

MBN1200F33F

Silicon N-channel IGBT 3300V 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
- * High thermal fatigue durability: ($\Delta T_c=70K$, $N>30,000$ cycles)

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

Item	Symbol	Unit	MBN1200F33F
Collector Emitter Voltage	V_{CES}	V	3,300
Gate Emitter Voltage	V_{GES}	V	± 20
Collector Current	DC	A	1,200
	1ms		2,400
Forward Current	DC	A	1,200
	1ms		2,400
Operating Junction Temperature	$T_{vj\text{ op}}$	$^\circ\text{C}$	-50 ~ +150
Storage Temperature	T_{stg}	$^\circ\text{C}$	-55 ~ +150
Isolation Voltage	V_{ISO}	V_{RMS}	6,000(AC 1 minute)
Screw Torque	Terminals (M4/M8)	N·m	2/15 (1)
	Mounting (M6)		6 (2)

Notes: (1) Recommended Value $1.8 \pm 0.2/15^{+0}_{-3} \text{N}\cdot\text{m}$ (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	-	-	0.4	$V_{CE}=3,300\text{V}$, $V_{GE}=0\text{V}$, $T_{vj}=25^\circ\text{C}$
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	2.5	2.85	3.5	$I_C=1,200\text{A}$, $V_{GE}=15\text{V}$, $T_{vj}=150^\circ\text{C}$
Gate Emitter Threshold Voltage	$V_{GE(th)}$	V	5.5	6.5	7.5	$V_{CE}=10\text{V}$, $I_C=1,200\text{mA}$, $T_{vj}=25^\circ\text{C}$
Input Capacitance	C_{ies}	nF	-	88	-	$V_{CE}=10\text{V}$, $V_{GE}=0\text{V}$, $f=100\text{kHz}$, $T_{vj}=25^\circ\text{C}$
Internal Gate Resistance	$R_{G(int)}$	Ω	-	1.9	-	$V_{CE}=10\text{V}$, $V_{GE}=0\text{V}$, $f=100\text{kHz}$, $T_{vj}=25^\circ\text{C}$
Turn On Delay Time	$t_{d(on)}$	μs	0.7	1.0	1.3	$V_{CC}=1,800\text{V}$, $I_C=1,200\text{A}$
Rise Time	t_r		0.1	0.2	0.3	$L_S=100\text{nH}$
Turn Off Delay Time	$t_{d(off)}$		1.7	2.7	3.3	$R_{G(on/off)}=6.8\Omega/8.2\Omega$ (3)
Fall Time	t_f		1.0	1.8	2.6	$V_{GE}=\pm 15\text{V}$, $T_{vj}=150^\circ\text{C}$
Forward Voltage Drop	V_F	V	2.2	2.6	2.9	$I_F=1,200\text{A}$, $V_{GE}=0\text{V}$, $T_{vj}=150^\circ\text{C}$
Reverse Recovery Time	t_{rr}	μs	0.2	0.7	1.1	$V_{CC}=1,800\text{V}$, $I_F=1,200\text{A}$, $L_S=100\text{nH}$ $T_{vj}=150^\circ\text{C}$
Turn On Loss	E_{on}	J/P	-	2.6	3.4	$V_{CC}=1,800\text{V}$, $I_C=1,200\text{A}$, $L_S=100\text{nH}$
Turn Off Loss	E_{off}	J/P	-	2.2	2.7	$R_{G(on/off)}=6.8\Omega/8.2\Omega$ (3)
Reverse Recovery Loss	E_{rr}	J/P	-	1.7	2.2	$V_{GE}=\pm 15\text{V}$, $T_{vj}=150^\circ\text{C}$
Short Circuit Pulse Width	t_{sc}	μs	10	-	-	$V_{CC}=2,000\text{V}$, $L_S=100\text{nH}$ $R_{G(on/off)}=6.8/8.2\Omega$, $V_{GE}=\pm 15\text{V}$, $T_{vj}=150^\circ\text{C}$
Stray inductance module	L_{SCE}	nH	-	10	-	
Thermal Impedance	IGBT	$R_{th(j-c)}$	K/W	-	-	Junction to case
	FWD	$R_{th(j-c)}$		-	-	
Contact Thermal Impedance		$R_{th(c-f)}$	K/W	-	0.008	Case to fin

