

# 1MBI650VXA-170EL-54

**IGBT Modules**

## IGBT MODULE (V series) 1700V / 650A / 1 in one package

### ■ Features

- High speed switching
- Voltage drive
- Low Inductance module structure

### ■ Applications

- NPC 3-level Inverter
- Inverter DB for Motor Drive
- AC and DC Servo Drive Amplifier (DB)
- Active PFC
- Industrial machines



### ■ Maximum Ratings and Characteristics

#### ● Absolute Maximum Ratings (at T<sub>c</sub>=25°C unless otherwise specified)

Items	Symbols	Conditions	Maximum ratings	Units
Collector-Emitter voltage	V <sub>CES</sub>		1700	V
Gate-Emitter voltage	V <sub>GES</sub>		±20	V
Collector current	I <sub>c</sub>	Continuous	T <sub>c</sub> =25°C 900 T <sub>c</sub> =100°C 650	A
	I <sub>c</sub> pulse	1ms	1300	
	-I <sub>c</sub>		650	
	-I <sub>c</sub> pulse	1ms	1300	
Collector Power Dissipation	P <sub>c</sub>	1 device	4150	W
Reverse voltage for FWD	V <sub>R</sub>		1700	V
Forward current for FWD	I <sub>F</sub>	Continuous	650	A
	I <sub>F</sub> pulse	1ms	1300	
Junction temperature	T <sub>j</sub>		175	°C
Operating junction temperature (under switching conditions)	T <sub>top</sub>		150	
Case temperature	T <sub>c</sub>		150	
Storage temperature	T <sub>stg</sub>		-40 ~ +150	
Isolation voltage	between terminal and copper base (*1)	AC : 1min.	4000	
	between thermistor and others (*2)			
Screw Torque (*3)	Mounting	M5	6.0	N m
	Main Terminals	M8	10.0	
	Sense Terminals	M4	2.1	

Note \*1: All terminals should be connected together during the test.

Note \*2: Two thermistor terminals should be connected together, other terminals should be connected together and shorted to base plate during the test.

Note \*3: Recommendable Value : Mounting 3.0 ~ 6.0 Nm (M5)  
 Recommendable Value : Main Terminals 8.0 ~ 10.0 Nm (M8)  
 Recommendable Value : Sense Terminals 1.8 ~ 2.1 Nm (M4)

● Electrical characteristics (at T<sub>j</sub>= 25°C unless otherwise specified)

Items	Symbols	Conditions	Characteristics			Units		
			min.	typ.	max.			
IGBT/Inverse Diode	Zero gate voltage collector current	I <sub>CEs</sub>	V <sub>CE</sub> = 1700V V <sub>GE</sub> = 0V	-	-	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> = 650mA	6.0	6.5	7.0	V	
	Collector-Emitter saturation voltage	V <sub>CE(sat)</sub> (terminal) (*4)	I <sub>c</sub> = 650A V <sub>GE</sub> = 15V	T <sub>j</sub> = 25°C	-	2.10	2.55	V
				T <sub>j</sub> = 125°C	-	2.50	-	
				T <sub>j</sub> = 150°C	-	2.55	-	
		T <sub>j</sub> = 25°C		-	2.00	2.45		
		T <sub>j</sub> = 125°C		-	2.40	-		
	V <sub>CE(sat)</sub> (chip)	T <sub>j</sub> = 150°C	-	2.45	-			
	Internal gate resistance	R <sub>G(int)</sub>	-	-	1.75	-	Ω	
	Input capacitance	C <sub>ies</sub>	V <sub>CE</sub> = 10V, V <sub>GE</sub> = 0V, f = 1MHz	-	63	-	nF	
Turn-on time	t <sub>on</sub>	V <sub>CC</sub> = 900V I <sub>c</sub> = 650A V <sub>GE</sub> = ±15V R <sub>G</sub> = 1.8 / -2.7 Ω L <sub>S</sub> = 70nH	-	1250	-	nsec		
	t <sub>r</sub>		-	500	-			
	t <sub>r(t)</sub>		-	150	-			
	t <sub>off</sub>		-	1550	-			
Turn-off time	t <sub>r</sub>	-	150	-	-			
Forward on voltage	V <sub>F</sub> (terminal) (*4)	I <sub>F</sub> = 650A V <sub>GE</sub> = 0V	T <sub>j</sub> = 25°C	-	1.95	2.40	V	
			T <sub>j</sub> = 125°C	-	2.20	-		
			T <sub>j</sub> = 150°C	-	2.15	-		
	T <sub>j</sub> = 25°C		-	1.85	2.30			
	T <sub>j</sub> = 125°C		-	2.10	-			
V <sub>F</sub> (chip)	T <sub>j</sub> = 150°C	-	2.05	-				
Reverse recovery time	t <sub>rr</sub>	I <sub>F</sub> = 650A	-	240	-	nsec		
Reverse Current	I <sub>R</sub>	V <sub>CE</sub> = 1700V	-	-	3.0	mA		
FWD	V <sub>F</sub> (terminal) (*4)	I <sub>F</sub> = 650A V <sub>GE</sub> = 0V	T <sub>j</sub> = 25°C	-	1.95	2.40	V	
			T <sub>j</sub> = 125°C	-	2.20	-		
			T <sub>j</sub> = 150°C	-	2.15	-		
	T <sub>j</sub> = 25°C		-	1.85	2.30			
	T <sub>j</sub> = 125°C		-	2.10	-			
V <sub>F</sub> (chip)	T <sub>j</sub> = 150°C	-	2.05	-				
Reverse recovery time	t <sub>rr</sub>	I <sub>F</sub> = 650A	-	240	-	nsec		
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	

