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August 2015

# FGA5065ADF

## 650 V, 50 A Field Stop Trench IGBT

### Features

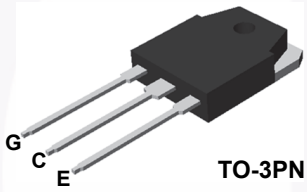
- Maximum Junction Temperature : $T_J$ = 175°C
- Positive Temperaure Co-efficient for Easy Parallel Operating
- High Current Capability
- Low Saturation Voltage: $V_{CE(sat)}$ = 1.7 V(Typ.) @ $I_C$ = 50 A
- 100% of the Parts Tested for $I_{LM}$(1)
- High Input Impedance
- Fast Switching
- Tighten Parameter Distribution
- RoHS Compliant

### General Description

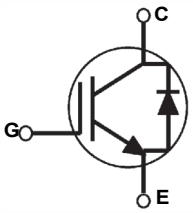
This ADF IGBT series adopted field stop trench 3rd generation IGBT which offer extreme low $V_{CE(sat)}$ and much faster switching characteristics for outstanding efficiency. And this kind of technology is fully optimized to variety PFC (Power Factor Correction) topology; Single Boost, Multi Channel Interleaved etc with over 20KHz switching performance. TO3P package provide super low thermal resistance for much wider SOA for system stability.

### Applications

- PFC topology for home applicnce: Single Boost, Multi Channel Interleaved etc.




TO-3PN




### Absolute Maximum Ratings

$T_C$ = 25°C unless otherwise noted

| Symbol | Description | | FGA5065ADF | Unit |
|---|---|---|---|---|
| $V_{CES}$ | Collector to Emitter Voltage | | 650 | V |
| $V_{GES}$ | Gate to Emitter Voltage | | ± 20 | V |
| | Transient Gate to Emitter Voltage | | ± 30 | V |
| $I_C$ | Collector Current | @ $T_C$ = 25°C | 100 | A |
| | Collector Current | @ $T_C$ = 100°C | 50 | A |
| $I_{LM}$ (1) | Pulsed Collector Current | @ $T_C$ = 25°C | 150 | A |
| $I_{CM}$ (2) | Pulsed Collector Current | | 150 | A |
| $I_F$ (3) | Diode Forward Current | @ $T_C$ = 25°C | 40 | A |
| | Diode Forward Current | @ $T_C$ = 100°C | 20 | A |
| $I_{FM}$ (2) | Pulsed Diode Maximum Forward Current | | 120 | A |
| $P_D$ | Maximum Power Dissipation | @ $T_C$ = 25°C | 268 | W |
| | Maximum Power Dissipation | @ $T_C$ = 100°C | 134 | W |
| $T_J$ | Operating Junction Temperature | | -55 to +175 | °C |
| $T_{stg}$ | Storage Temperature Range | | -55 to +175 | °C |
| $T_L$ | Maximum Lead Temp. for soldering Purposes, 1/8" from case for 5 seconds | | 300 | °C |

**Notes:**

1. $V_{CC}$ = 400 V, $V_{GE}$ = 15 V, $I_C$ =150 A, $R_G$ = 55.9 Ω, Inductive Load.
2. Repetitive rating: Pulse width limited by max. junction temperature.
3. The purpose of diode is protection for negative voltage.

## Thermal Characteristics

| Symbol | Parameter | FGA5065ADF | Unit |
|---|---|---|---|
| $R_{\theta JC}$(IGBT) | Thermal Resistance, Junction to Case, Max. | 0.56 | °C/W |
| $R_{\theta JC}$(Diode) | Thermal Resistance, Junction to Case, Max. | 1.71 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient, Max. | 40 | °C/W |

## Package Marking and Ordering Information

| Part Number | Top Mark | Package | Packaging Method | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|---|
| FGA5065ADF | FGA5065ADF | TO-3PN | Tube | - | - | 30 |

