High-Power Module　Silicon Carbide N-Channel MOSFET

MG800FXF2YMS3

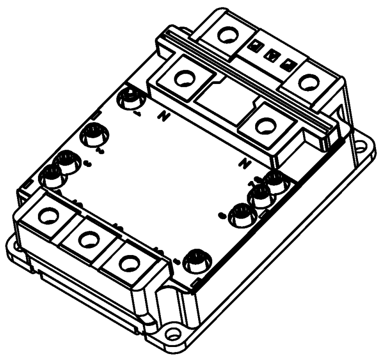
1. Applications

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

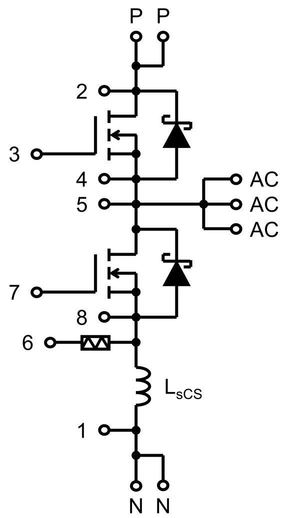
2. Features

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

3. Packaging and Internal Circuit (Note)



iXPLV



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

Start of commercial production
2021-09

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

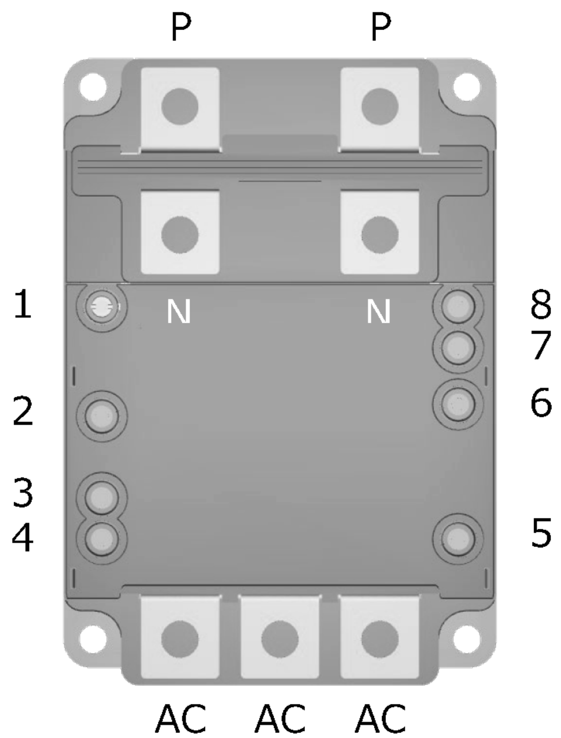


Fig. 4.1 Terminal image

5. Absolute Maximum Ratings (Note) (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 1)	V_{GS} = + 20 V	800	A
Drain current (pulsed)	I_{DP}	(Note 1)	V_{GS} = + 20 V , t = 0.5 ms , T_{ch} = 175 °C	1600	A
Power dissipation	P_D	(Note 1)		4680	W
Source current (DC)	I_S	(Note 1)	V_{GS} = + 20 V / - 6 V	800	A
Source current (pulsed)	I_{SP}	(Note 1)	V_{GS} = + 20 V , t = 0.5 ms , T_{ch} = 175 °C	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 2)	Main terminal: M8 / Signal terminal: M3	9.1 / 1.0	N · m
	TOR	(Note 3)	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: Ensure that the channel temperature does not exceed 175 °C.

Note 2: The recommended tightening torque for the main terminal (M8) is 7.0 N · m. The recommended tightening torque for the signal terminal (M3) is 0.8 N · m.

