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# SPECIFICATION (tentative)

(400A/1200V-IGBT Module)

Device Name : IGBT Module  
(RoHS compliant product)

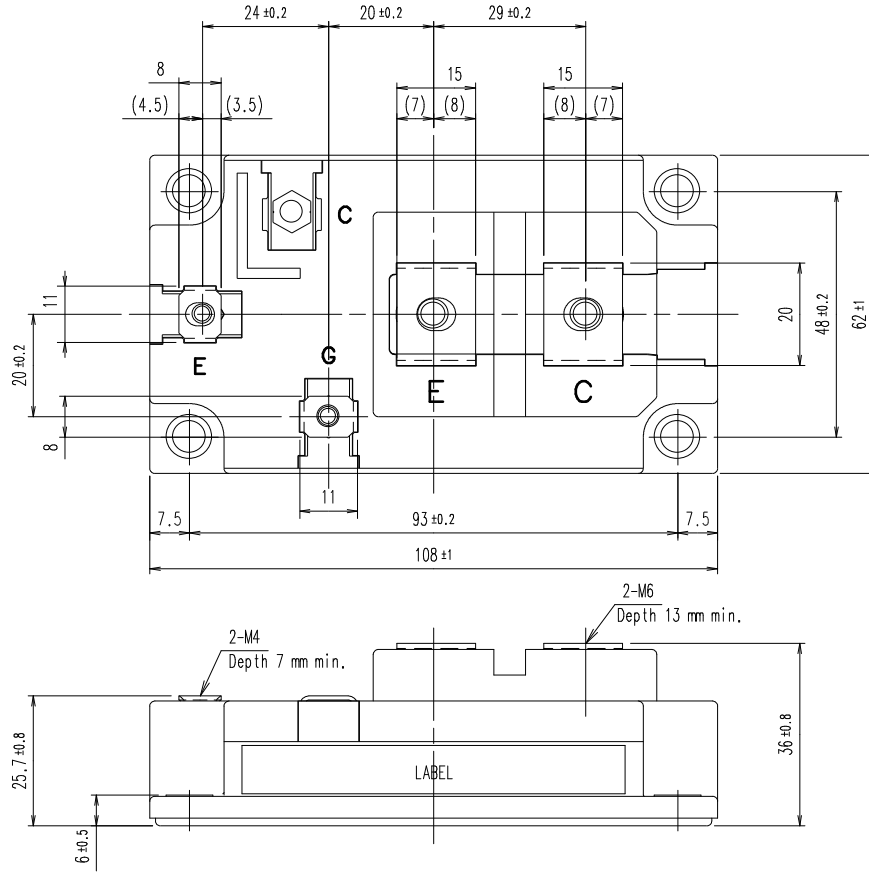
Type Name : 1MBI400V-120-50

Spec. No. : MT5F23630

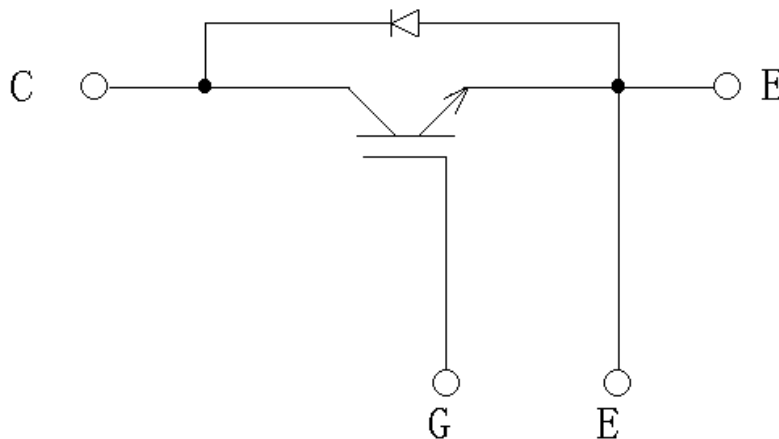
	DATE	NAME	APPROVAL	
DRAWN	Aug.-12-'10	S.Horie	S.Miyashita	Fuji Electric Systems Co., Ltd. <b>MT5F23630</b> 1 / 10
CHECKED	Aug.-12-'10	S.Ogawa		

