

MBM600F17D

PRELIMINARY SPECIFICATION

Silicon N-channel IGBT

FEATURES

- * High speed, low loss IGBT module.
- * Low driving power due to low input capacitance MOS gate.
- * Low noise due to ultra soft fast recovery diode.
- * Low thermal impedance due to direct liquid cooling.
- * High reliability, high durability module.
- * High thermal fatigue durability ($\Delta T_c=70^\circ\text{C}$, $N>30,000$ cycles)

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

Item	Symbol	Unit	Specification
Collector Emitter Voltage	V_{CES}	V	1,700
Gate Emitter Voltage	V_{GES}	V	± 20
Collector Current	DC	I_C	600
	1ms	I_{Cp}	1200
Forward Current	DC	I_F	600
	1ms	I_{FM}	1200
Maximum Junction Temperature	T_{jmax}	$^\circ\text{C}$	175
Temperature under switching conditions	T_{jop}	$^\circ\text{C}$	-40 ~ +150
Storage Temperature	T_{stg}	$^\circ\text{C}$	-50 ~ +150
Isolation Voltage	V_{ISO}	V_{RMS}	4,000 (AC 50Hz, 1 minute)
Screw Torque	Terminals (M6)	-	6 (1)
	Mounting (M5)	-	4 (2)

Notes: Recommended Value (1)5.5 \pm 0.5N·m (2)3.5 \pm 0.5N·m

ELECTRICAL CHARACTERISTICS

Item	Symbol	Unit	Min.	Typ.	Max.	Test Conditions	
Collector Emitter Cut-Off Current	I_{CES}	mA	-	-	5	$V_{ce}=1,700\text{V}$, $V_{ge}=0\text{V}$, $T_j=25^\circ\text{C}$	
			-	3	10	$V_{ce}=1,700\text{V}$, $V_{ge}=0\text{V}$, $T_j=150^\circ\text{C}$	
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	2.2	2.5	3.1	$I_c=600\text{A}$, $V_{ge}=15\text{V}$, $T_j=25^\circ\text{C}$	
Gate Emitter Threshold Voltage	$V_{GE(TO)}$	V	6.2	6.9	7.6	$V_{ce}=10\text{V}$, $I_c=60\text{mA}$, $T_j=25^\circ\text{C}$	
Input Capacitance	C_{ies}	nF	-	41	-	$V_{ce}=10\text{V}$, $V_{ge}=0\text{V}$, $f=100\text{kHz}$, $T_j=25^\circ\text{C}$	
Internal Gate Resistance	$R_{g(int)}$	Ω	-	3.3	-		
Switching Times	Rise Time	t_r	0.3	0.6	1.2	$V_{cc}=1100\text{V}$, $I_c=600\text{A}$ $L_s=55\text{nH}$, $C_{ge}=22\text{nF}$ $R_g=3.3\Omega$, $T_j=150^\circ\text{C}$	
	Turn On Time	t_{on}	0.5	1.0	2.0		
	Fall Time	t_f	0.3	0.6	1.2		
	Turn Off Time	t_{off}	0.9	1.8	3.6		
Peak Forward Voltage Drop	V_{FM}	V	1.9	2.4	2.9	$I_f=600\text{A}$, $V_{GE}=0\text{V}$, $T_j=150^\circ\text{C}$	
Reverse Recovery Time	t_{rr}	μs	0.2	0.3	0.6	$V_{CC}=1100\text{V}$, $I_c=600\text{A}$, $L_s=55\text{nH}$, $C_{ge}=22\text{nF}$	
Turn On Loss	$E_{on(10\%)}$	J/P	-	0.20	0.26	$R_g=3.3\Omega$	
Turn Off Loss	$E_{off(10\%)}$	J/P	-	0.27	0.35	$V_{ge}=\pm 15\text{V}$, $T_j=150^\circ\text{C}$	
Reverse Recovery Loss	$E_{rr(10\%)}$	J/P	-	0.17	0.26		
SCSOA	I_{sc}	A	-	3000	-	$V_{ge}\leq 15\text{V}$, $V_{cc}=1100\text{V}$ $T_w\leq 10\mu\text{s}$, $T_j=150^\circ\text{C}$	
Thermal Resistance	IGBT	$R_{th(j-cf)}$	K/W	-	0.039	-	Junction to case/fin, 8l/min, 50%LLC (per 1 arm)
	FWD	$R_{th(j-cf)}$	K/W	-	0.058	-	
	IGBT	$R_{th(cf-w)}$	K/W	-	0.041	-	Case/fin to water, 8l/min, 50%LLC (per 1 arm)
	FWD	$R_{th(cf-w)}$	K/W	-	0.047	-	

PACKAGE CHARACTERISTICS

Item	Unit	Characteristics	Test Conditions
Creepage Distance	Between terminal	mm	>16
	Terminal-Base	mm	>16
Comparative Tracking Index	CTI	V	600

* 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.

