

Description

The DFS09CU12EYQ1 is a Chopper SiC MOSFET Power Module. It integrates high performance SiC MOSFET chips designed for the applications such as xEV Application and Renewable energy.



Features

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

Applications

- xEV Applications
- Converter
- Vehicle Fast Chargers
- Renewable

Circuit diagram

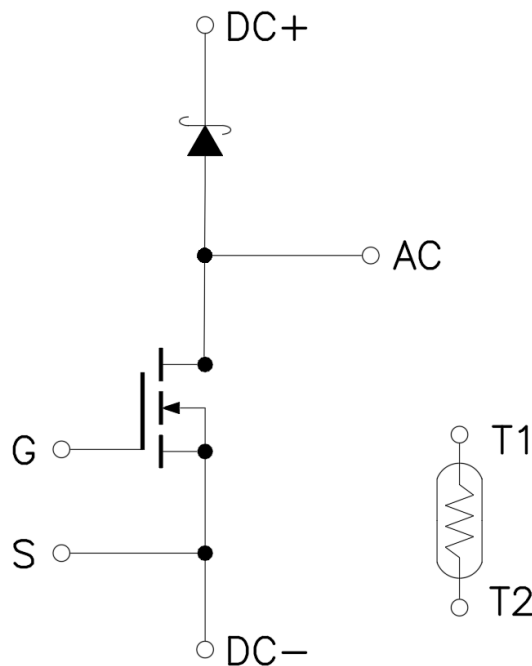


Figure 1. Out drawing & circuit diagram for DFS09CU12EYQ1

Pin Configuration and Marking Information

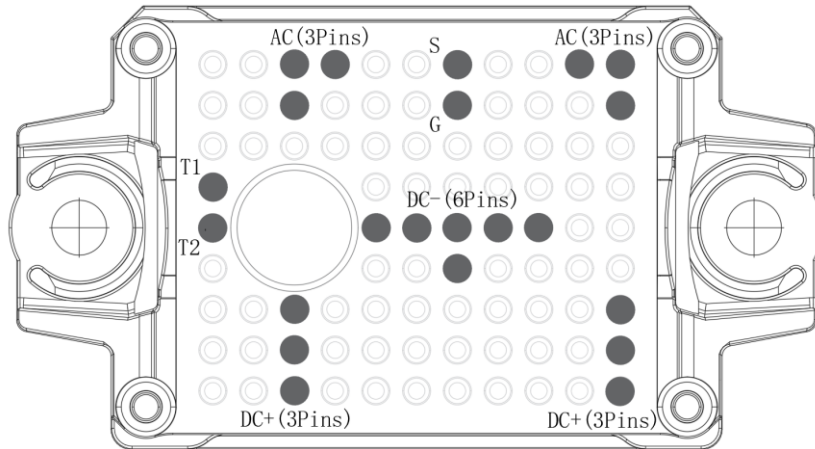


Figure 2. Pin configuration

Symbol	Description
AC	Output terminal of half bridge
S	Source signal terminal
G	Gate signal terminal
DC+	DC+ Bus connection
DC-	DC- Bus connection
T1	Thermistor connection T1
T2	Thermistor connection T2

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	150	A
I _{DSM}	Pulse Drain Current	Less than 1ms, Note2	300	A
I _F	Forward Current (Diode)	T _f =75°C	140	A
I _{FRM}	Pulse Forward Current (Diode)	Less than 1ms, Note2	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: 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	$V_{DS}=1000V, V_{GS}=0V$ $f=200kHz, V_{AC}=25mV$	-	12.77	-	nF	
C_{oss}	Output capacitance		-	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	$V_{DD}=600V$ $I_D=150A$ $V_{GS}=+15/-4V$ $R_G=2.2\Omega$ Inductive load switching operation	$T_j=25^\circ C$	-	35	-	ns
			$T_j=150^\circ C$	-	30	-	
t_r	Rise time		$T_j=25^\circ C$	-	20	-	ns
			$T_j=150^\circ C$	-	19	-	
$t_{d(off)}$	Turn-off delay time		$T_j=25^\circ C$	-	45	-	ns
			$T_j=150^\circ C$	-	55	-	
t_f	Fall time		$T_j=25^\circ C$	-	11	-	ns
			$T_j=150^\circ C$	-	12	-	
E_{on}	Turn-on power dissipation		$T_j=25^\circ C$	-	1.41	-	mJ
			$T_j=150^\circ C$	-	1.12	-	
E_{off}	Turn-off power dissipation		$T_j=25^\circ C$	-	0.51	-	mJ
			$T_j=150^\circ C$	-	0.47	-	
$R_{th(j-c)}$	FET Thermal Resistance	Junction to Case/MOSFET	-	0.09	-	K/W	
$R_{th(c-f)}$	Contact thermal resistance	With thermal conductive grease, Note3	-	0.15	-	K/W	

Note3: Assumes Thermal Conductivity of grease is 2.8 W/m·K and thickness is 50um.

