DFH08TL12EZE2A

1200V 3-Level Hybrid Power Module

Description

The DFH08TL12EZE2A is a 3 level Power Module. It integrates 1200V SiC MOSFET chips and 650V IGBT chips designed for the applications such as Solar Inverter, Energy storage Systems, DC/DC, etc.

Features

- 1200V/8mΩ SiC MOSFET
- 650V/200A IGBT
- SiC SBD
- Low Switching Losses
- High current density
- Press FIT Contact Technology
- Pre-applied thermal interface material
- Thermistor inside

Applications

- Solar inverter Systems
- DC/DC converter
- Energy Storage Systems

Circuit diagram

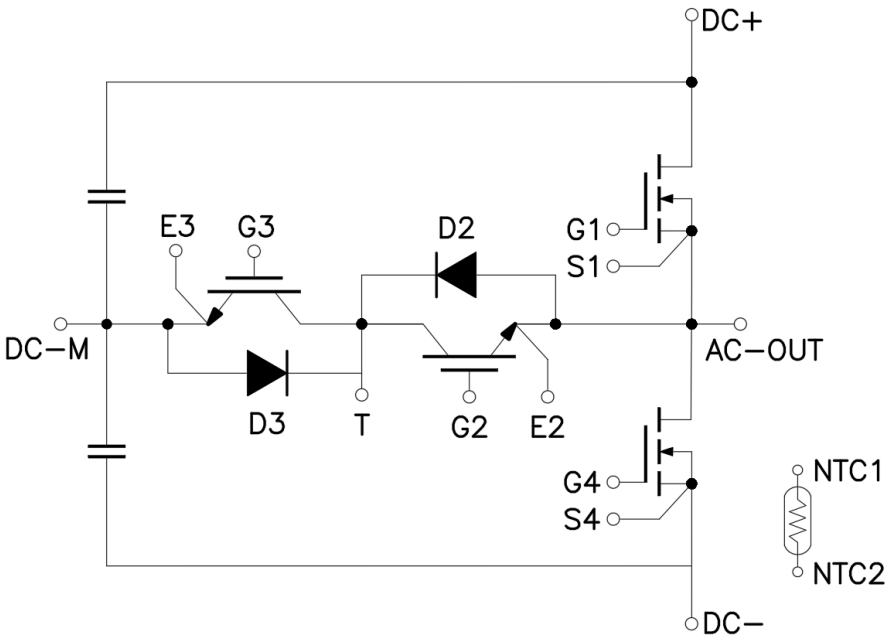


Figure 1. Out drawing & circuit diagram for DFH08TL12EZE2A

Pin Configuration and Marking Information

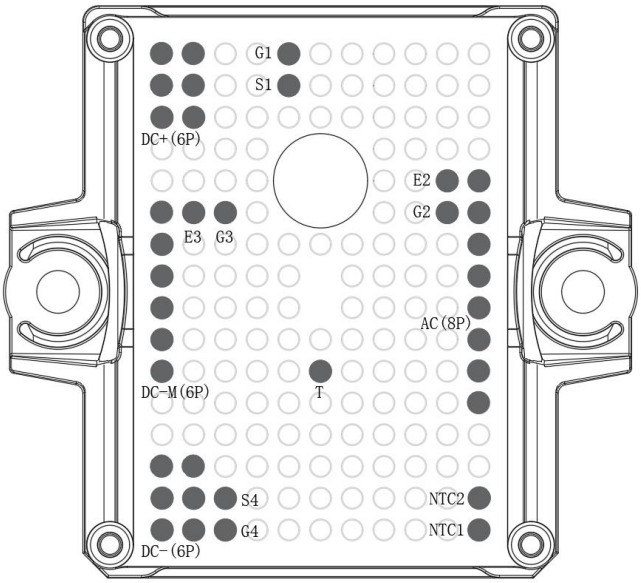


Figure 2. Pin configuration

Module

Parameter	Conditions	Value	Unit
Isolation Voltage	RMS, f =50Hz, t =1min	3.0	kV
Clearance	Terminal to Terminal	5.0	mm
	Terminal to Heatsink	10.0	mm
Creepage distance	Terminal to Terminal	6.3	mm
	Terminal to Heatsink	12.7	mm
Comparative Tracking Index	-	> 400	-
T_{stg}	Storage temperature	-40 to 125	°C
Weight	-	40	g

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

Capacitor (DC)

Symbol	Parameter	Conditions	Value	Unit
T_{OP}	Operation Temperature	-	-40 to 150	℃
C	Capacitance	DC bias voltage = 0v，25℃	150	nF
V	DC voltage ratings	-	630	V

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

Symbol	Parameter	Conditions	Ratings	Unit
V_{DSS}	Drain-Source Voltage	25° C≤T_j ≤175° C	1200	V
V_{GSS}	G-S Voltage	D-S Short, Note1	-8 to 22	V
I_{DS}	DC Continuous Drain Current	T_S =80°C	160	A
I_{DP}	Drain Pulse Current, Peak	Less than 1ms, Note2	400	A
T_j	junction temperature	-	-55 to 175	℃

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

Note2: Pulse width limited by maximum junction temperature

Maximum Ratings (IGBT, 3-Level, T_j =25°C unless otherwise specified)

Symbol	Parameter	Conditions	Ratings	Unit
V_{CES}	Collector-Emitter Voltage	G-E Short	650	V
V_{GES}	Gate-Emitter Voltage	C-E Short	±20	V
	Transient gate emitter voltage, T_P≤10μs, D<0.01	C-E Short	±30	
I_C	DC Continuous Collector Current	T_S =80°C	190	A
I_{CM}	Pulse Collector Current	t_p =1ms, Note1	400	A
T_j	junction temperature	-	-55 to 175	℃

Note1: Pulse width limited by maximum junction temperature

Maximum Ratings (SiC SBD, 3-Level, T_j =25°C unless otherwise specified)

Symbol	Parameter	Conditions	Ratings	Unit
V_{RRM}	Repetitive peak reverse Voltage	-	650	V
I_F	Diode forward Current	T_S =80°C	130	A
I_{FRM}	Repetitive peak forward Current	t_p =1ms, Note1	300	A
I^2t	I^2t for fusing	sine-wave pulse, t_p =10ms	924.5	A^2s
T_j	junction temperature	-	-55 to 175	℃

