

# FMC6G15US60

## Compact & Complex Module

### General Description

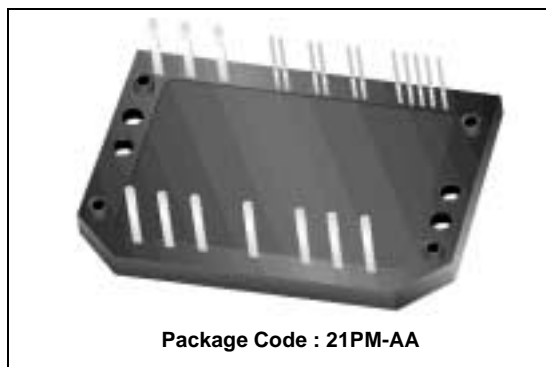
Fairchild's Insulated Gate Bipolar Transistor (IGBT) power modules provide low conduction and switching losses as well as short circuit ruggedness. They are designed for applications such as motor control, uninterrupted power supplies (UPS) and general inverters where short circuit ruggedness is a required feature.

### Features

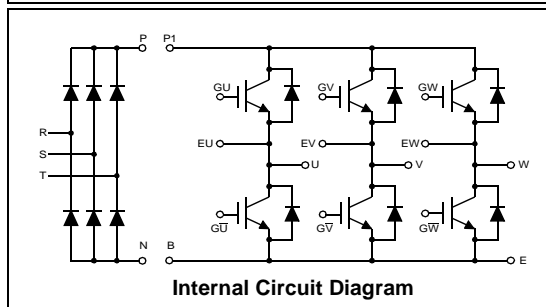
- UL Certified No. E209204
- Short circuit rated 10us @  $T_C = 100^\circ\text{C}$ ,  $V_{GE} = 15\text{V}$
- High speed switching
- Low saturation voltage :  $V_{CE(sat)} = 2.2\text{V}$  @  $I_C = 15\text{A}$
- High input impedance
- Built in 3 phase rectifier circuit
- Fast & soft anti-parallel FWD

### Applications

- AC & DC motor controls
- General purpose inverters
- Robotics
- Servo controls



Package Code : 21PM-AA



Internal Circuit Diagram

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

	Symbol	Description	FMC7G15US60	Units
Inverter	$V_{CES}$	Collector-Emitter Voltage	600	V
	$V_{GES}$	Gate-Emitter Voltage	$\pm 20$	V
	$I_C$	Collector Current @ $T_C = 25^\circ\text{C}$	15	A
	$I_{CM(1)}$	Pulsed Collector Current	30	A
	$I_F$	Diode Continuous Forward Current @ $T_C = 100^\circ\text{C}$	15	A
	$I_{FM}$	Diode Maximum Forward Current	30	A
	$P_D$	Maximum Power Dissipation @ $T_C = 25^\circ\text{C}$	45	W
Converter	$T_{SC}$	Short Circuit Withstand Time @ $T_C = 100^\circ\text{C}$	10	us
	$V_{RRM}$	Repetitive Peak Reverse Voltage	1200	V
	$I_O$	Average Output Rectified Current	20	A
	$I_{FSM}$	Surge Forward Current @ 1Cycle at 60Hz, Peak value Non-Repetitive	200	A
Common	$I^2t$	1 Cycle Surge Current	164	$\text{A}^2\text{s}$
	$T_J$	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		Mounting part Screw @ M4	1.25	N.m

**Notes :**

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

**Electrical Characteristics of the IGBT @ Inverter**  $T_C = 25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
<b>Off Characteristics</b>						
$BV_{CES}$	Collector-Emitter Breakdown Voltage	$V_{GE} = 0V, I_C = 250\mu A$	600	--	--	V
$\Delta BV_{CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	$V_{GE} = 0V, I_C = 1mA$	--	0.6	--	$V/^\circ C$
$I_{CES}$	Collector Cut-Off Current	$V_{CE} = V_{CES}, V_{GE} = 0V$	--	--	250	$\mu A$
$I_{GES}$	G-E Leakage Current	$V_{GE} = V_{GES}, V_{CE} = 0V$	--	--	$\pm 100$	nA

