SPECIFICATION
(450A/1700V-IGBT Module)

Device Name : IGBT Module
(RoHS compliant product)

Type Name : 2MBI450VN-170-50

Spec. No. : MS5F7800

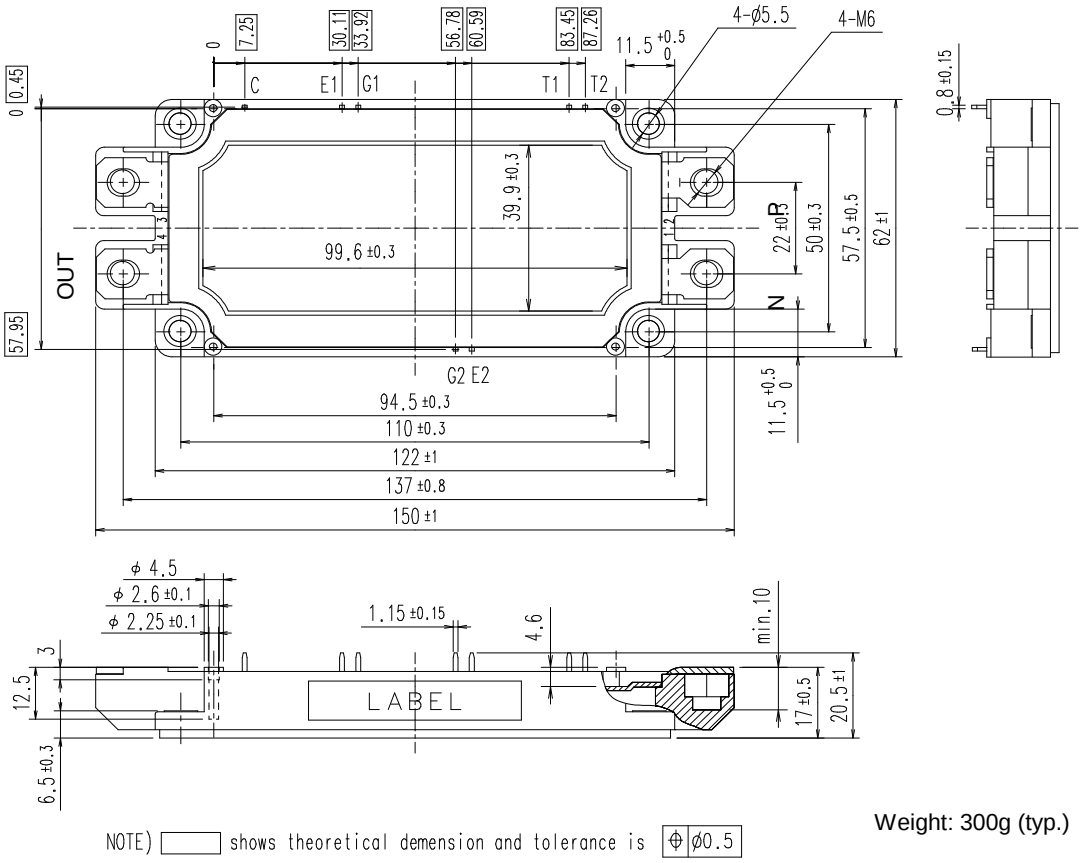
	DATE	NAME	APPROVAL		Fuji Electric Co.,Ltd.		
DRAWN	Apr.-19'-11	M.Atarashi	O.Ikawa		DWG.No.	MS5F7800	1 / 17
CHECKED	Apr.-19'-11	S.Miyashita					
CHECKED	Apr.-19'-11	M.Kosaka					

Revised Records

Date	Class-ification	Ind.	Content	Applied date	Drawn	Checked	Checked	Approved
Apr.-19-'11	enactment	-	-	Issued date	-	S.Miyashita	M.Kosaka	O.Ikawa

Type Name: 2MBI450VN-170-50 (RoHS compliant products)

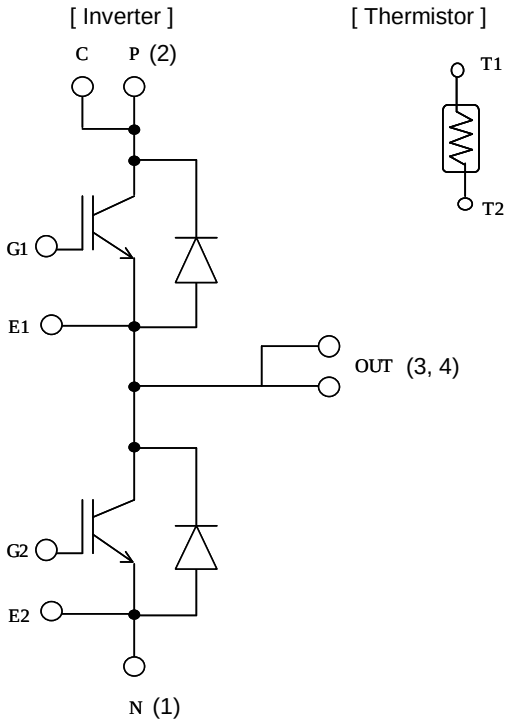
1. Outline Drawing (Unit : mm)



Weight: 300g (typ.)

NOTE) ☐ shows theoretical demension and tolerance is ⊕ φ0.5

2. Equivalent Circuit



3. Maximum Ratings (at Tc= 25°C unless otherwise specified)

Items		Symbols	Conditions		Maximum Ratings	Units
Inverter	Collector-Emitter voltage	Vces			1700	V
	Gate-Emitter voltage	Vges			±20	V
		Ic	Continuous	Tc=25°C	600	
				Tc=100°C	450	
		Ic pulse	1ms		900	
		-Ic			450	
		-Ic pulse	1ms		900	
	Collector power dissipation	Pc	1 device		2500	W
Junction temperature		Tj			175	°C
Operating junction temperature (under switching conditions)		Tjop			150	
Storage temperature		Tstg			-40 ~ 125	
Isolation voltage	between terminal and copper base (*1)	Viso	AC: 1min.		3400	VAC
	between thermistor and others (*2)					
Screw Torque	Mounting (*3)	-			3.5	N m
	Terminals (*4)	-			4.5	

(*1) All terminals should be connected together during the test.

