4MBI400VF-120R-50

IGBT Modules

IGBT Power Module (V series)
1200V/400A/IGBT, ±600V/450A/RB-IGBT, 4-in-1 package

■ Features

Higher efficiency
Optimized Advanced T-type circuit
Low inductance module structure

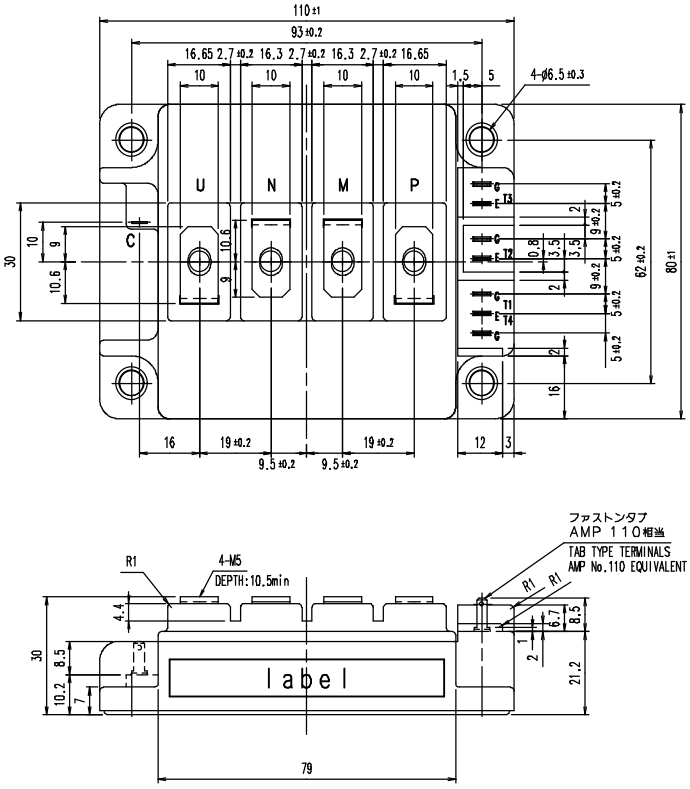


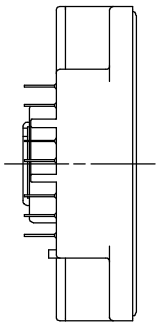
■ Applications

Inverter for motor drive
Uninterruptible powre supply
Power conditioner

■ Outline drawing

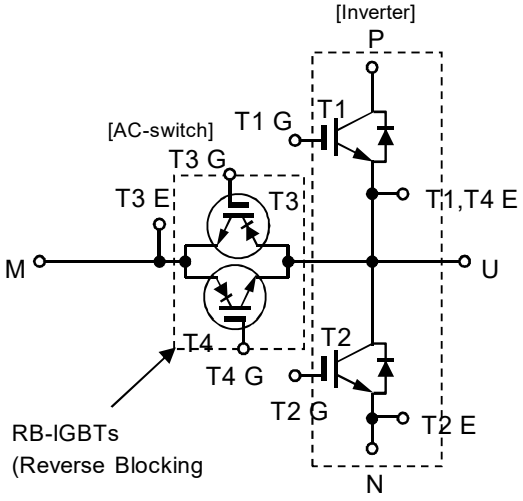
(Unit : mm)





Weight: 460g (typ.)

■ Equivalent Circuit



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

Item			Symbol	Condition		Maximum Rating	Unit
Inverter	Collector-Emitter voltage		V_{CES}			1200	V
	Gate-Emitter voltage		V_{GES}			±20	V
	Collector current	IGBT	I_C	Continuous	Tc=80°C	400	A
			I_{CP}	1ms	Tc=80°C	800	
		FWD	$-I_C$			300	
			$-I_C$ pulse			800	
	Collector power dissipation		P_C	1 device		1835	W
	Junction temperature		T_j			150	°C
	Operating temperature (under switching conditions)		T_{jop}			125	
AC-Switch	Collector-Emitter voltage		V_{CES}			±600	V
	Gate-Emitter voltage		V_{GES}			±20	V
	Collector current		I_C	Continuous	Tc=80°C	450	A
			I_{CP}	1ms	Tc=80°C	900	
	Collector power dissipation		P_C	1 device		2230	W
	Junction temperature		T_j			150	°C
	Operating junction temperature (under switching conditions)		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.		2500	VAC
Screw torque	Mounting (*2)		-	M5 or M6		3.5	Nm
	Terminal (*3)		-	M5		3.5	

