High-Power Module Silicon Carbide N-Channel MOSFET

MG800FXF2YMS3

1. Applications

- High-Power Switching
- Motor Controllers (including rail traction)

2. Features

(1) V_{DSS} = 3300 V, I_D = 800 A All SiC MOSFET Module(Low loss & High speed switching)

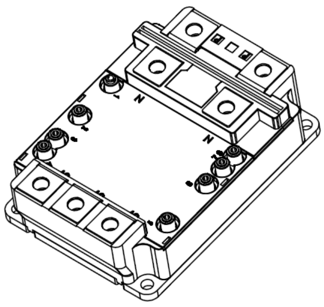
(2) Low stray inductance, low thermal resistance, maximum T_{ch} = 175 °C

(3) Equipped with current sensing terminal & build in thermistor

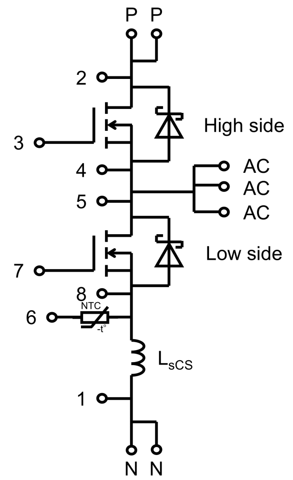
(4) New generation standard package(Compact & easily handled by paralleling)

(5) Electrodes are isolated from metal base plate.

3. Packaging and Internal Circuit (Note)



iXPLV



(Note) P and N terminals should be fastened by two screws each and AC terminals should be fastened by three screws.

Start of commercial production
2023-10

4. Terminal

Terminal No.	Connection
P	P (main terminal)
N	N (main terminal)
AC	AC (main terminal)
1	N (sense) / Current sense
2	P (sense)
3	High side gate
4	High side source sense
5	AC (sense)
6	Thermistor
7	Low side gate
8	Low side source sense

Marking	High side	Low side
A	MOSFET	MOSFET

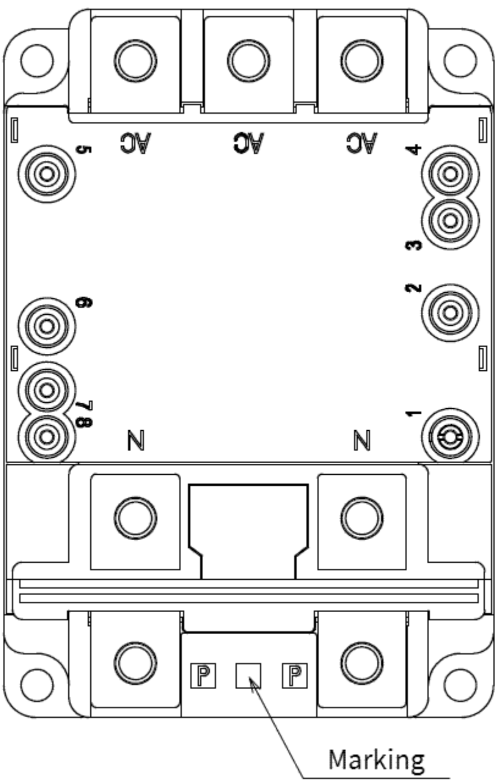


Fig. 4.1 Terminal image

5. Absolute Maximum Ratings (Note, Note 1) (T_C = 25 °C, unless otherwise specified)

Characteristics	Symbol	Note	Test Condition	Rating	Unit
Drain-source voltage	V_{DSS}			3300	V
Gate-source voltage	V_{GSS}			+ 25 / - 10	V
Drain current (DC)	I_D	(Note 2)		800	A
Drain current (pulsed)	I_{DP}	(Note 2)		1600	A
Power dissipation	P_D	(Note 2)		4680	W
Source current (DC)	I_S	(Note 2)		800	A
Source current (pulsed)	I_{SP}	(Note 2)		1600	A
Channel temperature	T_{ch}			175	°C
Storage temperature	T_{stg}			- 40 to 150	°C
Isolation voltage	V_{isol}		AC , 60 s	6000	Vrms
Mounting torque	TOR	(Note 3)	Main terminal: M8	9.1	N · m
		(Note 4)	Signal terminal: M3	1.0	N · m
		(Note 5)	Mounting: M6	5.2	N · m

Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings.
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 1: refer to the application notes.