Note \*4: Fuji defined V<sub>CE</sub> value of terminal by using Sense C1 and Sense C2E1 for Upper arm and Sense C2E1 and Sense E2 for Lower arm .

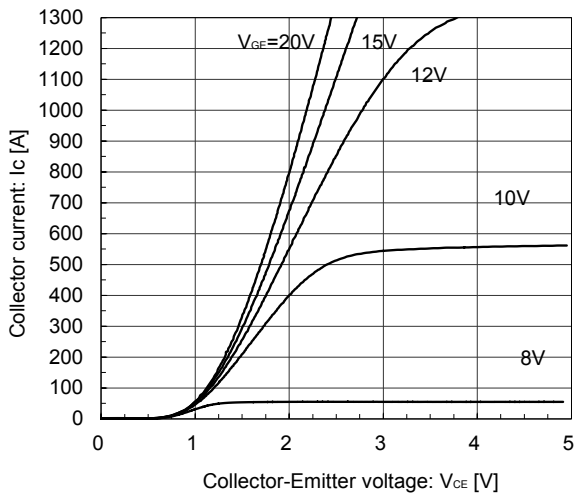
● Thermal resistance characteristics

Items	Symbols	Conditions	Characteristics			Units
			min.	typ.	max.	
Thermal resistance(1device)	R <sub>th(j-c)</sub>	Inverter IGBT	-	-	0.036	°C/W
		Inverse Diode	-	-	0.072	
		FWD	-	-	0.072	
Contact thermal resistance (1device) (*5)	R <sub>th(c-f)</sub>	with Thermal Compound	-	0.0125	-	

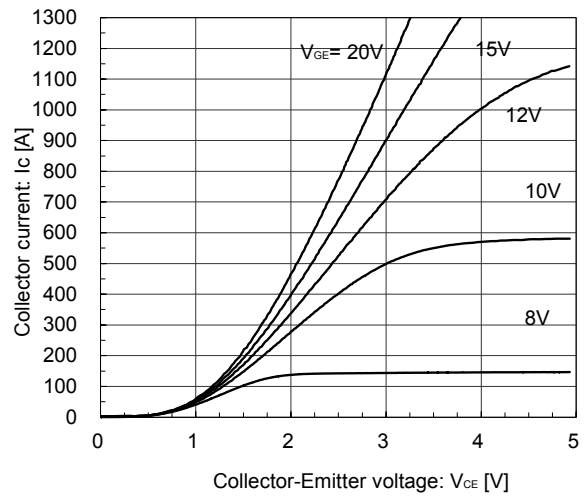
Note \*5: This is the value which is defined mounting on the additional cooling fin with thermal compound.

■ Characteristics (Representative)

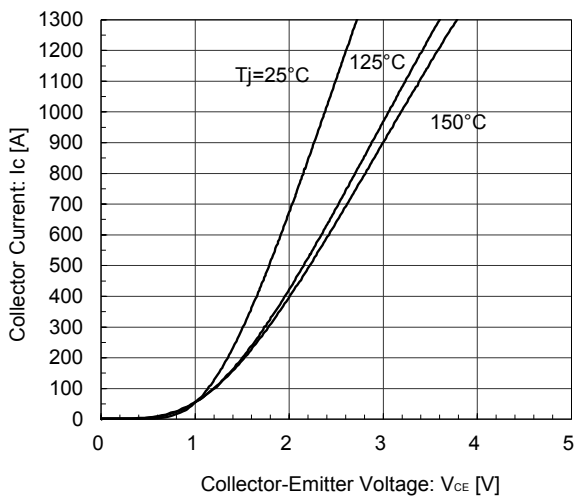
Collector current vs. Collector-Emitter voltage (typ.)  
T<sub>j</sub>= 25°C / chip



