FAIRCHILD SEMICONDUCTOR®

October 2001

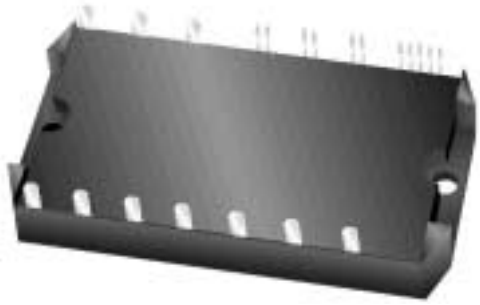
*IGBT*

# FMC7G30US60

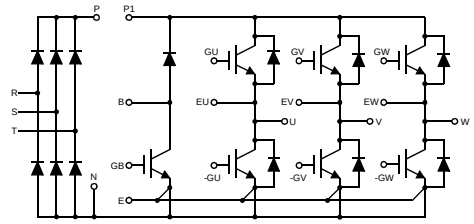
## Compact & Complex Module

### 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.



**Package Code : 21PM-BA**




**Internal Circuit Diagram**

### Features

- UL Certified No. E209204
- Short circuit rated 10us @ $T_C$ = 100°C, $V_{GE}$ = 15V
- High speed switching
- Low saturation voltage : $V_{CE}$(sat) = 2.2 V @ $I_C$ = 30A
- High input impedance
- Built in brake and 3 phase rectifier circuit
- Fast & soft anti-parallel FWD

### Applications

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

## Absolute Maximum Ratings

$T_C$ = 25°C unless otherwise noted

| | Symbol | Description | | FMC7G30US60 | Units |
|---|---|---|---|---|---|
| Inverter & Brake | $V_{CES}$ | Collector-Emitter Voltage | | 600 | V |
| | $V_{GES}$ | Gate-Emitter Voltage | | ± 20 | V |
| | $I_C$ | Collector Current | @ $T_C$ = 25°C | 30 | A |
| | $I_{CM\ (1)}$ | Pulsed Collector Current | | 60 | A |
| | $I_F$ | Diode Continuous Forward Current | @ $T_C$ = 100°C | 30 | A |
| | $I_{FM}$ | Diode Maximum Forward Current | | 60 | A |
| | $P_D$ | Maximum Power Dissipation | @ $T_C$ = 25°C | 125 | W |
| | $T_{SC}$ | Short Circuit Withstand Time | @ $T_C$ = 100°C | 10 | us |
| Converter | $V_{RRM}$ | Repetitive Peak Reverse Voltage | | 1200 | V |
| | $I_O$ | Average Output Rectified Current | | 30 | A |
| | $I_{FSM}$ | Surge Forward Current<br>@ 1Cycle at 60Hz, Peak value Non-Repetitive | | 300 | A |
| | $I^2t$ | 1 Cycle Surge Current | | 369 | $A^2s$ |
| Common | $T_J$ | Operating Junction Temperature | | -40 to +150 | °C |
| | $T_{STG}$ | Storage Temperature Range | | -40 to +125 | °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

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## Electrical Characteristics of the IGBT @ Inverter & Brake $T_C$ = 25°C unless otherwise noted