(*2) Two thermistor terminals should be connected together, other terminals should be connected together and shorted to base plate during the test.

(*3) Recommendable Value : 2.5-3.5 Nm (M5)

(*4) Recommendable Value : 3.5-4.5 Nm (M6)

4. Electrical characteristics (at Tj= 25°C unless otherwise specified)

NOTICE:
The external gate resistance (Rg) shown below is one of our recommended value for the purpose of **minimum switching loss. However the optimum Rg depends on circuit configuration and/or environment.**
We recommend that the Rg 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.

Items		Symbols	Conditions		Characteristics			Units
					min.	typ.	max.	
Inverter	Zero gate voltage Collector current	Ices	Vge=0V, Vce=1700V		-	-	3.0	mA
	Gate-Emitter leakage current	Iges	Vce=0V, Vge=±20V		-	-	600	nA
	Gate-Emitter threshold voltage	Vge(th)	Vce=20V, Ic=450mA		6.0	6.5	7.0	V
	Collector-Emitter saturation voltage	Vce(sat) (terminal)	Vge=15V, Ic=450A	Tj=25°C	-	2.65	3.10	V
				Tj=125°C	-	3.10	-	
				Tj=150°C	-	3.15	-	
		Vce(sat) (chip)		Tj=25°C	-	2.00	2.45	
				Tj=125°C	-	2.45	-	
				Tj=150°C	-	2.50	-	
	Input capacitance	Cies	Vce=10V, Vge=0V, f=1MHz		-	40	-	nF
	Turn-on time	ton	Vcc=900V, Ic=450A, Vge=±15V, Rg=3.3Ω		-	900	-	nsec
		tr			-	400	-	
		tr(i)			-	100	-	
	Turn-off time	toff			-	1300	-	
		tf			-	100	-	
	Forward on voltage	Vf (terminal)	Vge=0V, If=450A	Tj=25°C	-	2.45	2.90	V
				Tj=125°C	-	2.75	-	
				Tj=150°C	-	2.70	-	
		Vf (chip)		Tj=25°C	-	1.80	2.25	
				Tj=125°C	-	2.10	-	
				Tj=150°C	-	2.05	-	
	Reverse recovery time	trr	If=450A		-	250	-	nsec
Thermistor	Resistance	R	T=25°C		-	5000	-	Ω
			T=100°C		465	495	520	
	B value	B	T=25/50°C		3305	3375	3450	K

5. Thermal resistance characteristics

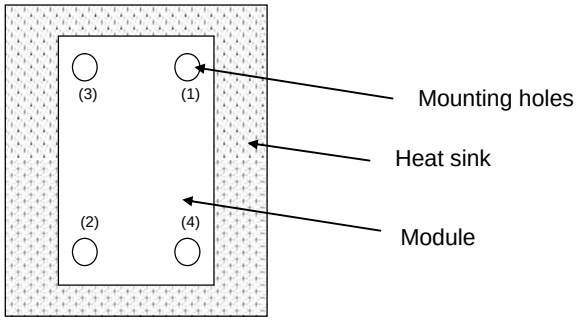
Items	Symbols	Conditions	Characteristics			Units
			min.	typ.	max.	
Thermal resistance(1device)	Rth(j-c)	Inverter IGBT	-	-	0.06	°C/W
		Inverter FWD	-	-	0.10	
Contact thermal resistance (1device) (*1)	Rth(c-f)	with Thermal Compound	-	0.0167	-	

(*1) This is the value which is defined mounting on the additional cooling fin with thermal compound.

6. Recommend way of module mounting to Heat sink Clamping

(1) Initial : 1/3 specified torque, sequence (1)→(2)→(3)→(4)

(2) Final ：Full specified torque (3.5 Nm),sequence(4)→(3)→(2)→(1)



7. Indication on module（モジュール表示）

Display on the module label

- Logo of production
- Type name : 2MBI450VN-170-50
- IC, VCES rating 450A 1700V
- Lot No. (5 digits)
- Place of manufacturing (code)
- Bar code

8. Applicable Category

This specification is applied to IGBT Module named 2MBI450VN-170-50 .

本納入仕様書はIGBT**モジュール** 2MBI450VN-170-50**に適用する。**

9. Storage and transportation notes（保管･運搬上の注意事項）

- 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.
  常温･常湿保存が望ましい。(5〜35°C, 45〜75%)
  本保存条件下で、正常から1年以上経過した場合は端子半田付け性に十分注意すること。

- Store modules in a place with few temperature changes in order to avoid condensation on the module surface.
  急激な温度変化のなきこと。(モジュール表面が結露しないこと)

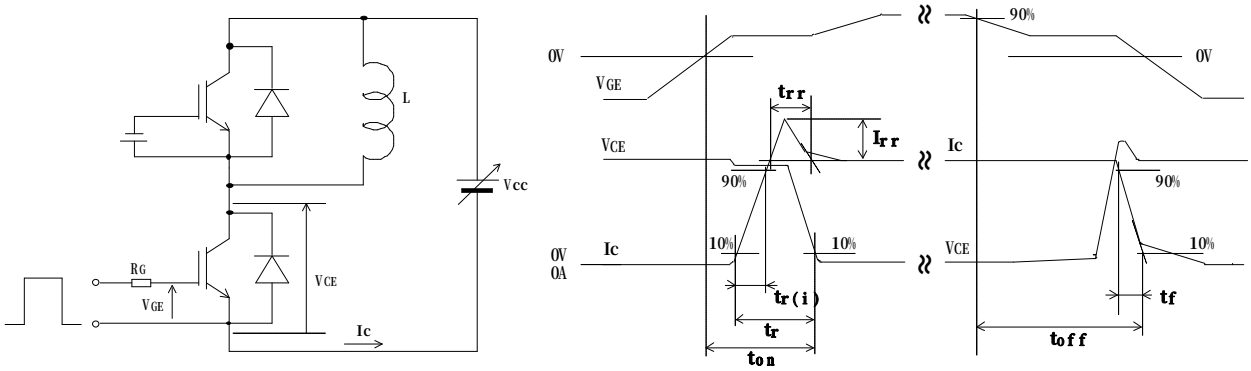
- Avoid exposure to corrosive gases and dust.
  腐食性ガスの発生場所、塵埃の多い場所は避けること。

