

4MBI400VG-060R-50

IGBT Modules

IGBT MODULE (V series)

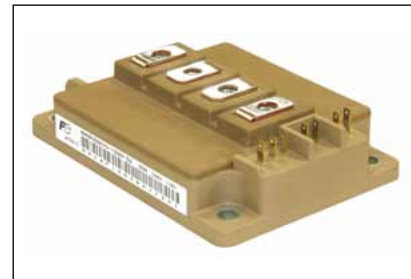
600V / 400A / IGBT, RB-IGBT 4 in one package

■ 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	$T_C=80^{\circ}\text{C}$	A
			I_{CP}	1ms	$T_C=80^{\circ}\text{C}$	
		FWD	$-I_C$			
			$-I_{CP}$	1ms		
	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	$T_C=80^{\circ}\text{C}$	400	A
		I_{CP}	1ms	$T_C=80^{\circ}\text{C}$	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 T_j = 25°C unless otherwise specified)

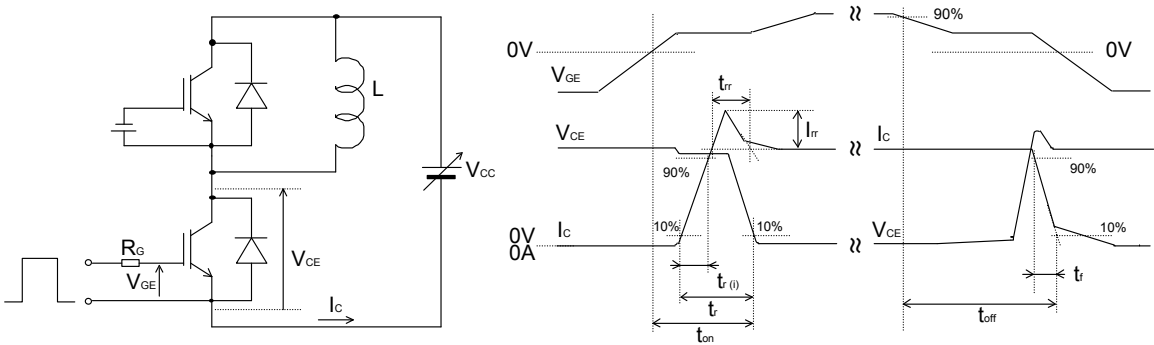
Items		Symbols	Conditions	Characteristics			Units	
				min.	typ.	max.		
T1, T2	Zero gate voltage collector current	I _{CES}	V _{GE} = 0V, V _{CE} = 600V		-	-	2.0	mA
	Gate-Emitter leakage current	I _{GES}	V _{CE} = 0V, V _{GE} = ±20V		-	-	400	nA
	Gate-Emitter threshold voltage	V _{GE (th)}	V _{CE} = 20V, 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 (l)}			-	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 (l)}			-	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

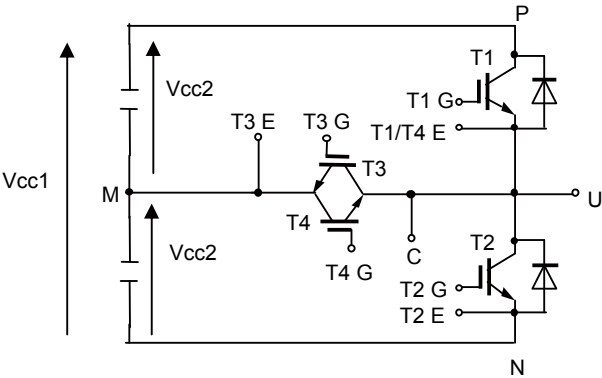
Items	Symbols	Conditions	Characteristics			Units
			min.	typ.	max.	
Thermal resistance (1device)	R _{th(j-c)}	T1, T2 IGBT	-	-	0.11	°C/W
		T1, T2 FWD	-	-	0.22	
		T3, T4 RB-IGBT	-	-	0.08	
Contact thermal resistance (1device) (*4)	R _{th(c-f)}	T1, T2	-	0.025	-	
		T3, T4	-	0.013	-	

