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# FGL40N120AND

## 1200V NPT IGBT

### Features

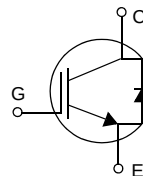
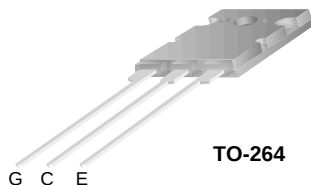
- High speed switching
- Low saturation voltage :  $V_{CE(sat)} = 2.6 \text{ V @ } I_C = 40 \text{ A}$
- High input impedance
- CO-PAK, IGBT with FRD :  $t_{rr} = 75 \text{ ns (typ.)}$

### Description

Employing NPT technology, Fairchild's AND series of IGBTs provides low conduction and switching losses. The AND series offers an solution for application such as induction heating (IH), motor control, general purpose inverters and uninterruptible power supplies (UPS).

### Applications

Induction Heating, UPS, AC & DC motor controls and general purpose inverters.



### Absolute Maximum Ratings

| Symbol      | Parameter                                                                                          | FGL40N120AND | Units            |
|-------------|----------------------------------------------------------------------------------------------------|--------------|------------------|
| $V_{CES}$   | Collector-Emitter Voltage                                                                          | 1200         | V                |
| $V_{GES}$   | Gate-Emitter Voltage                                                                               | $\pm 25$     | V                |
| $I_C$       | Collector Current @ $T_C = 25^\circ\text{C}$                                                       | 64           | A                |
|             | Collector Current @ $T_C = 100^\circ\text{C}$                                                      | 40           | A                |
| $I_{CM(1)}$ | Pulsed Collector Current                                                                           | 160          | A                |
| $I_F$       | Diode Continuous Forward Current @ $T_C = 100^\circ\text{C}$                                       | 40           | A                |
| $I_{FM}$    | Diode Maximum Forward Current                                                                      | 240          | A                |
| $P_D$       | Maximum Power Dissipation @ $T_C = 25^\circ\text{C}$                                               | 500          | W                |
|             | Maximum Power Dissipation @ $T_C = 100^\circ\text{C}$                                              | 200          | W                |
| SCWT        | Short Circuit Withstand Time, $V_{CE} = 600\text{V}, V_{GE} = 15\text{V}, T_C = 125^\circ\text{C}$ | 10           | $\mu\text{s}$    |
| $T_J$       | 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) Pulse width limited by max. junction temperature

### Thermal Characteristics

| Symbol                        | Parameter                               | Typ. | Max. | Units              |
|-------------------------------|-----------------------------------------|------|------|--------------------|
| $R_{\theta JC}(\text{IGBT})$  | Thermal Resistance, Junction-to-Case    | --   | 0.25 | $^\circ\text{C/W}$ |
| $R_{\theta JC}(\text{DIODE})$ | Thermal Resistance, Junction-to-Case    | --   | 0.7  | $^\circ\text{C/W}$ |
| $R_{\theta JA}$               | Thermal Resistance, Junction-to-Ambient | --   | 25   | $^\circ\text{C/W}$ |

## Package Marking and Ordering Information

| Device Marking | Device       | Package | Reel Size | Tape Width | Quantity |
|----------------|--------------|---------|-----------|------------|----------|
| FGL40N120AND   | FGL40N120AND | TO-264  | -         | -          | 25       |

