MBN1000FH45F-H

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°C)

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

Notes: (1) Recommended Value 1.8±0.2/9±1N·m (2) Recommended Value 5.5±0.5N·m

ELECTRICAL CHARACTERISTICS

Item		Symbol	Unit	Min.	Typ.	Max.	Test Conditions
Collector Emitter Cut-Off Current		I_{CES}	mA	-	-	4	V_{CE}=4,500V, V_{GE}=0V, T_{vj}=25°C
				-	-	120	V_{CE}=4,500V, V_{GE}=0V, T_{vj}=150°C
Gate Emitter Leakage Current		I_{GES}	nA	-500	-	+500	V_{GE}=±20V, V_{CE}=0V, T_{vj}=25°C
Collector Emitter Saturation Voltage		$V_{CE(sat)}$	V	-	4.35	5.0	I_C=1,000A, V_{GE}=15V, T_{vj}=150°C
Gate Emitter Threshold Voltage		$V_{GE(th)}$	V	6.0	6.5	7.0	V_{CE}=10V, I_C=1,000mA, T_{vj}=25°C
Input Capacitance		C_{ies}	nF	-	55	-	V_{CE}=10V, V_{GE}=0V, f=100kHz, T_{vj}=25°C
Internal Gate Resistance		$R_{G(int)}$	Ω	-	3.9	-	V_{CE}=10V, V_{GE}=0V, f=100kHz, T_{vj}=25°C
Turn On Delay Time		$t_{d(on)}$	μs	-	0.5	-	V_{CC}=2,800V, I_C=1,000A
Rise Time		t_r		-	0.3	-	L_S=180nH
Turn Off Delay Time		$t_{d(off)}$		-	2.5	-	R_G(on/off)=4.7/4.7Ω (3)
Fall Time		t_f		-	0.7	-	V_{GE}=±15V, T_{vj}=150°C
Forward Voltage Drop		V_F	V	-	2.8	3.2	I_F=1,000A, V_{GE}=0V, T_{vj}=150°C
Reverse Recovery Time		t_{rr}	μs	-	1.3	-	V_{CC}=2,800V, I_F=1,000A, L_S=180nH T_{vj}=150°C
Turn On Loss		E_{on}	J/P	-	3.9	-	V_{CC}=2,800V, I_C=1,000A, L_S=180nH
Turn Off Loss		E_{off}	J/P	-	3.3	-	R_G(on/off)=4.7/4.7Ω (3)
Reverse Recovery Loss		E_{rr}	J/P	-	3.6	-	V_{GE}=±15V, T_{vj}=150°C
Short Circuit Pulse Width		t_{sc}	μs	10	-	-	V_{CC}=3,000V, Ls=180nH R_G(on/off)=4.7/47Ω,V_{GE}=±15V, T_{vj}=150°C
Partial discharge extinction voltage		V_e	V_{RMS}	3,500	-	-	f=50Hz, Q_{PD}≤10pC(acc. to IEC 61287)
Stray inductance module		L_{SCE}	nH	-	15	-	Collector Main to Emitter Main
Thermal Impedance	IGBT	$R_{th(j-c)}$	K/W	-	-	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 (λ grease = 1W/(m·K) heat-sink flatness ≤ 50μm)

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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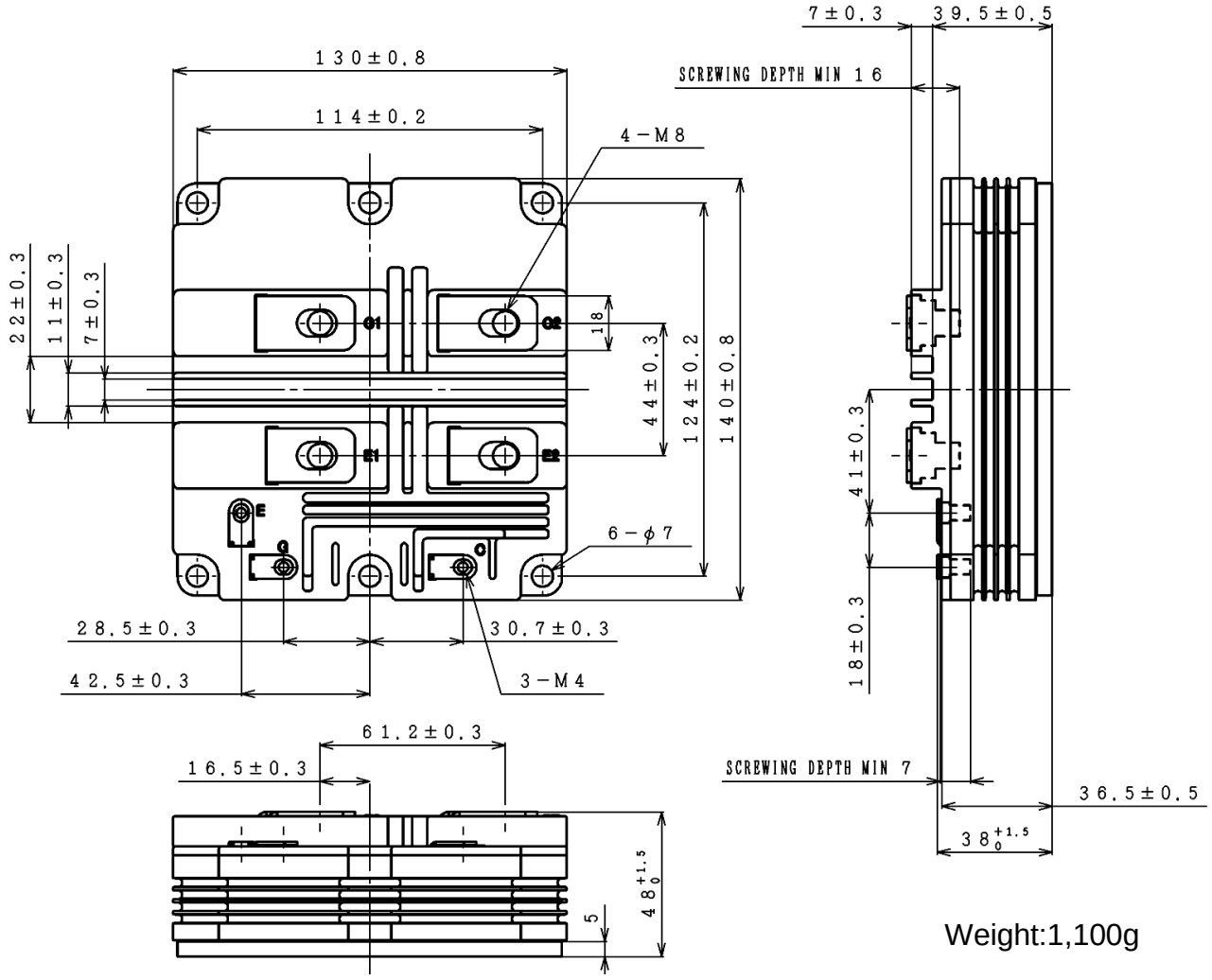
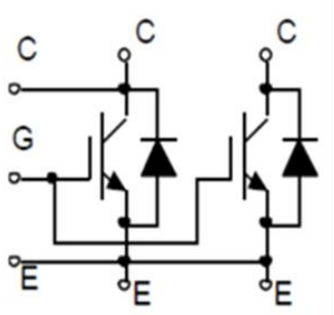
OUTLINE DRAWING

