

MBN500FH65E2

Silicon N-channel IGBT 6500V E2 version

FEATURES

- * Soft switching behavior & 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:
 AlSiC base-plate/AlN substrate

ABSOLUTE MAXIMUM RATINGS (T_C=25°C)

Item		Symbol	Unit	MBN500FH65E2
Collector Emitter Voltage	T _{vj} =125°C	V _{CES}	V	6,500
	T _{vj} =25°C			6,500
	T _{vj} =-40°C			6,000
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	-40 ~ +125
Storage Temperature		T _{stg}	°C	-50 ~ +125
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	-	-	17	V _{CE} =6,500V, V _{GE} =0V, T _{vj} =25°C
			-	17	67	V _{CE} =6,500V, V _{GE} =0V, T _{vj} =125°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	-	3.2	-	I _C =500A, V _{GE} =15V, T _{vj} =25°C
			4.0	4.5	5.0	I _C =500A, V _{GE} =15V, T _{vj} =125°C
Gate Emitter Threshold Voltage	V _{GE(th)}	V	5.8	6.3	6.8	V _{CE} =10V, I _C =500mA, T _{vj} =25°C
Input Capacitance	C _{ies}	nF	-	87	-	V _{CE} =10V, V _{GE} =0V, f=100kHz, T _{vj} =25°C
Internal Gate Resistance	R _{G(int)}	Ω	-	1.1	-	V _{CE} =10V, V _{GE} =0V, f=100kHz, T _{vj} =25°C
Turn On Delay Time	t _{d(on)}	μs	-	0.7	-	V _{CC} =3,600V, I _C =500A
Rise Time	t _r		2.0	3.2	4.8	L _S =210nH
Turn Off Delay Time	t _{d(off)}		-	3.3	-	R _G =10Ω (3)
Fall Time	t _f		2.1	3.1	4.7	V _{GE} =±15V, T _{vj} =125°C
Forward Voltage Drop	V _F	V	-	3.6	-	I _F =500A, V _{GE} =0V, T _{vj} =25°C
			3.3	3.9	4.6	I _F =500A, V _{GE} =0V, T _{vj} =125°C
Reverse Recovery Time	t _{rr}	μs	-	0.8	1.6	V _{CC} =3,600V, I _F =500A, L _S =210nH T _{vj} =125°C
Turn On Loss	E _{on(10%)}	J/P	-	3.2	3.9	V _{CC} =3,600V, I _C =500A, L _S =210nH R _G =10Ω (3) V _{GE} =±15V, T _{vj} =125°C
	E _{on(full)}		-	3.6	-	
Turn Off Loss	E _{off(10%)}	J/P	-	2.6	3.25	
	E _{off(full)}		-	2.8	-	
Reverse Recovery Loss	E _{rr(10%)}	J/P	-	1.6	2.05	
	E _{rr(full)}		-	1.7	-	
Short Circuit Pulse Width	t _{sc}	μs	10	-	-	V _{CC} =4,500V, L _S =210nH R _G (on/off)=10/100Ω, V _{GE} =±15V, T _{vj} =25°C
Partial discharge extinction voltage	V _e	V _{RMS}	5,100	-	-	f=50Hz, Q _{PD} ≤10pC(acc. to IEC 61287)

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.

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THERMAL CHARACTERISTICS

Item		Symbol	Unit	Min.	Typ.	Max.	Test Conditions
Thermal Impedance	IGBT	$R_{th(j-c)}$	K/W	-	-	0.0128	Junction to case
	FWD	$R_{th(f-c)}$		-	-	0.0255	
Contact Thermal Impedance		$R_{th(c-f)}$	K/W	-	0.007	-	Case to fin ($\lambda_{grease}=1W/(m \cdot K)$, heat-sink flatness $\leq 50\mu m$)

MODULE MECHANICAL CHARACTERISTICS

Item		Unit	Characteristics	Conditions
Weight		g	1,100	
Stray inductance in module	LS(CM-EM)	nH	15	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-Phenylene Sulfide	
Fire and Smoke Category		-	I2 / F3	NFF 16-102

