DFS40CU12F0Q1

1200V/40mΩ Dual Boost SiC MOSFET Module

Description

The DFS40CU12F0Q1 is a Dual Boost Power Module. It integrates high performance SiC MOSFET chips and SiC Diodes designed for the applications such as Solar Inverter, UPS, Fuel cell-DC/DC converter, Energy storage Systems.

Features

- Blocking voltage :1200V
- 40mΩ $R_{ds(on)}$@T_j =25°C
- SiC Diode
- 1600V Bypass Diodes
- Low Inductive Design
- Low thermal resistance
- Thermistor inside

Applications

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

Circuit diagram

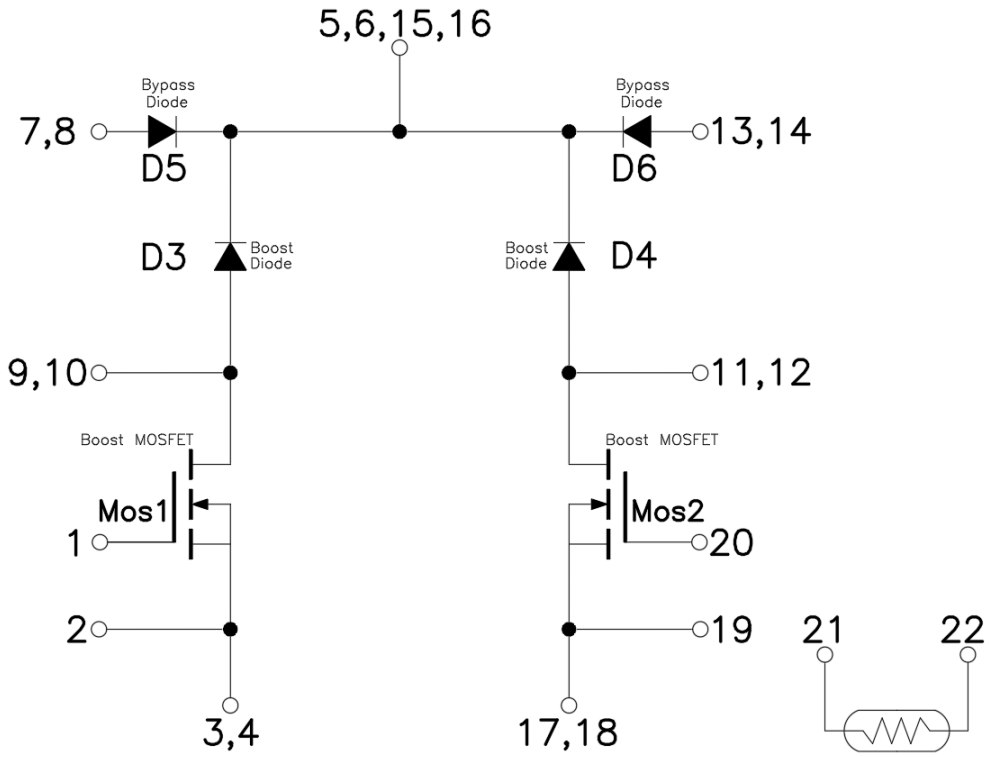


Figure 1. Out drawing & circuit diagram for DFS40CU12F0Q1

Pin Configuration and Marking Information

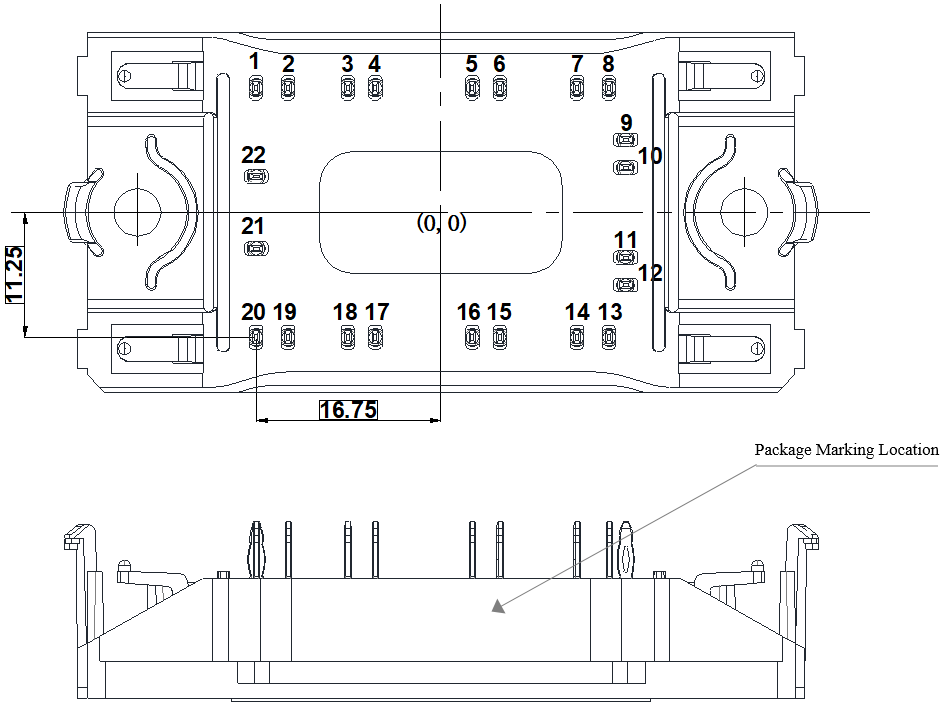


Figure 2. Pin configuration

Module

Parameter	Conditions	Value	Unit
Isolation Voltage	RMS, f =50Hz, t =1min	2.5	kV
Creepage distance	-	12.7	mm
Clearance	Press-fit pin	9.15	mm
Comparative Tracking Index	-	>200	-
Module lead resistance, terminals–chip	T_C = 25°C	0.8	mΩ
Weight	-	26.5	g

Thermistor Electrical characteristics

Symbol	Item	Condition	Value			Unit
			Min.	Typ.	Max	
R25	Nominal resistance	-	-	22	-	kΩ
R100	Nominal resistance	T =100°C	-	-	-	Ω
ΔR/R	Deviation of R25	-	-5	-	5	%
-	B-value	B(25/50) , tolerance ±3%	-	3950	-	K
-	B-value	B(25/100) , tolerance ±3%	-	3998	-	K