MBM600F17D

PRELIMINARY SPECIFICATION

DEFINITION OF TEST CIRCUIT

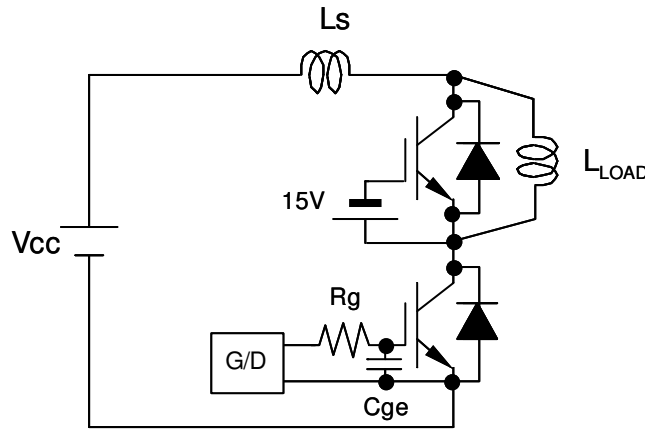


Fig.1 Switching test circuit

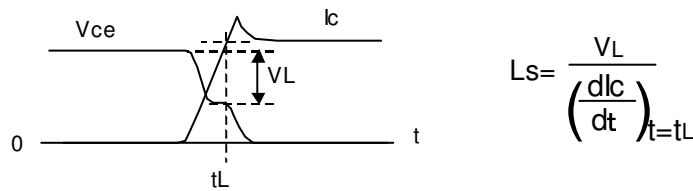


Fig.2 Definition of stray inductance

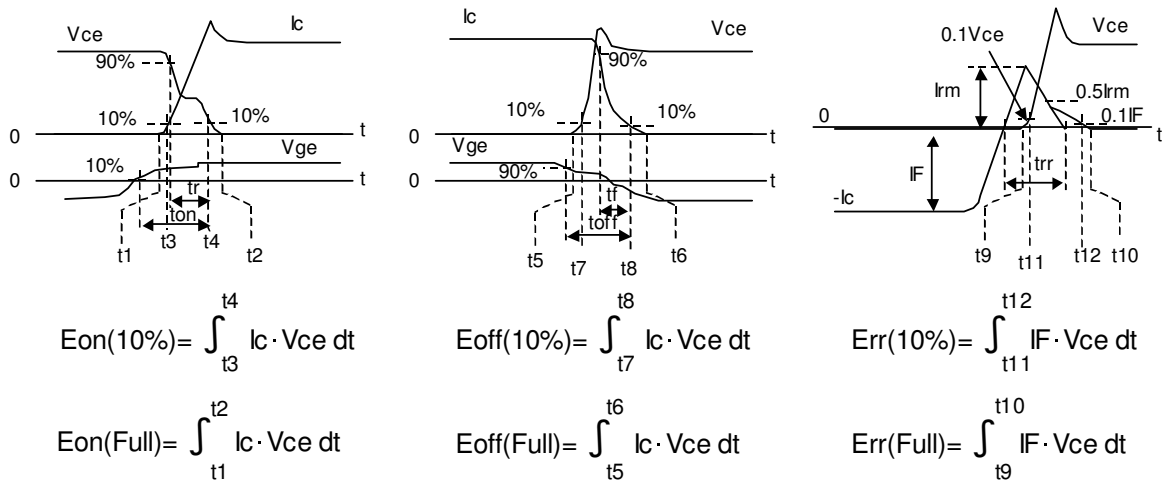
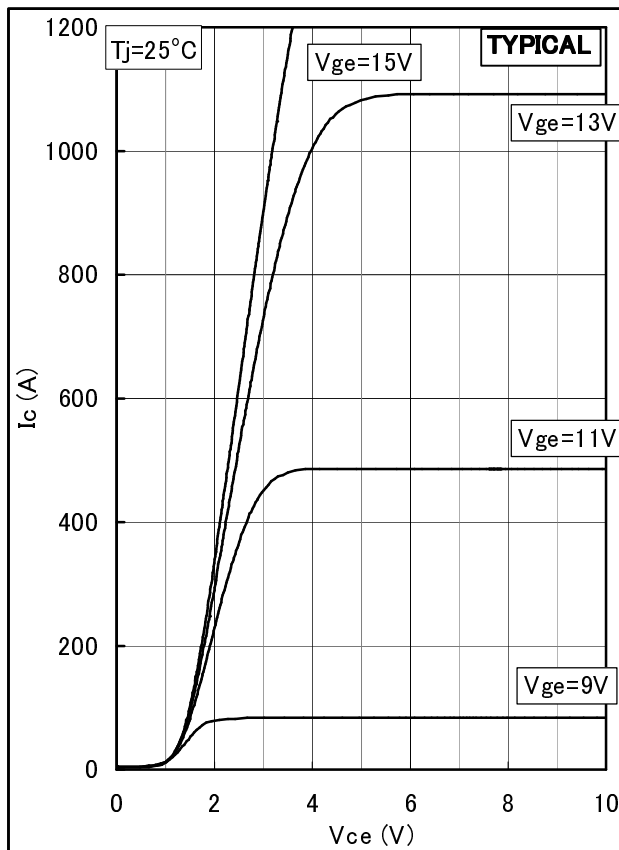


