

MBN1500FH45F

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	MBN1500FH45F
Collector Emitter Voltage	V_{CES}	V	4,500
Gate Emitter Voltage	V_{GES}	V	± 20
Collector Current	DC	A	1,500
	1ms		3,000
Forward Current	DC	A	1,500
	1ms		3,000
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	-	-	6	$V_{CE}=4,500\text{V}, V_{GE}=0\text{V}, T_{vj}=25^\circ\text{C}$
			-	60	180	$V_{CE}=4,500\text{V}, V_{GE}=0\text{V}, T_{vj}=150^\circ\text{C}$
Gate Emitter Leakage Current	I_{GES}	nA	-500	-	+500	$V_{GE}=\pm 20\text{V}, V_{CE}=0\text{V}, T_{vj}=25^\circ\text{C}$
Collector Emitter Saturation Voltage	V_{CESat}	V	-	3.0	3.4	$I_C=1,500\text{A}, V_{GE}=15\text{V}, T_{vj}=150^\circ\text{C}$
Gate Emitter Threshold Voltage	$V_{GE(th)}$	V	6.0	6.5	7.0	$V_{CE}=10\text{V}, I_C=1,500\text{mA}, T_{vj}=25^\circ\text{C}$
Input Capacitance	C_{ies}	nF	-	83	-	$V_{CE}=10\text{V}, V_{GE}=0\text{V}, f=100\text{kHz}, T_{vj}=25^\circ\text{C}$
Internal Gate Resistance	$R_{G(int)}$	Ω	-	2.6	-	$V_{CE}=10\text{V}, V_{GE}=0\text{V}, f=100\text{kHz}, T_{vj}=25^\circ\text{C}$
Turn On Delay Time	$t_{d(on)}$	μs	-	0.5	-	$V_{CC}=2,800\text{V}, I_C=1,500\text{A}$
Rise Time	t_r		-	0.25	-	$L_S=165\text{nH}$
Turn Off Delay Time	$t_{d(off)}$		-	2.8	-	$R_G(\text{on/off})=3.3/3.3\Omega$ (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	$I_F=1,500\text{A}, V_{GE}=0\text{V}, T_{vj}=150^\circ\text{C}$
Reverse Recovery Time	t_{rr}	μs	-	1.3	-	$V_{CC}=2,800\text{V}, I_F=1,500\text{A}, L_S=165\text{nH}$ $T_{vj}=150^\circ\text{C}$
Turn On Loss	E_{on}	J/P	-	4.8	-	$V_{CC}=2,800\text{V}, I_C=1,500\text{A}, L_S=165\text{nH}$
Turn Off Loss	E_{off}	J/P	-	8.0	-	$R_G(\text{on/off})=3.3/3.3\Omega$ (3)
Reverse Recovery Loss	E_{rr}	J/P	-	6.3	-	$V_{GE}=\pm 15\text{V}, T_{vj}=150^\circ\text{C}$
Short Circuit Pulse Width	t_{sc}	μs	10	-	-	$V_{CC}=3,000\text{V}, L_S=165\text{nH}$ $R_G(\text{on/off})=3.3/3.3\Omega, V_{GE}=\pm 15\text{V}, T_{vj}=150^\circ\text{C}$
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	-	10	-	
Thermal Impedance	IGBT	$R_{th(j-c)}$	-	-	0.0085	Junction to case
	FWD	$R_{th(j-c)}$	-	-	0.0115	
Contact Thermal Impedance	$R_{th(c-f)}$	K/W	-	0.005	-	Case to fin (λ grease = $1\text{W}/(\text{m}\cdot\text{K})$ heat-sink flatness $\leq 50\mu\text{m}$)

