

### Description

The DFS40HH12EYQ1 is a H Bridge SiC MOSFET Power Module. It integrates high performance SiC MOSFET chips designed for the applications such as Solar Inverter, UPS, Fuel cell-DC/DC converter, Energy storage Systems.



### Features

- Blocking voltage:1200V
- 40mΩ  $R_{ds(on)}$ @ $T_j = 25^{\circ}C$
- 74.5mΩ  $R_{ds(on)}$ @ $T_j = 175^{\circ}C$
- Low thermal resistance with Si<sub>3</sub>N<sub>4</sub> AMB
- Low Switching Losses
- 175°C maximum junction temperature
- Thermistor inside

### Applications

- Solar Inverter
- UPS
- Fuel cell-DC/DC converter
- Energy Storage Systems

### Circuit diagram

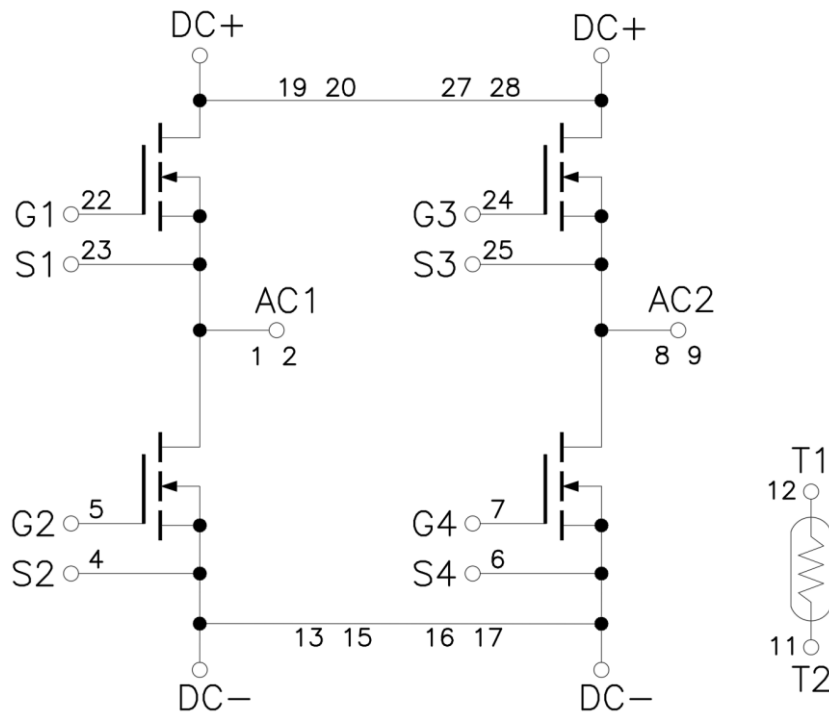


Figure 1. Out drawing & circuit diagram for DFS40HH12EYQ1

## Pin Configuration and Marking Information

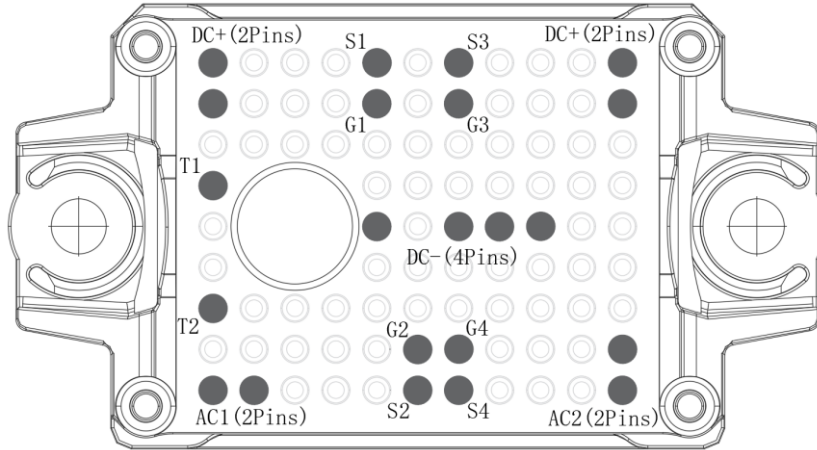


Figure 2. Pin configuration

PIN No.	Symbol	Description
1-2	AC1	Output terminal of half bridge
4	S2	Low side source signal terminal
5	G2	Low side gate signal terminal
6	S4	Low side source signal terminal
7	G4	Low side gate signal terminal
8-9	AC2	Output terminal of half bridge
11	T2	Thermistor connection 1
12	T1	Thermistor connection 2
13,15-17	DC-	DC – Bus connection
19-20	DC+	DC + Bus connection
22	G1	High side gate signal terminal
23	S1	High side source signal terminal
24	G3	High side gate signal terminal
25	S3	High side source signal terminal
27-28	DC+	DC + Bus connection