Note1: Pulse width limited by maximum junction temperature

SiC MOSFET Electrical characteristics (SiC MOSFET, 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 =0.2mA		1200	-	-	V
I_{DSS}	Zero gate voltage drain Current	V_{DS} =1200V, V_{GS} =0V		-	-	200	μA
$V_{GS(th)}$	Gate-Source threshold Voltage	I_D =40mA, V_{DS} =V_{GS}		1.9	2.6	3.5	V
I_{GSS}	Gate-Source Leakage Current	V_{GS} =18V, V_{DS} =0V		-	-	200	nA
$R_{DS(on)}$ (Chip)	Static drain-source On-state resistance	I_D =100A, V_{GS} =18V	T_j =25°C	-	8	13	mΩ
			T_j =175°C	-	14	-	mΩ
$V_{DS(on)}$ (Chip)	Static drain-source On-state Voltage	I_D =100A, V_{GS} =18V	T_j =25°C	-	0.8	1.45	V
			T_j =175°C	-	1.4	-	V
C_{iss}	Input Capacitance	- V_{DS} =1000V, V_{GS} =0V, f =1MHz		-	9400	-	pF
C_{oss}	Output Capacitance			-	400	-	pF
C_{rss}	Reverse transfer Capacitance			-	40	-	pF
Q_G	Total gate charge	V_{DD} =800V, I_D =100A, V_{GS} =0/+18V		-	430	-	nC
R_{Gint}	Internal Gate Resistance	f =1Mhz		-	0.3	-	Ω
$t_{d(on)}$	Turn-on delay time	V_{DD} =400V, I_D =100A, V_{GS} =+18/-4V, R_{GON} =5.0Ω, R_{GOFF} =3.3Ω, Inductive load switching operation	T_j =25°C	-	28	-	ns
			T_j =150°C	-	26	-	
t_r	Rise time		T_j =25°C	-	41	-	ns
			T_j =150°C	-	44	-	
$t_{d(off)}$	Turn-off delay time		T_j =25°C	-	66	-	ns
			T_j =150°C	-	70	-	
t_f	Fall time		T_j =25°C	-	23	-	ns
			T_j =150°C	-	24	-	
E_{on}	Turn-on power dissipation		T_j =25°C	-	1.44	-	mJ
			T_j =150°C	-	1.87	-	
E_{off}	Turn-off power dissipation		T_j =25°C	-	0.54	-	mJ
			T_j =150°C	-	0.67	-	
$R_{th(j-s)}$	Thermal Resistance, Junction to sink (Conductive Grease applied), Note1			-	0.24	-	K/W

Note1: Assumes Thermal Conductivity of grease is 2.8W/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	
I_{SD}	DC body diode forward Current	V_{GS} =-4V	T_S≤80°C	-	-	80	A
V_{SD}	Body Diode Forward Voltage	V_{GS} =-4V, I_{SD} =100A	T_j =25°C	-	4.7	-	V
			T_j =175°C	-	4.2	-	

IGBT (3-Level) Electrical characteristics (T_j =25°C unless otherwise specified, chip)

Symbol	Item	Condition		Value			Unit
				Min.	Typ.	Max	
$V_{CE(sat)}$ (Chip)	Collector-Emitter Saturation Voltage	I_C =100A, V_{GE} =15V	T_j =25°C	-	1.35	1.6	V
			T_j =150°C		1.50	-	V
			T_j =175°C		1.60	-	V
$V_{GE(th)}$	Gate-Emitter threshold Voltage	I_C =1mA, V_{CE} =V_{GE}		3.5	4.5	5.5	V
Q_G	Total gate charge	V_{GE} =15V, V_{CC}=520V, I_C=160A		-	348	-	nC
I_{CES}	Collector- Emitter Cut off Current	V_{CE} =650V, V_{GE} =0V		-	-	20	μA
I_{GES}	Gate-Emitter Leakage Current	V_{GE} =20V, V_{CE} =0V		-	-	0.2	μA
C_{iss}	Input Capacitance	V_{CE} =25V, V_{GE} =0V, f =100KHz		-	17296	-	pF
C_{oes}	Output Capacitance			-	306	-	pF
C_{res}	Reverse transfer Capacitance			-	9.8	-	pF
$t_{d(on)}$	Turn-on delay time	V_{CC} =400V, I_C =100A, V_{GE} =+15/-8V, R_{Gon} = R_{Goff} =5Ω, Inductive load	T_j =25°C	-	81	-	ns
			T_j =150°C	-	85	-	
t_r	Rise time		T_j =25°C	-	74	-	ns
			T_j =150°C	-	77	-	
$t_{d(off)}$	Turn-off delay time		T_j =25°C	-	230	-	ns
			T_j =150°C	-	249	-	
t_f	Fall time		T_j =25°C	-	20	-	ns
			T_j =150°C	-	42	-	
E_{on}	Turn-on power dissipation		T_j =25°C	-	2.6	-	mJ
			T_j =150°C	-	5.5	-	
E_{off}	Turn-off power dissipation		T_j =25°C	-	0.78	-	mJ
			T_j =150°C	-	1.33	-	
$R_{th(j-s)}$	Thermal Resistance, Junction to sink (Conductive Grease applied), Note1			-	0.25	-	K/W

Note1: Assumes Thermal Conductivity of grease is 2.8W/m·K and thickness is 50um.

SiC SBD (3-Level) Electrical characteristics (T_j =25°C unless otherwise specified, chip)

Symbol	Item	Condition		Value			Unit
				Min.	Typ.	Max	
V_F	Diode Forward Voltage	V_{GS} =-4V, I_{SD} =100A	T_j =25°C	-	1.40	1.70	V
			T_j =150°C	-	1.70	2.20	
C_d	Diode capacitance	f = 1MHz, V_R =1V	T_j =25°C	-	5864	-	pF
		f = 1MHz, V_R =400V		-	598	-	
I_R	Reverse Current	V_R =650V	T_j =25°C		8	600	μA
			T_j =175°C		120	2400	
Q_R	Recovered charge	V_R =400V, I_F =100A , di/dt=500A/μs	T_j =25°C	-	288	-	nC
E_{rr}	Reverse recovered energy	V_R =400V, I_F =100A, R_G =5.0Ω, V_{GS} =+15/-8V, Inductive load	T_j =25°C	-	0.44	-	mJ
			T_j =150°C	-	0.57	-	

$R_{th(j-s)}$	Thermal Resistance, Junction to sink (Conductive Grease applied), Note1	-	0.38	-	K/W

Note1: Assumes Thermal Conductivity of grease is 2.8W/m·K and thickness is 50um.