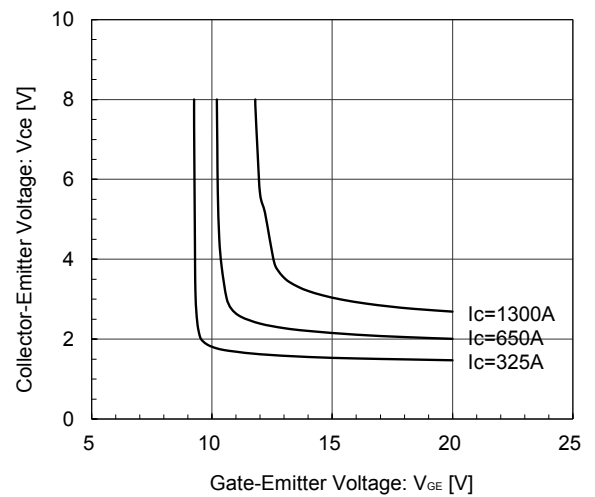
Collector current vs. Collector-Emitter voltage (typ.)  
T<sub>j</sub>= 150°C / chip



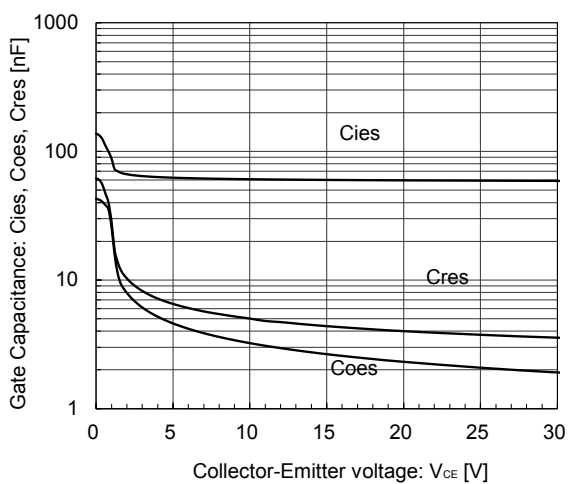
Collector current vs. Collector-Emitter voltage (typ.)  
V<sub>GE</sub>= 15V / chip



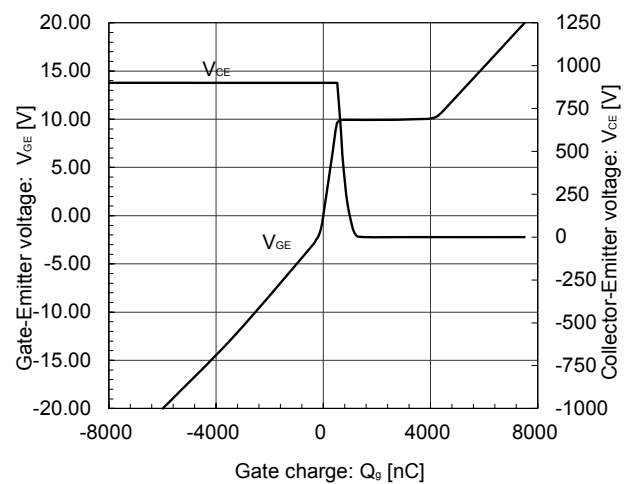
Collector-Emitter voltage vs. Gate-Emitter voltage (typ.)  
T<sub>j</sub>= 25°C / chip



Gate Capacitance vs. Collector-Emitter Voltage (typ.)  
V<sub>GE</sub>= 0V, f = 1MHz, T<sub>j</sub>= 25°C

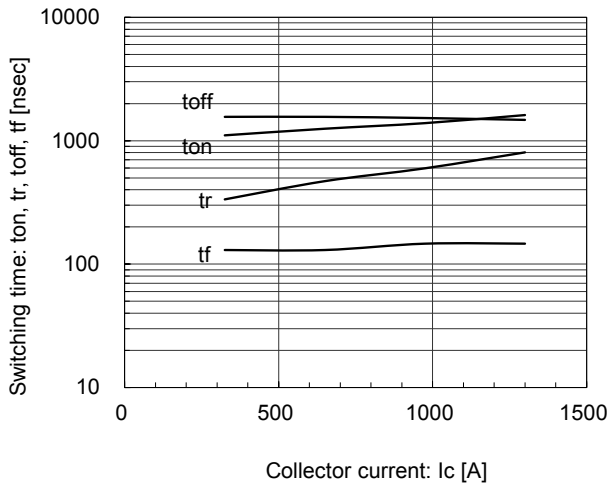


Dynamic Gate Charge (typ.)  
V<sub>CC</sub>=900V, I<sub>c</sub>=650A, T<sub>j</sub>= 25°C



