FAIRCHILD SEMICONDUCTOR®

December 2007

# FGA20N120FTD
## 1200V, 20A Trench IGBT

### Features

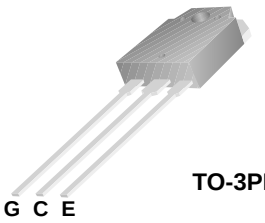
- Field stop trench technology
- High speed switching
- Low saturation voltage: $V_{CE(sat)}$ =1.6V @ $I_C$ = 20A
- High input impedance
- RoHS compliant

### Applications

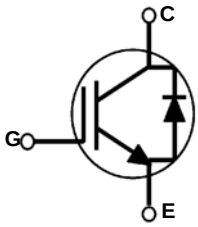
- Induction heating and Microwevave oven
- Soft switching applications

### General Description

Using advanced field stop trench technology, Fairchild's 1200V trench IGBTs offer superior conduction and switching performances, and easy parallel operation with exceptional avalanche ruggedness. This device is designed for soft switching applications.




TO-3PN




### Absolute Maximum Ratings

| Symbol | Description | | Ratings | Units |
|---|---|---|---|---|
| $V_{CES}$ | Collector to Emitter Voltage | | 1200 | V |
| $V_{GES}$ | Gate to Emitter Voltage | | ± 25 | V |
| $I_C$ | Continuous Collector Current | @ $T_C$ = 25°C | 40 | A |
| | Continuous Collector Current | @ $T_C$ = 100°C | 20 | A |
| $I_{CM\ (1)}$ | Pulsed Collector Current | | 60 | A |
| $I_F$ | Diode Continuous Forward Current | @ $T_C$ = 25°C | 20 | A |
| $P_D$ | Maximum Power Dissipation | @ $T_C$ = 25°C | 298 | W |
| | Maximum Power Dissipation | @ $T_C$ = 100°C | 119 | W |
| $T_J$ | Operating Junction Temperature | | -55 to +150 | °C |
| $T_{stg}$ | Storage Temperature Range | | -55 to +150 | °C |
| $T_L$ | Maximum Lead Temp. for soldering Purposes, 1/8" from case for 5 seconds | | 300 | °C |

**Notes:**
1: Repetitive rating, Pulse width limited by max. junction temperature

### Thermal Characteristics

| Symbol | Parameter | Typ. | Max. | Units |
|---|---|---|---|---|
| $R_{\theta JC}$(IGBT) | Thermal Resistance, Junction to Case | - | 0.42 | °C/W |
| $R_{\theta JC}$(Diode) | Thermal Resistance, Junction to Case | - | 2.0 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | - | 40 | °C/W |

## Package Marking and Ordering Information

| Device Marking | Device | Package | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|
| FGA20N120FTD | FGA20N120FTDTU | TO-3PN | - | - | 30 |