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

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

	Item	Symbol	Condition		Characteristics min.	typ.	max.	Units
Inverter	Zero gate voltage collector current	I_{CES}	V_{GE} = 0V V_{CE} = 1200V		-	-	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		6.0	6.5	7.0	V
	Collector-Emitter saturation voltage	$V_{CE(sat)}$ (chip)	V_{GE} = 15V I_C = 400A	T_j=25°C	-	2.00	2.25	
				T_j=125°C		2.40	-	
		$V_{CE(sat)}$ (terminal)	V_{GE} = 15V I_C = 400A	T_j=25°C	-	2.20	2.55	
				T_j=125°C		2.60	-	
	Internal gate resistance	$R_{g(int)}$	-		-	2.50	-	Ω
	Input capacitance	C_{ies}	V_{CE}=10V, V_{GE}=0V, f=1MHz		-	27.6	-	nF
	Turn-on time	t_{on}	SW mode: A V_{CC}= 400V I_C = 400A V_{GE}= ±15V R_G = +8.2/-1Ω		-	1.10	-	μs
		t_r			-	0.60	-	
		$t_{r(i)}$			-	0.20	-	
	Turn-off time	t_{off}			-	0.60	-	
		t_f			-	0.10	-	
	Forward on voltage	V_F (chip)	I_F = 300A	T_j=25°C	-	1.95	2.20	V
				T_j=125°C	-	2.20	-	
		V_F (terminal)	I_F = 300A	T_j=25°C	-	2.15	2.45	
				T_j=125°C	-	2.40	-	
	Reverse recovery time	t_{rr}	SW mode: B V_{CC}= 400V I_F = 400A V_{GE}= ±15V R_G = +6/-30Ω		-	0.15	-	μs
AC-switch	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	
				T_j=125°C		2.60	-	
		$V_{CE(sat)}$ (terminal)	V_{GE} = 15V I_C = 400A	T_j=25°C	-	2.65	3.15	
				T_j=125°C		2.80	-	
	Internal gate resistance	$R_{g(int)}$	-		-	2.20	-	Ω
	Input capacitance	C_{ies}	V_{CE}=10V, V_{GE}=0V, f=1MHz		-	26.0	-	nF
	Turn-on time	t_{on}	SW mode: B V_{CC}= 400V I_C = 400A V_{GE}= ±15V R_G = +6.0/-30Ω		-	0.35	-	μs
		t_r			-	0.20	-	
		$t_{r(i)}$			-	0.10	-	
	Turn-off time	t_{off}			-	1.00	-	
		t_f			-	0.10	-	
	Reverse recovery time	t_{rr}	SW mode: A V_{CC}= 400V I_F = 400A V_{GE}= ±15V R_G = +8.2/-1Ω		-	0.15	-	μs
Internal inductance			P-N		-	40	-	nH
			P-M		-	33	-	
			M-N		-	33	-	

■ **Thermal resistance characteristics**

Item	Symbol	Condition		Characteristics min.	typ.	max.	Units
Thermal resistance (1device)	$R_{th(j-c)}$	T1, T2 IGBT		-	-	0.068	°C/W
		T1, T2 FWD		-	-	0.173	
		T3, T4 RB-IGBT		-	-	0.056	
Contact thermal resistance (1device) (*1)	$R_{th(c-f)}$	T1, T2	with thermal compound	-	0.025	-	
		T3, T4		-	0.013	-	

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

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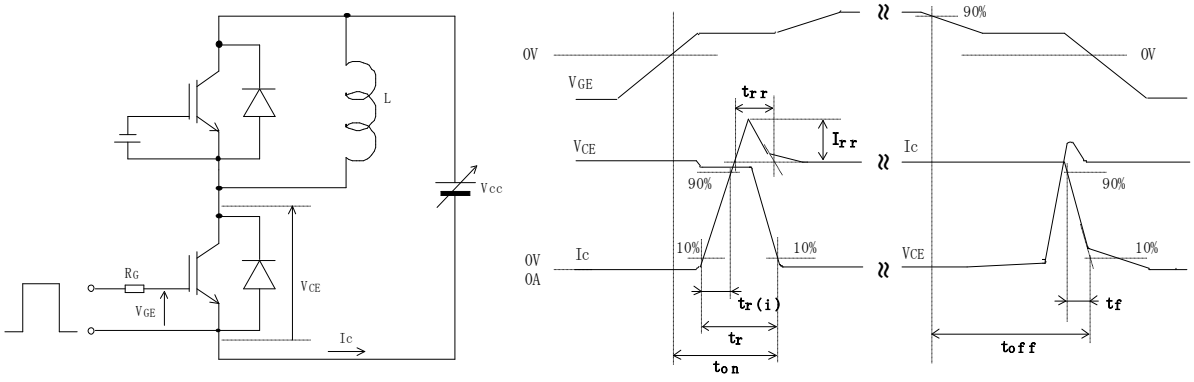
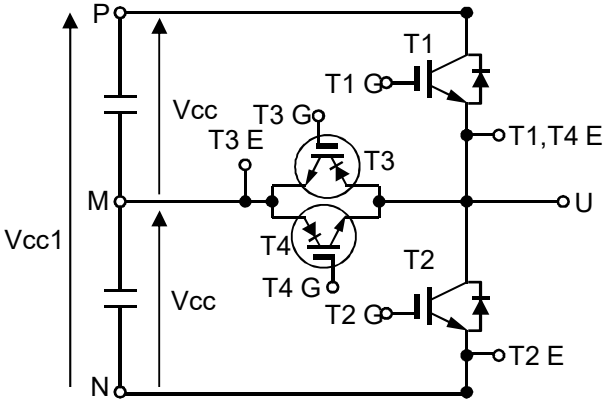
■ Definitions of switching time