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $BV_{CES}$ | Collector-Emitter Breakdown Voltage | $V_{GE}$ = 0V, $I_C$ = 250uA | 600 | -- | -- | V |
| $\Delta B_{VCES}/\Delta T_J$ | Temperature Coeff. of Breakdown Voltage | $V_{GE}$ = 0V, $I_C$ = 1mA | -- | 0.6 | -- | V/°C |
| $I_{CES}$ | Collector Cut-Off Current | $V_{CE}$ = $V_{CES}$, $V_{GE}$ = 0V | -- | -- | 250 | uA |
| $I_{GES}$ | G-E Leakage Current | $V_{GE}$ = $V_{GES}$, $V_{CE}$ = 0V | -- | -- | ± 100 | nA |
| **On Characteristics** | | | | | | |
| $V_{GE(th)}$ | G-E Threshold Voltage | $I_C$ = 30mA, $V_{CE}$ = $V_{GE}$ | 5.0 | 6.0 | 8.5 | V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | $I_C$ = 30A, $V_{GE}$ = 15V | -- | 2.2 | 2.8 | V |
| **Dynamic Characteristics** | | | | | | |
| $C_{ies}$ | Input Capacitance | $V_{CE}$ = 30V, $V_{GE}$ = 0V, f = 1MHz | -- | 1970 | -- | pF |
| $C_{oes}$ | Output Capacitance | | -- | 310 | -- | pF |
| $C_{res}$ | Reverse Transfer Capacitance | | -- | 74 | -- | pF |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$ = 300 V, $I_C$ = 30A, $R_G$ = 7Ω, $V_{GE}$ = 15V, Inductive Load, $T_C$ = 25°C | -- | 30 | -- | ns |
| $t_r$ | Rise Time | | -- | 65 | -- | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | -- | 54 | 80 | ns |
| $t_f$ | Fall Time | | -- | 138 | 200 | ns |
| $E_{on}$ | Turn-On Switching Loss | | -- | 0.92 | -- | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | -- | 0.82 | -- | mJ |
| $E_{ts}$ | Total Switching Loss | | -- | 1.74 | 2.4 | mJ |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$ = 300 V, $I_C$ = 30A, $R_G$ = 7Ω, $V_{GE}$ = 15V, Inductive Load, $T_C$ = 125°C | -- | 34 | -- | ns |
| $t_r$ | Rise Time | | -- | 67 | -- | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | -- | 60 | 90 | ns |
| $t_f$ | Fall Time | | -- | 281 | 400 | ns |
| $E_{on}$ | Turn-On Switching Loss | | -- | 0.93 | -- | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | -- | 1.56 | -- | mJ |
| $E_{ts}$ | Total Switching Loss | | -- | 2.49 | 3.4 | mJ |
| $T_{sc}$ | Short Circuit Withstand Time | $V_{CC}$ = 300 V, $V_{GE}$ = 15V @ $T_C$ = 100°C | 10 | -- | -- | us |
| $Q_g$ | Total Gate Charge | $V_{CE}$ = 300 V, $I_C$ = 30A, $V_{GE}$ = 15V | -- | 85 | 120 | nC |
| $Q_{ge}$ | Gate-Emitter Charge | | -- | 17 | 25 | nC |
| $Q_{gc}$ | Gate-Collector Charge | | -- | 39 | 55 | nC |

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## Electrical Characteristics of the DIODE @ Inverter & Brake $T_C$ = 25°C unless otherwise noted

| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|
| $V_{FM}$ | Diode Forward Voltage | $I_F$ = 30A | $T_C$ = 25°C | -- | 2.0 | 2.8 | V |
| | | | $T_C$ = 100°C | -- | 2.0 | -- | |
| $t_{rr}$ | Diode Reverse Recovery Time | $I_F$ = 30A<br>di / dt = 60 A/us | $T_C$ = 25°C | -- | 90 | 180 | ns |
| | | | $T_C$ = 100°C | -- | 130 | -- | |
| $I_{rr}$ | Diode Peak Reverse Recovery Current | | $T_C$ = 25°C | -- | 2.2 | 3.4 | A |
| | | | $T_C$ = 100°C | -- | 3.4 | -- | |
| $Q_{rr}$ | Diode Reverse Recovery Charge | | $T_C$ = 25°C | -- | 400 | 600 | nC |
| | | | $T_C$ = 100°C | -- | 880 | -- | |

## Electrical Characteristics of the DIODE @ Converter $T_C$ = 25°C unless otherwise noted

| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|
| $V_{FM}$ | Diode Forward Voltage | $I_F$ = 30A | $T_C$ = 25°C | -- | 1.1 | 1.5 | V |
| | | | $T_C$ = 100°C | -- | 1.0 | -- | |
| $I_{RRM}$ | Repetitive Reverse Current | $V_R = V_{RRM}$ | $T_C$ = 25°C | -- | -- | 8 | mA |
| | | | $T_C$ = 100°C | -- | 5 | -- | |

## Thermal Characteristics

| | Symbol | Parameter | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Inverter | $R_{\theta JC}$ | Junction-to-Case (IGBT Part, per 1/6 Module) | -- | 1.0 | °C/W |
| | $R_{\theta JC}$ | Junction-to-Case (DIODE Part, per 1/6 Module) | -- | 2.2 | °C/W |
| Brake | $R_{\theta JC}$ | Junction-to-Case (IGBT Part) | -- | 1.0 | °C/W |
| | $R_{\theta JC}$ | Junction-to-Case (DIODE Part) | -- | 2.2 | °C/W |
| Converter | $R_{\theta JC}$ | Junction-to-Case (DIODE Part, per 1/6 Module) | -- | 2.0 | °C/W |
| Weight | | Weight of Module | 270 | -- | g |

