

High-Power Module Silicon Carbide N-Channel MOSFET

MG800FXF2YMS3

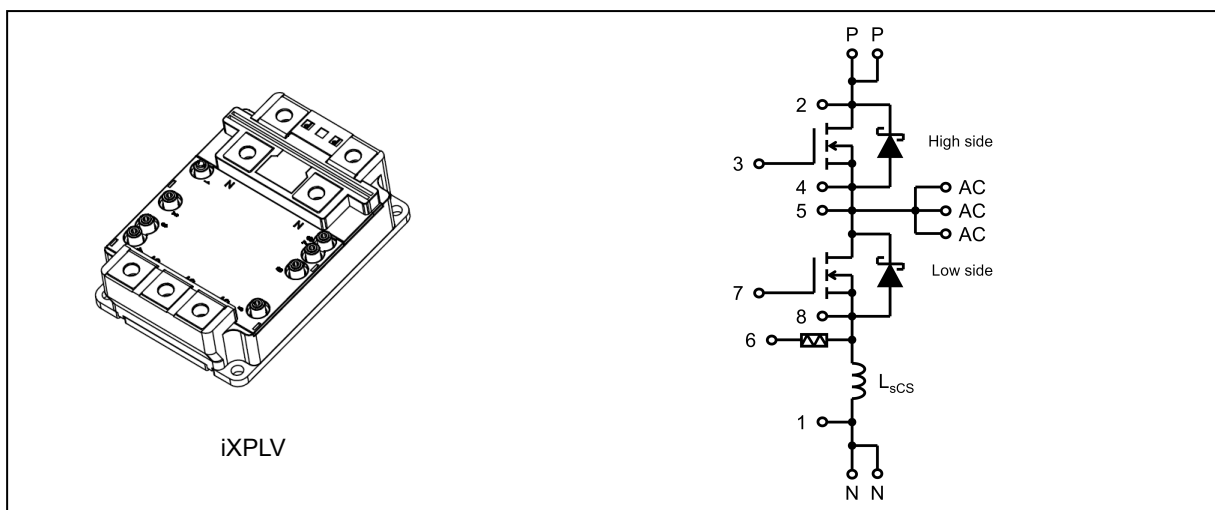
1. Applications

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

2. Features

- (1) $V_{DSS} = 3300\text{ V}$, $I_D = 800\text{ A}$ All SiC MOSFET Module (Low loss & High speed switching)
- (2) New generation standard package (Compact & easily handled by paralleling)
- (3) Low stray inductance, low thermal resistance, maximum $T_{ch} = 175\text{ }^{\circ}\text{C}$
- (4) Equipped with current sensing terminal & built in thermistor
- (5) Isolated base plate

3. Packaging and Internal Circuit (Note)



(Note) P and N terminal should use two screws fastened in each and AC terminal should use three screws fastened.

