

# MBN1500E33E3

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.
- \* High thermal fatigue durability:  
( $\Delta T_c=70K$ ,  $N>30,000$ cycles)

AlSiC base-plate/AlN substrate

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

Item	Symbol	Unit	MBN1500E33E3
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>	1,500 (T <sub>C</sub> =95°C)
	1ms	I <sub>Cp</sub>	3,000
Forward Current	DC	I <sub>F</sub>	1,500
	1ms	I <sub>Fm</sub>	3,000
Junction Temperature	T <sub>J</sub>	°C	-40 ~ +150
Storage Temperature	T <sub>stg</sub>	°C	-50 ~ +125
Isolation Voltage	V <sub>ISO</sub>	V <sub>RMS</sub>	6,000(AC 1 minute)
Screw Torque	Terminals (M4/M8)	-	2/15 (1)
	Mounting (M6)	-	6 (2)

Notes: (1) Recommended Value 1.8±0.2/15<sup>+0</sup>-3N·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 <sub>CEs</sub>	mA	-	-	12	V <sub>CE</sub> =3,300V, V <sub>GE</sub> =0V, T <sub>J</sub> =25°C
Gate Emitter Leakage Current	I <sub>GEs</sub>	nA	-500	-	+500	V <sub>CE</sub> =3,300V, V <sub>GE</sub> =0V, T <sub>J</sub> =125°C
Collector Emitter Saturation Voltage	V <sub>CE(sat)</sub>	V	-	2.45	-	V <sub>CE</sub> =1,500A, V <sub>GE</sub> =15V, T <sub>J</sub> =25°C
			2.80	3.20	3.80	I <sub>C</sub> =1,500A, V <sub>GE</sub> =15V, T <sub>J</sub> =125°C
			-	3.60	-	I <sub>C</sub> =1,500A, V <sub>GE</sub> =15V, T <sub>J</sub> =150°C
Gate Emitter Threshold Voltage	V <sub>GE(TO)</sub>	V	5.5	6.3	7.5	V <sub>CE</sub> =10V, I <sub>C</sub> =1,500mA, T <sub>J</sub> =25°C
Input Capacitance	C <sub>ies</sub>	nF	-	195	-	V <sub>CE</sub> =10V, V <sub>GE</sub> =0V, f=100kHz, T <sub>J</sub> =25°C
Internal Gate Resistance	R <sub>ge</sub>	Ω	-	0.9	-	V <sub>CE</sub> =10V, V <sub>GE</sub> =0V, f=100kHz, T <sub>J</sub> =25°C
Switching Times	Rise Time	t <sub>r</sub>	1.6	2.1	2.8	V <sub>CC</sub> =1,650V, I <sub>C</sub> =1,500A
	Turn On Time	t <sub>on</sub>	2.1	3.2	4.0	L=100nH
	Fall Time	t <sub>f</sub>	1.1	2.1	3.3	R <sub>G</sub> =2.7Ω/2.7Ω, C <sub>GE</sub> =330nF (3)
	Turn Off Time	t <sub>off</sub>	2.8	4.6	5.8	V <sub>GE</sub> =±15V, T <sub>J</sub> =125°C
Peak Forward Voltage Drop	V <sub>FM</sub>	V	-	2.50	-	I <sub>F</sub> =1,500A, V <sub>GE</sub> =0V, T <sub>J</sub> =25°C
			2.20	2.70	3.20	I <sub>F</sub> =1,500A, V <sub>GE</sub> =0V, T <sub>J</sub> =125°C
			-	2.60	-	I <sub>F</sub> =1,500A, V <sub>GE</sub> =0V, T <sub>J</sub> =150°C
Reverse Recovery Time	t <sub>rr</sub>	μs	-	0.9	1.4	V <sub>CC</sub> =1,650V, I <sub>F</sub> =1,500A, L=100nH T <sub>J</sub> =125°C
Short Circuit Pulse Width	t <sub>sc</sub>	μs	10	-	-	V <sub>CC</sub> =2000V, L <sub>s</sub> =120nH R <sub>G</sub> (on/off)=2.7/27Ω, V <sub>GE</sub> =±15V, T <sub>J</sub> =125°C
Turn On Loss	E <sub>on(10%)</sub>	J/P	-	3.2	3.7	T <sub>J</sub> =125°C
	E <sub>on(full)</sub>		-	3.5	-	T <sub>J</sub> =150°C
Turn Off Loss	E <sub>off(10%)</sub>	J/P	-	2.1	2.8	T <sub>J</sub> =125°C
	E <sub>off(full)</sub>		-	2.65	-	T <sub>J</sub> =150°C
			-	2.74	-	T <sub>J</sub> =150°C
Reverse Recovery Loss	E <sub>rr(10%)</sub>	J/P	-	1.5	2.0	T <sub>J</sub> =125°C
	E <sub>rr(full)</sub>		-	2.0	-	T <sub>J</sub> =125°C
			-	2.5	-	T <sub>J</sub> =150°C

Notes:(3) R<sub>G</sub> and C<sub>GE</sub> value are the test condition's value for evaluation of the switching times, not recommended value.Please, determine the suitable R<sub>G</sub> 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.