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DEFINITION OF TEST CIRCUIT

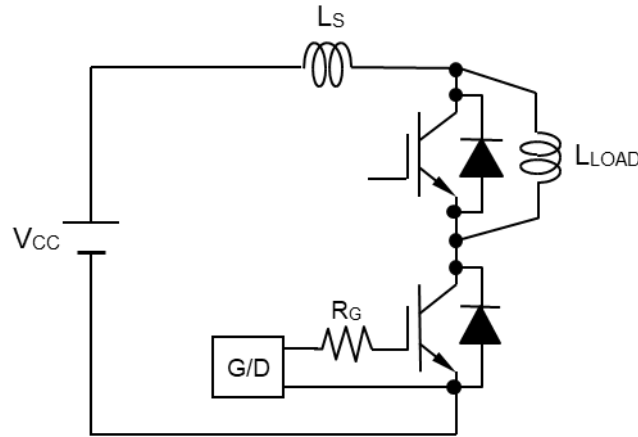


Fig.1 Switching test circuit

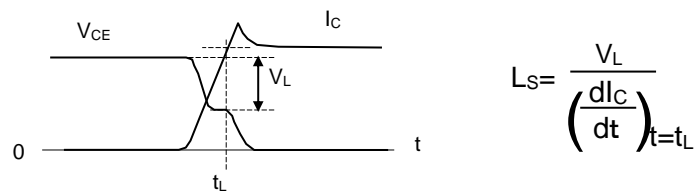


Fig.2 Definition of stray inductance

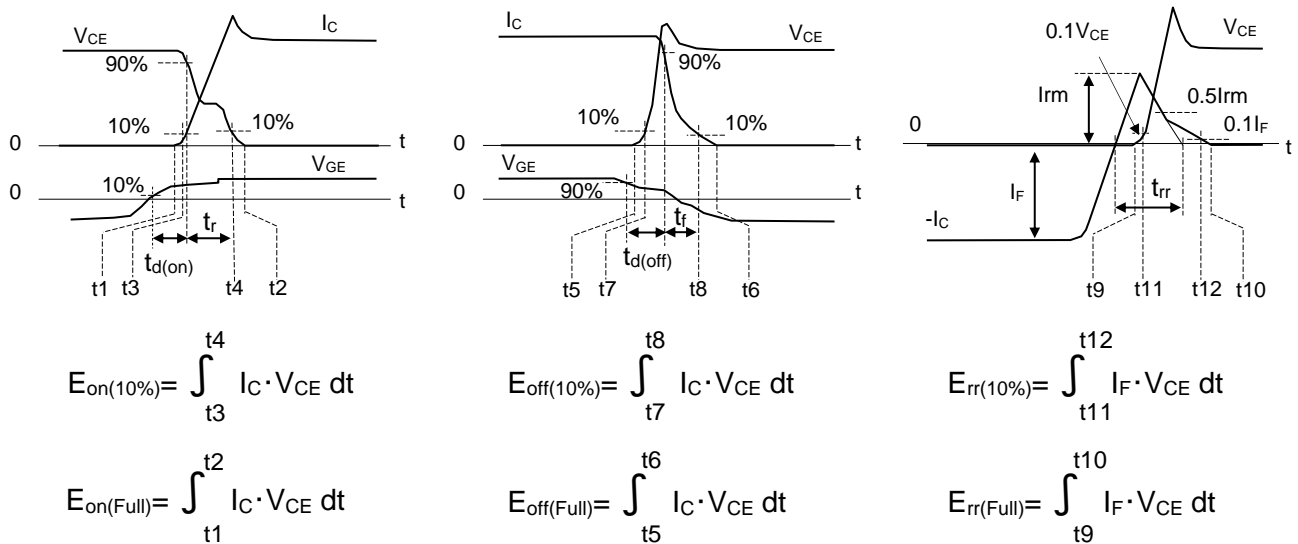
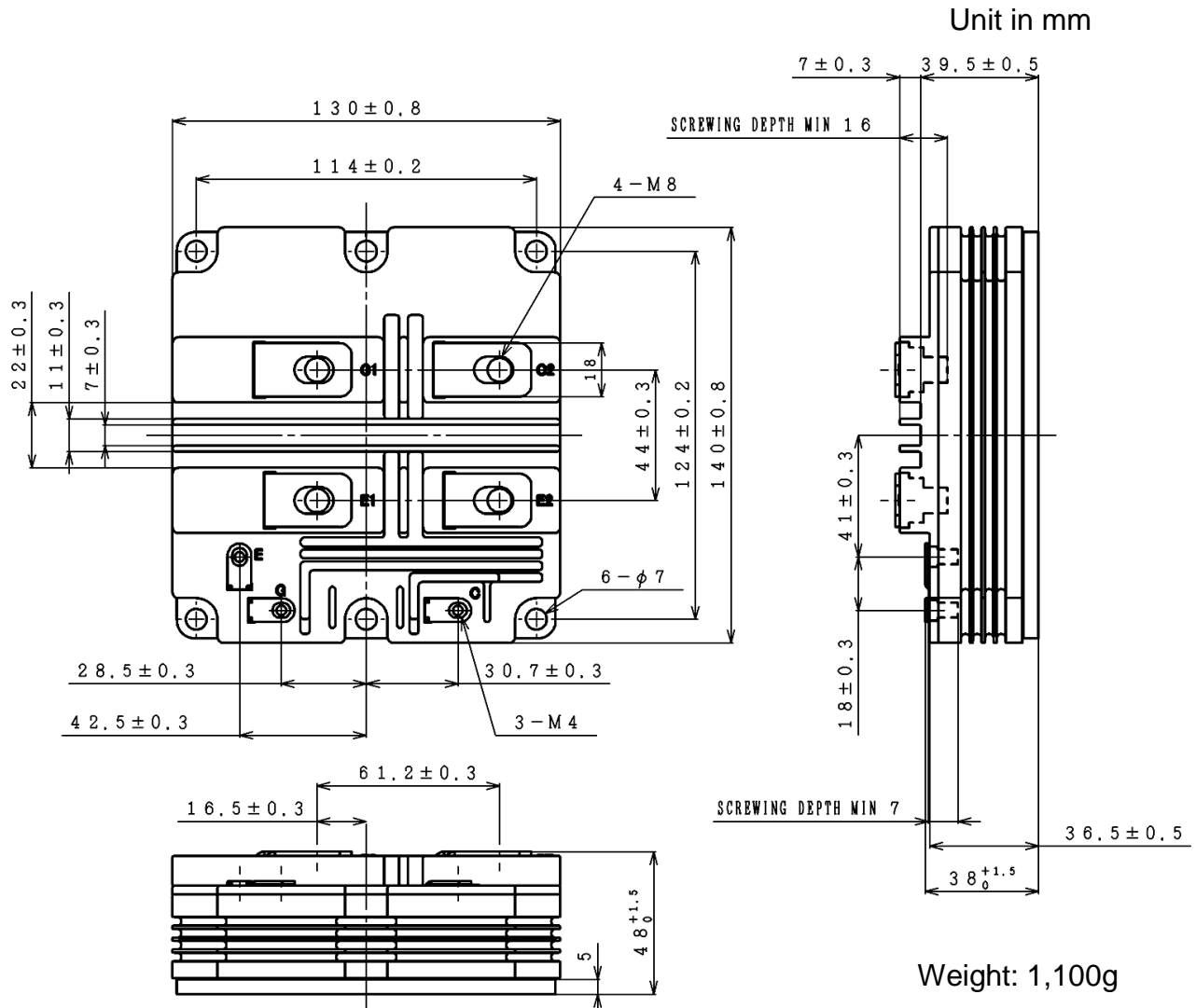


