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August 2014

# FGH25T120SMD

## 1200 V, 25 A Field Stop Trench IGBT

### Features

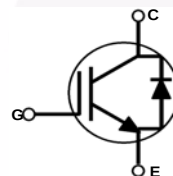
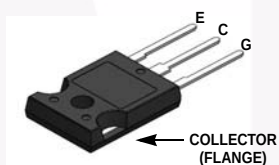
- FS Trench Technology, Positive Temperature Coefficient
- High Speed Switching
- Low Saturation Voltage:  $V_{CE(sat)} = 1.8 \text{ V}$  @  $I_C = 25 \text{ A}$
- 100% of The Parts Tested for  $I_{LM}(1)$
- High Input Impedance
- RoHS Compliant

### General Description

Using innovative field stop trench IGBT technology, Fairchild's new series of field stop trench IGBTs offer the optimum performance for hard switching application such as solar inverter, UPS, welder and PFC applications.

### Applications

- Solar Inverter, Welder, UPS & PFC Applications.



### Absolute Maximum Ratings

 $T_C = 25^\circ\text{C}$  unless otherwise noted

| Symbol      | Description                                                             | Ratings     | Unit             |
|-------------|-------------------------------------------------------------------------|-------------|------------------|
| $V_{CES}$   | Collector to Emitter Voltage                                            | 1200        | V                |
| $V_{GES}$   | Gate to Emitter Voltage                                                 | $\pm 25$    | V                |
|             | Transient Gate to Emitter Voltage                                       | $\pm 30$    | V                |
| $I_C$       | Collector Current @ $T_C = 25^\circ\text{C}$                            | 50          | A                |
|             | Collector Current @ $T_C = 100^\circ\text{C}$                           | 25          | A                |
| $I_{LM}(1)$ | Clamped Inductive Load Current @ $T_C = 25^\circ\text{C}$               | 100         | A                |
| $I_{CM}(2)$ | Pulsed Collector Current                                                | 100         | A                |
| $I_F$       | Diode Continuous Forward Current @ $T_C = 25^\circ\text{C}$             | 50          | A                |
|             | Diode Continuous Forward Current @ $T_C = 100^\circ\text{C}$            | 25          | A                |
| $I_{FM}$    | Diode Maximum Forward Current                                           | 200         | A                |
| $P_D$       | Maximum Power Dissipation @ $T_C = 25^\circ\text{C}$                    | 428         | W                |
|             | Maximum Power Dissipation @ $T_C = 100^\circ\text{C}$                   | 214         | W                |
| $T_J$       | Operating Junction Temperature                                          | -55 to +175 | $^\circ\text{C}$ |
| $T_{stg}$   | Storage Temperature Range                                               | -55 to +175 | $^\circ\text{C}$ |
| $T_L$       | Maximum Lead Temp. for soldering Purposes, 1/8" from case for 5 seconds | 300         | $^\circ\text{C}$ |

### Thermal Characteristics

| Symbol                        | Parameter                               | Typ. | Max. | Unit               |
|-------------------------------|-----------------------------------------|------|------|--------------------|
| $R_{\theta JC}(\text{IGBT})$  | Thermal Resistance, Junction to Case    | --   | 0.35 | $^\circ\text{C/W}$ |
| $R_{\theta JC}(\text{Diode})$ | Thermal Resistance, Junction to Case    | --   | 1.4  | $^\circ\text{C/W}$ |
| $R_{\theta JA}$               | Thermal Resistance, Junction to Ambient | --   | 40   | $^\circ\text{C/W}$ |

#### Notes:

1.  $V_{CC} = 600 \text{ V}$ ,  $V_{GE} = 15 \text{ V}$ ,  $I_C = 100 \text{ A}$ ,  $R_G = 23 \Omega$ , Inductive Load
2. Limited by  $T_{jmax}$

**Package Marking and Ordering Information**

| Device Marking | Device            | Package   | Reel Size | Tape Width | Quantity |
|----------------|-------------------|-----------|-----------|------------|----------|
| FGH25T120SMD   | FGH25T120SMD_F155 | TO-247G03 | -         | -          | 30       |