Unit in mm



Weight:1,100g

CIRCUIT DIAGRAM



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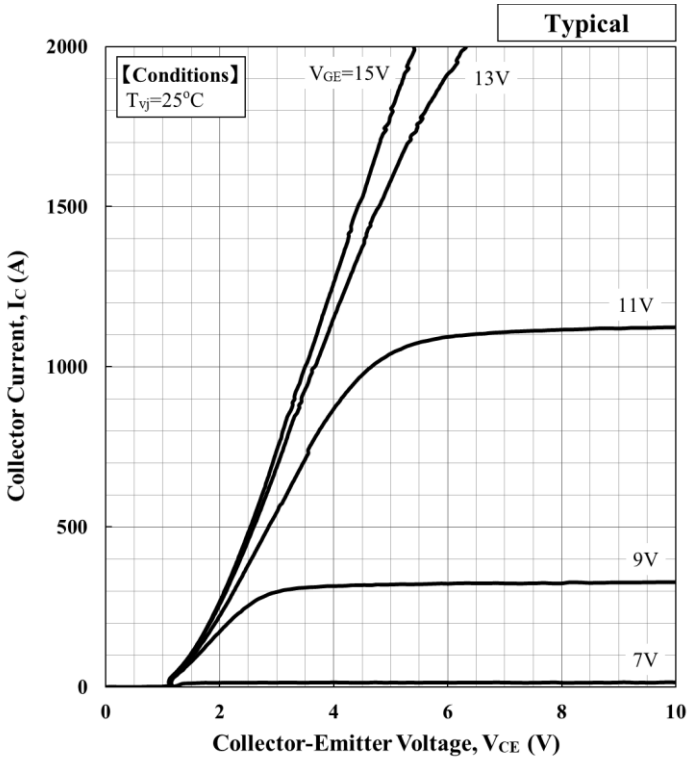
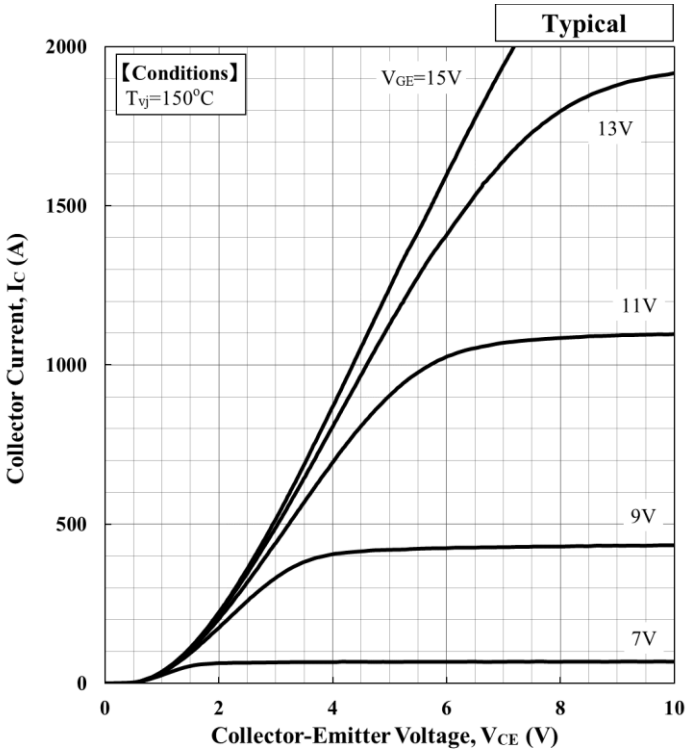


