

FMS7G20US60S

Compact & Complex Module

Features

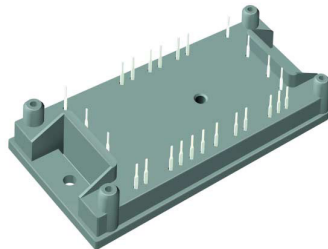
- Short Circuit Rated $10\mu\text{s}$ @ $T_C = 100^\circ\text{C}$, $V_{GE} = 15\text{V}$
- High Speed Switching
- Low Saturation Voltage : $V_{CE(sat)} = 2.1\text{V}$ @ $I_C = 20\text{A}$
- High Input Impedance
- Built-in Brake & 1 Phase Rectifier Circuit
- Fast & Soft Anti-Parallel FWD
- Built-in NTC Thermistor

Applications

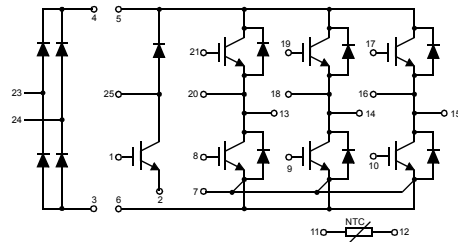
- AC & DC Motor Controls
- General Purpose Inverters
- Robotics
- Servo Controls

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 and general inverters where short-circuit ruggedness is required.



Package Code : 25PM-AA



Internal Circuit Diagram

Absolute Maximum Ratings T_C = 25°C unless otherwise noted

| | Symbol | Description | FMS7G20US60S | Units |
|------------------|--------------------------|---|--------------|------------------|
| Inverter & Brake | V _{CES} | Collector-Emitter Voltage | 600 | V |
| | V _{GES} | Gate-Emitter Voltage | ± 20 | V |
| | I _C | Collector Current @ T _C = 80°C | 20 | A |
| | I _{CM(1)} | Pulsed Collector Current | 40 | A |
| | I _F | Diode Continuous Forward Current @ T _C = 80°C | 20 | A |
| | I _{FM} | Diode Maximum Forward Current | 40 | A |
| | P _D | Maximum Power Dissipation @ T _C = 25°C | 89 | W |
| | T _{SC} | Short Circuit Withstand Time @ T _C = 100°C | 10 | µs |
| Converter | V _{RRM} | Repetitive Peak Reverse Voltage | 1600 | V |
| | I _O | Average Output Rectified Current | 30 | A |
| | I _{FSM} | Surge Forward Current @ 1Cycle at 60Hz, Peak value Non-Repetitive | 300 | A |
| | i ² t | Energy pulse @ 1Cycle at 60Hz | 369 | A ² s |
| 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 | 2.0 | N·m | |

Notes :

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

Package Marking and Ordering Information

| Device Marking | Device | Package | Reel Size | Tape Width | Quantity |
|----------------|--------------|---------|-----------|------------|----------|
| FMS7G20US60S | FMS7G20US60S | 25PM-AA | -- | -- | -- |

