SPECIFICATION

Device Name : IGBT Module

Type Name : 2MBI400TB-060

Spec. No. : MS5F 5293

Fuji Electric Co.,Ltd.
Matsumoto Factory

	DATE	NAME	APPROVED
DRAWN	Oct.- 22 -'02	Y.Kobayashi	T.Fujihira
CHECKED	Oct.- 23 -'02	T.Miyasaka	
		K.Yamada	

Fuji Electric Co.,Ltd.

DWG.NO. MS5F 5293 1/14

a
b
c

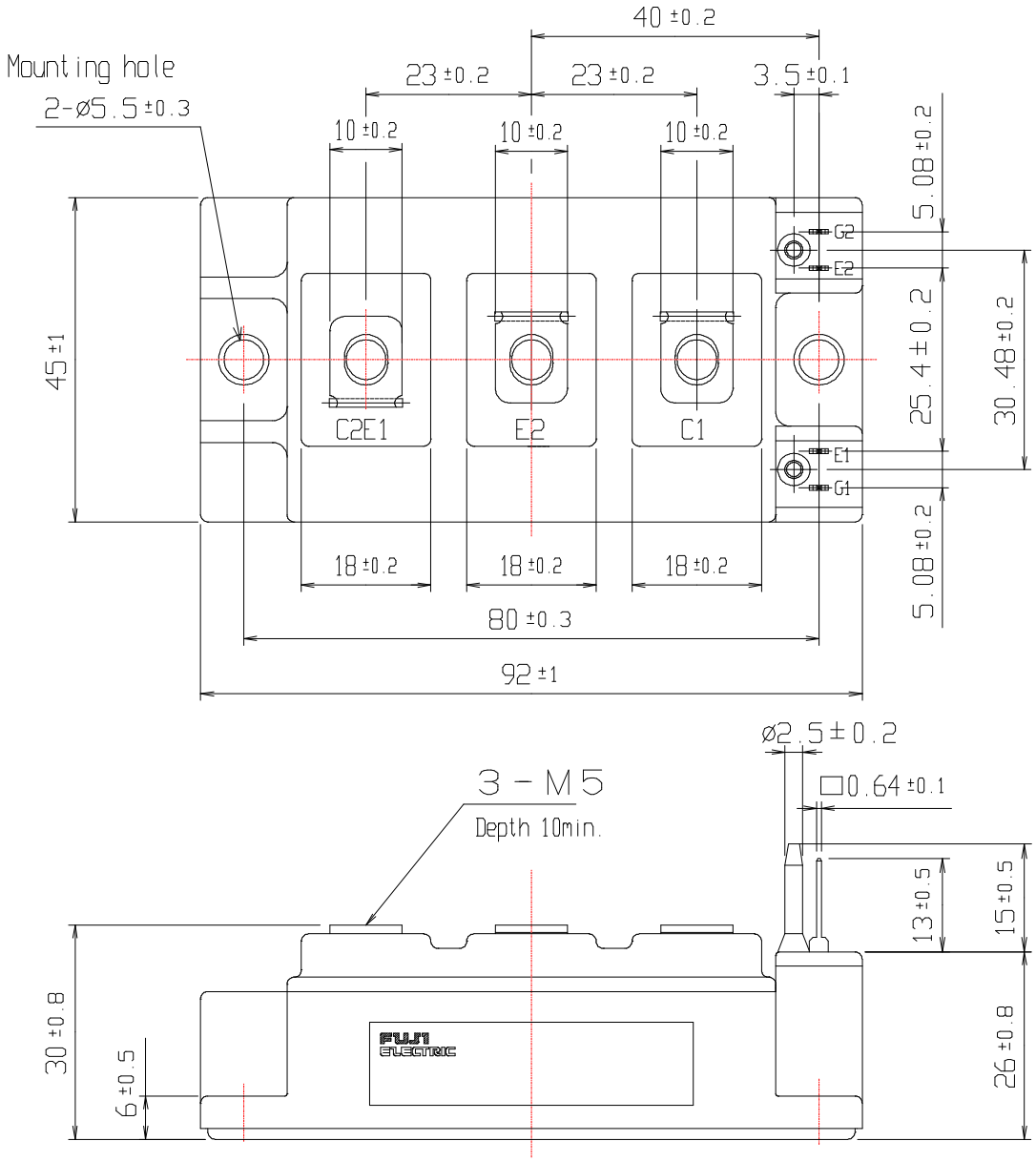
H04-004-07

Revised Records

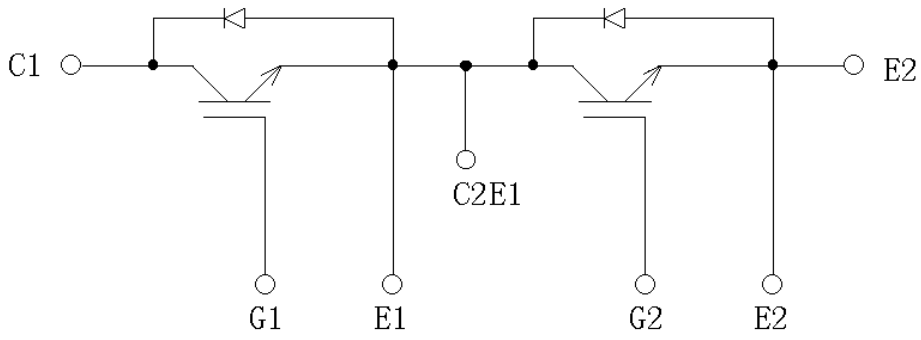
Date	Classi-fication	Ind.	Content	Applied date	Drawn	Checked	Approved
Oct.-23-'02	enactment	——	————————	Issued date	——	T.Miyasaka K.Yamada	T.Fujihira
Nov.-29-'02	Revision	a	Revised Reliability test condition (P7/14)		Y.Kobayashi	T.Miyasaka K.Yamada	T.Fujihira
Jan.-31-'03	Revision	b	Revised characteristics curve up to 800A (P11/14, 12/14)		Y.Kobayashi	T.Miyasaka K.Yamada	T.Fujihira
Apr.-07-'04	Revision	c	Revised ton,tr,toff,tf (P4/14) Revised Rth curve (P12/14)		Y.Kobayashi	T.Miyasaka K.Yamada	Y.Seki

2MBI400TB-060

1. Outline Drawing (Unit : mm)



2. Equivalent circuit



3. Absolute Maximum Ratings (at Tc= 25℃ unless otherwise specified)

Items	Symbols	Conditions	Maximum Ratings	Units
Collector-Emitter voltage	VCES	Ic=1mA	600	V
Gate-Emitter voltage	VGES		±20	V
Collector current	Ic	Duty=100 %	400	A
	Ic pulse	1ms	800	
	IF	Duty=56 %	400	
	IF pulse	1ms	800	
Collector Power Dissipation	Pc	1 device	1270	W
Junction temperature	Tj		150	℃