Note 3: 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 °C, unless otherwise specified)

Characteristics	Symbol	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}	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} = 150 °C	—	2.9	4.2	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} = 10 V, V_{GS} = 0 V, f = 100 kHz	—	170	—	nF	—
Switching time (turn-on delay time)	$t_{d(on)}$	Inductive load, V_{DD} = 1800 V, I_D = 800 A, V_{GS} = + 20 V / - 6 V, C_{gs} = 100 nF, $R_{G(on)}$ = 2.2 Ω, $R_{G(off)}$ = 3.9 Ω, T_{ch} = 150 °C, L_S ≈ 70 nH	—	0.35	—	μs	7.1 7.2 7.3
Switching time (rise time)	t_r		—	0.16	—	μs	
Switching time (turn-on time)	t_{on}		—	0.51	—	μs	
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 A, V_{GS} = + 20 V, T_{ch} = 25 °C	—	1.3	—	V	—
		I_S = 800 A, V_{GS} = + 20 V, T_{ch} = 150 °C	—	2.8	4.2	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	—
		I_S = 800 A, V_{GS} = - 6 V, T_{ch} = 150 °C	—	3.7	5.4	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}	Inductive load, I_S = 800 A, V_R = 1800 V, V_{GS} = - 6 V, C_{gs} = 100 nF, Q1 $R_{G(on)}$ = 2.2 Ω, T_{ch} = 150 °C, L_S ≈ 70 nH	—	86	—	ns	7.4 7.5 7.6
Reverse recovery loss	E_{rr}		—	10	—	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_{25}		—	5	—	kΩ	—
NTC B value	B	T_{NTC} = 25 to 150 °C	—	3375	—	K	—

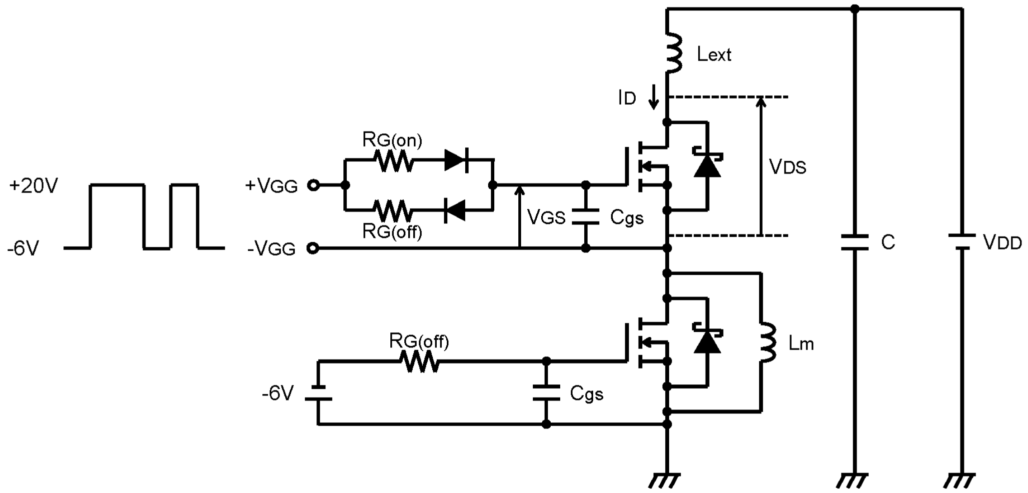


Fig. 7.1 Inductive Load Switching Test Circuit(High-Side Switching)

