

MBM200H45E2-H

Silicon N-channel IGBT 4500V E2 version

FEATURES

- * Low switching loss IGBT module.
- * Low noise due to ultra soft fast recovery diode.
- * Isolated heat sink (terminal to base).

ABSOLUTE MAXIMUM RATINGS (T_C=25°C)

Item	Symbol	Unit	MBM200H45E2-H
Collector Emitter Voltage	V _{CES}	V	4,500
Gate Emitter Voltage	V _{GES}	V	±20
Collector Current	DC	A	200(T _C =80°C)
	1ms		400
Forward Current	DC	A	200
	1ms		400
Peak Forward Surge Current	IFSM	Ap	1,500 (T _{vj} =125°C, 50Hz, 10ms Half-sinewave)
Total Power Dissipation	P _{tot}	W	1,960 (T _C =25°C per IGBT)
Junction Temperature	T _{vj}	°C	-40 ~ +125
Operating Junction Temperature	T _{vj op}	°C	-40 ~ +125
Case Temperature	T _C	°C	-40 ~ +125
Storage Temperature	T _{stg}	°C	-40 ~ +125
Isolation Voltage	V _{ISO}	V _{RMS}	9,000(AC 1 minute)
Screw Torque	Terminals (M6)	-	6 (1)
	Mounting (M6)	-	6 (1)

Notes: (1) 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	-	-	7	V _{CE} =4,500V, V _{GE} =0V, T _{vj} =25°C	
			-	4	16	V _{CE} =4,500V, 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 _{CE(sat)}	V	-	3.2	-	I _C =200A, V _{GE} =15V, T _{vj} =25°C	
			3.5	4.2	4.7	I _C =200A, V _{GE} =15V, T _{vj} =125°C	
Gate Emitter Threshold Voltage	V _{GE(th)}	V	5.4	6.4	7.4	V _{CE} =10V, I _C =200mA, T _{vj} =25°C	
Gate Charge	Q _g	μC	-	2.1	-	V _{CC} =2,800V, I _C =200A, V _{GE} =±15V	
Input Capacitance	C _{ies}	nF	-	28	-		
Output Capacitance	C _{oes}	nF	-	2.3	-	V _{CE} =10V, V _{GE} =0V, f=100kHz, T _{vj} =25°C	
Reverse transfer capacitance	C _{res}	nF	-	1.1	-		
Internal Gate Resistance	R _{G(int)}	Ω	-	4.8	-	V _{CE} =10V, V _{GE} =0V, f=100kHz, T _{vj} =25°C	
Turn On Delay Time	t _{d(on)}	μs	-	0.5	-	T _{vj} =25°C	V _{CC} =2,800V, I _C =200A L _S =400nH R _G =20Ω (2) V _{GE} =±15V
			-	0.6	-	T _{vj} =125°C	
Rise Time	t _r		-	1.9	-	T _{vj} =25°C	
			-	2.1	4.2	T _{vj} =125°C	
Turn Off Delay Time	t _{d(off)}		-	1.8	-	T _{vj} =25°C	
			-	1.9	-	T _{vj} =125°C	
Fall Time	t _f		-	1.8	-	T _{vj} =25°C	
		-	2.4	3.6	T _{vj} =125°C		
Turn On Loss	E _{on(full)}	J/P	-	0.73	-	T _{vj} =25°C	V _{CC} =2,800V, I _C =200A, L _S =400nH R _G =20Ω (2) V _{GE} =±15V
	E _{on(10%)}		-	0.85	1.30	T _{vj} =125°C	
	E _{on(full)}		-	0.92	-	T _{vj} =25°C	
Turn Off Loss	E _{off(full)}	J/P	-	0.60	-	T _{vj} =25°C	
	E _{off(10%)}		-	0.65	1.00	T _{vj} =125°C	
	E _{off(full)}		-	0.73	-	T _{vj} =125°C	
Partial discharge extinction voltage	V _e	V _{RMS}	5.100	-	-	f=50Hz, Q _{PD} ≤10pC(acc. to IEC 61287)	

Notes: (2) RG value 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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ELECTRICAL CHARACTERISTICS (Diode)

Item	Symbol	Unit	Min.	Typ.	Max.	Test Conditions	
Forward Voltage Drop	V _F	V	-	3.6	4.15	T _{vj} =25°C	I _F =200A, V _{GE} =0V
			3.2	3.9	4.7	T _{vj} =125°C	
Reverse Recovery Time	t _{rr}	μs	-	0.5	-	T _{vj} =25°C	V _{CC} =2,800V, I _F =200A, L _S =400nH, R _G =20Ω
			-	0.7	1.4	T _{vj} =125°C	
Reverse Recovery Current	I _{rr}	A	-	230	-	T _{vj} =25°C	
			-	250	-	T _{vj} =125°C	
Recovery charge	Q _{rr}	μC	-	100	-	T _{vj} =25°C	
			-	170	-	T _{vj} =125°C	
Reverse Recovery Loss	E _{rr(full)}	J/P	-	0.16	-	T _{vj} =25°C	V _{CC} =2,800V, I _F =200A, L _S =400nH, R _G =20Ω (3)
	E _{rr(10%)}		-	0.26	0.50	T _{vj} =125°C	
	E _{rr(full)}		-	0.29	-		

Notes: (3) R_G value is the test condition's value for evaluation of the switching times, not recommended value.

Please, determine the suitable R_G value after the measurement of switching waveforms (overshoot voltage, etc.) with appliance mounted.