**Type Name: 1MBI400V-120-50 (RoHS compliant products)**

**1. Outline Drawing ( Unit : mm )**



**2. Equivalent Circuit**



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

Items	Symbols	Conditions	Maximum Ratings	Units	
Collector-Emitter voltage	VCES		1200	V	
Gate-Emitter voltage	VGES		±20	V	
Collector current	Ic	Continuous	Tc=100°C	400	
			Tc=25°C	480	
	Ic pulse	1ms	800		
	-Ic		400		
	-Ic pulse	1ms	800		
Collector power dissipation	Pc	1 device	2400	W	
Junction temperature	Tj		175	°C	
Operating junction temperature (under switching conditions)	Tjop		150		
Case temperature	Tc		125		
Storage temperature	Tstg		-40 ~ 125		
Isolation voltage	between terminal and copper base (*1)	Viso	AC: 1min.		VAC
Screw Torque	Mounting (*2)	-		6.0	N m
	Terminals (*3)	M4		2.0	
		M6		5.0	

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

(\*2) Recommendable Value : 3.0-6.0 Nm (M5, M6)

(\*3) Recommendable Value : 1.1-2.0 Nm (M4)  
Recommendable Value : 2.5-5.0 Nm (M6)

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

##### NOTICE:

The external gate resistance (Rg) shown below is one of our recommend 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.		
Zero gate voltage Collector current	ICES	VGE=0V, VCE=1200V	-	-	4.0	mA	
Gate-Emitter leakage current	IGES	VCE=0V, VGE=±20V	-	-	800	nA	
Gate-Emitter threshold voltage	VGE(th)	VCE=20V, Ic=400mA	6.0	6.5	7.0	V	
Collector-Emitter saturation voltage	VCE(sat) (terminal)	VGE=15V, Ic=400A	Tj=25°C	-	TBD	TBD	V
			Tj=125°C	-	TBD	-	
			Tj=150°C	-	TBD	-	
	VCE(sat) (chip)	VGE=15V, Ic=400A	Tj=25°C	-	1.75	2.15	
			Tj=125°C	-	2.05	-	
Tj=150°C	-	2.10	-				
Input capacitance	Cies	VCE=10V, VGE=0V, f=1MHz	-	35	-	nF	
Turn-on time	ton	Vcc=600V, Ic=400A, VGE=±15V, Rg=1.8Ω, Tj=150°C	-	600	-	nsec	
	tr		-	200	-		
	tr(i)		-	80	-		
Turn-off time	toff		-	1000	-		
	tf		-	140	-		
Forward on voltage	VF (terminal)	VGE=0V, IF=400A	Tj=25°C	-	TBD	TBD	V
			Tj=125°C	-	TBD	-	
			Tj=150°C	-	TBD	-	
	VF (chip)	VGE=0V, IF=400A	Tj=25°C	-	1.70	2.15	
			Tj=125°C	-	1.85	-	
Tj=150°C	-	1.80	-				
Reverse recovery time	trr	IF=400A	-	200	-	nsec	

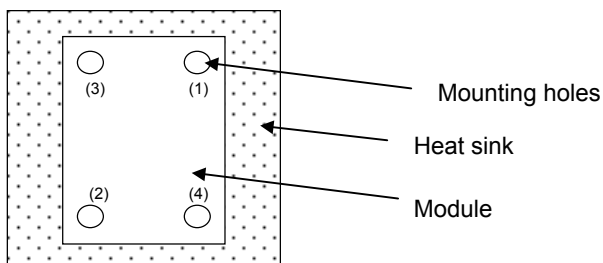
#### 5. Thermal resistance characteristics

Items	Symbols	Conditions	Characteristics			Units
			min.	typ.	max.	
Thermal resistance(1device)	Rth(j-c)	IGBT	-	-	0.062	°C/W
		FWD	-	-	0.110	
Contact thermal resistance (1device) (*1)	Rth(c-f)	with Thermal Compound	-	0.0125	-	

(\*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

- (1) Initial : 1/3 specified torque, sequence (1)→(2)→(3)→(4)  
 (2) Final : Full specified torque (3.0 - 6.0 Nm), sequence(4)→(3)→(2)→(1)



