

Description

The DFS36FB12EYQ1 is a 3 Phase SiC MOSFET Power Module. It integrates high performance SiC MOSFET chips designed for the applications such as DC/DC Converter, Motor converter, UPS, High Frequency Switching application.



Features

- Blocking voltage:1200V
- 36mΩ $R_{ds(on)}$ @ $T_j = 25^\circ\text{C}$
- 70mΩ $R_{ds(on)}$ @ $T_j = 175^\circ\text{C}$
- Low Switching Losses
- 175°C maximum junction temperature
- Thermistor inside

Applications

- DC/DC converter
- Motor converter
- Uninterruptible Power Supplier
- High Frequency Switching application

Circuit diagram

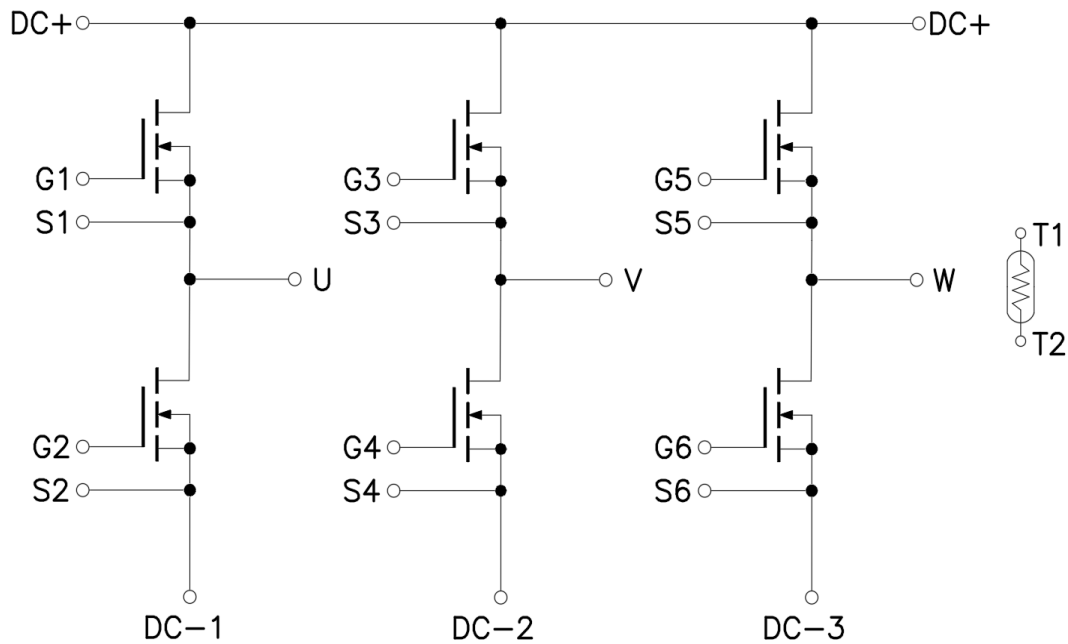


Figure 1. Out drawing & circuit diagram for DFS36FB12EYQ1

Pin Configuration and Marking Information

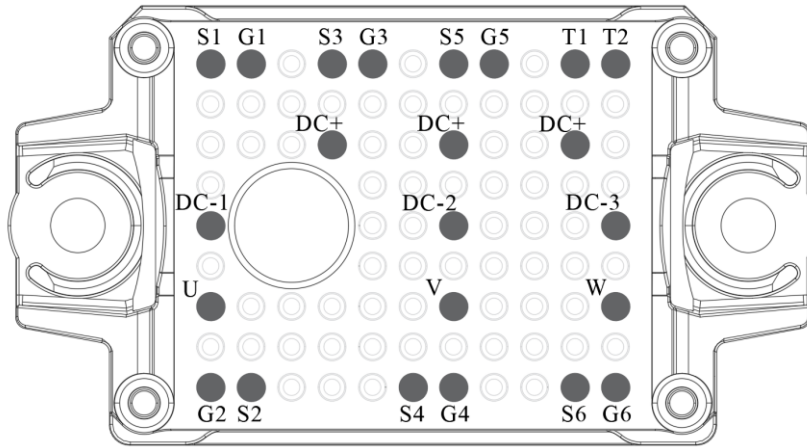


Figure 2. Pin configuration

Symbol	Description
U, V, W	Output terminal of 3 Phase
S2, S4, S6	Low side source signal terminal
G2, G4, G6	Low side gate signal terminal
DC+ (3Pin)	DC+ Bus connection
DC-1, 2, 3	DC- Bus connection
S1, S3, S5	High side source signal terminal
G1, G3, G5	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	-	24	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 =145°C, Note2	25	A
I _{SD}	Source (Body Diode) Current	T _f =145°C, with ON signal	25	A
I _{DP}	Drain Pulse Current, Peak	Less than 1ms, Note3	50	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 AMB substrate bottom 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	$V_{GS}=0V, I_D=1mA$	1200	-	-	V	
I_{DSS}	Zero gate voltage drain Current	$V_{DS}=1200V, V_{GS}=0V$	-	-	160	μA	
$V_{GS(th)}$	Gate-Source threshold Voltage	$I_D=20mA, V_{DS}=V_{GS}$	2.0	2.8	4.0	V	
I_{GSS+}	Gate-Source Leakage Current	$V_{GS}=20V, V_{DS}=0V, T_j=25^\circ C$	-	-	200	nA	
