DATA SHEET
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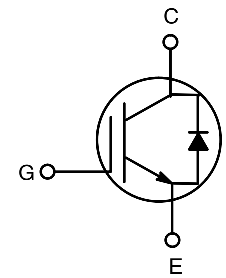
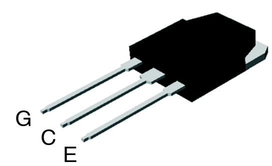
# IGBT – 场截止

## 650 V, 60 A

# FGA60N65SMD




TO−3P−3LD / EIAJ SC−65, ISOLATED
CASE 340BZ

### 概述

安森美 (**onsemi**) 的新型场截止第二代 IGBT 系列产品采用创新型场截 止 IGBT 技术，为光伏逆变器、UPS、焊机、通信电源、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。

### 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(Typ.) @ $I_C$ = 60 A
- 快速开关: $E_{OFF}$ = 7.5 μJ/A
- 紧密的参数分布
- 符合 RoHS 标准

### 应用

- 光伏逆变器、UPS、焊机、PFC、通信电源、ESS

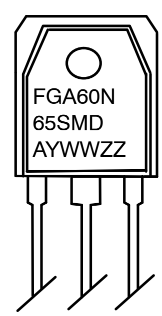
### 绝对最大额定值

| 符号 | 说明 | | 额定值 | 单位 |
|---|---|---|---|---|
| $V_{CES}$ | 集电极－发射极间电压 | | 650 | V |
| $V_{GES}$ | 栅极－发射极间电压 | | ±20 | V |
| | 瞬态栅极－发射极间电压 | | ±30 | V |
| $I_C$ | 集电极电流 | $T_C$ = 25°C | 120 | A |
| | | $T_C$ = 100°C | 60 | A |
| $I_{CM}$ | 集电极脉冲电流 (注 1) | | 180 | A |
| $I_F$ | 二极管正向电流 | $T_C$ = 25°C | 60 | A |
| | | $T_C$ = 100°C | 30 | A |
| $I_{FM}$ | 二极管最大正向脉冲电流 (注 1) | | 180 | A |
| $P_D$ | 最大功耗 | $T_C$ = 25°C | 600 | W |
| | | $T_C$ = 100°C | 300 | W |
| $T_J$ | 工作结温 | | −55 to +175 | °C |
| $T_{stg}$ | 存储温度范围 | | −55 to +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 |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.
(参考译文)
如果电压超过最大额定值表中列出的值范围，器件可能会损坏。如果超过任何这些限值，将无法保证器件功能，可能会导致器件损坏，影响可靠性。

1. 重复额定值：脉宽受最大结温限制

### MARKING DIAGRAM




FGA60N65SMD = Specific Device Code
A = Assembly Location
YWW = Date Code (Year & Work Week)
ZZ = Lot Code

### ORDERING INFORMATION

| Device | Package | Shipping |
|---|---|---|
| FGA60N65SMD | TO−3P−3L | 450 / Box |

### 热性能

| 符号 | 参数 | 最大值 | 单位 |
|---|---|---|---|
| $R_{\theta JC}$(IGBT) | 结点一壳体的热阻 | 0.25 | °C/W |
| $R_{\theta JC}$(Diode) | 结点一壳体的热阻 | 1.1 | °C/W |
| $R_{\theta JA}$ | 结至环境热阻 | 40 | °C/W |