THERMAL CHARACTERISTICS

Item	Symbol	Unit	Min.	Typ.	Max.	Test Conditions
Thermal Impedance	IGBT	$R_{th(j-c)}$	-	-	0.052	Junction to case
	FWD	$R_{th(j-c)}$	-	-	0.104	
Contact Thermal Impedance	$R_{th(c-f)}$	K/W	-	0.032	-	Case to fin (par 1 arm)

MODULE MECHANICAL CHARACTERISTICS

Item		Unit	Characteristics	Conditions
Weight		g	840	
Creepage Distance	Between terminal	mm	51	C1 main - C2/E1 main C2/E1 main - E2 main
	Terminal-Base	mm	57	G1E1 - base
Clearance Distance	Between terminal	mm	20	C1 main - C2/E1 main C2/E1 main - E2 main
	Terminal-Base	mm	36	C1 aux - base
Stray inductance module	L _{SCE}	nH	140	Between C1 main - E2 main
Resistance, Terminal-chip	R _{CC'+EE'}	mΩ	1.5	Terminal to chip
Comparative Tracking Index (CTI)			600	
Module base plate Material			Cu	
Baseplate Thickness		mm	5	
Insulation plate Material			AlN	
Terminal Surface treatment			Ni plating	
Case Material			Poly-Phenilene Sulfide	

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DEFINITION OF TEST CIRCUIT

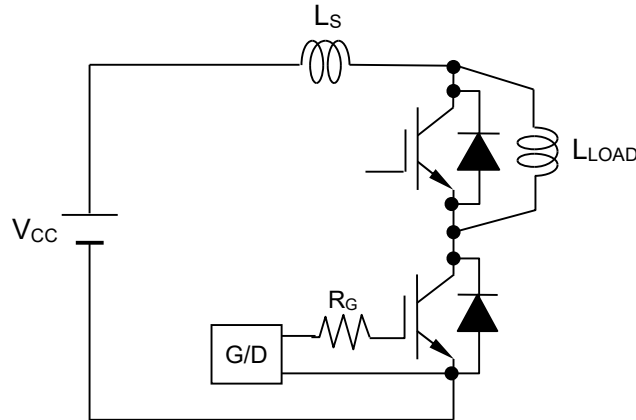


Fig.1 Switching test circuit

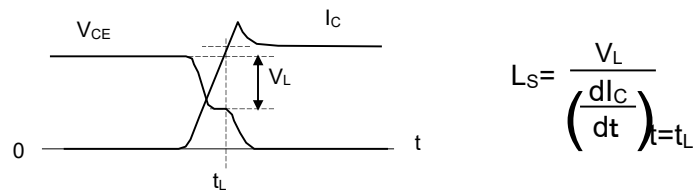


Fig.2 Definition of stray inductance

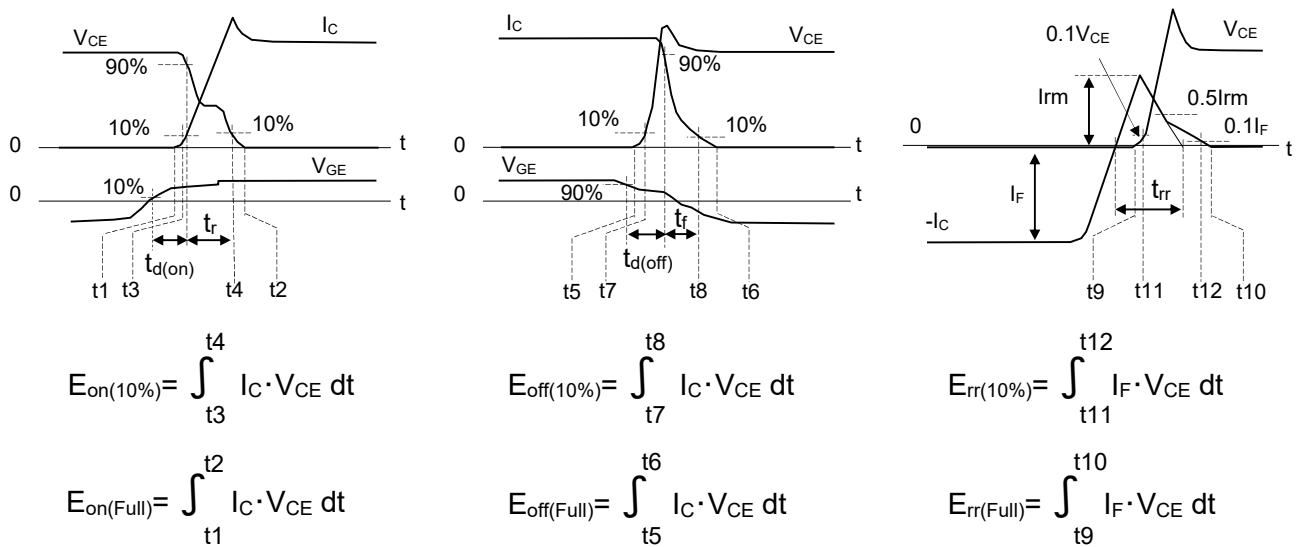
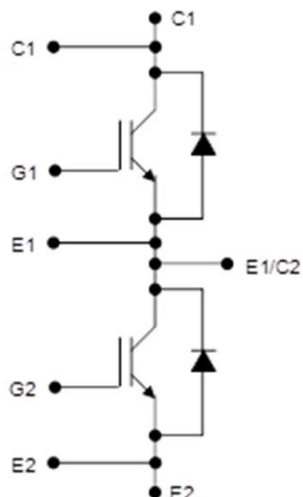
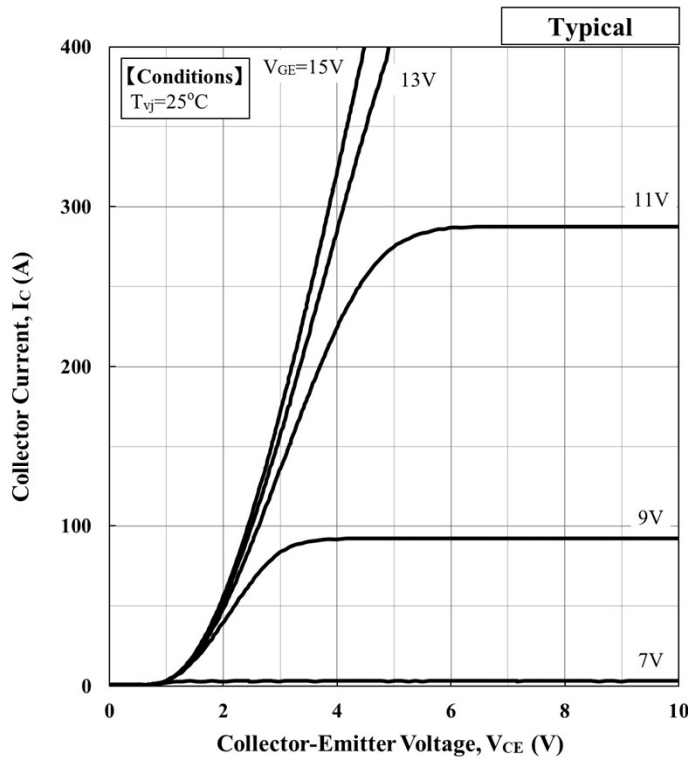