I_{GSS-}		$V_{GS}=-5V, V_{DS}=0V, T_j=25^\circ C$	-200	-	-	nA	
$R_{DS(on)}$ (Chip)	Static drain-source On-state resistance	$I_D=25A, V_{GS}=20V$	$T_j=25^\circ C$	-	36	45	mΩ
			$T_j=175^\circ C$	-	70	-	mΩ
$V_{DS(on)}$ (Chip)	Static drain-source On-state Voltage	$I_D=25A, V_{GS}=20V$	$T_j=25^\circ C$	-	0.9	1.13	V
			$T_j=175^\circ C$	-	1.75	-	V
C_{iss}	Input Vapacitance	$V_{DS}=1000V, V_{GS}=0V, f=200kHz$	-	3192	-	pF	
C_{oss}	Output Vapacitance		-	132	-	pF	
C_{rss}	Reverse transfer Capacitance		-	7	-	pF	
Q_G	Total gate charge	$V_{DD}=800V, I_D=40A, V_{GS}=+20/-5V$	-	118	-	nC	
R_{Gint}	Internal Gate Resistance	$T_j=25^\circ C$	-	1.9	-	Ω	
$t_{d(on)}$	Turn-on delay time	$V_{DD}=600V$ $I_D=25A$ $V_{GS}=+15/-4V$ $R_G=5.1\Omega$ Inductive load switching operation	$T_j=25^\circ C$	-	19	-	ns
			$T_j=150^\circ C$	-	20	-	
t_r	Rise time		$T_j=25^\circ C$	-	9	-	ns
			$T_j=150^\circ C$	-	8	-	
$t_{d(off)}$	Turn-off delay time		$T_j=25^\circ C$	-	26	-	ns
			$T_j=150^\circ C$	-	33	-	
t_f	Fall time		$T_j=25^\circ C$	-	13	-	ns
			$T_j=150^\circ C$	-	13	-	
E_{on}	Turn-on power dissipation		$T_j=25^\circ C$	-	0.18	-	mJ
			$T_j=150^\circ C$	-	0.25	-	
E_{off}	Turn-off power dissipation	$T_j=25^\circ C$	-	0.025	-	mJ	
		$T_j=150^\circ C$	-	0.016	-		
$R_{th(j-c)}$	FET Thermal Resistance	Junction to Case/MOSFET	-	0.52	-	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} =-4V I _{SD} =25A	T _j =25°C	-	3.9	-	V
			T _j =175°C	-	3.5	-	
T _{rr}	Reverse recovery time	V _{DD} =600V I _D =25A	T _j =25°C	-	27	-	ns
			T _j =150°C	-	28	-	
Q _{rr}	Reverse recovery charge	V _{GS} =+15/-4V R _G =5.1Ω	T _j =25°C	-	0.66	-	μC
			T _j =150°C	-	1.77	-	
E _{rr}	Diode switching power dissipation	Inductive load switching operation	T _j =25°C	-	0.304	-	mJ
			T _j =150°C	-	0.678	-	

