DFS400CL12I3C2

1200V/400A Chopper SiC MOSFET Module

Description

The DFS400CL12I3C2 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

- 1200V/4.5mΩ (V_{GS}=18V)
- Low thermal resistance with Si_3N_4 AMB
- 175°C maximum junction temperature
- Low inductive design
- Thermistor inside
- Pressfit terminal
- Copper base size: 79mm*62mm

Applications

- xEV Applications
- Converter
- Vehicle Fast Chargers
- Renewable energy

Circuit diagram

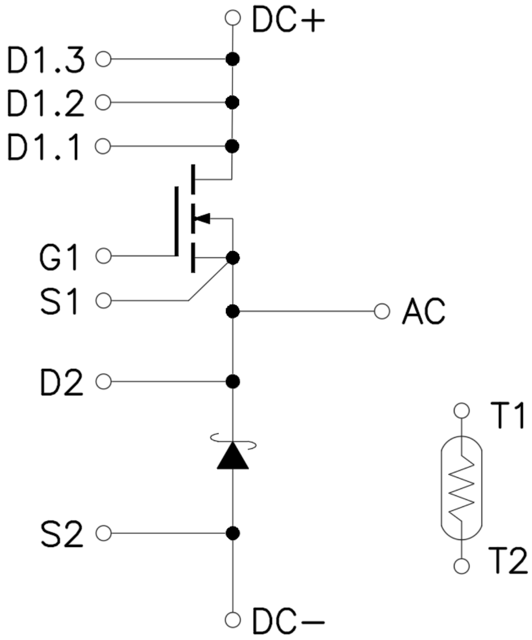


Figure 1. Out drawing & circuit diagram for DFS400CL12I3C2

Pin Configuration and Marking Information

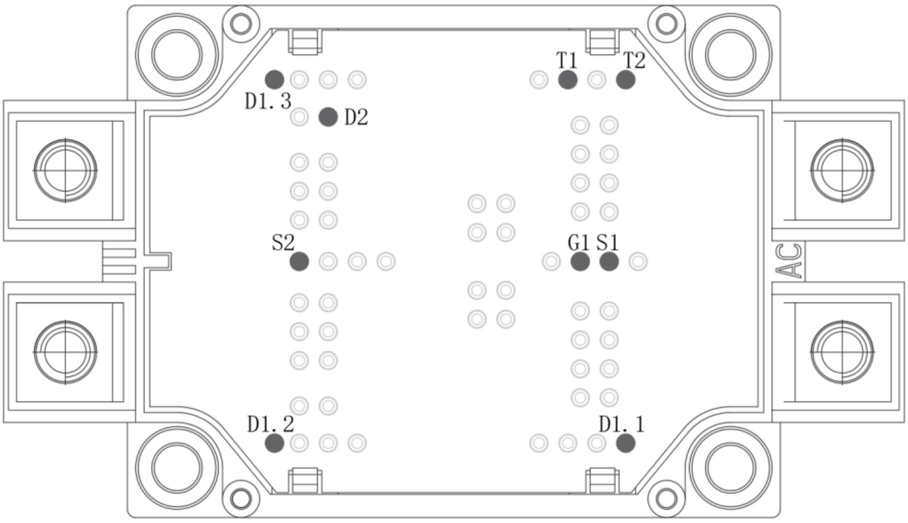


Figure 2. Pin configuration

Module

Parameter	Conditions	Value	Unit
Isolation Voltage	RMS, f =50Hz, t =1min	3.4	KV
Material of module baseplate	-	Cu	-
Creepage distance	terminal to heatsink terminal to terminal	14.5 10	mm
Clearance	terminal to heatsink terminal to terminal	12.5 10	mm
CTI	-	>400	-
Module lead resistance, terminals – chip	T_C =25°C	0.3	mΩ
Mounting torque for module mounting	M5, M6	3 to 6	Nm
Weight	-	250	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-Sourse Voltage	D-S Short, AC frequency ≥1Hz, Note1	-10 to 22	V
I_{DS}	DC Continuous Drain Current	T_f =65°C , V_{GS} =+15V	370	A
I_{DS}	DC Continuous Drain Current	T_f =65°C , V_{GS} =+18V	410	A
I_{DSM}	Pulse Drain Current	T_C =65°C, Pulse width =1ms, V_{GS} =+15V, Note2	800	A
I_F	Forward Current (Diode)	T_f =65°C	450	A
I_{FRM}	Pulse Forward Current (Diode)	Less than 1ms, Note2	800	A
P_{tot}	Total Power Dissipation	T_C =25°C	1720	W
T_{jmax}	Max Junction Temperature	-	175	°C
T_{stg}	Storage Temperature	-	-40 to 125	°C

