DFS09CU12EYQ1

1200V/9mΩ Chopper SiC MOSFET Module

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°C
- 150A@T_f =75°C
- 175°C maximum junction temperature
- Low thermal resistance with Si_3N_4 AMB
- Low Switching Losses
- Thermistor inside

Applications

- xEV Applications
- Converter
- Vehicle Fast Chargers
- Renewable

Circuit diagram

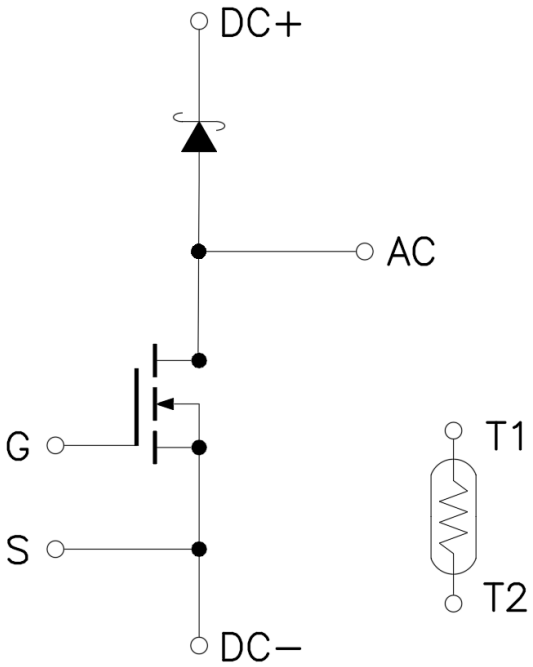


Figure 1. Out drawing & circuit diagram for DFS09CU12EYQ1

Pin Configuration and Marking Information

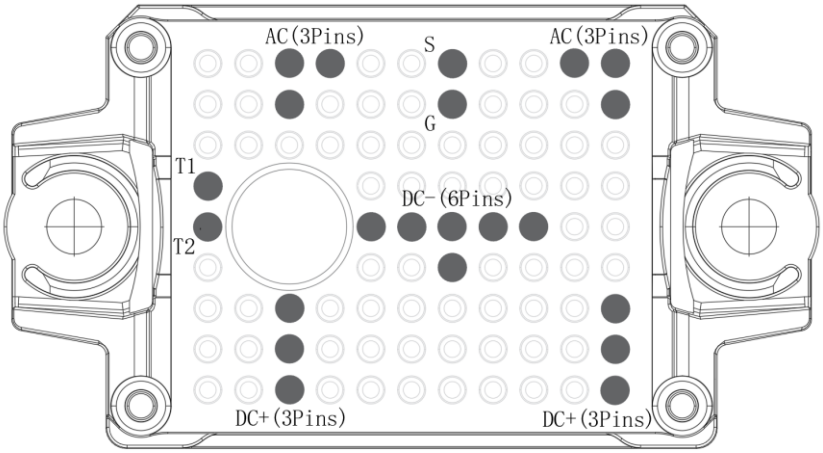


Figure 2. Pin configuration

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	R2 =R25 exp [$B_{25/50}$(1/T2 - 1/(298,15 K))]	-	3375	-	K
$B_{25/80}$	B-value	R2 =R25 exp [$B_{25/80}$(1/T2 - 1/(298,15 K))]	-	3411	-	K
$B_{25/100}$	B-value	R2 =R25 exp [$B_{25/100}$(1/T2 - 1/(298,15 K))]	-	3433	-	K