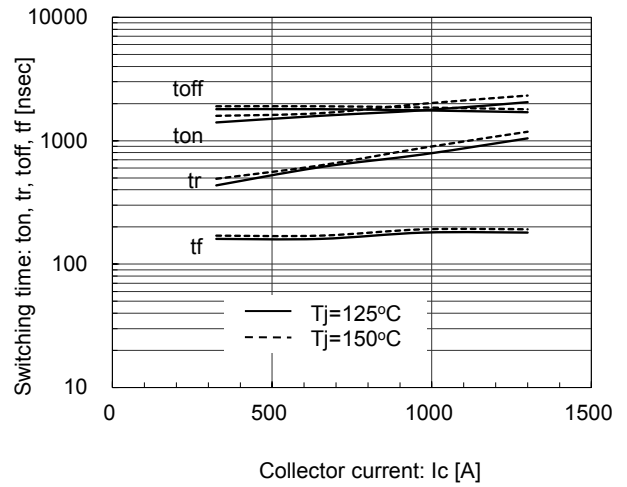
Switching time vs. Collector current (typ.)

$V_{cc}=900V, V_{GE}=\pm 15V, R_G=+1.8/-2.7\Omega, T_j=25^\circ C$



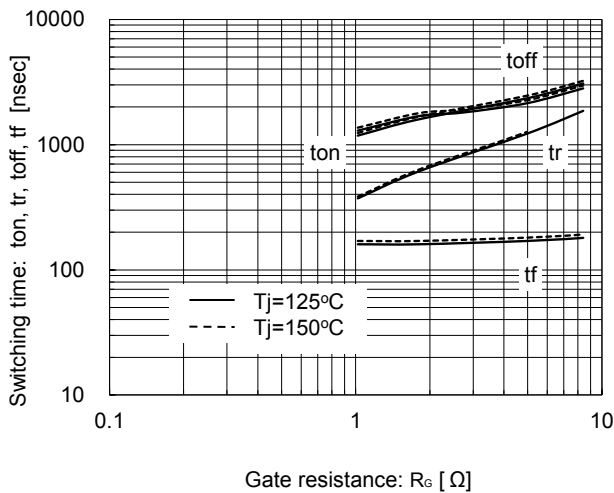
Switching time vs. Collector current (typ.)

$V_{cc}=900V, V_{GE}=\pm 15V, R_G=+1.8/-2.7\Omega, T_j=125^\circ C, 150^\circ C$



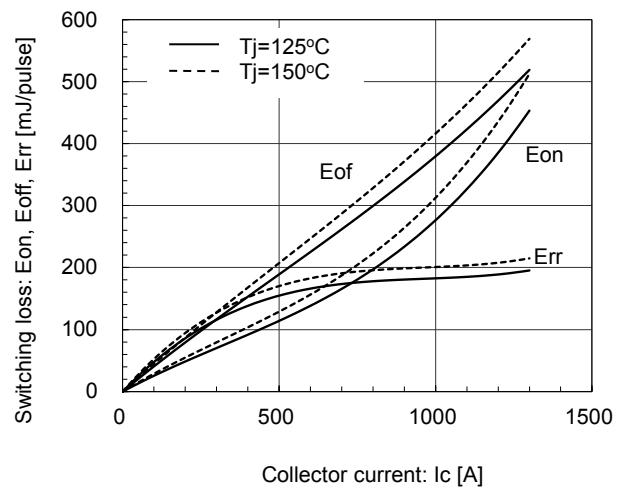
Switching time vs. Gate resistance (typ.)

$V_{cc}=900V, I_c=650A, V_{GE}=\pm 15V, T_j=125^\circ C, 150^\circ C$



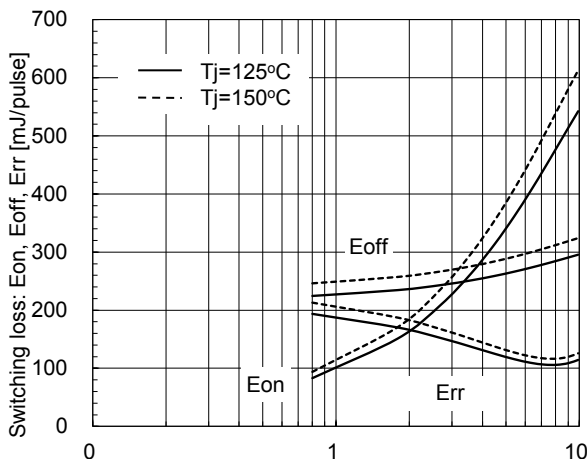
Switching loss vs. Collector current (typ.)