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

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $BV_{CES}$ | Collector to Emitter Breakdown Voltage | $V_{GE}$ = 0V, $I_C$ = 1 mA | 650 | - | - | V |
| $\Delta BV_{CES}$ / $\Delta T_J$ | Temperature Coefficient of Breakdown Voltage | $I_C$ = 1 mA, Reference to 25°C | - | 0.58 | - | V/°C |
| $I_{CES}$ | Collector Cut-Off Current | $V_{CE}$ = $V_{CES}$, $V_{GE}$ = 0 V | - | - | 250 | μA |
| $I_{GES}$ | G-E Leakage Current | $V_{GE}$ = $V_{GES}$, $V_{CE}$ = 0 V | - | - | ±400 | nA |
| **On Characteristics** | | | | | | |
| $V_{GE(th)}$ | G-E Threshold Voltage | $I_C$ = 50 mA, $V_{CE}$ = $V_{GE}$ | 4.1 | 5.6 | 7.6 | V |
| $V_{CE(sat)}$ | Collector to Emitter Saturation Voltage | $I_C$ = 50 A, $V_{GE}$ = 15 V | - | 1.7 | 2.2 | V |
| | | $I_C$ = 50 A, $V_{GE}$ = 15 V, $T_C$ = 175°C | - | 2.28 | - | V |
| **Dynamic Characteristics** | | | | | | |
| $C_{ies}$ | Input Capacitance | $V_{CE}$ = 30 V, $V_{GE}$ = 0 V, f = 1MHz | - | 1995 | - | pF |
| $C_{oes}$ | Output Capacitance | | - | 70 | - | pF |
| $C_{res}$ | Reverse Transfer Capacitance | | - | 23 | - | pF |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$ = 400 V, $I_C$ = 50 A, $R_G$ = 6 Ω, $V_{GE}$ = 15 V, Inductive Load, $T_C$ = 25°C | - | 20.8 | - | ns |
| $t_r$ | Rise Time | | - | 41.6 | - | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 62.4 | - | ns |
| $t_f$ | Fall Time | | - | 11.2 | - | ns |
| $E_{on}$ | Turn-On Switching Loss | | - | 1350 | - | uJ |
| $E_{off}$ | Turn-Off Switching Loss | | - | 309 | - | uJ |
| $E_{ts}$ | Total Switching Loss | | - | 1659 | - | uJ |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$ = 400 V, $I_C$ = 50 A, $R_G$ = 6 Ω, $V_{GE}$ = 15 V, Inductive Load, $T_C$ = 175°C | - | 19.2 | - | ns |
| $t_r$ | Rise Time | | - | 38.4 | - | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 67.2 | - | ns |
| $t_f$ | Fall Time | | - | 12.8 | - | ns |
| $E_{on}$ | Turn-On Switching Loss | | - | 1820 | - | uJ |
| $E_{off}$ | Turn-Off Switching Loss | | - | 558 | - | uJ |
| $E_{ts}$ | Total Switching Loss | | - | 2378 | - | uJ |

## Electrical Characteristics of the IGBT (Continued)

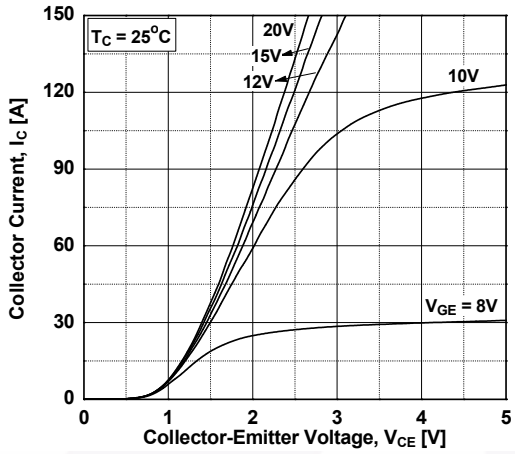
| Symbol | Parameter | Test Conditions | Min. | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| $Q_g$ | Total Gate Charge | $V_{CE}$ = 400 V, $I_C$ = 50 A, $V_{GE}$ = 15 V | - | 72.2 | - | nC |
| $Q_{ge}$ | Gate to Emitter Charge | | - | 13.5 | - | nC |
| $Q_{gc}$ | Gate to Collector Charge | | - | 28.5 | - | nC |

