

MBN500H65E2

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:
($\Delta T_c=70K$, $N>30,000$ cycles)
AlSiC base-plate/AlN substrate

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

Item		Symbol	Unit	MBN500H65E2
Collector Emitter Voltage	$T_{vj}=125^\circ C$	V_{CES}	V	6,500
	$T_{vj}=25^\circ C$			6,500
	$T_{vj}=-40^\circ C$			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		$T_{vj op}$	$^\circ C$	-40 ~ +125
Storage Temperature		T_{stg}	$^\circ C$	-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 $1.8 \pm 0.2/9 \pm 1 N \cdot m$

(2) Recommended Value $5.5 \pm 0.5 N \cdot m$

ELECTRICAL CHARACTERISTICS

Item	Symbol	Unit	Min.	Typ.	Max.	Test Conditions
Collector Emitter Cut-Off Current	I_{CES}	mA	-	-	17	$V_{CE}=6,500V$, $V_{GE}=0V$, $T_{vj}=25^\circ C$
Gate Emitter Leakage Current	I_{GES}	nA	-500	-	+500	$V_{CE}=6,500V$, $V_{GE}=0V$, $T_{vj}=125^\circ C$
Collector Emitter Saturation Voltage	V_{CESat}	V	-	3.2	-	$V_{GE}=\pm 20V$, $V_{CE}=0V$, $T_{vj}=25^\circ C$
			3.4	4.3	5.2	$I_C=500A$, $V_{GE}=15V$, $T_{vj}=25^\circ C$
Gate Emitter Threshold Voltage	$V_{GE(th)}$	V	5.8	6.3	6.8	$V_{CE}=10V$, $I_C=500mA$, $T_{vj}=25^\circ C$
Input Capacitance	C_{ies}	nF	-	87	-	$V_{CE}=10V$, $V_{GE}=0V$, $f=100kHz$, $T_{vj}=25^\circ C$
Internal Gate Resistance	$R_{G(int)}$	Ω	-	1.1	-	$V_{CE}=10V$, $V_{GE}=0V$, $f=100kHz$, $T_{vj}=25^\circ C$
Turn On Delay Time	$t_{d(on)}$	μs	-	0.7	-	$V_{CC}=3,600V$, $I_C=500A$
Rise Time	t_r		2.2	3.2	4.8	$L_S=210nH$
Turn Off Delay Time	$t_{d(off)}$		-	3.3	-	$R_G=12\Omega$ (3)
Fall Time	t_f		2.2	3.1	4.7	$V_{GE}=\pm 15V$, $T_{vj}=125^\circ C$
Forward Voltage Drop	V_F	V	-	3.6	-	$I_F=500A$, $V_{GE}=0V$, $T_{vj}=25^\circ C$
			3.5	3.9	4.4	$I_F=500A$, $V_{GE}=0V$, $T_{vj}=125^\circ C$
Reverse Recovery Time	t_{rr}	μs	-	0.8	1.6	$V_{CC}=3,600V$, $I_F=500A$, $L_S=200nH$ $T_{vj}=125^\circ C$
Turn On Loss	$E_{on(10\%)}$	J/P	-	3.3	4.3	$V_{CC}=3,600V$, $I_C=500A$, $L_S=210nH$ $R_G=12\Omega$ (3) $V_{GE}=\pm 15V$, $T_{vj}=125^\circ C$
	$E_{on(full)}$		-	3.7	-	
Turn Off Loss	$E_{off(10\%)}$	J/P	-	2.6	3.4	
	$E_{off(full)}$		-	2.8	-	
Reverse Recovery Loss	$E_{rr(10\%)}$	J/P	-	1.4	1.8	
	$E_{rr(full)}$		-	1.5	-	
Short Circuit Pulse Width	t_{sc}	μs	10	-	-	$V_{CC}=4,500V$, $L_S=210nH$ $R_{G(on/off)}=12/120\Omega$, $V_{GE}=\pm 15V$, $T_{vj}=25^\circ C$
Partial discharge extinction voltage	V_e	V_{RMS}	5,100	-	-	$f=50Hz$, $Q_{PD} \leq 10pC$ (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.
- * ELECTRICAL CHARACTERISTIC items shown in above table are according to IEC 60747-2 and IEC 60747-9.

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THERMAL CHARACTERISTICS

Item		Symbol	Unit	Min.	Typ.	Max.	Test Conditions
Thermal Impedance	IGBT	$R_{th(j-c)}$	K/W	-	-	0.0135	Junction to case
	FWD	$R_{th(f-c)}$		-	-	0.027	
Contact Thermal Impedance		$R_{th(c-f)}$	K/W	-	0.007	-	Case to fin (λ grease = 1W/(m·K) heat-sink flatness $\leq 50\mu\text{m}$)

MODULE MECHANICAL CHARACTERISTICS

Item		Unit	Characteristics	Conditions
Weight		g	1,050	
Stray inductance in module	LS(CM-EM)	nH	21	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

