

# 4MBI400VG-060R-50

IGBT Modules

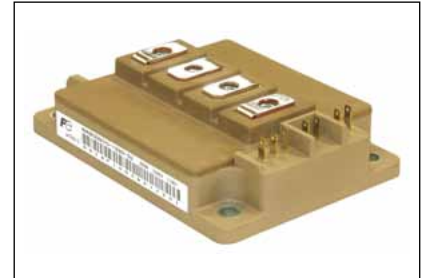
## IGBT MODULE (V series) 600V / 400A / IGBT, RB-IGBT 4 in one package

### ■ 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 <sub>CEs</sub>			600	V	
	Gate-Emitter voltage	V <sub>GEs</sub>			±20	V	
	Collector current	IGBT	I <sub>c</sub>	Continuous	T <sub>c</sub> =80°C	400	A
			I <sub>cp</sub>	1ms	T <sub>c</sub> =80°C	800	
		FWD	-I <sub>c</sub>			400	
			-I <sub>c pulse</sub>	1ms		800	
Collector power dissipation	P <sub>c</sub>	1 device		1135	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	400	A	
		I <sub>cp</sub>	1ms	T <sub>c</sub> =80°C	800		
Collector power dissipation	P <sub>c</sub>	1 device		1560	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<sub>j</sub> = 25°C unless otherwise specified)

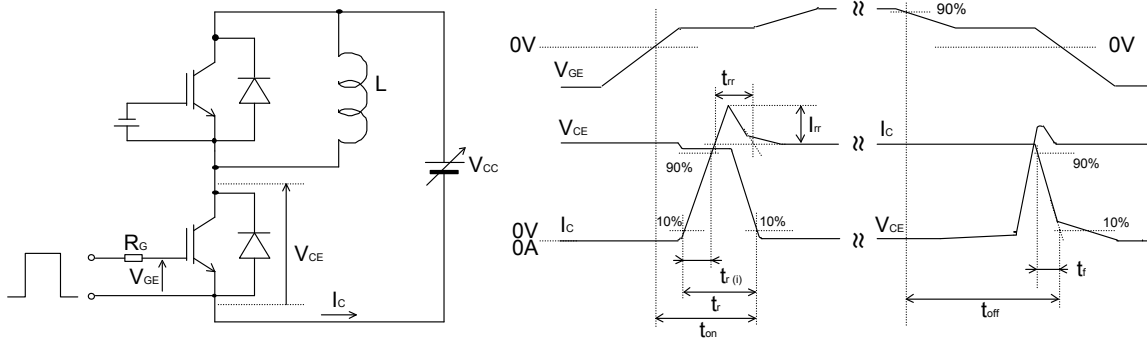
Items	Symbols	Conditions	Characteristics			Units		
			min.	typ.	max.			
T1, T2	Zero gate voltage collector current	I <sub>CES</sub>	V <sub>GE</sub> = 0V, V <sub>CE</sub> = 600V	-	-	2.0	mA	
	Gate-Emitter leakage current	I <sub>GES</sub>	V <sub>CE</sub> = 0V, V <sub>GE</sub> = ±20V	-	-	400	nA	
	Gate-Emitter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

● Thermal resistance characteristics

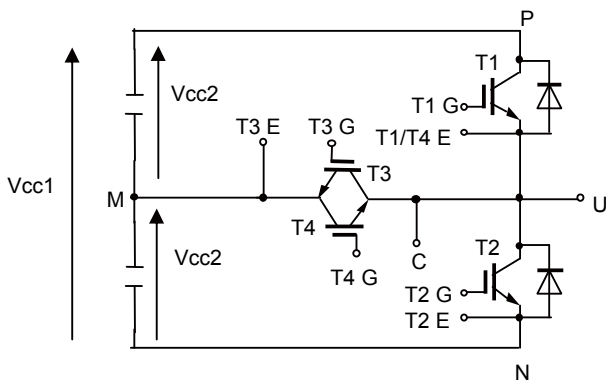
Items	Symbols	Conditions	Characteristics			Units
			min.	typ.	max.	
Thermal resistance (1device)	R <sub>th(j-c)</sub>	T1, T2 IGBT	-	-	0.11	°C/W
		T1, T2 FWD	-	-	0.22	
		T3, T4 RB-IGBT	-	-	0.08	
Contact thermal resistance (1device) (*4)	R <sub>th(c-f)</sub>	T1, T2	-	0.025	-	°C/W
		T3, T4	-	0.013	-	

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	<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