Storage temperature	Tstg		-40~ +125	℃
Isolation voltage(*1)	Viso	AC : 1min.	2500	V
Screw Torque	Mounting(*2)		3.5	N·m
	Terminals(*2)		3.5	

(*1) All terminals should be connected together when isolation test will be done.

(*2) Recommendable Value : Mounting 2.5~3.5 N·m (M5)

Terminal 2.5~3.5Nm (M5)

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

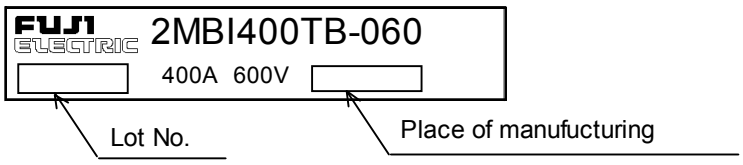
Items	Symbols	Conditions		Characteristics min.	Characteristics typ.	Characteristics Max.	Units
Zero gate voltage Collector current	ICES	VGE = 0 V, VCE = 600 V		-	-	2.0	mA
Gate-Emitter leakage current	IGES	VCE = 0 V, VGE = ±20 V		-	-	400	nA
Gate-Emitter threshold voltage	VGE(th)	VCE = 20 V, Ic = 400 mA		6.2	6.7	7.7	V
Collector-Emitter saturation voltage	VCE(sat)	VGE = 15 V	Chip	-	1.9	-	V
		Ic = 400 A	Terminal	-	2.2	2.5	
Input capacitance	Cies	VGE = 0 V		-	30000	-	pF
Output capacitance	Coes	VCE = 10 V		-	5200	-	
Reverse transfer capacitance	Cres	f = 1 MHz		-	4500	-	
Turn-on time	ton	Vcc = 300 V		-	c 0.4	1.2	μs
	tr	Ic = 400 A		-	c 0.2	0.6	
	$tr_{(i)}$	VGE = ±15 V		-	0.1	-	
Turn-off time	toff	RG = 6.8 Ω		-	c 0.55	1.2	
	tf			-	c 0.05	0.45	
Forward on voltage	VF	IF = 400 A	Chip	-	1.75	-	V
			Terminal	-	1.9	2.5	
Reverse recovery time	trr	IF = 400 A		-	-	0.3	μs
Allowabe avalanche energy during short circuit cutting off (Non-repetitive)	PAV	Ic > 800A, Tj = 125℃		200	-	-	mJ

