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# FGA20N120FTD

## 1200 V, 20 A Field Stop Trench IGBT

### Features

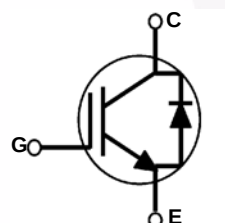
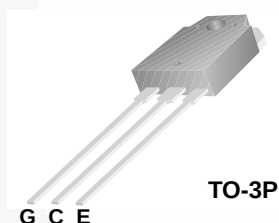
- Field Stop Trench Technology
- High Speed Switching
- Low Saturation Voltage:  $V_{CE(sat)} = 1.6\text{ V}$  @  $I_C = 20\text{ A}$
- High Input Impedance
- RoHS Compliant

### Applications

- Induction Heating, Microwave Oven

### General Description

Using advanced field stop trench technology, Fairchild's 1200V trench IGBTs offer superior conduction and switching performances for soft switching applications. The device can operate in parallel configuration with exceptional avalanche ruggedness. This device is designed for induction heating and microwave oven.



### Absolute Maximum Ratings

| Symbol       | Description                                                             | Ratings     | Unit             |
|--------------|-------------------------------------------------------------------------|-------------|------------------|
| $V_{CES}$    | Collector to Emitter Voltage                                            | 1200        | V                |
| $V_{GES}$    | Gate to Emitter Voltage                                                 | $\pm 25$    | V                |
| $I_C$        | Continuous Collector Current @ $T_C = 25^\circ\text{C}$                 | 40          | A                |
|              | Continuous Collector Current @ $T_C = 100^\circ\text{C}$                | 20          | A                |
| $I_{CM}$ (1) | Pulsed Collector Current                                                | 60          | A                |
| $I_F$        | Diode Continuous Forward Current @ $T_C = 25^\circ\text{C}$             | 20          | A                |
|              | Diode Continuous Forward Current @ $T_C = 100^\circ\text{C}$            | 10          | A                |
| $P_D$        | Maximum Power Dissipation @ $T_C = 25^\circ\text{C}$                    | 298         | W                |
|              | Maximum Power Dissipation @ $T_C = 100^\circ\text{C}$                   | 119         | W                |
| $T_J$        | Operating Junction Temperature                                          | -55 to +150 | $^\circ\text{C}$ |
| $T_{stg}$    | Storage Temperature Range                                               | -55 to +150 | $^\circ\text{C}$ |
| $T_L$        | Maximum Lead Temp. for soldering Purposes, 1/8" from case for 5 seconds | 300         | $^\circ\text{C}$ |

#### Notes:

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

### Thermal Characteristics

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

## Package Marking and Ordering Information

| Part Number    | Top Mark     | Package | Packing Method | Reel Size | Tape Width | Quantity |
|----------------|--------------|---------|----------------|-----------|------------|----------|
| FGA20N120FTDTU | FGA20N120FTD | TO-3P   | Tube           | N/A       | N/A        | 30       |