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## 7. Indication on module

Display on the module label

- Logo of production
- Type name : 1MBI400V-120-50
- IC, VCES rating : 400A 1200V
- Lot No. (5 digits)
- Place of manufacturing (code)
- Bar code

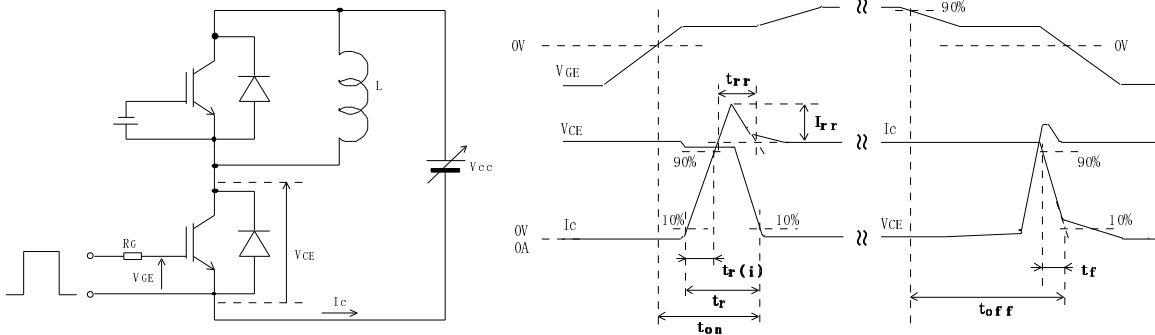
## 8. Applicable Category

This specification is applied to IGBT Module named 1MBI400V-120-50.

## 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% .  
常温・常湿保存が望ましい。(5~35°C, 45~75%)
- 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。
- Do not pull the springs when transporting and handling.  
製品の運搬時や取り扱い時にスプリングを引っ張らないこと。

## 10. Definitions of switching time



## 11. Packing and labeling

Display on the packing box

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


## 12. 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 : 3.0 ~ 6.0 N·m (M5, 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 <sup>2</sup> 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 accelerati : 5000m/s <sup>2</sup> Pulse width : 1.0msec. Direction : Each X,Y,Z axis Test time : 3 times/direction	Test Method 404 Condition code B	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 <sup>+0</sup> <sub>-5</sub> °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)

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### 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. : $T_j = 150^{\circ}\text{C}(-0^{\circ}\text{C}/+5^{\circ}\text{C})$ Bias Voltage : $V_C = 0.8 \times V_{CES}$ Bias Method : Applied DC voltage to C-E $V_{GE} = 0\text{V}$ Test duration : 1000hr.	Test Method 101	5	(0 : 1)
	2 High temperature Bias (for gate)	Test temp. : $T_j = 150^{\circ}\text{C}(-0^{\circ}\text{C}/+5^{\circ}\text{C})$ Bias Voltage : $V_C = V_{GE} = +20\text{V}$ or $-20\text{V}$ Bias Method : Applied DC voltage to G-E $V_{CE} = 0\text{V}$ Test duration : 1000hr.	Test Method 101	5	(0 : 1)
	3 Temperature Humidity Bias	Test temp. : $85 \pm 2^{\circ}\text{C}$ Relative humidity : $85 \pm 5\%$ Bias Voltage : $V_C = 0.8 \times V_{CES}$ Bias Method : Applied DC voltage to C-E $V_{GE} = 0\text{V}$ 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. : $100 \pm 5$ deg $T_j \leq 150^{\circ}\text{C}$ , $T_a = 25 \pm 5^{\circ}\text{C}$ 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 $\times$ 2	mA		
		$\pm$ IGES	-	USL $\times$ 2	$\mu$ A		
	Gate threshold voltage	VGE(th)	LSL $\times$ 0.8	USL $\times$ 1.2	mA		
	Saturation voltage	VCE(sat)	-	USL $\times$ 1.2	V		
	Forward voltage	VF	-	USL $\times$ 1.2	V		
	Thermal resistance	IGBT	$\Delta$ VGE or $\Delta$ VCE	-	USL $\times$ 1.2	mV	
		FWD	$\Delta$ VF	-	USL $\times$ 1.2	mV	
	Isolation voltage	Viso	Broken insulation	-	-		
Visual inspection	Visual inspection ┌ Peeling ├ Plating └ and the others	-	The visual sample	-	-		

LSL : Lower specified limit.