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



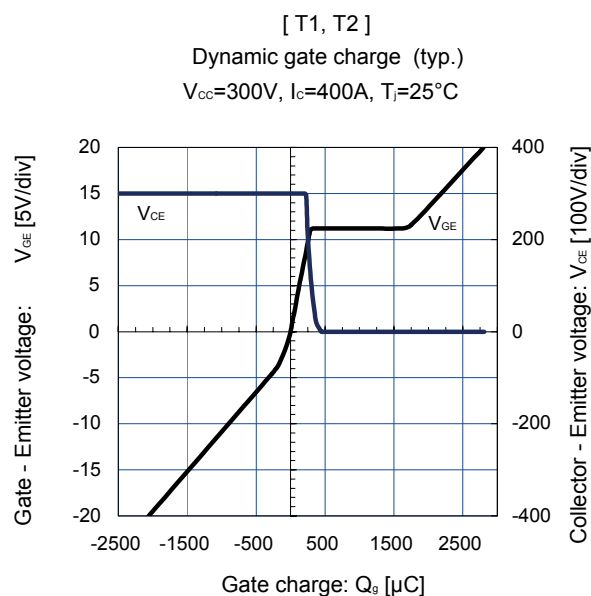
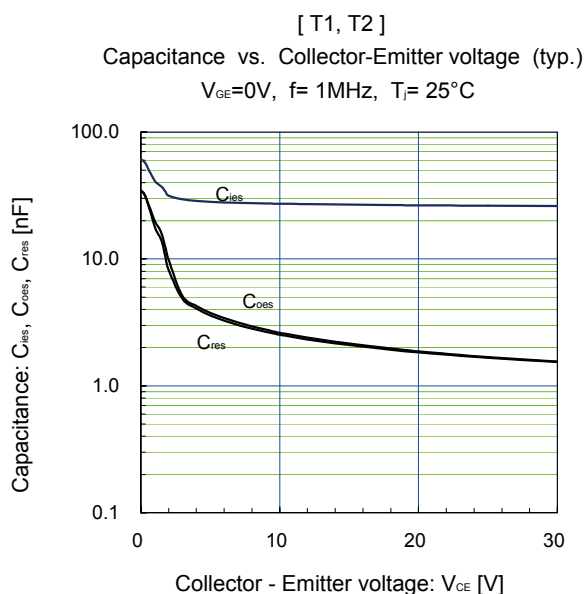
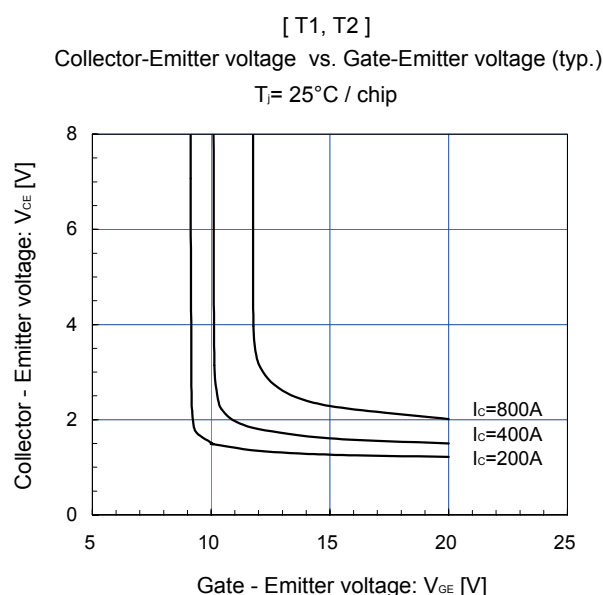
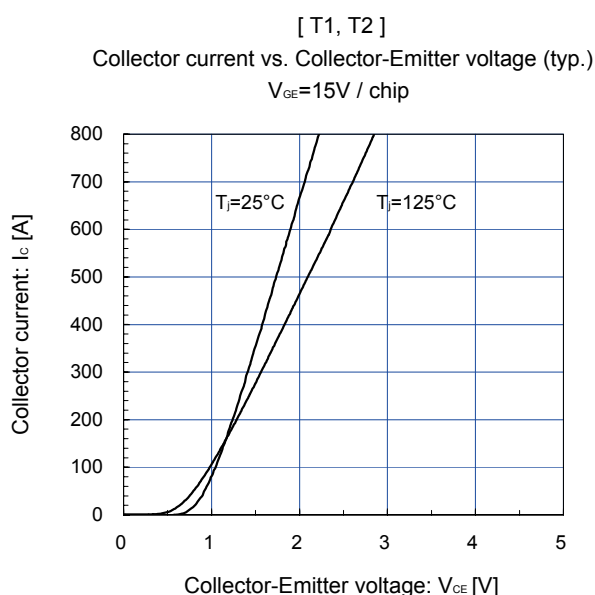
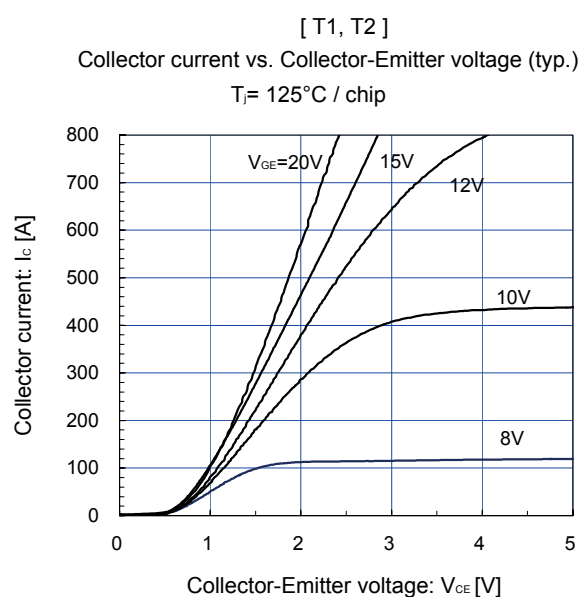
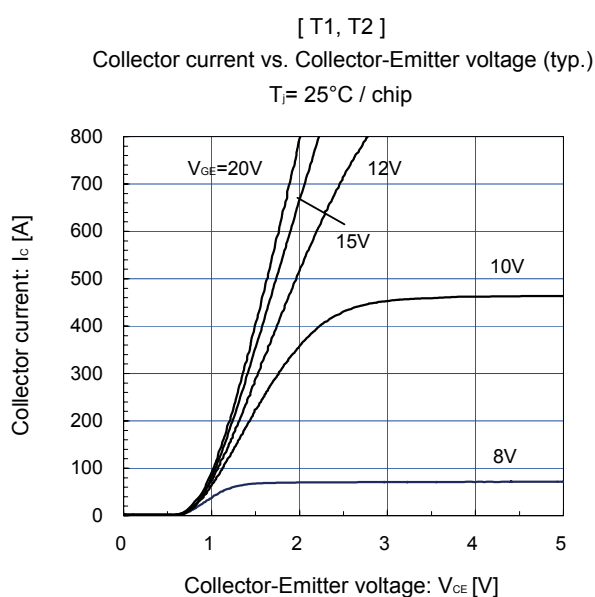
Definitions of switching mode