## Electrical Characteristics of the IGBT T<sub>C</sub> = 25°C unless otherwise noted

| Symbol                    | Parameter                               | Test Conditions                                                                                                                             | Min. | Typ. | Max. | Unit |
|---------------------------|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| Off Characteristics       |                                         |                                                                                                                                             |      |      |      |      |
| BV <sub>CES</sub>         | Collector to Emitter Breakdown Voltage  | V <sub>GE</sub> = 0 V, I <sub>C</sub> = 1 mA                                                                                                | 1200 | -    | -    | V    |
| I <sub>CES</sub>          | Collector Cut-Off Current               | V <sub>CE</sub> = V <sub>CES</sub> , V <sub>GE</sub> = 0 V                                                                                  | -    | -    | 1    | mA   |
| I <sub>GES</sub>          | G-E Leakage Current                     | V <sub>GE</sub> = V <sub>GES</sub> , V <sub>CE</sub> = 0 V                                                                                  | -    | -    | ±250 | nA   |
| On Characteristics        |                                         |                                                                                                                                             |      |      |      |      |
| V <sub>GE(th)</sub>       | G-E Threshold Voltage                   | I <sub>C</sub> = 20 mA, V <sub>CE</sub> = V <sub>GE</sub>                                                                                   | 3.5  | 5.9  | 7.5  | V    |
| V <sub>CE(sat)</sub>      | Collector to Emitter Saturation Voltage | I <sub>C</sub> = 20 A, V <sub>GE</sub> = 15 V<br>T <sub>C</sub> = 25°C                                                                      | -    | 1.59 | 2    | V    |
|                           |                                         | I <sub>C</sub> = 20 A, V <sub>GE</sub> = 15 V,<br>T <sub>C</sub> = 125°C                                                                    | -    | 1.85 | -    | V    |
| Dynamic Characteristics   |                                         |                                                                                                                                             |      |      |      |      |
| C <sub>ies</sub>          | Input Capacitance                       | V <sub>CE</sub> = 30 V, V <sub>GE</sub> = 0 V,<br>f = 1 MHz                                                                                 | -    | 3080 | -    | pF   |
| C <sub>oes</sub>          | Output Capacitance                      |                                                                                                                                             | -    | 95   | -    | pF   |
| C <sub>res</sub>          | Reverse Transfer Capacitance            |                                                                                                                                             | -    | 60   | -    | pF   |
| Switching Characteristics |                                         |                                                                                                                                             |      |      |      |      |
| t <sub>d(on)</sub>        | Turn-On Delay Time                      | V <sub>CC</sub> = 600 V, I <sub>C</sub> = 20 A,<br>R <sub>G</sub> = 10 Ω, V <sub>GE</sub> = 15 V,<br>Resistive Load, T <sub>C</sub> = 25°C  | -    | 30   | -    | ns   |
| t <sub>r</sub>            | Rise Time                               |                                                                                                                                             | -    | 79   | -    | ns   |
| t <sub>d(off)</sub>       | Turn-Off Delay Time                     |                                                                                                                                             | -    | 143  | -    | ns   |
| t <sub>f</sub>            | Fall Time                               |                                                                                                                                             | -    | 217  | 320  | ns   |
| E <sub>on</sub>           | Turn-On Switching Loss                  |                                                                                                                                             | -    | 0.42 | -    | mJ   |
| E <sub>off</sub>          | Turn-Off Switching Loss                 |                                                                                                                                             | -    | 0.71 | 1.05 | mJ   |
| E <sub>ts</sub>           | Total Switching Loss                    | V <sub>CC</sub> = 600 V, I <sub>C</sub> = 20 A,<br>R <sub>G</sub> = 10 Ω, V <sub>GE</sub> = 15 V,<br>Resistive Load, T <sub>C</sub> = 125°C | -    | 1.13 | -    | mJ   |
| t <sub>d(on)</sub>        | Turn-On Delay Time                      |                                                                                                                                             | -    | 29   | -    | ns   |
| t <sub>r</sub>            | Rise Time                               |                                                                                                                                             | -    | 93   | -    | ns   |
| t <sub>d(off)</sub>       | Turn-Off Delay Time                     |                                                                                                                                             | -    | 147  | -    | ns   |
| t <sub>f</sub>            | Fall Time                               |                                                                                                                                             | -    | 259  | -    | ns   |
| E <sub>on</sub>           | Turn-On Switching Loss                  |                                                                                                                                             | -    | 0.47 | -    | mJ   |
| E <sub>off</sub>          | Turn-Off Switching Loss                 |                                                                                                                                             | -    | 0.86 | -    | mJ   |
| E <sub>ts</sub>           | Total Switching Loss                    |                                                                                                                                             | -    | 1.33 | -    | mJ   |
| Q <sub>g</sub>            | Total Gate Charge                       | V <sub>CE</sub> = 600 V, I <sub>C</sub> = 20 A,<br>V <sub>GE</sub> = 15 V                                                                   | -    | 137  | -    | nC   |
| Q <sub>ge</sub>           | Gate to Emitter Charge                  |                                                                                                                                             | -    | 23   | -    | nC   |
| Q <sub>gc</sub>           | Gate to Collector Charge                |                                                                                                                                             | -    | 65   | -    | nC   |