### IGBT 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** | | | | | | |
| $BV_{CES}$ | 集电极一发射极击穿电压 | $V_{GE}$ = 0 V, $I_C$ = 250 μA | 650 | – | – | 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 | 4.5 | 6.0 | V |
| $V_{CE(sat)}$ | 集电极一发射极间饱和电压 | $I_C$ = 60 A, $V_{GE}$ = 15 V | – | 1.9 | 2.5 | V |
| | | $I_C$ = 60 A, $V_{GE}$ = 15 V, $T_C$ = 175°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 | – | 2915 | – | pF |
| $C_{oes}$ | 输出电容 | | – | 270 | – | pF |
| $C_{res}$ | 反向传输电容 | | – | 85 | – | pF |
| **开关特性** | | | | | | |
| $t_{d(on)}$ | 导通延迟时间 | $V_{CC}$ = 400 V, $I_C$ = 60 A, $V_{GE}$ = 15 V, $R_G$ = 3 Ω, Inductive Load, $T_C$ = 25°C | – | 18 | 27 | ns |
| $t_r$ | 上升时间 | | – | 47 | 70 | ns |
| $t_{d(off)}$ | 关断延迟时间 | | – | 104 | 146 | ns |
| $t_f$ | 下降时间 | | – | 50 | 68 | ns |
| $E_{on}$ | 导通开关损耗 | | – | 1.54 | 2.31 | mJ |
| $E_{off}$ | 关断开关损耗 | | – | 0.45 | 0.60 | mJ |
| $E_{ts}$ | 总开关损耗 | | – | 1.99 | 2.91 | mJ |
| $t_{d(on)}$ | 导通延迟时间 | $V_{CC}$ = 400 V, $I_C$ = 60 A, $V_{GE}$ = 15 V, $R_G$ = 3 Ω, Inductive Load, $T_C$ = 175°C | – | 18 | – | ns |
| $t_r$ | 上升时间 | | – | 41 | – | ns |
| $t_{d(off)}$ | 关断延迟时间 | | – | 115 | – | ns |
| $t_f$ | 下降时间 | | – | 48 | – | ns |
| $E_{on}$ | 导通开关损耗 | | – | 2.08 | – | mJ |
| $E_{off}$ | 关断开关损耗 | | – | 0.78 | – | mJ |
| $E_{ts}$ | 总开关损耗 | | – | 2.86 | – | mJ |
| $Q_g$ | 总栅极电荷 | $V_{CE}$ = 400 V, $I_C$ = 60 A, $V_{GE}$ = 15 V | – | 189 | 284 | nC |
| $Q_{ge}$ | 栅极一发射极间电荷 | | – | 20 | 30 | nC |
| $Q_{gc}$ | 栅极一集电极间电荷 | | – | 91 | 137 | nC |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.
(参考译文)
除非另有说明，“电气特性”表格中列出的是所列测试条件下的产品性能参数。如果在不同条件下运行，产品性能可能与“电气特性”表格中所列性能参数不一致。

**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 | $I_F$ = 30 A | $T_C$ = 25°C | – | 2.1 | 2.6 | V |
| | | | $T_C$ = 175°C | – | 1.7 | – | |
| $E_{rec}$ | 反向恢复电能 | $I_F$ = 30 A, $dI_F/dt$ = 200 A/μs | $T_C$ = 175°C | – | 127 | – | μJ |
| $t_{rr}$ | 二极管反向恢复时间 | | $T_C$ = 25°C | – | 47 | – | ns |
| | | | $T_C$ = 175°C | – | 212 | – | |
| $Q_{rr}$ | 二极管反向恢复电荷 | | $T_C$ = 25°C | – | 87 | – | nC |
| | | | $T_C$ = 175°C | – | 933 | – | |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.
(参考译文)
除非另有说明，“电气特性”表格中列出的是所列测试条件下的产品性能参数。如果在不同条件下运行，产品性能可能与“电气特性”表格中所列性能参数不一致。