Fig.3 Definition of switching loss

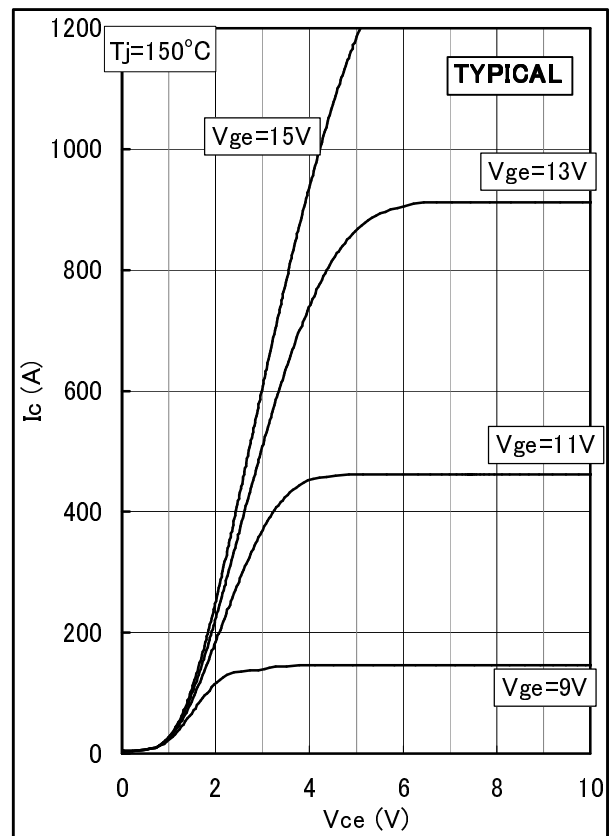
MBM600F17D

PRELIMINARY SPECIFICATION

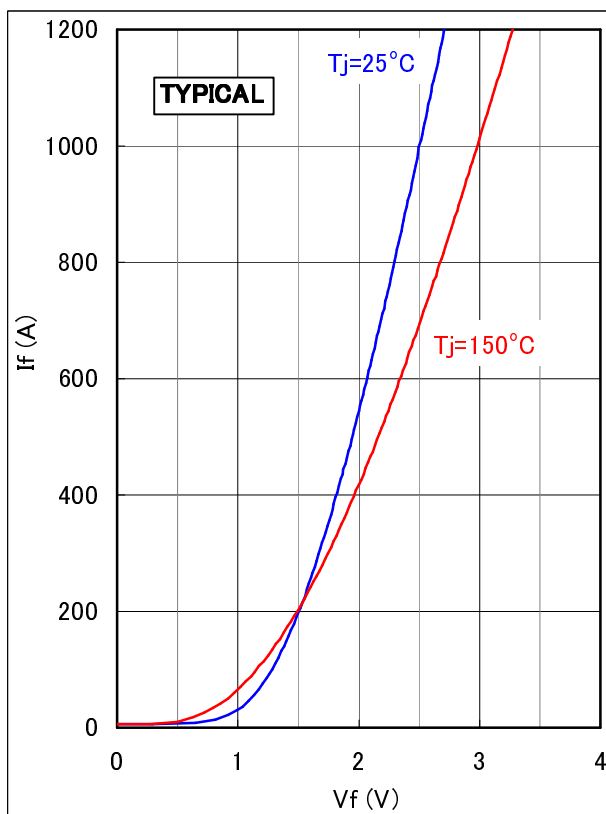
STATIC CHARACTERISTICS



Collector Current vs. Collector to Emitter Voltage



Collector Current vs. Collector to Emitter Voltage

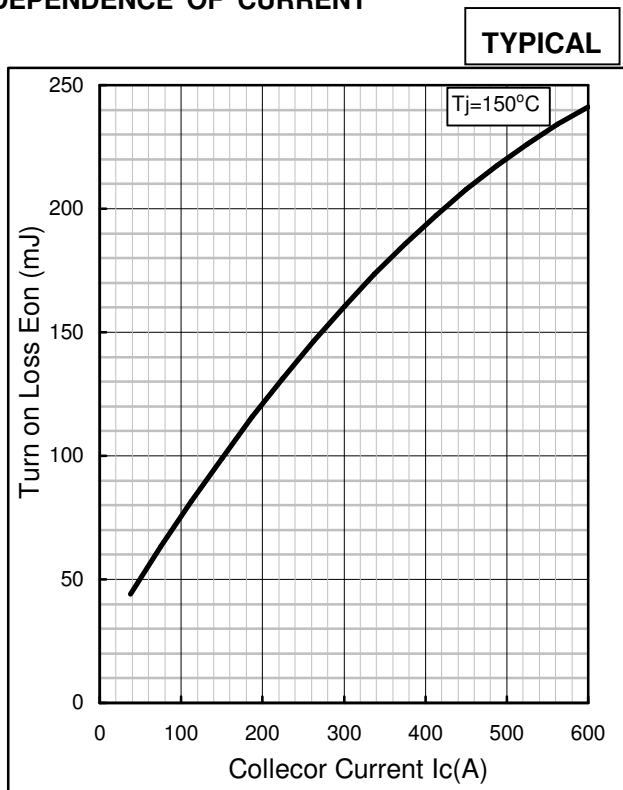


Forward Voltage of free-wheeling diode

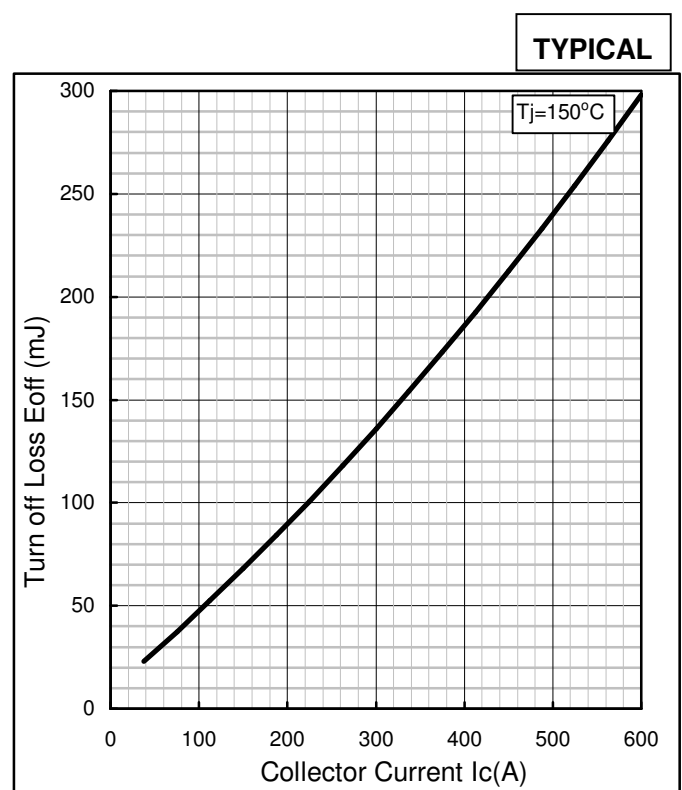
MBM600F17D