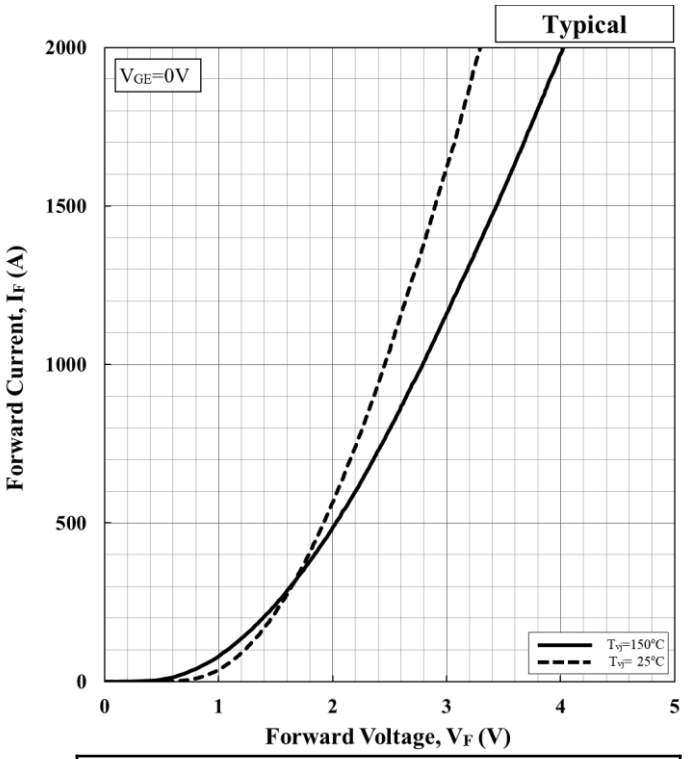
$V_{CE}(sat)[V] = a_3 \cdot \lvert I_c \rvert^3 + a_2 \cdot \lvert I_c \rvert^2 + a_1 \cdot \lvert I_c \rvert + a_0$					
Temp.[°C]	V_{GE}[V]	a_3	a_2	a_1	a_0
25	15	2.23E-10	-8.39E-07	2.86E-03	1.26E+00

Collector Current vs. Collector Emitter Voltage



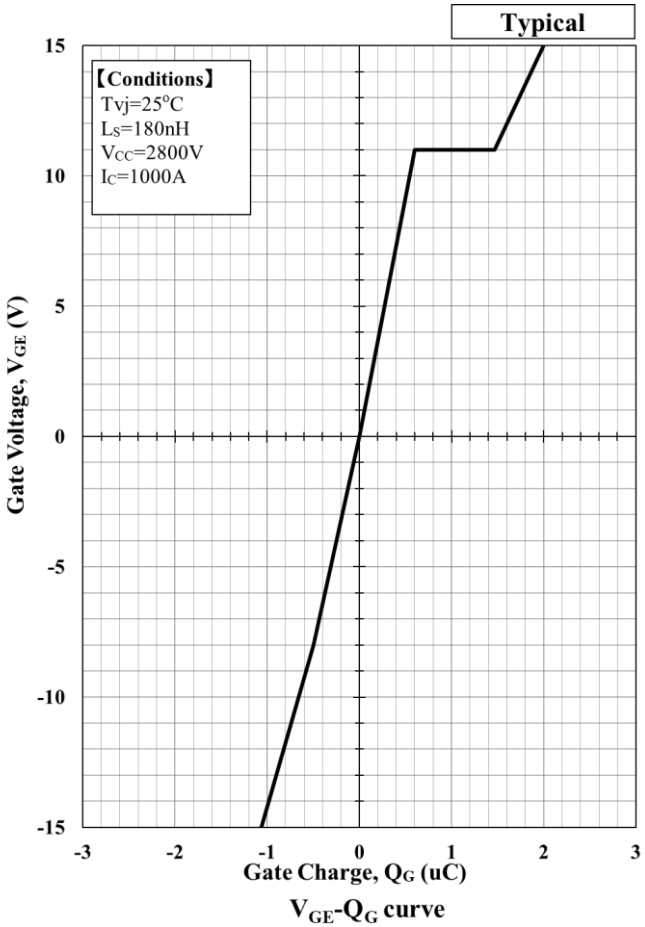
$V_{CE}(sat)[V] = a_3 \cdot \lvert I_c \rvert^3 + a_2 \cdot \lvert I_c \rvert^2 + a_1 \cdot \lvert I_c \rvert + a_0$					
Temp.[°C]	V_{GE}[V]	a_3	a_2	a_1	a_0
150	15	3.31E-10	-1.21E-06	4.13E-03	1.12E+00

Collector Current vs. Collector Emitter Voltage



$V_F[V] = a_3 \cdot \lvert I_F \rvert^3 + a_2 \cdot \lvert I_F \rvert^2 + a_1 \cdot \lvert I_F \rvert + a_0$				
Temp.[°C]	a_3	a_2	a_1	a_0
25	1.80E-10	-8.07E-07	2.01E-03	1.08E+00
150	2.89E-10	-1.25E-06	2.97E-03	8.06E-01