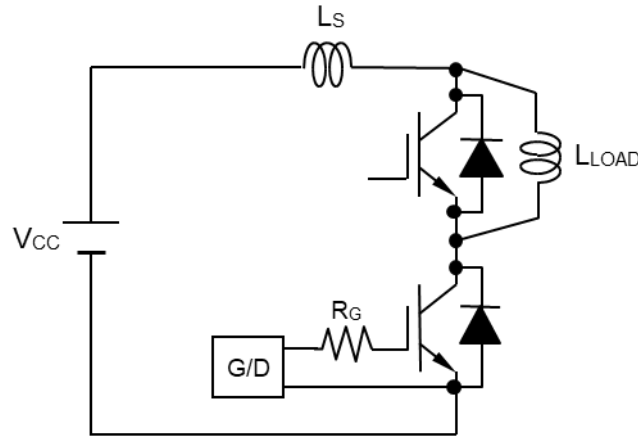


Fig.1 Switching test circuit

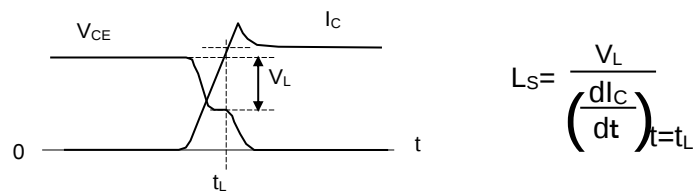


Fig.2 Definition of stray inductance