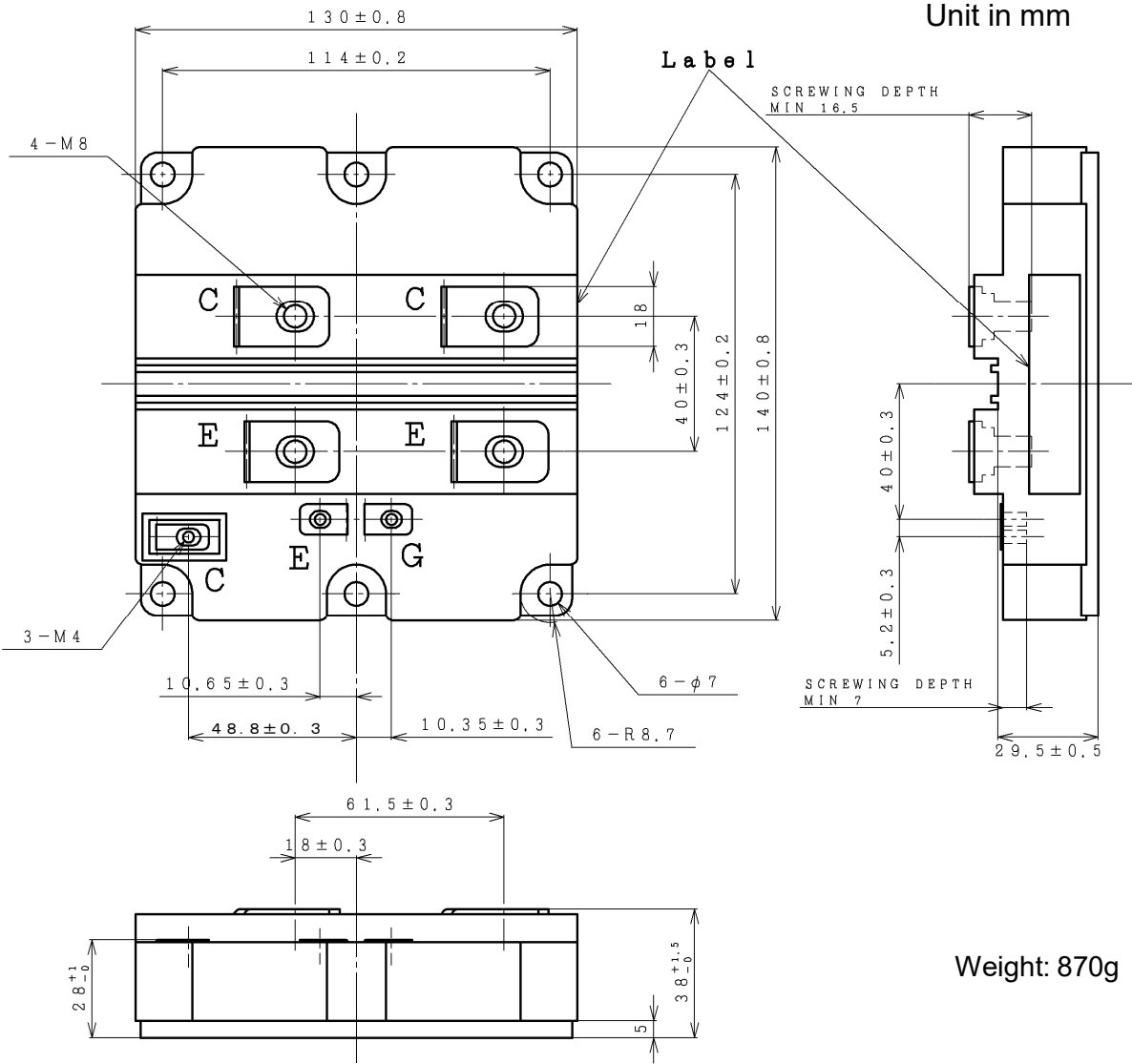
Notes: (3) R_G value is a test condition value for evaluation, not recommended value.

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.

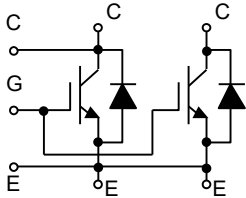
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OUTLINE DRAWING