$V_{cc}=900V, V_{GE}=\pm 15V, R_G=+1.8/-2.7\Omega, T_j=125^\circ C, 150^\circ C$



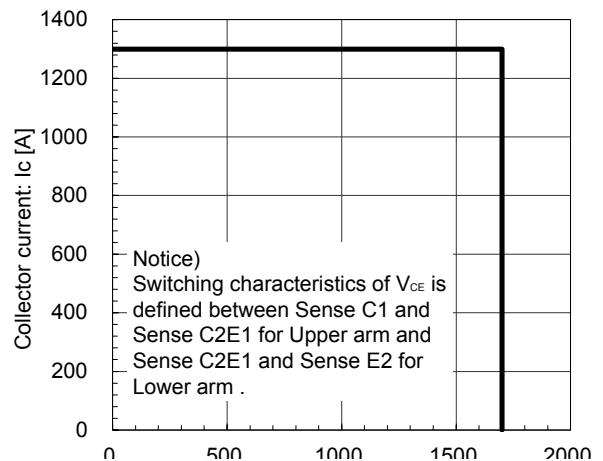
Switching loss vs. Gate resistance (typ.)

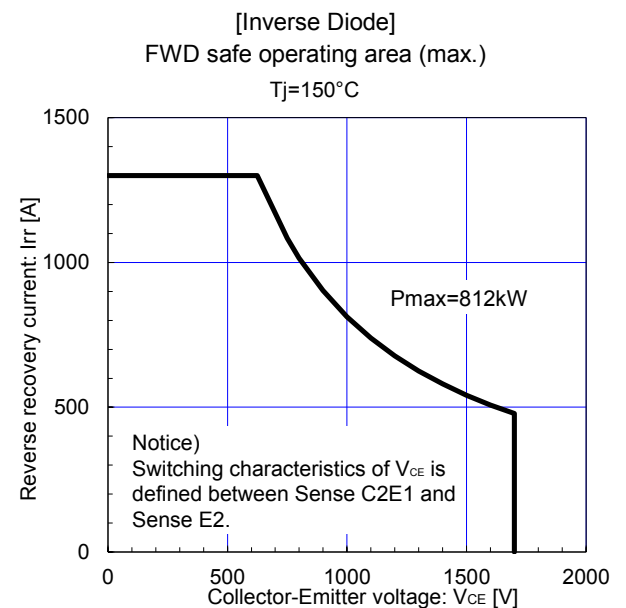
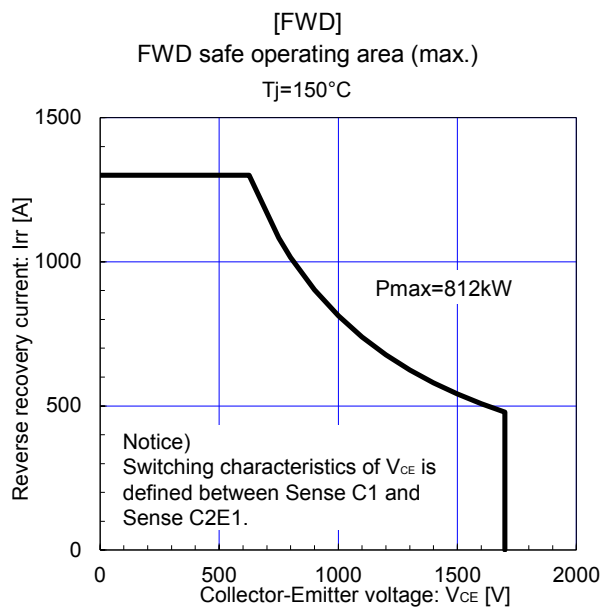