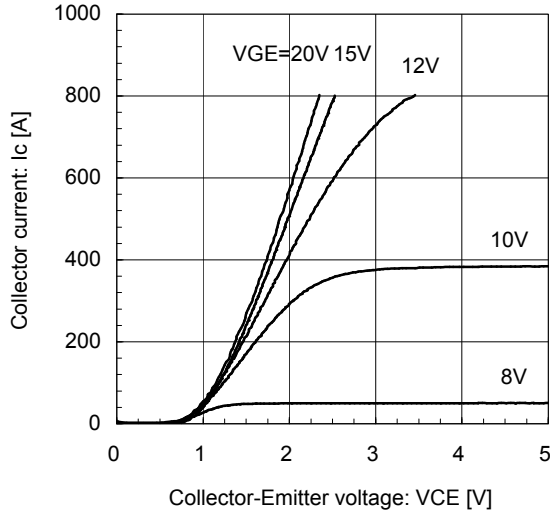
USL : Upper specified limit.

Note :

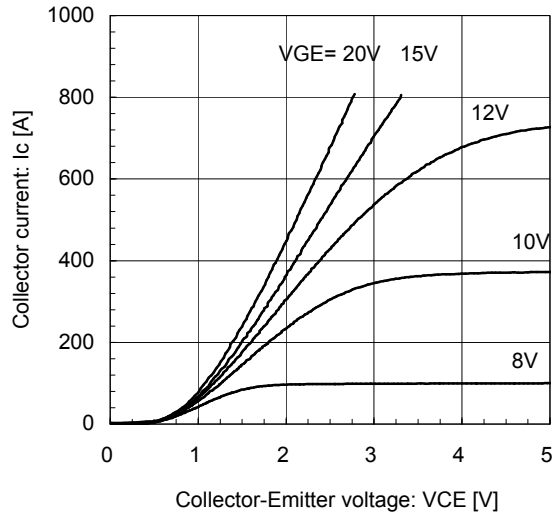
Each parameter measurement read-outs shall be made after stabilizing the components at room ambient for 2 hours minimum, 24 hours maximum after removal from the tests. And in case of the wetting tests, for example, moisture resistance tests, each component shall be made wipe or dry completely before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

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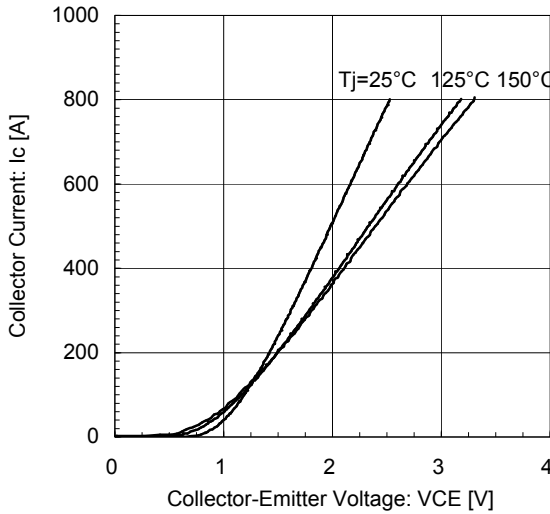
Collector current vs. Collector-Emitter voltage (typ.)  
Tj= 25°C / chip



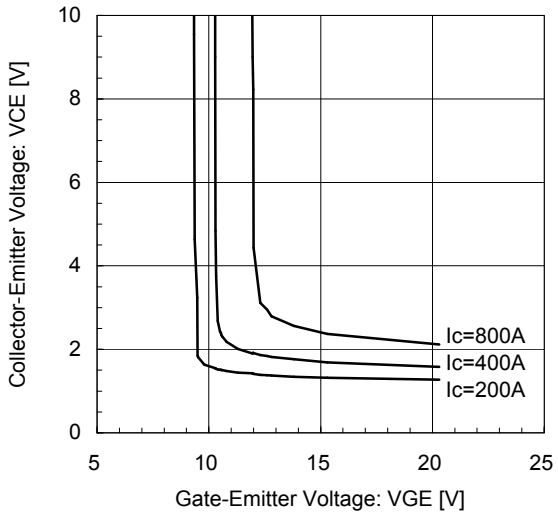
Collector current vs. Collector-Emitter voltage (typ.)  
Tj= 150°C / chip