**Electrical Characteristics of the IGBT**  $T_C = 25^\circ\text{C}$  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> = 250 uA                                                                                              | 1200                                                                      | -    | -    | V    |
| I <sub>CES</sub>          | Collector Cut-Off Current               | V <sub>CE</sub> = V <sub>CES</sub> , V <sub>GE</sub> = 0 V                                                                                  | -                                                                         | -    | 250  | uA   |
| I <sub>GES</sub>          | G-E Leakage Current                     | V <sub>GE</sub> = V <sub>GES</sub> , V <sub>CE</sub> = 0 V                                                                                  | -                                                                         | -    | ±400 | nA   |
| On Characteristics        |                                         |                                                                                                                                             |                                                                           |      |      |      |
| V <sub>GE(th)</sub>       | G-E Threshold Voltage                   | I <sub>C</sub> = 25 mA, V <sub>CE</sub> = V <sub>GE</sub>                                                                                   | 4.9                                                                       | 6.2  | 7.5  | V    |
| V <sub>CE(sat)</sub>      | Collector to Emitter Saturation Voltage | I <sub>C</sub> = 25 A, V <sub>GE</sub> = 15 V<br>T <sub>C</sub> = 25°C                                                                      | -                                                                         | 1.8  | 2.4  | V    |
|                           |                                         | I <sub>C</sub> = 25 A, V <sub>GE</sub> = 15 V,<br>T <sub>C</sub> = 175°C                                                                    | -                                                                         | 1.9  | -    | V    |
| Dynamic Characteristics   |                                         |                                                                                                                                             |                                                                           |      |      |      |
| C <sub>ies</sub>          | Input Capacitance                       | V <sub>CE</sub> = 30 V, V <sub>GE</sub> = 0 V,<br>f = 1MHz                                                                                  | -                                                                         | 2800 | -    | pF   |
| C <sub>oes</sub>          | Output Capacitance                      |                                                                                                                                             | -                                                                         | 105  | -    | 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> = 25 A,<br>R <sub>G</sub> = 23 Ω, V <sub>GE</sub> = 15 V,<br>Inductive Load, T <sub>C</sub> = 25°C  | -                                                                         | 40   | -    | ns   |
| t <sub>r</sub>            | Rise Time                               |                                                                                                                                             | -                                                                         | 45   | -    | ns   |
| t <sub>d(off)</sub>       | Turn-Off Delay Time                     |                                                                                                                                             | -                                                                         | 490  | -    | ns   |
| t <sub>f</sub>            | Fall Time                               |                                                                                                                                             | -                                                                         | 12   | -    | ns   |
| E <sub>on</sub>           | Turn-On Switching Loss                  |                                                                                                                                             | -                                                                         | 1.74 | -    | mJ   |
| E <sub>off</sub>          | Turn-Off Switching Loss                 |                                                                                                                                             | -                                                                         | 0.56 | -    | mJ   |
| E <sub>ts</sub>           | Total Switching Loss                    | V <sub>CC</sub> = 600 V, I <sub>C</sub> = 25 A,<br>R <sub>G</sub> = 23 Ω, V <sub>GE</sub> = 15 V,<br>Inductive Load, T <sub>C</sub> = 175°C | -                                                                         | 2.30 | -    | mJ   |
| t <sub>d(on)</sub>        | Turn-On Delay Time                      |                                                                                                                                             | -                                                                         | 40   | -    | ns   |
| t <sub>r</sub>            | Rise Time                               |                                                                                                                                             | -                                                                         | 48   | -    | ns   |
| t <sub>d(off)</sub>       | Turn-Off Delay Time                     |                                                                                                                                             | -                                                                         | 520  | -    | ns   |
| t <sub>f</sub>            | Fall Time                               |                                                                                                                                             | -                                                                         | 64   | -    | ns   |
| E <sub>on</sub>           | Turn-On Switching Loss                  |                                                                                                                                             | -                                                                         | 2.94 | -    | mJ   |
| E <sub>off</sub>          | Turn-Off Switching Loss                 |                                                                                                                                             | -                                                                         | 1.09 | -    | mJ   |
| E <sub>ts</sub>           | Total Switching Loss                    |                                                                                                                                             | -                                                                         | 4.03 | -    | mJ   |
| Q <sub>g</sub>            | Total Gate Charge                       |                                                                                                                                             | V <sub>CE</sub> = 600 V, I <sub>C</sub> = 25 A,<br>V <sub>GE</sub> = 15 V | -    | 225  | -    |
| Q <sub>ge</sub>           | Gate to Emitter Charge                  | -                                                                                                                                           |                                                                           | 20   | -    | nC   |
| Q <sub>gc</sub>           | Gate to Collector Charge                | -                                                                                                                                           |                                                                           | 128  | -    | nC   |