Test Conditions

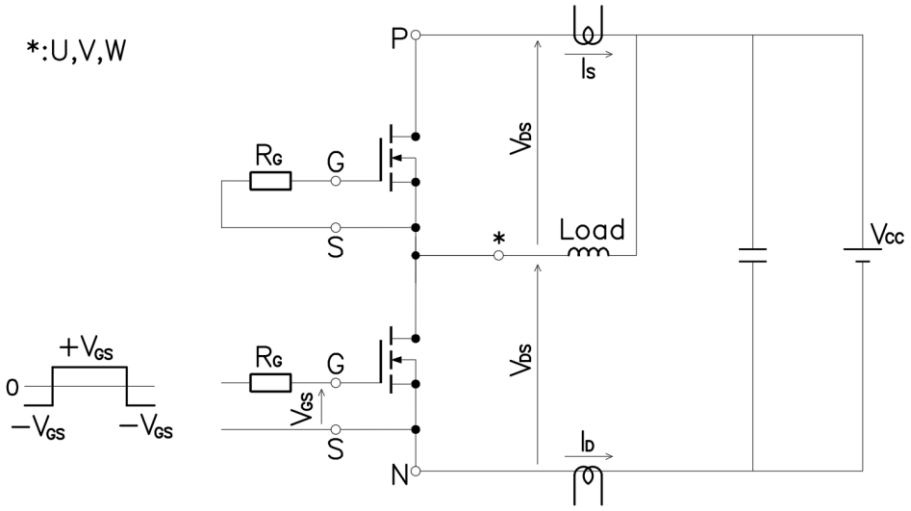


Figure 3. Switching time measure circuit

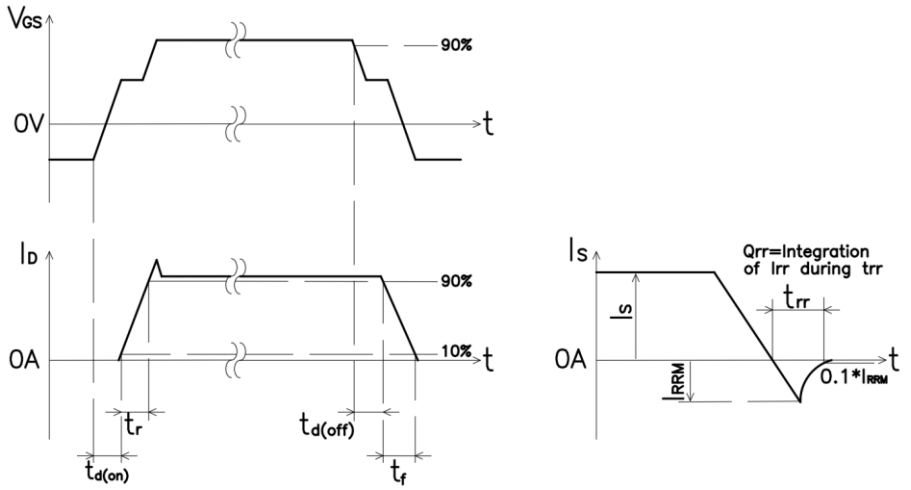


Figure 4. Switching time definition

SiC MOSFET, Body Diode

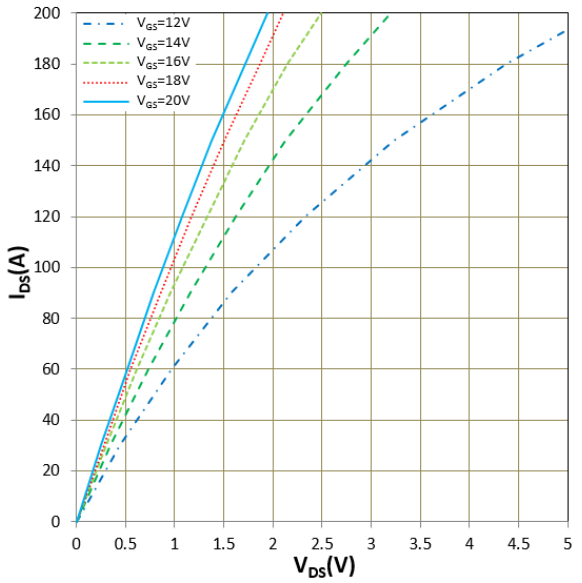


Figure 5. I_{DS} vs V_{DS}
T_j =25°C

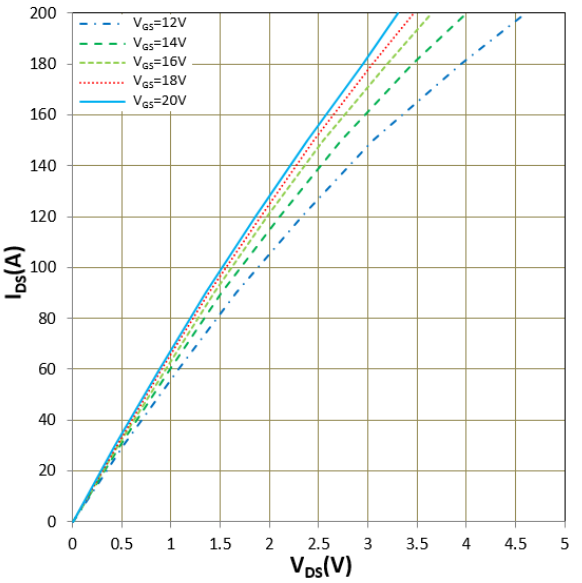


Figure 6. I_{DS} vs V_{DS}
T_j =175°C

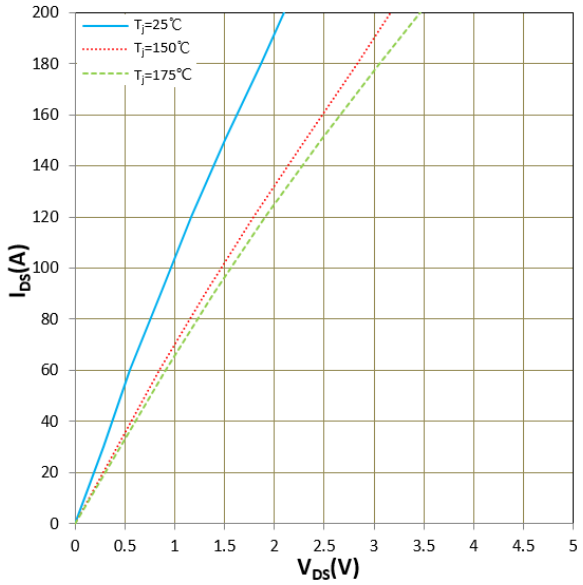


Figure 7. I_{DS} vs V_{DS}
V_{GS} =18V

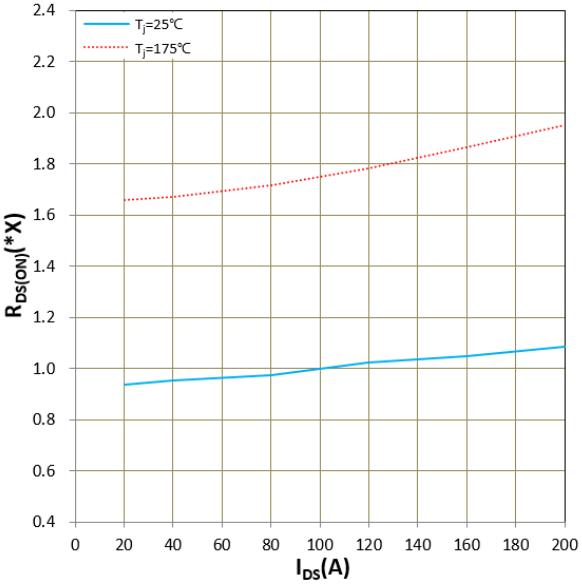


Figure 8. $R_{DS(ON)}$ vs I_{DS}
1.0x =8.0mΩ, V_{GS} =18V

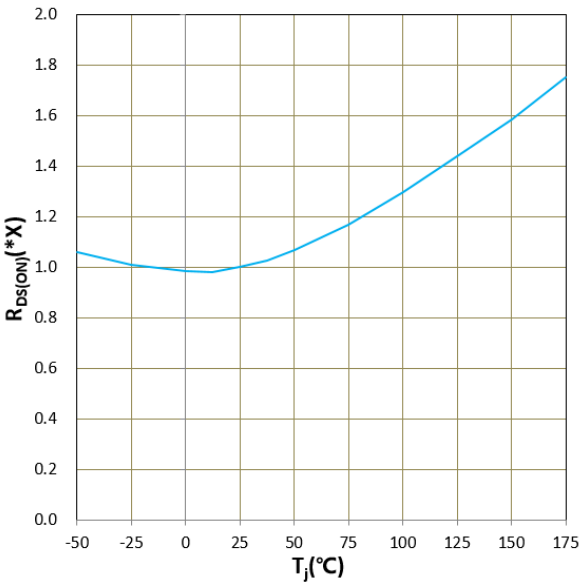