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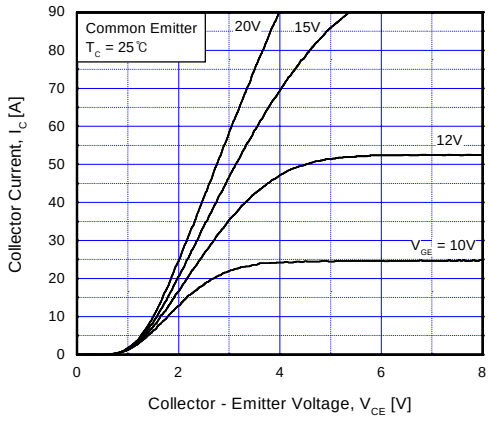


**Fig 1. Typical Output Characteristics**

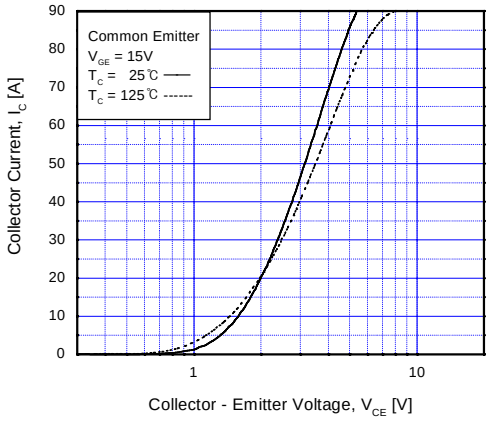


**Fig 2. Typical Saturation Voltage Characteristics**

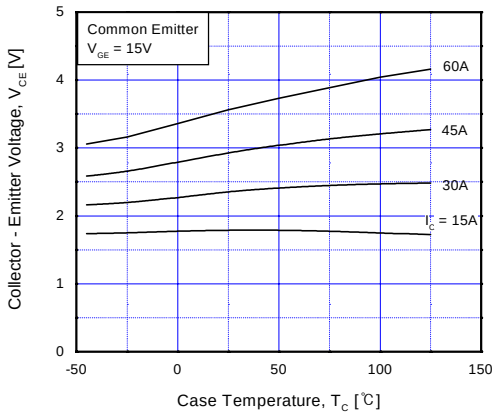


**Fig 3. Saturation Voltage vs. Case Temperature at Variant Current Level**

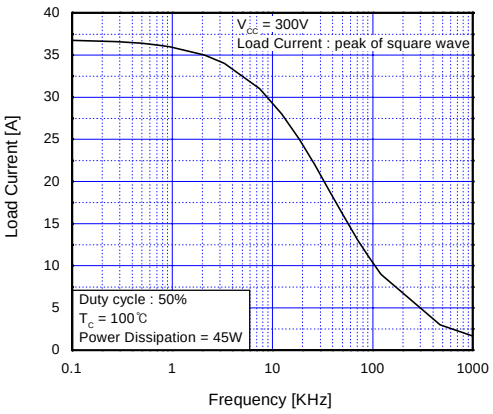


**Fig 4. Load Current vs. Frequency**

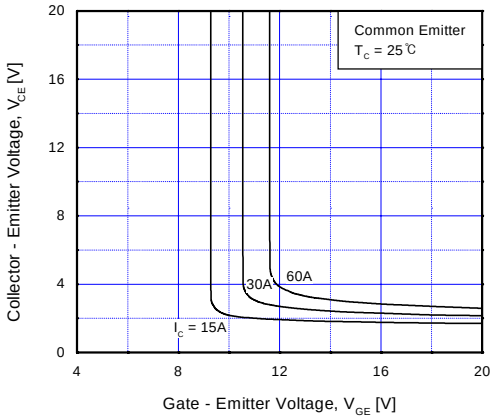


**Fig 5. Saturation Voltage vs. $V_{GE}$**

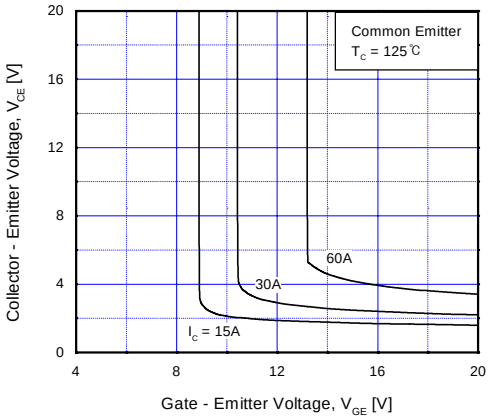


**Fig 6. Saturation Voltage vs. $V_{GE}$**

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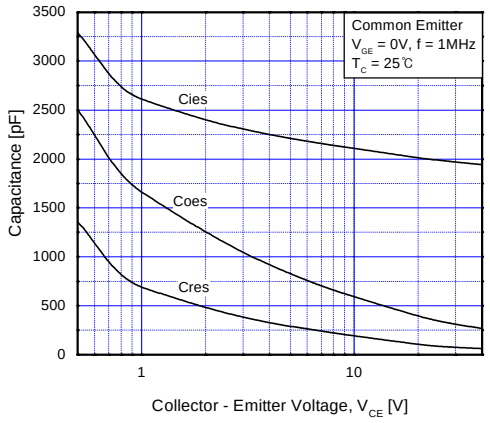


