

# MBM250H33E3

Silicon N-channel IGBT 3300V E3 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.

## ABSOLUTE MAXIMUM RATINGS (T<sub>c</sub>=25°C)

Item	Symbol	Unit	MBM250H33E3
Collector Emitter Voltage	V <sub>CES</sub>	V	3,300
Gate Emitter Voltage	V <sub>GES</sub>	V	±20
Collector Current	DC	I <sub>c</sub>	250 (T <sub>c</sub> =95°C)
	1ms	I <sub>cp</sub>	
Forward Current	DC	I <sub>F</sub>	250
	1ms	I <sub>FM</sub>	500
Peak Forward Surge Current	I <sub>FSM</sub>	A <sub>p</sub>	2000
Total Power Dissipation	P <sub>tot</sub>	W	2500 (T <sub>c</sub> =25°C per IGBT)
Junction Temperature	T <sub>j</sub>	°C	-40 ~ +150
Junction Operating Temperature	T <sub>jop</sub>	°C	-40 ~ +125
Case Temperature	T <sub>c</sub>	°C	-40 ~ +125
Storage Temperature	T <sub>stg</sub>	°C	-50 ~ +125
Isolation Voltage	V <sub>ISO</sub>	V <sub>RMS</sub>	7,700 (AC 1 minute)
Screw Torque	Mounting (M6)	-	6 (1)

Notes: (1) Recommended Value 5.5±0.5N·m

- \* 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.

# MBM250H33E3

## ELECTRICAL CHARACTERISTICS (IGBT)

Item	Symbol	Unit	Min.	Typ.	Max.	Test Conditions		
Collector Emitter Cut-Off Current	$I_{CES}$	mA	-	-	2	$T_j=25^\circ\text{C}$	$V_{CE}=3,300\text{V}, V_{GE}=0\text{V}$	
			-	4	10	$T_j=125^\circ\text{C}$		
Gate Emitter Leakage Current	$I_{GES}$	nA	-500	-	+500	$V_{GE}=\pm 20\text{V}, V_{CE}=0\text{V}, T_j=25^\circ\text{C}$		
Collector Emitter Saturation Voltage	$V_{CE(sat)}$	V	-	2.65	-	$T_j=25^\circ\text{C}$	$I_C=250\text{A}, V_{GE}=15\text{V}$	
			2.70	3.40	3.90	$T_j=125^\circ\text{C}$		
			-	3.60	-	$T_j=150^\circ\text{C}$		
Gate Emitter Threshold Voltage	$V_{GE(TO)}$	V	5.5	6.3	7.5	$V_{CE}=10\text{V}, I_C=250\text{mA}, T_j=25^\circ\text{C}$		
Gate Charge	$Q_g$	$\mu\text{C}$	-	2.8	-	$V_{CC}=2800\text{V}, I_C=250\text{A}, V_{GE}=\pm 15\text{V}$		
Input Capacitance	$C_{ies}$	nF	-	33	-	$V_{CE}=10\text{V}, V_{GE}=0\text{V}, f=100\text{kHz}, T_j=25^\circ\text{C}$		
Output Capacitance	$C_{oes}$	nF	-	3.3	-			
Reverse transfer capacitance	$C_{res}$	nF	-	2.3	-			
Internal Gate Resistance	$R_{ge}$	$\Omega$	-	5.4	-	$V_{CE}=10\text{V}, V_{GE}=0\text{V}, f=100\text{kHz}, T_j=25^\circ\text{C}$		
Switching Times	Rise Time	$t_r$	$\mu\text{s}$	-	1.5	-	$T_j=25^\circ\text{C}$	$V_{CC}=1,800\text{V}, I_C=250\text{A},$ $L_s=400\text{nH},$ $R_G=15\Omega$ (2), $V_{GE}=\pm 15\text{V}$
				-	1.8	2.5	$T_j=125^\circ\text{C}$	
				-	1.9	-	$T_j=150^\circ\text{C}$	
	Turn On Time	$t_{on}$	-	2.1	-	$T_j=25^\circ\text{C}$		
			-	2.5	3.3	$T_j=125^\circ\text{C}$		
			-	2.5	-	$T_j=150^\circ\text{C}$		
	Fall Time	$t_f$	-	1.6	-	$T_j=25^\circ\text{C}$		
			-	1.9	3.2	$T_j=125^\circ\text{C}$		
			-	1.9	-	$T_j=150^\circ\text{C}$		
	Turn Off Time	$t_{off}$	-	3.6	-	$T_j=25^\circ\text{C}$		
-			4.0	5.2	$T_j=125^\circ\text{C}$			
-			4.0	-	$T_j=150^\circ\text{C}$			
Turn On Loss	$E_{on(full)}$	J/p	-	0.35	-	$T_j=25^\circ\text{C}$	$V_{CC}=1800\text{V}, I_C=250\text{A},$ $L_s=400\text{nH}$ $R_G=15\Omega$ (2) $V_{GE}=\pm 15\text{V}$	
	$E_{on(10\%)}$		-	0.43	0.58	$T_j=125^\circ\text{C}$		
	$E_{on(full)}$		-	0.48	-	$T_j=125^\circ\text{C}$		
Turn Off Loss	$E_{off(full)}$	-	0.50	-	$T_j=150^\circ\text{C}$			
	$E_{off(full)}$	-	0.40	-	$T_j=25^\circ\text{C}$			
	$E_{off(10\%)}$	-	0.37	0.50	$T_j=125^\circ\text{C}$			
	$E_{off(full)}$	-	0.48	-	$T_j=125^\circ\text{C}$			
	$E_{off(full)}$	-	0.49	-	$T_j=150^\circ\text{C}$			

Notes:(2)  $R_G$  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.

