

# 4MBI300VG-120R-50

IGBT Modules

## IGBT MODULE (V series)

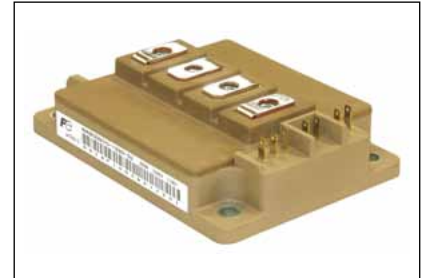
### 1200V / 300A / IGBT, 600V/300A/RB-IGBT, 4 in one package

#### ■ 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 T<sub>c</sub>=25°C unless otherwise specified)

Items		Symbols	Conditions		Maximum ratings	Units	
T1, T2	Collector-Emitter voltage	V <sub>CEs</sub>			1200	V	
	Gate-Emitter voltage	V <sub>GEs</sub>			±20	V	
	Collector current	IGBT	I <sub>c</sub>	Continuous	T <sub>c</sub> =80°C	300	A
			I <sub>cp</sub>	1ms	T <sub>c</sub> =80°C	600	
		FWD	-I <sub>c</sub>			300	
			-I <sub>c pulse</sub>	1ms		600	
Collector power dissipation	P <sub>c</sub>	1 device		1250	W		
T3, T4	Collector-Emitter voltage	V <sub>CEs</sub>			600	V	
	Gate-Emitter voltage	V <sub>GEs</sub>			±20	V	
	Collector current	I <sub>c</sub>	Continuous	T <sub>c</sub> =80°C	300	A	
		I <sub>cp</sub>	1ms	T <sub>c</sub> =80°C	600		
Collector power dissipation	P <sub>c</sub>	1 device		1250	W		
Junction temperature		T <sub>j</sub>			150	°C	
Case temperature		T <sub>c</sub>			125		
Storage temperature		T <sub>stg</sub>			-40 ~ +125		
Isolation voltage	between terminal and copper base (*1)	V <sub>iso</sub>	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  $T_J = 25^\circ\text{C}$  unless otherwise specified)

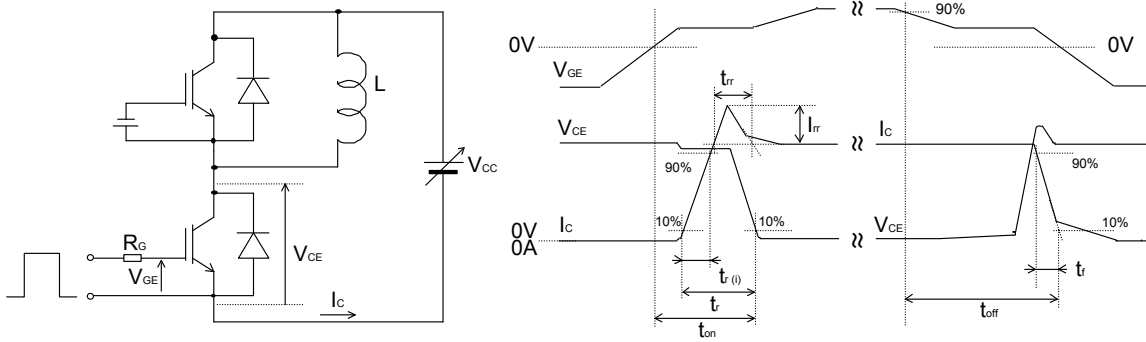
Items	Symbols	Conditions	Characteristics			Units		
			min.	typ.	max.			
T1, T2	Zero gate voltage collector current	$I_{CES}$	$V_{GE} = 0V, V_{CE} = 1200V$	-	-	2.0	mA	
	Gate-Emitter leakage current	$I_{GES}$	$V_{CE} = 0V, V_{GE} = \pm 20V$	-	-	400	nA	
	Gate-Emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = 20V, I_c = 300mA$	6.0	6.5	7.0	V	
	Collector-Emitter saturation voltage	$V_{CE(sat)}$ (chip)	$V_{GE} = 15V$ $I_c = 300A$	$T_J = 25^\circ\text{C}$	-	1.85	2.10	V
				$T_J = 125^\circ\text{C}$	-	2.20	-	
		$V_{CE(sat)}$ (terminal)	$V_{GE} = 15V$ $I_c = 300A$	$T_J = 25^\circ\text{C}$	-	2.05	2.35	
				$T_J = 125^\circ\text{C}$	-	2.40	-	
	Input capacitance	$C_{ies}$	$V_{CE} = 10V, V_{GE} = 0V, f = 1MHz$	-	25.2	-	nF	
	Turn-on time	$t_{on}$	SW mode : A $V_{CC} = 800V$ $I_c = 300A$ $V_{GE} = \pm 15V$		-	1.10	1.90	$\mu\text{s}$
		$t_r$			-	0.70	1.25	
		$t_{r(f)}$			-	0.14	-	
	Turn-off time	$t_{off}$	$R_G = +10/-1\Omega$		-	0.62	1.10	$\mu\text{s}$
$t_f$				-	0.09	0.35		
Forward on voltage	$V_F$ (chip)	$I_F = 300A$	$T_J = 25^\circ\text{C}$	-	1.70	1.95	V	
			$T_J = 125^\circ\text{C}$	-	1.85	-		
	$V_F$ (terminal)	$I_F = 300A$	$T_J = 25^\circ\text{C}$	-	1.95	2.25		
			$T_J = 125^\circ\text{C}$	-	2.10	-		
Reverse recovery time	$t_{rr}$	SW mode : A $V_{CC} = 800V$ $V_{GE} = \pm 15V$ $I_F = 300A$ $R_G = +10/-1\Omega$		-	-	0.35	$\mu\text{s}$	
T3, T4	Zero gate voltage collector current	$I_{CES}$	$V_{GE} = 0V, V_{CE} = 600V$	-	-	3.0	mA	
	Gate-Emitter leakage current	$I_{GES}$	$V_{CE} = 0V, V_{GE} = \pm 20V$	-	-	600	nA	
	Gate-Emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = 20V, I_c = 300mA$	5.5	6.5	7.5	V	
	Collector-Emitter saturation voltage	$V_{CE(sat)}$ (chip)	$V_{GE} = 15V$ $I_c = 300A$	$T_J = 25^\circ\text{C}$	-	2.45	2.80	V
				$T_J = 125^\circ\text{C}$	-	2.60	-	
		$V_{CE(sat)}$ (terminal)	$V_{GE} = 15V$ $I_c = 300A$	$T_J = 25^\circ\text{C}$	-	2.55	2.95	
				$T_J = 125^\circ\text{C}$	-	2.70	-	
	Input capacitance	$C_{ies}$	$V_{CE} = 10V, V_{GE} = 0V, f = 1MHz$	-	19.5	-	nF	
	Turn-on time	$t_{on}$	SW mode : B $V_{CC} = 400V$ $I_c = 300A$ $V_{GE} = \pm 15V$		-	0.45	1.05	$\mu\text{s}$
		$t_r$			-	0.27	0.53	
		$t_{r(f)}$			-	0.12	-	
	Turn-off time	$t_{off}$	$R_G = +8.2/-39\Omega$		-	1.32	3.00	$\mu\text{s}$
$t_f$				-	0.11	0.35		
Reverse recovery time	$t_{rr}$	SW mode : C $V_{CC} = 400V$ $V_{GE} = \pm 15V$ $I_c = 300A$ $R_G = +10/-1\Omega$		-	-	0.30	$\mu\text{s}$	
Internal inductance	L	P-N		-	40	-	nH	
		P-M		-	33	-		
		M-N		-	33	-		