Forward Voltage of free-wheeling diode



V_{GE}-Q_G curve

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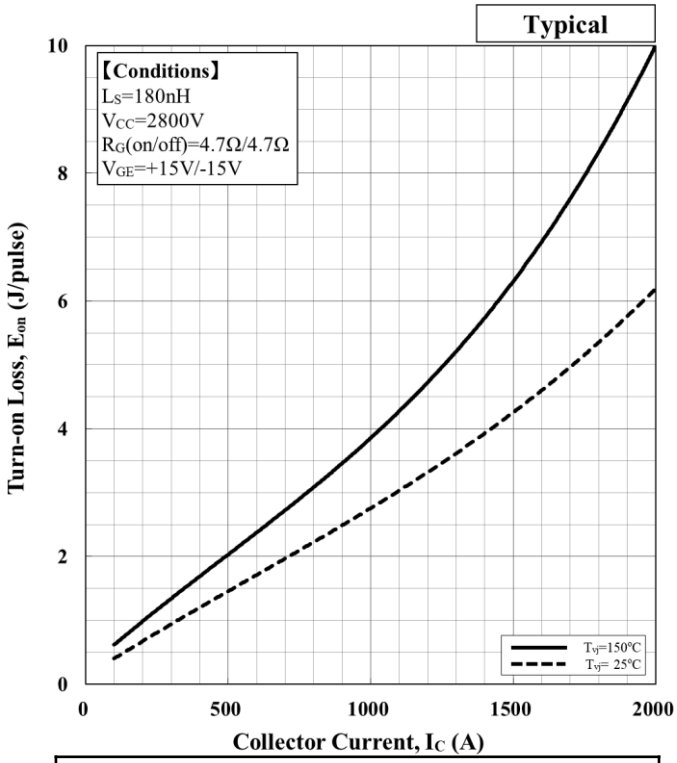
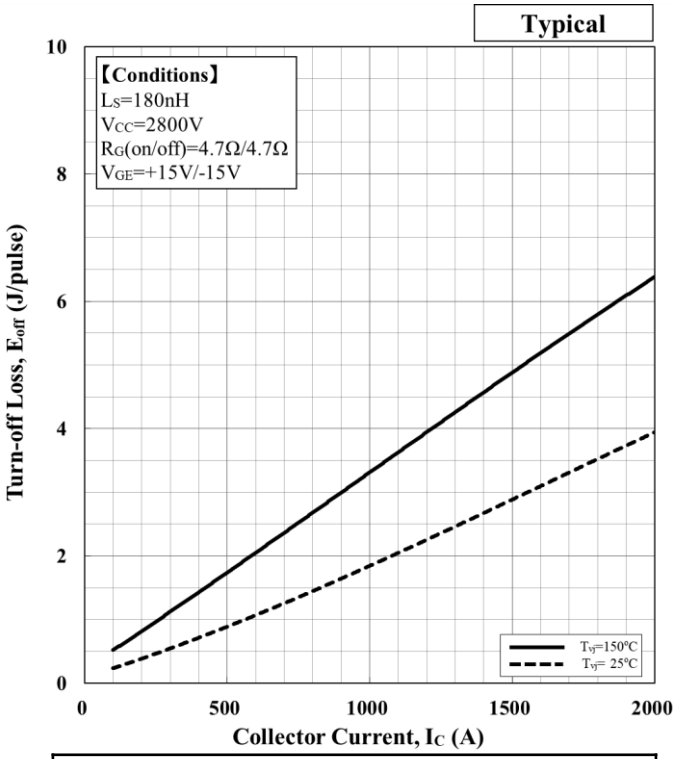


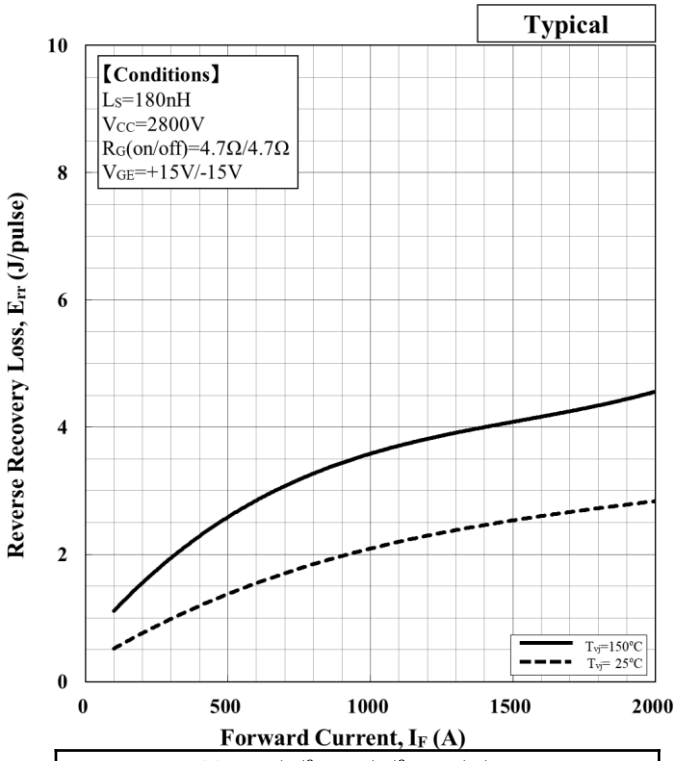
$E\,[J] = a_3 \cdot \lvert I_c \rvert^3 + a_2 \cdot \lvert I_c \rvert^2 + a_1 \cdot \lvert I_c \rvert + a_0$				
Temp.[°C]	a_3	a_2	a_1	a_0
25	3.18E-10	-5.51E-07	2.87E-03	1.23E-01
150	8.14E-10	-1.18E-06	4.00E-03	2.29E-01