5. Thermal resistance characteristics

Items	Symbols	Conditions	Characteristics min.	Characteristics typ.	Characteristics Max.	Units
Thermal resistance (1 device)	Rth(j-c)	IGBT	-	-	0.098	℃/W
		FWD	-	-	0.19	
Contact Thermal resistance	Rth(c-f)	With thermal compound *	-	0.025	-	

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

6. Indication on module



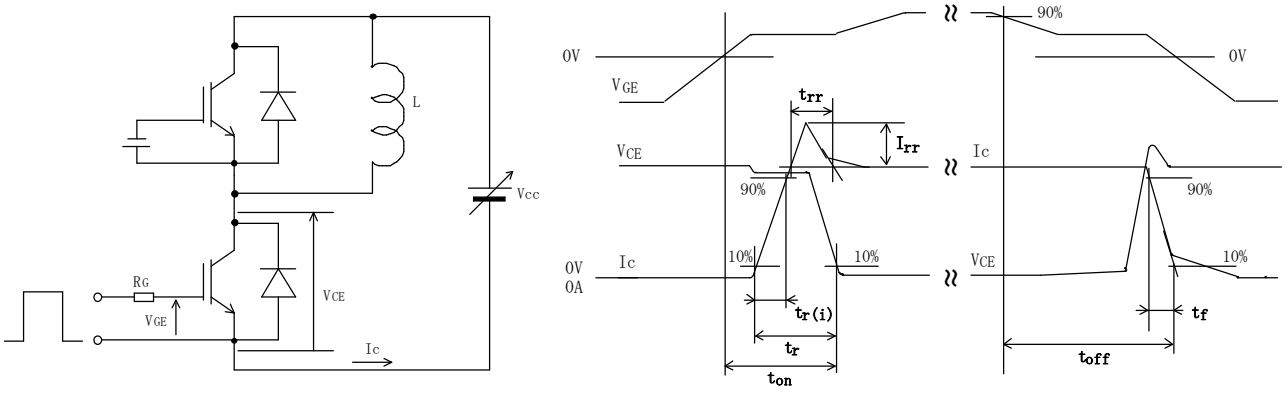
7. Applicable category

This specification is applied to IGBT Module named 2MBI400TB-060

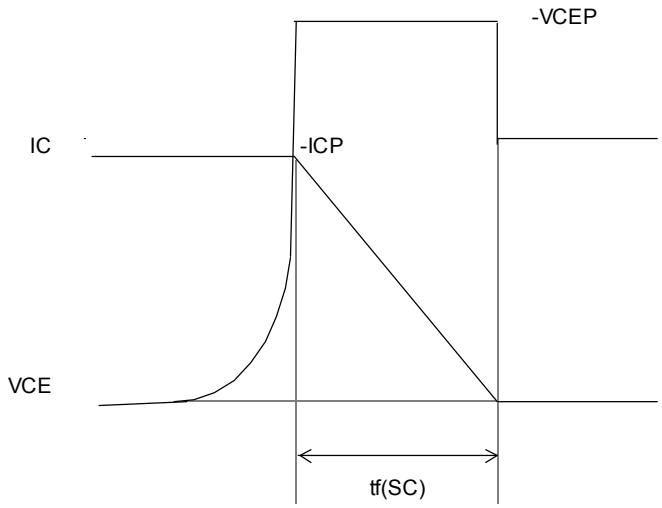
8. Storage and transportation notes

- The module should be stored at a standard temperature of 5 to 35C and humidity of 45 to 75% .
- 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 tranporting.

9. Definitions of switching time



10. Definition of the allowable avalance energy during short circuit cutfing of.

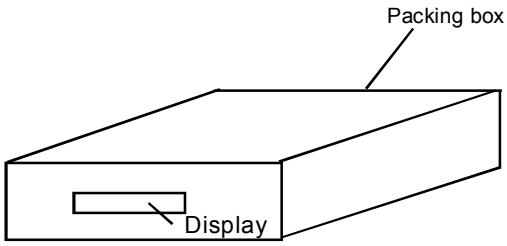


$$PAV = \frac{1}{2} \times VCEP \times ICP \times tf(SC)$$

11. UL recognition

This products is recognized by Underwriters Laboratories Inc., the file No. is E82988.

12. Packing and Labeling



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

* Each modules are packed with electrical protection.

