FAIRCHILD SEMICONDUCTOR®

Nov 2009

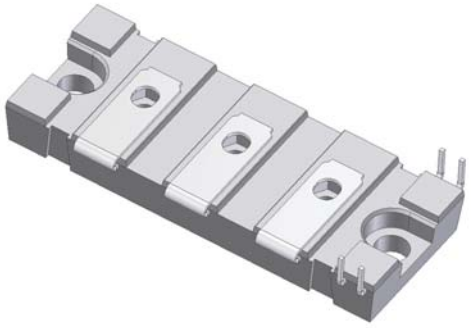
Power-SPM™

# FP7G150US60

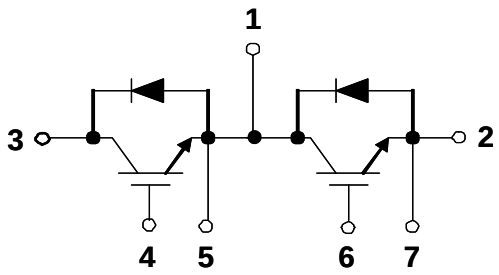
## Transfer Molded Type IGBT Module

## General Description

Fairchild's New IGBT Modules ( Transfer Molded Type ) 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 : EPM7**




**Internal Circuit Diagram**

## Features

- Short Circuit rated 10us @Tc=100°C, Vge=15V
- High Speed Switching
- Low Saturation Voltage : Vce(sat) =2.3V @Ic=150A
- High Input Impedance
- Fast & Soft Anti-Parallel FWD

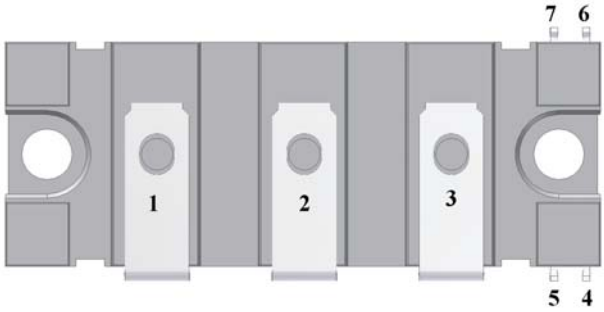
## Application

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

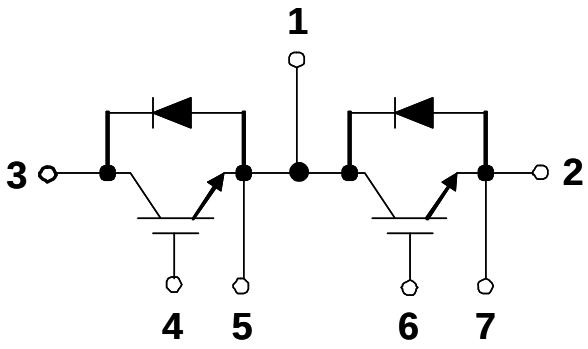
## Absolute Maximum Ratings

| Symbol | Description | | Rating | Units |
|---|---|---|---|---|
| $V_{CES}$ | Collector-Emitter Voltage | | 600 | V |
| $V_{GES}$ | Gate-Emitter Voltage | | ± 20 | V |
| $I_C$ | Collector Current | @ $T_C$ = 25°C | 150 | A |
| $I_{CM\ (1)}$ | Maximum Pulsed Collector Current | | 300 | A |
| $I_F$ | Diode Continuous Forward Current | @ $T_C$ = 100°C | 150 | A |
| $I_{FM}$ | Diode Maximum Forward Current | | 300 | A |
| $T_{SC}$ | Short Circuit Withstand Time | @ $T_C$ = 100°C | 10 | us |
| $P_D$ | Maximum Power Dissipation | @ $T_C$ = 25°C | 450 | W |
| $T_J$ | Operating Junction Temperature | | -40 to +125 | °C |
| $T_{stg}$ | Storage Temperature Range | | -40 to +125 | °C |
| $V_{iso}$ | Isolation Voltage | @ AC 1minute | 2500 | V |
| Mounting Torque | Power Terminals Screw : M5 | | 2.0 | N.m |
| | Mounting Screw : M5 | | 2.0 | N.m |