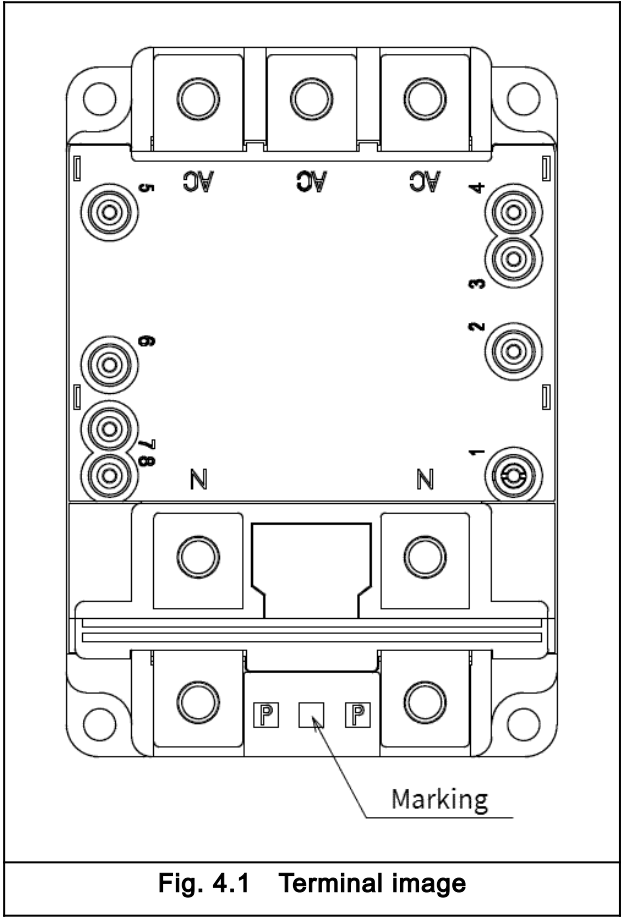
Start of commercial production

2021-10

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



5. Absolute Maximum Ratings (Note, Note 1) ($T_c = 25\text{ }^{\circ}\text{C}$, unless otherwise specified)

Characteristics	Symbol	Note	Test Condition	Rating	Unit
Drain-source voltage	V_{DS}			3300	V
Gate-source voltage	V_{GS}			+ 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	$^{\circ}\text{C}$
Storage temperature	T_{stg}			- 40 to 150	$^{\circ}\text{C}$
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 $^{\circ}\text{C}$.

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 (Note) ($T_c = 25\text{ }^{\circ}\text{C}$, unless otherwise specified)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit	Fig. No
Gate-source leakage current	I_{GSS}	$V_{GS} = +25\text{ V} / -10\text{ V}$, $V_{DS} = 0\text{ V}$	—	—	± 100	nA	—
Drain-source cut-off current	I_{DSS}	$V_{DS} = 3300\text{ V}$, $V_{GS} = 0\text{ V}$	—	—	1	mA	—
Gate threshold voltage	V_{th}	$I_D = 0.8\text{ A}$, $V_{DS} = 10\text{ V}$	—	4.8	—	V	—
Drain-source on-voltage (sense)	$V_{DS(on)sense}$	$I_D = 800\text{ A}$, $V_{GS} = +20\text{ V}$, $T_{ch} = 25\text{ }^{\circ}\text{C}$	—	1.3	—	V	—
		$I_D = 800\text{ A}$, $V_{GS} = +20\text{ V}$, $T_{ch} = 150\text{ }^{\circ}\text{C}$	—	2.9	4.2	V	—
Drain-source on-voltage (terminal)	$V_{DS(on)terminal}$	$I_D = 800\text{ A}$, $V_{GS} = +20\text{ V}$, $T_{ch} = 25\text{ }^{\circ}\text{C}$	—	1.4	—	V	—
Input capacitance	C_{iss}	$V_{DS} = 10\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 100\text{ kHz}$	—	170	—	nF	—
Switching time (turn-on delay time)	$t_{d(on)}$	Inductive load, $V_{DD} = 1800\text{ V}$, $I_D = 800\text{ A}$, $V_{GS} = +20\text{ V} / -6\text{ V}$, $C_{gs} = 100\text{ nF}$, $R_{G(on)} = 2.2\text{ }\Omega$, $R_{G(off)} = 3.9\text{ }\Omega$, $T_{ch} = 150\text{ }^{\circ}\text{C}$, $L_S \approx 70\text{ nH}$	—	0.35	—	μs	7.1
Switching time (rise time)	t_r		—	0.16	—	μs	7.2
Switching time (turn-on time)	t_{on}		—	0.51	—	μs	7.3
Switching time (turn-off delay time)	$t_{d(off)}$		—	1.53	—	μs	
Switching time (fall time)	t_f		—	0.12	—	μs	
Switching time (turn-off time)	t_{off}		—	1.65	—	μs	
Turn-on switching loss	E_{on}		—	250	—	mJ	
Turn-off switching loss	E_{off}		—	240	—	mJ	
Source-drain on-voltage (sense)	$V_{SD(on)sense}$	$I_S = 800\text{ A}$, $V_{GS} = +20\text{ V}$, $T_{ch} = 25\text{ }^{\circ}\text{C}$	—	1.3	—	V	—
		$I_S = 800\text{ A}$, $V_{GS} = +20\text{ V}$, $T_{ch} = 150\text{ }^{\circ}\text{C}$	—	2.8	4.2	V	—
Source-drain on-voltage (terminal)	$V_{SD(on)terminal}$	$I_S = 800\text{ A}$, $V_{GS} = +20\text{ V}$, $T_{ch} = 25\text{ }^{\circ}\text{C}$	—	1.4	—	V	—
Source-drain off-voltage (sense)	$V_{SD(off)sense}$	$I_S = 800\text{ A}$, $V_{GS} = -6\text{ V}$, $T_{ch} = 25\text{ }^{\circ}\text{C}$	—	2.1	—	V	—
		$I_S = 800\text{ A}$, $V_{GS} = -6\text{ V}$, $T_{ch} = 150\text{ }^{\circ}\text{C}$	—	3.7	5.4	V	—
Source-drain off-voltage (terminal)	$V_{SD(off)terminal}$	$I_S = 800\text{ A}$, $V_{GS} = -6\text{ V}$, $T_{ch} = 25\text{ }^{\circ}\text{C}$	—	2.2	—	V	—
Reverse recovery time	t_{rr}	Inductive load, $I_S = 800\text{ A}$, $V_R = 1800\text{ V}$, $V_{GS} = -6\text{ V}$, $C_{gs} = 100\text{ nF}$, Drive side $R_{G(on)} = 2.2\text{ }\Omega$, $T_{ch} = 150\text{ }^{\circ}\text{C}$, $L_S \approx 70\text{ nH}$	—	86	—	ns	7.4
Reverse recovery loss	E_{rr}		—	10	—	mJ	7.5 7.6
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	$T_c = 25\text{ }^{\circ}\text{C}$	3.5	5.0	6.5	k Ω	—
		$T_c = 150\text{ }^{\circ}\text{C}$	125	165	205	Ω	—
NTC B value	B	$T_{NTC} = 25\text{ to }150\text{ }^{\circ}\text{C}$	—	3375	—	K	—