13. Reliability test results

Reliability Test Items

Test categories		Test items	Test methods and conditions	Reference norms EIAJ ED-4701	Number of sample	Acceptance number
Mechanical Tests	1	Terminal Strength (Pull test)	Pull force : [a] 40N Test time : 10±1 sec.	A - 111 Method 1	5	(1 : 0)
	2	Mounting Strength	Screw torque : 2.5 ~ 3.5 N·m (M5) Test time : 10±1 sec.	A - 112 Method 2	5	(1 : 0)
	3	Vibration	Range of frequency : 10 ~ 500Hz Sweeping time : 15 min. Acceleration : [a] 10G Sweeping direction : Each X,Y,Z axis Test time : 6 hr. (2hr./direction)	A - 121	5	(1 : 0)
	4	Shock	Maximum acceleration : 1000G Pulse width : 0.5msec. Direction : Each X,Y,Z axis Test time : 3 times/direction	A - 122	5	(1 : 0)
Environment Tests	1	High Temperature Storage	Storage temp. : 125±5 ℃ Test duration : 1000hr.	B - 111	5	(1 : 0)
	2	Low Temperature Storage	Storage temp. : -40±5 ℃ Test duration : 1000hr.	B - 112	5	(1 : 0)
	3	Temperature Humidity Storage	Storage temp. : 85±3 ℃ Relative humidity : 85±5% Test duration : 1000hr.	B - 121	5	(1 : 0)
	4	Unsaturated Pressure Cooker	Test temp. : 121 ℃ Atmospheric pressure : 2.03×10^5 Pa (Reference value) Test duration : 20hr.	B - 123	5	(1 : 0)
	5	Temperature Cycle	Test temp. : Low temp. -40^{+3}_{-5} ℃; High temp. 125^{+5}_{-5} ℃; RT 5 ~ 35 ℃ Dwell time : High ~ RT ~ Low ~ RT 1hr. 0.5hr. 1hr. 0.5hr. Number of cycles : 100 cycles	B - 131	5	(1 : 0)
	6	Thermal Shock	Test temp. : High temp. 100^{+0}_{-5} ℃; Low temp. 0^{+5}_{-0} ℃ Used liquid : Water with ice and [a] boiling water Dipping time : 5 min. par each temp. Transfer time : 10 sec. Number of cycles : 10 cycles	B - 141	5	(1 : 0)

Reliability Test Items

Test categories		Test items	Test methods and conditions	Reference norms EIAJ ED-4701	Number of sample	Acceptance number
Endurance Tests	1	High temperature Reverse Bias	Test temp. : Ta = 125 $^{+0}_{-5}$ ℃ (Tj ≦ 150 ℃) Bias Voltage : VC = 0.8×VCES Bias Method : Applied DC voltage to C-E VGE = 0V Test duration : 1000hr.	D - 313	5	(1 : 0)
	2	High temperature Bias	Test temp. : Ta = 125 $^{+0}_{-5}$ ℃ (Tj ≦ 150 ℃) Bias Voltage : VC = VGE = +20V or -20V Bias Method : Applied DC voltage to G-E VCE = 0V Test duration : 1000hr.	D - 323	5	(1 : 0)
	3	Temperature Humidity Bias	Test temp. : 85 +-3°C Relative humidity : 85 +-5% Bias Voltage : VC = 0.8×VCES Bias Method : Applied DC voltage to C-E VGE = 0V Test duration : 1000hr.	B - 121	5	(1 : 0)
	4	Intermitted Operating Life (Power cycle) (for IGBT)	ON time : 2 sec. OFF time : 18 sec. Test temp. : Δ Tj=100±5 deg Tj ≦ 150 ℃, Ta=25±5 ℃ Number of cycles : 15000 cycles	D - 322	5	(1 : 0)

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		-	

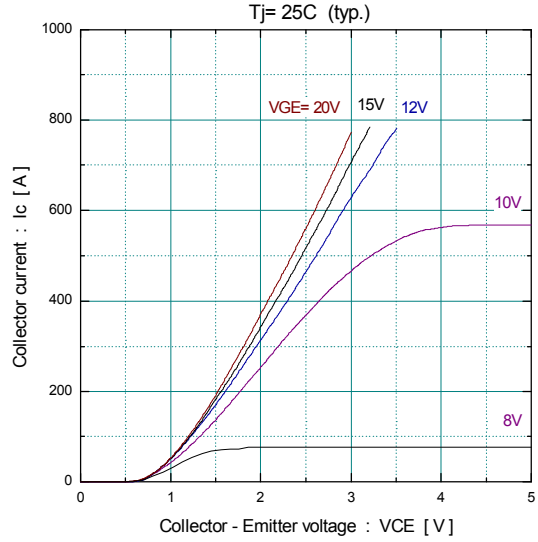
LSL : Lower specified limit.
USL : Upper specified limit.

