MBM500E33E2-R

Silicon N-channel IGBT 3300V E2 version

FEATURES

* Soft switching behavior, low switching loss & low conduction loss :
  Soft low-injection punch-through High conductivity IGBT.
* Low driving power due to low input capacitance MOS gate.
* Low noise recovery: Ultra soft fast recovery diode.
* High thermal fatigue durability:
  (delta Tc=70K, N>30,000cycles)
  AlSiC base-plate/AlN substrate

ABSOLUTE MAXIMUM RATINGS (T_C=25°C)

Item		Symbol	Unit	MBM500E33E2-R
Collector Emitter Voltage		V_{CES}	V	3,300
Gate Emitter Voltage		V_{GES}	V	±20
Collector Current	DC	I_C	A	500
	1ms	I_{CRM}		1,000
Forward Current	DC	I_F	A	500
	1ms	I_{FRM}		1,000
Operating Junction Temperature		$T_{vj\ op}$	°C	-50 ~ +150
Maximum Junction Temperature		$T_{vj\ max}$	°C	175 (1)
Storage Temperature		T_{stg}	°C	-55 ~ +125
Isolation Voltage		V_{ISO}	V_{RMS}	6,000(AC 1 minute)
Screw Torque	Terminals (M4/M8)	-	N·m	2/15 (2)
	Mounting (M6)	-		6 (3)

Notes: (1) Only static operation is applicable. Please refer to LD-ES-130737.
(https://www.hitachi-power-semiconductor-device.co.jp/products/igbt/pdf/junction_temperature.pdf)
(2) Recommended Value 1.8±0.2/15$^{+0}_{-3}$N·m (3) 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}=3,300V, V_{GE}=0V, T_{vj}=25°C	
			-	7	20	V_{CE}=3,300V, 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_{CEsat}	V	2.5	2.95	3.5	I_C=500A, V_{GE}=15V, T_{vj}=125°C	
			-	3.1	-	I_C=500A, V_{GE}=15V, T_{vj}=150°C	
Gate Emitter Threshold Voltage	$V_{GE(th)}$	V	5.5	6.5	7.5	V_{CE}=10V, I_C=500mA, T_{vj}=25°C	
Input Capacitance	C_{ies}	nF	-	65	-	V_{CE}=10V, V_{GE}=0V, f=100kHz, T_{vj}=25°C	
Internal Gate Resistance	$R_{G(int)}$	Ω	-	2.1	-	V_{CE}=10V, V_{GE}=0V, f=100kHz, T_{vj}=25°C	
Turn On Delay Time	$t_{d(on)}$	μs	-	0.4	-	V_{CC}=1650V, I_C=500A	
Rise Time	t_r		0.8	1.3	1.8	L_S=150nH	
Turn Off Delay Time	$t_{d(off)}$		-	2.1	-	$R_{G(on/off)}$=5.6/8.2Ω (4)	
Fall Time	t_f		0.9	1.7	2.6	V_{GE}=±15V, T_{vj}=125°C	
Forward Voltage Drop	V_F	V	2.2	2.5	3.0	I_F=500A, V_{GE}=0V, T_{vj}=125°C	
			-	2.5	-	I_F=500A, V_{GE}=0V, T_{vj}=150°C	
Reverse Recovery Time	t_{rr}	μs	-	0.60	0.87	V_{CC}=1,650V, I_F=500A, L_S=150nH $R_{G(on)}$=5.6Ω, V_{GE}=±15V, T_{vj}=125°C	
Short Circuit Pulse Width	t_{sc}	μs	10	-	-	V_{CC}=2200V,Ls=130nH $R_{G(on/off)}$=5.6/82Ω, V_{GE}=±15V, T_{vj}=150°C	
Turn On Loss	$E_{on(10\%)}$	J/P	-	0.65	0.95	T_{vj}=125°C	V_{CC}=1650V, I_C=500A L_S=150nH $R_{G(on/off)}$=5.6/8.2Ω (4) V_{GE}=±15V
	$E_{on(full)}$		-	0.70	-		
			-	0.75	-	T_{vj}=150°C	
Turn Off Loss	$E_{off(10\%)}$	J/P	-	0.72	0.86	T_{vj}=125°C	
	$E_{off(full)}$		-	0.79	-		
			-	0.82	-	T_{vj}=150°C	
Reverse Recovery Loss	$E_{rr(10\%)}$	J/P	-	0.66	0.80	T_{vj}=125°C	
	$E_{rr(full)}$		-	0.78	-		
			-	0.93	-	T_{vj}=150°C	

Notes: (4) RG is the test condition's value for evaluation of the switching times, not recommended value. Please, determine the suitable RG value after the measurement of switching waveforms(overshoot voltage, etc.) with appliance mounted.

* 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.

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THERMAL CHARACTERISTICS

Item		Symbol	Unit	Min.	Typ.	Max.	Test Conditions
Thermal Impedance	IGBT	$R_{th(j-c)}$	K/W	-	-	0.024	Junction to case
	FWD	$R_{th(j-c)}$		-	-	0.049	
Contact Thermal Impedance		$R_{th(c-f)}$	K/W	-	0.008	-	Case to fin.(λ grease=1W/(m·K) Heat-sink flatness ≤ 50μm

MODULE MECHANICAL CHARACTERISTICS

Item		Unit	Characteristics	Conditions
Weight		g	900	
Creepage Distance	Between terminal	mm	>34	E2aux-C2aux
	Terminal-Base	mm	>32	Base-E1aux
Clearance Distance	Between terminal	mm	>19	C1main-E1aux
	Terminal-Base	mm	>28	Base-E1aux
Stray inductance in module		nH	36	Collector-main to Emitter-main
Comparative Tracking Index (CTI)			600	
Module base plate Material			Al-SiC	
Baseplate Thickness		mm	5	
Insulation plate Material			Al N	
Terminal Surface treatment			Ni plating	
Case Material			Poly-Phenilene Sulfide	
Fire and Smoke Category			I2 / F3	NFF 16-102