- Avoid excessive external force on the module.
  製品に荷重がかからないように十分注意すること。

- Store modules with unprocessed terminals.
  モジュールの端子は未加工の状態で保管すること。

- Do not drop or otherwise shock the modules when transporting.
  製品の運搬時に衝撃を与えたり、落下させたりしないこと。

10. Definitions of switching time（スイッチング時間の定義）



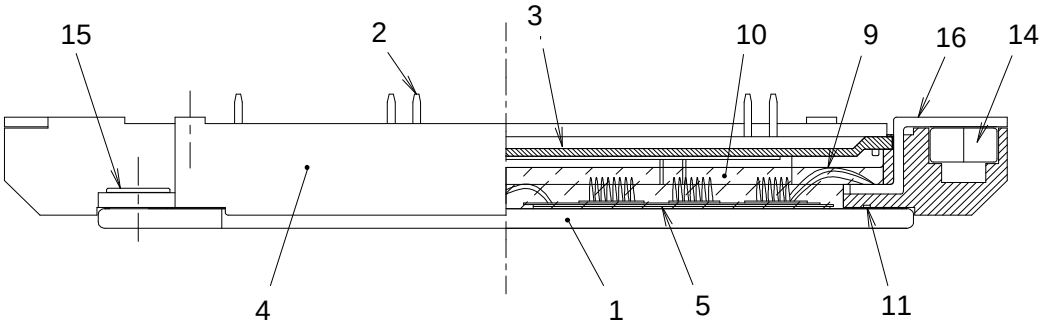
11. Packing and labeling（梱包仕様）

Display on the packing box
- Logo of production
- Type name
- Lot No
- Products quantity in a packing box

12. RoHS directive compliance（RoHS指令適用について）

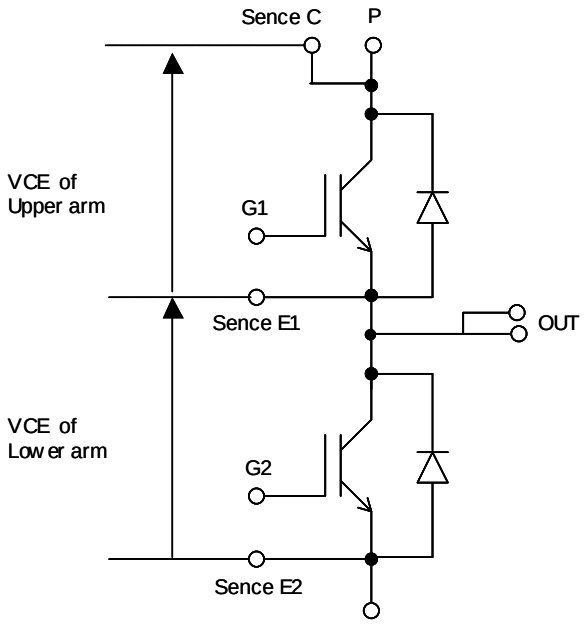
The document (MS5F6209) about RoHS that Fuji Electric issued is applied to this IGBT Module. The Japanese Edition(MS5F6212) is made into a reference grade.
本IGBT**モジュールは富士電機が発行している**RoHS**に関する資料**MS5F6209**を適用する。**
日本語版(MS5F6212)は参考資料とする。

13. List of materials（材料リスト）



No.	Parts	Material (main)	Ref.
1	Base Plate	Cu	Ni plating
2	Terminal	Cu	Ni plating (Internal)
			Lead free solder plating (External)
3	Cover	PPS resin	UL 94V-0
4	Case	PPS resin	UL 94V-0
5	Isolation substrate	Al_2O_3 + Cu	
6	IGBT chip	Silicon	(Not drawn in above)
7	FWD chip	Silicon	(Not drawn in above)
8	Thermistor	Lead glass	(Not drawn in above)
9	Wiring	Aluminum	
10	Silicone Gel	Silicone resin	
11	Adhesive	Silicone resin	
12	Solder (Under chip) (Under Isolation substrate)	Sn/Ag base	(Not drawn in above)
13	Label	PET	(Not drawn in above)
14	Ring	Fe	Trivalent Chromate treatment
15	Nut	Fe	Trivalent Chromate treatment
16	Terminal	Cu	Ni plating

14. Definition of switching characteristics（スイッチング特性についての定義）



Switching characteristics of VCE is defined between Sense C and Sense E1 for Upper arm and Sense E1 and Sense E2 for Lower arm .

Please use these terminals whenever measure spike voltage.