## 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	-	600	-

### Maximum Ratings (T<sub>j</sub>=25°C unless otherwise specified)

Symbol	Parameter	Conditions	Ratings	Unit
V <sub>DSS</sub>	Drain-Source Voltage	G-S Short	1200	V
V <sub>GSS</sub>	Gate-Source Voltage(+)	D-S Short	20	V
V <sub>GSS</sub>	Gate-Source Voltage(-)	D-S Short	-5	V
V <sub>GSSSurge</sub>	G-S Voltage(t <sub>surge</sub> <300nsec)	D-S Short, Note1	-10 to 25	V
I <sub>DS</sub>	DC Continuous Drain Current	T <sub>f</sub> =80°C, Note2	50	A
I <sub>SD</sub>	Source (Body Diode) Current	T <sub>f</sub> =80°C, with ON signal	50	A
I <sub>DP</sub>	Drain Pulse Current, Peak	Less than 1ms, Note3	100	A
T <sub>j</sub>	junction temperature	-	-40 to 175	°C
T <sub>stg</sub>	Storage temperature	-	-40 to 125	°C

Note1: Recommended Operating Value, +20V/-5V; +18V/-5V; +15V/-4V

Note2: Case temperature(T<sub>c</sub>) 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 <sub>25</sub>	Resistance	T <sub>c</sub> =25°C	-	5	-	kΩ
ΔR/R	Deviation of R100	T <sub>c</sub> =100°C, R <sub>100</sub> =493Ω	5	-	5	%
P <sub>25</sub>	Power dissipation	T <sub>c</sub> =25°C	-	-	20	mW
B <sub>25/50</sub>	B-value	$R_2 = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298,15 K))]$	-	3375	-	K
B <sub>25/80</sub>	B-value	$R_2 = R_{25} \exp [B_{25/80}(1/T_2 - 1/(298,15 K))]$	-	3411	-	K
B <sub>25/100</sub>	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	$\mu A$					
$V_{GS(th)}$	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	$I_D=50A$	-	$T_j=25^\circ C$	40	50	$m\Omega$				
	On-state resistance	$V_{GS}=+20V$		$T_j=175^\circ C$	74.5	-	$m\Omega$				
$V_{DS(on)}$ (Chip)	Static drain-source	$I_D=50A$	-	$T_j=25^\circ C$	2.0	2.5	V				
	On-state Voltage	$V_{GS}=+20V$		$T_j=175^\circ C$	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	$V_{DD}=800V, I_D=50A, V_{GS}=+20/-4V$	-	106	-	nC					
$R_{Gint}$	Internal Gate Resistance	$T_j=25^\circ C$	-	1.5	-	$\Omega$					
$t_{d(on)}$	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		$V_{DD}=600V$ $I_D=50A$ $V_{GS}=+15/-4V$ $R_G=5.1\Omega$ Inductive load switching operation	-	$T_j=25^\circ C$	9	-	ns			
					$T_j=150^\circ C$	8	-				
$t_{d(off)}$	Turn-off delay time			$V_{DD}=600V$ $I_D=50A$ $V_{GS}=+15/-4V$ $R_G=5.1\Omega$ Inductive load switching operation	-	$T_j=25^\circ C$	27	-	ns		
						$T_j=150^\circ C$	32	-			
$t_f$	Fall time				$V_{DD}=600V$ $I_D=50A$ $V_{GS}=+15/-4V$ $R_G=5.1\Omega$ Inductive load switching operation	-	$T_j=25^\circ C$	14	-	ns	
							$T_j=150^\circ C$	13	-		
$E_{on}$	Turn-on power dissipation					$V_{DD}=600V$ $I_D=50A$ $V_{GS}=+15/-4V$ $R_G=5.1\Omega$ Inductive load switching operation	-	$T_j=25^\circ C$	0.3	-	mJ
								$T_j=150^\circ C$	0.43	-	
$E_{off}$	Turn-off power dissipation	$V_{DD}=600V$ $I_D=50A$ $V_{GS}=+15/-4V$ $R_G=5.1\Omega$ Inductive load switching operation					-	$T_j=25^\circ C$	0.11	-	mJ
								$T_j=150^\circ C$	0.08	-	
$R_{th(j-c)}$	FET Thermal Resistance		Junction to Case/MOSFET				-	0.36	-	K/W	
$R_{th(c-f)}$	Contact thermal resistance		With thermal conductive grease /MOSFET				-	0.15	-	K/W	