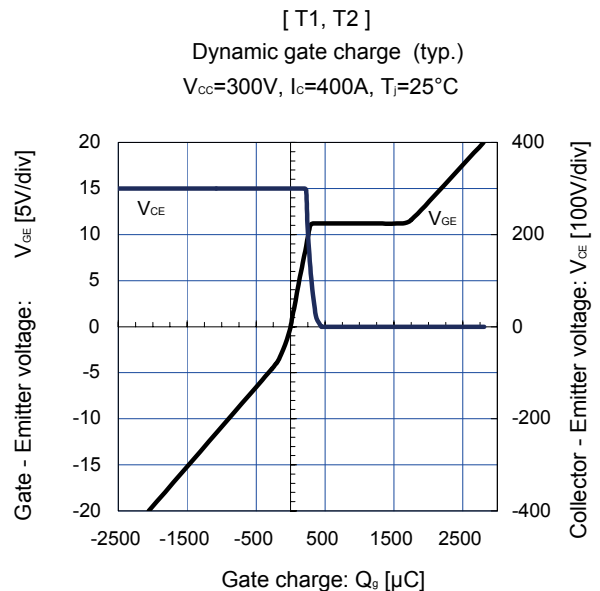
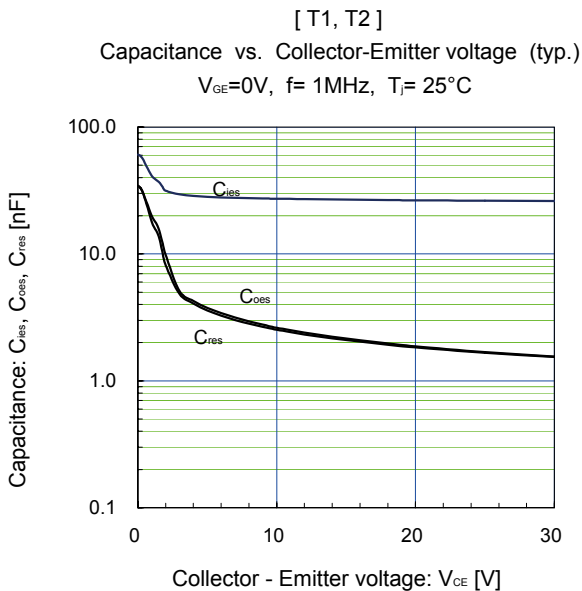
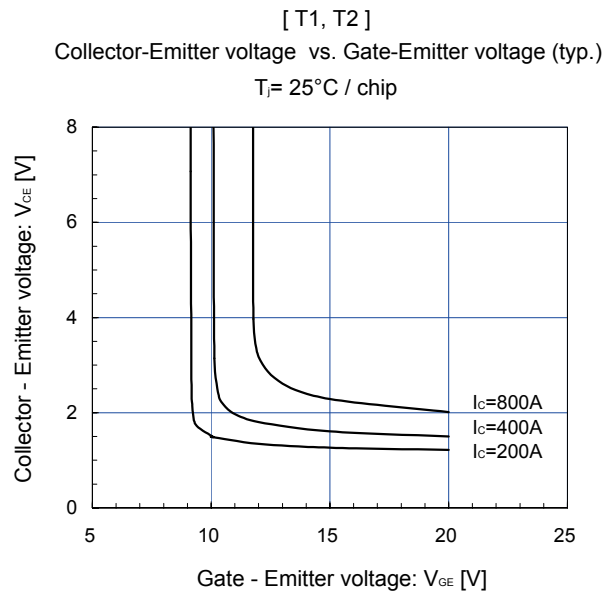
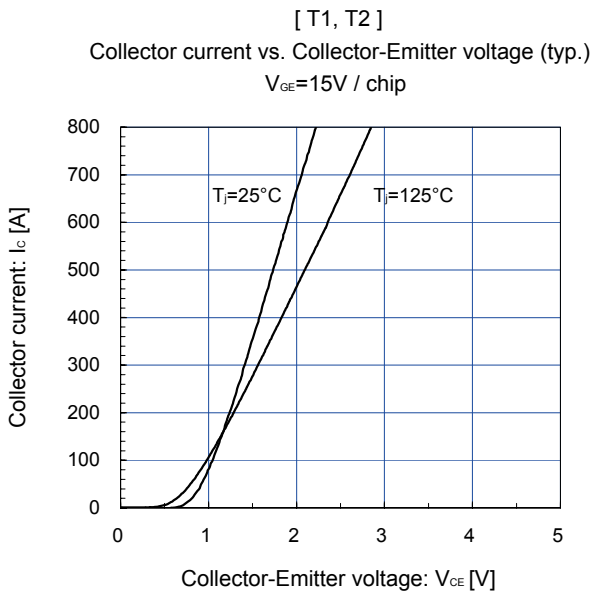
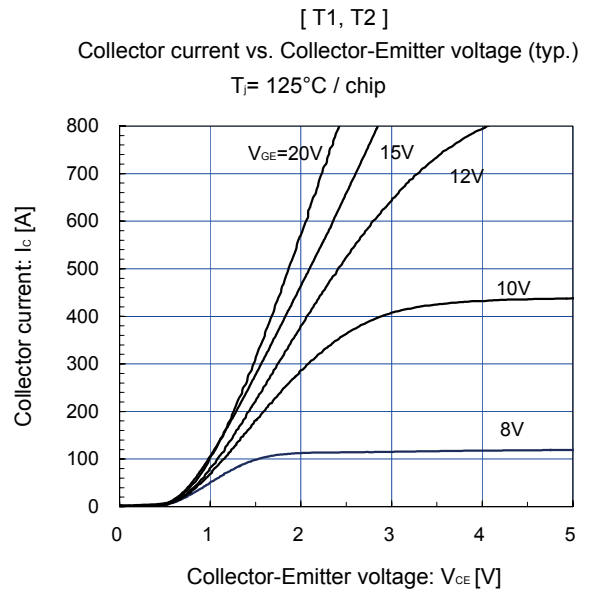
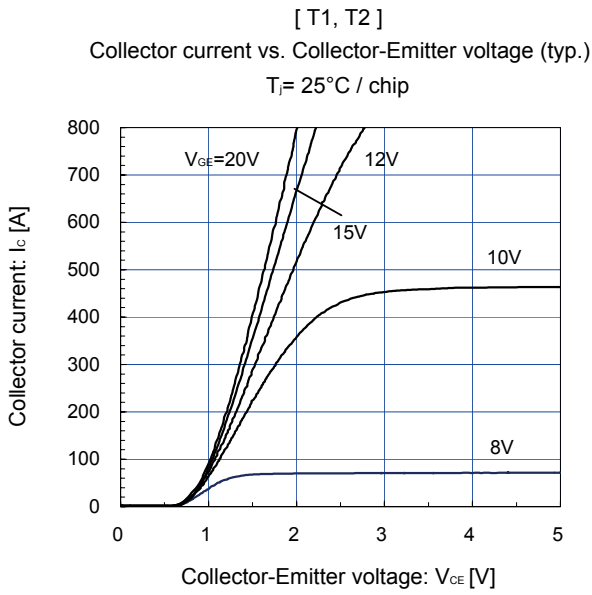
SW: Connect to drive circuit and input gate signal

