

# FMG1G400US60L

## Molding Type Module

### General Description

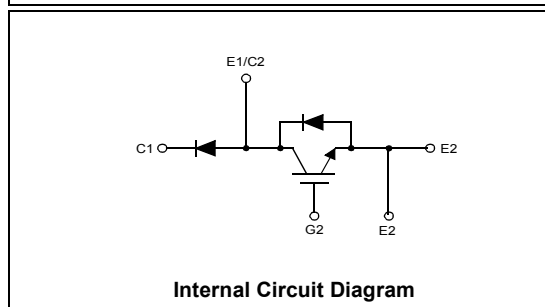
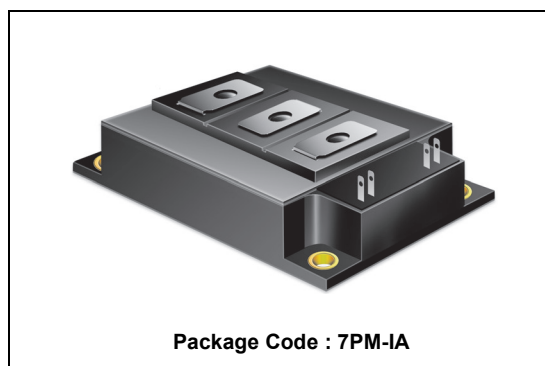
Fairchild IGBT Power Module provides low conduction and switching losses as well as short circuit ruggedness. It's designed for the applications such as motor control, uninterrupted power supplies (UPS) and general inverters where short-circuit ruggedness is required.

### Features

- Short Circuit Rated Time; 10us @  $T_C = 100^\circ\text{C}$ ,  $V_{GE} = 15\text{V}$
- High Speed Switching
- Low Saturation Voltage :  $V_{CE(sat)} = 2.1\text{V}$  @  $I_C = 400\text{A}$
- High Input Impedance
- Fast & Soft Anti-Parallel FWD
- UL Certified No.E209204

### Application

- AC & DC Motor Controls
- General Purpose Inverters
- Robotics
- Servo Controls
- UPS



### Absolute Maximum Ratings $T_C = 25^\circ\text{C}$ unless otherwise noted

Symbol	Description	FMG1G400US60L	Units
$V_{CES}$	Collector-Emitter Voltage	600	V
$V_{GES}$	Gate-Emitter Voltage	$\pm 20$	V
$I_C$	Collector Current @ $T_C = 80^\circ\text{C}$	400	A
$I_{CM(1)}$	Pulsed Collector Current	800	A
$I_F$	Diode Continuous Forward Current @ $T_C = 80^\circ\text{C}$	400	A
$I_{FM}$	Diode Maximum Forward Current	800	A
$P_D$	Maximum Power Dissipation @ $T_C = 25^\circ\text{C}$	1136	W
$T_{SC}$	Short Circuit Withstand Time @ $T_C = 100^\circ\text{C}$	10	us
$T_J$	Operating Junction Temperature	-40 to +150	$^\circ\text{C}$
$T_{STG}$	Storage Temperature Range	-40 to +125	$^\circ\text{C}$
$V_{ISO}$	Isolation Voltage @ AC 1minute	2500	V
Mounting Torque	Power Terminal Screw : M6	4.0	N.m
	Mounting Screw : M6	4.0	N.m

**Notes :**

(1) Repetitive rating : Pulse width limited by max. junction temperature

### Electrical Characteristics of IGBT T<sub>C</sub> = 25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
<b>Off Characteristics</b>						
BV <sub>CES</sub>	Collector-Emitter Breakdown Voltage	V <sub>GE</sub> = 0V, I <sub>C</sub> = 250uA	600	--	--	V
ΔBV <sub>CES</sub> /ΔT <sub>J</sub>	Temperature Coeff. of Breakdown Voltage	V <sub>GE</sub> = 0V, I <sub>C</sub> = 1mA	--	0.6	--	V/°C
I <sub>CES</sub>	Collector Cut-Off Current	V <sub>CE</sub> = V <sub>CES</sub> , V <sub>GE</sub> = 0V	--	--	250	uA
I <sub>GES</sub>	Gate - Emitter Leakage Current	V <sub>GE</sub> = V <sub>GES</sub> , V <sub>CE</sub> = 0V	--	--	± 100	nA

