

6MBI800XV-075V-01

IGBT Modules

Power Module (X series)

750V / 800A / 6-in-one package

■ Features

7th-generation X-series RC-IGBT(RC-IGBT: Reverse Conducting IGBT)

Built-in two on-chip sensor (temperature and currents)

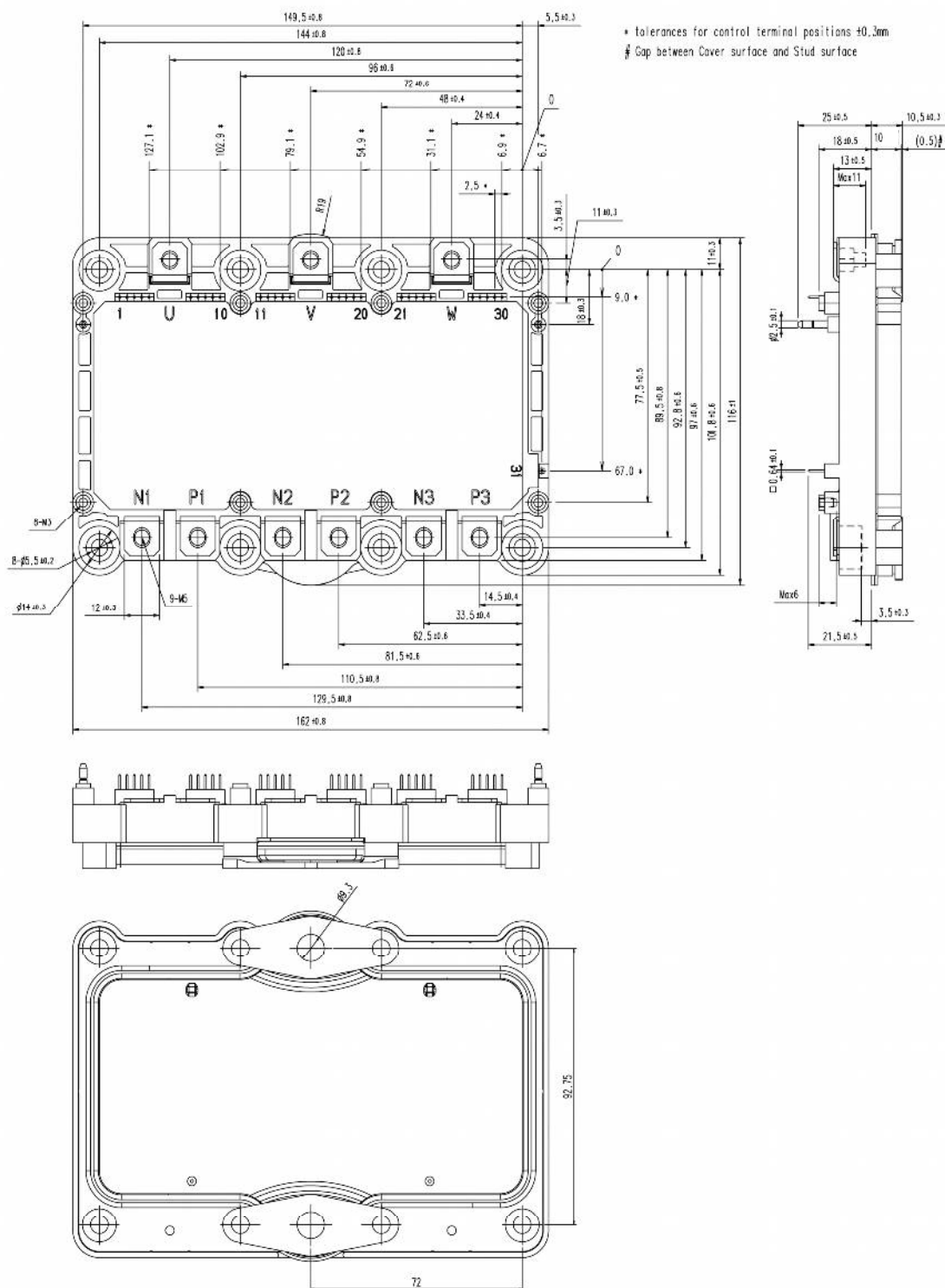
3rd-generation direct liquid-cooling structure with water jacket



■ Applications

Automotive system

■ Outline drawing (Unit : mm)