Turn-on loss vs. Collector current



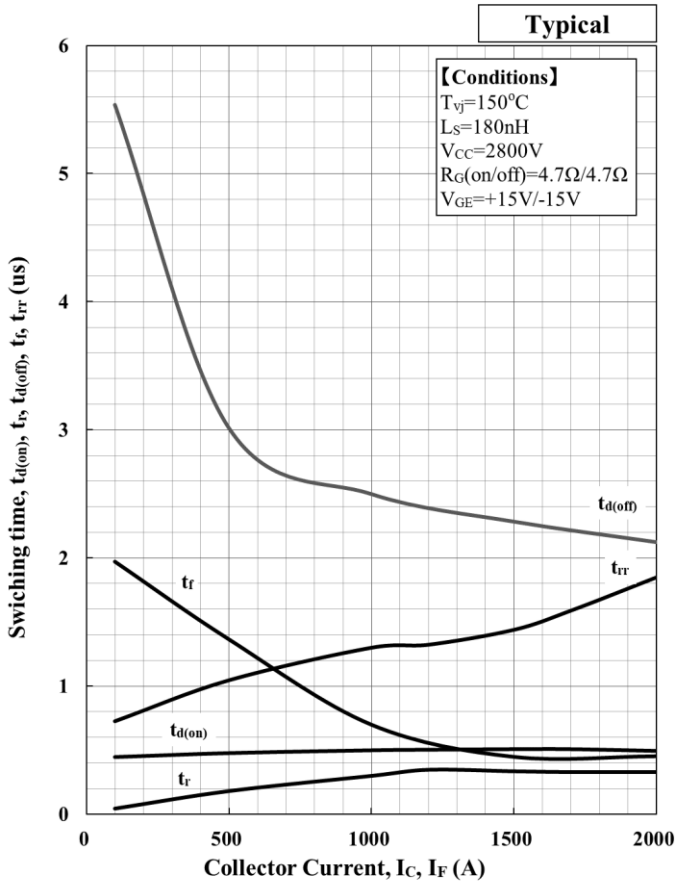
$E\,[J] = a_3 \cdot \lvert I_c \rvert^3 + a_2 \cdot \lvert I_c \rvert^2 + a_1 \cdot \lvert I_c \rvert + a_0$				
Temp.[°C]	a_3	a_2	a_1	a_0
25	-9.29E-11	4.52E-07	1.39E-03	9.14E-02
150	-8.53E-11	2.48E-07	2.92E-03	2.26E-01

Turn-off loss vs. Collector current



$E\,[J] = a_3 \cdot \lvert I_F \rvert^3 + a_2 \cdot \lvert I_F \rvert^2 + a_1 \cdot \lvert I_F \rvert + a_0$				
Temp.[°C]	a_3	a_2	a_1	a_0
25	1.76E-10	-1.07E-06	2.73E-03	2.60E-01
150	6.31E-10	-2.89E-06	5.22E-03	6.22E-01