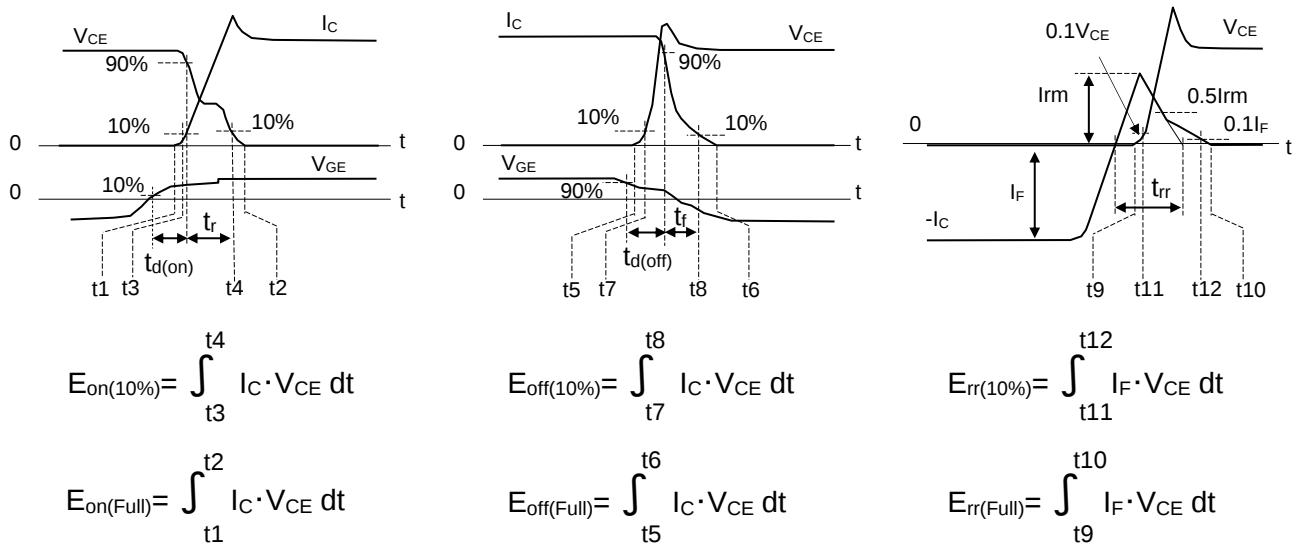
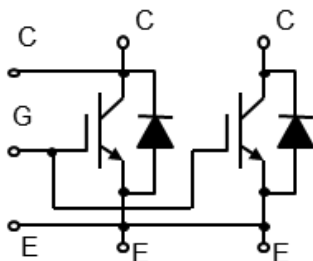
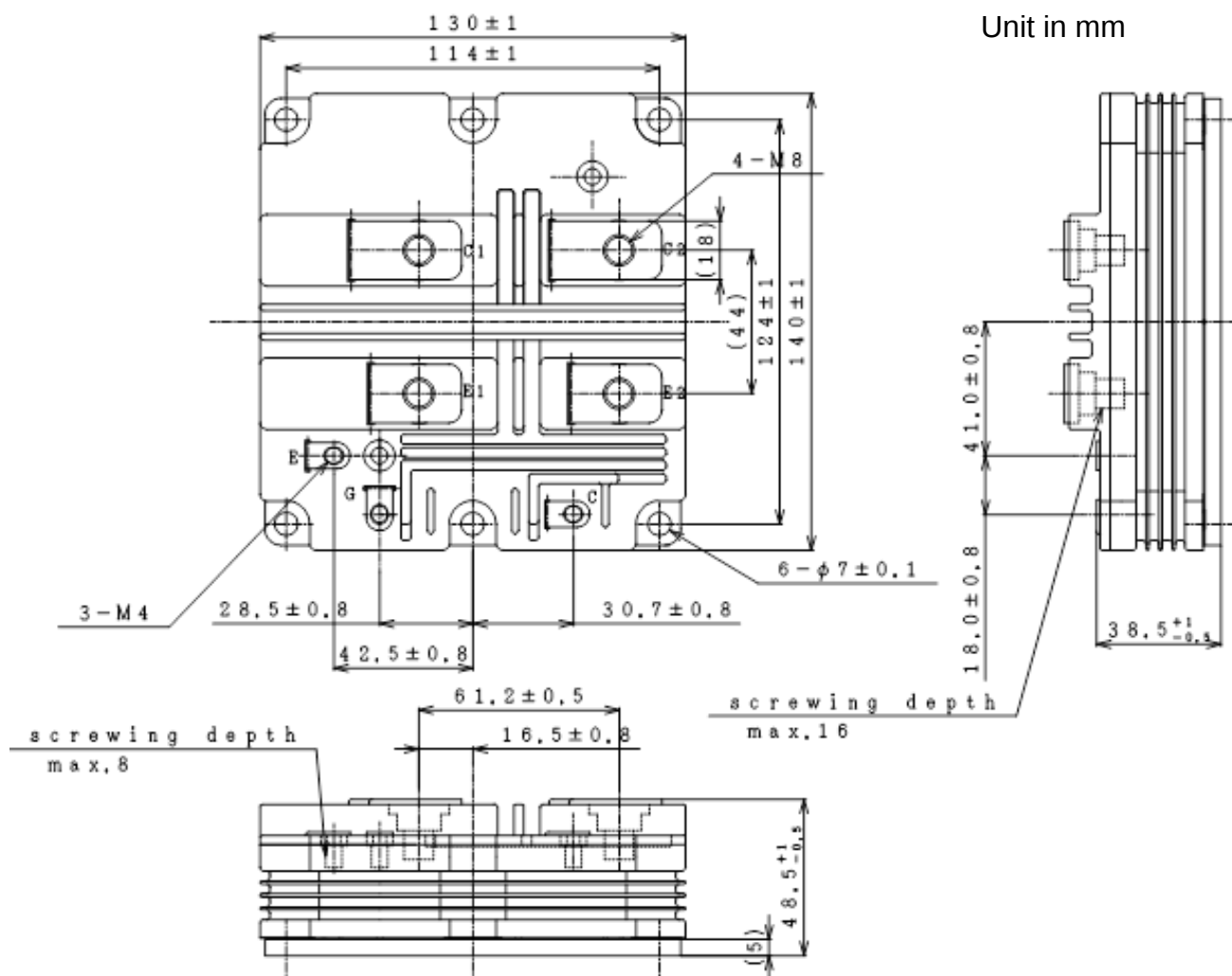
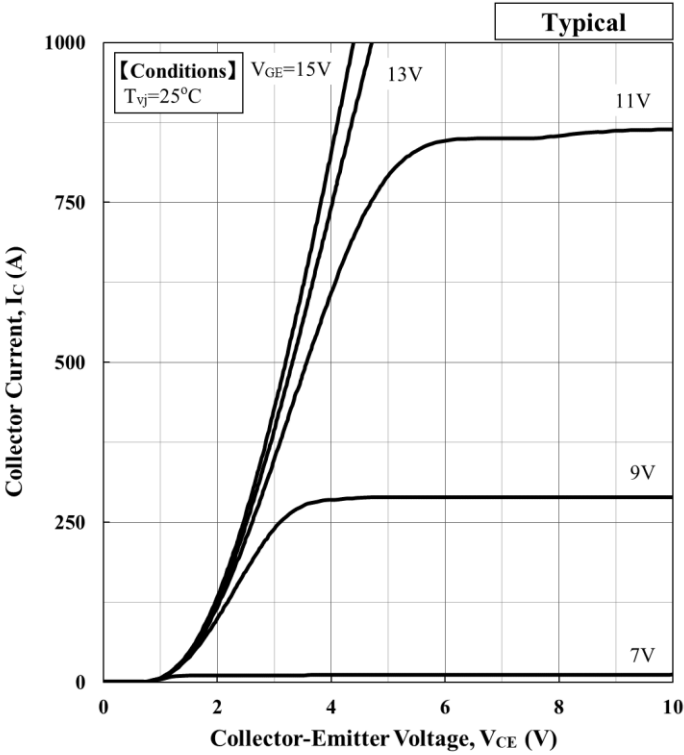