PRELIMINARY SPECIFICATION

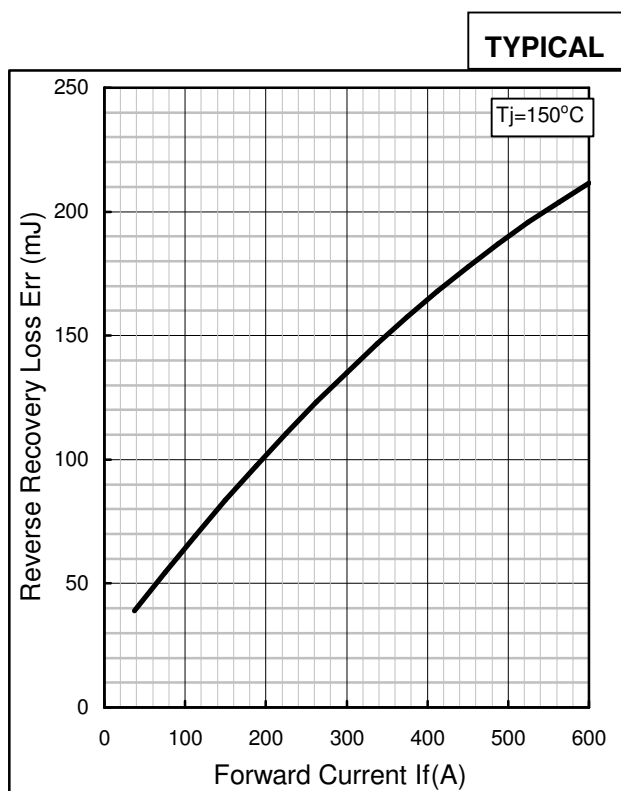
DYNAMIC CHARACTERISTICS DEPENDENCE OF CURRENT



Turn-on Loss vs. Collector Current



Turn-off Loss vs. Collector Current



Recovery Loss vs. Collector Current

【Conditions】

$T_j=150^\circ\text{C}$, $V_{cc}=1100\text{V}$, $L_s=55\text{nH}$

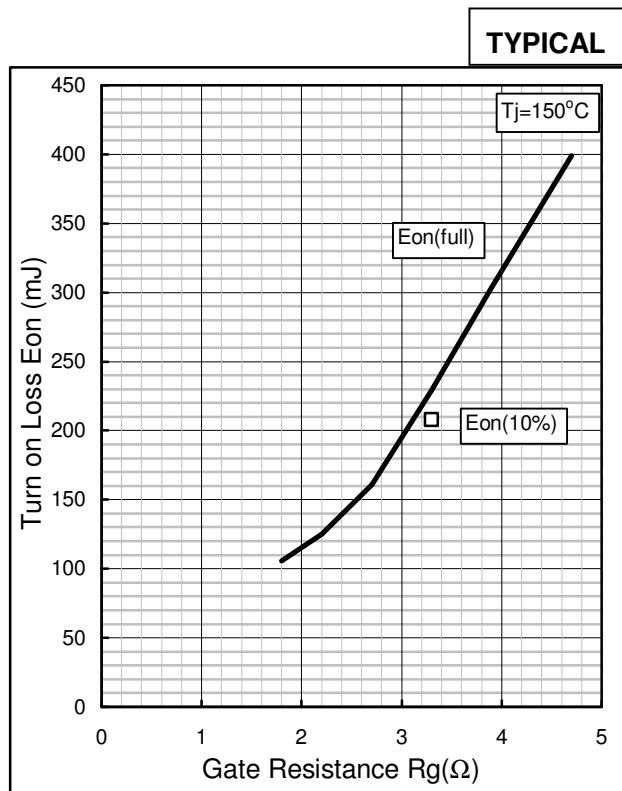
$R_g=3.3\Omega$, $C_{ge}=22\text{nF}$, $V_{ge}=\pm 15\text{V}$