## ELECTRICAL CHARACTERISTICS (DIODE)

Item	Symbol	Unit	Min.	Typ.	Max.	Test Conditions	
Peak Forward Voltage Drop	$V_{FM}$	V	-	2.70	-	$T_j=25^\circ\text{C}$	$I_F=250\text{A}, V_{GE}=0\text{V}$
			2.30	2.90	3.30	$T_j=125^\circ\text{C}$	
			-	2.80	-	$T_j=150^\circ\text{C}$	
Reverse Recovery Time	$t_{rr}$	$\mu\text{s}$	-	0.50	-	$T_j=25^\circ\text{C}$	$V_{CC}=1800\text{V}, I_F=250\text{A},$ $L_s=400\text{nH}, R_G=15\Omega$ (3)
			-	0.70	1.2	$T_j=125^\circ\text{C}$	
			-	0.80	-	$T_j=150^\circ\text{C}$	
Reverse Recovery Current	$I_{rr}$	A	-	270	-	$T_j=25^\circ\text{C}$	
			-	330	-	$T_j=125^\circ\text{C}$	
			-	330	-	$T_j=150^\circ\text{C}$	
Recovery charge	$Q_{rr}$	$\mu\text{C}$	-	70	-	$T_j=25^\circ\text{C}$	
			-	120	-	$T_j=125^\circ\text{C}$	
			-	120	-	$T_j=150^\circ\text{C}$	
Reverse Recovery Loss	$E_{rr(full)}$	J/p	-	0.21	-	$T_j=25^\circ\text{C}$	$V_{CC}=1800\text{V}, I_F=250\text{A},$ $L_s=400\text{nH}, R_G=15\Omega$ (3)
	$E_{rr(10\%)}$		-	0.31	0.41	$T_j=125^\circ\text{C}$	
	$E_{rr(full)}$		-	0.40	-	$T_j=125^\circ\text{C}$	
	$E_{rr(full)}$		-	0.45	-	$T_j=150^\circ\text{C}$	

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.

# MBM250H33E3

## THERMAL CHARACTERISTICS

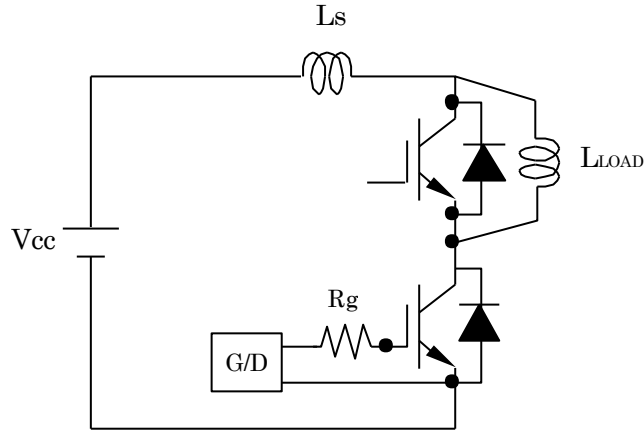
Item	Symbol	Unit	Min.	Typ.	Max.	Test Conditions	
Thermal Impedance	IGBT	$R_{th(j-c)}$	K/W	-	-	0.050	Junction to case
	FWD	$R_{th(j-c)}$		-	-	0.100	
Contact Thermal Impedance		$R_{th(c-f)}$	K/W	-	0.032	-	Case to fin ( $\lambda_{grease}=1W/(m \cdot K)$ , heat-sink flatness $\leq 50\mu m$ )

## MODULE MECHANICAL CHARACTERISTICS

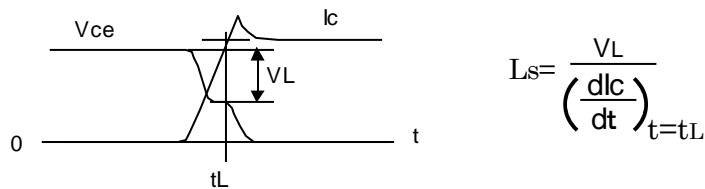
Item	Unit	Characteristics	Conditions	
Weight	g	840		
Creepage Distance	Between terminal	mm	54	Collector-sense to Emitter-main
	Terminal-Base	mm	64	
Clearance Distance	Between terminal	mm	19	Collector-sense to Emitter-main
	Terminal-Base	mm	35	
Stray inductance in module	LS(CM-EM)	nH	140	Between C1- E2
Resistance, Terminal-chip	$R_{CC+EE}$	m $\Omega$	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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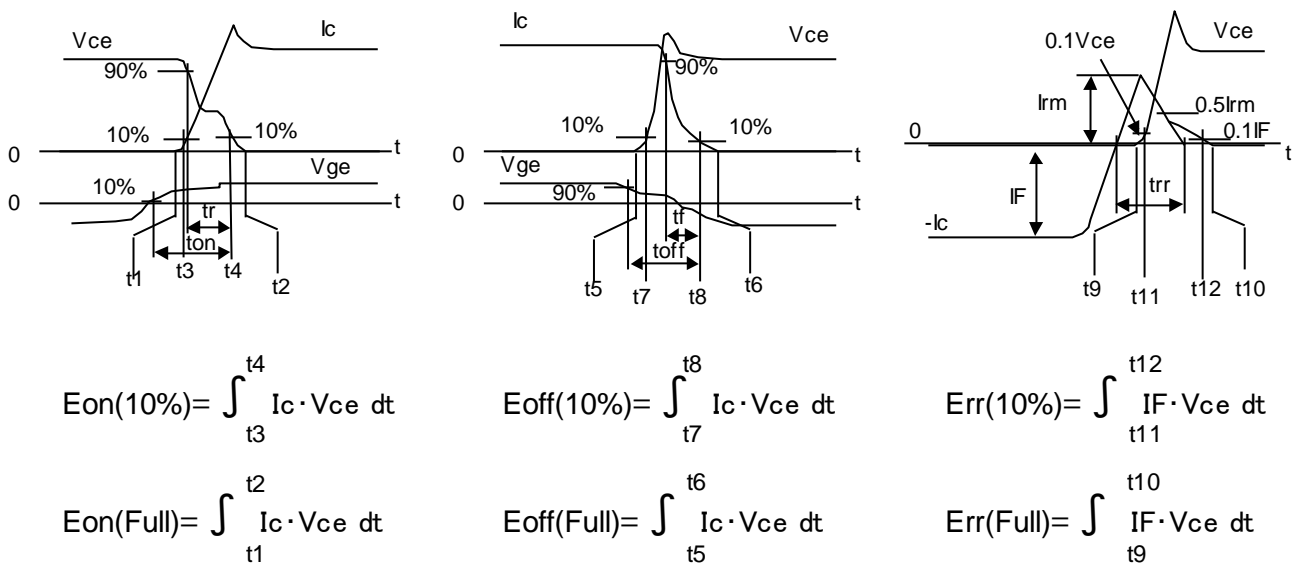
## DEFINITION OF TEST CIRCUIT