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DEFINITION OF TEST CIRCUIT

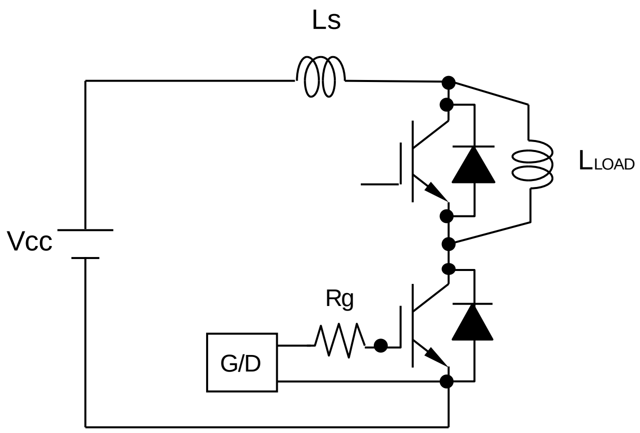
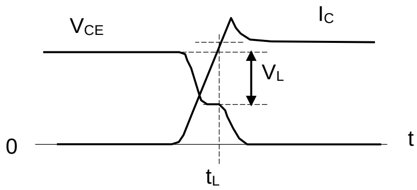
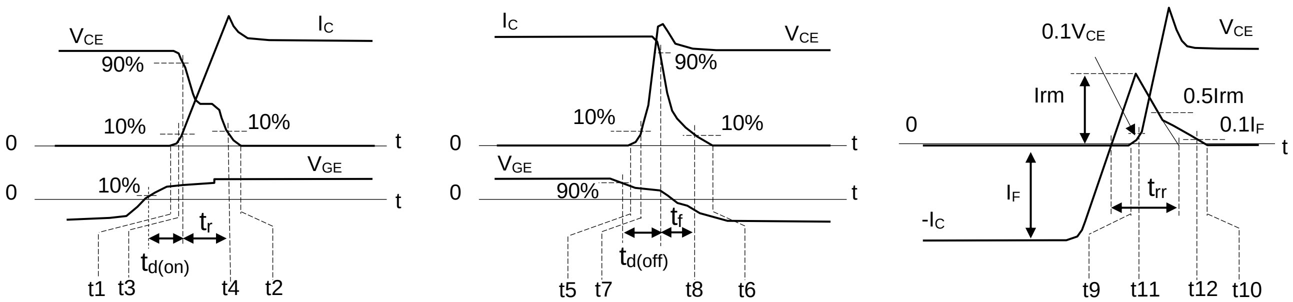


Fig.1 Switching test circuit



$$L_S = \frac{V_L}{\left(\frac{dI_C}{dt}\right)_{t=t_L}}$$

Fig.2 Definition of stray inductance



$$E_{on(10\%)} = \int_{t3}^{t4} I_C \cdot V_{CE}\, dt \qquad E_{off(10\%)} = \int_{t7}^{t8} I_C \cdot V_{CE}\, dt \qquad E_{rr(10\%)} = \int_{t11}^{t12} I_F \cdot V_{CE}\, dt$$

$$E_{on(Full)} = \int_{t1}^{t2} I_C \cdot V_{CE}\, dt \qquad E_{off(Full)} = \int_{t5}^{t6} I_C \cdot V_{CE}\, dt \qquad E_{rr(Full)} = \int_{t9}^{t10} I_F \cdot V_{CE}\, dt$$

Fig.3 Definition of switching loss

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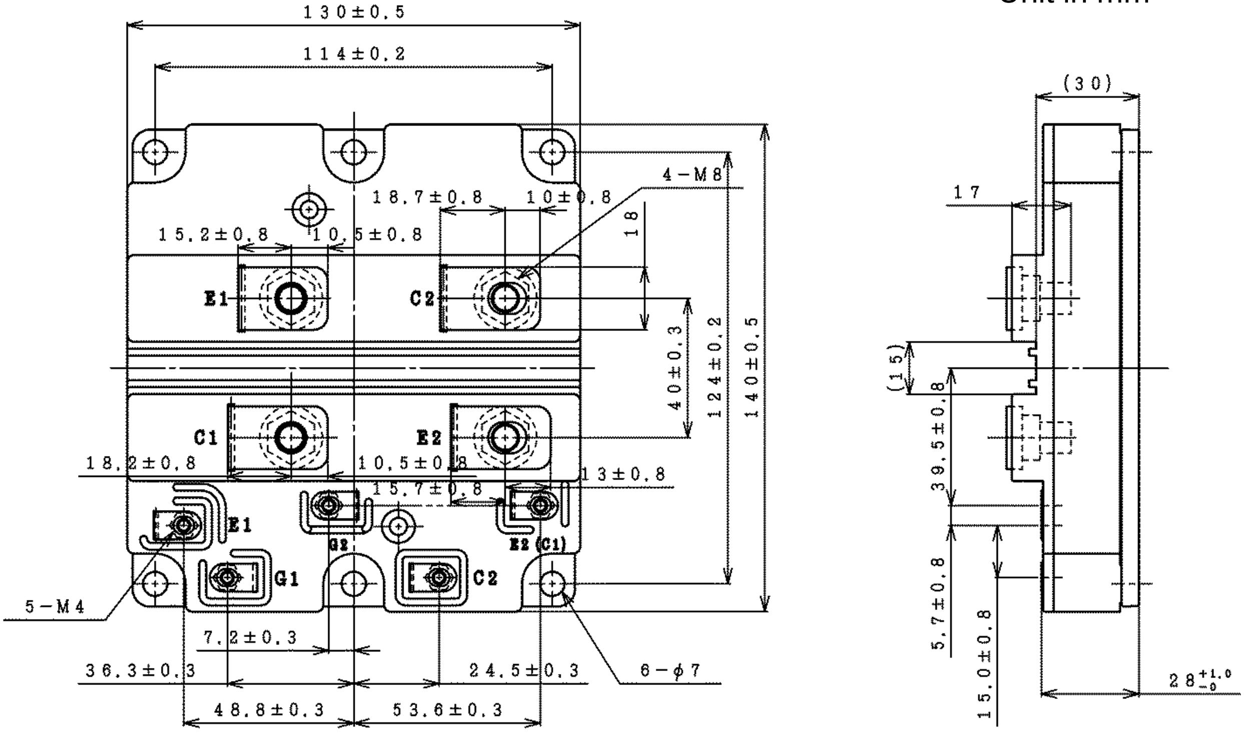
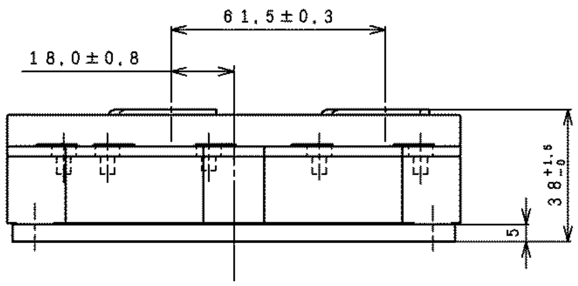
OUTLINE DRAWING