Test Conditions

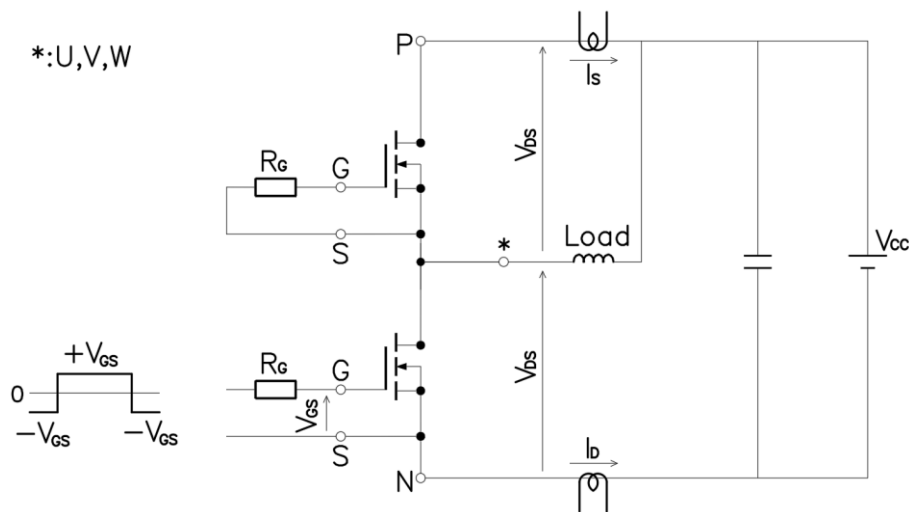


Figure 3. Switching time measure circuit

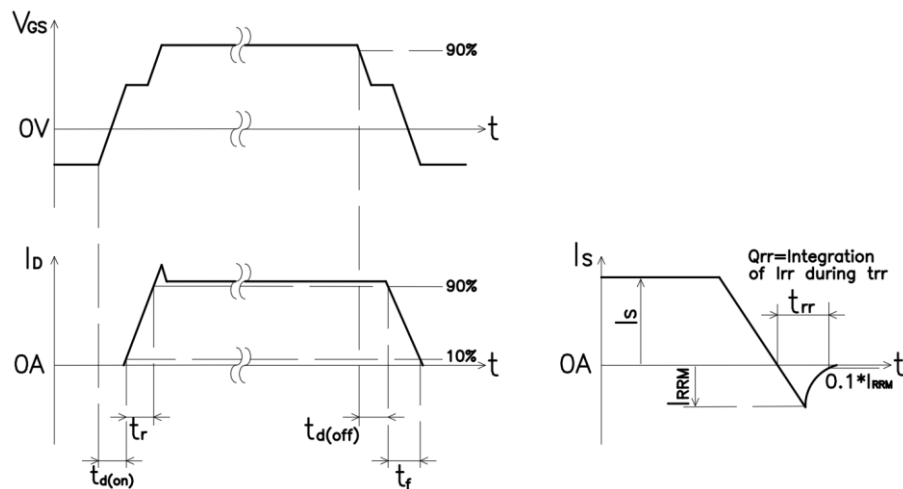


Figure 4. Switching time definition

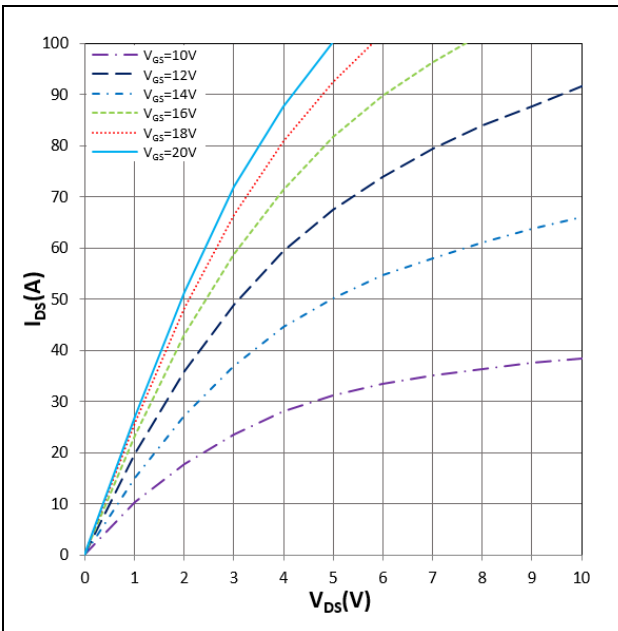


Figure 5. I_{D_S} vs V_{D_S}
