

# MBN1000FH45F

Silicon N-channel IGBT 4500V F version

## FEATURES

- \* Soft switching behavior, low switching loss & low conduction loss :
  - Soft low-injection punch-through
  - Advanced Trench High conductivity IGBT.
- \* Low driving power due to low input capacitance with trench MOS gate.
- \* Low noise recovery: Ultra soft fast recovery diode.
- \* High Current rate Package.
- \* Low  $R_{th(j-c)}$  & low stray inductance.
- \* RoHS

## ABSOLUTE MAXIMUM RATINGS ( $T_C=25^\circ\text{C}$ )

Item	Symbol	Unit	MBN1000FH45F
Collector Emitter Voltage	$V_{CES}$	V	4,500
Gate Emitter Voltage	$V_{GES}$	V	$\pm 20$
Collector Current	DC	$I_C$	1,000
	1ms	$I_{CRM}$	2,000
Forward Current	DC	$I_F$	1,000
	1ms	$I_{FRM}$	2,000
Junction Temperature	$T_{vj,op}$	$^\circ\text{C}$	-50 ~ +150
Storage Temperature	$T_{stg}$	$^\circ\text{C}$	-50 ~ +150
Isolation Voltage	$V_{ISO}$	$V_{RMS}$	10,200(AC 1 minute)
Screw Torque	Terminals (M4/M8)	-	2/10 (1)
	Mounting (M6)	-	6 (2)

Notes: (1) Recommended Value  $1.8\pm 0.2/9\pm 1\text{N}\cdot\text{m}$  (2) Recommended Value  $5.5\pm 0.5\text{N}\cdot\text{m}$

## ELECTRICAL CHARACTERISTICS

Item	Symbol	Unit	Min.	Typ.	Max.	Test Conditions
Collector Emitter Cut-Off Current	$I_{CES}$	mA	-	-	4	$V_{CE}=4,500\text{V}, V_{GE}=0\text{V}, T_{vj}=25^\circ\text{C}$
Gate Emitter Leakage Current	$I_{GES}$	nA	-500	-	+500	$V_{CE}=4,500\text{V}, V_{GE}=0\text{V}, T_{vj}=150^\circ\text{C}$
Collector Emitter Saturation Voltage	$V_{CEsat}$	V	-	3.0	3.4	$I_C=1,000\text{A}, V_{GE}=15\text{V}, T_{vj}=150^\circ\text{C}$
Gate Emitter Threshold Voltage	$V_{GE(th)}$	V	6.0	6.5	7.0	$V_{CE}=10\text{V}, I_C=1,000\text{mA}, T_{vj}=25^\circ\text{C}$
Input Capacitance	$C_{ies}$	nF	-	55	-	$V_{CE}=10\text{V}, V_{GE}=0\text{V}, f=100\text{kHz}, T_{vj}=25^\circ\text{C}$
Internal Gate Resistance	$R_{G(int)}$	$\Omega$	-	3.9	-	$V_{CE}=10\text{V}, V_{GE}=0\text{V}, f=100\text{kHz}, T_{vj}=25^\circ\text{C}$
Turn On Delay Time	$t_{d(on)}$	$\mu\text{s}$	-	0.5	-	$V_{CC}=2,800\text{V}, I_C=1,000\text{A}$
Rise Time	$t_r$		-	0.25	-	$L_S=180\text{nH}$
Turn Off Delay Time	$t_{d(off)}$		-	2.8	-	$R_G(\text{on/off})=4.7/4.7\Omega$ (3)
Fall Time	$t_f$		-	2.1	-	$V_{GE}=\pm 15\text{V}, T_{vj}=150^\circ\text{C}$
Forward Voltage Drop	$V_F$	V	-	2.8	3.2	$I_F=1,000\text{A}, V_{GE}=0\text{V}, T_{vj}=150^\circ\text{C}$
Reverse Recovery Time	$t_{rr}$	$\mu\text{s}$	-	1.3	-	$V_{CC}=2,800\text{V}, I_F=1,000\text{A}, L_S=180\text{nH}$ $T_{vj}=150^\circ\text{C}$
Turn On Loss	$E_{on}$	J/P	-	3.6	-	$V_{CC}=2,800\text{V}, I_C=1,000\text{A}, L_S=180\text{nH}$
Turn Off Loss	$E_{off}$	J/P	-	5.3	-	$R_G(\text{on/off})=4.7/4.7\Omega$ (3)
Reverse Recovery Loss	$E_{rr}$	J/P	-	3.6	-	$V_{GE}=\pm 15\text{V}, T_{vj}=150^\circ\text{C}$
Short Circuit Pulse Width	$t_{sc}$	$\mu\text{s}$	10	-	-	$V_{CC}=3,000\text{V}, L_S=180\text{nH}$ $R_G(\text{on/off})=4.7/4.7\Omega, V_{GE}=\pm 15\text{V}, T_{vj}=150^\circ\text{C}$
Partial discharge extinction voltage	$V_e$	$V_{RMS}$	3,500	-	-	$f=50\text{Hz}, Q_{PD}\leq 10\text{pC}(\text{acc. to IEC 61287})$
Stray inductance module	$L_{SCE}$	nH	-	15	-	
Thermal Impedance	IGBT	$R_{th(j-c)}$	-	-	0.013	Junction to case
	FWD	$R_{th(j-c)}$	-	-	0.017	
Contact Thermal Impedance	$R_{th(c-f)}$	K/W	-	0.007	-	Case to fin ( $\lambda$ grease = $1\text{W}/(\text{m}\cdot\text{K})$ heat-sink flatness $\leq 50\mu\text{m}$ )