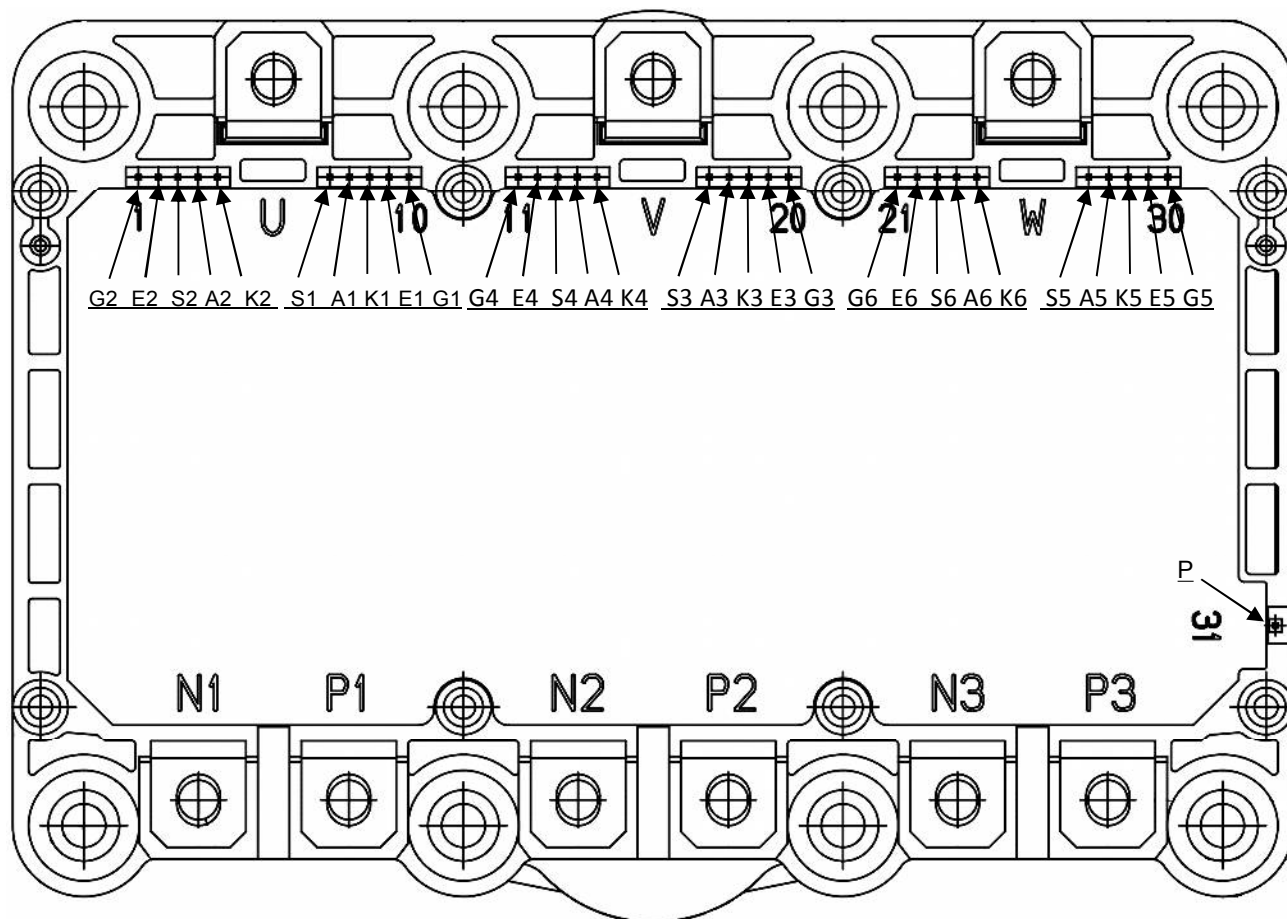


6MBI800XV-075V-01

IGBT Modules

■ terminal arrangement

Symbol	Terminal name	Symbol	Terminal name
G1~G6	Gate	P	Collector voltage sense
E1~E6	Emitter	U,V,W	Output terminal
A1~A6	Anode (temperature sense diode)	P1~P3	High voltage (+)
K1~K6	Kathode (temperature sense diode)	N1~N3	High voltage (-)
S1~S6	Sense emitter		



6MBI800XV-075V-01

IGBT Modules

■ Maximum Ratings (at $T_f = 25^\circ\text{C}$ unless otherwise specified)

Items		Symbols	Conditions	Maximum Ratings	Units
Inverter	Collector-Emitter voltage	V_{CES}	$T_{vj}=25^\circ\text{C}$	750	V
			$T_{vj}=-40^\circ\text{C}$	700	V
	Gate-Emitter voltage	V_{GES}		± 20	V
	implemented Collector current	I_{CN}	$T_f=80^\circ\text{C}$, $T_{vj(max)}=175^\circ\text{C}$	800	A
	Collector current	I_{Cnom}	$T_{win}=25^\circ\text{C}$	570	
		$-I_{Cnom}$	$T_{vj(max)}=175^\circ\text{C}$	570	
		I_C	$T_{win}=65^\circ\text{C}$	460	
		$-I_C$	$T_{vj(max)}=175^\circ\text{C}$	460	
		I_{CRM}	1ms	1600	
		$-I_{CRM}$		1600	
	Collector power dissipation	P_C	1 arm, $T_{win}=25^\circ\text{C}$, $T_{vj(max)}=175^\circ\text{C}$	890	W
Operating junction temperature (under switching condition)		T_{vjop}		-40 ~ +175	$^\circ\text{C}$
Storage temperature		T_{stg}		-40 ~ +125	
fin temperature		T_f		125	
Isolation voltage		V_{iso}	AC: 1min. between terminal and cooler	2500	Vrms
Electro Static Discharge		HBM	C=100pF, R=1500 Ω	500	V
		MM	C=200pF, R=0 Ω	100	V
Cooler	maximum cooling water temperature	T_{win}		65	$^\circ\text{C}$
	maximum cooling water flow rate	FR		10	L/min
	maximum pressure	P		200	kPa
Screw Torque	Mounting M5	-	M5	4.5	Nm
	Main Terminals M5	-	M5	4.5	
	PCB mounting M3	-	M3	0.7	
Control terminal soldering		-	number of soldering times	1	times
		-	soldering temperature	240	$^\circ\text{C}$
		-	soldering time	5	sec
module mounting angle		-		5	deg.

6MBI800XV-075V-01

IGBT Modules

■ Electrical characteristics (at $T_{vj}=25^{\circ}\text{C}$ unless otherwise specified)

Items		Symbols	Conditions		Characteristics			Units
					min.	typ.	max.	
Inverter	Zero gate voltage Collector current	I_{CES}	$V_{GE}=0V, V_{CE}=750V$		-	-	10.0	μA
	Gate-Emitter leakage current	I_{GES}	$V_{CE}=0V, V_{GE}=\pm 20V$		-	-	500	nA
	Gate-Emitter threshold voltage	$V_{GE(th)}$	$V_{CE}=20V, I_C=800mA$		5.8	6.3	6.8	V
	Collector-Emitter saturation voltage	$V_{CE(sat)}$ (terminal)	$V_{GE}=15V, I_C=800A$	$T_{vj}=25^{\circ}C$	-	1.80	2.00	V
				$T_{vj}=150^{\circ}C$	-	2.10	2.30	
				$T_{vj}=175^{\circ}C$	-	2.15	2.35	
		$V_{CE(sat)}$ (Chip)		$T_{vj}=25^{\circ}C$	-	1.45	1.65	
				$T_{vj}=150^{\circ}C$	-	1.60	1.80	
				$T_{vj}=175^{\circ}C$	-	1.65	1.85	
	Input capacitance	C_{ies}	$V_{CE}=10V, V_{GE}=0V, f=1MHz$		-	60.2	-	nF
	Turn-on time	$t_{d(on)}$	$V_{CC}=400V,$ $I_C, I_F=800A,$ $V_{GE}=+15/0V,$ $R_G=+2.7/-1.8\Omega,$ $L_S=15nH,$ $C_{GE}=56nF$	$T_{vj}=25^{\circ}C$	0.16	0.39	0.62	μs
				$T_{vj}=150^{\circ}C$	0.15	0.37	0.59	
				$T_{vj}=175^{\circ}C$	0.14	0.36	0.58	
		t_r		$T_{vj}=25^{\circ}C$	-	0.17	0.34	
				$T_{vj}=150^{\circ}C$	-	0.18	0.36	
				$T_{vj}=175^{\circ}C$	-	0.18	0.36	
	Turn-off time	$t_{d(off)}$	$V_{CC}=400V,$ $I_C, I_F=800A,$ $V_{GE}=+15/0V,$ $R_G=+2.7/-1.8\Omega,$ $L_S=15nH,$ $C_{GE}=56nF$	$T_{vj}=25^{\circ}C$	0.51	1.28	2.05	μs
				$T_{vj}=150^{\circ}C$	0.53	1.32	2.11	
				$T_{vj}=175^{\circ}C$	0.56	1.40	2.24	
		t_f		$T_{vj}=25^{\circ}C$	-	0.12	0.24	
$T_{vj}=150^{\circ}C$				-	0.14	0.28		
$T_{vj}=175^{\circ}C$				-	0.14	0.28		
Switching loss (per pulse)	E_{on}	$V_{CC}=400V,$ $I_C, I_F=800A,$ $V_{GE}=+15/0V,$ $R_G=+2.7/-1.8\Omega,$ $L_S=15nH,$ $C_{GE}=56nF$	$T_{vj}=25^{\circ}C$	-	50	63	mJ	
			$T_{vj}=150^{\circ}C$	-	66	83		
			$T_{vj}=175^{\circ}C$	-	74	93		
	E_{off}		$T_{vj}=25^{\circ}C$	-	70	88		
			$T_{vj}=150^{\circ}C$	-	80	100		
			$T_{vj}=175^{\circ}C$	-	84	105		
	E_{rr}		$T_{vj}=25^{\circ}C$	-	19	24		
			$T_{vj}=150^{\circ}C$	-	30	38		
			$T_{vj}=175^{\circ}C$	-	34	43		
Reverse recovery time	t_{rr}	$V_{CC}=400V,$ $I_C, I_F=800A,$ $V_{GE}=+15/0V,$	$T_{vj}=25^{\circ}C$	-	0.24	0.48	μs	
			$T_{vj}=150^{\circ}C$	-	0.33	0.66		
			$T_{vj}=175^{\circ}C$	-	0.35	0.70		
Reverse current	I_{rrm}	$R_G=+2.7/-1.8\Omega,$ $L_S=15nH,$ $C_{GE}=56nF$	$T_{vj}=25^{\circ}C$	-	400	600	A	
			$T_{vj}=150^{\circ}C$	-	480	720		
			$T_{vj}=175^{\circ}C$	-	500	750		

NOTICE :

The external gate resistance (R_G) shown above is one of our recommended value.