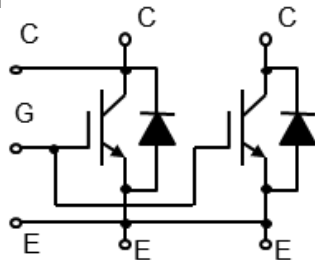
Fig.3 Definition of switching loss

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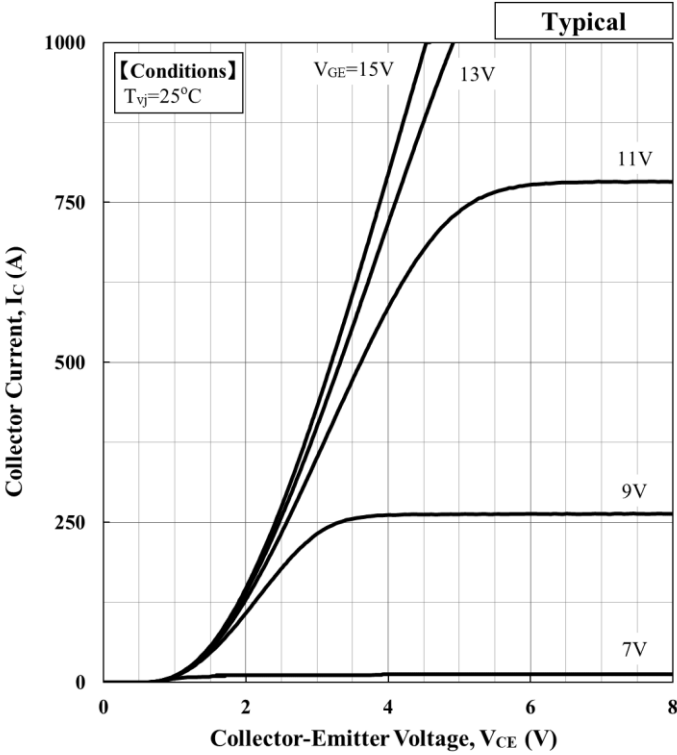
OUTLINE DRAWING



CIRCUIT DIAGRAM

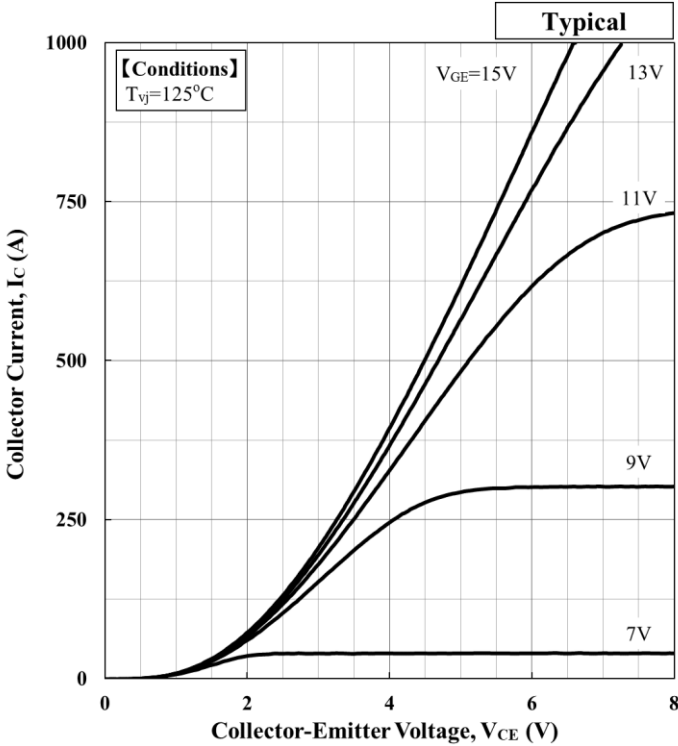


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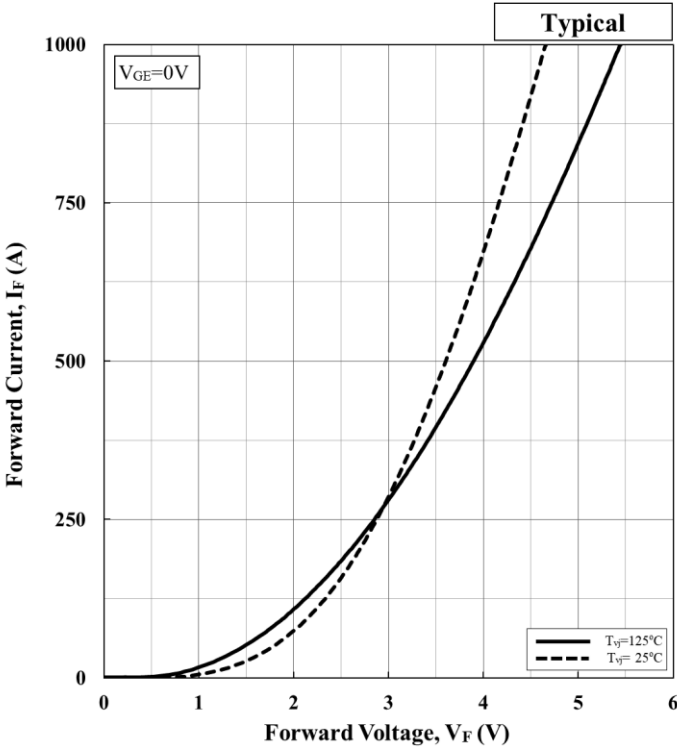
$V_{CE}(sat)[V] = a_3 \cdot I_c ^3 + a_2 \cdot I_c ^2 + a_1 \cdot I_c + a_0$					
Temp.[°C]	V _{GE} [V]	a ₃	a ₂	a ₁	a ₀
25	15	1.98.E-09	-4.22.E-06	5.56.E-03	1.25.E+00

