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FAIRCHILD SEMICONDUCTOR®

2013 年 12 月

# FGH40N60SMDF

## 600 V、 40 A 场截止 IGBT

### 特性

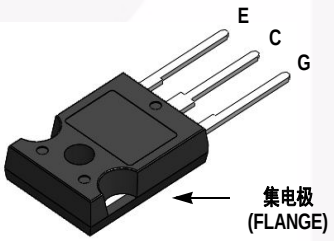
- 最大结温：$T_J$=175°C
- 正温度系数，易于并联运行
- 高电流能力
- 低饱和电压：$V_{CE(sat)}$=1.9 V （典型值） @ $I_C$=40 A
- 高输入阻抗
- 快速开关 $E_{OFF}$ =6.5 μJ/A
- 紧密的参数分布
- 符合 RoHS 标准

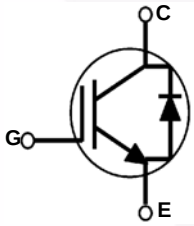
### 应用

- 太阳能逆变器、 UPS、电焊机、 PFC、电信、 ESS

### 概述

飞兆半导体的场截止第 2 代 IGBT 新系列采用新型场截止 IGBT 技术，为光伏逆变器、 UPS、焊机、通讯、 ESS 和 PFC 等低导通和开关损耗至关重要的应用提供最佳性能。




### 绝对最大额定值

| 符号 | 说明 | | 额定值 | 单位 |
|---|---|---|---|---|
| $V_{CES}$ | 集电极 - 发射极之间电压 | | 600 | V |
| $V_{GES}$ | 栅极－发射极间电压 | | ± 20 | V |
| $I_C$ | 集电极电流 | @ $T_C$ = 25°C | 80 | A |
| | 集电极电流 | @ $T_C$ = 100°C | 40 | A |
| $I_{CM\ (1)}$ | 集电极脉冲电流 | @ $T_C$ = 25°C | 120 | A |
| $P_D$ | 最大功耗 | @ $T_C$ = 25°C | 349 | W |
| | 最大功耗 | @ $T_C$ = 100°C | 174 | W |
| $T_J$ | 工作结温 | | -55 至 +175 | °C |
| $T_{stg}$ | 存储温度范围 | | -55 至 +175 | °C |
| $T_L$ | 用于焊接的最大引脚温度，距离外壳 1/8"，持续 5 秒 | | 300 | °C |

**注意：**
1：可重复的额定值：脉宽受最大结温限制

### 热性能

| 符号 | 参数 | 典型值 | 最大值 | 单位 |
|---|---|---|---|---|
| $R_{\theta JC}$(IGBT) | 结点 - 壳体的热阻 | - | 0.43 | °C/W |
| $R_{\theta JC}$（二极管） | 结点 - 壳体的热阻 | - | 1.45 | °C/W |
| $R_{\theta JA}$ | 结至环境热阻 | - | 40 | °C/W |

## 封装标识与定购信息

| 器件编号 | 顶标 | 封装 | 包装方法 | 卷尺寸 | 带宽 | 数量 |
|---|---|---|---|---|---|---|
| FGH40N60SMDF | FGH40N60SMDF | TO-247 | 塑料管 | 不适用 | 不适用 | 30 |