However the optimum R_G depends on circuit configuration and/or environment.

We recommend that the R_G has to be carefully chosen based on consideration if IGBT module matches design criteria, for example, switching loss, EMC/EMI, spike voltage, surge current and no unexpected oscillation and so on.

6MBI800XV-075V-01

IGBT Modules

Items		Symbols	Conditions		Characteristics			Units	
					min.	typ.	max.		
Inverter	Forward on voltage	V_{F1} (terminal)	$V_{GE}=0V, I_F=800A$	$T_{vj}=25^{\circ}C$	-	1.80	2.00	V	
				$T_{vj}=150^{\circ}C$	-	1.95	2.15		
				$T_{vj}=175^{\circ}C$	-	1.95	2.15		
		V_{F1} (chip)		$T_{vj}=25^{\circ}C$	-	1.45	1.65		
				$T_{vj}=150^{\circ}C$	-	1.50	1.70		
				$T_{vj}=175^{\circ}C$	-	1.50	1.70		
		V_{F2} (terminal)		$V_{GE}=15V, I_F=800A$	$T_{vj}=25^{\circ}C$	-	1.90		2.10
					$T_{vj}=150^{\circ}C$	-	2.10		2.30
					$T_{vj}=175^{\circ}C$	-	2.10		2.30
		V_{F2} (chip)	$T_{vj}=25^{\circ}C$		-	1.50	1.70		
			$T_{vj}=150^{\circ}C$		-	1.55	1.75		
			$T_{vj}=175^{\circ}C$		-	1.55	1.75		
	Static sense emitter voltage	V_{SE}	$V_{GE}=15V$ $R_S=120\Omega$ $I_C=800A$		$T_{vj}=25^{\circ}C$	600	800	1000	mV
					$T_{vj}=150^{\circ}C$	900	1150	1400	
					$T_{vj}=175^{\circ}C$	950	1200	1450	
Temperature sense diode forward on voltage	V_{AK}	$I_{AK}=1mA$	$T_{vj}=25^{\circ}C$	2.19	2.23	2.27	V		
			$T_{vj}=150^{\circ}C$	1.70	1.74	1.78			
			$T_{vj}=175^{\circ}C$	1.61	1.65	1.69			
Short circuit capability		SC	$V_{CC}=400V, V_{GE}<15V$ $T_{vj}<175^{\circ}C$		3.6	-	-	J	

NOTICE :

When using this IGBT module, implement short circuit protection function in the gate driver board and confirm that excessive surge voltage and oscillation do not occur.

We recommend sense-emitter current protection method for short circuit protection.

For sense-emitter current protection method, refer to Fuji Electric application manual.

■ Thermal resistance characteristics

Items	Symbols	Conditions	Characteristics			Units
			min.	typ.	max.	
Thermal resistance	$R_{th(j-win)}$	Cooling fluid = 50% water / 50% ethylene glycol $T_{win}=65^{\circ}C, FR=10L/min$	-	0.141	0.168	$^{\circ}C/W$

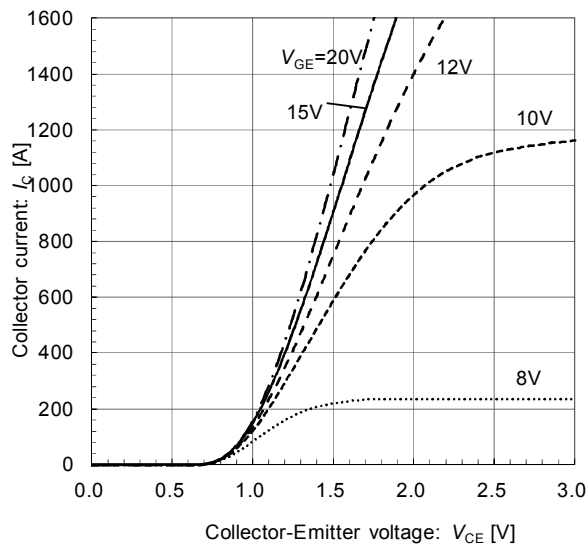
■ Cooler characteristics

Items	Symbols	Conditions	Characteristics			Units
			min.	typ.	max.	
Pressure drop	ΔP	Cooling fluid = 50% water / 50% ethylene glycol $T_{win}=65^{\circ}C, FR=10L/min$	-	9	10	kPa
Air tightness	-	Helium leak test@200kPa	-	-	2.5×10^{-5}	$Pa \cdot m^3/s$
Surface roughness of flange	-	R_a	-	-	0.8	μm
		R_z	-	-	3.2	μm
Flatness of flange	-	-	-	-	600	μm
Flatness of fastening portion	-	-	-	-	1500	μm

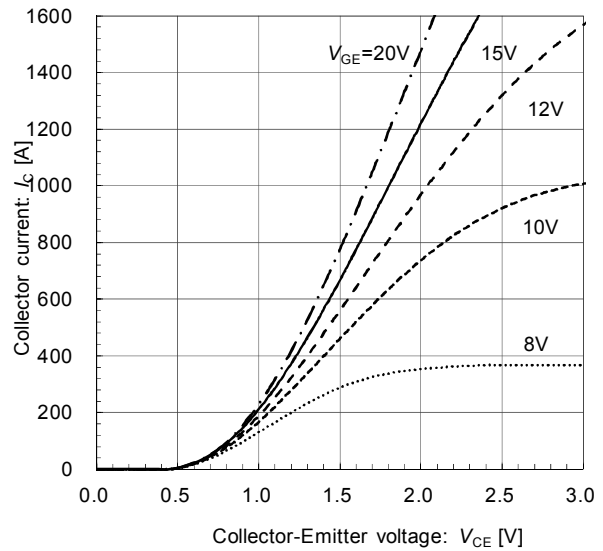
6MBI800XV-075V-01

IGBT Modules

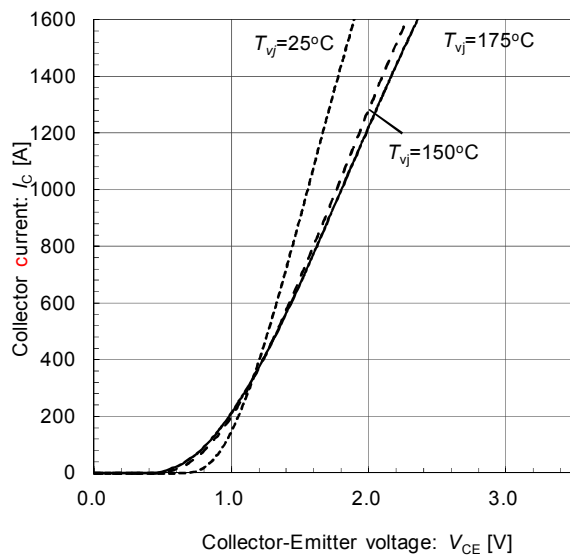
Collector current vs. Collector-Emitter voltage (typ.)
 $T_{vj} = 25^{\circ}\text{C}$ / chip