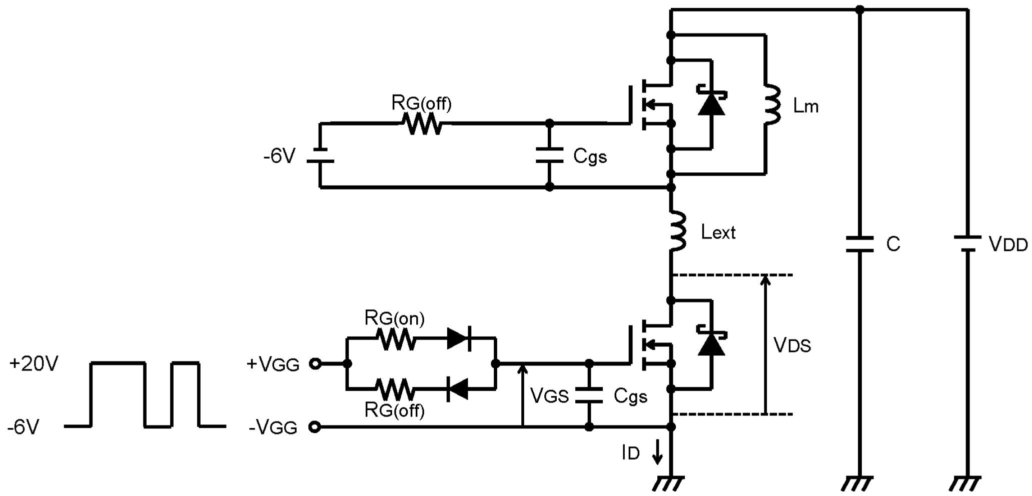


Fig. 7.2 Inductive Load Switching Test Circuit(Low-Side Switching)

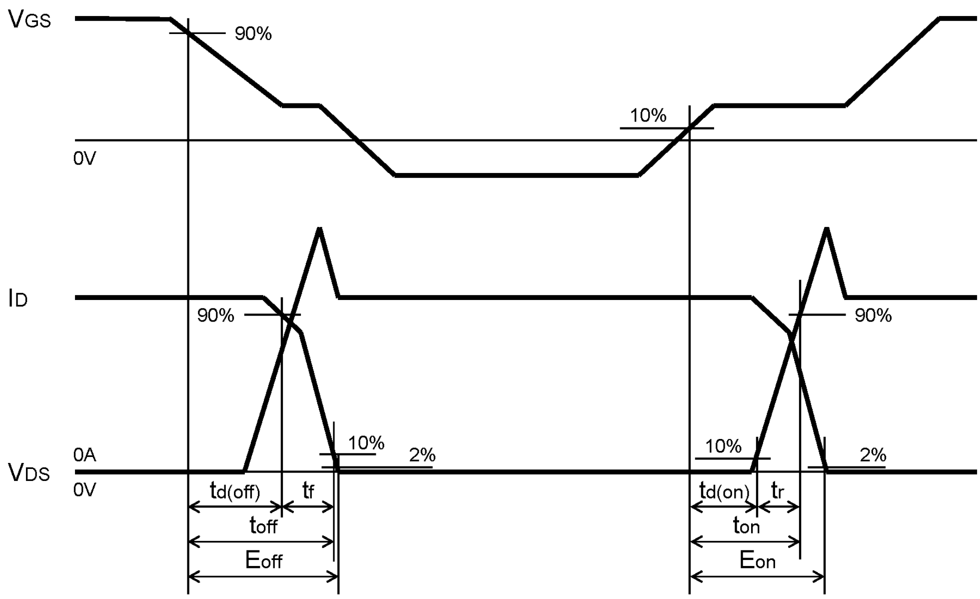


Fig. 7.3 Timing Chart (MOSFET part)

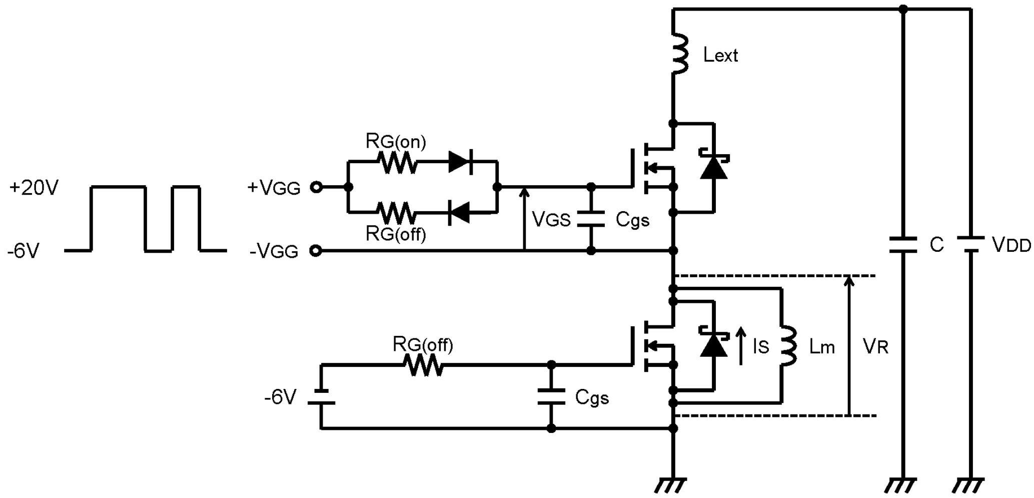


Fig. 7.4 Reverse Inductive Load Switching Test Circuit(High-Side Switching)