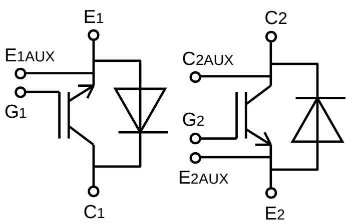
Unit in mm





Weight: 900g

CIRCUIT DIAGRAM



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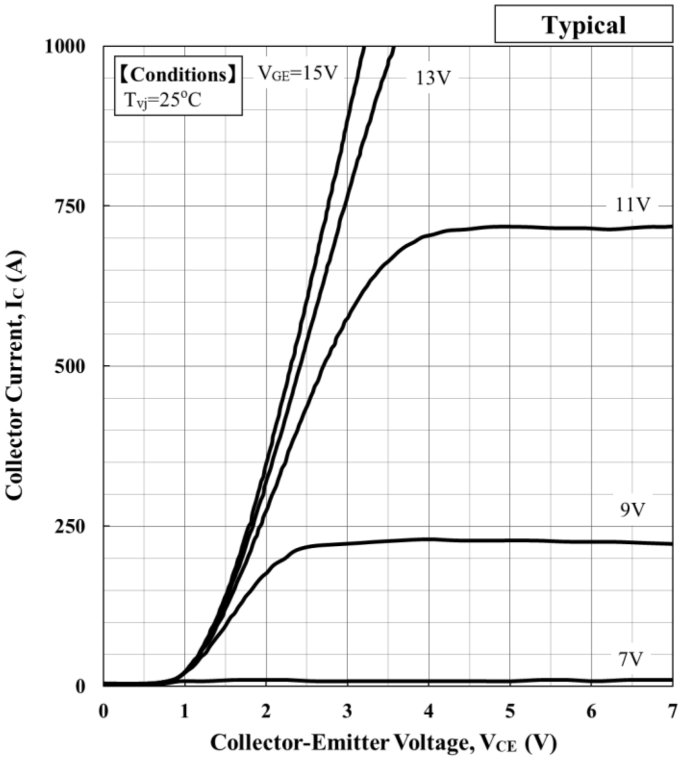
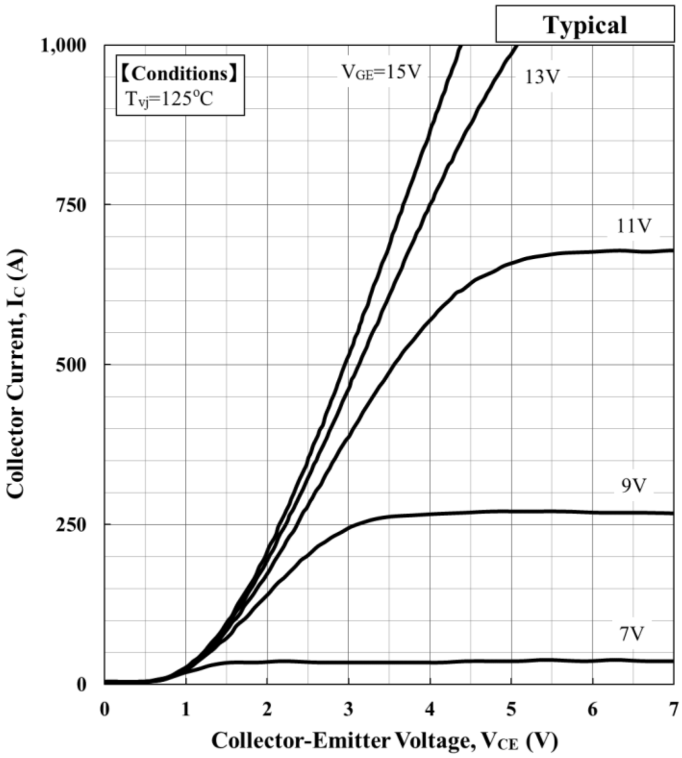


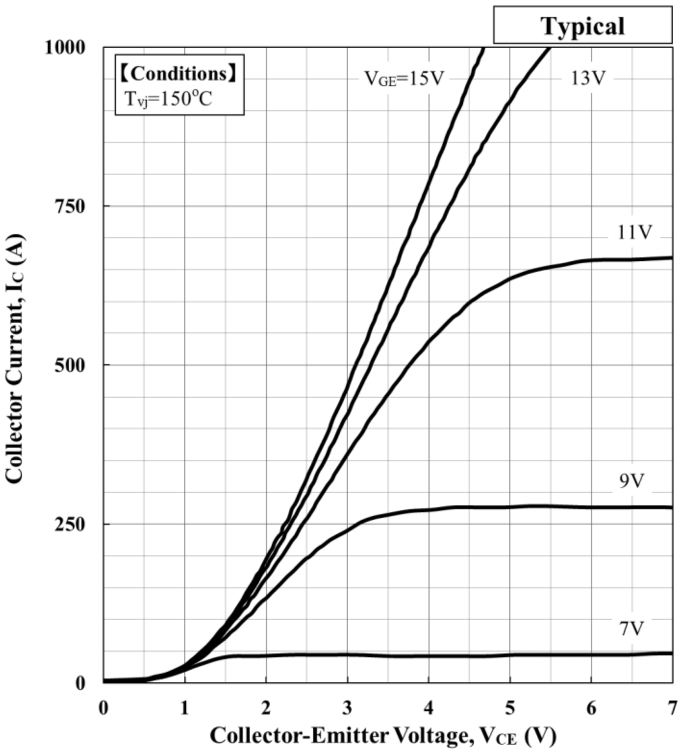
$V_{CE}(sat)[V] = a_3 \cdot \lvert I_c \rvert^3 + a_2 \cdot \lvert I_c \rvert^2 + a_1 \cdot \lvert I_c \rvert + a_0$					
Temp.[°C]	V_{GE}[V]	a_3	a_2	a_1	a_0
25	15	1.05E-09	-2.33E-06	3.44E-03	1.04E+00