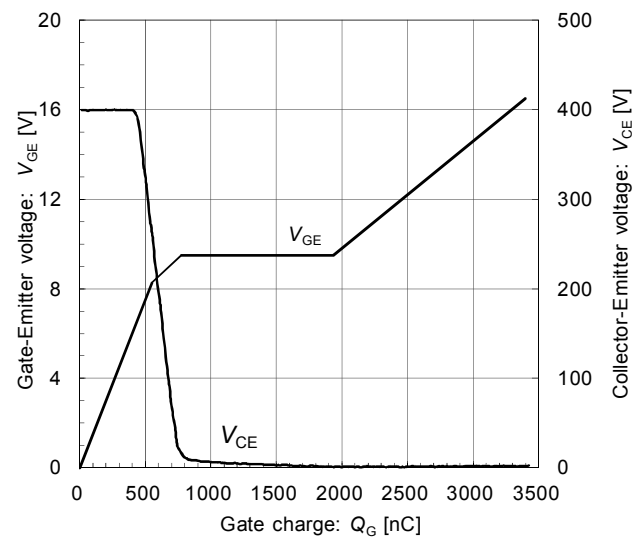
Collector current vs. Collector-Emitter voltage (typ.)
 $T_{vj} = 175^{\circ}\text{C}$ / chip



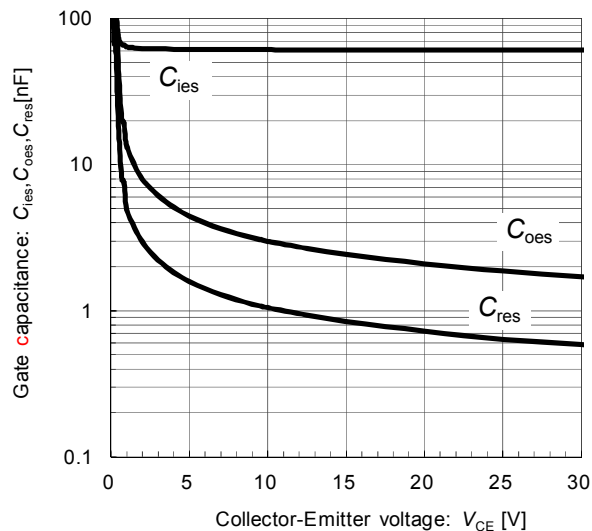
Collector current vs. Collector-Emitter voltage (typ.)
 $V_{GE} = 15\text{V}$ / chip



Dynamic Gate charge (typ.)
 $V_{CC}=400\text{V}, I_C=800\text{A}, T_{vj}=25^{\circ}\text{C}$

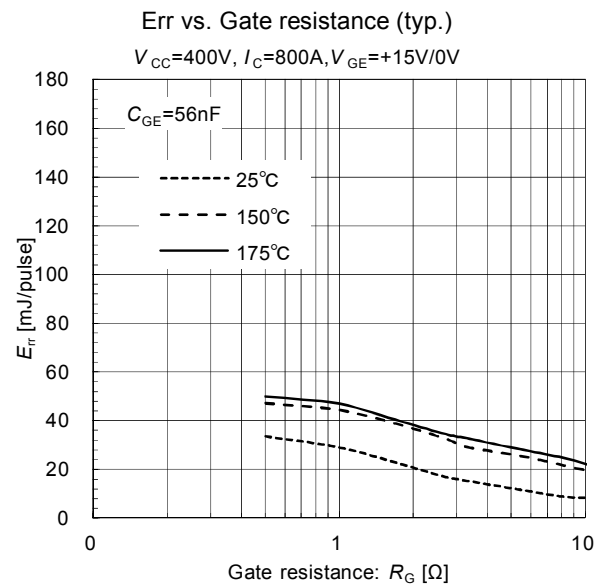
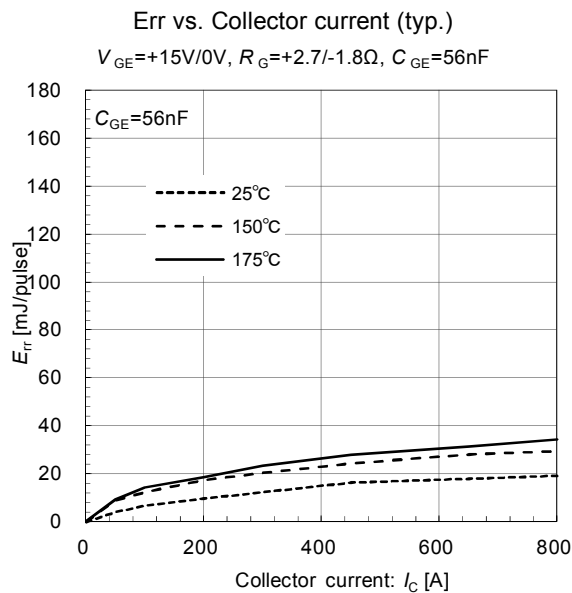
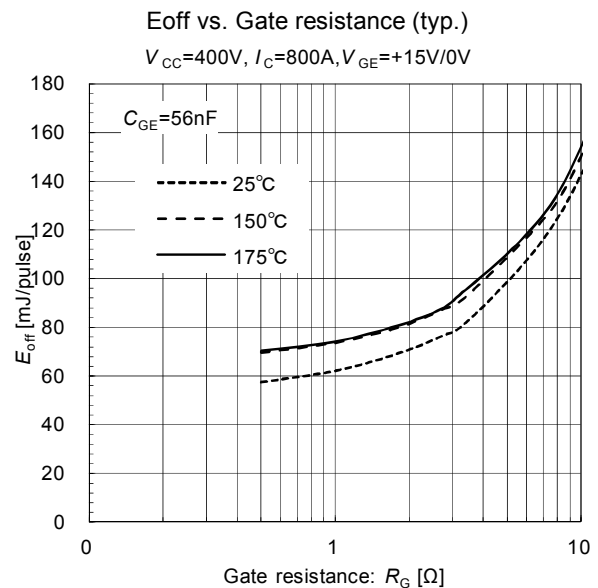
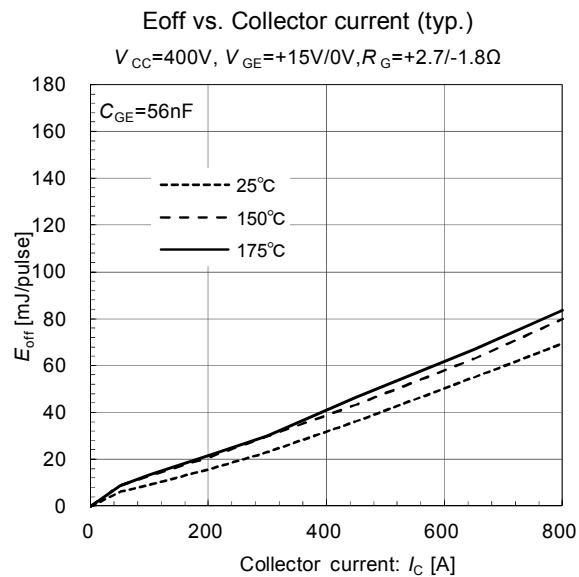
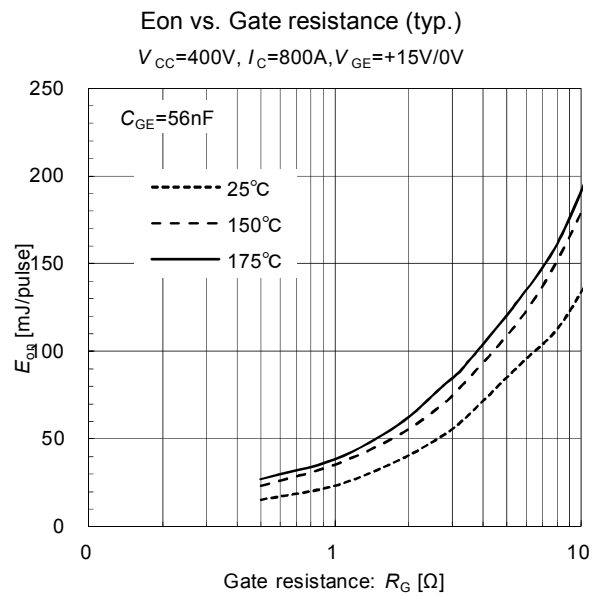
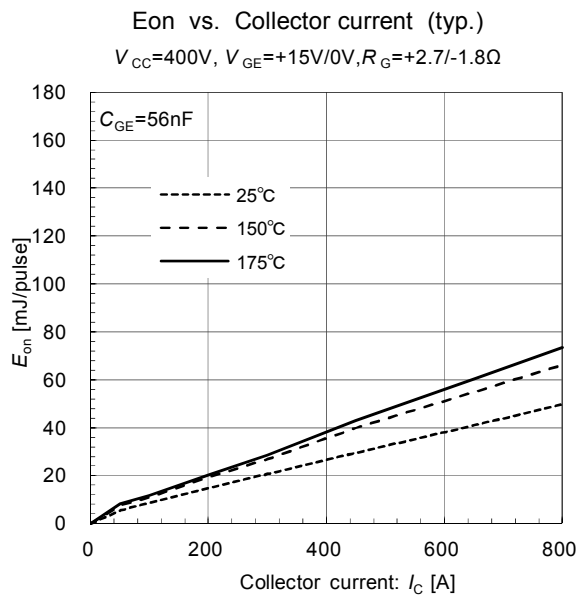


