

### 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  $R_{ds(on)}$ @ $T_j = 25^\circ\text{C}$
- 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

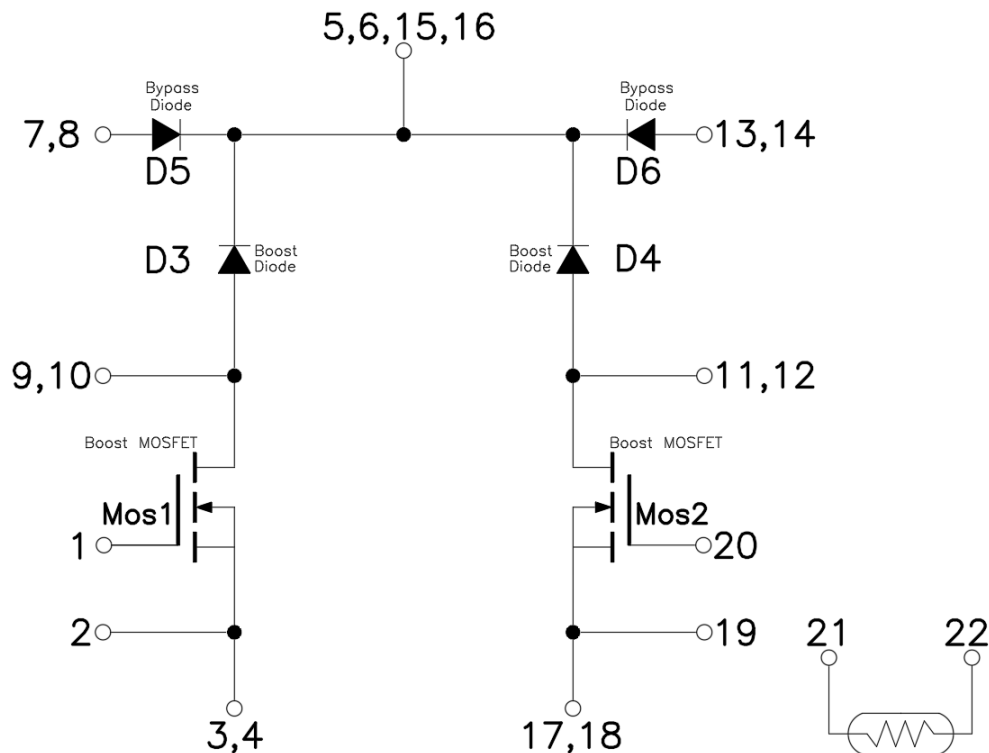


Figure 1. Out drawing & circuit diagram for DFS40CU12F0Q1

## Pin Configuration and Marking Information

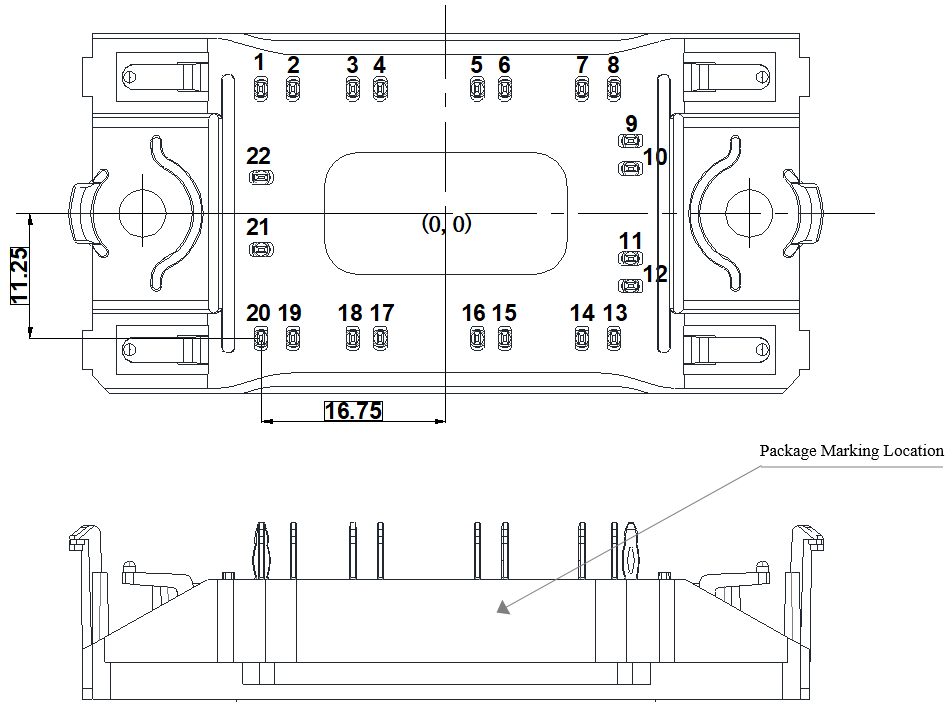


Figure 2. Pin configuration

## 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 <sub>c</sub> = 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 <sub>D</sub>	Power Dissipation	-	-	200	-	mW