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

| Symbol                             | Parameter                                    | Conditions                                                                                                                             | Min. | Typ. | Max. | Units |
|------------------------------------|----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|------|------|------|-------|
| Off Characteristics                |                                              |                                                                                                                                        |      |      |      |       |
| BV <sub>CES</sub>                  | Collector-Emitter Breakdown Voltage          | V <sub>GE</sub> = 0V, I <sub>C</sub> = 1mA                                                                                             | 1200 | --   | --   | V     |
| BV <sub>CES</sub> /ΔT <sub>J</sub> | Temperature Coefficient of Breakdown Voltage | V <sub>GE</sub> = 0V, I <sub>C</sub> = 1mA                                                                                             | --   | 0.6  | --   | V/°C  |
| I <sub>CES</sub>                   | Collector Cut-Off Current                    | V <sub>CE</sub> = V <sub>CES</sub> , V <sub>GE</sub> = 0V                                                                              | --   | --   | 1    | mA    |
| I <sub>GES</sub>                   | G-E Leakage Current                          | V <sub>GE</sub> = V <sub>GES</sub> , V <sub>CE</sub> = 0V                                                                              | --   | --   | ±250 | nA    |
| On Characteristics                 |                                              |                                                                                                                                        |      |      |      |       |
| V <sub>GE(th)</sub>                | G-E Threshold Voltage                        | I <sub>C</sub> = 250μA, V <sub>CE</sub> = V <sub>GE</sub>                                                                              | 3.5  | 5.5  | 7.5  | V     |
| V <sub>CE(sat)</sub>               | Collector to Emitter Saturation Voltage      | I <sub>C</sub> = 40A, V <sub>GE</sub> = 15V                                                                                            | --   | 2.6  | 3.2  | V     |
|                                    |                                              | I <sub>C</sub> = 40A, V <sub>GE</sub> = 15V, T <sub>C</sub> = 125°C                                                                    | --   | 2.9  | --   | V     |
|                                    |                                              | I <sub>C</sub> = 64A, V <sub>GE</sub> = 15V                                                                                            | --   | 3.15 | --   | V     |
| Dynamic Characteristics            |                                              |                                                                                                                                        |      |      |      |       |
| C <sub>ies</sub>                   | Input Capacitance                            | V <sub>CE</sub> = 30V, V <sub>GE</sub> = 0V<br>f = 1MHz                                                                                | --   | 3200 | --   | pF    |
| C <sub>oes</sub>                   | Output Capacitance                           |                                                                                                                                        | --   | 370  | --   | pF    |
| C <sub>res</sub>                   | Reverse Transfer Capacitance                 |                                                                                                                                        | --   | 125  | --   | pF    |
| Switching Characteristics          |                                              |                                                                                                                                        |      |      |      |       |
| t <sub>d(on)</sub>                 | Turn-On Delay Time                           | V <sub>CC</sub> = 600V, I <sub>C</sub> = 40A,<br>R <sub>G</sub> = 5Ω, V <sub>GE</sub> = 15V,<br>Inductive Load, T <sub>C</sub> = 25°C  | --   | 15   | --   | ns    |
| t <sub>r</sub>                     | Rise Time                                    |                                                                                                                                        | --   | 20   | --   | ns    |
| t <sub>d(off)</sub>                | Turn-Off Delay Time                          |                                                                                                                                        | --   | 110  | --   | ns    |
| t <sub>f</sub>                     | Fall Time                                    |                                                                                                                                        | --   | 40   | 80   | ns    |
| E <sub>on</sub>                    | Turn-On Switching Loss                       |                                                                                                                                        | --   | 2.3  | 3.45 | mJ    |
| E <sub>off</sub>                   | Turn-Off Switching Loss                      |                                                                                                                                        | --   | 1.1  | 1.65 | mJ    |
| E <sub>ts</sub>                    | Total Switching Loss                         |                                                                                                                                        | --   | 3.4  | 5.1  | mJ    |
| t <sub>d(on)</sub>                 | Turn-On Delay Time                           | V <sub>CC</sub> = 600V, I <sub>C</sub> = 40A,<br>R <sub>G</sub> = 5Ω, V <sub>GE</sub> = 15V,<br>Inductive Load, T <sub>C</sub> = 125°C | --   | 20   | --   | ns    |
| t <sub>r</sub>                     | Rise Time                                    |                                                                                                                                        | --   | 25   | --   | ns    |
| t <sub>d(off)</sub>                | Turn-Off Delay Time                          |                                                                                                                                        | --   | 120  | --   | ns    |
| t <sub>f</sub>                     | Fall Time                                    |                                                                                                                                        | --   | 45   | --   | ns    |
| E <sub>on</sub>                    | Turn-On Switching Loss                       |                                                                                                                                        | --   | 2.5  | --   | mJ    |
| E <sub>off</sub>                   | Turn-Off Switching Loss                      |                                                                                                                                        | --   | 1.8  | --   | mJ    |
| E <sub>ts</sub>                    | Total Switching Loss                         |                                                                                                                                        | --   | 4.3  | --   | mJ    |
| Q <sub>g</sub>                     | Total Gate charge                            | V <sub>CE</sub> = 600V, I <sub>C</sub> = 40A,<br>V <sub>GE</sub> = 15V                                                                 | --   | 220  | 330  | nC    |
| Q <sub>ge</sub>                    | Gate-Emitter Charge                          |                                                                                                                                        | --   | 25   | 38   | nC    |
| Q <sub>gc</sub>                    | Gate-Collector Charge                        |                                                                                                                                        | --   | 130  | 195  | nC    |