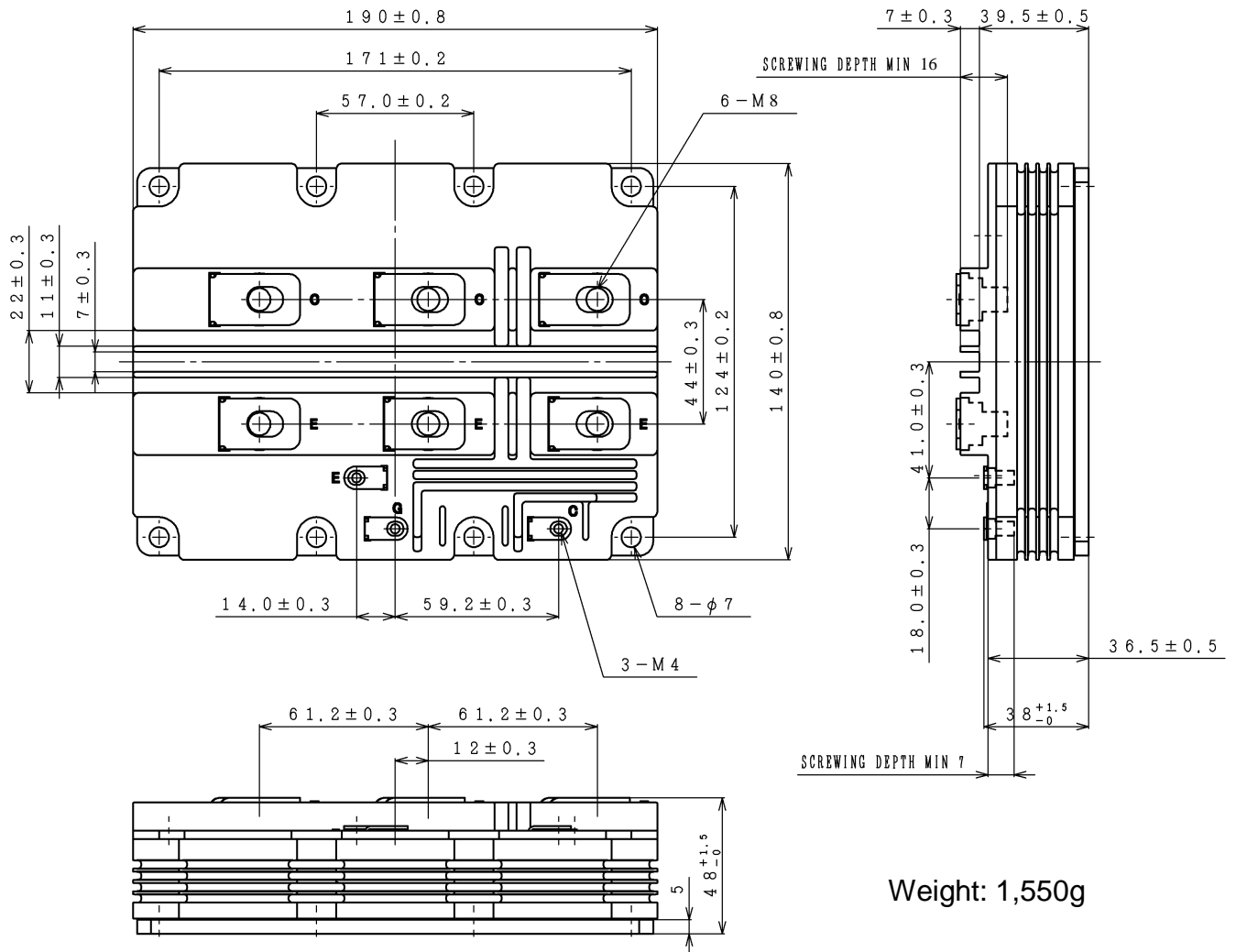
Notes: (3) R_G value is a test condition value for evaluation, not recommended value.
Please, determine the suitable R_G value by measuring switching behaviors.

- * 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.

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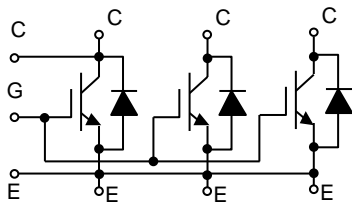
OUTLINE DRAWING

