

MBN500H65E2

Silicon N-channel IGBT 6500V E2 version

FEATURES

- * Low driving power due to low input capacitance MOS gate.
- * Low noise due to ultra soft fast recovery diode.
- * High reliability, high durability module.
- * High thermal fatigue durability.
($\Delta T_c=70^\circ\text{C}$, $N>30,000$ cycles)
- * Isolated head sink (terminal to base).

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

Item	Symbol	Unit	MBN500H65E2	
Collector Emitter Voltage	$T_j=125^\circ\text{C}$	V_{CES}	V	6,500
	$T_j=25^\circ\text{C}$			6,500
	$T_j=-40^\circ\text{C}$			6,000
Gate Emitter Voltage	V_{GES}	V	± 20	
Collector Current	DC	I_C	A	500 ($T_c=80^\circ\text{C}$)
	1ms	I_{Cp}		1,000
Forward Current	DC	I_F	A	500
	1ms	I_{FM}		1,000
Junction Temperature	T_j	$^\circ\text{C}$	$-40 \sim +125$	
Storage Temperature	T_{stg}	$^\circ\text{C}$	$-50 \sim +125$	
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·m

(2) Recommended Value 5.5 ± 0.5 N·m

ELECTRICAL CHARACTERISTICS

Item	Symbol	Unit	Min.	Typ.	Max.	Test Conditions	
Collector Emitter Cut-Off Current	I_{CES}	mA	-	-	17	$V_{CE}=6,500\text{V}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$	
			-	17	67	$V_{CE}=6,500\text{V}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$	
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	-	3.2	-	$I_C=500\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$	
			3.4	4.3	5.2	$I_C=500\text{A}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}$	
Gate Emitter Threshold Voltage	$V_{GE(To)}$	V	5.8	6.3	6.8	$V_{CE}=10\text{V}, I_C=500\text{mA}, T_j=25^\circ\text{C}$	
Input Capacitance	C_{ies}	nF	-	87	-	$V_{CE}=10\text{V}, V_{GE}=0\text{V}, f=100\text{kHz}, T_j=25^\circ\text{C}$	
Internal Gate Resistance	R_{ge}	Ω	-	1.1	-	$V_{CE}=10\text{V}, V_{GE}=0\text{V}, f=100\text{kHz}, T_j=25^\circ\text{C}$	
Switching Times	Rise Time	t_r	μs	2.2	3.2	4.8	$V_{CC}=3,600\text{V}, I_C=500\text{A}$ $L_s=210\text{nH}$ $R_G=12\Omega$ (3) $V_{GE}=\pm 15\text{V}, T_j=125^\circ\text{C}$
	Turn On Time	t_{on}		2.7	3.9	5.9	
	Fall Time	t_f		2.2	3.1	4.7	
	Turn Off Time	t_{off}		4.5	6.4	9.6	
Peak Forward Voltage Drop	V_{FM}	V	-	3.6	-	$I_F=500\text{A}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$	
			3.5	3.9	4.4	$I_F=500\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$	
Reverse Recovery Time	t_{rr}	μs	-	0.8	1.6	$V_{CC}=3,600\text{V}, I_F=500\text{A}, L_s=210\text{nH}$ $T_j=125^\circ\text{C}$	
Short Circuit Pulse Width	t_{sc}	μs	10	-	-	$V_{CC}=4500\text{V}, L_s=210\text{nH}$ $R_G(\text{on/off})=12/120\Omega,$ $V_{GE}=\pm 15\text{V}, T_j=25^\circ\text{C}$	
Turn On Loss	$E_{on(10\%)}$	J/p	-	3.3	4.3	$V_{CC}=3600\text{V}, I_C=I_F=500\text{A}, L_s=210\text{nH}$ $R_G=12\Omega$ (3) $V_{GE}=\pm 15\text{V}, T_j=125^\circ\text{C}$	
	$E_{on(full)}$		-	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	-		

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.

* 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.	Conditions
Thermal Impedance	IGBT	Rth(j-c)	K/W	-	-	0.0135	Junction to case
	FWD	Rth(j-c)		-	-	0.027	
Contact Thermal Impedance		Rth(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	1,050	
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-Phenilene Sulfide	
Fire and Smoke Category			I2 / F3	NFF 16-102