# MBN1500E33E3

## THERMAL CHARACTERISTICS

Item	Symbol	Unit	Min.	Typ.	Max.	Conditions
Thermal Impedance	IGBT	Rth(j-c)	-	-	0.0078	Junction to case
	FWD	Rth(j-c)	-	-	0.0156	
Contact Thermal Impedance	Rth(c-f)	K/W	-	0.005	-	Case to fin ( $\lambda_{grease}=1W/(m \cdot K)$ , heat-sink flatness $\leq 50\mu m$ )

## DEFINITION OF TEST CIRCUIT

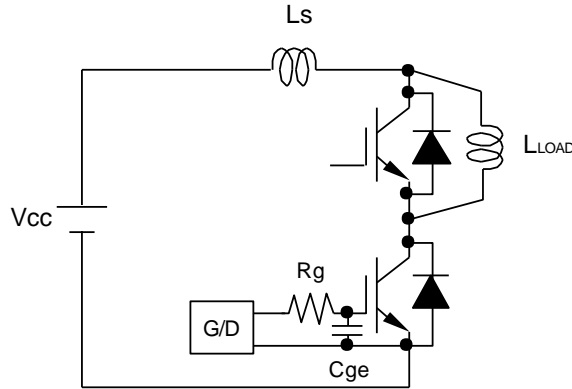


Fig.1 Switching test circuit

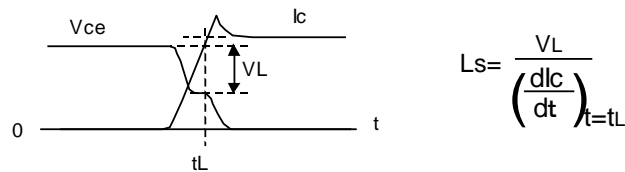


Fig.2 Definition of stray inductance

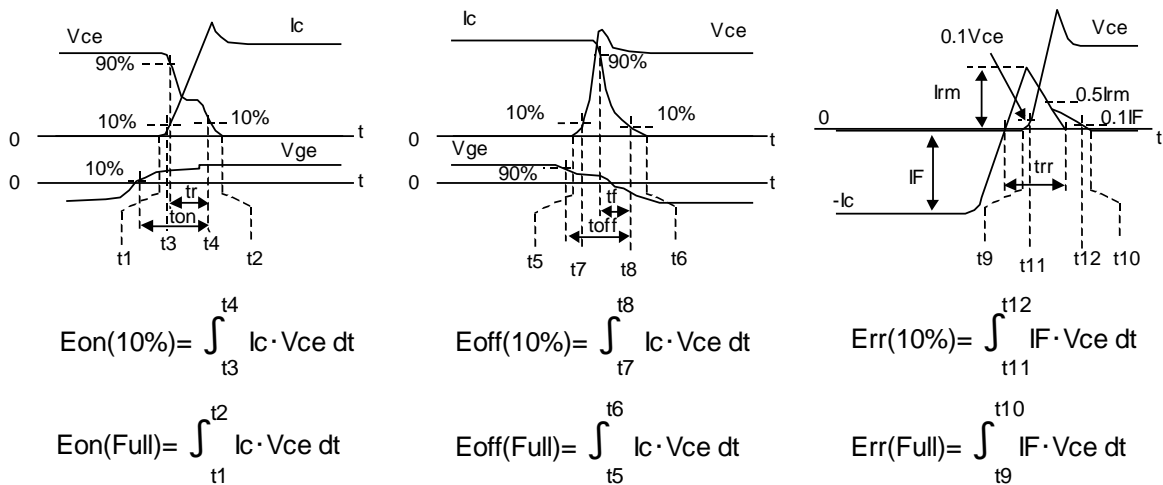
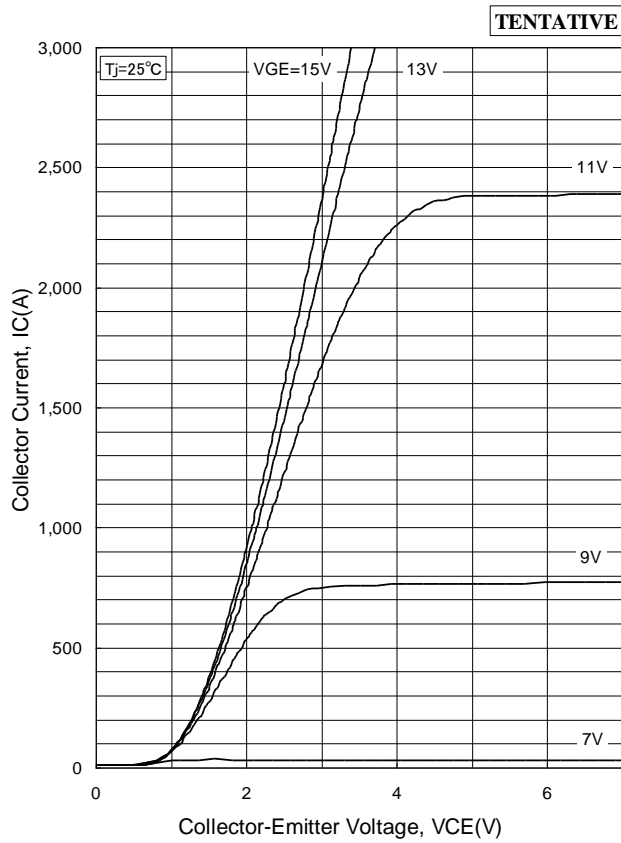