**On Characteristics**

$V_{GE(th)}$	G-E Threshold Voltage	$I_C = 15mA, V_{CE} = V_{GE}$	5.0	6.0	8.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C = 15A, V_{GE} = 15V$	--	2.2	2.8	V

**Dynamic Characteristics**

$C_{ies}$	Input Capacitance	$V_{CE} = 30V, V_{GE} = 0V,$ $f = 1MHz$	--	948	--	pF
$C_{oes}$	Output Capacitance		--	101	--	pF
$C_{res}$	Reverse Transfer Capacitance		--	33	--	pF

**Switching Characteristics**

$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 300V, I_C = 15A,$ $R_G = 13\Omega, V_{GE} = 15V,$ Inductive Load, $T_C = 25^\circ C$	--	17	--	ns
$t_r$	Rise Time		--	33	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	44	65	ns
$t_f$	Fall Time		--	118	200	ns
$E_{on}$	Turn-On Switching Loss		--	0.32	--	mJ
$E_{off}$	Turn-Off Switching Loss		--	0.36	--	mJ
$E_{ts}$	Total Switching Loss	--	0.68	0.95	mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 300V, I_C = 15A,$ $R_G = 13\Omega, V_{GE} = 15V,$ Inductive Load, $T_C = 125^\circ C$	--	20	--	ns
$t_r$	Rise Time		--	34	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	48	70	ns
$t_f$	Fall Time		--	212	350	ns
$E_{on}$	Turn-On Switching Loss		--	0.34	--	mJ
$E_{off}$	Turn-Off Switching Loss		--	0.7	--	mJ
$E_{ts}$	Total Switching Loss	--	1.04	1.45	mJ	
$T_{sc}$	Short Circuit Withstand Time	$V_{CC} = 300V, V_{GE} = 15V$ @ $T_C = 100^\circ C$	10	--	--	us
$Q_g$	Total Gate Charge	$V_{CE} = 300V, I_C = 15A,$ $V_{GE} = 15V$	--	42	60	nC
$Q_{ge}$	Gate-Emitter Charge		--	7	10	nC
$Q_{gc}$	Gate-Collector Charge		--	17	24	nC

**Electrical Characteristics of the DIODE @ Inverter**  $T_C = 25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units	
$V_{FM}$	Diode Forward Voltage	$I_F = 15\text{A}$	$T_C = 25^\circ\text{C}$	--	1.9	2.8	V
			$T_C = 100^\circ\text{C}$	--	2.0	--	
$t_{rr}$	Diode Reverse Recovery Time		$T_C = 25^\circ\text{C}$	--	75	130	ns
			$T_C = 100^\circ\text{C}$	--	100	--	
$I_{rr}$	Diode Peak Reverse Recovery Current	$I_F = 15\text{A}$ $di / dt = 30 \text{ A/us}$	$T_C = 25^\circ\text{C}$	--	1.0	1.8	A
			$T_C = 100^\circ\text{C}$	--	1.3	--	
$Q_{rr}$	Diode Reverse Recovery Charge		$T_C = 25^\circ\text{C}$	--	40	100	nC
			$T_C = 100^\circ\text{C}$	--	70	--	

**Electrical Characteristics of the DIODE @ Converter**  $T_C = 25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units	
$V_{FM}$	Diode Forward Voltage	$I_F = 20\text{A}$	$T_C = 25^\circ\text{C}$	--	1.1	1.5	V
			$T_C = 100^\circ\text{C}$	--	1.0	--	
$I_{RRM}$	Repetitive Reverse Current	$V_R = V_{RRM}$	$T_C = 25^\circ\text{C}$	--	--	8	mA
			$T_C = 100^\circ\text{C}$	--	5	--	