P_D	Power Dissipation	-	-	200	-	mW

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

Boost SiC MOSFET

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_S =80°C	43	A
I_{DS}	DC Continuous Drain Current	T_C =80°C	50	A
I_{SD}	Source (Body Diode) Current	T_S =80°C, with ON signal	43	A
I_{SD}	Source (Body Diode) Current	T_C =80°C, with ON signal	50	A
I_{DP}	Drain Pulse Current, Peak	Less than 1ms, Note2	150	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

Boost Diode

Symbol	Parameter	Conditions	Ratings	Unit
V_{RRM}	Peak Repetitive Revers Voltage	-	1200	V
I_F	Continuous Forward Current	T_j =T_{jmax} , T_S <80°C	33	A
		T_j =T_{jmax} , T_C <80°C	37	A
I_{FSM}	Surge Forward Current	T_C =25°C	111	A
I^2t	Surge Current Capability	(60Hz single half-sine wave)	142	A^2s
P_{tot}	Total Power Dissipation	T_j =T_{jmax} , T_S <80°C	100	W
		T_j =T_{jmax} , T_C <80°C	118	W
T_{jmax}	Maximum Junction temperature	-	175	°C

Bypass Diode

Symbol	Parameter	Conditions	Ratings	Unit
V_{RRM}	Peak Repetitive Revers Voltage	-	1600	V
I_F	Continuous Forward Current	T_j =T_{jmax} , T_S <80°C	43	A
		T_j =T_{jmax} , T_C <80°C	50	A
I_{FRM}	Repetitive Peak Forward Current	T_j =T_{jmax}	150	A
P_{tot}	Total Power Dissipation	T_j =T_{jmax} , T_S <80°C	82	W
		T_j =T_{jmax} , T_C <80°C	100	W
T_{jmax}	Maximum Junction temperature	-	150	°C

