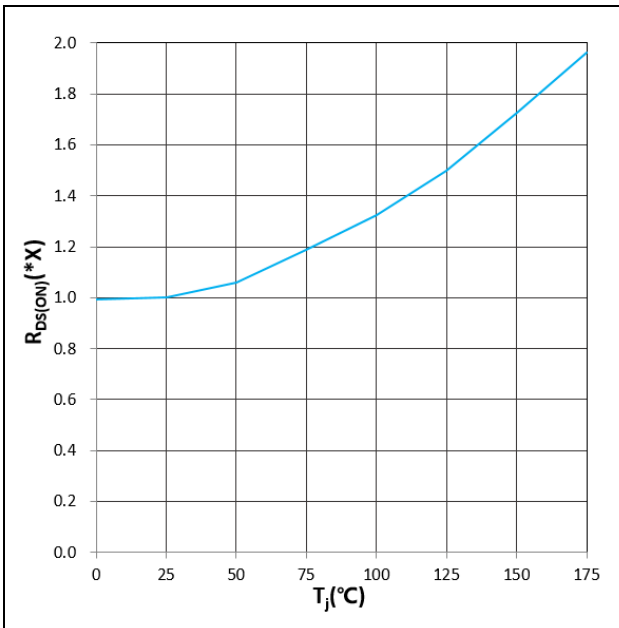


Figure 9. $R_{DS(ON)}$ vs T_J
 $V_{GS} = 20V$, $1.0X = 9.2m\Omega$

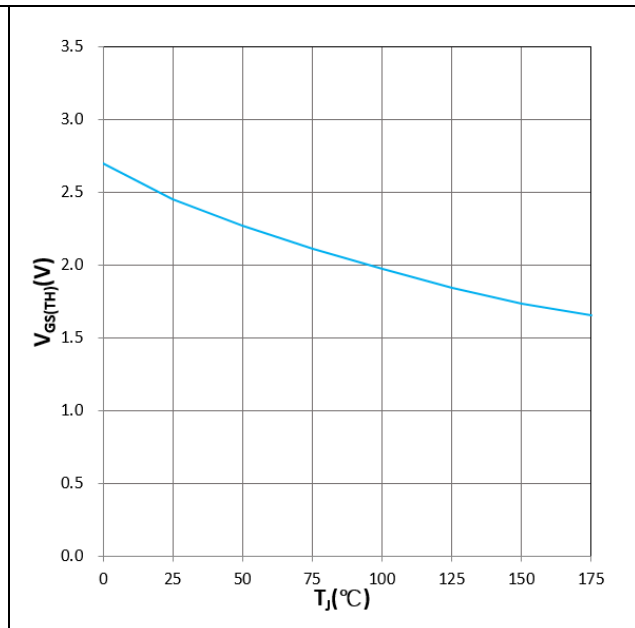


Figure 10. $V_{GS(TH)}$ vs T_J
 $V_{DS} = V_{GS}$, $I_{DS} = 40mA$

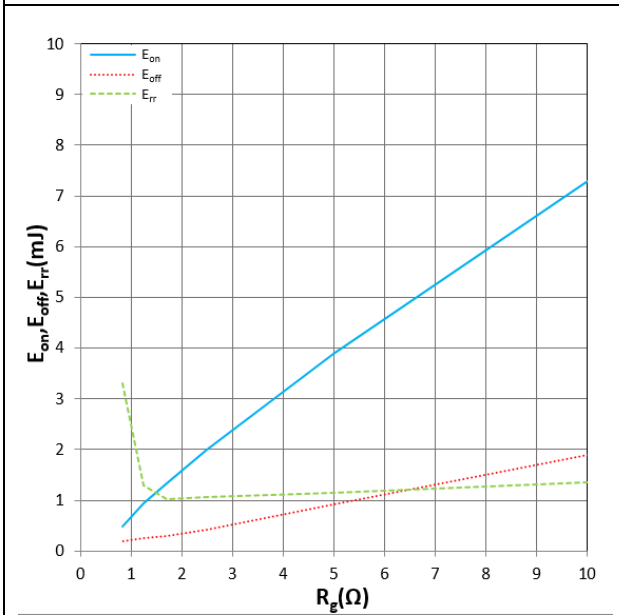


Figure 11. E_{on} , E_{off} , E_{rr} vs R_G
 $T_J = 25^\circ C$, $I_D = 150A$, $V_{GS} = +15/-4V$