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.

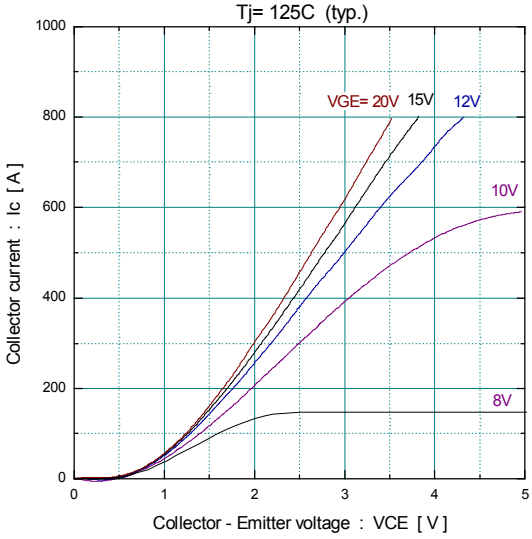
Reliability Test Results

Test categories		Test items	Reference norms EIAJ ED-4701	Number of test sample	Number of failure sample
Mechanical Tests	1	Terminal Strength (Pull test)	A - 111 Method 1	5	0
	2	Mounting Strength	A - 112 Method 2	5	0
	3	Vibration	A - 121	5	0
	4	Shock	A - 122	5	0
Environment Tests	1	High Temperature Storage	B - 111	5	0
	2	Low Temperature Storage	B - 112	5	0
	3	Temperature Humidity Storage	B - 121	5	0
	4	Unsaturated Pressure Cooker	B - 123	5	0
	5	Temperature Cycle	B - 131	5	0
	6	Thermal Shock	B - 141	5	0
Endurance Tests	1	High temperature Reverse Bias	D - 313	5	0
	2	High temperature Bias (for gate)	D - 323	5	0
	3	Temperature Humidity Bias	B - 121	5	0
	4	Intermitted Operating Life (Power cycling) (for IGBT)	D - 322	5	0

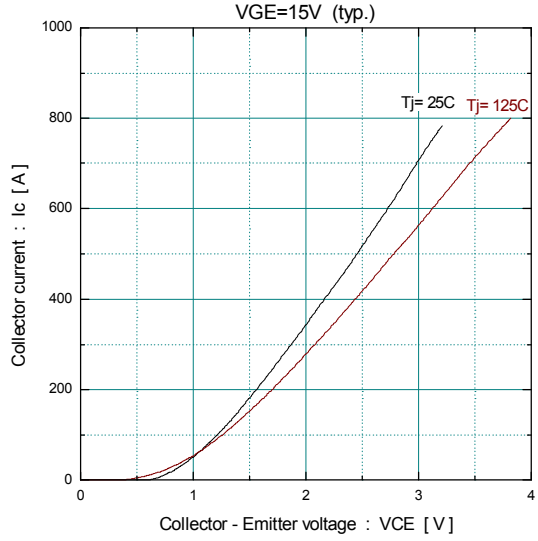
[Inverter]
Collector current vs. Collector-Emitter voltage
Tj= 25C (typ.)



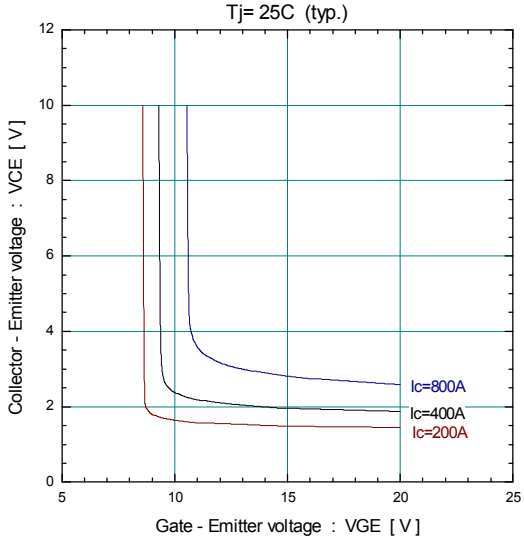
[Inverter]
Collector current vs. Collector-Emitter voltage
Tj= 125C (typ.)