Assumes Thermal Conductivity of grease is  $2.8 \text{ W/m} \cdot \text{K}$  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> = -4V 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	-	

### Test Conditions

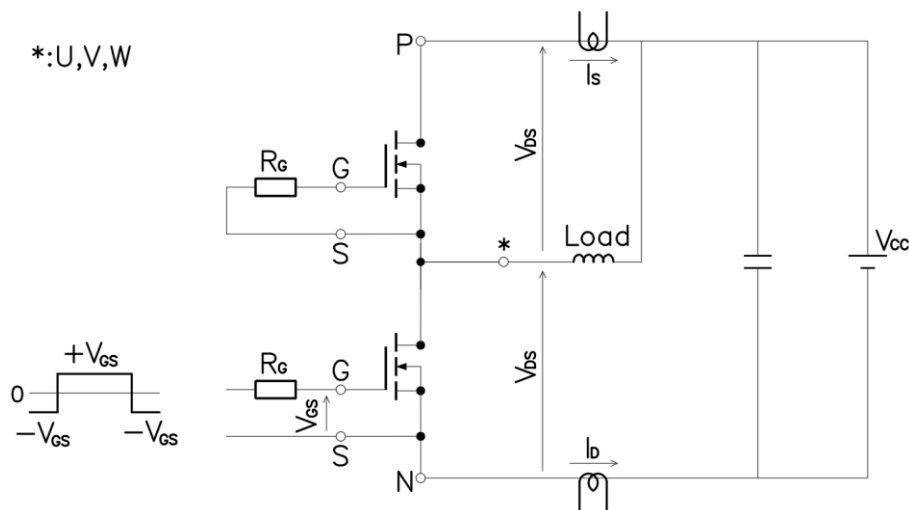


Figure 3. Switching time measure circuit

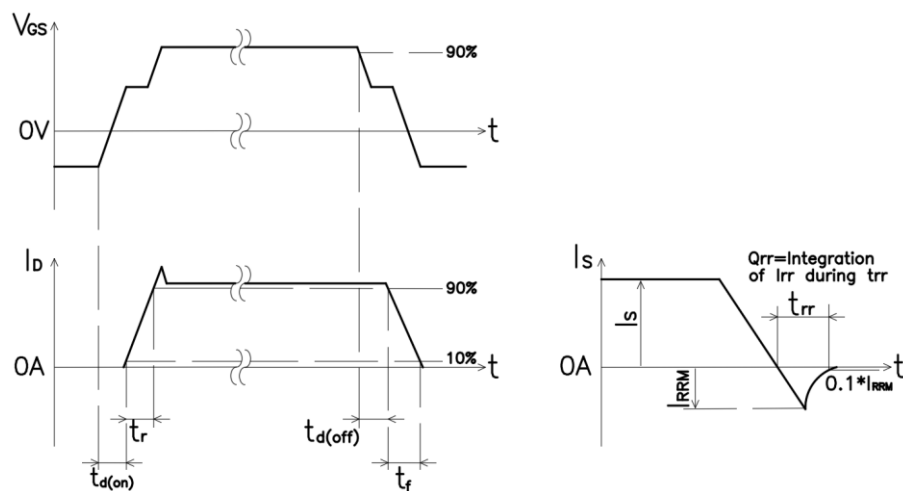


