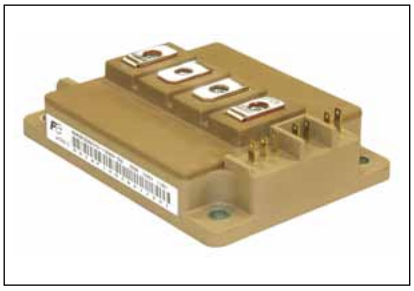
4MBI400VG-060R-50

IGBT Modules

IGBT MODULE (V series)
600V / 400A / IGBT, RB-IGBT 4 in one package

Features

Higher Efficiency
Optimized A (T-type) -3 level circuit
Low inductance module structure
Featuring Reverse Blocking IGBT (RB-IGBT)



Applications

Inverter for Motor Drive
Uninterruptible Power Supply
Power conditioner

Maximum Ratings and Characteristics

● **Absolute Maximum Ratings (at Tc=25°C unless otherwise specified)**

Items			Symbols	Conditions		Maximum ratings	Units
T1, T2	Collector-Emitter voltage		V_{CES}			600	V
	Gate-Emitter voltage		V_{GES}			±20	V
	Collector current	IGBT	I_C	Continuous	T_C=80°C	400	A
			I_{cp}	1ms	T_C=80°C	800	
		FWD	$-I_C$			400	
			$-I_{C\ pulse}$	1ms		800	
	Collector power dissipation		P_C	1 device		1135	W
T3, T4	Collector-Emitter voltage		V_{CES}			600	V
	Gate-Emitter voltage		V_{GES}			±20	V
	Collector current		I_C	Continuous	T_C=80°C	400	A
			I_{cp}	1ms	T_C=80°C	800	
	Collector power dissipation		P_C	1 device		1560	W
Junction temperature			T_j			150	°C
Case temperature			T_C			125	
Storage temperature			T_{stg}			-40 ~ +125	
Isolation voltage	between terminal and copper base (*1)		V_{iso}	AC : 1min.		2500	VAC
Screw torque	Mounting (*2)		-	M5 or M6		3.5	N m
	Terminals (*3)		-	M5		3.5	

Note *1: All terminals should be connected together during the test.
Note *2: Recommendable value : 2.5-3.5 Nm (M5 or M6)
Note *3: Recommendable value : 2.5-3.5 Nm (M5)

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

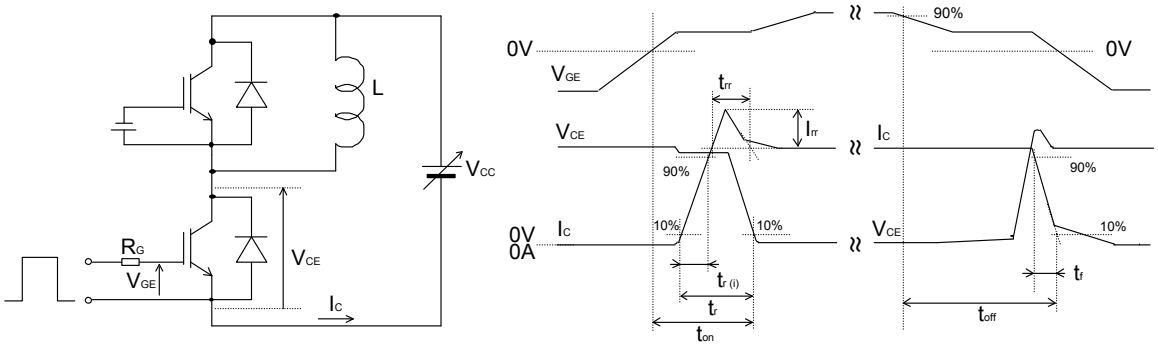
Items		Symbols	Conditions		Characteristics min.	Characteristics typ.	Characteristics max.	Units
T1, T2	Zero gate voltage collector current	I_{CES}	V_{GE} = 0V, V_{CE} = 600V		-	-	2.0	mA
	Gate-Emitter leakage current	I_{GES}	V_{CE} = 0V, V_{GE} = ±20V		-	-	400	nA
	Gate-Emitter threshold voltage	$V_{GE\ (th)}$	V_{CE} = 20V, I_C = 400mA		6.2	6.7	7.2	V
	Collector-Emitter saturation voltage	$V_{CE\ (sat)}$ (chip)	V_{GE} = 15V, I_C = 400A	T_j= 25°C	-	1.60	1.85	V
				T_j=125°C	-	1.90	-	
		$V_{CE\ (sat)}$ (terminal)	V_{GE} = 15V, I_C = 400A	T_j= 25°C	-	1.79	2.10	
				T_j=125°C	-	2.09	-	
	Input capacitance	C_{ies}	V_{CE} = 10V, V_{GE} =0V, f = 1MHz		-	27		nF
	Turn-on time	t_{on}	SW mode : A, V_{CC} = 400V, I_C = 400A, V_{GE} = ±15V, R_G = +10/-39Ω, L_S = 80nH		-	0.95	1.90	μs
		t_r			-	0.65	1.30	
		$t_{r\ (i)}$			-	0.30	-	
	Turn-off time	t_{off}			-	3.20	6.40	
		t_f			-	0.20	0.50	
	Forward on voltage	V_F (chip)	I_F = 400A	T_j= 25°C	-	1.60	1.85	V
				T_j=125°C	-	1.50	-	
		V_F (terminal)	I_F = 400A	T_j= 25°C	-	1.72	2.05	
				T_j=125°C	-	1.62	-	
	Reverse recovery time	t_{rr}	SW mode : A, V_{CC} = 400V, I_F = 400A, V_{GE} = ±15V, R_G = +10/-39Ω		-	-	0.35	μs
T3, T4	Zero gate voltage collector current	I_{CES}	V_{GE} = 0V, V_{CE} = 600V		-	-	4.0	mA
	Gate-Emitter leakage current	I_{GES}	V_{CE} = 0V, V_{GE} = ±20V		-	-	800	nA
	Gate-Emitter threshold voltage	$V_{GE\ (th)}$	V_{CE} = 20V, I_C = 400mA		5.5	6.5	7.5	V
	Collector-Emitter saturation voltage	$V_{CE\ (sat)}$ (chip)	V_{GE} = 15V, I_C = 400A	T_j= 25°C	-	2.45	2.80	V
				T_j=125°C	-	2.60	-	
		$V_{CE\ (sat)}$ (terminal)	V_{GE} = 15V, I_C = 400A	T_j= 25°C	-	2.67	3.10	
				T_j=125°C	-	2.82	-	
	Input capacitance	C_{ies}	V_{CE} = 10V, V_{GE} = 0V, f = 1MHz		-	26	-	nF
	Turn-on time	t_{on}	SW mode : B, V_{CC} = 200V, I_C = 400A, V_{GE} = ±15V, R_G = +2.2/-39Ω, L_S = 54nH		-	0.35	0.70	μs
		t_r			-	0.25	0.50	
		$t_{r\ (i)}$			-	0.15	-	
	Turn-off time	t_{off}			-	1.75	3.50	
		t_f			-	0.15	0.35	
	Reverse recovery time	t_{rr}	SW mode : C, V_{CC} = 200V, I_C = 400A, V_{GE} = ±15V, R_G = +10/-39Ω		-	-	0.35	μs
Internal inductance		L	P-N		-	40	-	nH
			P-M		-	33	-	
			M-N		-	33	-	