Collector Current vs. Collector Emitter Voltage



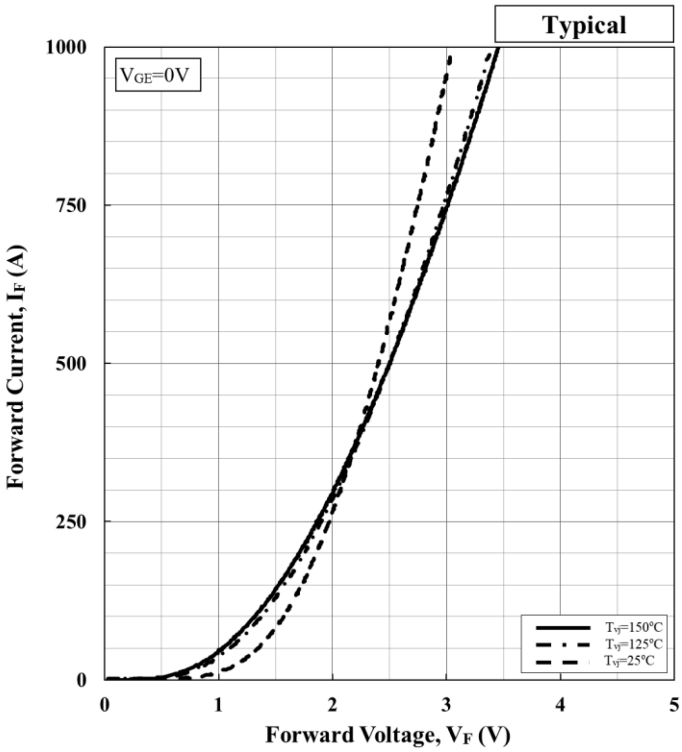
$V_{CE}(sat)[V] = a_3 \cdot \lvert I_c \rvert^3 + a_2 \cdot \lvert I_c \rvert^2 + a_1 \cdot \lvert I_c \rvert + a_0$					
Temp.[°C]	V_{GE}[V]	a_3	a_2	a_1	a_0
125	15	1.55E-09	-3.37E-06	5.17E-03	1.03E+00

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	1.71E-09	-3.67E-06	5.61E-03	1.01E+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	1.26E-09	-2.97E-06	3.52E-03	1.24E+00
125	1.44E-09	-3.54E-06	4.54E-03	9.47E-01
150	1.51E-09	-3.64E-06	4.72E-03	8.75E-01

Forward Voltage of free-wheeling diode

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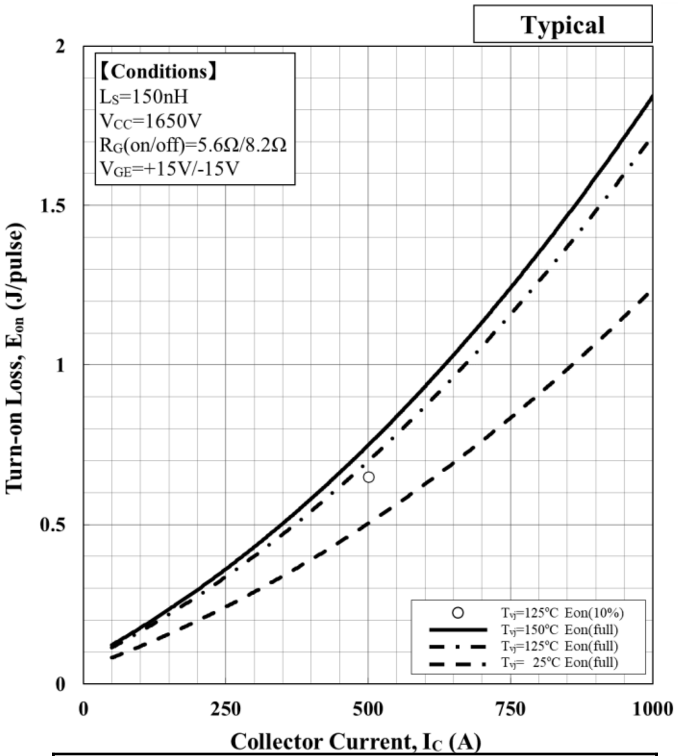
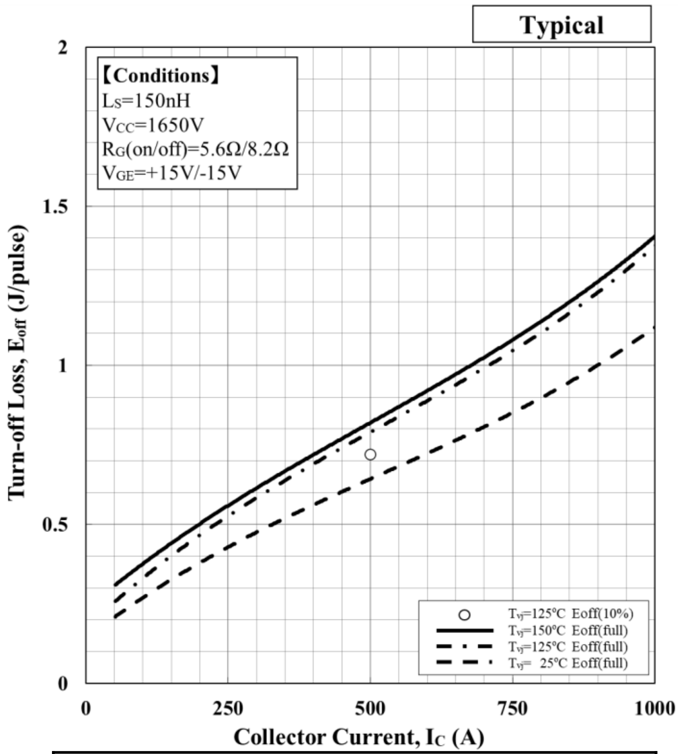