Note 2: Ensure that the channel temperature does not exceed 175 °C.

Note 3: The recommended tightening torque for the main terminal (M8) is 7.0 N · m.

Note 4: The recommended tightening torque for the signal terminal (M3) is 0.8 N · m.

Note 5: The recommended tightening torque for installation (M6) is 4.0 N · m.

6. Thermal Characteristics

Characteristics	Symbol	Note	Min	Typ.	Max	Unit
Thermal resistance (channel-to-case)	$R_{th(ch-c)}$	(Note 1)	—	—	0.032	K/W
Thermal resistance (case-to-fin)	$R_{th(c-f)}$	(Note 2)	—	0.0026	—	K/W

Note 1: The value per half a module.

Note 2: The value per module.
Apply 50 μm of 3 W/m · K grease between the case and fin while taking care not to create a void, and tighten to the recommended torque before use.

7. Electrical Characteristics (T_c = 25 °C, unless otherwise specified)

Characteristics	Symbol	Note	Test Condition	Min	Typ.	Max	Unit	Fig. No
Gate-source leakage current	I_{GSS}		V_{GS} = + 25 V / - 10 V, V_{DS} = 0 V	—	—	±100	nA	—
Drain-source cut-off current	I_{DSS}		V_{DS} = 3300V, V_{GS} = 0 V	—	—	1	mA	—
Gate threshold voltage	V_{th}	(Note 1)	I_D = 0.8 A, V_{DS} = 10 V	—	4.8	—	V	—
Drain-source on-voltage (sense)	$V_{DS(on)}$ sense		I_D = 800 A, V_{GS} = + 20 V, T_{ch} = 25 °C	—	1.3	—	V	—
			I_D = 800 A, V_{GS} = + 20 V, T_{ch} = 175 °C	—	3.6	5.2	V	—
Drain-source on-voltage (terminal)	$V_{DS(on)}$ terminal		I_D = 800 A, V_{GS} = + 20 V, T_{ch} = 25 °C	—	1.4	—	V	—
Input capacitance	C_{iss}		V_{DS} = 1800 V, V_{GS} = 0 V, f = 100 kHz	—	173	—	nF	—
Internal gate resistance	r_{ig}		f = 1 MHz	—	2.75	—	Ω	—
Switching time (turn-on delay time)	$t_{d(on)}$	(Note 2)	Inductive load, V_{DD} = 1800 V, I_D = 800 A, V_{GS} = + 20 V / - 6 V, C_{gs} = 100 nF, $R_{G(on)}$ = 1.5 Ω, $R_{G(off)}$ = 3.6 Ω, T_{ch} = 175 °C, $L_S \approx$ 70 nH	—	0.57	—	µs	7.1 7.2 7.3
Switching time (rise time)	t_r			—	0.16	—	µs	
Switching time (turn-on time)	t_{on}			—	0.73	—	µs	
Switching time (turn-off delay time)	$t_{d(off)}$			—	1.80	—	µs	
Switching time (fall time)	t_f			—	0.15	—	µs	
Switching time (turn-off time)	t_{off}			—	1.95	—	µs	
Turn-on switching loss	E_{on}			—	230	—	mJ	
Turn-off switching loss	E_{off}			—	230	—	mJ	
Source-drain on-voltage (sense)	$V_{SD(on)}$ sense		I_S = 800 A, V_{GS} = + 20 V, T_{ch} = 25 °C	—	1.3	—	V	—
	$V_{SD(on)}$ sense		I_S = 800 A, V_{GS} = + 20 V, T_{ch} = 175 °C	—	3.5	5.1	V	—
Source-drain on-voltage (terminal)	$V_{SD(on)}$ terminal		I_S = 800 A, V_{GS} = + 20 V, T_{ch} = 25 °C	—	1.4	—	V	—
Source-drain off-voltage (sense)	$V_{SD(off)}$ sense		I_S = 800 A, V_{GS} = - 6 V, T_{ch} = 25 °C	—	2.1	—	V	—
	$V_{SD(off)}$ sense		I_S = 800 A, V_{GS} = - 6 V, T_{ch} = 175 °C	—	4.3	6.3	V	—
Source-drain off-voltage (terminal)	$V_{SD(off)}$ terminal		I_S = 800 A, V_{GS} = - 6 V, T_{ch} = 25 °C	—	2.2	—	V	—
Reverse recovery time	t_{rr}	(Note 2)	Inductive load, I_S = 800 A, V_{DD} = 1800 V, V_{GS} = - 6 V, C_{gs} = 100 nF, Drive side $R_{G(on)}$ = 1.5 Ω, T_{ch} = 175 °C, $L_S \approx$ 70 nH	—	0.08	—	µs	7.4 7.5 7.6
Reverse recovery loss	E_{rr}			—	12	—	mJ	
Stray inductance	L_{sPN}		P terminal-N terminal	—	12	—	nH	—
Current sensing inductance	L_{sCS}		1 terminal-8 terminal	—	2.7	—	nH	—
Rated NTC resistance	R		T_c = 25 °C	3.5	5.0	6.5	kΩ	—
	R		T_c = 150 °C	125	165	205	Ω	—
NTC B value	B		T_{NTC} = 25 to 150 °C	—	3375	—	K	—