## Pin Configuration and Pin Description




**Top View**




**Internal Circuit Diagram**

**Pin Description**

| Pin Number | Pin Description |
|---|---|
| 1 | Emitter of Q1, IGBT,<br>Collector of Q2, IGBT |
| 2 | Emitter of Q2, IGBT |
| 3 | Collector of Q1, IGBT |
| 4 | Gate of Q1, IGBT |
| 5 | Emitter of Q1, IGBT |
| 6 | Gate of Q2, IGBT |
| 7 | Emitter of Q2, IGBT |

## Electrical Characteristics ($T_J$ = 25°C, Unless Otherwise Specified)

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $BV_{CES}$ | Collector-Emitter Breakdown Voltage | $V_{GE}$= 0V, $I_C$ = 250μA | 600 | - | - | V |
| $\Delta BV_{CES}/\Delta T_J$ | Temperature Coeff. of Breakdown Voltage | $V_{GE}$= 0V, $I_C$ = 1mA | - | 0.6 | - | V |
| $I_{CES}$ | Collector Cut-off Current | $V_{CE}$= $V_{CES}$, $V_{GE}$= 0V | - | - | 250 | uA |
| $I_{GES}$ | Gate-Emitter Leakage Current | $V_{GE}$= $V_{GES}$, $V_{CE}$= 0V | - | - | ± 100 | nA |
| **On Characteristics** | | | | | | |
| $V_{GE(th)}$ | G-E Threshold Voltage | $V_{GE}$ = 0V, $I_C$=150mA | 5.0 | 6.0 | 8.5 | V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | $I_C$ = 150A, $V_{GE}$ = 15V | - | 2.3 | 2.8 | V |
| **Dynamic Characteristics** | | | | | | |
| $C_{ies}$ | Input Capacitance | $V_{CE}$ = 30V, $V_{GE}$ = 0V, f = 1MHz | | 11.2 | | nF |
| $C_{oes}$ | Output Capacitance | | | 1.03 | | nF |
| $C_{res}$ | Reverse Capacitance | | | 0.1 | | nF |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$ = 300 V, $I_C$ = 150A, $R_G$ = 2.4Ω, $V_{GE}$ = 15V Inductive Load, $T_C$ = 25°C | - | 45 | - | ns |
| $t_r$ | Rise Time | | - | 35 | - | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 135 | - | ns |
| $t_f$ | Fall Time | | - | 70 | - | ns |
| $E_{on}$ | Turn-On Switching Loss | | - | 0.66 | - | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | - | 2.7 | - | mJ |
| $E_{ts}$ | Total Switching Loss | | - | 3.36 | - | mJ |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$ = 300 V, $I_C$ = 150A, $R_G$ = 2.4Ω, $V_{GE}$ = 15V Inductive Load, $T_C$ = 125°C | - | 45 | - | ns |
| $t_r$ | Rise Time | | - | 35 | - | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 160 | - | ns |
| $t_f$ | Fall Time | | - | 170 | - | ns |
| $E_{on}$ | Turn-On Switching Loss | | - | 1.5 | - | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | - | 4.4 | - | mJ |
| $E_{ts}$ | Total Switching Loss | | - | 5.9 | - | 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, $I_C$ = 150A, $V_{GE}$ = 15V | - | 336 | - | nC |
| $Q_{ge}$ | Gate-Emitter Charge | | - | 68 | - | nC |
| $Q_{gc}$ | Gate-Collector Charge | | - | 178 | - | nC |