15. Reliability test result

Reliability Test Items

Test categories		Test items	Test methods and conditions	Reference norms EIAJ ED-4701 (Aug.-2001 edition)	Number of sample	Acceptance number
Mechanical Tests	1	Terminal Strength (Pull test)	Pull force : 20N (Controle terminal) 40N (Main terminal) Test time : 10±1 sec.	Test Method 401 method Ⅰ	5	(0 : 1)
	2	Mounting Strength	Screw torque : 2.5 ~ 3.5 N·m (M5) : 3.5 ~ 4.5 N·m (M6) Test time : 10±1 sec.	Test Method 402 method Ⅱ	5	(0 : 1)
	3	Vibration	Range of frequency : 10 ~ 500Hz Sweeping time : 15 min. Acceleration : 100m/s^2 Sweeping direction : Each X,Y,Z axis Test time : 6 hr. (2hr./direction)	Test Method 403 Reference 1 Condition code B	5	(0 : 1)
	4	Shock	Maximum accelerat : 5000m/s^2 Pulse width : 1.0msec. Direction : Each X,Y,Z axis Test time : 3 times/direction	Test Method 404 Condition code B	5	(0 : 1)
	5	Solderabitlity	Solder temp. : 245 ± 5 °C Immersion time : 5 ± 0.5sec. Test time : 1 time Each terminal should be Immersed in solder within 1 ~ 1.5mm from the body.	Test Method 303 Condition code A	5	(0 : 1)
	6	Resistance to Soldering Heat	Solder temp. : 260 ± 5 °C Immersion time : 10 ± 1sec. Test time : 1 time Each terminal should be Immersed in solder within 1 ~ 1.5mm from the body.	Test Method 302 Condition code A	5	(0 : 1)
Environment Tests	1	High Temperature Storage	Storage temp. : 125 ± 5 °C Test duration : 1000hr.	Test Method 201	5	(0 : 1)
	2	Low Temperature Storage	Storage temp. : -40 ± 5 °C Test duration : 1000hr.	Test Method 202	5	(0 : 1)
	3	Temperature Humidity Storage	Storage temp. : 85 ± 2 °C Relative humidity : 85 ± 5% Test duration : 1000hr.	Test Method 103 Test code C	5	(0 : 1)
	4	Unsaturated Pressurized Vapor	Test temp. : 120 ± 2 °C Test humidity : 85 ± 5% Test duration : 96hr.	Test Method 103 Test code E	5	(0 : 1)
	5	Temperature Cycle	Low temp. -40 ± 5 °C Test temp. : High temp. 125 ± 5 °C RT 5 ~ 35 °C Dwell time : High ~ RT ~ Low ~ RT 1hr. 0.5hr. 1hr. 0.5hr. Number of cycles : 100 cycles	Test Method 105	5	(0 : 1)
	6	Thermal Shock	Test temp. : High temp. 100 $^{+0}_{-5}$ °C Used liquid : Water with ice and boiling water Dipping time : 5 min. par each temp. Transfer time : 10 sec. Number of cycles : 10 cycles	Test Method 307 method Ⅰ Condition code B	5	(0 : 1)

Reliability Test Items

Test categories		Test items	Test methods and conditions	Reference norms EIAJ ED-4701 (Aug.-2001 edition)	Number of sample	Acceptance number
Endurance Tests	1	High temperature Reverse Bias (for Collector - Emitter)	Test temp. : Tj = 150℃(-0 ℃/+5 ℃) Bias Voltage : VC = 0.8×VCES Bias Method : Applied DC voltage to C-E VGE = 0V Test duration : 1000hr.	Test Method 101	5	(0 : 1)
	2	High temperature Bias (for gate)	Test temp. : Tj = 150℃(-0 ℃/+5 ℃) Bias Voltage : VC = VGE = +20V or -20V Bias Method : Applied DC voltage to G-E VCE = 0V Test duration : 1000hr.	Test Method 101	5	(0 : 1)
	3	Temperature Humidity Bias	Test temp. : 85±2 °C Relative humidi : 85±5% Bias Voltage : VC = 0.8×VCES Bias Method : Applied DC voltage to C-E VGE = 0V Test duration : 1000hr.	Test Method 102 Condition code C	5	(0 : 1)
	4	Intermitted Operating Life (Power cycle) (for IGBT)	ON time : 2 sec. OFF time : 18 sec. Test temp. : 100±5 deg Tj ≦ 150 ℃, Ta=25±5 ℃ No. of cycles : 15000 cycles	Test Method 106	5	(0 : 1)

Failure Criteria

Item	Characteristic		Symbol	Failure criteria		Unit	Note
				Lower limit	Upper limit		
Electrical characteristic	Leakage current		ICES	-	USL×2	mA	
			±IGES	-	USL×2	μA	
	Gate threshold voltage		VGE(th)	LSL×0.8	USL×1.2	mA	
	Saturation voltage		VCE(sat)	-	USL×1.2	V	
	Forward voltage		VF	-	USL×1.2	V	
	Thermal resistance	IGBT	Δ VGE or Δ VCE	-	USL×1.2	mV	
		FWD	Δ VF	-	USL×1.2	mV	
	Isolation voltage		Viso	Broken insulation		-	
Visual inspection	Visual inspection Peeling Plating and the others		-	The visual sample		-	

LSL : Lower specified limit.

USL : Upper specified limit.

Note :

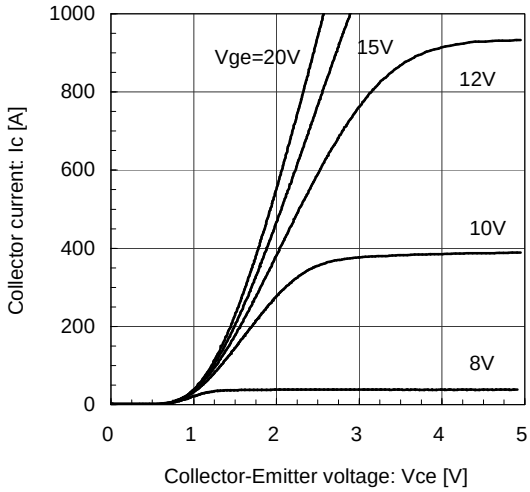
Each parameter measurement read-outs shall be made after stabilizing the components at room ambient for 2 hours minimum, 24 hours maximum after removal from the tests. And in case of the wetting tests, for example, moisture resistance tests, each component shall be made wipe or dry completely before the measurement.