**Fig 7. Capacitance Characteristics**

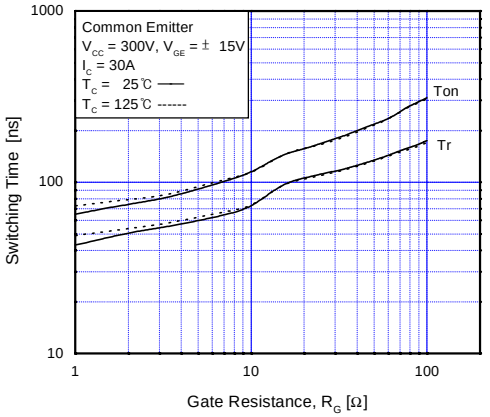


**Fig 8. Turn-On Characteristics vs. Gate Resistance**

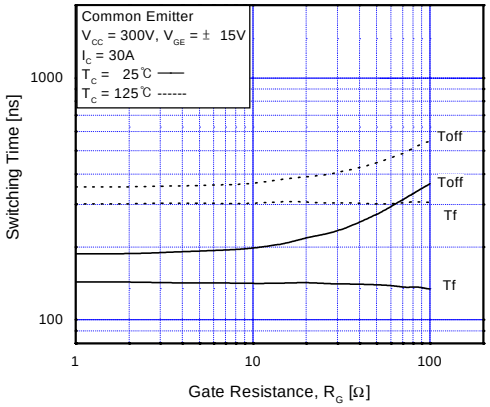


**Fig 9. Turn-Off Characteristics vs. Gate Resistance**

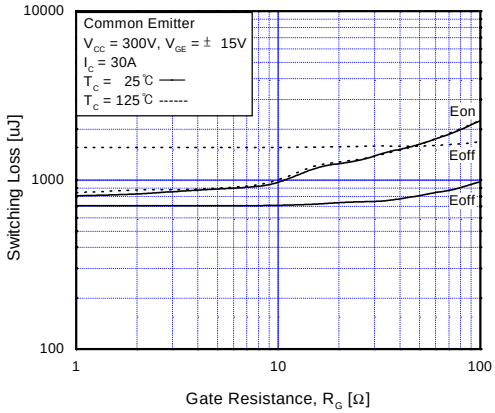


**Fig 10. Switching Loss vs. Gate Resistance**

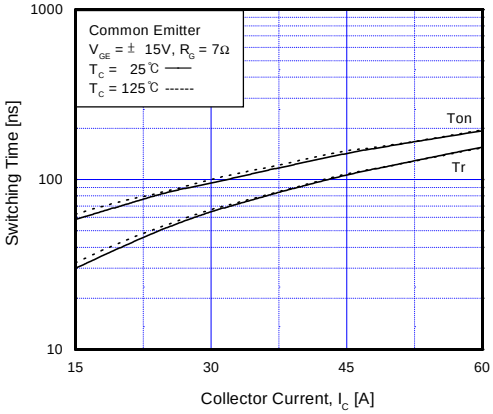


**Fig 11. Turn-On Characteristics vs. Collector Current**

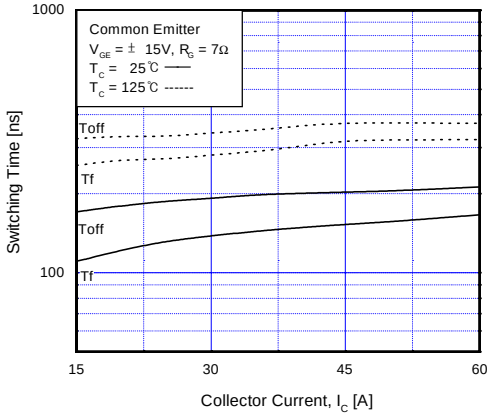


**Fig 12. Turn-Off Characteristics vs. Collector Current**

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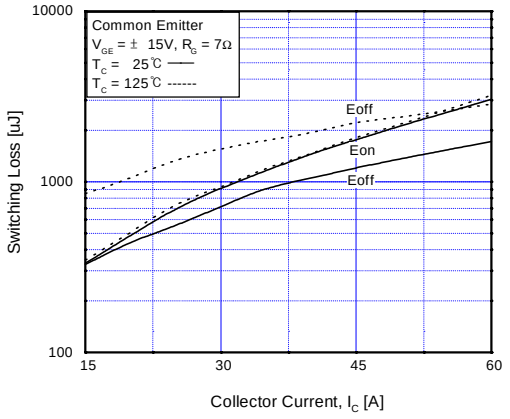