### Maximum Ratings ( $T_j=25^{\circ}\text{C}$ 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( $t_{surge}<300\text{nsec}$ )	D-S Short, Note1	-10 to 25	V
$I_{DS}$	DC Continuous Drain Current	$T_s=80^{\circ}\text{C}$	43	A
$I_{DS}$	DC Continuous Drain Current	$T_c=80^{\circ}\text{C}$	50	A
$I_{SD}$	Source (Body Diode) Current	$T_s=80^{\circ}\text{C}$ , with ON signal	43	A
$I_{SD}$	Source (Body Diode) Current	$T_c=80^{\circ}\text{C}$ , with ON signal	50	A
$I_{DP}$	Drain Pulse Current, Peak	Less than 1ms, Note2	150	A
$T_j$	junction temperature	-	-40 to 175	$^{\circ}\text{C}$
$T_{stg}$	Storage temperature	-	-40 to 125	$^{\circ}\text{C}$

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	$T_j=T_{jmax}$ , $T_s<80^{\circ}\text{C}$	33	A
		$T_j=T_{jmax}$ , $T_c<80^{\circ}\text{C}$	37	A
$I_{FSM}$	Surge Forward Current	$T_c=25^{\circ}\text{C}$	111	A
$I^2t$	Surge Current Capability	(60Hz single half-sine wave)	142	$\text{A}^2\text{s}$
$P_{tot}$	Total Power Dissipation	$T_j=T_{jmax}$ , $T_s<80^{\circ}\text{C}$	100	W
		$T_j=T_{jmax}$ , $T_c<80^{\circ}\text{C}$	118	W
$T_{jmax}$	Maximum Junction temperature	-	175	$^{\circ}\text{C}$

#### Bypass Diode

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

### 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	$\mu A$		
$V_{GS(th)}$	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	$I_D=50A, V_{GS}=20V$		$T_j=25^\circ C$	-	40	50	$m\Omega$
	On-state resistance			$T_j=175^\circ C$	-	74.5	-	$m\Omega$
$V_{DS(on)}$ (Chip)	Static drain-source	$I_D=50A, V_{GS}=20V$		$T_j=25^\circ C$	-	2.0	2.5	V
	On-state Voltage			$T_j=175^\circ C$	-	3.725	-	V
$C_{iss}$	Input Vapacitance			-	2872	-	pF	
$C_{oss}$	Output Vapacitance	$V_{DS}=1000V, V_{GS}=0V, f=200kHz$		-	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	$T_j=25^\circ C$		-	0.75	-	$\Omega$	
$t_{d(on)}$	Turn-on delay time	$V_{DD}=600V$ $I_D=50A$ $V_{GS}=+15/-4V$ $R_G=5.1\Omega$ Inductive load switching operation		$T_j=25^\circ C$	-	20	-	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			$T_j=25^\circ C$	-	27	-	ns
				$T_j=150^\circ C$	-	32	-	
$t_f$	Fall time			$T_j=25^\circ C$	-	14	-	ns
				$T_j=150^\circ C$	-	13	-	
$E_{on}$	Turn-on power dissipation			$T_j=25^\circ C$	-	0.3	-	mJ
				$T_j=150^\circ C$	-	0.43	-	
$E_{off}$	Turn-off power dissipation			$T_j=25^\circ C$	-	0.11	-	mJ
				$T_j=150^\circ C$	-	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  $2.8 \text{ W/m} \cdot \text{K}$  and thickness is  $50\mu\text{m}$ .

### Body Diode Electrical characteristics (T<sub>j</sub>=25°C unless otherwise specified, chip: Target)

Symbol	Item	Condition		Value			Unit
				Min.	Typ.	Max	
V <sub>SD</sub>	Body Diode Forward Voltage	V <sub>GS</sub> =0V I <sub>SD</sub> =50A	T <sub>j</sub> =25°C	-	4.5	-	V
			T <sub>j</sub> =175°C	-	4.0	-	
T <sub>rr</sub>	Reverse recovery time	V <sub>DD</sub> =600V I <sub>D</sub> =50A	T <sub>j</sub> =25°C	-	26	-	ns
			T <sub>j</sub> =150°C	-	28	-	
Q <sub>rr</sub>	Reverse recovery charge	V <sub>GS</sub> =+15/-4V R <sub>G</sub> =5.1Ω	T <sub>j</sub> =25°C	-	0.65	-	μC
			T <sub>j</sub> =150°C	-	1.79	-	
E <sub>rr</sub>	Diode switching power dissipation	Inductive load switching operation	T <sub>j</sub> =25°C	-	0.34	-	mJ
			T <sub>j</sub> =150°C	-	0.98	-	