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

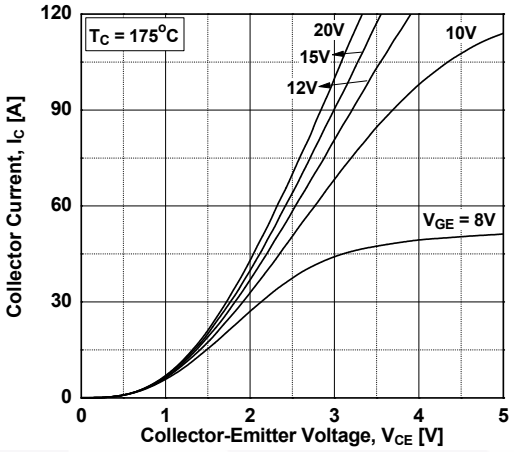
| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{FM}$ | Diode Forward Voltage | $I_F$ = 20 A | $T_C$ = 25°C | - | 2.1 | 2.6 | V |
| | | | $T_C$ = 175°C | - | 1.94 | - | |
| $E_{rec}$ | Reverse Recovery Energy | $I_F$ =20 A, $dI_F/dt$ = 200 A/μs | $T_C$ = 175°C | - | 50 | - | uJ |
| $t_{rr}$ | Diode Reverse Recovery Time | | $T_C$ = 25°C | - | 31.8 | - | ns |
| | | | $T_C$ = 175°C | - | 192 | - | |
| $Q_{rr}$ | Diode Reverse Recovery Charge | | $T_C$ = 25°C | - | 50.6 | - | nC |
| | | | $T_C$ = 175°C | - | 699 | - | |

## Typical Performance Characteristics

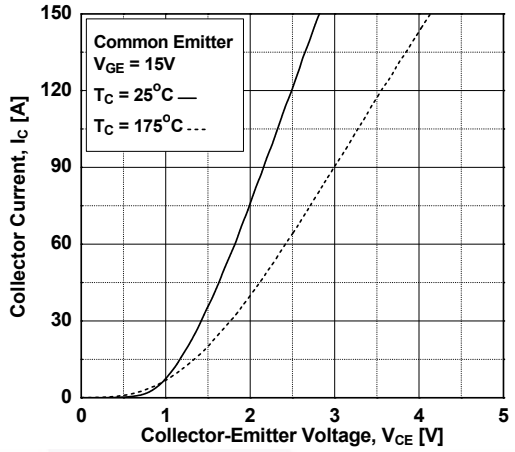
### Figure 1. Typical Output Characteristics