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

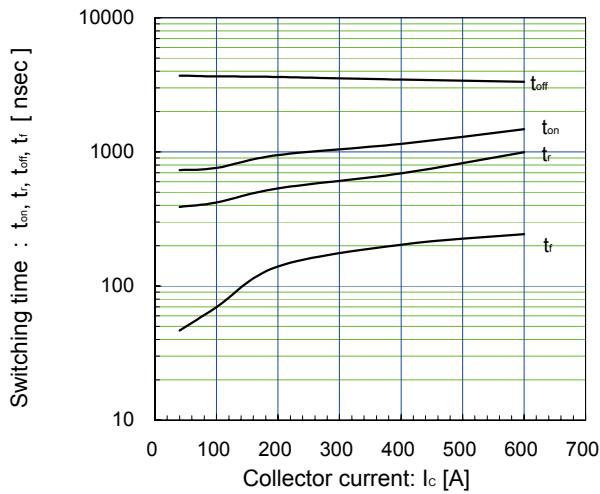
SW: Connect to drive circuit and input gate signal
ON: Bias voltage of gate +15V
OFF: Reverse bias voltage of gate -15V
V_{CC2}=V_{CC1}/2

■ Characteristics (Representative)



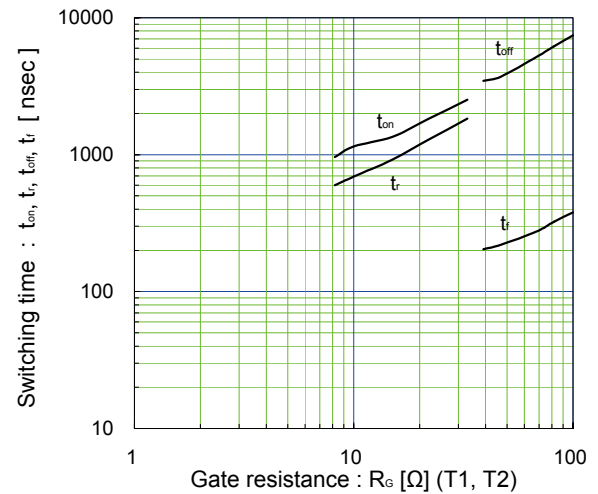
[SW mode A]

Switching time vs. Collector current (typ.)

 $V_{CC}=400V$, $V_{GE}=\pm 15V$, $R_G=+10/-39\Omega$, $T_J=125^\circ C$ (T1, T2)

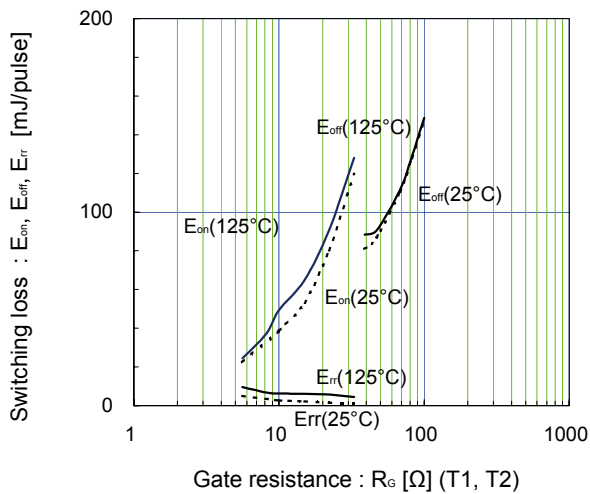
[SW mode A]

Switching time vs. Collector current (typ.)