■ 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
Vcc=Vcc1/2

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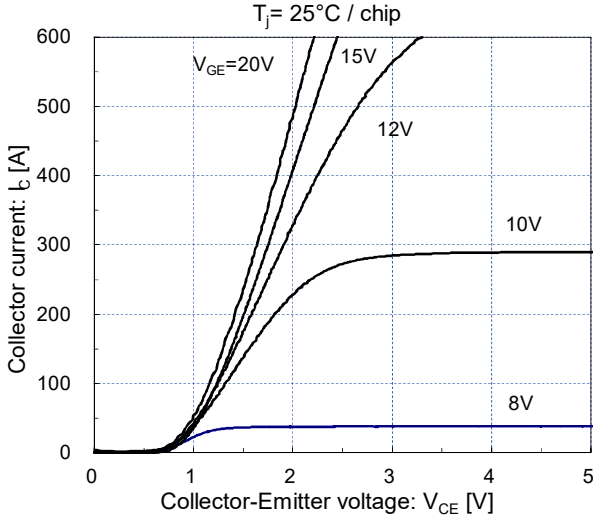
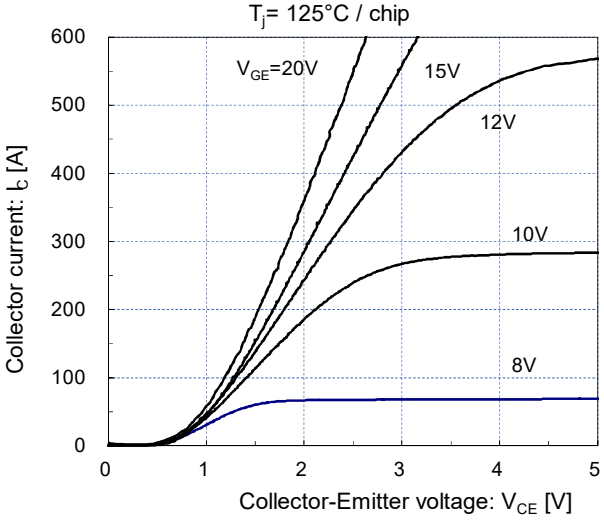
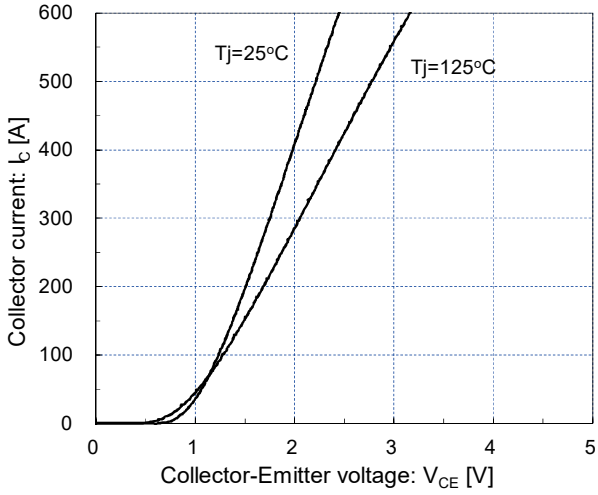
[Inverter (T1, T2)]
Collector current vs. Collector-Emitter voltage (typ.)
T_j= 25°C / chip



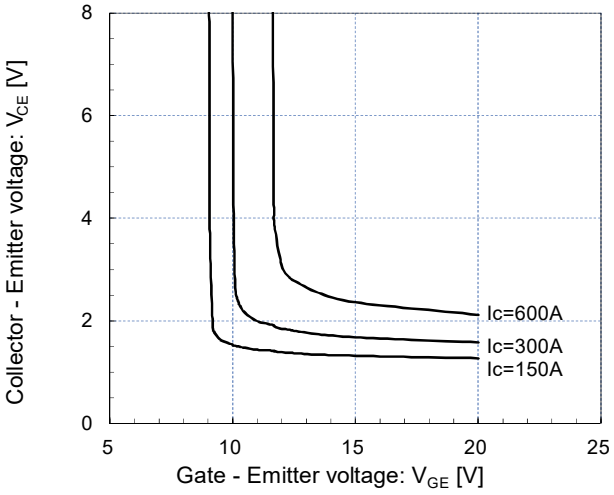
[Inverter (T1, T2)]
Collector current vs. Collector-Emitter voltage (typ.)
T_j= 125°C / chip



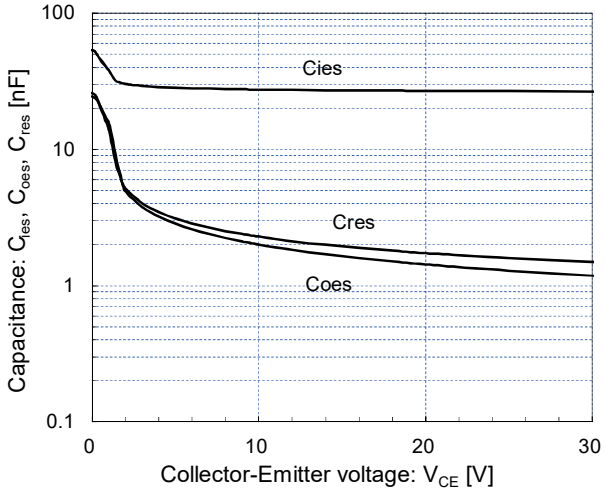
[Inverter (T1, T2)]
Collector current vs. Collector-Emitter voltage (typ.)
V_{GE}= 15V / chip



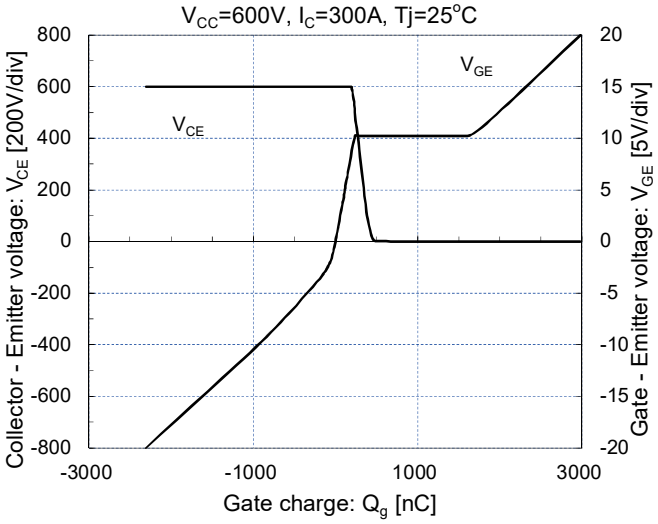
[Inverter (T1, T2)]
Collector-Emitter voltage vs. Gate-Emitter voltage (typ.)
Tj= 25°C / chip