Collector Current vs. Collector Emitter Voltage



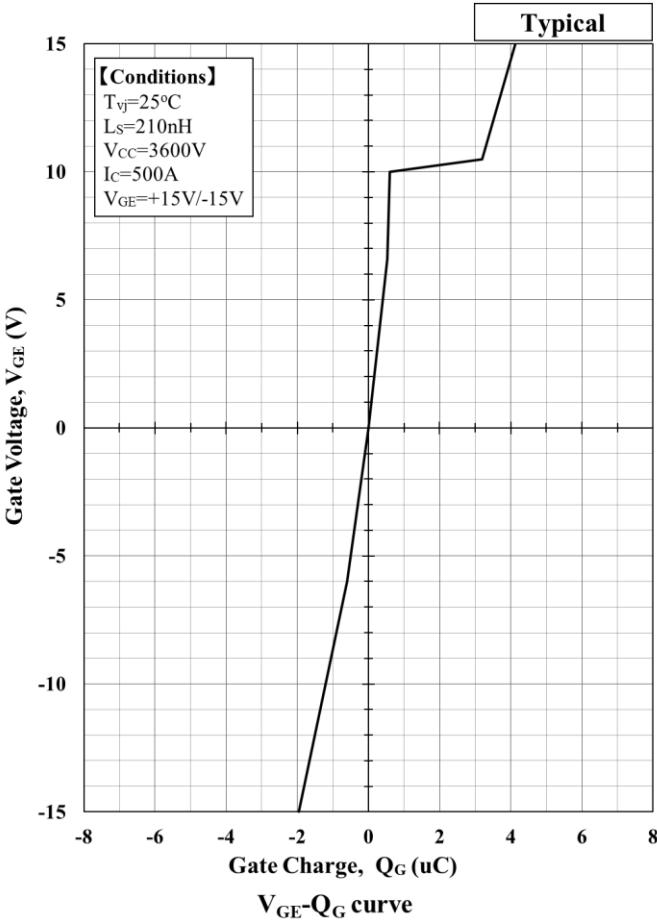
$V_{CE}(sat)[V] = a_3 \cdot I_c ^3 + a_2 \cdot I_c ^2 + a_1 \cdot I_c + a_0$					
Temp.[°C]	V _{GE} [V]	a ₃	a ₂	a ₁	a ₀
125	15	3.16.E-09	-6.68.E-06	8.70.E-03	1.43.E+00

Collector Current vs. Collector Emitter Voltage

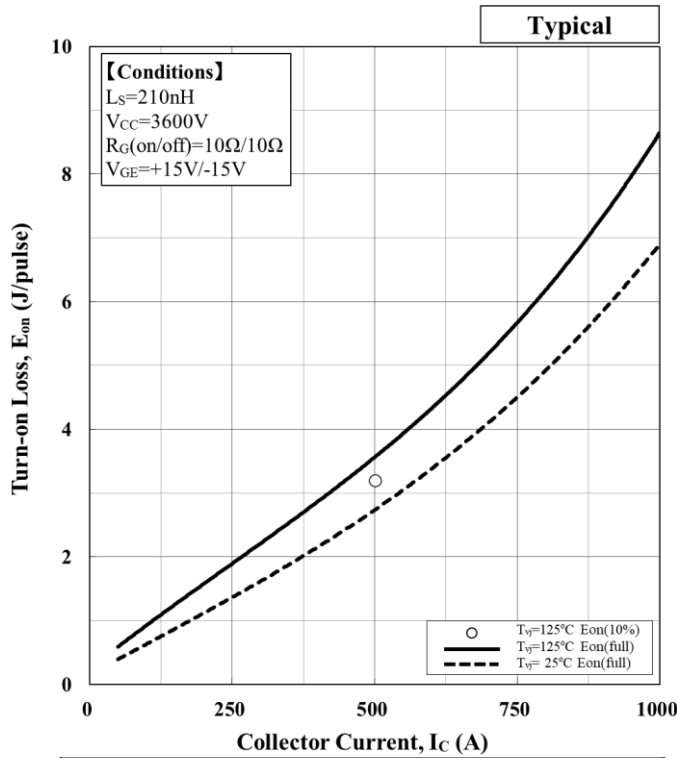


$V_F[V] = a_3 \cdot I_F ^3 + a_2 \cdot I_F ^2 + a_1 \cdot I_F + a_0$				
Temp.[°C]	a ₃	a ₂	a ₁	a ₀
25	2.83.E-09	-6.19.E-06	6.47.E-03	1.58.E+00
125	2.93.E-09	-6.73.E-06	8.10.E-03	1.18.E+00

