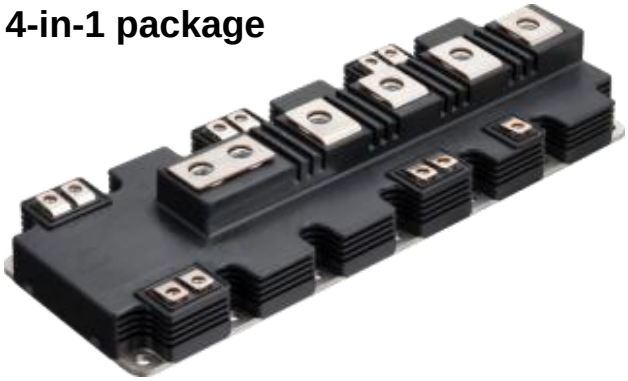
4MBI650VB-120R1-50

IGBT Modules

IGBT Power Module (V series)
1200V/650A/IGBT, ±900V/650A/RB-IGBT, 4-in-1 package



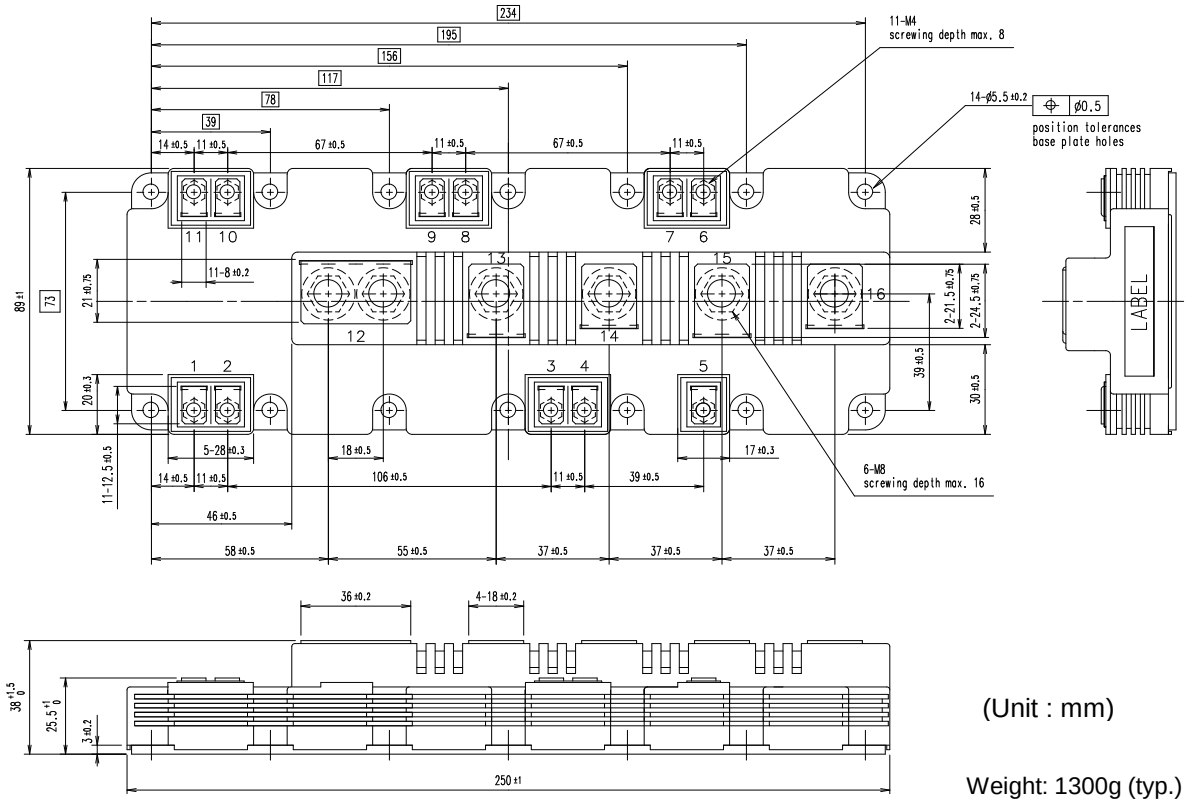
■ Features

Higher efficiency
Optimized Advanced T-type circuit
Revese-Blocking IGBT as for AC Switch
Low inductance module structure

■ Applications

Inverter for motor drive
Uninterruptible powre supply
Power conditioner for PV, Wind turbine

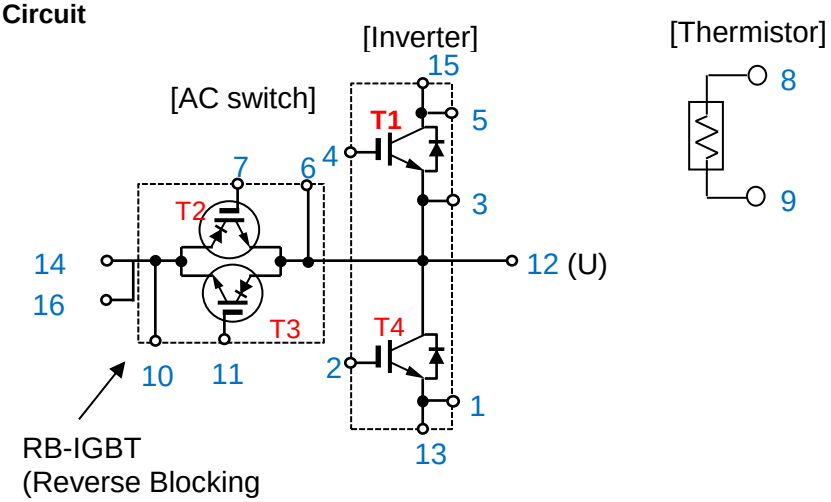
■ Outline drawing



(Unit : mm)

Weight: 1300g (typ.)