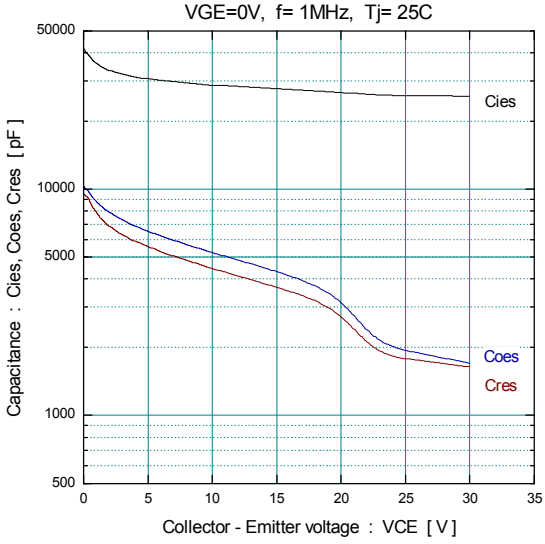
[Inverter]
Collector current vs. Collector-Emitter voltage
VGE=15V (typ.)



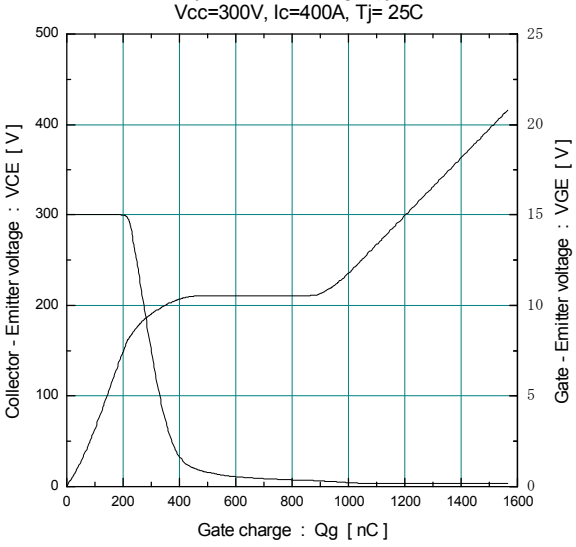
[Inverter]
Collector-Emitter voltage vs. Gate-Emitter voltage
Tj= 25C (typ.)



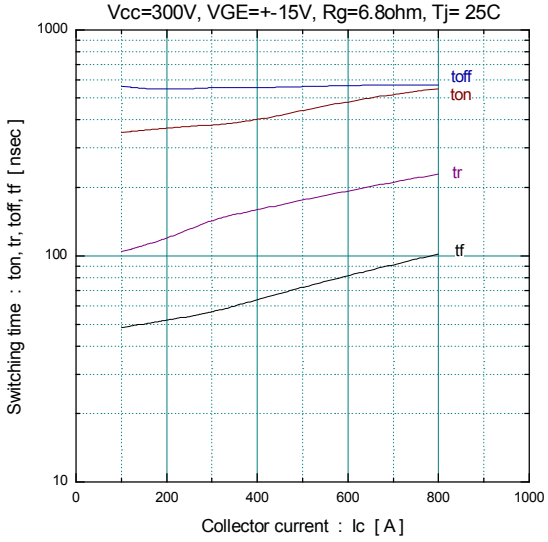
[Inverter]
Capacitance vs. Collector-Emitter voltage (typ.)
VGE=0V, f= 1MHz, Tj= 25C



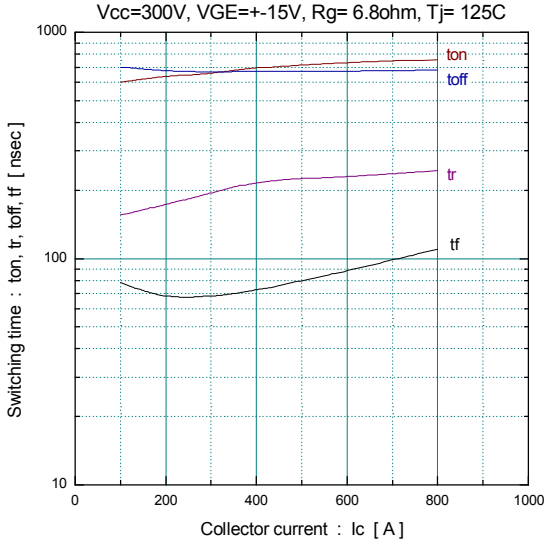
[Inverter]
Dynamic Gate charge (typ.)
Vcc=300V, Ic=400A, Tj= 25C