Figure 9. $R_{DS(ON)}$ vs T_j
1.0x =8.0mΩ, I_D =100A

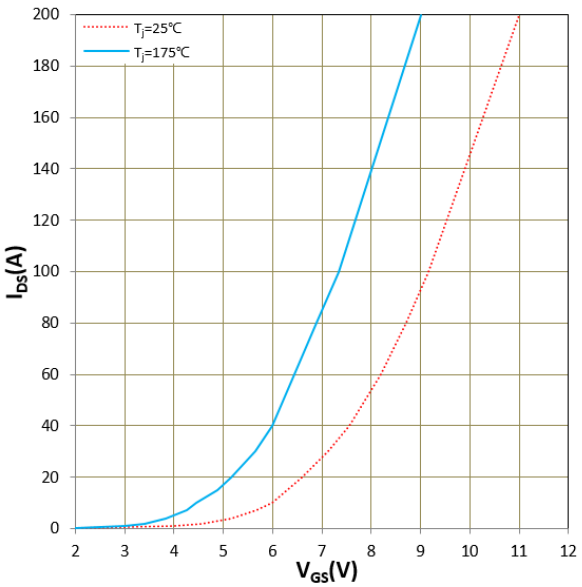


Figure 10. I_{DS} vs V_{GS}
V_{DS} =10V

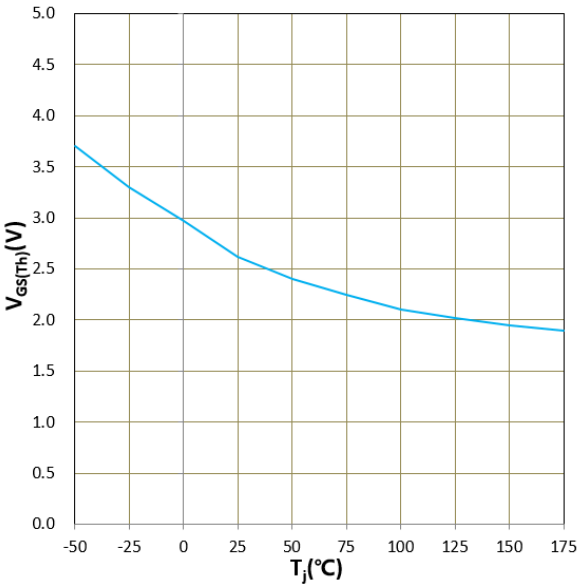


Figure 11. $V_{GS(Th)}$ vs T_j
V_{DS} =10V, I_{DS} =40mA

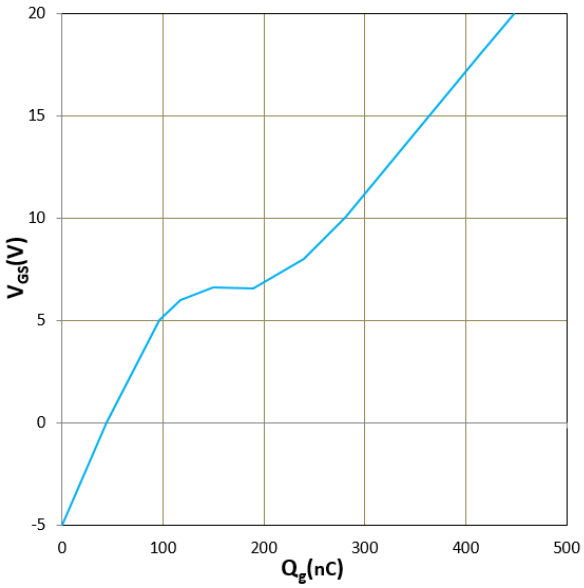


Figure 12. Gate charge
I_{DS} =100A, I_{GS} =0.2mA, V_{DS} =400V

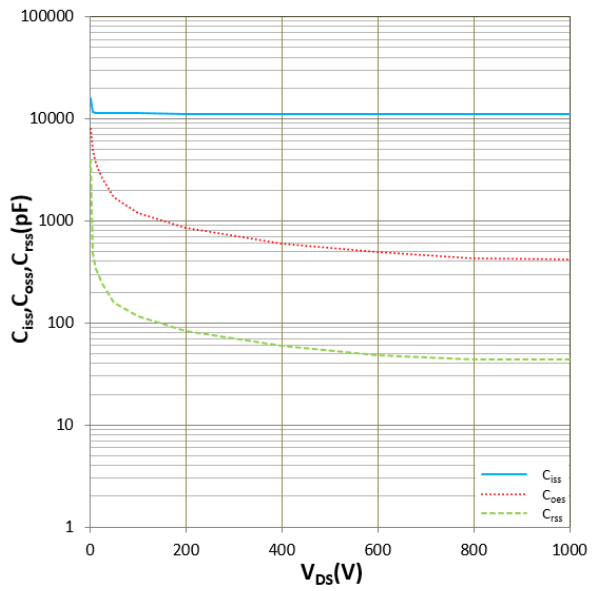


Figure 13. C_{iss}, C_{oss}, C_{rss} vs V_{CE}
V_{AC} =25mV, f =1MHz

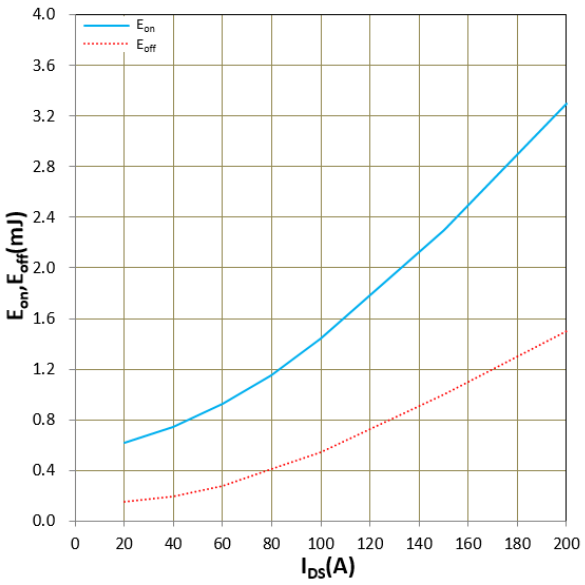


Figure 14. E_{on}, E_{off} vs I_{DS}(Typ)
T_j =25°C, V_{DD} =400V, V_{GE} =+18/-4V
R_{GON} =5.0Ω, R_{GOFF} =3.3Ω, Inductive Load