■ Equivalent Circuit



FM5F8520
2014/12

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IGBT Modules

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

	Item		Symbol	Condition		Maximum Rating	Unit
Inverter	Collector-Emitter voltage		V_{CES}			1200	A
	Gate-Emitter voltage		V_{GES}			±20	V
	Collector current	IGBT	I_C	Continuous	T_c=25°C	850	A
					T_c=100°C	650	
			I_C pulse	1ms		1300	
		FWD	$-I_C$			650	
			$-I_C$ pulse			1300	
	Collector power dissipation		P_C	1 device		3060	W
	Junction temperature		T_j			175	°C
	Operating temperature		T_{jop}			150	
AC switch	Collector-Emitter voltage		V_{CES}			±900	A
	Gate-Emitter voltage		V_{GES}			±20	V
	Collector current		I_C	Continuous	T_c=25°C	850	A
					T_c=80°C	650	
			I_C pulse	1ms		1300	
	Collector power dissipation		P_C	1 device		2660	W
	Junction temperature		T_j			150	°C
	Operating temperature		T_{jop}			125	
Case temperature			T_c			125	
Storage temperature			T_{stg}			-40 ~ 125	
Isolation voltage	between terminal and copper base (*1)		V_{iso}	AC: 1min.		4000	VAC
Screw torque	Mounting		-	M5		6.0	N m
	Main terminals		-	M8		10.0	
	Sense terminals		-	M4		2.1	

(*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) Recommended value : Mounting 3.0 ~ 6.0 Nm (M5)
Recommended value : Main Terminals 8.0 ~ 10.0 Nm (M8)
Recommended value : Sense Terminals 1.8 ~ 2.1 Nm (M4)

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IGBT Modules

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

	Item		Symbol	Condition		Characteristics min.	Characteristics typ.	Characteristics max.	Units
Inverter	Zero gate voltage Collector current		I_{CES}	V_{GE} = 0V, V_{CE} = 1200V		-	-	6.0	mA
	Gate-Emitter leakage current		I_{GES}	V_{CE} = 0V, V_{GE} = ±20V		-	-	1200	nA
	Gate-Emitter threshold voltage		$V_{GE(th)}$	V_{CE} = 20V, I_C = 650mA		6.0	6.5	7.0	V
	Collector-Emitter saturation voltage		$V_{CE(sat)}$ (chip)	V_{GE} = 15V, I_C = 650A	T_j=25°C	-	1.80	2.30	V
					T_j=125°C	-	2.10	-	
					T_j=150°C	-	2.15	-	
			$V_{CE(sat)}$ (terminal)	V_{GE} = 15V, I_C = 650A	T_j=25°C	-	1.90	2.40	
					T_j=125°C	-	2.20	-	
					T_j=150°C	-	2.25	-	
	Internal gate		$R_{G(int)}$	-		-	1.25	-	Ω
	Input capacitance		C_{ies}	V_{CE}=10V, V_{GE}=0V, f=1MHz		-	55	-	nF
	Turn-on time		t_{on}	Switching mode: A		-	0.75	-	μs
			t_r	V_{CC}= 500V		-	0.30	-	
			$t_{r(i)}$	I_C = 650A		-	0.10	-	
	Turn-off time		t_{off}	V_{GE}= ±15V		-	0.85	-	
			t_f	R_G = +3.9/-0.56Ω		-	0.15	-	
	Forward on voltage		V_F (chip)	I_F = 650A	T_j=25°C	-	1.75	2.30	V
					T_j=125°C	-	1.90	-	
					T_j=150°C	-	1.85	-	
			V_F (terminal)	I_F = 650A	T_j=25°C	-	1.80	2.35	
					T_j=125°C	-	1.95	-	
					T_j=150°C	-	1.90	-	
	Reverse recovery time		t_{rr}	Switching mode: B V_{CC}= 500V I_F = 650A V_{GE}= ±15V R_G = +2.7/-18Ω		-	0.20	-	μs
AC-switch	Zero gate voltage Collector current		I_{CES}	V_{GE} = 0V, V_{CE} = 900V		-	-	9.0	mA
	Gate-Emitter leakage current		I_{GES}	V_{CE} = 0V, V_{GE} = ±20V		-	-	1800	nA
	Gate-Emitter threshold voltage		$V_{GE(th)}$	V_{CE} = 20V, I_C = 650mA		5.6	6.6	7.6	V
	Collector-Emitter saturation voltage		$V_{CE(sat)}$ (chip)	V_{GE} = 15V, I_C = 650A	T_j=25°C	-	2.25	2.85	V
					T_j=125°C	-	2.65	-	
			$V_{CE(sat)}$ (terminal)	V_{GE} = 15V, I_C = 650A	T_j=25°C	-	2.35	2.95	
					T_j=125°C	-	2.75	-	
	Internal gate		$R_{G(int)}$	-		-	3.44	-	Ω
	Input capacitance		C_{ies}	V_{CE}=10V, V_{GE}=0V, f=1MHz		-	40	-	nF
	Turn-on time		t_{on}	Switching mode: B		-	0.35	-	μs
			t_r	V_{CC}= 500V		-	0.15	-	
			$t_{r(i)}$	I_C = 650A		-	0.10	-	
	Turn-off time		t_{off}	V_{GE}= ±15V		-	2.00	-	
			t_f	R_G = +2.7/-18Ω		-	0.25	-	
	Reverse recovery time		t_{rr}	Switching mode: A V_{CC}= 500V I_F = 650A V_{GE}= ±15V R_G =+3.9/-0.56Ω		-	0.15	-	μs
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

(*1) Please refer to section 8, there is definition of A mode and B mode.