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

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 =400uA		1200	-	-	V
I_{DSS}	Zero gate voltage drain Current	V_{DS} =1200V, V_{GS} =0V		-	4	-	µA
$V_{GS(th)}$	Gate-source threshold Voltage	I_D =140mA, V_{DS} =V_{GS}	T_j =25°C	1.8	2.7	-	V
I_{GSS}	Gate-Source Leakage Current	V_{GS} =20V, V_{DS} =0V	T_j =25°C	-	-	400	nA
$R_{DS(on)}$ (Chip)	Static drain-source On-state resistance	I_D =400A, V_{GS} =+15V	T_j =25°C	-	5.4	8.0	mΩ
			T_j =175°C	-	7.7	-	mΩ
		I_D =400A, V_{GS} =+18V	T_j =25°C	-	4.5	-	mΩ
			T_j =175°C	-	6.4	-	mΩ
$V_{DS(on)}$ (Chip)	Static drain-source On-state Voltage	I_D =400A, V_{GS} =+15V	T_j =25°C	-	2.16	3.2	V
			T_j =175°C	-	3.08	-	V
		I_D =400A, V_{GS} =+18V	T_j =25°C	-	1.80	-	V
			T_j =175°C	-	2.56	-	V
V_{SD}	Body Diode Forward Voltage	V_{GS} =0V, I_{SD} =400A	T_j =25°C	-	5.2	-	V
			T_j =175°C	-	4.3	-	V
C_{iss}	Input Capacitance	V_D =800V, V_{GS} =0V, f =100KHz		-	23.3	-	nF
C_{oss}	Output Capacitance			-	0.70	-	nF
C_{rss}	Reverse transfer Capacitance			-	0.057	-	nF
Q_g	Total gate charge	V_{DD} =800V, I_D =240A, V_{GS} =+15/-5V		-	720	-	nC
$t_{d(on)}$	Turn-on delay time	V_{DD} =600V, I_D =400A, V_{GS} =+15/-4V, R_{gon}/R_{goff}=5.1/3.3Ω, Inductive load switching operation	T_j =25°C	-	56	-	ns
			T_j =150°C	-	49	-	
t_r	Rise time		T_j =25°C	-	33	-	ns
			T_j =150°C	-	27	-	
$t_{d(off)}$	Turn-off delay time		T_j =25°C	-	119	-	ns
			T_j =150°C	-	131	-	
t_f	Fall time		T_j =25°C	-	19	-	ns
			T_j =150°C	-	48	-	
E_{on}	Turn-on power dissipation		T_j =25°C	-	13.64	-	mJ
			T_j =150°C	-	13.42	-	
E_{off}	Turn-off power dissipation		T_j =25°C	-	5.64	-	mJ
			T_j =150°C	-	6.11	-	
$R_{th(j-c)}$	FET Thermal Resistance	Junction to Case		-	0.087	-	K/W
$R_{th(c-f)}$	Contact thermal Resistance	With thermal conductive grease, Note1		-	0.015	-	K/W

Note1: Assumes Thermal Conductivity of grease is 0.9W/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	
V_{DC}	DC blocking Voltage	T_j =25°C		-	1200	-	V
V_{BR}	Breakdown Voltage	$_R$ =20mA, T_j =25°C		-	1350	-	V
V_F	Forward Voltage	I_F =400A	T_j=25°C	-	1.75	-	V
			T_j=175°C	-	2.83	-	
I_{RRM}	Reverse Current	V_{RRM} =1200V	T_j=25°C	-	24	400	uA
			T_j=175°C	-	772	3000	
Q_C	Total Capacitive Charge	V_R =800V	T_j=25°C	-	1076	-	nc
C	Total Capacitance	f =1MHz	V_R =1V	-	12160	-	pF
			V_R=400V	-	1012	-	
			V_R=800V	-	724	-	
T_{rr}	Reverse recovery time	V_{RR} =600V, I_F =400A V_{GS} =+15/-4V R_G =6.8Ω Inductive load	T_j=25°C	-	17	-	ns
			T_j=150°C	-	14	-	
E_{rr}	Diode switching power dissipation		T_j=25°C	-	0.60	-	mJ
			T_j=150°C	-	0.87	-	
$R_{th(j-c)}$	SiC SBD Thermal Resistance	Junction to Case		-	0.060	-	K/W
$R_{th(c-f)}$	Contact thermal Resistance	With thermal conductive grease, Note1		-	0.015	-	K/W