## Electrical Characteristics of DIODE ($T_J$ = 25°C, Unless Otherwise Specified)

| Symbol | Parameter | Conditions | | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| $V_{FM}$ | Diode Forward Voltage | $I_F$ = 150A | $T_C$ = 25°C | - | 1.8 | 2.8 | V |
| | | | $T_C$ = 100°C | - | 1.7 | - | |
| $t_{rr}$ | Diode Reverse Recovery Time | $I_F$ = 150A<br>di / dt = 300 A/us | $T_C$ = 25°C | - | 115 | 165 | ns |
| | | | $T_C$ = 100°C | - | 190 | - | |
| $I_{rr}$ | Diode Peak Reverse Recovery Current | | $T_C$ = 25°C | - | 23 | 33 | A |
| | | | $T_C$ = 100°C | - | 45 | - | |
| $Q_{rr}$ | Diode Reverse Recovery Charge | | $T_C$ = 25°C | - | 1322 | - | nC |
| | | | $T_C$ = 100°C | - | 4307 | - | |

## Thermal Characteristics

| Symbol | Parameter | Typ. | Max. | Units |
|---|---|---|---|---|
| $R_{\theta JC}$ | Junction-to-Case (IGBT Part, per 1/2 Module) | - | 0.22 | °C/W |
| $R_{\theta JC}$ | Junction-to-Case (DIODE Part, per 1/2 Module) | - | 0.54 | °C/W |
| $R_{\theta CS}$ | Case-to-Sink (Conductive grease applied) | 0.05 | - | °C/W |
| Weight | Weight of Module | - | 90 | g |