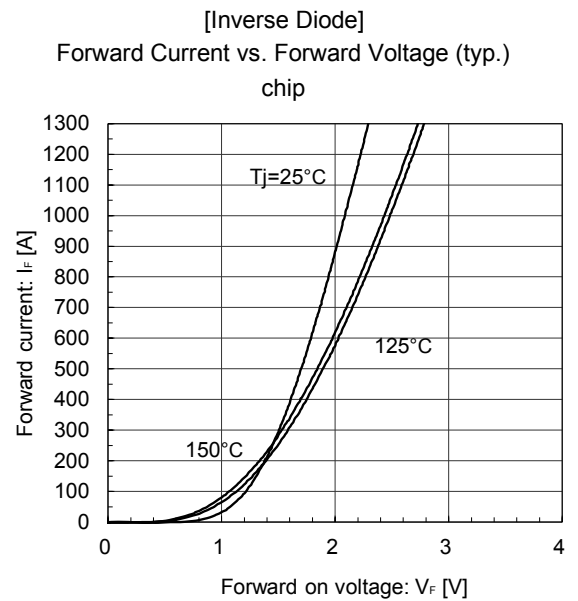
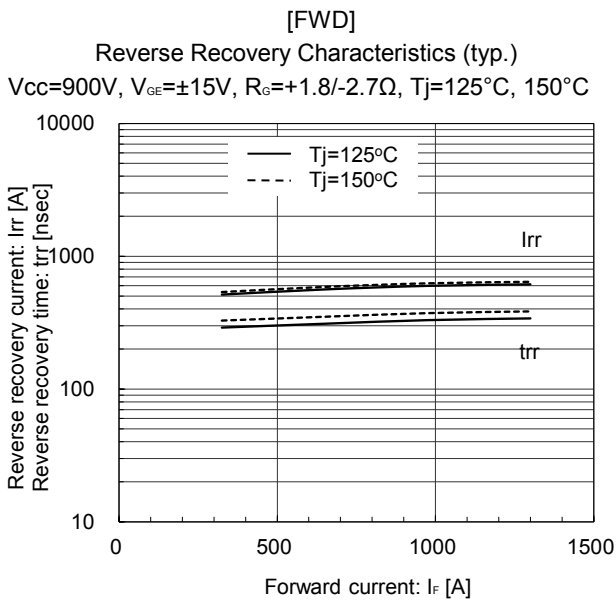
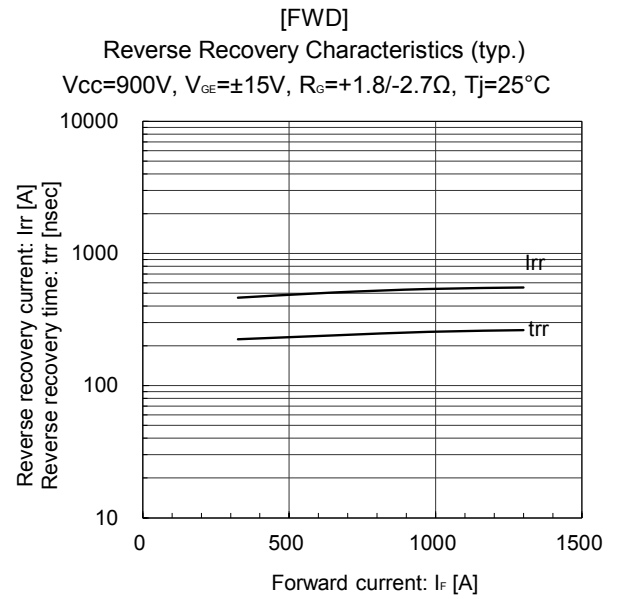
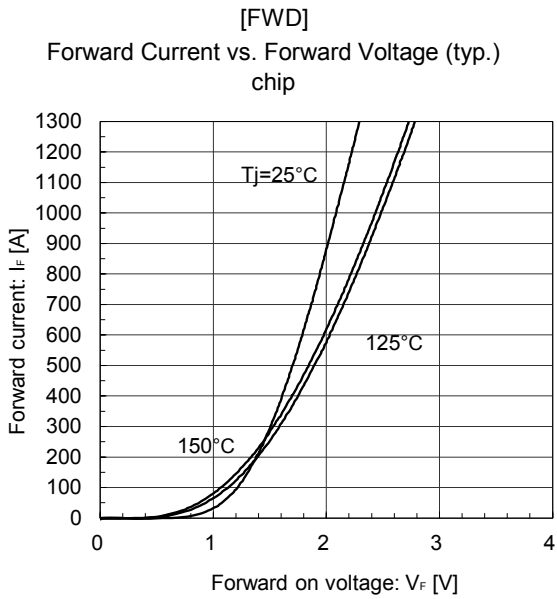
$V_{cc}=900V, I_c=650A, V_{GE}=\pm 15V, T_j=125^\circ C, 150^\circ C$