Test Conditions

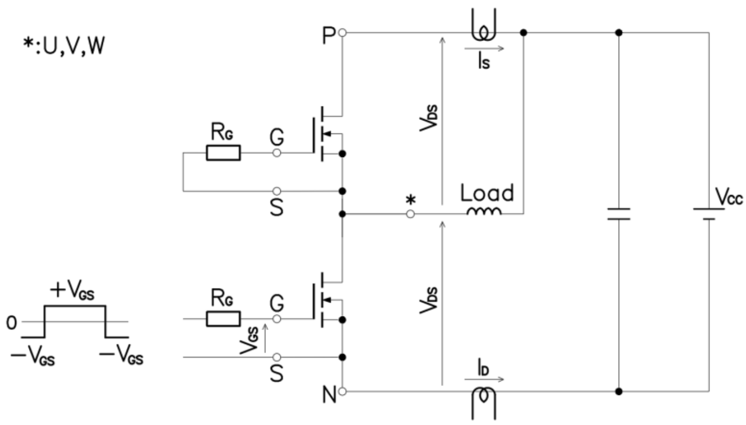


Figure 3. Switching time measure circuit

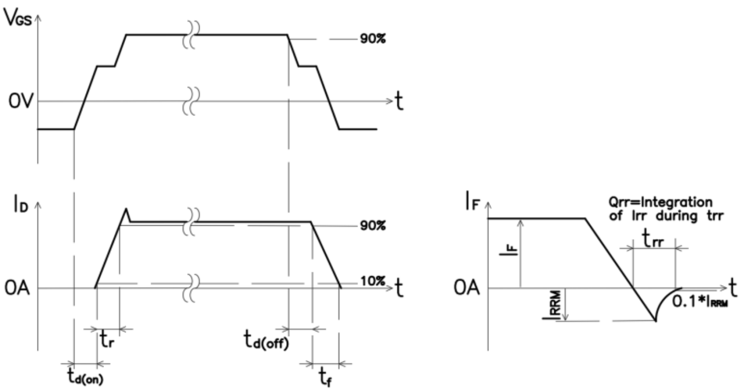


Figure 4. Switching time definition

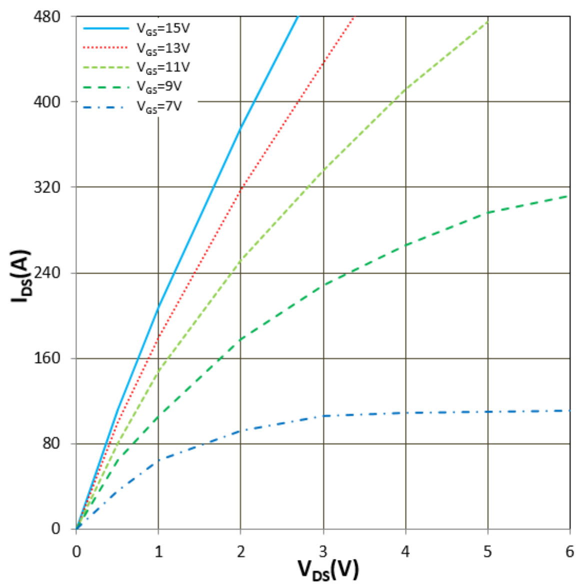


Figure 5. I_{DS} vs V_{DS}

T_j =25°C

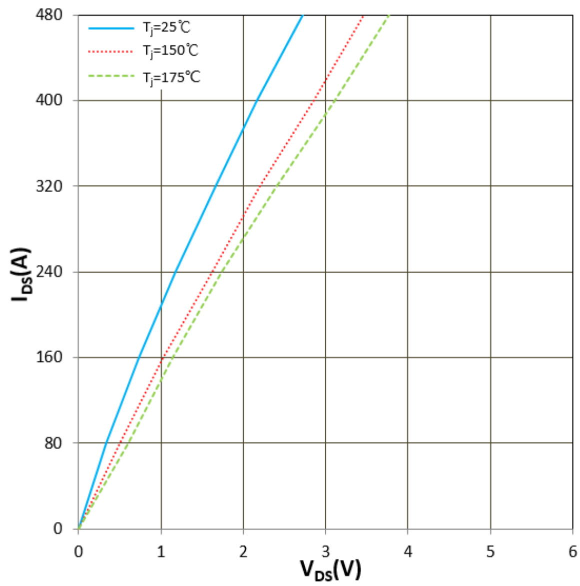


Figure 6. I_{DS} vs V_{DS}

V_{GS} =+15V

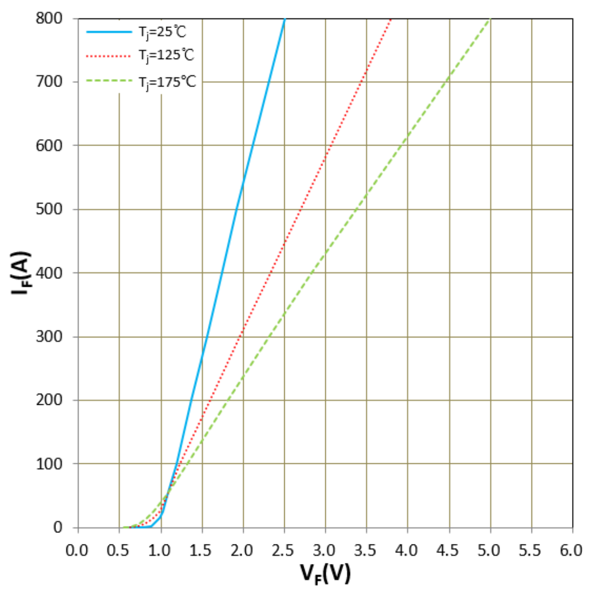


Figure 7. I_{SD} vs V_{SD} (V_F)