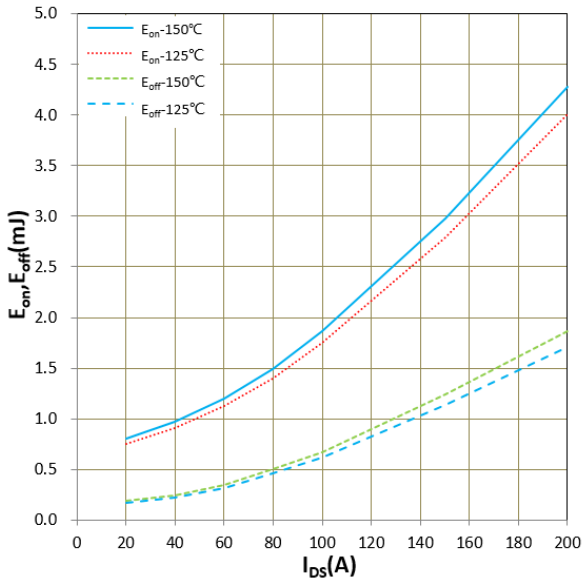


Figure 15. E_{on}, E_{off} vs I_{DS}(Typ)
T_j =125/150°C, V_{DD} =400V, V_{GE} =+18/-4V
R_{GON} =5.0Ω, R_{GOFF} =3.3Ω, Inductive Load

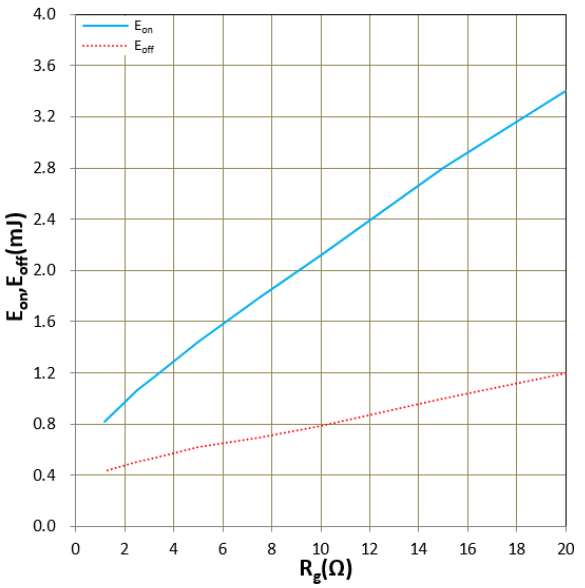


Figure 16. E_{on}, E_{off} vs R_g(Typ)
V_{DD} =400V, V_{GE} =+18/-4V, I_D =100A
T_j =25°C, Inductive Load

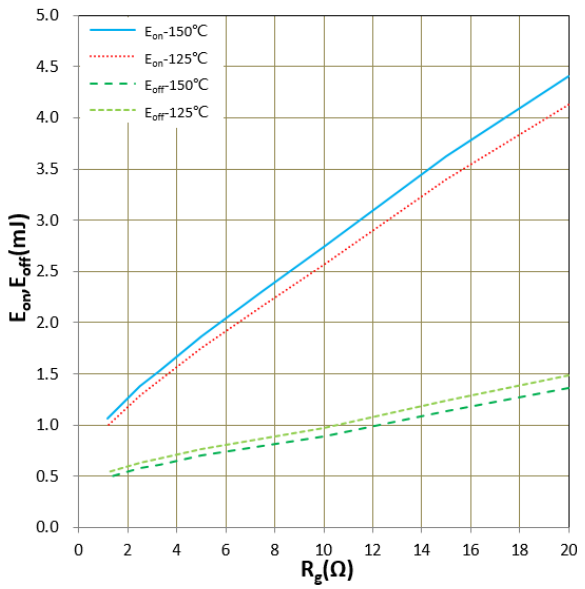


Figure 17. E_{on}, E_{off} vs R_g(Typ)
V_{DD} =400V, V_{GE} =+18/-4V,I_D =100A,
T_j =125/150°C, Inductive Load

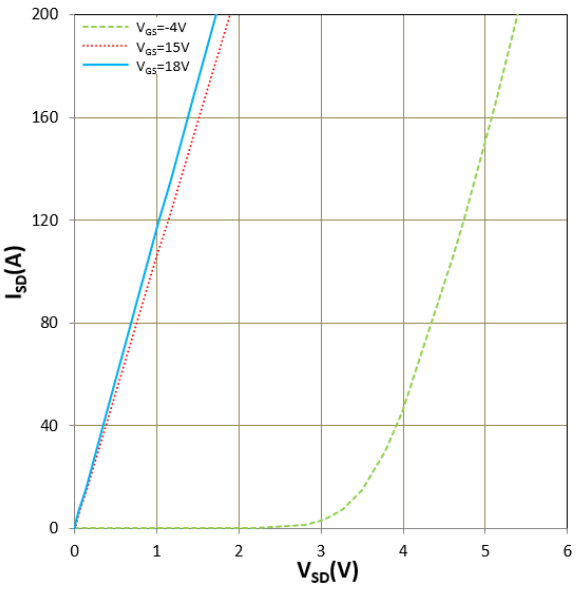


Figure 18. I_{SD} vs V_{SD}
T_j =25°C

IGBT, (3-Level)