 $V_{CC}=400V$, $I_c=400A$, $V_{GE}=\pm 15V$, $T_J=125^\circ C$ 

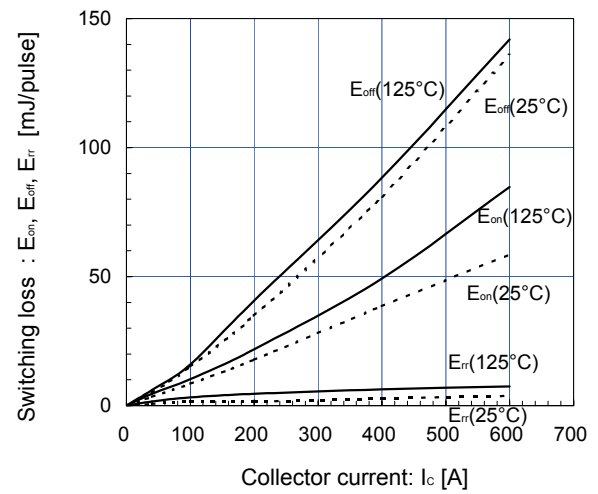
[SW mode A]

Switching loss vs. gate resistance (typ.)

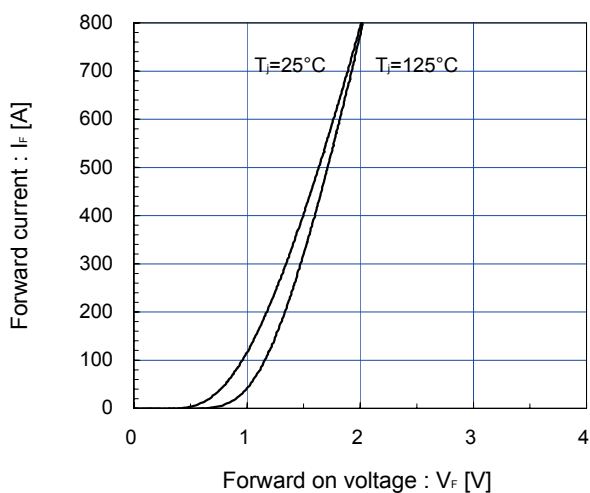
 $V_{CC}=400V$, $I_c=400A$, $V_{GE}=\pm 15V$ 

[SW mode A]

Switching loss vs. Collector current (typ.)

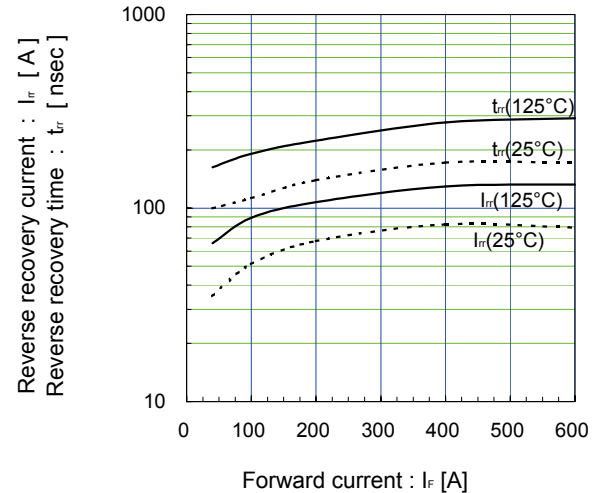
 $V_{CC}=400V$, $V_{GE}=\pm 15V$, $R_G=+10/-39\Omega$ (T1, T2)

[T1, T2]

Forward current vs. forward on voltage (typ.)
chip

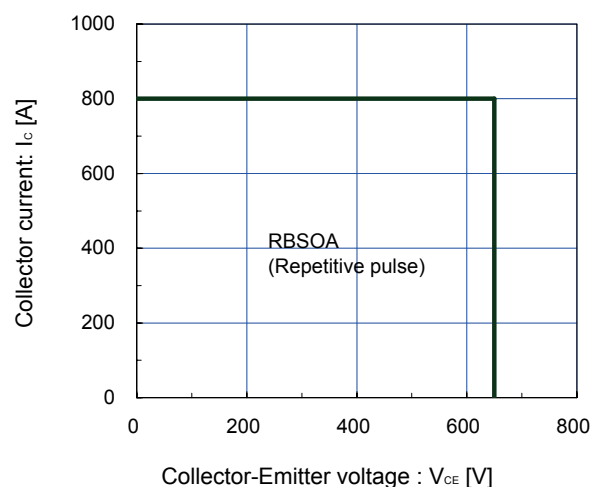
[T1, T2]

Reverse recovery characteristics (typ.)