● Thermal resistance characteristics

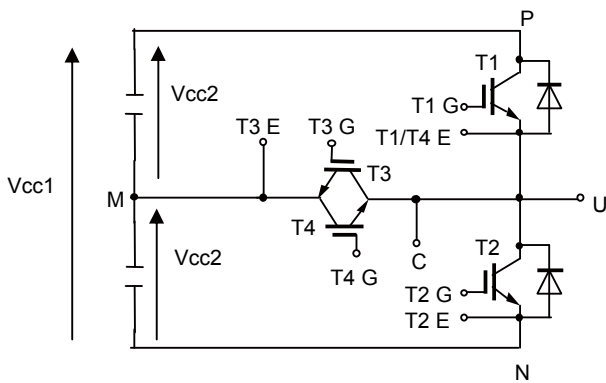
Items	Symbols	Conditions	Characteristics			Units
			min.	typ.	max.	
Thermal resistance (1device)	$R_{th(j-c)}$	T1, T2 IGBT	-	-	0.10	$^\circ\text{C/W}$
		T1, T2 FWD	-	-	0.16	
		T3, T4 RB-IGBT	-	-	0.10	
Contact thermal resistance (1device) (*4)	$R_{th(c-f)}$	T1, T2	-	0.025	-	
		T3, T4	-	0.017	-	

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

■ Definitions of switching time



Definitions of switching mode



SW mode	Load L	T1	T2	T3	T4
A	U-N	<b>SW</b>	OFF	OFF	OFF
	P-U	OFF	<b>SW</b>	OFF	OFF
B	P-U	OFF	OFF	<b>SW</b>	<b>ON</b>
	U-N	OFF	OFF	<b>ON</b>	<b>SW</b>
C	M-U	<b>SW</b>	OFF	OFF	<b>ON</b>
	M-U	OFF	<b>SW</b>	<b>ON</b>	OFF

SW: Connect to drive circuit and input gate signal

ON: Bias voltage of gate +15V

OFF: Reverse bias voltage of gate -15V

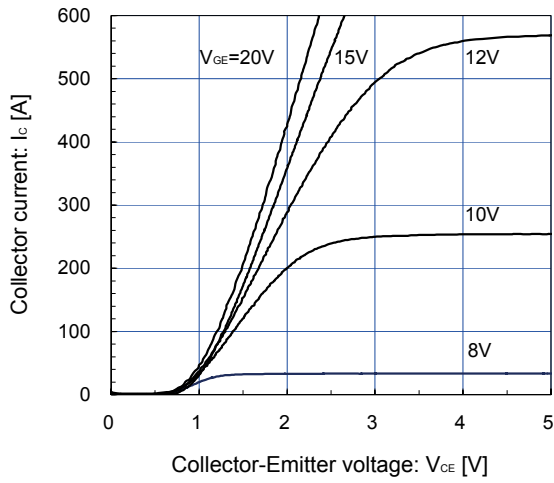
Vcc2=Vcc1/2

■ Characteristics (Representative)

[ T1, T2 ]

Collector current vs. Collector-Emittter voltage (typ.)

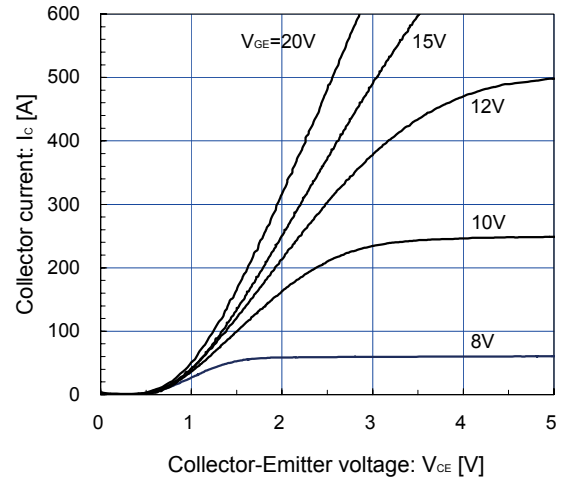
$T_j = 25^\circ\text{C}$  / chip



[ T1, T2 ]

Collector current vs. Collector-Emittter voltage (typ.)