(2) TMC2 Reliability test was done under -45°C ~ 125°C

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

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units |
|--------------------------------------|---|---|------|------|-----------|---------------------|
| Off Characteristics | | | | | | |
| BV_{CES} | Collector-Emitter Breakdown Voltage | $V_{GE} = 0V, I_C = 250\mu A$ | 600 | -- | -- | V |
| $\frac{\Delta BV_{CES}}{\Delta T_J}$ | Temperature Coeff. of Breakdown Voltage | $V_{GE} = 0V, I_C = 1mA$ | -- | 0.6 | -- | V/ $^\circ\text{C}$ |
| I_{CES} | Collector Cut-Off Current | $V_{CE} = V_{CES}, V_{GE} = 0V$ | -- | -- | 250 | μA |
| I_{GES} | Gate - Emitter Leakage Current | $V_{GE} = V_{GES}, V_{CE} = 0V$ | -- | -- | ± 100 | nA |
| On Characteristics | | | | | | |
| $V_{GE(th)}$ | Gate - Emitter Threshold Voltage | $I_C = 20mA, V_{CE} = V_{GE}$ | 5.0 | 6.5 | 8.5 | V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | $I_C = 20A, V_{GE} = 15V$ | -- | 2.1 | 2.7 | V |
| Dynamic Characteristics | | | | | | |
| C_{ies} | Input Capacitance | $V_{CE} = 30V, V_{GE} = 0V,$ $f = 1MHz$ | -- | 1277 | -- | pF |
| C_{oes} | Output Capacitance | | -- | 98 | -- | pF |
| C_{res} | Reverse Transfer Capacitance | | -- | 21 | -- | pF |
| Switching Characteristics | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC} = 300V, I_C = 20A,$ $R_G = 10\Omega, V_{GE} = 15V,$ Inductive Load, $T_C = 25^\circ\text{C}$ | -- | 65 | 130 | ns |
| t_r | Rise Time | | -- | 100 | 200 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | -- | 80 | 160 | ns |
| t_f | Fall Time | | -- | 100 | 200 | ns |
| E_{on} | Turn-On Switching Loss | | -- | 0.45 | -- | mJ |
| E_{off} | Turn-Off Switching Loss | | -- | 0.42 | -- | mJ |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC} = 300V, I_C = 20A,$ $R_G = 10\Omega, V_{GE} = 15V,$ Inductive Load, $T_C = 125^\circ\text{C}$ | -- | 70 | 140 | ns |
| t_r | Rise Time | | -- | 100 | 200 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | -- | 110 | 220 | ns |
| t_f | Fall Time | | -- | 210 | 350 | ns |
| E_{on} | Turn-On Switching Loss | | -- | 0.5 | -- | mJ |
| E_{off} | Turn-Off Switching Loss | | -- | 0.72 | -- | mJ |
| T_{sc} | Short Circuit Withstand Time | $V_{CC} = 300V, V_{GE} = 15V$ @ $T_C = 100^\circ\text{C}$ | 10 | -- | -- | μs |
| Q_g | Total Gate Charge | $V_{CE} = 300V, I_C = 20A,$ $V_{GE} = 15V$ | -- | 55 | 65 | nC |
| Q_{ge} | Gate-Emitter Charge | | -- | 10 | 15 | nC |
| Q_{gc} | Gate-Collector Charge | | -- | 20 | 30 | nC |

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

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units | |
|----------|-------------------------------------|---|---------------------------|------|------|-------|----|
| V_{FM} | Diode Forward Voltage | $I_F = 20\text{A}$ | $T_C = 25^\circ\text{C}$ | -- | 1.9 | 2.8 | V |
| | | | $T_C = 100^\circ\text{C}$ | -- | 2.0 | -- | |
| t_{rr} | Diode Reverse Recovery Time | $I_F = 20\text{A}$ $di/dt = 40\text{ A}/\mu\text{s}$ | $T_C = 25^\circ\text{C}$ | -- | 75 | 150 | ns |
| | | | $T_C = 100^\circ\text{C}$ | -- | 110 | -- | |
| I_{rr} | Diode Peak Reverse Recovery Current | | $T_C = 25^\circ\text{C}$ | -- | 1.3 | 2.6 | A |
| | | | $T_C = 100^\circ\text{C}$ | -- | 1.8 | -- | |
| Q_{rr} | Diode Reverse Recovery Charge | | $T_C = 25^\circ\text{C}$ | -- | 50 | 195 | nC |
| | | | $T_C = 100^\circ\text{C}$ | -- | 100 | -- | |

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

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units | |
|-----------|----------------------------|--------------------|---------------------------|------|------|-------|----|
| V_{FM} | Diode Forward Voltage | $I_F = 30\text{A}$ | $T_C = 25^\circ\text{C}$ | -- | 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) | -- | 1.4 | $^\circ\text{C}/\text{W}$ |
| | $R_{\theta JC}$ | Junction-to-Case (DIODE Part, per 1/6 Module) | -- | 2.3 | $^\circ\text{C}/\text{W}$ |
| Brake | $R_{\theta JC}$ | Junction-to-Case (IGBT Part) | -- | 1.4 | $^\circ\text{C}/\text{W}$ |
| | $R_{\theta JC}$ | Junction-to-Case (DIODE Part) | -- | 2.3 | $^\circ\text{C}/\text{W}$ |
| Converter | $R_{\theta JC}$ | Junction-to-Case (DIODE Part, per 1/6 Module) | -- | 1.3 | $^\circ\text{C}/\text{W}$ |
| Weight | | Weight of Module | 60 | -- | g |