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



[Inverter (T1, T2)]
Dynamic gate charge (typ.)
V_{CC}=600V, I_C=300A, Tj=25°C



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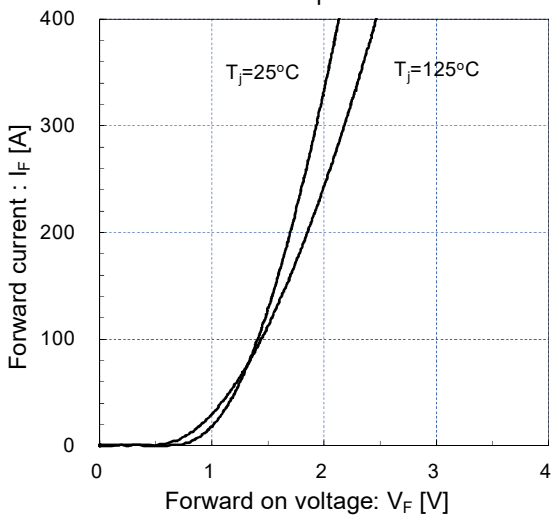
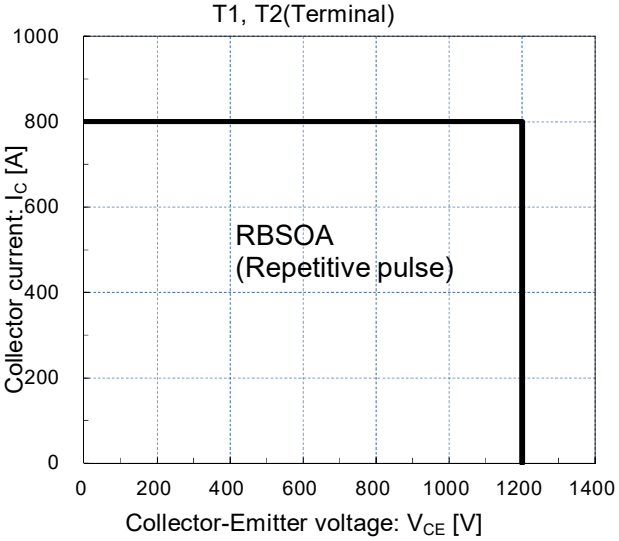
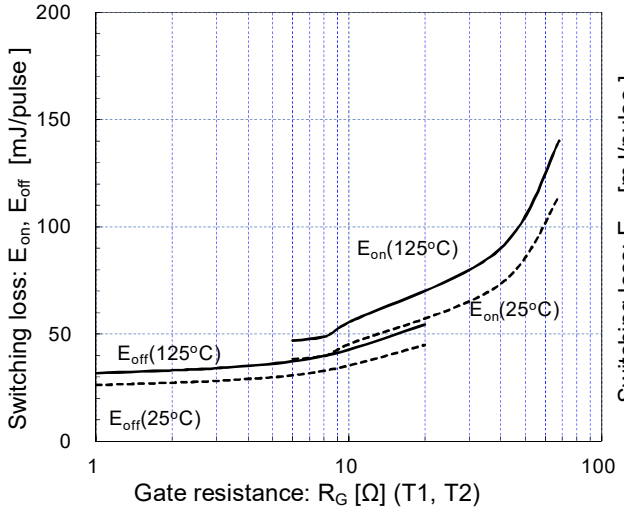
[Inverter (T1, T2)]
Forward current vs. forward on voltage (typ.)
chip



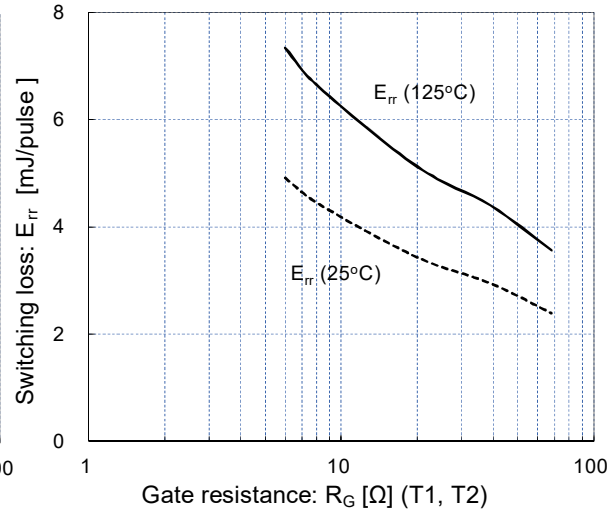
Reverse bias safe operating area(max.)
V_{GE}=±15V, R_G ≧Recommended, T_j=125°C (T1, T2)
T1, T2(Terminal)



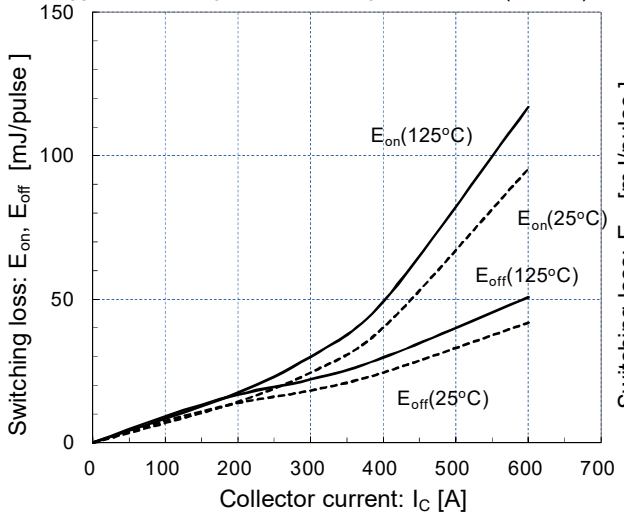
[SW mode A]
Switching loss vs. gate resistance (typ.)
V_{CC}= 400V, I_C= 400A, V_{GE}= ±15V



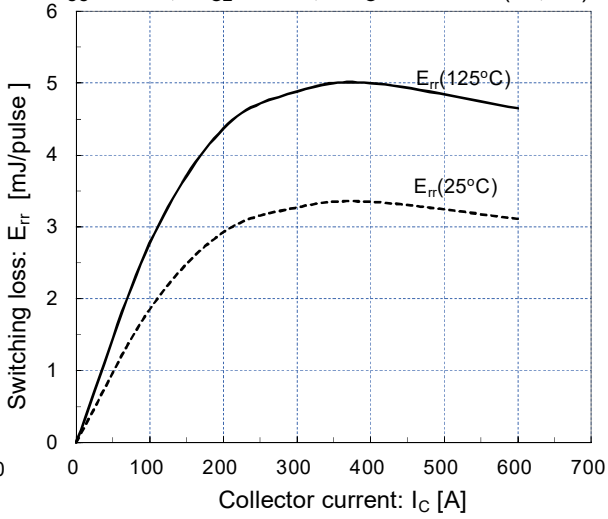
[SW mode A(T3, T4 RB-IGBT recovery)]
Switching loss vs. gate resistance (typ.)
V_{CC}= 400V, I_C= 400A, V_{GE}= ±15V