### Boost Diode Electrical characteristics (T<sub>j</sub>=25°C unless otherwise specified, chip)

Symbol	Item	Condition		Value			Unit
				Min.	Typ.	Max	
V <sub>R</sub>	Breakdown Voltage	I <sub>R</sub> =1mA		1200	-	-	V
I <sub>R</sub>	Reverse Leakage Current	V <sub>R</sub> =1200V	T <sub>j</sub> =25°C	-	3	40	uA
			T <sub>j</sub> =150°C	-	93	-	uA
V <sub>F</sub>	Diode Forward Voltage	I <sub>F</sub> =20A V <sub>GE</sub> =0V	T <sub>j</sub> =25°C	-	1.46	1.6	V
			T <sub>j</sub> =150°C	-	2.03	2.65	
t <sub>rr</sub>	Reverse recovery time	V <sub>CC</sub> =700V	T <sub>j</sub> =25°C	-	0.012	-	us
			T <sub>j</sub> =125°C	-	0.016	-	
I <sub>RM</sub>	Peak reverse recovery Current	I <sub>C</sub> =50A V <sub>GE</sub> =+15V/-8V	T <sub>j</sub> =25°C	-	6.0	-	A
			T <sub>j</sub> =125°C	-	12.0	-	
Q <sub>rr</sub>	Recovered charge	R <sub>G</sub> =5.0Ω	T <sub>j</sub> =25°C	-	0.048	-	uC
			T <sub>j</sub> =125°C	-	0.118	-	
R <sub>th(j-c)</sub>	Thermal Resistance, Junction to Case (Diode)		-	0.8	-	°C/W	
R <sub>th(c-s)</sub>	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<sub>j</sub>=25°C unless otherwise specified, chip)

Symbol	Item	Condition	Value			Unit	
			Min.	Typ.	Max		
V <sub>R</sub>	Breakdown Voltage	I <sub>R</sub> =5μA	1600	-	-	V	
I <sub>R</sub>	Reverse Leakage Current	V <sub>R</sub> =1600V	T <sub>j</sub> =25°C	-	-	5	μA
			T <sub>j</sub> =150°C	-	-	1	mA
V <sub>F</sub>	Diode Forward Voltage	I <sub>F</sub> =16A V <sub>GE</sub> =0V	T <sub>j</sub> =25°C	-	1.0	1.4	V
			T <sub>j</sub> =150°C	-	0.9	-	
R <sub>th(j-c)</sub>	Thermal Resistance, Junction to Case (Diode)		-	0.7	-	°C/W	
R <sub>th(c-s)</sub>	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 50μm.