**Fig 13. Switching Loss vs. Collector Current**

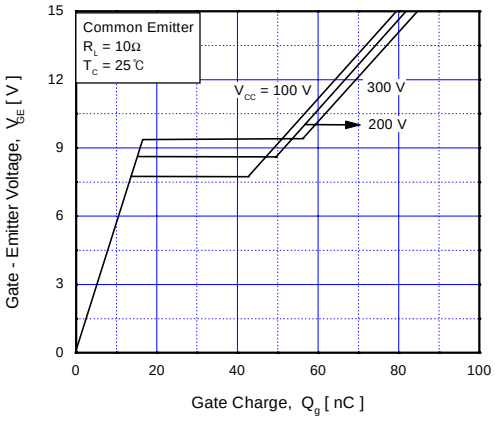


**Fig 14. Gate Charge Characteristics**

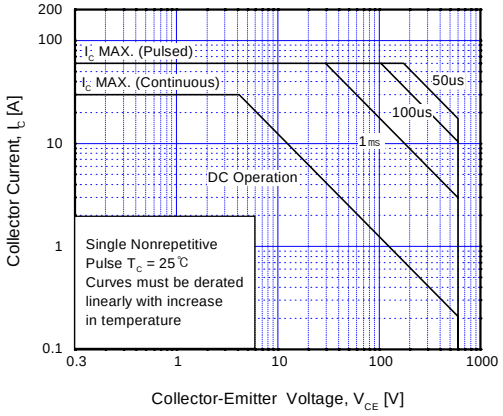


**Fig 15. SOA Characteristics**

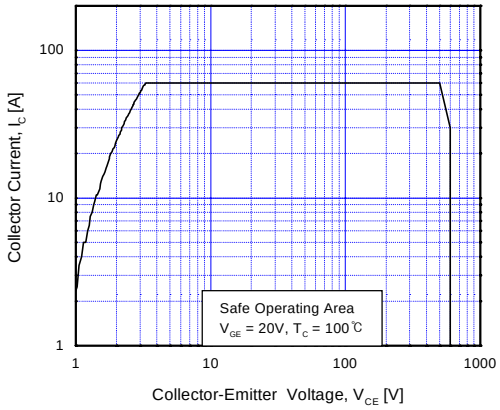


**Fig 16. Turn-Off SOA Characteristics**

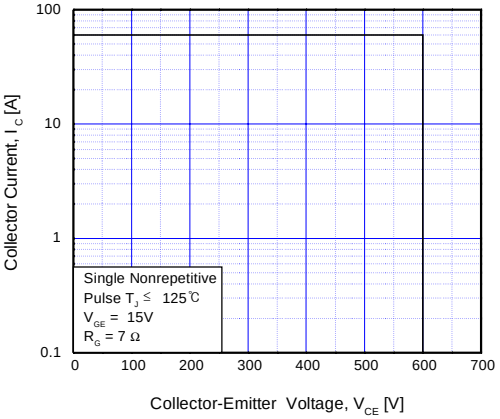


**Fig 17. RBSOA Characteristics**

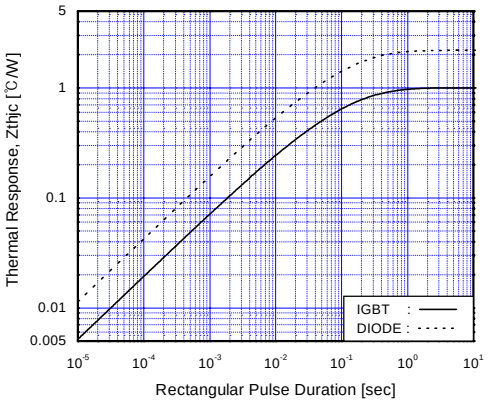