## Electrical Characteristics of the IGBT $T_C$ = 25°C unless otherwise noted

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | $V_{GE}$ = 0V, $I_C$ = 1mA | 1200 | - | - | V |
| $I_{CES}$ | Collector Cut-Off Current | $V_{CE}$ = $V_{CES}$, $V_{GE}$ = 0V | - | - | 1 | mA |
| $I_{GES}$ | G-E Leakage Current | $V_{GE}$ = $V_{GES}$, $V_{CE}$ = 0V | - | - | ±250 | nA |
| **On Characteristics** | | | | | | |
| $V_{GE(th)}$ | G-E Threshold Voltage | $I_C$ = 20mA, $V_{CE}$ = $V_{GE}$ | 3.5 | 5.9 | 7.5 | V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | $I_C$ = 20A, $V_{GE}$ = 15V<br>$T_C$ = 25°C | - | 1.60 | 2.00 | V |
| | | $I_C$ = 20A, $V_{GE}$ = 15V,<br>$T_C$ = 125°C | - | 1.85 | - | V |
| **Dynamic Characteristics** | | | | | | |
| $C_{ies}$ | Input Capacitance | $V_{CE}$ = 30V, $V_{GE}$ = 0V,<br>f = 1MHz | - | 3080 | - | pF |
| $C_{oes}$ | Output Capacitance | | - | 95 | - | pF |
| $C_{res}$ | Reverse Transfer Capacitance | | - | 60 | - | pF |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$ = 600V, $I_C$ = 20A,<br>$R_G$ = 10Ω, $V_{GE}$ = 15V,<br>Resistive Load, $T_C$ = 25°C | - | 30 | - | ns |
| $t_r$ | Rise Time | | - | 79 | - | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 143 | - | ns |
| $t_f$ | Fall Time | | - | 217 | 320 | ns |
| $E_{on}$ | Turn-On Switching Loss | | - | 0.42 | - | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | - | 0.71 | 1.05 | mJ |
| $E_{ts}$ | Total Switching Loss | | - | 1.13 | - | mJ |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$ = 600V, $I_C$ = 20A,<br>$R_G$ = 10Ω, $V_{GE}$ = 15V,<br>Resistive Load, $T_C$ = 125°C | - | 29 | - | ns |
| $t_r$ | Rise Time | | - | 93 | - | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 147 | - | ns |
| $t_f$ | Fall Time | | - | 259 | - | ns |
| $E_{on}$ | Turn-On Switching Loss | | - | 0.47 | - | mJ |
| $E_{off}$ | Turn-Off Switching Loss | | - | 0.86 | - | mJ |
| $E_{ts}$ | Total Switching Loss | | - | 1.33 | - | mJ |
| $Q_g$ | Total Gate Charge | $V_{CE}$ = 600V, $I_C$ = 20A,<br>$V_{GE}$ = 15V | - | 137 | - | nC |
| $Q_{ge}$ | Gate to Emitter Charge | | - | 23 | - | nC |
| $Q_{gc}$ | Gate to Collector Charge | | - | 65 | - | nC |

## Electrical Characteristics of the Diode $T_C$ = 25°C unless otherwise noted

| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max | Units |
|---|---|---|---|---|---|---|---|
| $V_{FM}$ | Diode Forward Voltage | $I_F$ = 20A | $T_C$ = 25°C | - | 1.3 | 1.7 | V |
| | | | $T_C$ = 125°C | - | 1.3 | - | |
| $t_{rr}$ | Diode Reverse Recovery Time | $I_{ES}$ =20A, dI/dt = 200A/μs | $T_C$ = 25°C | - | 447 | - | ns |
| | | | $T_C$ = 125°C | - | 485 | - | |
| $I_{rr}$ | Diode Peak Reverse Recovery Current | | $T_C$ = 25°C | - | 48 | - | A |
| | | | $T_C$ = 125°C | - | 50 | - | |
| $Q_{rr}$ | Diode Reverse Recovery Charge | | $T_C$ = 25°C | - | 10.8 | - | μC |
| | | | $T_C$ = 125°C | - | 12 | - | |