Recovery loss vs. Forward current



Switching time vs. Collector Current

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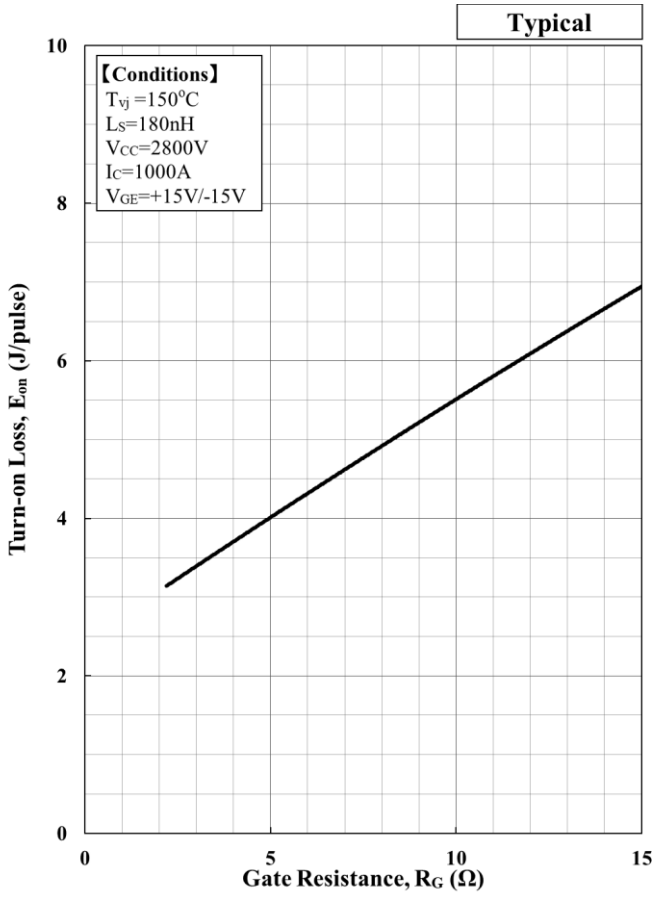
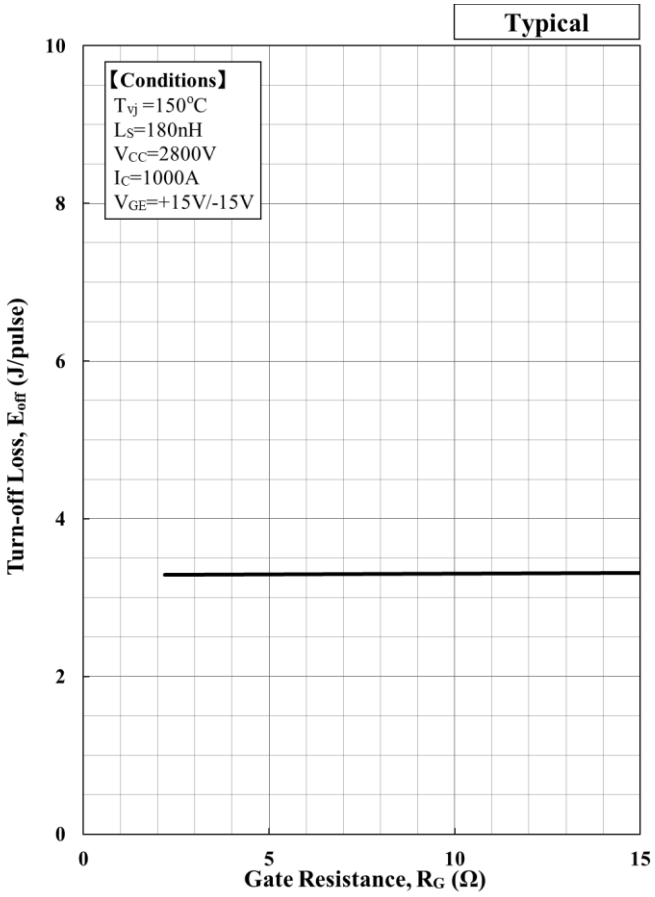
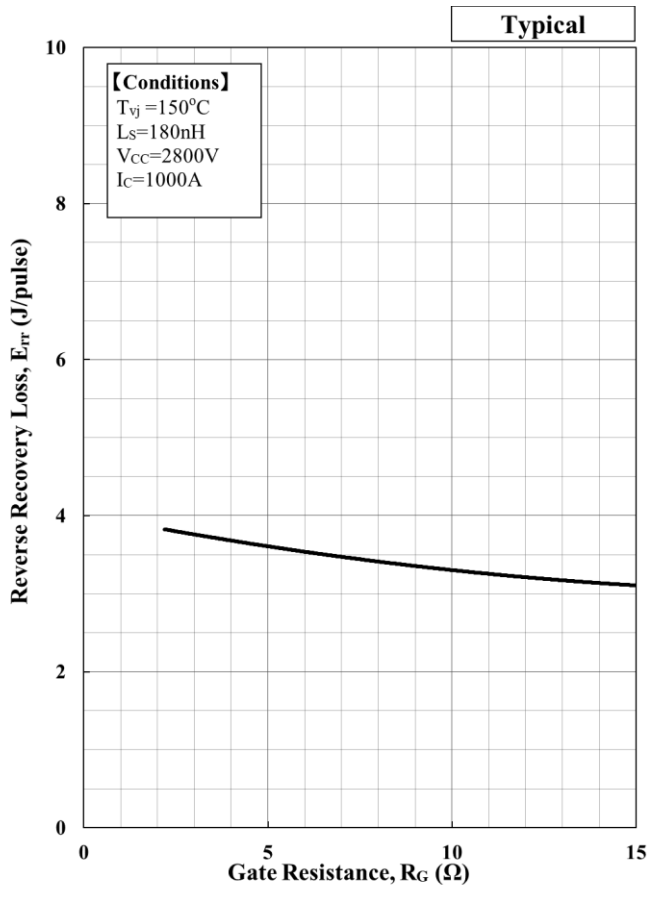