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

| Symbol    | Parameter                           | Test Conditions                                                                                  | Min. | Typ. | Max. | Unit |
|-----------|-------------------------------------|--------------------------------------------------------------------------------------------------|------|------|------|------|
| $V_{FM}$  | Diode Forward Voltage               | $I_F = 25\text{ A}, T_C = 25^\circ\text{C}$                                                      | -    | 2.8  | 3.7  | V    |
|           |                                     | $I_F = 25\text{ A}, T_C = 175^\circ\text{C}$                                                     | -    | 2.1  | -    | V    |
| $t_{rr}$  | Diode Reverse Recovery Time         | $V_R = 600\text{ V}, I_F = 25\text{ A},$<br>$di_F/dt = 200\text{ A/us}, T_C = 25^\circ\text{C}$  | -    | 60   | -    | ns   |
| $I_{rr}$  | Diode Peak Reverse Recovery Current |                                                                                                  | -    | 6.6  | -    | A    |
| $Q_{rr}$  | Diode Reverse Recovery Charge       |                                                                                                  | -    | 197  | -    | nC   |
| $E_{rec}$ | Reverse Recovery Energy             | $V_R = 600\text{ V}, I_F = 25\text{ A},$<br>$di_F/dt = 200\text{ A/us}, T_C = 175^\circ\text{C}$ | -    | 330  | -    | uJ   |
| $t_{rr}$  | Diode Reverse Recovery Time         |                                                                                                  | -    | 325  | -    | ns   |
| $I_{rr}$  | Diode Peak Reverse Recovery Current |                                                                                                  | -    | 13   | -    | A    |
| $Q_{rr}$  | Diode Reverse Recovery Charge       |                                                                                                  | -    | 2113 | -    | nC   |