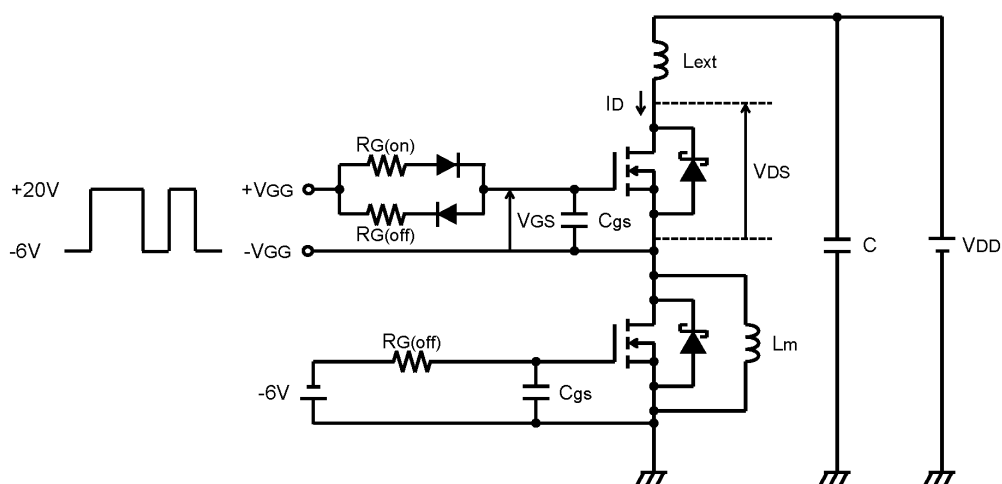


Fig. 7.1 Inductive Load Switching Test Circuit(High side Switching)

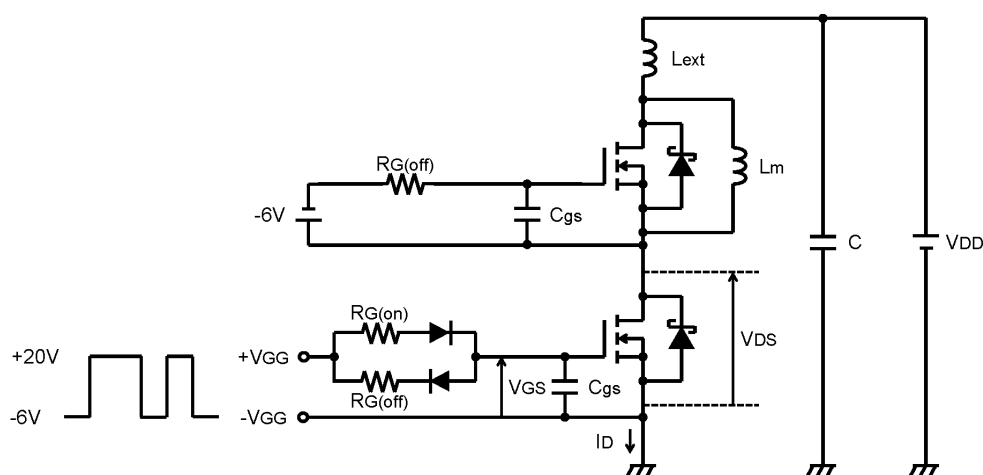


Fig. 7.2 Inductive Load Switching Test Circuit(Low side Switching)