 $V_{CC}=400V$, $V_{GE}=\pm 15V$, $R_G=+10/-39\Omega$ (T1, T2)

Reverse bias safe operating area (max.)

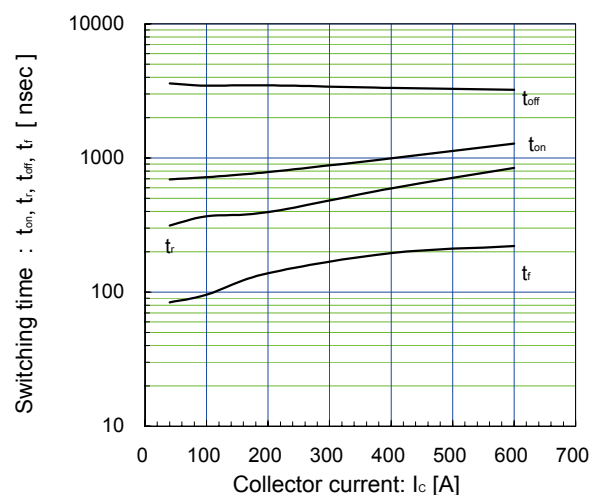
$V_{GE}=15V$, $-V_{GE} \leq 15V$, $R_G \geq +10/-39\Omega$, $T_J \leq 125^\circ C$ (T1, T2)
T1, T2 (Terminal)



[SW mode C]

Switching time vs. Collector current (typ.)

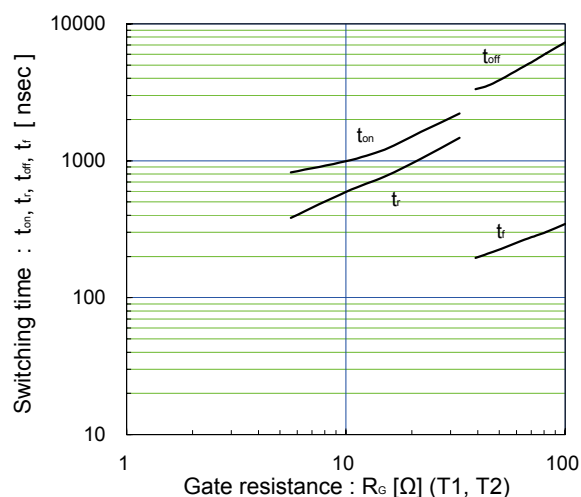
$V_{CC}=200V$, $V_{GE}=\pm 15V$, $R_G=\pm 10/-39\Omega$, $T_J=125^\circ C$ (T1, T2)



[SW mode C]

Switching time vs. Collector current (typ.)

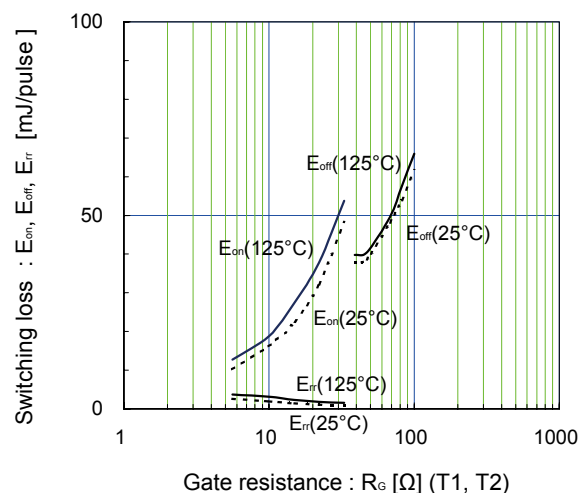
$V_{CC}=200V$, $I_c=400A$, $V_{GE}=\pm 15V$, $T_J=125^\circ C$



[SW mode C]

Switching loss vs. gate resistance (typ.)

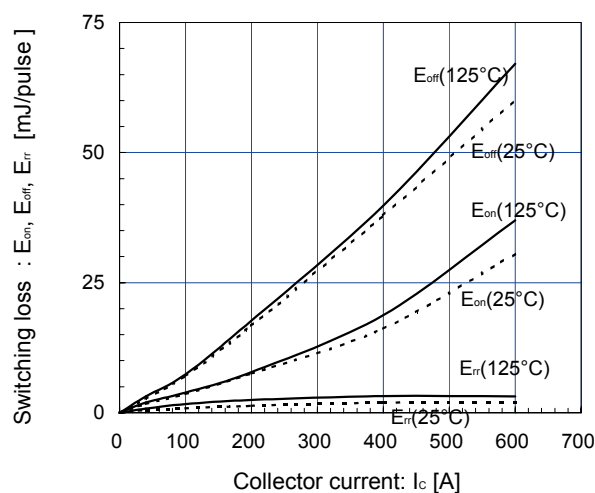
$V_{CC}=200V$, $I_c=400A$, $V_{GE}=\pm 15V$