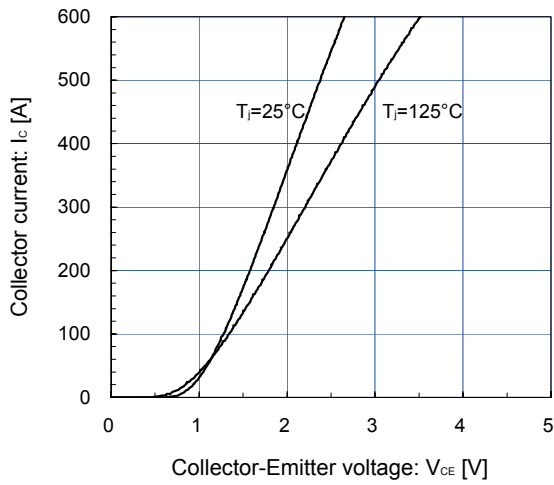
$T_j = 125^\circ\text{C}$  / chip



[ T1, T2 ]

Collector current vs. Collector-Emittter voltage (typ.)

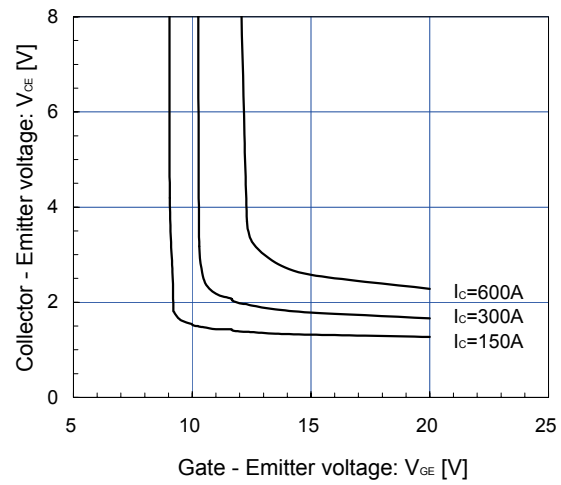
$V_{GE} = 15\text{V}$  / chip



[ T1, T2 ]

Collector-Emittter voltage vs. Gate-Emittter voltage (typ.)

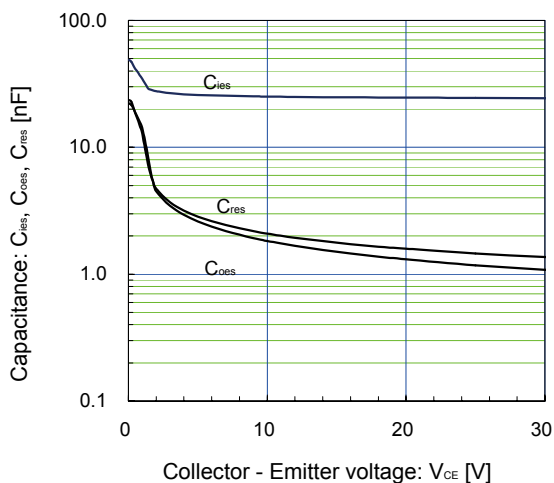
$T_j = 25^\circ\text{C}$  / chip



[ T1, T2 ]

Capacitance vs. Collector-Emittter voltage (typ.)

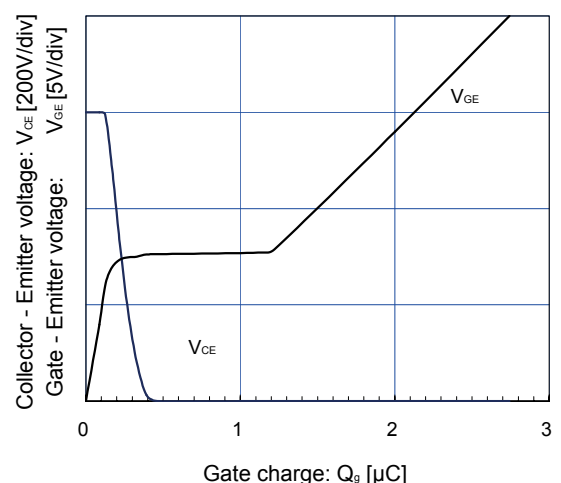
$V_{GE} = 0\text{V}$ ,  $f = 1\text{MHz}$ ,  $T_j = 25^\circ\text{C}$



[ T1, T2 ]

Dynamic gate charge (typ.)

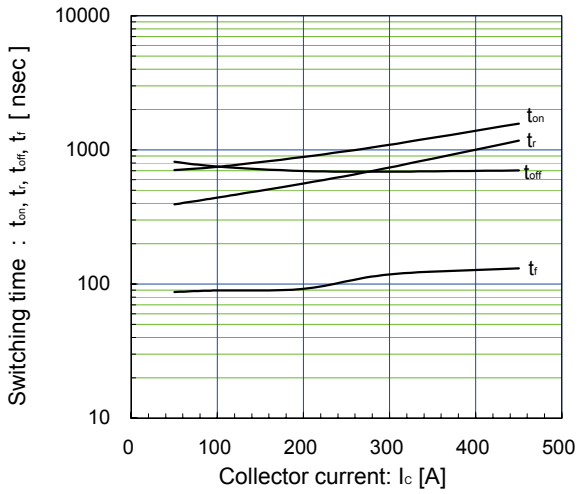
$V_{CC} = 600\text{V}$ ,  $I_c = 300\text{A}$ ,  $T_j = 25^\circ\text{C}$



[ SW mode A ]

Switching time vs. Collector current (typ.)