■ Thermal resistance characteristics

Item	Symbol	Condition		Characteristics min.	Characteristics typ.	Characteristics max.	Units
Thermal resistance (1device)	$R_{th(j-c)}$	T1, T4 IGBT		-	-	0.049	°C/W
		T1, T4 FWD		-	-	0.077	
		T2, T3 RB-IGBT		-	-	0.047	
Contact thermal resistance	$R_{th(c-f)}$	T1, T4	with thermal compound	-	0.0083	-	
		T2, T3		-	0.0056	-	

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

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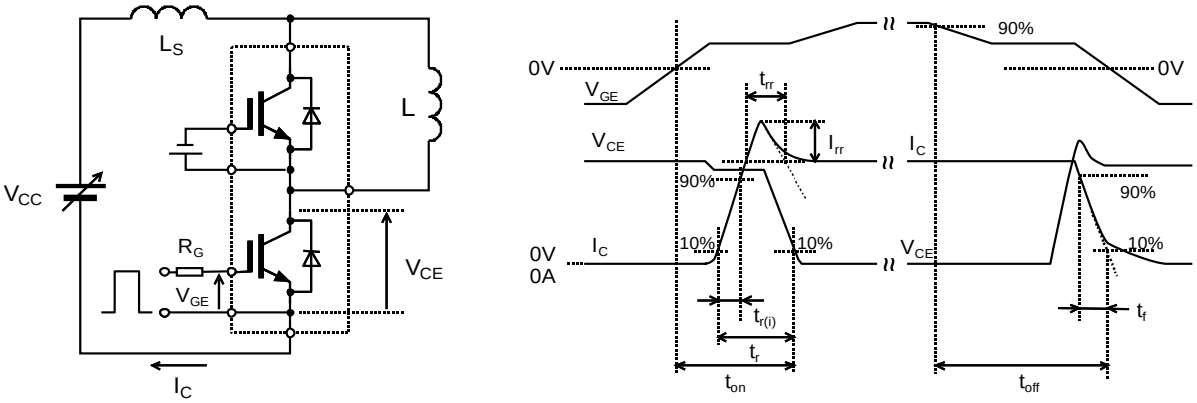
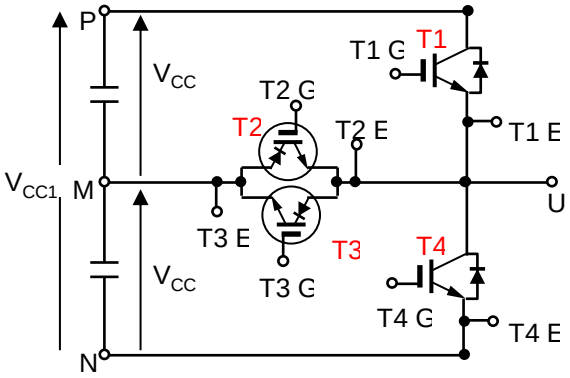
■ Definitions of switching time



■ Definitions of switching mode



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

SW: Connect to drive circuit and input gate signal
ON: Bias voltage of gate +15V
OFF: Reverse bias voltage of gate -15V
$V_{CC} = V_{CC1}/2$

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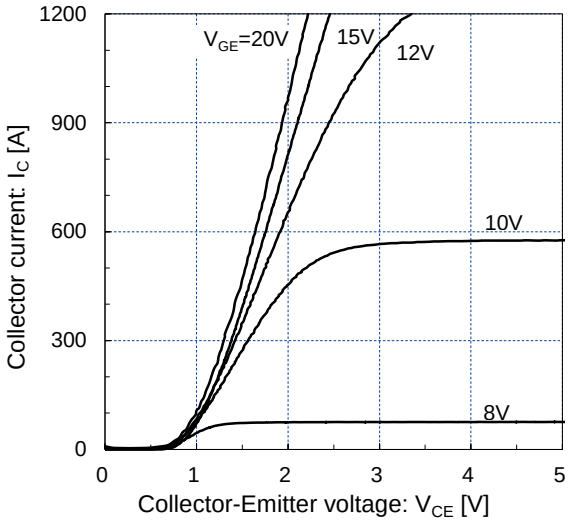
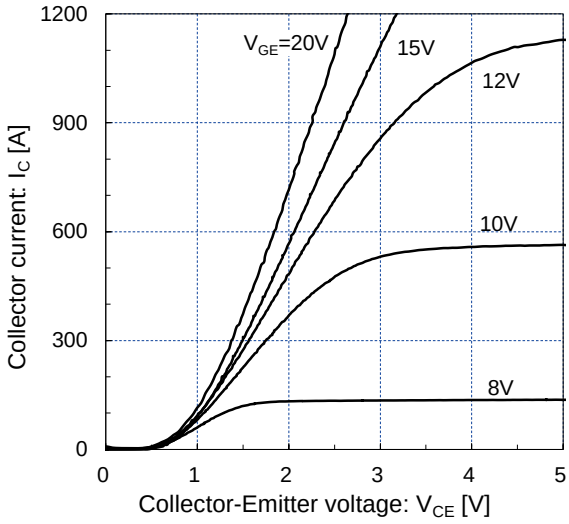
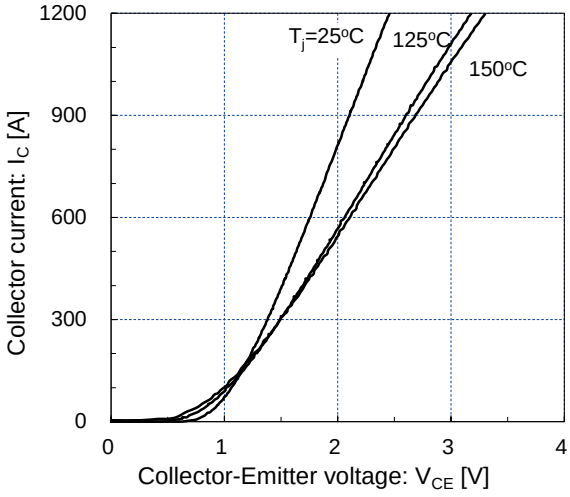
[Inverter (T1, T4)]
Collector current vs. Collector-Emitter voltage
T_j= 25°C / chip



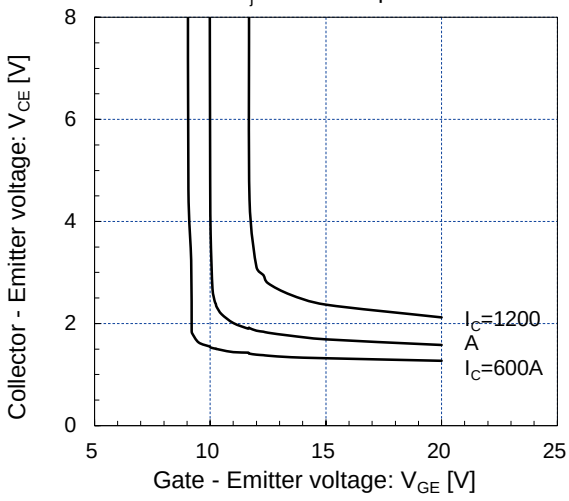
[Inverter (T1, T4)]
Collector current vs. Collector-Emitter voltage
T_j= 125°C / chip