**Thermal Characteristics**

	Symbol	Parameter	Typ.	Max.	Units
Inverter	$R_{\theta JC}$	Junction-to-Case (IGBT Part, per 1/6 Module)	--	2.77	$^\circ\text{C/W}$
	$R_{\theta JC}$	Junction-to-Case (DIODE Part, per 1/6 Module)	--	3.5	$^\circ\text{C/W}$
Converter	$R_{\theta JC}$	Junction-to-Case (DIODE Part, per 1/6 Module)	--	2.7	$^\circ\text{C/W}$
Weight		Weight of Module	60	--	g

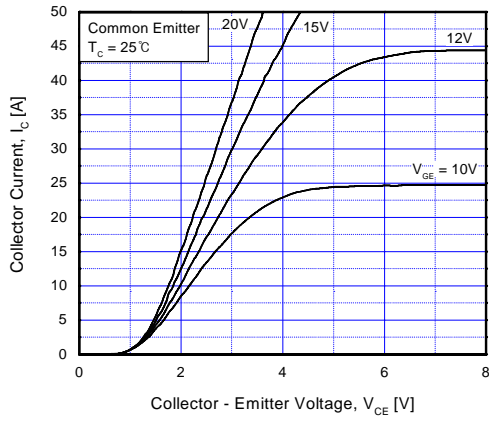


Fig 1. Typical Output Characteristics

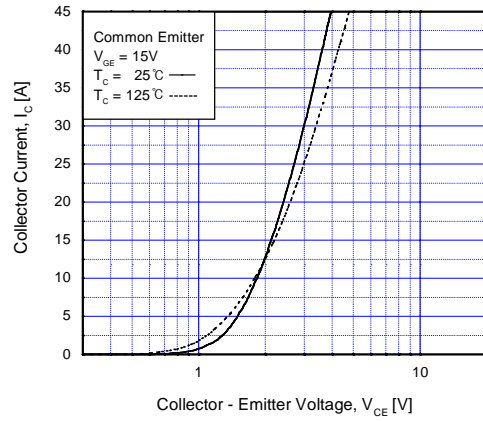


Fig 2. Typical Saturation Voltage Characteristics