Fig.3 Definition of switching loss

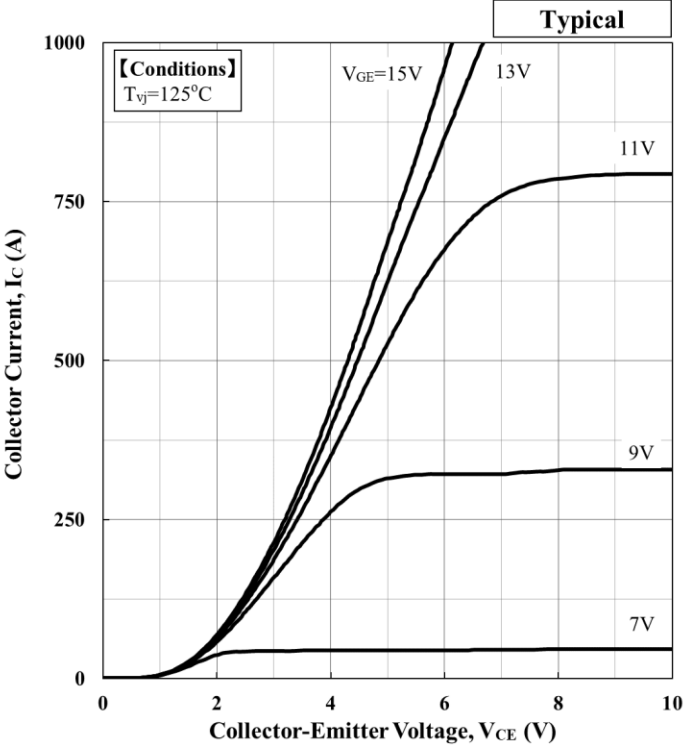


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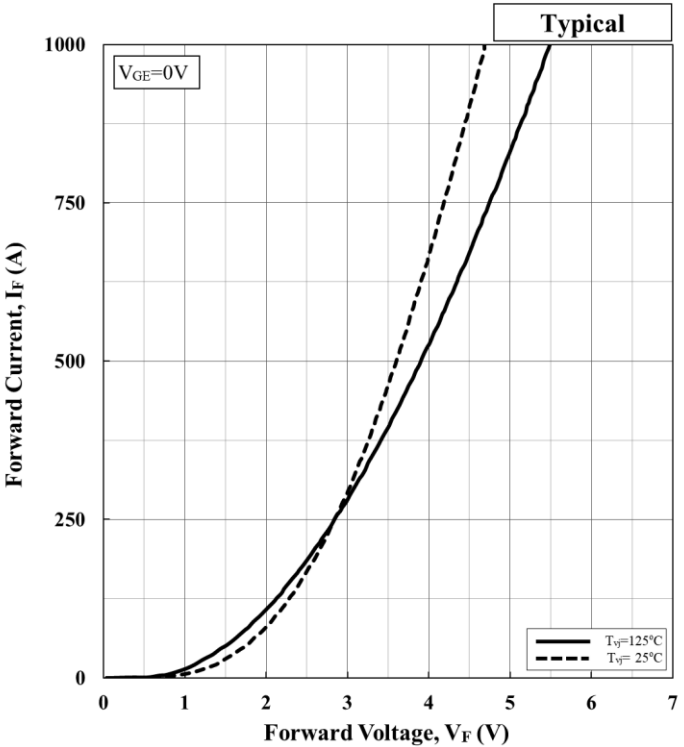
$V_{CE}(sat)[V] = a_3 \cdot I_c ^3 + a_2 \cdot I_c ^2 + a_1 \cdot I_c + a_0$					
Temp.[°C]	$V_{GE}[V]$	a_3	a_2	a_1	a_0
25	15	1.87E-09	-4.16E-06	5.37E-03	1.33E+00

Collector Current vs. Collector Emitter Voltage



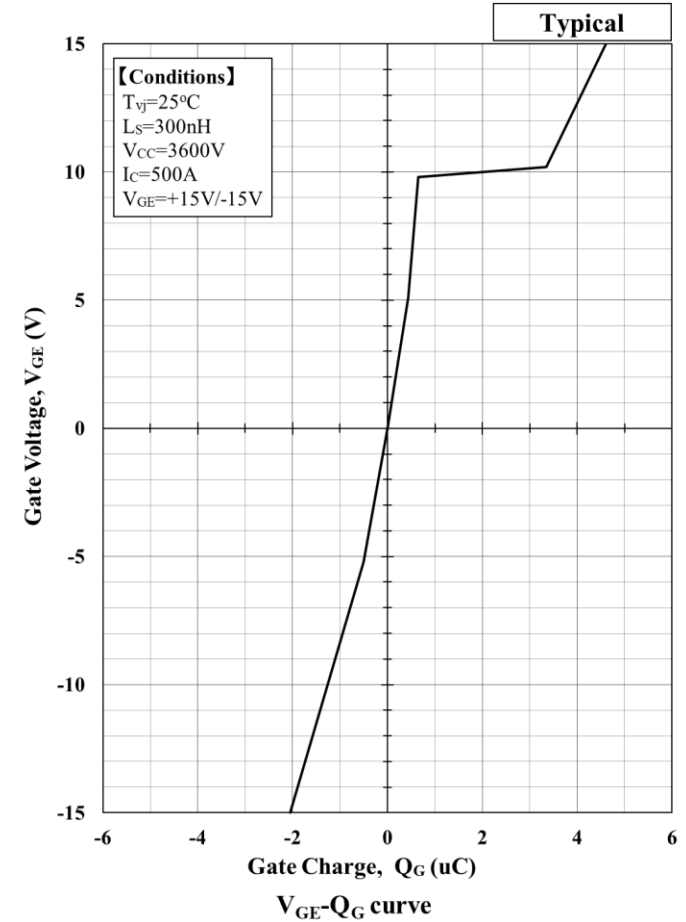
$V_{CE}(sat)[V] = a_3 \cdot I_c ^3 + a_2 \cdot I_c ^2 + a_1 \cdot I_c + a_0$					
Temp.[°C]	$V_{GE}[V]$	a_3	a_2	a_1	a_0
125	15	3.06E-09	-6.49E-06	8.10E-03	1.50E+00

Collector Current vs. Collector Emitter Voltage



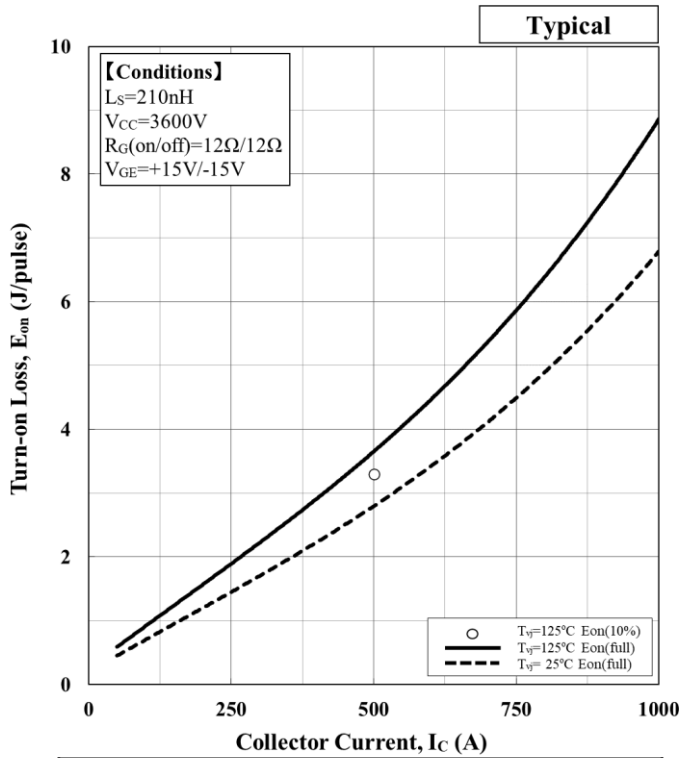
$V_F[V] = a_3 \cdot I_F ^3 + a_2 \cdot I_F ^2 + a_1 \cdot I_F + a_0$				
Temp.[°C]	a_3	a_2	a_1	a_0
25	2.87E-09	-6.30E-06	6.66E-03	1.51E+00
125	2.74E-09	-6.36E-06	7.95E-03	1.19E+00