## 典型性能特征

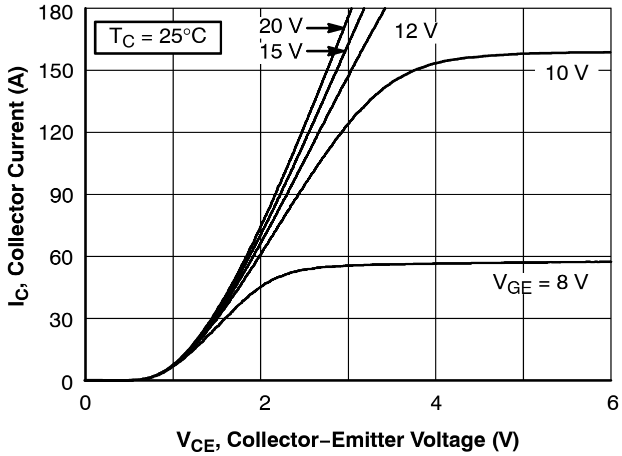



图 1. 典型输出特性

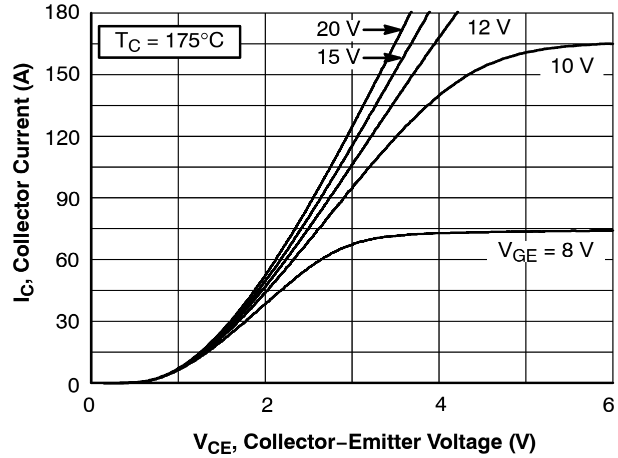



图 2. 典型输出特性

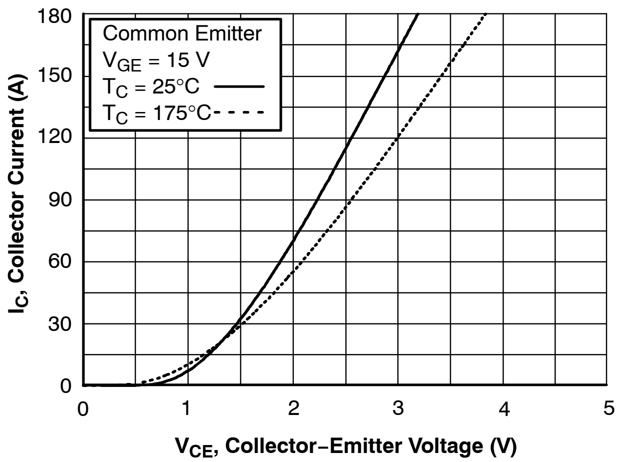



图 3. 典型饱和电压特性

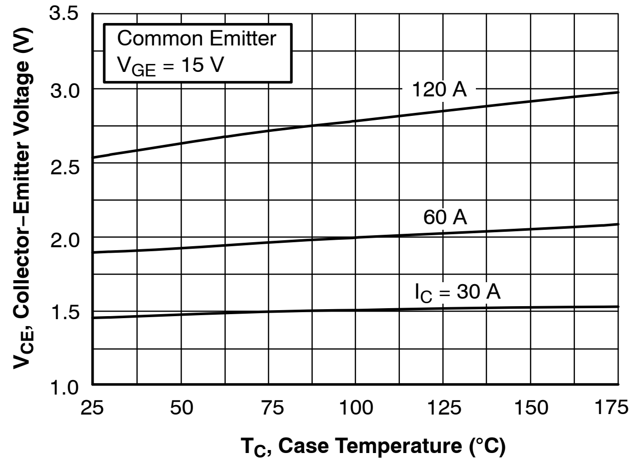



图 4. 典型饱和电压与可变电流强度下壳温的关系