## Typical Performance Characteristics

**Fig 1. Typical Output Characteristics**

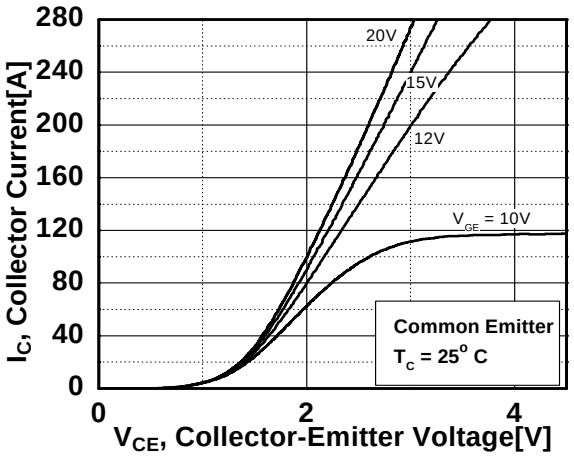



**Fig 2. Typical Saturation Voltage Characteristics**

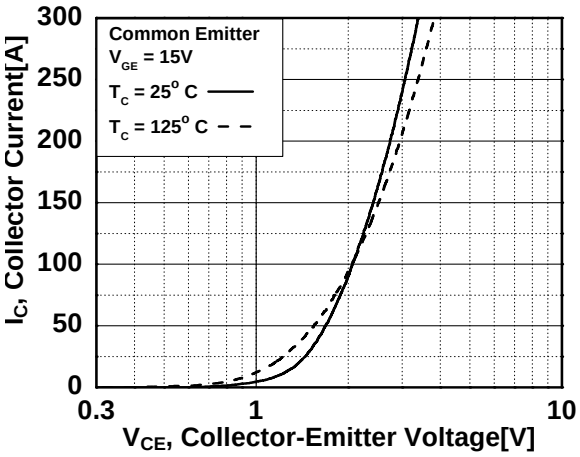



**Fig 3. Saturation Voltage vs. Case Temperature at Variant Current Level**

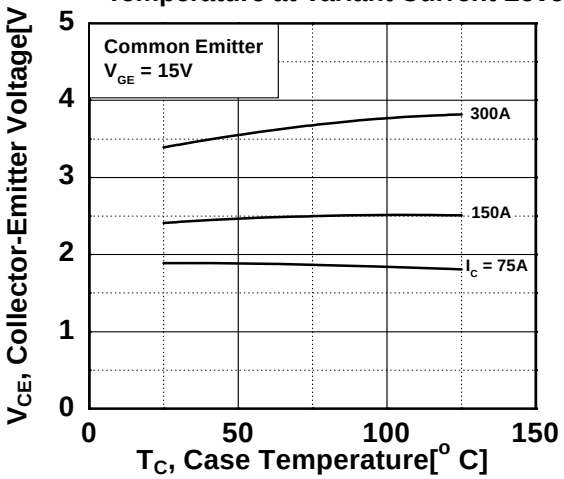



**Fig 4. Load Current vs. Frequency**

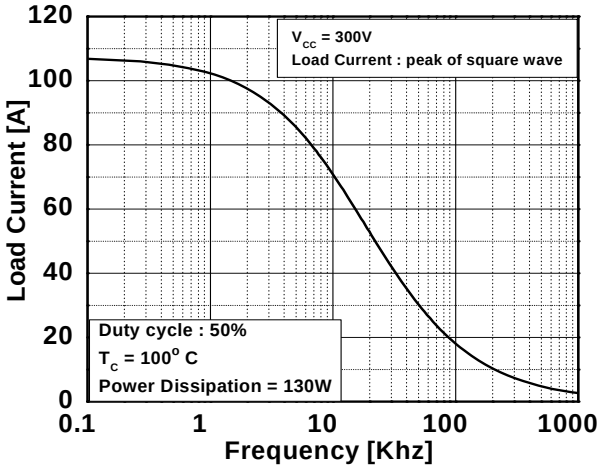