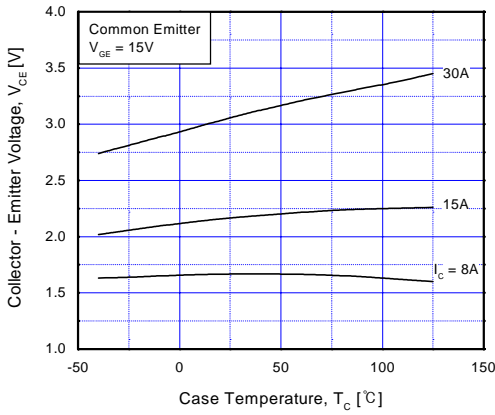


Fig 3. Saturation Voltage vs. Case Temperature at Variant Current Level

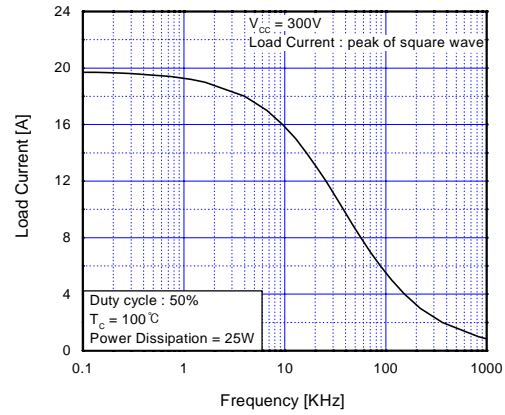


Fig 4. Load Current vs. Frequency

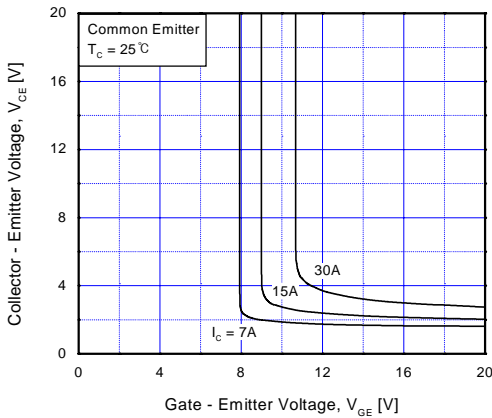


Fig 5. Saturation Voltage vs.  $V_{GE}$

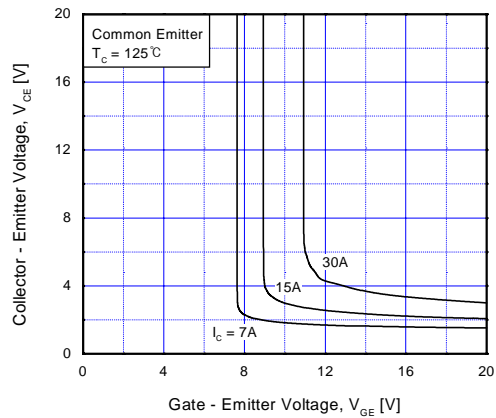


Fig 6. Saturation Voltage vs.  $V_{GE}$

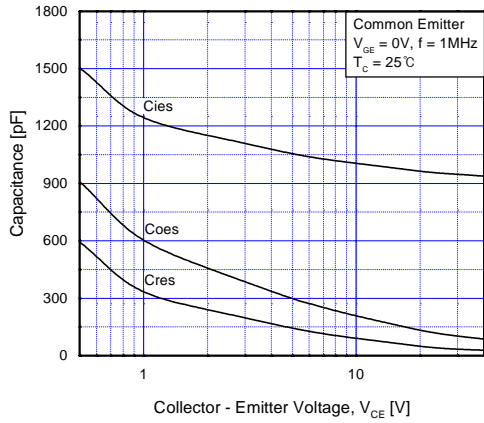


Fig 7. Capacitance Characteristics

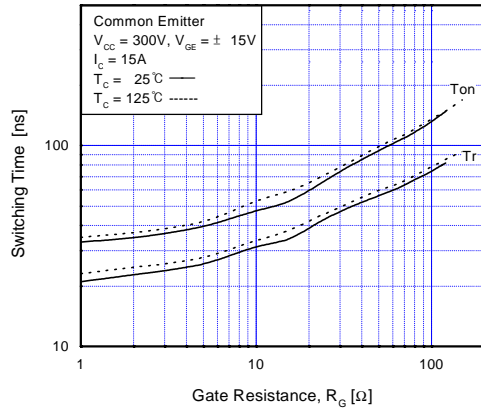


Fig 8. Turn-On Characteristics vs. Gate Resistance