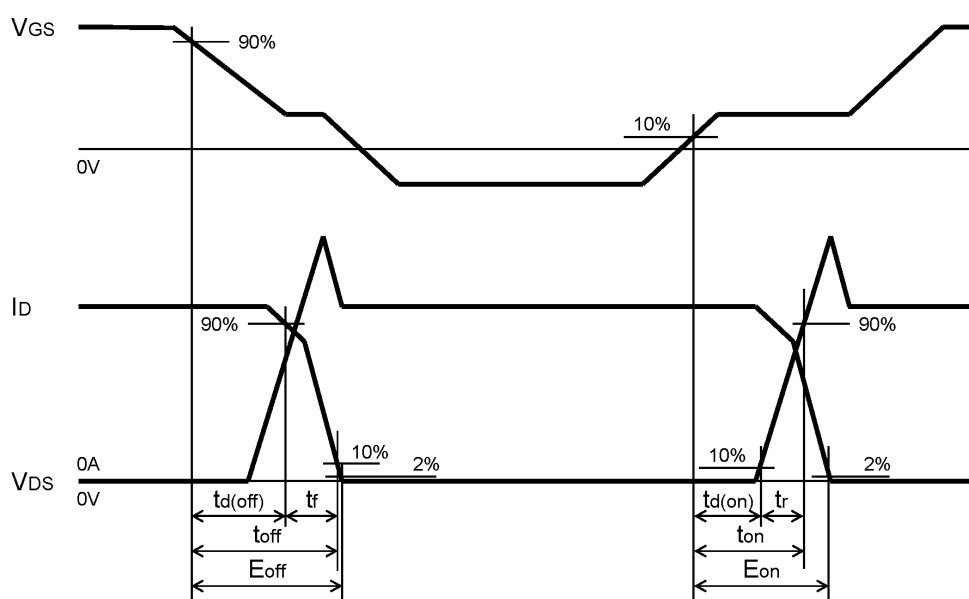


Fig. 7.3 Timing Chart (MOSFET part)

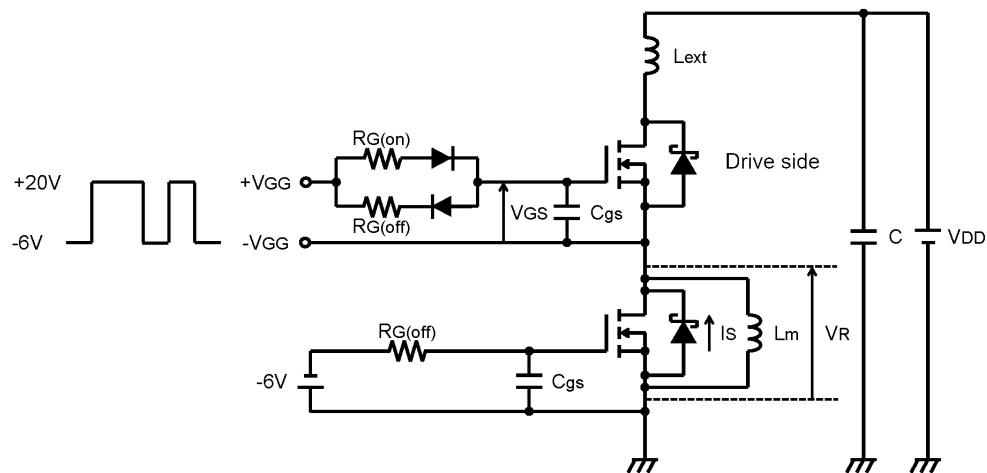


Fig. 7.4 Reverse Inductive Load Switching Test Circuit(High side Switching)

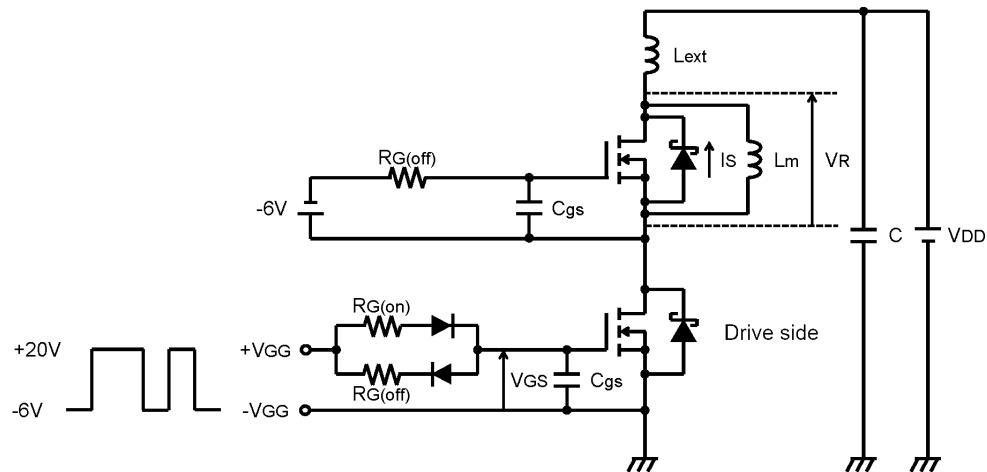


Fig. 7.5 Reverse Inductive Load Switching Test Circuit(Low side Switching)