**Fig 5. Saturation Voltage vs. $V_{GE}$**

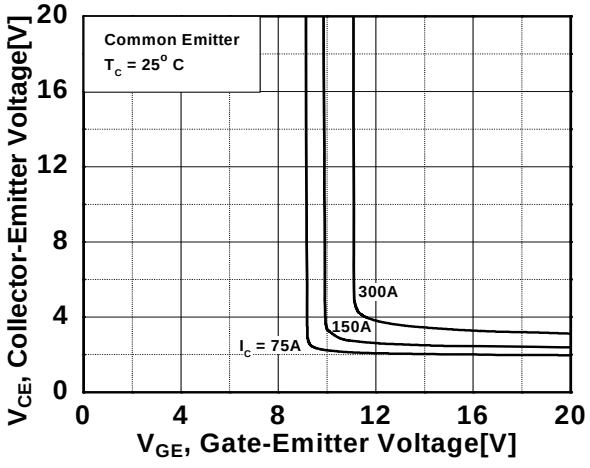



**Fig 6. Saturation Voltage vs. $V_{GE}$**

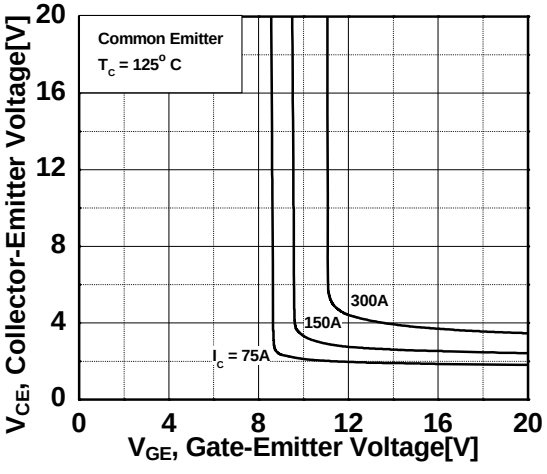


**Fig 7.Capacitance Characteristic**

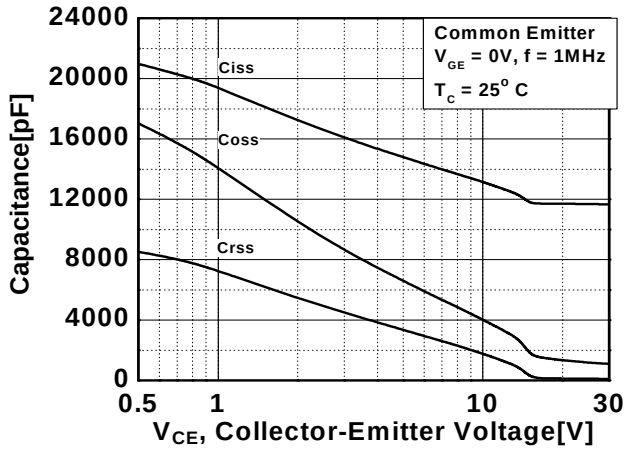



**Fig 8. Turn-On Characteristics vs. Gate Resistance**

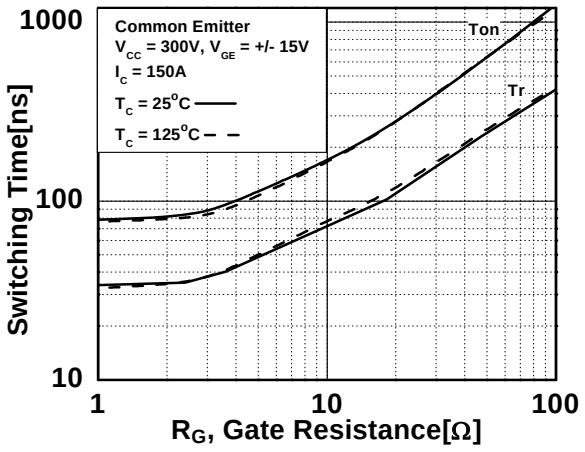