Forward Voltage of free-wheeling diode

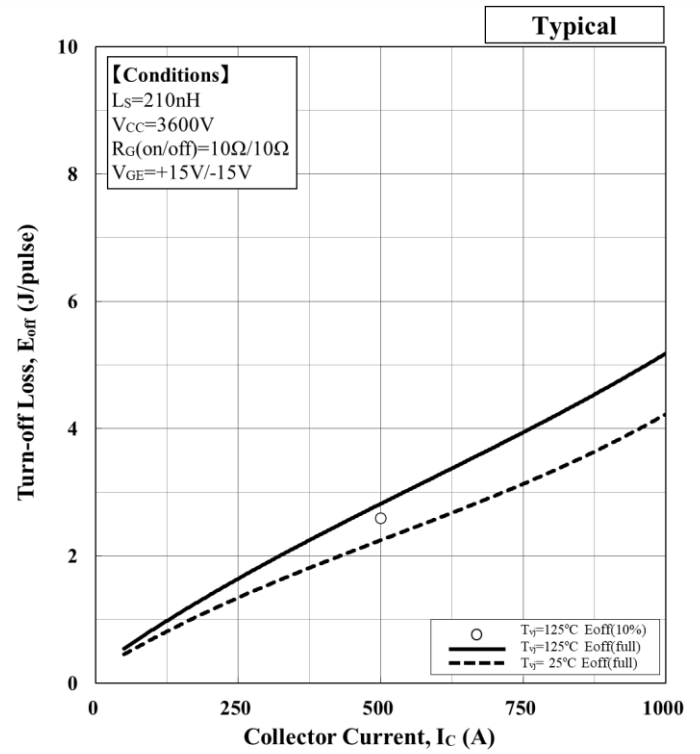


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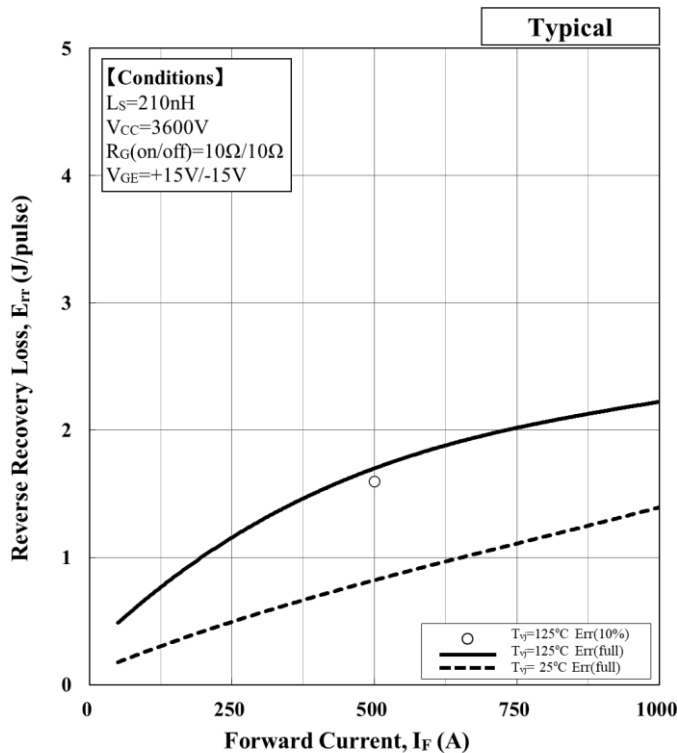
$E [J] = a_3 \cdot I_c ^3 + a_2 \cdot I_c ^2 + a_1 \cdot I_c + a_0$				
Temp.[°C]	a_3	a_2	a_1	a_0
25	2.53.E-09	-6.25.E-07	4.84.E-03	1.57.E-01
125	4.56.E-09	-3.31.E-06	7.15.E-03	2.45.E-01

Turn-on loss vs. Collector current



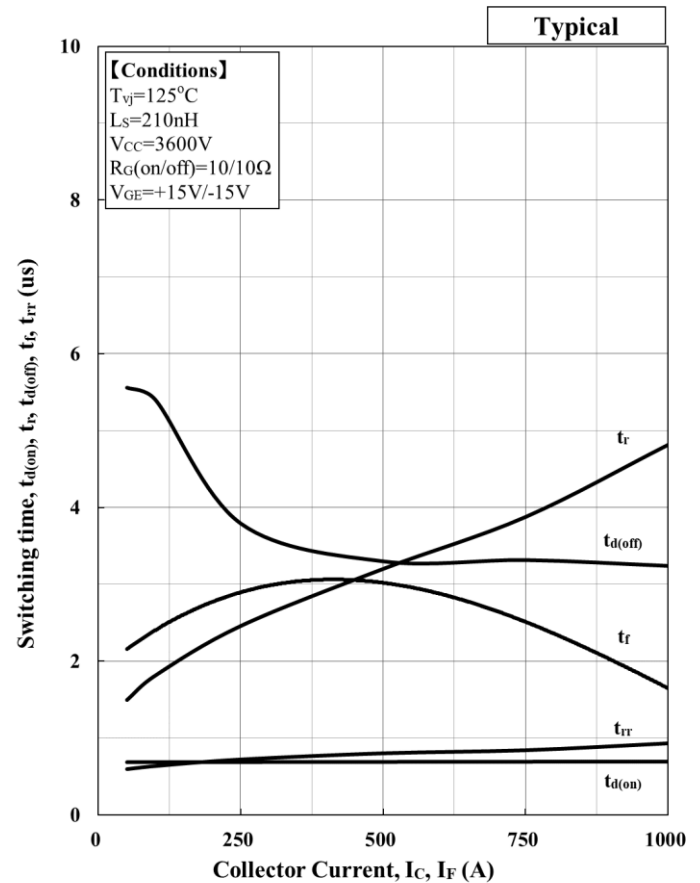
$E [J] = a_3 \cdot I_c ^3 + a_2 \cdot I_c ^2 + a_1 \cdot I_c + a_0$				
Temp.[°C]	a_3	a_2	a_1	a_0
25	2.46.E-09	-3.83.E-06	5.41.E-03	1.94.E-01
125	1.83.E-09	-3.17.E-06	6.28.E-03	2.43.E-01