Forward Voltage of free-wheeling diode



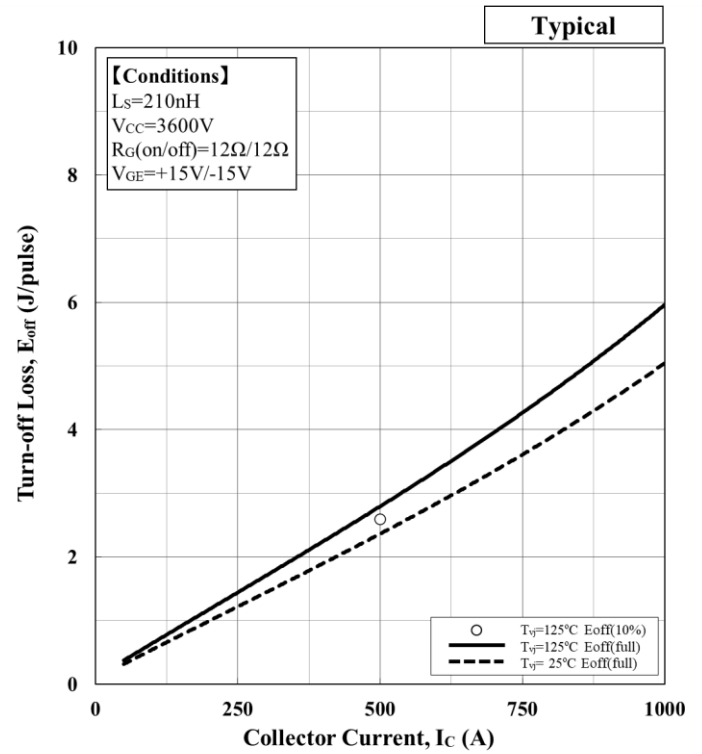
V_{GE} - Q_G curve

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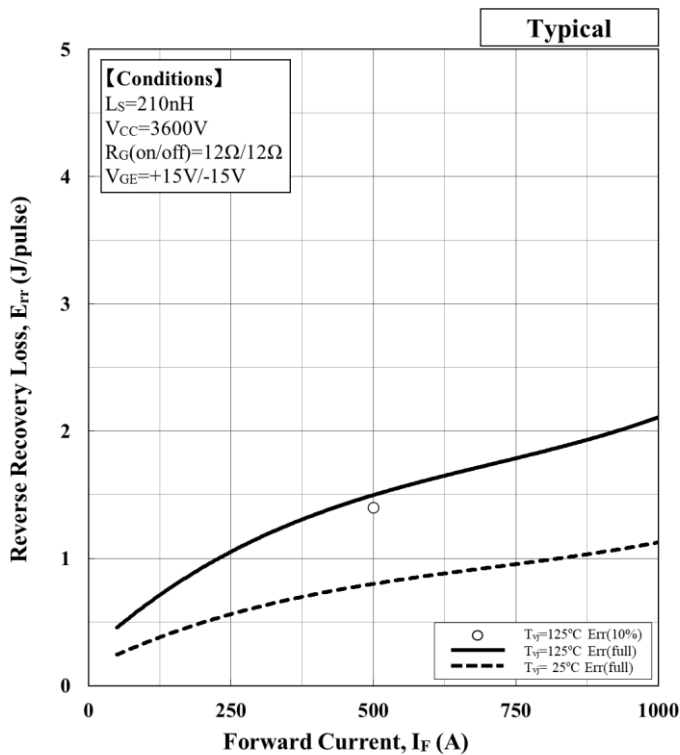
$E [J] = a_3 \cdot I_C ^3 + a_2 \cdot I_C ^2 + a_1 \cdot I_C + a_0$				
Temp.[°C]	a_3	a_2	a_1	a_0
25	2.70E-09	-1.27E-06	5.16E-03	1.98E-01
125	3.52E-09	-1.65E-06	6.73E-03	2.59E-01

Turn-on loss vs. Collector current



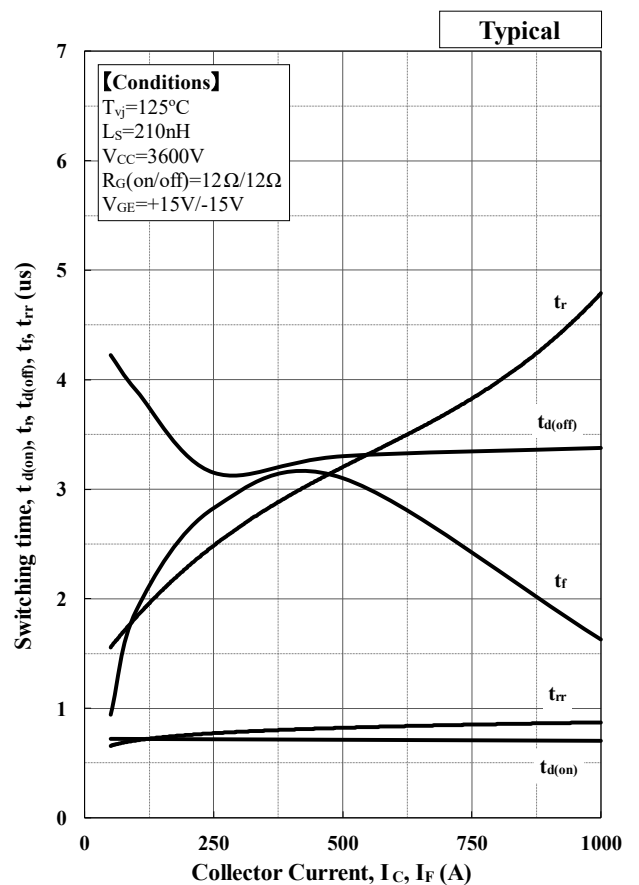
$E [J] = a_3 \cdot I_C ^3 + a_2 \cdot I_C ^2 + a_1 \cdot I_C + a_0$				
Temp.[°C]	a_3	a_2	a_1	a_0
25	9.59E-10	-6.32E-07	4.63E-03	8.96E-02
125	1.13E-09	-7.47E-07	5.47E-03	1.06E-01