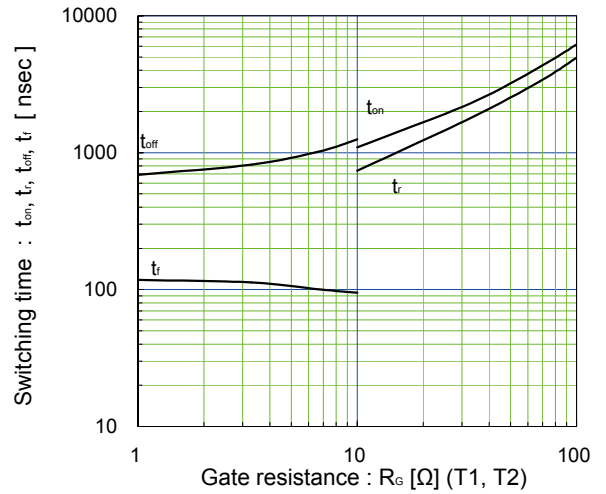
$V_{CC}=800V, V_{GE}=\pm 15V, R_G=+10/-1\Omega, T_J=125^\circ C (T1, T2)$



[ SW mode A ]

Switching time vs. Collector current (typ.)

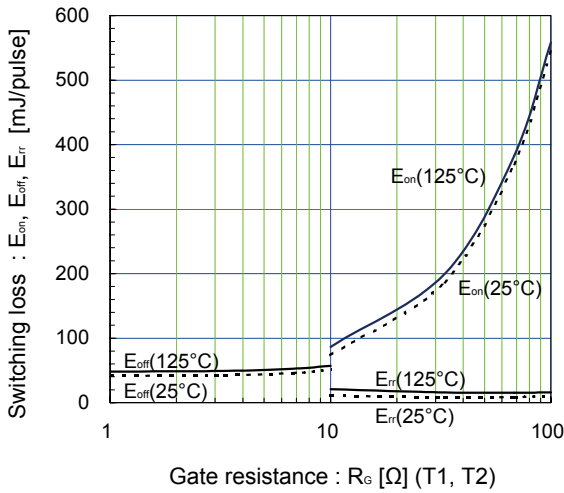
$V_{CC}=800V, I_c=300A, V_{GE}=\pm 15V, T_J=125^\circ C$



[ SW mode A ]

Switching loss vs. gate resistance (typ.)

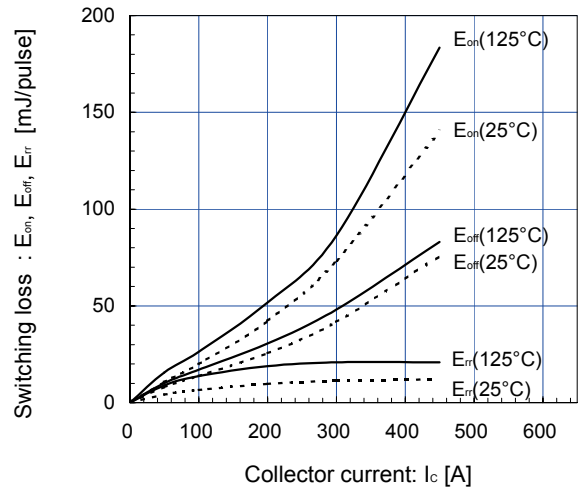
$V_{CC}=800V, I_c=300A, V_{GE}=\pm 15V$



[ SW mode A ]

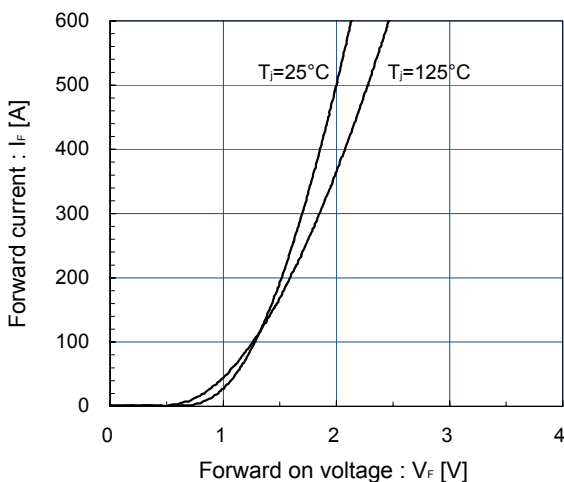
Switching loss vs. Collector current (typ.)

$V_{CC}=800V, V_{GE}=\pm 15V, R_G=+10/-1\Omega (T1, T2)$



[ T1, T2 ]

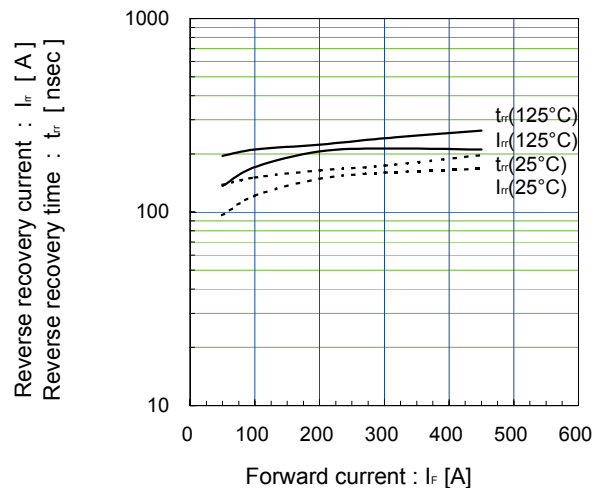
Forward current vs. forward on voltage (typ.)  
chip



[ T1, T2 ]

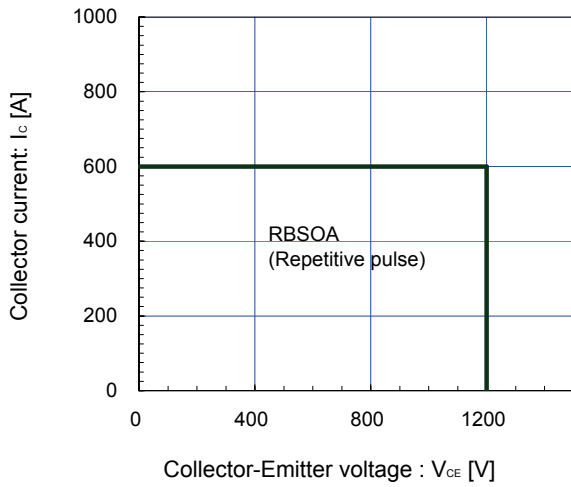
Reverse recovery characteristics (typ.)