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=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°C		-	-	400	nA
I_{GSS-}		V_{GS}=-5V, V_{DS}=0V, T_j=25°C		-	-	-400	nA
$R_{DS(on)}$ (Chip)	Static drain-source On-state resistance	I_D=150A, T_j=25°C	V_{GS}=20V	-	9.2	12.8	mΩ
		I_D=150A T_j=175°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°C	V_{GS}=20V	-	1.38	1.92	V
		I_D=150A T_j=175°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°C		-	0.475	-	Ω
$t_{d(on)}$	Turn-on delay time	V_{DD}=600V I_D=150A V_{GS}=+15/-4V R_G=2.2Ω Inductive load switching operation	T_j=25°C	-	35	-	ns
			T_j=150°C	-	30	-	
t_r	Rise time		T_j=25°C	-	20	-	ns
			T_j=150°C	-	19	-	
$t_{d(off)}$	Turn-off delay time		T_j=25°C	-	45	-	ns
			T_j=150°C	-	55	-	
t_f	Fall time		T_j=25°C	-	11	-	ns
			T_j=150°C	-	12	-	
E_{on}	Turn-on power dissipation		T_j=25°C	-	1.41	-	mJ
			T_j=150°C	-	1.12	-	
E_{off}	Turn-off power dissipation		T_j=25°C	-	0.51	-	mJ
			T_j=150°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: V_{GS} =+15/-4V R_G =2.2Ω Inductive load switching operation	T_j =25°C	-	22	-	ns
			T_j =150°C	-	21	-	
Q_{rr}	Reverse recovery charge		T_j =25°C	-	1.227	-	uC
			T_j =150°C	-	1.428	-	
E_{rr}	Diode switching power dissipation		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