**Fig.1 Switching test circuit**



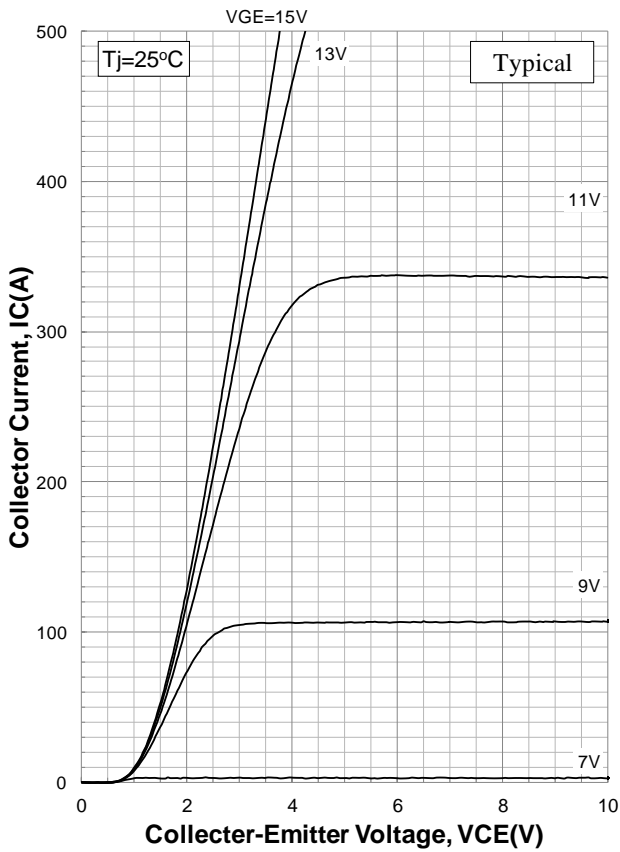
**Fig.2 Definition of Ls**



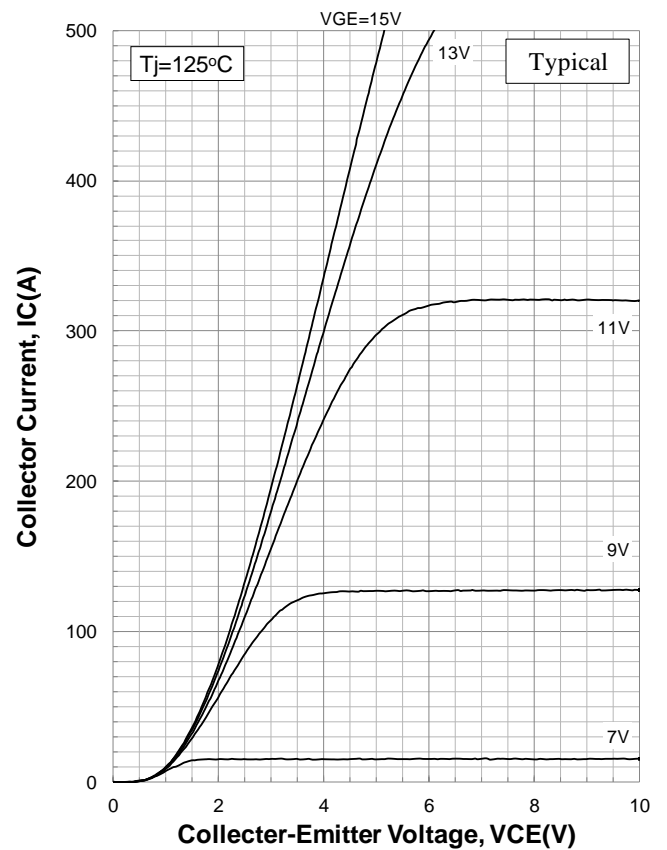
**Fig.3 Definition of switching loss**

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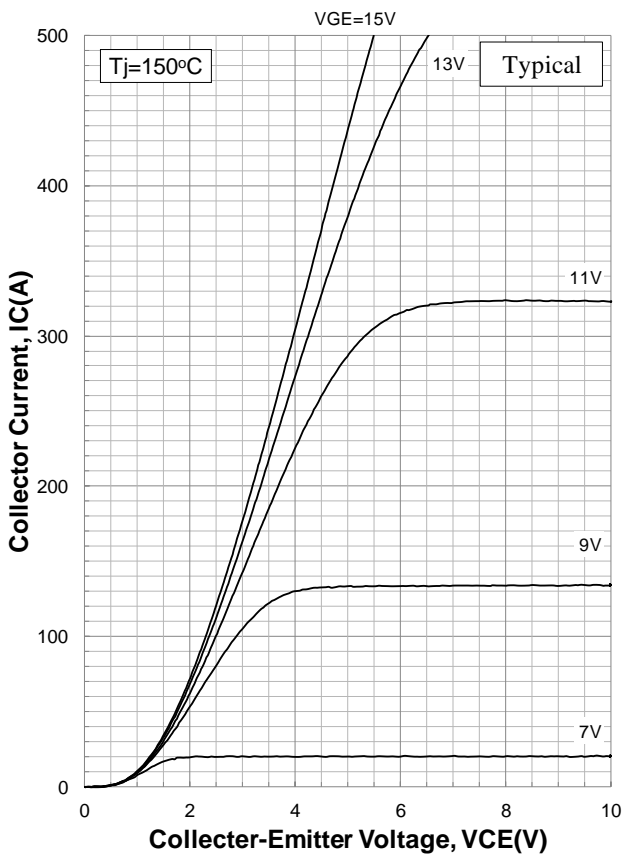
## STATIC CHARACTERISTICS