Reliability Test Results

Test categories		Test items	Reference norms EIAJ ED-4701 (Aug.-2001 edition)	Number of test sample	Number of failure sample
Mechanical Tests	1	Terminal Strength (Pull test)	Test Method 401 Method Ⅰ	5	0
	2	Mounting Strength	Test Method 402 method Ⅱ	5	0
	3	Vibration	Test Method 403 Condition code B	5	0
	4	Shock	Test Method 404 Condition code B	5	0
	5	Solderabitlity	Test Method 303 Condition code A	5	0
	6	Resistance to Soldering Heat	Test Method 302 Condition code A	5	0
Environment Tests	1	High Temperature Storage	Test Method 201	5	0
	2	Low Temperature Storage	Test Method 202	5	0
	3	Temperature Humidity Storage	Test Method 103 Test code C	5	0
	4	Unsaturated Pressurized Vapor	Test Method 103 Test code E	5	0
	5	Temperature Cycle	Test Method 105	5	0
	6	Thermal Shock	Test Method 307 method Ⅰ Condition code A	5	0
Endurance Tests	1	High temperature Reverse Bias	Test Method 101	5	0
	2	High temperature Bias (for gate)	Test Method 101	5	0
	3	Temperature Humidity Bias	Test Method 102 Condition code C	5	0
	4	Intermitted Operating Life (Power cycling) (for IGBT)	Test Method 106	5	0

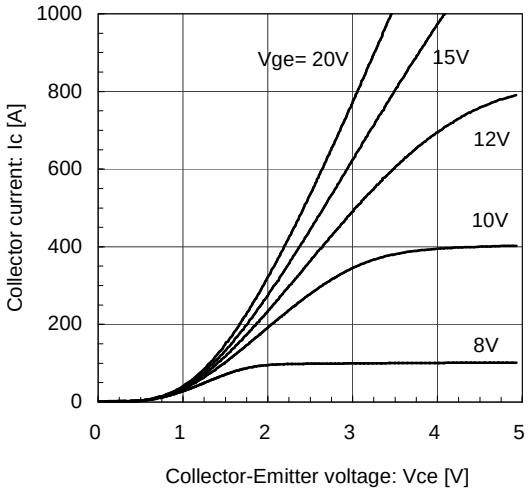
[INVERTER]

Collector current vs. Collector-Emitter voltage (typ.)
Tj= 25°C / chip



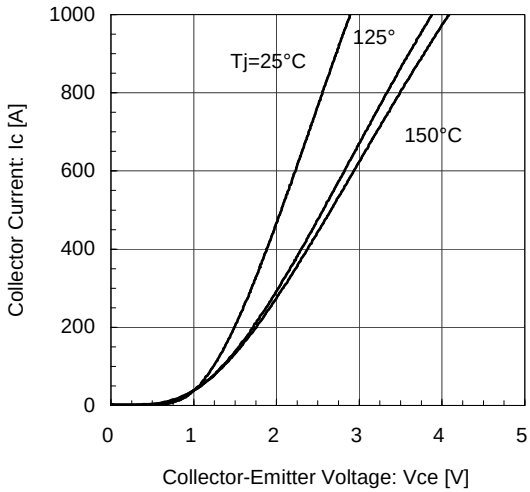
[INVERTER]

Collector current vs. Collector-Emitter voltage (typ.)
Tj= 150°C / chip



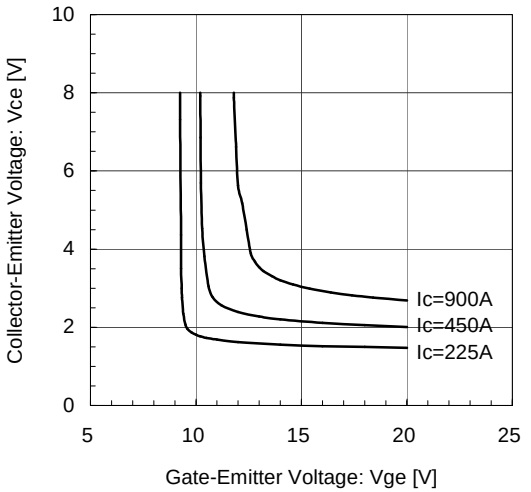
[INVERTER]

Collector current vs. Collector-Emitter voltage (typ.)
Vge= 15V / chip



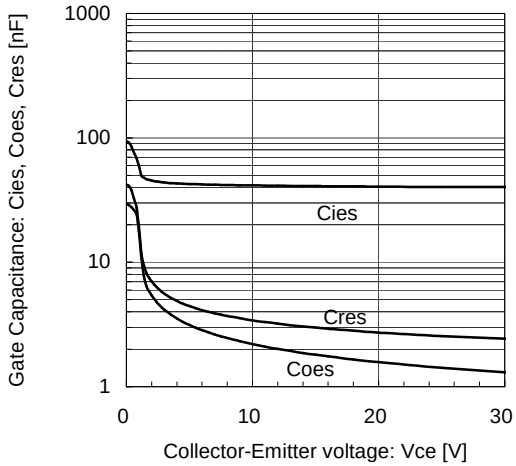
[INVERTER]

Collector-Emitter voltage vs. Gate-Emitter voltage (typ.)
Tj= 25°C / chip



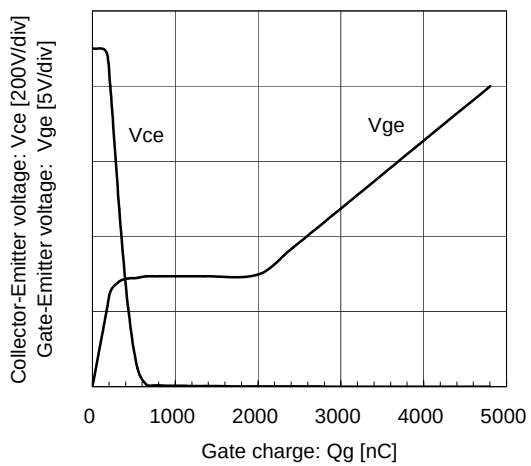
[INVERTER]