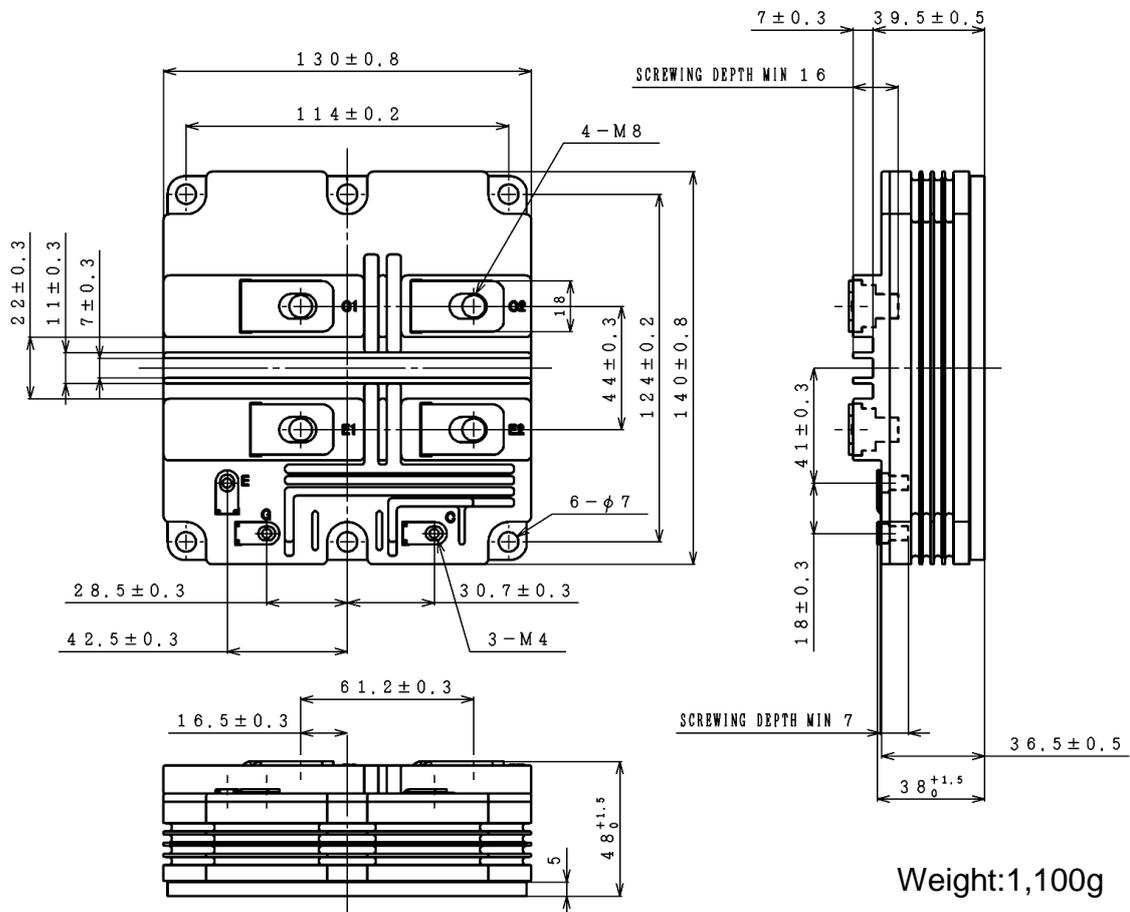
Notes: (3)  $R_G$  value is a test condition value for evaluation, not recommended value.  
Please, determine the suitable  $R_G$  value by measuring switching behaviors.

- \* Please contact our representatives at order.
- \* For improvement, specifications are subject to change without notice.
- \* For actual application, please confirm this spec sheet is the newest revision.
- \* ELECTRICAL CHARACTERISTIC items shown in above table are according to IEC 60747-2 and IEC 60747-9.