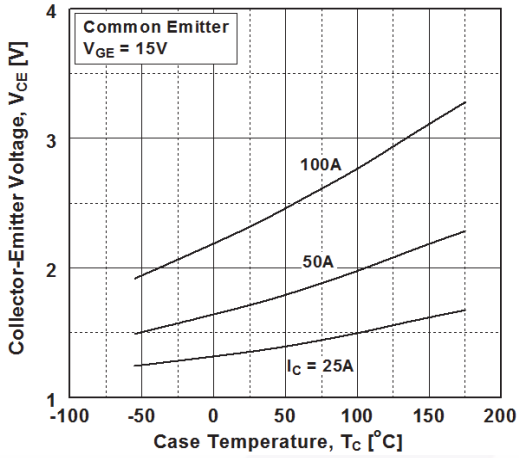

### Figure 2. Typical Output Characteristics



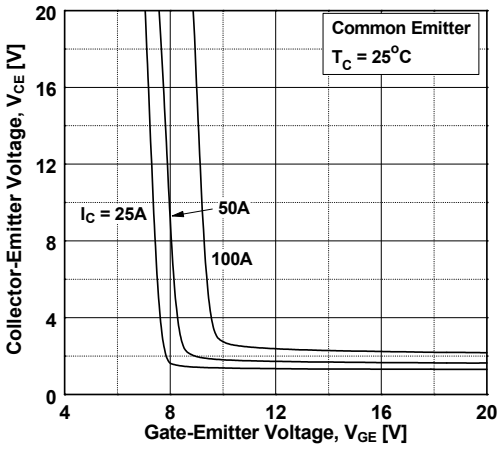

### Figure 3. Typical Saturation Voltage Characteristics



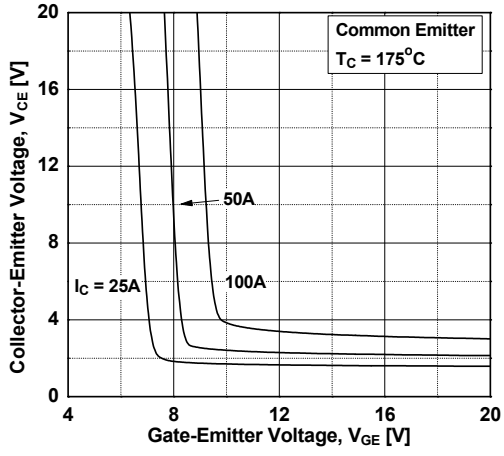

### Figure 4. Saturation Voltage vs. Case Temperature at Variant Current Level




### Figure 5. Saturation Voltage vs. $V_{GE}$




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



## Typical Performance Characteristics

**Figure 7. Capacitance Characteristics**

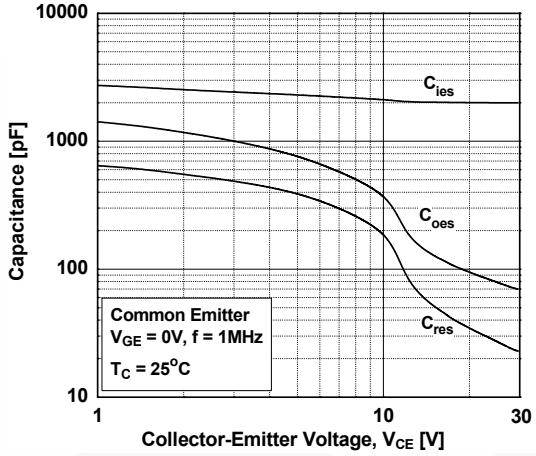