Note 1: Gate—source voltage (-10V) is applied 5ms before measurement.

Note 2: L_s is the sum of the stray inductance between the P and N terminals (L_{sPN}) and the stray inductance of external circuitry (L_{ext}) .

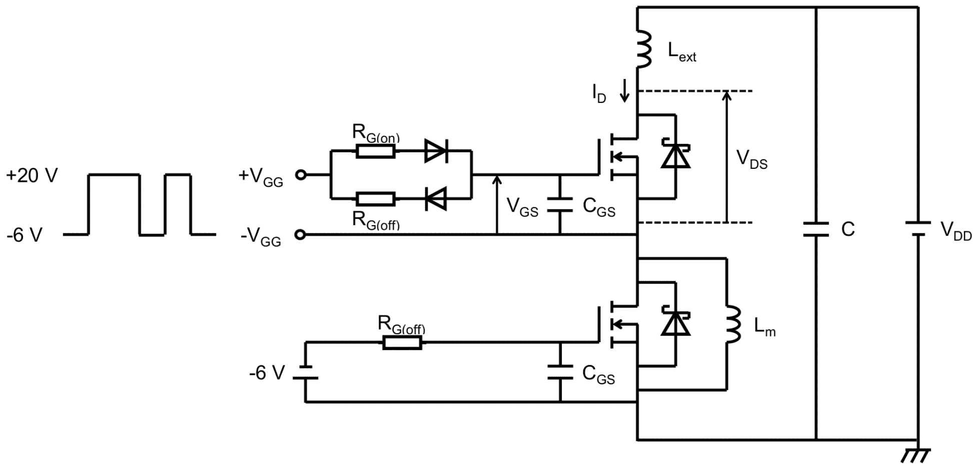


Fig. 7.1 Inductive Load Switching Test Circuit (High side Switching)

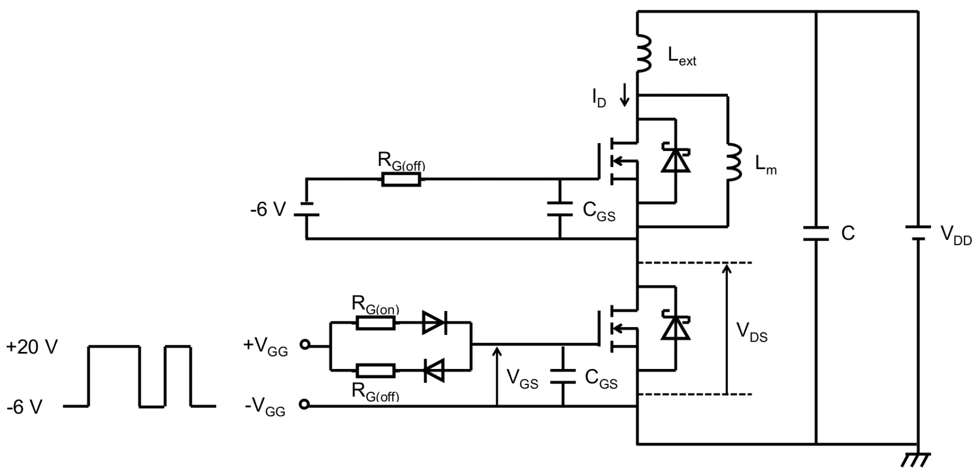


Fig. 7.2 Inductive Load Switching Test Circuit (Low side Switching)