● Thermal resistance characteristics

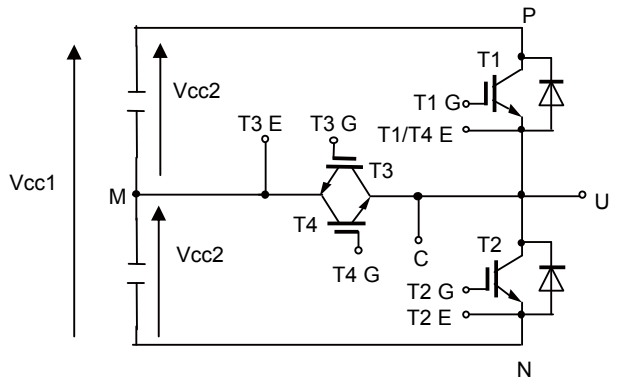
Items	Symbols	Conditions		Characteristics min.	Characteristics typ.	Characteristics max.	Units
Thermal resistance (1device)	$R_{th(j-c)}$	T1, T2 IGBT		-	-	0.11	°C/W
		T1, T2 FWD		-	-	0.22	
		T3, T4 RB-IGBT		-	-	0.08	
Contact thermal resistance (1device) (*4)	$R_{th(c-f)}$	T1, T2	with Thermal Compound	-	0.025	-	
		T3, T4		-	0.013	-	

Note *4: This is the value which is defined mounting on the additional cooling fin with thermal compound (thermal conductivity = 1W/m ·k).

■ Definitions of switching time



Definitions of switching mode

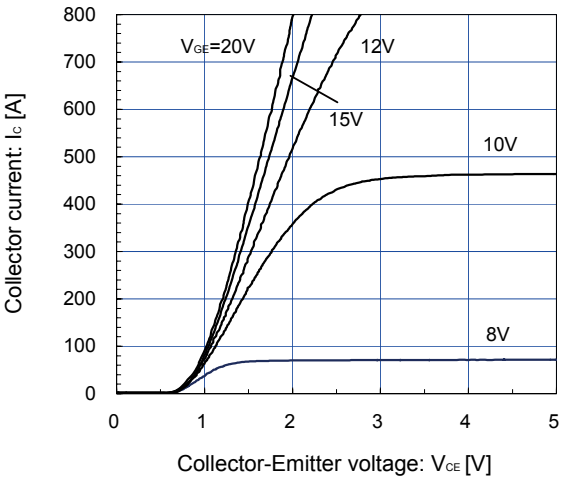


SW mode	Load L	T1	T2	T3	T4
A	U-N	**SW**	OFF	OFF	OFF
	P-U	OFF	**SW**	OFF	OFF
B	P-U	OFF	OFF	**SW**	**ON**
	U-N	OFF	OFF	**ON**	**SW**
C	M-U	**SW**	OFF	OFF	**ON**
	M-U	OFF	**SW**	**ON**	OFF

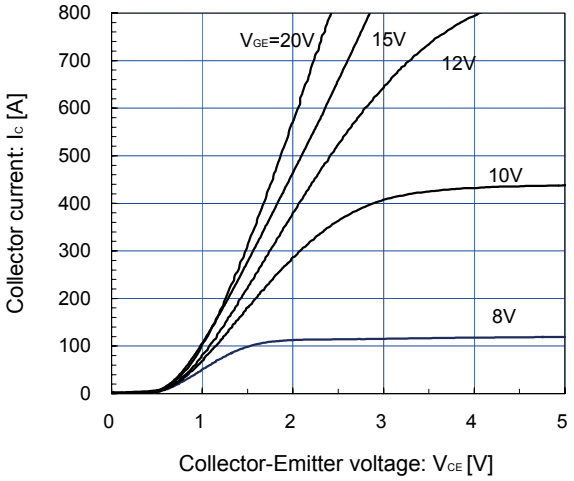
SW: Connect to drive circuit and input gate signal
ON: Bias voltage of gate +15V
OFF: Reverse bias voltage of gate -15V
Vcc2=Vcc1/2

■ Characteristics (Representative)

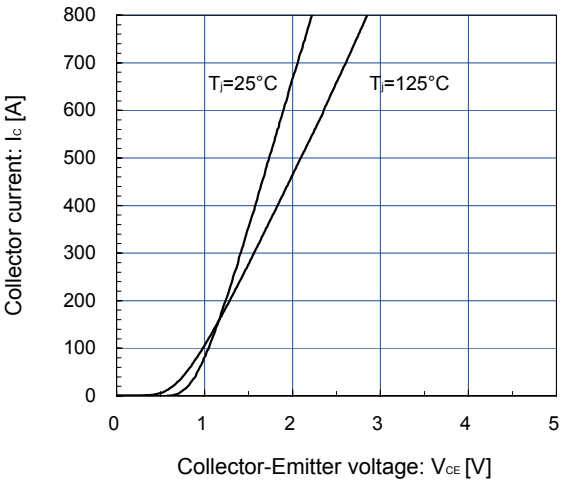
[T1, T2]
Collector current vs. Collector-Emitter voltage (typ.)
T_j= 25°C / chip