## IGBT 的电气特性 $T_C$ = 25°C 除非另有说明

| 符号 | 参数 | 测试条件 | 最小值 | 典型值 | 最大值 | 单位 |
|---|---|---|---|---|---|---|
| **关断特性** | | | | | | |
| $BV_{CES}$ | 集电极 - 发射极击穿电压 | $V_{GE}$ = 0 V， $I_C$ = 250 μA | 600 | - | - | V |
| $\frac{\Delta BV_{CES}}{\Delta T_J}$ | 击穿温度系数电压 | $V_{GE}$ = 0 V， $I_C$ = 250 μA | - | 0.6 | - | V/°C |
| $I_{CES}$ | 集电极切断电流 | $V_{CE}$ = $V_{CES}$， $V_{GE}$ = 0 V | - | - | 250 | μA |
| $I_{GES}$ | G-E 漏电流 | $V_{GE}$ = $V_{GES}$， $V_{CE}$ = 0 V | - | - | ±400 | nA |
| **导通特性** | | | | | | |
| $V_{GE(th)}$ | G-E 阈值电压 | $I_C$ = 250 μA， $V_{CE}$ = $V_{GE}$ | 3.5 | 4.6 | 6.0 | V |
| $V_{CE(sat)}$ | 集电极 - 发射极间饱和电压 | $I_C$ = 40 A, $V_{GE}$ = 15 V | - | 1.9 | 2.5 | V |
| | | $I_C$ = 40 A， $V_{GE}$ = 15 V，$T_C$ = 150 °C | - | 2.1 | - | V |
| **动态特性** | | | | | | |
| $C_{ies}$ | 输入电容 | $V_{CE}$ = 30 V， $V_{GE}$ = 0 V，f =1 MHz | - | 1880 | - | pF |
| $C_{oes}$ | 输出电容 | | - | 180 | - | pF |
| $C_{res}$ | 反向传输电容 | | - | 50 | - | pF |
| **开关特性** | | | | | | |
| $t_{d(on)}$ | 导通延迟时间 | $V_{CC}$ = 400 V， $I_C$ = 40 A，$R_G$ = 6 Ω， $V_{GE}$ = 15 V，感性负载， $T_C$ = 25°C | - | 12 | - | ns |
| $t_r$ | 上升时间 | | - | 20 | - | ns |
| $t_{d(off)}$ | 关断延迟时间 | | - | 92 | - | ns |
| $t_f$ | 下降时间 | | - | 13 | 20 | ns |
| $E_{on}$ | 导通开关损耗 | | - | 1.3 | - | mJ |
| $E_{off}$ | 关断开关损耗 | | - | 0.26 | - | mJ |
| $E_{ts}$ | 总开关损耗 | | - | 1.56 | - | mJ |
| $t_{d(on)}$ | 导通延迟时间 | $V_{CC}$ = 400 V， $I_C$ = 40 A，$R_G$=6 Ω， $V_{GE}$ = 15 V，感性负载， $T_C$ = 150°C | - | 12 | - | ns |
| $t_r$ | 上升时间 | | - | 19 | - | ns |
| $t_{d(off)}$ | 关断延迟时间 | | - | 97 | - | ns |
| $t_f$ | 下降时间 | | - | 14 | 21 | ns |
| $E_{on}$ | 导通开关损耗 | | - | 2.09 | - | mJ |
| $E_{off}$ | 关断开关损耗 | | - | 0.44 | - | mJ |
| $E_{ts}$ | 总开关损耗 | | - | 2.53 | - | mJ |
| $Q_g$ | 总栅极电荷 | $V_{CE}$ = 400 V， $I_C$ = 40 A，$V_{GE}$ = 15 V | - | 119 | - | nC |
| $Q_{ge}$ | 栅极－发射极间电荷 | | - | 13 | - | nC |
| $Q_{gc}$ | 栅极－发射极间电荷 | | - | 58 | - | nC |

## 二极管电气特性 $T_C$ = 25°C 除非另有说明

| 符号 | 参数 | 测试条件 | | 最小值 | 典型值 | 最大值 | 单位 |
|---|---|---|---|---|---|---|---|
| $V_{FM}$ | 二极管正向电压 | $I_F$ = 20 A | $T_C$ = 25°C | - | 1.3 | 1.7 | V |
| | | | $T_C$ = 150°C | - | 1.2 | | |
| $t_{rr}$ | 二极管反向恢复时间 | $I_F$ = 20 A， $di_F/dt$ = 200 A/μs | $T_C$ = 25°C | - | 70 | 90 | ns |
| | | | $T_C$ = 150°C | - | 126 | | |
| $Q_{rr}$ | 二极管反向恢复电荷 | | $T_C$ = 25°C | - | 207 | 290 | nC |
| | | | $T_C$ = 150°C | - | 638 | | |