NTC Thermistor Characteristics

| | Symbol | Parameter | Tol. | Typ. | Units |
|------------|-----------|---|---------|------|------------------|
| Thermistor | R25 | Rated Resistance @ $T_c = 25^\circ\text{C}$ | +/- 5 % | 4.7 | $\text{K}\Omega$ |
| | B(25/100) | B - Value | +/- 3 % | 3530 | |

Typical Performance Characteristics

Figure 1. Typical Output Characteristics

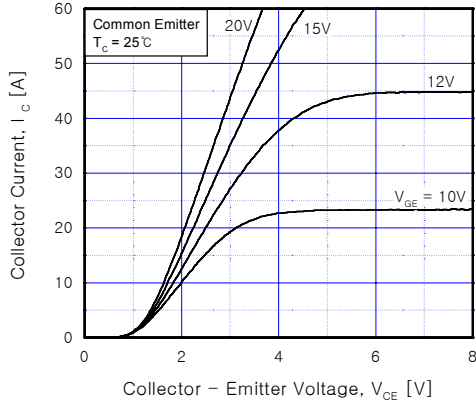


Figure 2. Typical Saturation Voltage Characteristics

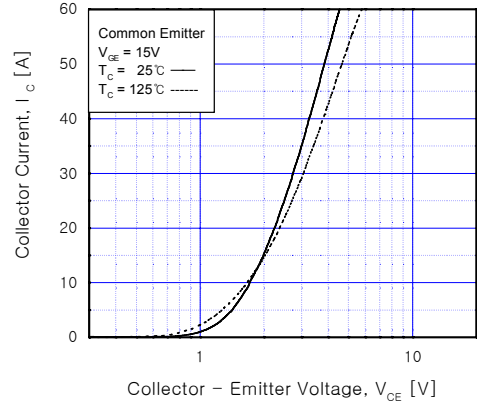


Figure 3. Saturation Voltage vs. Case Temperature at Variant Current Level

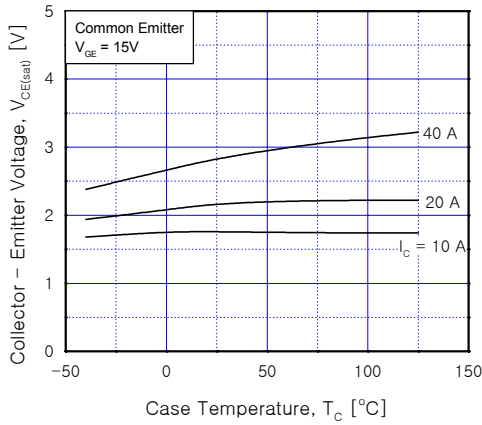


Figure 4. Transient Thermal Impedance

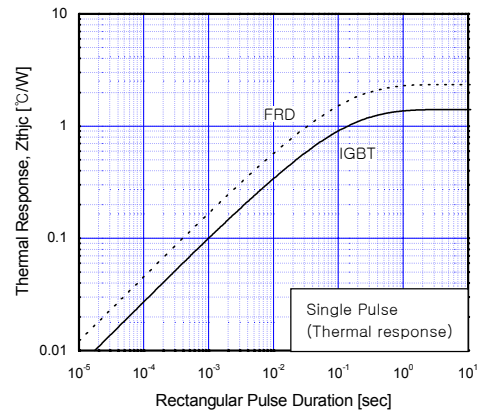


Figure 5. Saturation Voltage vs. V_GE

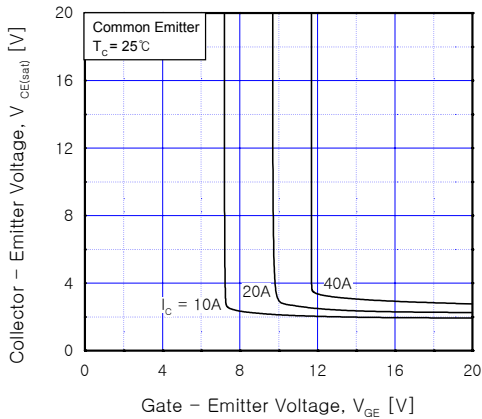
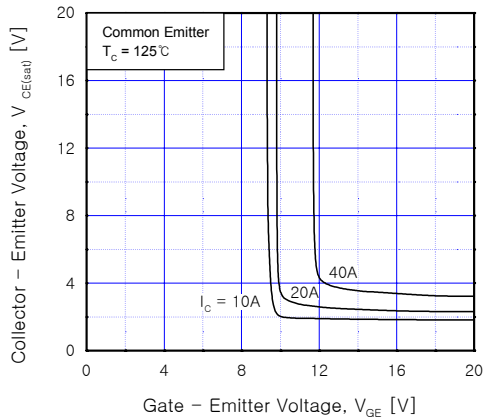


Figure 6. Saturation Voltage vs. V_GE



Typical Performance Characteristics (Continued)