 $T_j = 25^\circ\text{C}$, V_{G_S} parameter

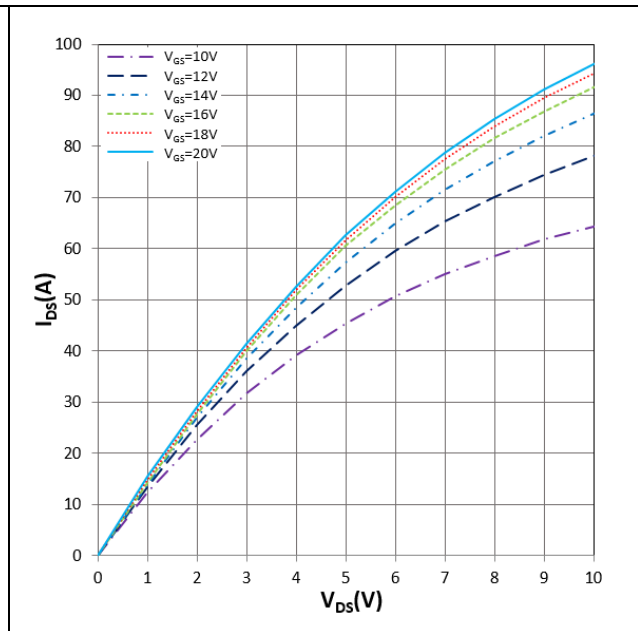


Figure 6. I_{D_S} vs V_{D_S}
 $T_j = 175^\circ\text{C}$, V_{G_S} parameter

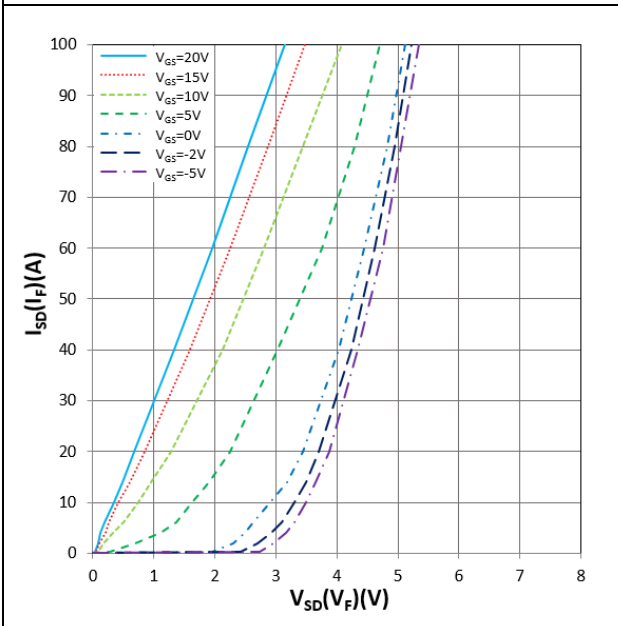


Figure 7. $I_{S_D}(I_F)$ vs $V_{S_D}(V_F)$
 $T_j = 25^\circ\text{C}$, V_{G_S} parameter