SiC SBD Electrical characteristics (T_j=25°C unless otherwise specified, chip)

Symbol	Item	Condition	Value			Unit
			Min.	Typ.	Max	
I _{RRM}	Reverse Current	V _{RRM} =1200V	-	-	200	uA
V _F	Forward Voltage	I _F =150A	T _j =25°C	1.7	2.1	V
			T _j =175°C	2.7	-	
T _{rr}	Reverse recovery time	V _{RR} =600V, I _F =150A MOSFET side:	T _j =25°C	22	-	ns
			T _j =150°C	21	-	
Q _{rr}	Reverse recovery charge	V _{GS} =+15/-4V R _G =2.2Ω	T _j =25°C	1.227	-	uC
			T _j =150°C	1.428	-	
E _{rr}	Diode switching power dissipation	Inductive load switching operation	T _j =25°C	0.56	-	mJ
			T _j =150°C	0.75	-	
R _{th(j-c)}	SiC SBD Thermal Resistance	Junction to Case	-	0.12	-	K/W
R _{th(c-f)}	Contact thermal Resistance	With thermal conductive grease, Note4	-	0.15	-	K/W

Note4: Assumes Thermal Conductivity of grease is 2.8W/m·K and thickness is 50um.

Test Conditions

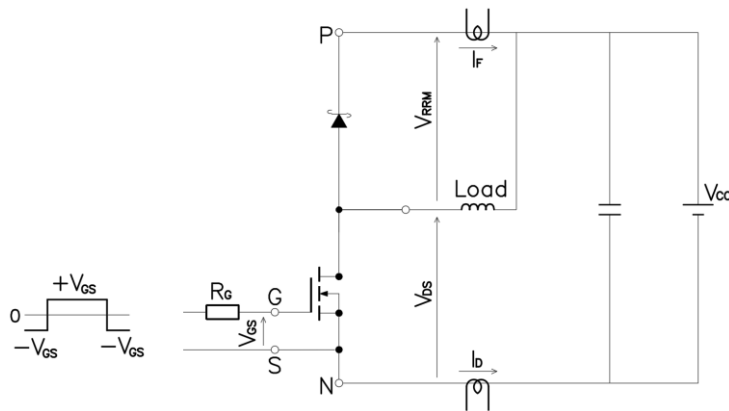


Figure 3. Switching time measure circuit

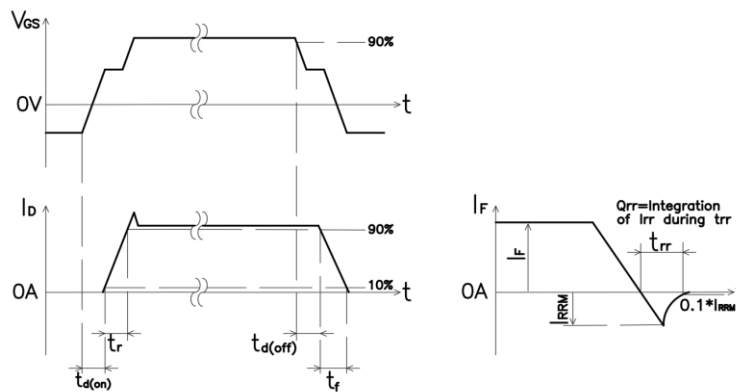


Figure 4. Switching time definition

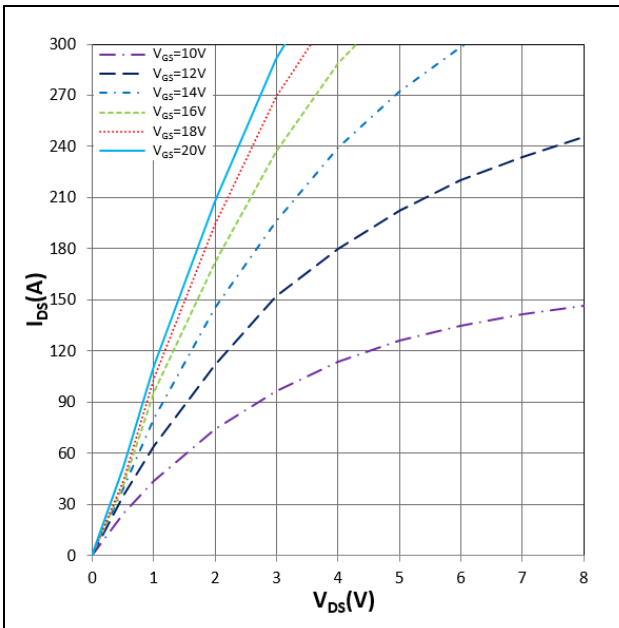


Figure 5. I_{DS} vs V_{DS}
 $T_j = 25^\circ\text{C}$, V_{GS} parameter

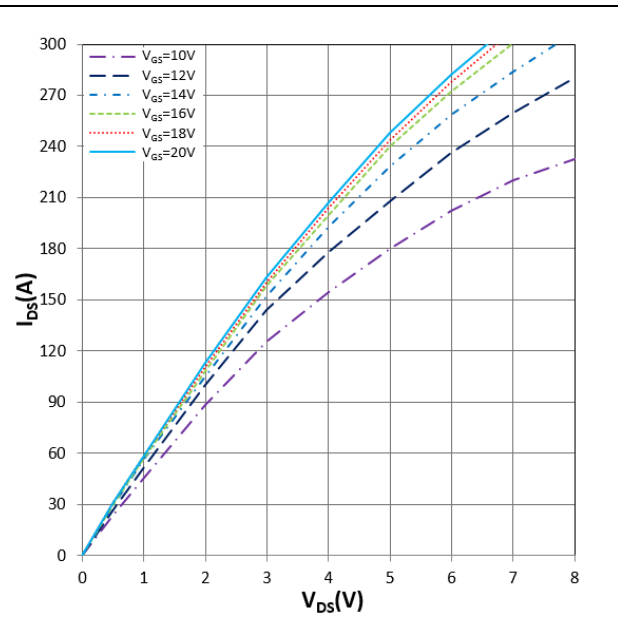