Gate capacitance vs. Collector-Emitter voltage (typ.)
 $V_{GE} = 0\text{V}, f = 1\text{MHz}, T_{vj} = 25^{\circ}\text{C}$



6MBI800XV-075V-01

IGBT Modules

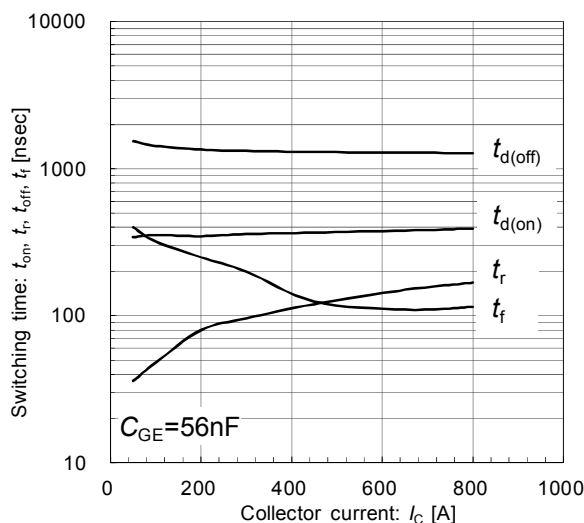


6MBI800XV-075V-01

IGBT Modules

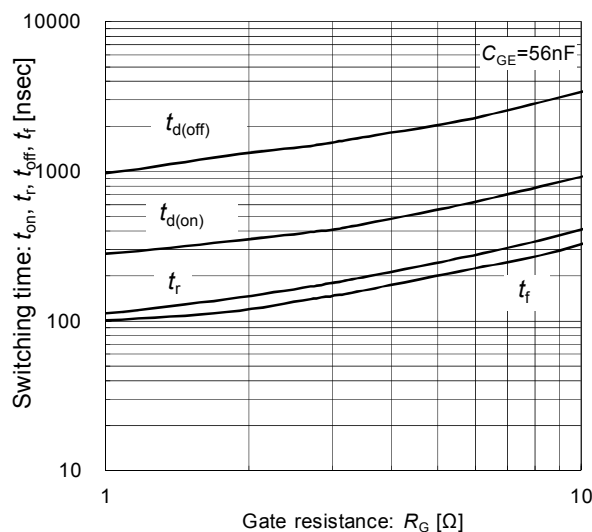
Switching time vs. Collector current (typ.)

$V_{CC}=400V, V_{GE}=+15V/0V, R_G=+2.7/-1.8\Omega, T_{vj}=25^\circ C$



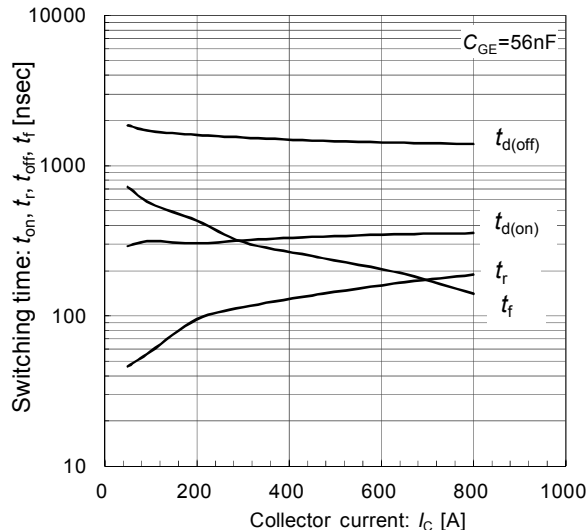
Switching time vs. Gate resistance (typ.)

$V_{CC}=400V, V_{GE}=+15V/0V, R_G=+2.7/-1.8\Omega, T_{vj}=25^\circ C$



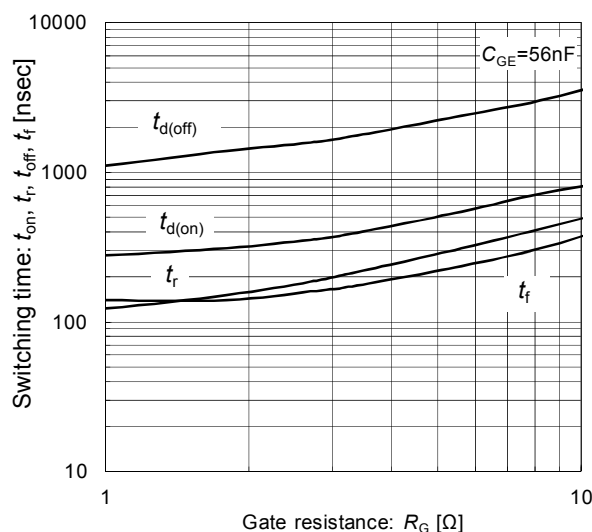
Switching time vs. Collector current (typ.)