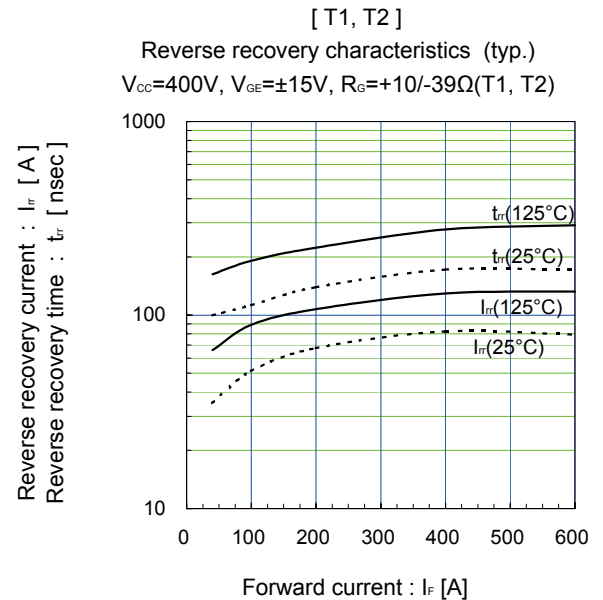
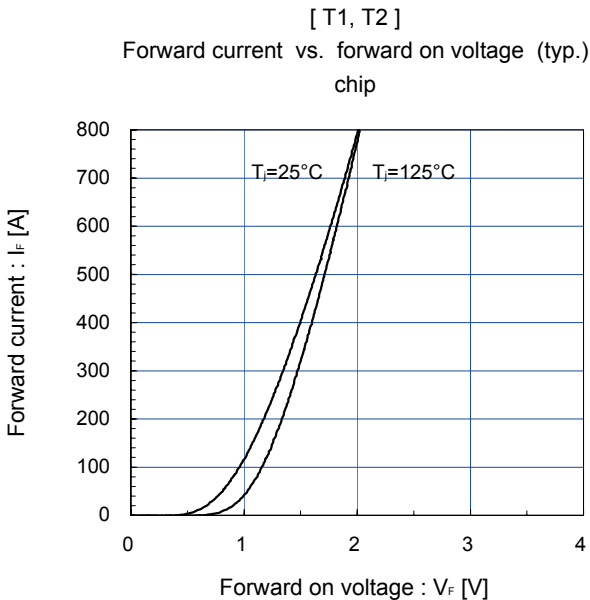
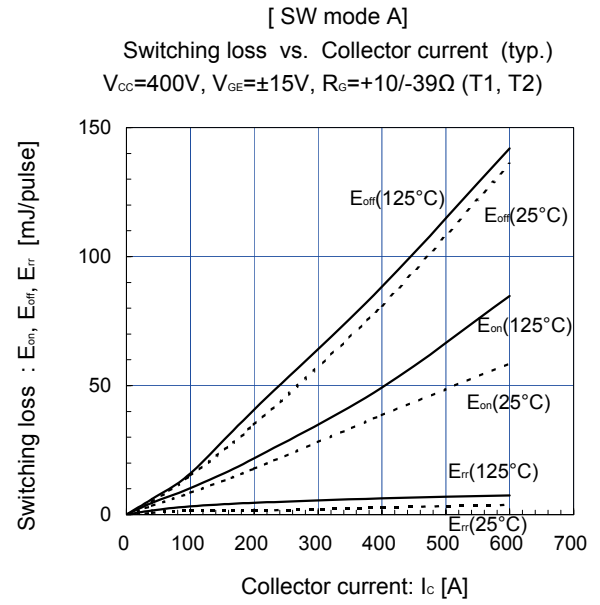
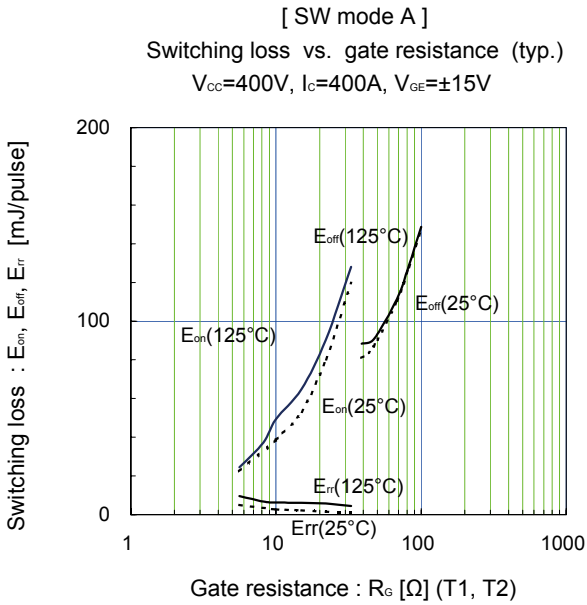
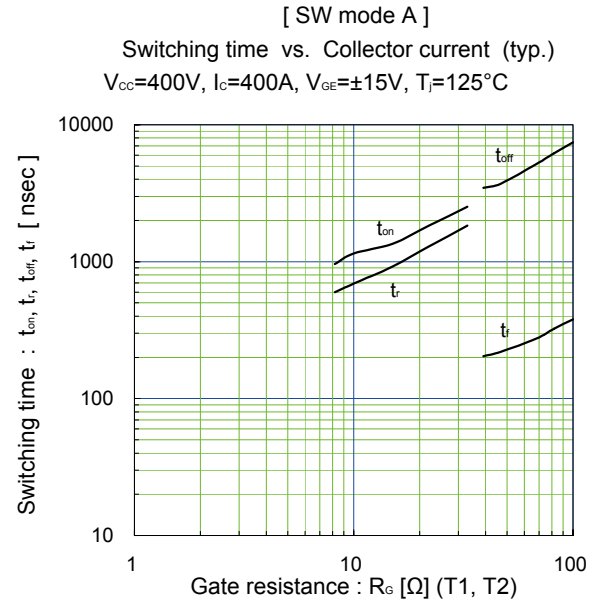
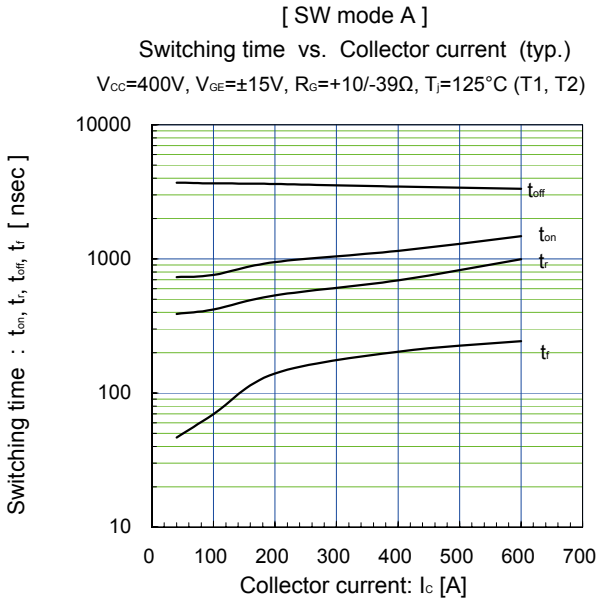
ON: Bias voltage of gate +15V