Figure 4. Switching time definition

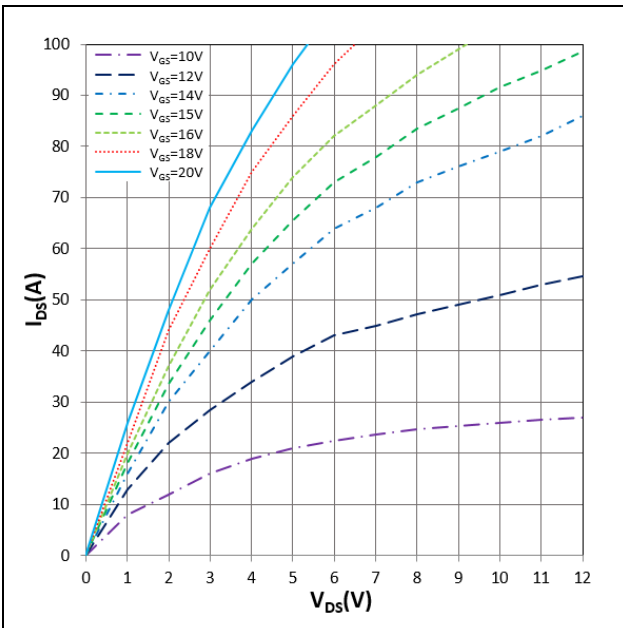


Figure 5.  $I_{D_S}$  vs  $V_{D_S}$   
 $T_j = 25^\circ\text{C}$ ,  $V_{G_S}$  parameter

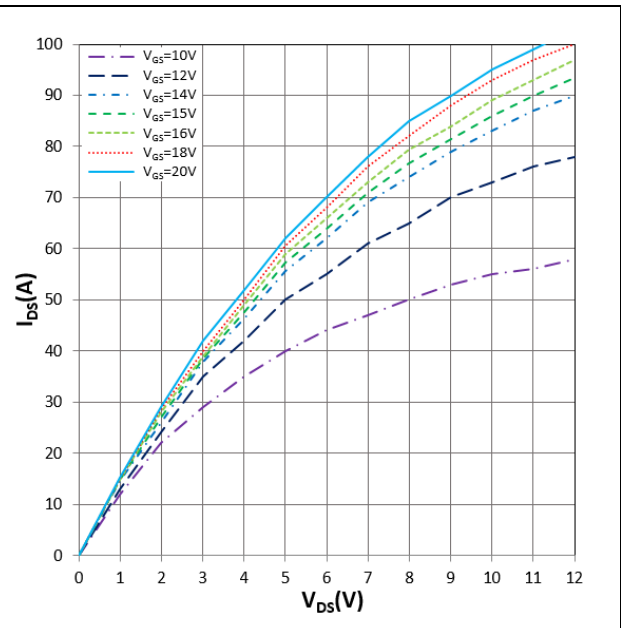


Figure 6.  $I_{D_S}$  vs  $V_{D_S}$   
 $T_j = 175^\circ\text{C}$ ,  $V_{G_S}$  parameter