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

| Symbol          | Parameter                           | Test Conditions                                         |                                     | Min. | Typ. | Max | Unit |
|-----------------|-------------------------------------|---------------------------------------------------------|-------------------------------------|------|------|-----|------|
| V <sub>FM</sub> | Diode Forward Voltage               | I <sub>F</sub> = 20 A                                   | T <sub>C</sub> = 25 <sup>o</sup> C  | -    | 1.3  | 1.7 | V    |
|                 |                                     |                                                         | T <sub>C</sub> = 125 <sup>o</sup> C | -    | 1.3  | -   |      |
| t <sub>rr</sub> | Diode Reverse Recovery Time         | I <sub>F</sub> =20 A,<br>di <sub>F</sub> /dt = 200 A/μs | T <sub>C</sub> = 25 <sup>o</sup> C  | -    | 447  | -   | ns   |
|                 |                                     |                                                         | T <sub>C</sub> = 125 <sup>o</sup> C | -    | 485  | -   |      |
| I <sub>rr</sub> | Diode Peak Reverse Recovery Current |                                                         | T <sub>C</sub> = 25 <sup>o</sup> C  | -    | 48   | -   | A    |
|                 |                                     |                                                         | T <sub>C</sub> = 125 <sup>o</sup> C | -    | 50   | -   |      |
| Q <sub>rr</sub> | Diode Reverse Recovery Charge       |                                                         | T <sub>C</sub> = 25 <sup>o</sup> C  | -    | 10.8 | -   | μC   |
|                 |                                     |                                                         | T <sub>C</sub> = 125 <sup>o</sup> C | -    | 12   | -   |      |