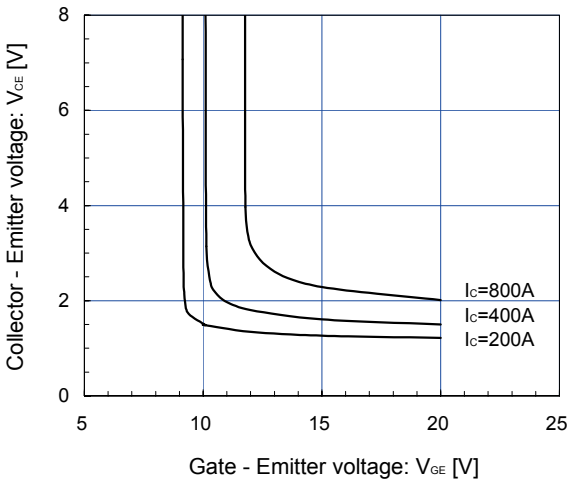
[T1, T2]
Collector current vs. Collector-Emitter voltage (typ.)
T_j= 125°C / chip



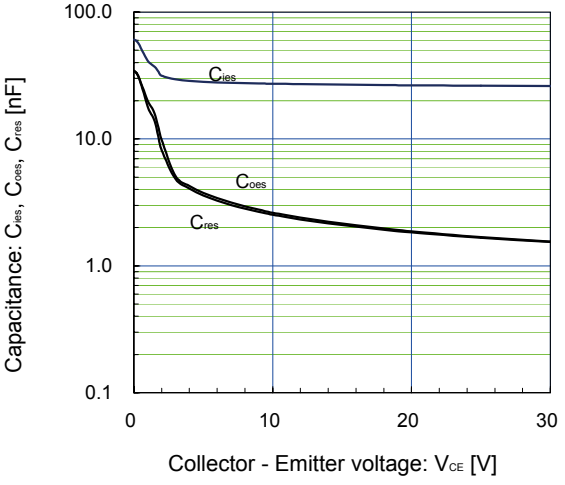
[T1, T2]
Collector current vs. Collector-Emitter voltage (typ.)
V_{GE}=15V / chip



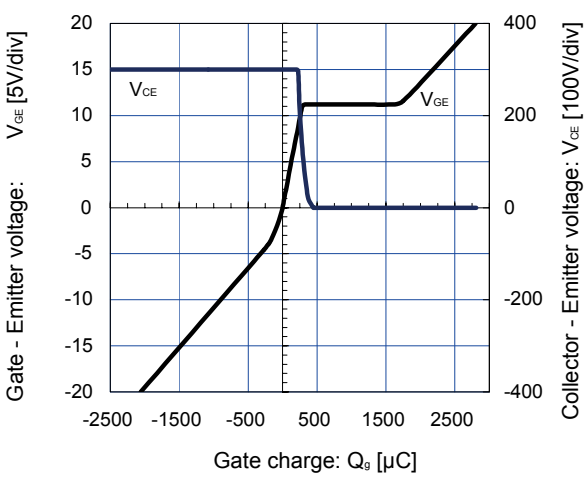
[T1, T2]
Collector-Emitter voltage vs. Gate-Emitter voltage (typ.)
T_j= 25°C / chip



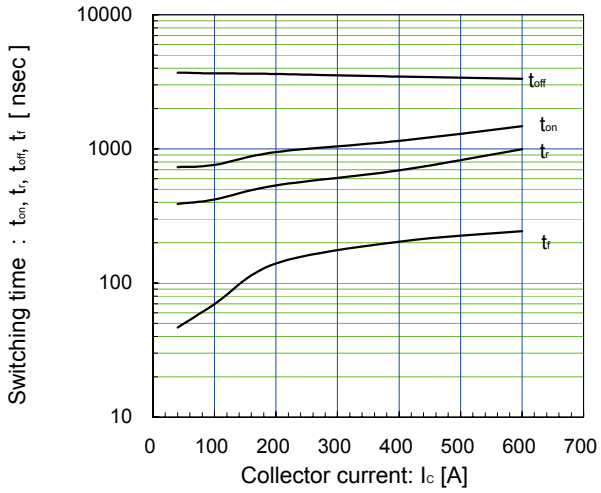
[T1, T2]
Capacitance vs. Collector-Emitter voltage (typ.)
V_{GE}=0V, f= 1MHz, T_j= 25°C



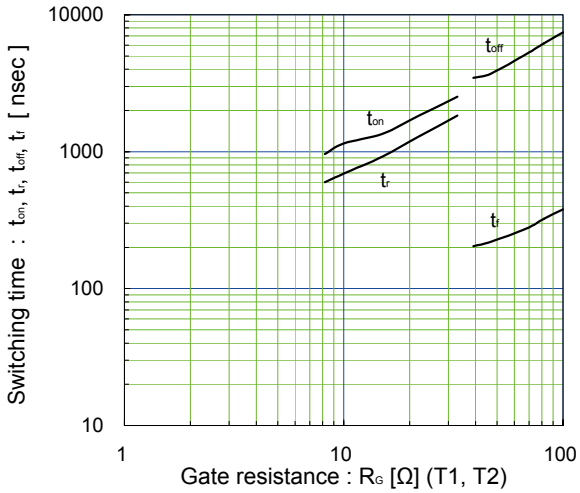
[T1, T2]
Dynamic gate charge (typ.)
V_{CC}=300V, I_C=400A, T_j=25°C