# MBN1000FH45F

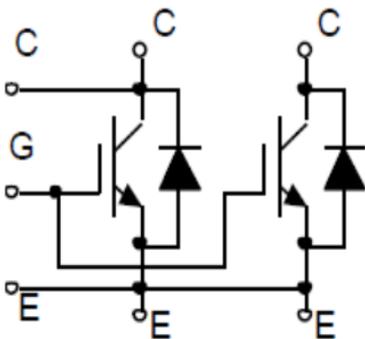
## OUTLINE DRAWING

Unit in mm

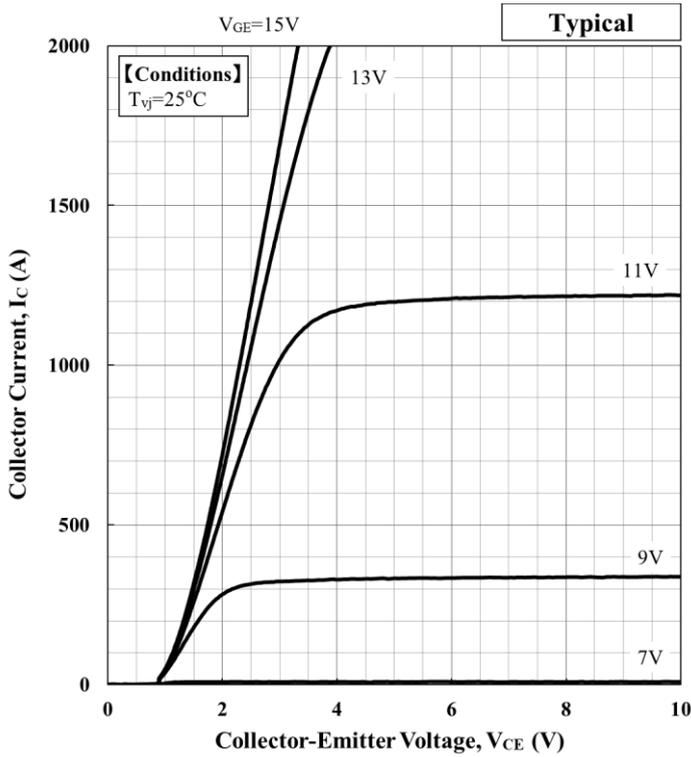


Weight: 1,100g

## CIRCUIT DIAGRAM



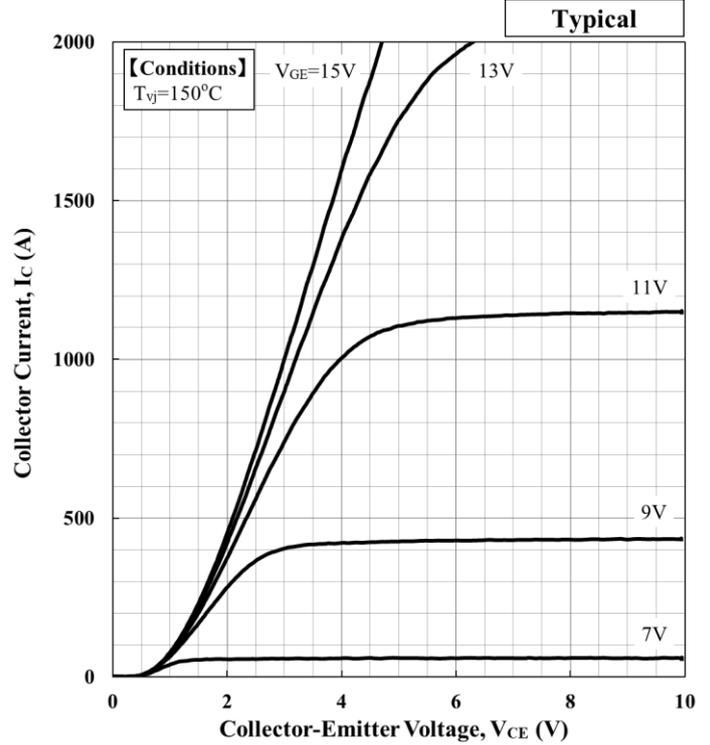
# MBN1000FH45F



$$V_{CE}(sat)[V] = a_3 \cdot |I_c|^3 + a_2 \cdot |I_c|^2 + a_1 \cdot |I_c| + a_0$$

Temp.[°C]	V <sub>GE</sub> [V]	a <sub>3</sub>	a <sub>2</sub>	a <sub>1</sub>	a <sub>0</sub>
25	15	1.32E-10	-5.37E-07	1.71E-03	9.98E-01

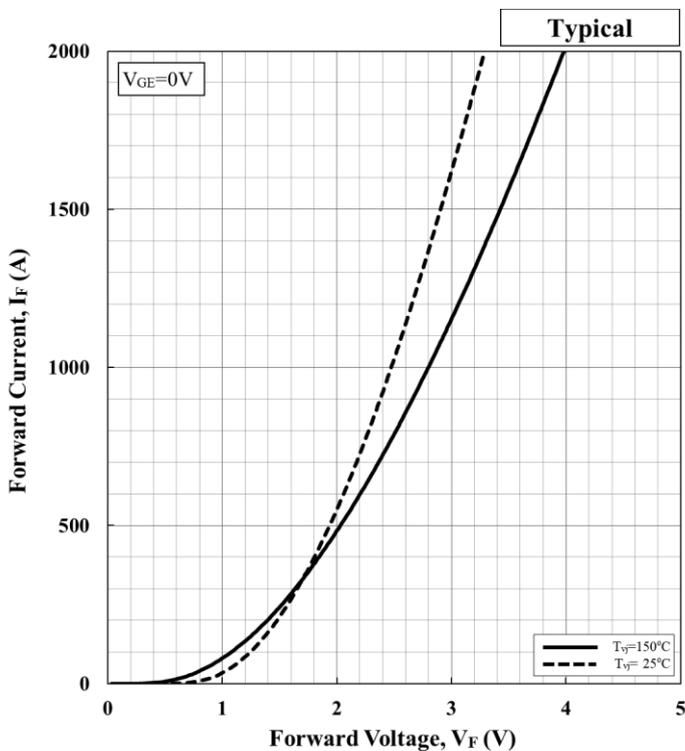
Collector Current vs. Collector Emitter Voltage



$$V_{CE}(sat)[V] = a_3 \cdot |I_c|^3 + a_2 \cdot |I_c|^2 + a_1 \cdot |I_c| + a_0$$

Temp.[°C]	V <sub>GE</sub> [V]	a <sub>3</sub>	a <sub>2</sub>	a <sub>1</sub>	a <sub>0</sub>
150	15	2.15E-10	-8.54E-07	2.76E-03	8.92E-01