OFF: Reverse bias voltage of gate -15V

Vcc2=Vcc1/2

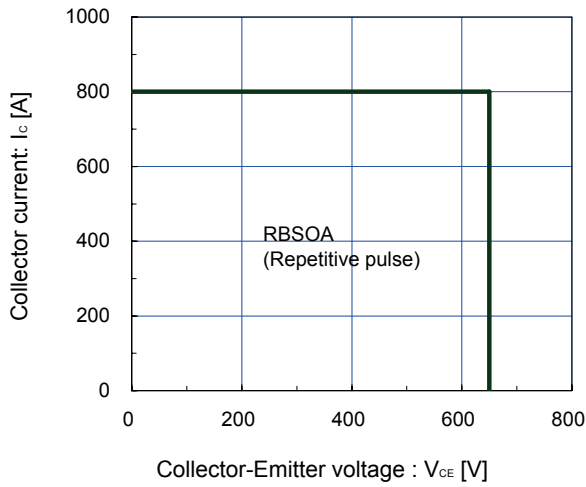
■ Characteristics (Representative)





Reverse bias safe operating area (max.)

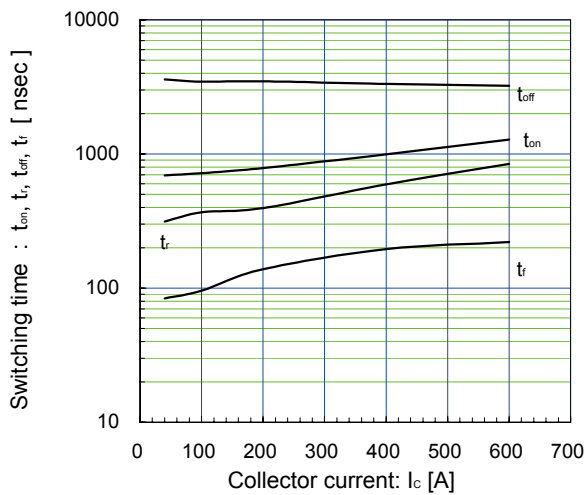
$V_{GE}=15V, -V_{GE} \leq 15V, R_G \geq +10 / -39\Omega, T_J \leq 125^\circ C$  (T1, T2)  
T1, T2 (Terminal)



[ SW mode C ]

Switching time vs. Collector current (typ.)