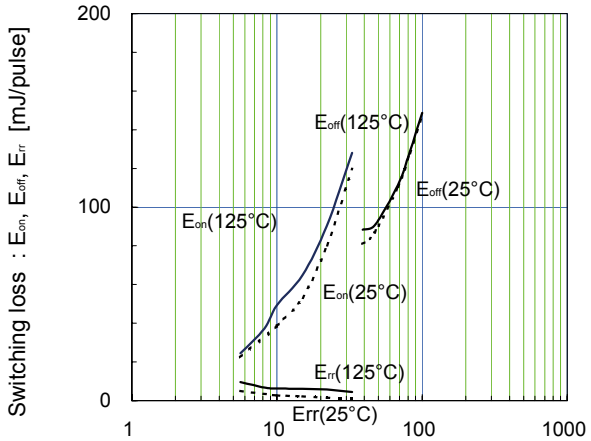
[SW mode A]
Switching time vs. Collector current (typ.)
V_{CC}=400V, V_{GE}=±15V, R_G=+10/-39Ω, T_j=125°C (T1, T2)



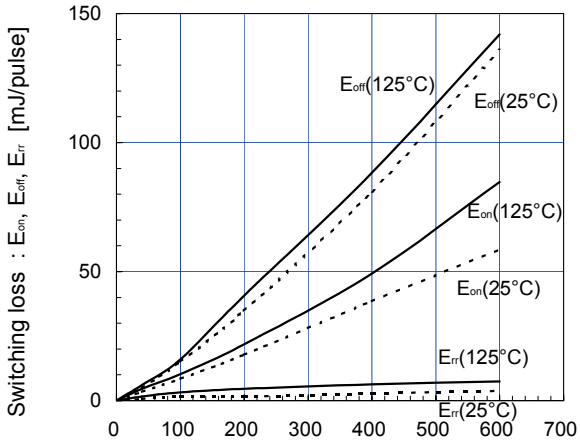
[SW mode A]
Switching time vs. Collector current (typ.)
V_{CC}=400V, I_C=400A, V_{GE}=±15V, T_j=125°C



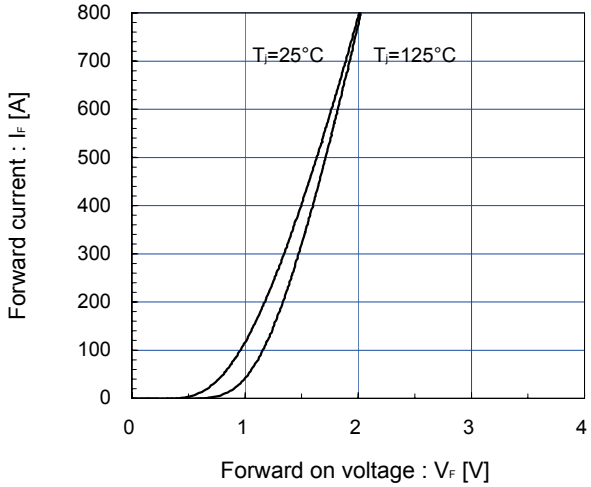
[SW mode A]
Switching loss vs. gate resistance (typ.)
V_{CC}=400V, I_C=400A, V_{GE}=±15V



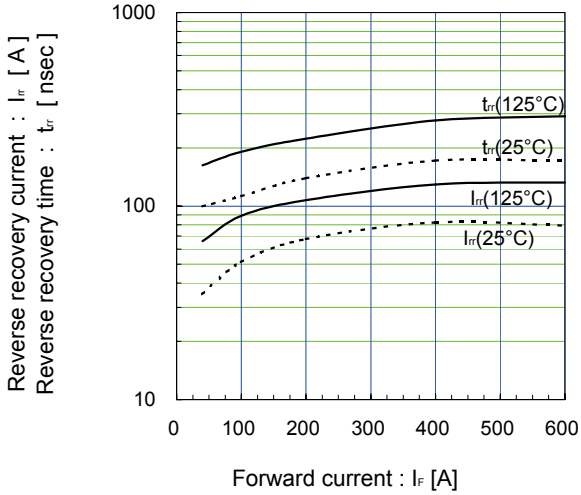
[SW mode A]
Switching loss vs. Collector current (typ.)
V_{CC}=400V, V_{GE}=±15V, R_G=+10/-39Ω (T1, T2)



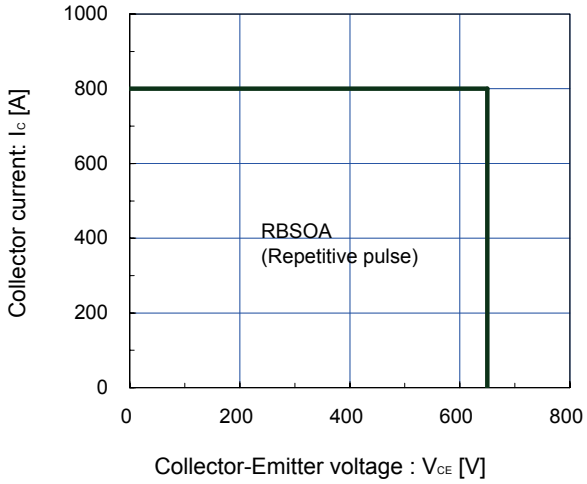
[T1, T2]
Forward current vs. forward on voltage (typ.)
chip



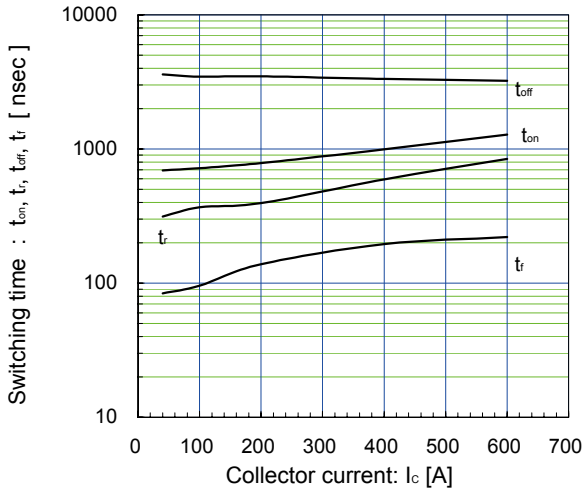
[T1, T2]
Reverse recovery characteristics (typ.)
V_{CC}=400V, V_{GE}=±15V, R_G=+10/-39Ω(T1, T2)