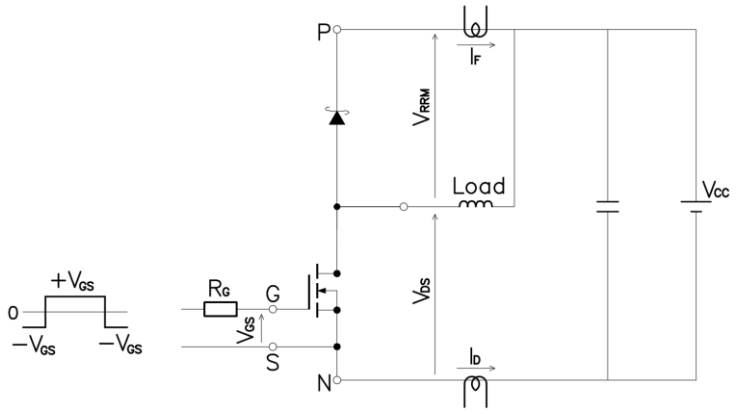


Figure 3. Switching time measure circuit

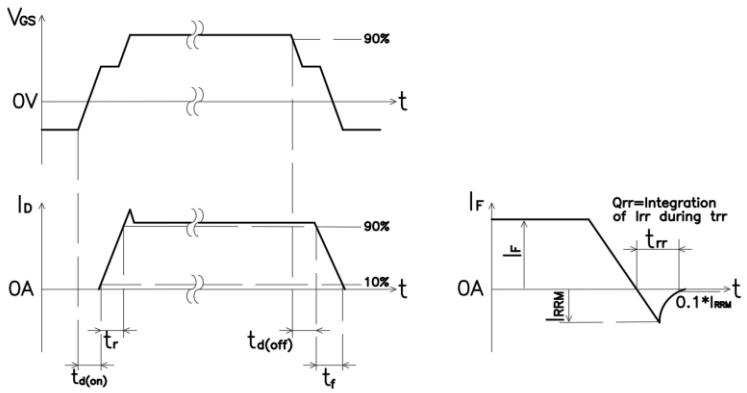


Figure 4. Switching time definition

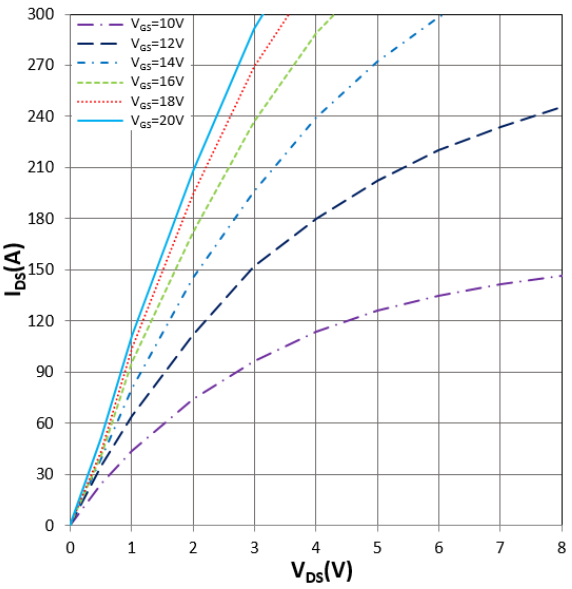


Figure 5. I_{DS} vs V_{DS}
T_j =25°C, V_{GS} parameter

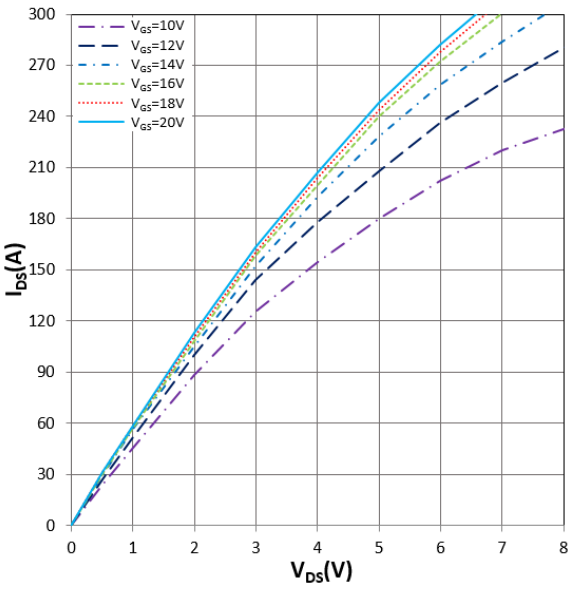


Figure 6. I_{DS} vs V_{DS}
T_j =175°C, V_{GS} parameter

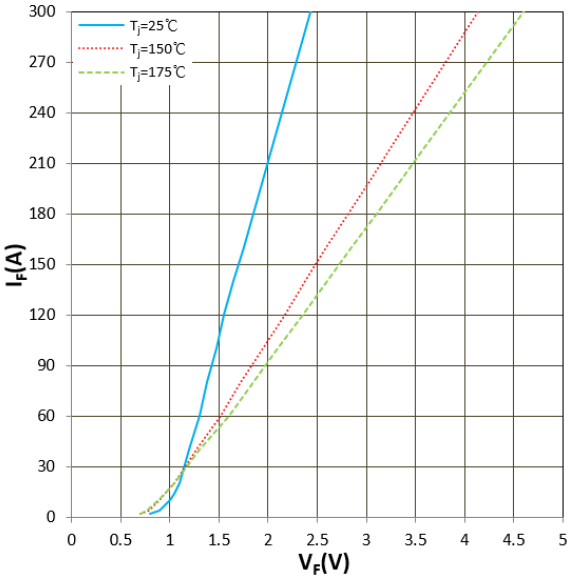


Figure 7. I_F vs V_F

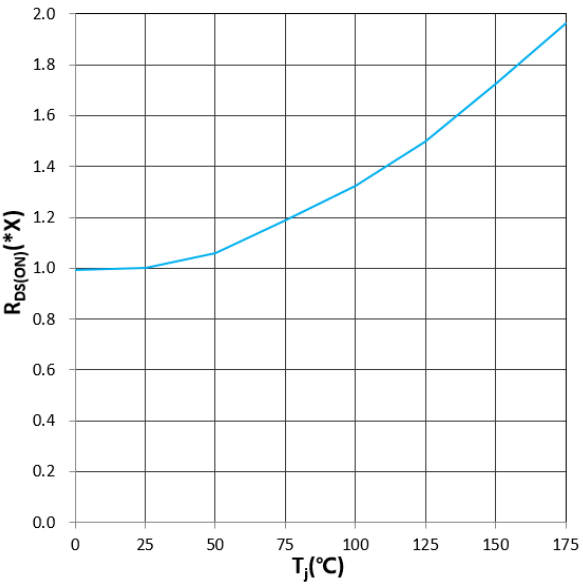