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

| Symbol          | Parameter                           | Test Conditions                          |                        | Min. | Typ. | Max. | Units |
|-----------------|-------------------------------------|------------------------------------------|------------------------|------|------|------|-------|
| V <sub>FM</sub> | Diode Forward Voltage               | I <sub>F</sub> = 40A                     | T <sub>C</sub> = 25°C  | --   | 3.2  | 4.0  | V     |
|                 |                                     |                                          | T <sub>C</sub> = 125°C | --   | 2.7  | --   |       |
| t <sub>rr</sub> | Diode Reverse Recovery Time         | I <sub>F</sub> = 40A,<br>di/dt = 200A/μs | T <sub>C</sub> = 25°C  | --   | 75   | 112  | nS    |
|                 |                                     |                                          | T <sub>C</sub> = 125°C | --   | 130  | --   |       |
| I <sub>rr</sub> | Diode Peak Reverse Recovery Current |                                          | T <sub>C</sub> = 25°C  | --   | 8    | 12   | A     |
|                 |                                     |                                          | T <sub>C</sub> = 125°C | --   | 13   | --   |       |
| Q <sub>rr</sub> | Diode Reverse Recovery Charge       |                                          | T <sub>C</sub> = 25°C  | --   | 300  | 450  | nC    |
|                 |                                     |                                          | T <sub>C</sub> = 125°C | --   | 845  | --   |       |