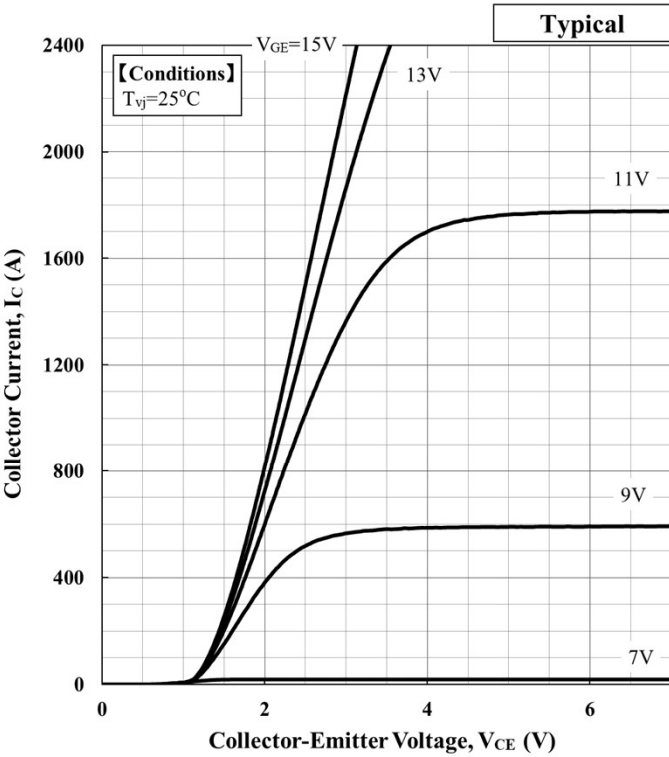


Weight: 870g

CIRCUIT DIAGRAM

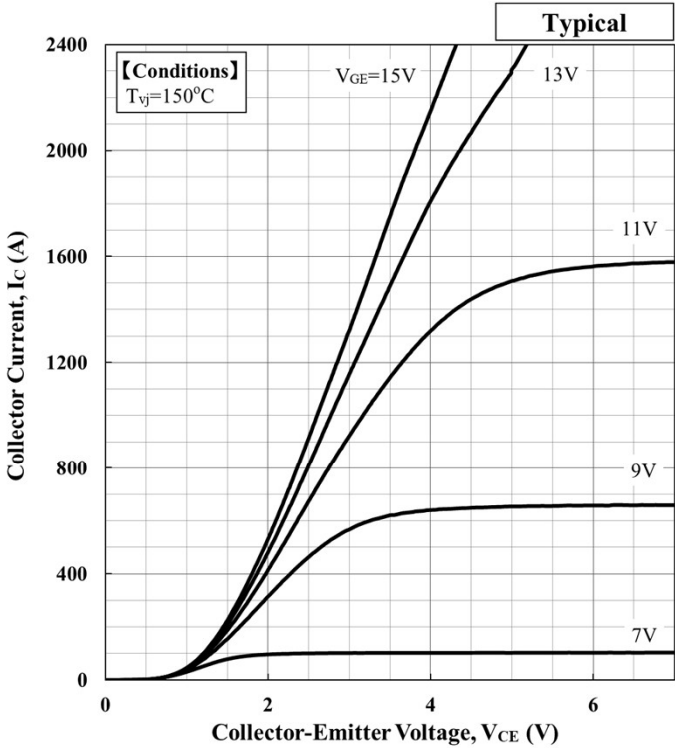


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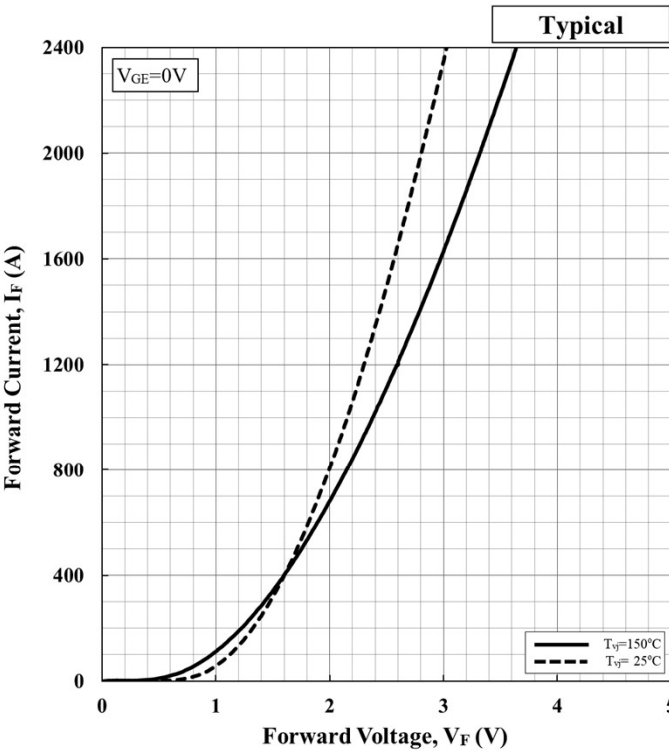
$V_{CE(sat)}[V] = a_3 \cdot I_c ^3 + a_2 \cdot I_c ^2 + a_1 \cdot I_c + a_0$					
Temp.[°C]	V _{GE} [V]	a ₃	a ₂	a ₁	a ₀
25	15	5.44.E-11	-2.74.E-07	1.14.E-03	1.22.E+00

Collector Current vs. Collector Emitter Voltage



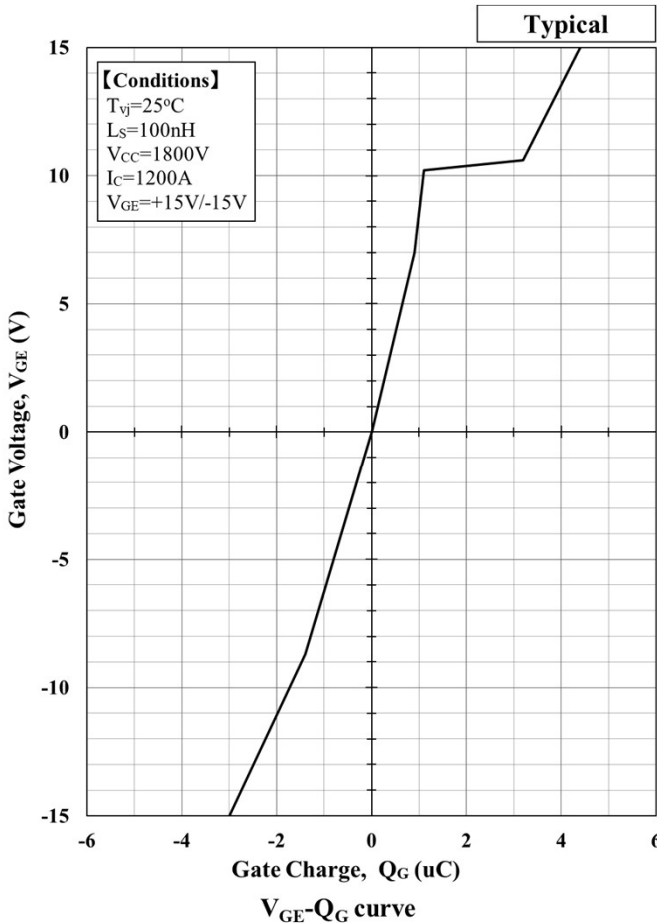
$V_{CE(sat)}[V] = a_3 \cdot I_c ^3 + a_2 \cdot I_c ^2 + a_1 \cdot I_c + a_0$					
Temp.[°C]	V _{GE} [V]	a ₃	a ₂	a ₁	a ₀
150	15	1.13.E-10	-5.11.E-07	1.93.E-03	1.09.E+00