## Typical Performance Characteristics

Figure 1. Typical Output Characteristics

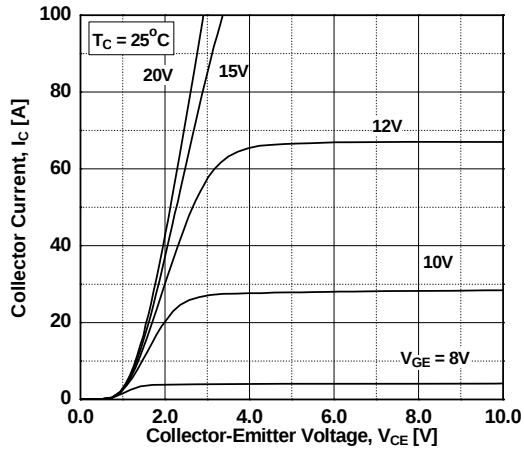


Figure 2. Typical Output Characteristics

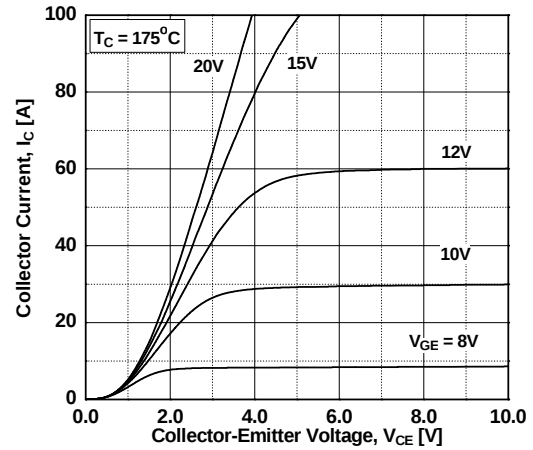


Figure 3. Typical Saturation Voltage Characteristics

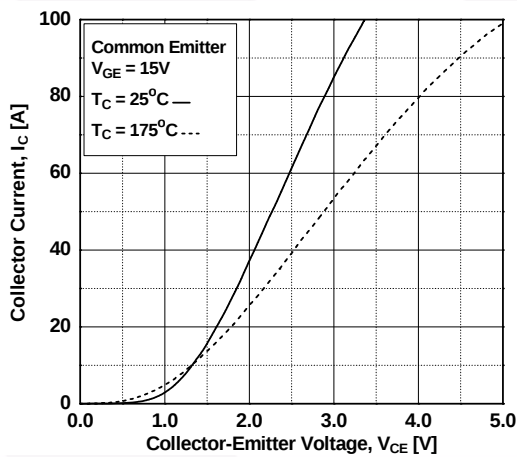


Figure 4. Saturation Voltage vs. Case Temperature at Variant Current Level

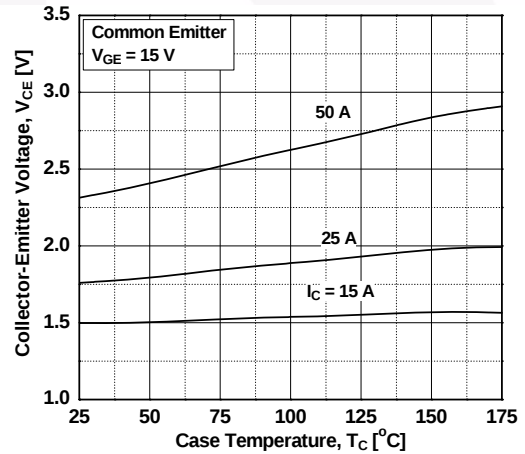


Figure 5. Saturation Voltage vs.  $V_{GE}$

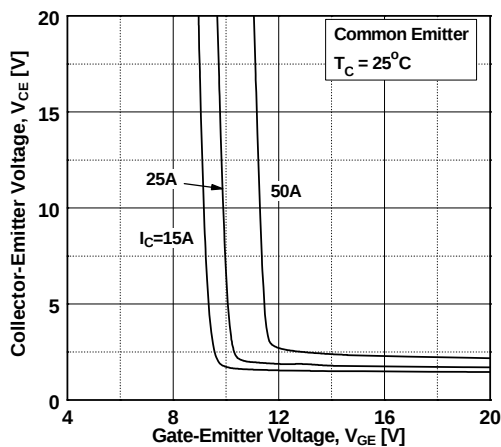
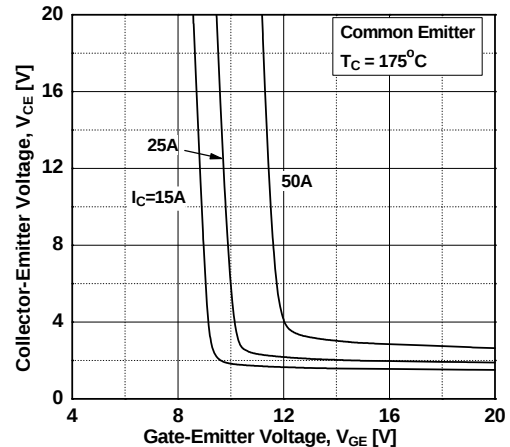