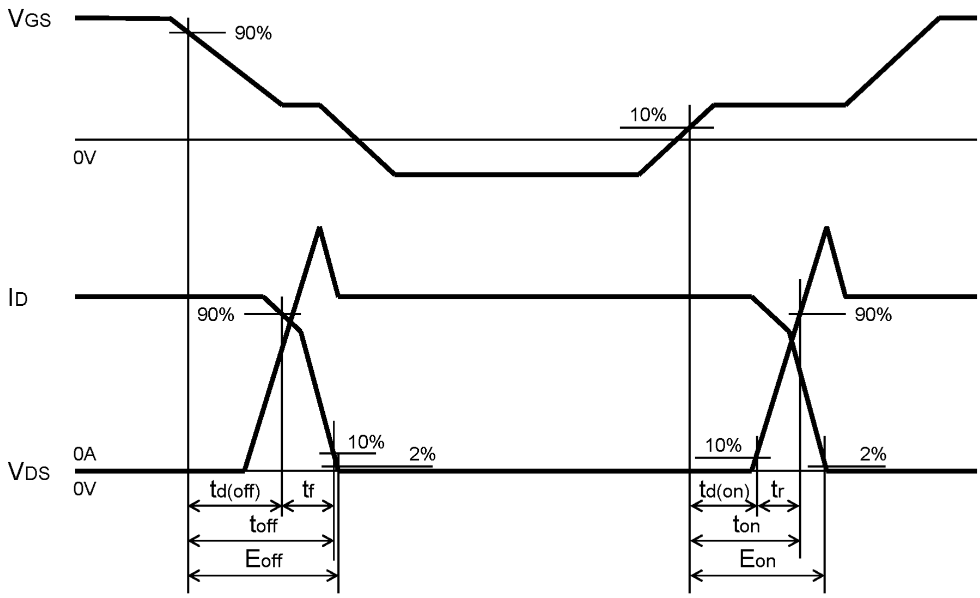


Fig. 7.3 Timing Chart (MOSFET part)

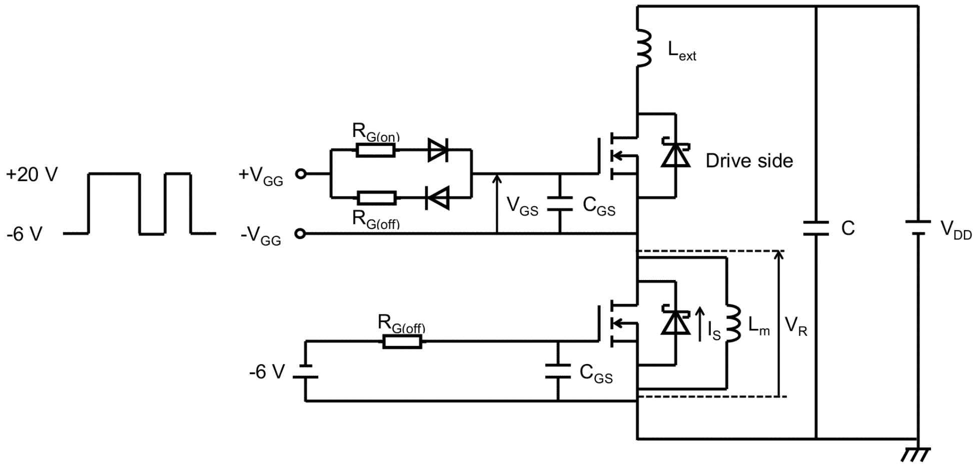


Fig. 7.4 Reverse Inductive Load Switching Test Circuit (High side Switching)