Figure 8. $R_{DS(ON)}$ vs T_J
V_{GS} =20V, 1.0X =9.2mΩ

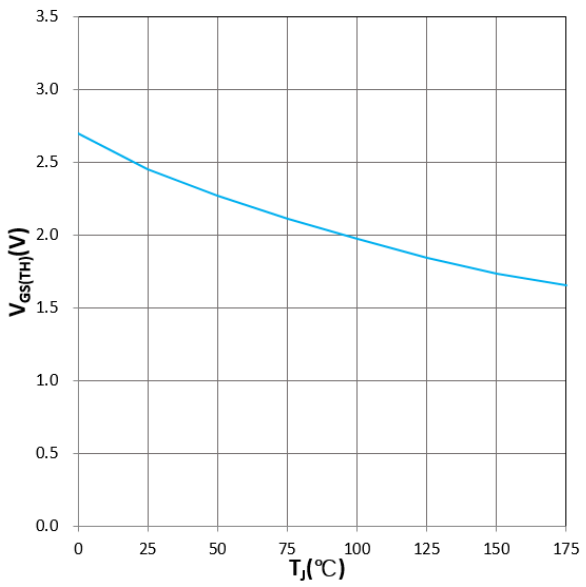


Figure 9. $V_{GS(TH)}$ vs T_J
V_{DS} =V_{GS}, I_{DS} =40mA

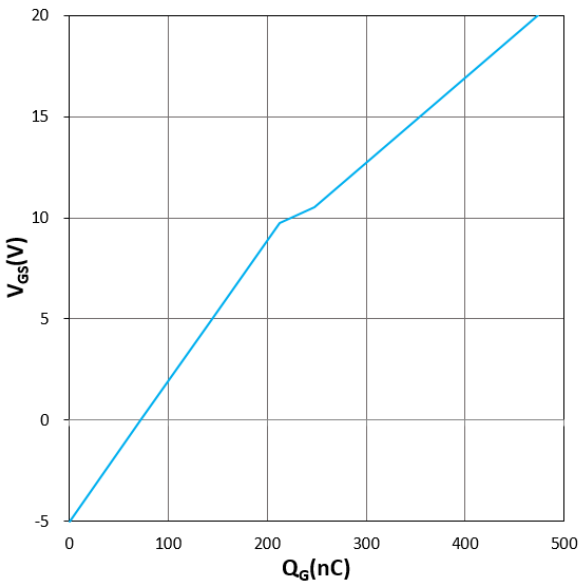


Figure 10. V_{GS} vs Q_G
V_{DD} =800V, I_D =150A

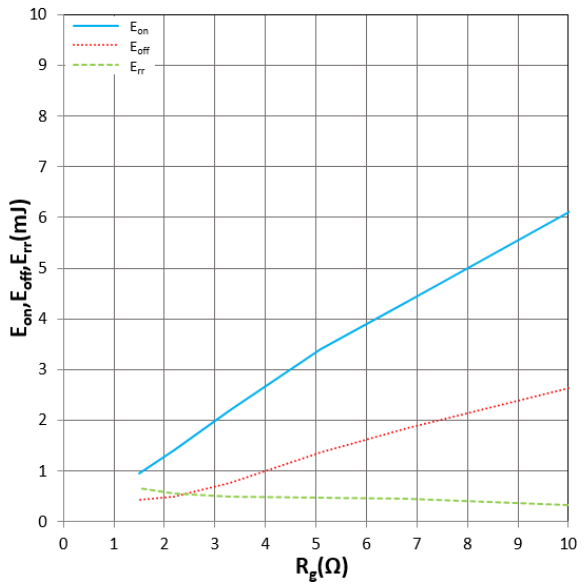


Figure 11. E_{on}, E_{off}, E_{rr} vs R_G
T_j =25°C, I_D =150A, V_{GS} =+15/-4V

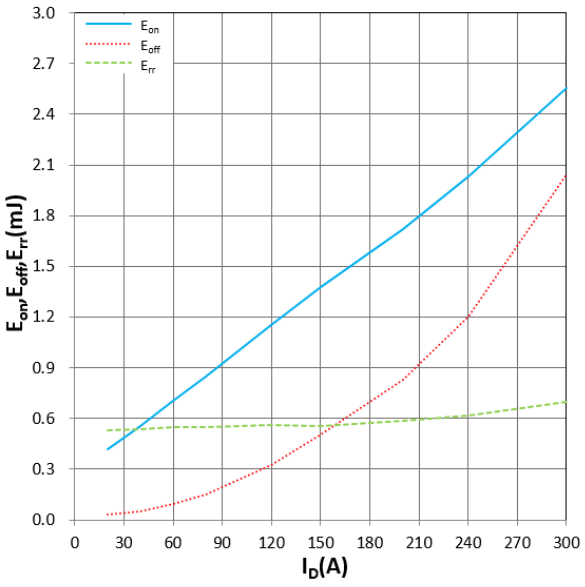