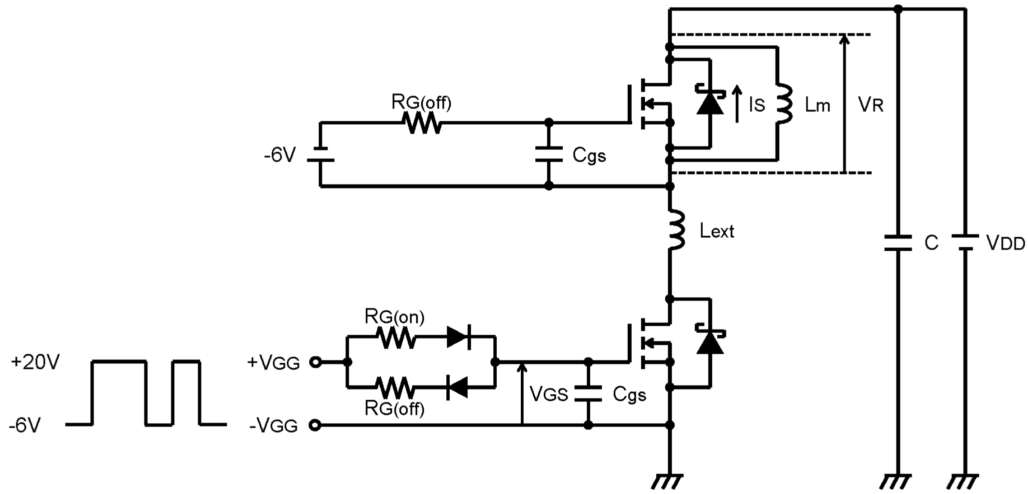


Fig. 7.5 Reverse Inductive Load Switching Test Circuit(Low-Side Switching)

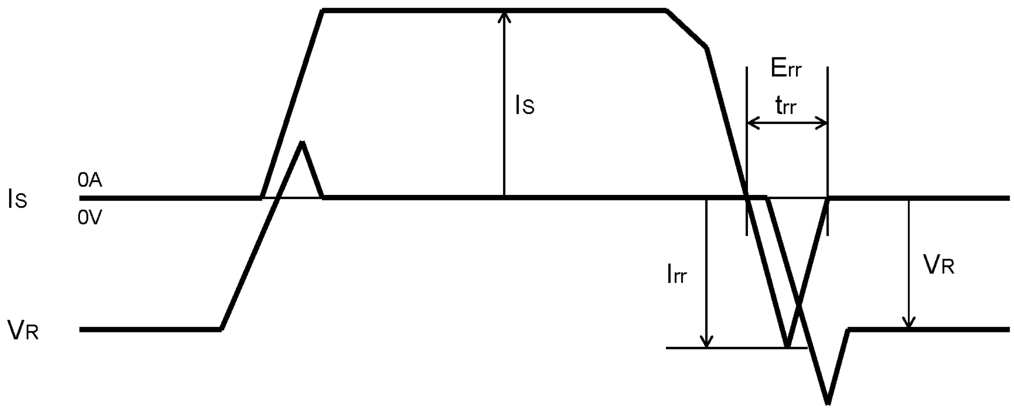


Fig. 7.6 Timing Chart (Diode part)