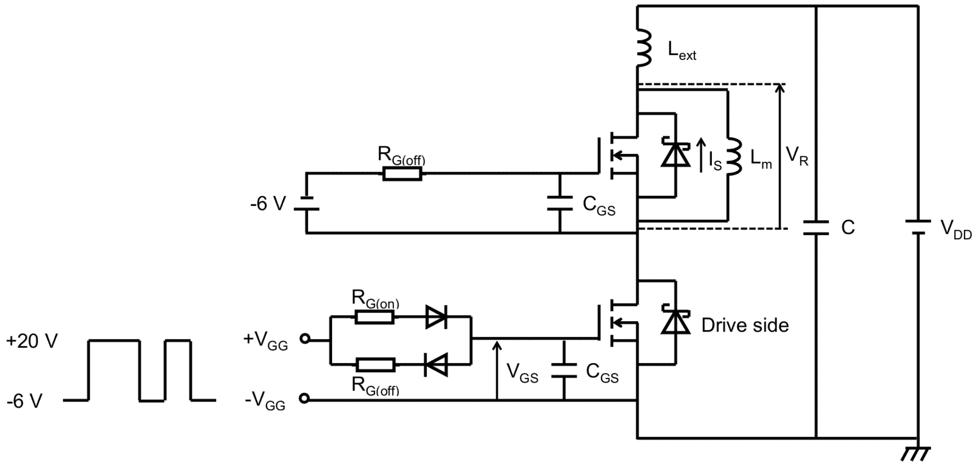


Fig. 7.5 Reverse Inductive Load Switching Test Circuit (Low side Switching)

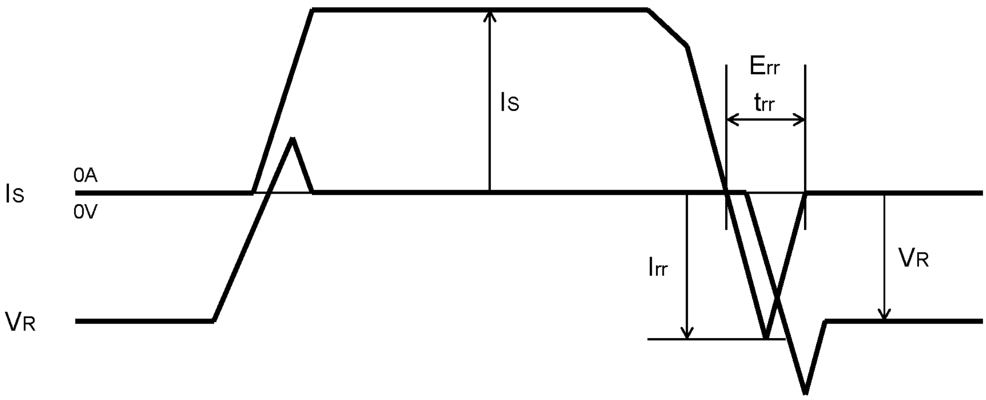


Fig. 7.6 Timing Chart (Diode part)

8. Characteristics Curves (Note)

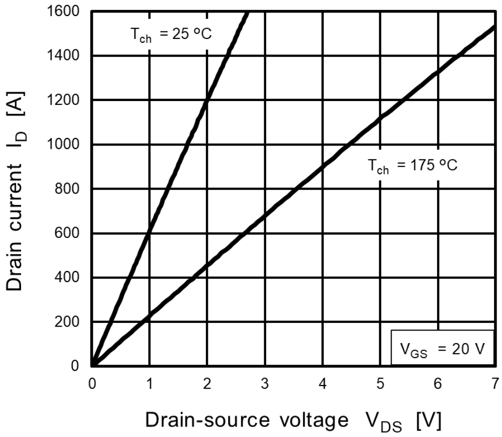


Fig. 8.1 I_D - V_{DS} (Note 1)

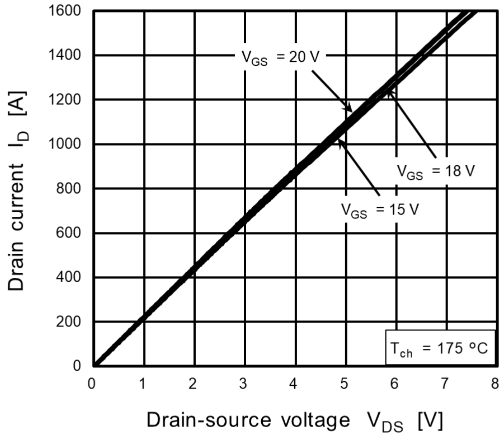


Fig. 8.2 I_D - V_{DS} (Note 1)