## 典型性能特征

**图 1. 典型输出特性**

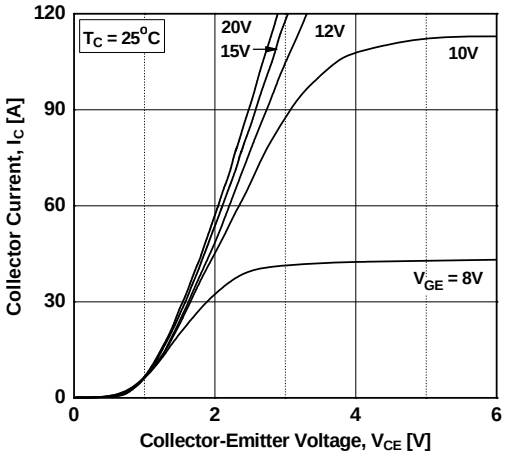



**图 2. 典型输出特性**

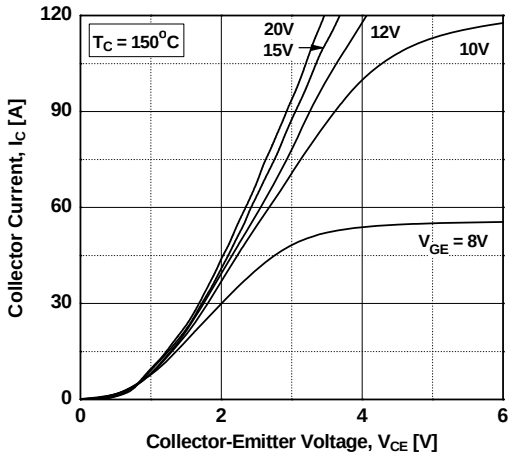



**图 3. 典型饱和电压特性**

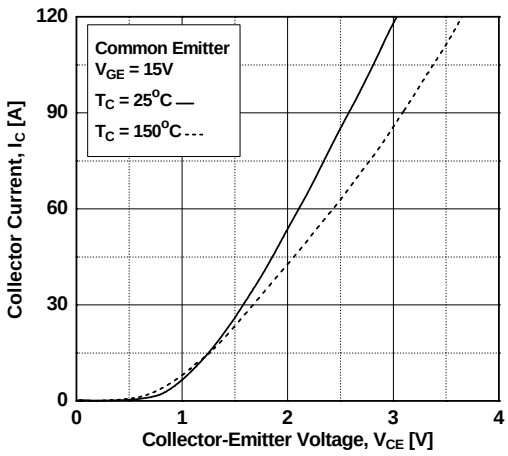



**图 4. 传输特性**

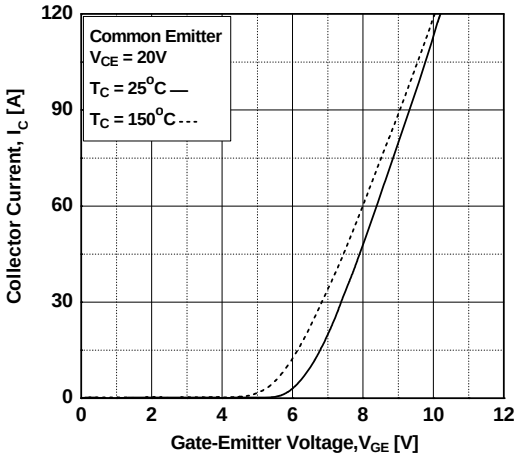



**图 5. 饱和电压与壳温的关系 （在可变电流强度下）**

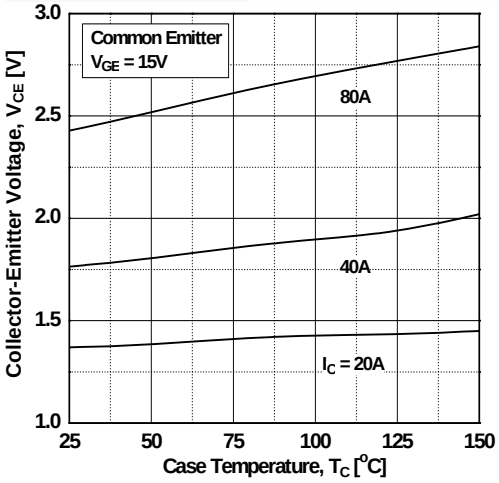
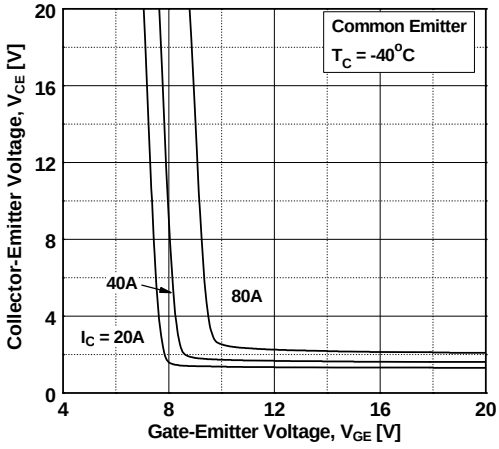