Fig.3 Definition of switching loss

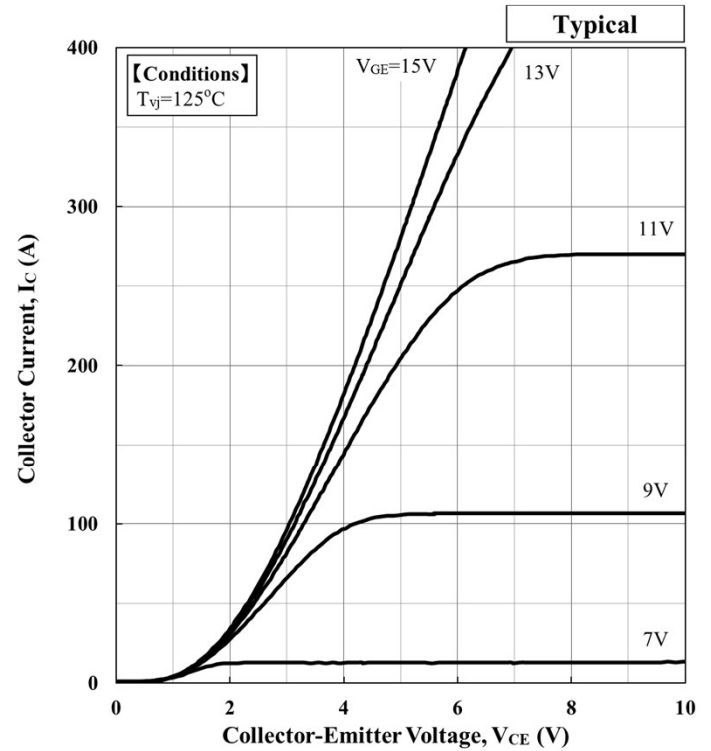


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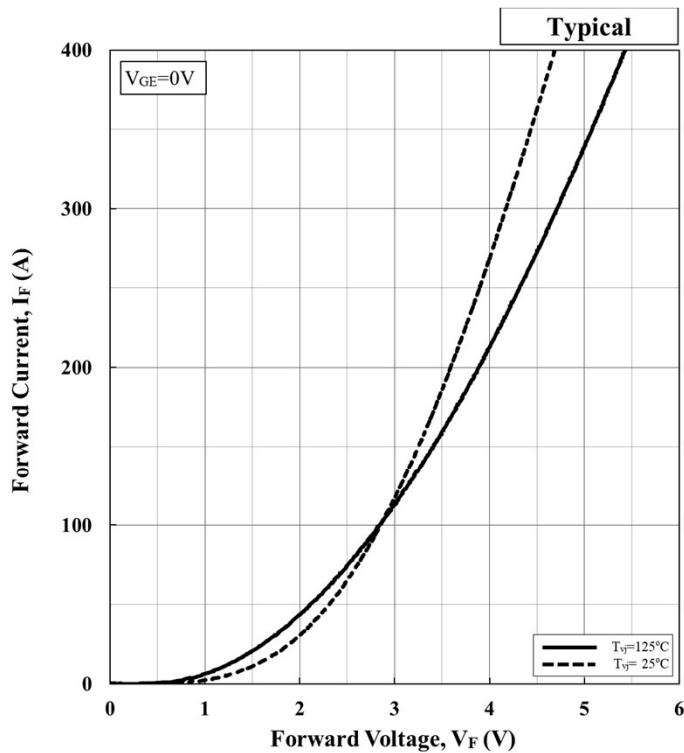
$V_{CE}(sat)[V] = a_3 \cdot I_c ^3 + a_2 \cdot I_c ^2 + a_1 \cdot I_c + a_0$					
Temp.[°C]	$V_{GE}[V]$	a_3	a_2	a_1	a_0
25	15	3.19E-08	-2.74E-05	1.39E-02	1.28E+00