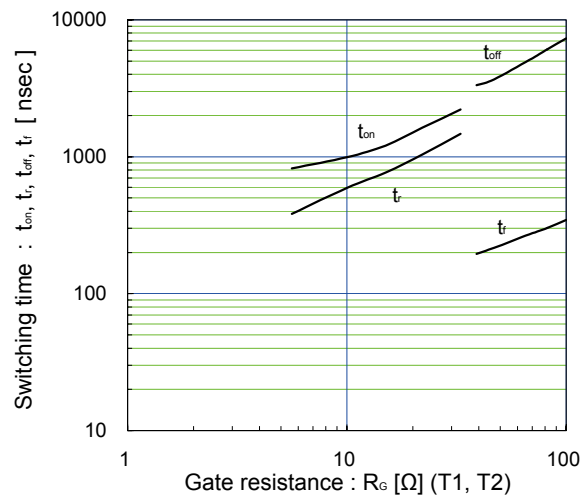
$V_{CC}=200V, V_{GE}=\pm 15V, R_G=\pm 10/-39\Omega, T_J=125^\circ C$  (T1, T2)



[ SW mode C ]

Switching time vs. Collector current (typ.)

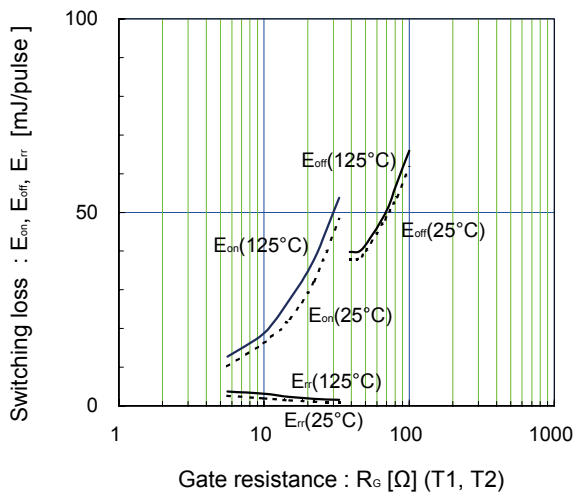
$V_{CC}=200V, I_c=400A, V_{GE}=\pm 15V, T_J=125^\circ C$



[ SW mode C ]

Switching loss vs. gate resistance (typ.)