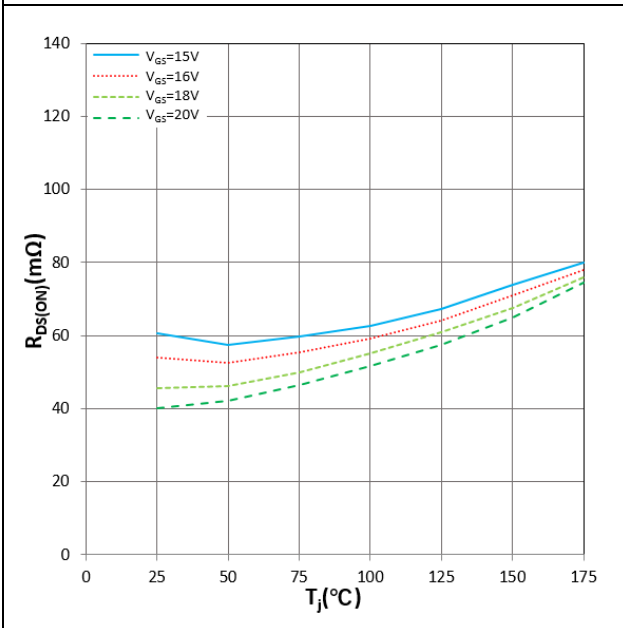


Figure 7.  $R_{D_S(ON)}$  vs  $T_j$   
 $I_D = 50\text{A}$

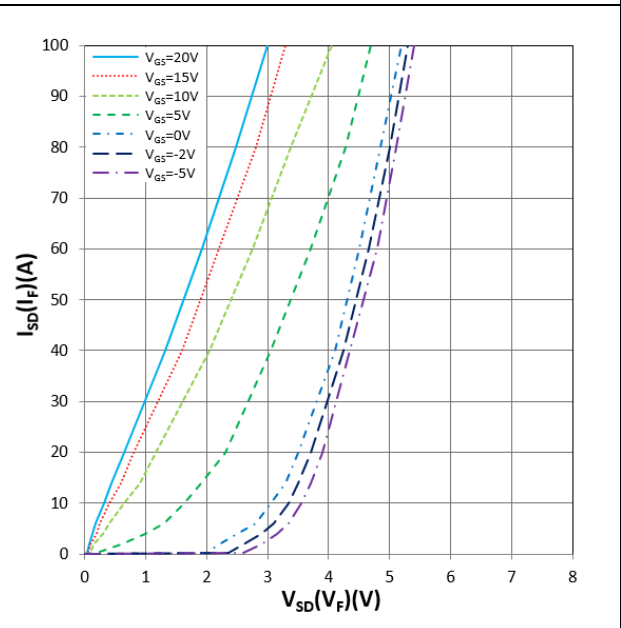


Figure 8.  $I_{S_D(I_F)}$  vs  $V_{S_D(V_F)}$   
 $T_j = 25^\circ\text{C}$ ,  $V_{G_S}$  parameter

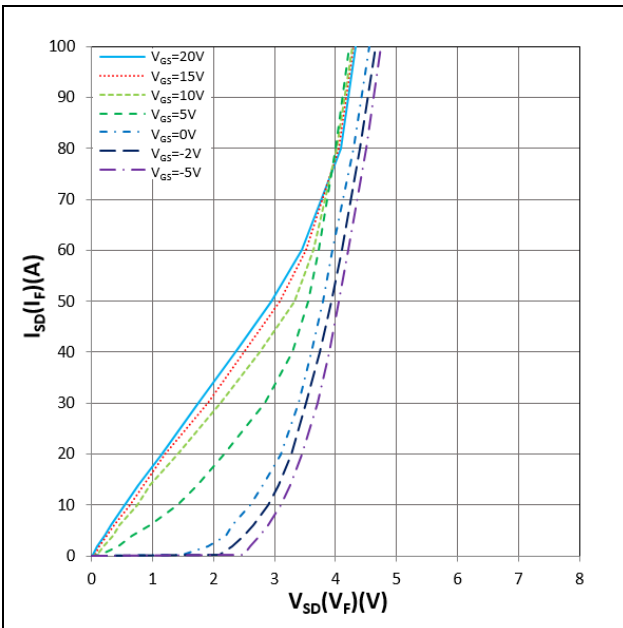


Figure 9.  $I_{SD}(I_F)$  vs  $V_{SD}(V_F)$   
 $T_j = 175^\circ\text{C}$ ,  $V_{GS}$  parameter

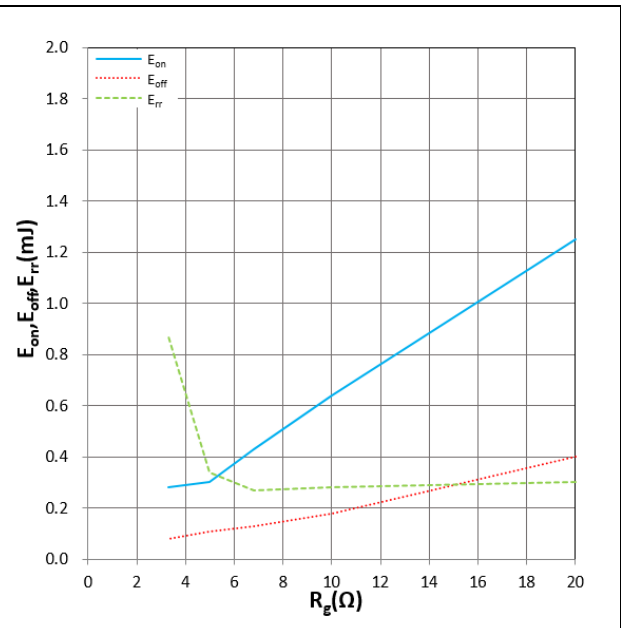


Figure 10.  $E_{on}$ ,  $E_{off}$ ,  $E_{rr}$  vs  $R_G$   
 $T_j = 25^\circ\text{C}$ ,  $I_D = 50\text{A}$ ,  $V_{GS} = +15/-4\text{V}$