Figure 6. I_{DS} vs V_{DS}
 $T_j = 175^\circ\text{C}$, V_{GS} parameter

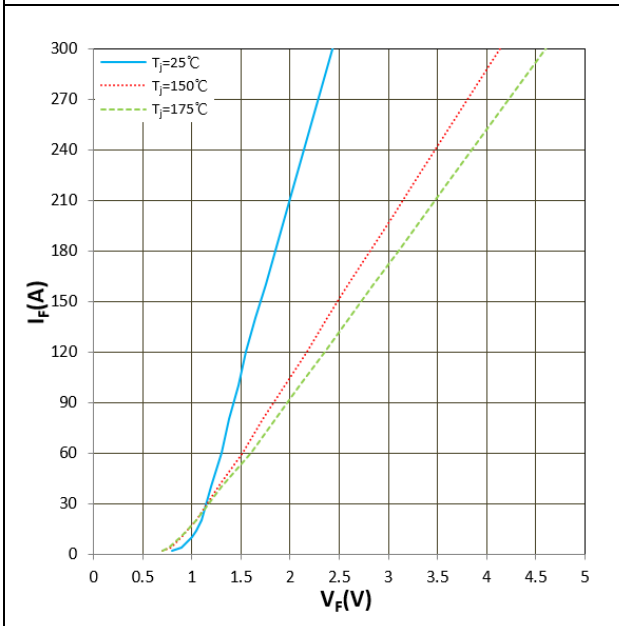


Figure 7. I_F vs V_F

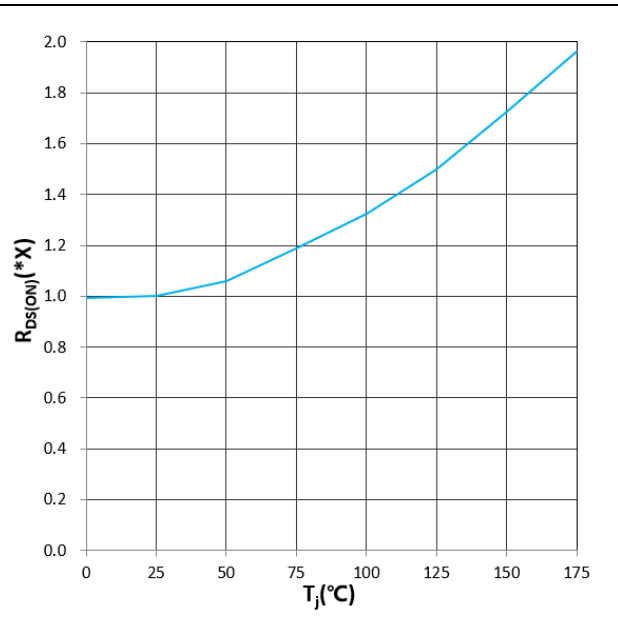


Figure 8. $R_{DS(on)}$ vs T_j
 $V_{GS} = 20\text{V}$, $1.0X = 9.2\text{m}\Omega$

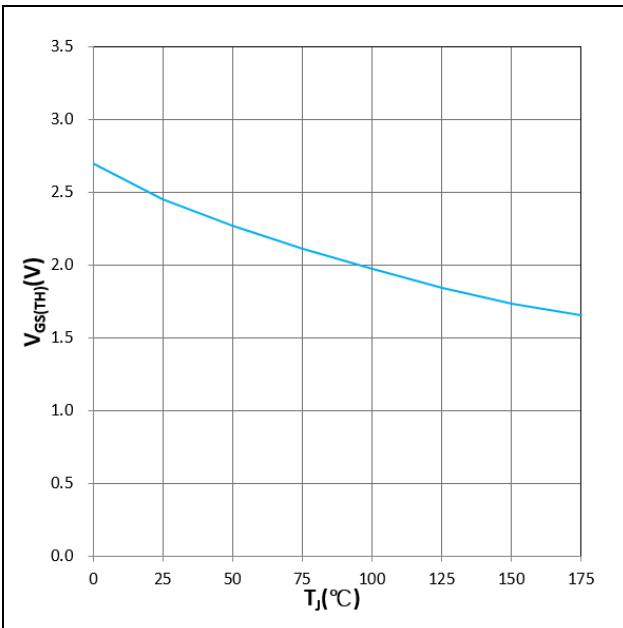


Figure 9. V_{GS(TH)} vs T_J
V_{DS} = V_{GS}, I_{DS} = 40mA

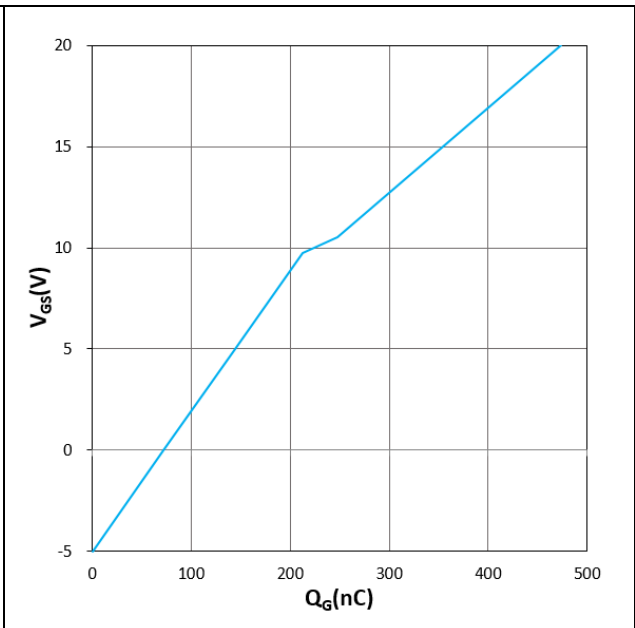


Figure 10. V_{GS} vs Q_G
V_{DD} = 800V, I_D = 150A

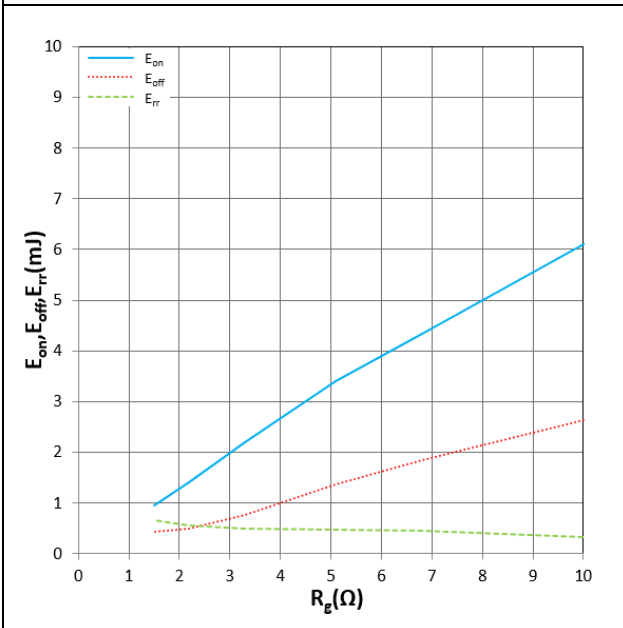


Figure 11. E_{on}, E_{off}, E_{rr} vs R_G
T_J = 25°C, I_D = 150A, V_{GS} = +15/-4V