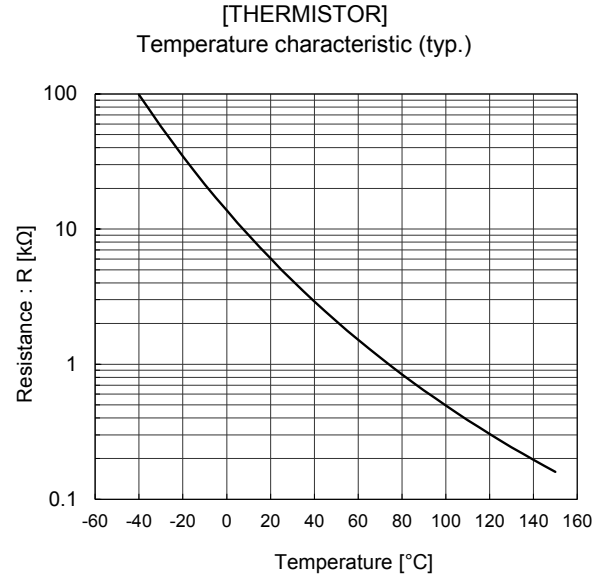
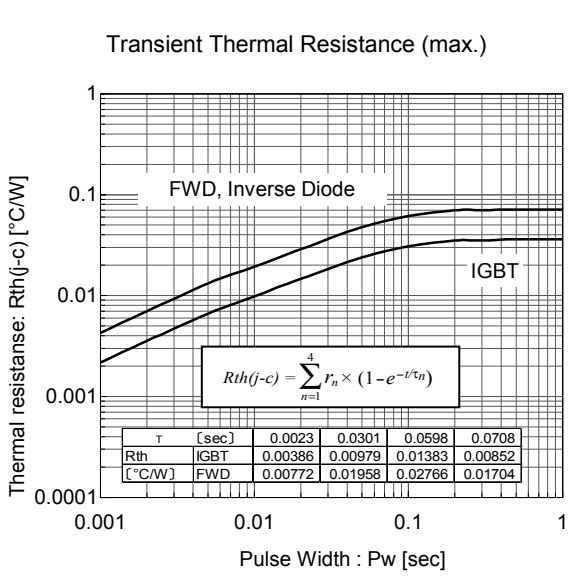


Reverse bias safe operating area (max.)

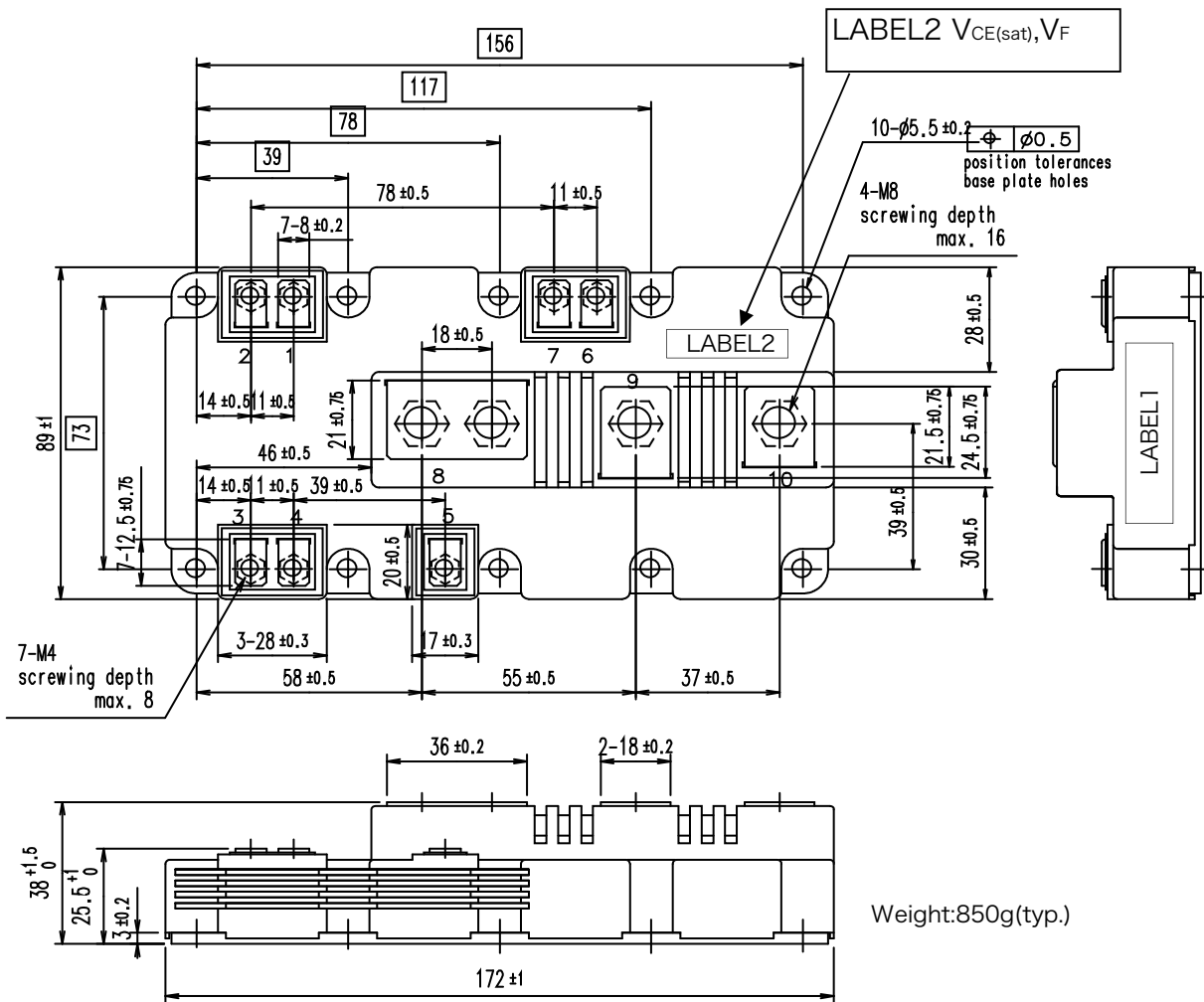
$+V_{GE}=15V, -V_{GE}=\pm 15V, R_G=+1.8/-2.7\Omega, T_j=150^\circ C$