### Test Conditions

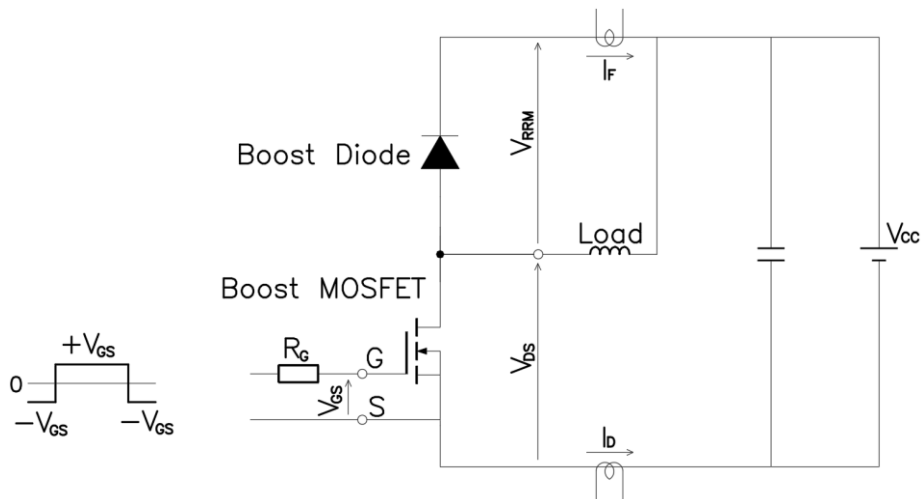


Figure 3. Switching time measure circuit

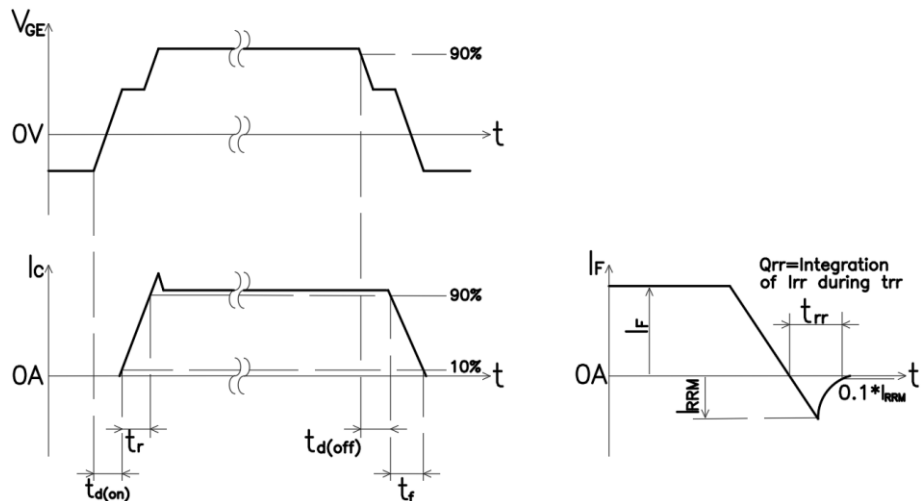


Figure 4. Switching time definition

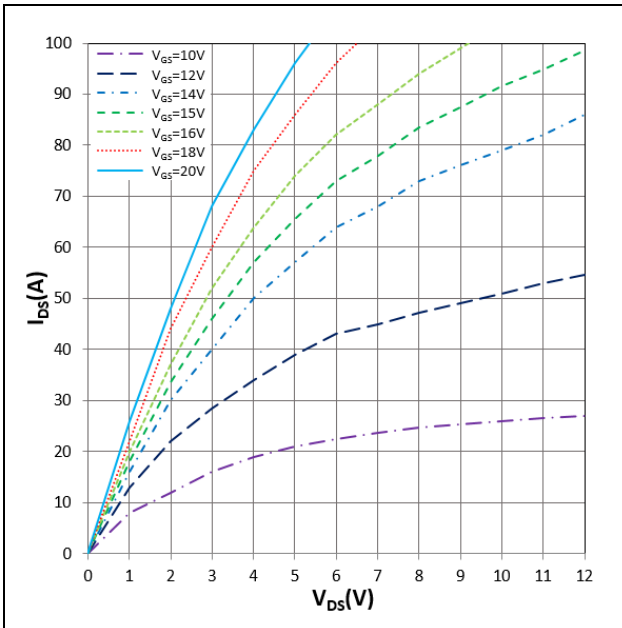


Figure 5.  $I_{DS}$  vs  $V_{DS}$   
 $T_j = 25^\circ\text{C}$ ,  $V_{GS}$  parameter

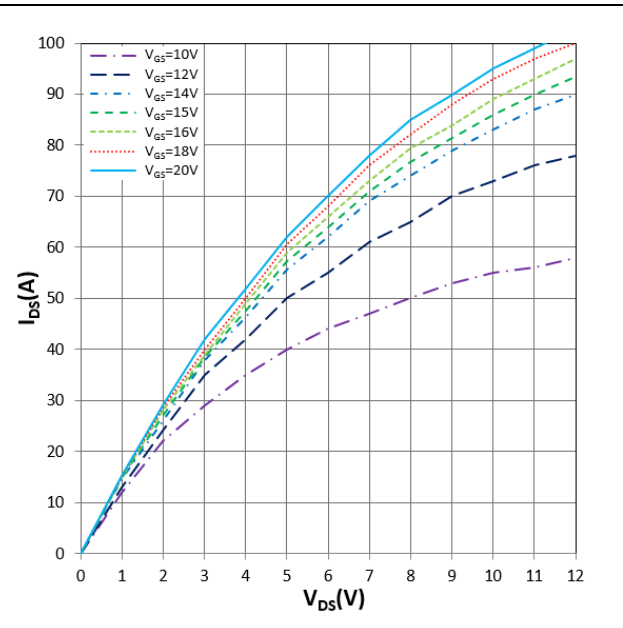


Figure 6.  $I_{DS}$  vs  $V_{DS}$   
 $T_j = 175^\circ\text{C}$ ,  $V_{GS}$  parameter