8. Characteristics Curves (Note)

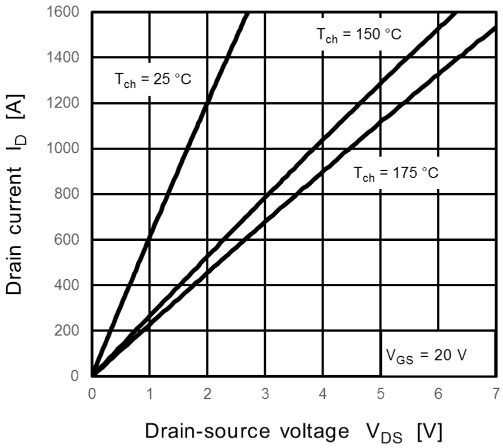


Fig. 8.1 I_D - V_{DS}

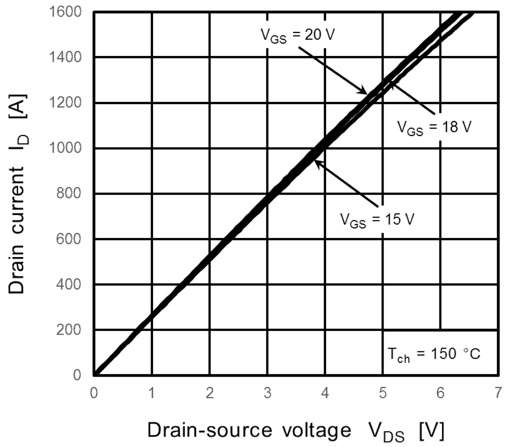


Fig. 8.2 I_D - V_{DS}

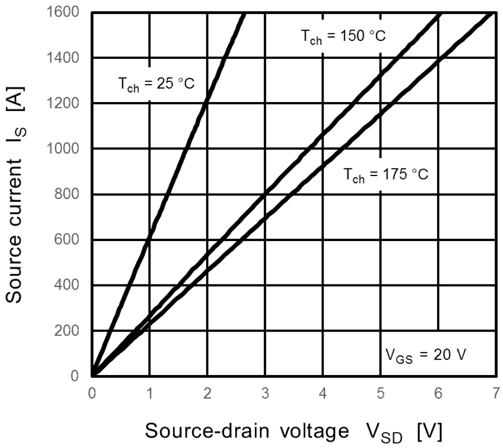


Fig. 8.3 I_S - V_{SD}

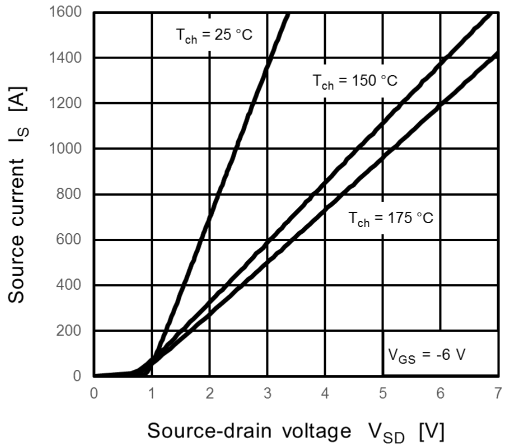


Fig. 8.4 I_S - V_{SD}

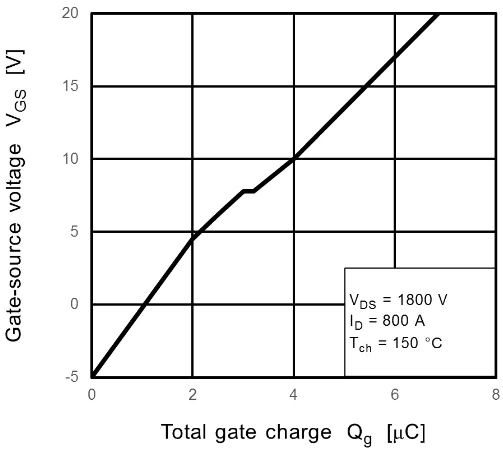


Fig. 8.5 V_{GS} -Q_g

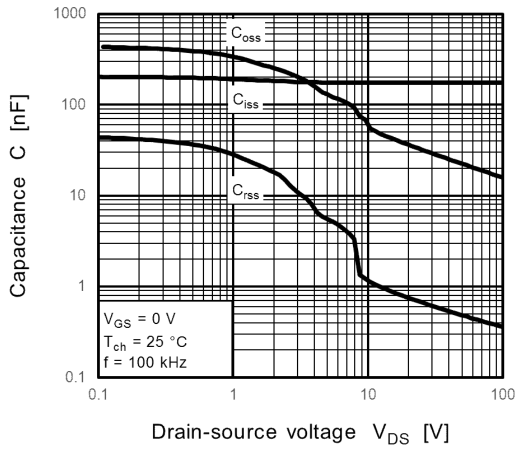