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DEFINITION OF TEST CIRCUIT

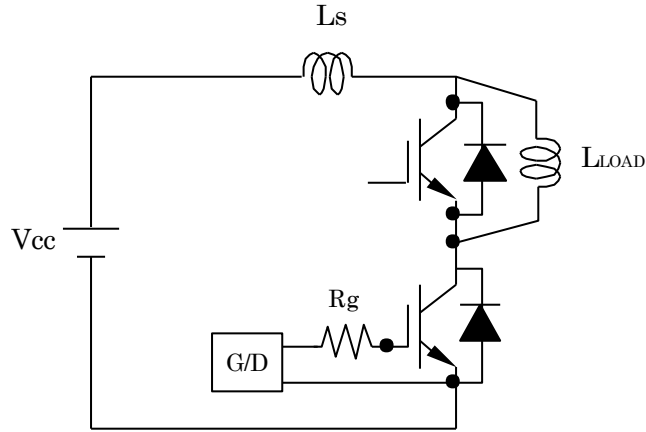


Fig.1 Switching test circuit

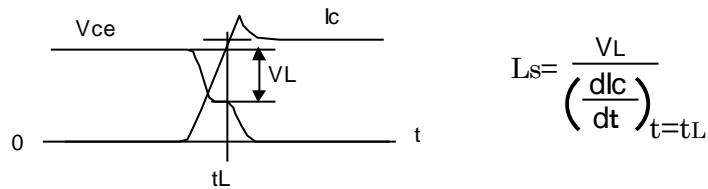


Fig.2 Definition of Ls

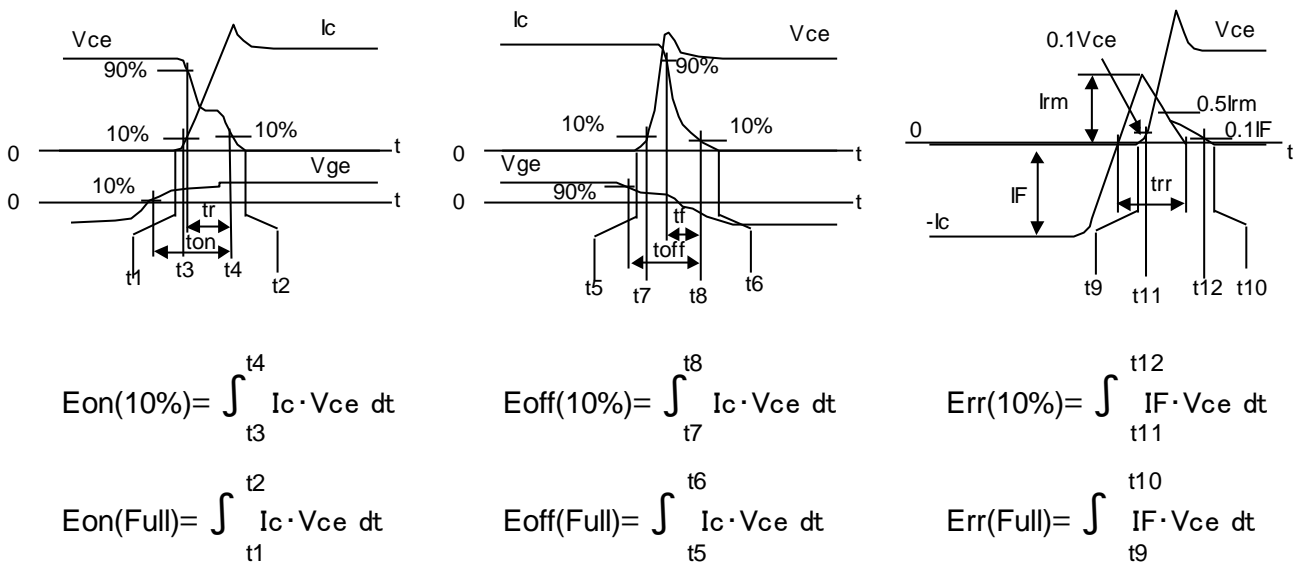
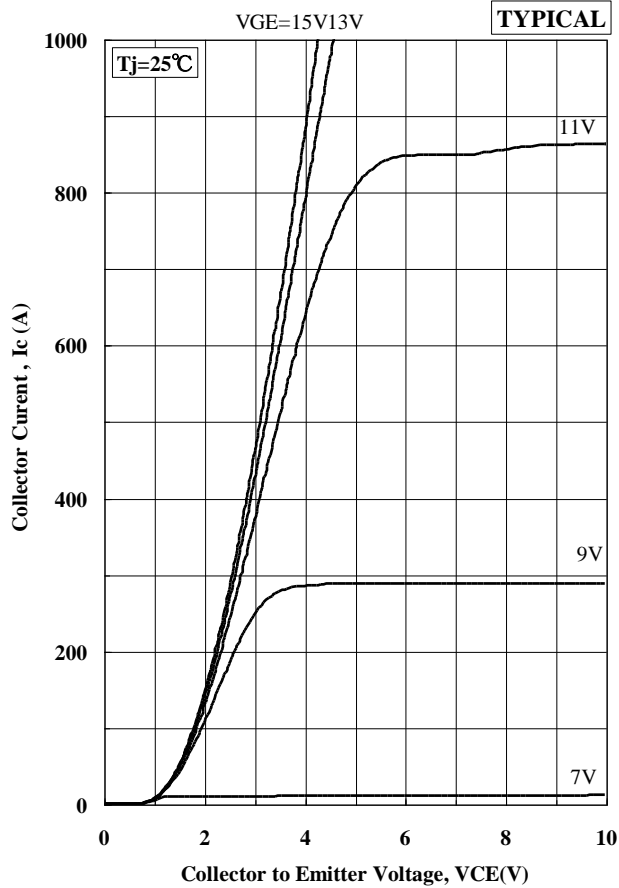