## Typical Performance Characteristics

Figure 1. Typical Output Characteristics

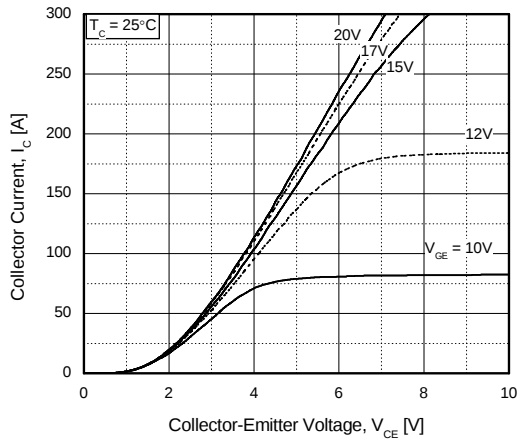


Figure 2. Typical Saturation Voltage Characteristics

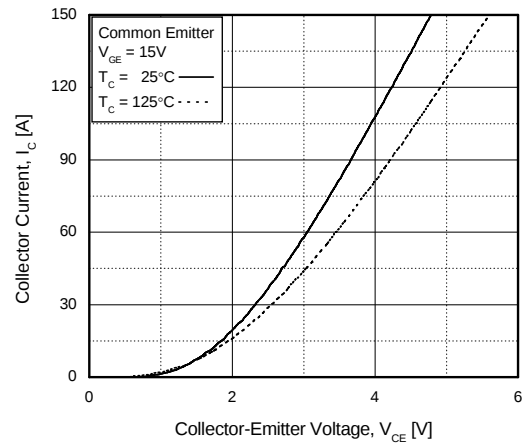


Figure 3. Saturation Voltage vs. Case Temperature at Variant Current Level

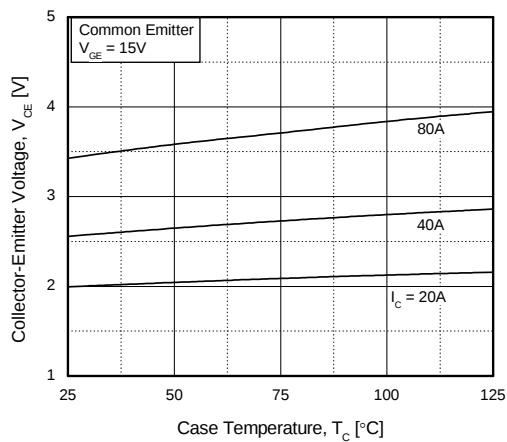


Figure 4. Load Current vs. Frequency

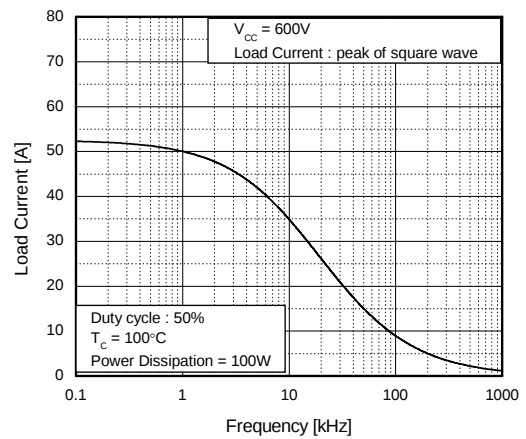


Figure 5. Saturation Voltage vs.  $V_{GE}$

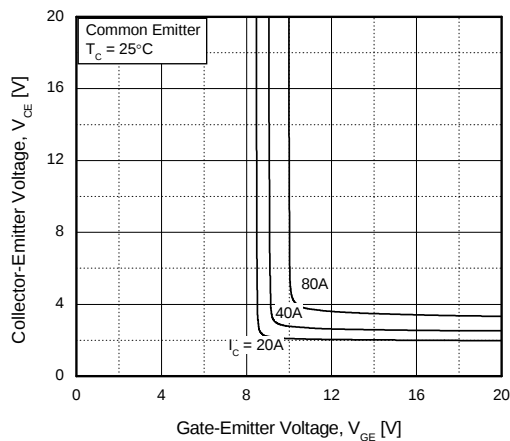
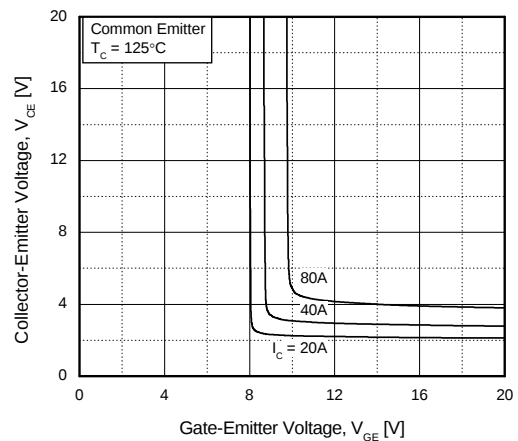