Fig. 8.6 C_{iss}, C_{oss}, C_{rss} - V_{DS}

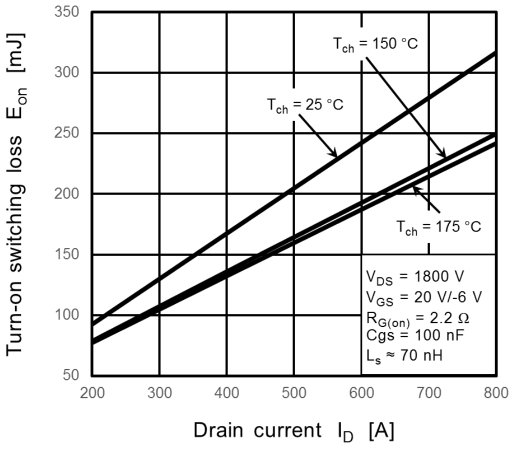


Fig. 8.7 E_{on} - I_D

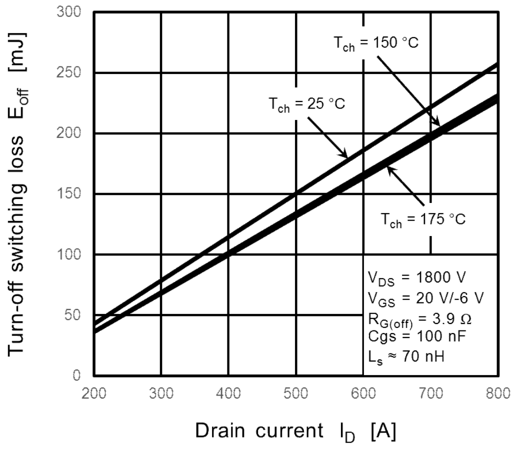


Fig. 8.8 E_{off} - I_D

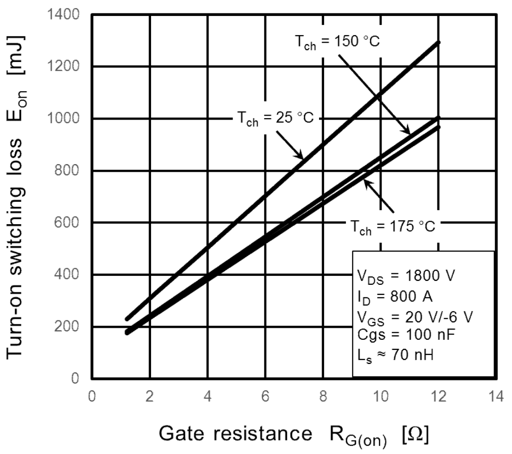


Fig. 8.9 E_{on} - $R_{G(on)}$

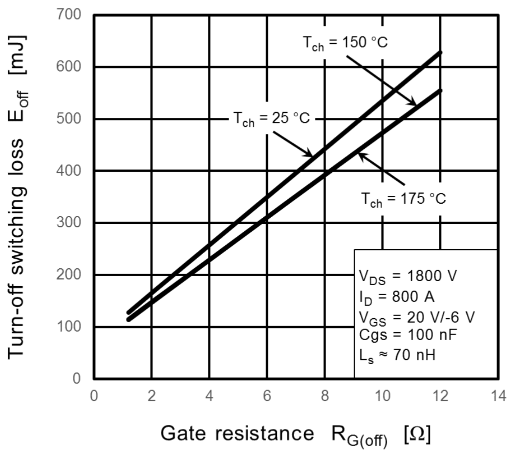


Fig. 8.10 E_{off} - $R_{G(off)}$

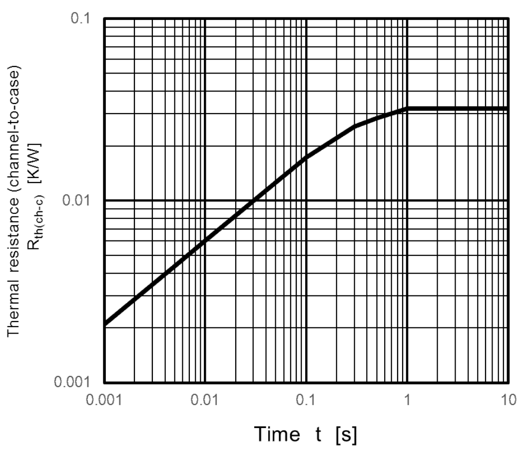