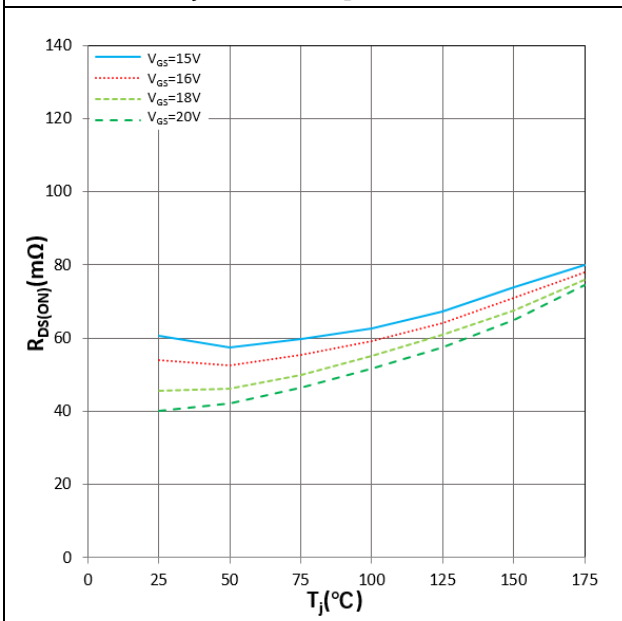


Figure 7.  $R_{DS(ON)}$  vs  $T_j$   
 $I_D = 50\text{A}$

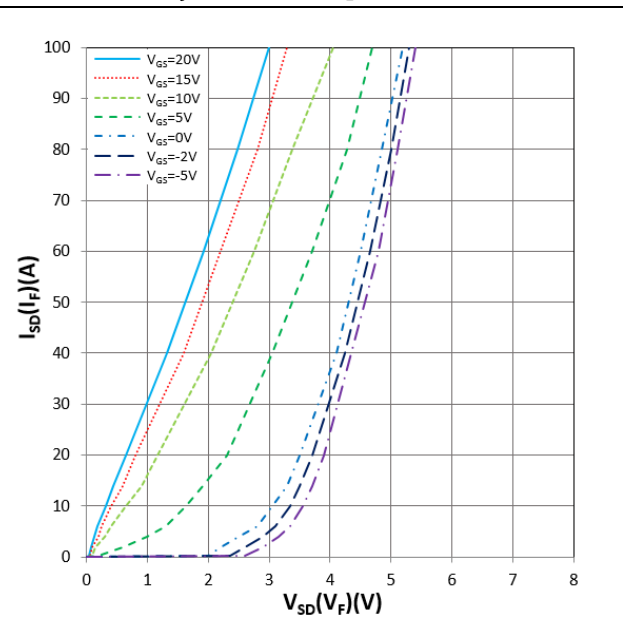


Figure 8.  $I_{SD}(I_F)$  vs  $V_{SD}(V_F)$   
 $T_j = 25^\circ\text{C}$ ,  $V_{GS}$  parameter

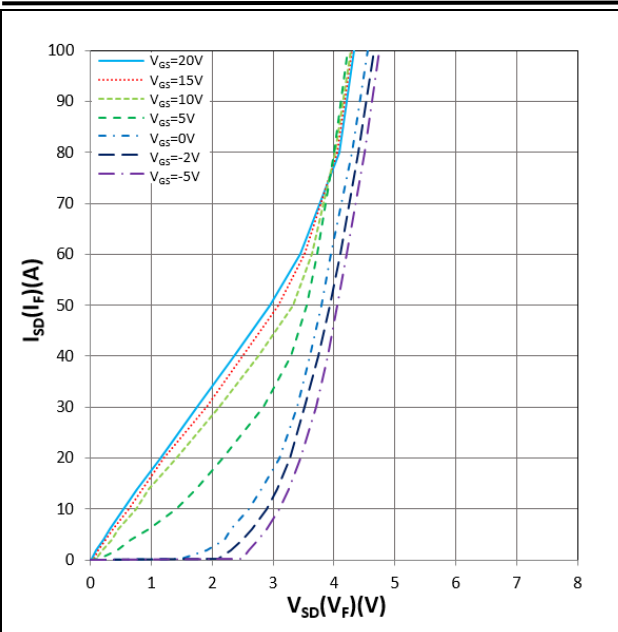


Figure 9.  $I_{SD}(I_F)$  vs  $V_{SD}(V_F)$   
 $T_j = 175^\circ\text{C}$ ,  $V_{GS}$  parameter

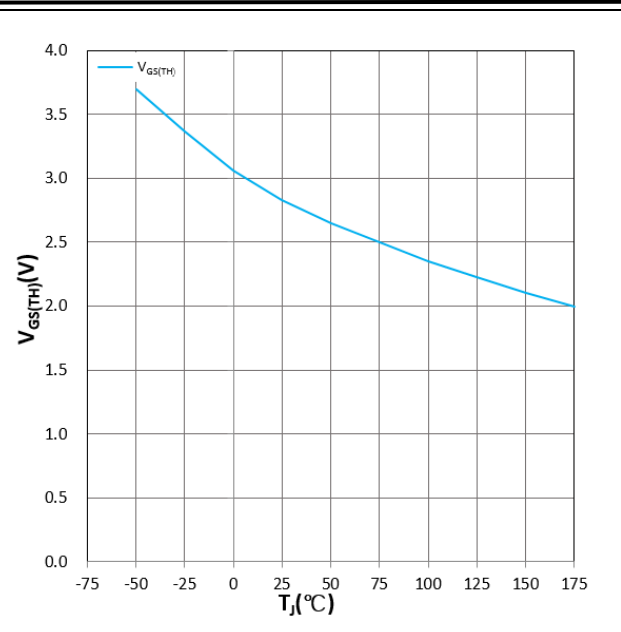


Figure 10.  $V_{GS(TH)}$  vs  $T_J$   
 $V_{DS} = V_{GS}$ ,  $I_{DS} = 10\text{mA}$