## Typical Performance Characteristics

Figure 1. Typical Output Characteristics

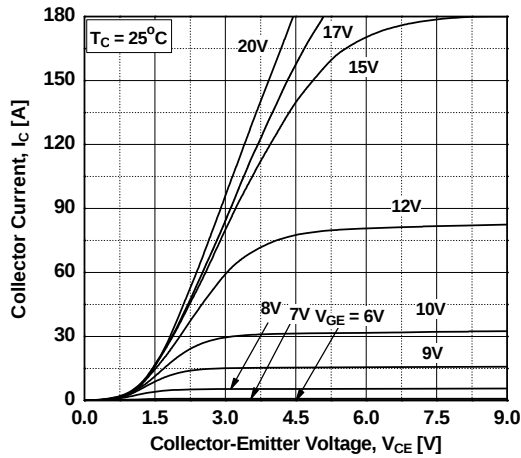


Figure 2. Typical Output Characteristics

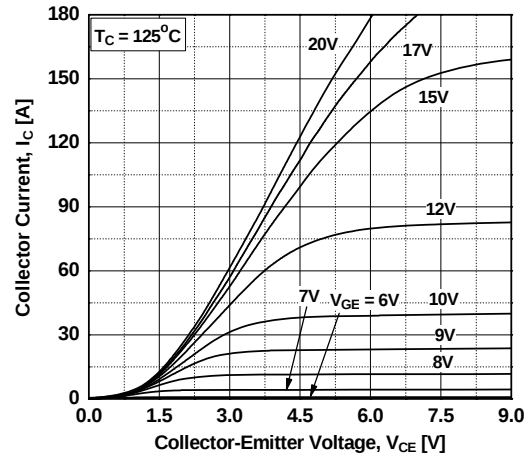


Figure 3. Typical Saturation Voltage Characteristics

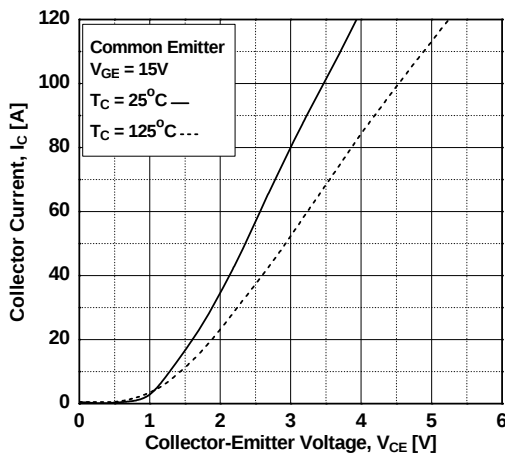


Figure 4. Transfer Characteristics

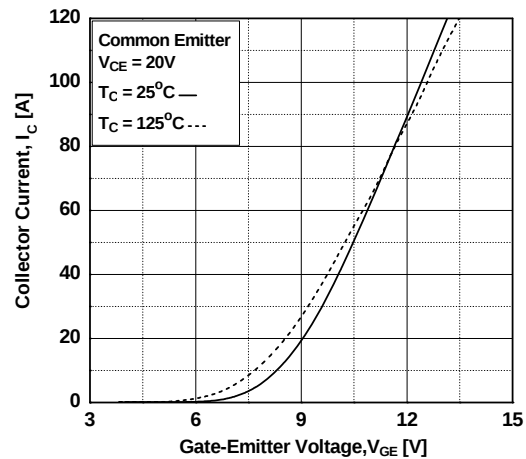


Figure 5. Saturation Voltage vs. Case Temperature at Variant Current Level

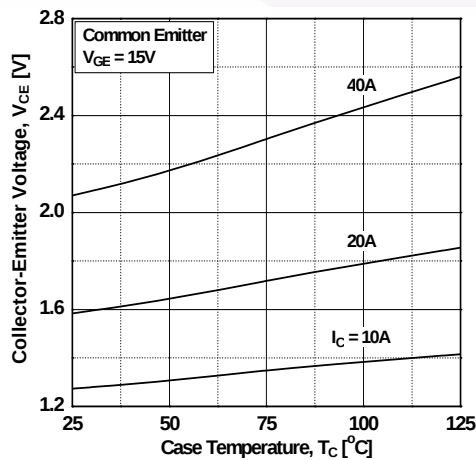
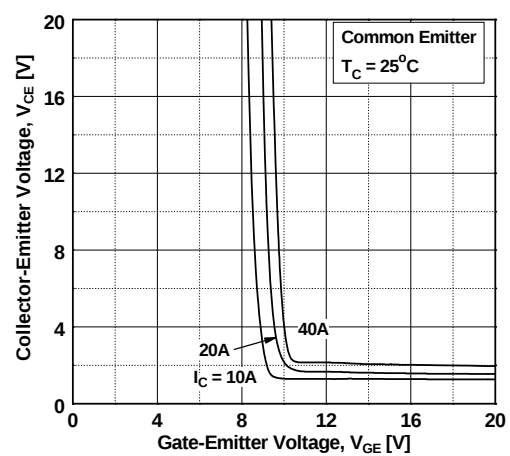