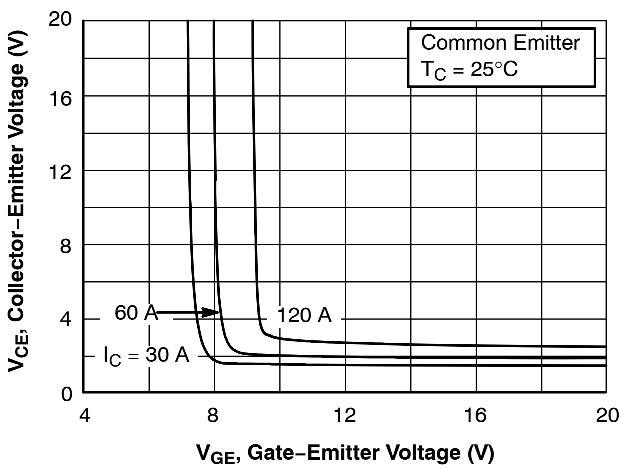



图 5. 饱和电压与 $V_{GE}$ 的关系

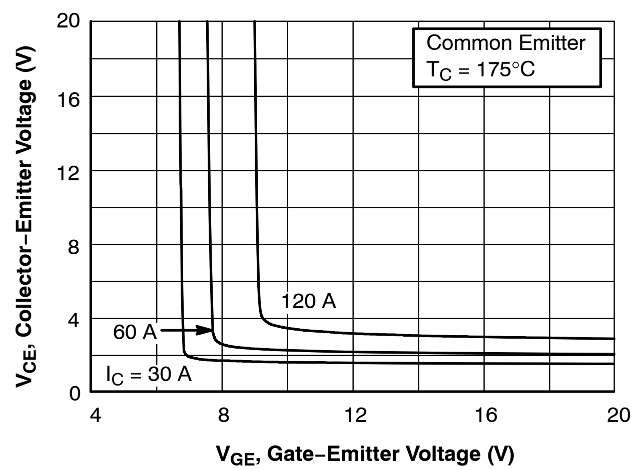



图 6. 饱和电压与 $V_{GE}$ 的关系

## 典型性能特征

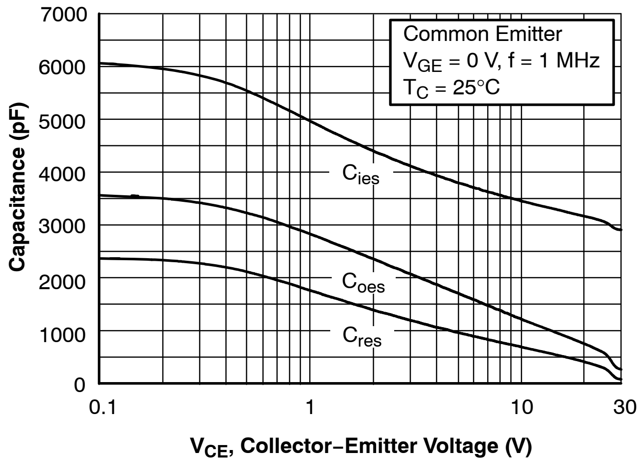



图 7. 电容特性

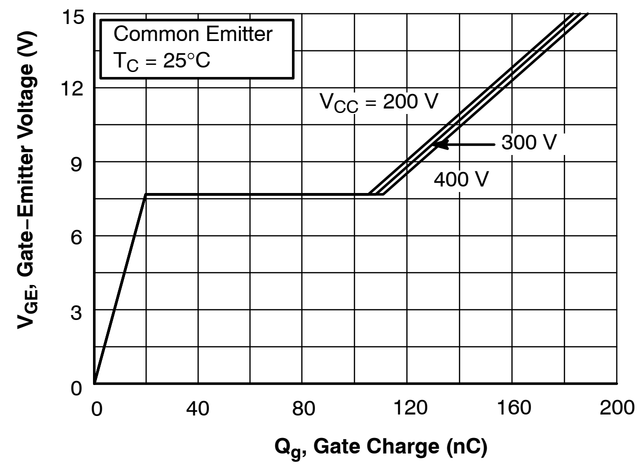



图 8. 栅极电荷特性

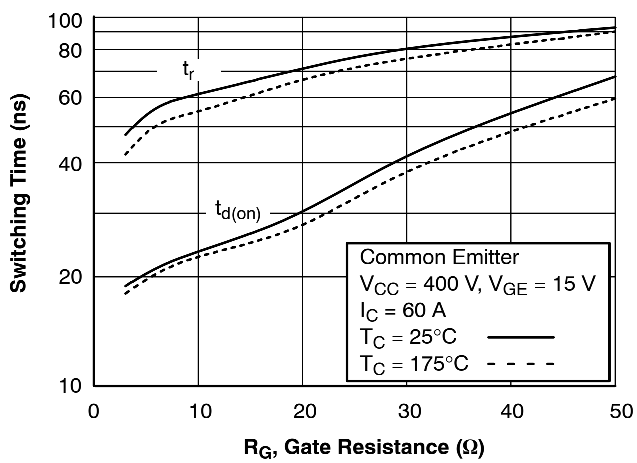