Collector Current vs. Collector Emitter Voltage

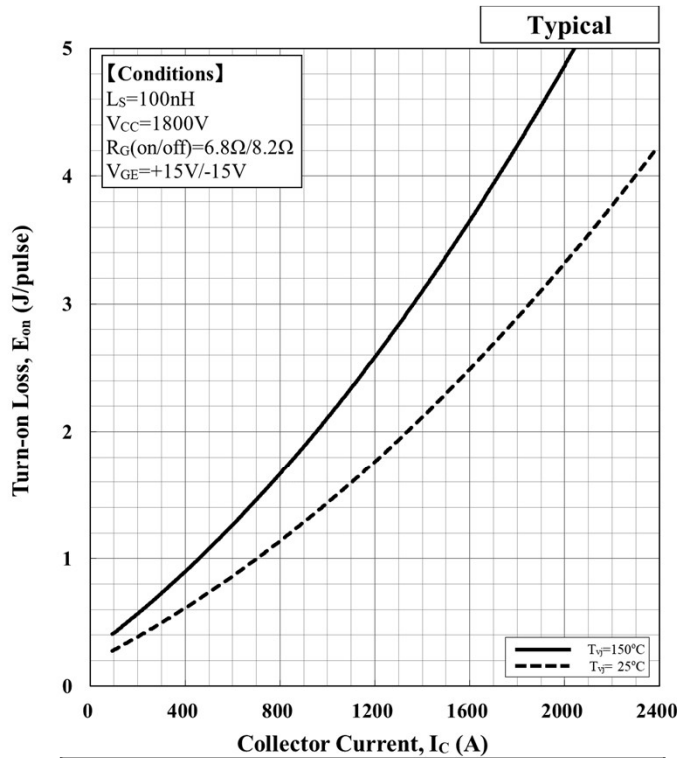


$V_F[V] = a_3 \cdot I_F ^3 + a_2 \cdot I_F ^2 + a_1 \cdot I_F + a_0$				
Temp.[°C]	a ₃	a ₂	a ₁	a ₀
25	9.88.E-11	-5.47.E-07	1.58.E-03	1.03.E+00
150	1.18.E-10	-6.74.E-07	2.11.E-03	8.30.E-01

Forward Voltage of free-wheeling diode

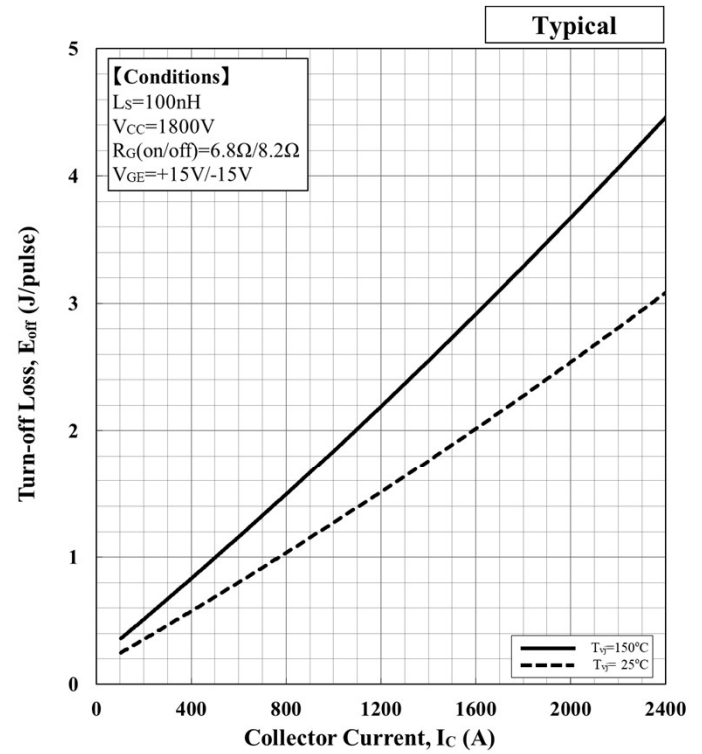


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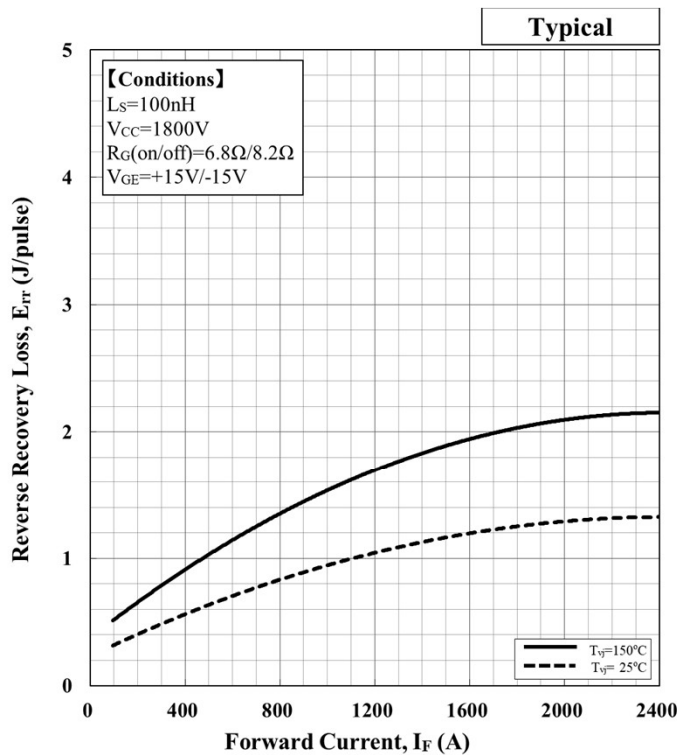
$E [J] = a_3 \cdot I_c ^3 + a_2 \cdot I_c ^2 + a_1 \cdot I_c + a_0$				
Temp.[°C]	a_3	a_2	a_1	a_0
25	-	3.15E-07	9.35E-04	1.89E-01
150	-	4.62E-07	1.37E-03	2.77E-01