**Figure 8. Gate charge Characteristics**

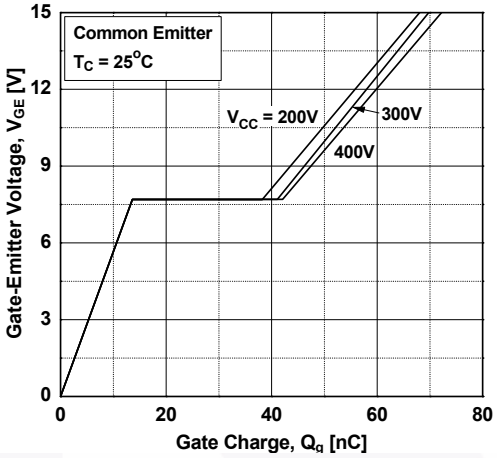



**Figure 9. Turn-on Characteristics vs. Gate Resistance**

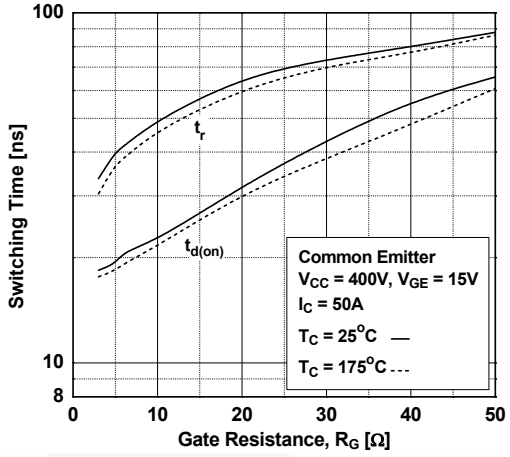



**Figure 10. Turn-off Characteristics vs. Gate Resistance**

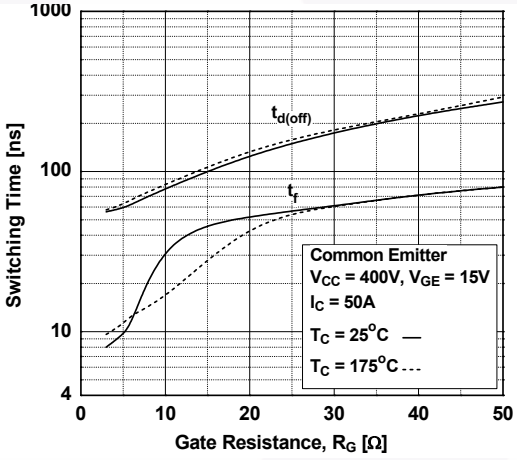



**Figure 11. Switching Loss vs. Gate Resistance**

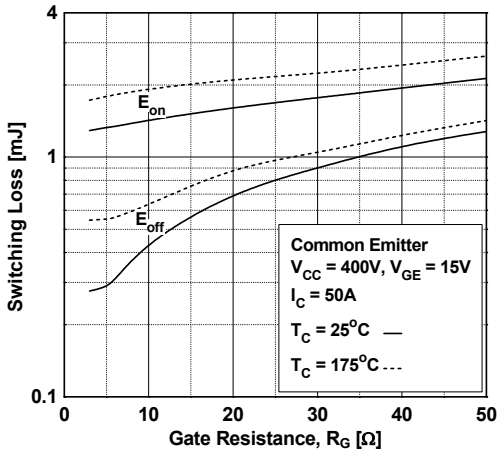
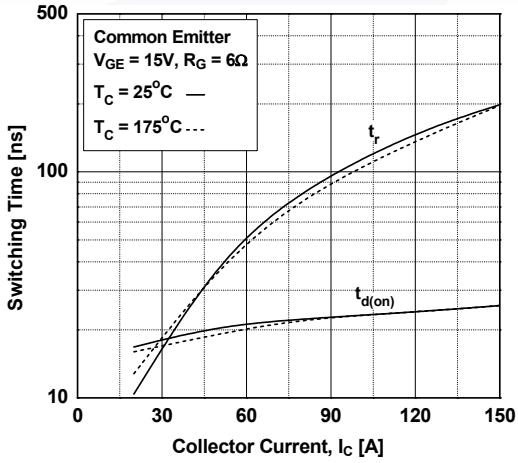