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=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°C		-	-	200	nA
I_{GSS-}		V_{GS}=-5V, V_{DS}=0V, T_j=25°C		-200	-	-	nA
$R_{DS(on)}$ (Chip)	Static drain-source On-state resistance	I_D=50A , V_{GS}=20V	T_j=25°C	-	40	50	mΩ
			T_j=175°C	-	74.5	-	mΩ
$V_{DS(on)}$ (Chip)	Static drain-source On-state Voltage	I_D=50A , V_{GS}=20V	T_j=25°C	-	2.0	2.5	V
			T_j=175°C	-	3.725	-	V
C_{iss}	Input Vapacitance	V_{DS}=1000V, V_{GS}=0V, f=200kHz		-	2872	-	pF
C_{oss}	Output Vapacitance			-	124	-	pF
C_{rss}	Reverse transfer Capacitance			-	6	-	pF
Q_G	Total gate charge	V_{DD}=800V, I_D=50A, V_{GS}=-4/+20V		-	106	-	nC
R_{Gint}	Internal Gate Resistance	T_j=25°C		-	0.75	-	Ω
$t_{d(on)}$	Turn-on delay time	V_{DD}=600V I_D=50A V_{GS}=+15/-4V R_G=5.1Ω Inductive load switching operation	T_j=25°C	-	20	-	ns
			T_j=150°C	-	20	-	
t_r	Rise time		T_j=25°C	-	9	-	ns
			T_j=150°C	-	8	-	
$t_{d(off)}$	Turn-off delay time		T_j=25°C	-	27	-	ns
			T_j=150°C	-	32	-	
t_f	Fall time		T_j=25°C	-	14	-	ns
			T_j=150°C	-	13	-	
E_{on}	Turn-on power dissipation		T_j=25°C	-	0.3	-	mJ
			T_j=150°C	-	0.43	-	
E_{off}	Turn-off power dissipation		T_j=25°C	-	0.11	-	mJ
			T_j=150°C	-	0.08	-	
$R_{th(j-c)}$	Thermal Resistance, Junction to Case/MOSFET			-	0.53	-	K/W
$R_{th(c-s)}$	Thermal Resistance, Case to sink (Conductive Grease applied)			-	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} =50A	T_j=25°C	-	4.5	-	V
			T_j=175°C	-	4.0	-	
T_{rr}	Reverse recovery time	V_{DD} =600V I_D =50A V_{GS} =+15/-4V R_G =5.1Ω Inductive load switching operation	T_j=25°C	-	26	-	ns
			T_j=150°C	-	28	-	
Q_{rr}	Reverse recovery charge		T_j=25°C	-	0.65	-	μC
			T_j=150°C	-	1.79	-	
E_{rr}	Diode switching power dissipation		T_j=25°C	-	0.34	-	mJ
			T_j=150°C	-	0.98	-	

Boost Diode Electrical characteristics (T_j =25°C unless otherwise specified, chip)

Symbol	Item	Condition		Value			Unit
				Min.	Typ.	Max	
V_R	Breakdown Voltage	I_R =1mA		1200	-	-	V
I_R	Reverse Leakage Current	V_R =1200V	T_j=25°C	-	3	40	uA
			T_j=150°C	-	93	-	uA
V_F	Diode Forward Voltage	I_F =20A V_{GE} =0V	T_j=25°C	-	1.46	1.6	V
			T_j=150°C	-	2.03	2.65	
t_{rr}	Reverse recovery time	V_{CC} =700V I_C =50A V_{GE} =+15V/-8V R_G =5.0Ω	T_j=25°C	-	0.012	-	us
			T_j=125°C	-	0.016	-	
I_{RM}	Peak reverse recovery Current		T_j=25°C	-	6.0	-	A
			T_j=125°C	-	12.0	-	
Q_{rr}	Recovered charge		T_j=25°C	-	0.048	-	uC
			T_j=125°C	-	0.118	-	
$R_{th(j-c)}$	Thermal Resistance, Junction to Case (Diode)			-	0.8	-	°C/W
$R_{th(c-s)}$	Thermal Resistance, Case to sink (Conductive Grease applied)			-	0.15	-	°C/W

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

Bypass Diode Electrical characteristics(T_j=25°C unless otherwise specified, chip)

Symbol	Item	Condition		Value			Unit
				Min.	Typ.	Max	
V_R	Breakdown Voltage	I_R =5uA		1600	-	-	V
I_R	Reverse Leakage Current	V_R =1600V	T_j=25°C	-	-	5	uA
			T_j=150°C	-	-	1	mA
V_F	Diode Forward Voltage	I_F =16A	T_j=25°C	-	1.0	1.4	V
		V_{GE} =0V	T_j=150°C	-	0.9	-	
$R_{th(j-c)}$	Thermal Resistance, Junction to Case (Diode)			-	0.7	-	°C/W
$R_{th(c-s)}$	Thermal Resistance, Case to sink (Conductive Grease applied)			-	0.15	-	°C/W