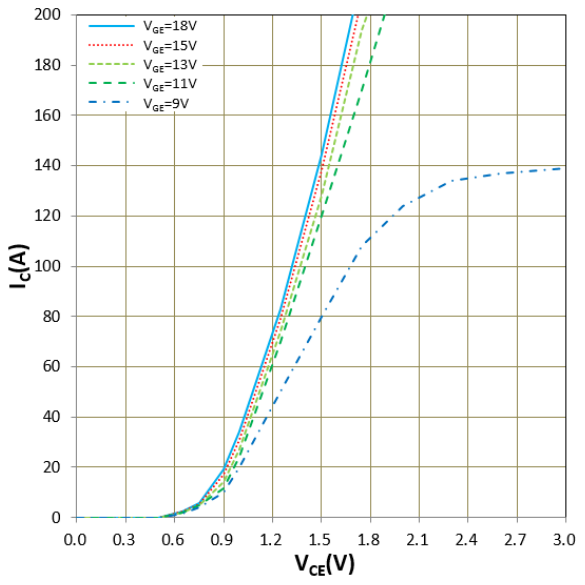


Figure 19. Ic vs V_{CE}
T_j =25°C

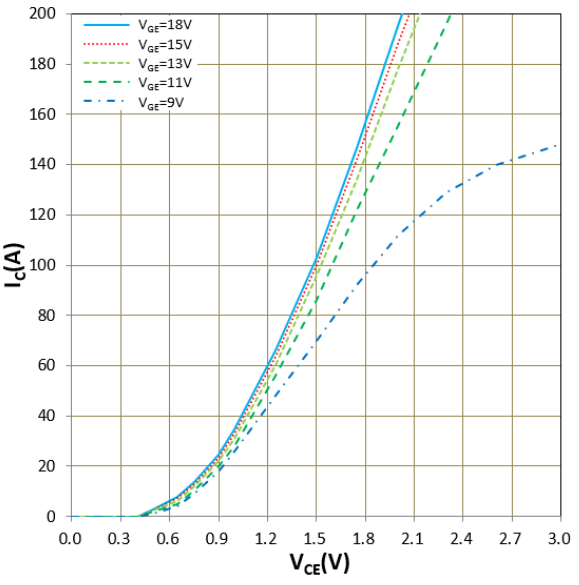


Figure 20. Ic vs V_{CE}
T_j =150°C

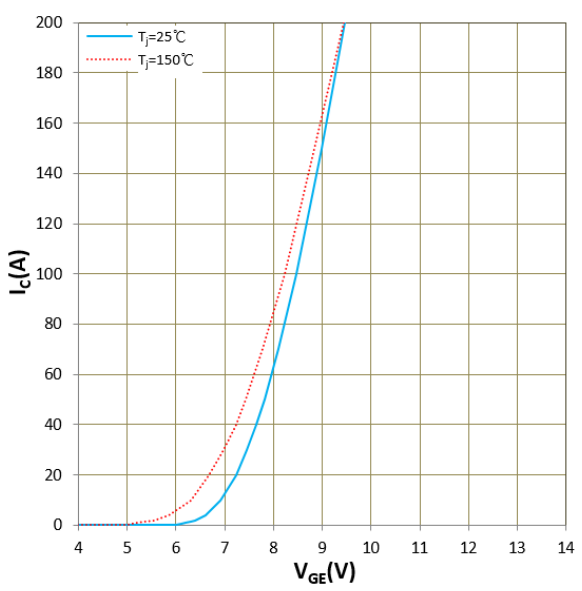


Figure 21. Ic vs V_{GE}
V_{CE} =20V

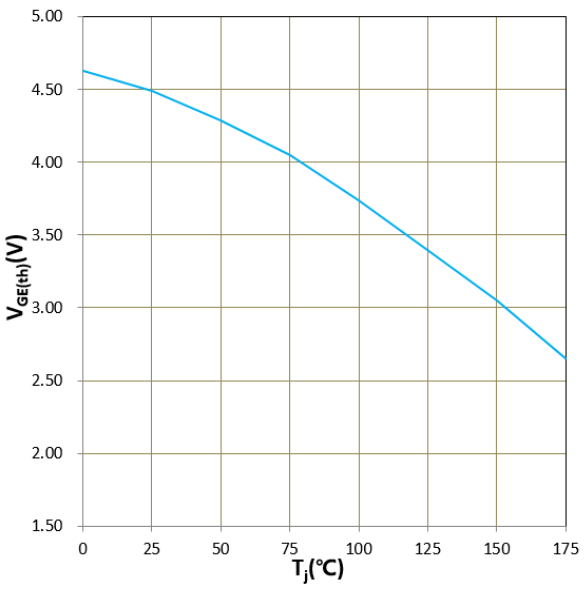


Figure 22. $V_{GE(TH)}$ vs T_j
I_C =1mA

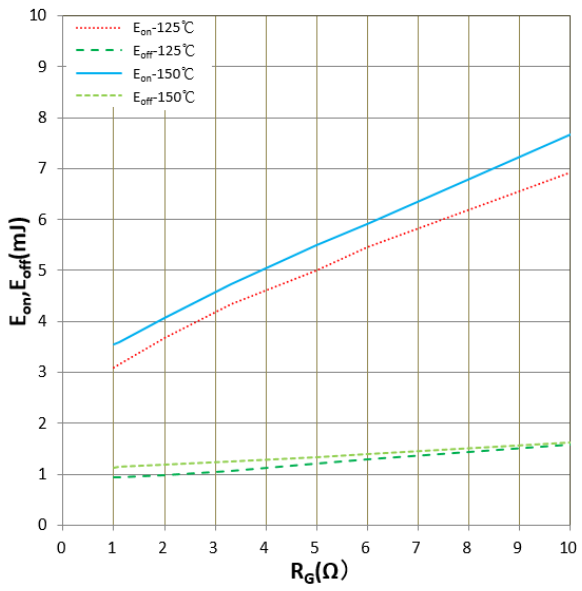


Figure 23. E_{on}, E_{off} vs R_G(Typ)
V_{CC} =400V, V_{GE} =+15V/-8V, I_C =100A
Inductive Load