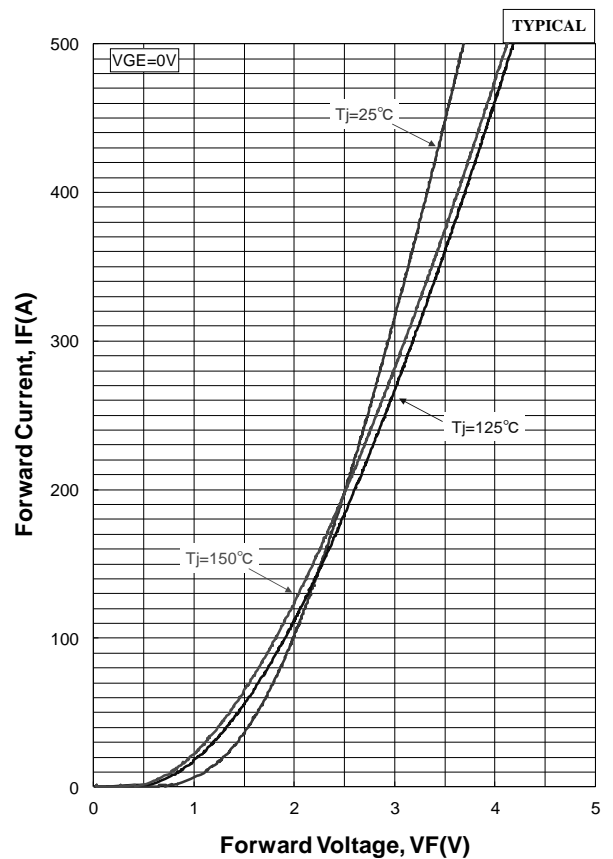
Collector Current vs. Collector to Emitter Voltage



Collector Current vs. Collector to Emitter Voltage



Collector Current vs. Collector to Emitter Voltage

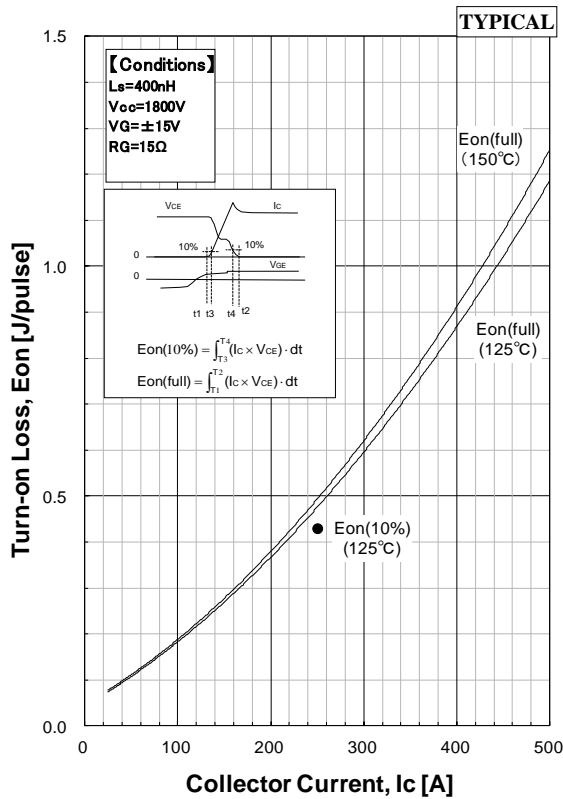


Forward Voltage of free-wheeling diode

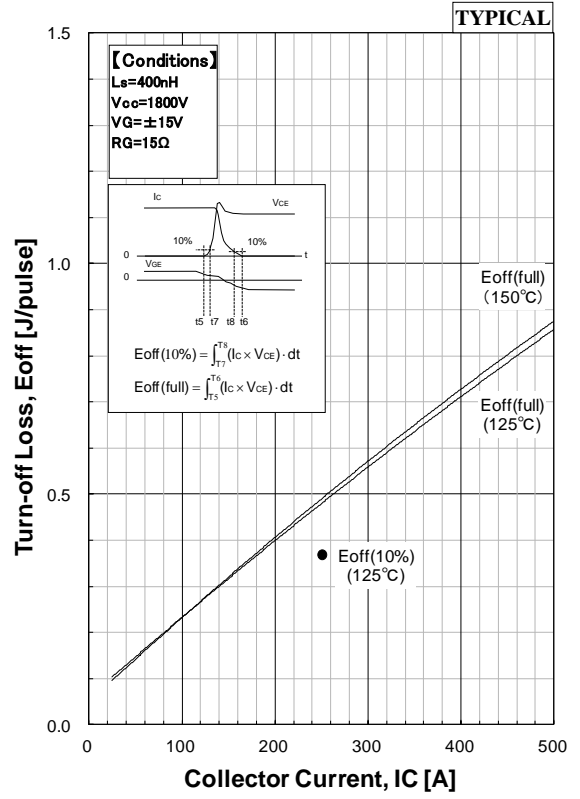
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## DYNAMIC CHARACTERISTICS