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

Test Conditions

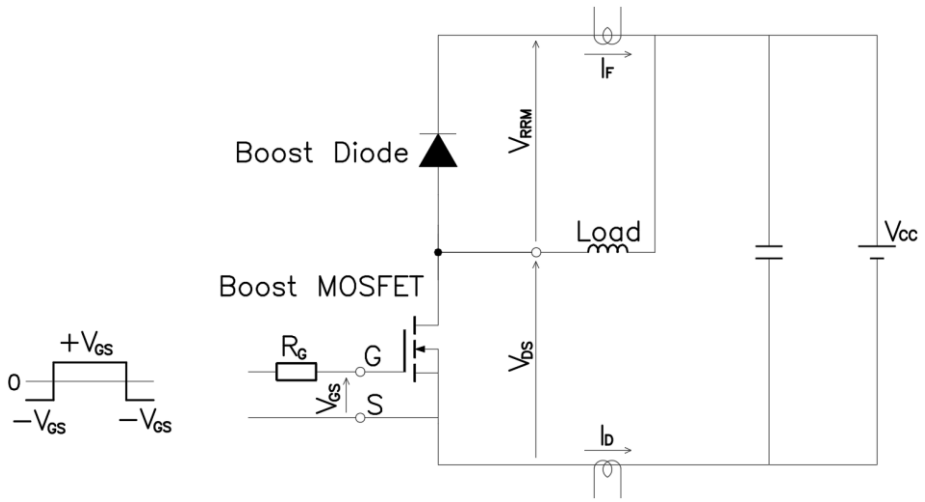


Figure 3. Switching time measure circuit

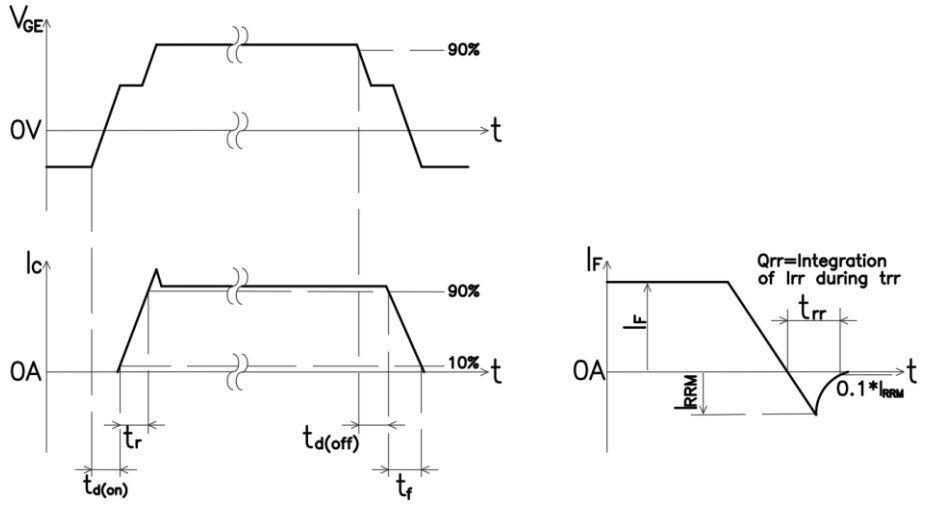


Figure 4. Switching time definition

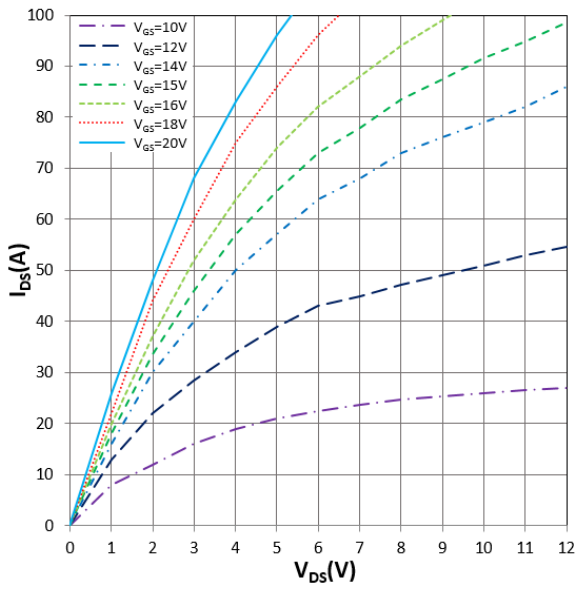


Figure 5. I_{DS} vs V_{DS}
T_j =25°C, V_{GS} parameter

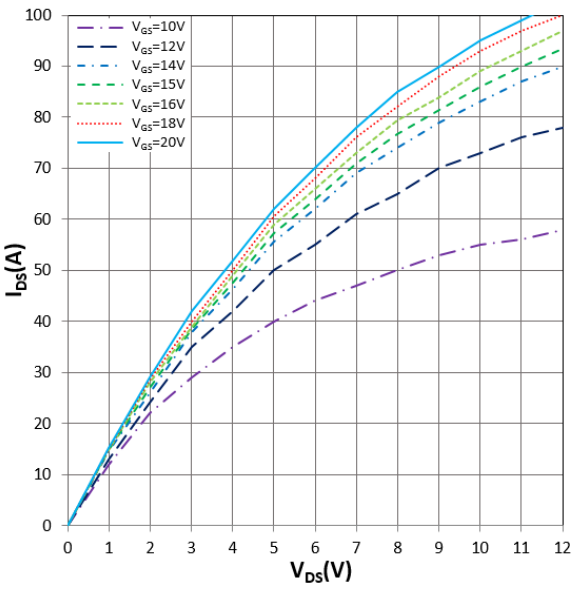


Figure 6. I_{DS} vs V_{DS}
T_j =175°C, V_{GS} paramete