### On Characteristics

V <sub>GE(th)</sub>	Gate - Emitter Threshold Voltage	I <sub>C</sub> = 400mA, V <sub>CE</sub> = V <sub>GE</sub>	5.0	6.5	8.5	V
V <sub>CE(sat)</sub>	Collector to Emitter Saturation Voltage	I <sub>C</sub> = 400A, V <sub>GE</sub> = 15V	--	2.1	2.7	V

### Switching Characteristics

t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>CC</sub> = 300 V, I <sub>C</sub> = 400A, R <sub>G</sub> = 2Ω, V <sub>GE</sub> = 15V, Inductive Load, T <sub>C</sub> = 25°C	--	160	--	ns
t <sub>r</sub>	Rise Time		--	220	--	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		--	230	--	ns
t <sub>f</sub>	Fall Time		--	150	250	ns
E <sub>on</sub>	Turn-On Switching Loss		--	9.5	--	mJ
E <sub>off</sub>	Turn-Off Switching Loss	--	21	--	mJ	
t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>CC</sub> = 300 V, I <sub>C</sub> = 400A, R <sub>G</sub> = 2Ω, V <sub>GE</sub> = 15V, Inductive Load, T <sub>C</sub> = 125°C	--	320	--	ns
t <sub>r</sub>	Rise Time		--	240	--	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		--	290	--	ns
t <sub>f</sub>	Fall Time		--	230	--	ns
E <sub>on</sub>	Turn-On Switching Loss		--	11	--	mJ
E <sub>off</sub>	Turn-Off Switching Loss	--	26	--	mJ	
T <sub>sc</sub>	Short Circuit Withstand Time	V <sub>CC</sub> = 300 V, V <sub>GE</sub> = 15V @ T <sub>C</sub> = 100°C	10	--	--	us
Q <sub>g</sub>	Total Gate Charge	V <sub>CE</sub> = 300 V, I <sub>C</sub> = 400A, V <sub>GE</sub> = 15V	--	1200	--	nC
Q <sub>ge</sub>	Gate-Emitter Charge		--	310	--	nC
Q <sub>gc</sub>	Gate-Collector Charge		--	490	--	nC

### Electrical Characteristics of DIODE T<sub>C</sub> = 25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units	
V <sub>FM</sub>	Diode Forward Voltage	I <sub>F</sub> = 400A	T <sub>C</sub> = 25°C	--	1.9	2.8	V
			T <sub>C</sub> = 100°C	--	1.8	--	
t <sub>rr</sub>	Diode Reverse Recovery Time	I <sub>F</sub> = 400A	T <sub>C</sub> = 25°C	--	90	130	ns
			T <sub>C</sub> = 100°C	--	130	--	
I <sub>rr</sub>	Diode Peak Reverse Recovery Current	di / dt = 800 A/us	T <sub>C</sub> = 25°C	--	35	46	A
			T <sub>C</sub> = 100°C	--	76	--	
Q <sub>rr</sub>	Diode Reverse Recovery Charge	I <sub>F</sub> = 400A	T <sub>C</sub> = 25°C	--	1580	3000	nC
			T <sub>C</sub> = 100°C	--	4940	--	

### Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Units
R <sub>θJC</sub>	Junction-to-Case (IGBT Part, per 1/2 Module)	--	0.11	°C/W
R <sub>θJC</sub>	Junction-to-Case (DIODE Part, per 1/2 Module)	--	0.18	°C/W
R <sub>θJC</sub>	Case-to-Sink (Conductive grease applied)	0.03	--	°C/W
Weight	Weight of Module	360	--	g