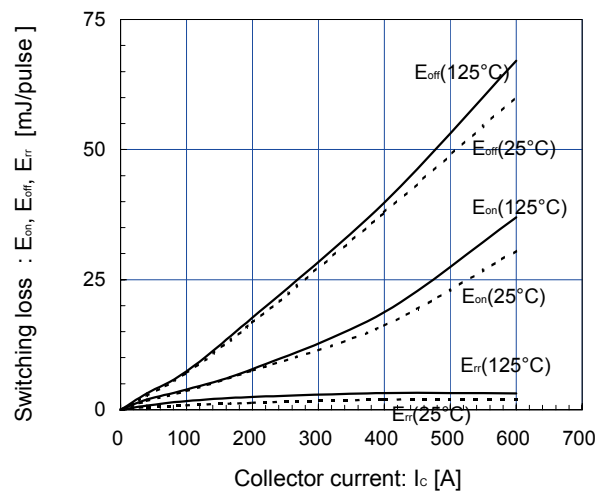
$V_{CC}=200V, I_c=400A, V_{GE}=\pm 15V$

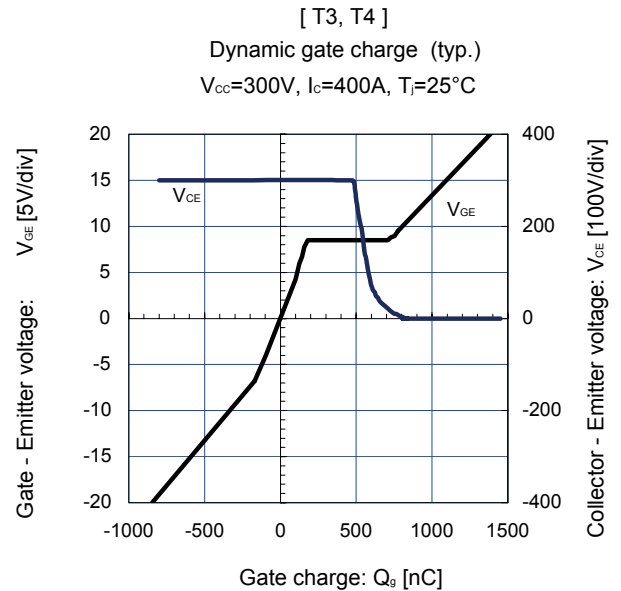
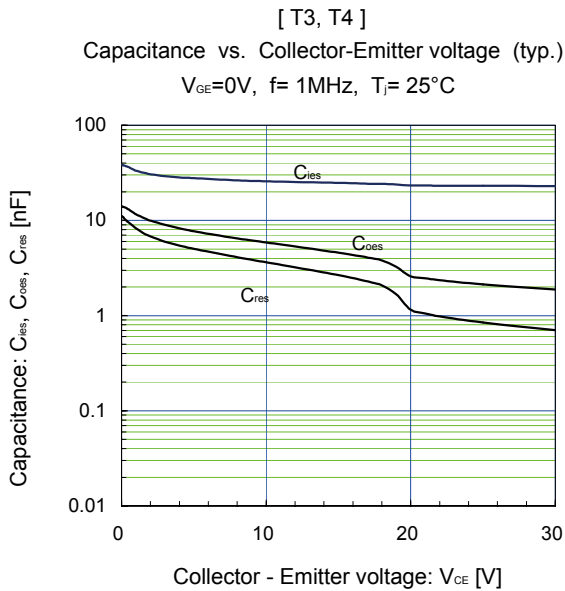
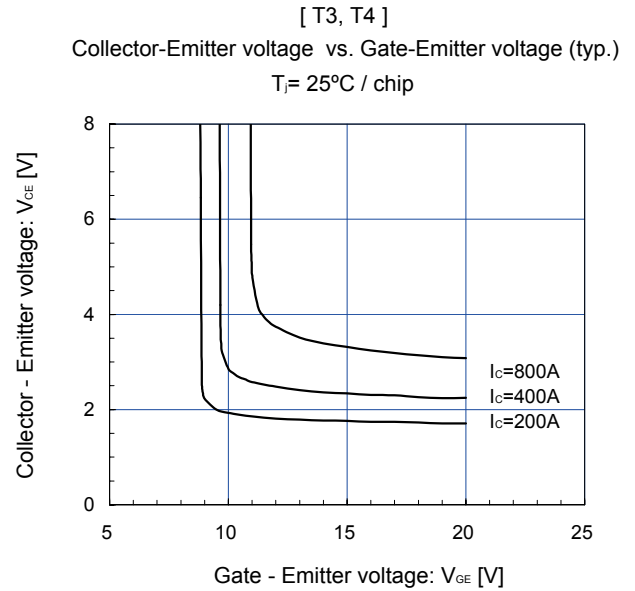
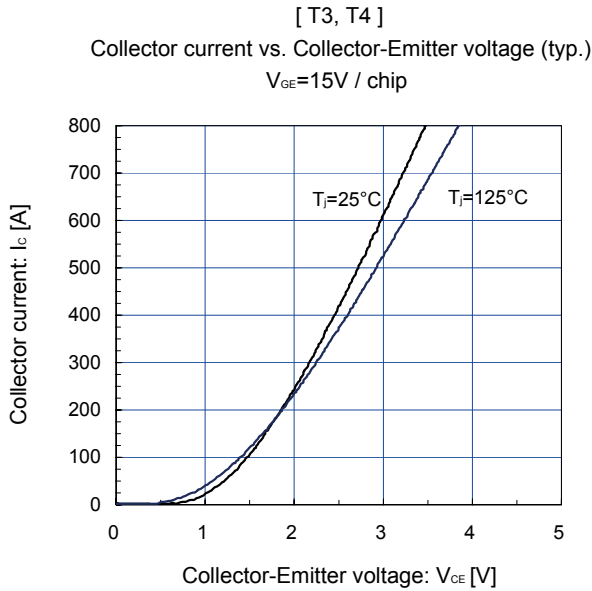
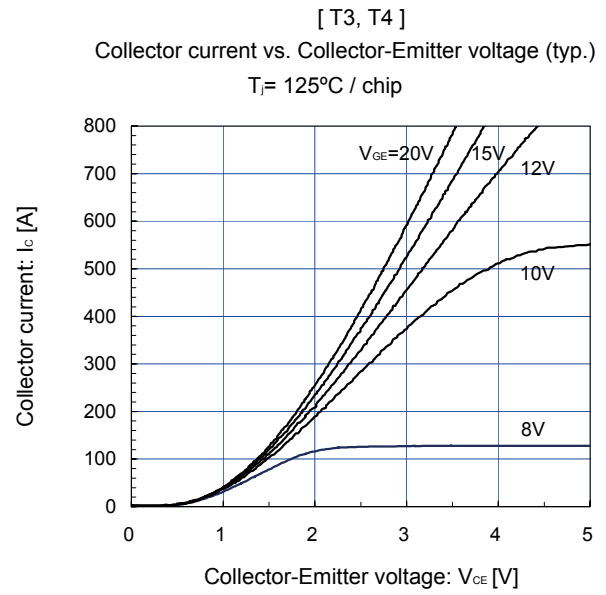
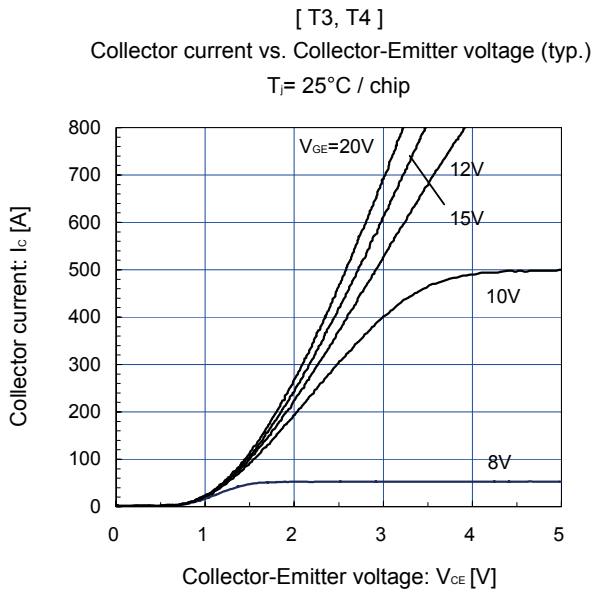


[ SW mode C ]

Switching loss vs. Collector current (typ.)