$V_{CC}=800V, V_{GE}=\pm 15V, R_G=+10/-1\Omega (T1, T2)$



Reverse bias safe operating area (max.)

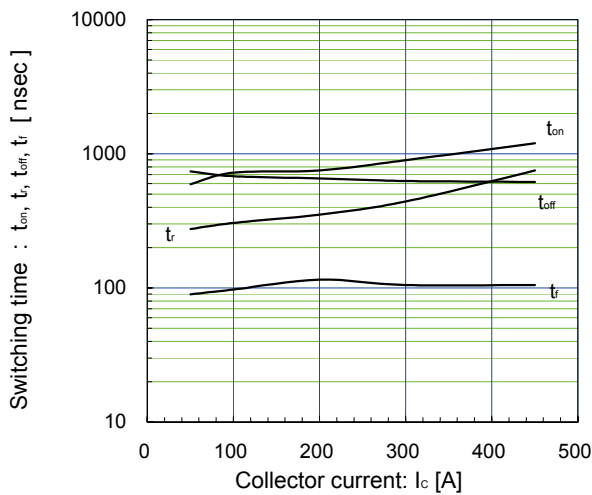
$V_{GE}=15V, -V_{GE} \leq 15V, R_G \geq +10 / -1\Omega, T_j \leq 125^\circ C, L_s = 46nH$  (T1, T2)  
T1, T2 (Terminal)



[ SW mode C ]

Switching time vs. Collector current (typ.)

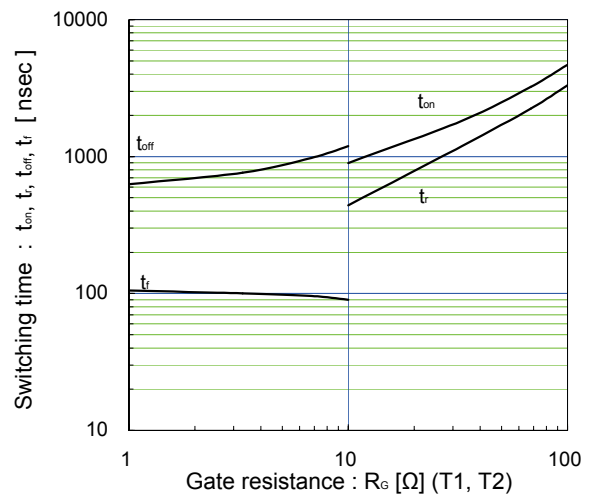
$V_{CC}=400V, V_{GE}=\pm 15V, R_G=\pm 10/-1\Omega, T_j=125^\circ C$  (T1, T2)



[ SW mode C ]

Switching time vs. Collector current (typ.)

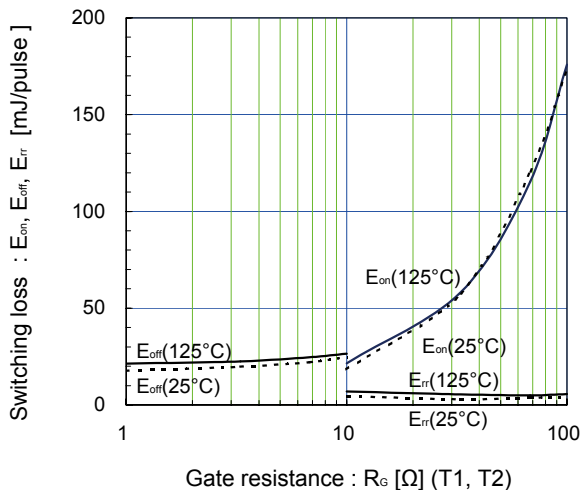
$V_{CC}=400V, I_c=300A, V_{GE}=\pm 15V, T_j=125^\circ C$



[ SW mode C ]

Switching loss vs. gate resistance (typ.)