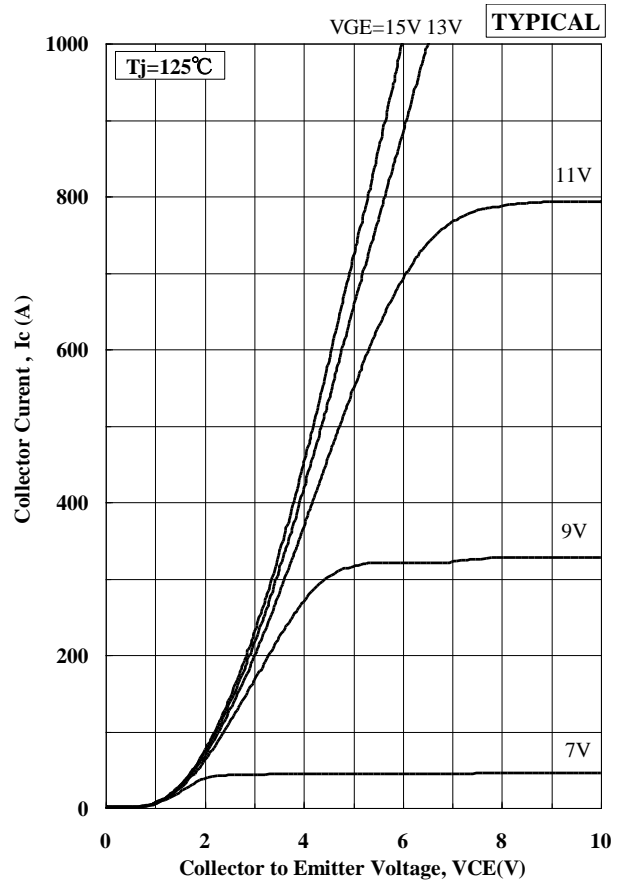
Fig.3 Definition of switching loss

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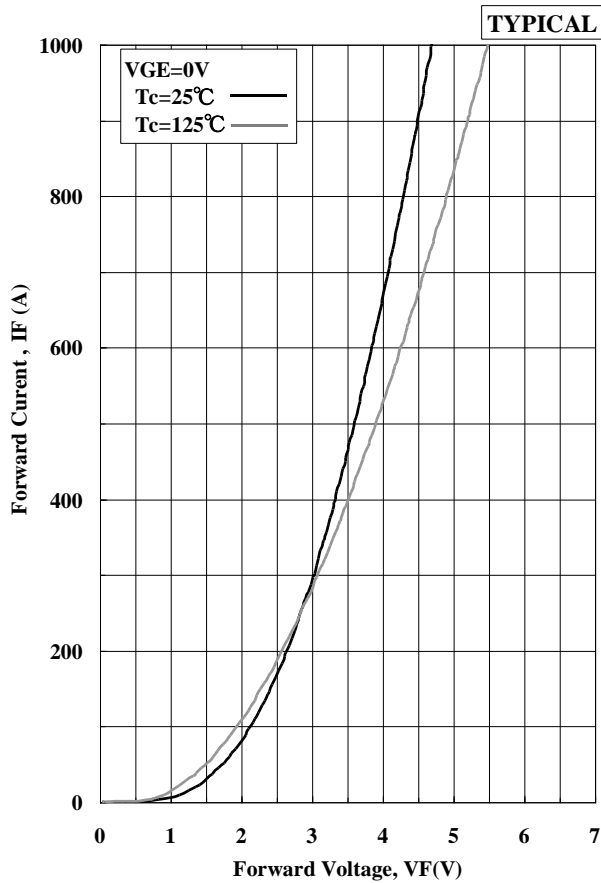
STATIC CHARACTERISTICS



Collector Current vs. Collector to Emitter Voltage



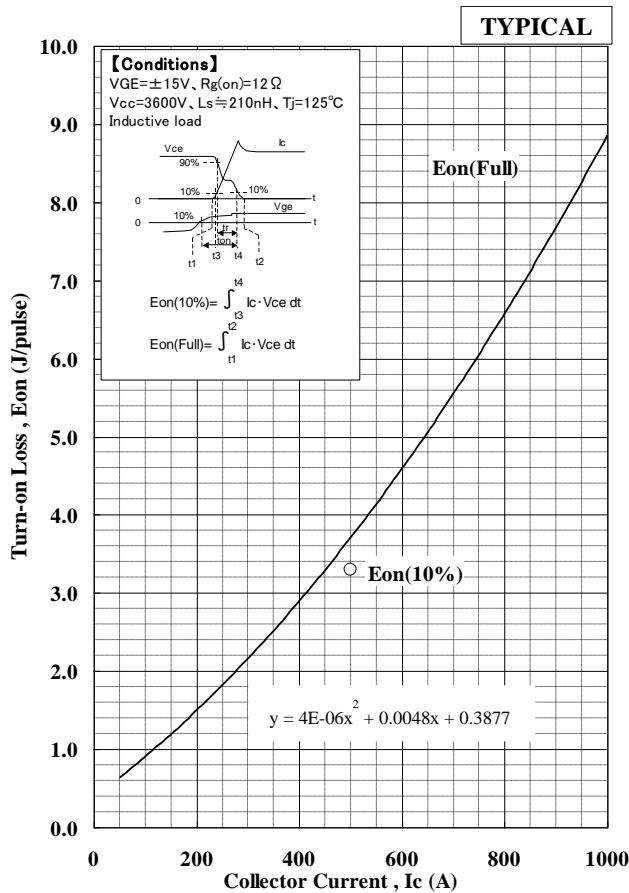
Collector Current vs. Collector to Emitter Voltage