Figure 6. Saturation Voltage vs.  $V_{GE}$



## Typical Performance Characteristics

Figure 7. Capacitance Characteristics

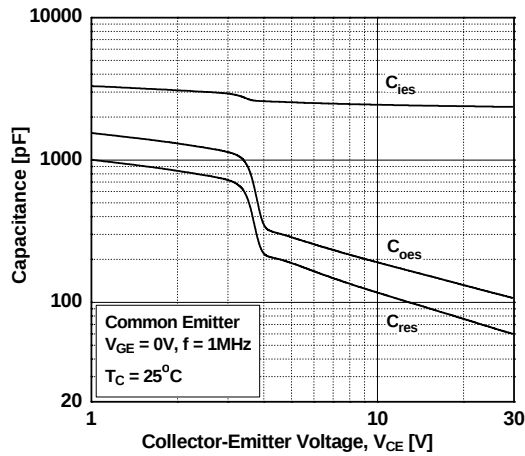


Figure 8. Gate Charge Characteristics

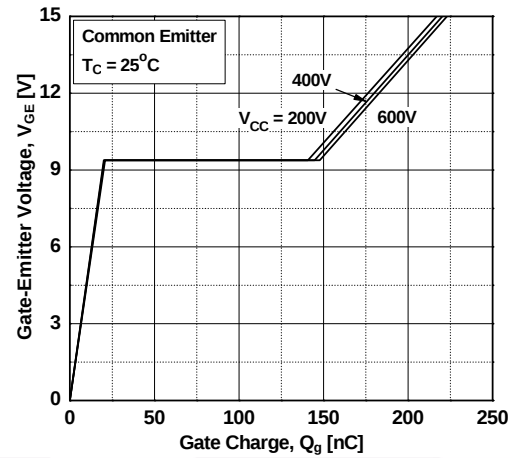


Figure 9. Turn-on Characteristics vs. Gate Resistance

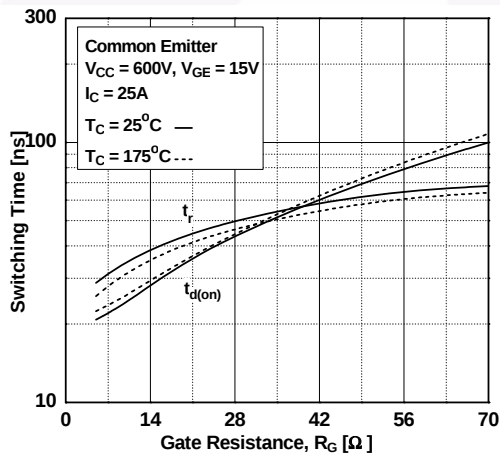


Figure 10. Turn-off Characteristics vs. Gate Resistance

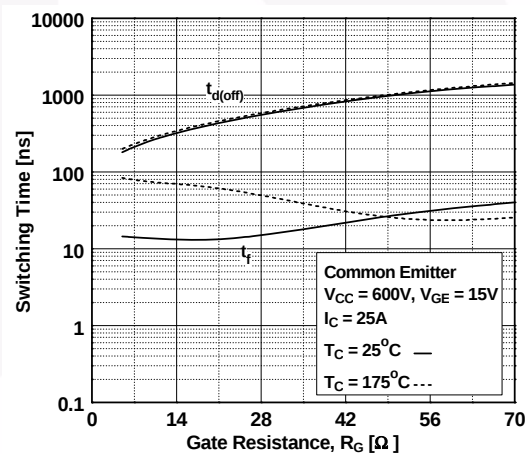


Figure 11. Switching Loss vs. Gate Resistance

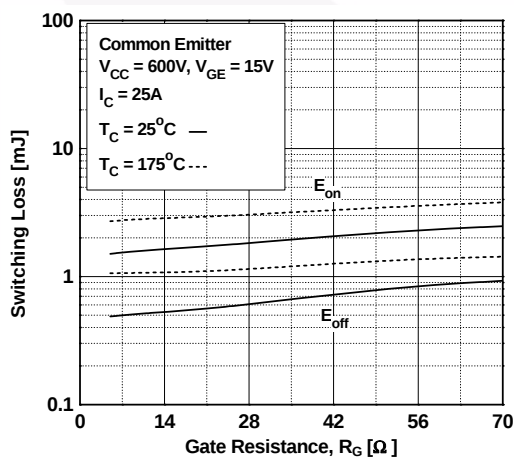
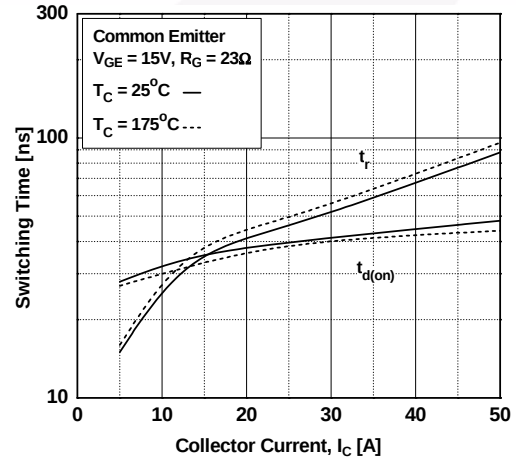