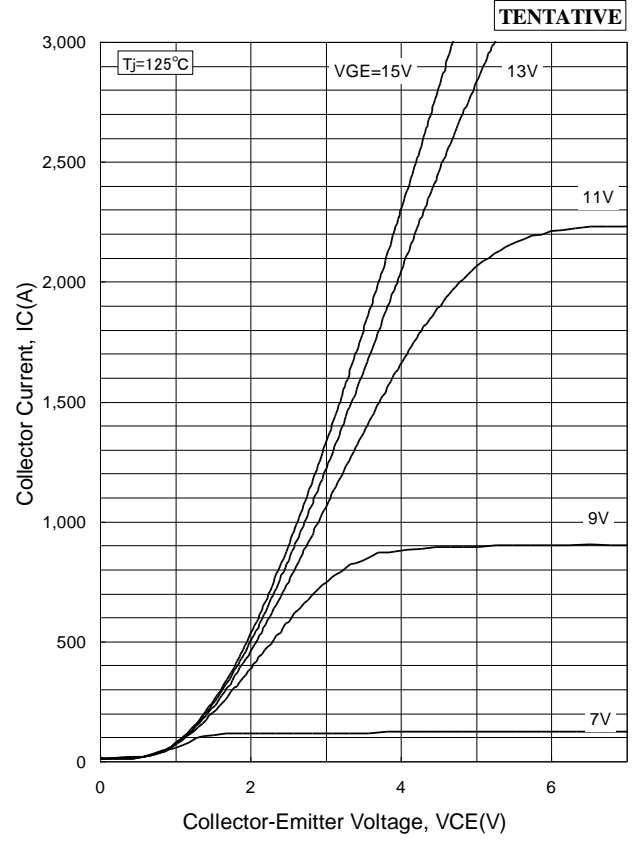
Fig.3 Definition of switching loss

# MBN1500E33E3

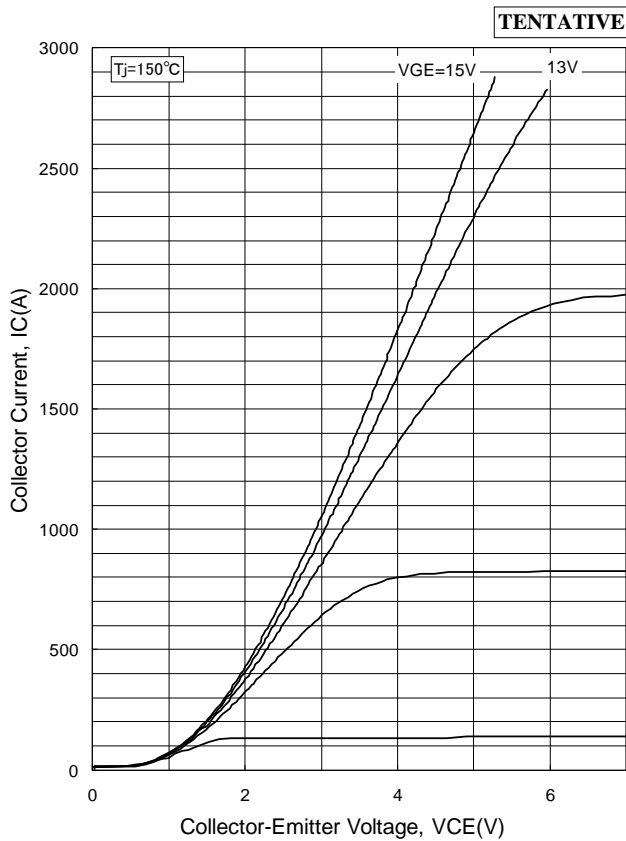
## STATIC CHARACTERISTICS



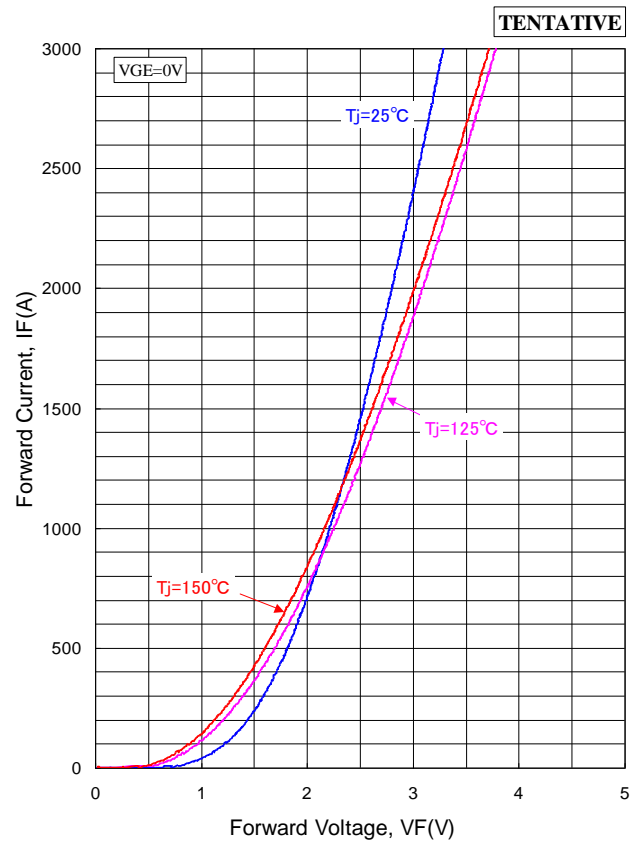
Collector Current vs. Collector to Emmitter Voltage