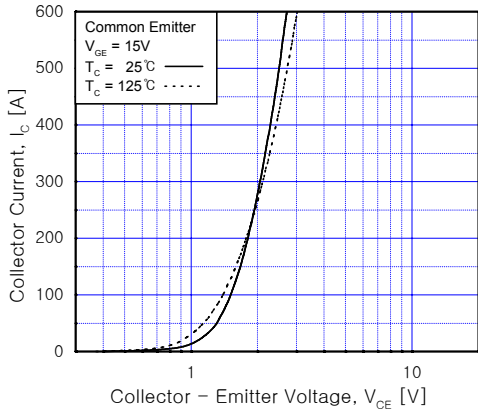


Fig 1. Typical Output Characteristics

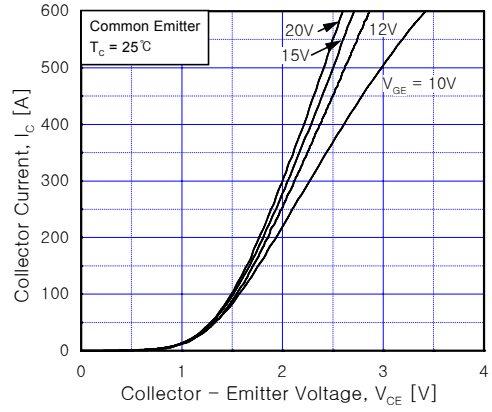


Fig 2. Typical Saturation Voltage Characteristics

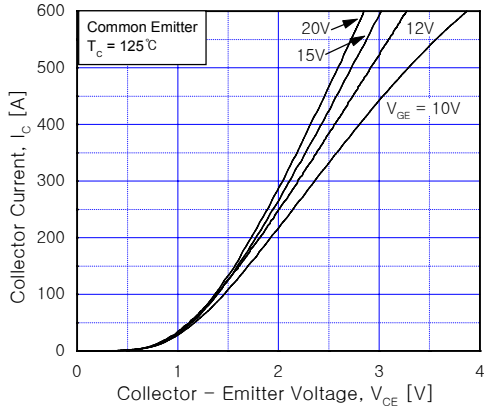


Fig 3. Typical Saturation Voltage Characteristics

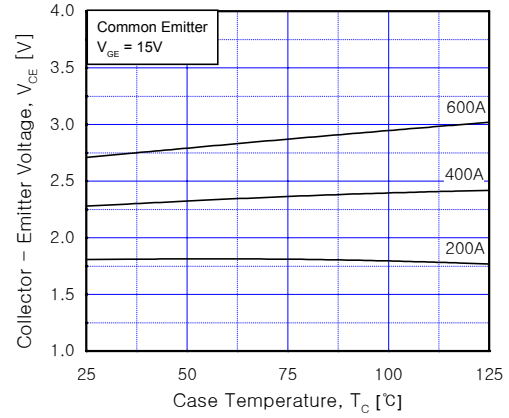


Fig 4. Saturation Voltage vs. Case Temperature at Variant Current Level

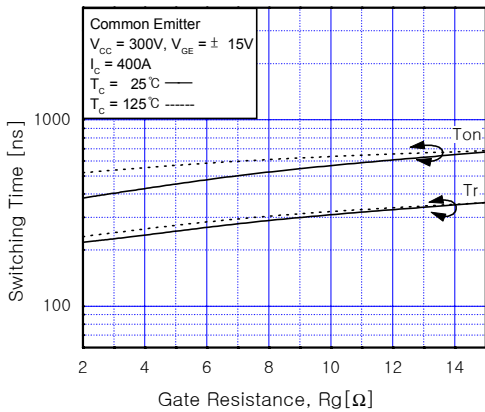


Fig 5. Turn-On Characteristics vs. Gate Resistance

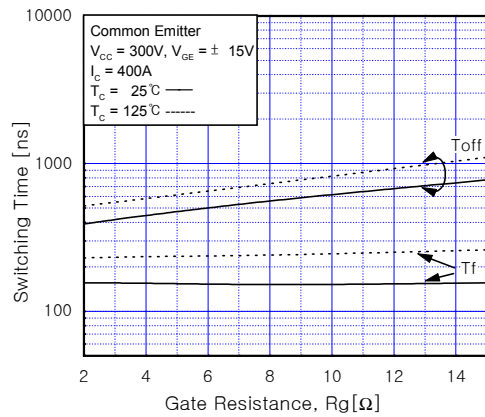
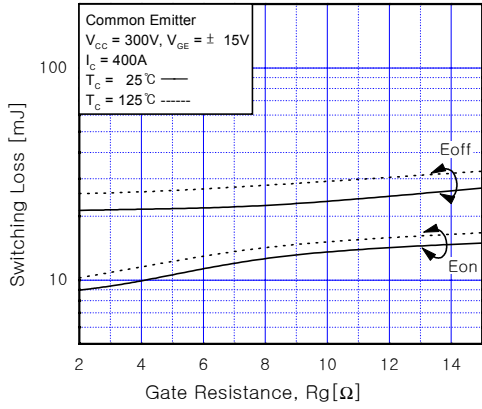
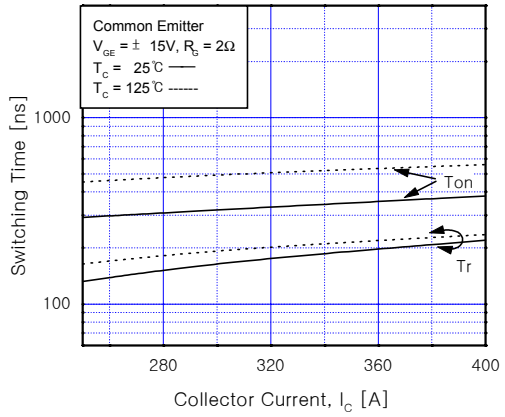