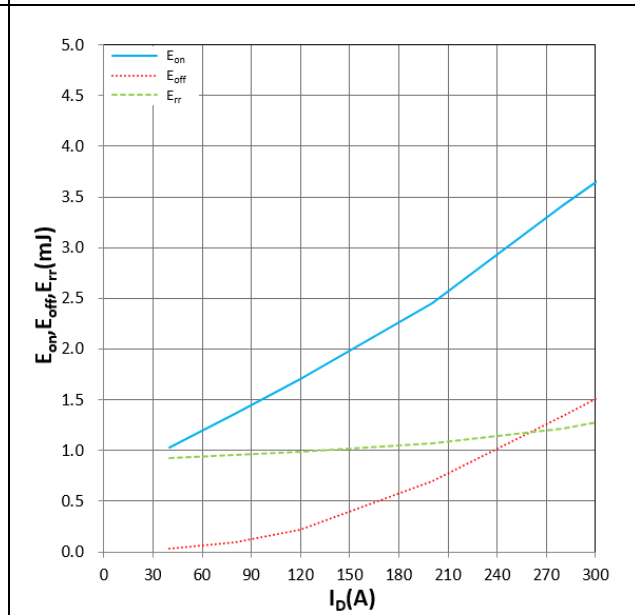


Figure 12. E_{on} , E_{off} , E_{rr} vs I_D
 $T_J = 25^\circ C$, $R_G = 2.5\Omega$, $V_{GS} = +15/-4V$

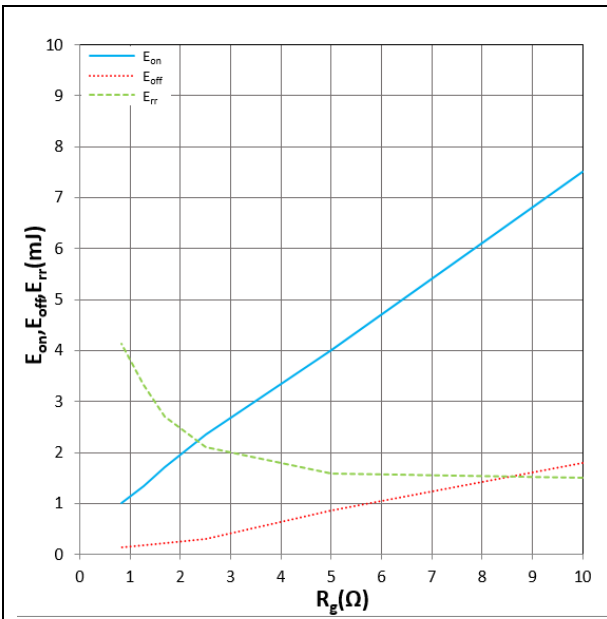


Figure 13. E_{on} , E_{off} , E_{rr} vs R_g
 $T_j = 150^\circ\text{C}$, $I_D = 150\text{A}$, $V_{GS} = +15/-4\text{V}$

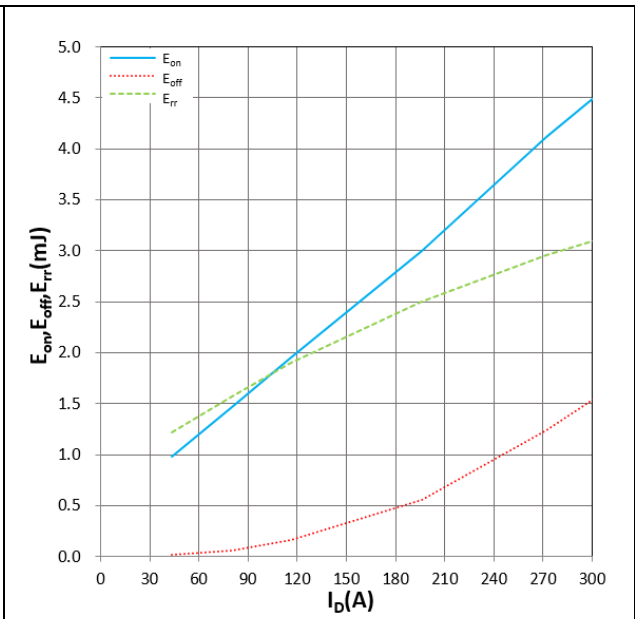


Figure 14. E_{on} , E_{off} , E_{rr} vs I_D
 $T_j = 150^\circ\text{C}$, $R_g = 2.5\Omega$, $V_{GS} = +15/-4\text{V}$