Unit in mm

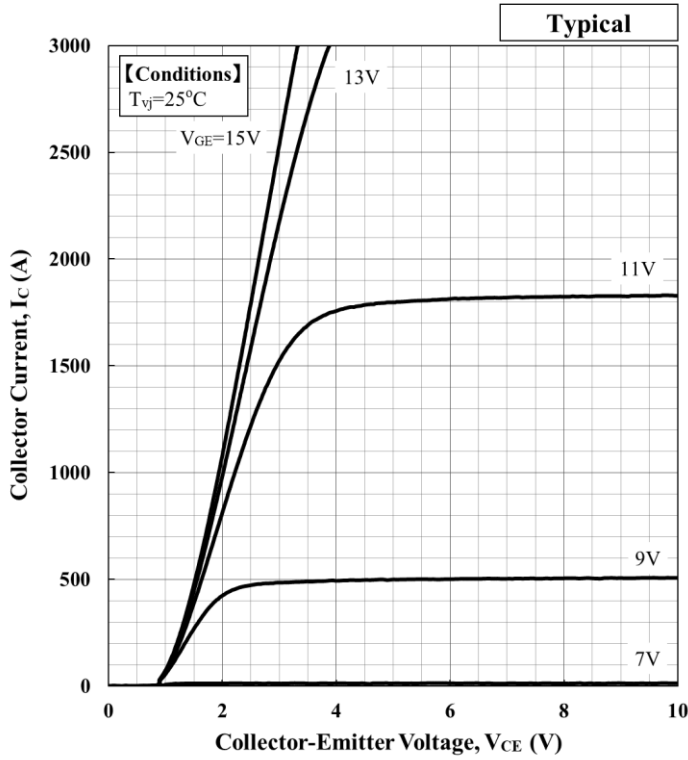


Weight: 1,550g

CIRCUIT DIAGRAM



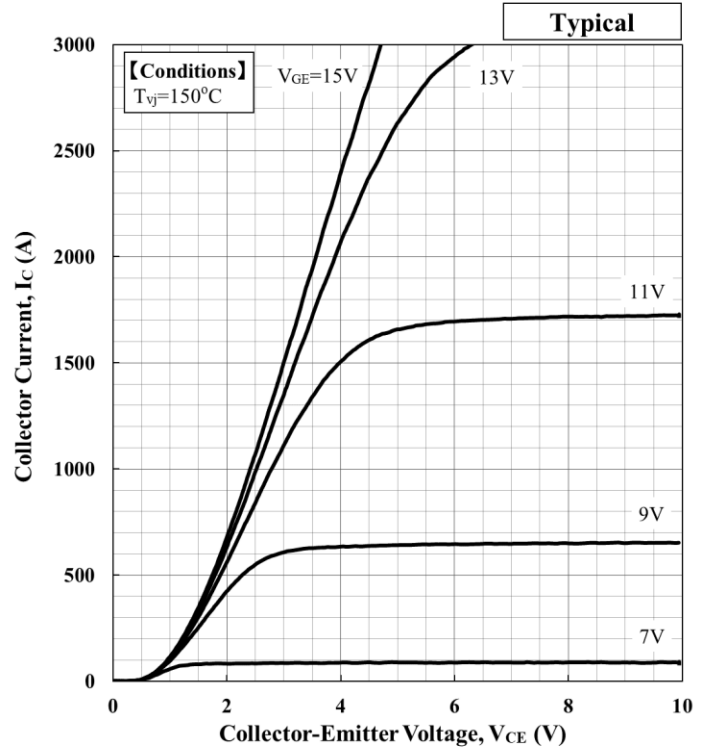
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$$V_{CE(sat)}[V] = a_3 \cdot |I_c|^3 + a_2 \cdot |I_c|^2 + a_1 \cdot |I_c| + a_0$$

Temp.[°C]	$V_{GE}[V]$	a_3	a_2	a_1	a_0
25	15	3.92E-11	-2.39E-07	1.14E-03	9.98E-01

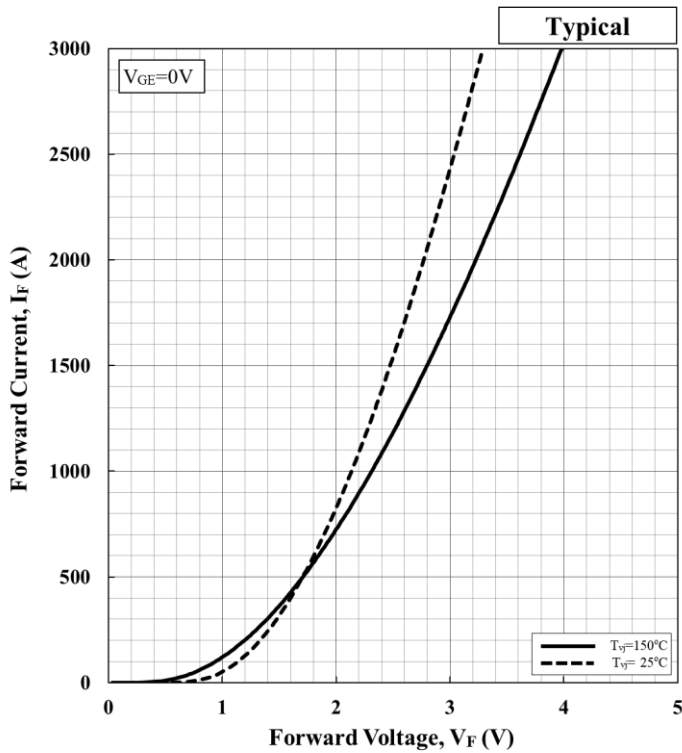
Collector Current vs. Collector Emitter Voltage



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

Temp.[°C]	$V_{GE}[V]$	a_3	a_2	a_1	a_0
150	15	6.37E-11	-3.80E-07	1.84E-03	8.92E-01

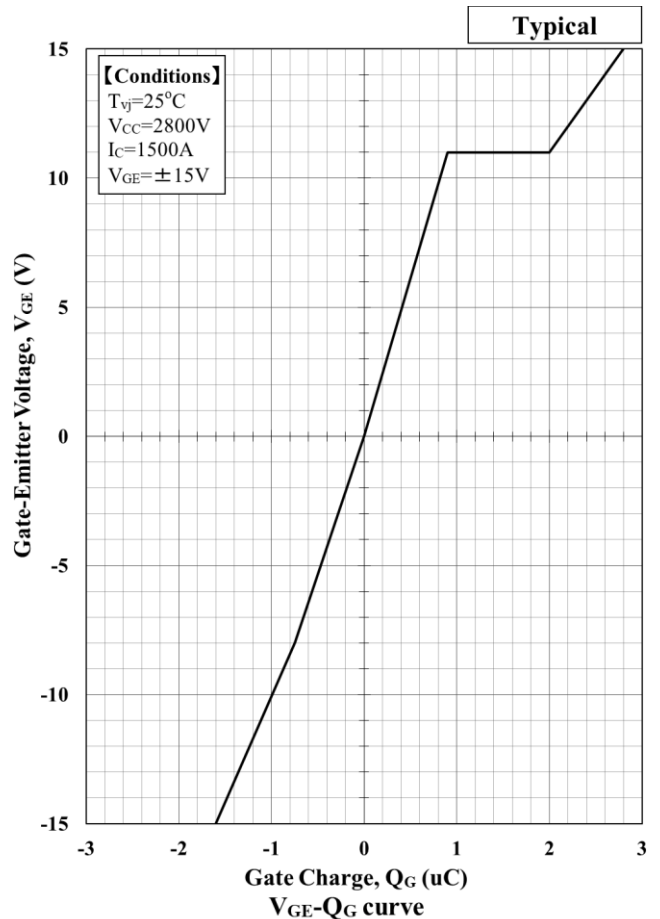
Collector Current vs. Collector Emitter Voltage