Turn-on loss vs. Collector current



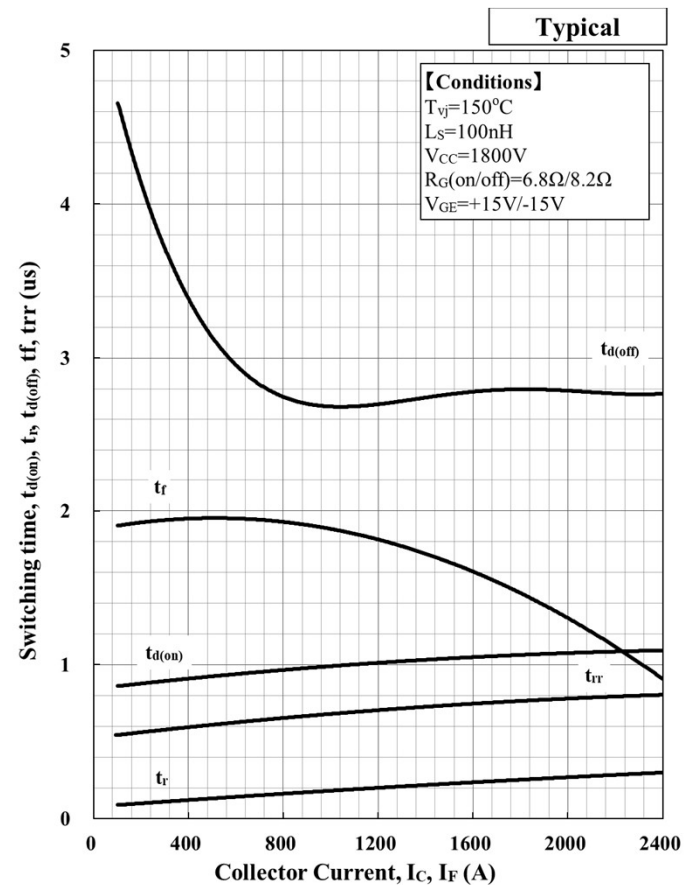
$E [J] = a_3 \cdot I_c ^3 + a_2 \cdot I_c ^2 + a_1 \cdot I_c + a_0$				
Temp.[°C]	a_3	a_2	a_1	a_0
25	-	6.66E-08	1.07E-03	1.38E-01
150	-	9.64E-08	1.54E-03	2.00E-01

Turn-off loss vs. Collector current



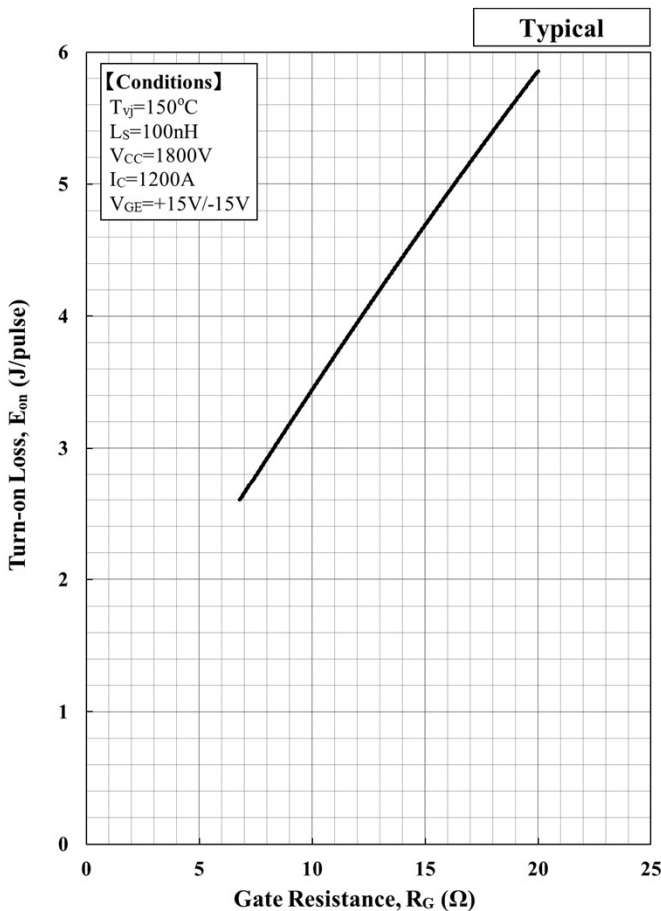
$E [J] = a_3 \cdot I_F ^3 + a_2 \cdot I_F ^2 + a_1 \cdot I_F + a_0$				
Temp.[°C]	a_3	a_2	a_1	a_0
25	-	-1.85E-07	8.99E-04	2.31E-01
150	-	-3.00E-07	1.46E-03	3.75E-01