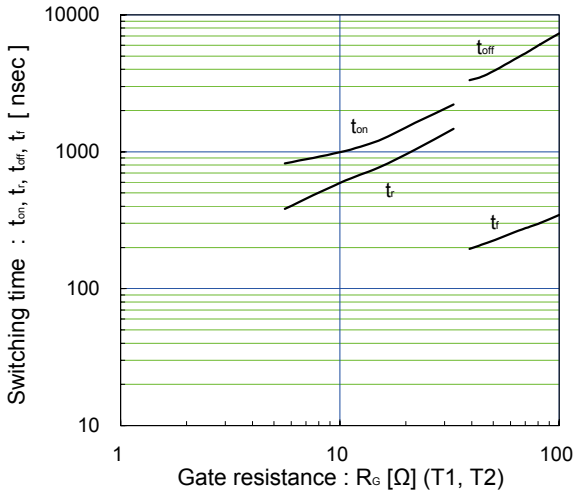
Reverse bias safe operating area (max.)
V_{GE}=15V, -V_{GE} ≦ 15V, R_G ≧ +10 / -39Ω, T_j ≦ 125°C (T1, T2)
T1, T2 (Terminal)



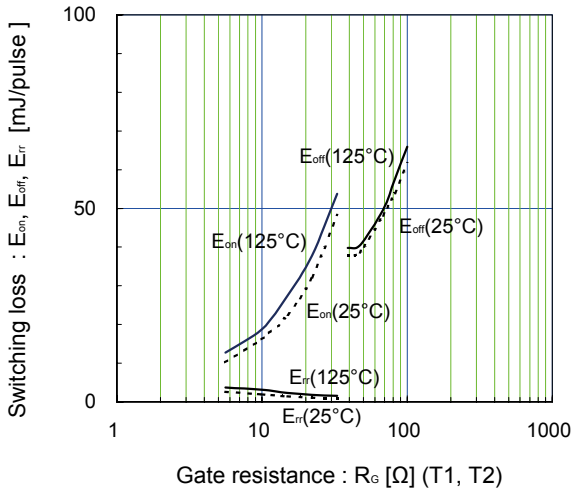
[SW mode C]
Switching time vs. Collector current (typ.)
V_{CC}=200V, V_{GE}=±15V, R_G=+10/-39Ω, T_j=125°C (T1, T2)



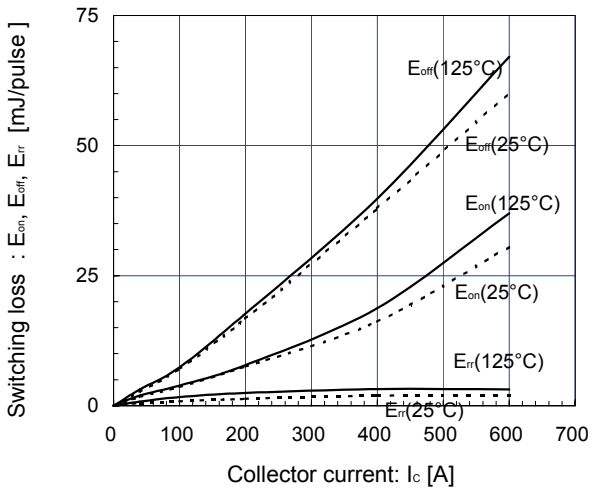
[SW mode C]
Switching time vs. Collector current (typ.)
V_{CC}=200V, I_C=400A, V_{GE}=±15V, T_j=125°C



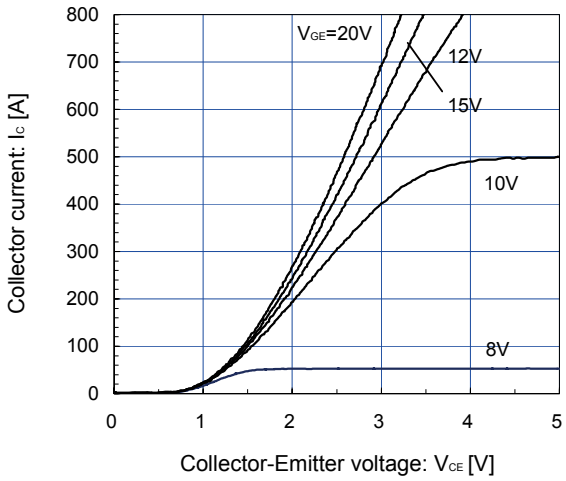
[SW mode C]
Switching loss vs. gate resistance (typ.)
V_{CC}=200V, I_C=400A, V_{GE}=±15V



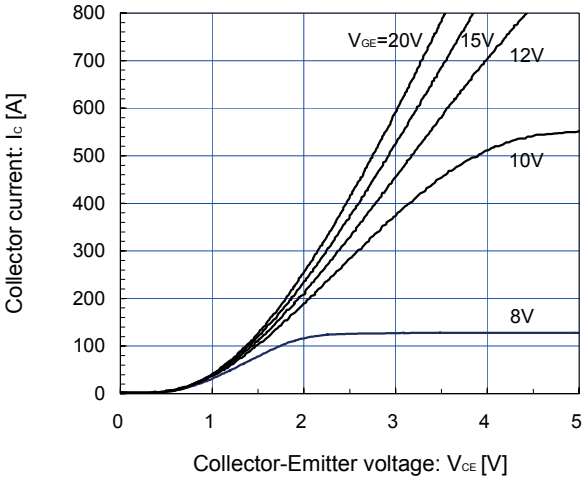
[SW mode C]
Switching loss vs. Collector current (typ.)
V_{CC}=200V, V_{GE}=±15V, R_G=+10/-39Ω (T1, T2)