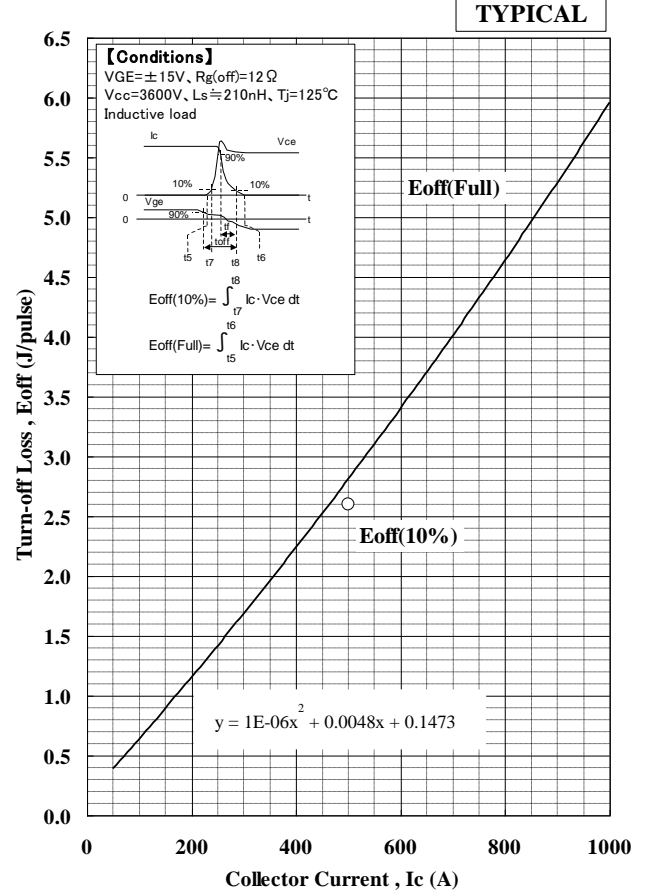
Forward Voltage of free-wheeling diode

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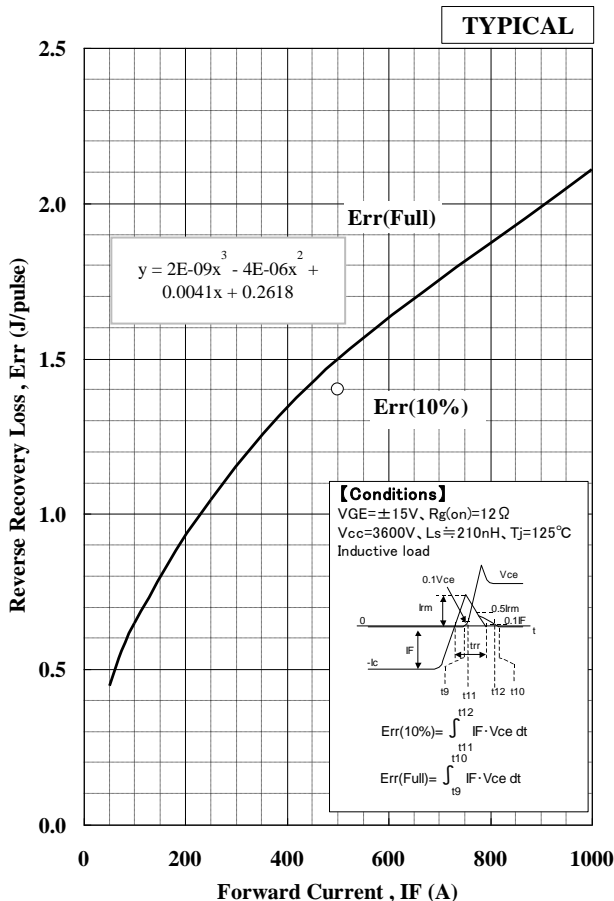
DYNAMIC CHARACTERISTICS