Collector Current vs. Collector to Emmitter Voltage



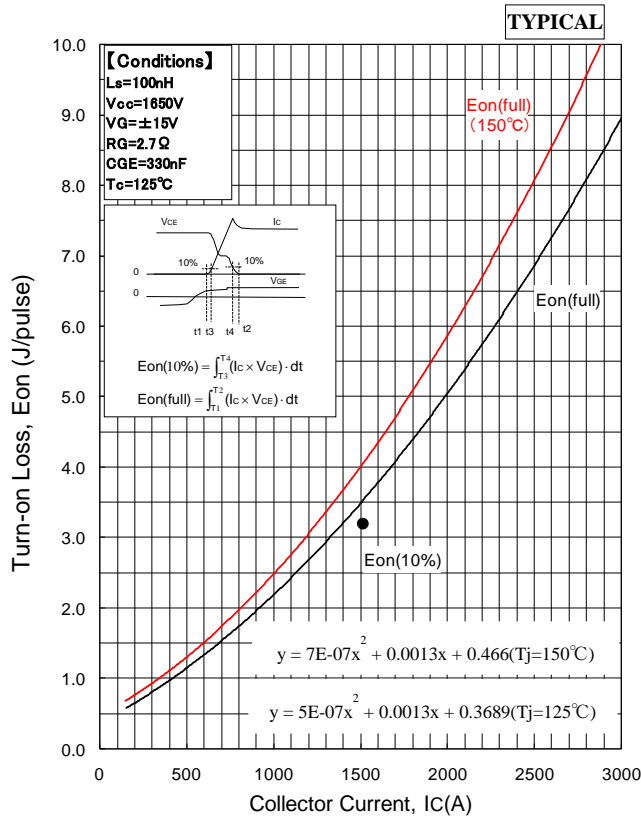
Collector Current vs. Collector to Emmitter Voltage