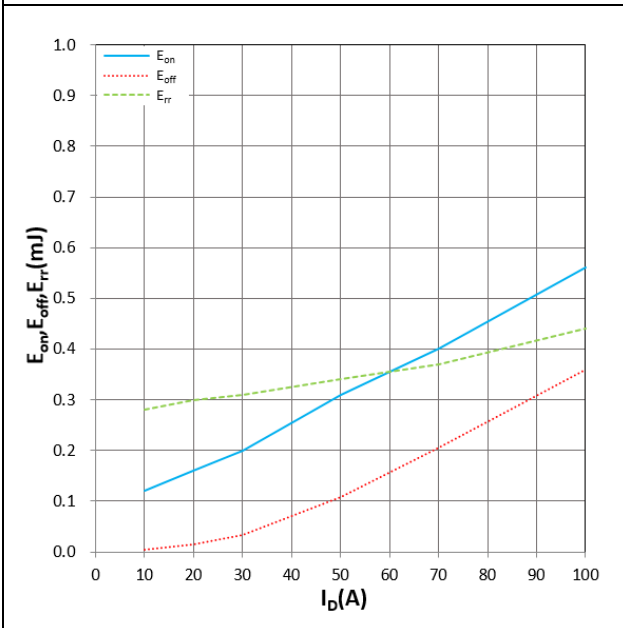


Figure 11.  $E_{on}$ ,  $E_{off}$ ,  $E_{rr}$  vs  $I_D$   
 $T_j = 25^\circ\text{C}$ ,  $R_G = 5.1\Omega$ ,  $V_{GS} = +15/-4\text{V}$

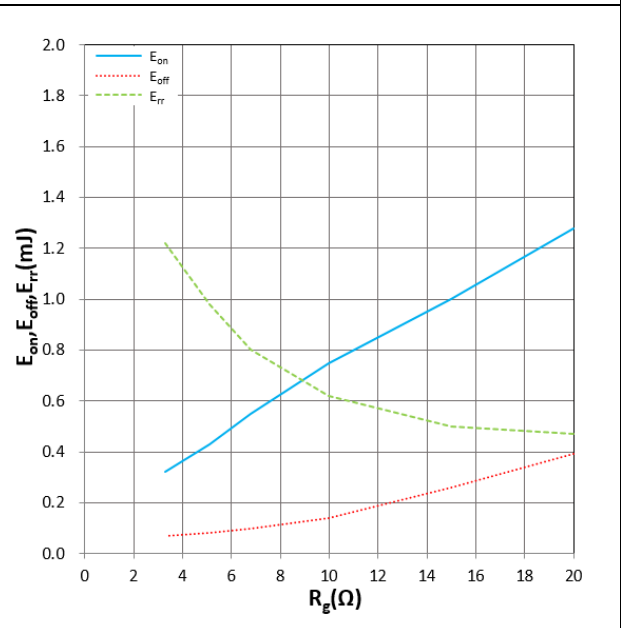


Figure 12.  $E_{on}$ ,  $E_{off}$ ,  $E_{rr}$  vs  $R_G$   
 $T_j = 150^\circ\text{C}$ ,  $I_D = 50\text{A}$ ,  $V_{GS} = +15/-4\text{V}$