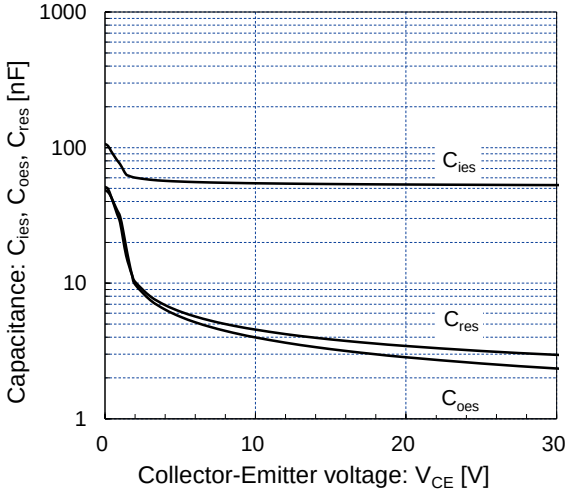
[Inverter (T1, T4)]
Collector current vs. Collector-Emitter voltage
V_{GE}= 15V / chip



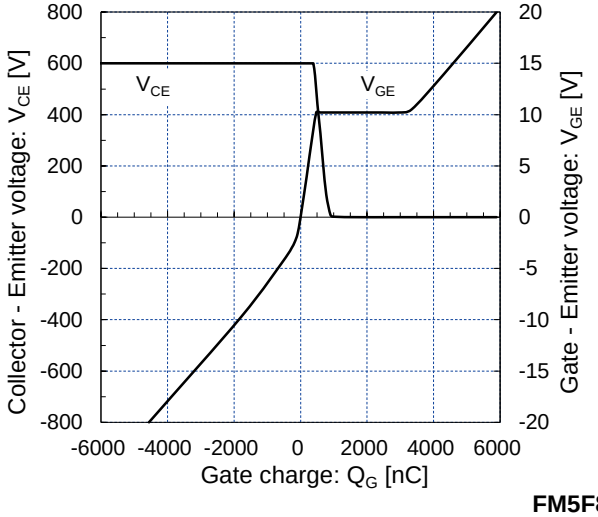
[Inverter (T1, T4)]
Collector-Emitter voltage vs. Gate-Emitter voltage (typ.)
T_j= 25°C / chip



[Inverter (T1, T4)]
Capacitance vs. Collector-Emitter voltage (typ.)
V_{GE}=0V, f= 1MHz, T_j= 25°C



[Inverter (T1, T4)]
Dynamic gate charge (typ.)
V_{CC}=600V, I_C= 650A, T_j=25°C



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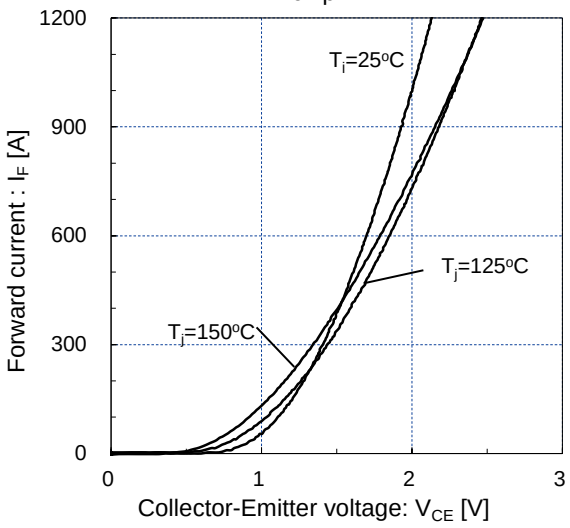
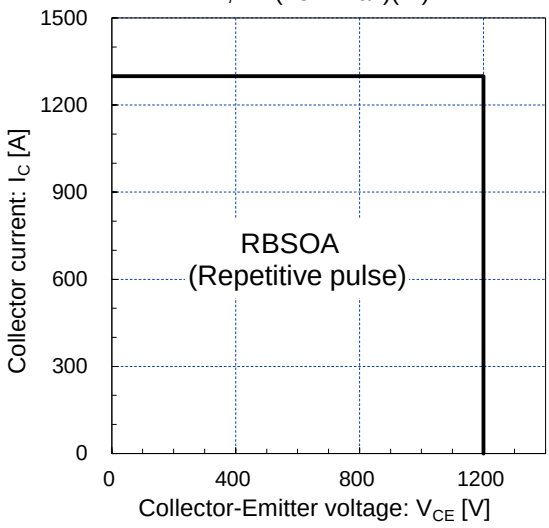
[Inverter (T1, T4)]
Forward current vs. forward on voltage (typ.)
chip

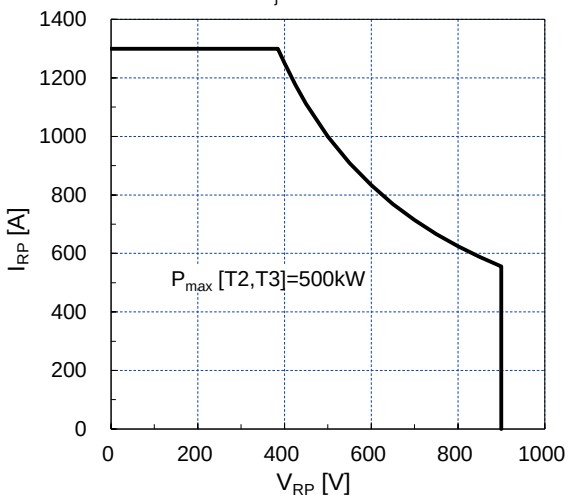


Revese bias safe operating area (max.)
V_{GE}=±15V, R_G ≧Recommended, T_j=150°C (T1, T4)
T1, T4 (Terminal)(*1)

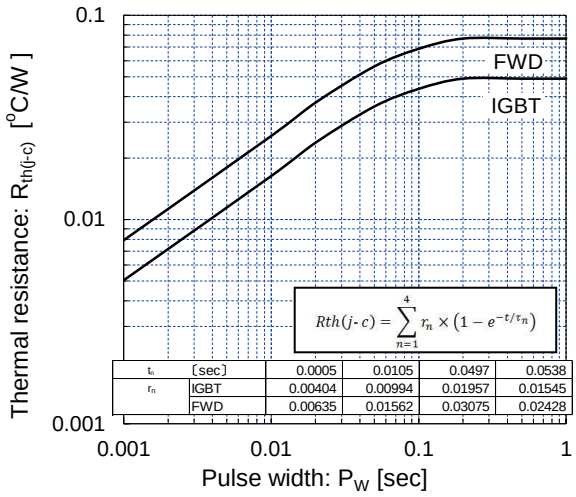


(*1) Please refer to page 1 for the terminal definition

Reverse recovery withstand capability for RB-IGBT
T_j= 125°C



Transient thermal resistance (max.)