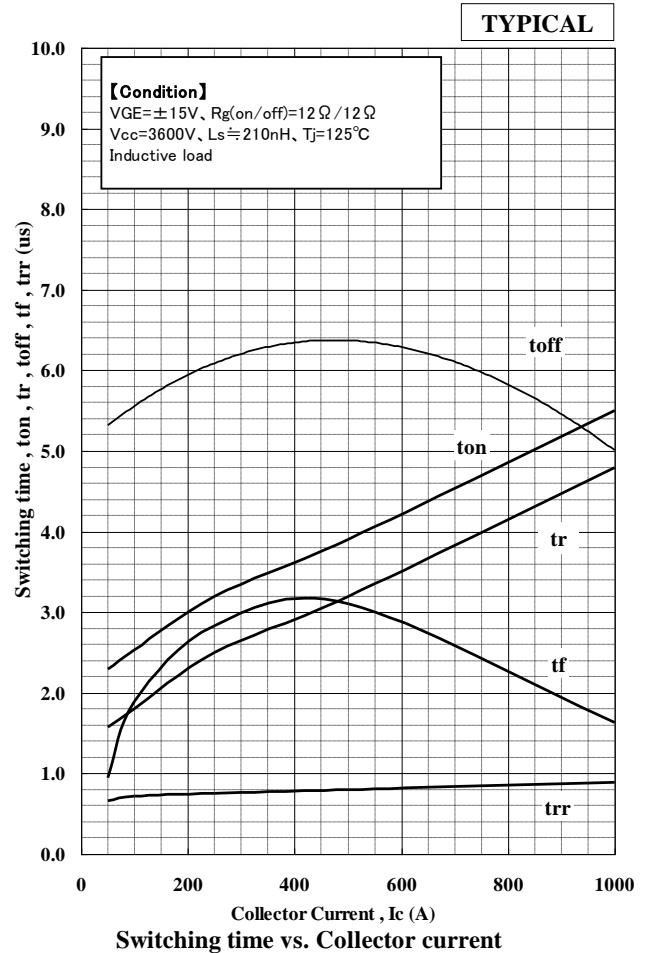
Turn-on Loss vs. Collector Current



Turn-off Loss vs. Collector Current

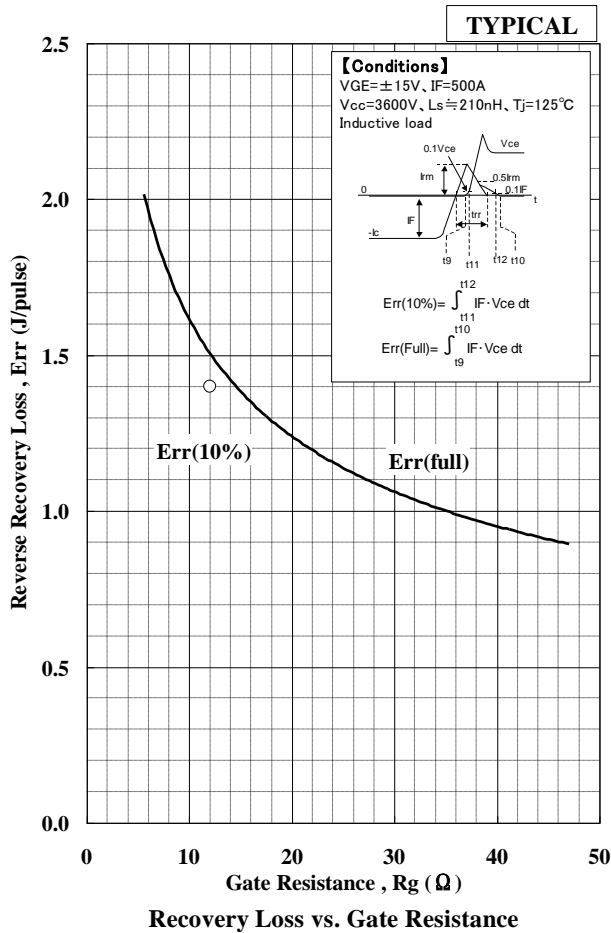
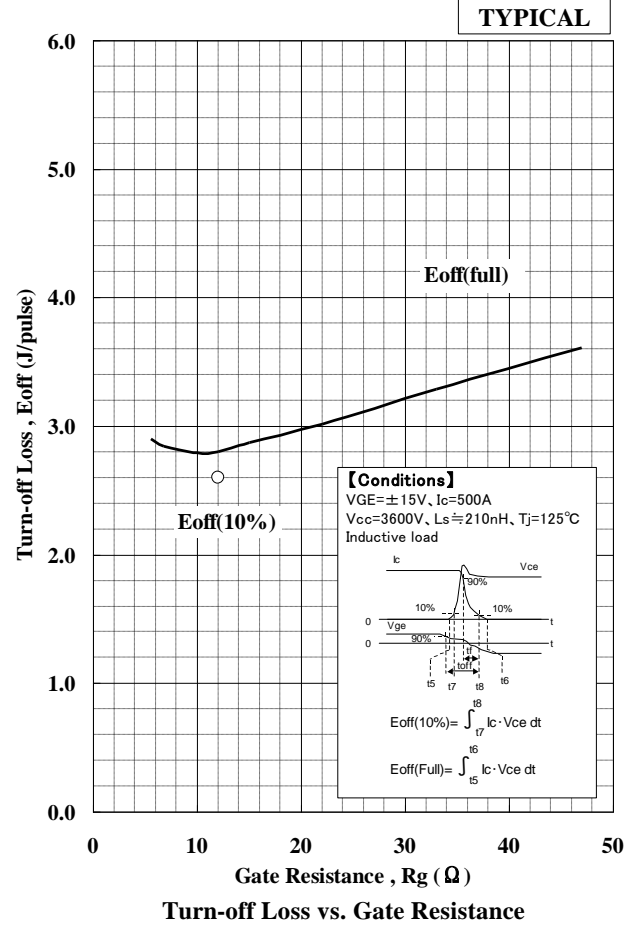
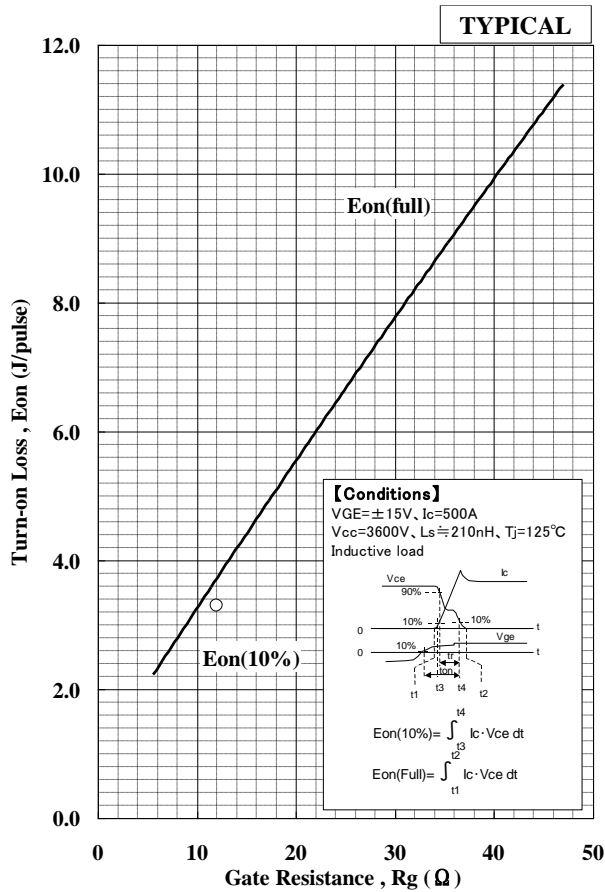