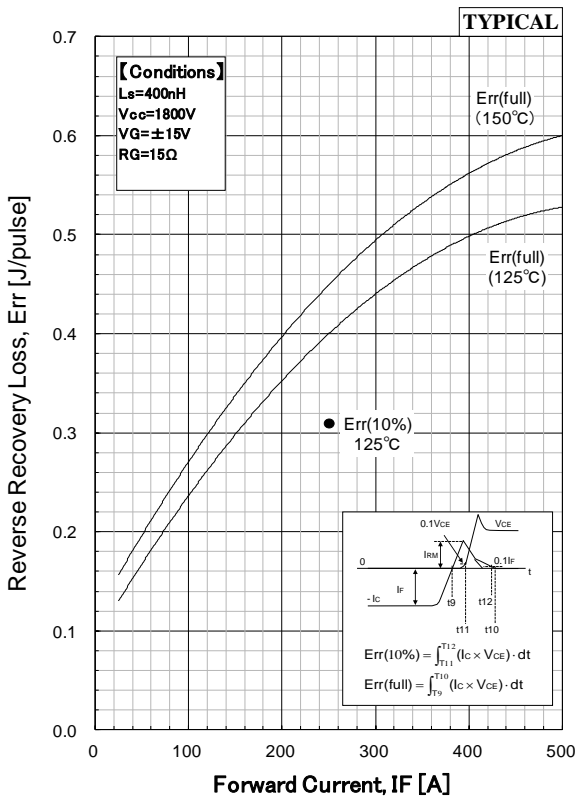
### DEPENDENCE OF CURRENT



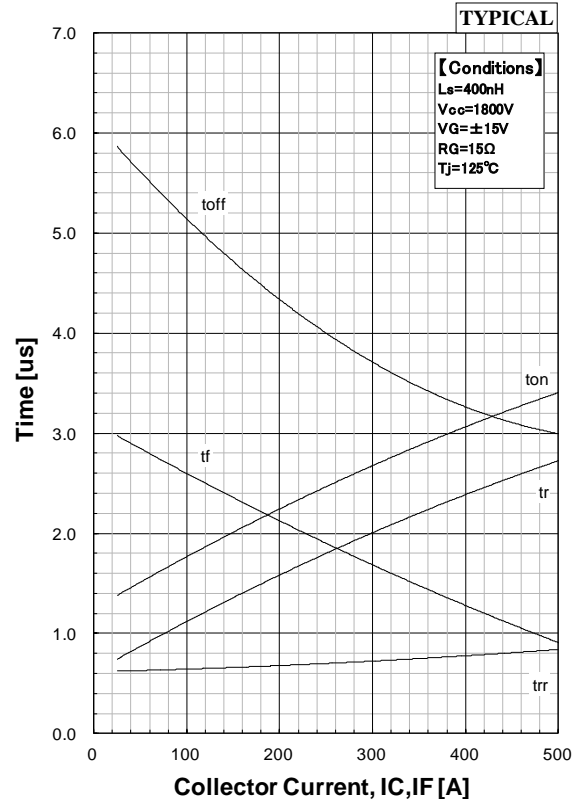
Turn-on Loss vs. Collector current



Turn-off Loss vs. Collector current



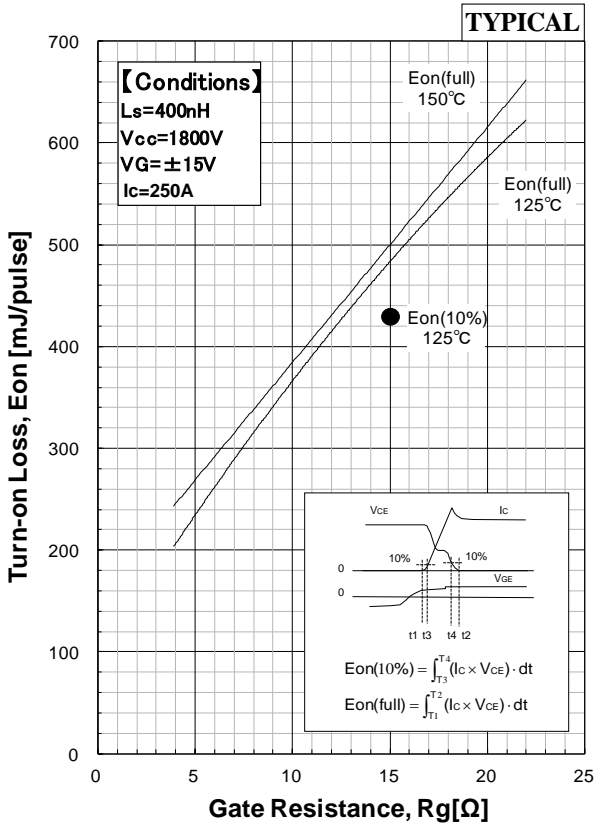
Recovery loss vs. Forward current



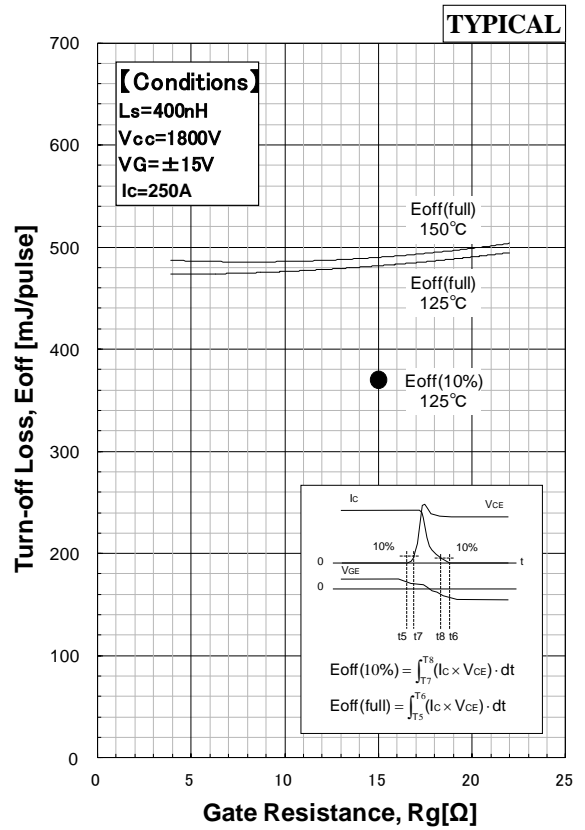
Switching time vs. Collector current

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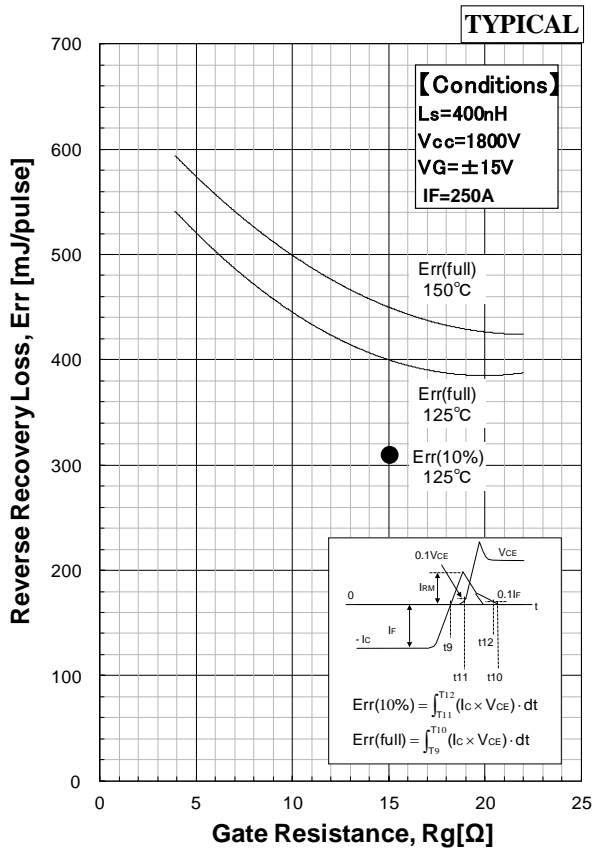
## DEPENDENCE OF RG