τ_n	[sec]	0.0005	0.0105	0.0497	0.0538
r_n	IGBT	0.00404	0.00994	0.01957	0.01545
	FWD	0.00635	0.01562	0.03075	0.02428

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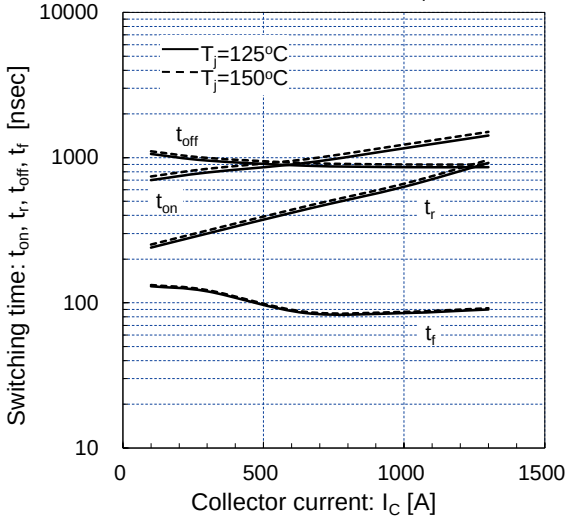
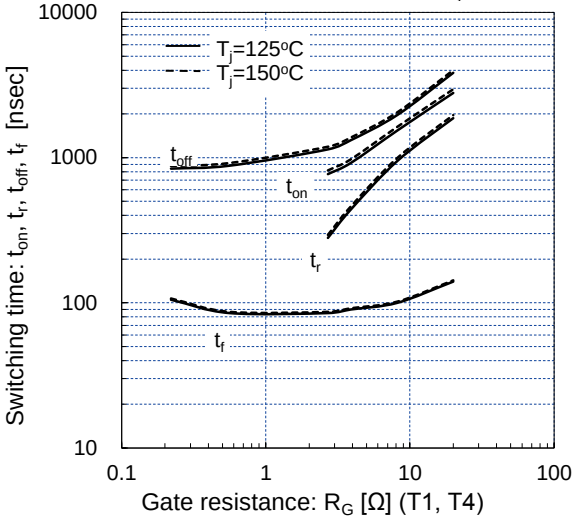
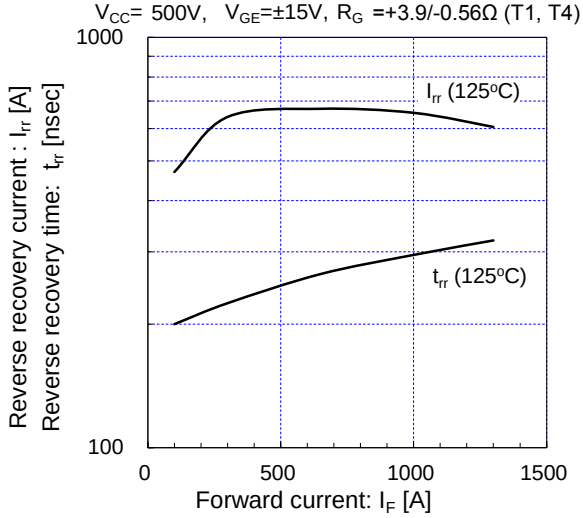
[SW mode: A]
Switching time vs. Collector current (typ.)
V_{CC} =500V, V_{GE}=±15V, R_G =+3.9/-0.56Ω, T_j=125,150°C (T1, T4)



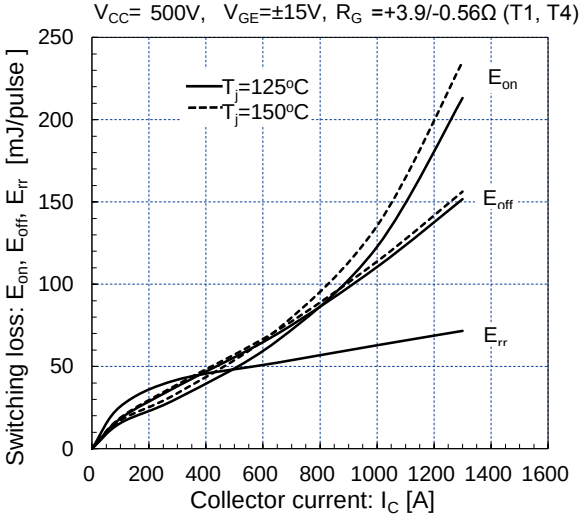
[SW mode: A]
Switching time vs. Collector current (typ.)
V_{CC} =500V, I_C= 650A, V_{GE}=±15V, T_j=125, 150°C



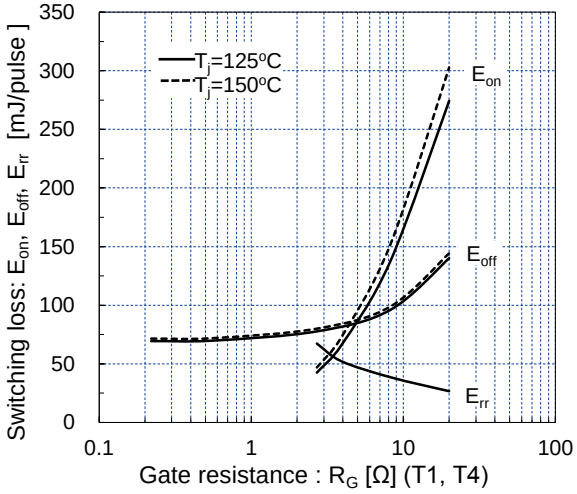
[SW mode: A (T2, T3 RB-IGBT recovery)]
Reverse recovery characteristics (typ.)
V_{CC}= 500V, V_{GE}=±15V, R_G =+3.9/-0.56Ω (T1, T4)