Collector Current vs. Collector Emitter Voltage



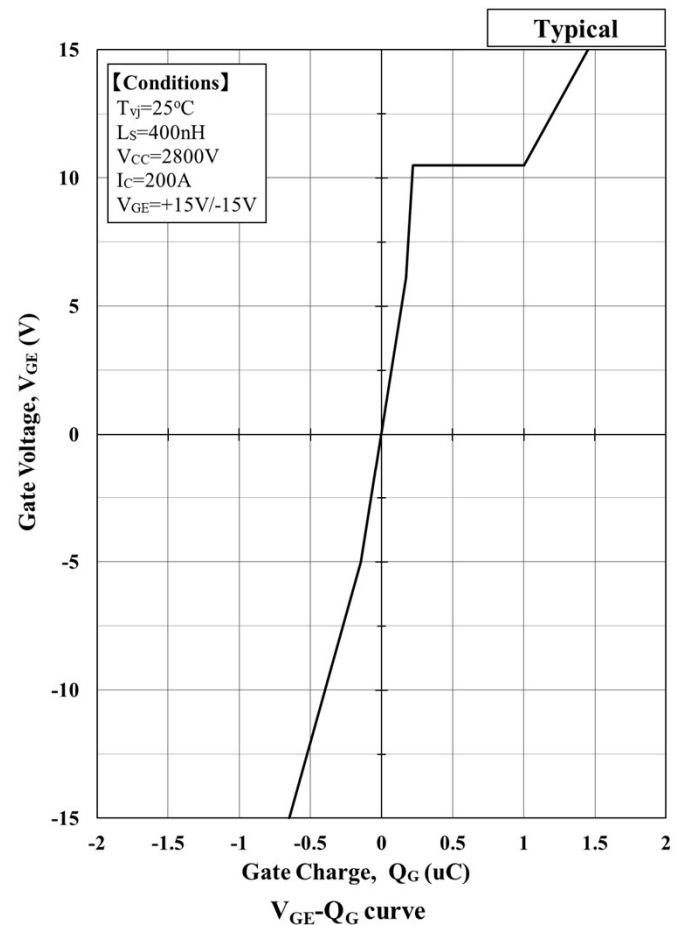
$V_{CE}(sat)[V] = a_3 \cdot I_c ^3 + a_2 \cdot I_c ^2 + a_1 \cdot I_c + a_0$					
Temp.[°C]	$V_{GE}[V]$	a_3	a_2	a_1	a_0
125	15	4.61E-08	-3.91E-05	2.04E-02	1.33E+00

Collector Current vs. Collector Emitter Voltage

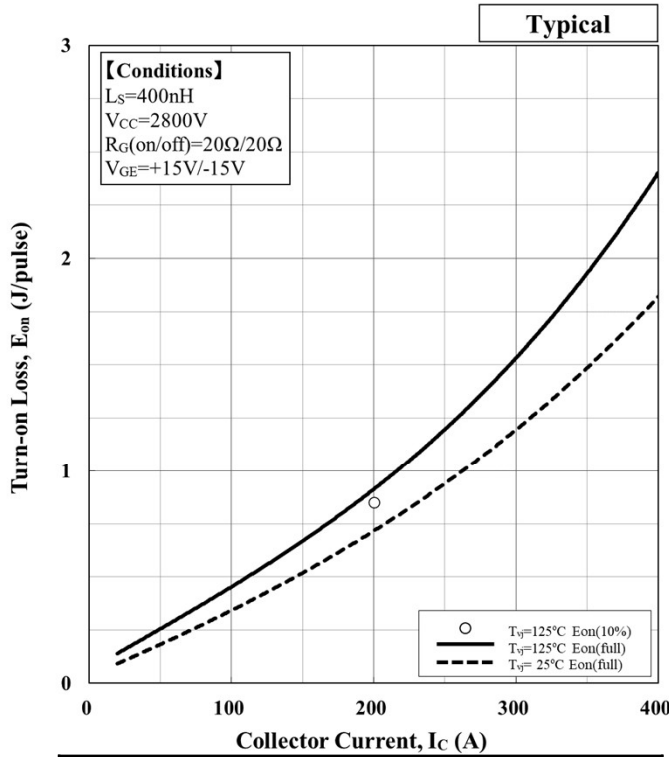


$V_F[V] = a_3 \cdot I_F ^3 + a_2 \cdot I_F ^2 + a_1 \cdot I_F + a_0$				
Temp.[°C]	a_3	a_2	a_1	a_0
25	4.54E-08	-3.90E-05	1.63E-02	1.55E+00
125	4.73E-08	-4.32E-05	2.04E-02	1.17E+00