Recovery loss vs. Forward current

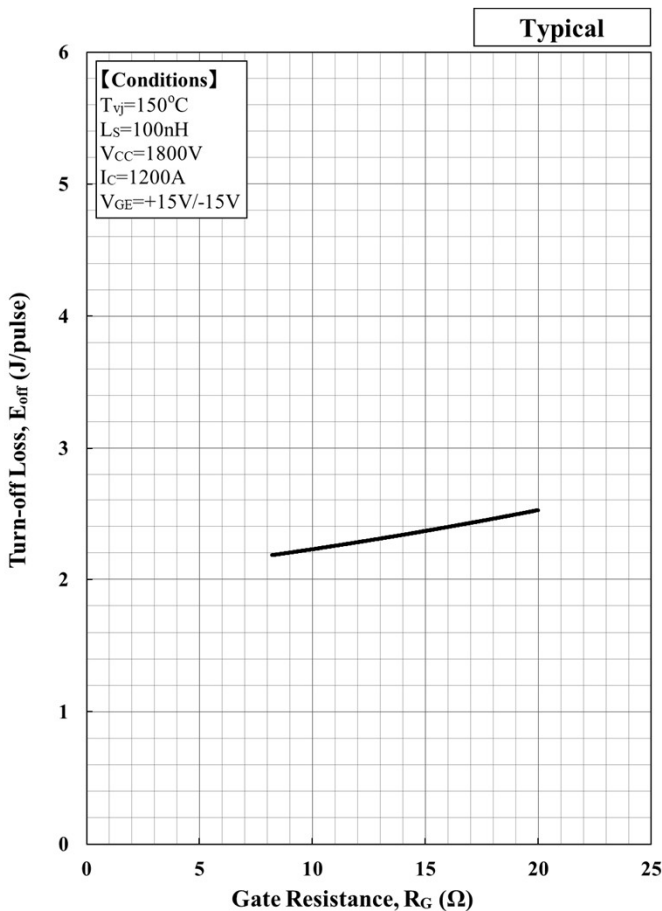


Switching time vs. Collector Current

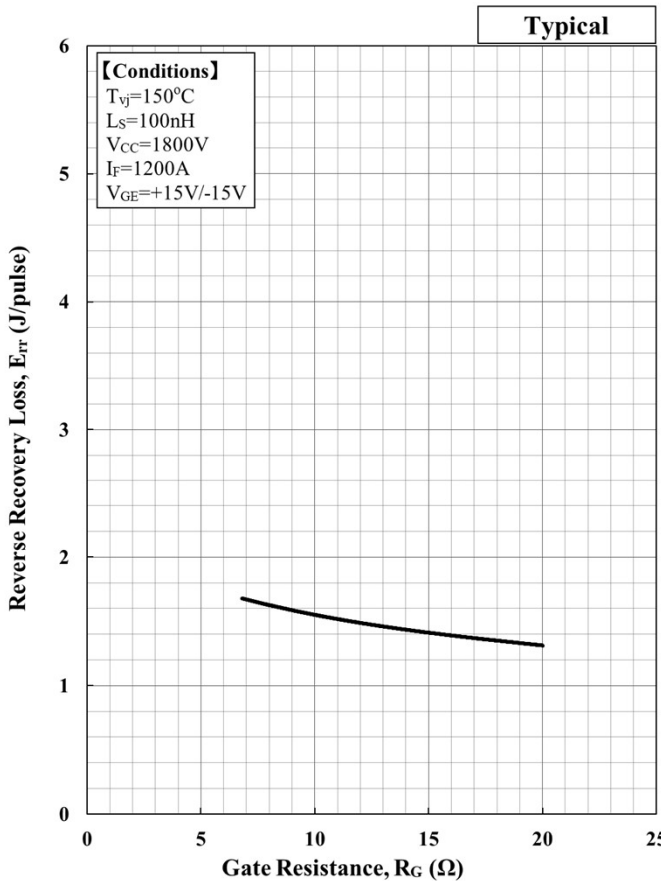
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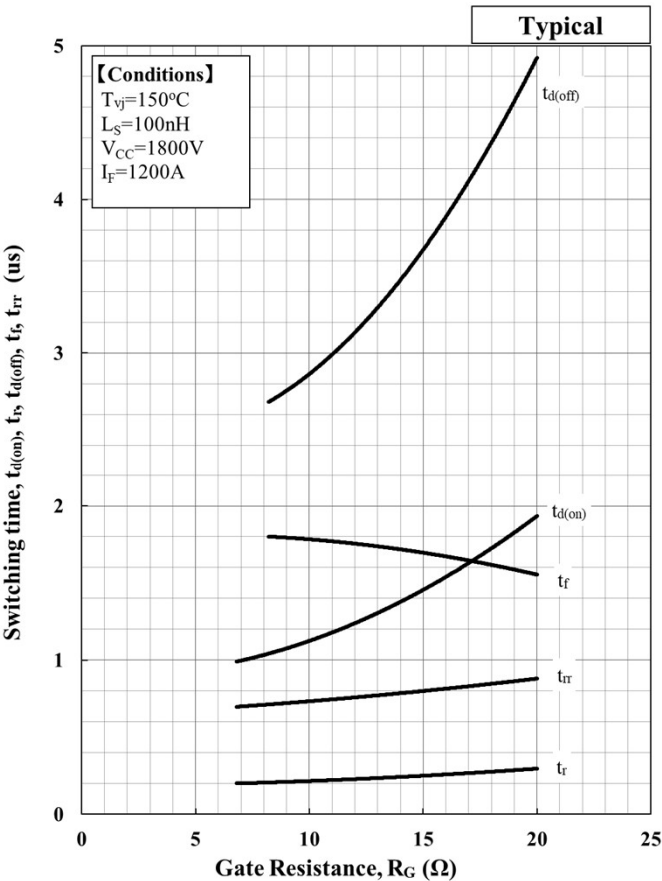
Turn-on loss vs. Gate Resistance