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

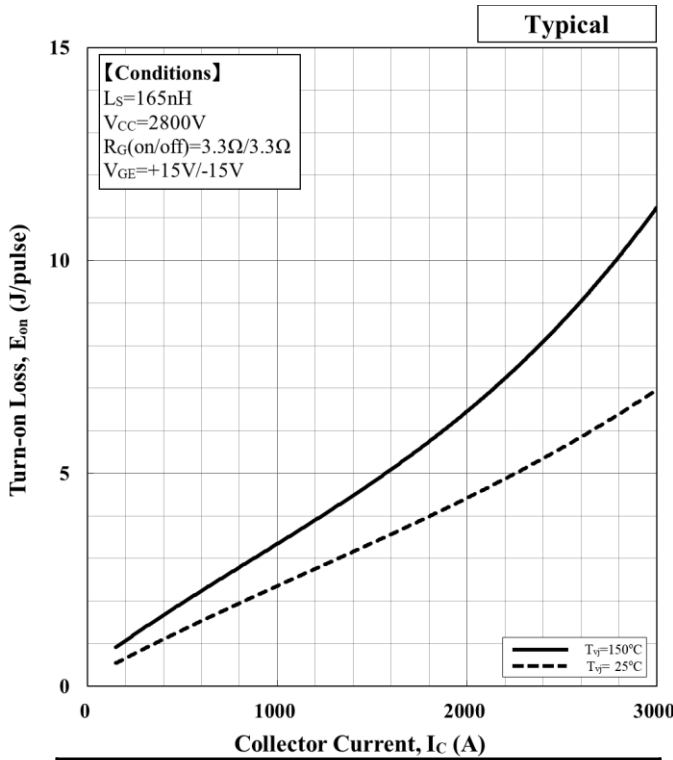
Temp.[°C]	a_3	a_2	a_1	a_0
25	5.30E-11	-3.63E-07	1.35E-03	1.10E+00
150	6.59E-11	-4.62E-07	1.83E-03	8.75E-01

Forward Voltage of free-wheeling diode



Gate-Emitter Voltage, V_{GE} (V)
Gate Charge, Q_G (μC)
 V_{GE} - Q_G curve

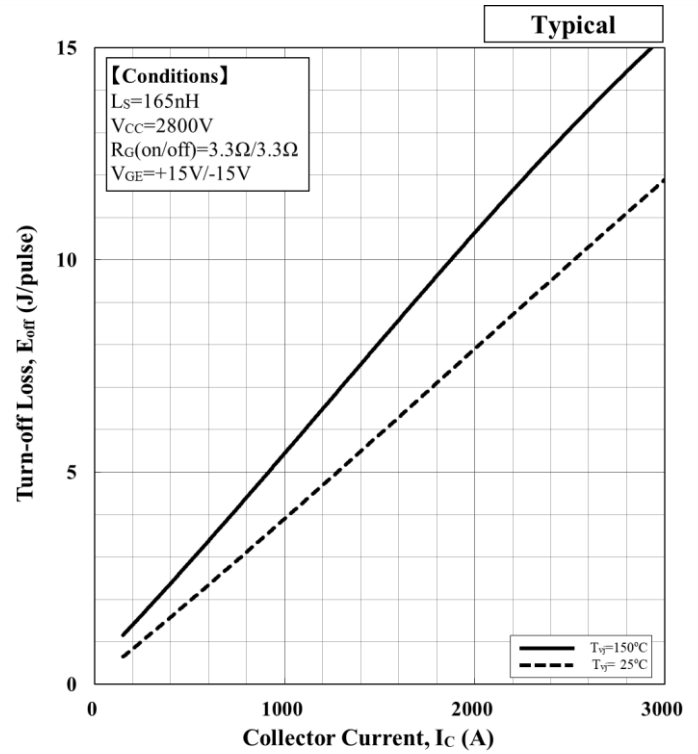
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$$E [J] = a_3 \cdot |I_c|^3 + a_2 \cdot |I_c|^2 + a_1 \cdot |I_c| + a_0$$

Temp.[°C]	a_3	a_2	a_1	a_0
25	9.68E-11	-3.41E-07	2.41E-03	1.90E-01
150	2.47E-10	-6.38E-07	3.30E-03	4.38E-01