Forward Voltage of free-wheeling diode

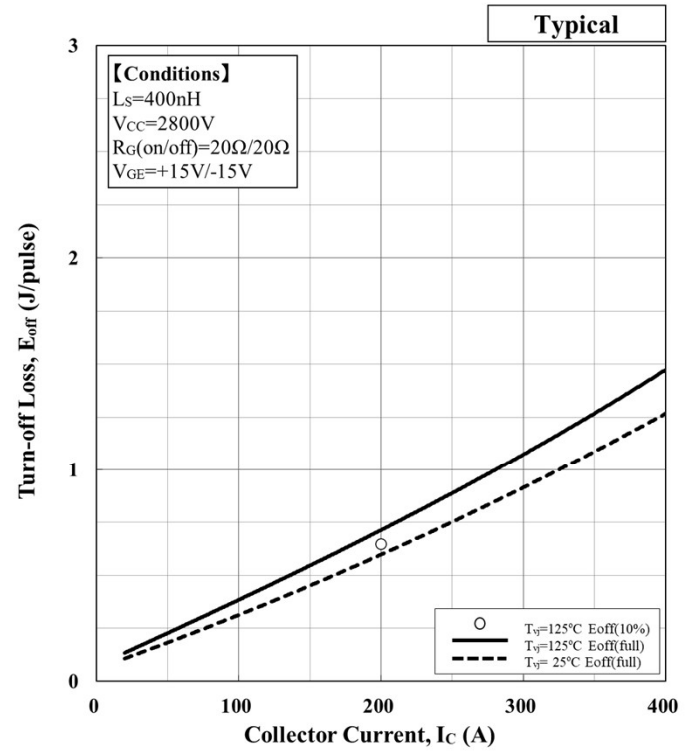


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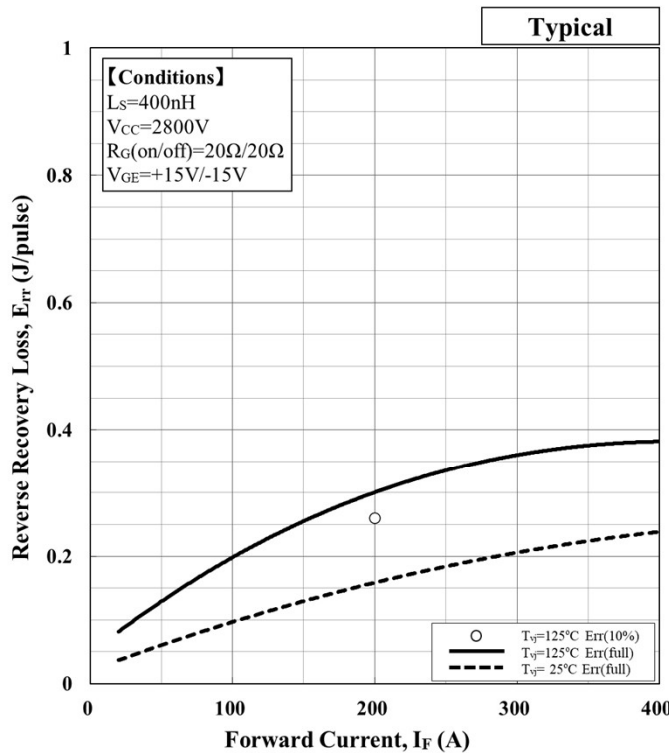
$E [J] = a_3 \cdot I_c ^3 + a_2 \cdot I_c ^2 + a_1 \cdot I_c + a_0$				
Temp.[°C]	a_3	a_2	a_1	a_0
25	6.69E-09	1.26E-06	2.89E-03	3.41E-02
125	1.50E-08	-9.73E-07	3.84E-03	6.42E-02

Turn-on loss vs. Collector current



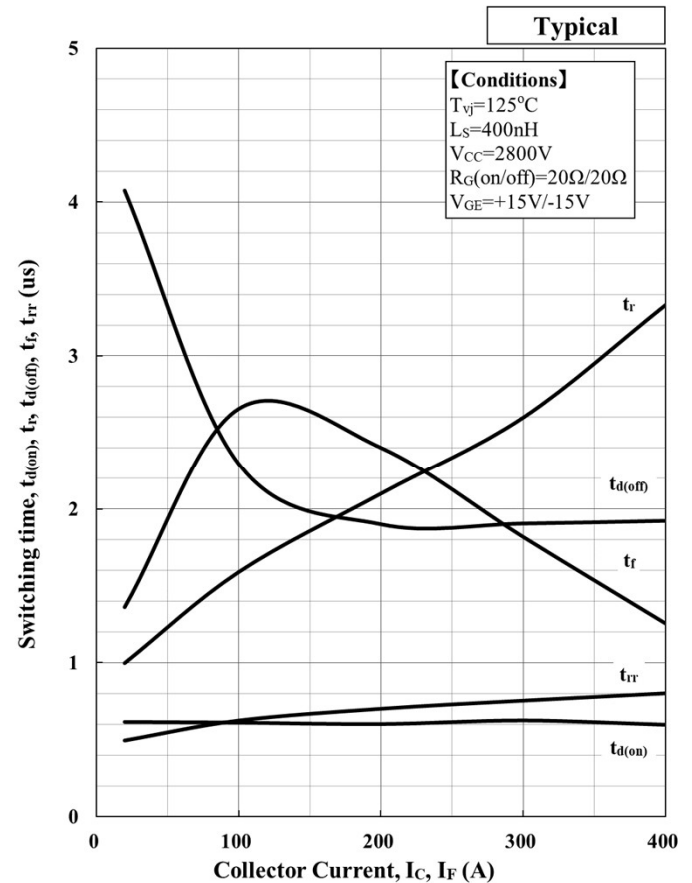
$E [J] = a_3 \cdot I_c ^3 + a_2 \cdot I_c ^2 + a_1 \cdot I_c + a_0$				
Temp.[°C]	a_3	a_2	a_1	a_0
25	1.65E-10	1.54E-06	2.38E-03	6.00E-02
125	1.83E-09	3.90E-07	3.05E-03	7.37E-02