T_j parameter

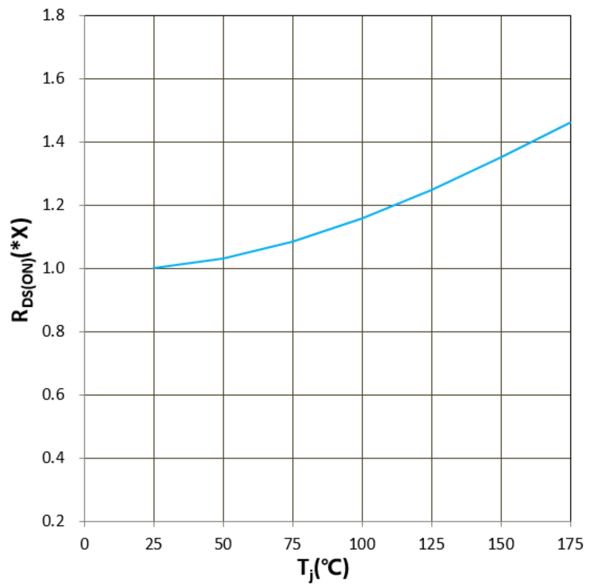


Figure 8. $R_{DS(ON)}$ vs T_j

V_{GS} =+18V, I_D =400A, 1.0X =4.5mΩ

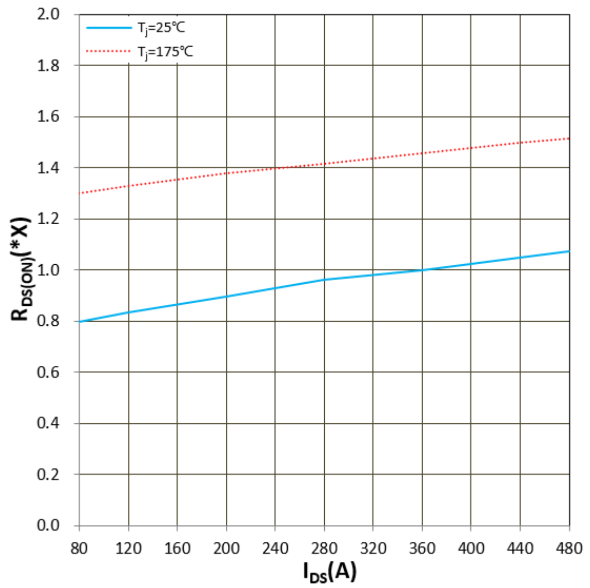


Figure 9. $R_{DS(ON)}$ vs I_{DS}

V_{GS} =+18V, I_D =400A, 1.0X =4.5mΩ

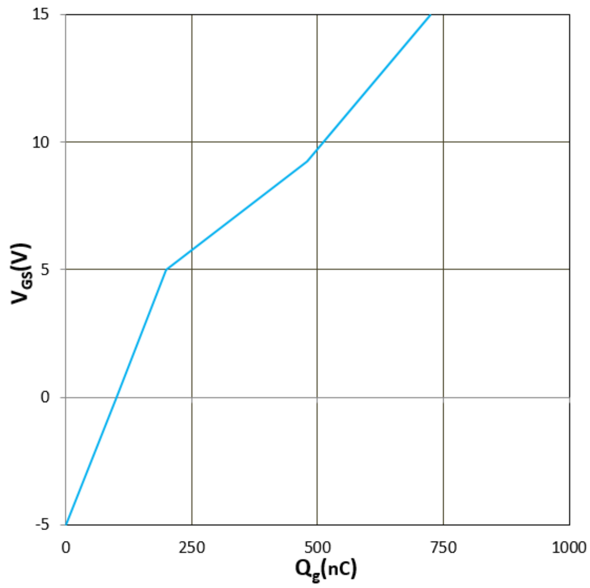


Figure 10. V_{GS} vs Q_g