Fig. 8.11 $R_{th(ch-c)}$ - t

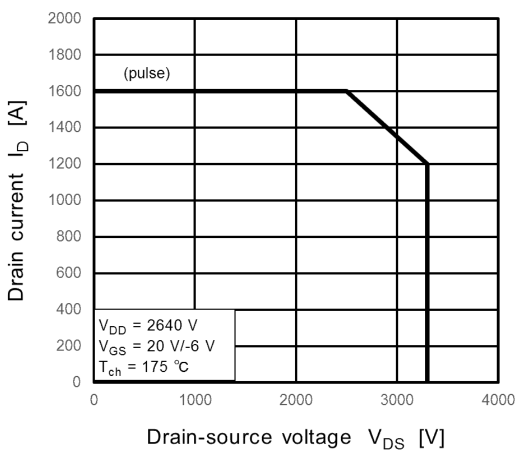
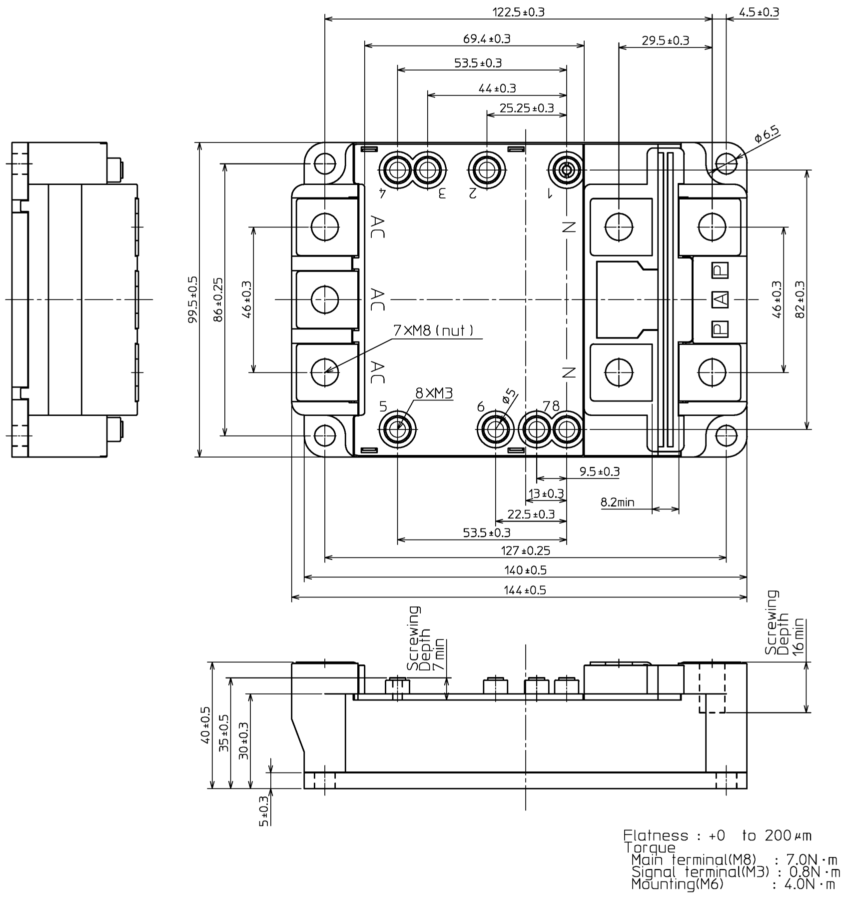


Fig. 8.12 Reverse bias safe operating area (RBSOA)

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

Package Dimensions

Unit: mm



Weight: 750 g (typ.)

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

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