Gate Capacitance vs. Collector-Emitter Voltage (typ.)
Vge= 0V, f= 1MHz, Tj= 25°C



[INVERTER]

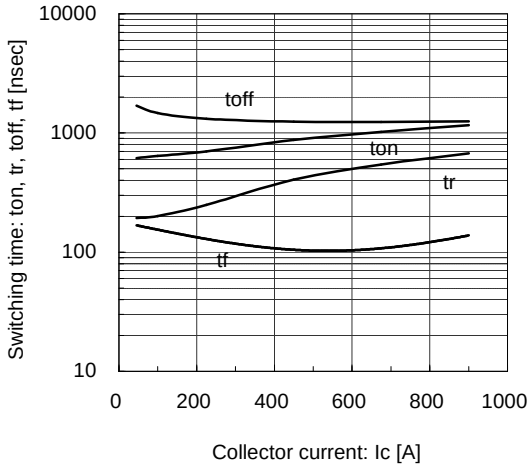
Dynamic Gate Charge (typ.)
Vcc=900V, Ic=450A, Tj= 25°C



[INVERTER]

Switching time vs. Collector current (typ.)

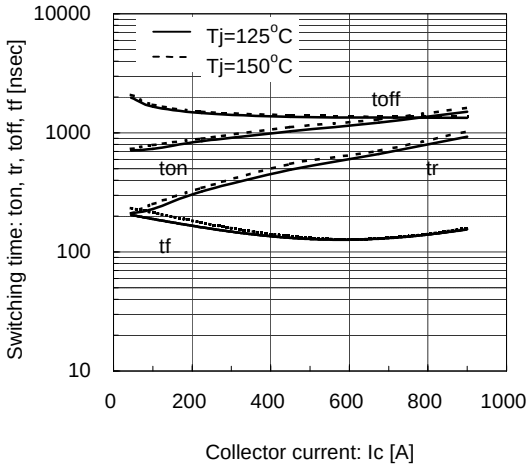
Vcc=900V, Vge=±15V, Rg=3.3Ω, Tj=25°C



[INVERTER]

Switching time vs. Collector current (typ.)

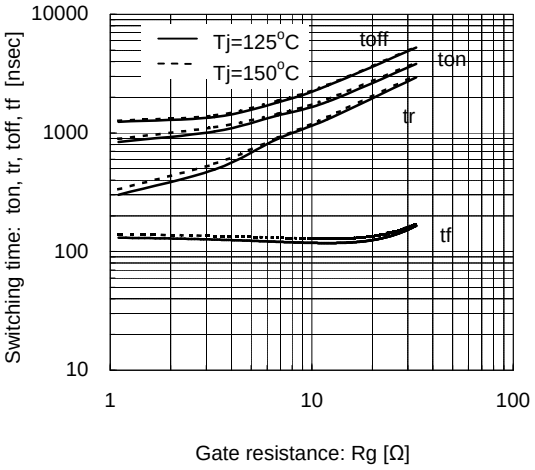
Vcc=900V, Vge=±15V, Rg=3.3Ω, Tj=125°C, 150°C



[INVERTER]

Switching time vs. Gate resistance (typ.)

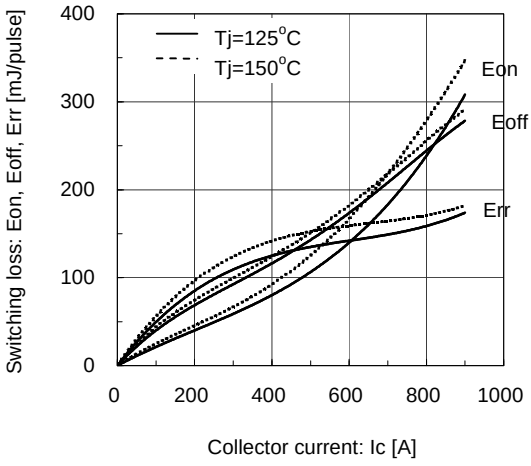
Vcc=900V, Ic=450A, Vge=±15V, Tj=125°C, 150°C



[INVERTER]

Switching loss vs. Collector current (typ.)

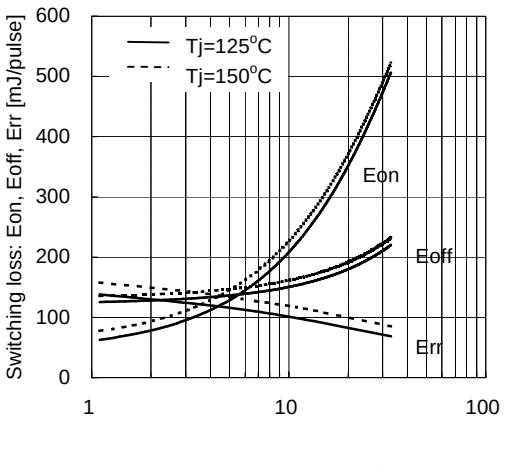
Vcc=, Vge=±15V, Rg=Ω, Tj=125°C, 150°C



[INVERTER]

Switching loss vs. Gate resistance (typ.)

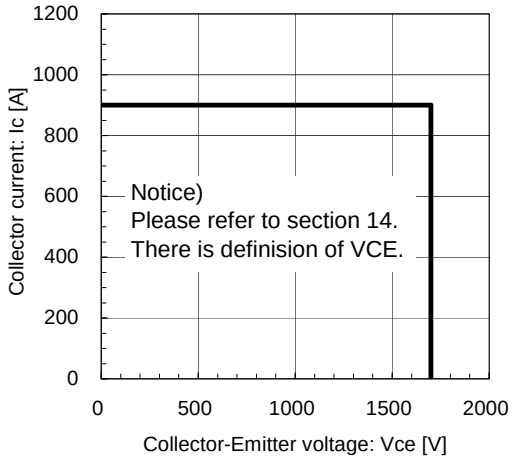
Vcc=900V, Ic=450A, Vge=±15V, Tj=125°C, 150°C



[INVERTER]

Reverse bias safe operating area (max.)