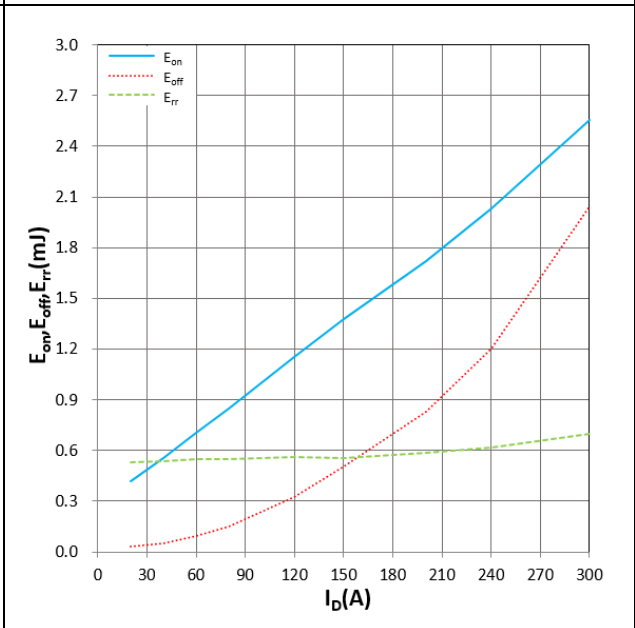


Figure 12. E_{on}, E_{off}, E_{rr} vs I_D
T_J = 25°C, R_G = 2.2Ω, V_{GS} = +15/-4V

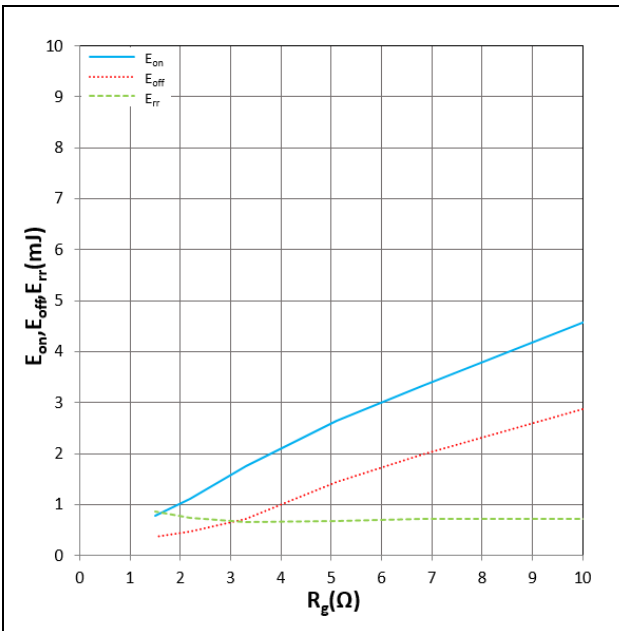


Figure 13. E_{on} , E_{off} , E_{rr} vs R_g
 $T_j = 150^\circ\text{C}$, $I_D = 150\text{A}$, $V_{GS} = +15/-4\text{V}$

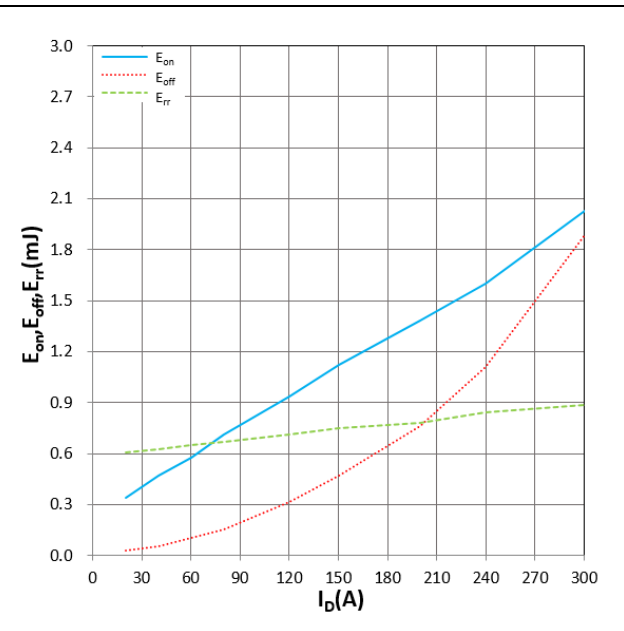


Figure 14. E_{on} , E_{off} , E_{rr} vs I_D
 $T_j = 150^\circ\text{C}$, $R_g = 2.2\Omega$, $V_{GS} = +15/-4\text{V}$