Turn-off loss vs. Collector current



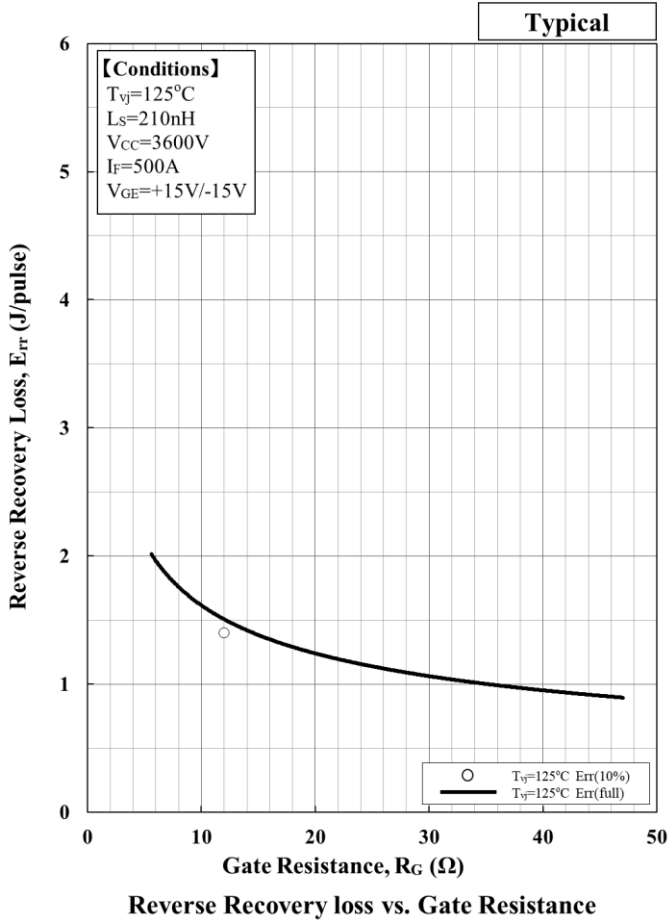
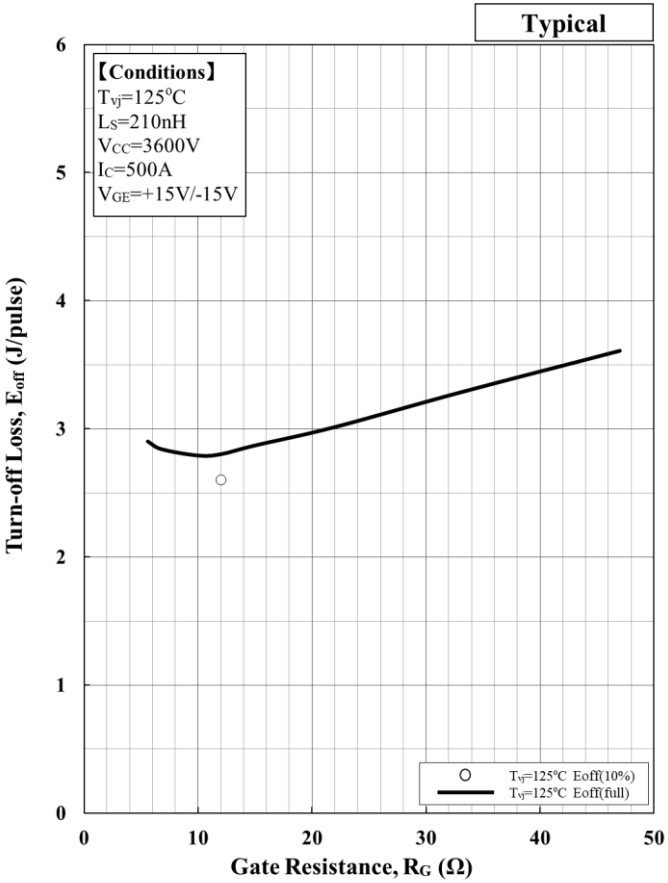
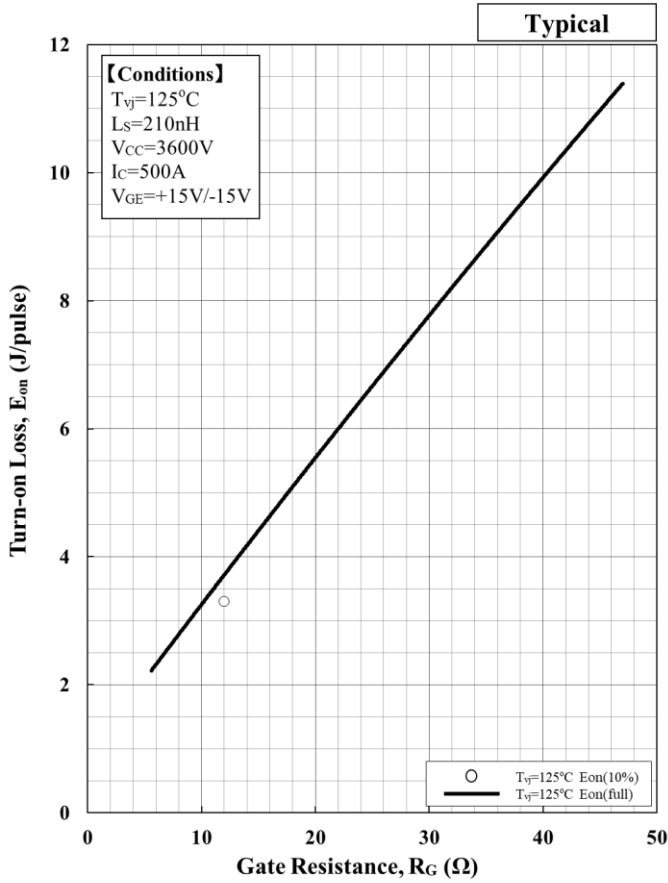
$E [J] = a_3 \cdot I_F ^3 + a_2 \cdot I_F ^2 + a_1 \cdot I_F + a_0$				
Temp.[°C]	a_3	a_2	a_1	a_0
25	1.08E-09	-2.28E-06	2.19E-03	1.40E-01
125	2.02E-09	-4.27E-06	4.11E-03	2.62E-01