[SW mode: A]
T1,T4 IGBT switching, T2,T3 RB-IGBT recovery
Switching loss vs. Collector current (typ.)
V_{CC}= 500V, V_{GE}=±15V, R_G =+3.9/-0.56Ω (T1, T4)



[SW mode: A]
T1,T4 IGBT switching, T2,T3 RB-IGBT recovery
Switching loss vs. gate resistance (typ.)
V_{CC}= 500V, I_C= 650A, V_{GE}=±15V



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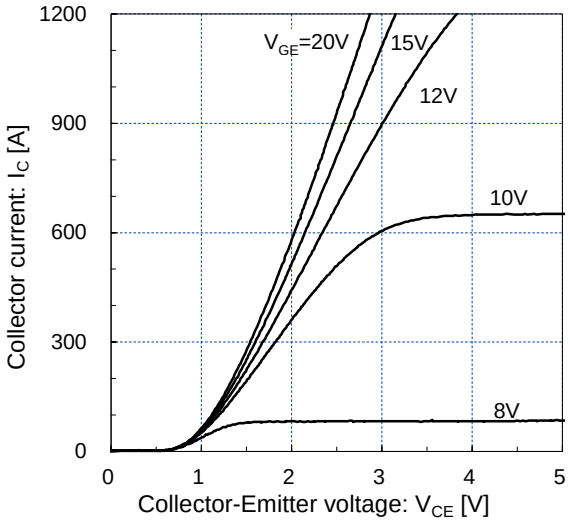
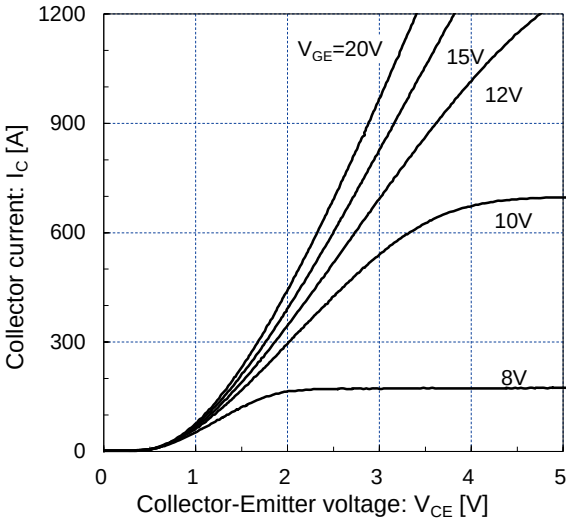
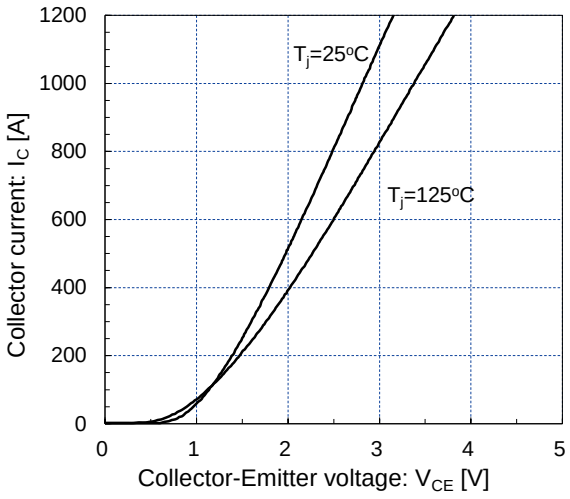
[AC-switch (T2, T3)]
Collector current vs. Collector-Emitter voltage (typ.)
T_j = 25°C / chip



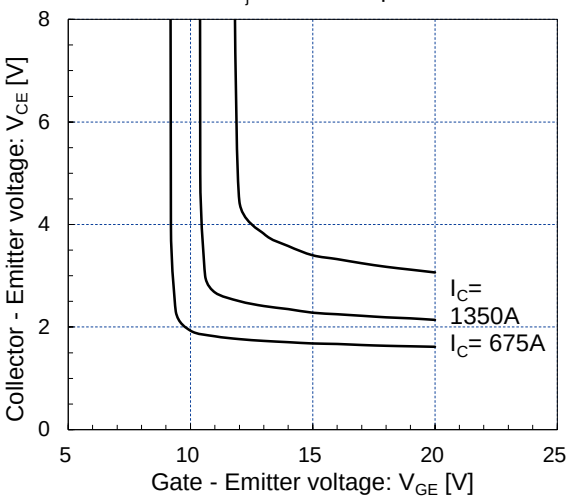
[AC-switch (T3, T4)]
Collector current vs. Collector-Emitter voltage (typ.)
T_j = 125°C / chip



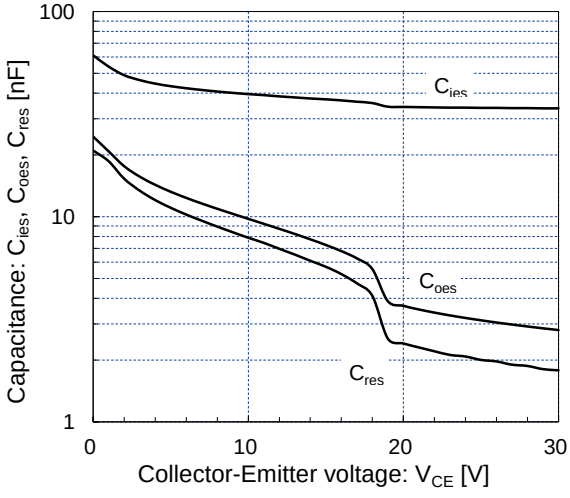
[AC-switch (T2, T3)]
Collector current vs. Collector-Emitter voltage (typ.)
V_{GE} =15V / chip