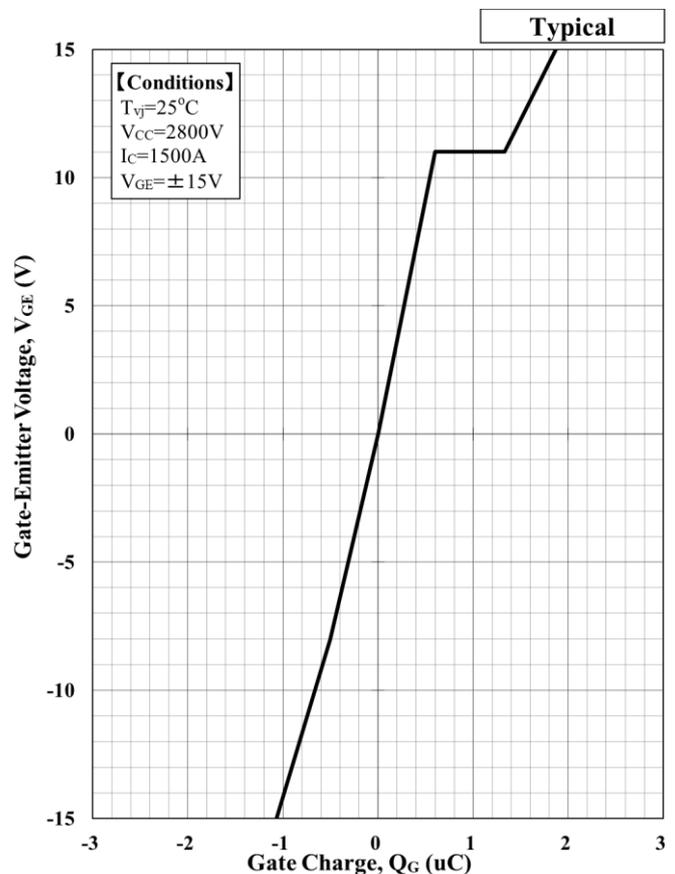
Collector Current vs. Collector Emitter Voltage



$$V_F[V] = a_3 \cdot |I_F|^3 + a_2 \cdot |I_F|^2 + a_1 \cdot |I_F| + a_0$$

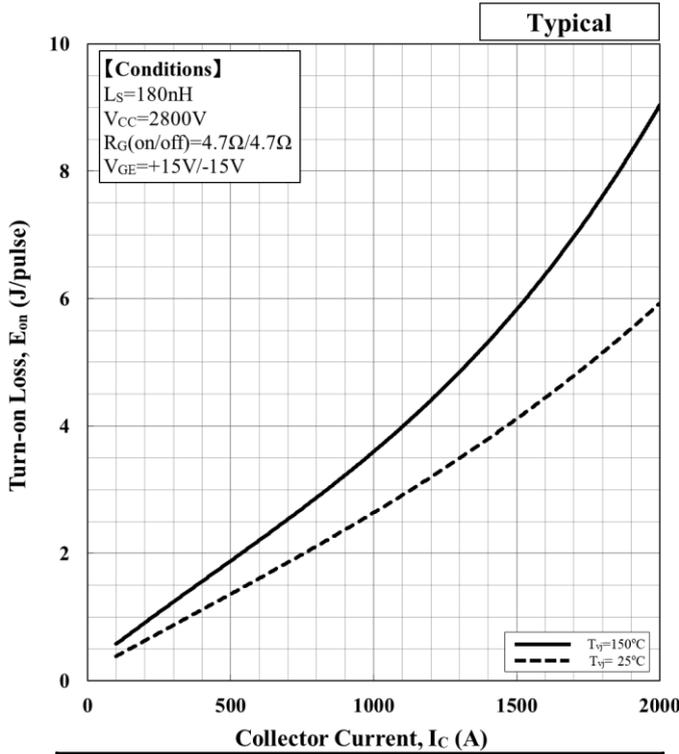
Temp.[°C]	a <sub>3</sub>	a <sub>2</sub>	a <sub>1</sub>	a <sub>0</sub>
25	1.79E-10	-8.17E-07	2.02E-03	1.10E+00
150	2.23E-10	-1.04E-06	2.75E-03	8.75E-01

Forward Voltage of free-wheeling diode



V<sub>GE</sub>-Q<sub>G</sub> curve

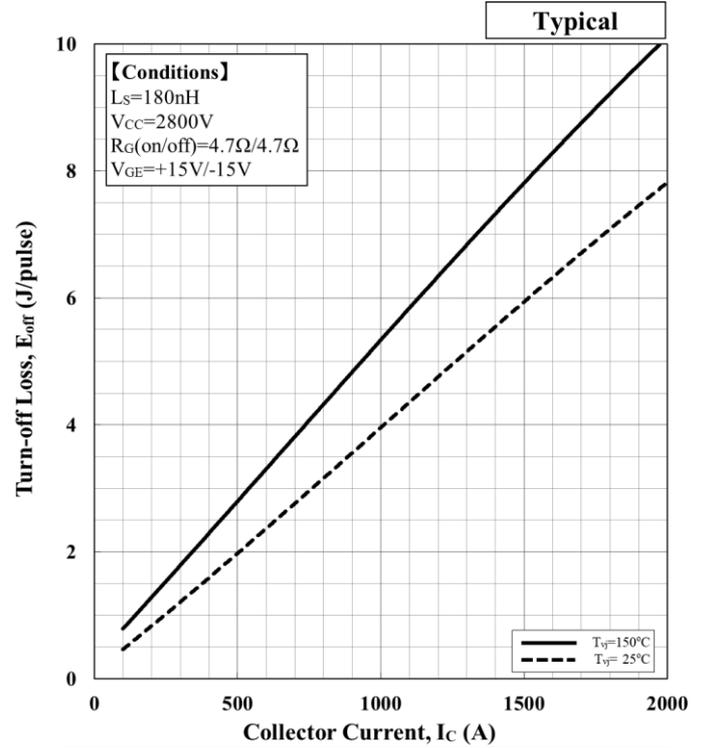
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$$E [J] = a_3 \cdot |I_c|^3 + a_2 \cdot |I_c|^2 + a_1 \cdot |I_c| + a_0$$