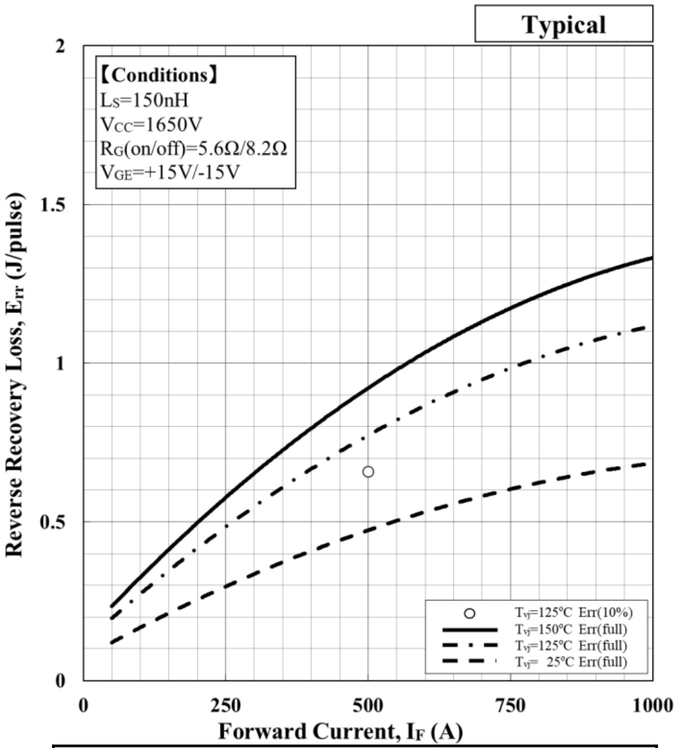
$E\,[J] = a_3 \cdot \lvert I_c\rvert^3 + a_2 \cdot \lvert I_c\rvert^2 + a_1 \cdot \lvert I_c\rvert + a_0$				
Temp.[°C]	a_3	a_2	a_1	a_0
25	2.82E-11	5.21E-07	6.40E-04	4.93E-02
125	3.92E-11	7.24E-07	8.89E-04	6.85E-02
150	4.20E-11	7.76E-07	9.52E-04	7.34E-02

Turn-on loss vs. Collector current



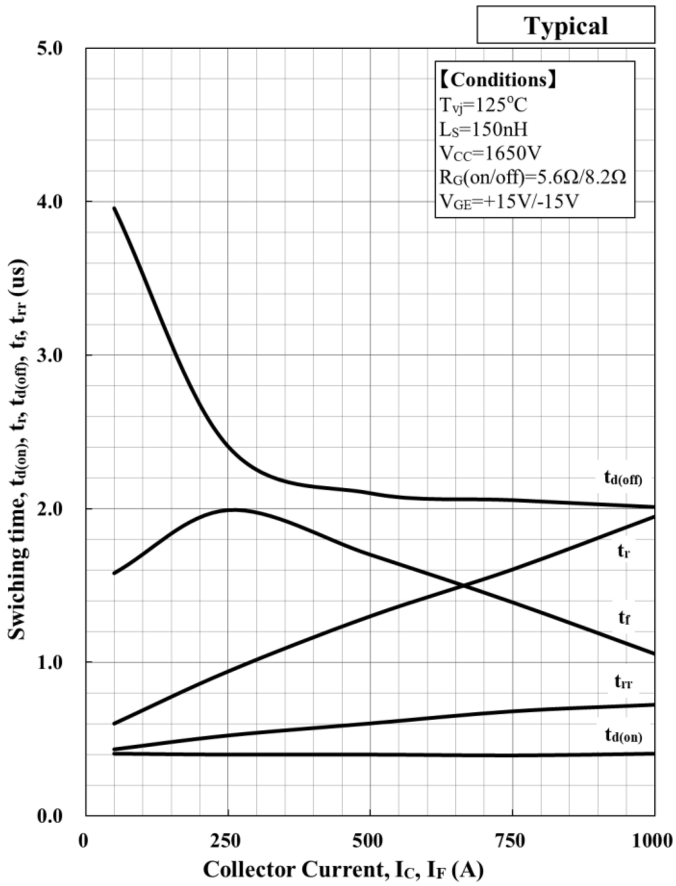
$E\,[J] = a_3 \cdot \lvert I_c\rvert^3 + a_2 \cdot \lvert I_c\rvert^2 + a_1 \cdot \lvert I_c\rvert + a_0$				
Temp.[°C]	a_3	a_2	a_1	a_0
25	7.11E-10	-1.12E-06	1.38E-03	1.42E-01
125	8.74E-10	-1.37E-06	1.70E-03	1.74E-01
150	6.88E-10	-1.03E-06	1.51E-03	2.35E-01

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	0.00E+00	-3.82E-07	9.95E-04	7.17E-02
125	0.00E+00	-6.24E-07	1.62E-03	1.17E-01
150	0.00E+00	-7.43E-07	1.94E-03	1.40E-01