Figure 6. Saturation Voltage vs. V\_GE



## Typical Performance Characteristics

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

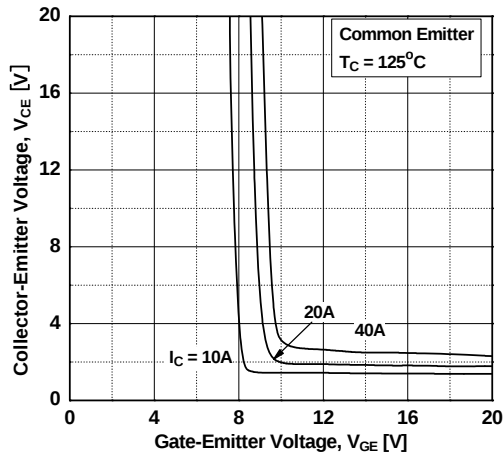


Figure 8. Capacitance Characteristics

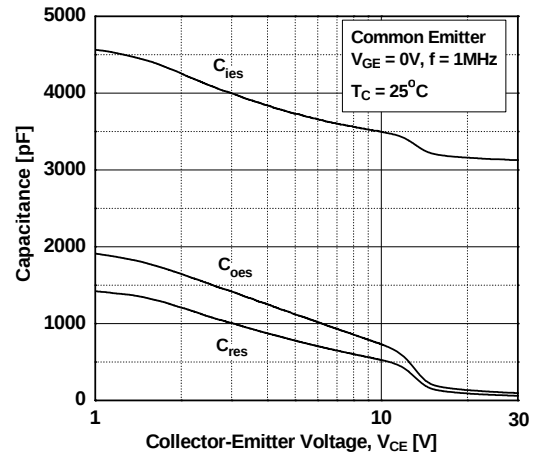


Figure 9. Gate charge Characteristics

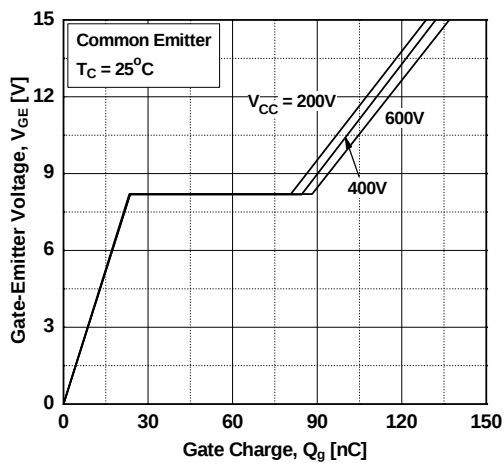


Figure 10. SOA Characteristics

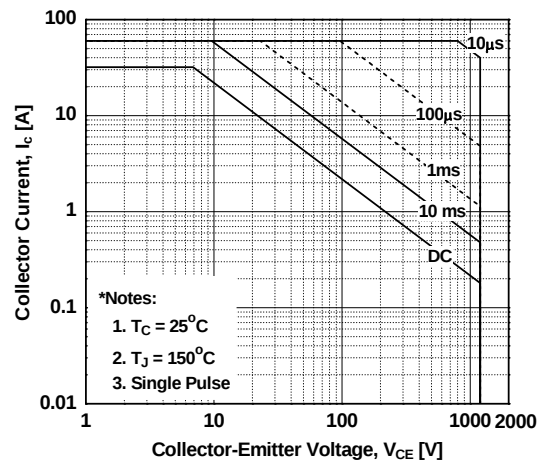


Figure 11. Turn-on Characteristics vs. Gate Resistance

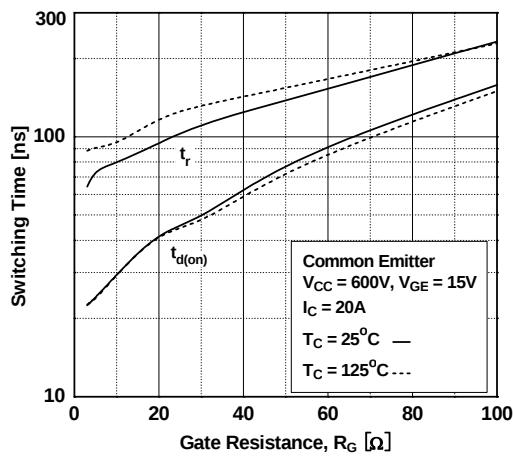
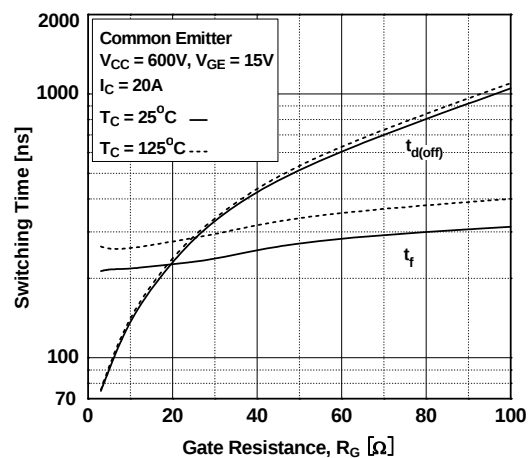