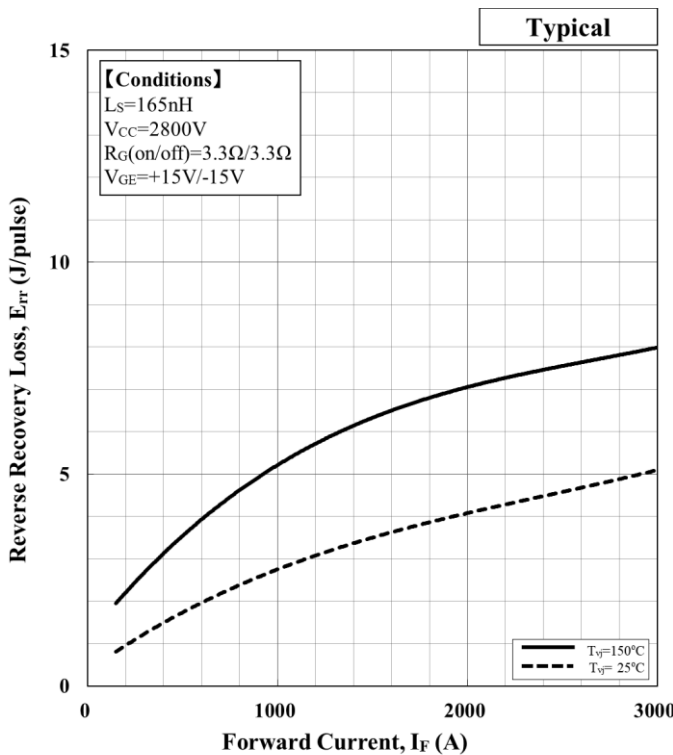
Turn-on loss vs. Collector current



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

Temp.[°C]	a_3	a_2	a_1	a_0
25	-3.59E-11	2.07E-07	3.63E-03	1.02E-01
150	-1.26E-10	4.82E-07	4.63E-03	4.59E-01