Turn-off loss vs. Collector current



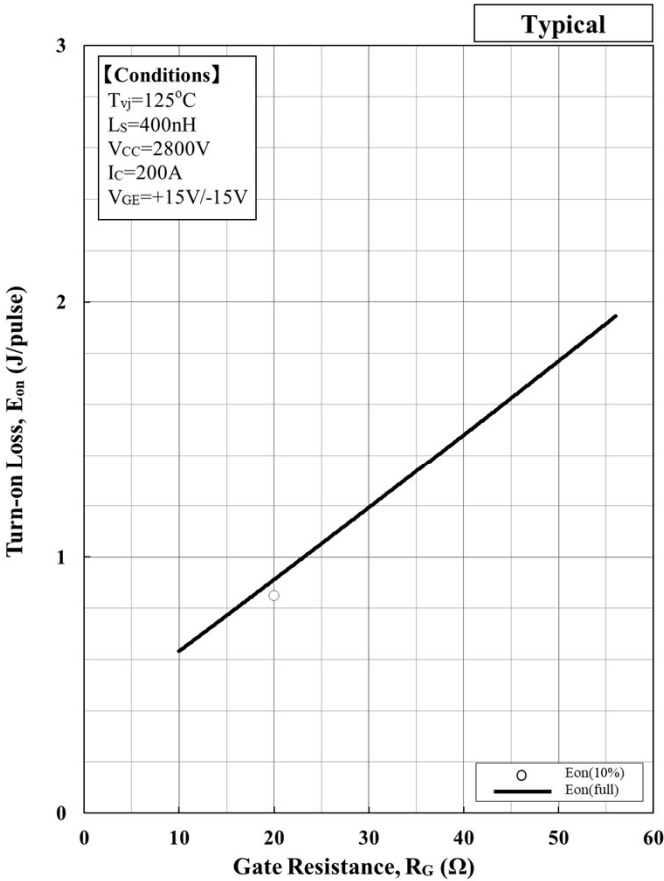
$E [J] = a_3 \cdot I_F ^3 + a_2 \cdot I_F ^2 + a_1 \cdot I_F + a_0$				
Temp.[°C]	a_3	a_2	a_1	a_0
25	0.00E+00	-7.29E-07	8.37E-04	2.04E-02
125	8.77E-10	-2.68E-06	1.77E-03	4.75E-02

Recovery loss vs. Forward current

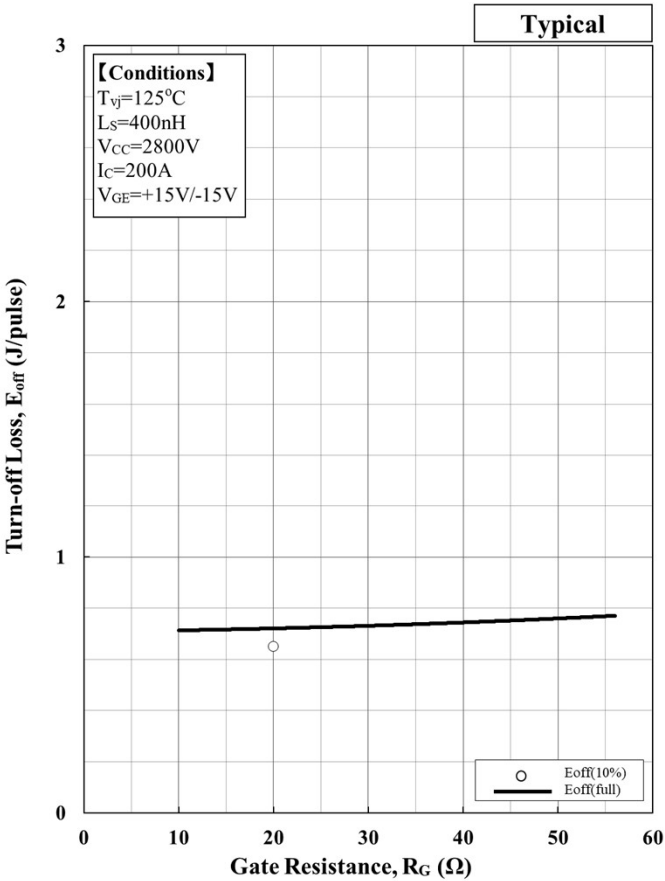


Switching time vs. Collector Current

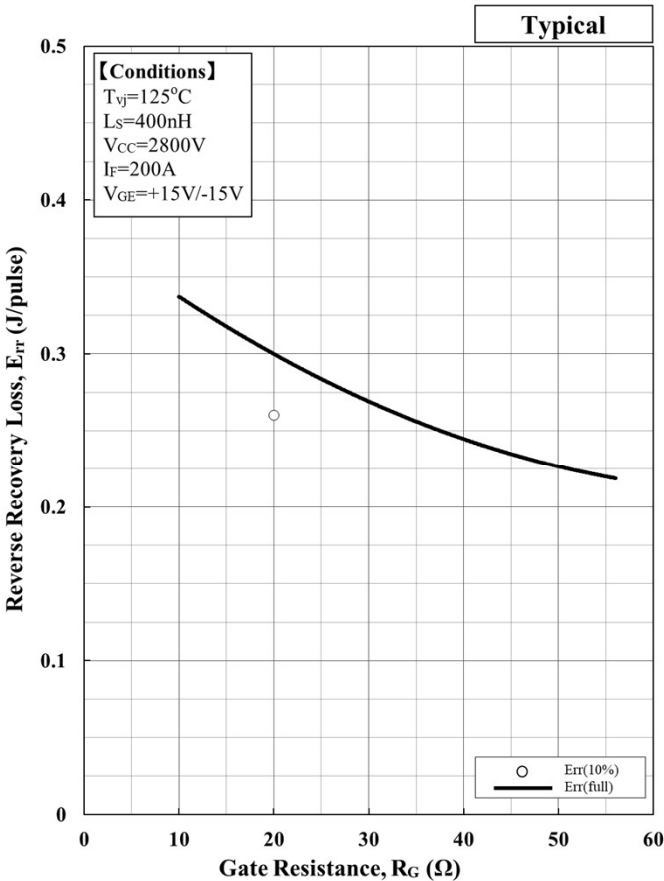
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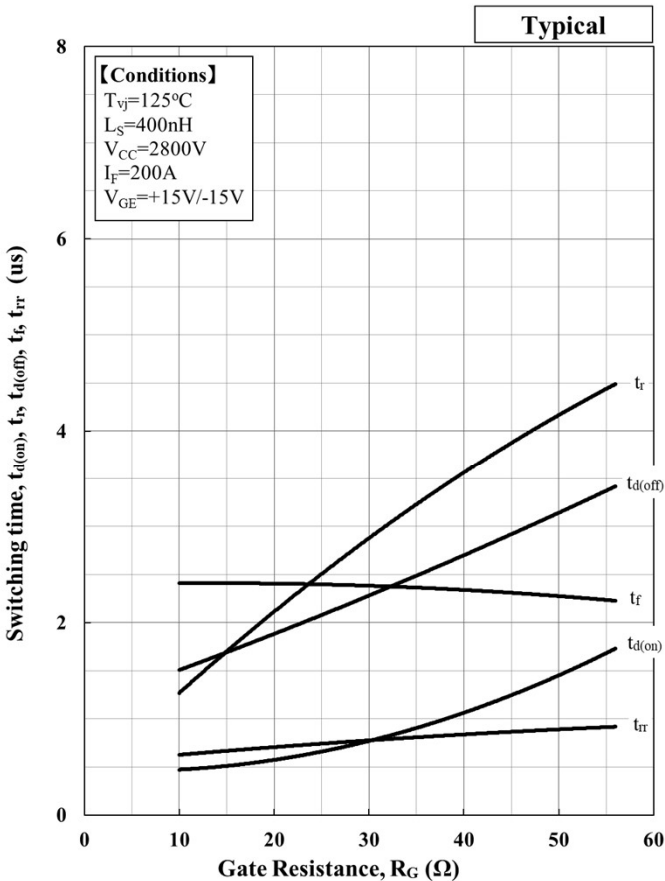
Turn-on loss vs. Gate Resistance