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

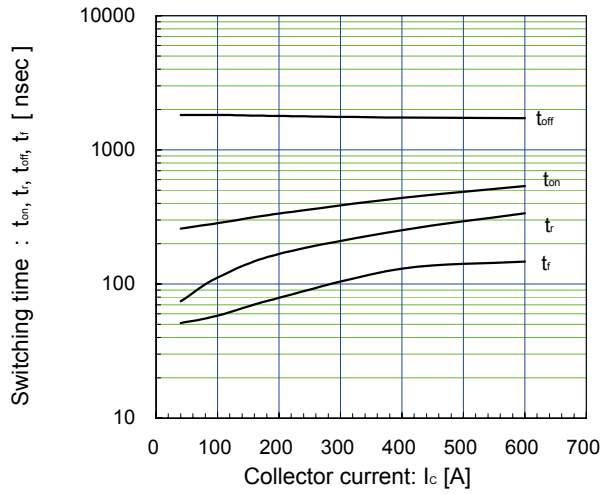




[ SW mode B ]

Switching time vs. Collector current (typ.)

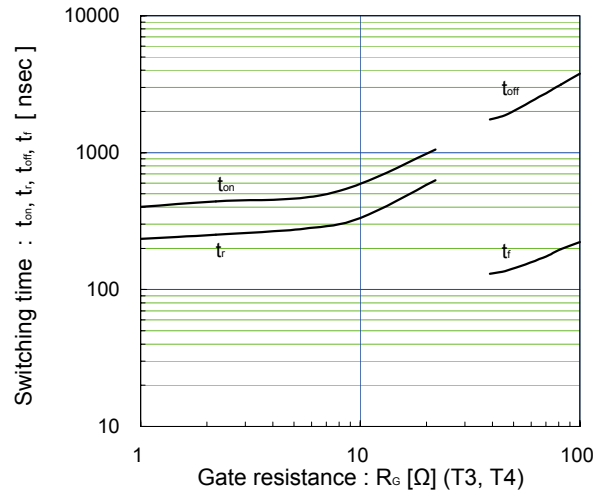
$V_{CC}=200V, V_{GE}=\pm 15V, R_G=+2.2/-39\Omega, T_J=125^\circ C$  (T3, T4)



[ SW mode B ]

Switching time vs. Collector current (typ.)

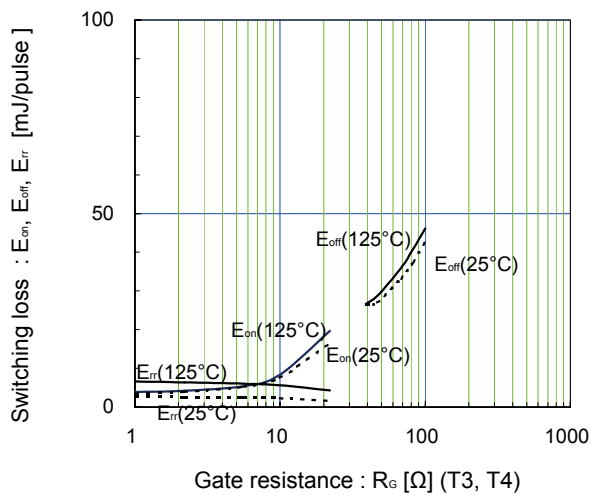
$V_{CC}=200V, I_C=400A, V_{GE}=\pm 15V, T_J=125^\circ C$



[ SW mode B ]

Switching loss vs. gate resistance (typ.)

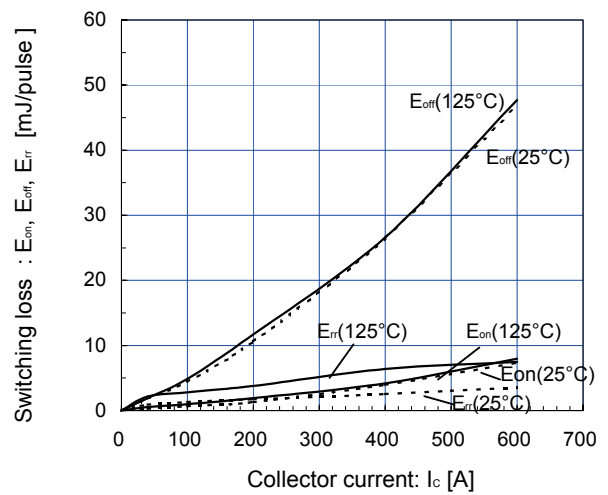
$V_{CC}=200V, I_C=400A, V_{GE}=\pm 15V$



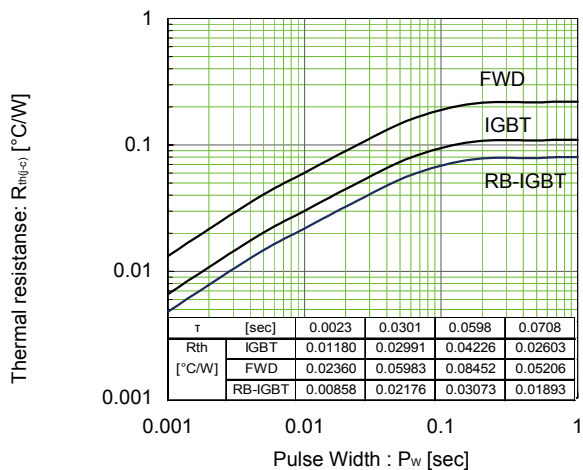
[ SW mode B ]

Switching loss vs. Collector current (typ.)