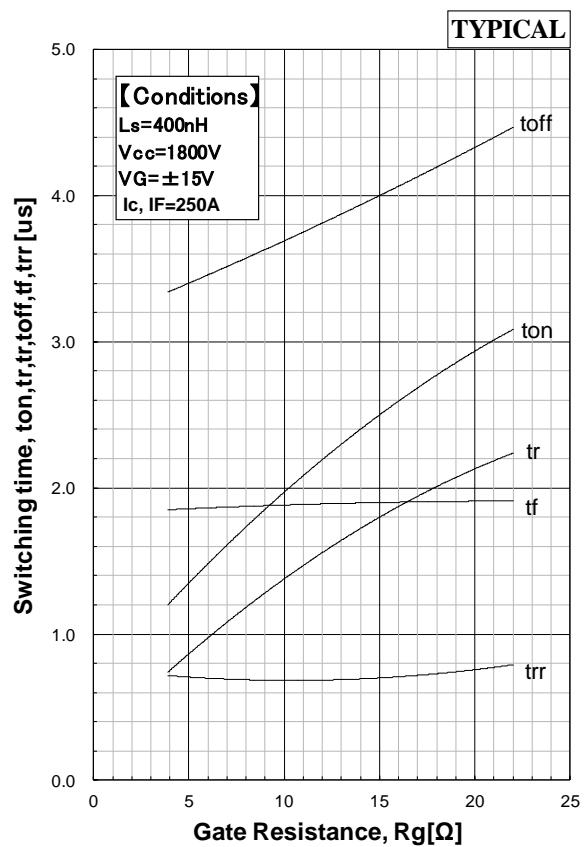
Turn-on Loss vs Gate Resistance



Turn-off Loss vs Gate Resistance



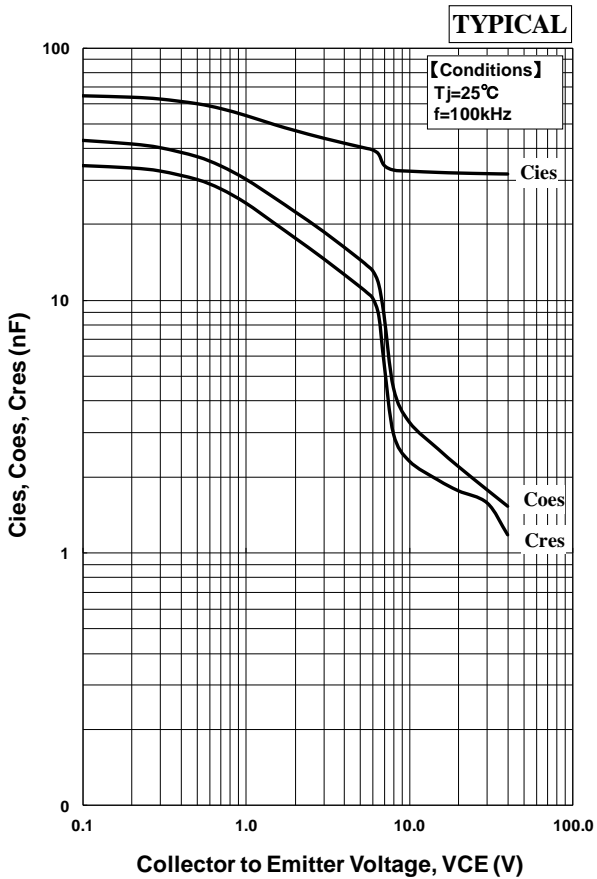
Recovery Loss vs Gate Resistance



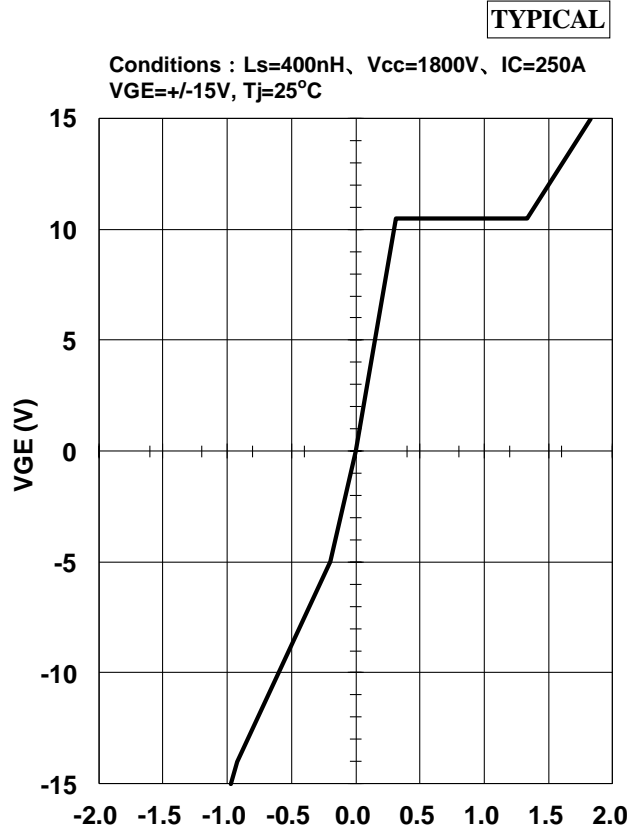
Switching time vs Gate Resistance