Figure 7. Capacitance Characteristics

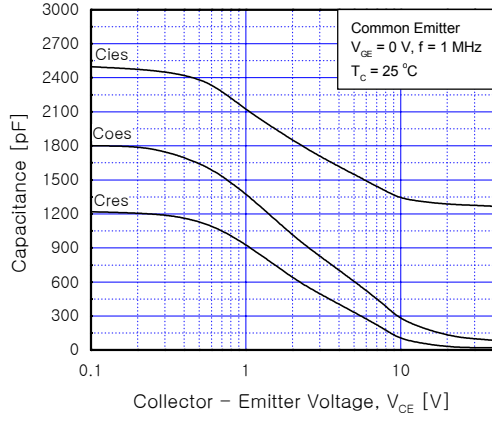


Figure 9. Turn-Off Characteristics vs. Gate Resistance

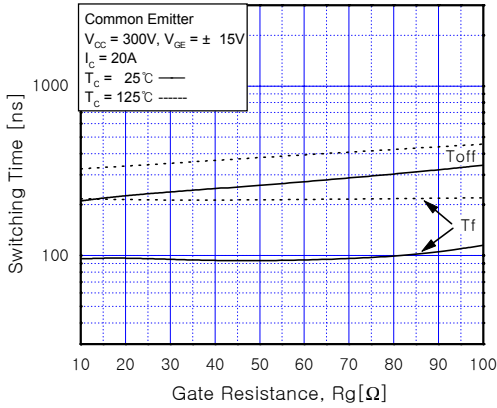


Figure 11. Turn-On Characteristics vs. Collector Current

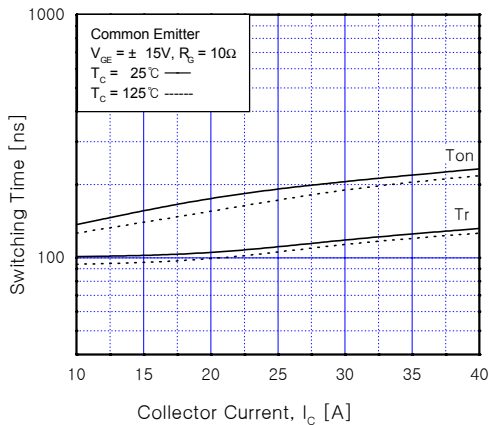


Figure 8. Turn-On Characteristics vs. Gate Resistance

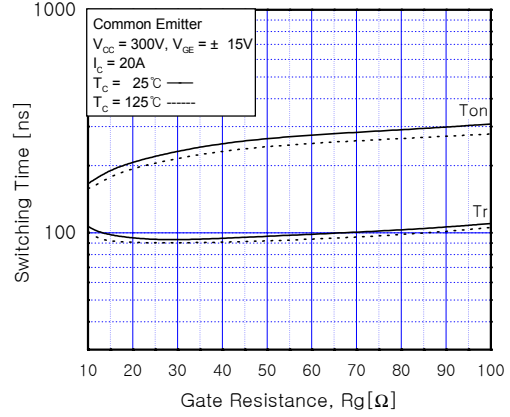


Figure 10. Switching Loss vs. Gate Resistance

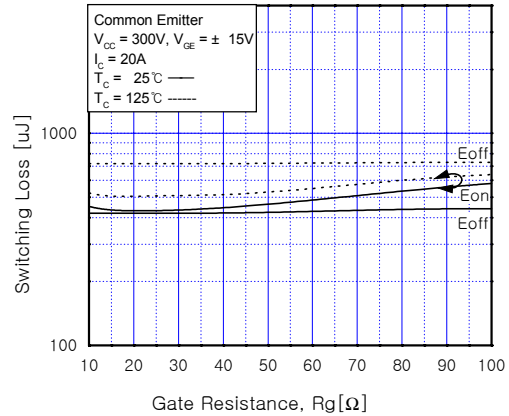
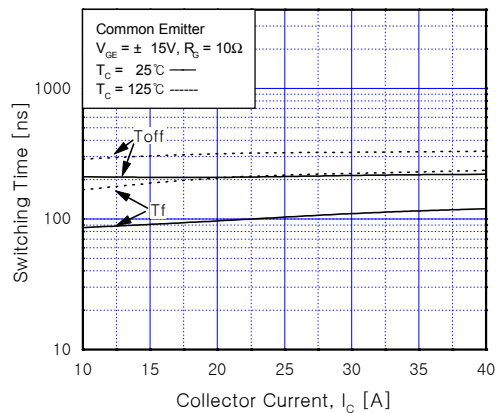


Figure 12. Turn-Off Characteristics vs. Collector Current



Typical Performance Characteristics (Continued)