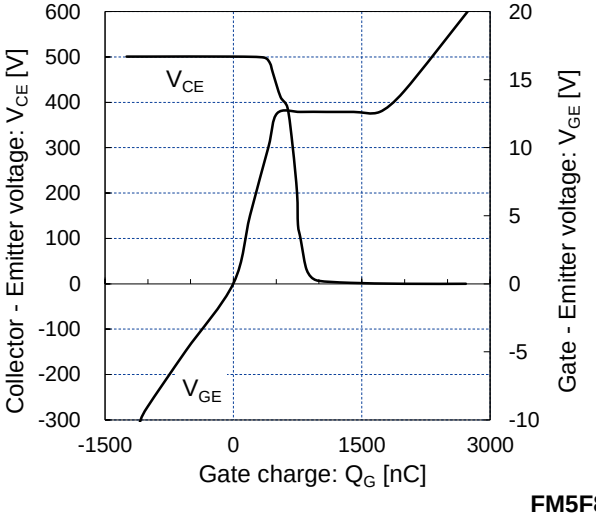
[AC-switch (T2, T3)]
Collector-Emitter voltage vs. Gate-Emitter voltage (typ.)
T_j = 25°C / chip



[AC-switch (T2, T3)]
Capacitance vs. Collector-Emitter voltage (typ.)
V_{GE} = 0V, f = 1MHz, T_j = 25°C



[AC-switch (T2, T3)]
Dynamic gate charge (typ.)
V_{CC}= 500V, I_C= 650A, T_j = 25°C



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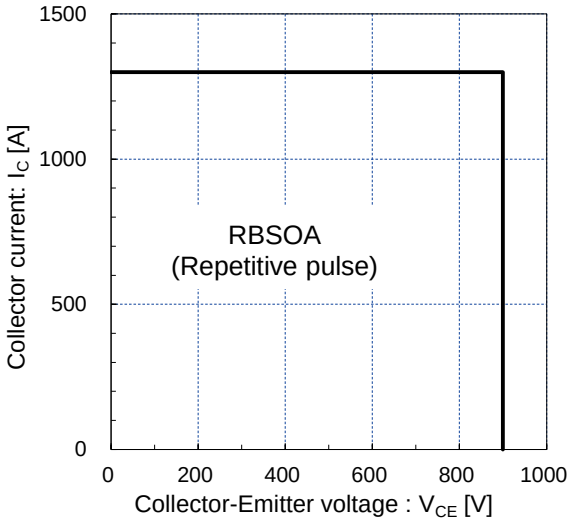
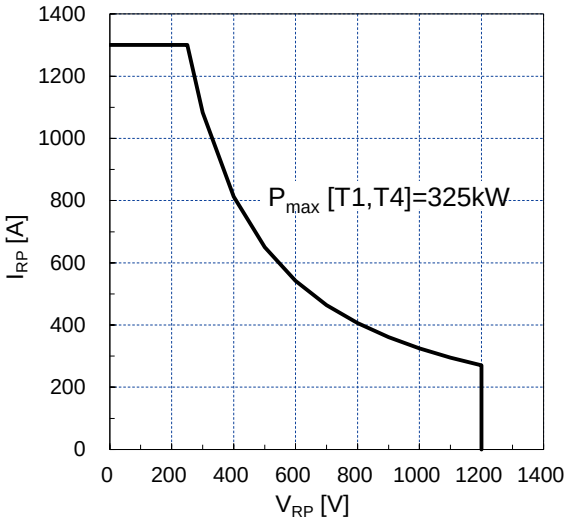
Reverse bias safe operating area (max.)
V_{GE}=±15V, R_G ≧Recommended, T_j=125°C (T2, T3)
T2, T3 (Terminal) (*1)

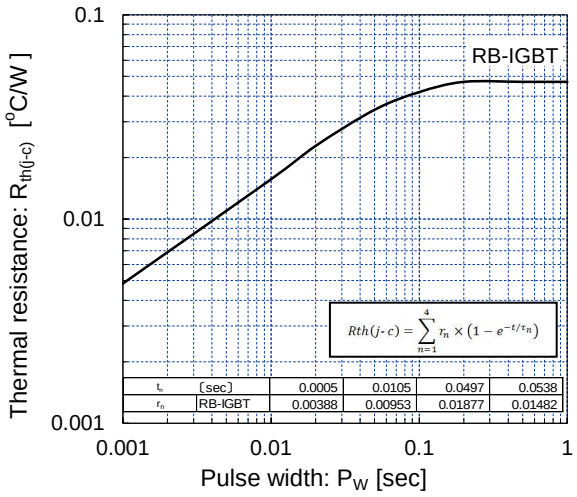


(*1) Please refer to page 1 for the terminal definition

Reverse recovery withstand capability for FWD
T_j=150°C



Transient thermal resistance (max.)



τ_n	[sec]	0.0005	0.0105	0.0497	0.0538
r_n	RB-IGBT	0.00388	0.00953	0.01877	0.01482