V_{DS} =800V, I_D =240A, T_j =25℃

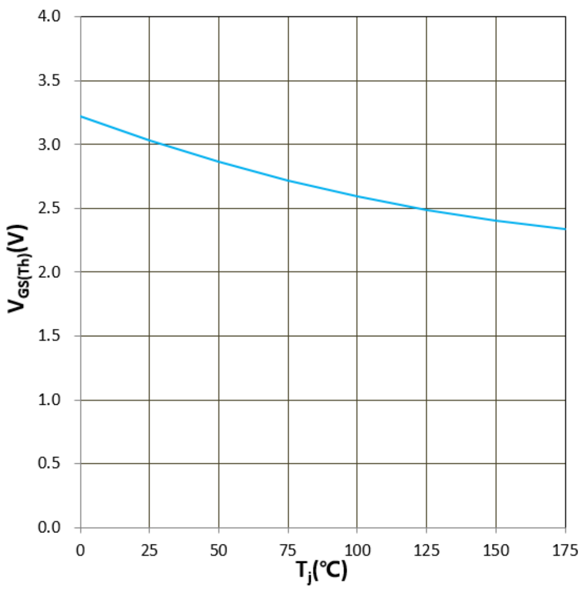


Figure 11. $V_{GS(TH)}$ vs T_j
V_{GS} =V_{DS}, I_D =140mA

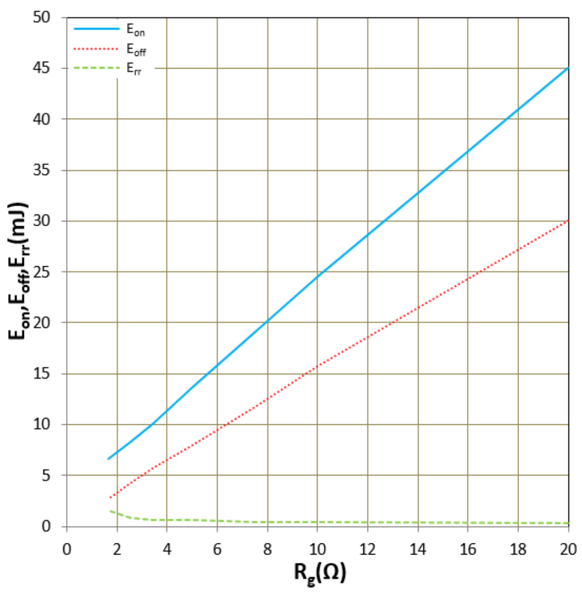


Figure 12. E_{on}, E_{off}, E_{rr} vs R_g
T_j =25°C, V_{CC} =600V, V_{GS} =+15V/-4V, I_D =400A
Inductive Load