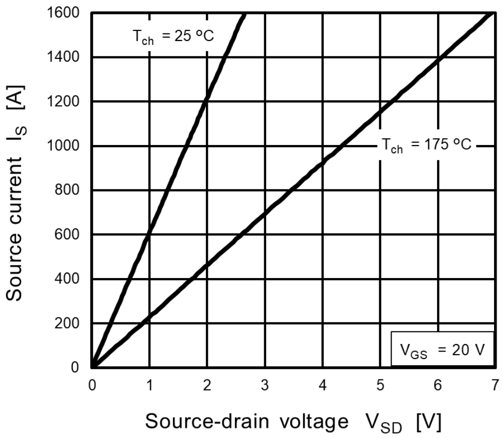


Fig. 8.3 I_S - V_{SD} (Note 1)

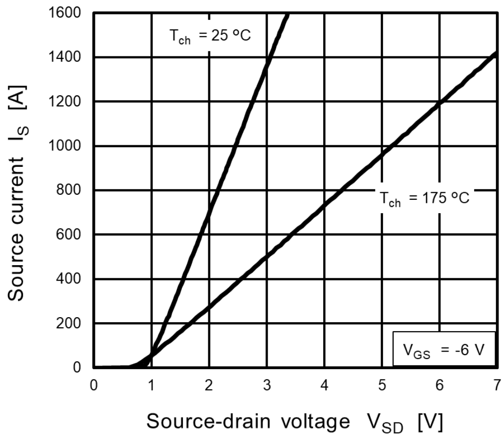


Fig. 8.4 I_S - V_{SD} (Note 1)