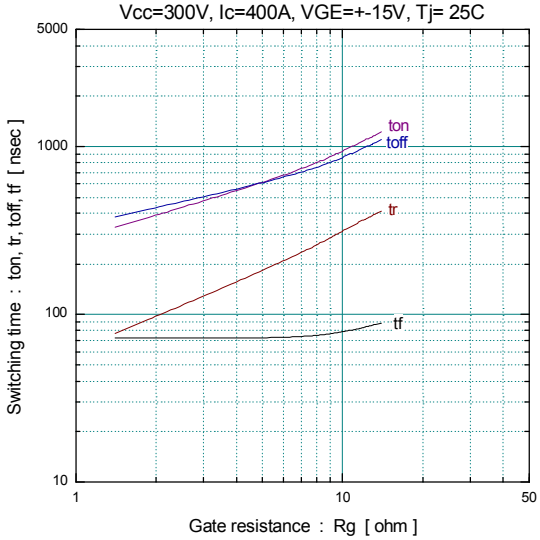
[Inverter]
b
Switching time vs. Collector current (typ.)
Vcc=300V, VGE=+-15V, Rg=6.8ohm, Tj= 25C



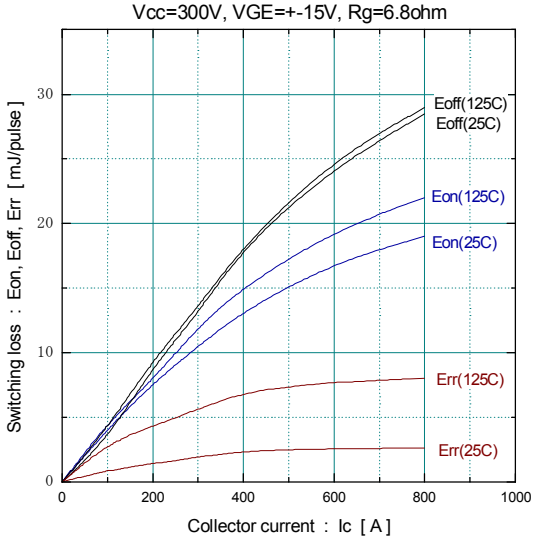
[Inverter]
b
Switching time vs. Collector current (typ.)
Vcc=300V, VGE=+-15V, Rg= 6.8ohm, Tj= 125C



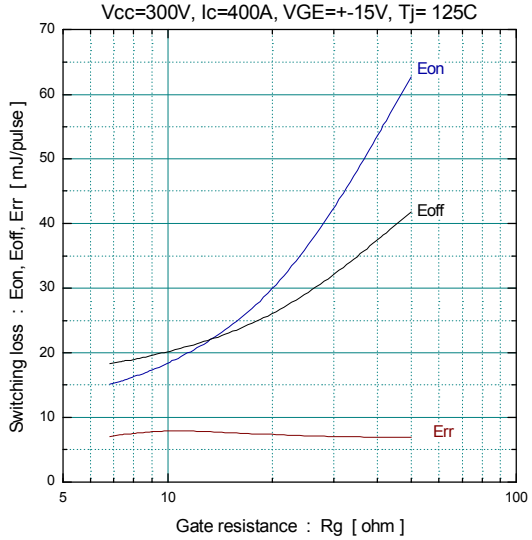
[Inverter]
Switching time vs. Gate resistance (typ.)
Vcc=300V, Ic=400A, VGE=+-15V, Tj= 25C



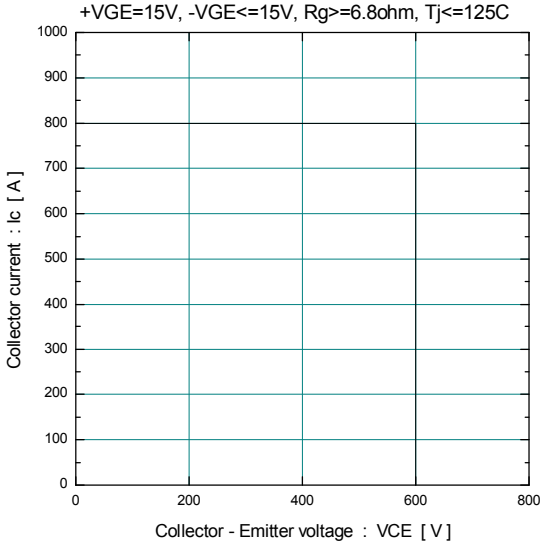
[Inverter]
b
Switching loss vs. Collector current (typ.)
Vcc=300V, VGE=+-15V, Rg=6.8ohm



[Inverter]
Switching loss vs. Gate resistance (typ.)
Vcc=300V, Ic=400A, VGE=+-15V, Tj= 125C