Figure 12. Turn-on Characteristics vs. Collector Current



## Typical Performance Characteristics

Figure 13. Turn-off Characteristics vs. Collector Current

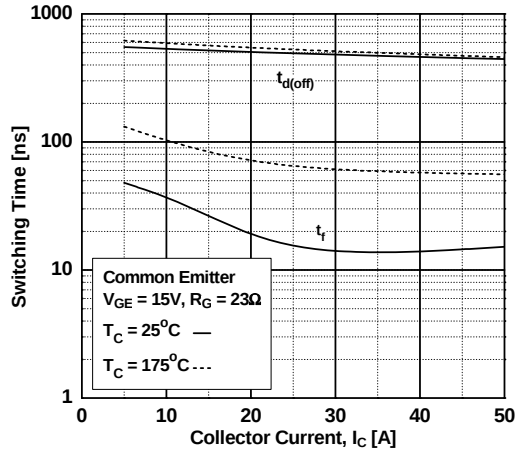


Figure 14. Switching Loss vs. Collector Current

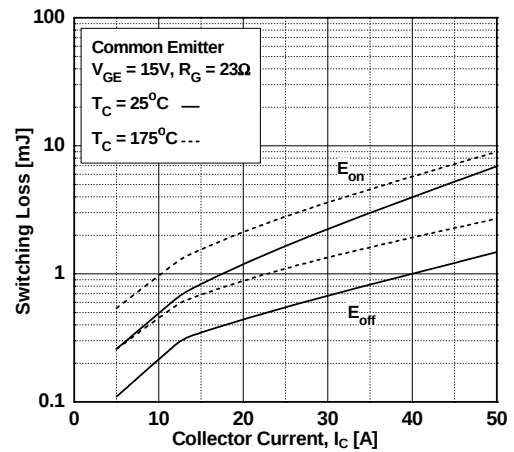


Figure 15. Load Current vs. Frequency

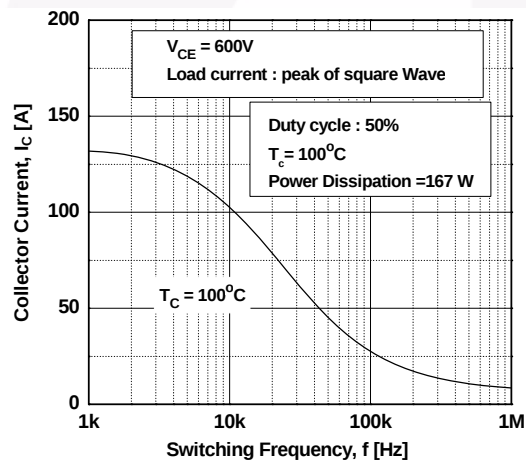


Figure 16. SOA Characteristics

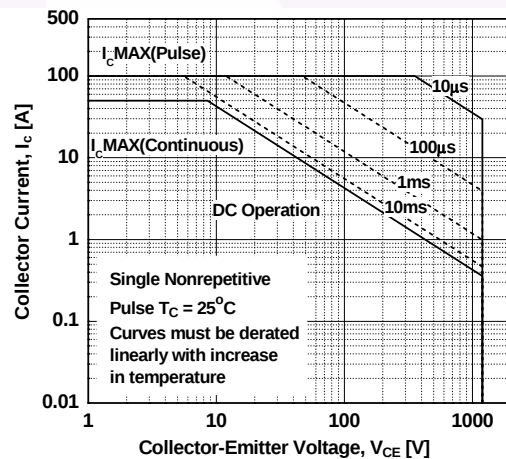


Figure 17. Forward Characteristics

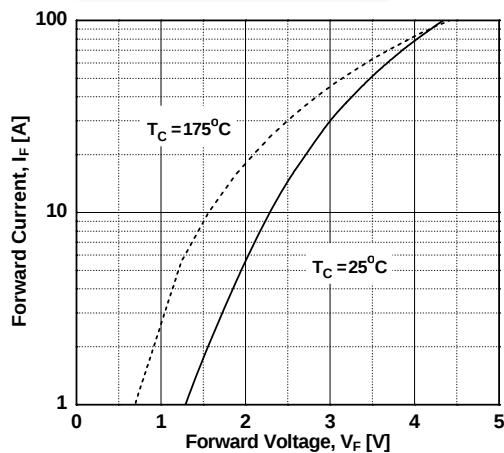
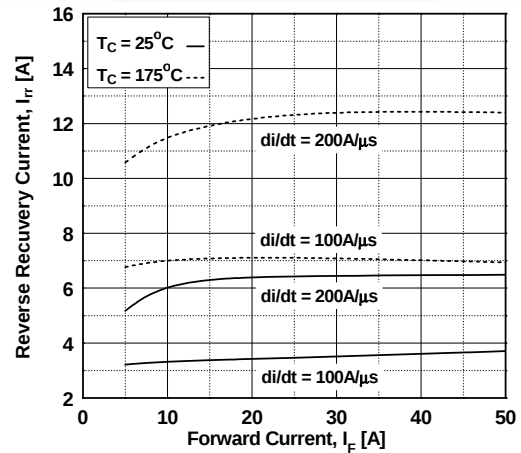