Recovery Loss vs. Forward Current



Switching time vs. Collector current

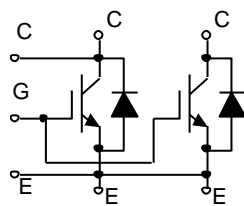
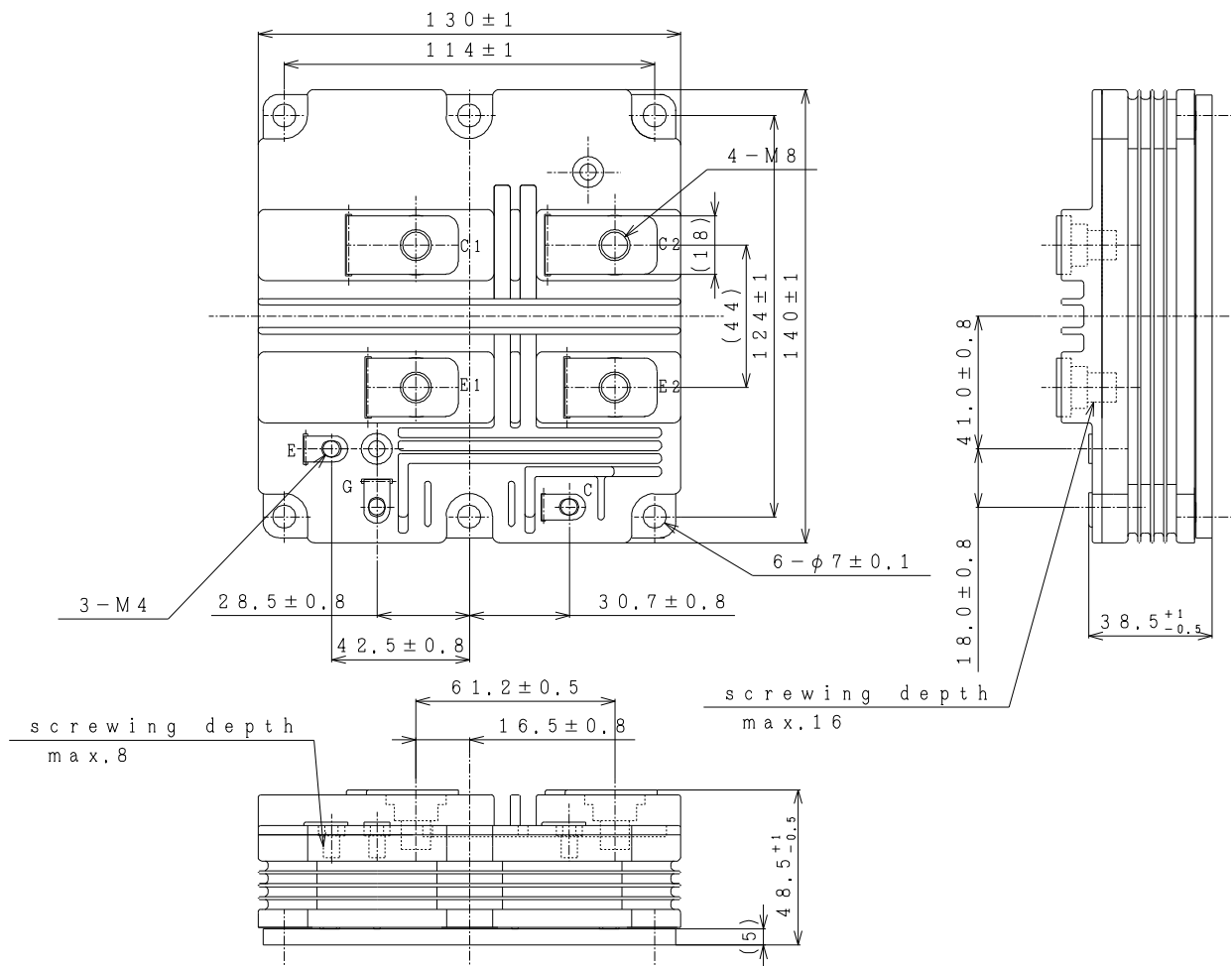
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PACKAGE OUTLINE DRAWING