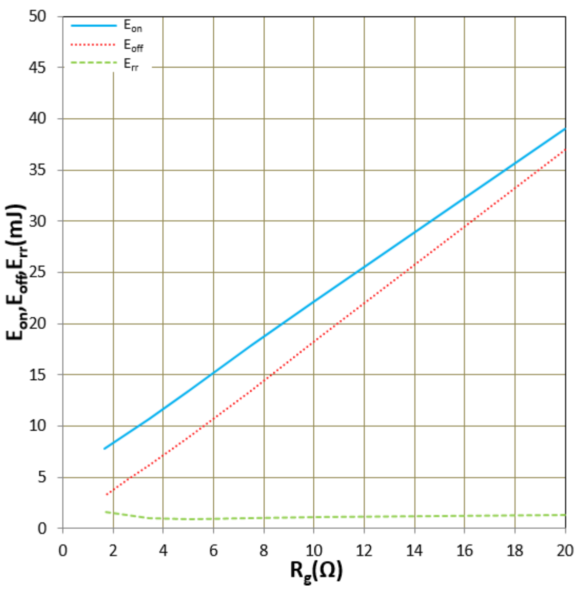


Figure 13. E_{on}, E_{off}, E_{rr} vs R_g
T_j =150°C, V_{CC} =600V, V_{GS} =+15V/-4V, I_D =400A
Inductive Load

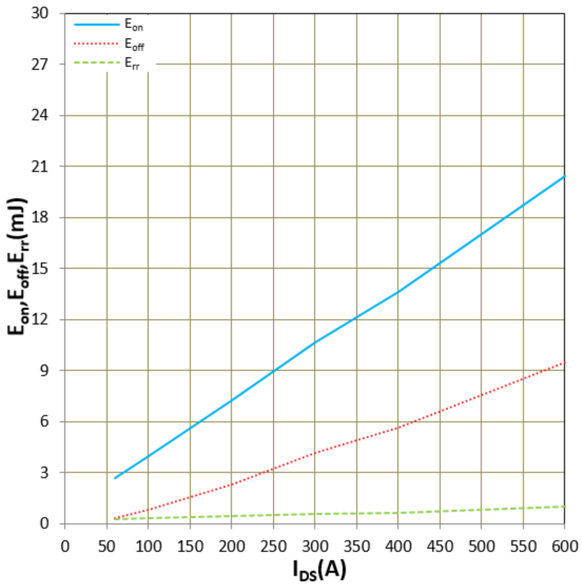


Figure 14. E_{on}, E_{off}, E_{rr} vs I_{DS}
T_j =25°C, V_{CC} =600V, V_{GS} =+15V/-4V
R_{gon}/R_{goff} =5.1/3.3Ω, Inductive Load