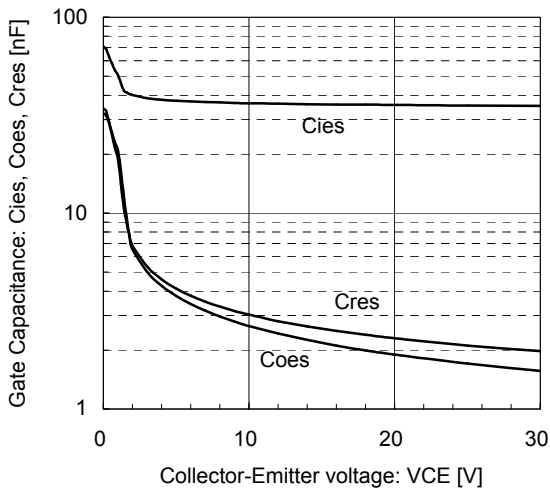
Collector current vs. Collector-Emitter voltage (typ.)  
VGE= 15V / chip



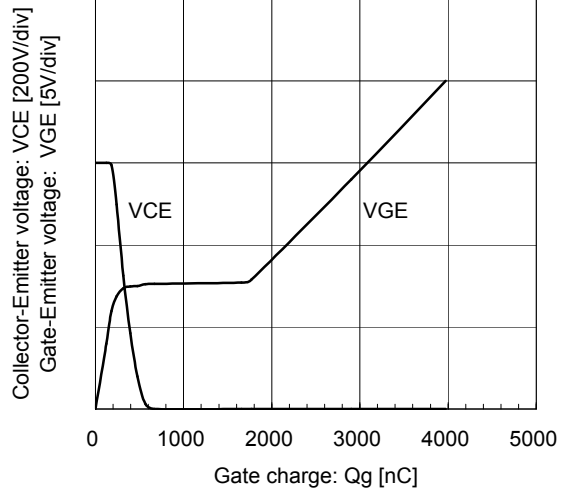
Collector-Emitter voltage vs. Gate-Emitter voltage  
Tj= 25°C / chip



Gate Capacitance vs. Collector-Emitter Voltage  
VGE= 0V, f= 1MHz, Tj= 25°C



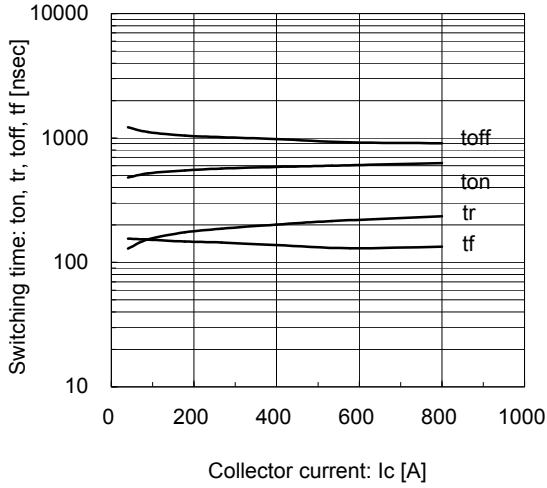
Dynamic Gate Charge (typ.)  
Vcc=600V, Ic=400A, Tj= 25°C