Turn-off loss vs. Collector current



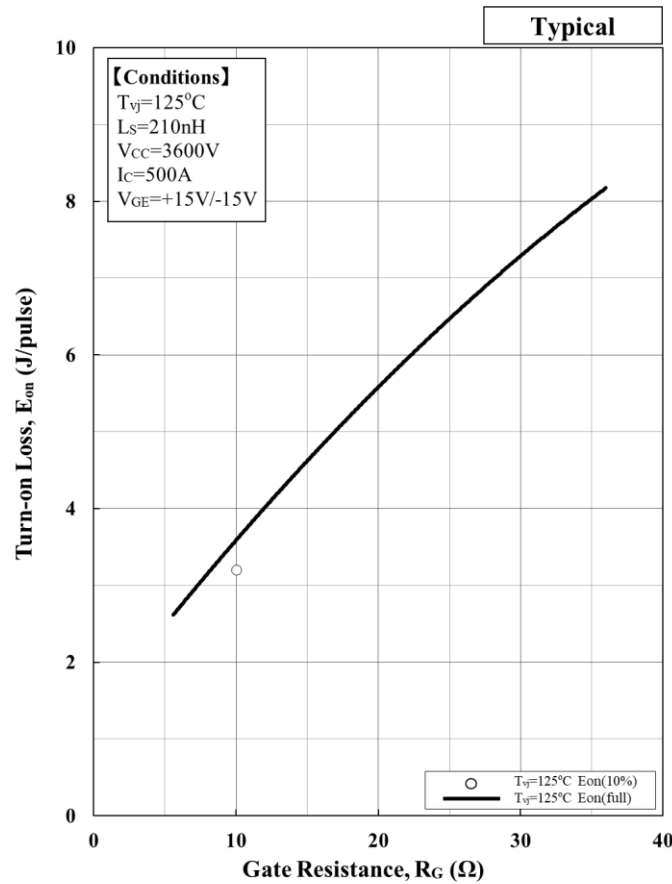
$E [J] = a_3 \cdot I_F ^3 + a_2 \cdot I_F ^2 + a_1 \cdot I_F + a_0$				
Temp.[°C]	a_3	a_2	a_1	a_0
25	3.93.E-10	-9.12.E-07	1.82.E-03	8.74.E-02
125	1.18.E-09	-3.57.E-06	4.33.E-03	2.78.E-01

Recovery loss vs. Forward current

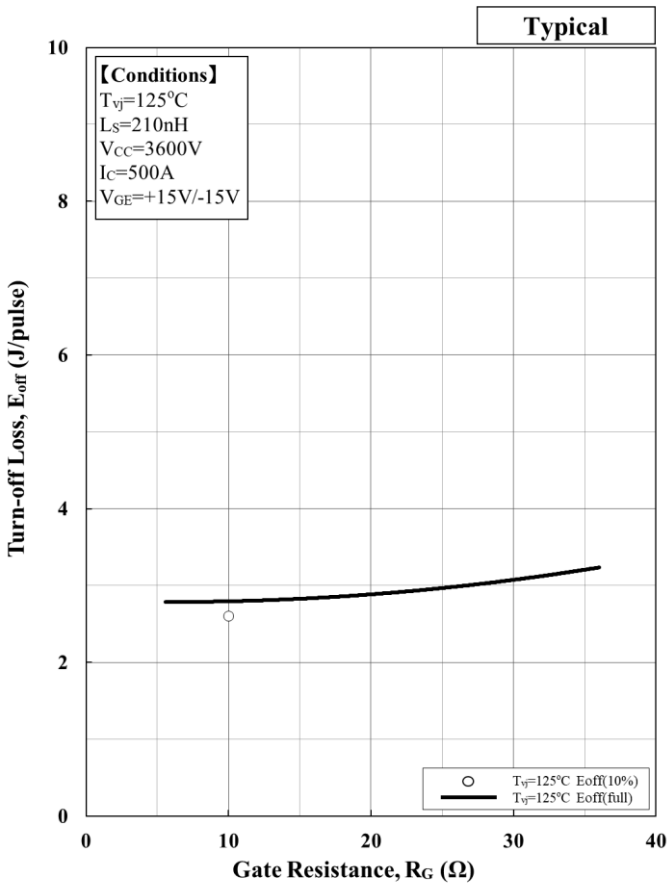


Switching time vs. Collector Current

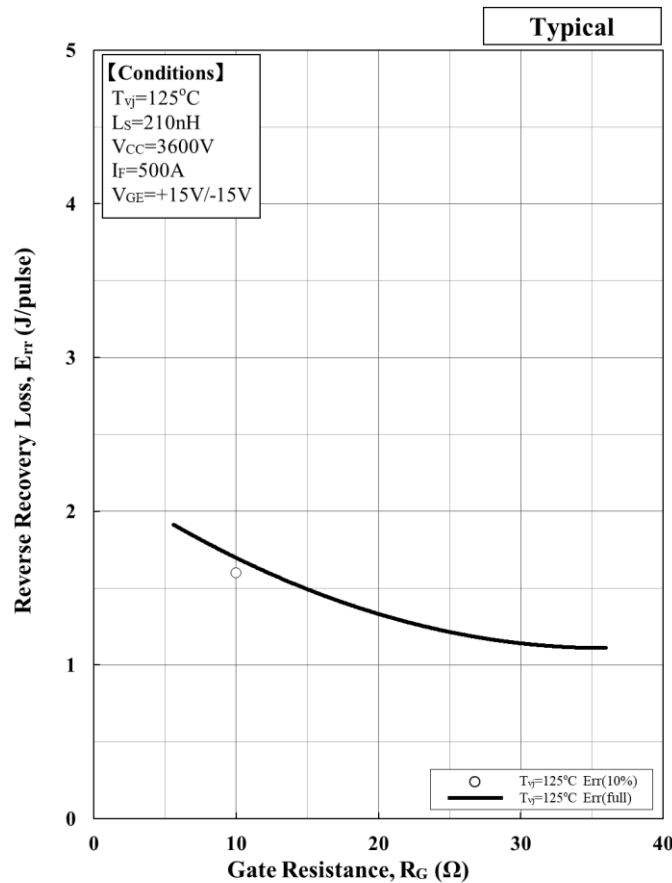
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Turn-on loss vs. Gate Resistance