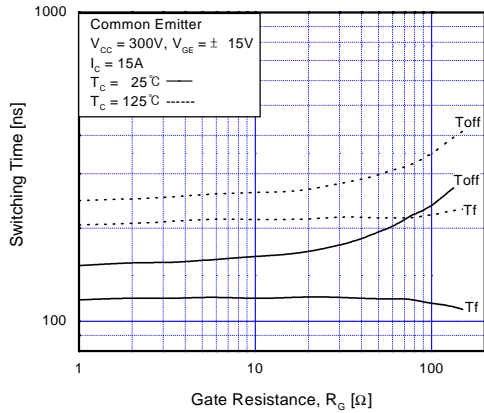


Fig 9. Turn-Off Characteristics vs. Gate Resistance

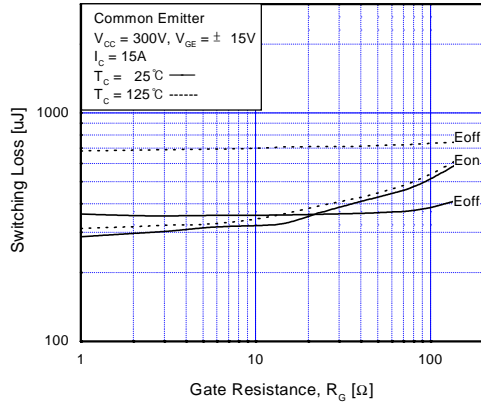


Fig 10. Switching Loss vs. Gate Resistance

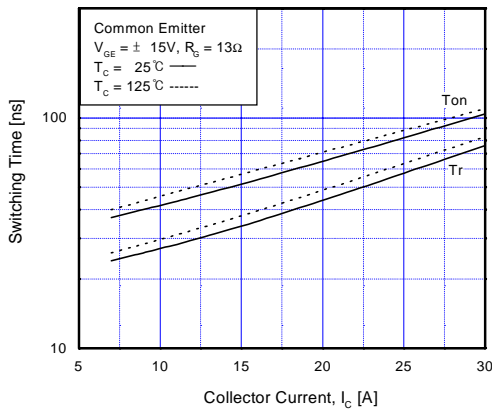


Fig 11. Turn-On Characteristics vs. Collector Current

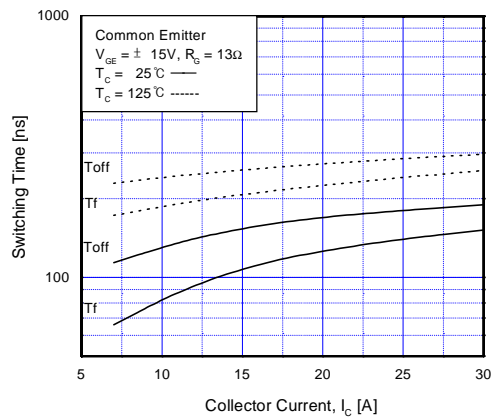


Fig 12. Turn-Off Characteristics vs. Collector Current

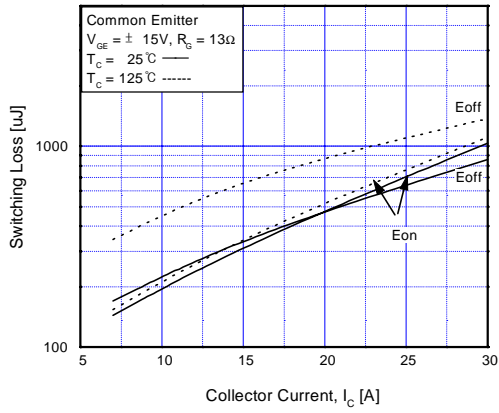


Fig 13. Switching Loss vs. Collector Current

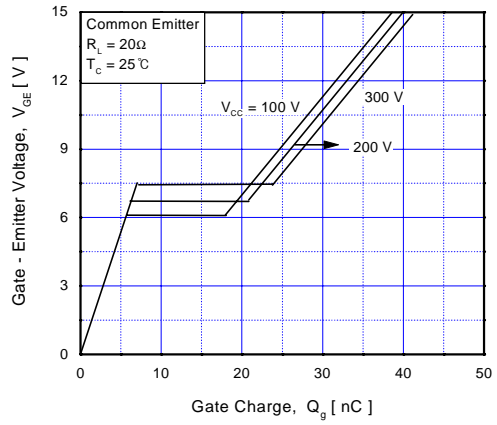


Fig 14. Gate Charge Characteristics