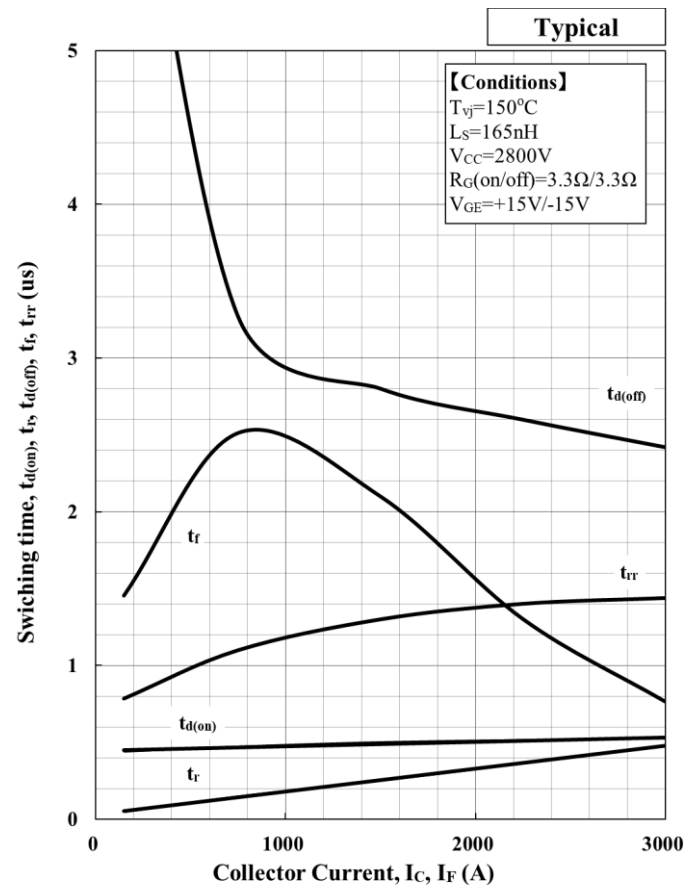
Turn-off loss vs. Collector current



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

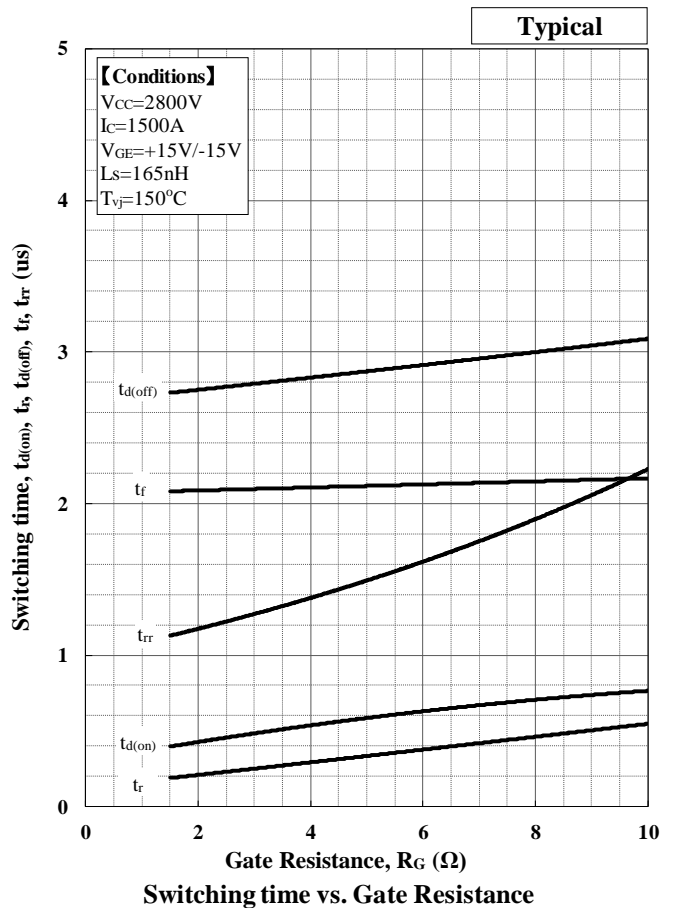
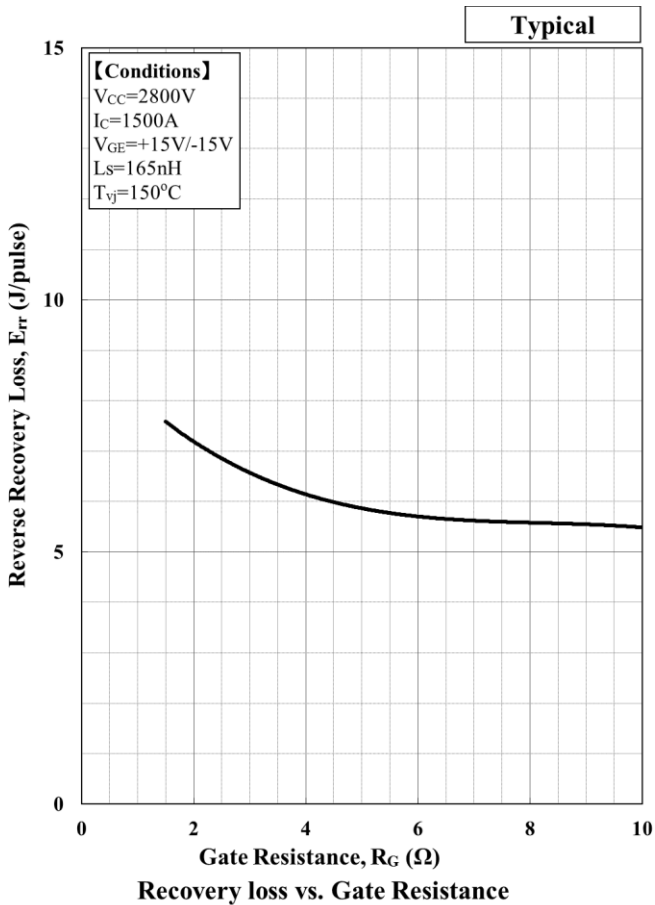
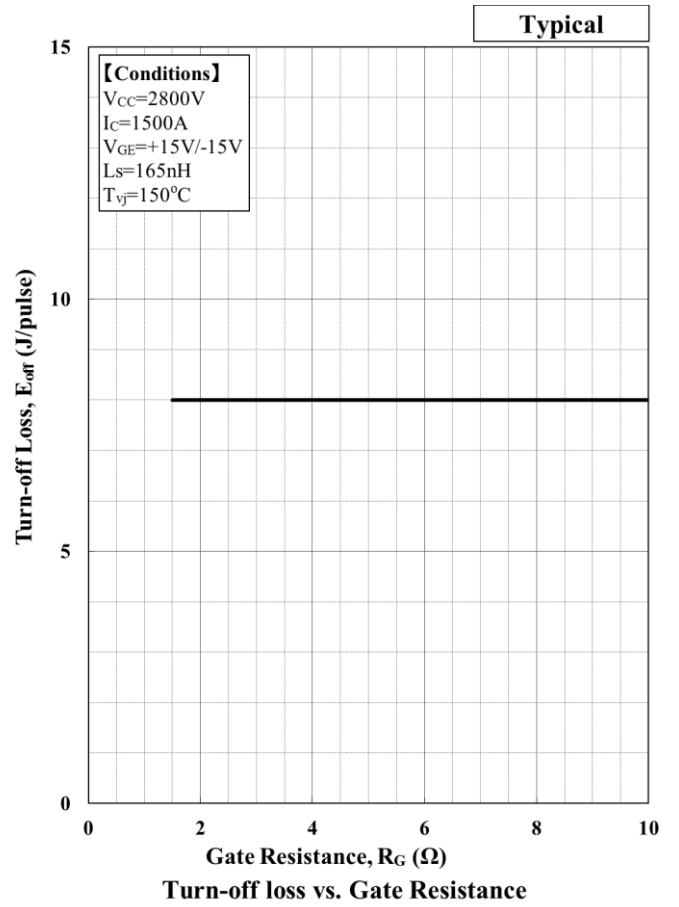
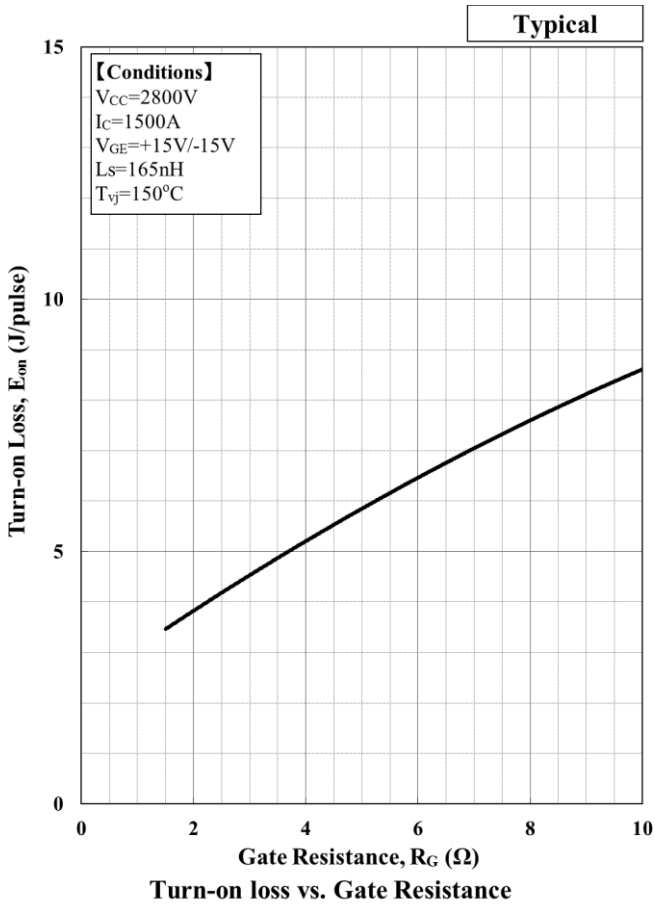
Temp.[°C]	a_3	a_2	a_1	a_0
25	1.26E-10	-9.11E-07	3.18E-03	3.56E-01
150	2.20E-10	-1.77E-06	5.61E-03	1.15E+00