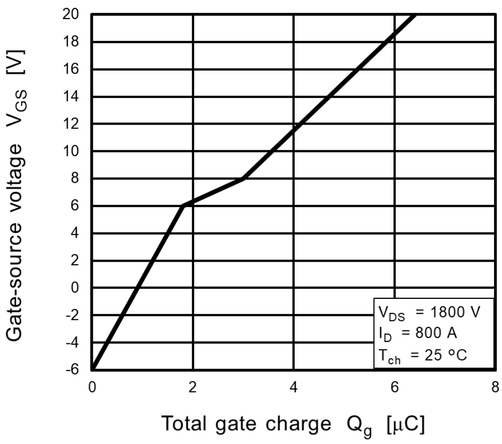


Fig. 8.5 V_{GS} -Q_g

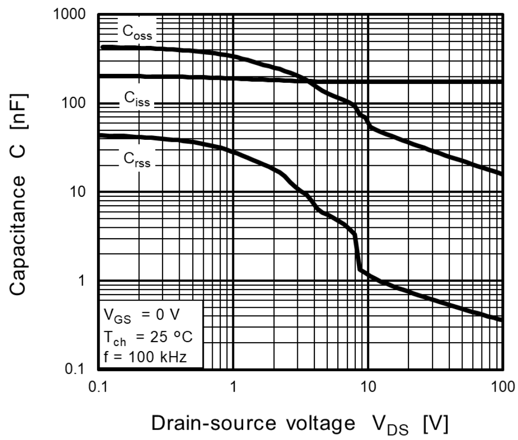


Fig. 8.6 C_{iss}, C_{oss}, C_{rss} - V_{DS}

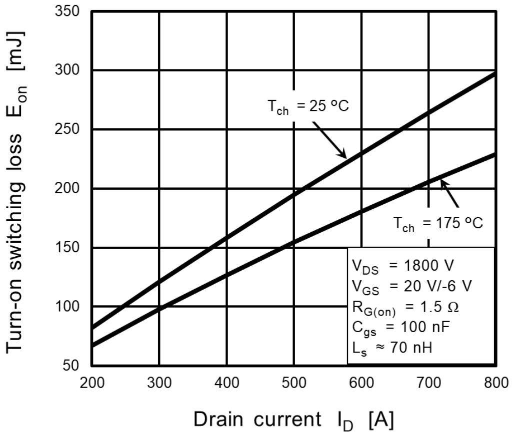


Fig. 8.7 E_{on} - I_D

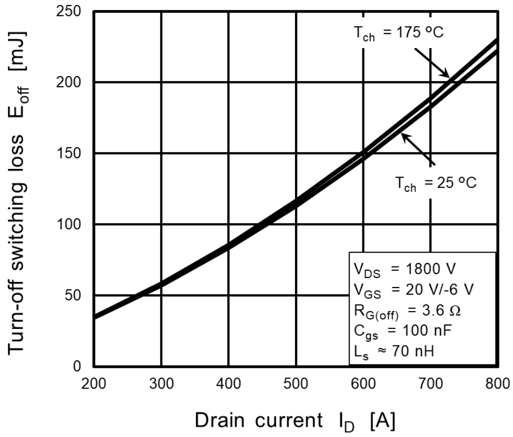


Fig. 8.8 E_{off} - I_D

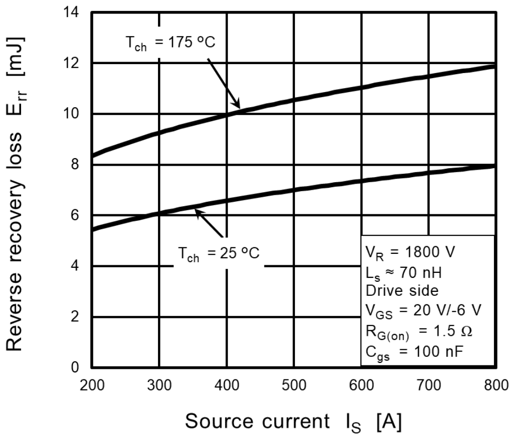


Fig. 8.9 E_{rr} - I_S

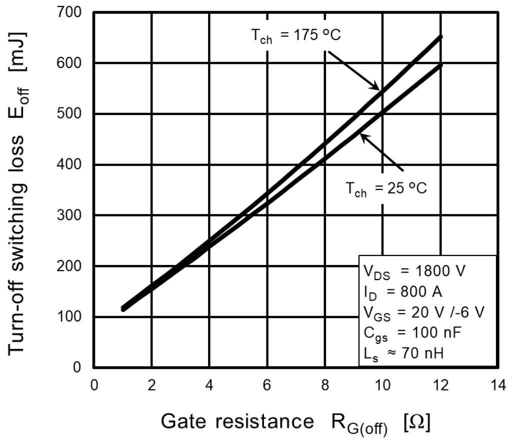


Fig. 8.10 E_{on} - $R_{G(on)}$

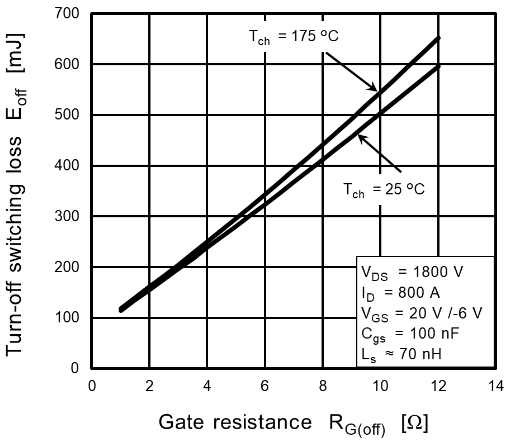


Fig. 8.11 E_{off} - $R_{G(off)}$

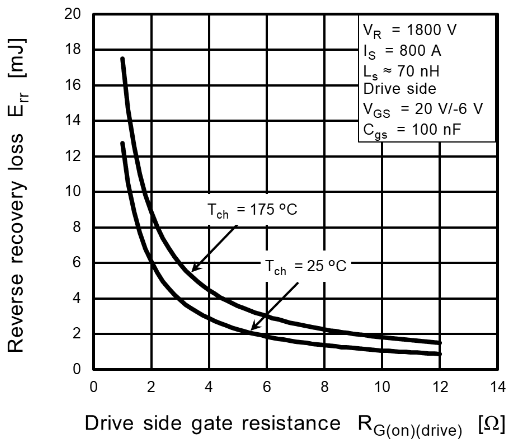


Fig. 8.12 E_{rr} - $R_{G(on)}$