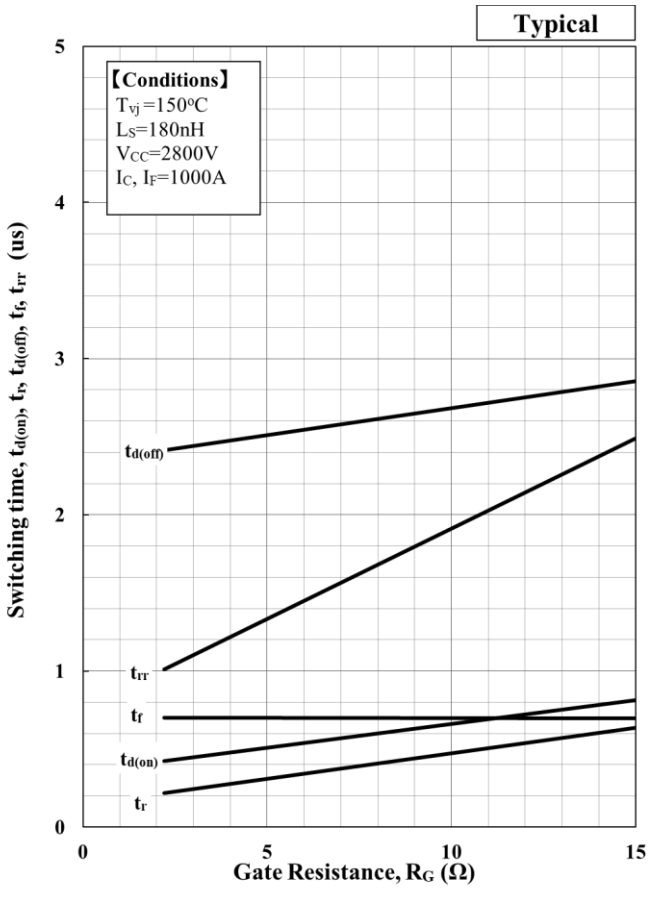
Turn-on Loss vs. Gate Resistance



Turn-off Loss vs. Gate Resistance



Reverse Recovery Loss vs. Gate Resistance



Switching time vs. Gate Resistance

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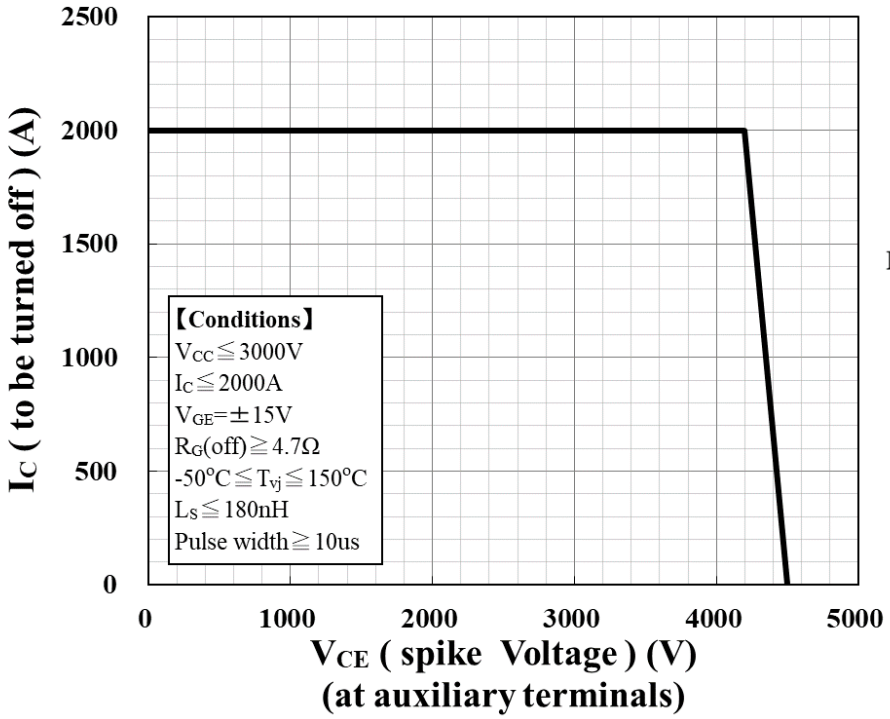
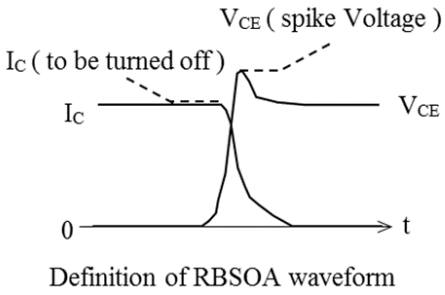
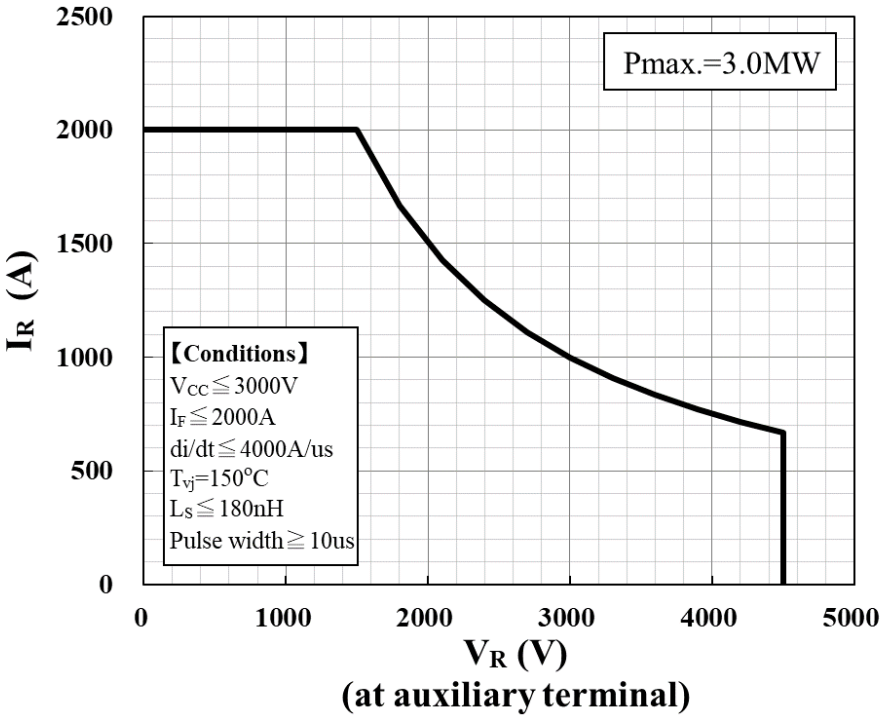
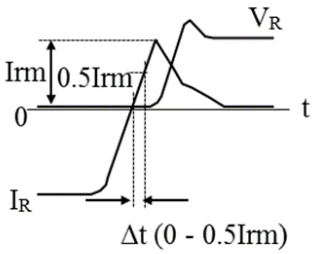




Definition of RBSOA waveform

Reverse bias safe operation area (RBSOA)





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

Definition of Recovery di/dt

Reverse recovery safe operation area (RRSOA)