Temp.[°C]	$a_3$	$a_2$	$a_1$	$a_0$
25	1.88E-10	-1.73E-07	2.49E-03	1.40E-01
150	6.10E-10	-7.92E-07	3.55E-03	2.31E-01

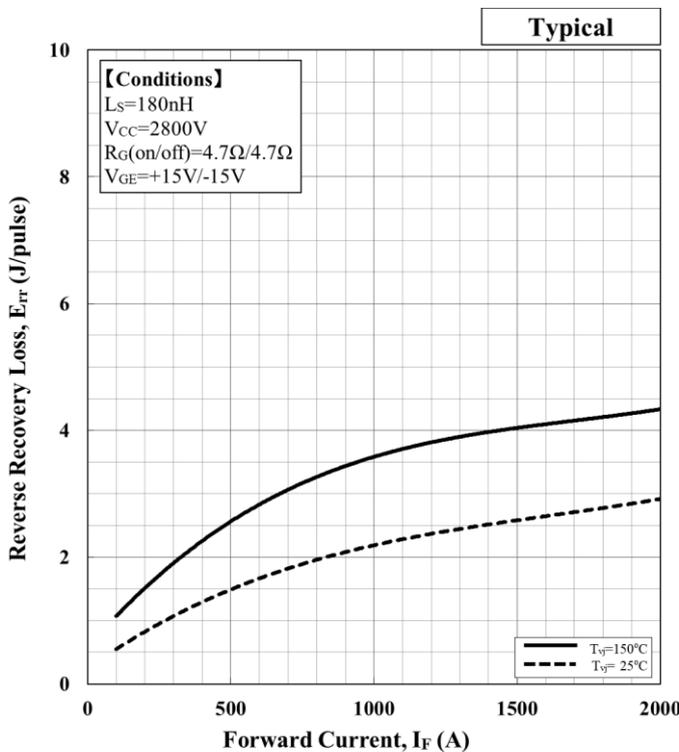
Turn-on loss vs. Collector current



$$E [J] = a_3 \cdot |I_c|^3 + a_2 \cdot |I_c|^2 + a_1 \cdot |I_c| + a_0$$

Temp.[°C]	$a_3$	$a_2$	$a_1$	$a_0$
25	-1.38E-10	4.16E-07	3.58E-03	1.05E-01
150	-1.39E-10	2.83E-07	4.90E-03	2.98E-01