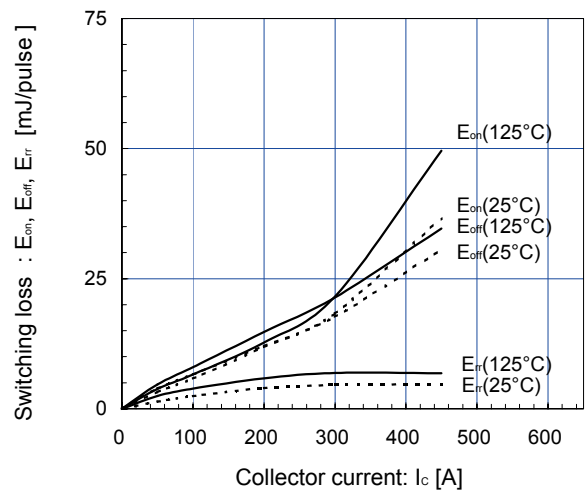
$V_{CC}=400V, I_c=300A, V_{GE}=\pm 15V$

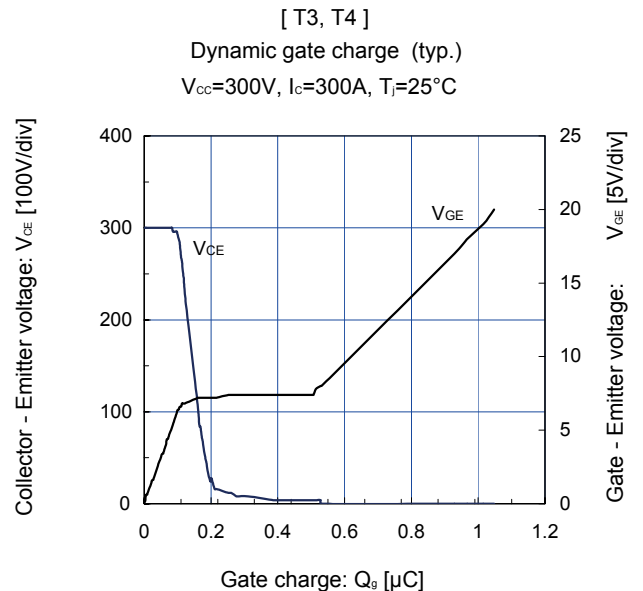
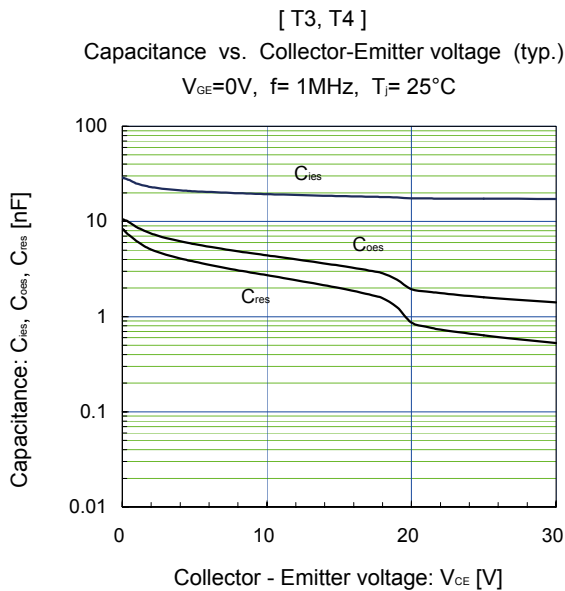
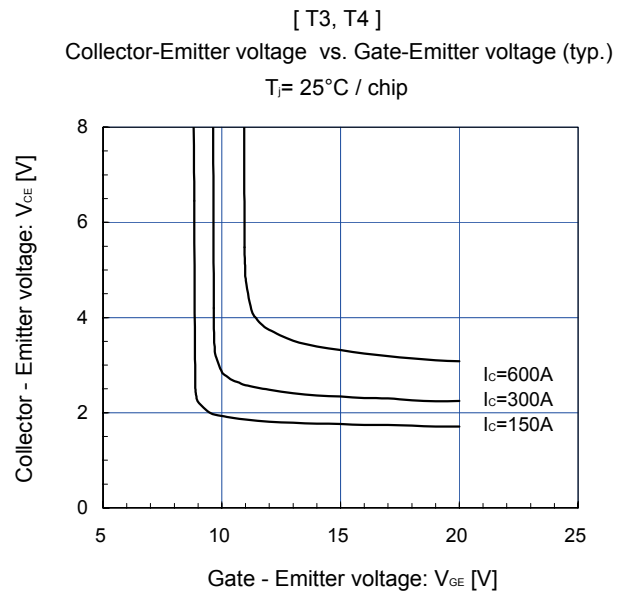
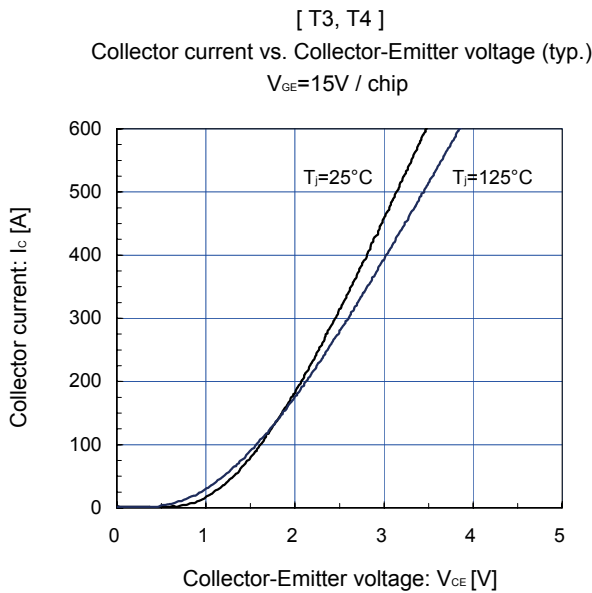
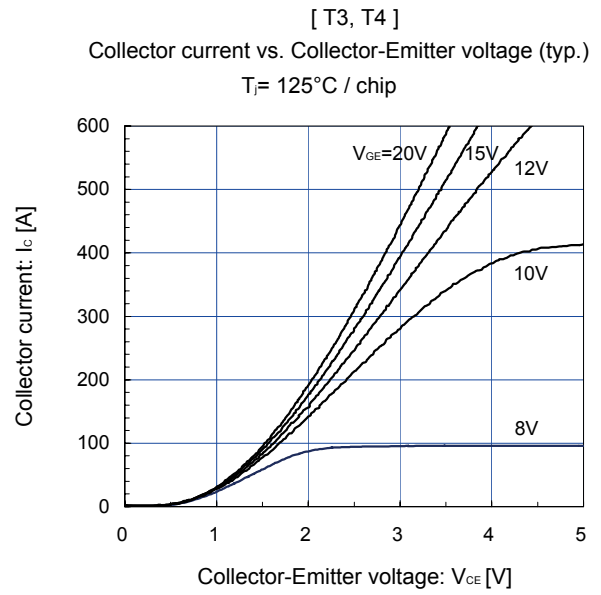
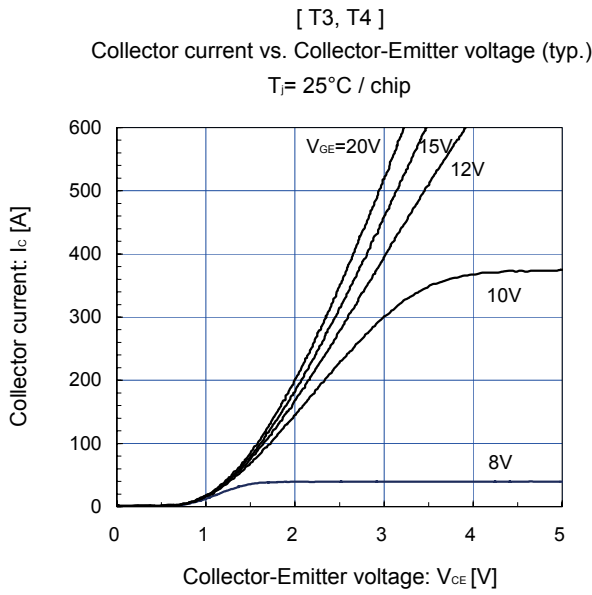


[ SW mode C ]

Switching loss vs. Collector current (typ.)