## Typical Performance Characteristics

**Figure 1. Typical Output Characteristics**

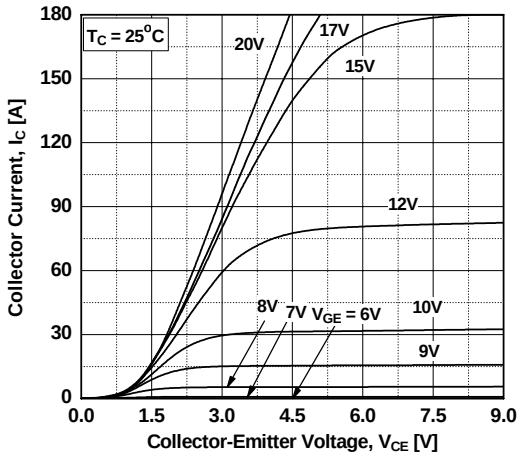



**Figure 2. Typical Output Characteristics**

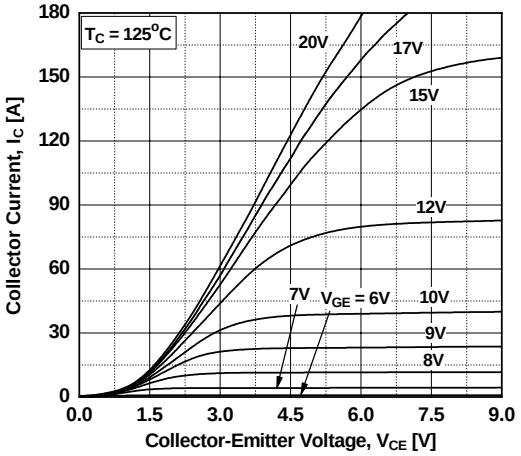



**Figure 3. Typical Saturation Voltage Characteristics**

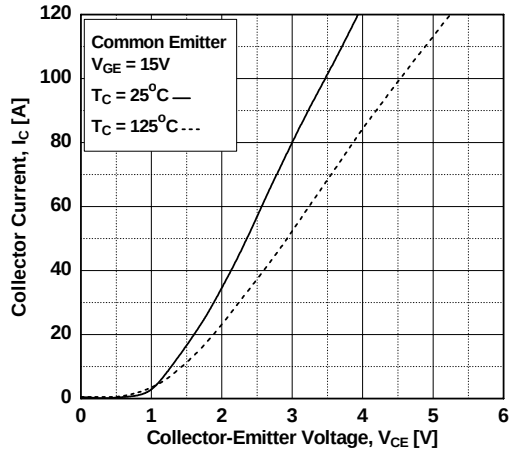



**Figure 4. Transfer Characteristics**

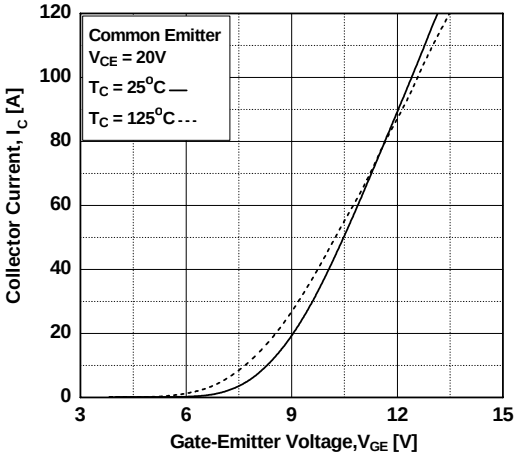



**Figure 5. Saturation Voltage vs. Case Temperature at Variant Current Level**

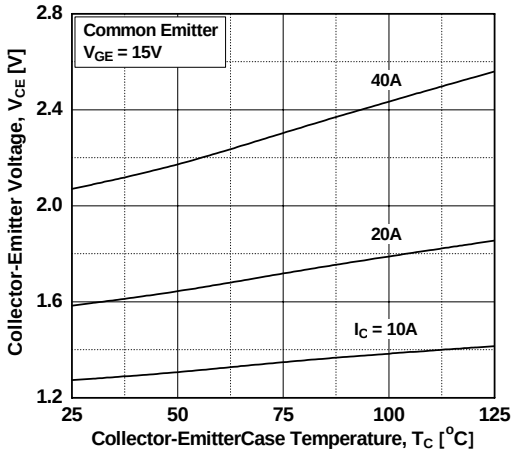
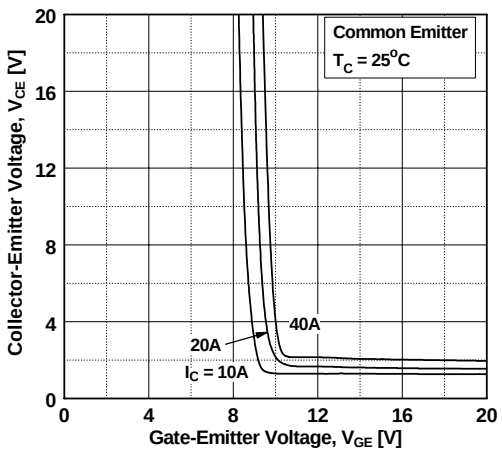
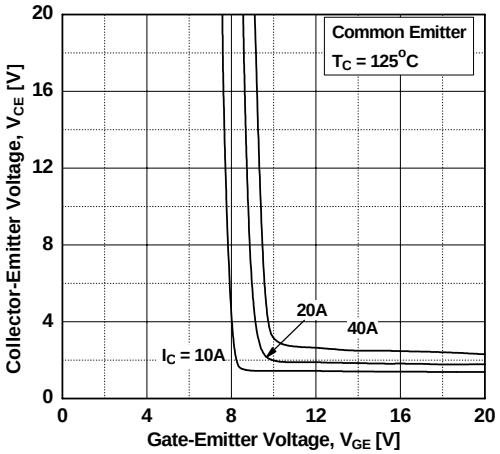