Figure 13. Switching Loss vs. Collector Current

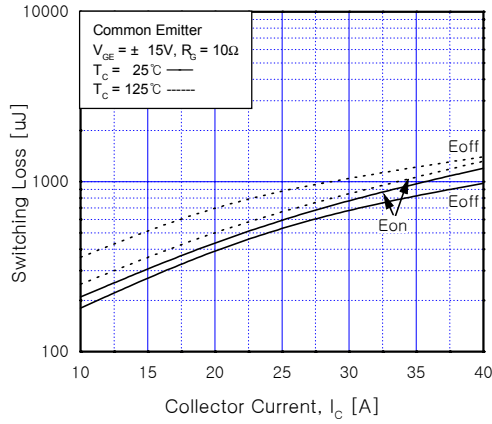


Figure 14. Gate Charge Characteristics

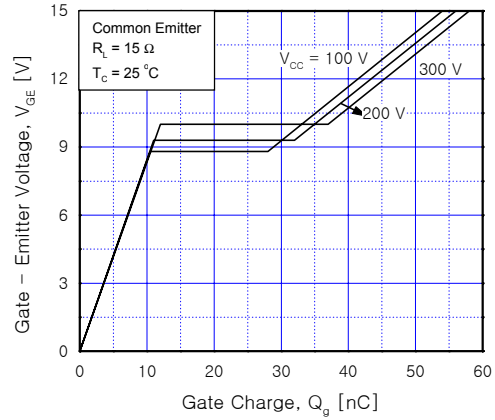


Figure 15. SOA Characteristics

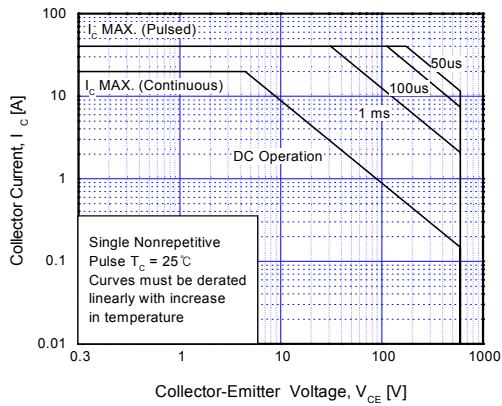


Figure 16. RBSOA Characteristics

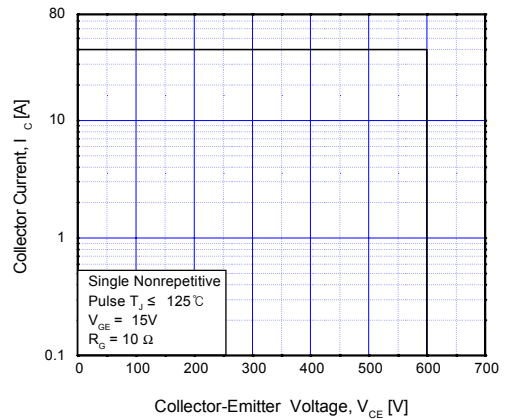


Figure 17. Forward Characteristics

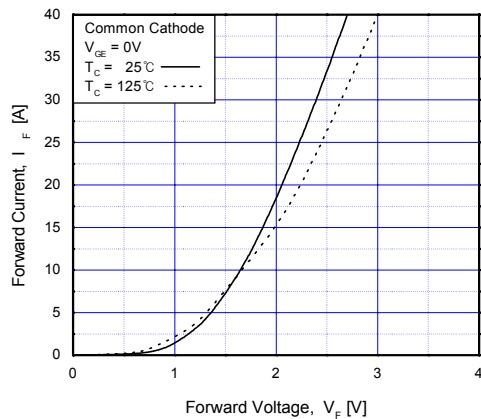