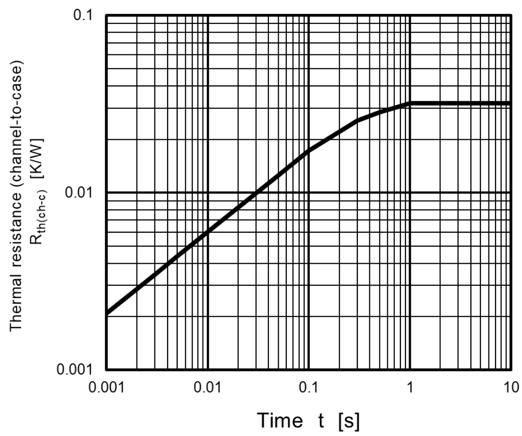


Fig. 8.13 $R_{th(ch-c)}$ - t (Guaranteed Maximum)

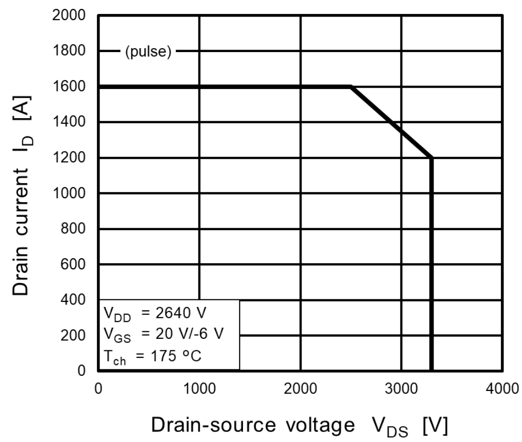


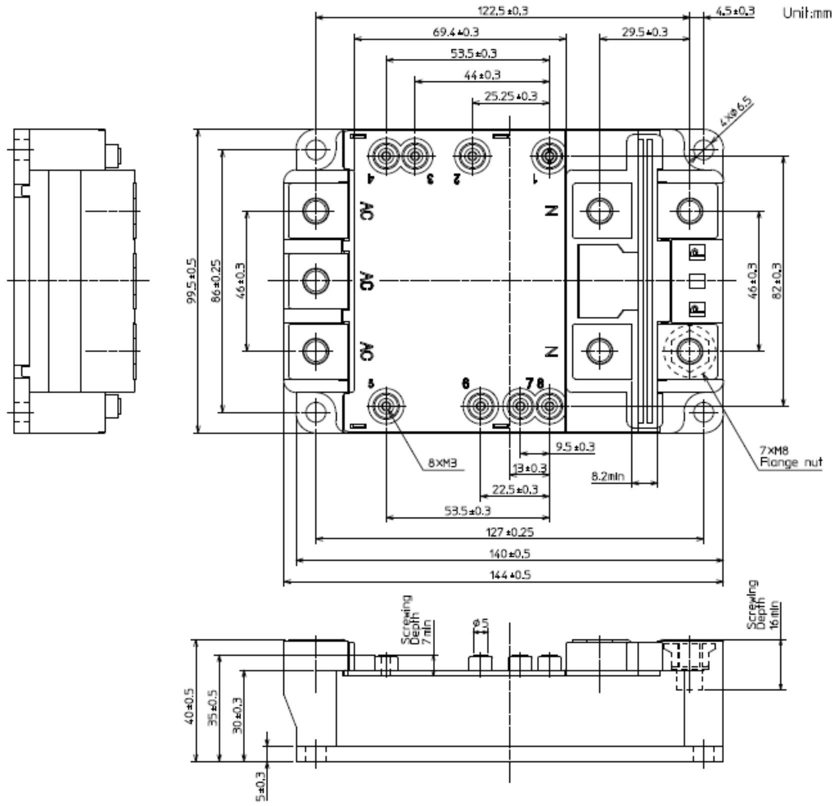
Fig. 8.14 Reverse bias safe operating area (RBSOA)(Guaranteed Maximum)

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

Note 1: Source - drain voltage and Drain - source voltage are measured at sense terminals.

Package Dimensions

Unit: mm



Weight: 840 g (typ.)

Package Name(s)
TOSHIBA: 2-144A1A
Nickname: iXPLV

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