**图 6. 饱和电压与 $V_{GE}$ 的关系**



## 典型性能特征

**图 7. 饱和电压与 $V_{GE}$ 的关系**

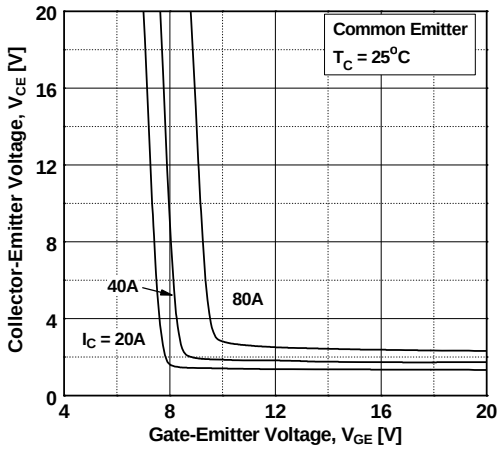



**图 8. 饱和电压与 $V_{GE}$ 的关系**

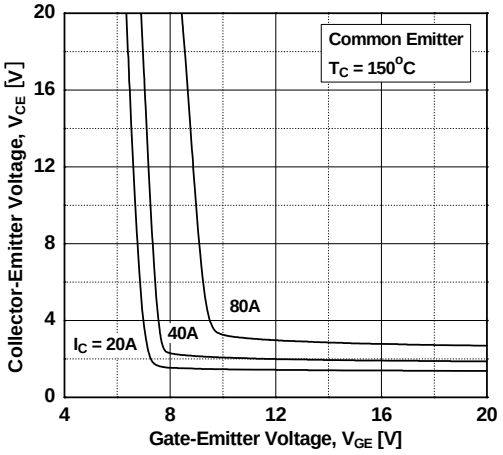



**图 9. 电容特性**

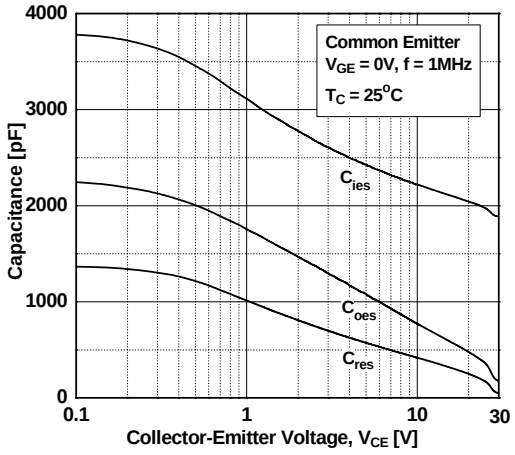



**图 10. 栅极电荷特性**

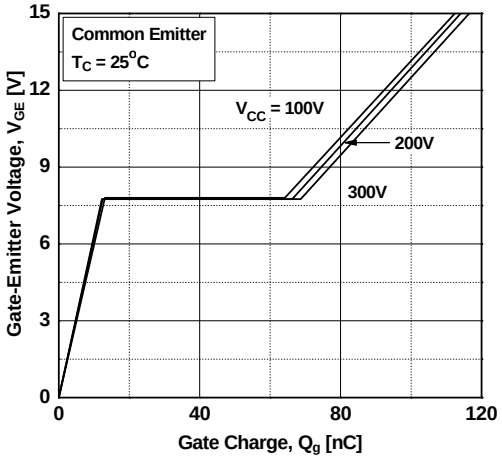



**图 11. SOA 特性**

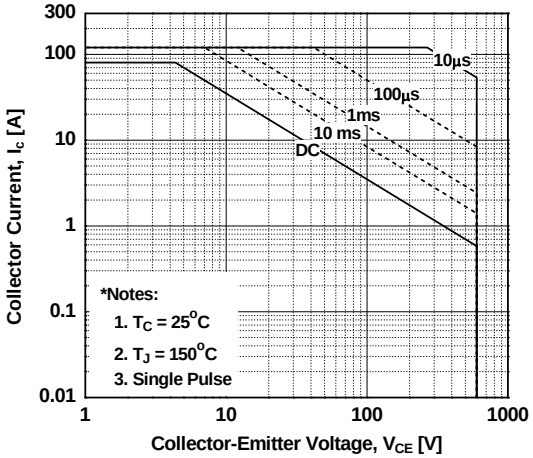
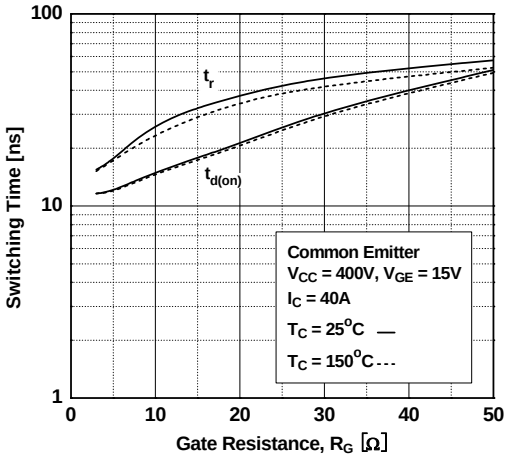