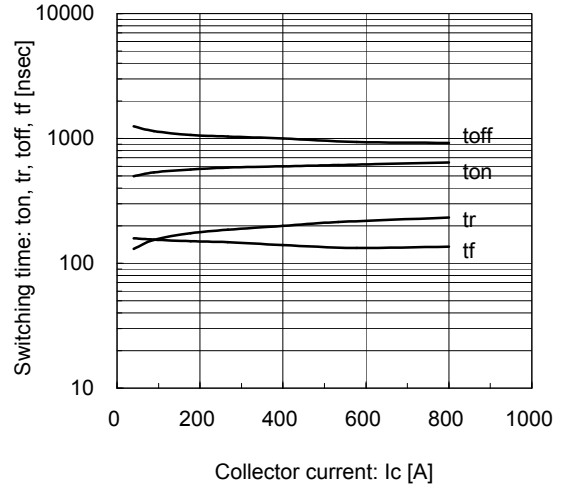



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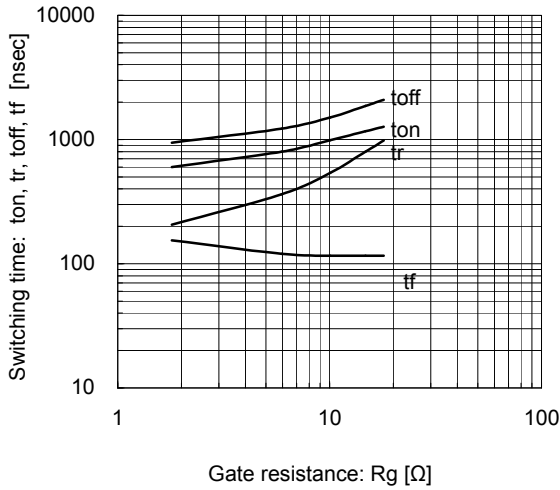
Switching time vs. Collector current (typ.)  
 $V_{cc}=600V, V_{GE}=\pm 15V, R_g=1.8\Omega, T_j=125^\circ C$



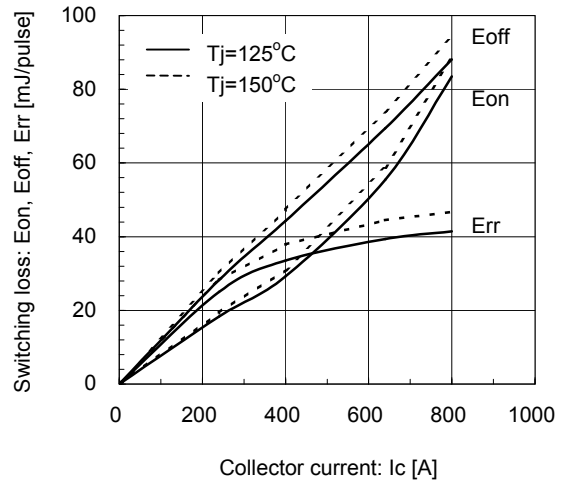
Switching time vs. Collector current (typ.)  
 $V_{cc}=600V, V_{GE}=\pm 15V, R_g=1.8\Omega, T_j=150^\circ C$



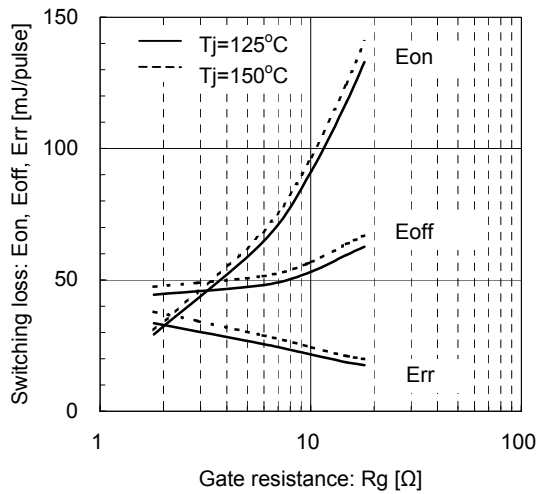
Switching time vs. Gate resistance (typ.)  
 $V_{cc}=600V, I_c=400A, V_{GE}=\pm 15V, T_j=125^\circ C$