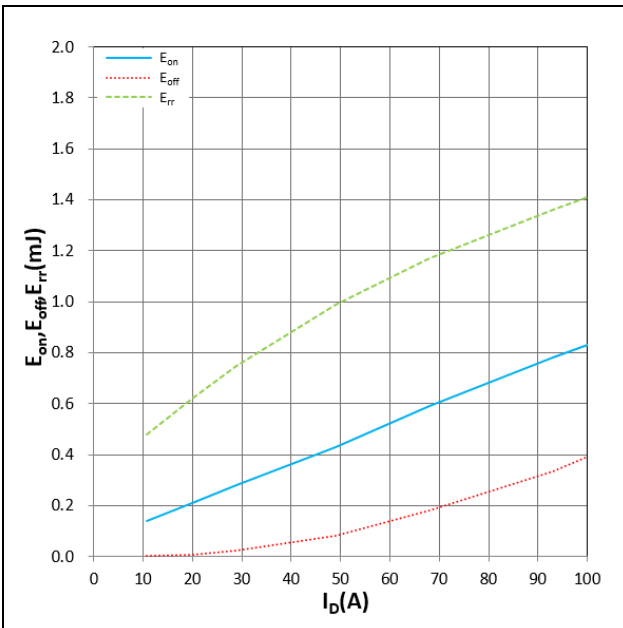


Figure 13.  $E_{on}$ ,  $E_{off}$ ,  $E_{rr}$  vs  $I_D$   
 $T_j = 150^\circ\text{C}$ ,  $R_G = 5.1\Omega$ ,  $V_{GS} = +15/-4\text{V}$

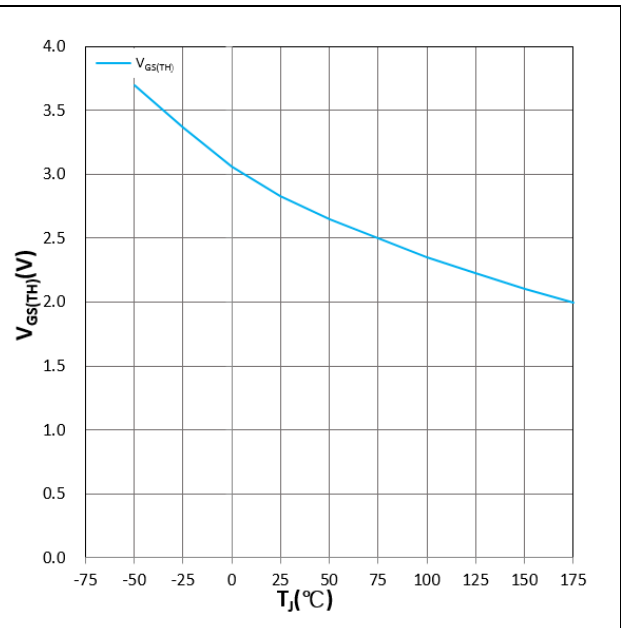


Figure 14.  $V_{GS(TH)}$  vs  $T_j$   
 $V_{DS} = V_{GS}$ ,  $I_{DS} = 20\text{mA}$