**图 12. 开启特性与栅极阻抗**



## 典型性能特征

**图 13. 关断特性与栅极电阻的关系**

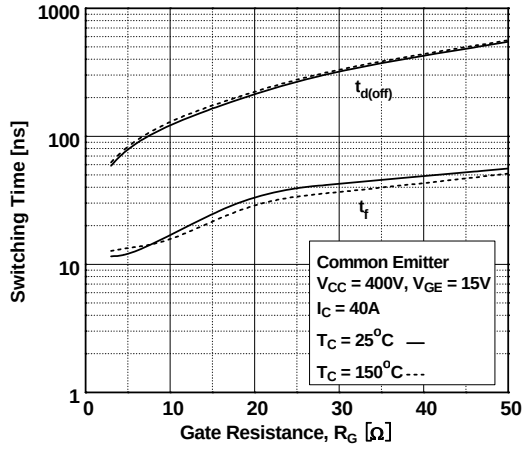



**图 14. 开启特性与集电极电流的关系**

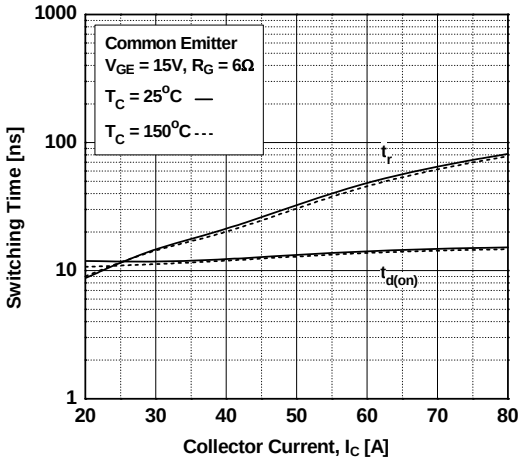



**图 15. 关断特性与集电极电流的关系**

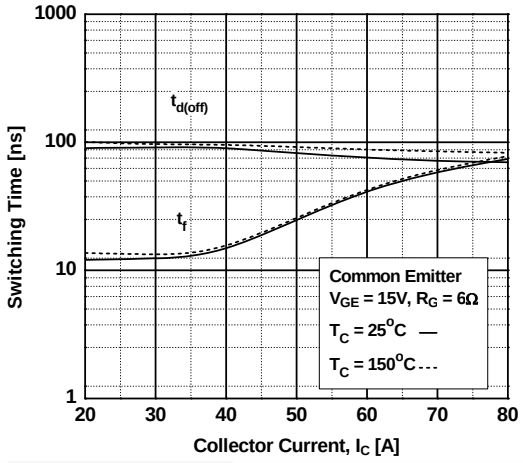



**图 16. 开关损耗与栅极电阻**

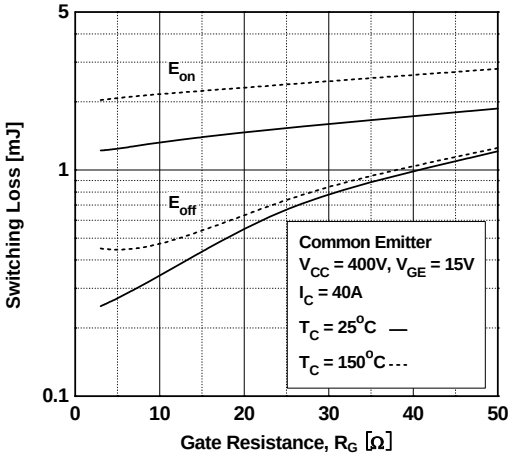



**图 17. 开关损耗与集电极电流**

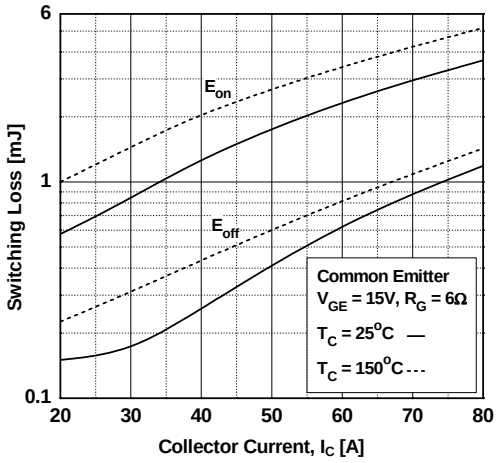
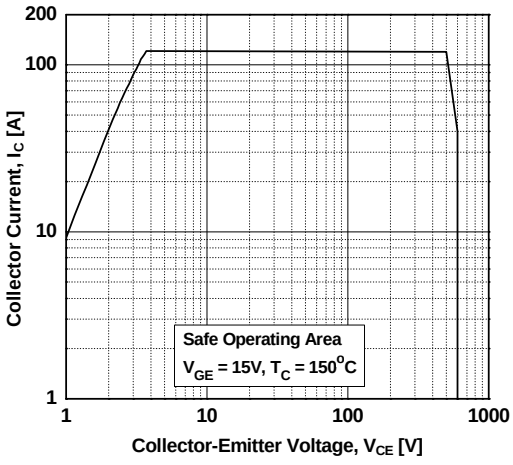