图 9. 导通特性与栅极电阻的关系

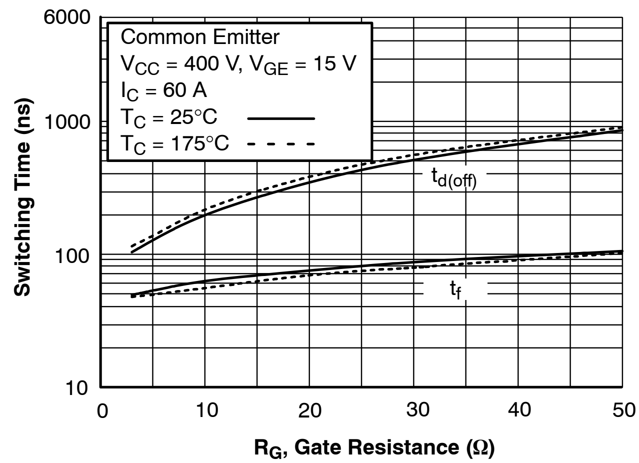



图 10. 关断特性与栅极电阻的关系

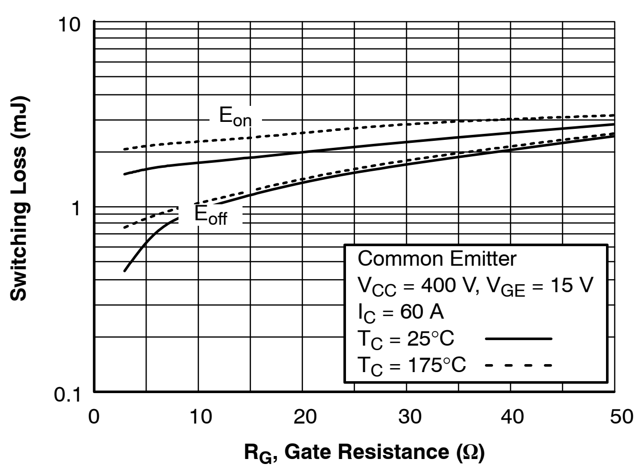



图 11. 开关损耗与栅极电阻的关系

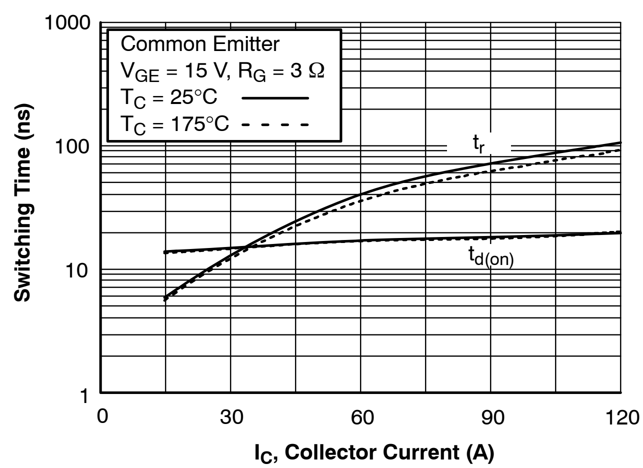



图 12. 导通特性与集电极电流的关系

## 典型性能特征

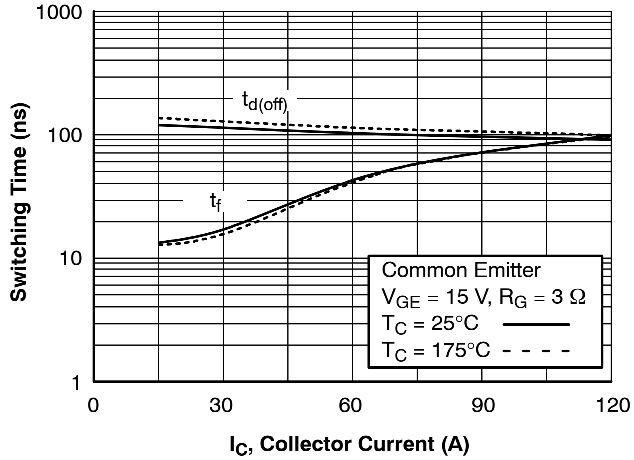