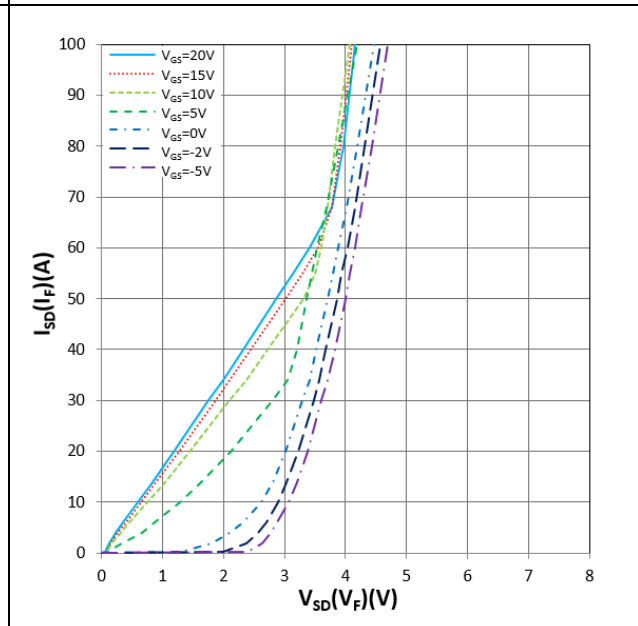


Figure 8. $I_{S_D}(I_F)$ vs $V_{S_D}(V_F)$
 $T_j = 175^\circ\text{C}$, V_{G_S} parameter