Turn-off loss vs. Gate Resistance

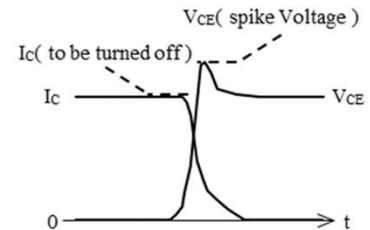
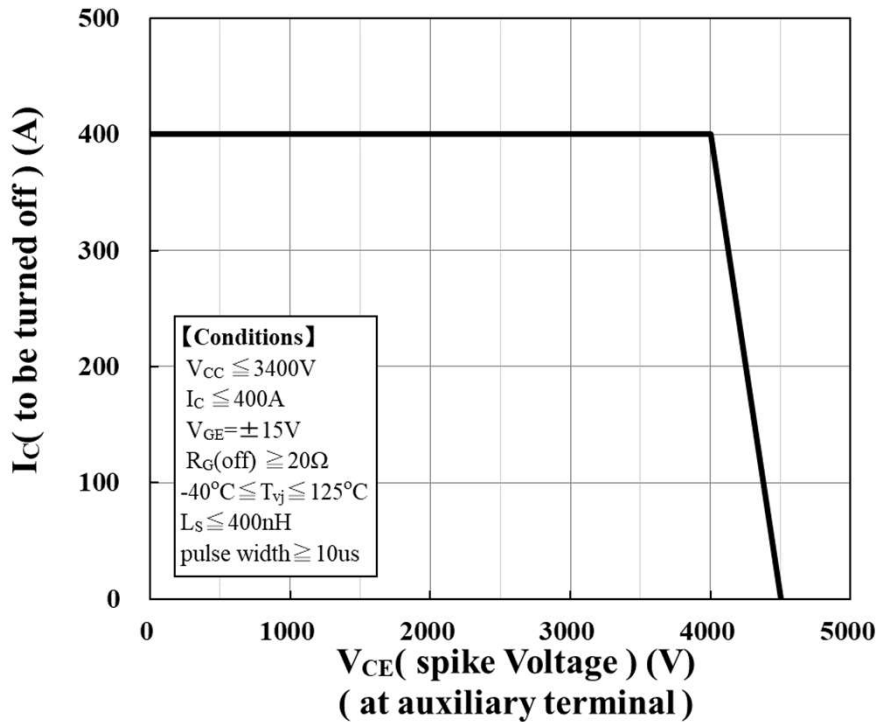


Reverse Recovery loss vs. Gate Resistance



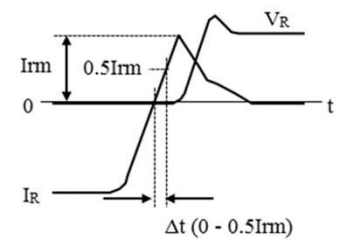
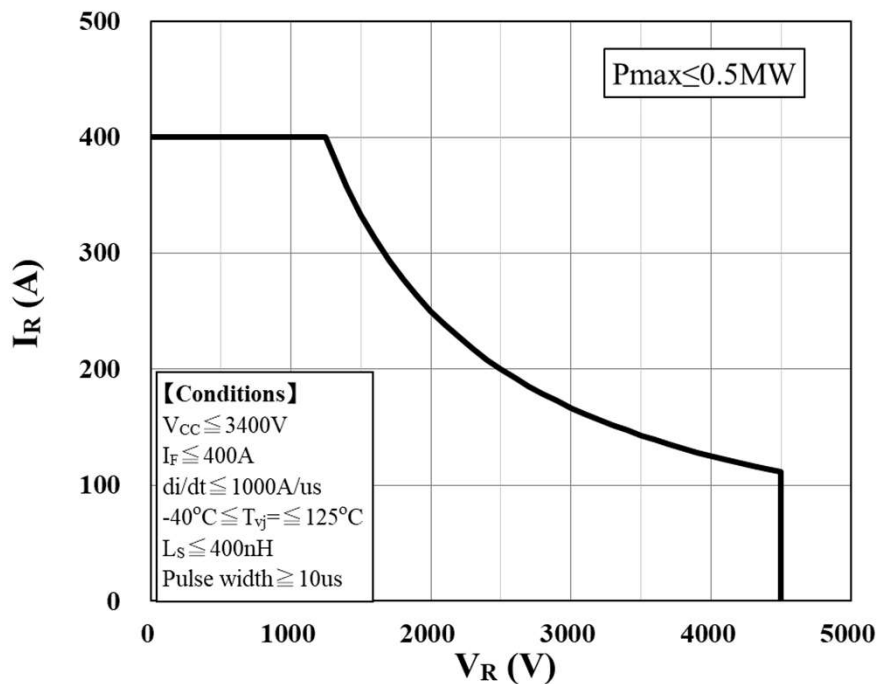
Switching time vs. Gate Resistance