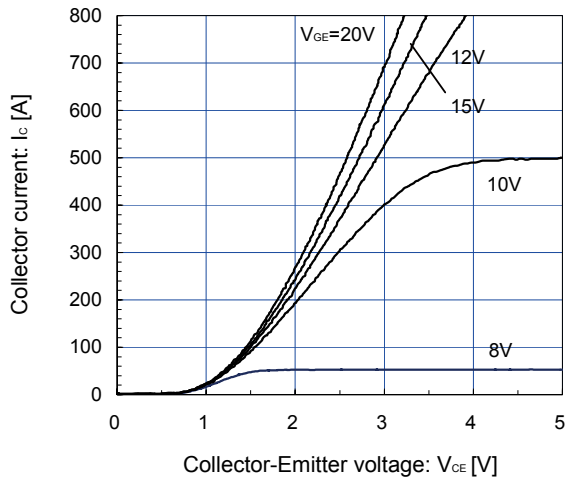
[SW mode C]

Switching loss vs. Collector current (typ.)

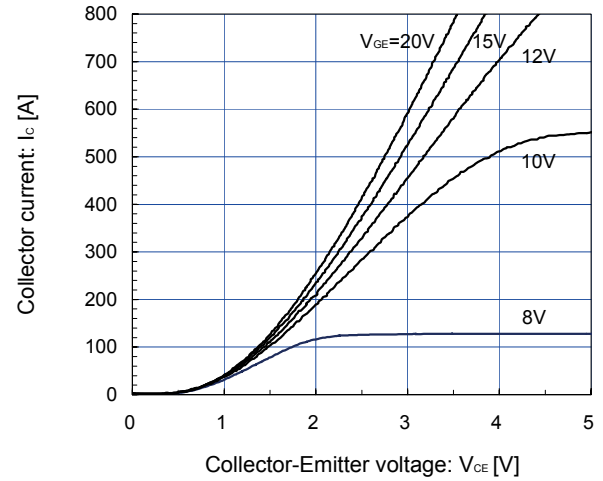
$V_{CC}=200V$, $V_{GE}=\pm 15V$, $R_G=\pm 10/-39\Omega$ (T1, T2)



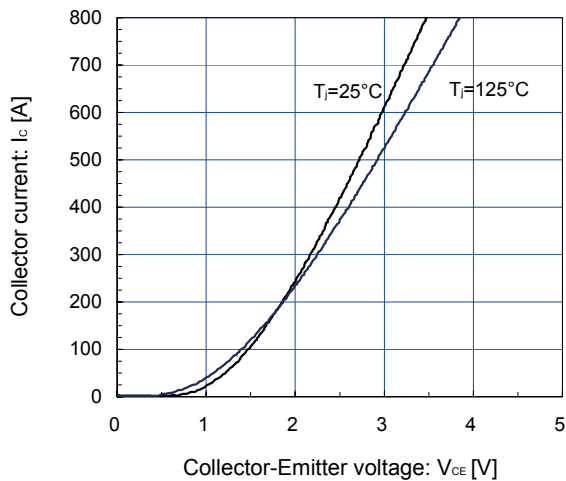
[T3, T4]
Collector current vs. Collector-Emitter voltage (typ.)
 $T_J = 25^\circ\text{C}$ / chip



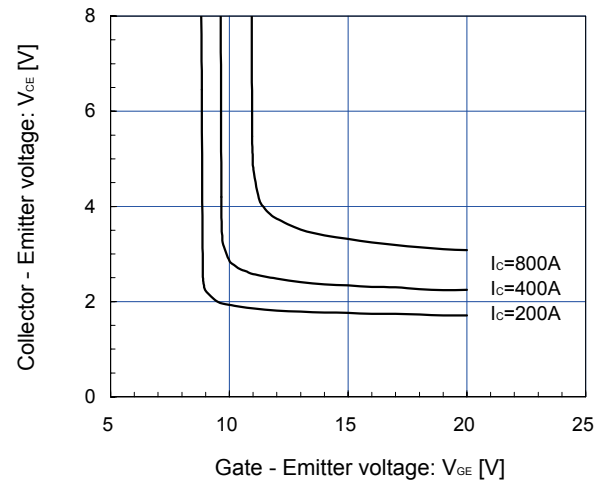
[T3, T4]
Collector current vs. Collector-Emitter voltage (typ.)
 $T_J = 125^\circ\text{C}$ / chip