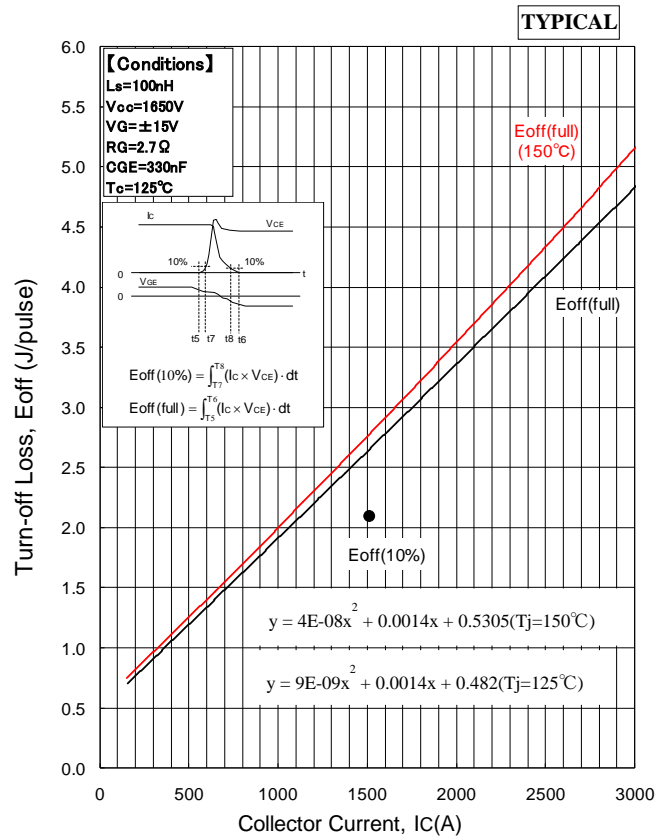
Forward Voltage of free-wheeling diode

# MBN1500E33E3

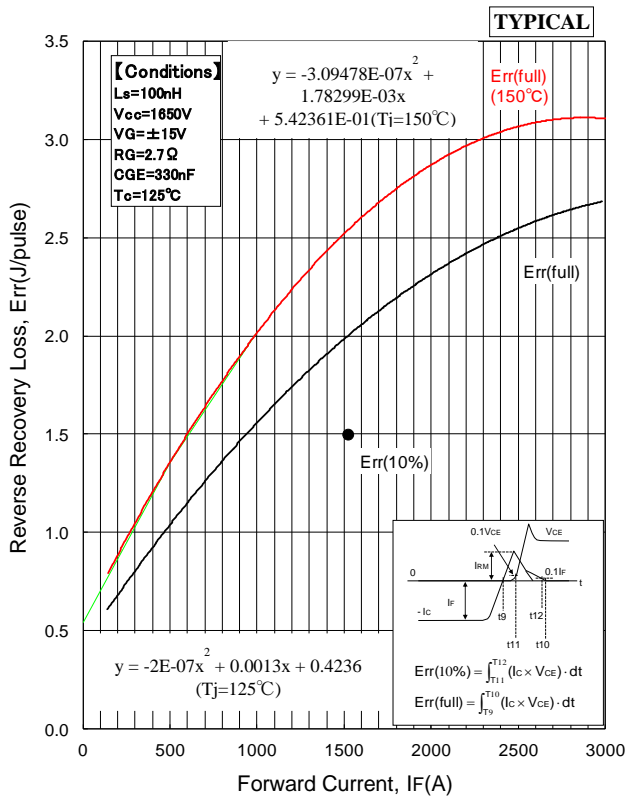
## DYNAMIC CHARACTERISTICS



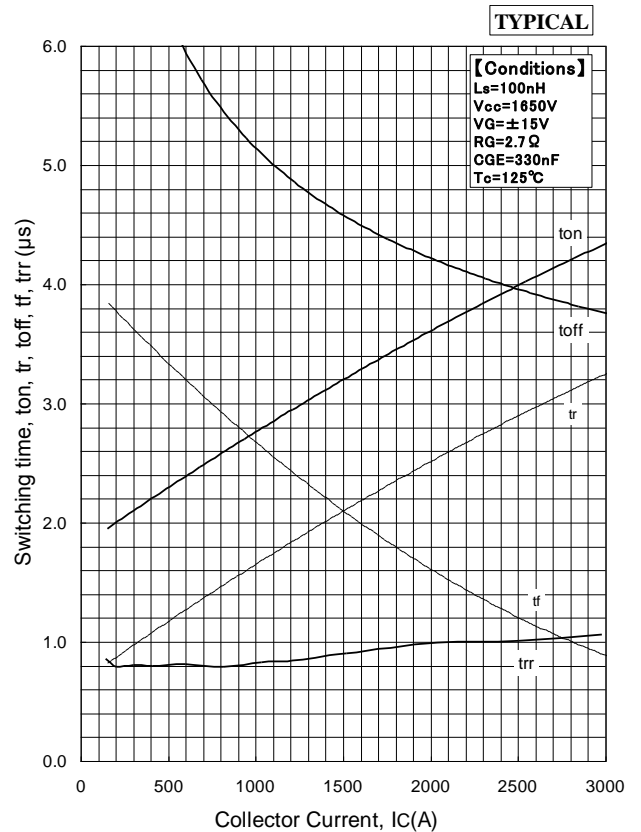
Turn-on Loss vs. Collector Current



Turn-off Loss vs. Collector Current

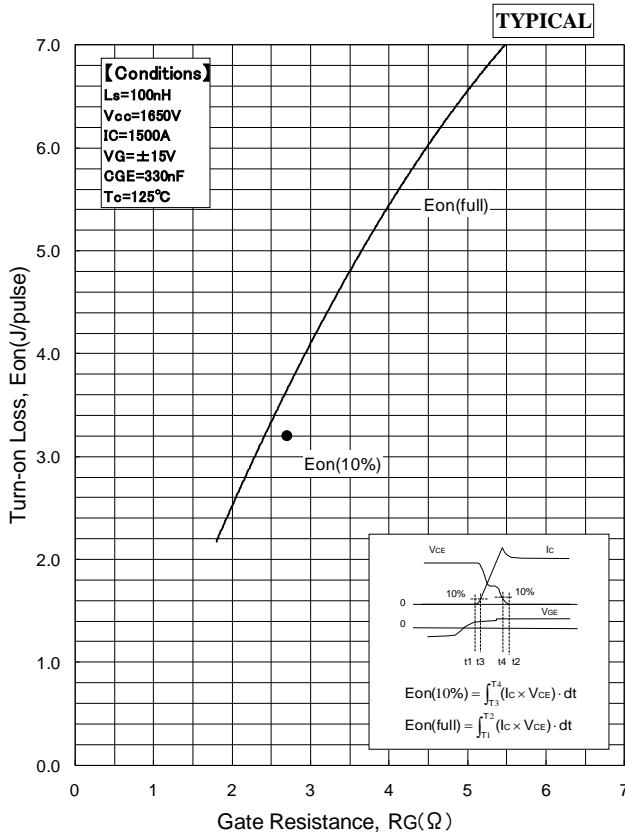


Recovery Loss vs. Forward Current