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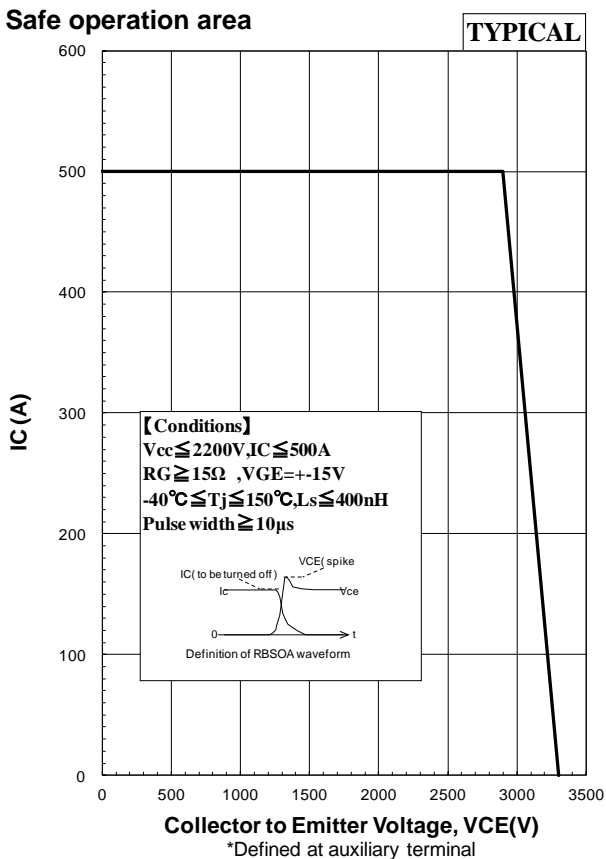
Cies, Coes, Cres-VCE, QG-VG



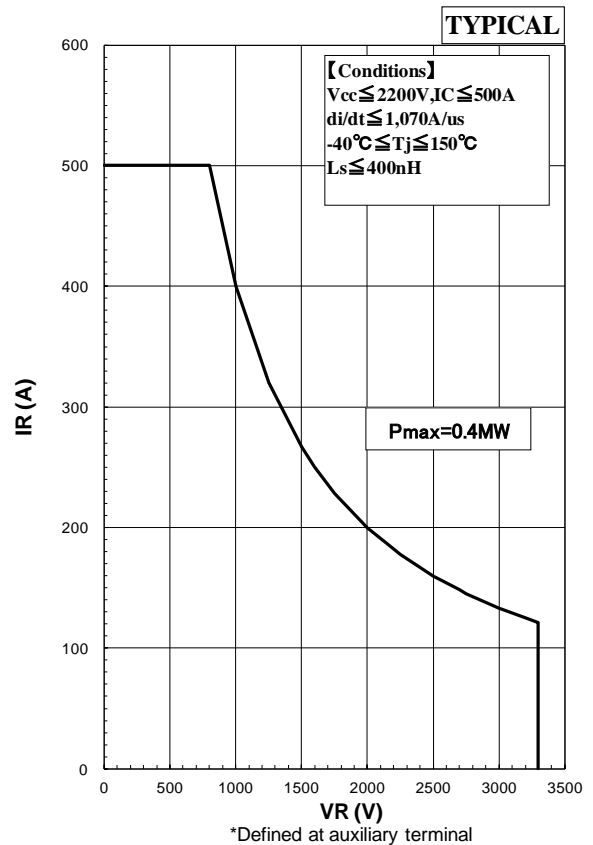
Cies, Coes, Cres-VCE



QG-VGE Curve



Reverse bias Safe operation area (RBSOA)



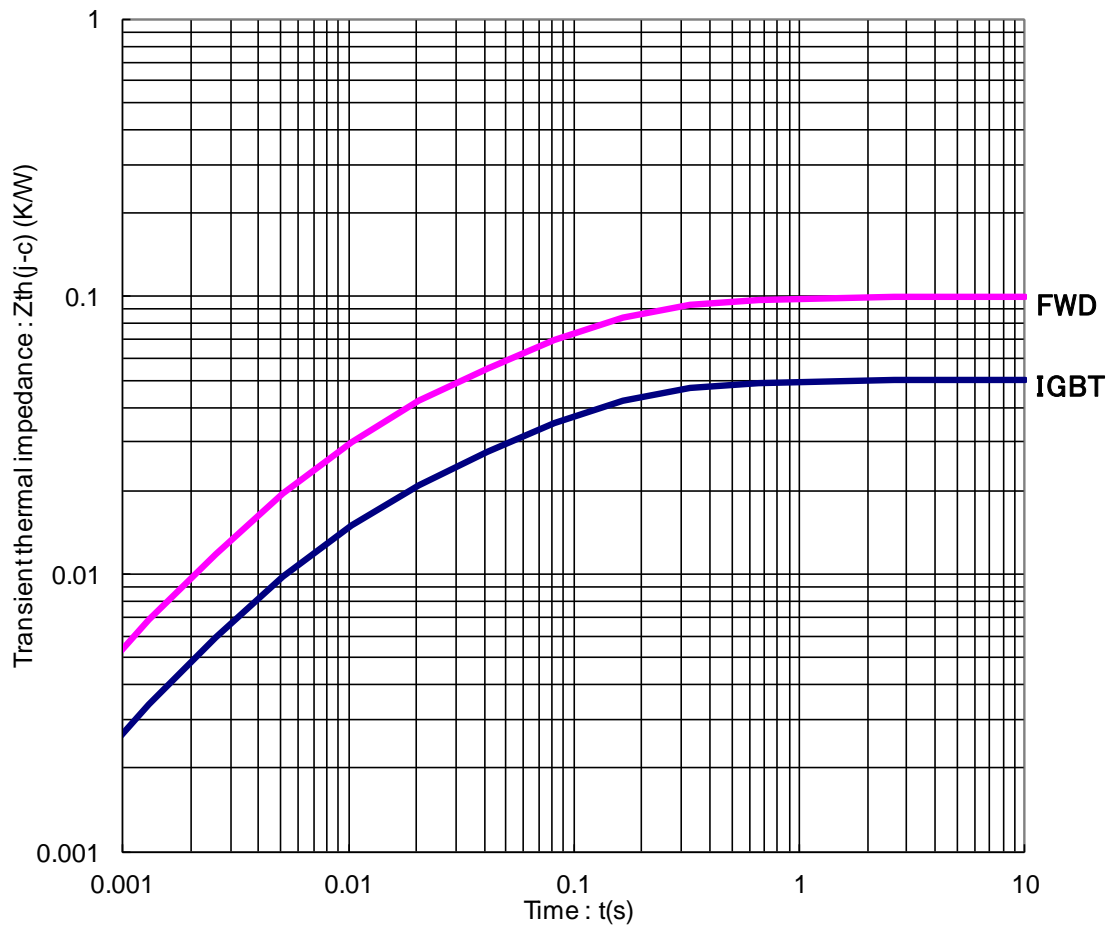
Reverse Recovery Safe operation area (RecSOA)