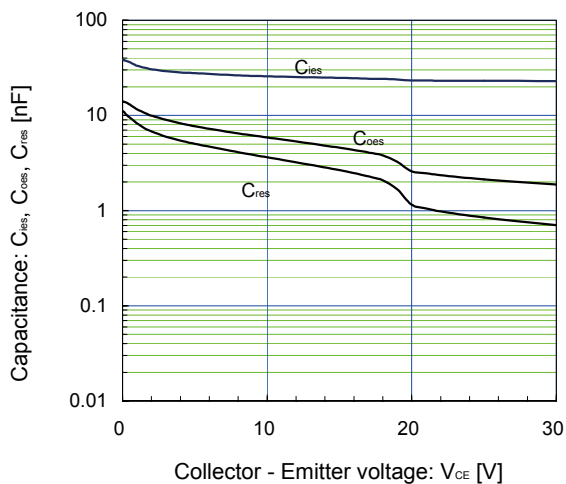
[T3, T4]
Collector current vs. Collector-Emitter voltage (typ.)
 $V_{GE} = 15\text{V}$ / chip



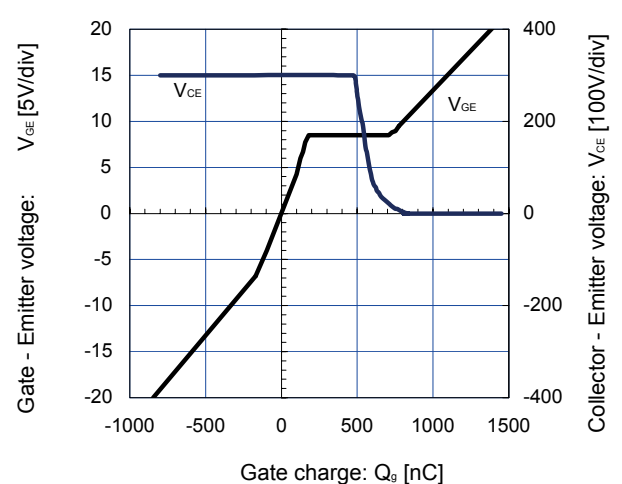
[T3, T4]
Collector-Emitter voltage vs. Gate-Emitter voltage (typ.)
 $T_J = 25^\circ\text{C}$ / chip



[T3, T4]
Capacitance vs. Collector-Emitter voltage (typ.)
 $V_{GE} = 0\text{V}$, $f = 1\text{MHz}$, $T_J = 25^\circ\text{C}$

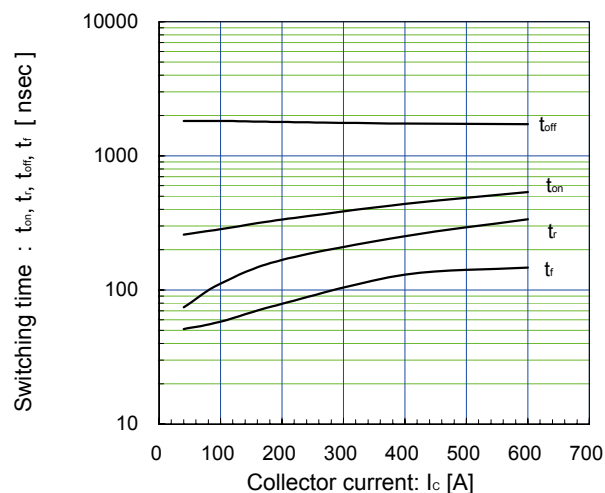


[T3, T4]
Dynamic gate charge (typ.)
 $V_{CC} = 300\text{V}$, $I_C = 400\text{A}$, $T_J = 25^\circ\text{C}$



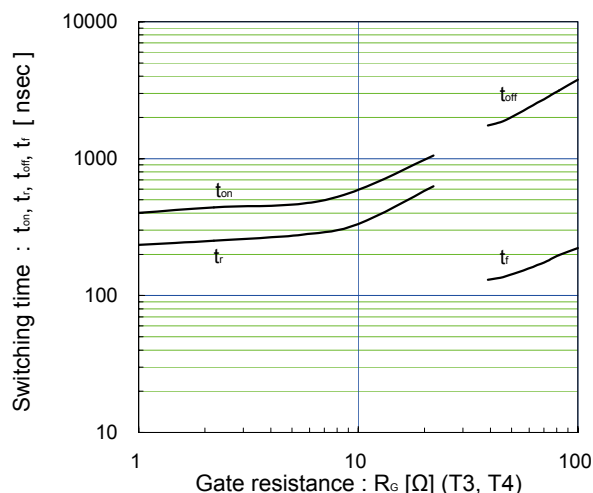
[SW mode B]

Switching time vs. Collector current (typ.)