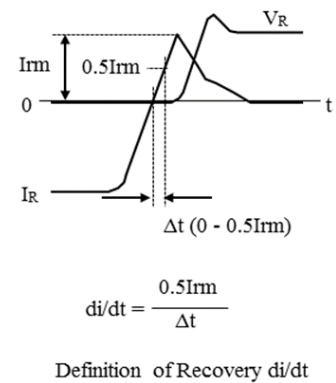
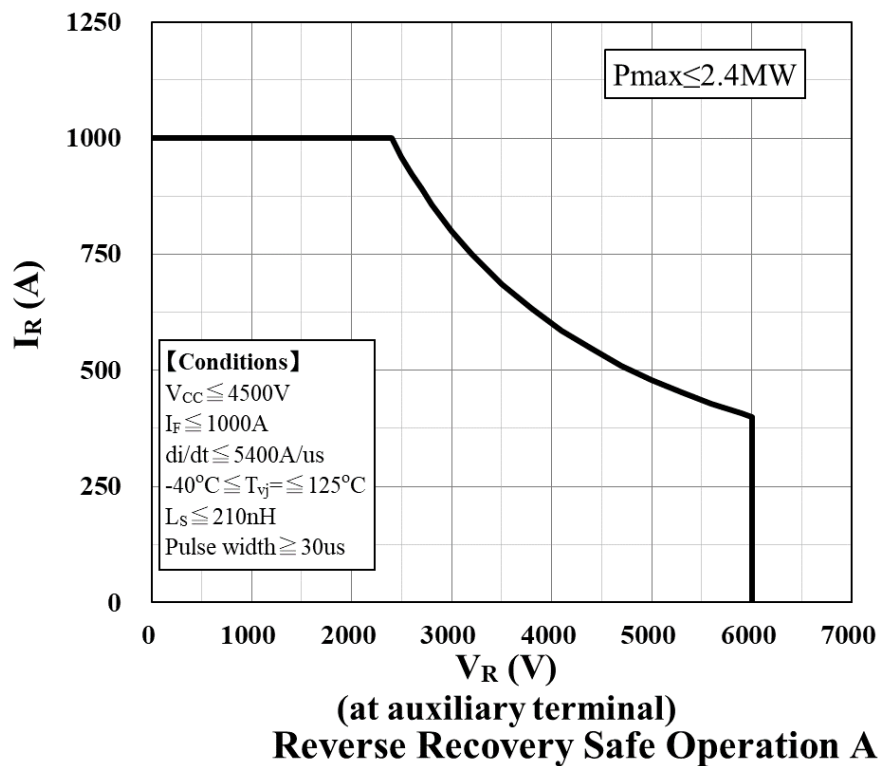
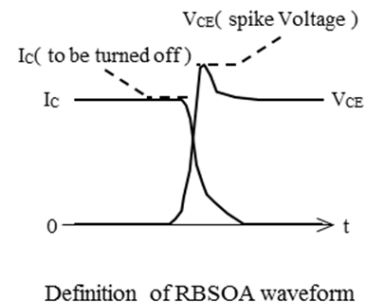
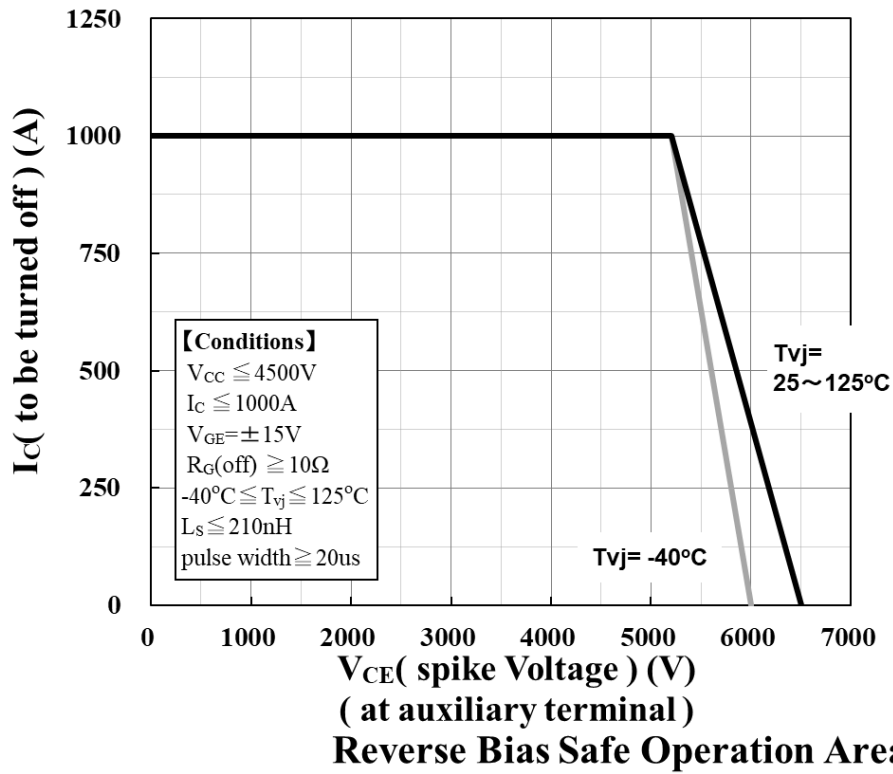