Figure 18. Reverse Recovery Current



## Typical Performance Characteristics

Figure 19. Reverse Recovery Time

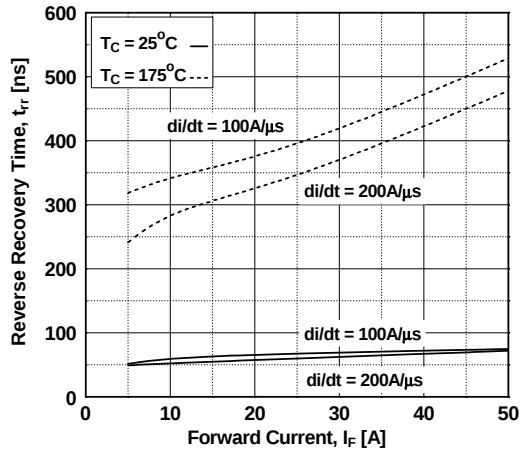


Figure 20. Stored Charge

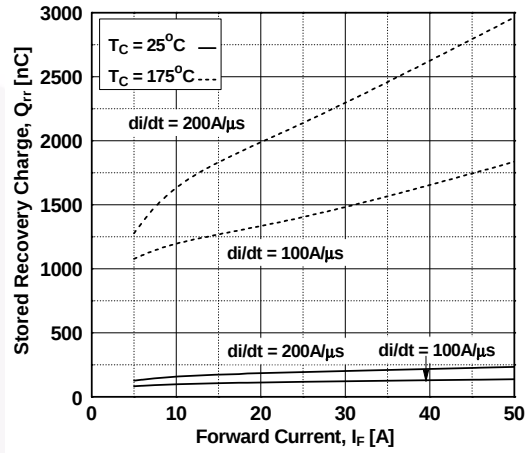


Figure 21. Transient Thermal Impedance of IGBT

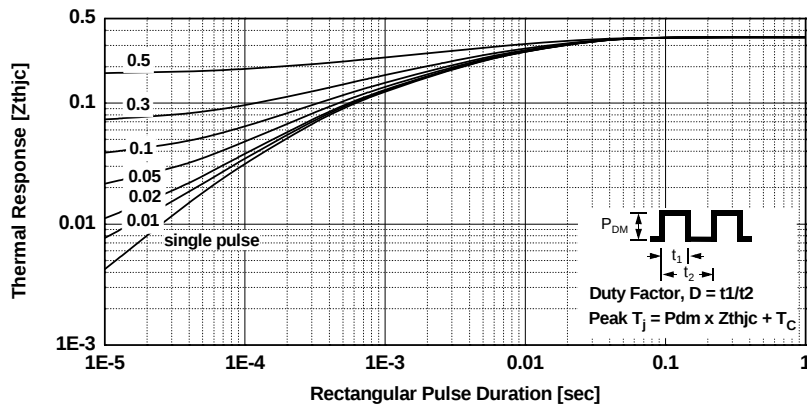
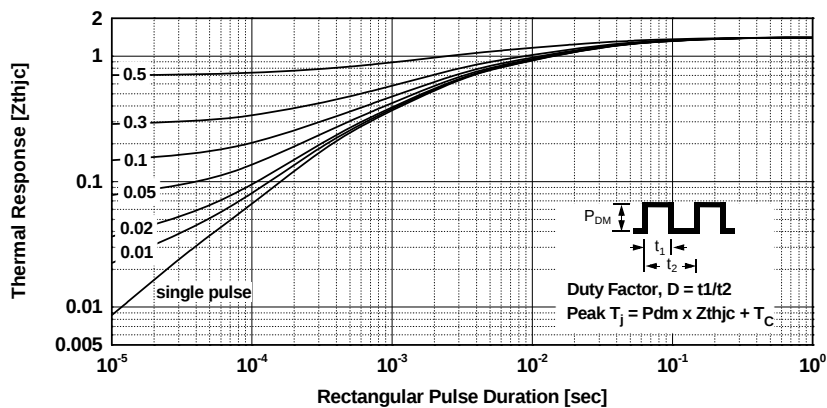
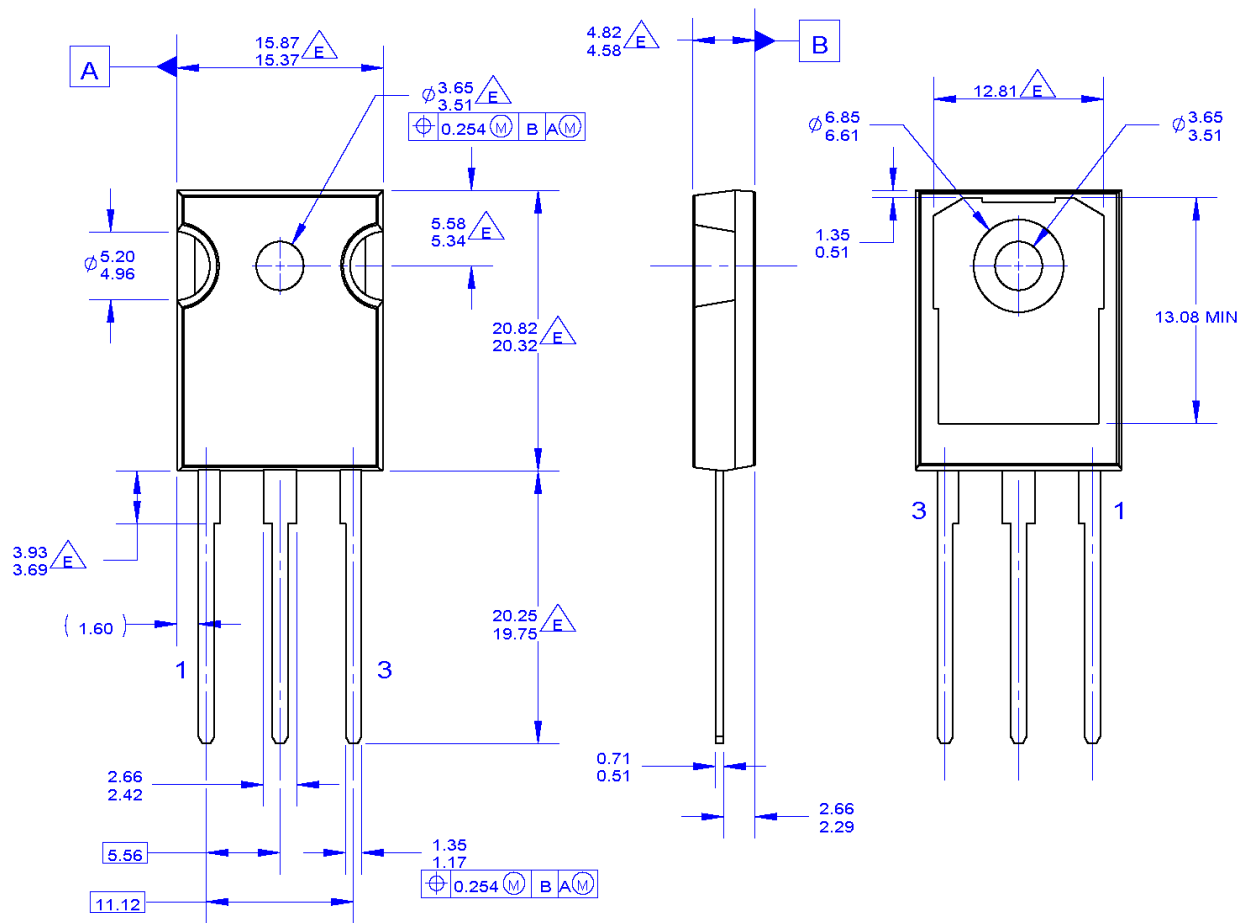