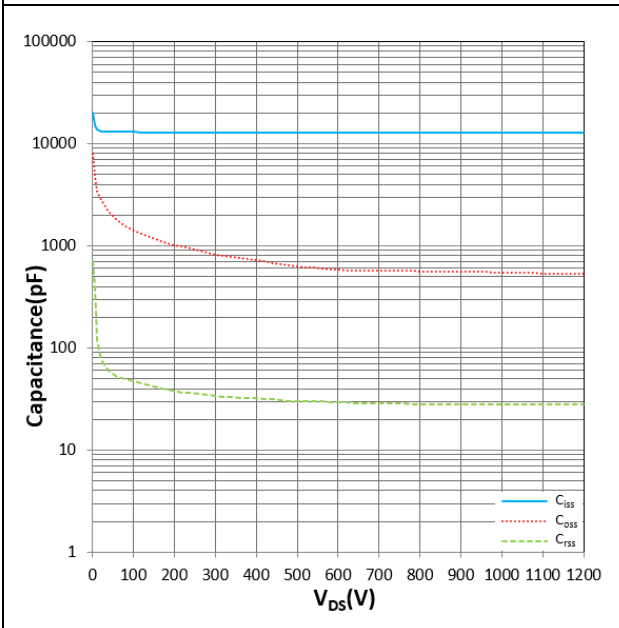
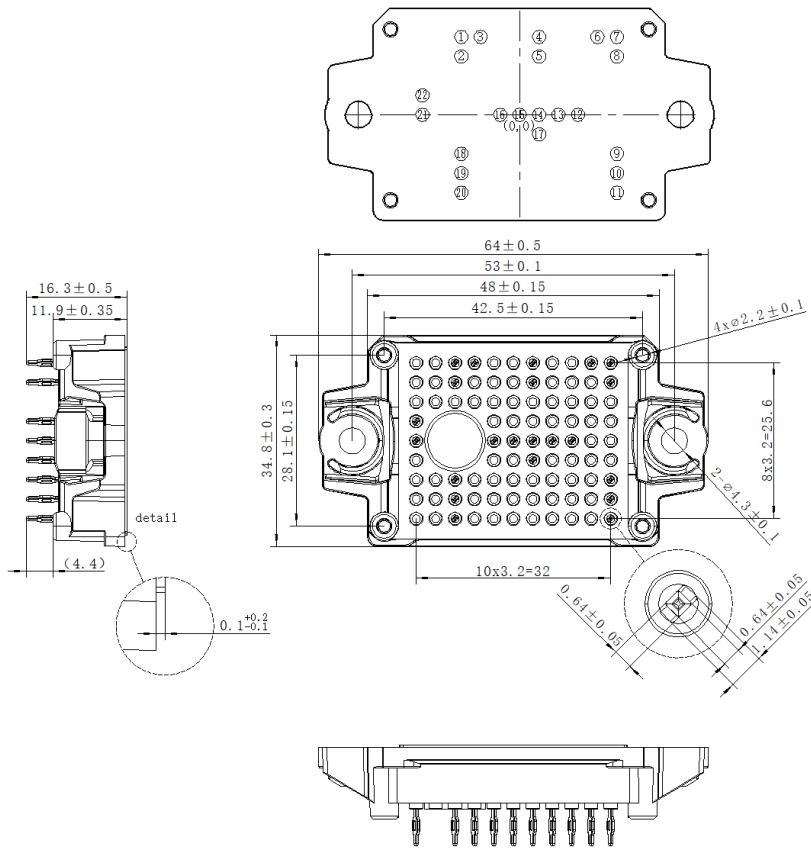


Figure 15. C_{iss} , C_{oss} , C_{rss} vs V_{DS}
 $T_j = 25^\circ\text{C}$

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	-9.6	-6.4
19	-9.6	-9.6
20	-9.6	-12.8
21	-16	0
22	-16	3.2

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