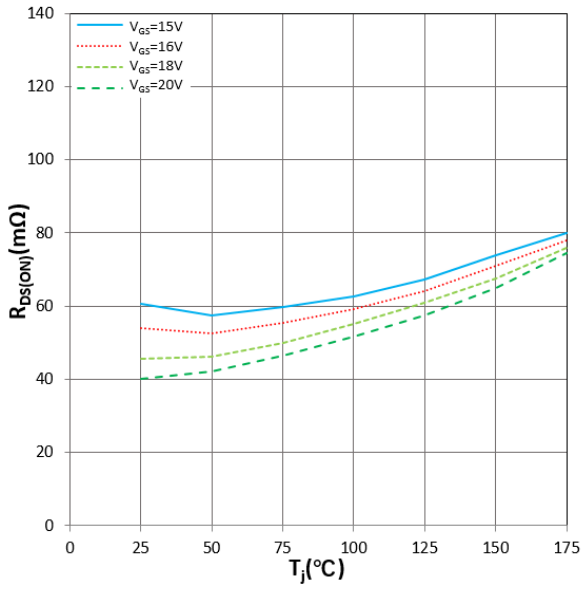


Figure 7. $R_{DS(ON)}$ vs T_J
I_D =50A

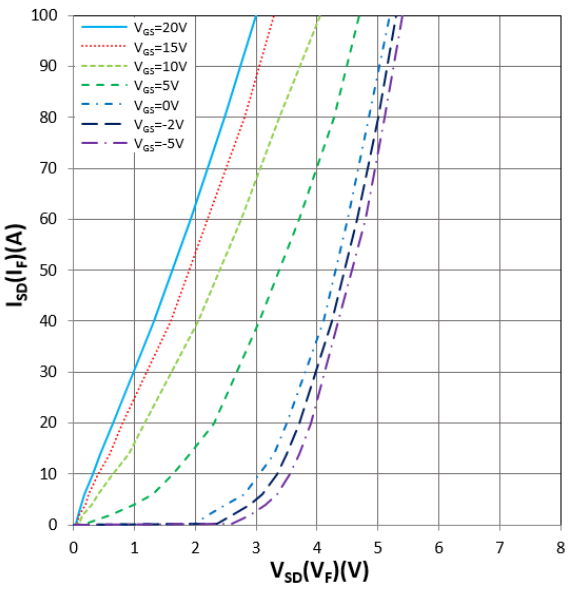


Figure 8. I_{SD}(I_F) vs V_{SD} (V_F)
T_j =25°C, V_{GS} parameter

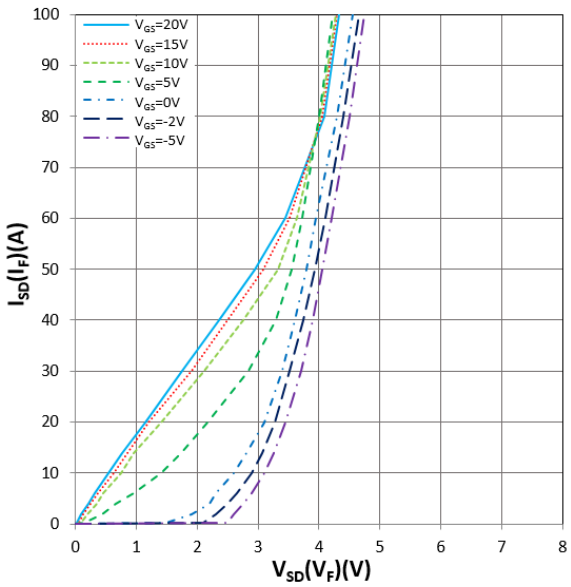


Figure9. $I_{SD}(I_F)$ vs V_{SD} (V_F)
T_j =175°C, V_{GS} parameter

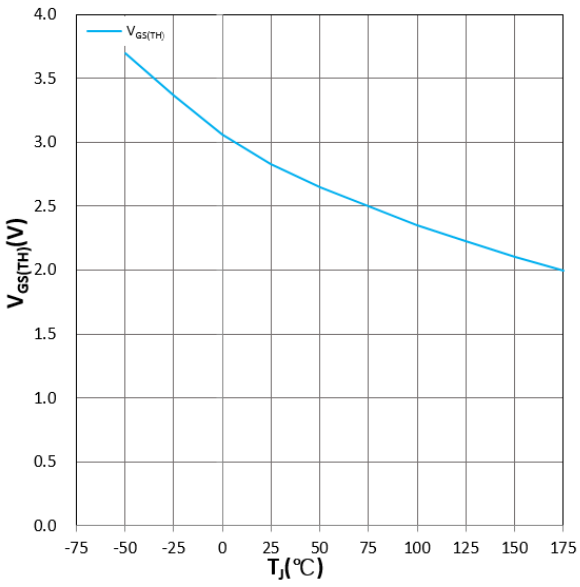


Figure 10. $V_{GS(TH)}$ vs T_J
V_{DS} =V_{GS}, I_{DS} =10mA