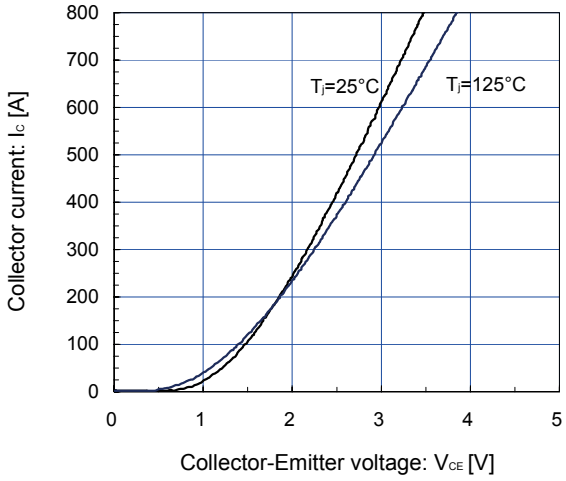
[T3, T4]
Collector current vs. Collector-Emitter voltage (typ.)
T_j= 25°C / chip



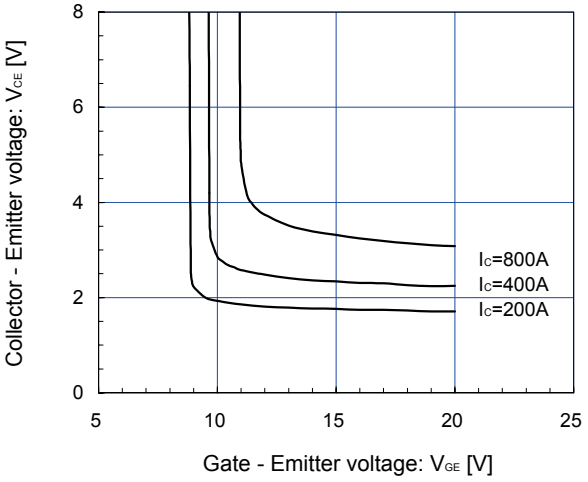
[T3, T4]
Collector current vs. Collector-Emitter voltage (typ.)
T_j= 125ºC / chip



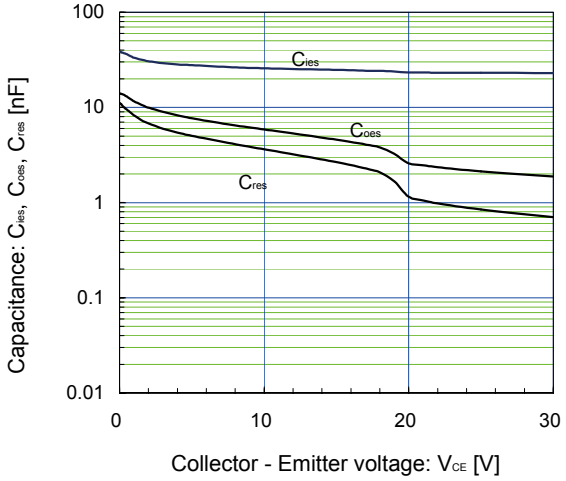
[T3, T4]
Collector current vs. Collector-Emitter voltage (typ.)
V_{GE}=15V / chip



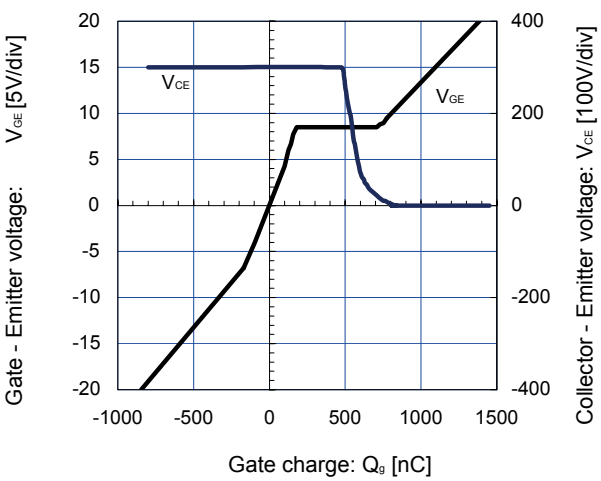
[T3, T4]
Collector-Emitter voltage vs. Gate-Emitter voltage (typ.)
T_j= 25ºC / chip



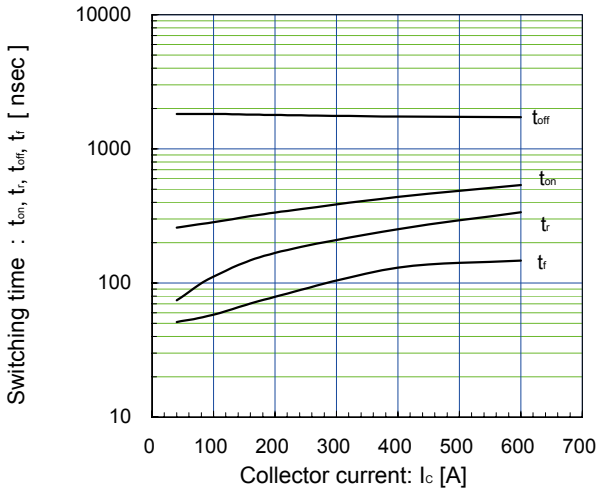
[T3, T4]
Capacitance vs. Collector-Emitter voltage (typ.)
V_{GE}=0V, f= 1MHz, T_j= 25°C



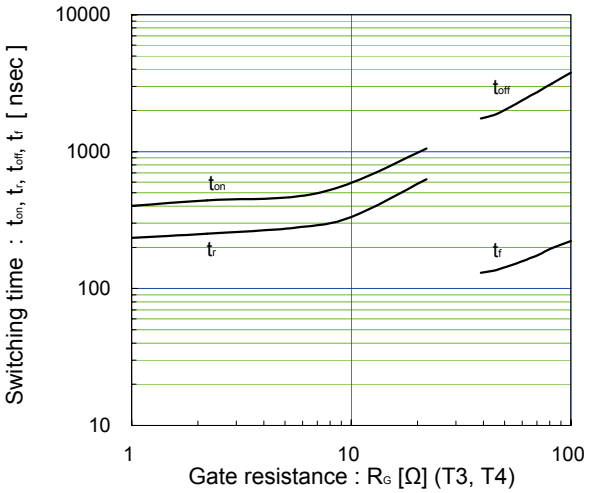
[T3, T4]
Dynamic gate charge (typ.)
V_{CC}=300V, I_C=400A, T_j=25°C