**Figure 6. Saturation Voltage vs. $V_{GE}$**

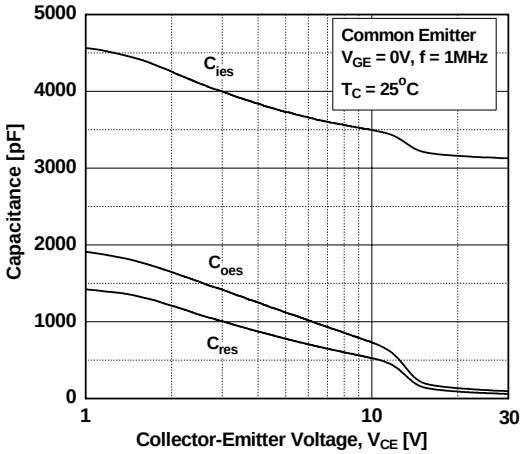


## Typical Performance Characteristics

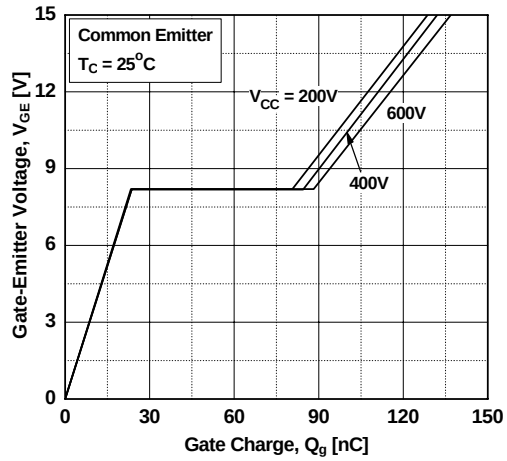
### Figure 7. Saturation Voltage vs. $V_{GE}$