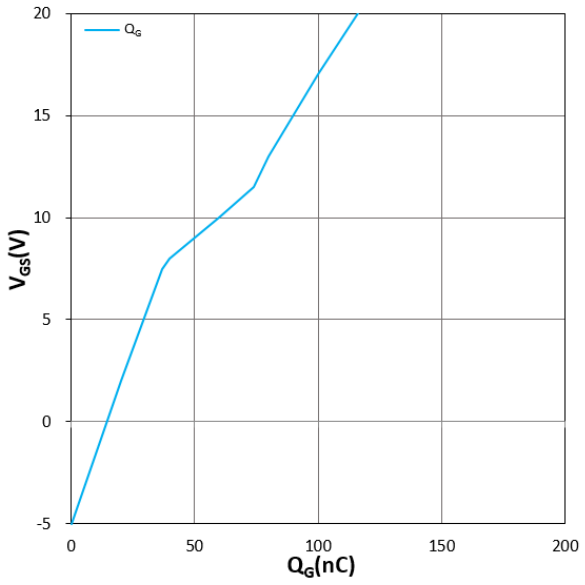


Figure 11. V_{GS} vs Q_G
V_{DD} =800V, I_D =50A

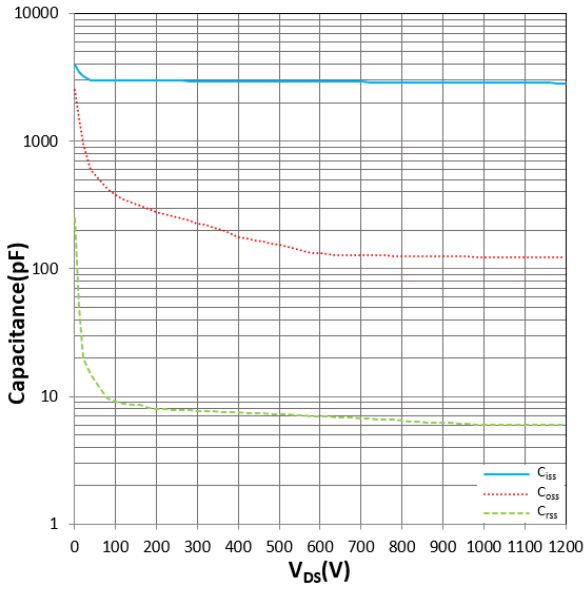


Figure 12. C_{iss}, C_{oss}, C_{rss} vs V_{DS}
T_j =25°C

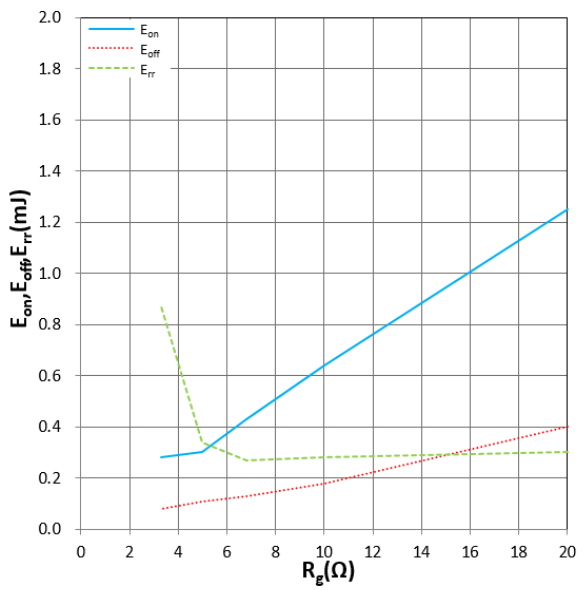


Figure 13. E_{on}, E_{off}, E_{rr} vs R_G
T_j =25°C, I_D =50A, V_{GS} =+15/-4V

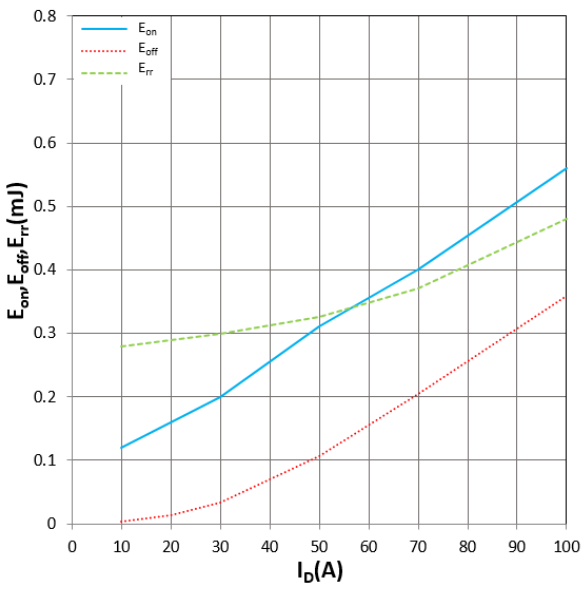


Figure 14. E_{on}, E_{off}, E_{rr} vs I_D
T_j =25°C, R_G =5.1Ω, V_{GS} =+15/-4V