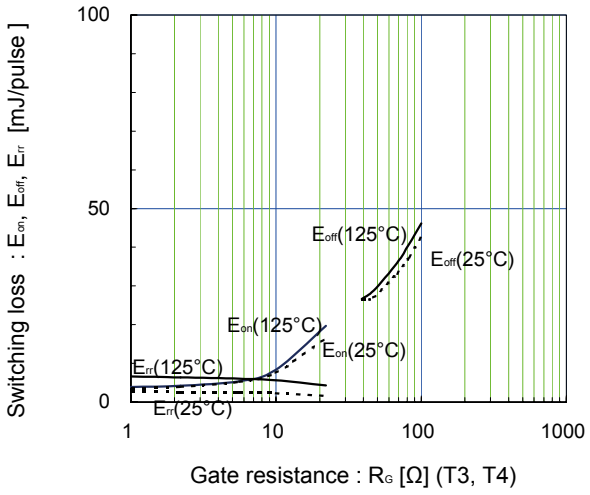
[SW mode B]
Switching time vs. Collector current (typ.)
V_{CC}=200V, V_{GE}=±15V, R_G=+2.2/-39Ω, T_j=125°C (T3, T4)



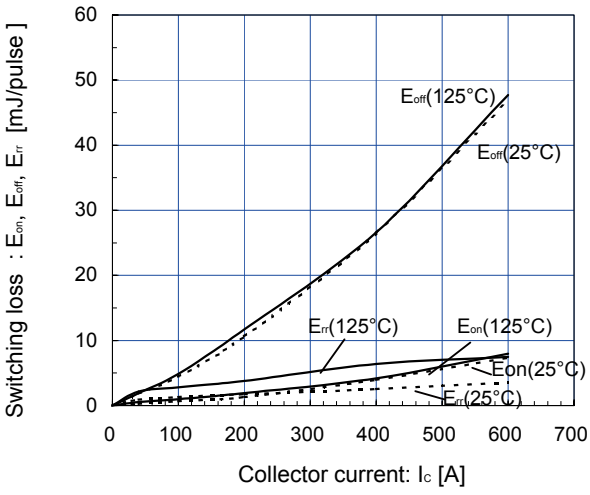
[SW mode B]
Switching time vs. Collector current (typ.)
V_{CC}=200V, I_C=400A, V_{GE}=±15V, T_j=125°C



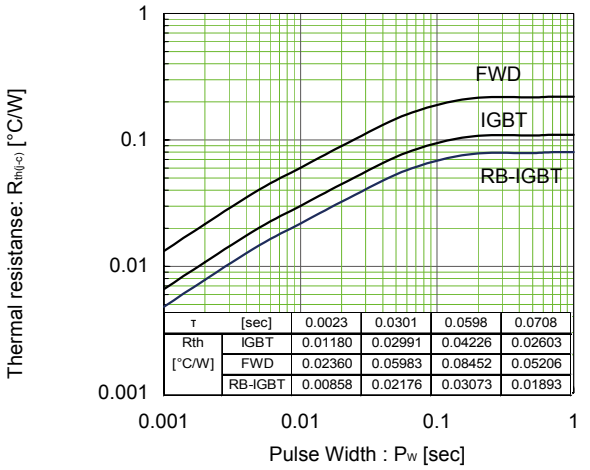
[SW mode B]
Switching loss vs. gate resistance (typ.)
V_{CC}=200V, I_C=400A, V_{GE}=±15V



[SW mode B]
Switching loss vs. Collector current (typ.)
V_{CC}=200V, V_{GE}=±15V, R_G=+2.2/-39Ω (T3, T4)

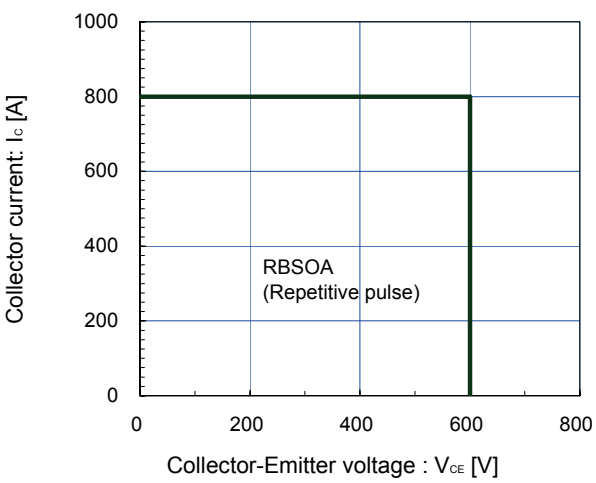


Transient Thermal Resistance (max.)