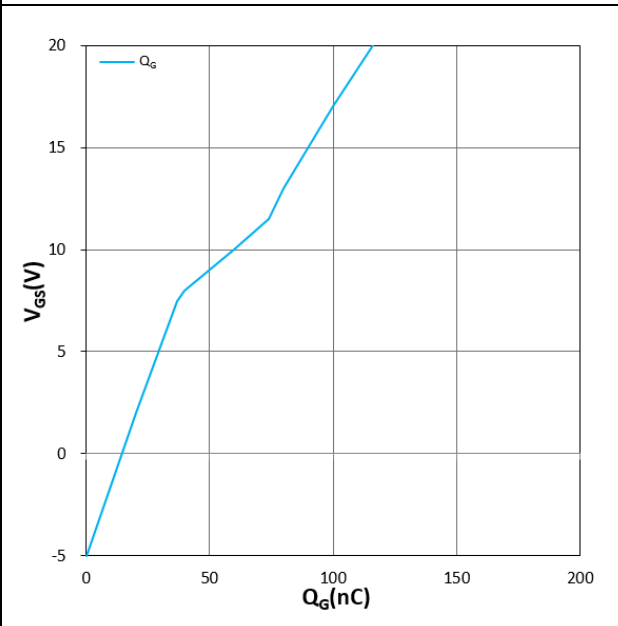


Figure 11.  $V_{GS}$  vs  $Q_G$   
 $V_{DD} = 800\text{V}$ ,  $I_D = 50\text{A}$

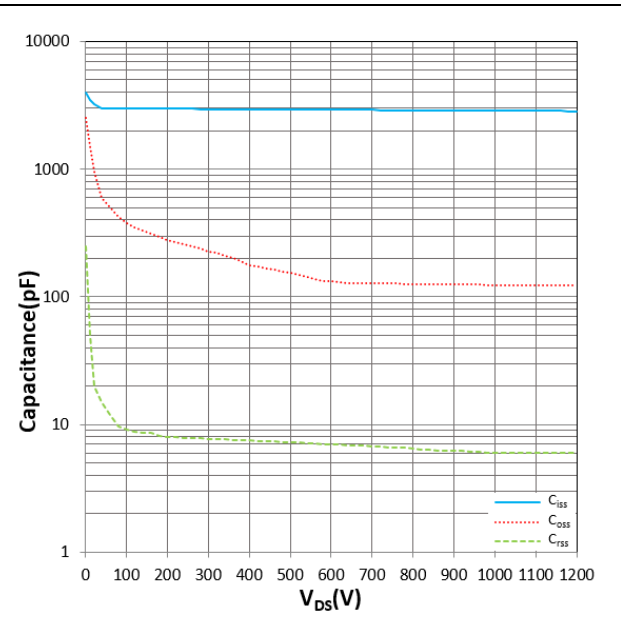


Figure 12.  $C_{iss}$ ,  $C_{oss}$ ,  $C_{rss}$  vs  $V_{DS}$   
 $T_j = 25^\circ\text{C}$



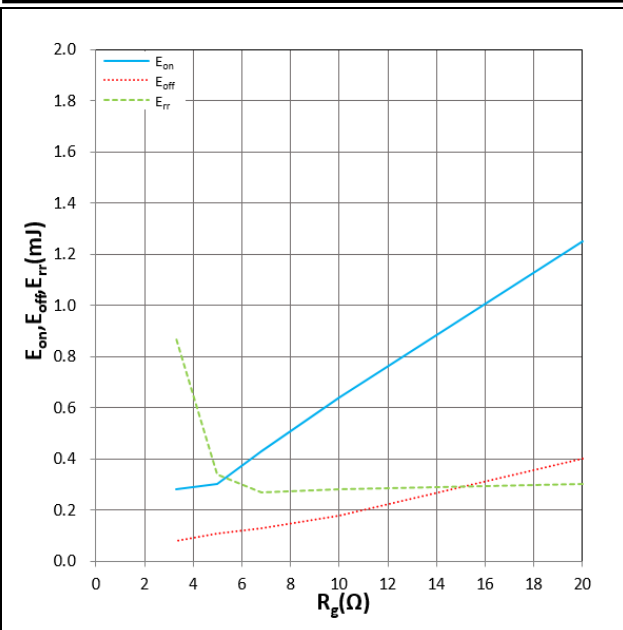


Figure 13.  $E_{on}$ ,  $E_{off}$ ,  $E_{rr}$  vs  $R_g$   
 $T_j = 25^\circ\text{C}$ ,  $I_D = 50\text{A}$ ,  $V_{GS} = +15/-4\text{V}$