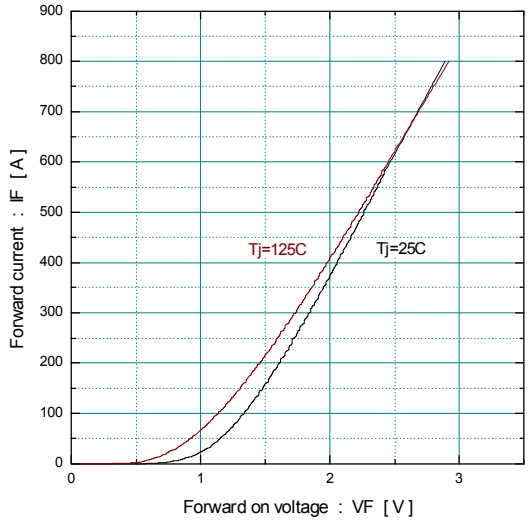
[Inverter]
Reverse bias safe operating area
+VGE=15V, -VGE<=15V, Rg>=6.8ohm, Tj<=125C



b

[Inverter]

Forward current vs. Forward on voltage (typ.)

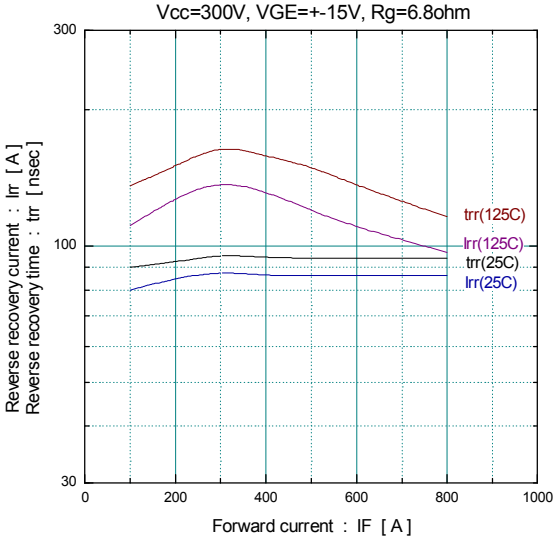


b

[Inverter]

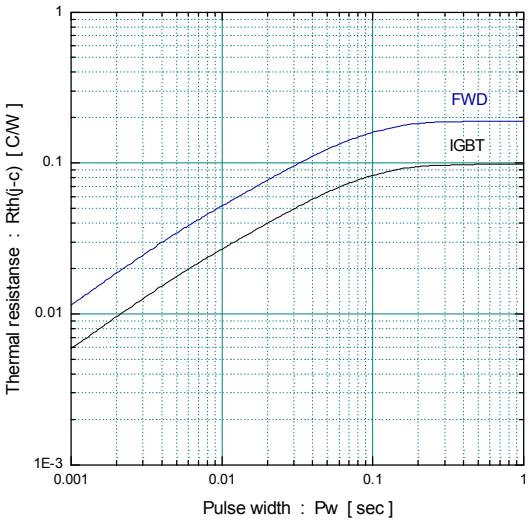
Reverse recovery characteristics (typ.)

Vcc=300V, VGE=+-15V, Rg=6.8ohm



c

Transient thermal resistance



Warnings

- This product shall be used within its abusolute maximun rating (voltage, current, and temperature).
  This product may be broken in case of using beyond the ratings.
  製品の絶対最大定格(電圧, 電流, 温度等)の範囲内で御使用下さい。
  絶対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。

- Conect adequate fuse or protector of circuit between three-phase line and this product to prevent the equipment from causing secondary destruction.
  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・外観などの保証は
  致しかねます。

- Use this product within the power cycle curve(Thechnical Rep.No:MT6M4057)
  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.:MT6M4057)

- Never add mechanical stress to deform the main or control terminal.
  The deformed terminal may cause poor contact probrem.
  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。

- According to the outline drawing, select proper length of screw for main terminal.
  Longer screws may break the case.
  本製品に使用する主端子用のネジの長さは、外形図に従い正しく選定下さい。
  ネジが長いとケースが破損する場合があります。

- Use this product with keeping the cooling fin's flatness between screw holes within 100um and the rouphness within 10um. Also keep the tightening torque within the limits of this specification.
  Improper handling may cause isolation breakdown and this may lead to a cirtical accident.
  冷却フィンはネジ取り付け位置間で平坦度を100um以下、表面の粗さは10um以下にして下さい。 誤った取り扱
  いをすると絶縁破壊を起こし、重大事故に発展する場合があります。

- 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 can 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。

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 injuly 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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