Recovery loss vs. Forward current

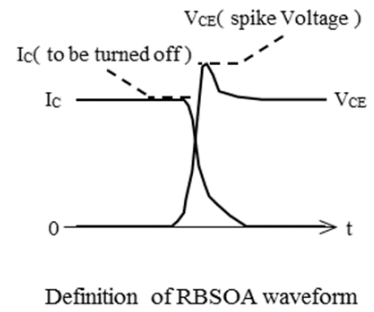
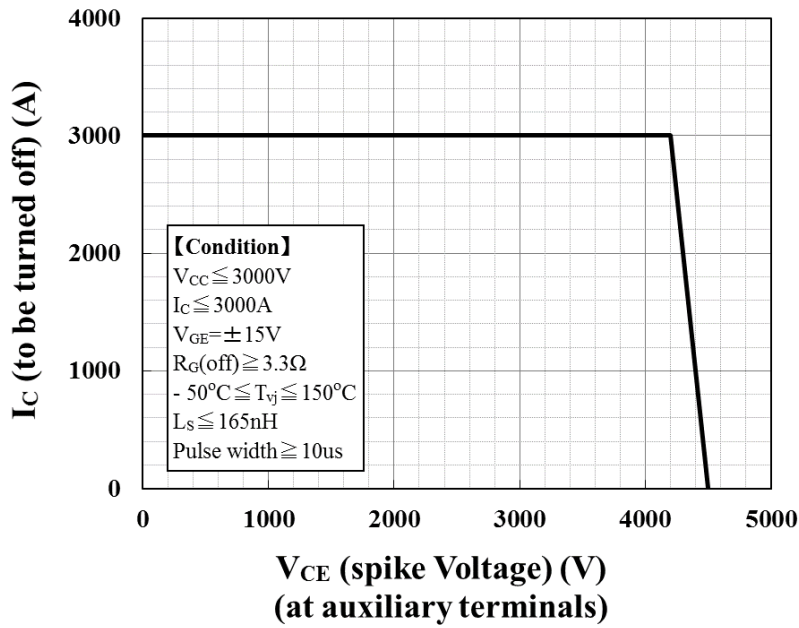