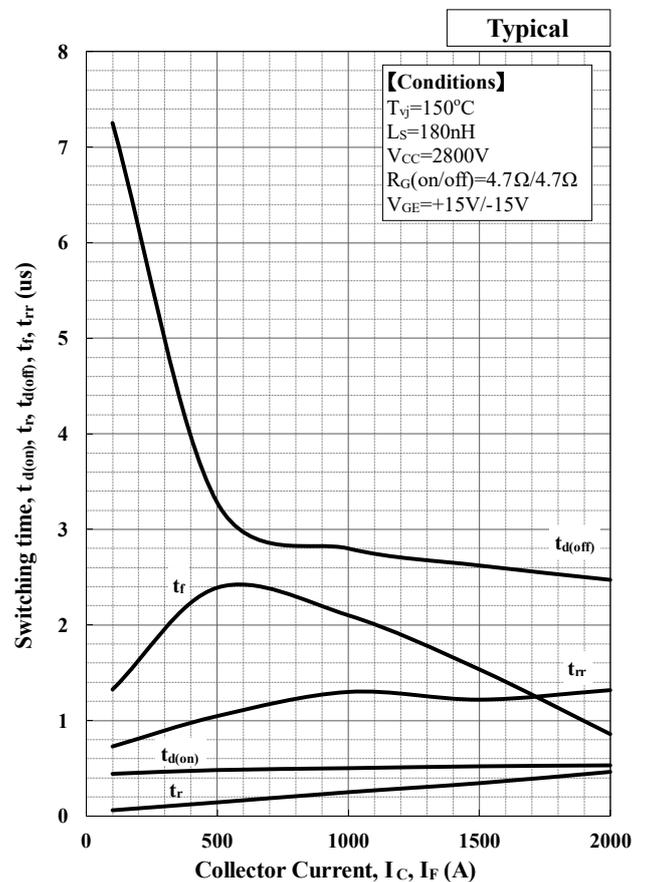
Turn-off loss vs. Collector current



$$E [J] = a_3 \cdot |I_f|^3 + a_2 \cdot |I_f|^2 + a_1 \cdot |I_f| + a_0$$

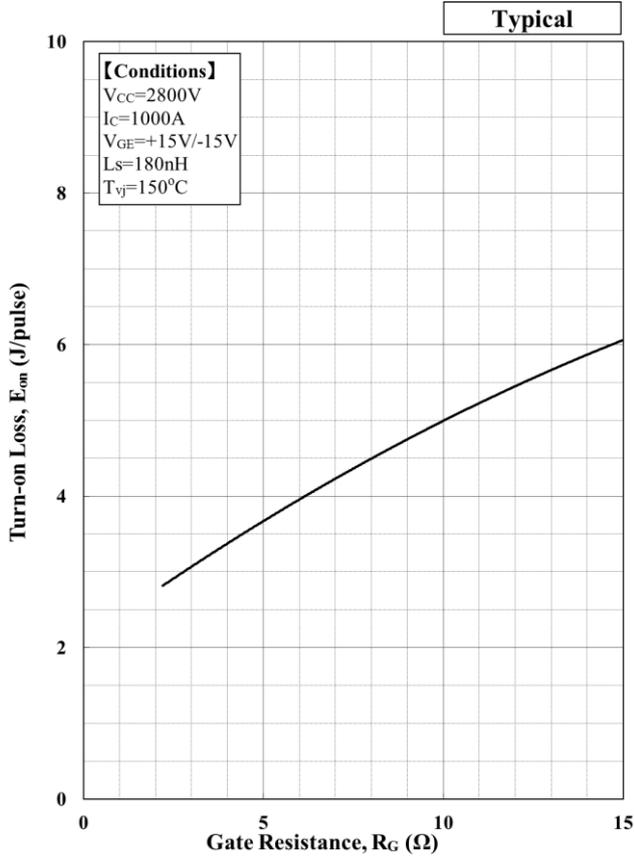
Temp.[°C]	$a_3$	$a_2$	$a_1$	$a_0$
25	3.27E-10	-1.59E-06	3.21E-03	2.43E-01
150	5.37E-10	-2.74E-06	5.21E-03	5.77E-01

Recovery loss vs. Forward current

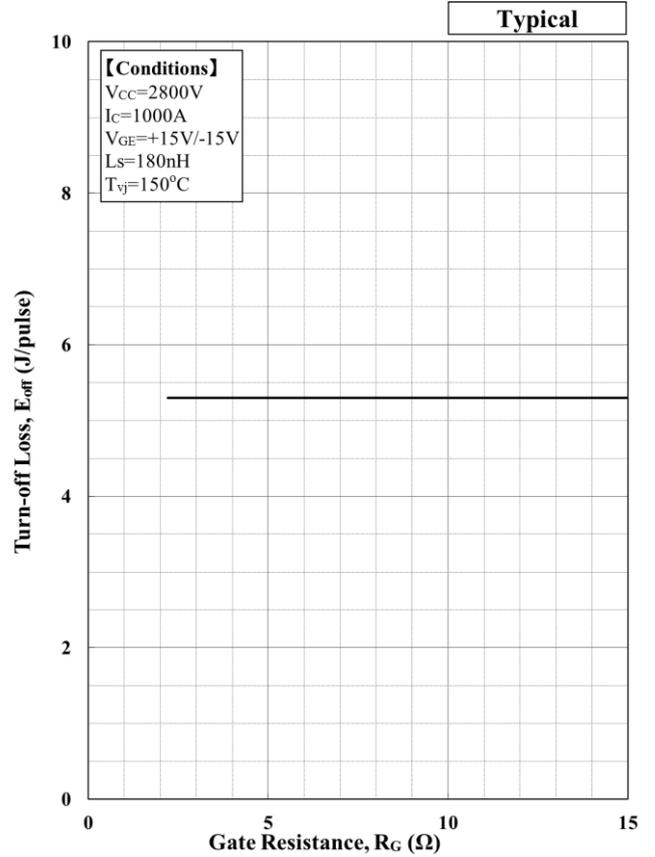


Switching time vs. Collector Current

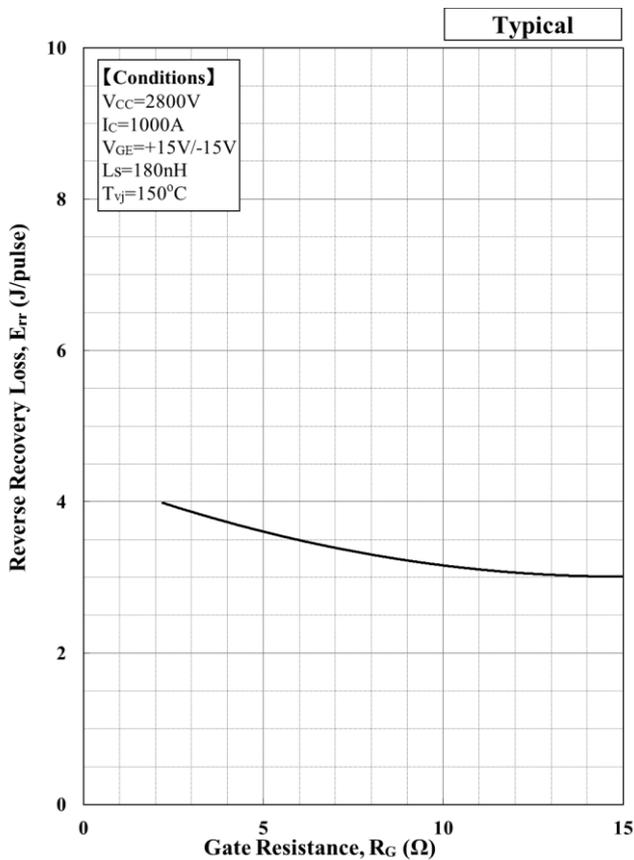
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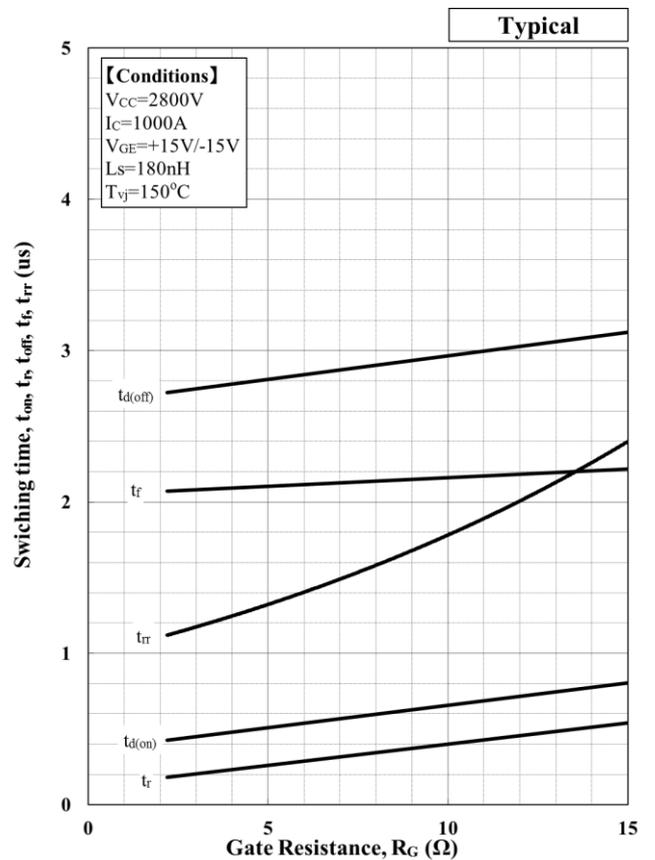
Turn-on loss vs. Gate Resistance