Inductive Load, Full range Losses

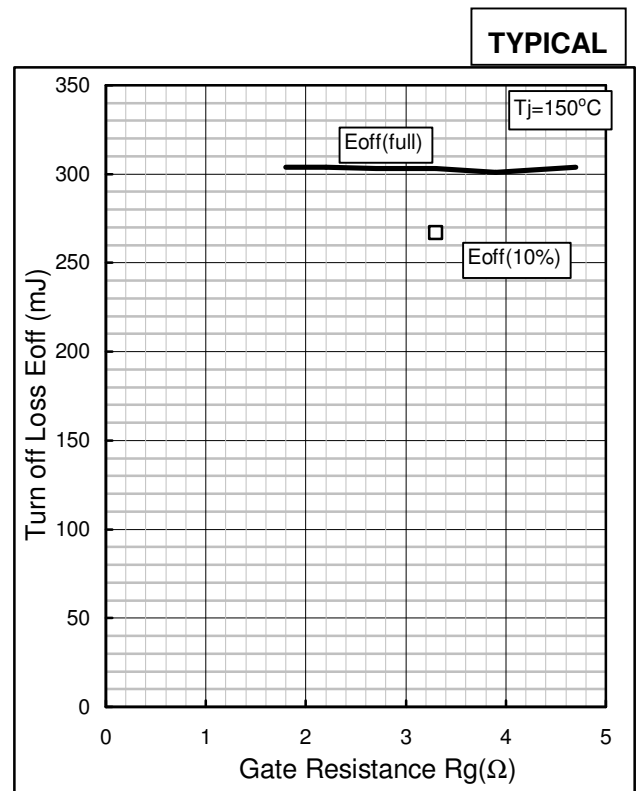
MBM600F17D

PRELIMINARY SPECIFICATION

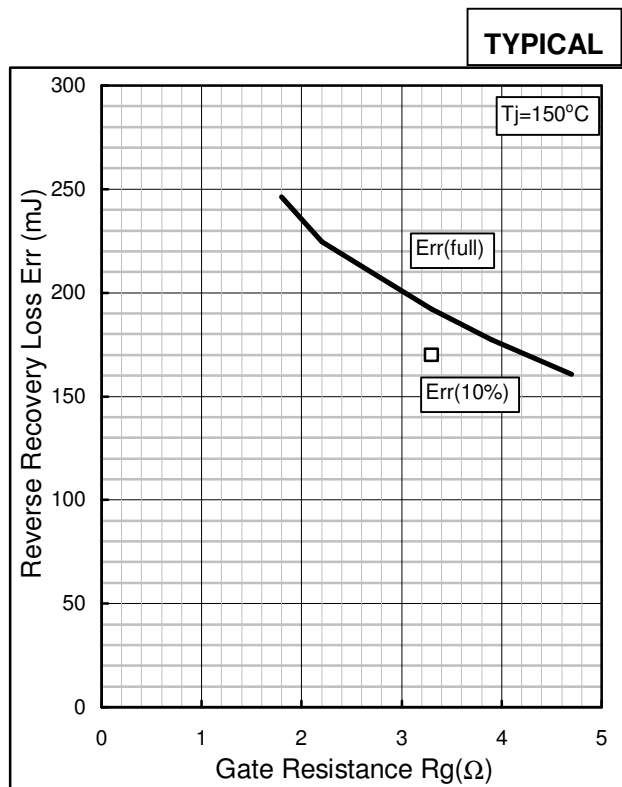
DEPENDENCE OF R_G



Turn-on Loss vs. Gate Resistance



Turn-off Loss vs. Gate Resistance



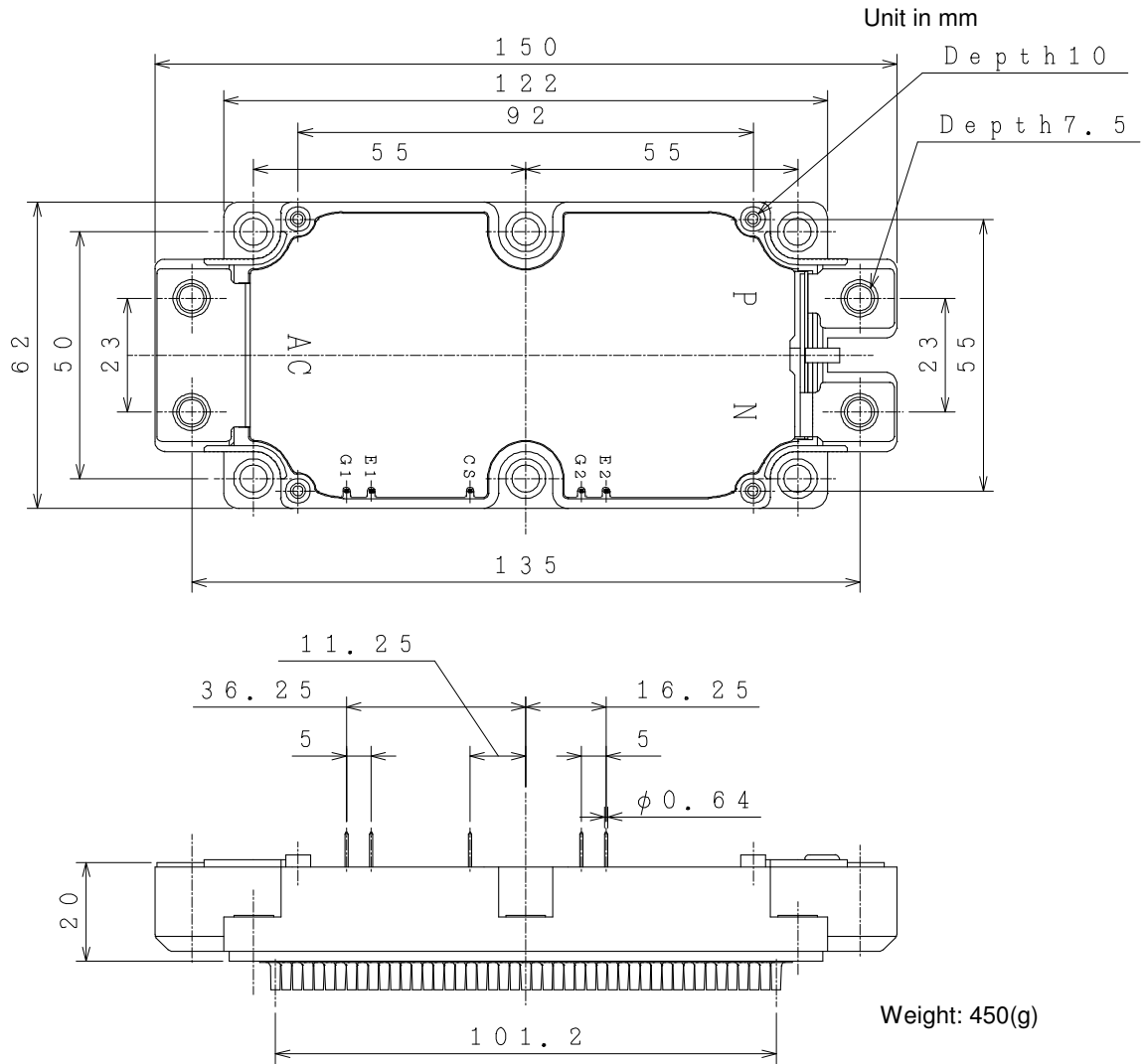
Recovery Loss vs. Gate Resistance

【Conditions】
 T_j=150°C, V_{cc}=1100V, L_s=55nH
 I_c=600A, C_{ge}=22nF, V_{ge}=±15V

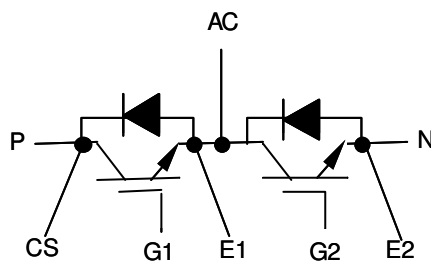
MBM600F17D

PRELIMINARY SPECIFICATION

PACKAGE OUTLINE DRAWING



CIRCUIT DIAGRAM

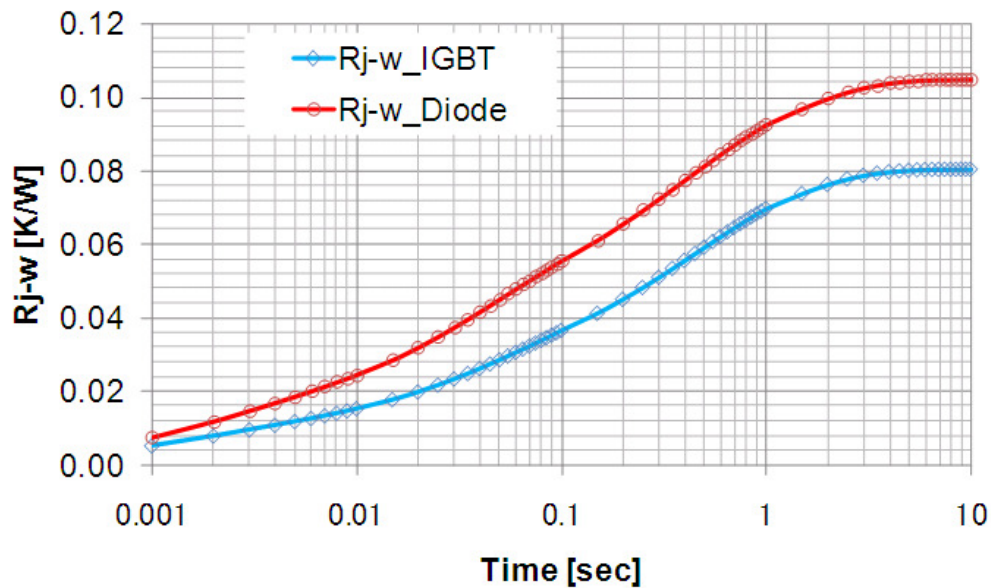


MBM600F17D

PRELIMINARY SPECIFICATION

THERMAL IMPEDANCE

TRANSIENT THERMAL IMPEDANCE



8L/min,50%LLC

HANDLING

MOUNTING IGBT MODULES TO COOLING JACKET

CLAMPING TORQUE

Table below lists recommended clamping torque values.

No	Screw	Rated Torque N-m	Recommended Torque (N-m)	Pre-clamping Torque (N-m)	Final clamping Torque (N-m)
1	M5	4	3.5	0.33 to 0.55	3.5

COOLING JACKET

IGBT module(s) should be mounted on a cooling jacket. An example of the cooling jacket is shown in the following figure, and design rules are described below. Cooling jacket should have flow-channel with openings. Each opening is covered with heatsink of IGBT module. Depth of the openings is recommended to be from 5.8mm to 6.85mm. Maximum depth (6.85mm) is specified to guarantee the thermal resistances on this sheet. Minimum depth (5.8) is specified to ensure no contact between channel wall and heatsink of IGBT module. Also, area of opening should be more than 31.5x109mm² to avoid contact between channel wall and heatsink of IGBT module. Cooling jacket should also have grooves for mounting O-ring for proper sealing. Average surface roughness (Ra) on sealing surfaces should be less than 3.2 and be preferably less than 1.6. Convex or concave warp between mounting screw holes should not exceed 0.1mm to avoid liquid leakage. Length between opening and groove should be at least 2mm. The groove of O-ring should be located between each mounting screw hole and the opening. Please contact our representatives for further information for designing effective cooling jackets suitable for our IGBT module.