**Fig 9. Turn-Off Characteristics vs. Gate Resistance**

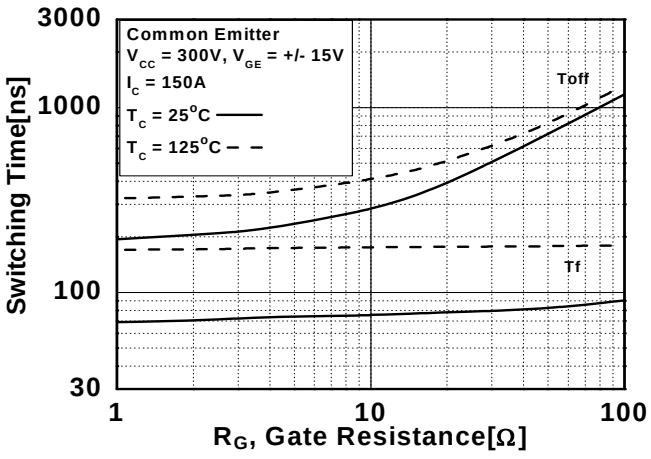



**Fig 10. Switching Loss vs. Gate Resistance**

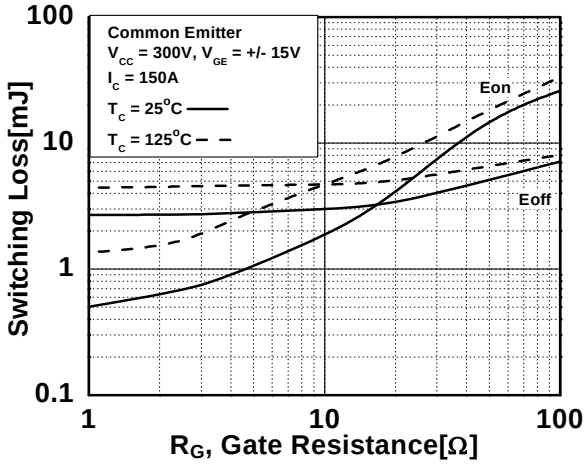



**Fig 11. Turn-On Characteristics vs. Collector Current**

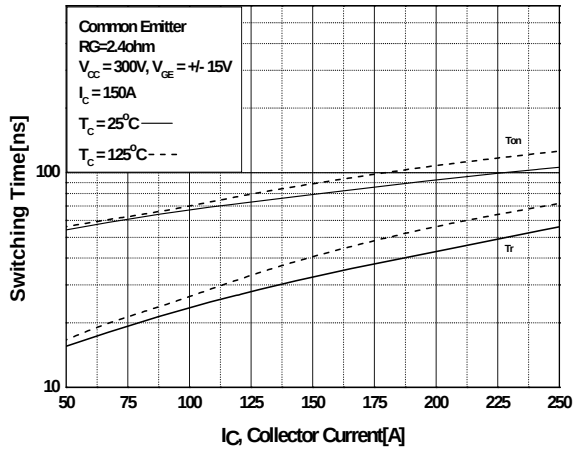



**Fig 12. Turn-Off Characteristics vs. Collector Current**

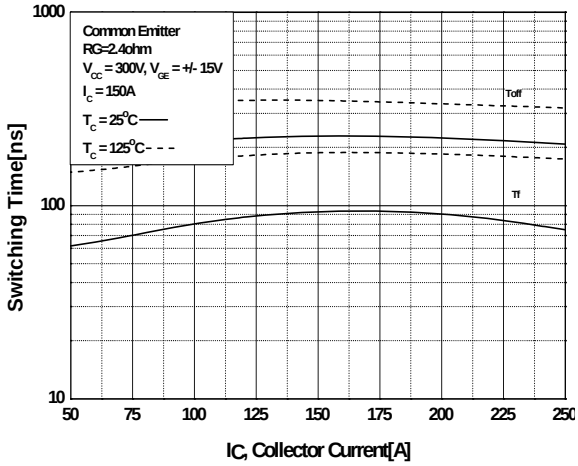