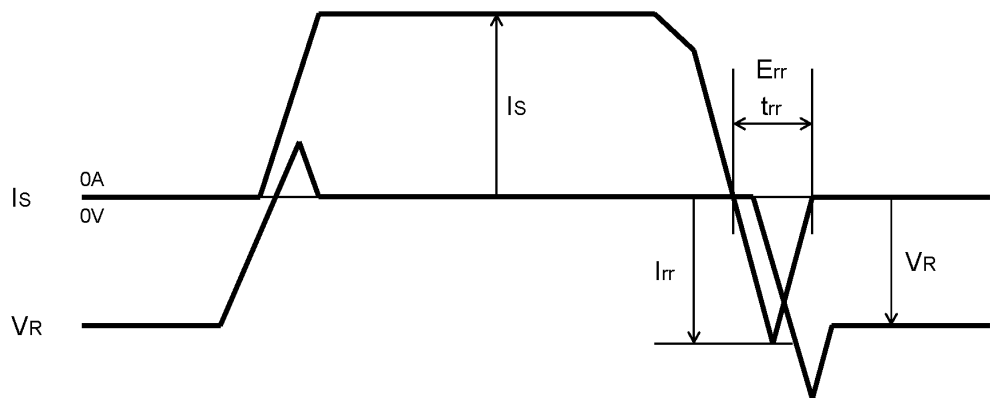


Fig. 7.6 Timing Chart (Diode part)

8. Characteristics Curves (Note)

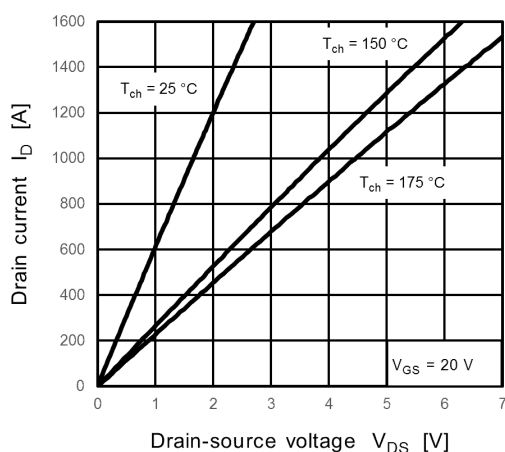


Fig. 8.1 $I_D - V_{DS}$ (Note 1)

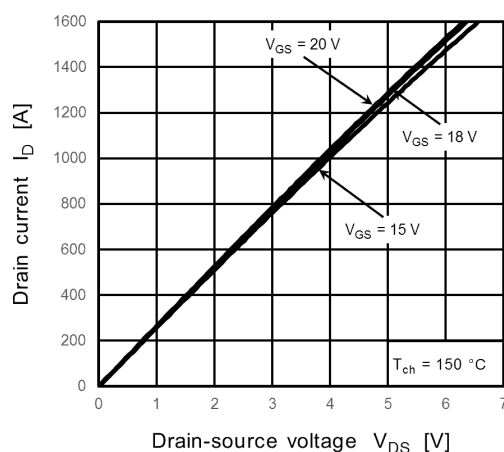


Fig. 8.2 $I_D - V_{DS}$ (Note 1)

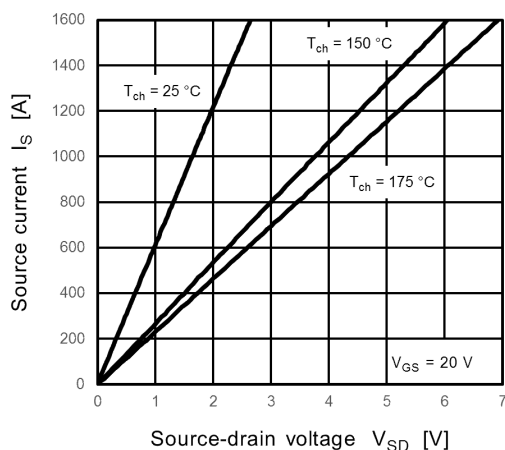


Fig. 8.3 $I_S - V_{SD}$ (Note 1)