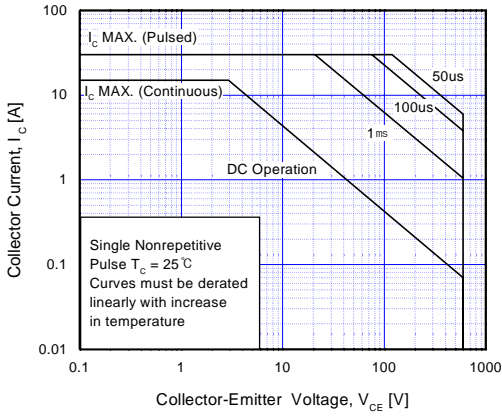


Fig 15. SOA Characteristics

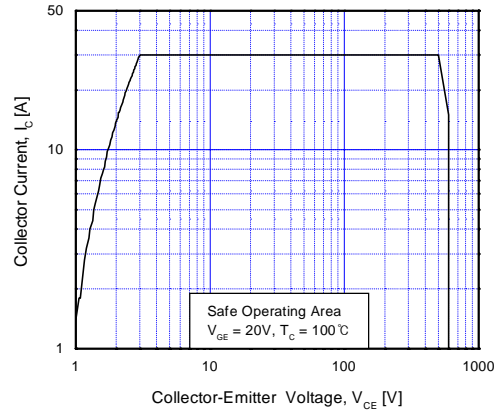


Fig 16. Turn-Off SOA Characteristics

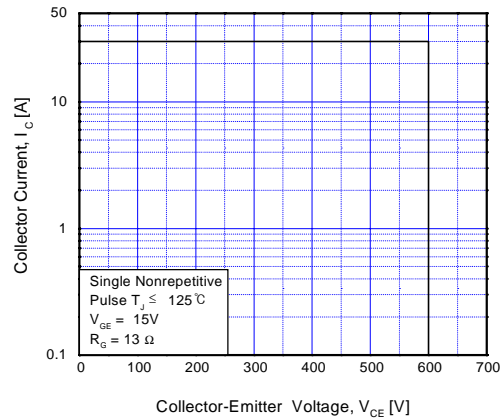


Fig 17. RBSOA Characteristics

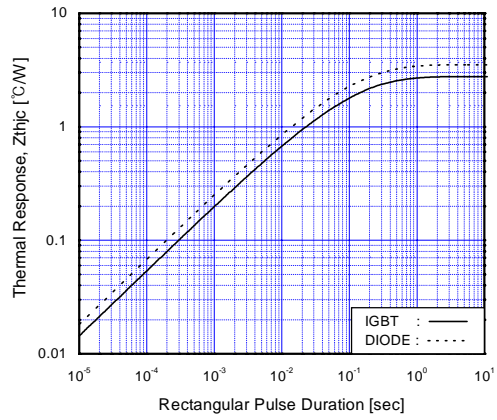


Fig 18. Transient Thermal Impedance

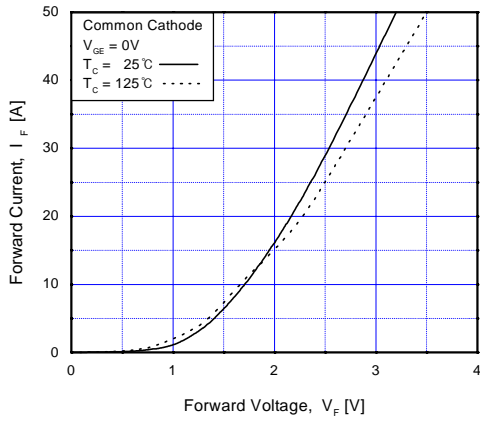


Fig 19. Forward Characteristics

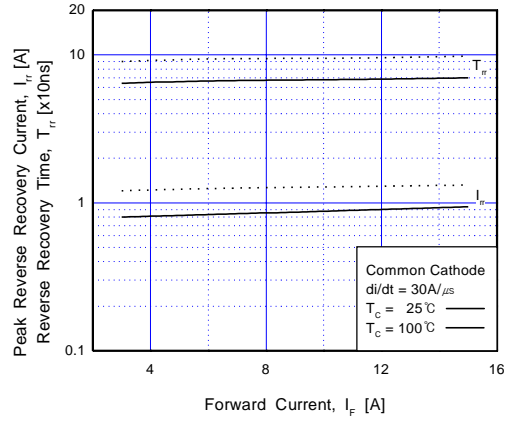


Fig 20. Reverse Recovery Characteristics





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