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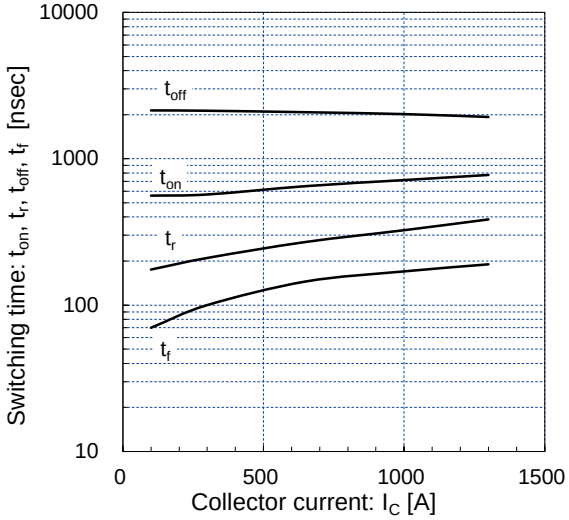
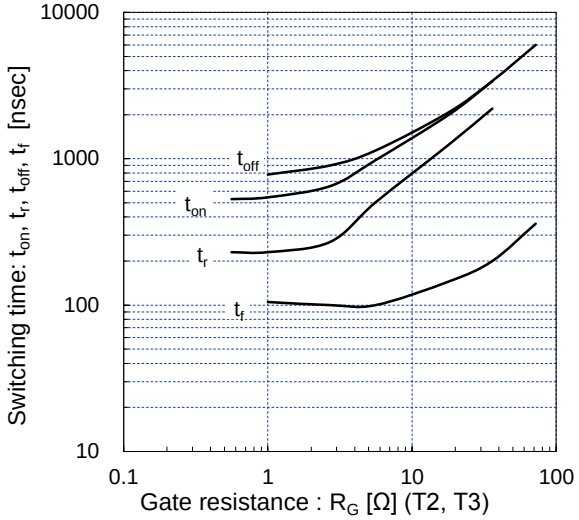
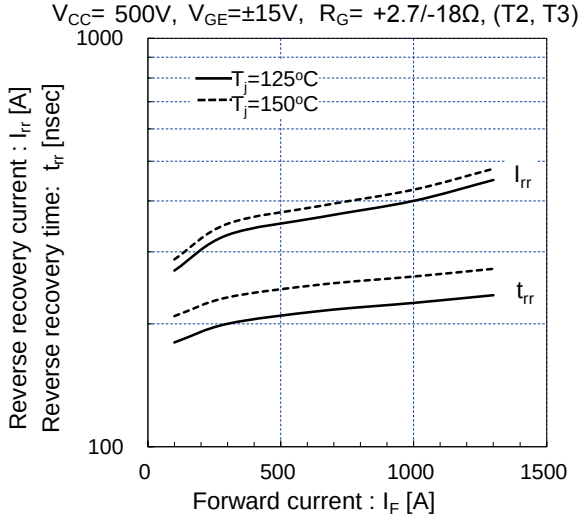
[SW mode: B]
Switching time vs. collector current (typ.)
V_{CC} =500V, V_{GE}=±15V, R_G =+2.7/-18Ω, T_j=125°C (T2, T3)



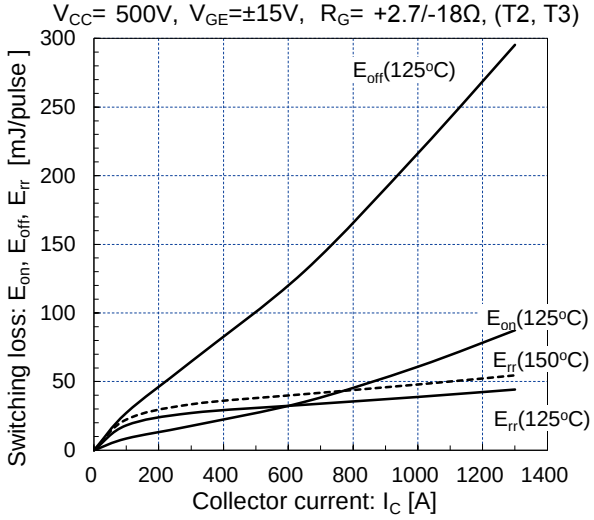
[SW mode: B]
Switching time vs. gate resistanec (typ.)
V_{CC}= 500V, I_C =650A, V_{GE}=±15V, T_j=125°C



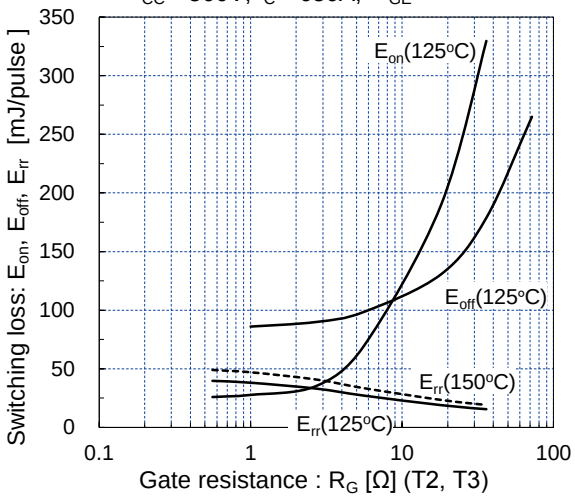
[SW mode B (T1,T4 FWD recovery)]
Reverse recovery characteristics (typ.)
V_{CC}= 500V, V_{GE}=±15V, R_G= +2.7/-18Ω, (T2, T3)



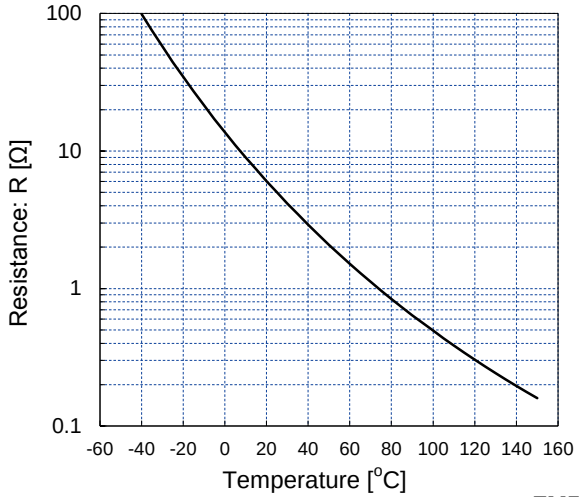
[SW mode: B]
T2,T3 RB-IGBT switching, T1,T4 FWD recovery
Switching loss vs. Collector current (typ.)
V_{CC}= 500V, V_{GE}=±15V, R_G= +2.7/-18Ω, (T2, T3)



[SW mode B]
T2,T3 RB-IGBT switching, T1,T4 FWD recovery
Switching loss vs. gate resistance (typ.)
V_{CC}= 500V, I_C= 650A, V_{GE}=±15V



[THERMISTOR]
Temperature characteristic (typ.)



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Warnings

1. This Catalog contains the product specifications, characteristics, data, materials, and structures as of 12/2014.
   The contents are subject to change without notice for specification changes or other reasons. When using a product listed in this Catalog, be sure 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 fail-safe, 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

7.

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.