Recovery loss vs. Forward current

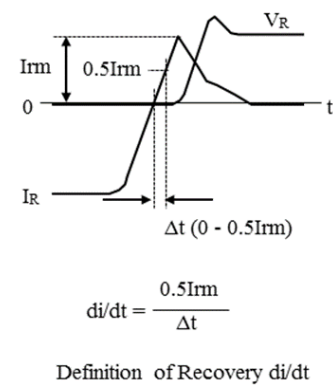
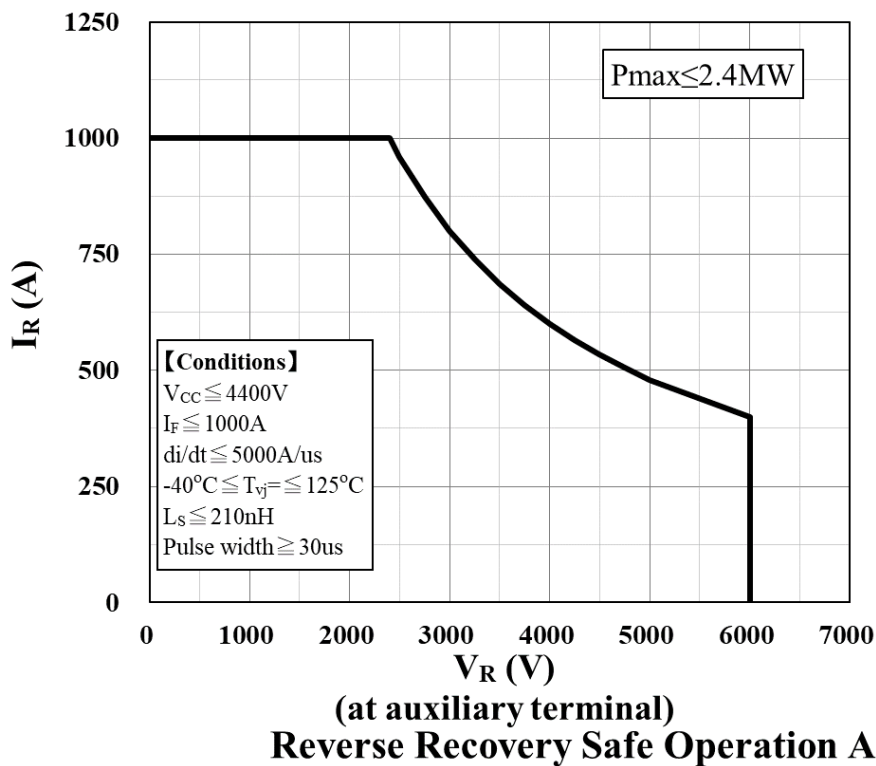
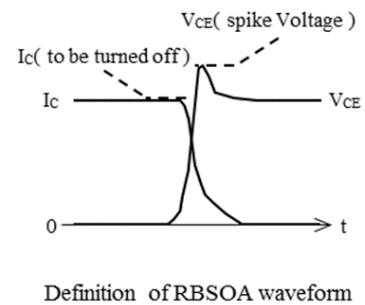
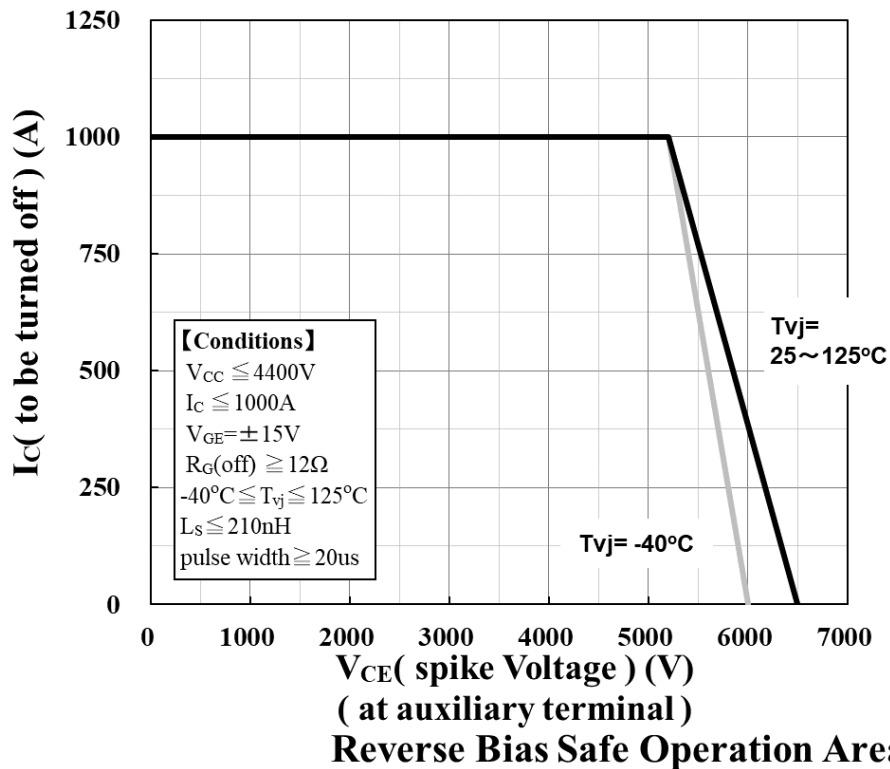