 $V_{CC}=200V$, $V_{GE}=\pm 15V$, $R_G=+2.2/-39\Omega$, $T_J=125^\circ C$ (T3, T4)

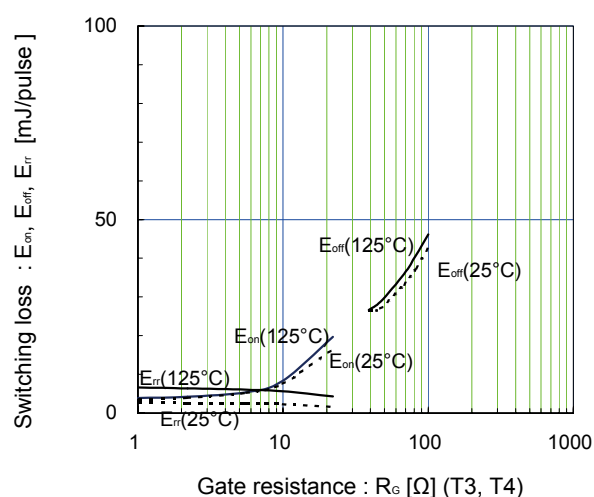
[SW mode B]

Switching time vs. Collector current (typ.)

 $V_{CC}=200V$, $I_c=400A$, $V_{GE}=\pm 15V$, $T_J=125^\circ C$ 

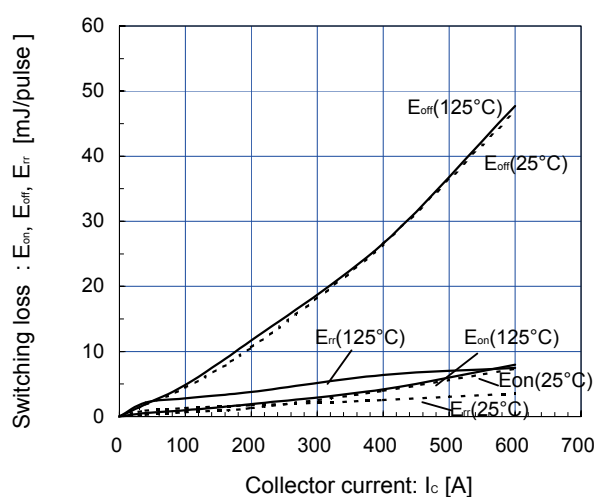
[SW mode B]

Switching loss vs. gate resistance (typ.)

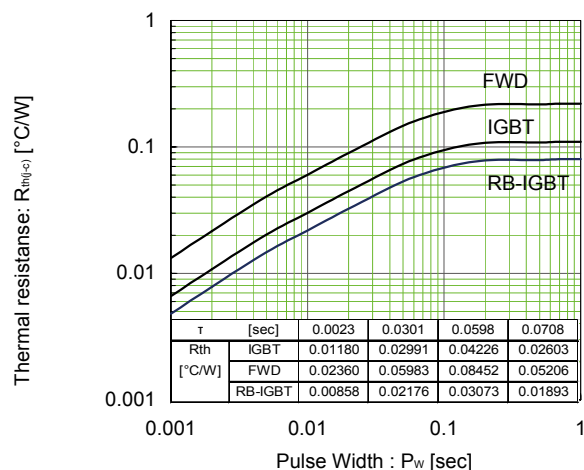
 $V_{CC}=200V$, $I_c=400A$, $V_{GE}=\pm 15V$ 

[SW mode B]

Switching loss vs. Collector current (typ.)

 $V_{CC}=200V$, $V_{GE}=\pm 15V$, $R_G=+2.2/-39\Omega$ (T3, T4)

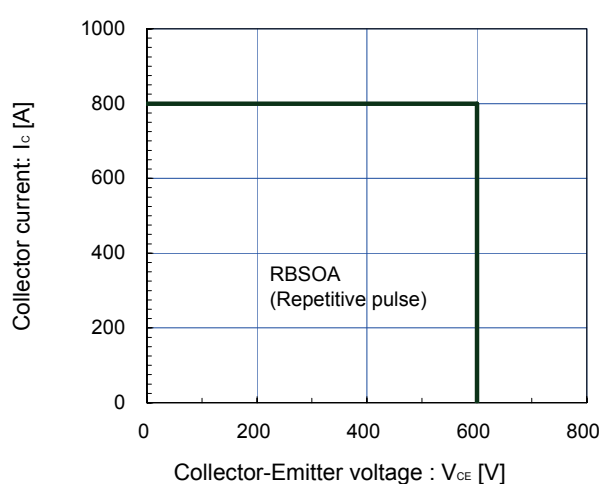
Transient Thermal Resistance (max.)



Reverse bias safe operating area (max.)

 $V_{GE}=15V$, $-V_{GE} \leq 15V$, $R_G \geq +2.2/-39\Omega$, $T_J \leq 125^\circ C$ (T3, T4)

T3, T4 (Terminal)



[illegible]

WARNING

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• Machine tools	• Audiovisual equipment	• Electrical home appliances	• Personal equipment
			• Industrial robots etc.
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• Emergency equipment for responding to disasters and anti-burglary devices	• Safety devices
• Medical equipment	
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