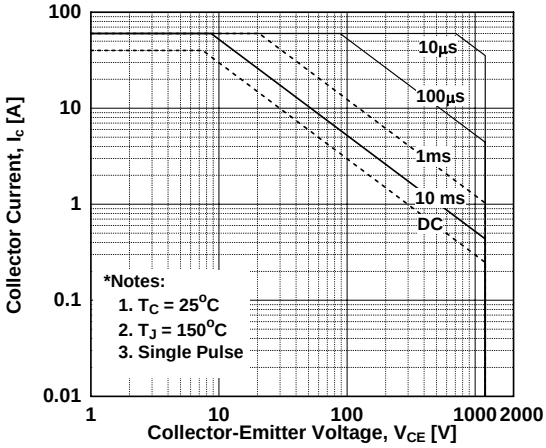

### Figure 8. Capacitance Characteristics



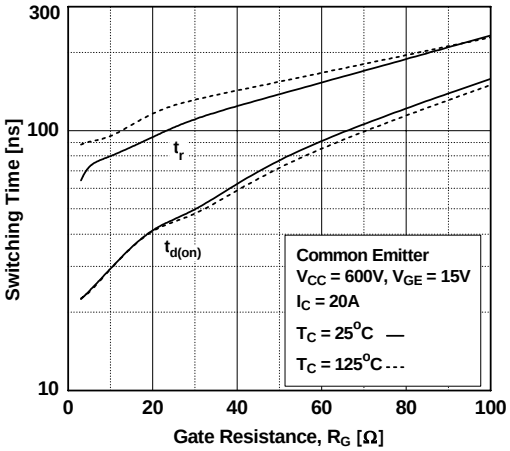

### Figure 9. Gate charge Characteristics



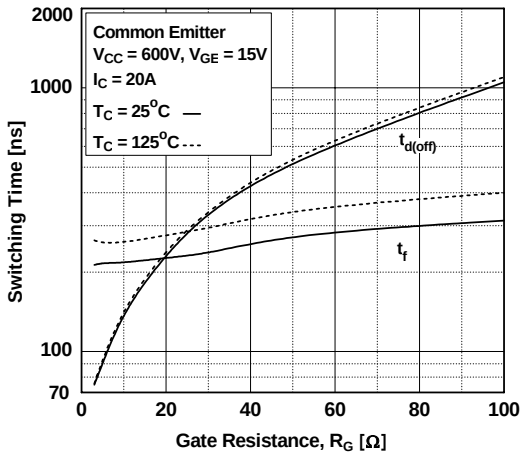

### Figure 10. SOA Characteristics




### Figure 11. Turn-on Characteristics vs. Gate Resistance




### Figure 12. Turn-off Characteristics vs. Gate Resistance



## Typical Performance Characteristics

**Figure 13. Turn-on Characteristics vs. Collector Current**

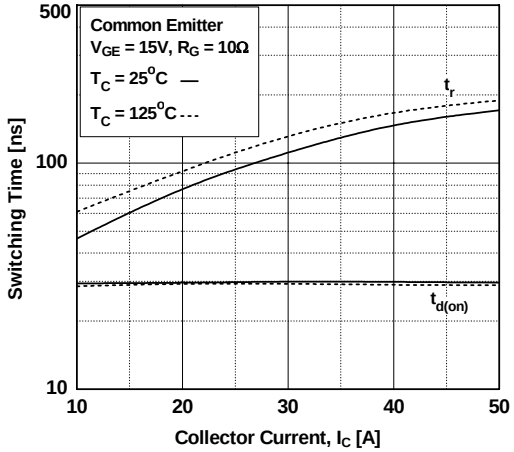