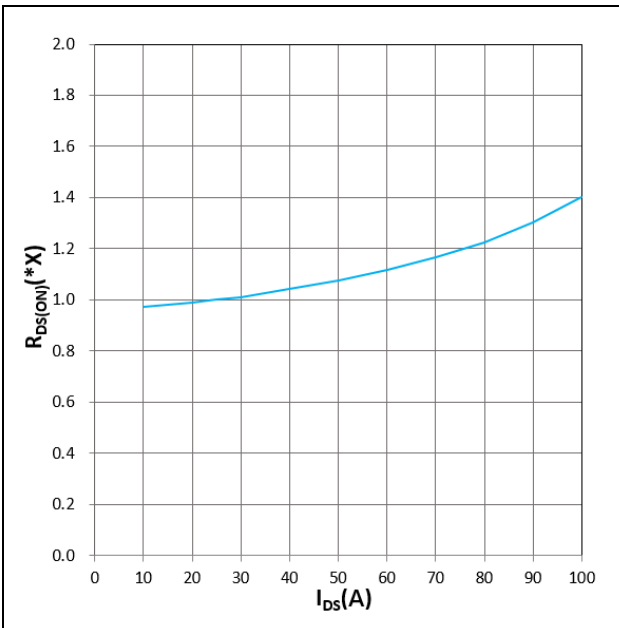


Figure 9. $R_{DS(ON)}$ vs I_{DS}
 $V_{GS} = 20V$, $1.0X = 36m\Omega$

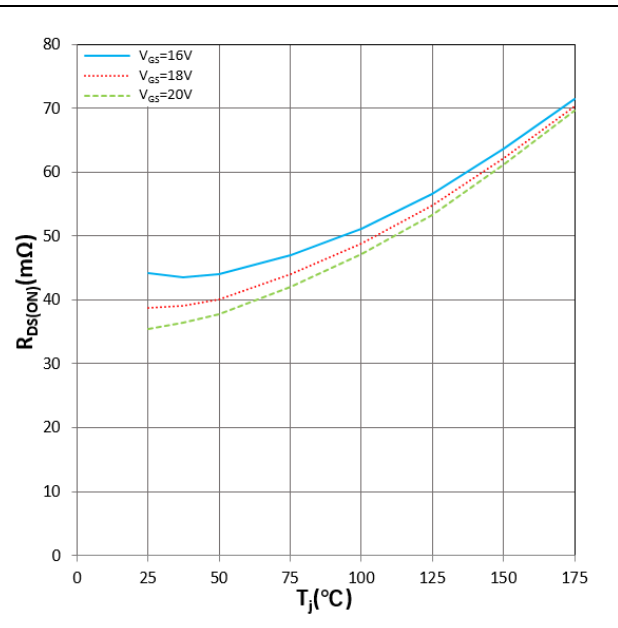


Figure 10. $R_{DS(ON)}$ vs T_j
 $I_D = 25A$

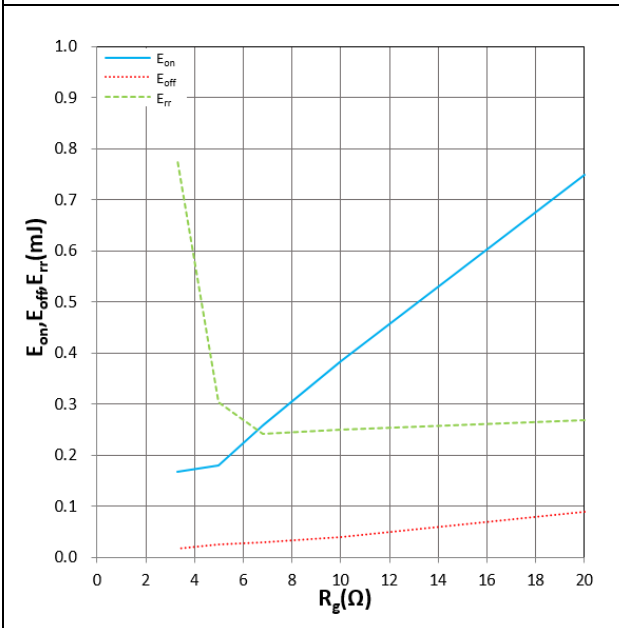


Figure 11. E_{on} , E_{off} , E_{rr} vs R_G
 $T_j = 25^\circ C$, $I_D = 25A$, $V_{GS} = +15/-4V$

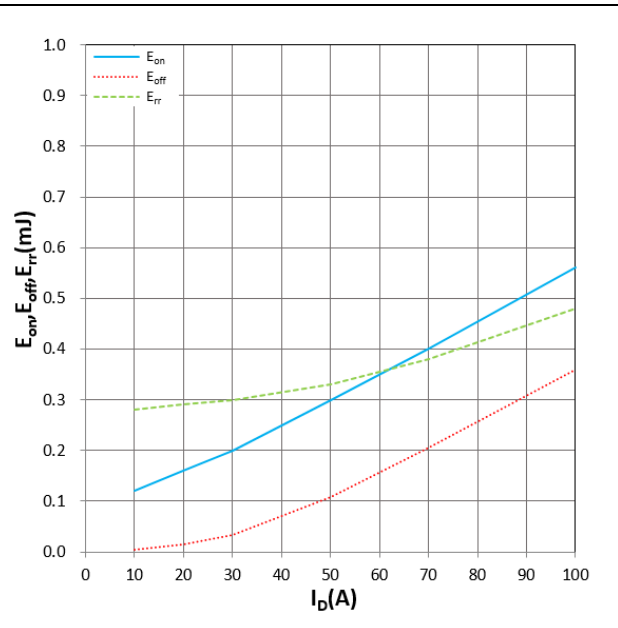


Figure 12. E_{on} , E_{off} , E_{rr} vs I_D
 $T_j = 25^\circ C$, $R_G = 5.1\Omega$, $V_{GS} = +15/-4V$

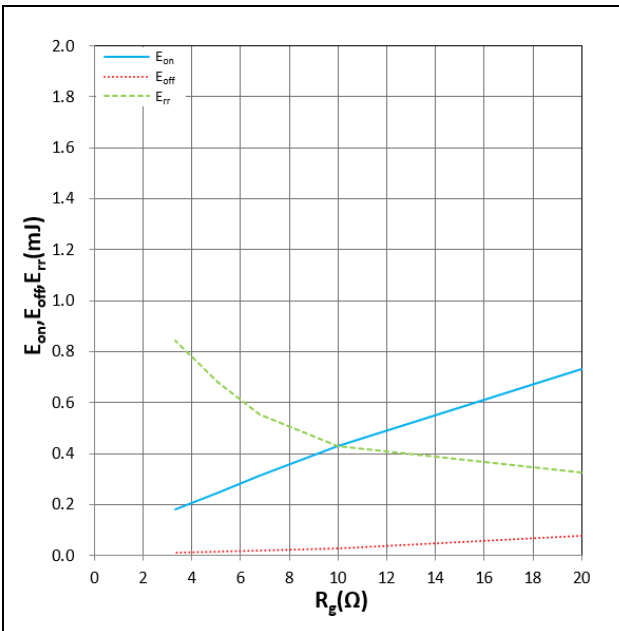


Figure 13. E_{on} , E_{off} , E_{rr} vs R_g
 $T_j = 150^\circ\text{C}$, $I_D = 25\text{A}$, $V_{GS} = +15/-4\text{V}$