Figure 6. Saturation Voltage vs.  $V_{GE}$



## Typical Performance Characteristics (Continued)

Figure 7. Capacitance Characteristics

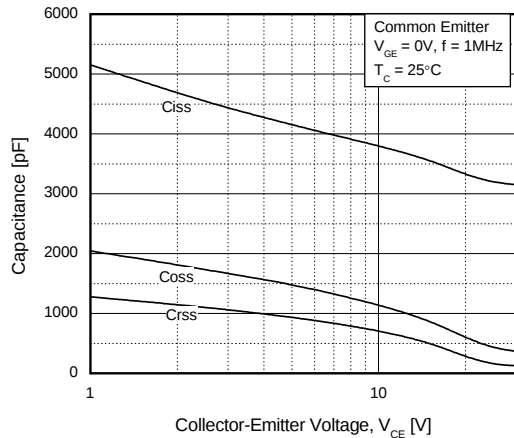


Figure 8. Turn-On Characteristics vs. Gate Resistance

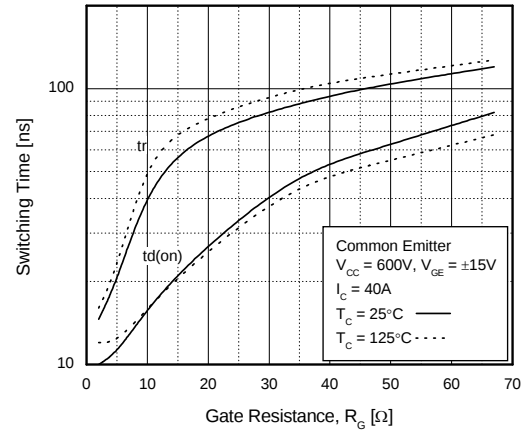


Figure 9. Turn-Off Characteristics vs. Gate Resistance

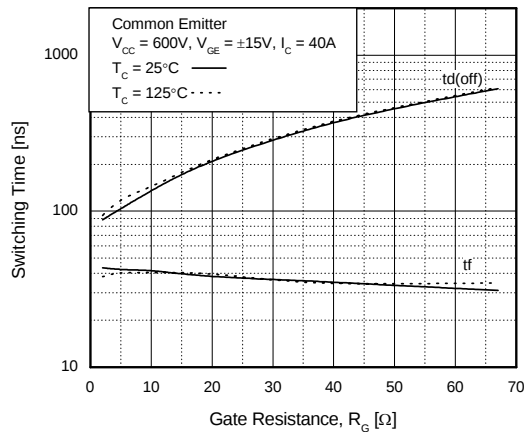


Figure 10. Switching Loss vs. Gate Resistance

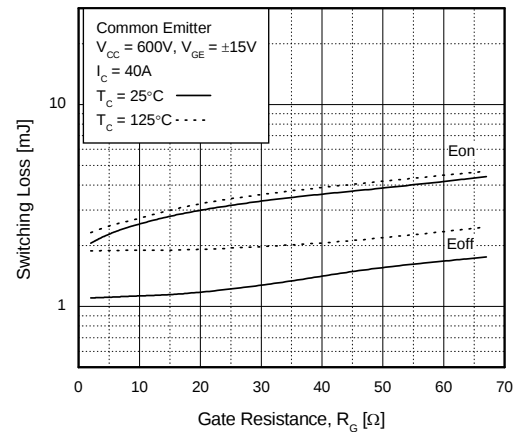


Figure 11. Turn-On Characteristics vs. Collector Current

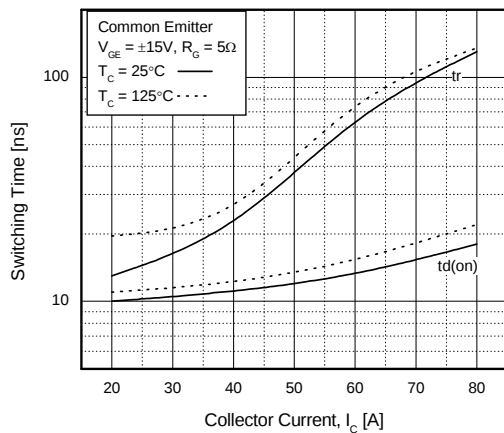
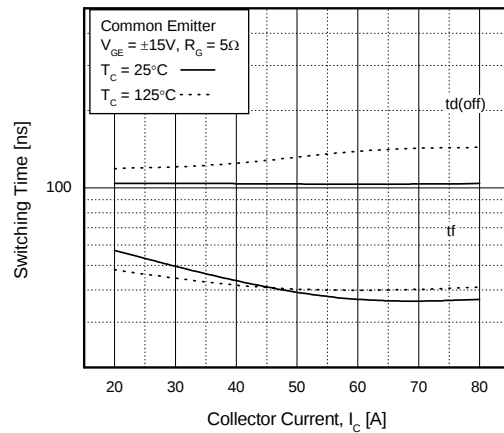