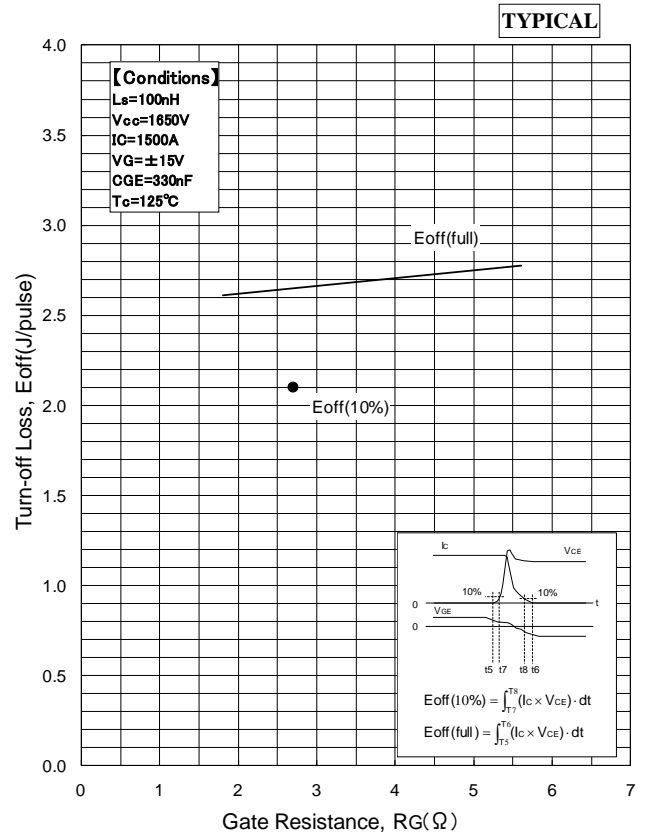


Switching time vs. Collector current

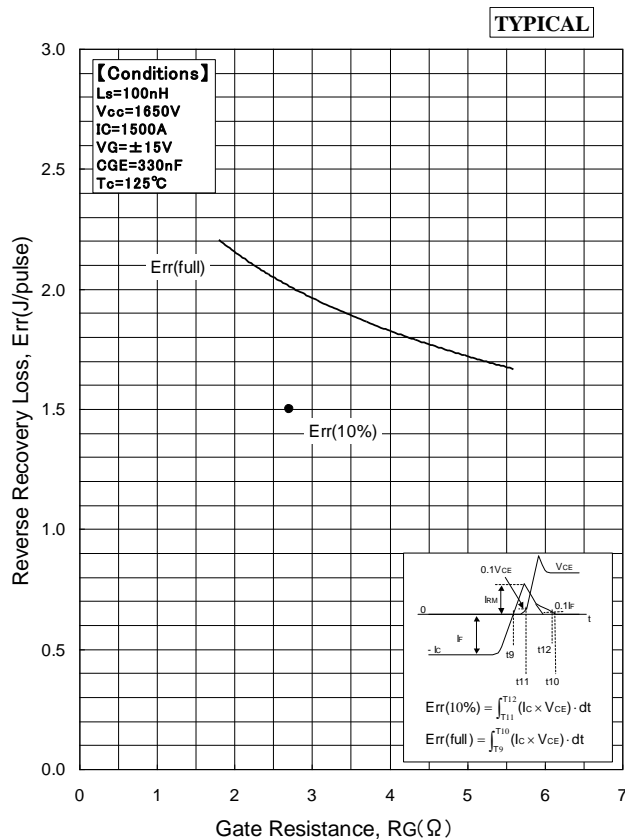
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Turn-on Loss vs. Gate Resistance



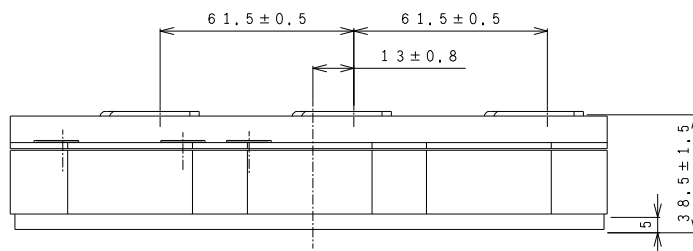
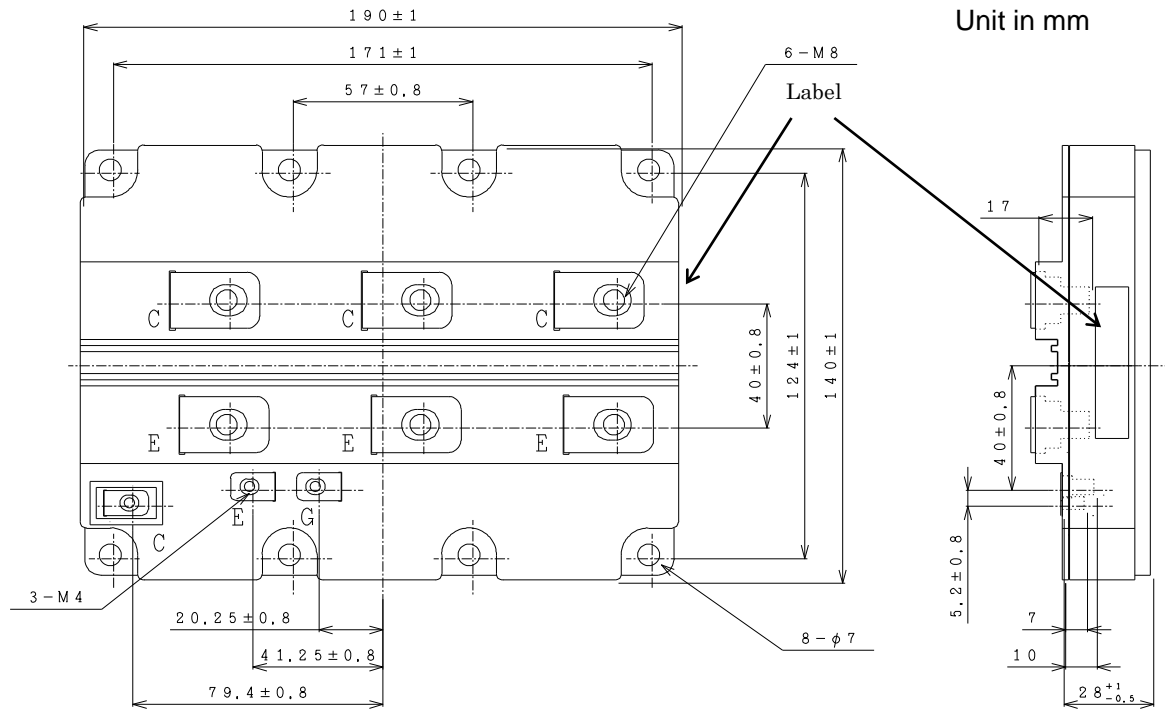
Turn-off Loss vs. Gate Resistance