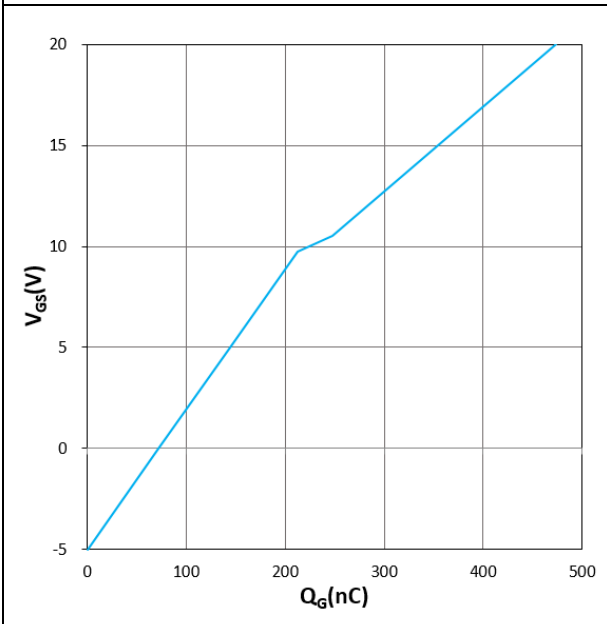


Figure 15. V_{GS} vs Q_g
 $V_{DD} = 800\text{V}$, $I_D = 150\text{A}$

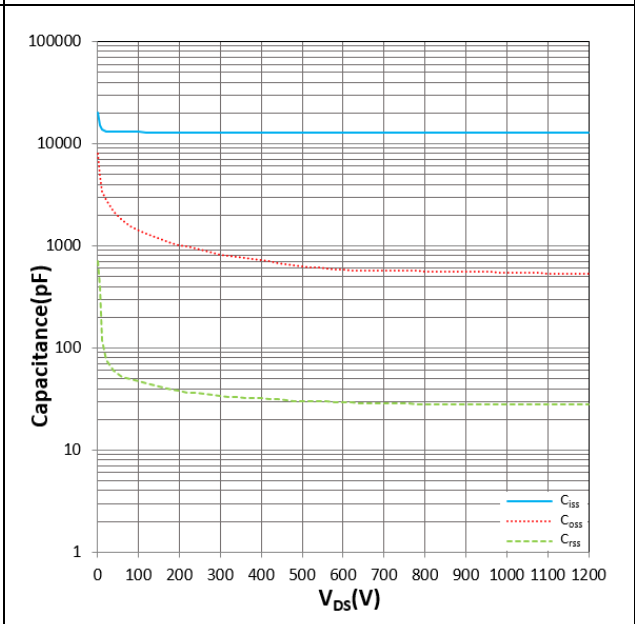
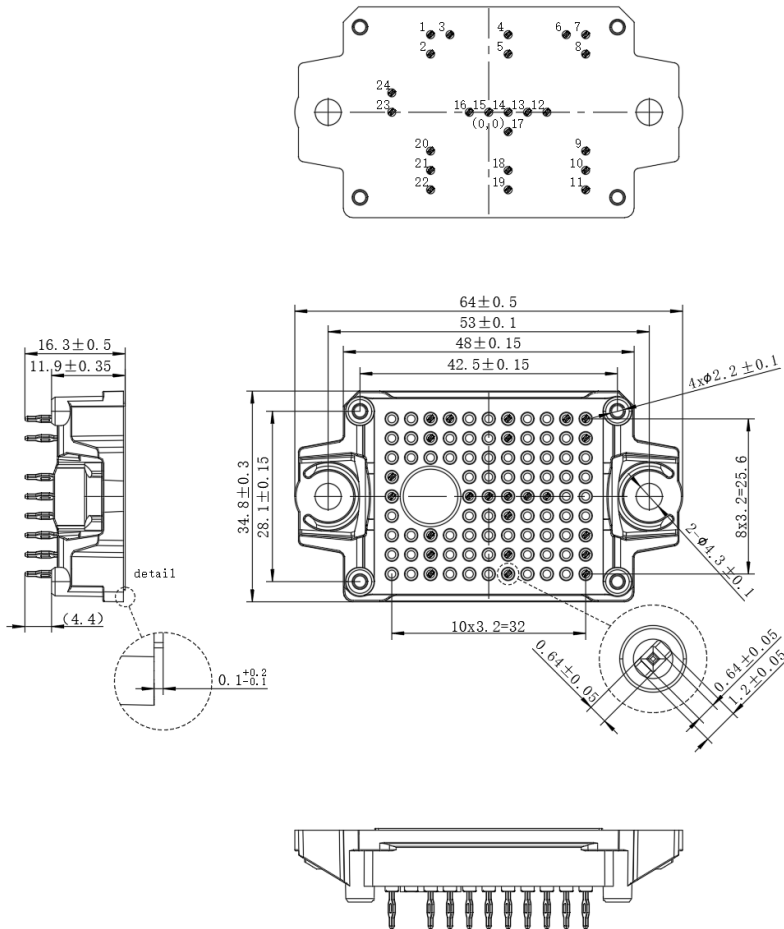


Figure 16. C_{iss} , C_{oss} , C_{rss} vs V_{DS}
 $T_j = 25^\circ\text{C}$

Package dimensions



Pin table		
Pin	X	Y
1	-9.6	12.8
2	-9.6	9.6
3	-6.4	12.8
4	3.2	12.8
5	3.2	9.6
6	12.8	12.8
7	16	12.8
8	16	9.6
9	16	-6.4
10	16	-9.6
11	16	-12.8
12	9.6	0
13	6.4	0
14	3.2	0
15	0	0
16	-3.2	0
17	3.2	-3.2
18	3.2	-9.6
19	3.2	-12.8
20	-9.6	-6.4
21	-9.6	-9.6
22	-9.6	-12.8
23	-16	0
24	-16	3.2

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