Figure 12. Turn-Off Characteristics vs. Collector Current



## Typical Performance Characteristics (Continued)

Figure 13. Switching Loss vs. Collector Current

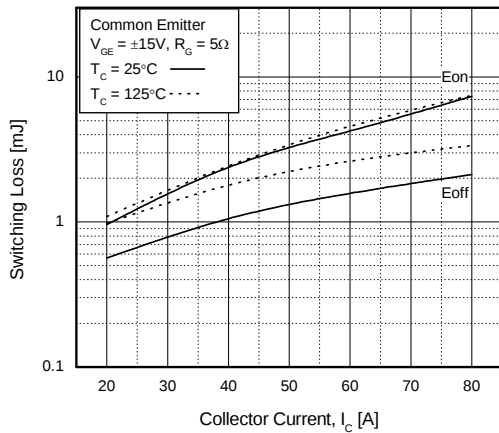


Figure 14. Gate Charge Characteristics

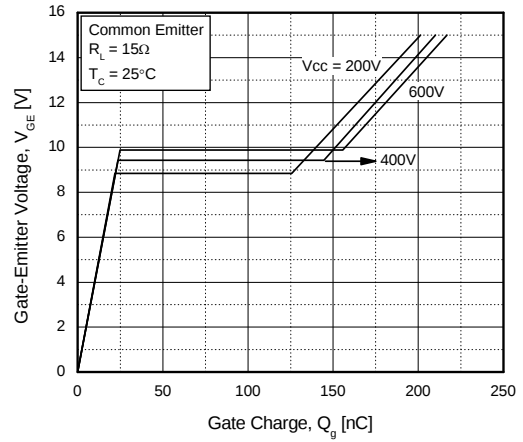


Figure 15. SOA Characteristics

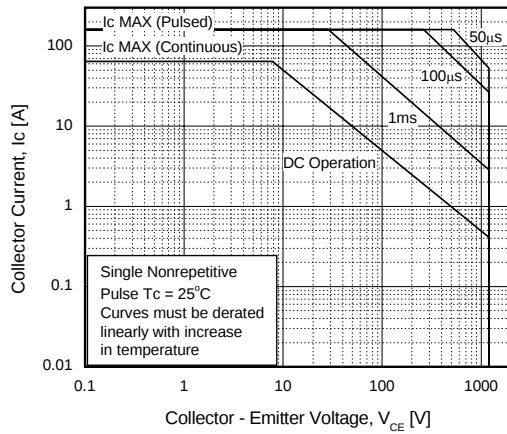


Figure 16. Turn-Off SOA

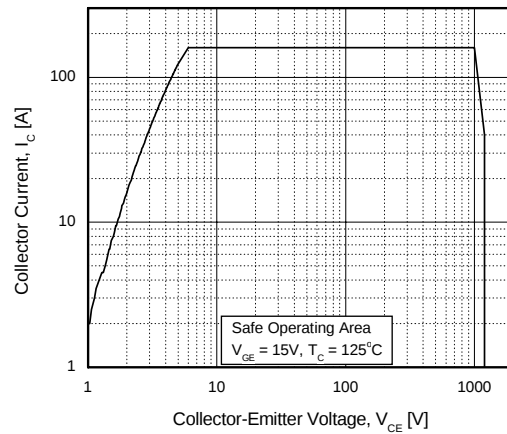


Figure 17. Forward Characteristics

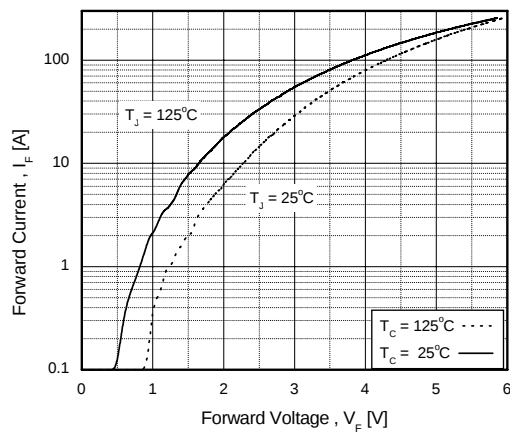
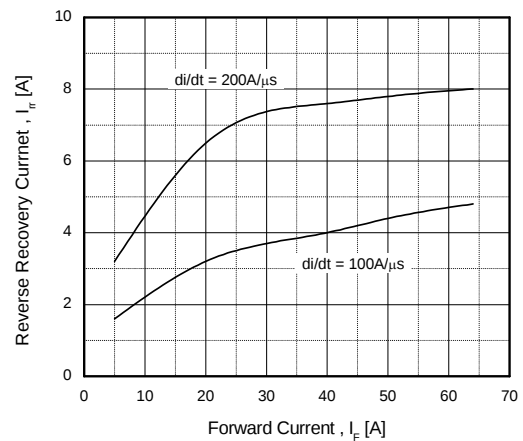