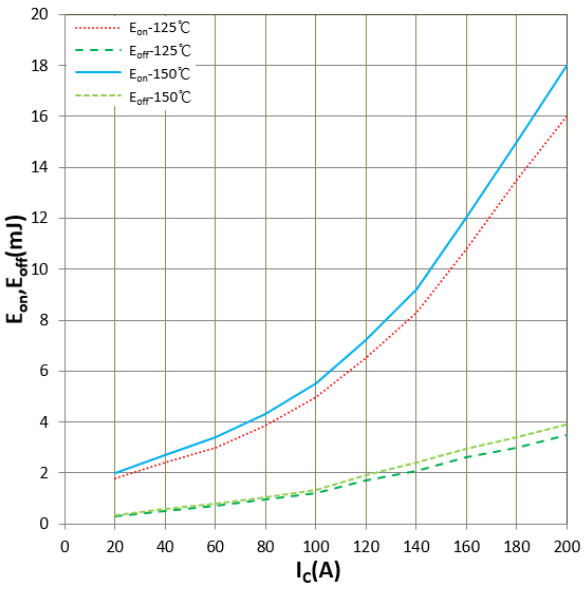


Figure 24. E_{on}, E_{off} vs Ic(Typ)
V_{CC} =400V, V_{GE} =+15V/-8V, R_G =5.0Ω
Inductive Load

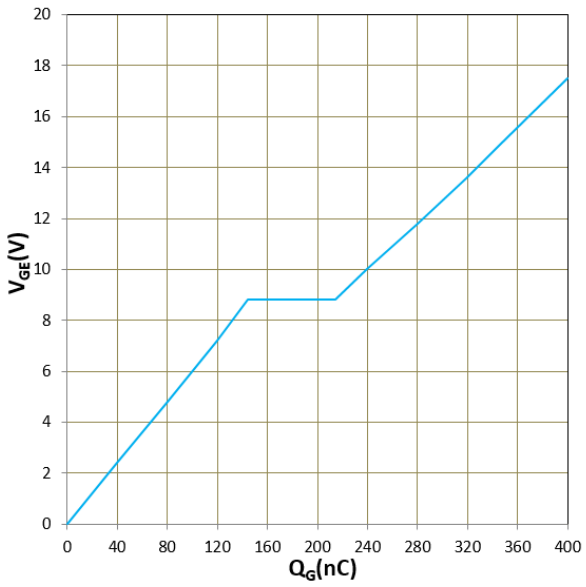


Figure 25. Gate charge
V_{CE} =520V, I_C =160A

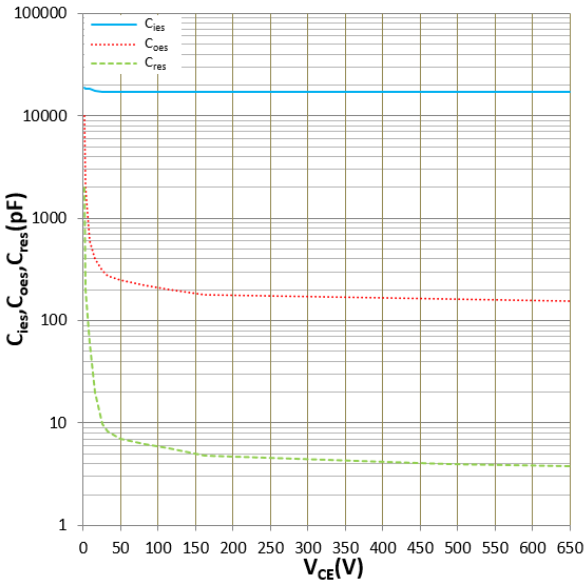


Figure 26. C_{ies}, C_{oes}, C_{res} vs V_{CE}
T_j =25°C, f =100KHz

SiC SBD, (3-Level)

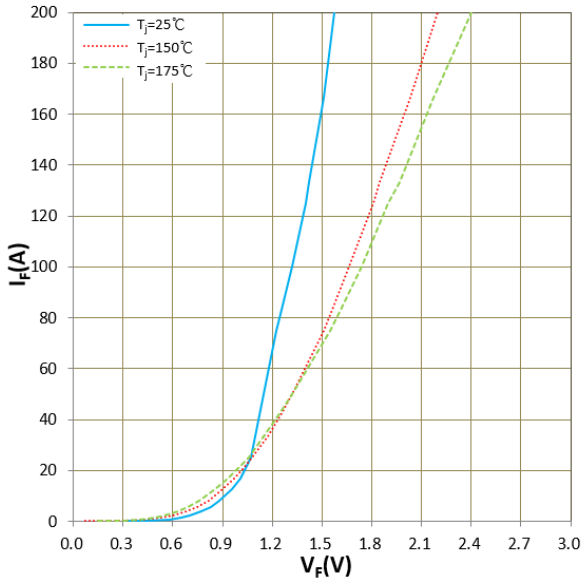


Figure 27. I_F vs V_F (Typ)

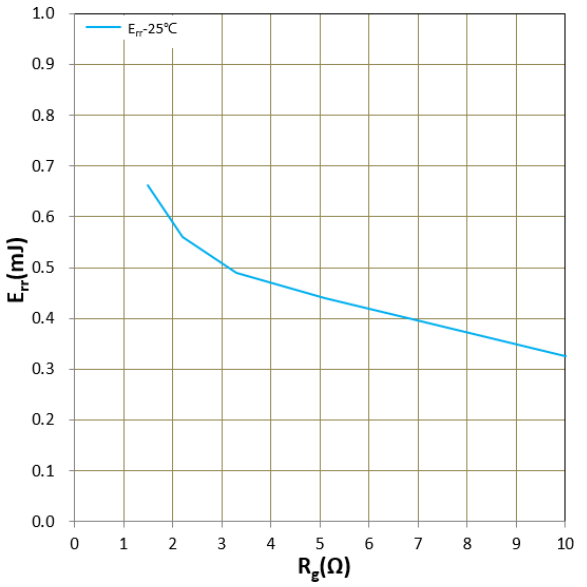


Figure 28. Err vs R_g(Typ)
V_R =400V, I_F =100A, V_{GE} =+15/-8V
T_j =25°C, Inductive Load