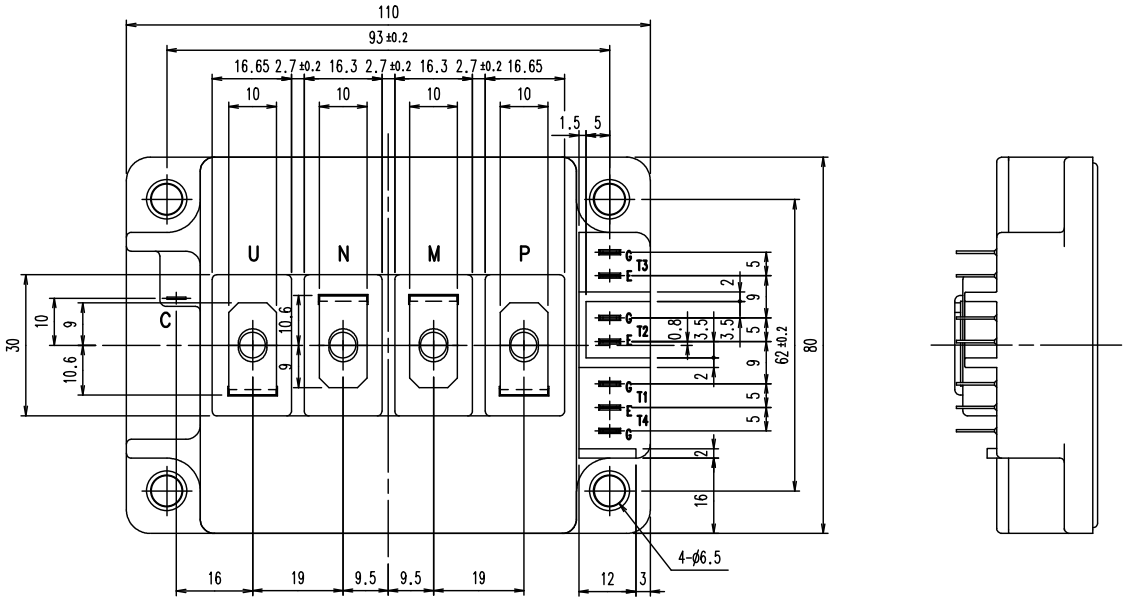


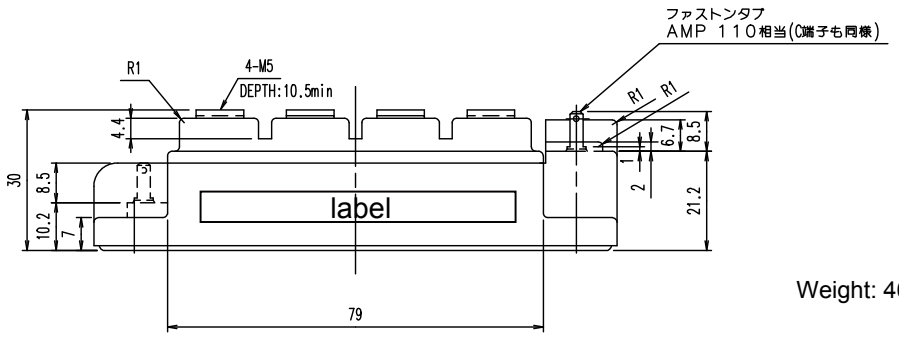
τ	[sec]	0.0023	0.0301	0.0598	0.0708
Rth [°C/W]	IGBT	0.01180	0.02991	0.04226	0.02603
	FWD	0.02360	0.05983	0.08452	0.05206
	RB-IGBT	0.00858	0.02176	0.03073	0.01893

Reverse bias safe operating area (max.)
V_{GE}=15V,-V_{GE} ≦ 15V, R_G ≧ +2.2 / -39Ω, T_j ≦ 125°C (T3, T4)
T3, T4 (Terminal)



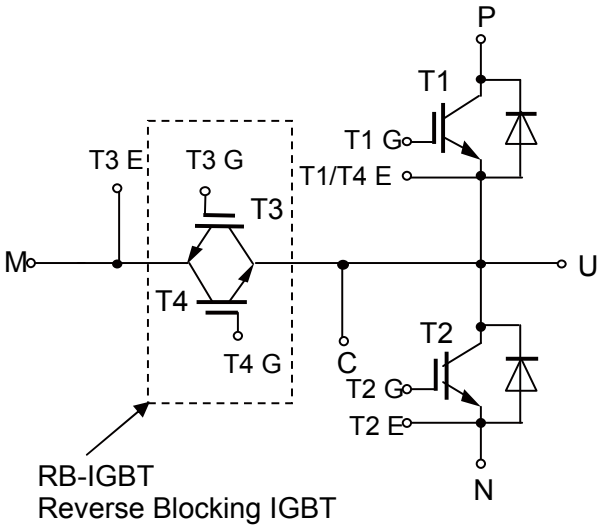
■ Outline Drawings, mm





Weight: 460g (typ.)

■ Equivalent Circuit Schematic



WARNING

1. This Catalog contains the product specifications, characteristics, data, materials, and structures as of May 2011.
The contents are subject to change without notice for specification changes or other reasons. When using a product listed in this Catalog, be sur to obtain the latest specifications.

2. All applications described in this Catalog exemplify the use of Fuji's products for your reference only. No right or license, either express or implied, under any patent, copyright, trade secret or other intellectual property right owned by Fuji Electric Co., Ltd. is (or shall be deemed) granted. Fuji Electric Co., Ltd. makes no representation or warranty, whether express or implied, relating to the infringement or alleged infringement of other's intellectual property rights which may arise from the use of the applications described herein.

3. Although Fuji Electric Co., Ltd. is enhancing product quality and reliability, a small percentage of semiconductor products may become faulty. When using Fuji Electric semiconductor products in your equipment, you are requested to take adequate safety measures to prevent the equipment from causing a physical injury, fire, or other problem if any of the products become faulty. It is recommended to make your design failsafe, flame retardant, and free of malfunction.

4. The products introduced in this Catalog are intended for use in the following electronic and electrical equipment which has normal reliability requirements.
- Computers
- OA equipment
- Communications equipment (terminal devices)
- Measurement equipment
- Machine tools
- Audiovisual equipment
- Electrical home appliances
- Personal equipment
- Industrial robots etc.

5. If you need to use a product in this Catalog for equipment requiring higher reliability than normal, such as for the equipment listed below, it is imperative to contact Fuji Electric Co., Ltd. to obtain prior approval. When using these products for such equipment, take adequate measures such as a backup system to prevent the equipment from malfunctioning even if a Fuji's product incorporated in the equipment becomes faulty.
- Transportation equipment (mounted on cars and ships)
- Trunk communications equipment
- Traffic-signal control equipment
- Gas leakage detectors with an auto-shut-off feature
- Emergency equipment for responding to disasters and anti-burglary devices
- Safety devices
- Medical equipment

6. Do not use products in this Catalog for the equipment requiring strict reliability such as the following and equivalents to strategic equipment (without limitation).
- Space equipment
- Aeronautic equipment
- Nuclear control equipment
- Submarine repeater equipment

8. If you have any question about any portion in this Catalog, ask Fuji Electric Co., Ltd. or its sales agents before using the product.
Neither Fuji Electric Co., Ltd. nor its agents shall be liable for any injury caused by any use of the products not in accordance with instructions set forth herein.