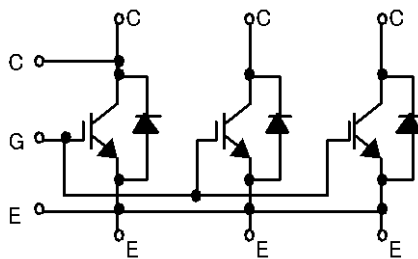
Recovery Loss vs. Gate Resistance

# MBN1500E33E3

## OUTLINE DRAWINGS



Weight: 1300(g)

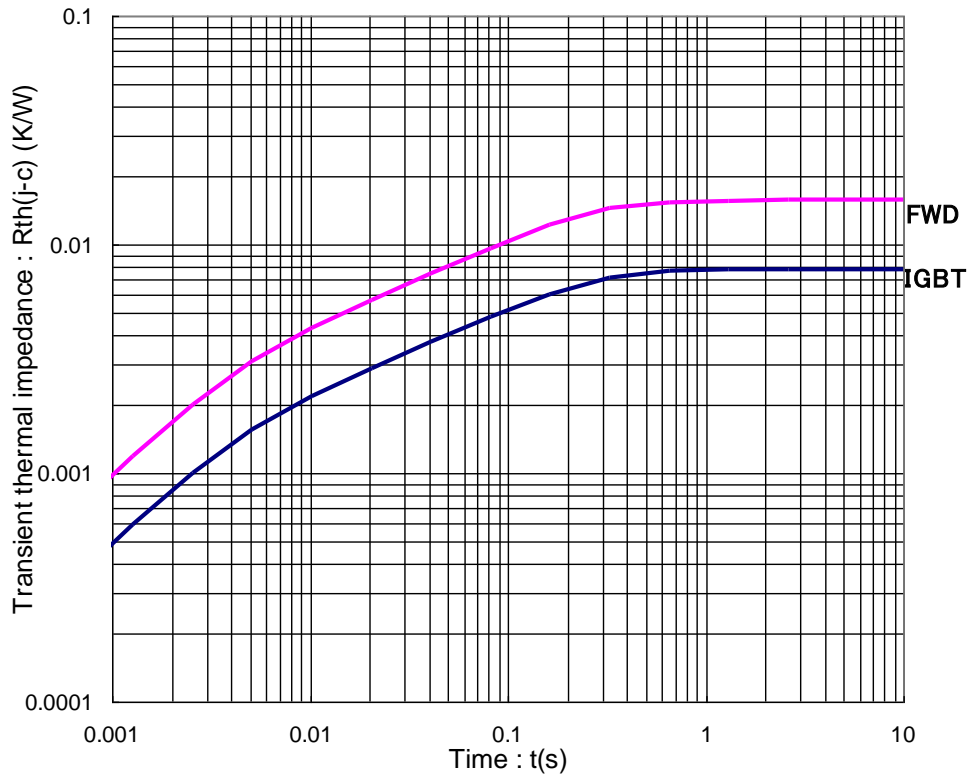


Circuit diagram

# MBN1500E33E3

**TRANSIENT THERMAL IMPEDANCE**

**Maximum**



**Transient Thermal Impedance Curve**

Curve approximation model

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

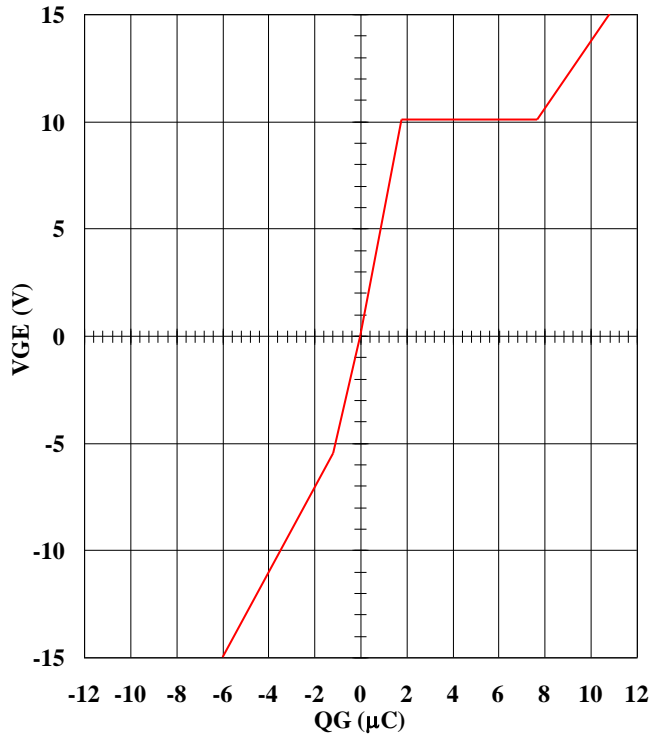
n	1	2	3	4	Unit
$\tau_{th}[n]$	1.60E-01	2.77E-02	4.10E-03	8.06E-04	sec
$r_{th}[n,IGBT]$	4.84E-03	1.41E-03	1.39E-03	1.63E-04	K/W
$r_{th}[n,Diode]$	9.62E-03	2.94E-03	2.70E-03	3.38E-04	K/W

# MBN1500E33E3

**QG-VG CURVE**

TYPICAL

Conditions:  $L_s=100\text{nH}$ ,  $V_{CC}=1650\text{V}$ ,  $I_C=1500\text{A}$ ,  
 $V_{GE}=\pm 15\text{V}$ ,  $T_j=25^\circ\text{C}$



**QG-VGE curve**

**Material declaration**

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