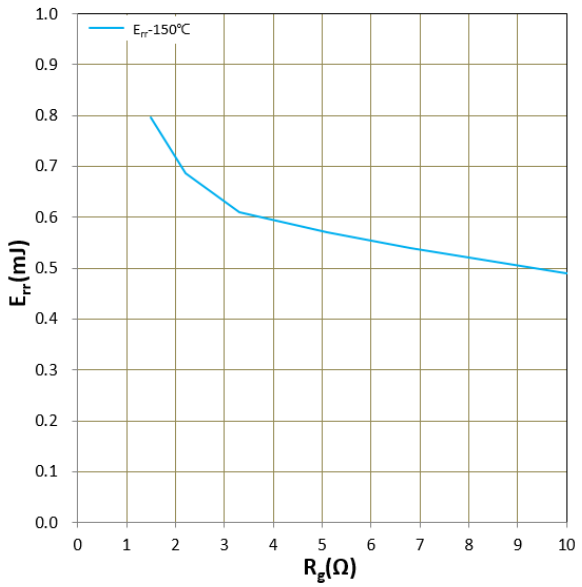


Figure 29. Err vs R_g(Typ)
V_R =400V, I_F =100A, V_{GE} =+15/-8V
T_j =150°C, Inductive Load

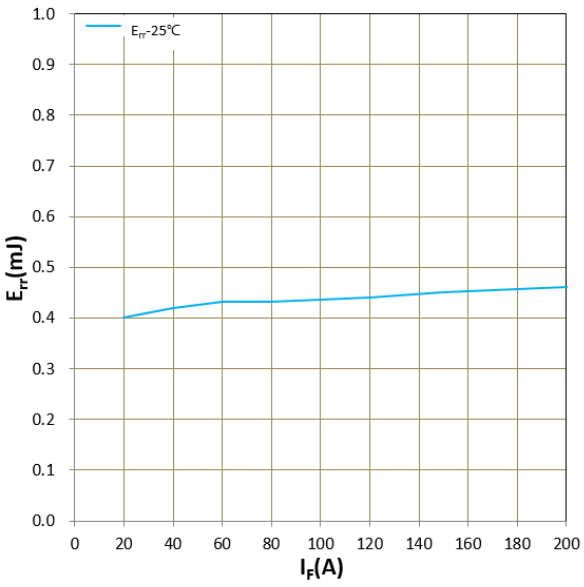


Figure 30. E_{rr} vs I_F(Typ)
V_R =400V, V_{GE} =+15/-8V, R_G =5.0Ω
T_j =25°C, Inductive Load

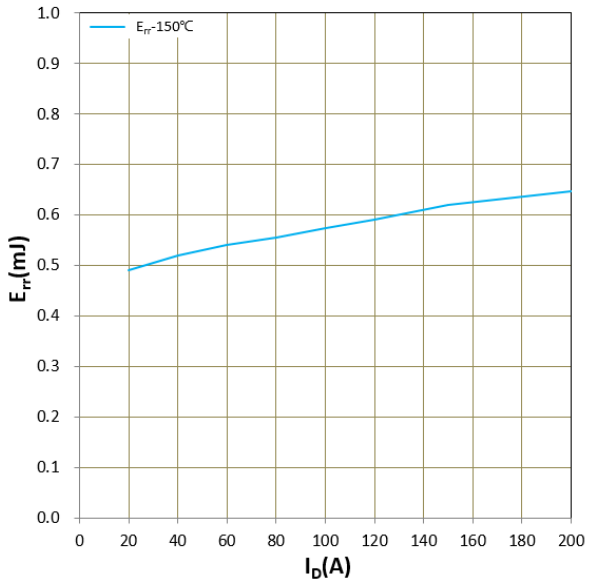
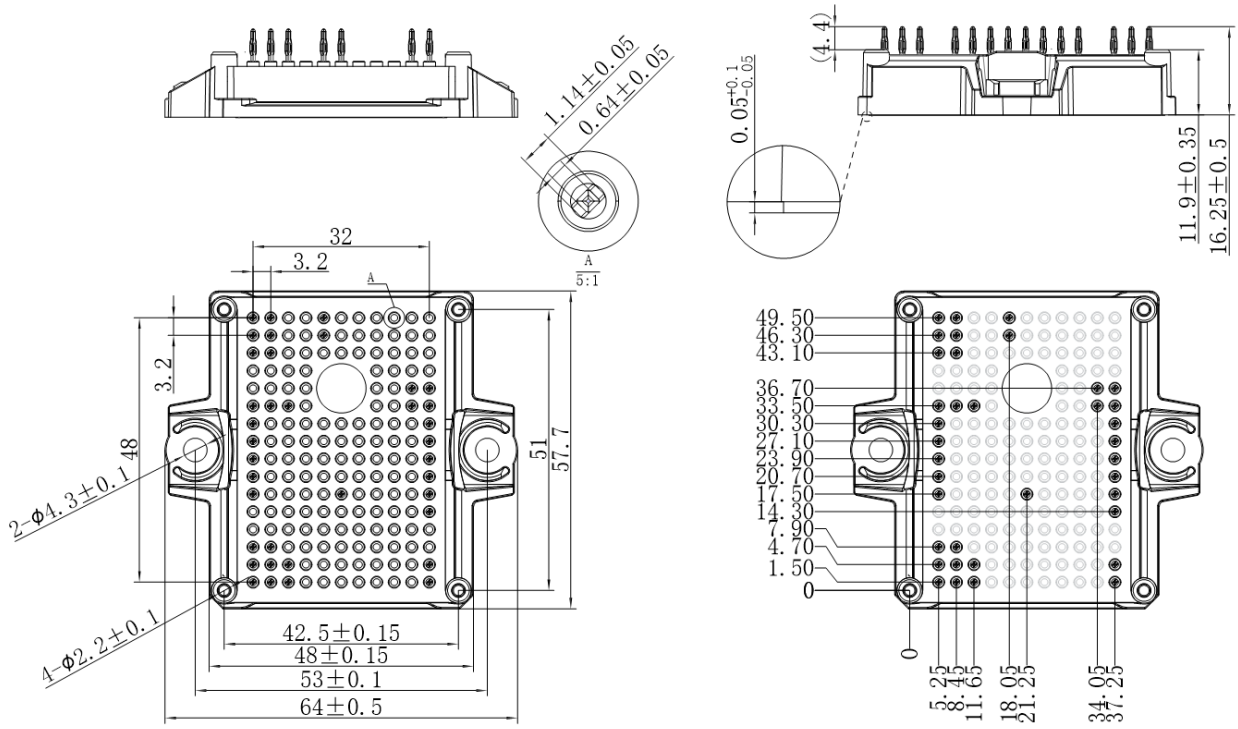


Figure 31. E_{rr} vs I_F(Typ)
V_R =400V, V_{GE} =+15/-8V, R_G =5.0Ω
T_j =150°C, Inductive Load

Package dimensions



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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.

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