Switching time vs. Collector Current

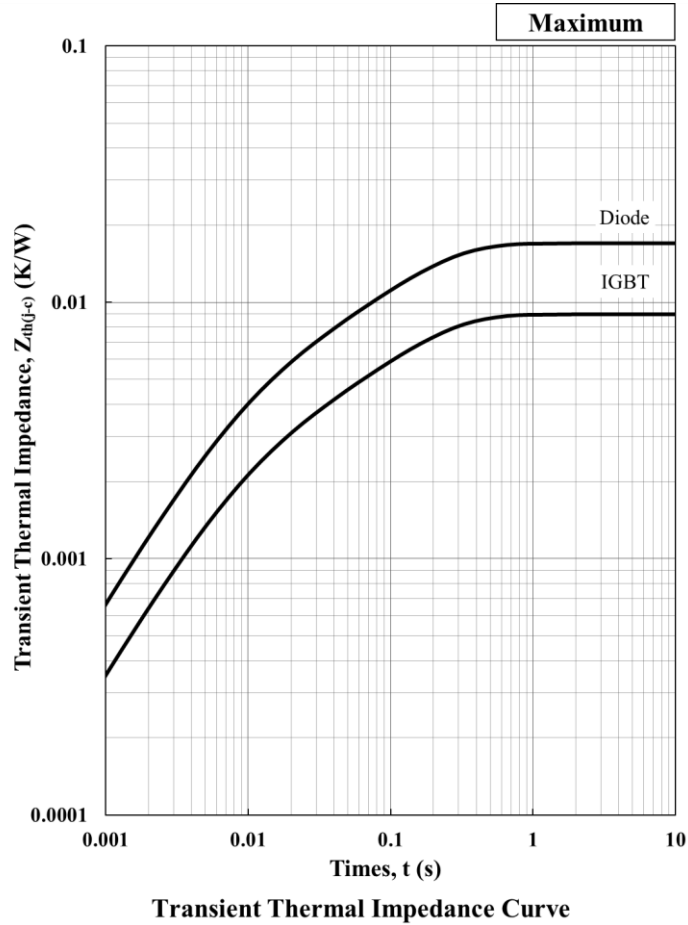
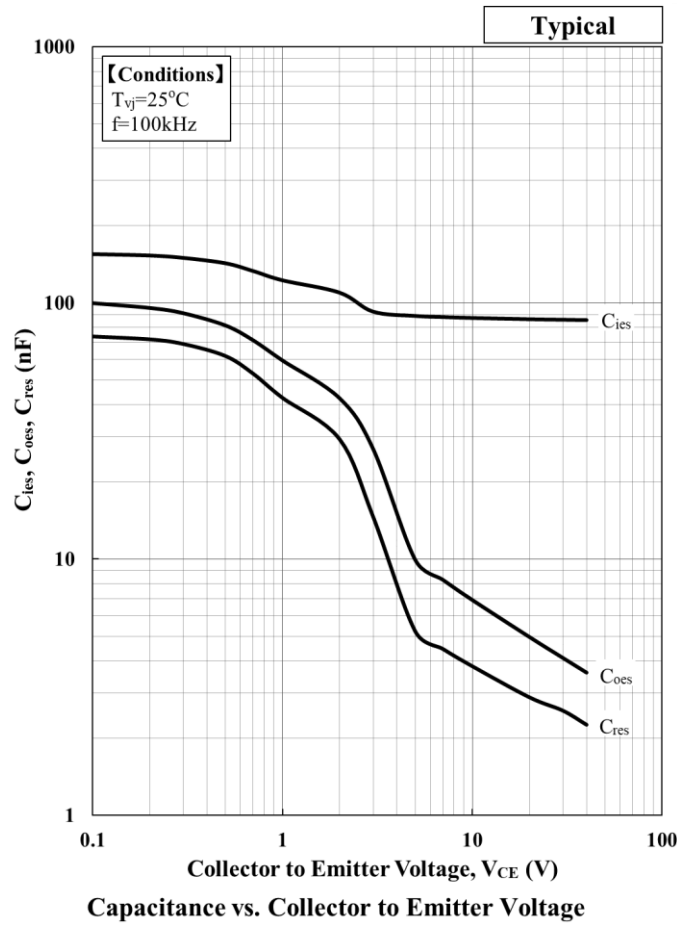
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Foster model lumped circuit constant

n	1	2	3	4	Unit
R th, IGBT [n]	8.36E-03	2.59E-03	2.43E-03	1.04E-04	[K/W]
C th, IGBT [n]	1.97E+01	1.12E+01	2.89E+00	9.03E+00	[J/K]
R th, Diode [n]	1.67E-02	5.25E-03	4.81E-03	2.13E-04	[K/W]
C th, Diode [n]	9.85E+00	5.51E+00	1.46E+00	4.42E+00	[J/K]

Cauer model lumped circuit constant

n	1	2	3	4	Unit
R th, IGBT [n]	2.09E-03	2.74E-03	4.26E-03	4.40E-03	[K/W]
C th, IGBT [n]	1.68E+00	9.76E-01	8.10E+00	2.22E+01	[J/K]
R th, Diode [n]	4.14E-03	5.52E-03	8.50E-03	8.80E-03	[K/W]
C th, Diode [n]	8.37E-01	4.91E-01	4.02E+00	1.11E+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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Minebea POWER SEMICONDUCTORS

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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.
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)".
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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.
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 Minebea 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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