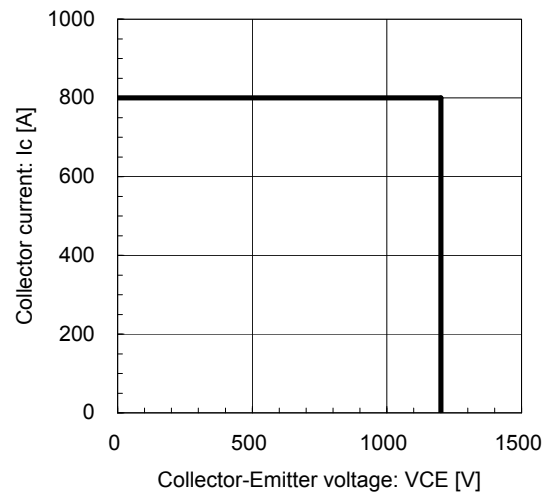
Switching loss vs. Collector current (typ.)  
 $V_{cc}=600, V_{GE}=\pm 15V, R_g=1.8\Omega, T_j=125^\circ C$



Switching loss vs. Gate resistance (typ.)  
 $V_{cc}=600V, I_c=400A, V_{GE}=\pm 15V, T_j=125^\circ C$

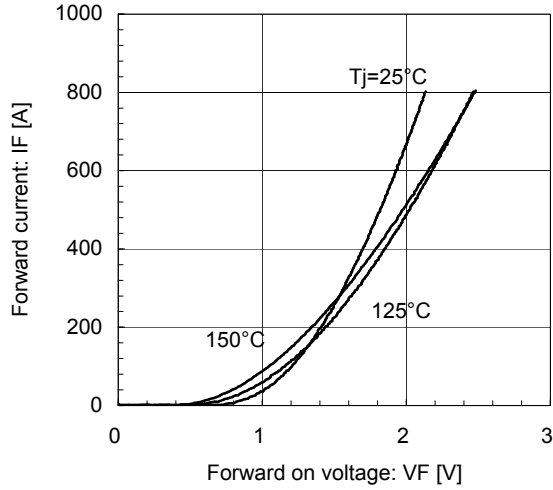


Reverse bias safe operating area (max.)  
 $+V_{GE}=15V, -V_{GE}=15V, R_g=1.8\Omega, T_j=150^\circ C$

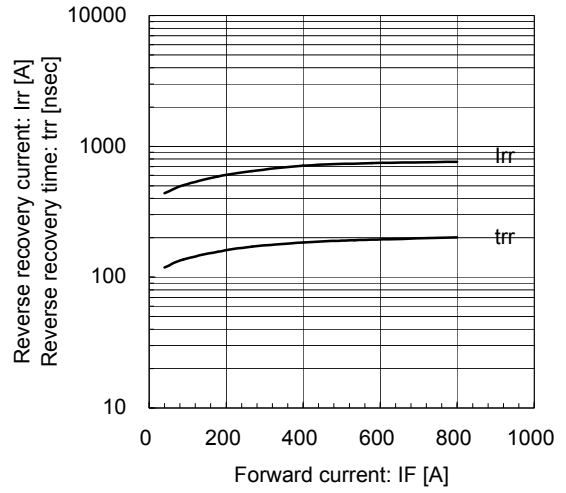



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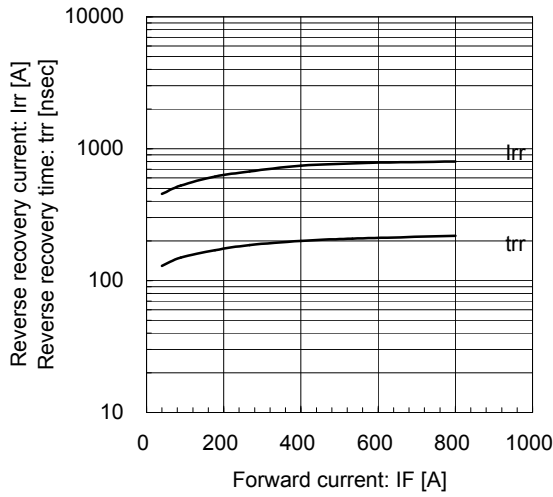
Forward Current vs. Forward Voltage (typ.)  
chip



Reverse Recovery Characteristics (typ.)  
Vcc=600V, VGE=±15V, Rg=1.8Ω, Tj=125°C



Reverse Recovery Characteristics (typ.)  
Vcc=600V, VGE=±15V, Rg=1.8Ω, Tj=150°C



Transient Thermal Resistance (max.)