Turn-off loss vs. Gate Resistance

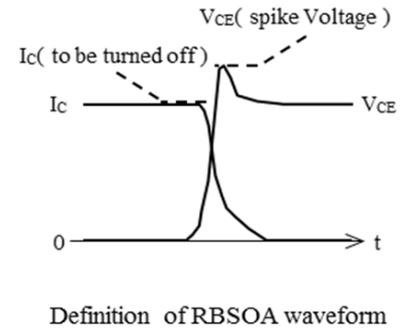
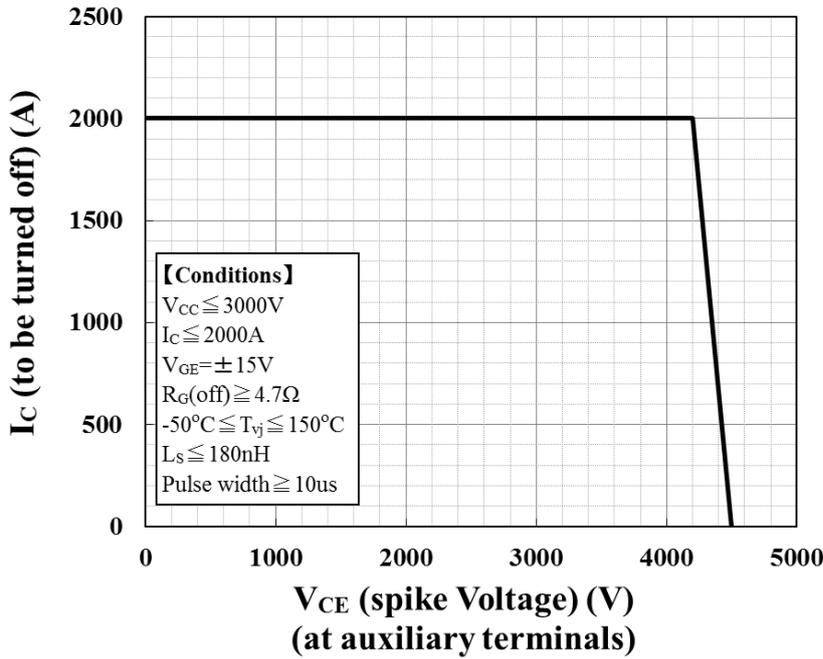


Reverse Recovery loss vs. Gate Resistance

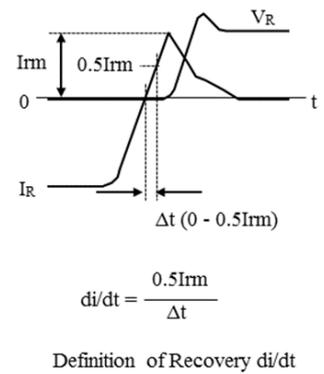
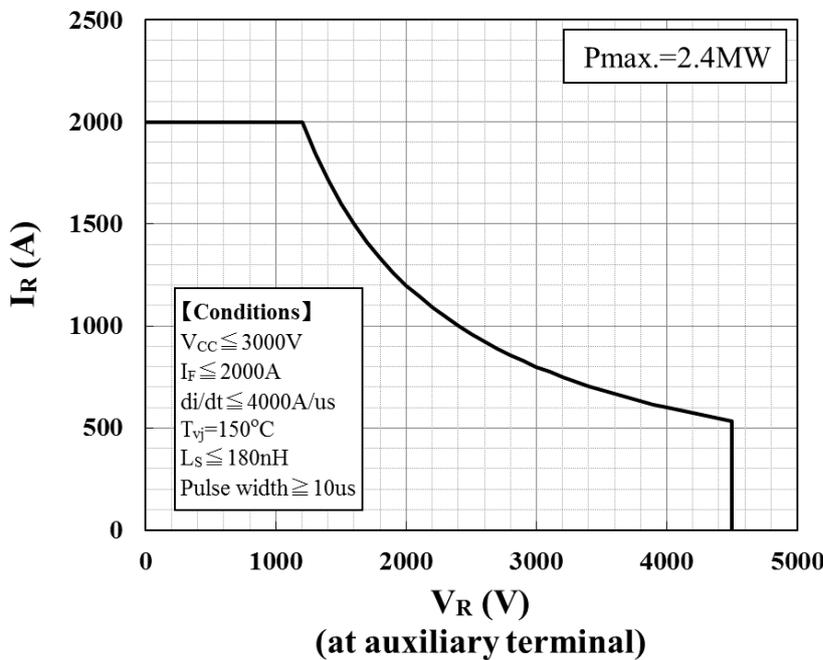