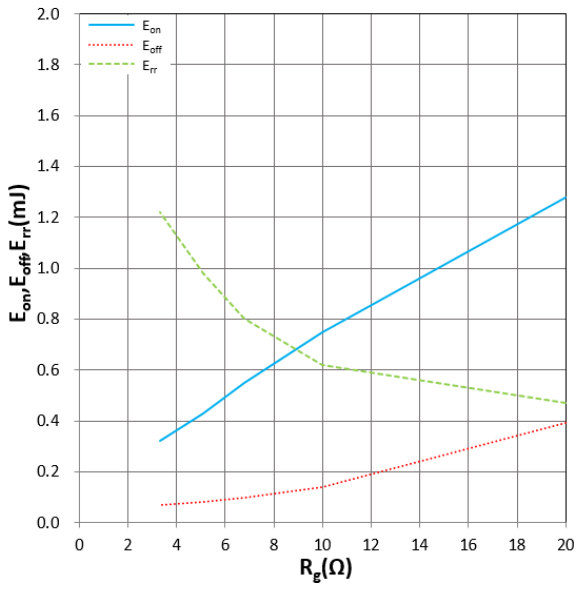


Figure 15. E_{on}, E_{off}, E_{rr} vs R_G
T_j =150°C, I_D =50A, V_{GS} =+15/-4V

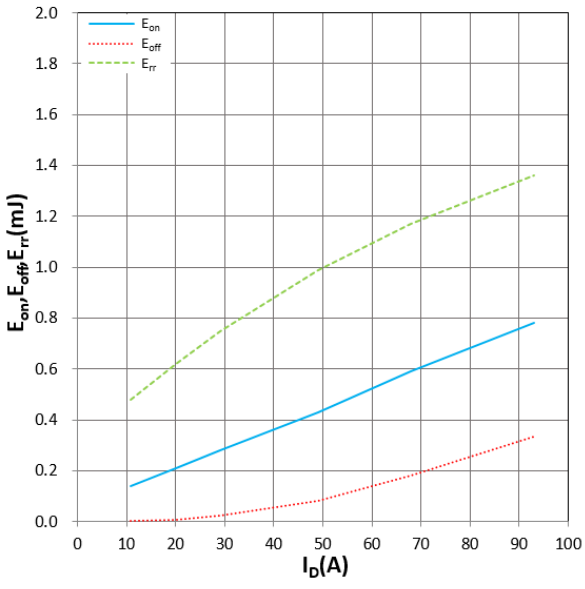


Figure 16. E_{on}, E_{off}, E_{rr} vs I_D
T_j =150°C, R_G =5.1Ω, V_{GS} =+15/-4V

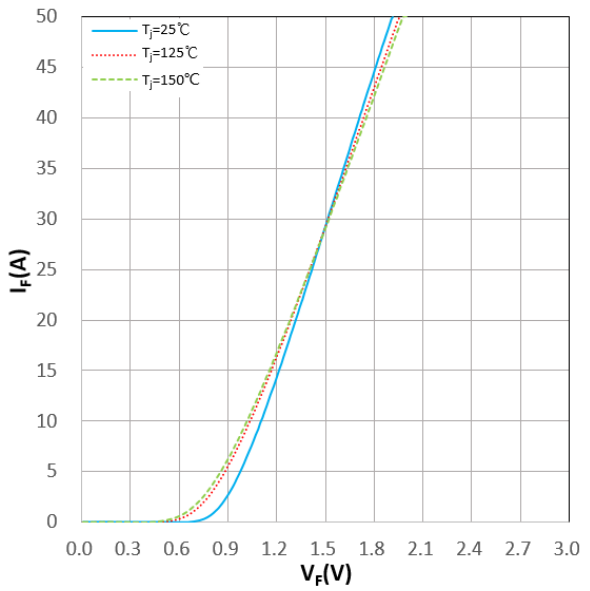


Figure17. I_F vs V_F
Bypass Diode

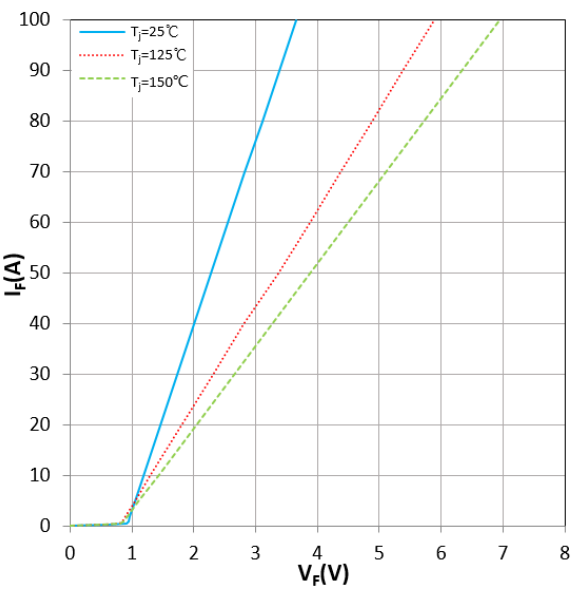
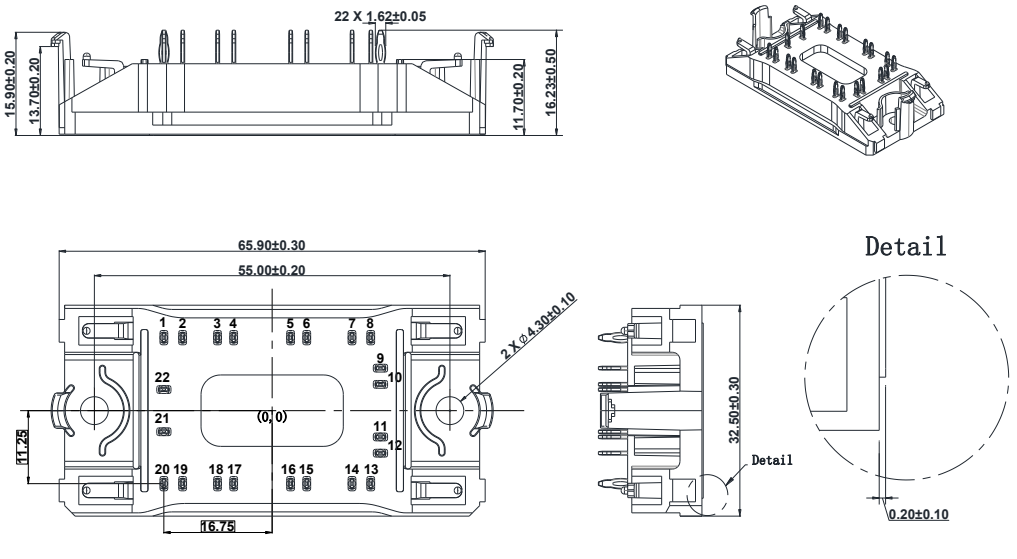


Figure18. I_F vs V_F
Boost Diode

Package Dimensions

Pin Table		
Pin	X	Y
1	-16.75	11.25
2	-13.85	11.25
3	-8.45	11.25
4	-5.95	11.25
5	2.85	11.25
6	5.35	11.25
7	12.35	11.25
8	15.25	11.25
9	16.75	6.55
10	16.75	4.05
11	16.75	-4.05
12	16.75	-6.55
13	15.25	-11.25
14	12.35	-11.25
15	5.35	-11.25
16	2.85	-11.25
17	-5.95	-11.25
18	-8.45	-11.25
19	-13.85	-11.25
20	-16.75	-11.25
21	-16.75	-3.25
22	-16.75	3.25



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