[SW mode A]
Switching loss vs. Collector current (typ.)
V_{CC}= 400V, V_{GE}= ±15V, R_G= +8.2/-1Ω (T1, T2)



[SW mode A (T3,T4 RB-IGBT recovery)]
Switching loss vs. Collector current (typ.)
V_{CC}= 400V, V_{GE}= ±15V, R_G= +8.2/-1Ω (T1, T2)



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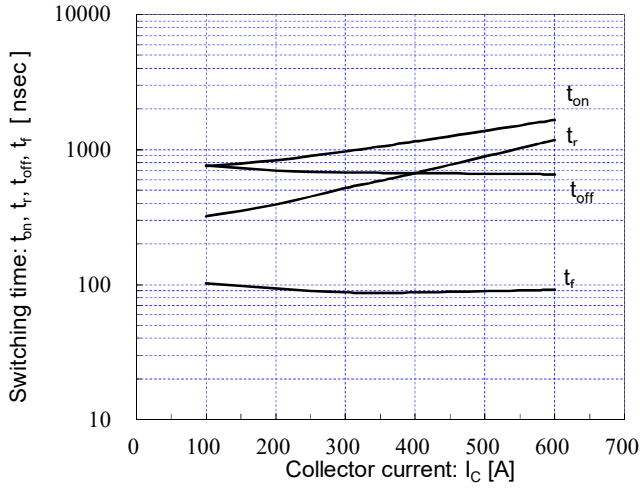
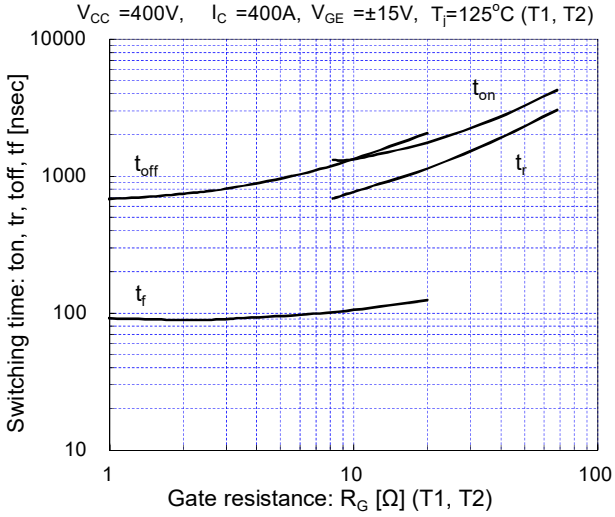
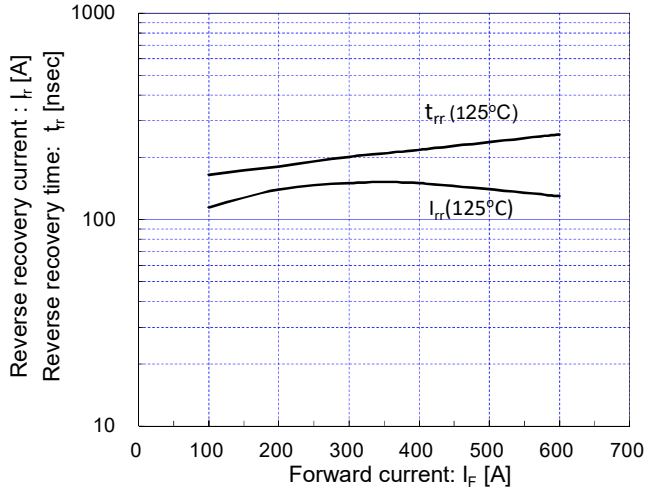
[Switching mode A]
Switching time vs. Collector current (typ.)
V_{CC} =400V, I_C =400A, R_G =+8.2/-1Ω, T_j=125°C (T1, T2)



[Switching mode A]
Switching time vs. Collector current (typ.)
V_{CC} =400V, I_C =400A, V_{GE} =±15V, T_j=125°C (T1, T2)



[SW mode A (T3, T4 RB-IGBT recovery)]
Reverse recovery characteristics (typ.)
V_{CC} =400V, V_{GE} =±15V, R_G =+8.2/-1Ω(T1,T2)