Switching time vs. Gate Resistance

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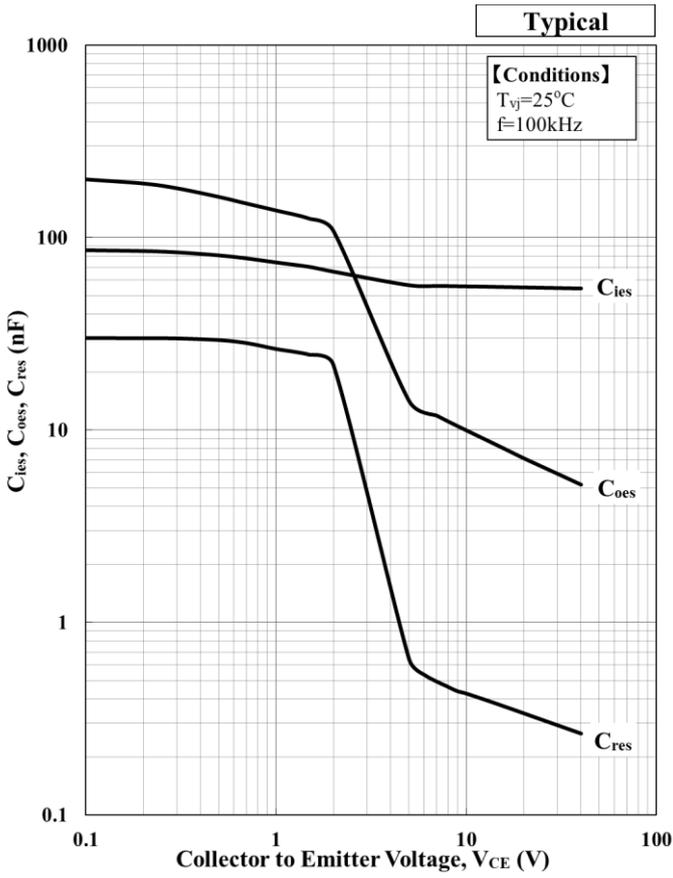


**Reverse bias safe operation area (RBSOA)**

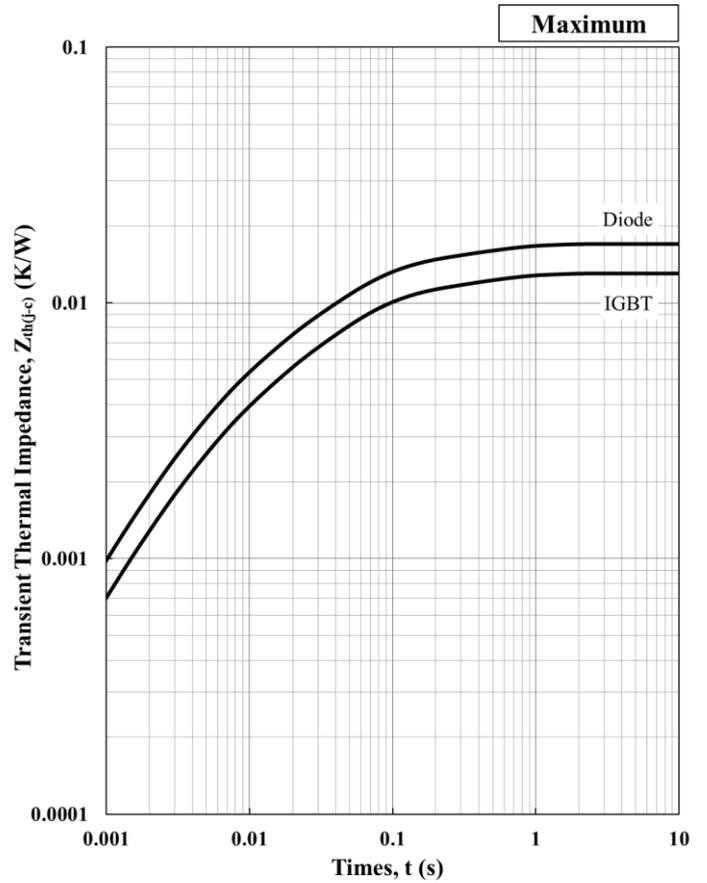


**Reverse recovery safe operation area (RRSOA)**

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Capacitance vs. Collector to Emitter Voltage



Transient Thermal Impedance Curve

Foster model lumped circuit constant

n	1	2	3	4	Unit
R th, IGBT [n]	2.69E-03	7.25E-03	2.44E-03	6.21E-04	[K/W]
C th, IGBT [n]	1.48E+02	6.42E+00	2.86E+00	3.79E+00	[J/K]
R th, Diode [n]	3.44E-03	9.26E-03	3.34E-03	9.61E-04	[K/W]
C th, Diode [n]	1.16E+02	5.03E+00	2.09E+00	2.45E+00	[J/K]

Cauer model lumped circuit constant

n	1	2	3	4	Unit
R th, IGBT [n]	3.64E-03	2.73E-03	4.65E-03	1.99E-03	[K/W]
C th, IGBT [n]	1.29E+00	2.33E+00	5.84E+00	1.90E+02	[J/K]
R th, Diode [n]	4.86E-03	3.61E-03	5.99E-03	2.54E-03	[K/W]
C th, Diode [n]	9.13E-01	1.80E+00	4.68E+00	1.48E+02	[J/K]

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