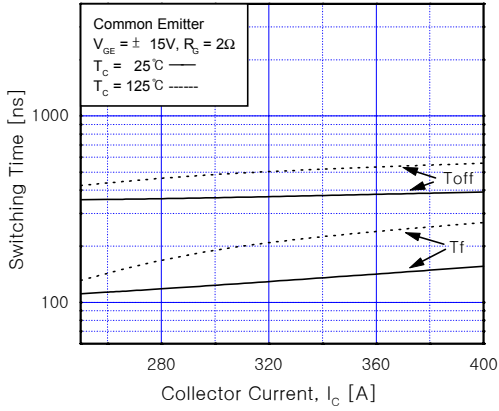
Fig 6. Turn-Off Characteristics vs. Gate Resistance



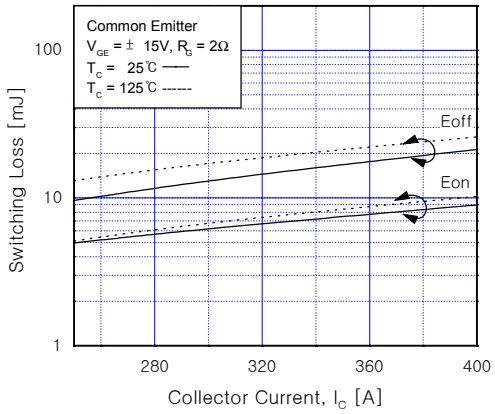
**Fig 7. Switching Loss vs. Gate Resistance**



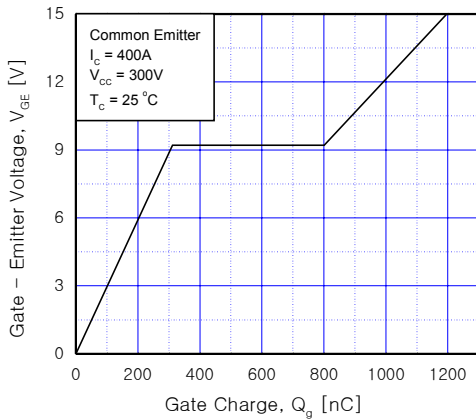
**Fig 8. Turn-On Characteristics vs. Collector Current**



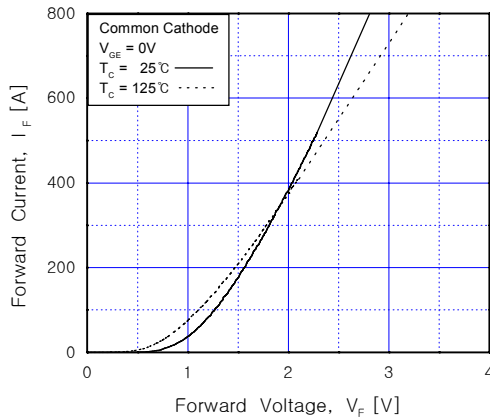
**Fig 9. Turn-Off Characteristics vs. Collector Current**