图 13. 关断特性与集电极电流的关系

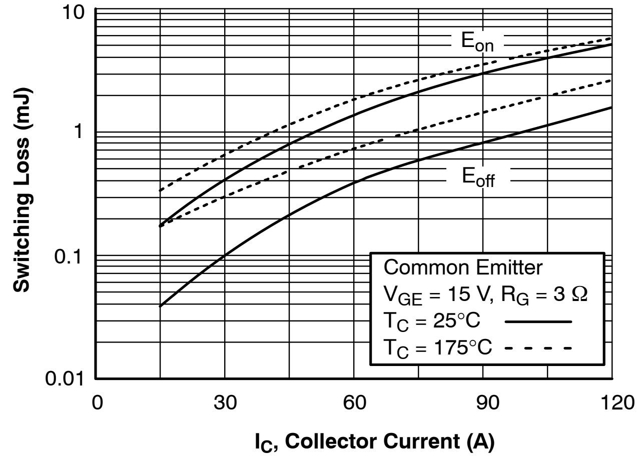



图 14. 开关损耗与集电极电流的关系

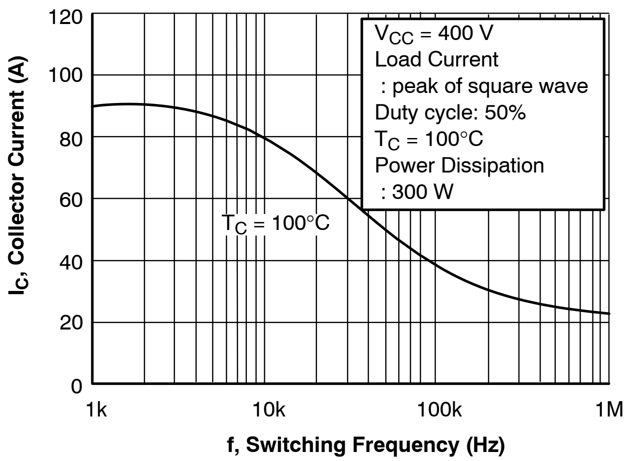



图 15. 负载电流与频率的关系

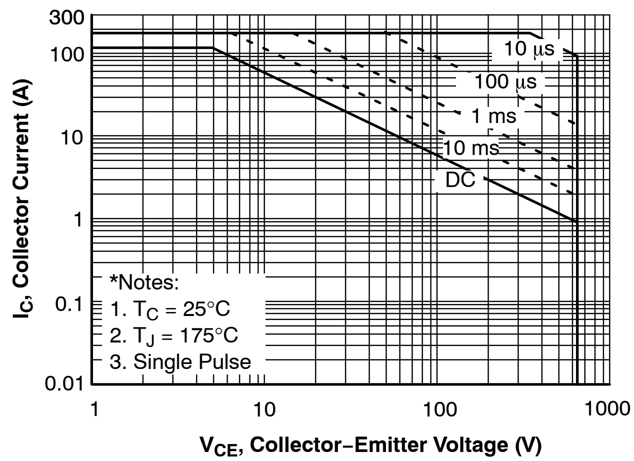



图 16. **SOA** 特性

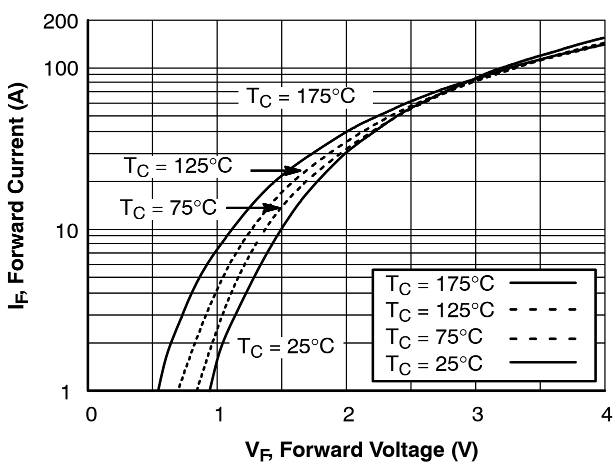