Turn-off loss vs. Gate Resistance

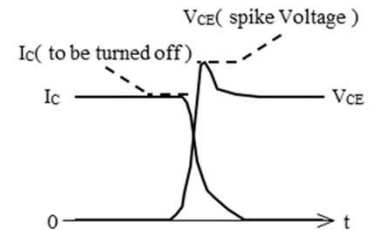
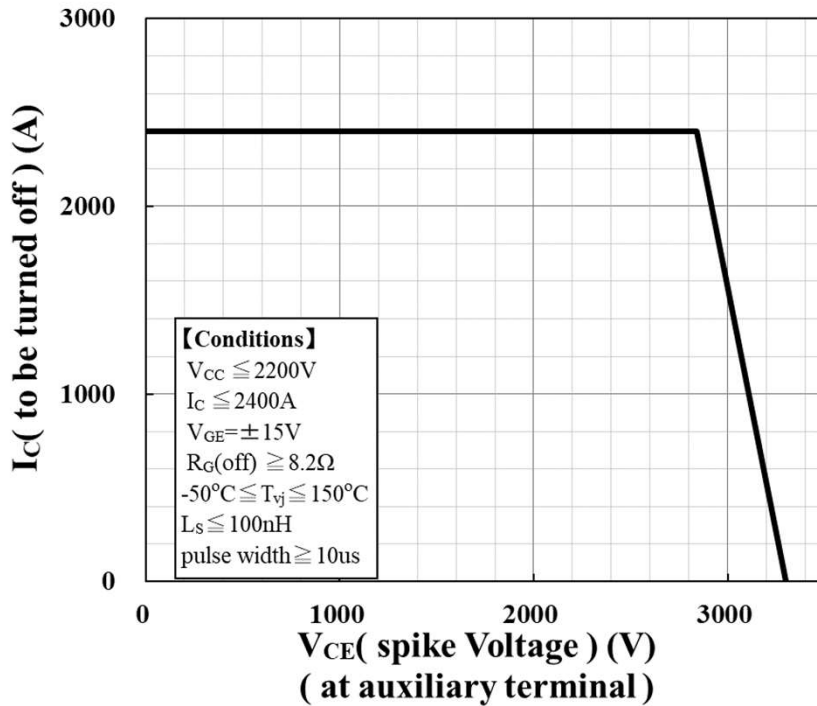


Recovery loss vs. Gate Resistance



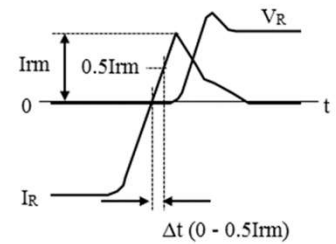
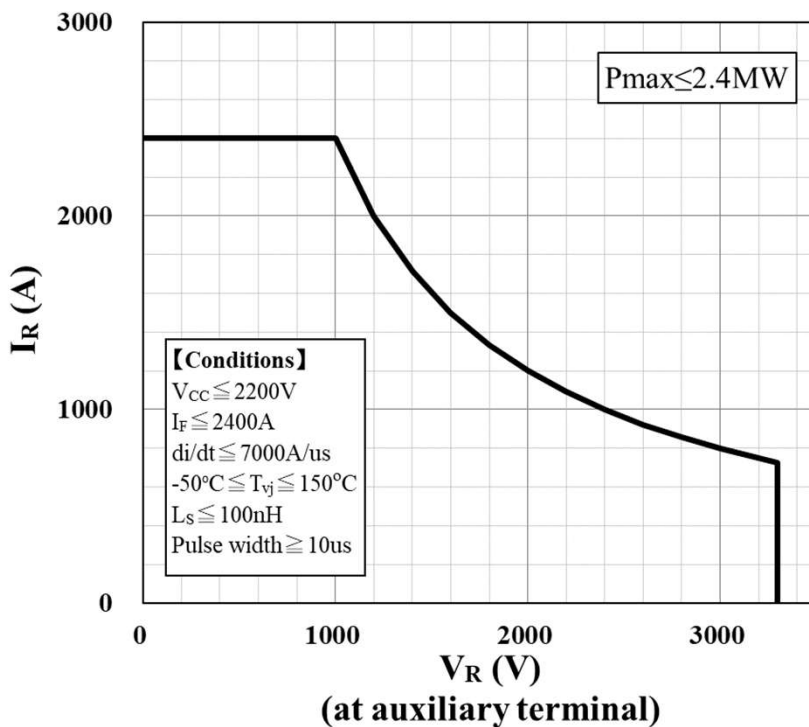
Switching time vs. Gate Resistance