**Figure 12. Turn-on Characteristics vs. Collector Current**



## Typical Performance Characteristics

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

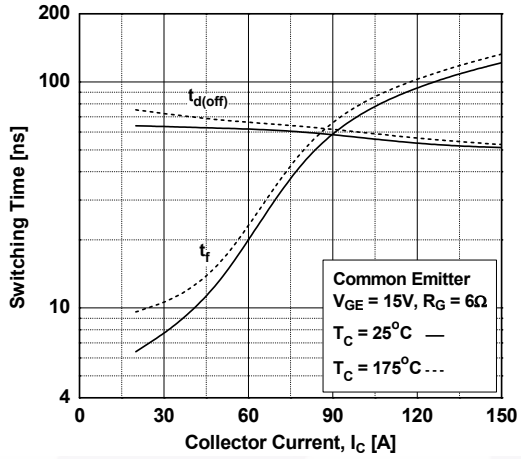



**Figure 14. Switching Loss vs. Collector Current**

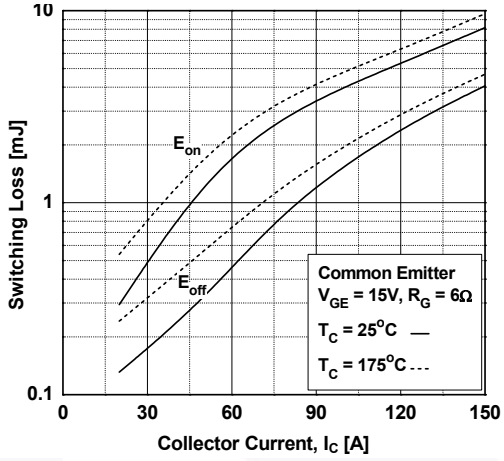



**Figure 15. Load Current Vs. Frequency**

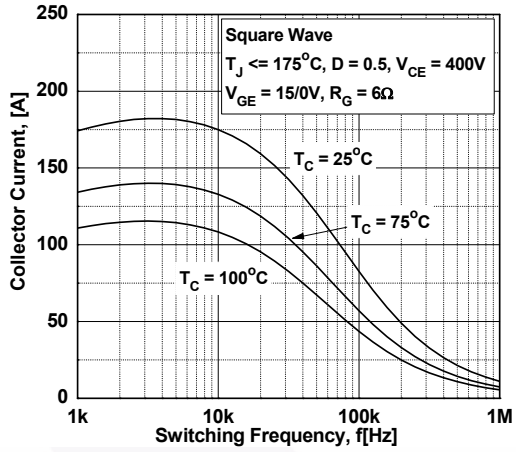



**Figure 16. SOA Characteristics**

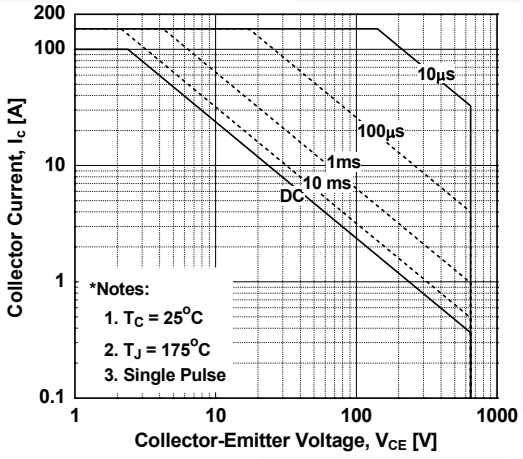



**Figure 17. Forward Characteristics**

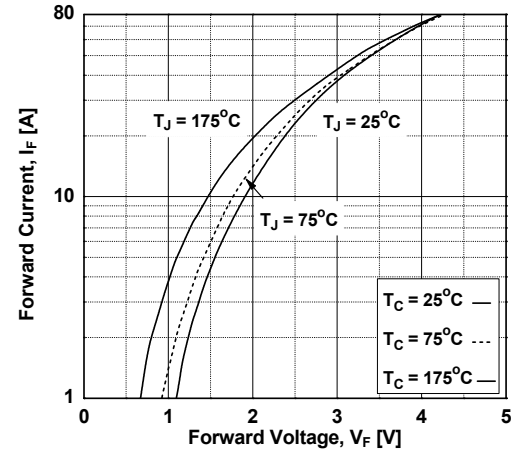
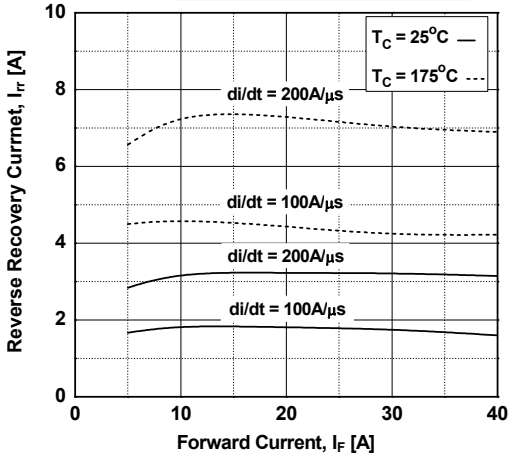