**Fig 13. Switching Loss vs. Collector**

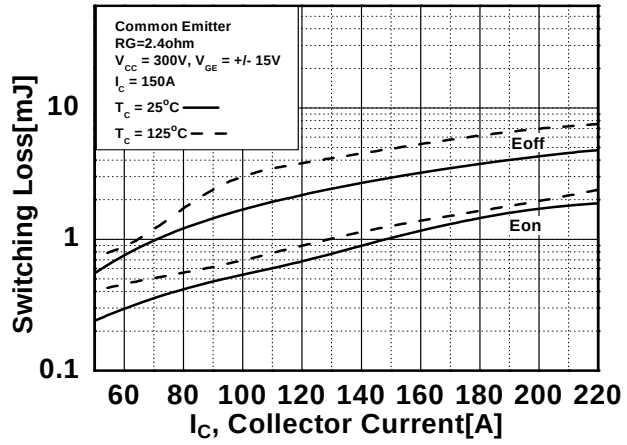



**Fig 14. Gate Charge Characteristics**

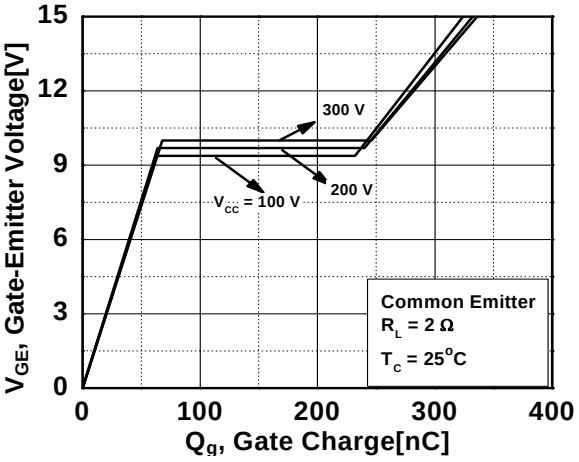



**Fig 15. FBSOA Characteristics**

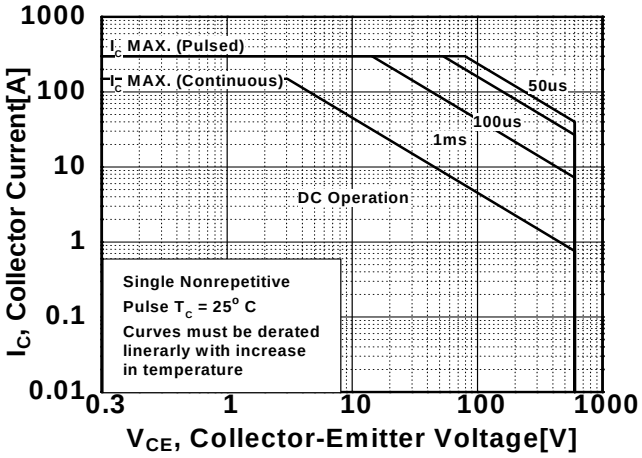



**Fig 16. Turn-Off SOA Characteristics**

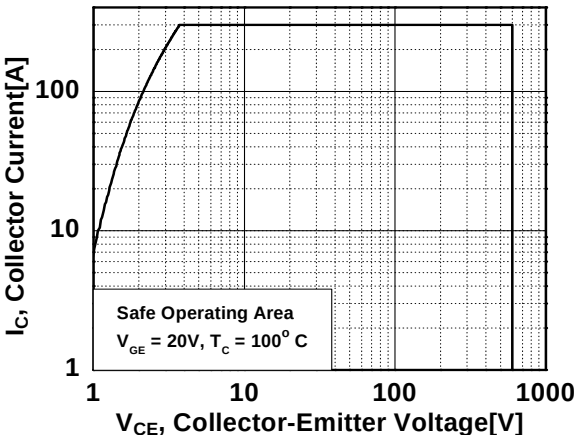



**Fig 17. RBSOA Characteristics**

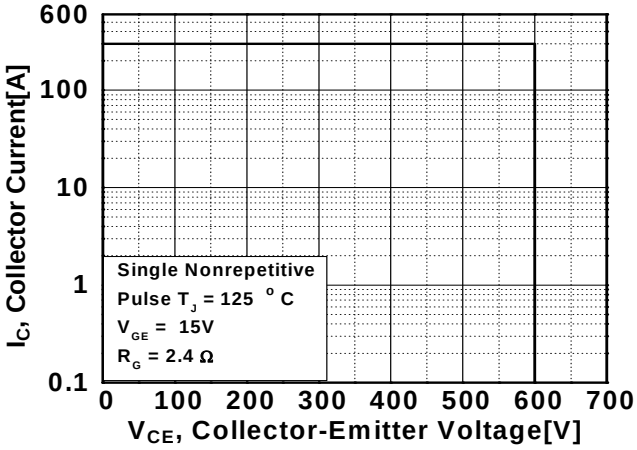