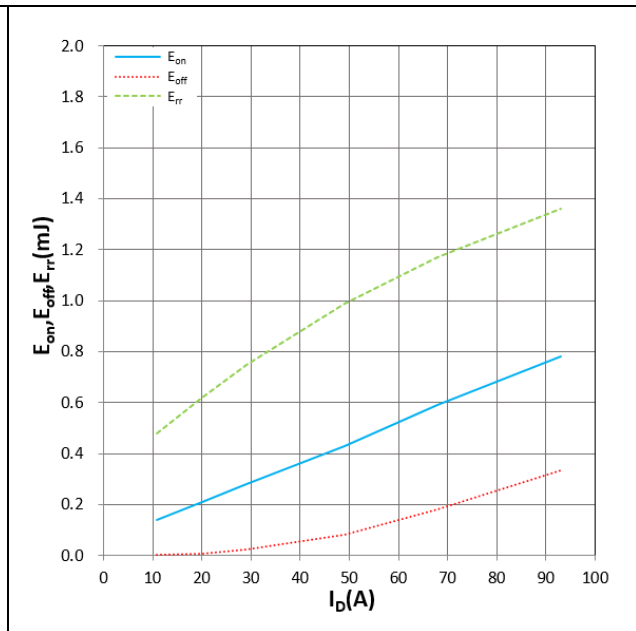


Figure 14. E_{on} , E_{off} , E_{rr} vs I_D
 $T_j = 150^\circ\text{C}$, $R_g = 5.1\Omega$, $V_{GS} = +15/-4\text{V}$