Recovery loss vs. Forward current



Switching time vs. Collector Current

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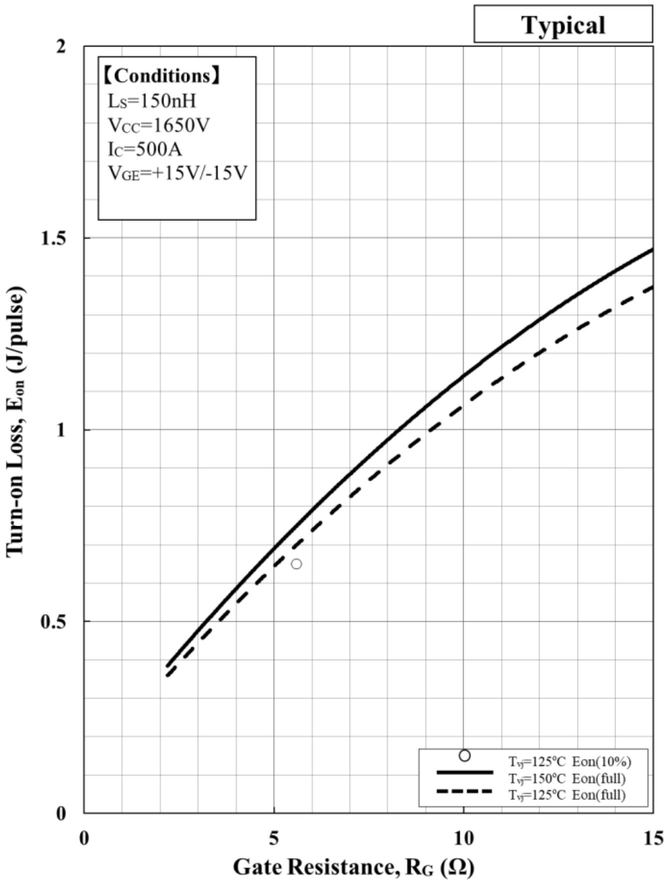
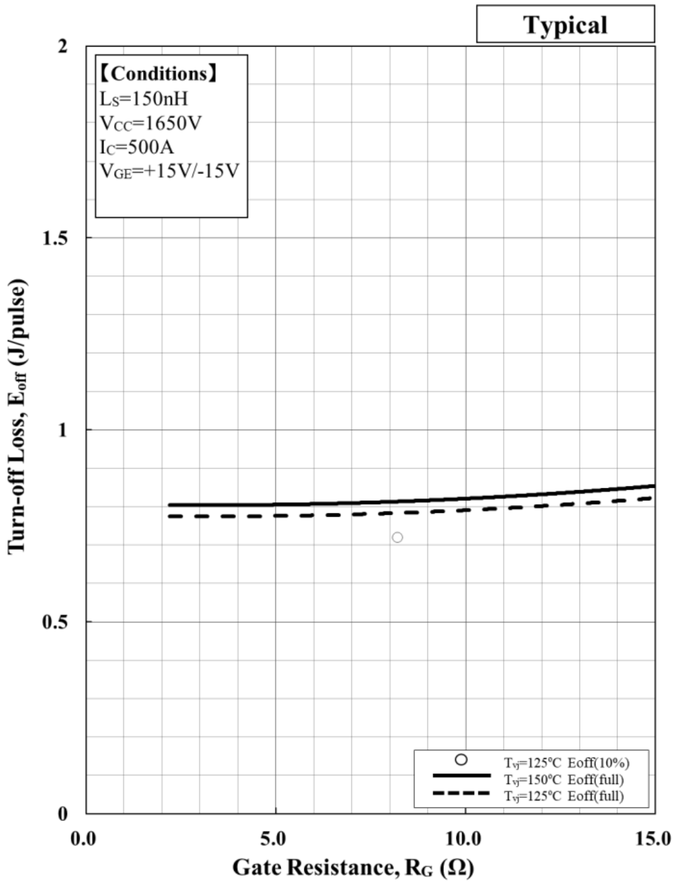
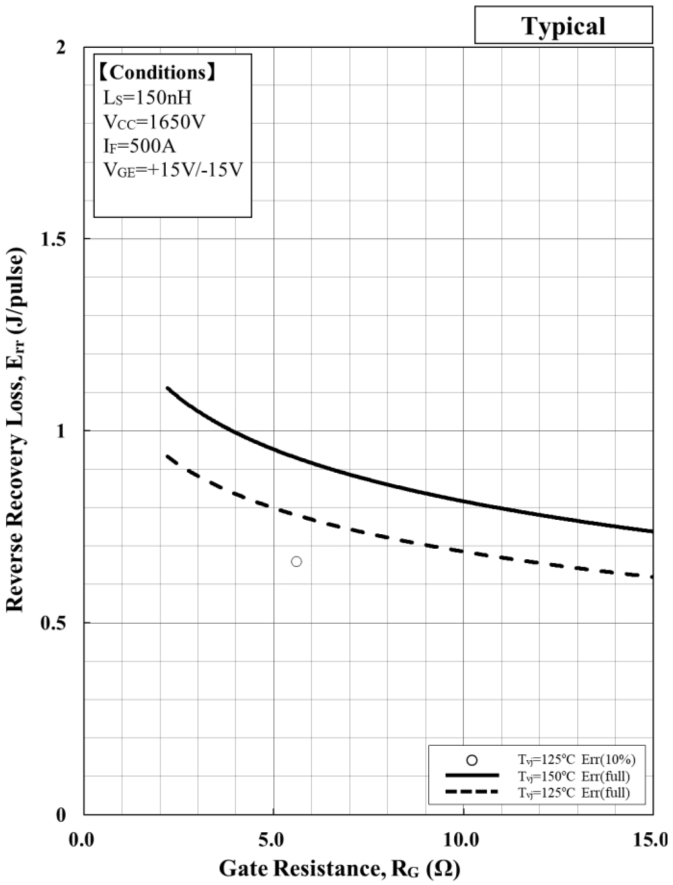