MBM600F17D

PRELIMINARY SPECIFICATION

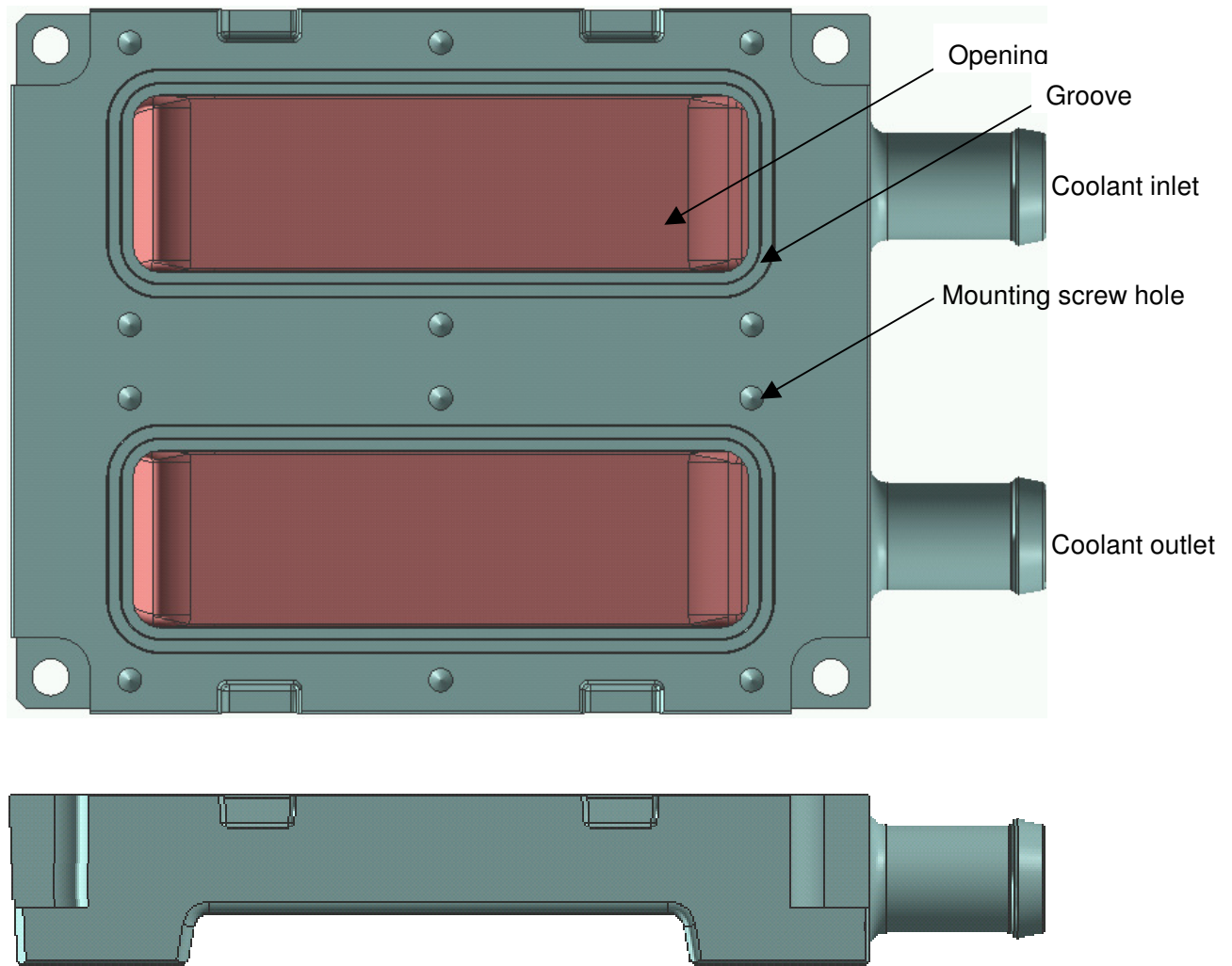


Figure: Example of cooling jacket

O-ring

O-ring should be placed in the groove of cooling jacket before IGBT module is mounted on cooling jacket. Example of O-ring placed between cooling jacket and IGBT module is shown below. O-ring rubber material should be chosen to avoid coolant leakage caused by degradation or swelling of O-ring. EPDM rubber is recommended if ethylene glycol or propylene glycol coolant is used. Recommended diameter of the O-ring is 1.9mm.