**Fig 18. Transient Thermal Impedance**

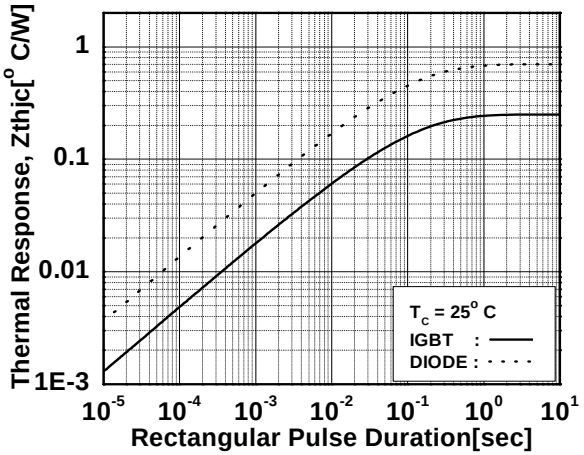


**Fig 19. Forward Characteristics**

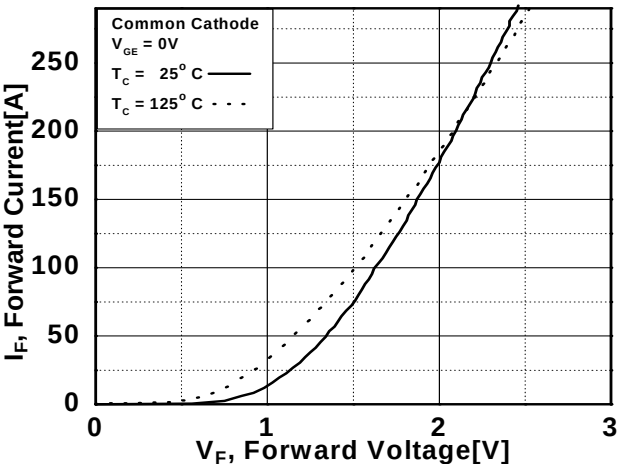
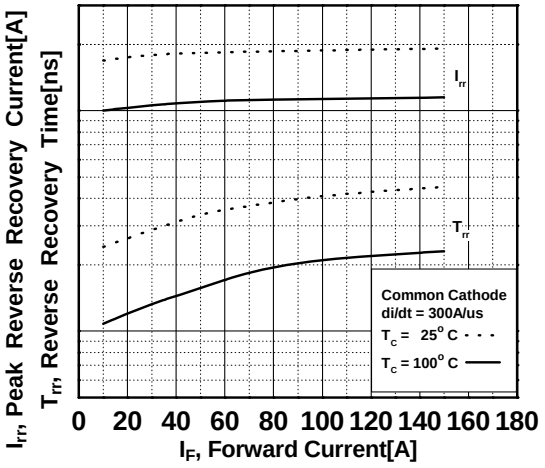
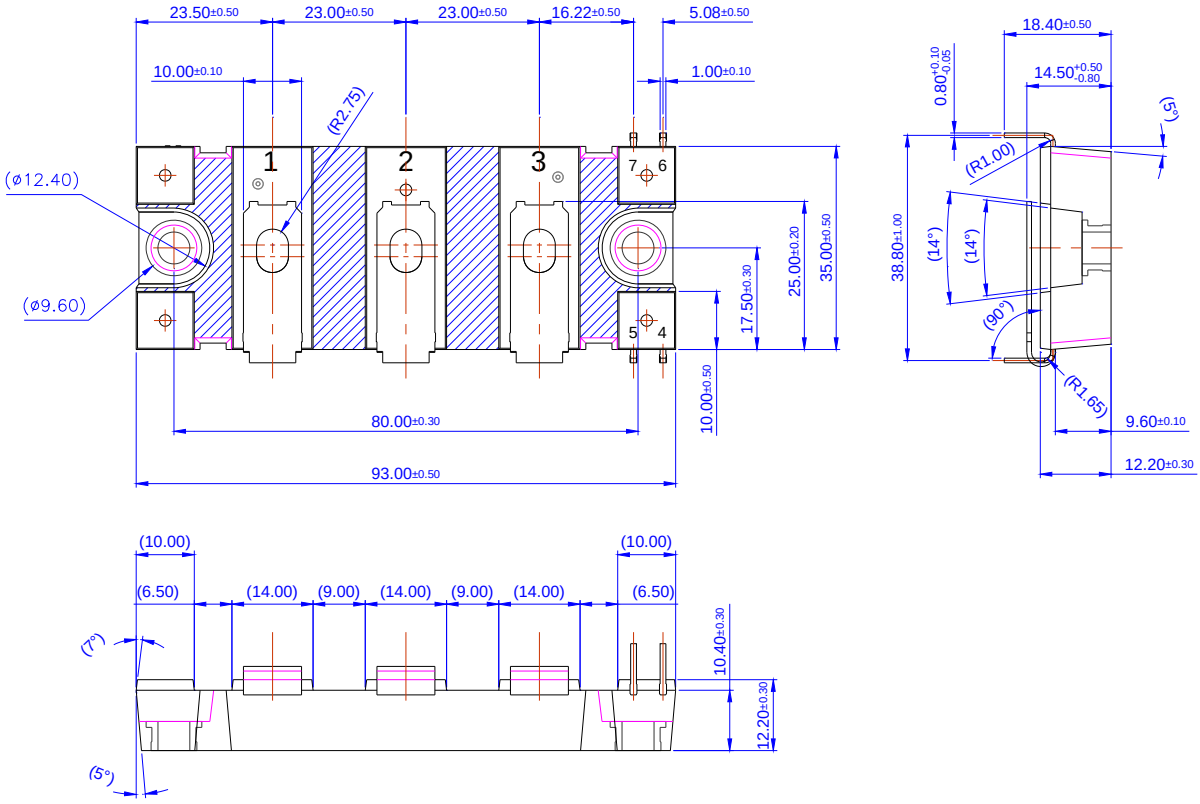



**Fig 20. Reverse Recovery Characteristics**



## Detailed Package Outline Drawings



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