$V_{CC}=400V, I_C=800A, V_{GE}=+15V/0V, T_{vj}=175^\circ C$



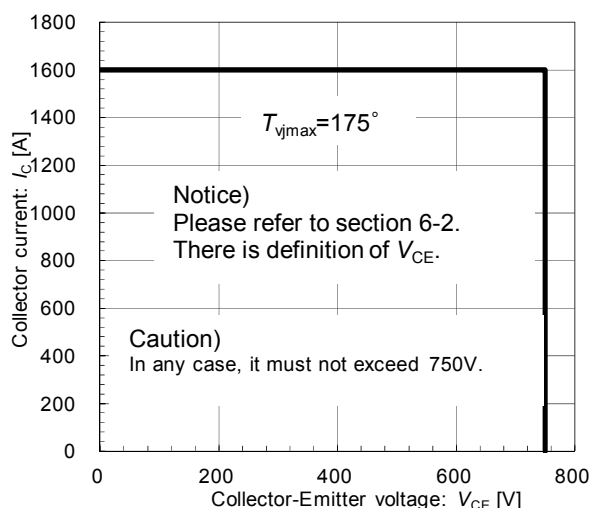
Switching time vs. Gate resistance (typ.)

$V_{CC}=400V, I_C=800A, V_{GE}=+15V/0V, T_{vj}=175^\circ C$



Reverse bias safe operating area (max.)

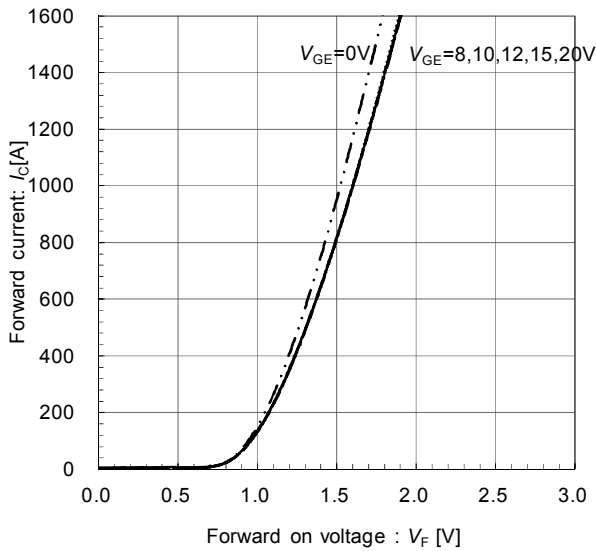
$V_{GE}=+15V/0V, R_G=+2.7/-1.8\Omega, C_{GE}=56nF$



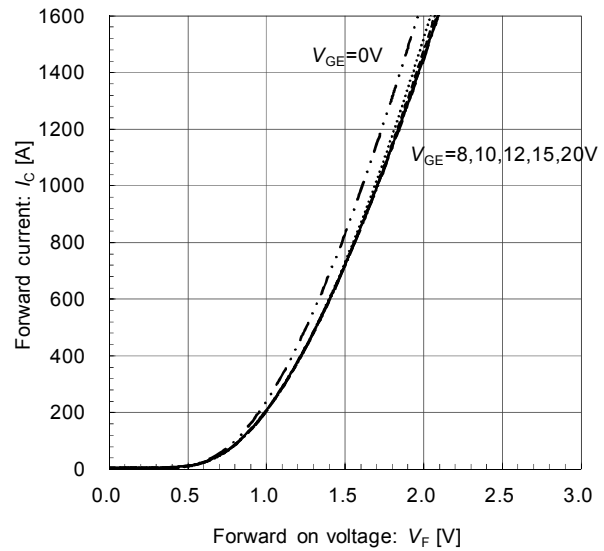
6MBI800XV-075V-01

IGBT Modules

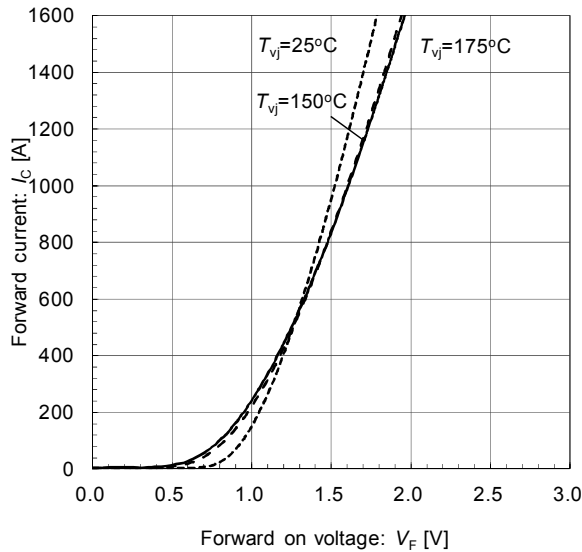
Forward current vs. Forward voltage (typ.)
 $T_{vj} = 25^{\circ}\text{C}$ / chip



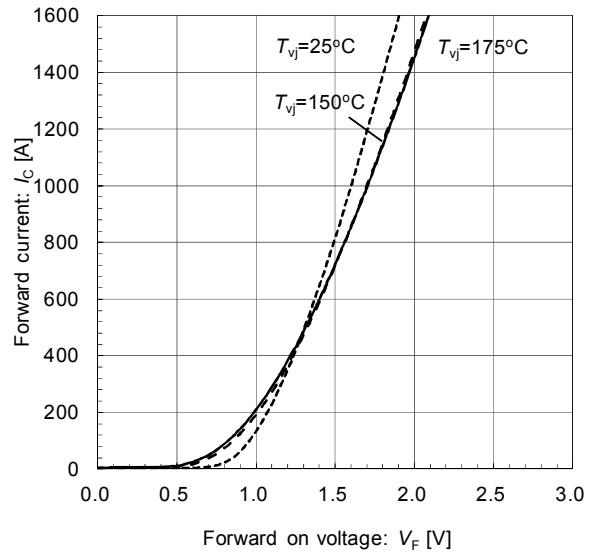
Forward current vs. Forward voltage (typ.)
 $T_{vj} = 175^{\circ}\text{C}$ / chip