**图 18. 关断开关 SOA 特性**



## 典型性能特征

**图 19. 正向特性**

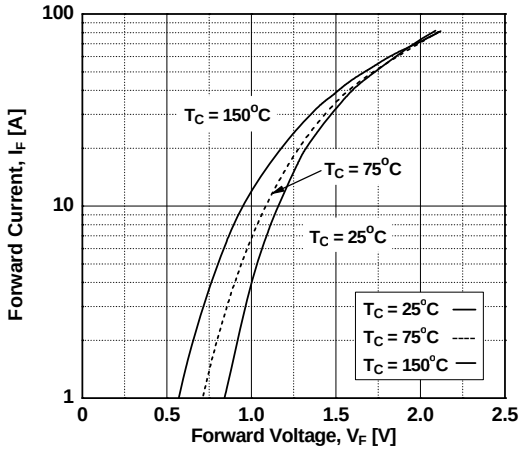



**图 20. 反向电流**

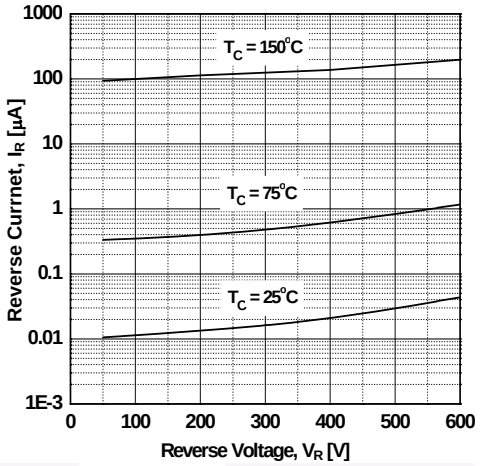