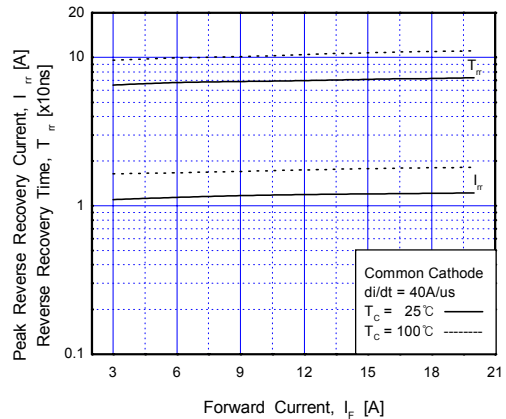


Figure 18. Reverse Recovery Characteristics



Typical Performance Characteristics (Continued)

Figure 19. Rectifier (Converter) Characteristics

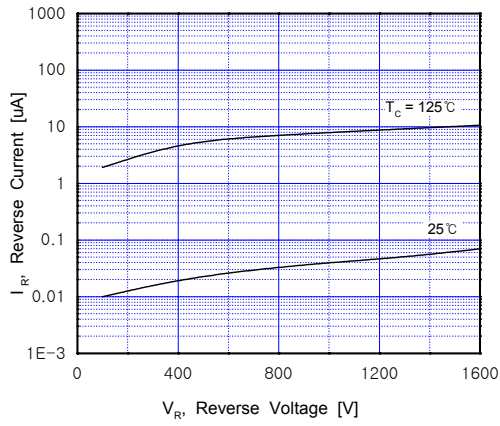


Figure 20. Rectifier (Converter) Characteristics

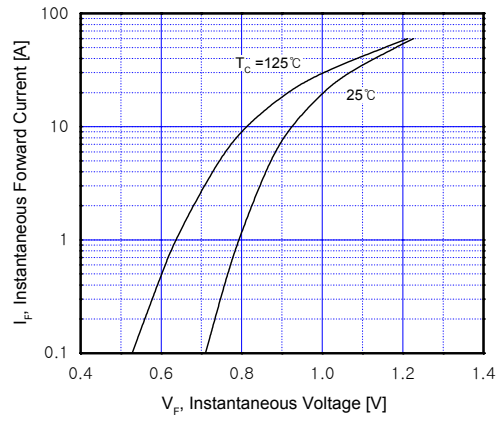
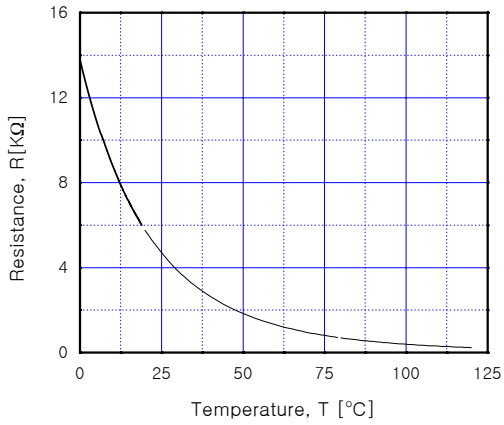