# MBM250H33E3

## TRANSIENT THERMAL IMPEDANCE

**Maximum**



### Transient Thermal Impedance Curve

Curve approximation model  
 $Z_{th} = \sum r_{th}[n] * (1 - \exp(-t/\tau_{th}[n]))$

n	1	2	3	4	Unit
$\tau_{th}[n]$	2.73E-01	7.21E-02	8.98E-03	2.02E-03	sec
$r_{th}[n,IGBT]$	9.27E-03	2.52E-02	1.32E-02	2.35E-03	K/W
$r_{th}[n,Diode]$	1.83E-02	5.07E-02	2.61E-02	4.89E-03	K/W

### Material Declaration

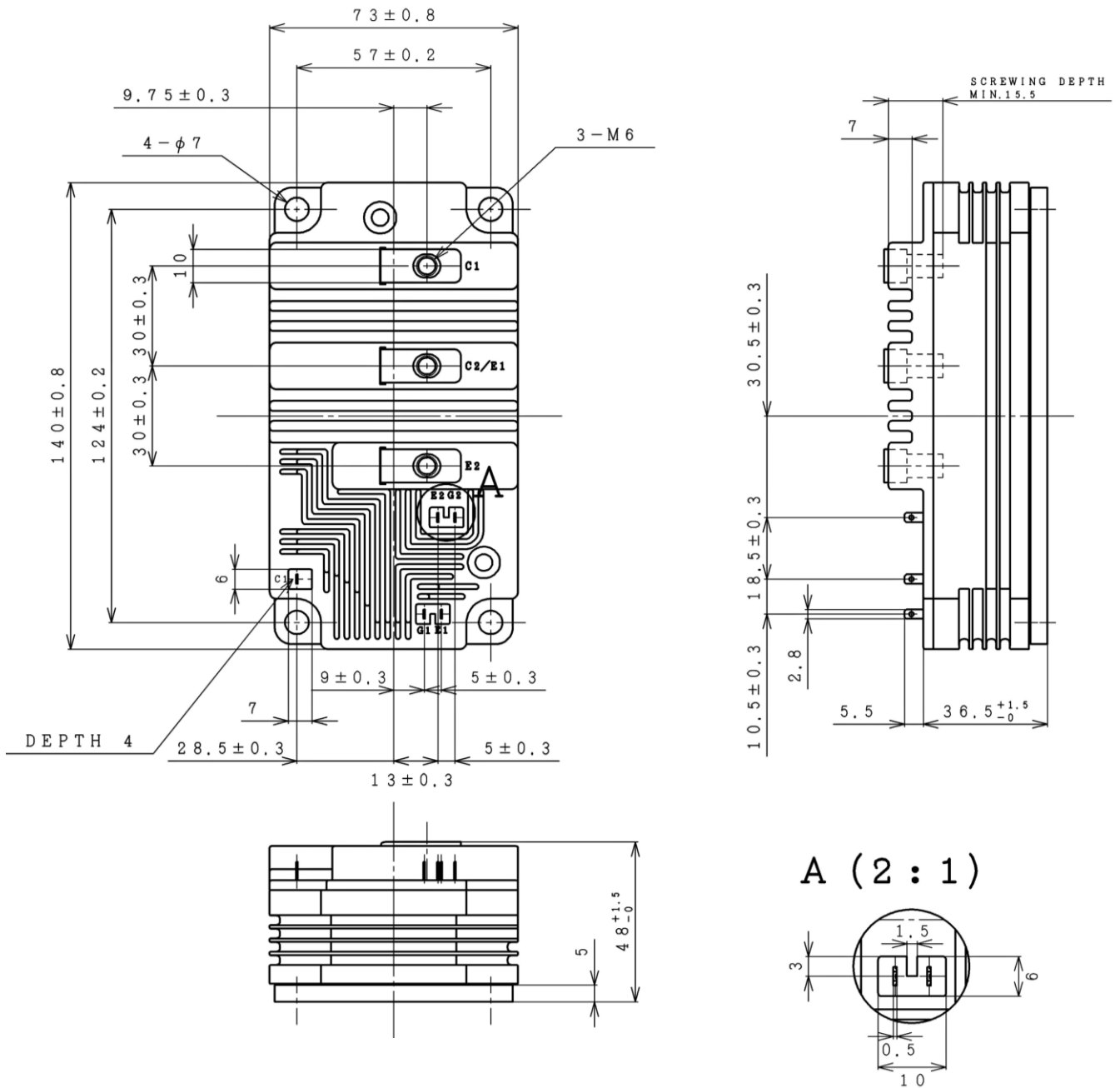
Please note the following material is contained in the product in order to keep product characteristic and reliability level.

Material	Contained part
Lead (Pb) and its compounds	Solder

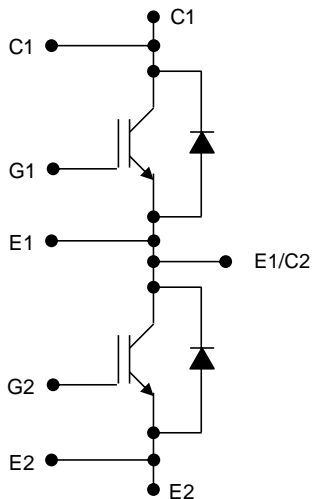
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## Module Outline Drawing

Unit: mm



## CIRCUIT DIAGRAM



# MBM250H33E3

## HITACHI POWER SEMICONDUCTORS

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