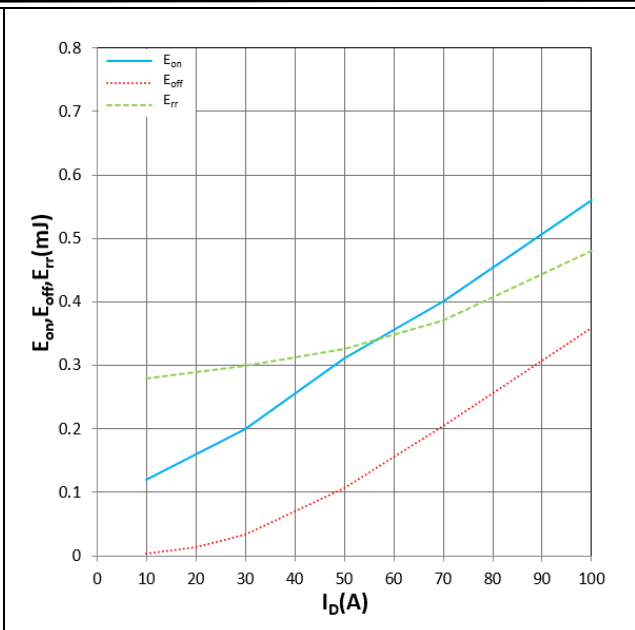


Figure 14.  $E_{on}$ ,  $E_{off}$ ,  $E_{rr}$  vs  $I_D$   
 $T_j = 25^\circ\text{C}$ ,  $R_g = 5.1\Omega$ ,  $V_{GS} = +15/-4\text{V}$

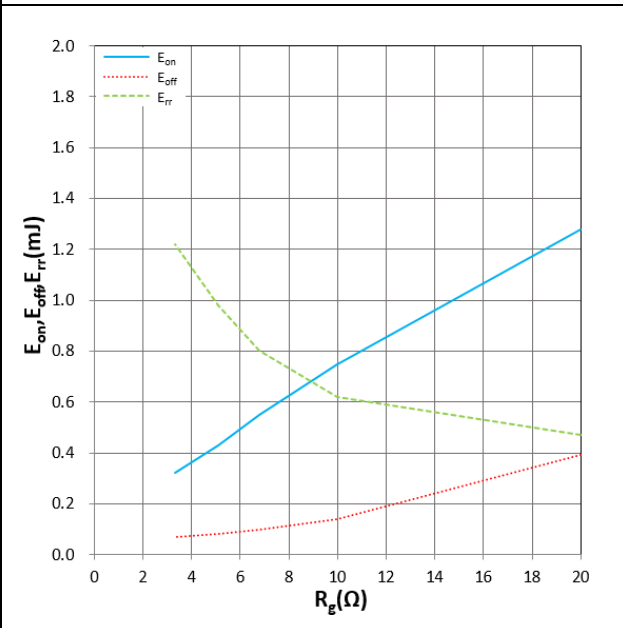


Figure 15.  $E_{on}$ ,  $E_{off}$ ,  $E_{rr}$  vs  $R_g$   
 $T_j = 150^\circ\text{C}$ ,  $I_D = 50\text{A}$ ,  $V_{GS} = +15/-4\text{V}$

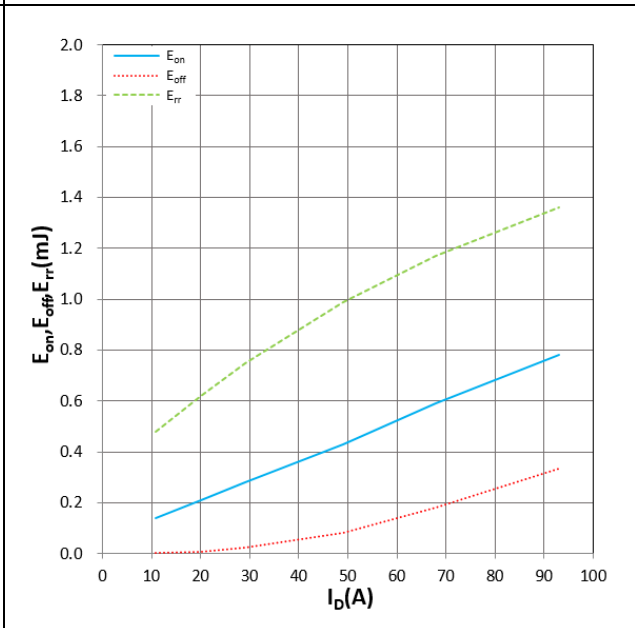


Figure 16.  $E_{on}$ ,  $E_{off}$ ,  $E_{rr}$  vs  $I_D$   
 $T_j = 150^\circ\text{C}$ ,  $R_g = 5.1\Omega$ ,  $V_{GS} = +15/-4\text{V}$