Turn-off loss vs. Gate Resistance

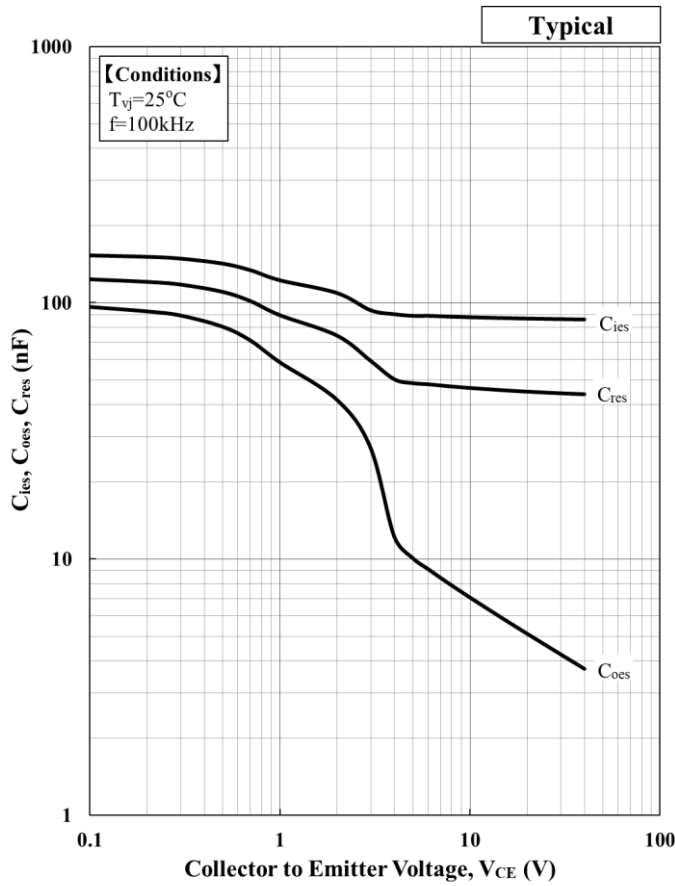


Reverse Recovery loss vs. Gate Resistance

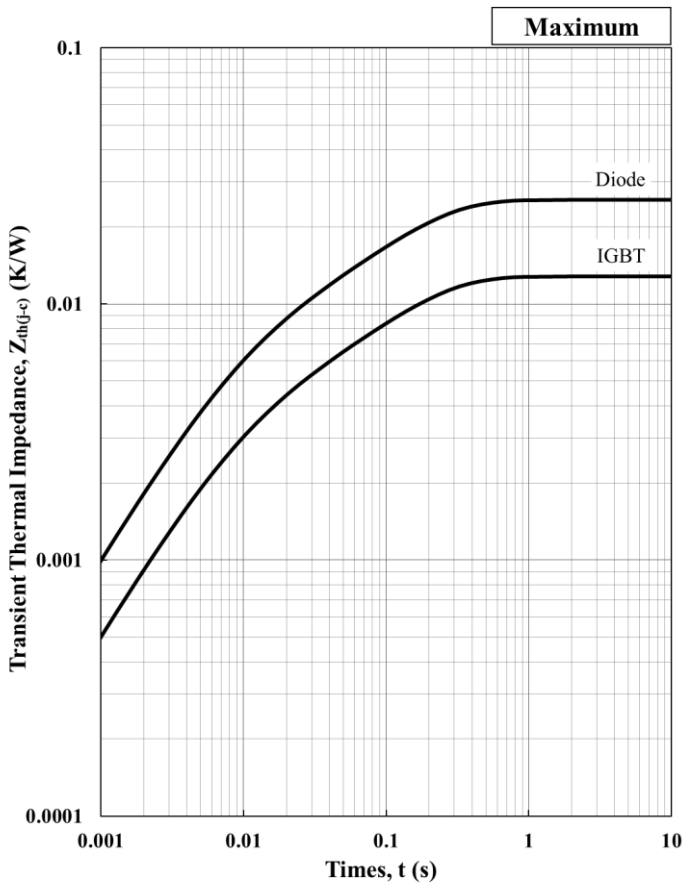
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Capacitance vs. Collector to Emitter Voltage



Transient Thermal Impedance Curve

Foster model lumped circuit constant

n	1	2	3	4	Unit
R th, IGBT [n]	7.99E-03	2.53E-03	2.21E-03	6.99E-05	[K/W]
C th, IGBT [n]	2.05E+01	1.09E+01	3.02E+00	1.06E+01	[J/K]
R th, Diode [n]	1.59E-02	5.02E-03	4.42E-03	1.38E-04	[K/W]
C th, Diode [n]	1.03E+01	5.48E+00	1.51E+00	5.38E+00	[J/K]

Cauer model lumped circuit constant

n	1	2	3	4	Unit
R th, IGBT [n]	1.78E-03	2.67E-03	3.98E-03	4.38E-03	[K/W]
C th, IGBT [n]	1.77E+00	8.35E-01	8.14E+00	2.26E+01	[J/K]
R th, Diode [n]	3.55E-03	5.30E-03	7.92E-03	8.73E-03	[K/W]
C th, Diode [n]	8.88E-01	4.18E-01	4.09E+00	1.13E+01	[J/K]

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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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.
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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.
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8. For handling other than described in this manual, follow the handling instructions (IGBT-HI-00002).

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