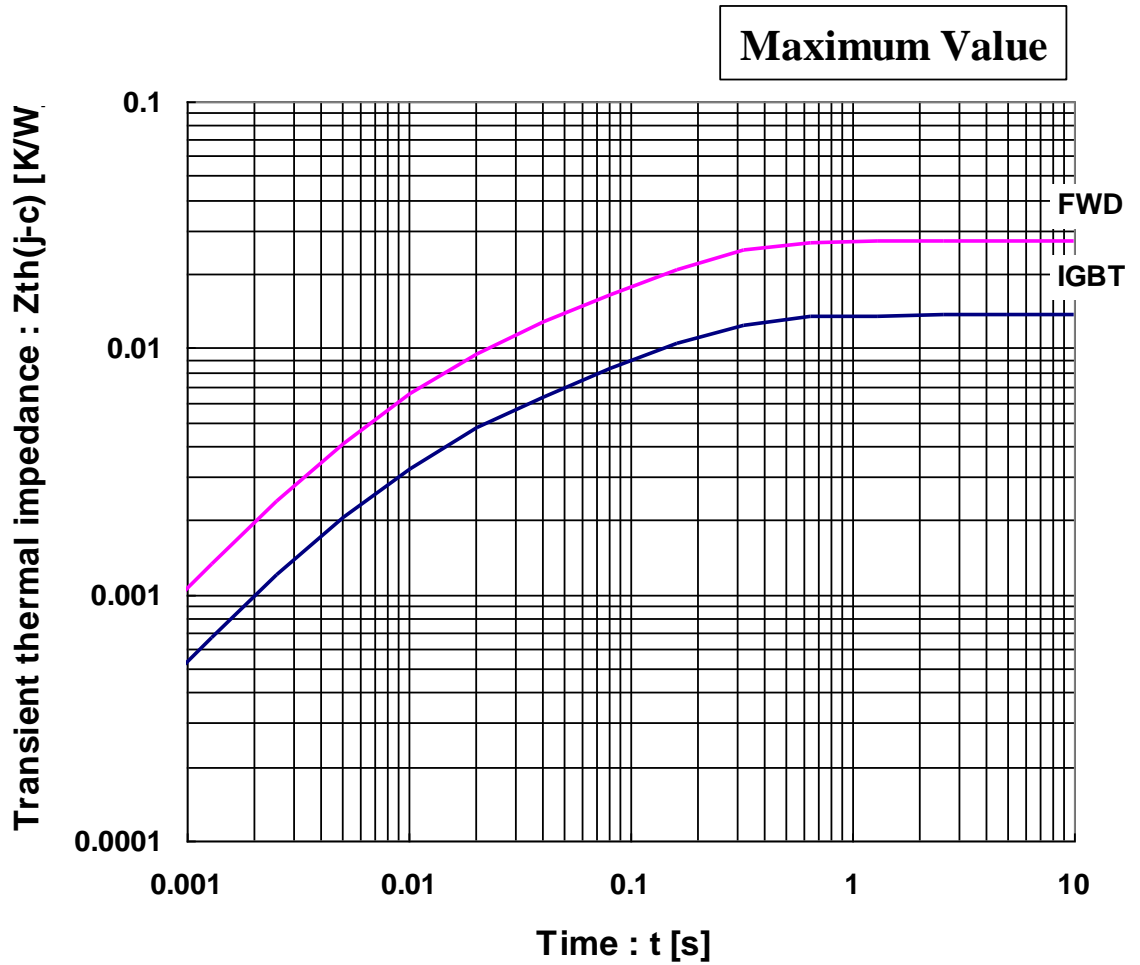
Unit: mm



Circuit diagram

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TRANSIENT THERMAL IMPEDANCE



Transient Thermal Impedance Curve

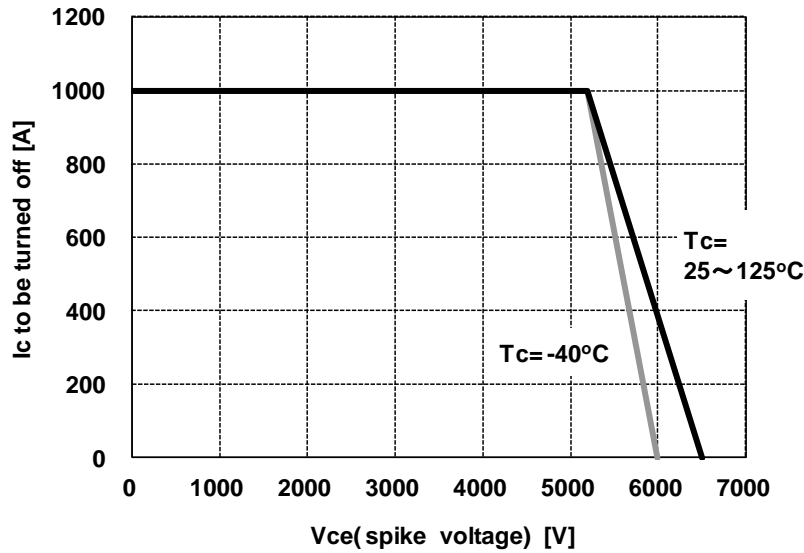
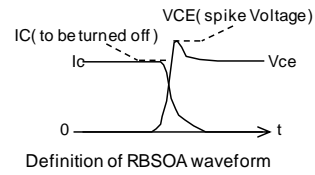
Curve approximation model
 $Z_{th} = \sum r_{th}[n] * (1 - \exp(-t/\tau_{th}[n]))$

n	1	2	3	4	Unit
$\tau_{th}[n]$	1.64E-01	2.89E-02	7.02E-03	9.42E-04	sec
$r_{th}[n,IGBT]$	8.36E-03	2.59E-03	2.43E-03	1.04E-04	K/W
$r_{th}[n,Diode]$	1.67E-02	5.25E-03	4.81E-03	2.13E-04	K/W