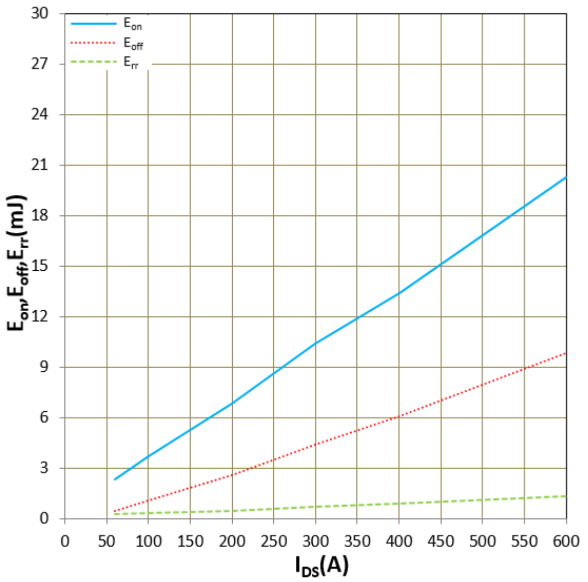
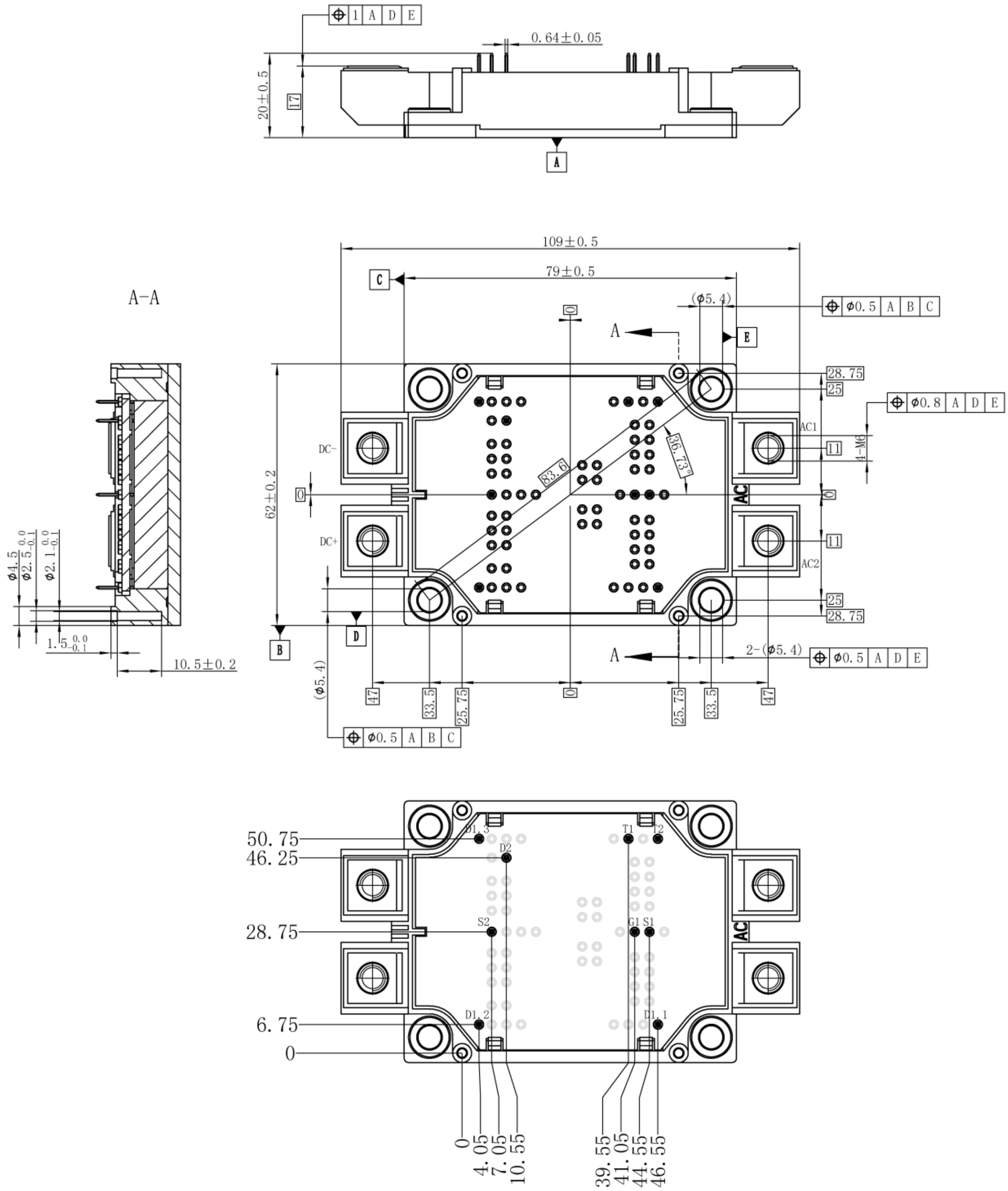


Figure 15. E_{on}, E_{off}, E_{rr} vs I_{DS}
T_j =150°C, V_{CC} =600V, V_{GS} =+15V/-4V
R_{gon}/R_{goff} =5.1/3.3Ω, Inductive Load

Package dimensions



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