**Fig 10. Switching Loss vs. Collector Current**



**Fig 11. Gate Charge Characteristics**



**Fig 12. Forward Characteristics (diode)**

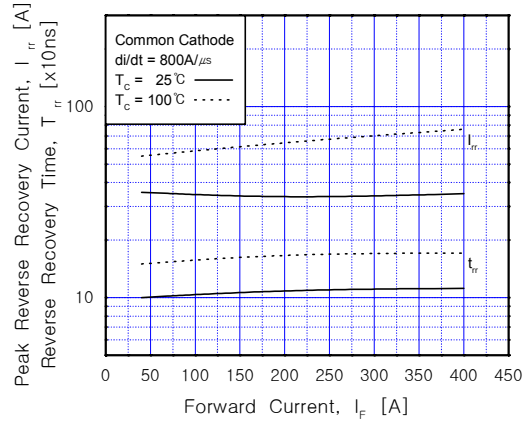
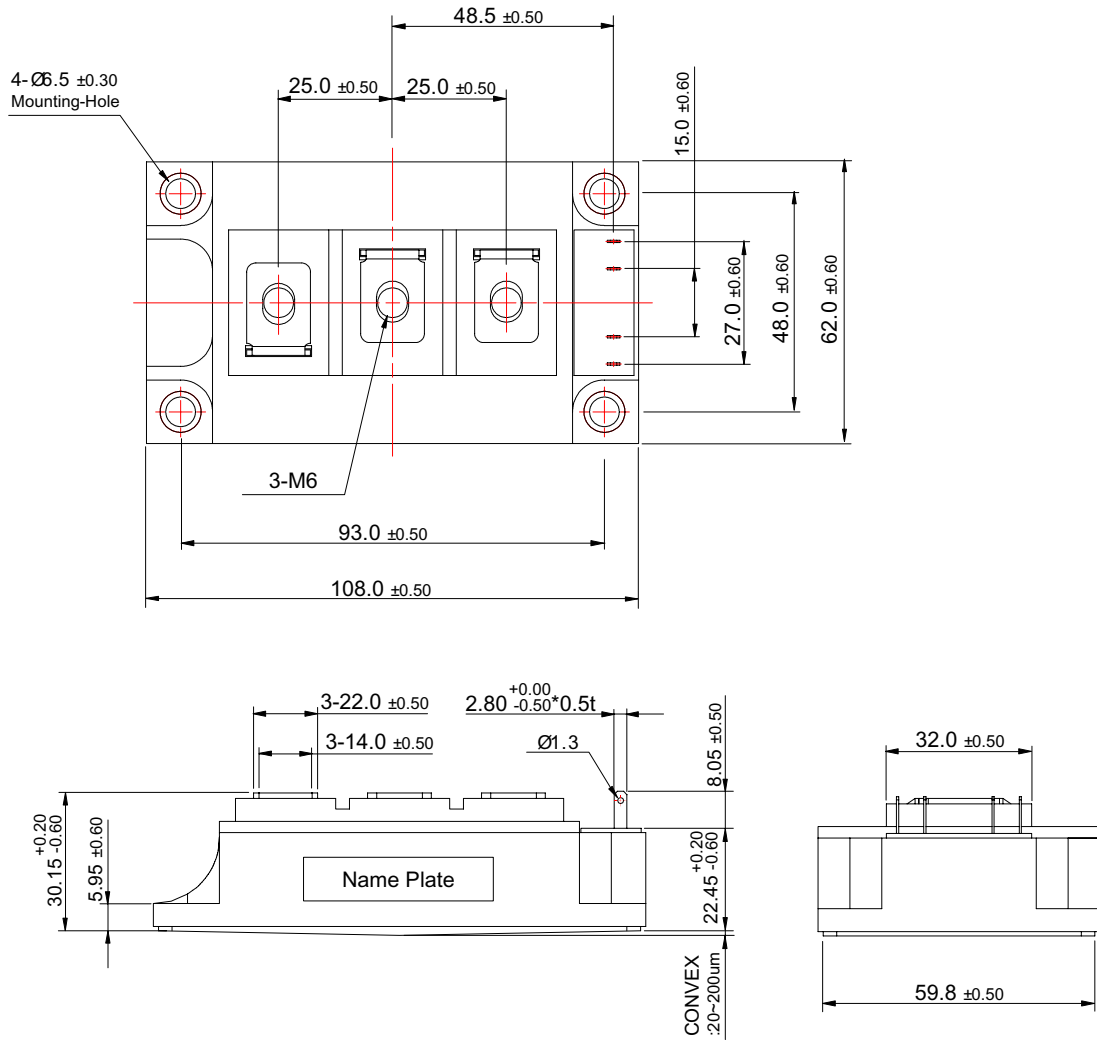


Fig 13. Reverse Recovery Characteristics(diode)

Package Dimension

7PM-IA



Dimensions in Millimeters

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