$V_{CC}=400V, V_{GE}=\pm 15V, R_G=\pm 10/-1\Omega$  (T1, T2)

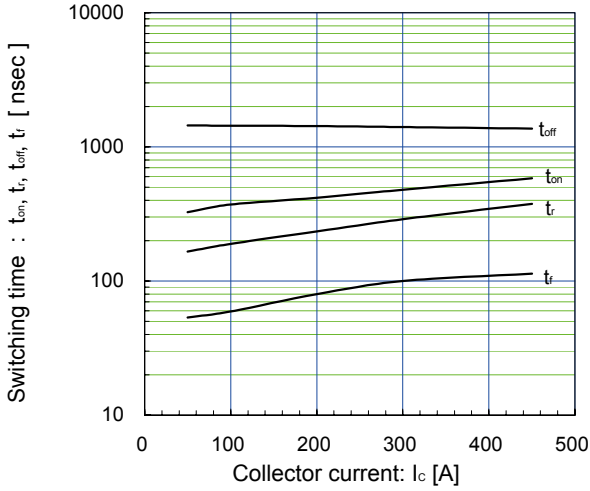




[ SW mode B ]

Switching time vs. Collector current (typ.)

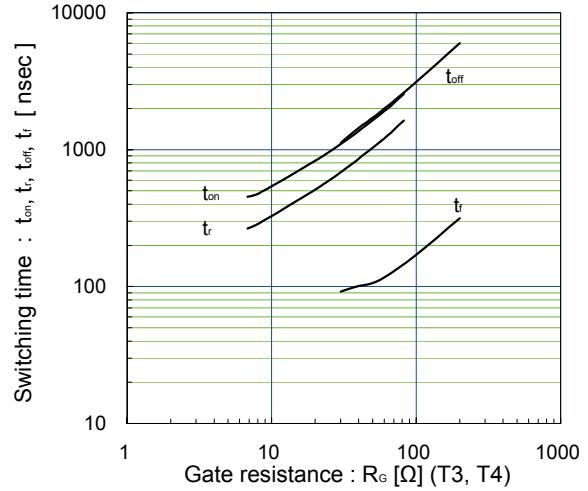
$V_{CC}=400V, V_{GE}=\pm 15V, R_G=+8.2/-39\Omega, T_J=125^\circ C (T_3, T_4)$



[ SW mode B ]

Switching time vs. Collector current (typ.)

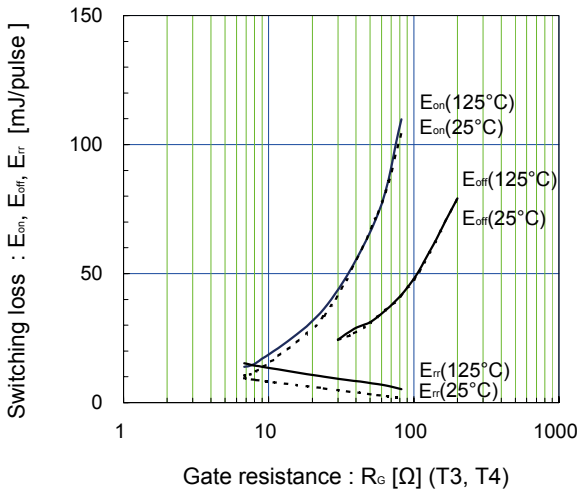
$V_{CC}=400V, I_c=300A, V_{GE}=\pm 15V, T_J=125^\circ C$



[ SW mode B ]

Switching loss vs. gate resistance (typ.)

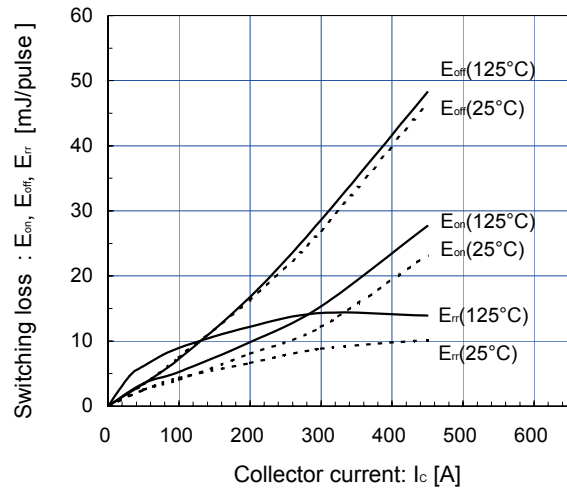
$V_{CC}=400V, I_c=300A, V_{GE}=\pm 15V$



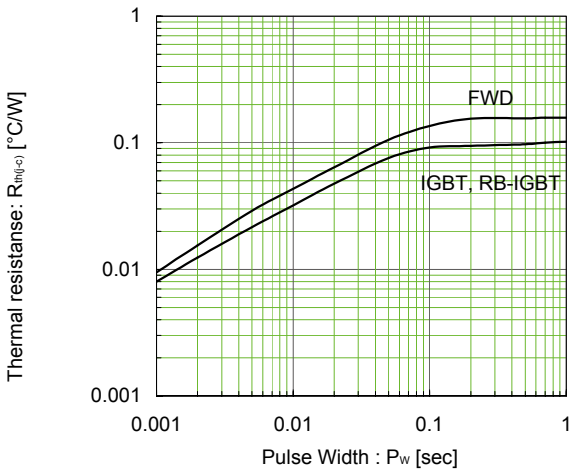
[ SW mode B ]

Switching loss vs. Collector current (typ.)