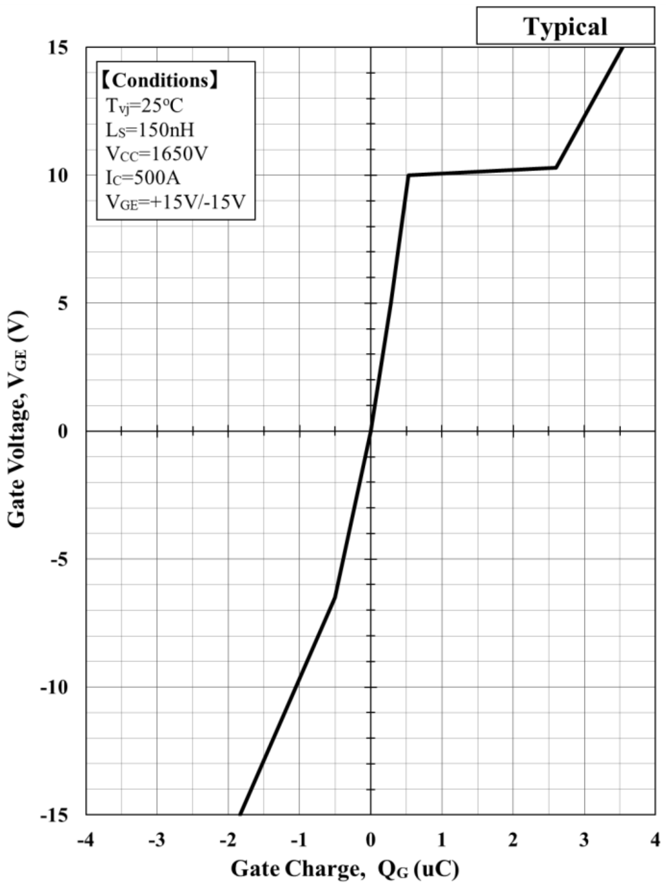
Turn-on loss vs. Gate Resistance



Turn-off loss vs. Gate Resistance



Reverse Recovery loss vs. Gate Resistance



V_{GE}-Q_G curve

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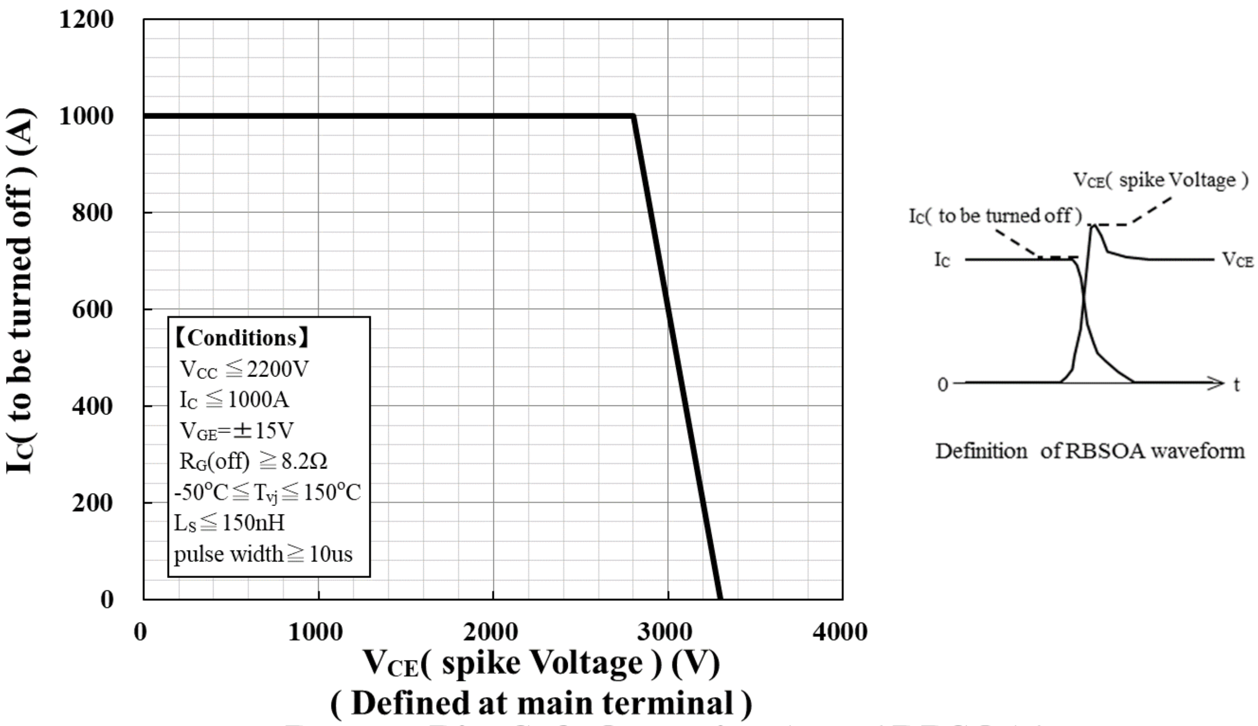
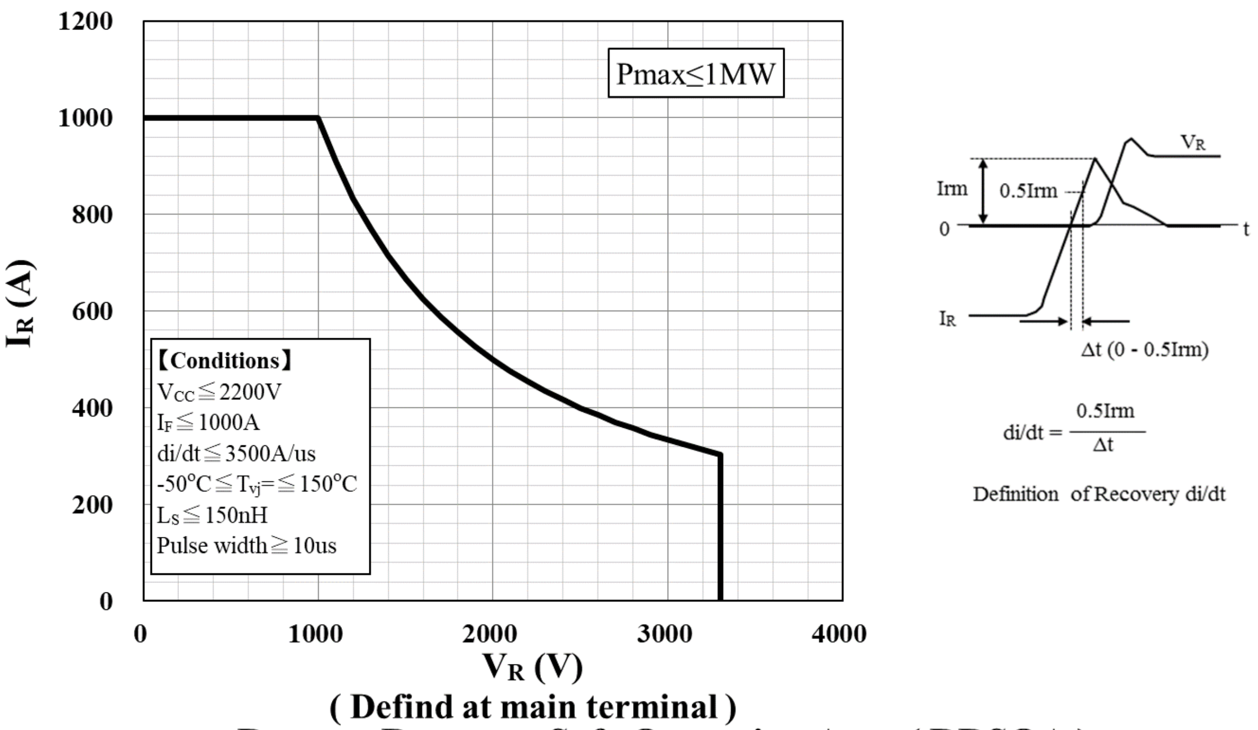