图 17. 正向特性

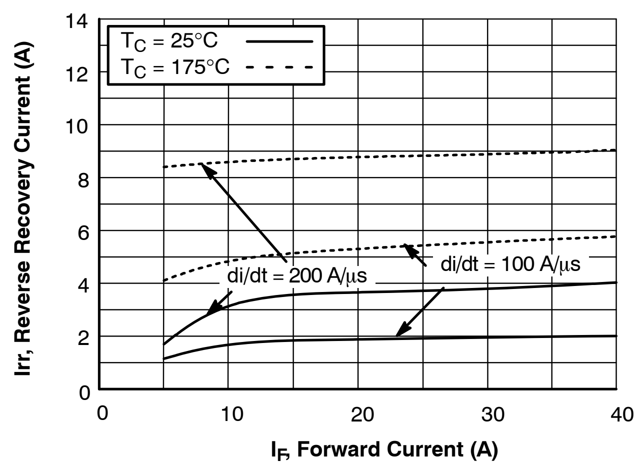



图 18. 反向恢复电流

## 典型性能特征

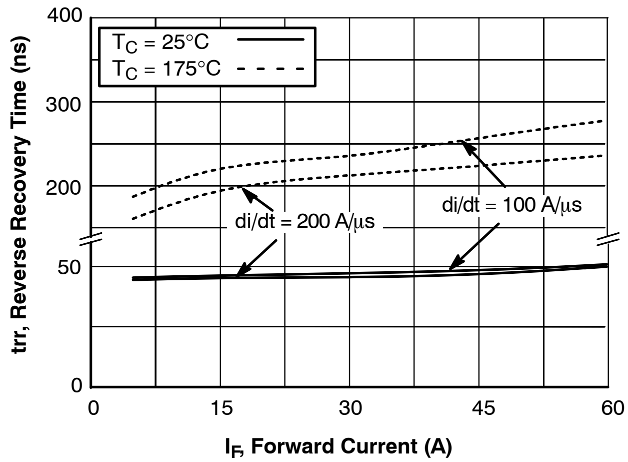



图 19. 反向恢复时间

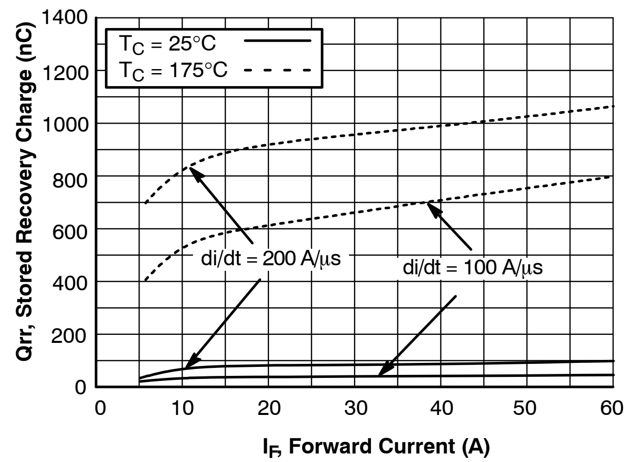



图 20. 存储电荷

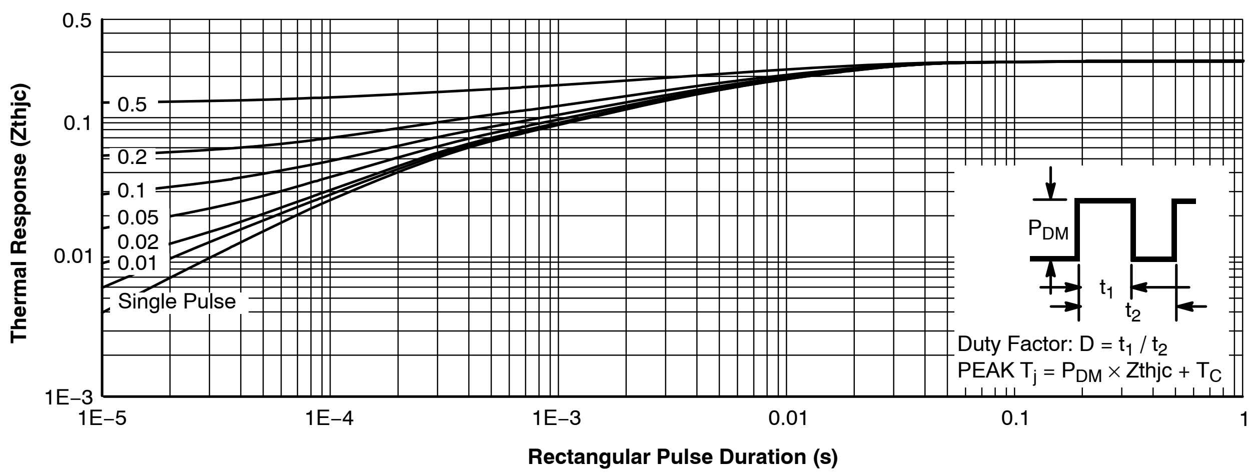



图 21. **IGBT** 的瞬态热阻