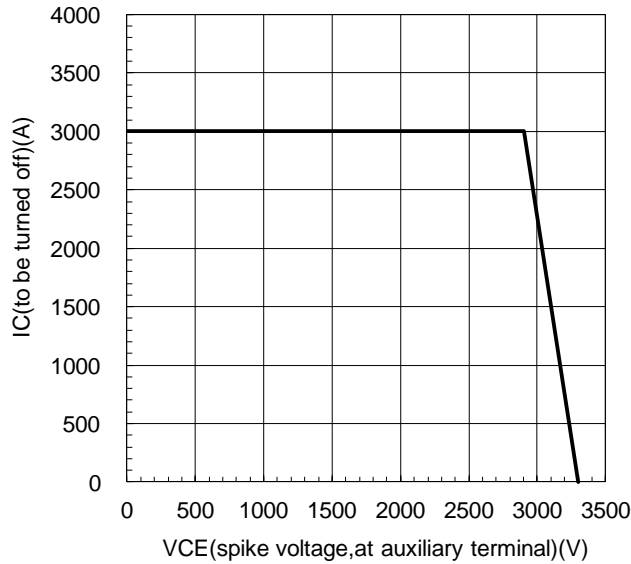
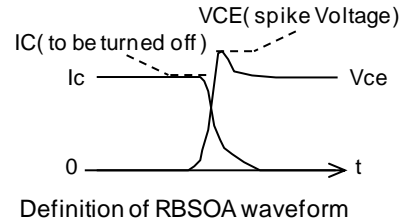
Material	Contained part
Lead (Pb) and its compounds	Solder



# MBN1500E33E3

**RBSOA**

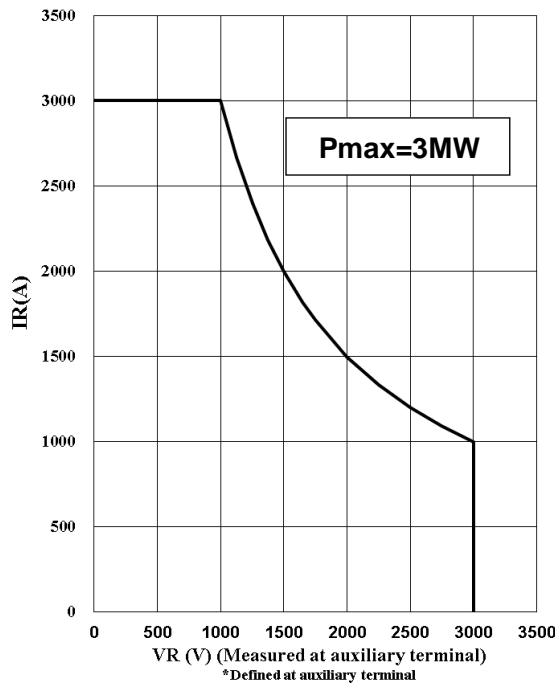
**Conditions:  $V_{cc} \leq 2200V$ ,  $I_c \leq 3000A$ ,  
 $R_g \geq 2.7\Omega$ ,  $C_{GE} \geq 330nF$   
 $V_{GE} = \pm 15V$ ,  $-40^\circ C \leq T_j \leq 150^\circ C$ ,  
 $L_s \leq 100nH$ , on pulse width  $\geq 10\mu s$   
 ( Vce spike voltage and  $L_s$  are defined at auxiliary terminal)**



**Reverse bias safe operation area ( RBSOA )**

**RecSOA**

**Conditions:  $V_{cc} \leq 2000V$ ,  $di/dt \leq 6,400A/\mu s$ ,  
 $T_j = 150^\circ C$ ,  $L_s \leq 100nH$**



**Reverse recovery operation area(RecSOA)**

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## HITACHI POWER SEMICONDUCTORS

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