Figure 22. Transient Thermal Impedance of Diode



## Mechanical Dimensions



NOTES: UNLESS OTHERWISE SPECIFIED.

- A. PACKAGE REFERENCE: JEDEC TO-247, ISSUE E, VARIATION AB, DATED JUNE, 2004.
- B. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
- C. ALL DIMENSIONS ARE IN MILLIMETERS.
- D. DRAWING CONFORMS TO ASME Y14.5 - 1994

**E** DOES NOT COMPLY JEDEC STANDARD VALUE  
 F. DRAWING FILENAME: MKT-TO247G03\_REV01

**Figure 23. TO-247, MOLDED, 3 LEAD, JEDEC AB LONG LEADS (Active)**

Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to verify or obtain the most recent revision. Package specifications do not expand the terms of Fairchild's worldwide terms and conditions, specifically the warranty therein, which covers Fairchild products.

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Dimensions in Millimeters



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|                                                                                   |                                                 |                                                                                   |                                                                                     |
|-----------------------------------------------------------------------------------|-------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
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| AX-CAP®*                                                                          | FRFET®                                          | PowerTrench®                                                                      | TinyBoost®                                                                          |
| BitSiC™                                                                           | Global Power Resource™                          | PowerXS™                                                                          | TinyBuck®                                                                           |
| Build it Now™                                                                     | GreenBridge™                                    | Programmable Active Droop™                                                        | TinyCalc™                                                                           |
| CorePLUS™                                                                         | Green FPS™                                      | QFET®                                                                             | TinyLogic®                                                                          |
| CorePOWER™                                                                        | Green FPS™ e-Series™                            | QS™                                                                               | TINYOPTO™                                                                           |
| CROSSVOLT™                                                                        | Gmax™                                           | Quiet Series™                                                                     | TinyPower™                                                                          |
| CTL™                                                                              | GTO™                                            | RapidConfigure™                                                                   | TinyPWM™                                                                            |
| Current Transfer Logic™                                                           | IntelliMAX™                                     |  | TinyWire™                                                                           |
| DEUXPEED®                                                                         | ISOPLANAR™                                      | Saving our world, 1mW/W/kW at a time™                                             | TransiC™                                                                            |
| Dual Cool™                                                                        | Marking Small Speakers Sound Louder and Better™ | SignalWise™                                                                       | TriFault Detect™                                                                    |
| EcoSPARK®                                                                         | MegaBuck™                                       | SmartMax™                                                                         | TRUECURRENT®*                                                                       |
| EfficientMax™                                                                     | MICROCOUPLER™                                   | SMART START™                                                                      | µSerDes™                                                                            |
| ESBC™                                                                             | MicroFET™                                       | Solutions for Your Success™                                                       |  |
|  | MicroPak™                                       | SPM®                                                                              | UHC®                                                                                |
| Fairchild®                                                                        | MicroPak2™                                      | STEALTH™                                                                          | Ultra FRFET™                                                                        |
| Fairchild Semiconductor®                                                          | MillerDrive™                                    | SuperFET®                                                                         | UniFET™                                                                             |
| FACT Quiet Series™                                                                | MotionMax™                                      | SuperSOT™-3                                                                       | VCX™                                                                                |
| FACT®                                                                             | mWSaver®                                        | SuperSOT™-6                                                                       | VisualMax™                                                                          |
| FAST®                                                                             | OptoHiT™                                        | SuperSOT™-8                                                                       | VoltagePlus™                                                                        |
| FastvCore™                                                                        | OPTOLOGIC®                                      | SupreMOS®                                                                         | XS™                                                                                 |
| FETBench™                                                                         | OPTOPLANAR®                                     | SyncFET™                                                                          | 仙童™                                                                                 |
| FPS™                                                                              |                                                 | Sync-Lock™                                                                        |                                                                                     |

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