Forward current vs. Forward voltage (typ.)
chip / $V_{GF} = 0\text{V}$

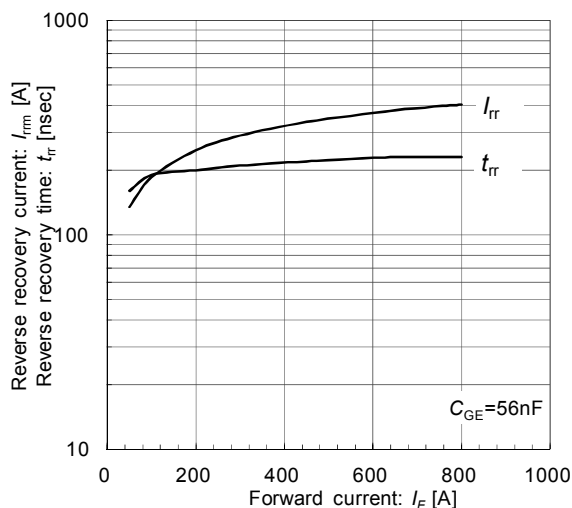


Forward current vs. Forward voltage (typ.)
chip / $V_{GF} = 15\text{V}$



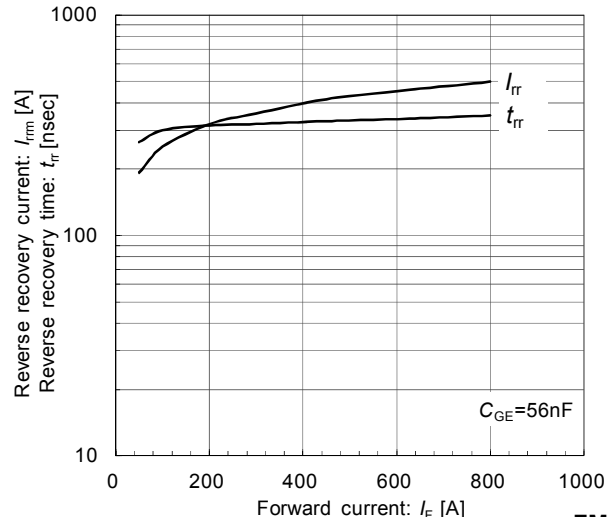
Reverse recovery characteristics (typ.)

$V_{CC} = 400\text{V}$, $V_{GE} = +15\text{V}/0\text{V}$, $R_G = +2.7/-1.8\Omega$, $T_{vj} = 25^{\circ}\text{C}$



Reverse recovery characteristics (typ.)

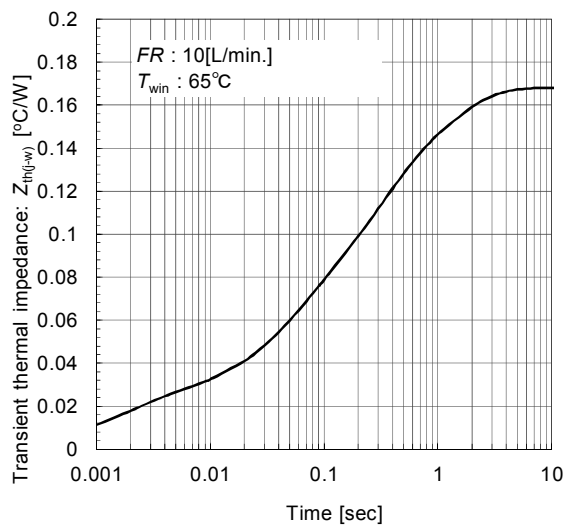
$V_{CC} = 400\text{V}$, $V_{GE} = +15\text{V}/0\text{V}$, $R_G = +2.7/-1.8\Omega$, $T_{vj} = 175^{\circ}\text{C}$



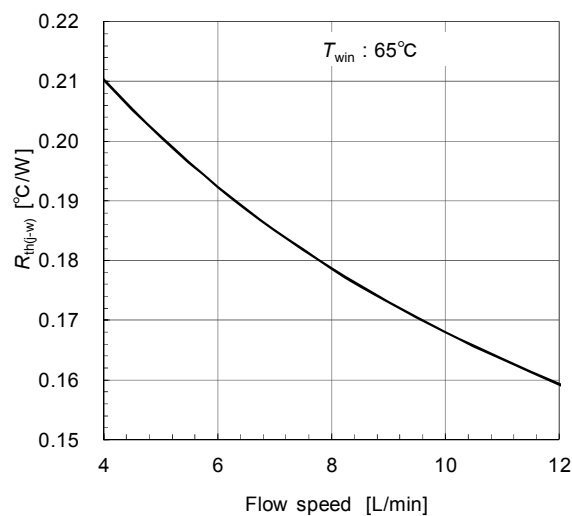
6MBI800XV-075V-01

IGBT Modules

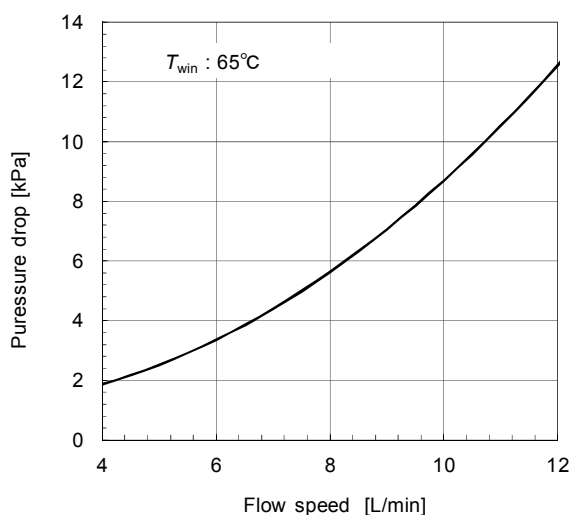
Transient thermal impedance (max.)



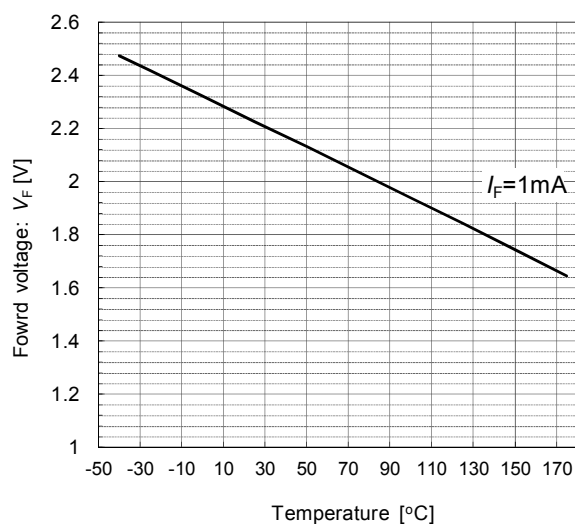
Thermal resistance (max.)



Puressure drop (typ.)



[Temperature sense Diode]
Temperature characteristic (typ.)



Warnings

- This product shall be used within its maximum rating (voltage, current, and temperature). This product have risk of destruction in case of using beyond the maximum ratings.
- Connect adequate fuse or protector of circuit between battery line and this product to prevent the equipment from causing secondary destruction.
- Use this product after realizing enough working on environment and considering of product's reliability life. This product have risk of destruction before target life of the system in case of using beyond the product's reliability life.
- If the product had been used in the environment with acid, organic matter, and corrosive gas (hydrogen sulfide, sulfurous acid gas), the product's performance and appearance can not be ensured easily.
- Never add mechanical stress to deform the main or control terminal. The deformed terminal may cause poor contact problem.
- Confirm die temperature rise (ΔT_{vj}) within power cycle life time of this product in vehicle operating condition (i.e. mission profile). Please contact to Fuji Electric about power cycle curve.
- According to the outline drawing, select proper length of screw for terminal. Longer screws may break the case.
- Mount this product horizontally so that the main terminal and the control terminal are on the top. This product is not guaranteed to install vertically or upside down.
- It shall be confirmed that IGBT's operating locus of the turn-off voltage and current are within the RBSOA specification. This product have risk of destruction in case of locus beyond RBSOA.
- This product have risk of destruction by avalanche in case of V_{CE} beyond maximum rating V_{CES} is applied between C-E terminals. Use this product within its maximum voltage.
- In case of higher turn-on dv/dt of IGBT, erroneous turn-on of opposite arm IGBT may occur. Use this product in the most suitable drive conditions, such as $+V_{GE}$, R_G , C_{GE} to prevent the malfunction.
- To arm short circuit, it may cause the oscillation and destruction. Please implement the short circuit protection circuit to gate drive board. We recommend sense-emitter detection method for short circuit protection. Confirm application manual for the sense-emitter protection method. And we do not recommend de-saturation protection method that may cause unstable operation such as oscillation.
- Monitor die temperature properly using temperature-sensing diode. Consider the variation of temperature-sensing diode, and prevent die destruction with overheating.
- This product have risk of destruction in case excessive static electricity is applied to the control terminals. Take some countermeasures against static electricity when handle this product.
- When assembling this product, earth with the equipment and human body to work it. Also, take ESD countermeasure to place a conductive mat on the workbench or floor, etc.