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Definition of RBSOA waveform

Reverse Bias Safe Operation Area (RBSOA)

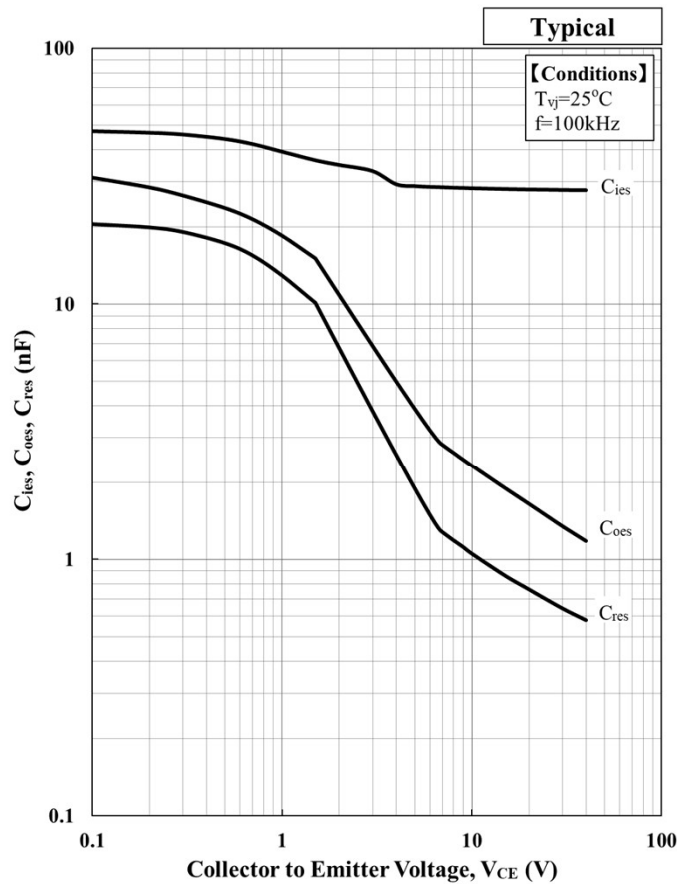


$$\frac{di}{dt} = \frac{0.5I_{rm}}{\Delta t}$$

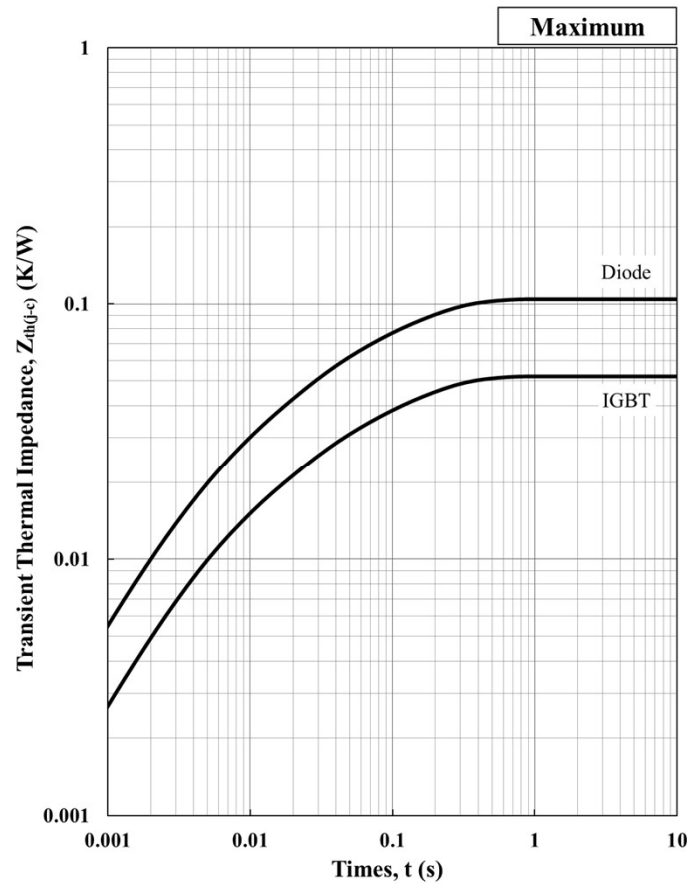
Definition of Recovery di/dt

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]	2.73E-02	1.67E-02	8.05E-03	8.60E-10	[K/W]
C th, IGBT [n]	5.22E+00	1.38E+00	4.99E-01	1.77E+06	[J/K]
R th, Diode [n]	5.41E-02	3.45E-02	1.44E-02	9.72E-04	[K/W]
C th, Diode [n]	2.63E+00	6.67E-01	2.78E-01	1.57E+00	[J/K]

Cauer model lumped circuit constant

n	1	2	3	4	Unit
R th, IGBT [n]	1.60E-02	1.89E-02	1.39E-02	3.17E-03	[K/W]
C th, IGBT [n]	3.42E-01	1.15E+00	6.43E+00	5.91E-01	[J/K]
R th, Diode [n]	2.70E-02	1.27E-02	3.13E-02	3.30E-02	[K/W]
C th, Diode [n]	1.64E-01	2.71E-01	3.90E-01	3.27E+00	[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

Notices

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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.
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