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RBSOA

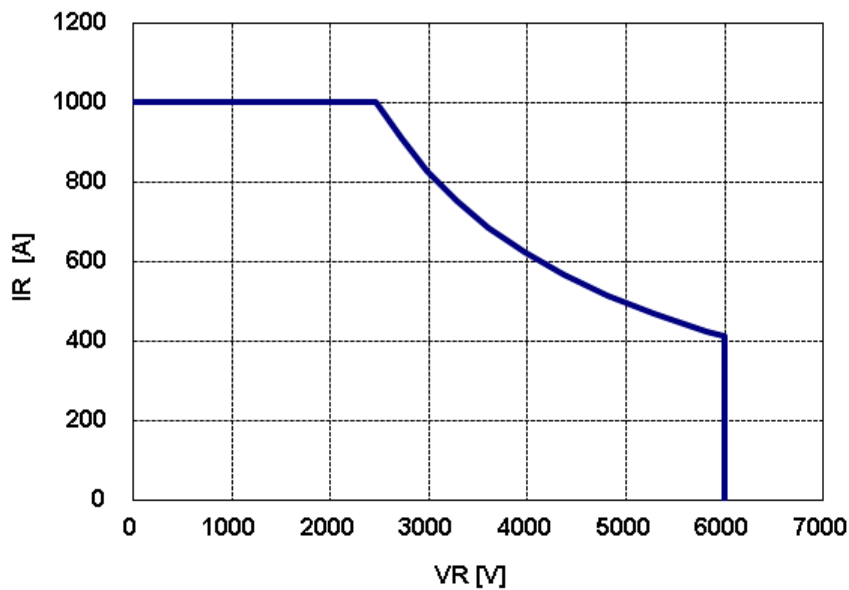
Conditions: $L_s \leq 210\text{nH}$, $V_{cc} \leq 4400\text{V}$,
 $I_c \leq 1000\text{A}$, $V_{GE} = \pm 15\text{V}$,
 $R_{g(\text{on/off})} \geq 12/12\Omega$, $-40^\circ\text{C} \leq T_c \leq 125^\circ\text{C}$
 on pulse width $\geq 20\mu\text{s}$
 (V_{ce} spike voltage and L_s are defined
 at auxiliary terminal)



Reverse bias safe operation area (RBSOA)

Recovery SOA

Conditions:
 $L_s \leq 210\text{nH}$, $V_{cc} \leq 4400\text{V}$, $I_R \leq 1000\text{A}$, $V_{GE} = -15\text{V}$,
 $R_{g(\text{on})}$ of across IGBT $\geq 12\Omega$, V_{GE} of across IGBT $= \pm 15\text{V}$,
 $-40^\circ\text{C} \leq T_c \leq 125^\circ\text{C}$, V_R defined at auxiliary terminal
 Conduction pulse width of diode $\geq 30\mu\text{s}$



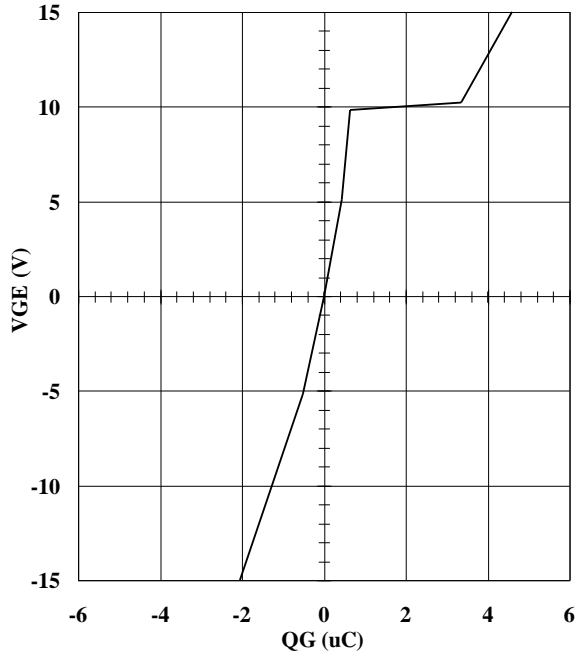
RecSOA

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QG-VGE Curve

TYPICAL

Conditions: $L_s=300\text{nH}$, $V_{CC}=3600\text{V}$, $V_{GE}=\pm 15\text{V}$,
 $R_{G(\text{on/off})}=68\Omega/12\Omega$, $T_j=25^\circ\text{C}$,



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

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HITACHI POWER SEMICONDUCTORS

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