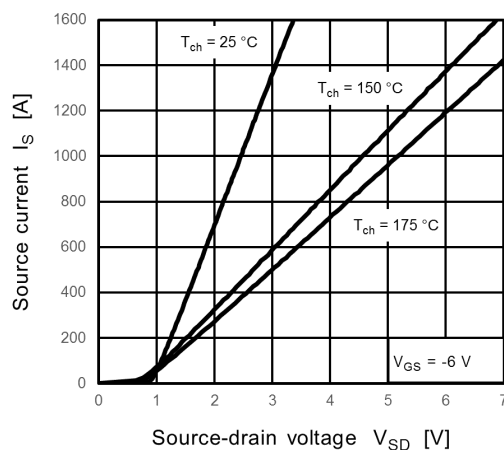


Fig. 8.4 $I_S - V_{SD}$ (Note 1)

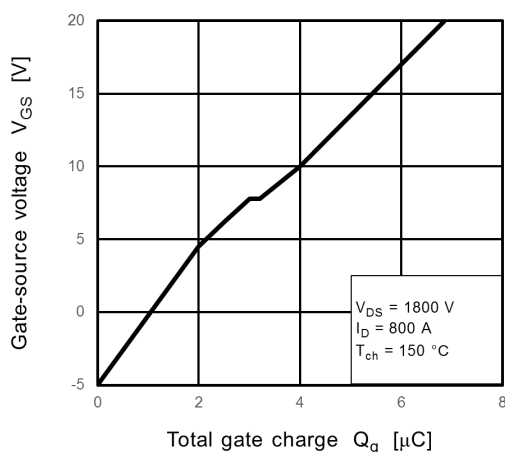


Fig. 8.5 $V_{GS} - Q_g$

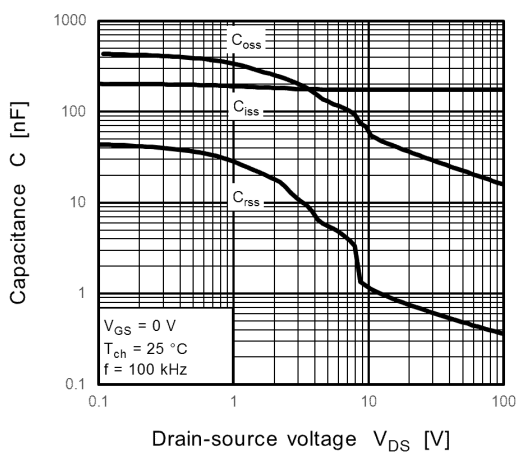


Fig. 8.6 $C_{iss}, C_{oss}, C_{rss} - V_{DS}$

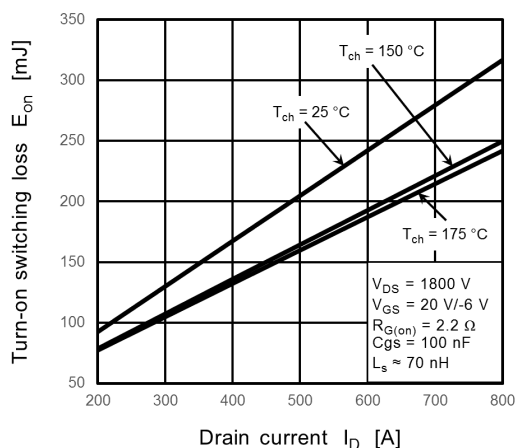


Fig. 8.7 $E_{on} - I_D$

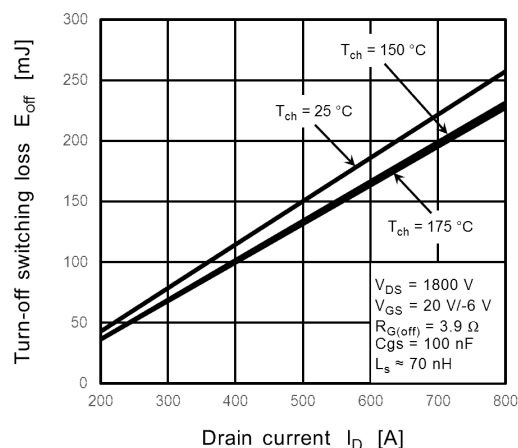


Fig. 8.8 $E_{off} - I_D$