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

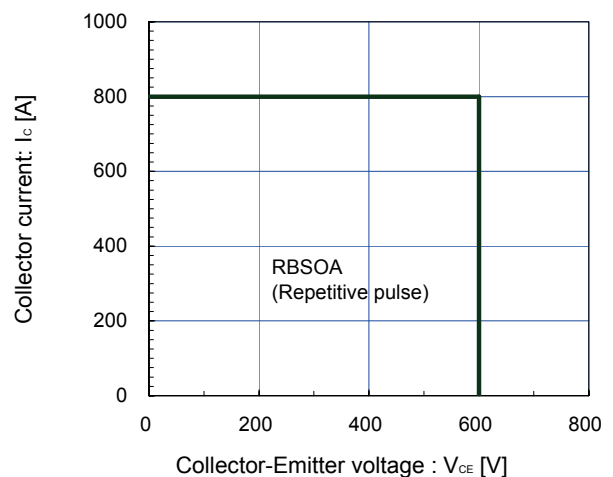


Transient Thermal Resistance (max.)



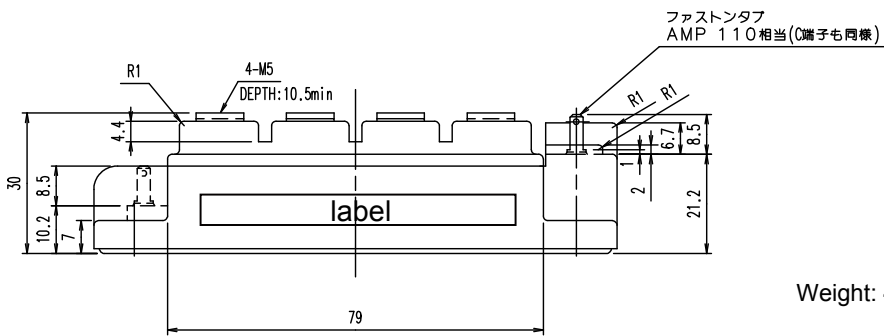
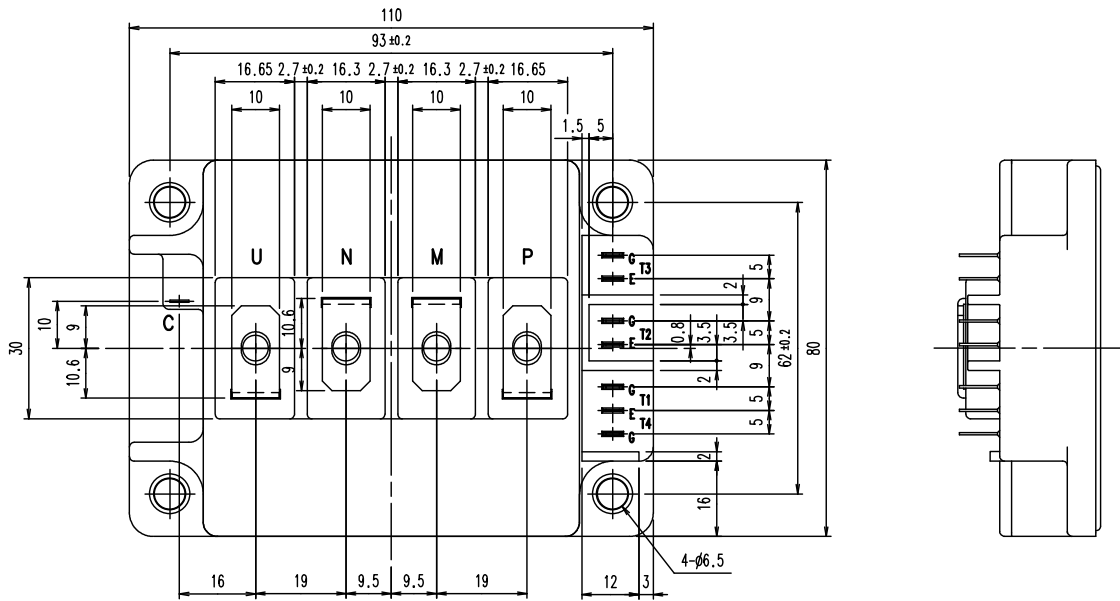
Reverse bias safe operating area (max.)

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



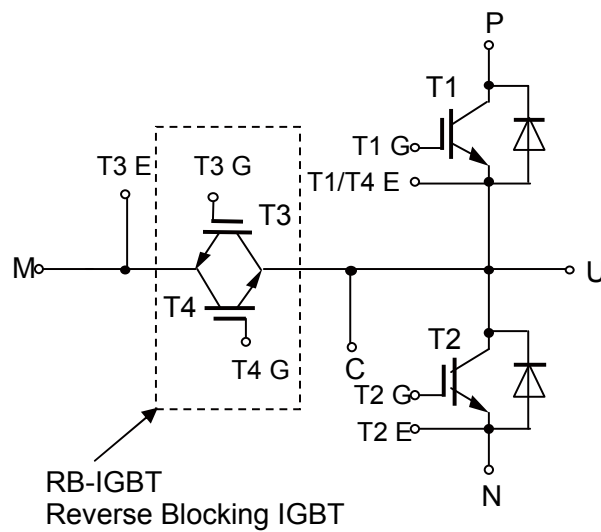


■ Outline Drawings, mm



Weight: 460g (typ.)

■ Equivalent Circuit Schematic



**WARNING**

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