MBM600F17D

PRELIMINARY SPECIFICATION

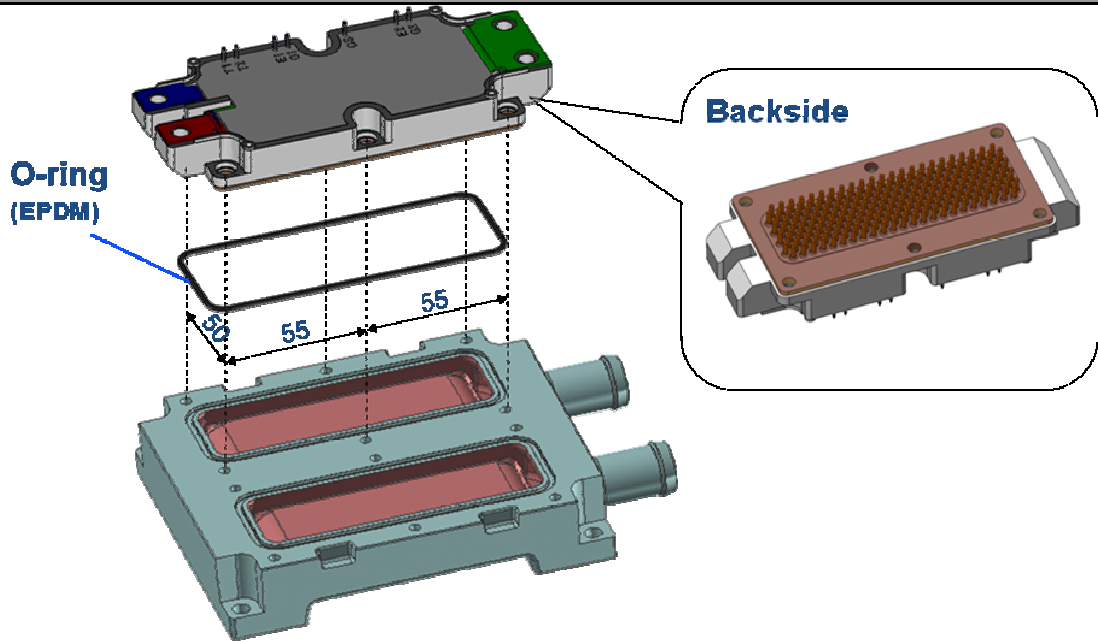


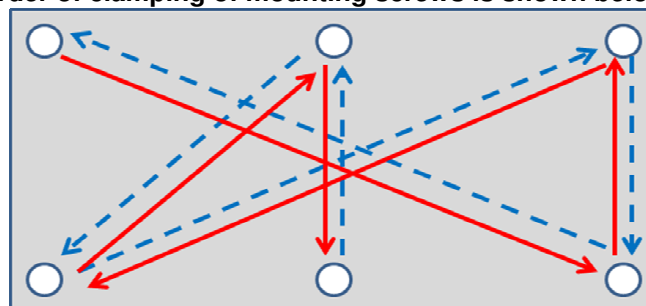
Figure: Example of O-ring placed between cooling jacket and O-ring

Coolant

Coolant should include antifreezing solution in order to avoid breakage of IGBT module, cooling jacket or other devices by freezing of coolant under low temperature. Coolant should also include pH buffering agent and corrosion inhibitor for copper, aluminum, steel and so on. In order to avoid corrosion of IGBT module base plate, density of buffering agent and corrosion inhibitor should be monitored periodically, and the density should not be less than minimum criteria recommended by coolant manufacturer. Corrosion inhibitor and pH buffer agent should be added or replaced, before its density will be less than the criteria, under the rule fixed by coolant manufacturer. Foreign body in the coolant, whose diameter is greater than 1.0mm, will be trapped in pin-fin and it causes the degradation of thermal resistance. Therefore foreign bodies in the coolant should be removed.

Clamping order of screws

Recommended order of clamping of mounting screws is shown below.



---> Pre-clamping
 ———> Final clamping

Important notices

- (1) Confirm that the surface of cooling jacket is free from burrs.
- (2) Always be certain to look for and remove all foreign substances, such as cut chips, which may get caught between the IGBT module and cooling jacket.

MBM600F17D

PRELIMINARY SPECIFICATION

Negative environmental impact material

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

Material	Contained part
Arsenic and its compounds	Si chip

MBM600F17D

PRELIMINARY SPECIFICATION

HITACHI POWER SEMICONDUCTORS

Notices

1. 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 Hitachi sales department for the latest version of this data sheets.
2. Please be sure to read "Precautions for Safe Use and Notices" in the individual brochure before use.
3. In cases where extremely high reliability is required (such as use in nuclear power control, aerospace and aviation, traffic equipment, life-support-related medical equipment, fuel control equipment and various kinds of safety equipment), safety should be ensured by using semiconductor devices that feature assured safety or by means of users' fail-safe precautions or other arrangement. Or consult Hitachi's sales department staff.
4. In no event shall Hitachi be liable for any damages that may result from an accident or any other cause during operation of the user's units according to this data sheets. Hitachi assumes no responsibility for any intellectual property claims or any other problems that may result from applications of information, products or circuits described in this data sheets.
5. In no event shall Hitachi be liable for any failure in a semiconductor device or any secondary damage resulting from use at a value exceeding the absolute maximum rating.
6. No license is granted by this data sheets under any patents or other rights of any third party or Hitachi, Ltd.
7. This data sheets may not be reproduced or duplicated, in any form, in whole or in part, without the expressed written permission of Hitachi, Ltd.
8. The products (technologies) described in this data sheets are not to be provided to any party whose purpose in their application will hinder maintenance of international peace and safety not are they to be applied to that purpose by their direct purchasers or any third party. When exporting these products (technologies), the necessary procedures are to be taken in accordance with related laws and regulations.

- For inquiries relating to the products, please contact nearest overseas representatives that is located "Inquiry" portion on the top page of a home page.

Hitachi power semiconductor home page address <http://www.hitachi.co.jp/products/power/pse/>