**图 21. 存储电荷**

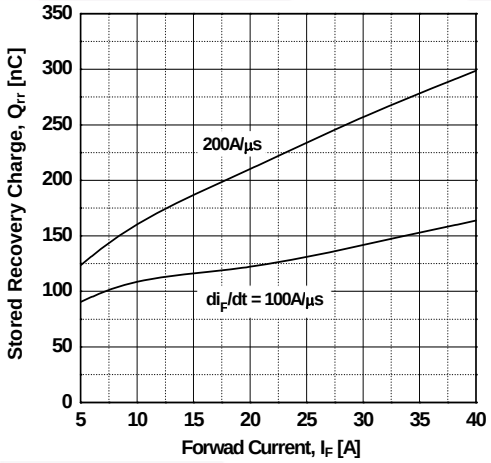



**图 22. 反向恢复时间**

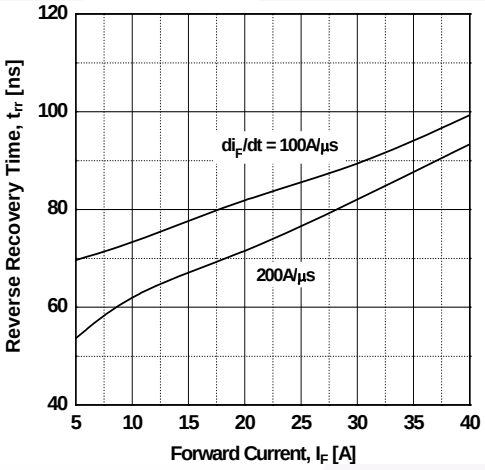
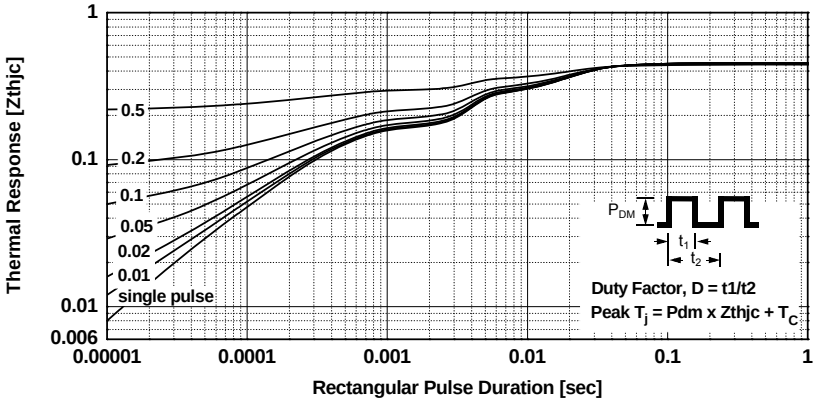
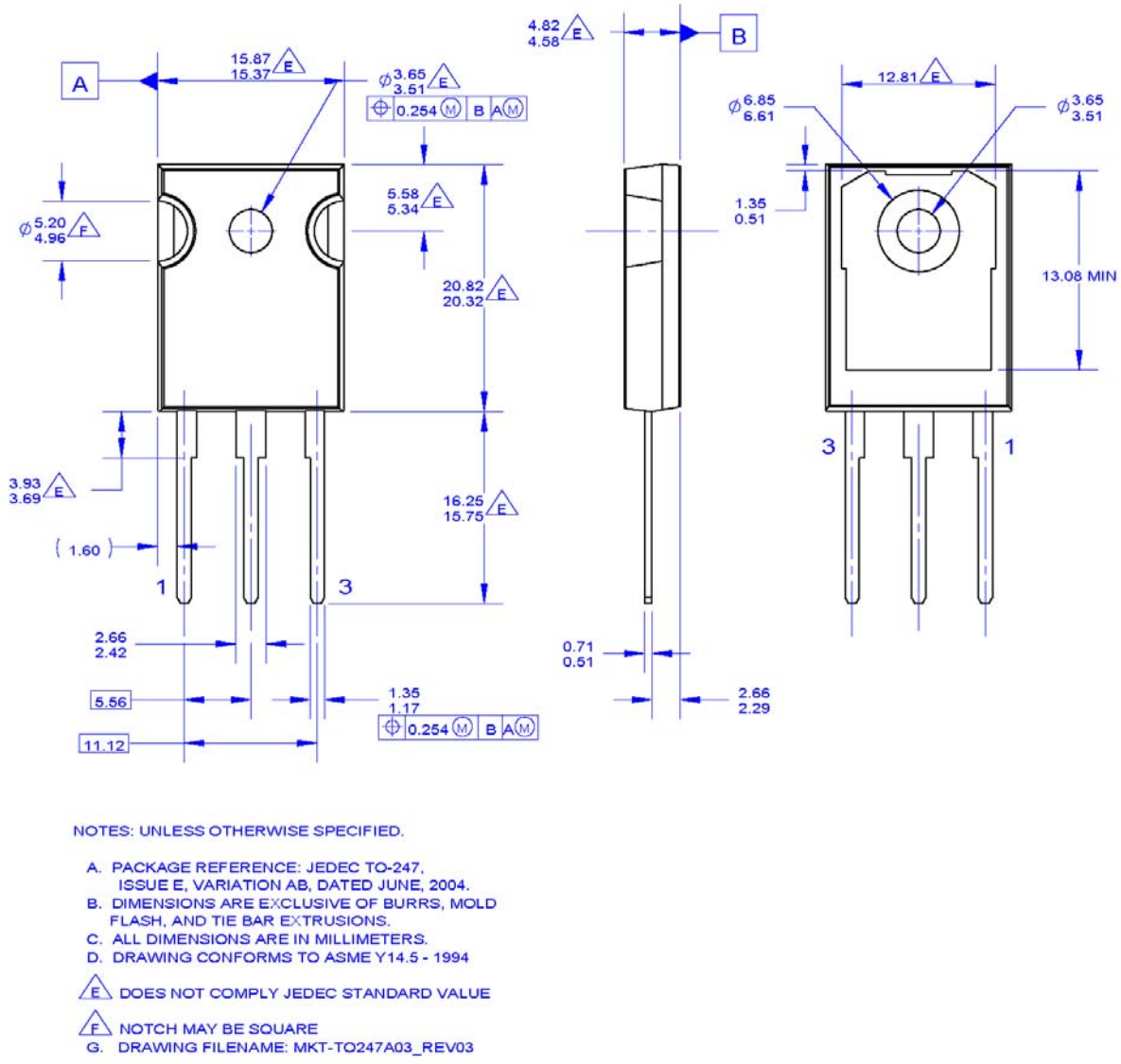