$V_{CC}=400V, V_{GE}=\pm 15V, R_G=+8.2/-39\Omega (T_3, T_4)$



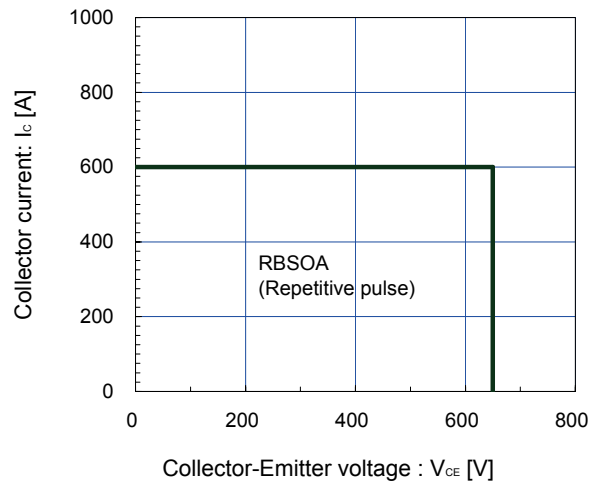
Transient Thermal Resistance (max.)



Reverse bias safe operating area (max.)

$V_{GE} = 15V, -V_{GE} \leq 15V, R_G \geq +8.2 / -39\Omega, T_J \leq 125^\circ C, L_S = 46nH (T_3, T_4)$

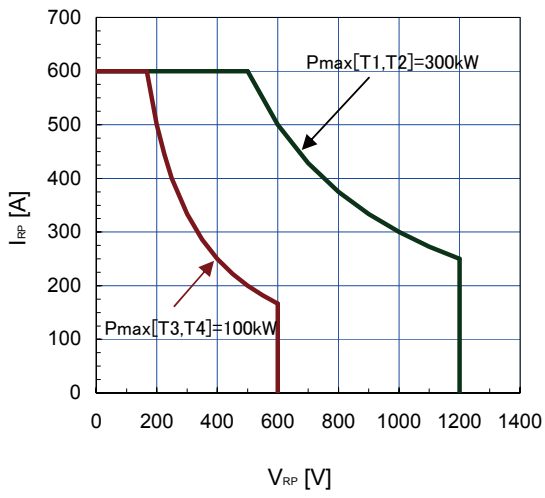
T3, T4 (Terminal)



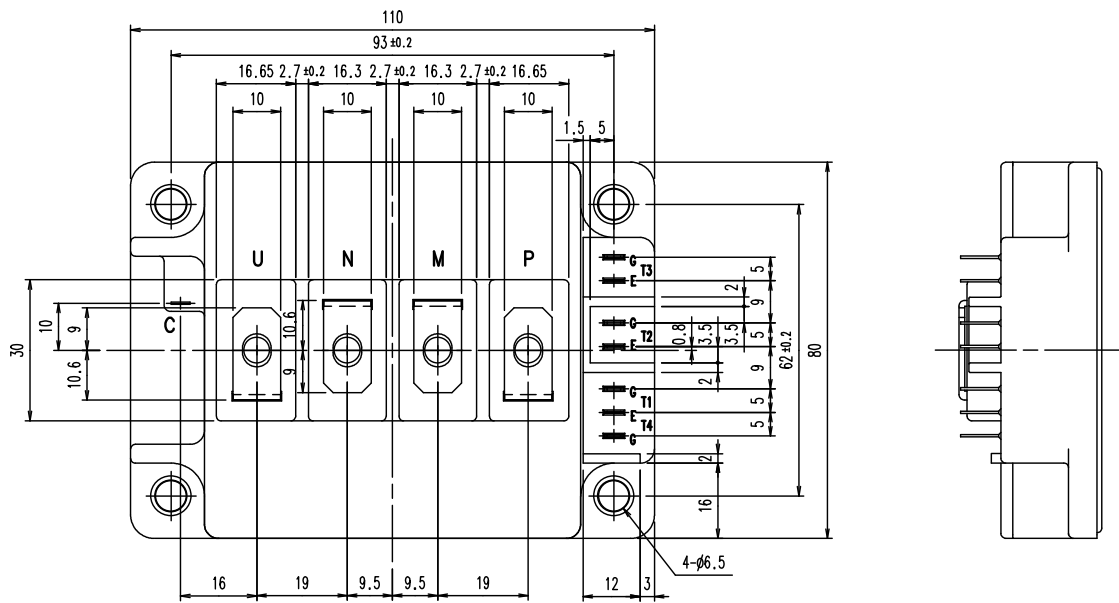


Reverse recovery withstand capability for FWD, RB-IGBT

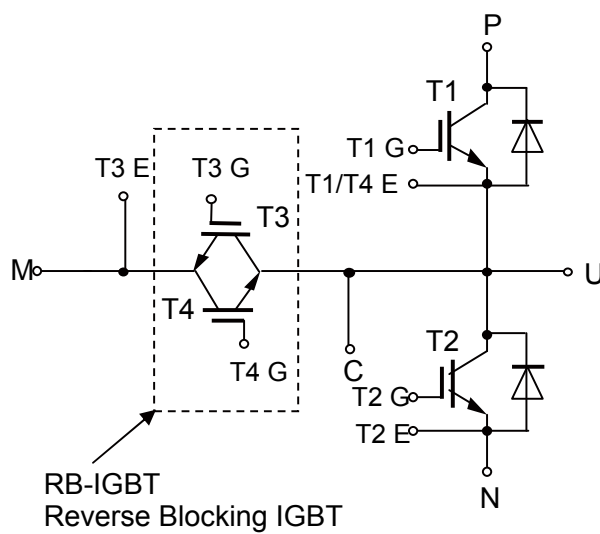
$T_j=125^{\circ}\text{C}$



■ Outline Drawings, mm



■ Equivalent Circuit Schematic



**WARNING**

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  - Measurement equipment
  - Machine tools
  - Audiovisual equipment
  - Electrical home appliances
  - Personal equipment
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  - Safety devices
  - Medical equipment
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