**Figure 14. Turn-off Characteristics vs. Collector Current**

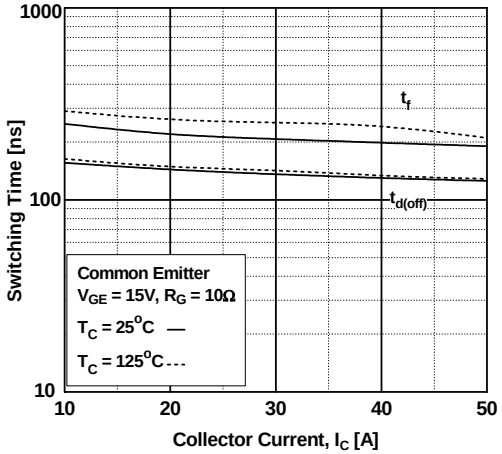



**Figure 15. Switching Loss vs. Gate Resistance**

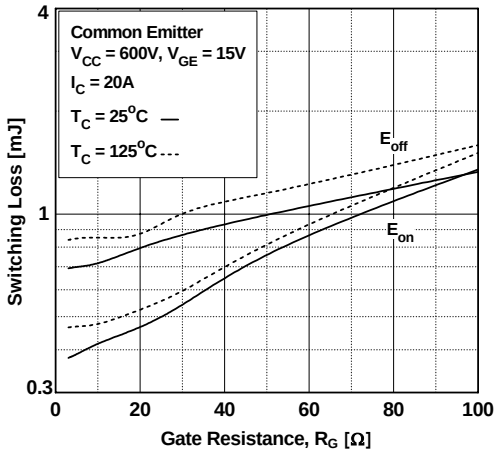



**Figure 16. Switching Loss vs. Collector Current**

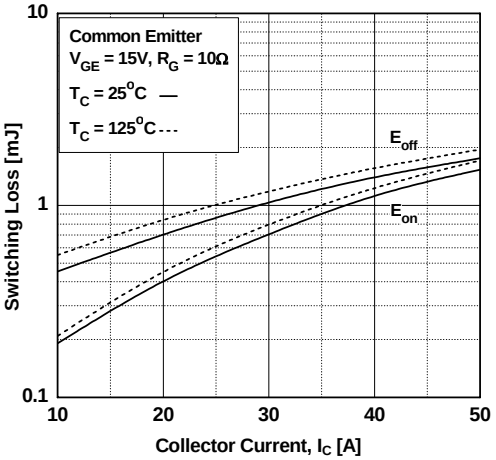



**Figure 17. Turn off Switching SOA Characteristics**

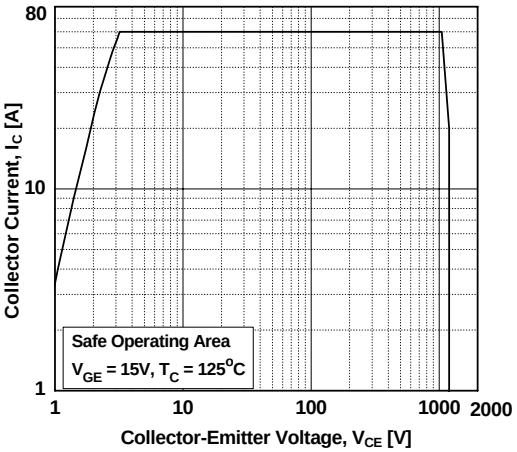
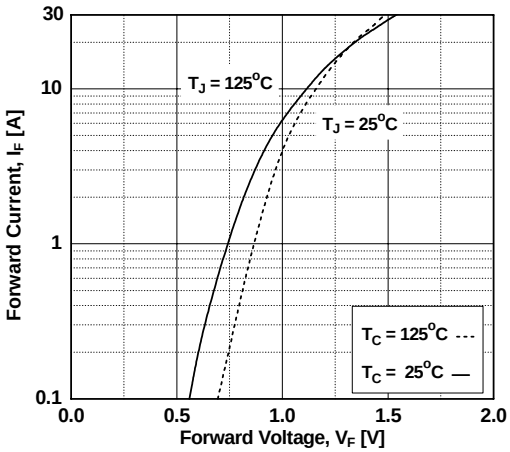