Figure 12. Turn-off Characteristics vs. Gate Resistance



## Typical Performance Characteristics

Figure 13. Turn-on Characteristics vs. Collector Current

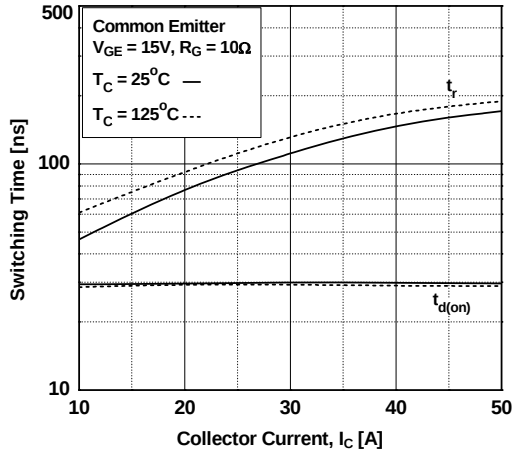


Figure 14. Turn-off Characteristics vs. Collector Current

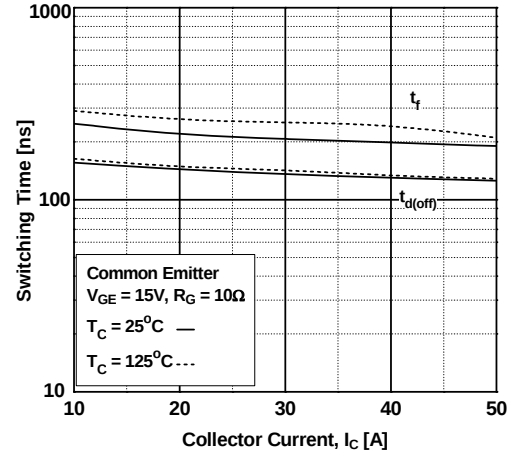


Figure 15. Switching Loss vs. Gate Resistance

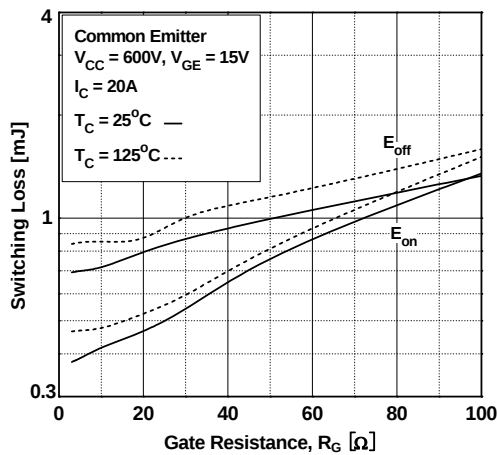


Figure 16. Switching Loss vs. Collector Current

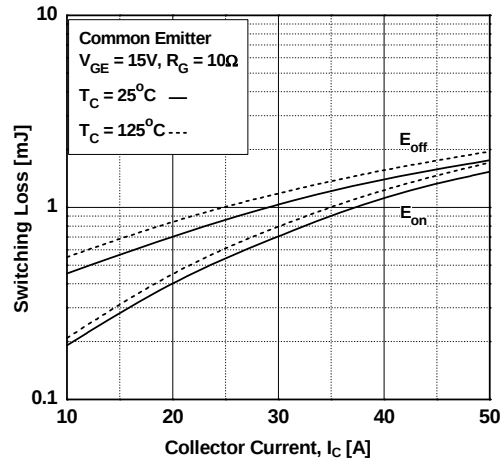


Figure 17. Turn off Switching SOA Characteristics

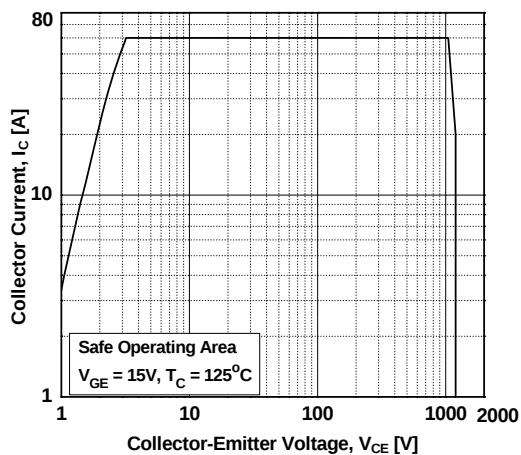
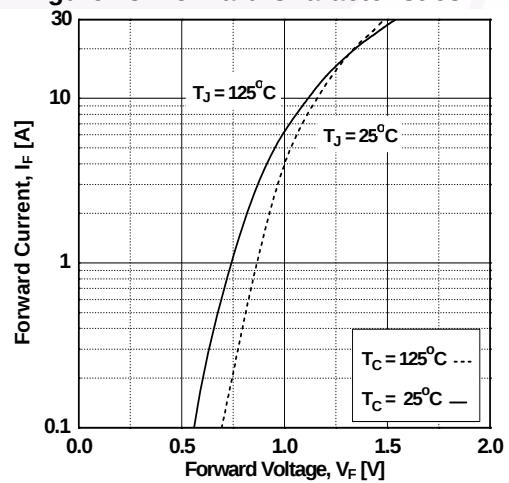