**图 23. IGBT 的瞬态热阻**



## 机械尺寸

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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 NOTCH MAY BE SQUARE

G. DRAWING FILENAME: MKT-TO247A03_REV03

**图 24. TO-247 3L - TO-247，模塑， 3 引脚， JEDEC 变体 AB**

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As used here in:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury of the user.
2. A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

**ANTI-COUNTERFEITING POLICY**

Fairchild Semiconductor Corporation's Anti-Counterfeiting Policy. Fairchild's Anti-Counterfeiting Policy is also stated on our external website, www.Fairchildsemi.com, under Sales Support.

Counterfeiting of semiconductor parts is a growing problem in the industry. All manufactures of semiconductor products are experiencing counterfeiting of their parts. Customers who inadvertently purchase counterfeit parts experience many problems such as loss of brand reputation, substandard performance, failed application, and increased cost of production and manufacturing delays. Fairchild is taking strong measures to protect ourselves and our customers from the proliferation of counterfeit parts. Fairchild strongly encourages customers to purchase Fairchild parts either directly from Fairchild or from Authorized Fairchild Distributors who are listed by country on our web page cited above. Products customers buy either from Fairchild directly or from Authorized Fairchild Distributors are genuine parts, have full traceability, meet Fairchild's quality standards for handing and storage and provide access to Fairchild's full range of up-to-date technical and product information. Fairchild and our Authorized Distributors will stand behind all warranties and will appropriately address and warranty issues that may arise. Fairchild will not provide any warranty coverage or other assistance for parts bought from Unauthorized Sources. Fairchild is committed to combat this global problem and encourage our customers to do their part in stopping this practice by buying direct or from authorized distributors.

**PRODUCT STATUS DEFINITIONS**

**Definition of Terms**

| Datasheet Identification | Product Status | Definition |
|---|---|---|
| Advance Information | Formative / In Design | Datasheet contains the design specifications for product development. Specifications may change in any manner without notice. |
| Preliminary | First Production | 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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