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Definition of RBSOA waveform

Reverse Bias Safe Operation Area (RBSOA)

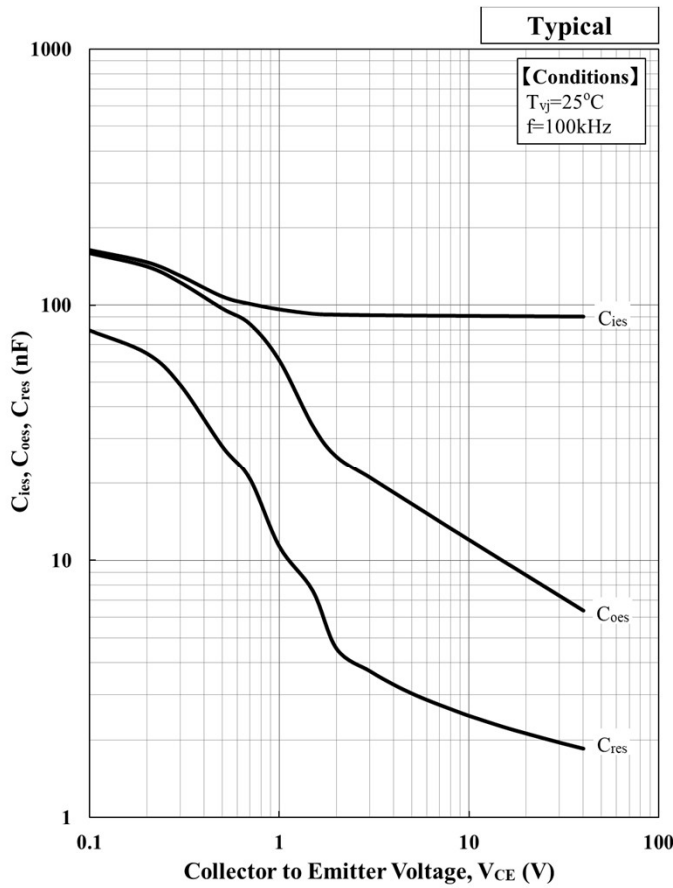


$$di/dt = \frac{0.5I_{rm}}{\Delta t}$$

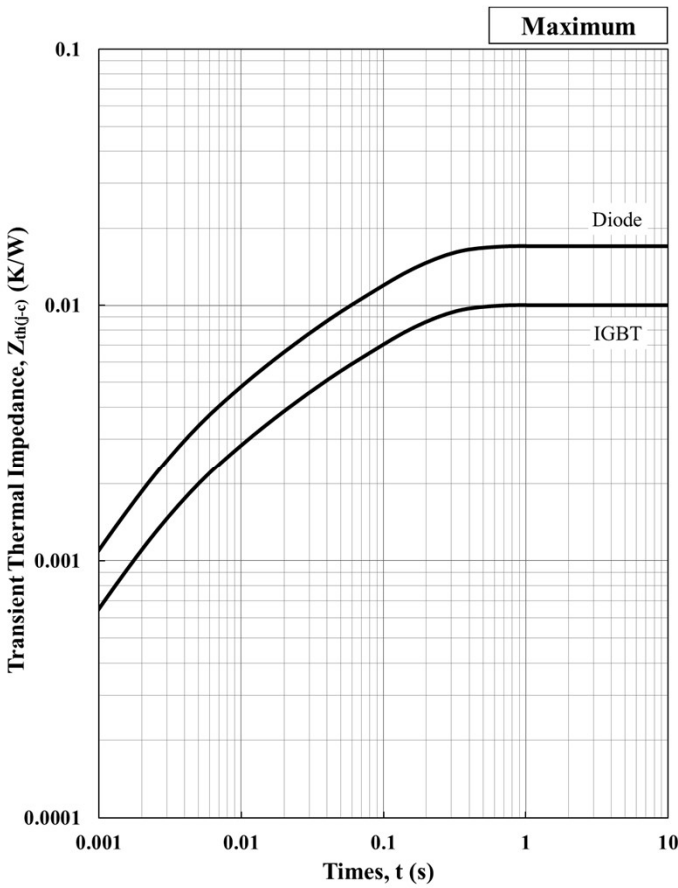
Definition of Recovery di/dt

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]	6.47E-03	2.18E-03	1.28E-03	7.04E-05	[K/W]
C th, IGBT [n]	1.98E+01	7.16E+00	2.10E+00	4.49E+00	[J/K]
R th, Diode [n]	1.10E-02	3.78E-03	2.13E-03	1.24E-04	[K/W]
C th, Diode [n]	1.17E+01	4.13E+00	1.26E+00	2.56E+00	[J/K]

Cauer model lumped circuit constant

n	1	2	3	4	Unit
R th, IGBT [n]	8.88E-04	1.68E-03	2.96E-03	4.48E-03	[K/W]
C th, IGBT [n]	1.12E+00	7.16E-01	5.36E+00	2.00E+01	[J/K]
R th, Diode [n]	1.48E-03	2.89E-03	5.04E-03	7.60E-03	[K/W]
C th, Diode [n]	6.61E-01	4.30E-01	3.10E+00	1.18E+01	[J/K]

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