Warnings

- This product has risk of destruction when ESD in human body, machinery equipment, packing material is applied to the control terminals (gate, sense-emitter and temperature sensing diode). Until the gate driver board is connected to the control terminal, short circuit the gate, sense-emitter and temperature-sensing diode to the emitter.
- Do not handle this product with gate, sense-emitter, temperature-sensing diode open.
- Use inlet and outlet of cooler as described in the specification. This product is not guaranteed to use inlet and outlet reverse.
- Prevent freezing of the cooling water, cooler will be damaged if the cooling water freezes.
- Select the refrigerant to prevent corroding the aluminum cooler of this product. Do not use deteriorated LLC or tap water only.
- Never add the excessive mechanical stress to the flanges and studs when the product is applied to equipments. These parts have risk of deformation.
- Set O-ring between the IGBT module and customer system to prevent water leakage. If the O-ring sealing surface is damaged, water may leak from there. Be careful not to damage the O-ring mounting area on both the IGBT module and customer system.
- Remove contaminants from the surface of the cooler flange when mounting this product.
- Select suitable O-ring considering various dimensions, durability and so on.
- Contaminants in the cooling water cause clogging of the fins and deteriorates cooling performance. Remove contaminants from the cooling water.
- Cooling capability will be decreased, if air bubbles are remained in fin area during cooling fluid is used. Therefore, be careful of the pouring method of cooling fluid in order that air bubbles are not generated, inflow and stayed in water jacket.
- If cavitation in water jacket is happened, erosion will be occurred. Use flow rate within the range of specification.
- Excessive pressure deforms the cooler of this product. Use pressure within the range of specification.
- Confirm this product does not resonate by vibration under vibration condition the system.
- IGBT modules have random failure mode by primary or secondary cosmic ray in general. The failure rate by this failure mode depends on the usage location (latitude, longitude, altitude), environment and condition (voltage). In case the product is used under high altitude and/or voltage condition, please contact to Fuji Electric Co., Ltd.
- Items not described in this specification are not guaranteed.
- If the product is used by departing from the section 15, Fuji Electric will be made outside the scope of compensation for any damages.

Causation

- The module should be stored at a standard temperature of 5 to 35°C and humidity of 45 to 75% .
Be careful to solderability of the terminals if the module has passed over one year from manufacturing date, under the above storage condition.
- Store modules in a place with few temperature changes in order to avoid condensation on the module surface.
- Avoid exposure to corrosive gases and dust.
- Avoid excessive external force on the module.
- Store modules with unprocessed terminals.
- Do not drop or otherwise shock the modules when transporting.
- Please use this product within 12 months from the date of manufacture.
- Fuji Electric is constantly making every endeavor to improve the product quality and reliability. However, semiconductor products may rarely happen to fail or malfunction. To prevent accidents causing injury or death, damage to property like by fire, and other social damage resulted from a failure or malfunction of the Fuji Electric semiconductor products, take some measures to keep safety such as redundant design, spread-fire-preventive design, and malfunction-protective design.
- The application examples described in this specification only explain typical ones that used the Fuji Electric products. This specification never ensure to enforce the industrial property and other rights, nor license the enforcement rights.

Technical Information

IGBT Modules

- Please refer to URLs below for further information about products, application manuals and design support.
- 关于本规格书中没有记载的产品信息，应用手册，技术信息等，请参考以下链接。
- 本データシートに記載されていない製品情報，アプリケーションマニュアル，デザインサポートは以下の URL をご参照下さい。

FUJI ELECTRIC Power Semiconductor WEB site

日本	www.fujielectric.co.jp/products/semiconductor/
Global	www.fujielectric.com/products/semiconductor/
中国	www.fujielectric.com.cn/products/semiconductor/
Europe	www.fujielectric-europe.com/en/power_semiconductor/
North America	www.americas.fujielectric.com/products/semiconductors/

Information

日本

1 半導体総合カタログ	www.fujielectric.co.jp/products/semiconductor/catalog/
2 製品情報	www.fujielectric.co.jp/products/semiconductor/model/
3 アプリケーションマニュアル	www.fujielectric.co.jp/products/semiconductor/model/igbt/application/
4 デザインサポート	www.fujielectric.co.jp/products/semiconductor/model/igbt/technical/
5 マウンティングインストラクション	www.fujielectric.co.jp/products/semiconductor/model/igbt/mounting/
6 IGBT 損失シミュレーションソフト	www.fujielectric.co.jp/products/semiconductor/model/igbt/simulation/
7 富士電機技報	www.fujielectric.co.jp/products/semiconductor/journal/
8 製品のお問い合わせ	www.fujielectric.co.jp/products/semiconductor/contact/
9 改廃のお知らせ	www.fujielectric.co.jp/products/semiconductor/discontinued/

Global

1 Semiconductors General Catalog	www.fujielectric.com/products/semiconductor/catalog/
2 Product Information	www.fujielectric.com/products/semiconductor/model/
3 Application Manuals	www.fujielectric.com/products/semiconductor/model/igbt/application/
4 Design Support	www.fujielectric.com/products/semiconductor/model/igbt/technical/
5 Mounting Instructions	www.fujielectric.com/products/semiconductor/model/igbt/mounting/
6 IGBT Loss Simulation Software	www.fujielectric.com/products/semiconductor/model/igbt/simulation/
7 Fuji Electric Journal	www.fujielectric.com/products/semiconductor/journal/
8 Contact	www.fujielectric.com/contact/
9 Revised and discontinued product information	www.fujielectric.com/products/semiconductor/discontinued/

中国

1 半导体综合目录	www.fujielectric.com.cn/products/semiconductor/catalog/
2 产品信息	www.fujielectric.com.cn/products/semiconductor/model/
3 应用手册	www.fujielectric.com.cn/products/semiconductor/model/igbt/application/
4 技术信息	www.fujielectric.com.cn/products/semiconductor/model/igbt/technical/
5 安装说明书	www.fujielectric.com.cn/products/semiconductor/model/igbt/mounting/
6 IGBT 损耗模拟软件	www.fujielectric.com.cn/products/semiconductor/model/igbt/simulation/
7 富士电机技报	www.fujielectric.com.cn/products/semiconductor/journal/
8 产品咨询	www.fujielectric.com/contact/
9 产品更改和停产信息	www.fujielectric.com.cn/products/semiconductor/discontinued/