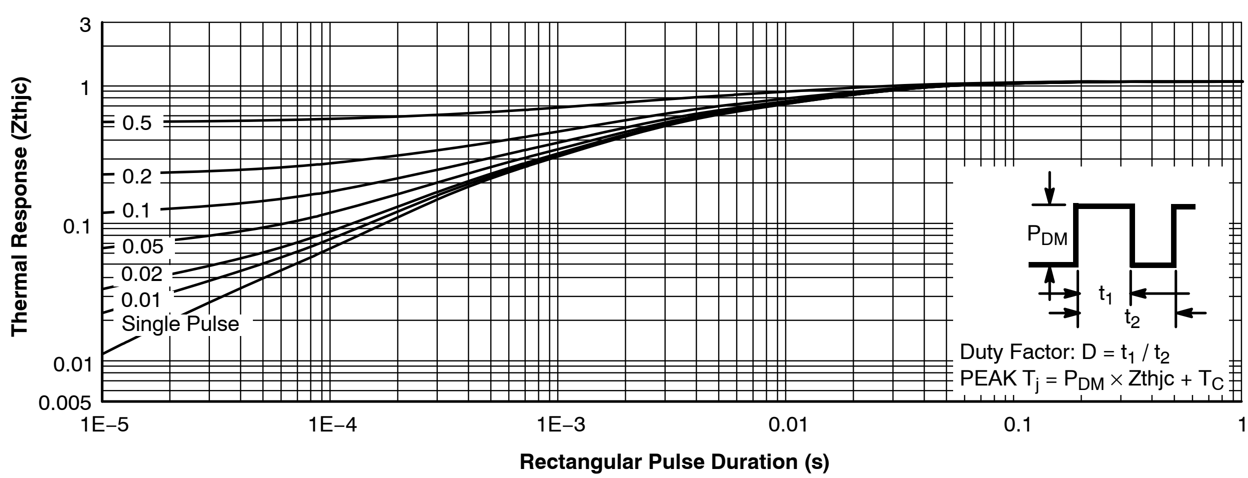



图 22. 二极管瞬态热阻抗

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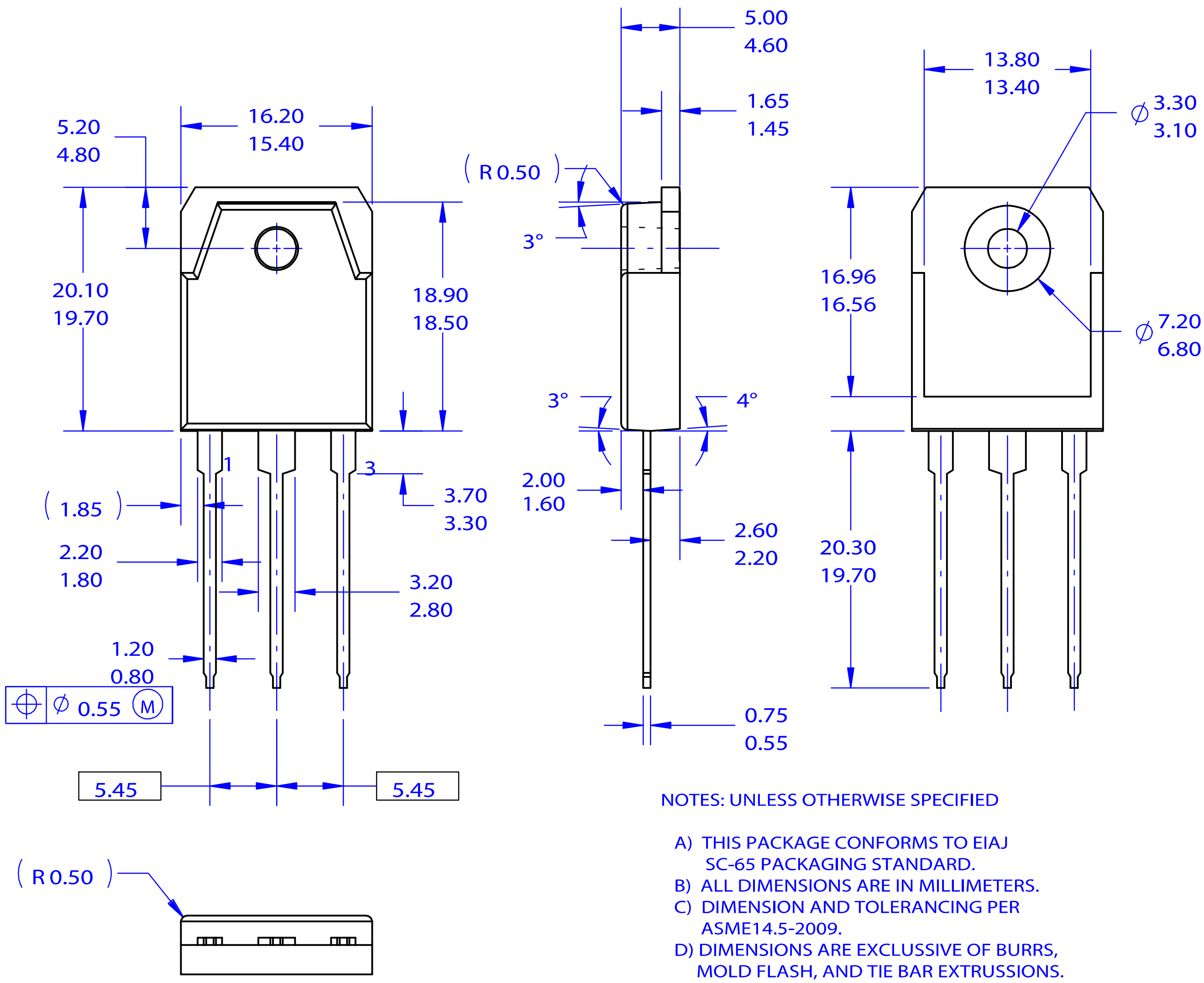
DATE 31 OCT 2016




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.

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