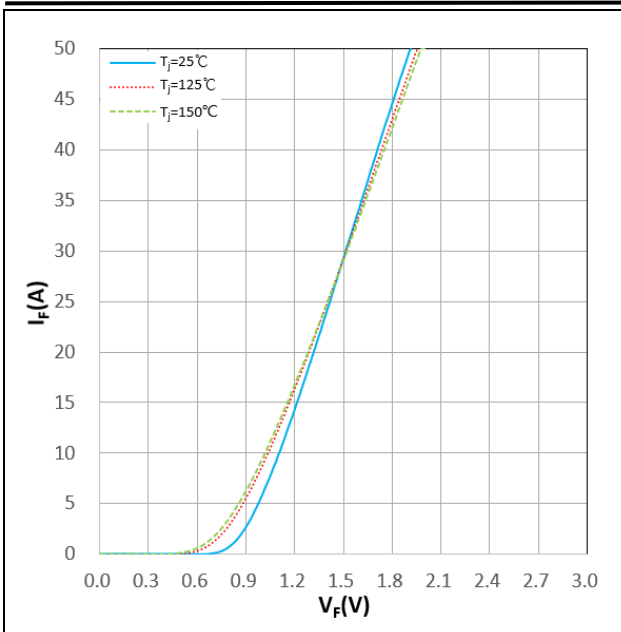


Figure17.  $I_F$  vs  $V_F$   
Bypass Diode

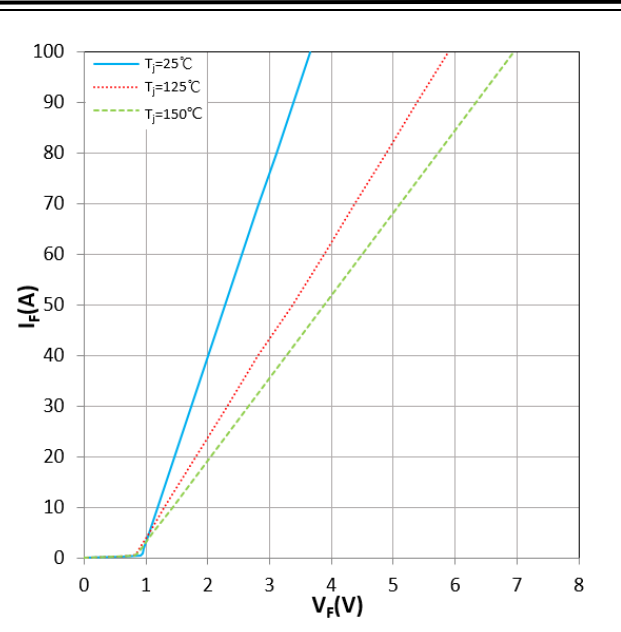
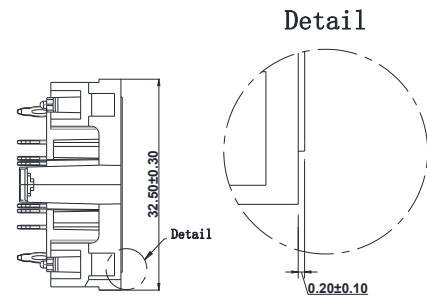
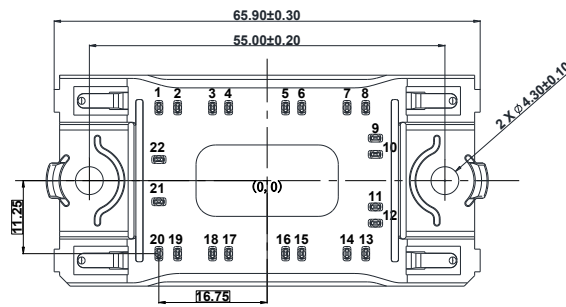
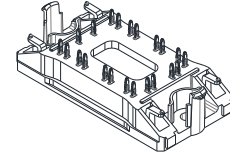
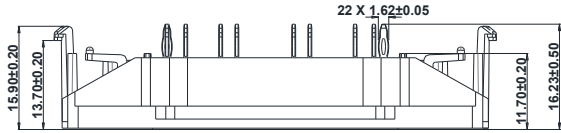


Figure18.  $I_F$  vs  $V_F$   
Boost Diode

### 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



### IMPORTANT NOTICE:

This product data sheet describes the characteristics of this product for which a warranty is granted. Any such warranty is granted exclusively under the terms and conditions of the supply agreement. There will be no guarantee or of any kind for the product and its characteristics.

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.

Due to technical requirements, our product may contain dangerous substances. For information on the types in question, please contact the sales staff responsible for you.

Changes to this product data sheet are reserved.

Please contact the sales staff (Sales@leapers-power.com) for further information on the product, technology, delivery terms, conditions and prices.