Switching time vs. Collector Current

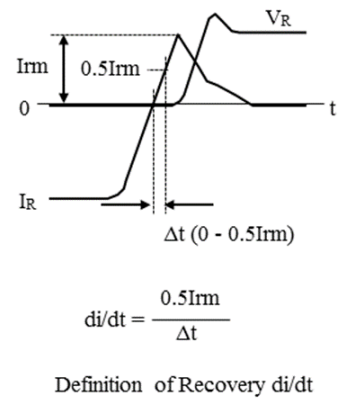
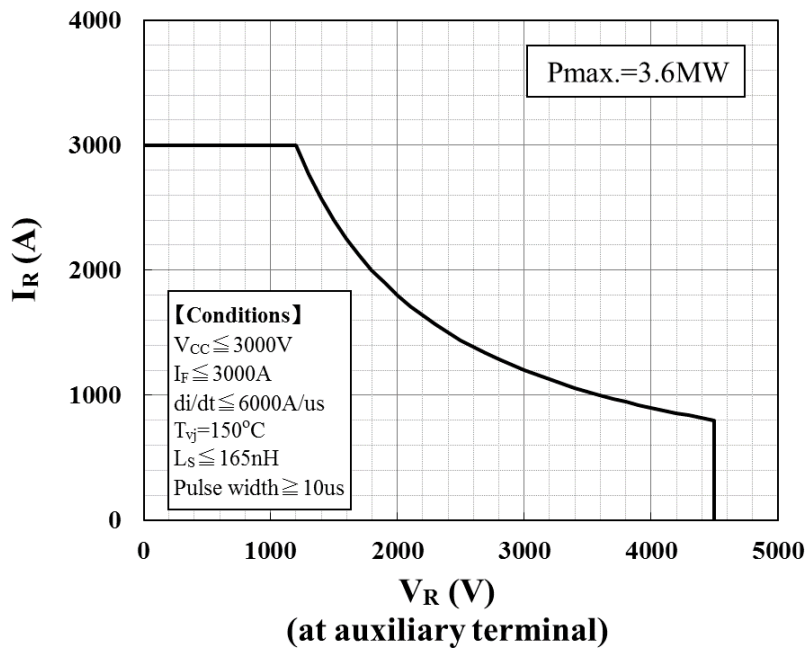
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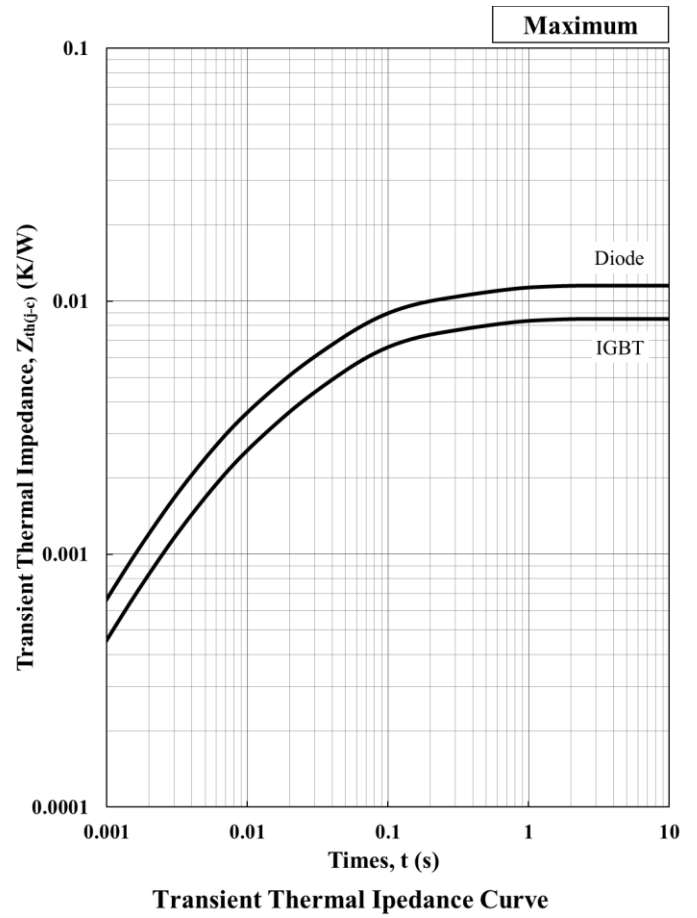
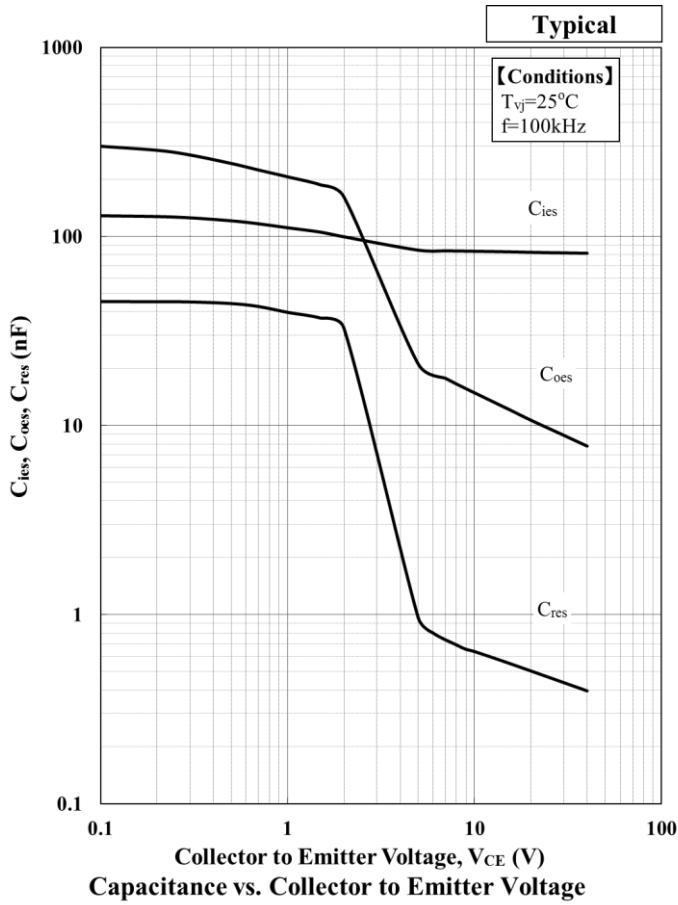


Reverse bias safe operation area (RBSOA)



Reverse recovery safe operation area (RRSOA)

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Foster model lumped circuit constant

n	1	2	3	4	Unit
R th, IGBT [n]	1.76E-03	4.75E-03	1.63E-03	3.62E-04	[K/W]
C th, IGBT [n]	2.26E+02	9.79E+00	4.18E+00	6.17E+00	[J/K]
R th, Diode [n]	2.34E-03	6.25E-03	2.33E-03	5.78E-04	[K/W]
C th, Diode [n]	1.70E+02	7.43E+00	2.93E+00	3.86E+00	[J/K]

Cauer model lumped circuit constant

n	1	2	3	4	Unit
R th, IGBT [n]	2.35E-03	1.74E-03	3.11E-03	1.30E-03	[K/W]
C th, IGBT [n]	1.97E+00	3.35E+00	8.89E+00	2.90E+02	[J/K]
R th, Diode [n]	3.25E-03	2.39E-03	4.14E-03	1.73E-03	[K/W]
C th, Diode [n]	1.35E+00	2.49E+00	6.92E+00	2.18E+02	[J/K]

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