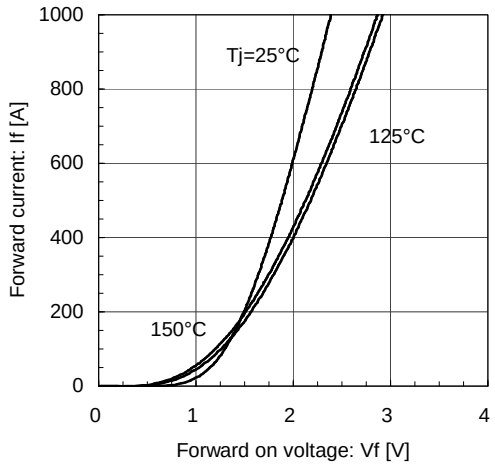
+Vge=15V, -Vge=15V, Rg=3.3Ω, Tj=150°C



[INVERTER]

Forward Current vs. Forward Voltage (typ.)

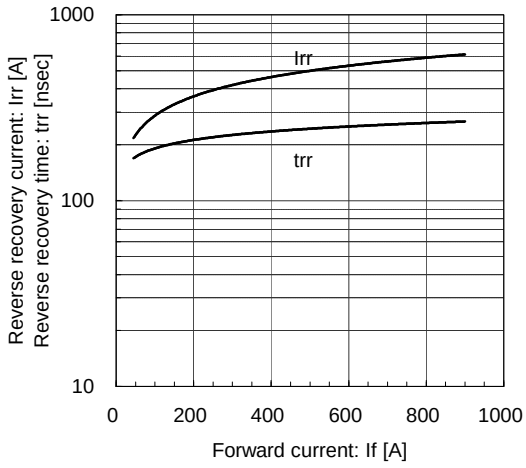
chip



[INVERTER]

Reverse Recovery Characteristics (typ.)

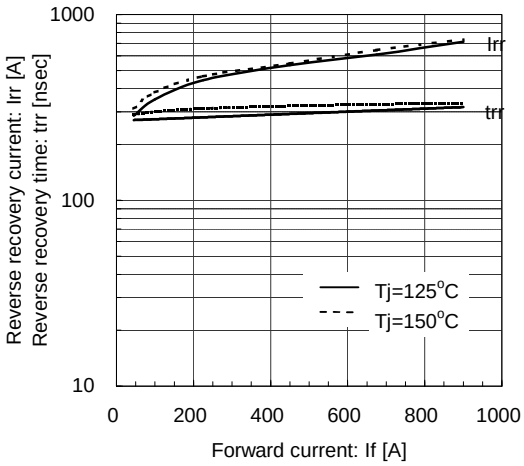
Vcc=900V, Vge=±15V, Rg=3.3Ω, Tj=25°C



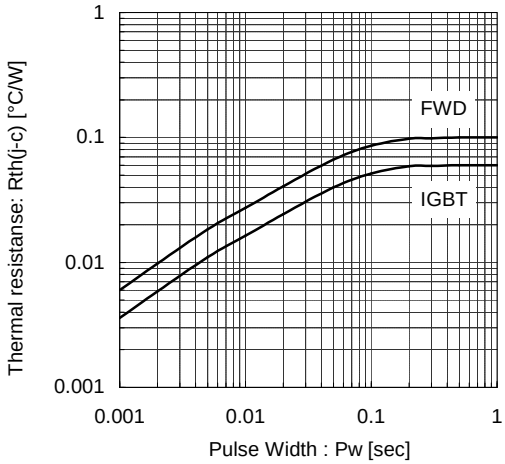
[INVERTER]

Reverse Recovery Characteristics (typ.)

Vcc=900V, Vge=±15V, Rg=3.3Ω, Tj=125°C, 150°C

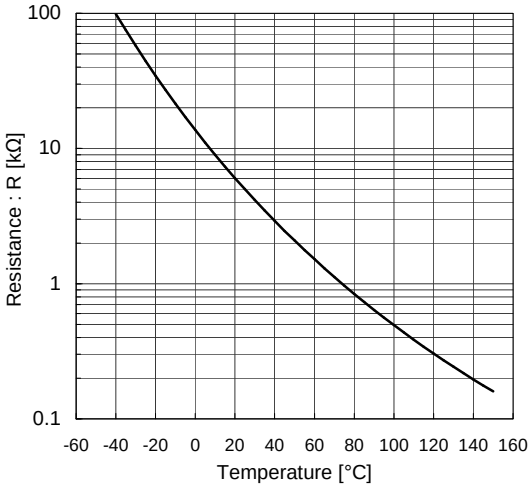


Transient Thermal Resistance (max.)



[THERMISTOR]

Temperature characteristic (typ.)