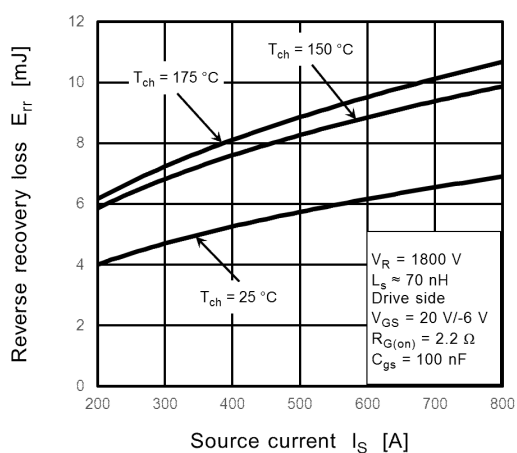


Fig. 8.9 $E_{rr} - I_S$

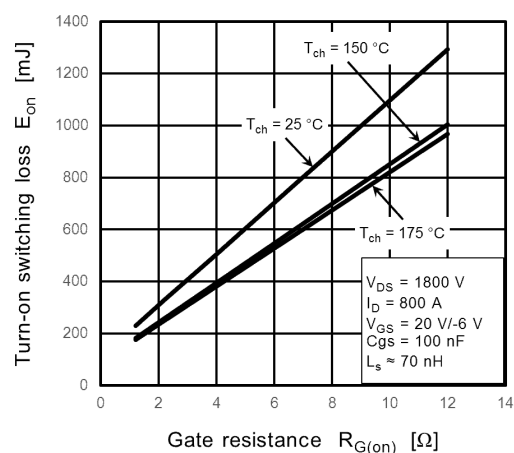


Fig. 8.10 $E_{on} - R_{G(on)}$

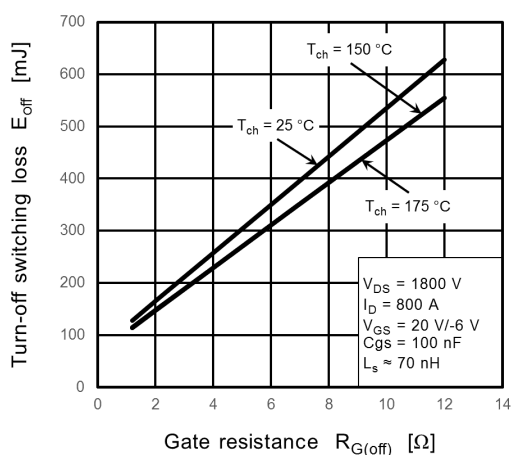


Fig. 8.11 $E_{off} - R_{G(off)}$

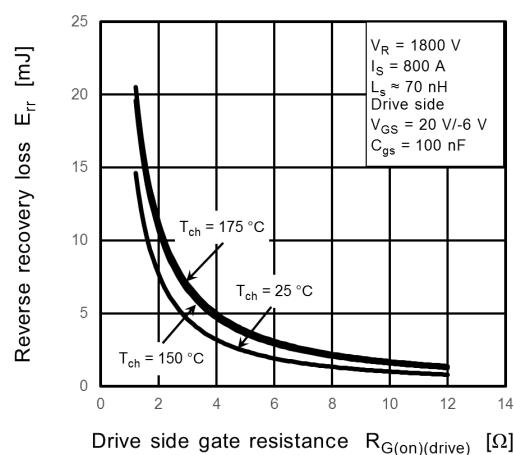


Fig. 8.12 $E_{rr} - R_{G(on)}$

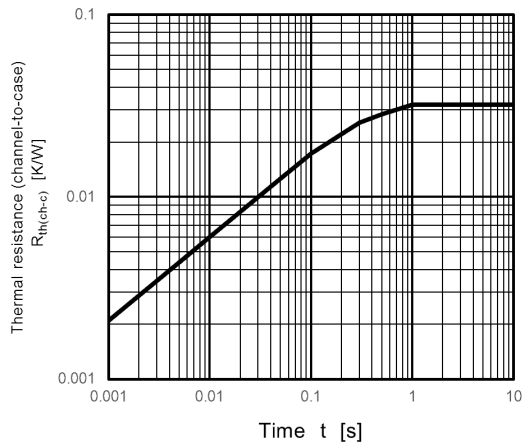


Fig. 8.13 R_{th(ch-c)} - t (Guaranteed Maximum)