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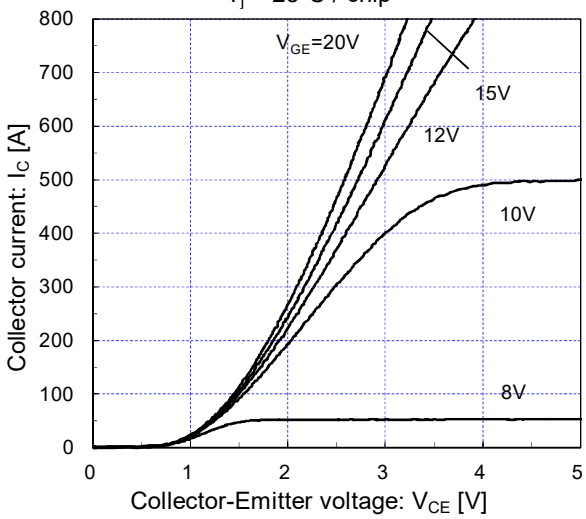
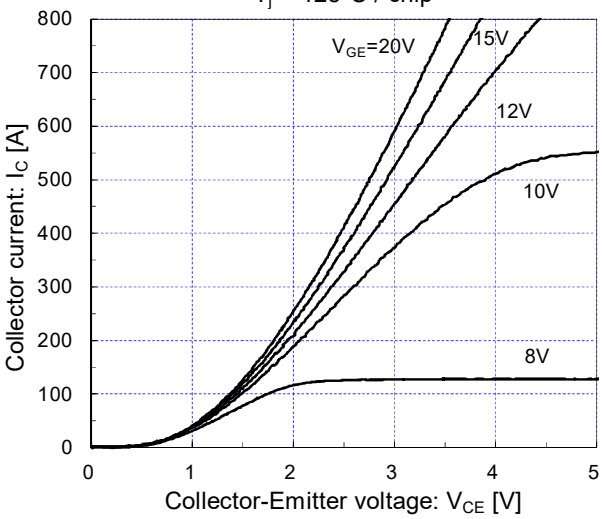
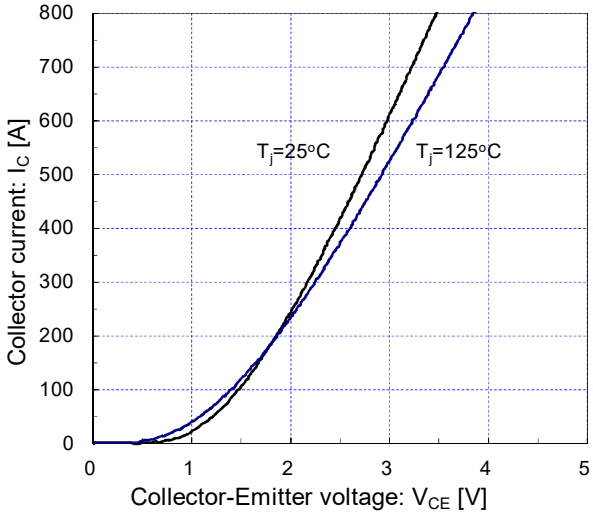
[AC-switch (T3, T4)]
Collector current vs. Collector-Emitter voltage (typ.)
T_j = 25°C / chip



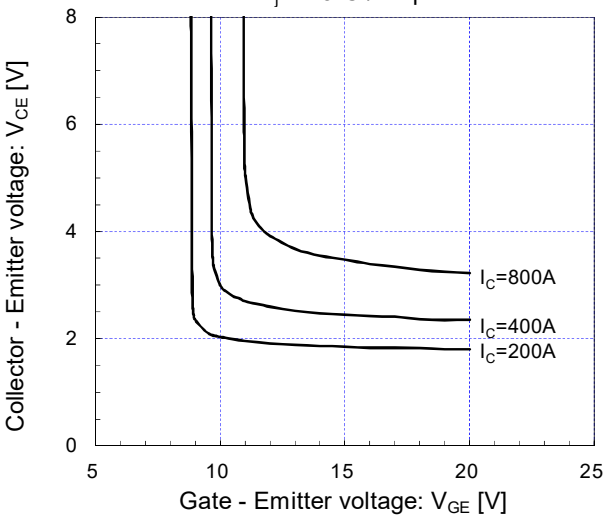
[AC-switch (T3, T4)]
Collector current vs. Collector-Emitter voltage (typ.)
T_j = 125°C / chip



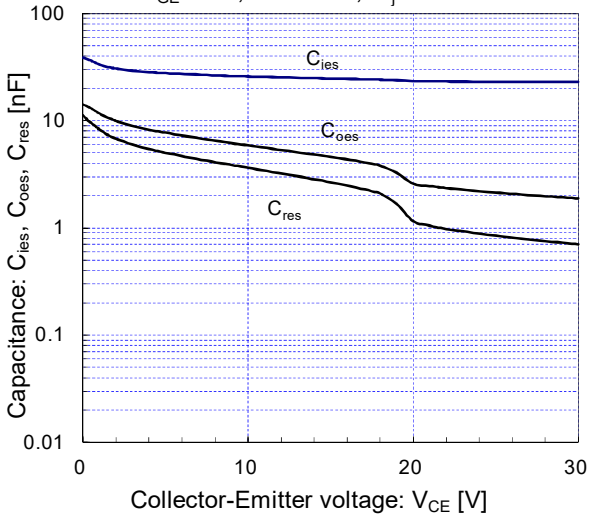
[AC-switch (T3, T4)]
Collector current vs. Collector-Emitter voltage (typ.)
V_{GE} =15V / chip



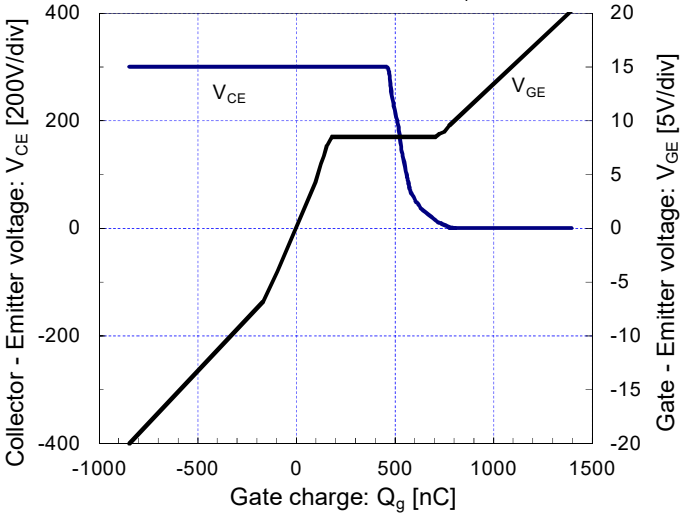
[AC-switch (T3, T4)]
Collector-Emitter voltage vs. Gate-Emitter voltage (typ.)
T_j = 25°C / chip