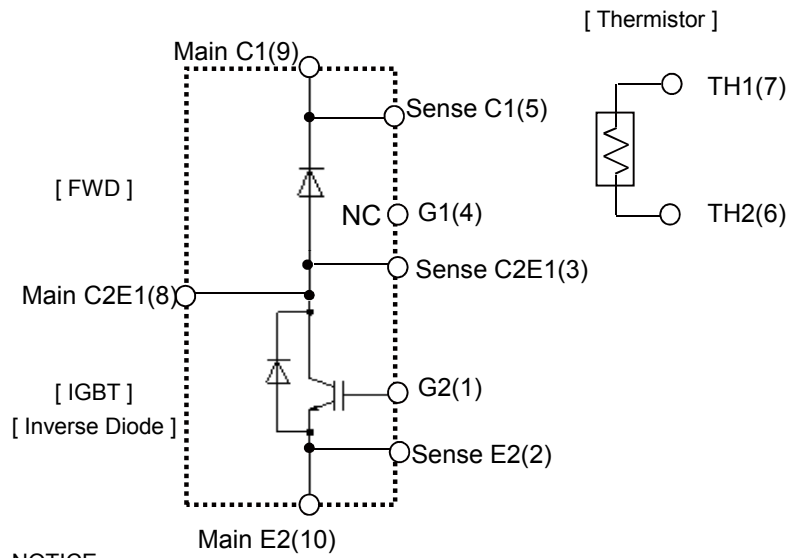




■ Outline Drawings, mm



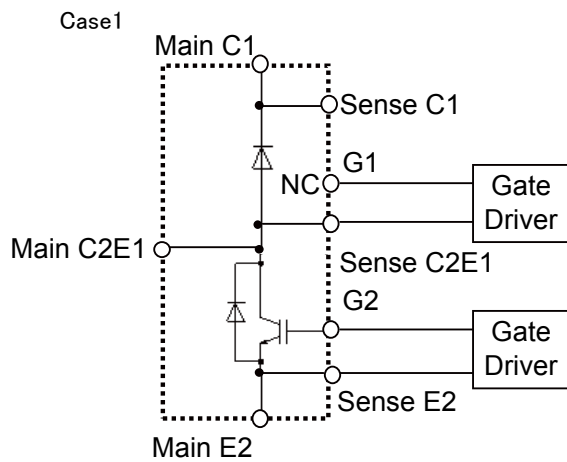
Equivalent Circuit Schematic



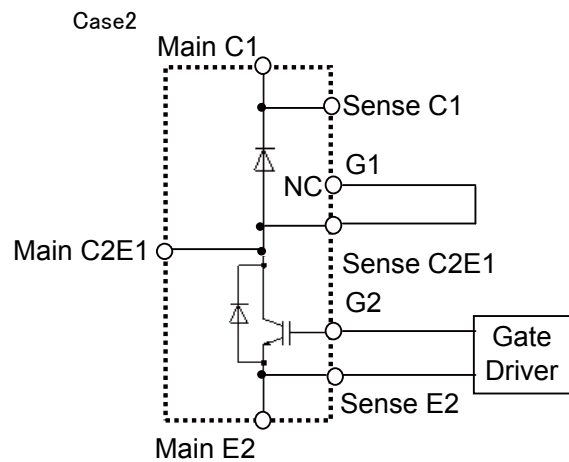
NOTICE

There is recommendation of wiring for NC terminal as follows.

Fuji recommends wire connection of CASE1 or CASE2 to fix NC terminal voltage.



NC terminal (G1) and sense C2E1 should be connected by Gate-Driver.



NC terminal (G1) and sense C2E1 should be connected by wire.

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