Figure 18. Reverse Recovery Current



# Typical Performance Characteristics (Continued)

Figure 19. Stored Charge

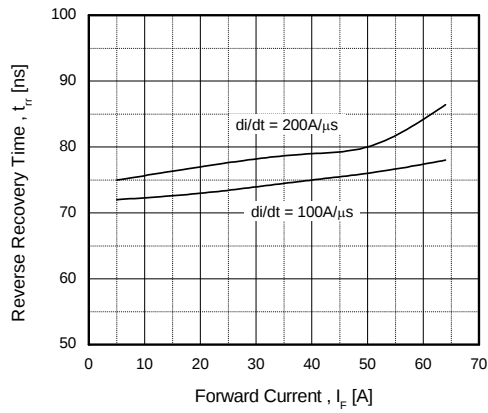


Figure 20. Reverse Recovery Time

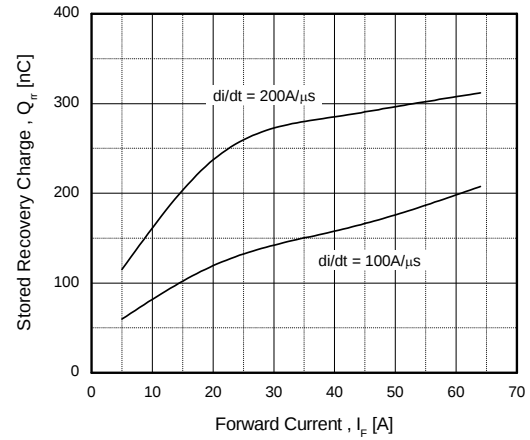
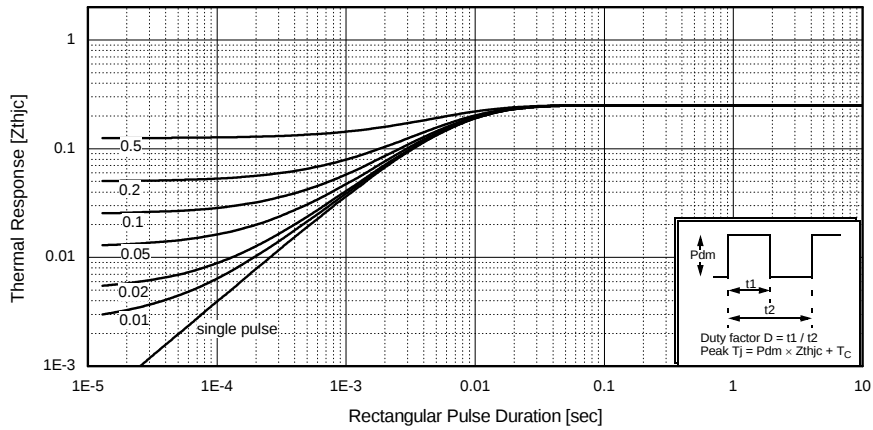
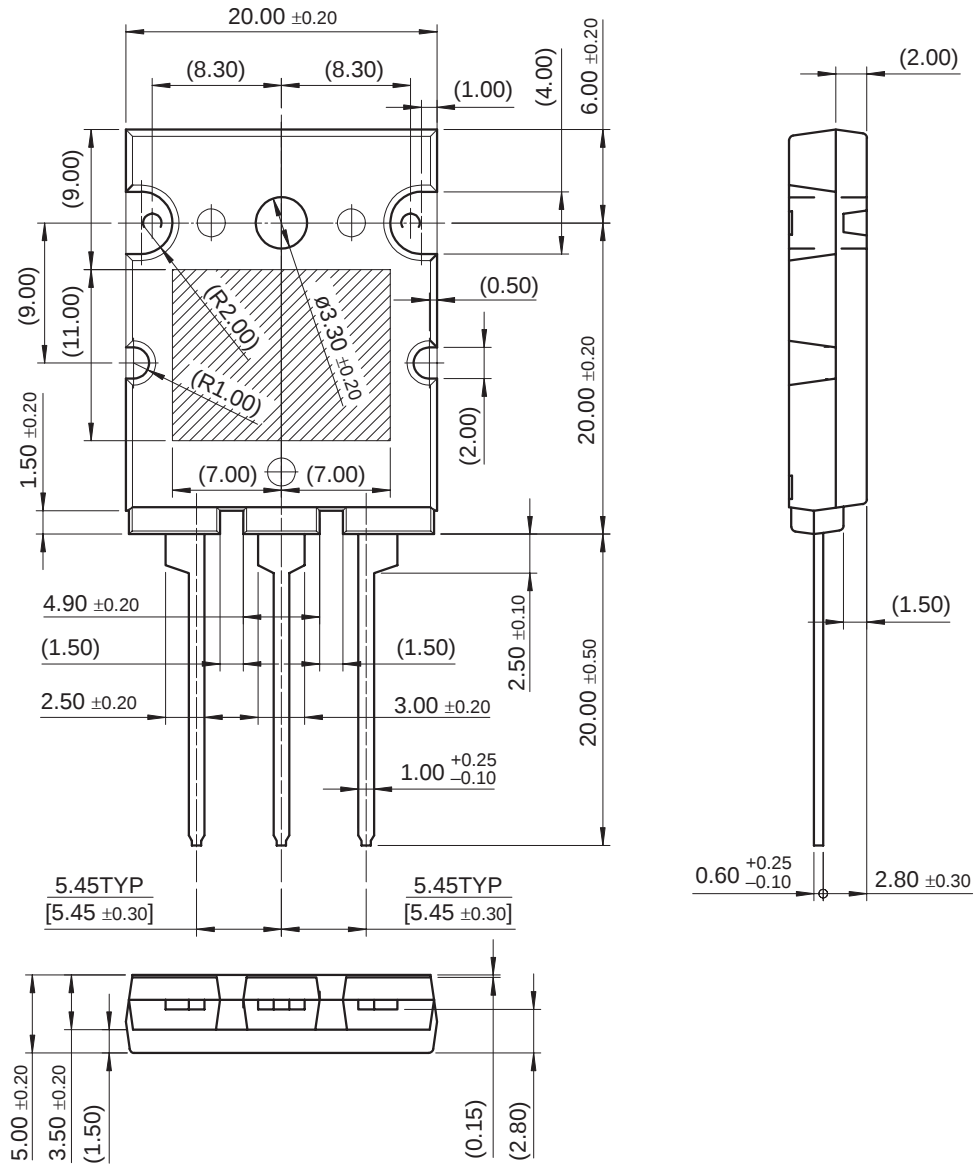


Figure 21. Transient Thermal Impedance of IGBT



# Mechanical Dimensions

## TO-264



Dimensions in Millimeters



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| EZSWITCH <sup>™</sup> *                                                                           | IntelliMAX <sup>™</sup>                                                           | QS <sup>™</sup>                        | TinyLogic <sup>®</sup>                                                                                          |
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|  F <sup>®</sup>  | MegaBuck <sup>™</sup>                                                             | Quiet Series <sup>™</sup>              | TinyPower <sup>™</sup>                                                                                          |
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| FAST <sup>®</sup>                                                                                 | Motion-SPM <sup>™</sup>                                                           | SuperFET <sup>™</sup>                  | Ultra FRFET <sup>™</sup>                                                                                        |
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| FlashWriter <sup>®</sup> *                                                                        | OPTOPLANAR <sup>®</sup>                                                           | SuperSOT <sup>™</sup> -6               | V CX <sup>™</sup>                                                                                               |
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## PRODUCT STATUS DEFINITIONS

### Definition of Terms

| Datasheet Identification | Product Status         | Definition                                                                                                                                                                                               |
|--------------------------|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Advance Information      | Formative or In Design | This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.                                                                       |
| Preliminary              | First Production       | This datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design. |
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