**Figure 18. Forward Characteristics**



## Typical Performance Characteristics

**Figure 19. Reverse Recovery Current**

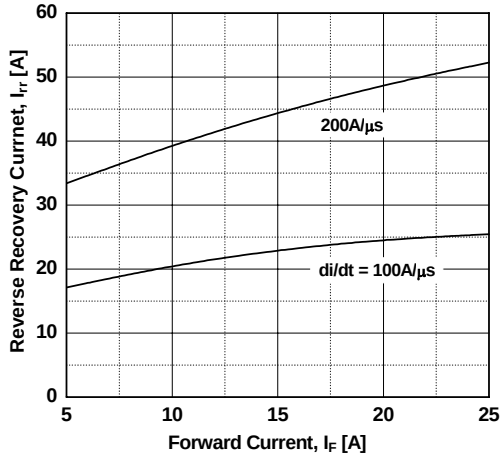



**Figure 20. Stored Charge**

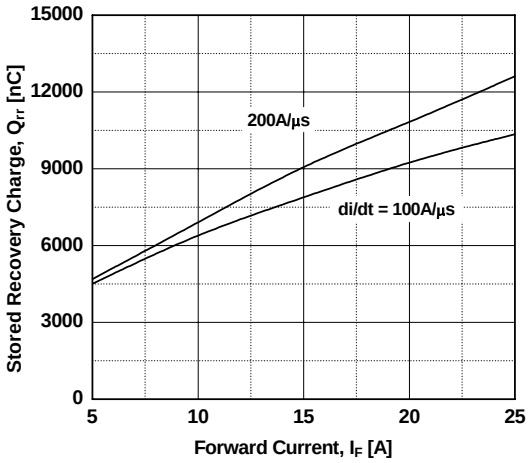



**Figure 21.Reverse Recovery Time**

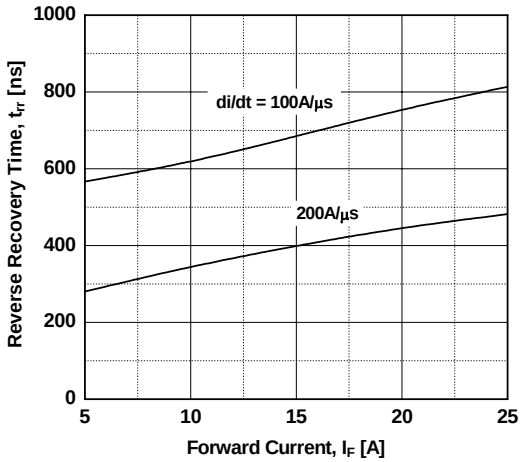
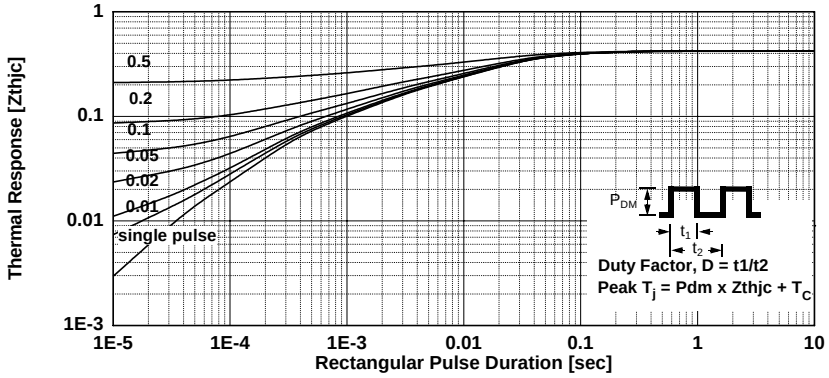
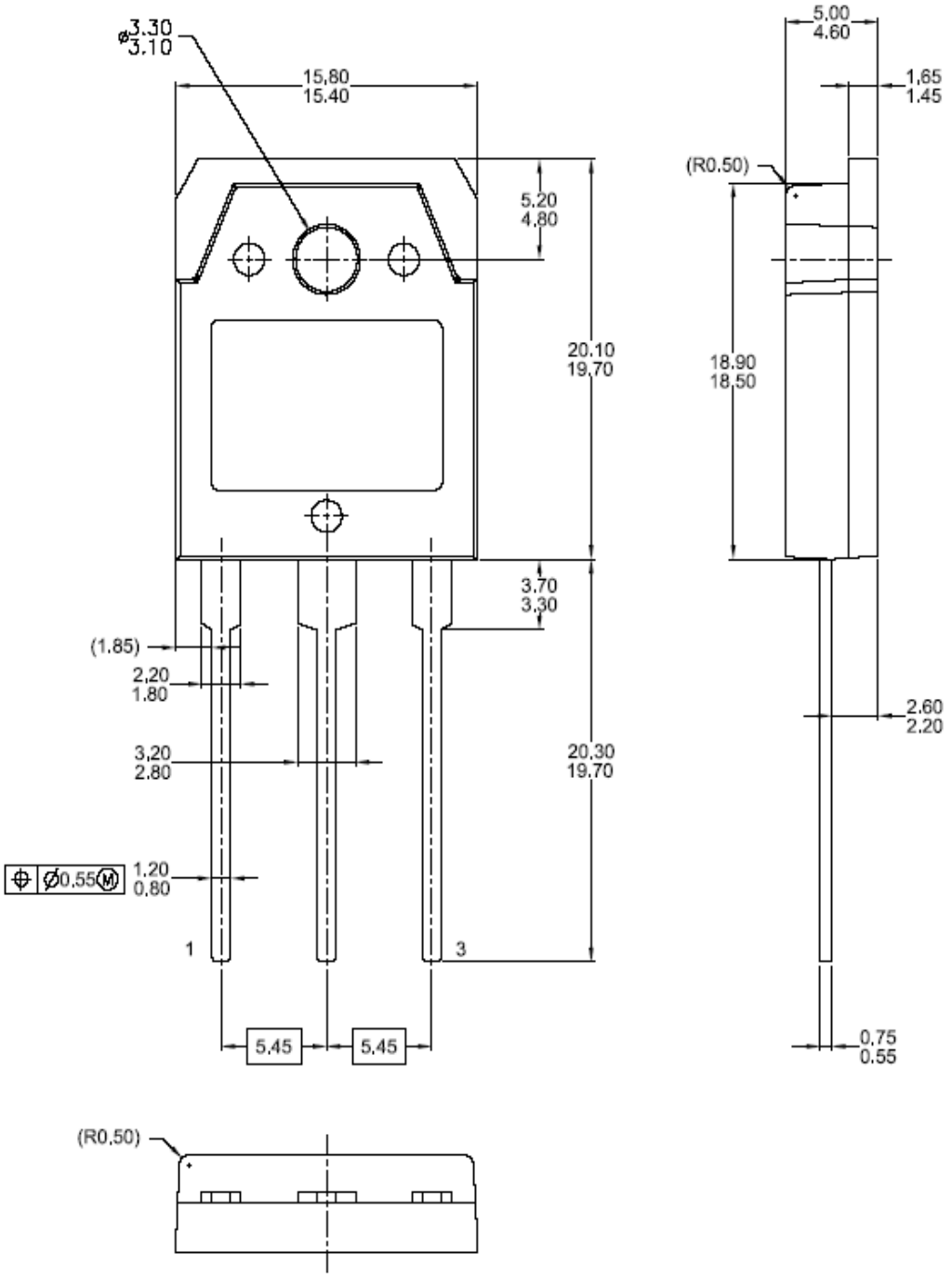



**Figure 22.Transient Thermal Impedance of IGBT**



## Mechanical Dimensions

# TO-3PN




Dimensions in Millimeters

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