Reverse Bias Safe Operation Area (RBSOA)



Reverse Recovery Safe Operation Area (RRSOA)

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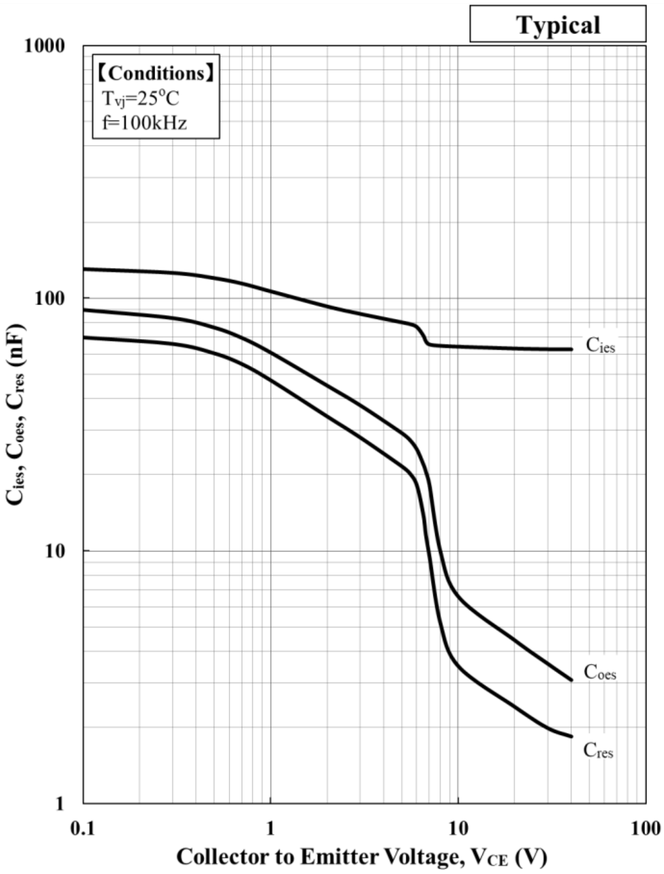
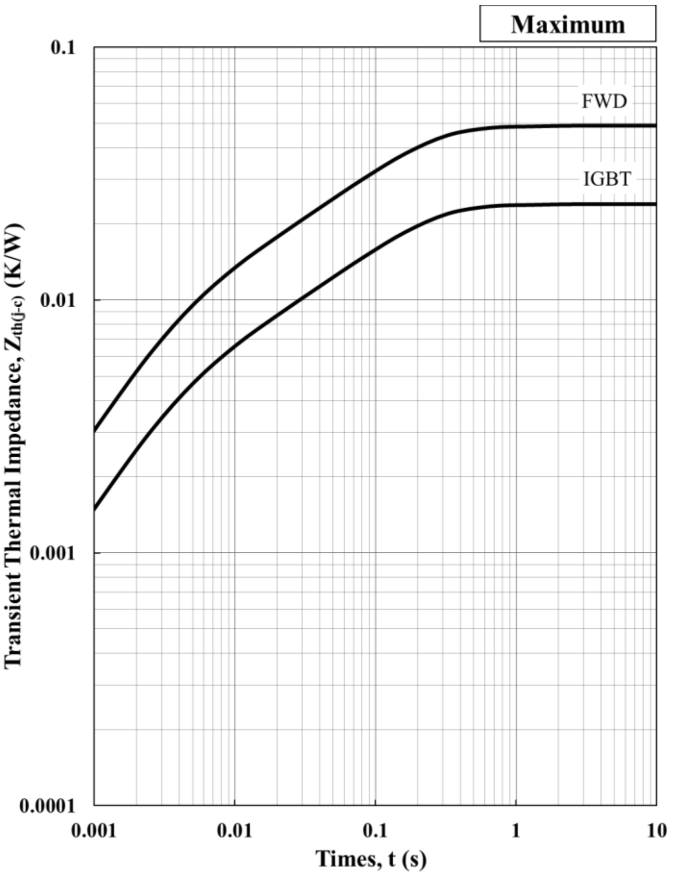


Capacitance vs. Collector to Emitter Voltage



Transient Thermal Ipedance Curve

Foster model lumped circuit constant

n	1	2	3	4
R th, IGBT [n]	1.49E-02	4.33E-03	4.28E-03	5.03E-04
C th, IGBT [n]	1.07E+01	6.40E+00	9.60E-01	1.60E+00
R th, Diode [n]	3.02E-02	9.24E-03	8.50E-03	1.06E-03
C th, Diode [n]	5.28E+00	3.00E+00	4.83E-01	7.58E-01

Cauer model lumped circuit constant

n	1	2	3	4
R th, IGBT [n]	3.55E-03	3.77E-03	8.31E-03	8.37E-03
C th, IGBT [n]	5.22E-01	6.29E-01	4.01E+00	1.20E+01
R th, Diode [n]	7.11E-03	7.80E-03	1.70E-02	1.71E-02
C th, Diode [n]	2.56E-01	3.13E-01	1.90E+00	5.95E+00

Material declaration

Please note the following materials are contained in the product, in order to keep characteristic and reliability level.

Material	Contained part
Lead (Pb) and its compounds	Solder

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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).

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Usage

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