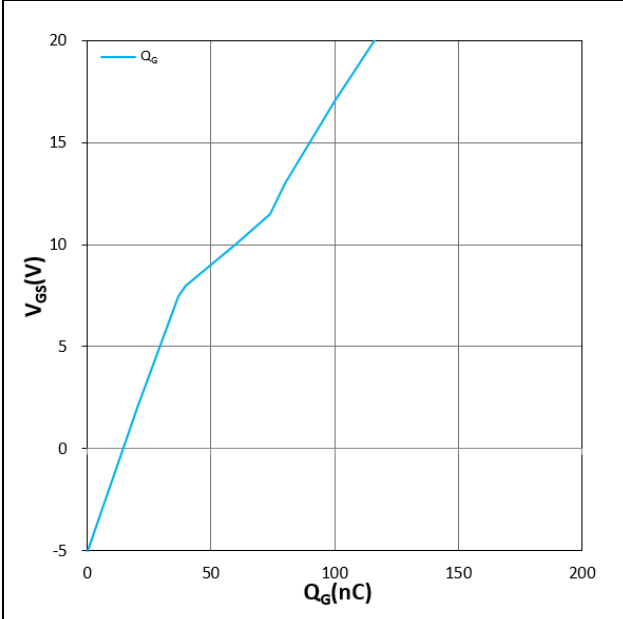


Figure 15.  $V_{GS}$  vs  $Q_G$   
 $V_{DD} = 800\text{V}$ ,  $I_D = 50\text{A}$

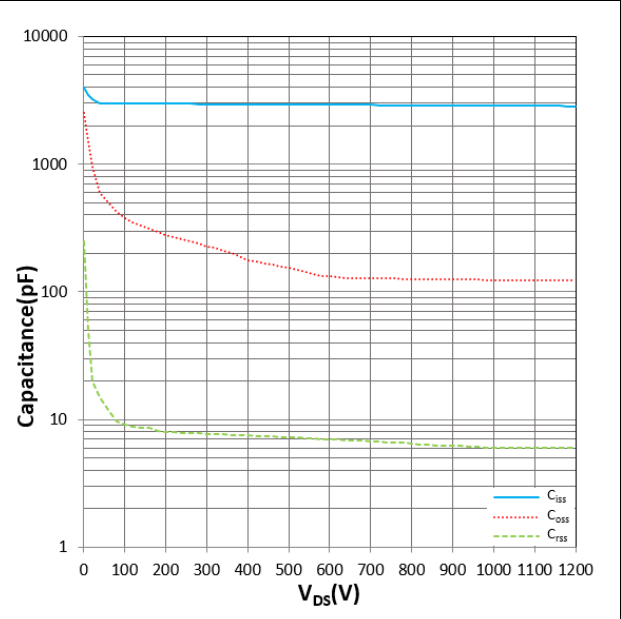
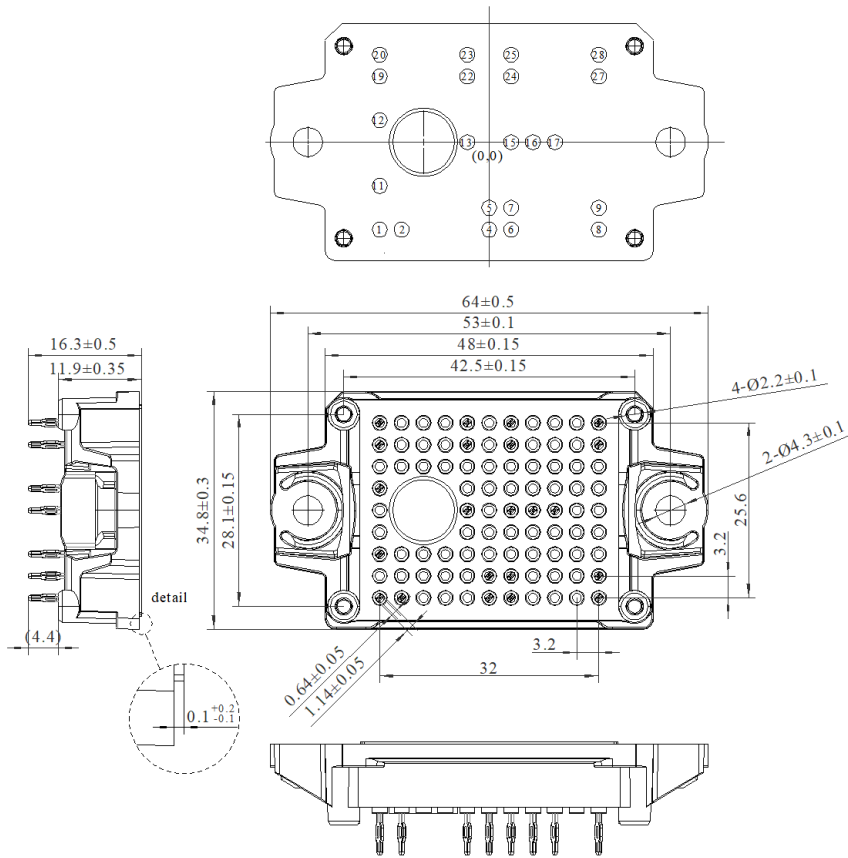


Figure 16.  $C_{iss}$ ,  $C_{oss}$ ,  $C_{rss}$  vs  $V_{DS}$   
 $T_j = 25^\circ\text{C}$



## Package dimensions



Pin table		
Pin	X	Y
1	-16	-12.8
2	-12.8	-12.8
4	0	-12.8
5	0	-9.6
6	3.2	-12.8
7	3.2	-9.6
8	16	-12.8
9	16	-6.4
11	-16	-6.4
12	-16	3.2
13	-3.2	0
15	3.2	0
16	6.4	0
17	9.6	0
19	-16	9.6
20	-16	12.8
22	-3.2	9.6
23	-3.2	12.8
24	3.2	9.6
25	3.2	12.8
27	16	9.6
28	16	12.8

## 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.

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.

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