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



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



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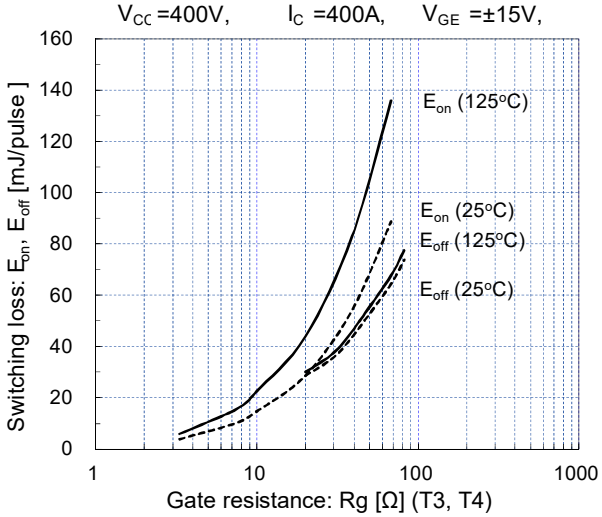
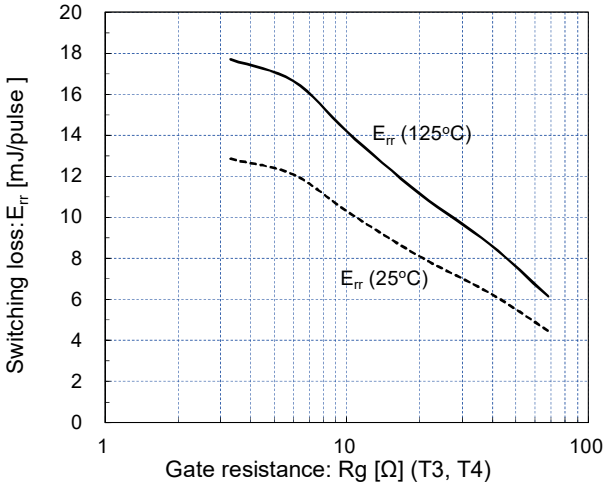
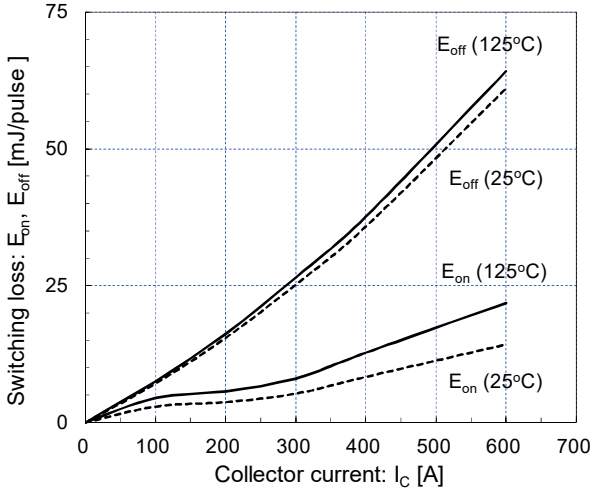
[SW mode B]
Switching loss vs. gate resistance (typ.)
V_{CC} =400V, I_C =400A, V_{GE} =±15V,



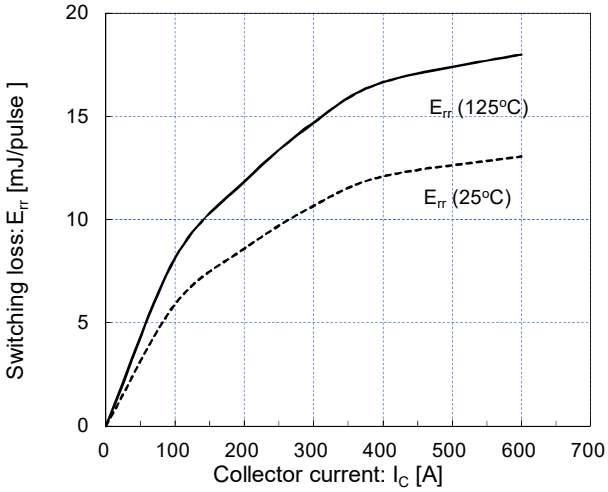
[SW mode B (T1,T2 FWD recovery)]
Switching loss vs. gate resistance (typ.)
V_{CC} =400V, I_C =400A, V_{GE} =±15V,



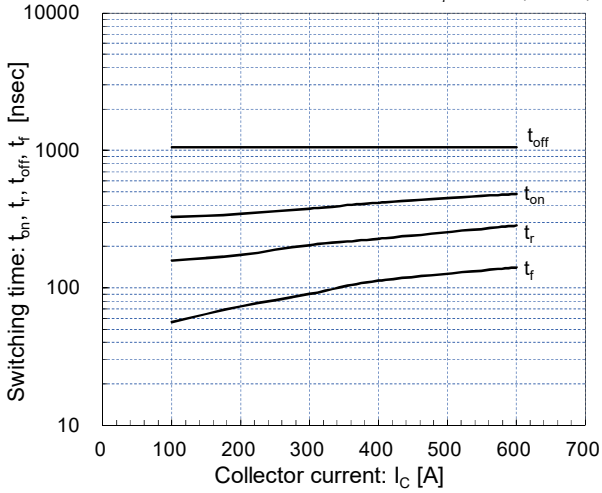
[SW mode B]
Switching loss vs. Collector current (typ.)
V_{CC}= 400V, V_{GE} =±15V, R_G =+6.0/-30Ω (T3, T4)