Figure 18. Forward Characteristics



## Typical Performance Characteristics

Figure 19. Reverse Recovery Current

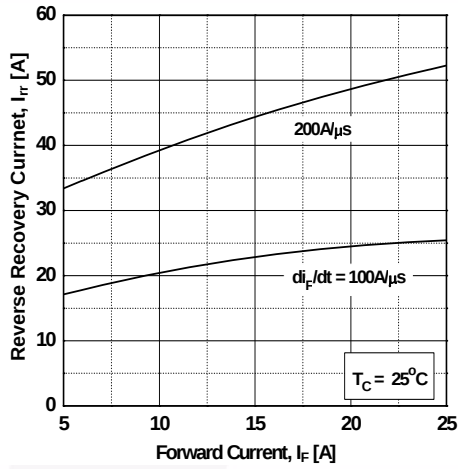


Figure 20. Stored Charge

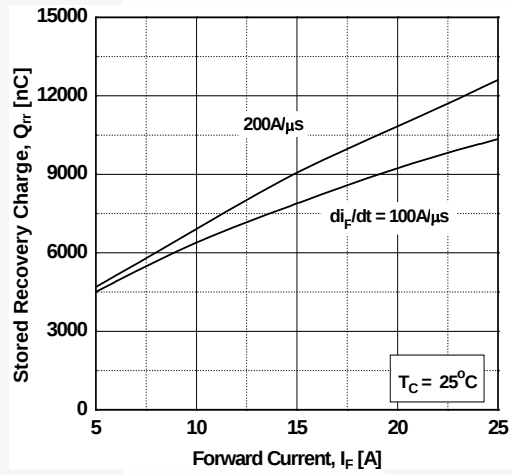


Figure 21. Reverse Recovery Time

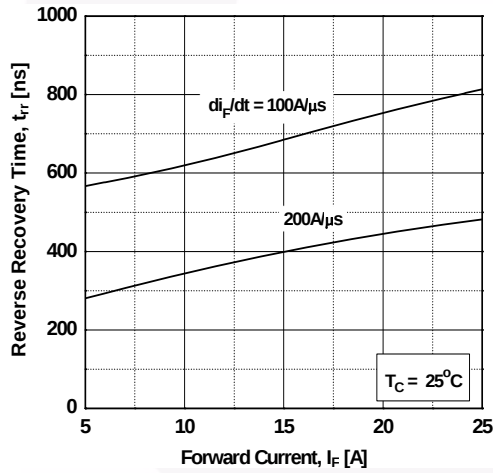
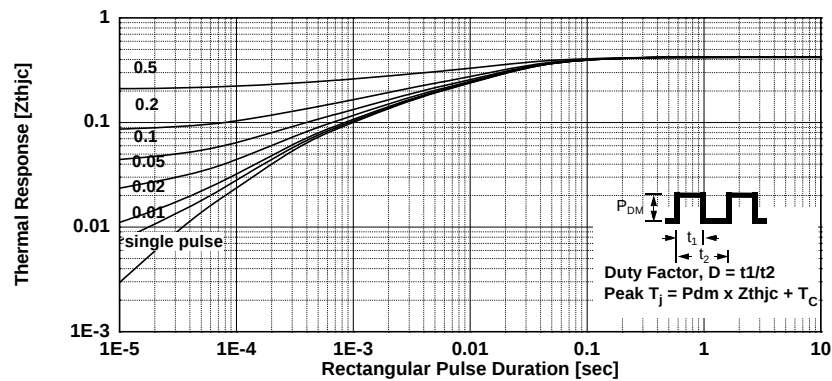