**Figure 18. Reverse Recovery Current**



## Typical Performance Characteristics

**Figure 19. Reverse Recovery Time**

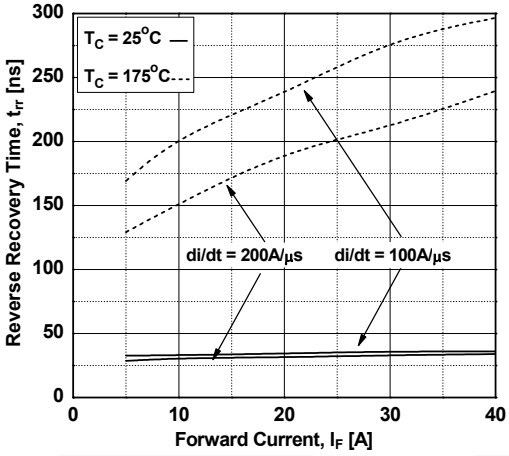



**Figure 20. Stored Charge**

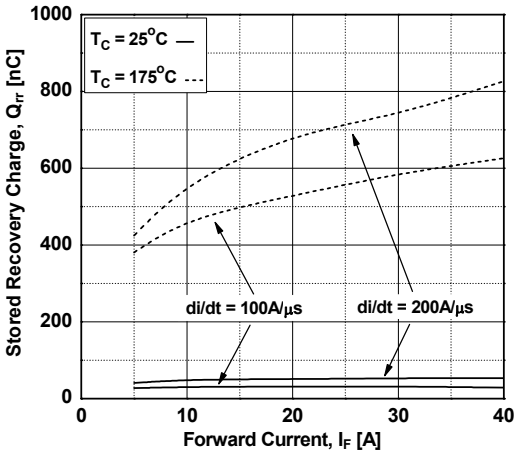



**Figure 21.Transient Thermal Impedance of IGBT**

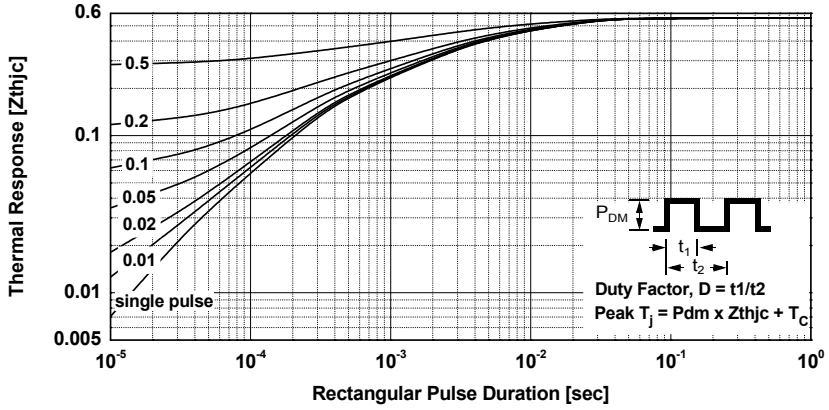
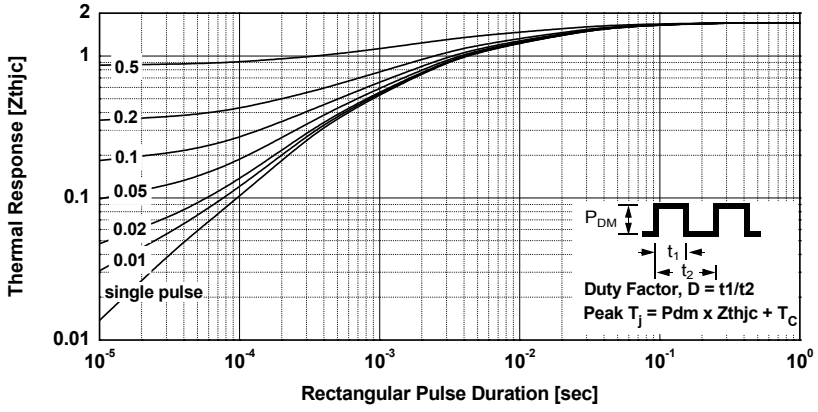
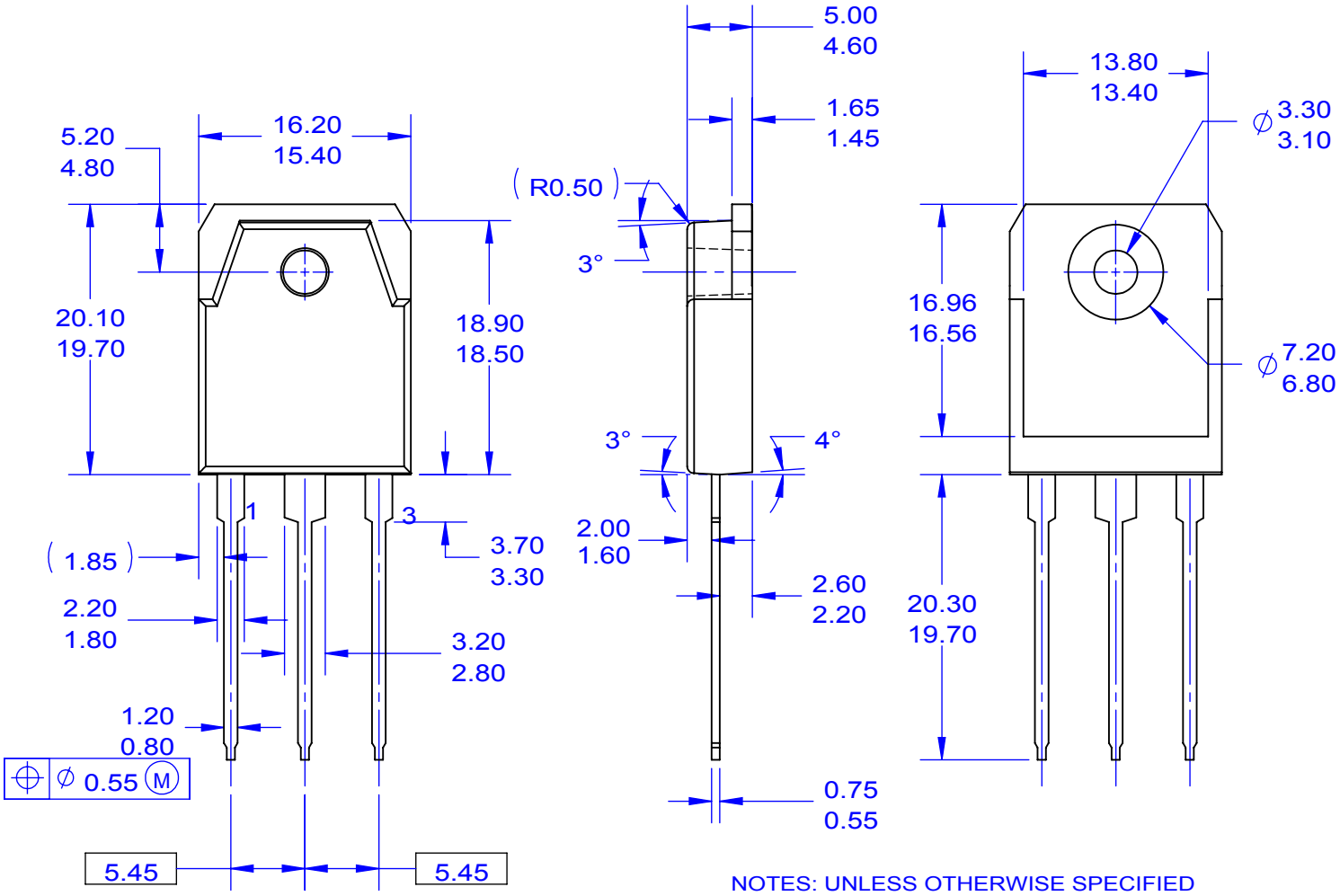
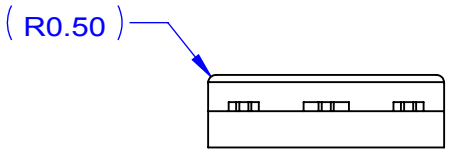



**Figure 22.Transient Thermal Impedance of Diode**






NOTES: UNLESS OTHERWISE SPECIFIED

A) THIS PACKAGE CONFORMS TO EIAJ SC-65 PACKAGING STANDARD.
B) ALL DIMENSIONS ARE IN MILLIMETERS.
C) DIMENSION AND TOLERANCING PER ASME14.5-2009.
D) DIMENSIONS ARE EXCLUSSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSSIONS.
E) DRAWING FILE NAME: TO3PN03AREV2.
F) FAIRCHILD SEMICONDUCTOR.

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