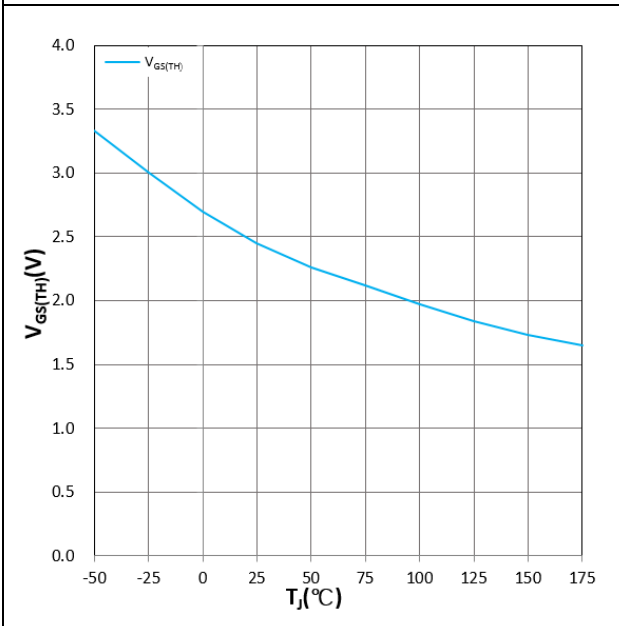


Figure 15. $V_{GS(TH)}$ vs T_j
 $V_{DS} = V_{GS}$, $I_{DS} = 20\text{mA}$

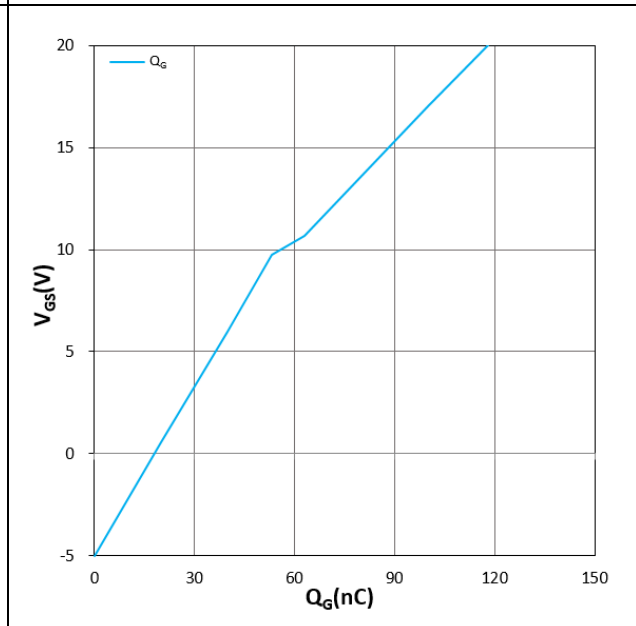


Figure 16. V_{GS} vs Q_G
 $V_{DD} = 800\text{V}$, $I_D = 40\text{A}$

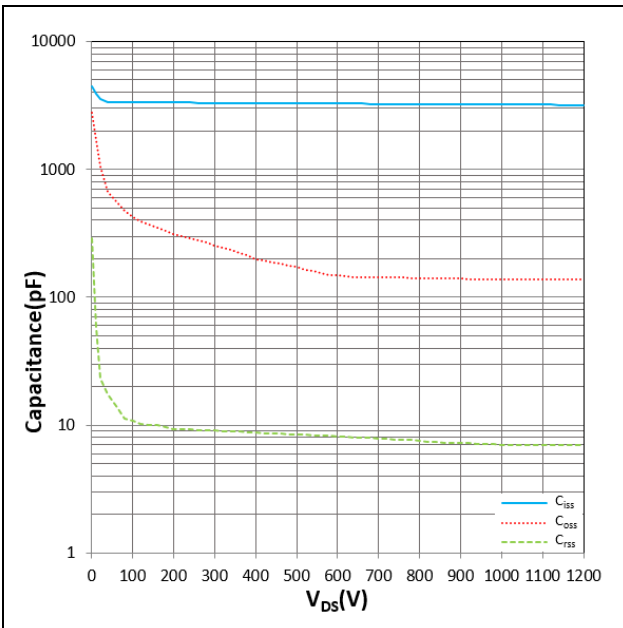
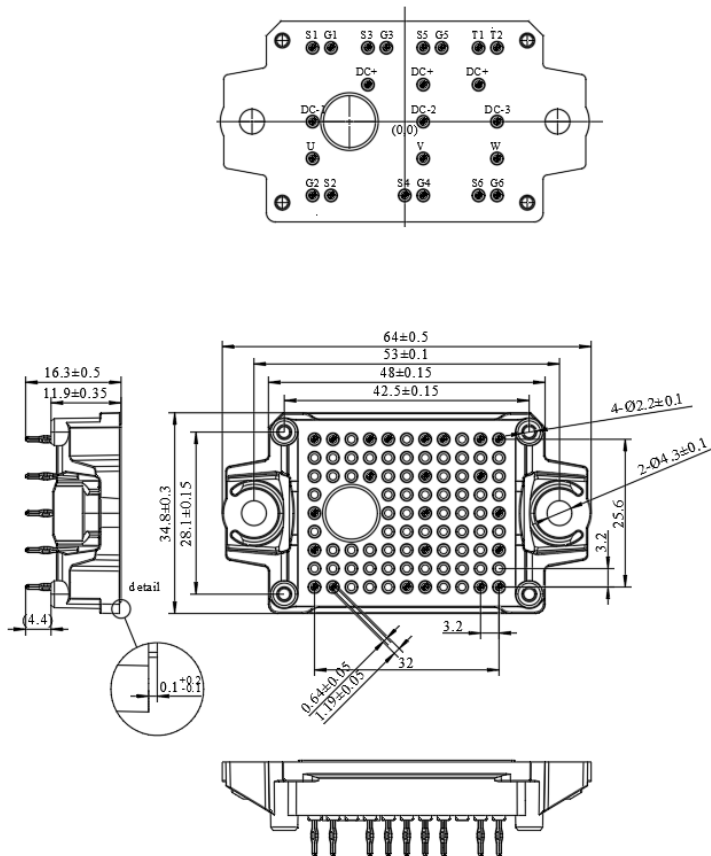


Figure 17. C_{iss} , C_{oss} , C_{rss} vs V_{DS}
 $T_j = 25^\circ\text{C}$

Package dimensions



Pin table		
Pin	X	Y
T2	16	12.8
T1	12.8	12.8
G5	6.4	12.8
S5	3.2	12.8
G3	-3.2	12.8
S3	-6.4	12.8
G1	-12.8	12.8
S1	-16	12.8
DC+	12.8	6.4
DC+	3.2	6.4
DC+	-6.4	6.4
DC-3	16	0
DC-2	3.2	0
DC-1	-16	0
W	16	-6.4
V	3.2	-6.4
U	-16	-6.4
G6	16	-12.8
S6	12.8	-12.8
G4	3.2	-12.8
S4	0	-12.8
S2	-12.8	-12.8
G2	-16	-12.8

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