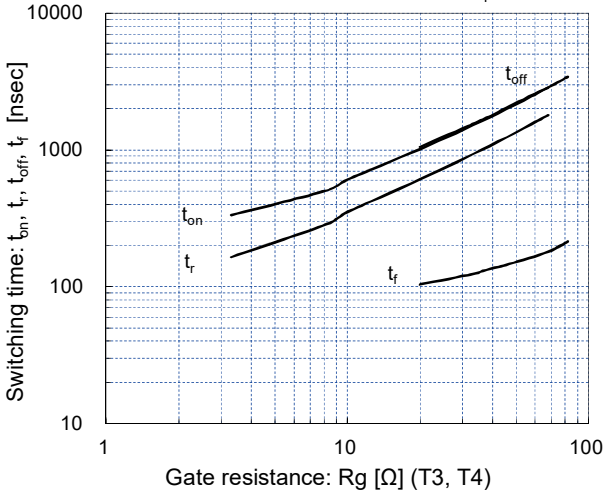
[SW mode B (T1,T2 FWD recovery)]
Switching loss vs. Collector current (typ.)
V_{CC}= 400V, V_{GE} =±15V, R_G =+6.0/-30Ω (T3,T4)



[SW mode B]
Switching time vs. Collector current (typ.)
V_{CC} =400V, V_{GE} =±15V, R_G =+6.0/-30Ω, T_j=125°C (T3, T4)



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



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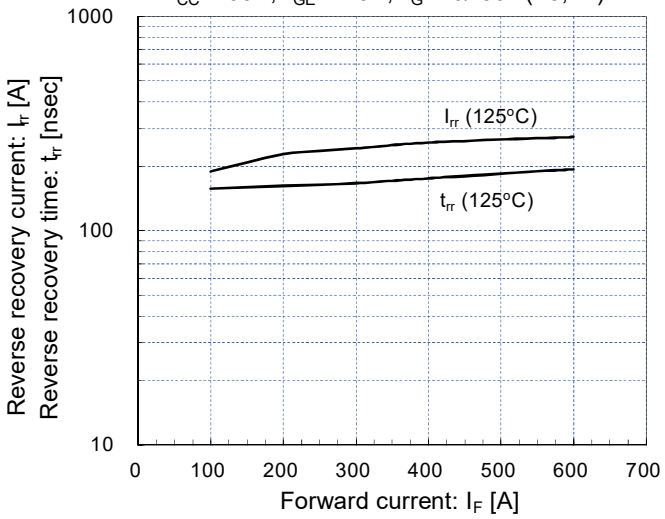
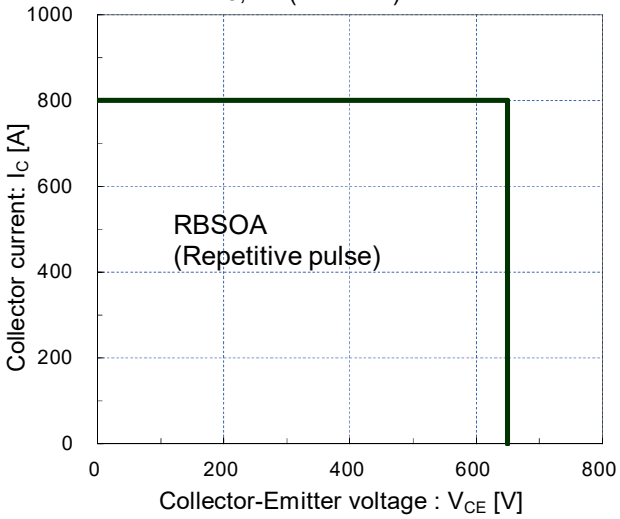
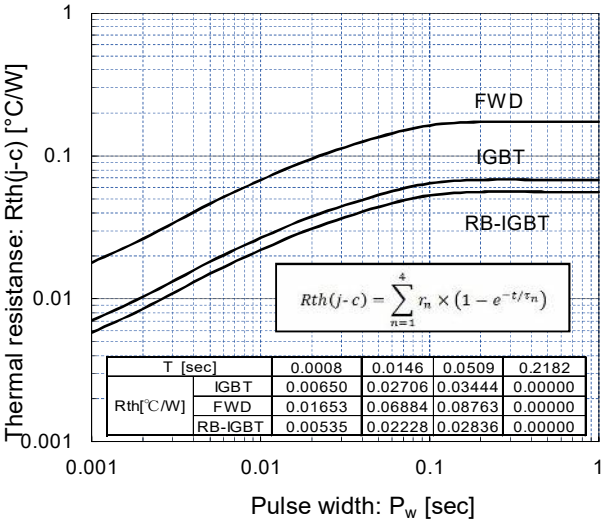
[SW mode B (T1,T2 FWD recovery)]
Reverse recovery characteristics (typ.)
V_{CC}=400V,V_{GE}=±15V,R_G=+6/-30Ω(T3,T4)



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

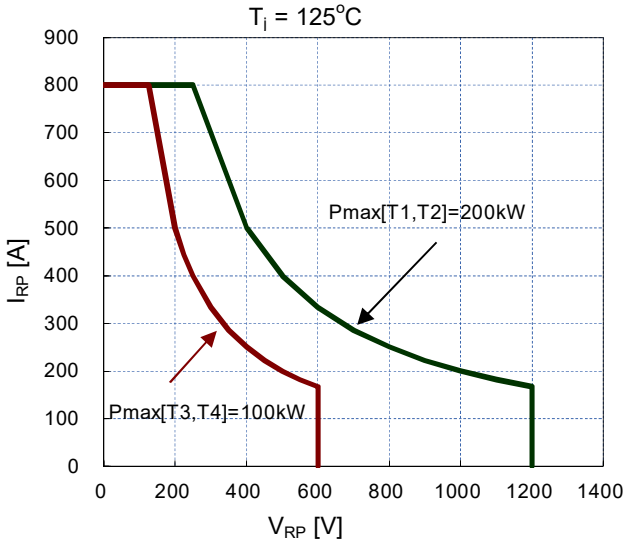


Transient thermal resistance (max.)



T [sec]		0.0008	0.0146	0.0509	0.2182
Rth[℃/W]	IGBT	0.00650	0.02706	0.03444	0.00000
	FWD	0.01653	0.06884	0.08763	0.00000
	RB-IGBT	0.00535	0.02228	0.02836	0.00000

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



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IGBT Modules

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