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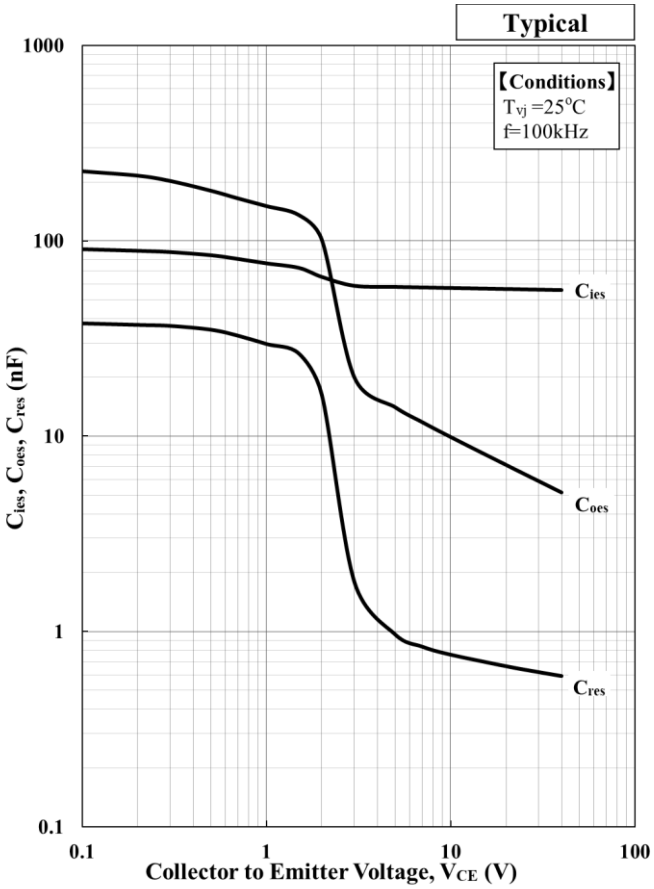
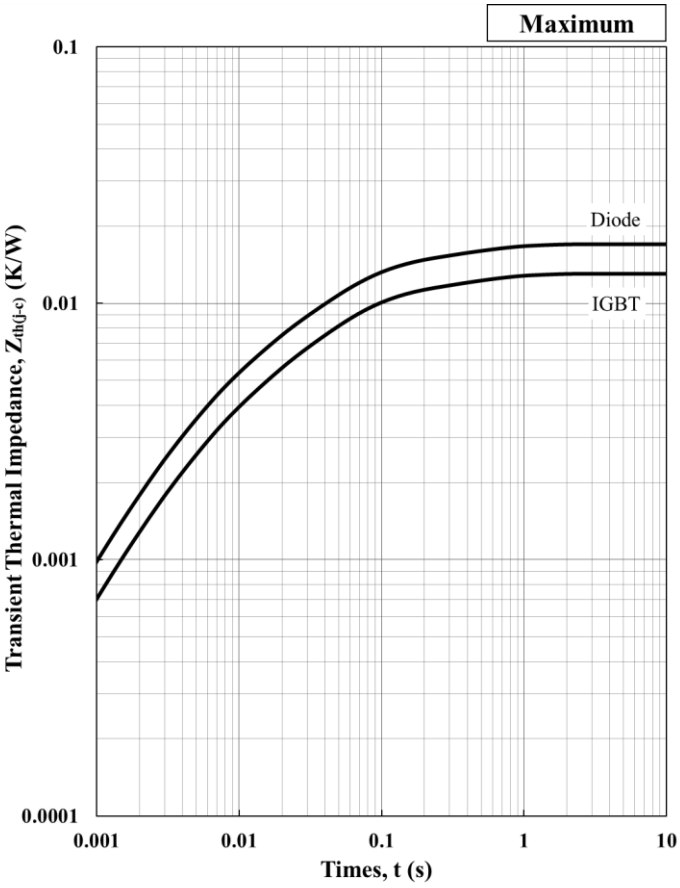


Capacitance vs. Collector to Emitter Voltage



Transient Thermal Ipedance 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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HITACHI POWER SEMICONDUCTORS

Notices

1. Since mishandling of semiconductor devices may cause malfunctions, please be sure to read "Precautions for Safe Use and Notices" in the individual brochure before use.
2. When designing an electronic circuit using semiconductor devices, please do not exceed the absolute maximum rating specified for the device under any external fluctuations. And for pulse applications, please also do not exceed the "Safe Operating Area (SOA)".
3. Semiconductor devices may sometimes break down by accidental or unexpected surge voltage, so please be careful about the safety design such as redundant design and malfunction prevention design which don't cause the damage expand even if they break down.
4. In cases where extremely high reliability is required (such as use in nuclear power control, aerospace and aviation, traffic equipment, life-support-related medical equipment, fuel control equipment and various kinds of safety equipment), safety should be ensured by using semiconductor devices that feature assured safety or by means of users' fail-safe precautions or other arrangement. Or consult with Hitachi's sales department staff. (When semiconductor devices fail, as a result the semiconductor devices or wiring, wiring pattern may smoke, ignite, or the semiconductor devices themselves may burst.)
5. A semi-processed article is done now using solder which contains lead inside the semiconductor devices. There is possibility of the regulation substance depend on the applied models, so please check before using.
6. This specification is a material for component selection, which describes specifications of power semiconductor devices (hereinafter referred to as products), characteristic charts, and external dimension drawings.
7. The information given herein, including the specifications and dimensions, is subject to change without prior notice to improve product characteristics. Before ordering, purchasers are advised to contact with Hitachi power semiconductor sales department for the latest version of this data sheets.
8. For handling other than described in this manual, follow the handling instructions (IGBT-HI-00002).

■ For inquiries relating to the products, please contact nearest representatives that is located "Inquiry" portion on the top page of a home page.

Hitachi power semiconductor home page address
http://www.hitachi-power-semiconductor-device.co.jp/
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HITACHI POWER SEMICONDUCTORS

Usage

1. HPSD warrants that the HPSD products have the specified performance according to the respective specifications at the time of its sale. Testing and other quality control techniques of the HPSD products by HPSD are utilized to the extent HPSD needs to meet the specifications described in this document. Not every device of the HPSD products is specifically tested on all parameters, except those mandated by relevant laws and/or regulations.
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