Figure 12. E_{on}, E_{off}, E_{rr} vs I_D
T_j =25°C, R_G =2.2Ω, V_{GS} =+15/-4V

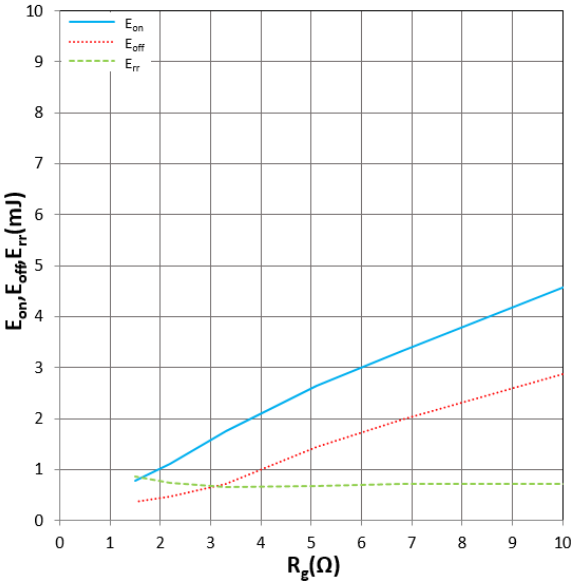


Figure 13. E_{on}, E_{off}, E_{rr} vs R_G
T_j =150°C, I_D =150A, V_{GS} =+15/-4V

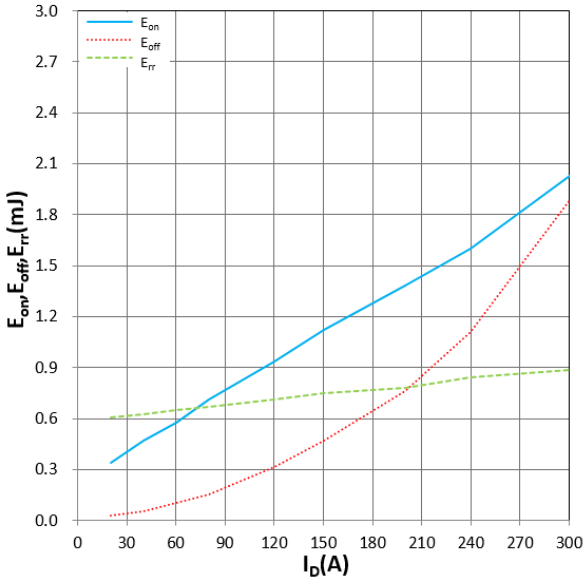


Figure 14. E_{on}, E_{off}, E_{rr} vs I_D
T_j =150°C, R_G =2.2Ω, V_{GS} =+15/-4V

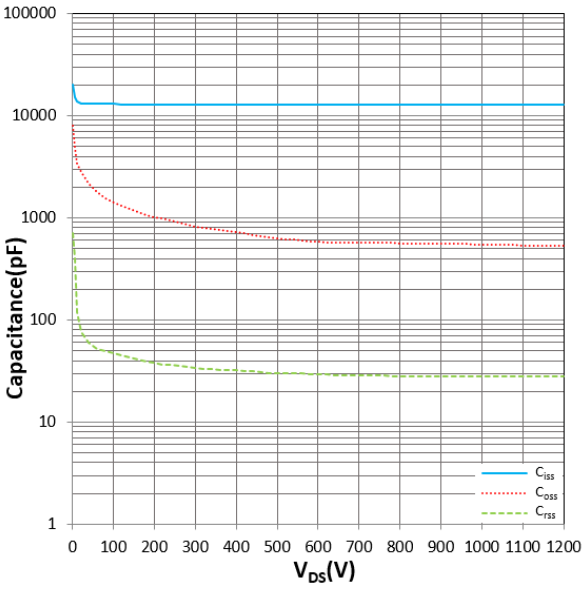
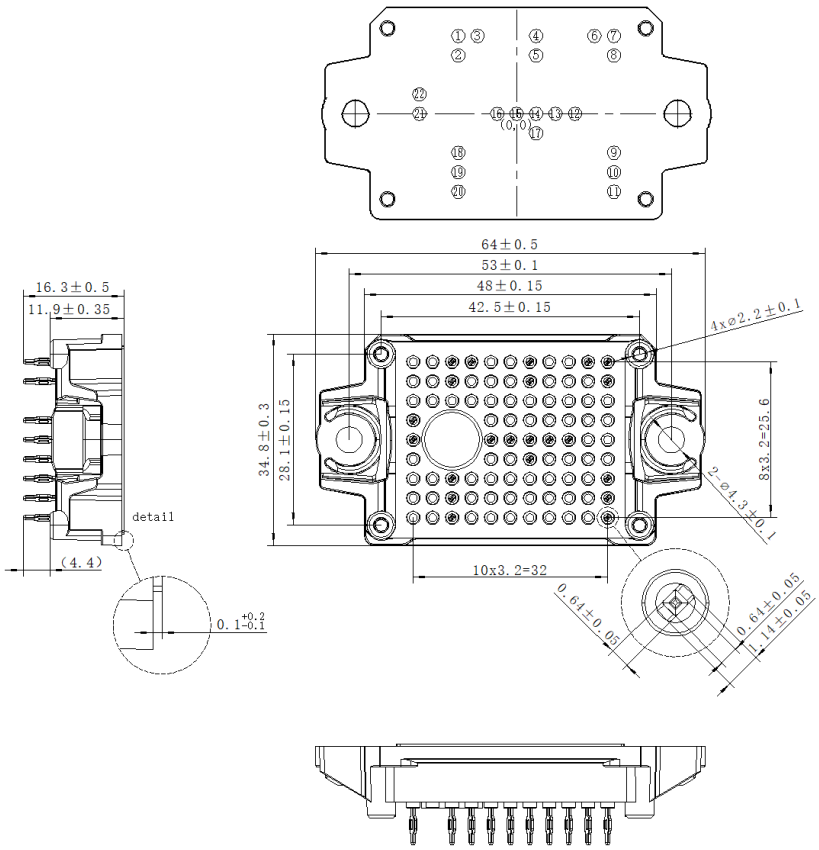


Figure 15. C_{iss}, C_{oss}, C_{rss} vs V_{DS}
T_j =25°C

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

IMPORTANT NOTICE

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The data contained in this document is exclusively intended for technically trained staff. You and your technical departments will have to evaluate the product's suitability for the intended application and the completeness of the product data concerning such application.

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