Figure 22. Transient Thermal Impedance of IGBT



## Mechanical Dimensions

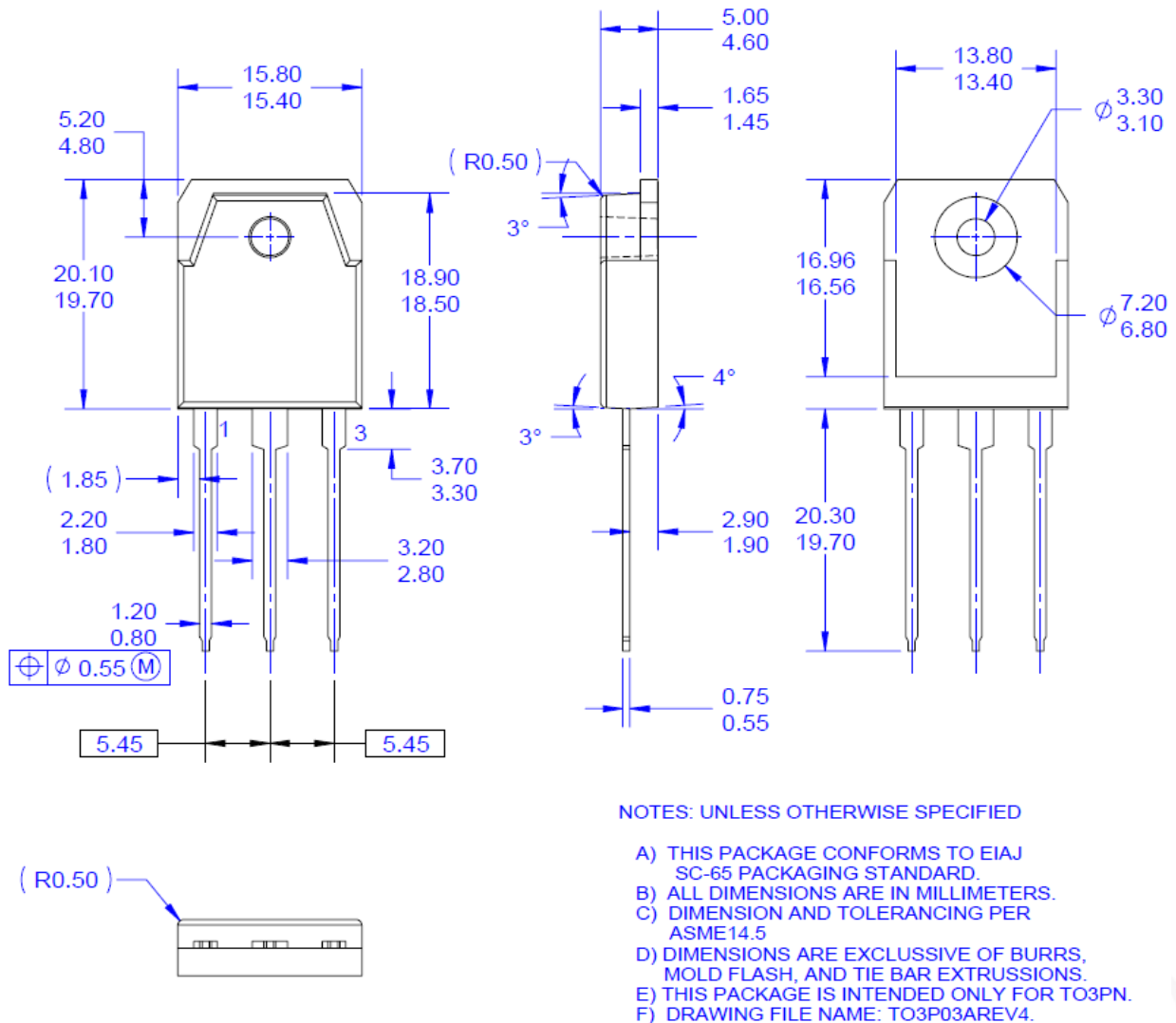


Figure 23. TO-3P 3L - 3LD, T03, PLASTIC, EIAJ SC-65

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