**Fig 18. Transient Thermal Impedance**

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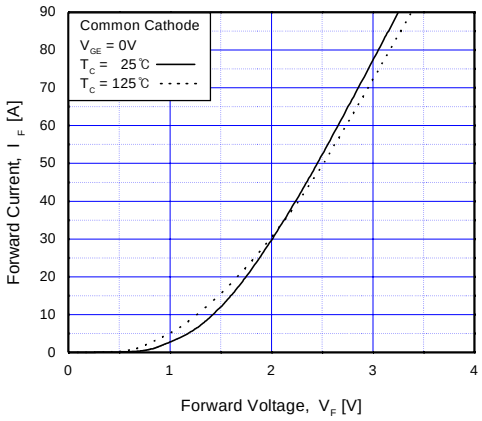


**Fig 19. Forward Characteristics**

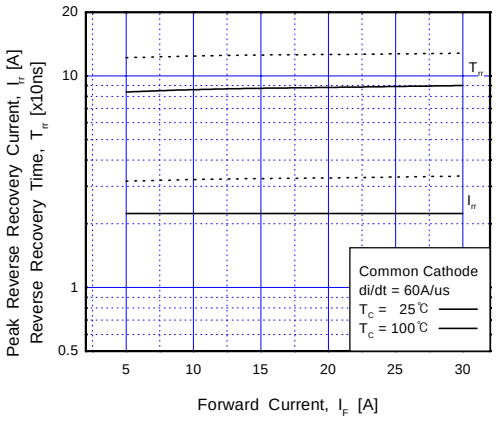


**Fig 20. Reverse Recovery Characteristics**

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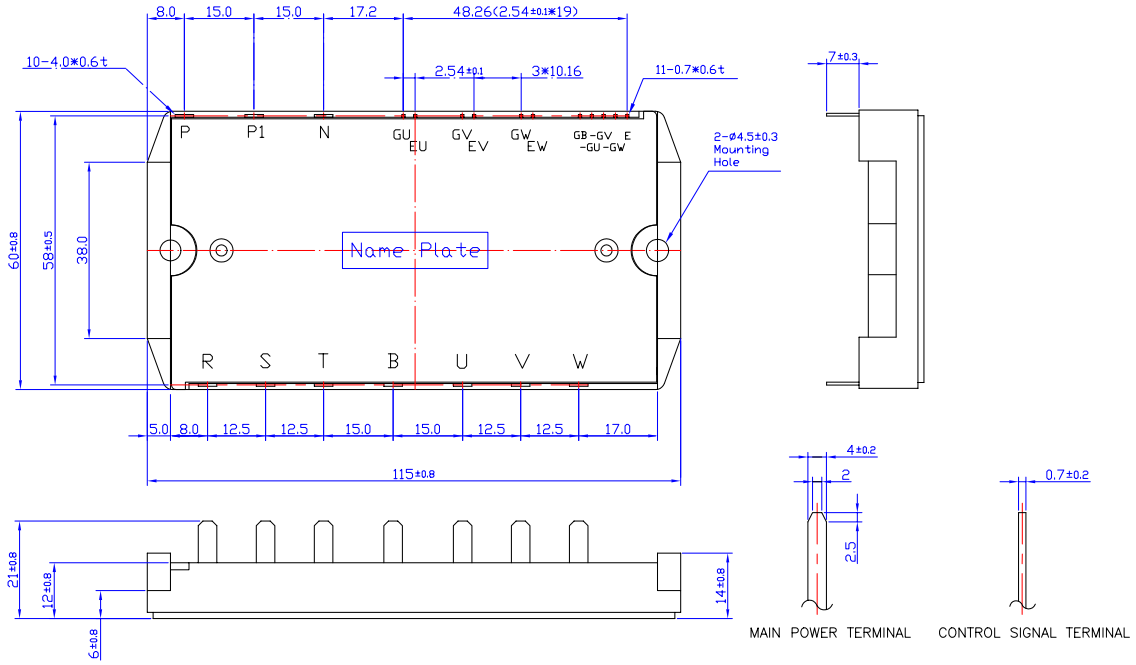
## Package Dimension

# 21PM-BA (FS PKG CODE BK)




Dimensions in Millimeters

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