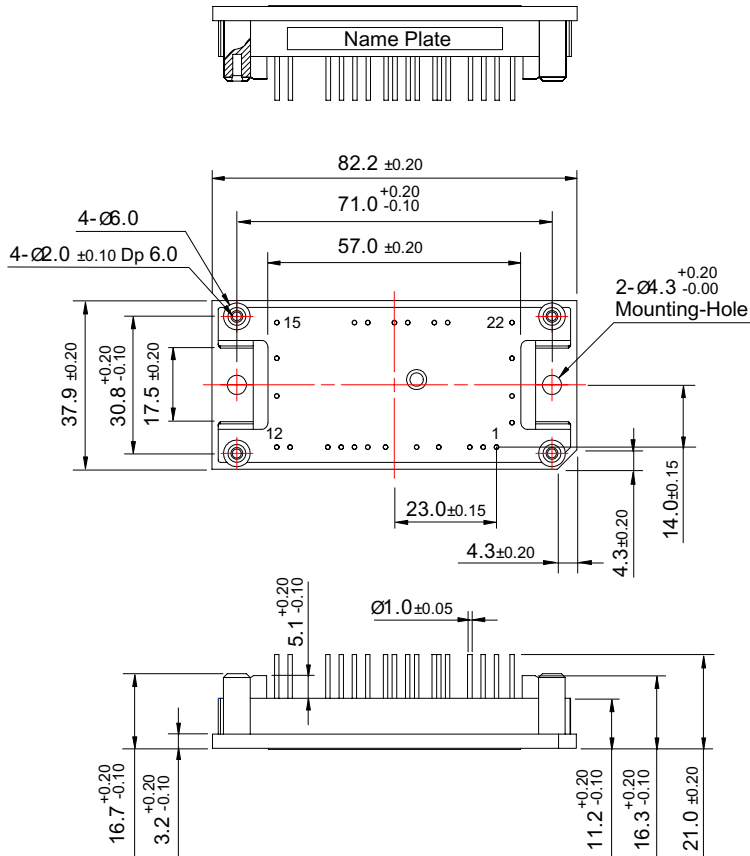
Figure 21. NTC Characteristics



Dimensions in Millimeters

Mechanical Dimensions

25PM-AA



- Pin Coordinate

| Pin #No | Coordinate | |
|---------|------------|------|
| | x | y |
| 1 | 0.0 | 0.0 |
| 2 | -3.0 | 0.0 |
| 3 | -6.0 | 0.0 |
| 4 | -13.0 | 0.0 |
| 5 | -18.0 | 0.0 |
| 6 | -25.0 | 0.0 |
| 7 | -29.0 | 0.0 |
| 8 | -32.0 | 0.0 |
| 9 | -35.0 | 0.0 |
| 10 | -38.0 | 0.0 |
| 11 | -46.5 | 0.0 |
| 12 | -49.5 | 0.0 |
| 13 | -49.5 | 11.5 |
| 14 | -49.5 | 20.0 |
| 15 | -49.5 | 28.0 |
| 16 | -32.0 | 28.0 |
| 17 | -29.0 | 28.0 |
| 18 | -23.0 | 28.0 |
| 19 | -20.0 | 28.0 |
| 20 | -14.0 | 28.0 |
| 21 | -11.0 | 28.0 |
| 22 | 3.5 | 28.0 |
| 23 | 3.5 | 20.0 |
| 24 | 3.5 | 11.5 |
| 25 | 3.5 | 5.5 |

* datum pin : #1

* Pin Tilt : ± 0.15

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| CROSSVOLT™ | GTO™ | MICROWIRE™ | Quiet Series™ | UHC™ |
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PRODUCT STATUS DEFINITIONS

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| Datasheet Identification | Product Status | Definition |
|--------------------------|------------------------|---|
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Rev. I16