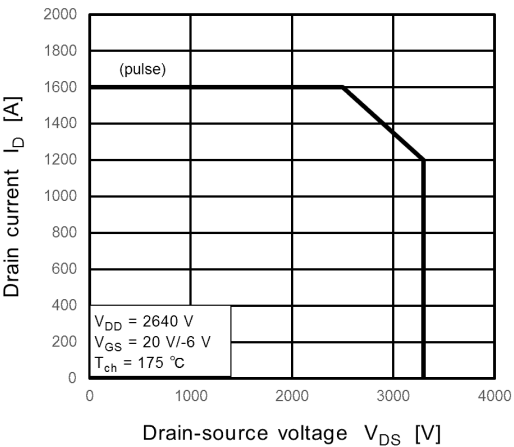


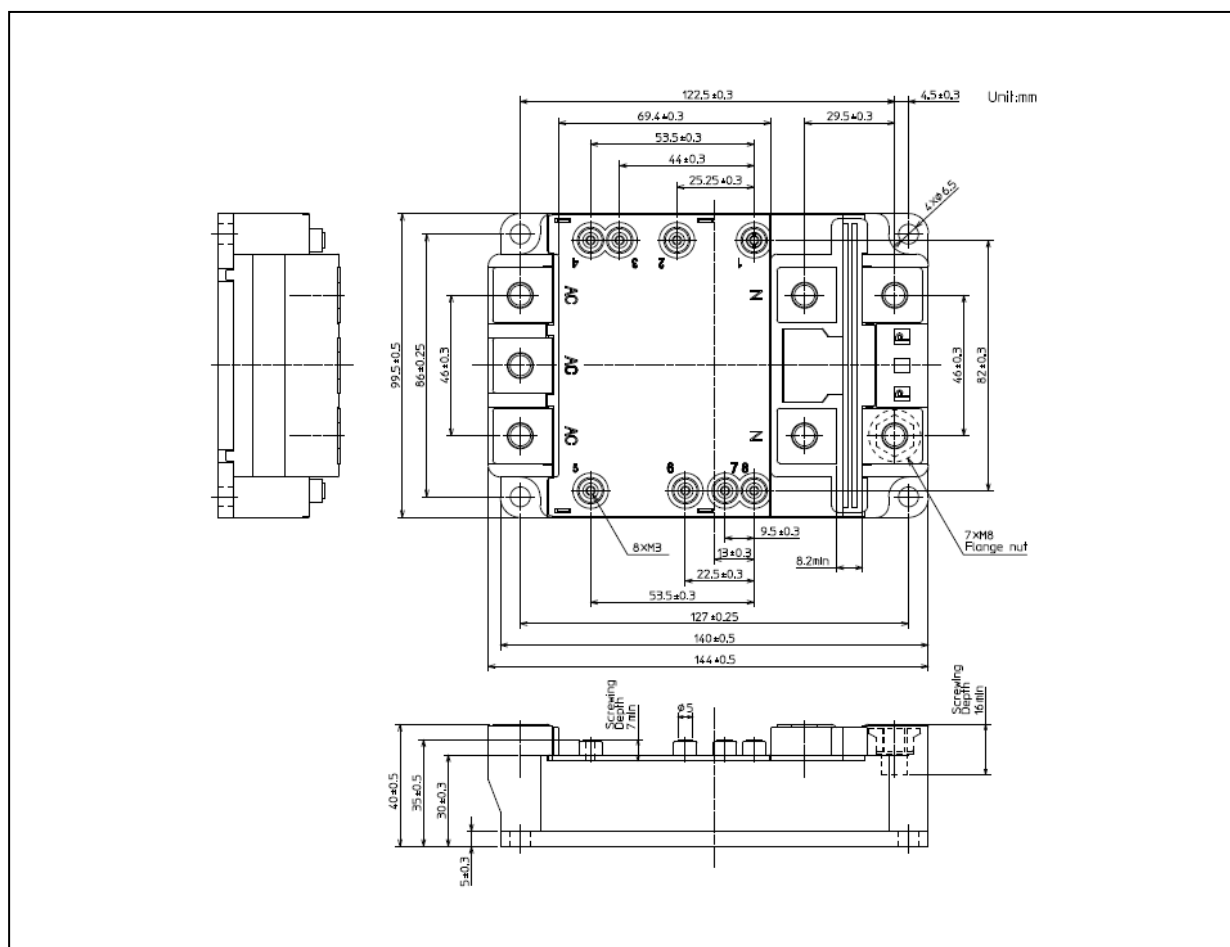
Fig. 8.14 Reverse bias safe operating area (RBSOA)(Guaranteed Maximum)

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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