Warnings

- This product shall be used within its maximum rating (voltage, current, and temperature). This product may be broken in case of using beyond the maximum ratings. If Printed Circuit Board is not suitable, the main pin terminals may have higher temperature than Tstg. Also the pin terminals shall be used within Tstg.
  製品の最大定格（電圧，電流，温度等）の範囲内で御使用下さい。最大定格を超えて使用すると、素子が破壊する場合があります。また、使用するプリント板が不適切な場合、主端子ピンの温度が Tstg**以上になることがあります。主端子ピンも**Tstg**範囲内でご使用下さい。**

- Connect adequate fuse or protector of circuit between three-phase line and this product to prevent the equipment from causing secondary destruction, such as fire, its spreading, or explosion.
  万一の不慮の事故で素子が破壊した場合を考慮し、商用電源と本製品の間に適切な容量のヒューズ又はブレーカーを必ず付けて火災，爆発，延焼等の２次破壊を防いでください。

- Use this product after realizing enough working on environment and considering of product's reliability life. This product may be broken before target life of the system in case of using beyond the product's reliability life.
  製品の使用環境を十分に把握し、製品の信頼性寿命が満足できるか検討の上、本製品を適用して下さい。製品の信頼性寿命を超えて使用した場合、装置の目標寿命より前に素子が破壊する場合があります。

- 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.
  酸･有機物･腐食性ガス（硫化水素，亜硫酸ガス等）を含む環境下で使用された場合、製品機能･外観等の保証はできません。

- Use this product within the power cycle curve (Technical Rep.No. : MT5F12959). Power cycle capability is classified to delta-Tj mode which is stated as above and delta-Tc mode. Delta-Tc mode is due to rise and down of case temperature (Tc), and depends on cooling design of equipment which use this product. In application which has such frequent rise and down of Tc, well consideration of product life time is necessary.
  本製品は、パワーサイクル寿命カーブ以下で使用下さい(技術資料 No.: MT5F12959)。**パワーサイクル耐量にはこの**ΔTj **による場合の他に、**ΔTc**による場合があります。これはケース温度**(Tc)**の上昇下降による熱ストレスであり、本製品をご使用する際の放熱設計に依存します。ケース温度の上昇下降が頻繁に起こる場合は、製品寿命に十分留意してご使用下さい。**

- Never add mechanical stress to deform the main or control terminal. The deformed terminal may cause poor contact problem.
  主端子及び制御端子に応力を与えて変形させないで下さい。 端子の変形により、接触不良などを引き起こす場合があります。

- Use this product with keeping the cooling fin's flatness between screw holes within 50um at 100mm and the roughness within 10um. Also keep the tightening torque within the limits of this specification. Too large convex of cooling fin may cause isolation breakdown and this may lead to a critical accident. On the other hand, too large concave of cooling fin makes gap between this product and the fin bigger, then, thermal conductivity will be worse and over heat destruction may occur.
  冷却フィンはネジ取り付け位置間で平坦度を100mm**で**50um**以下、表面の粗さは**10um**以下にして下さい。過大な凸反りがあったりすると本製品が絶縁破壊を起こし、重大事故に発展する場合があります。また、過大な凹反りやゆがみ等があると、本製品と冷却フィンの間に空隙が生じて放熱が悪くなり、熱破壊に繋がることがあります。**

Warnings

- In case of mounting this product on cooling fin, use thermal compound to secure thermal conductivity. If the thermal compound amount was not enough or its applying method was not suitable, its spreading will not be enough, then, thermal conductivity will be worse and thermal run away destruction may occur.
  Confirm spreading state of the thermal compound when its applying to this product.
  (Spreading state of the thermal compound can be confirmed by removing this product after mounting.)
  素子を冷却フィンに取り付ける際には、熱伝導を確保するためのコンパウンド等をご使用ください。又、塗布量が不足したり、塗布方法が不適だったりすると、コンパウンドが十分に素子全体に広がらず、放熱悪化による熱破壊に繋がる事があります。
  コンパウンドを塗布する際には、製品全面にコンパウンドが広がっている事を確認してください。
  (実装した後に素子を取りはずすとコンパウンドの広がり具合を確認する事が出来ます。)

- It shall be confirmed that IGBT's operating locus of the turn-off voltage and current are within the RBSOA specification. This product may be broken if the locus is out of the RBSOA.
  ターンオフ電圧・電流の動作軌跡がRBSOA**仕様内にあることを確認して下さい。**RBSOA**の範囲を超えて使用すると素子が破壊する可能性があります。**

- If excessive static electricity is applied to the control terminals, the devices may be broken. Implement some countermeasures against static electricity.
  制御端子に過大な静電気が印加された場合、素子が破壊する場合があります。取り扱い時は静電気対策を実施して下さい。

- Never add the excessive mechanical stress to the main or control terminals when the product is applied to equipments. The module structure may be broken.
  素子を装置に実装する際に、主端子や制御端子に過大な応力を与えないで下さい。端子構造が破壊する可能性があります。

- In case of insufficient -VGE, erroneous turn-on of IGBT may occur. -VGE shall be set enough value to prevent this malfunction. (Recommended value : -VGE = -15V)
  逆バイアスゲート電圧-VGE**が不足しますと誤点弧を起こす可能性があります。誤点弧を起こさない為に**-VGE**は十分な値で設定して下さい。(推奨値** : -VGE = -15V)

- 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 +VGE, -VGE, RG, CGE to prevent the malfunction.
  ターンオン dv/dt **が高いと対向アームのIGBTが誤点弧を起こす可能性があります。誤点弧を起こさない為の最適なドライブ条件**(+VGE, -VGE, RG, CGE)**でご使用下さい。**

- This product may be broken by avalanche in case of VCE beyond maximum rating VCES is applied between C-E terminals. Use this product within its maximum voltage.
  VCES**を超えた電圧が印加された場合、アバランシェを起こして素子破壊する場合があります。**VCE**は必ず最大定格の範囲内でご使用下さい。**

- In case of soldering this product at excessive heat condition, the package of this product may be deteriorated. Please handle with care for soldering process.
  製品を過大な温度で半田付けした場合、パッケージの劣化を引起す可能性があります。半田付けプロセスに注意してご使用ください。

Cautions

- 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.
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- The product described in this specification is not designed nor made for being applied to the equipment or systems used under life-threatening situations. When you consider applying the product of this specification to particular used, such as vehicle-mounted units, shipboard equipment, aerospace equipment, medical devices, atomic control systems and submarine relaying equipment or systems, please apply after confirmation of this product to be satisfied about system construction and required reliability.
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