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2015 年 4 月

# FPF1C2P5MF07AM
# 用于 PV 应用的 F1 模块解决方案

## 概述

Fairchild 的新型 DC-AC 模块设计用于需要更紧凑型设计的功率平台。另外，压装技术提供简单、可靠的安装。该模块已针对需要高效率和稳健型设计的应用诸如太阳能逆变器而优化。

## 电气特性

- 高效率
- 低导通损耗和开关损耗
- 低 $V_{CE(sat)}$：1.1 V 典型值 @ $I_C$=30 A
- 低 $R_{DS(ON)}$：90 mΩ 最大
- 快速恢复体二极管

## 机械特性

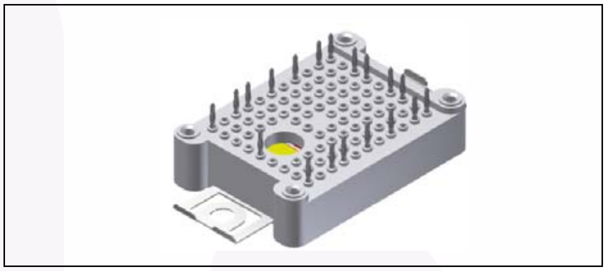
- 结构紧凑 F1 封装
- 压装接触技术

## 应用

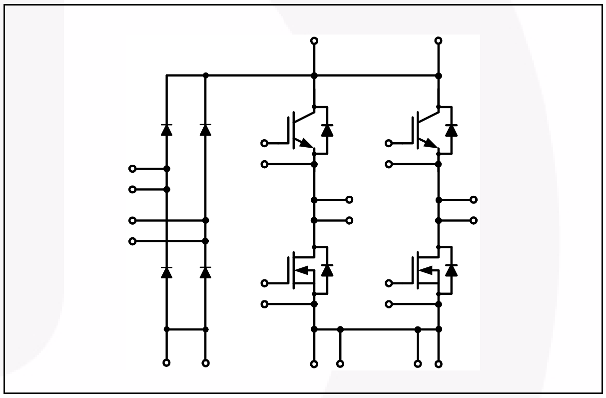
- 太阳能变频器

## 认证

- UL approved (E209204)



封装代码 F1



内部电路图

## 最大绝对额定值 $T_C$ =25°C，除非另有说明。

| 符号 | 描述 | | 额定值 | 单位 |
|---|---|---|---|---|
| **整流二极管** | | | | |
| $V_{RRM}$ | 重复反向峰值电压 | | 620 | V |
| $I_{Fav}$ | 二极管正向连续电流 | @ $T_C$ = 80°C | 27 | A |
| $I_{FSM}$ | 二极管最大正向电流 | | 245 | A |
| $I^2t$ | $I^2t$ 值 | | 300 | $A^2s$ |
| $P_D$ | 最大功耗 | @ $T_C$ = 25°C | 77 | W |
| $T_J$ | 工作结温 | | -40 至 +150 | °C |

## 最大绝对额定值 $T_C$ = 25°C，除非另有说明。（续）

| 符号 | 描述 | | 额定值 | 单位 |
|---|---|---|---|---|
| **高端 IGBT** | | | | |
| $V_{CES}$ | 集电极一发射极之间电压 | | 620 | V |
| $V_{GES}$ | 栅极一发射极间电压 | | ± 20 | V |
| $I_C$ | 集电极电流 | @ $T_C$ = 80°C | 39 | A |
| $I_{CM}$ | 集电极脉冲电流 | | 90 | A |
| $I_F$ | 二极管正向连续电流 | @ $T_C$ = 80°C | 22 | A |
| $I_{FM}$ | 二极管最大正向电流 | | 90 | A |
| $P_D$ | 最大功耗 | @ $T_C$ = 25°C | 231 | W |
| $T_J$ | 工作结温 | | -40 至 +150 | °C |
| **低端 MOSFET** | | | | |
| $V_{DSS}$ | 漏极一源极电压 | | 620 | V |
| $V_{GSS}$ | 栅极一源极电压 | | ± 20 | V |
| $I_D$ | 连续漏极电流 | @ $T_C$ = 25°C | 36 | A |
| | | @ $T_C$ = 80°C | 27 | A |
| $I_{DM}$ | 脉冲漏极电流 | 受限于最大结温。 | 156 | A |
| $I_S$ | 连续源漏极二极管正向电流 | | 36 | A |
| $I_{SM}$ | 漏源极二极管最大正向脉冲电流 | | 156 | A |
| $P_D$ | 最大功耗 | @ $T_C$ = 25°C | 250 | W |
| $T_J$ | 工作结温 | | -40 至 +150 | °C |
| **功率模块** | | | | |
| $T_{STG}$ | 存储温度 | | -40 至 +125 | °C |
| $V_{ISO}$ | 绝缘电压 | @ AC $1_{MIN}$ | 2500 | V |
| 绝缘材料 | 内部绝缘材料 | | $Al_2O_3$ | |
| $F_{MOUNT}$ | 紧固力 | | 20 至 50 | N |
| 重量 | | 典型值。 | 22 | g |
| 爬电距离 | 端子到散热片 | | 11.5 | mm |
| | 端子到端子 | | 6.3 | mm |
| 电气间隙 | 端子到散热片 | | 10.0 | mm |
| | 端子到端子 | | 5.0 | mm |

## 封装标识与定购信息

| 器件 | 器件标识 | 封装 | 包装类型 | 数量 / 托盘 |
|---|---|---|---|---|
| FPF1C2P5MF07AM | FPF1C2P5MF07AM | F1 | 托盘 | 22 |

## 电气特性 $T_C$ = 25°C 除非另有说明。

| 符号 | 参数 | 工作条件 | 最小值 | 典型值 | 最大值 | 单位 |
|---|---|---|---|---|---|---|
| **整流二极管** | | | | | | |
| $V_F$ | 二极管正向电压 | IF = 30 A | - | - | 1.9 | V |
| | | $I_F$ = 30 A @$T_C$ = 125°C | - | 1.45 | - | V |
| $I_R$ | 反向漏电流 | $V_R$ = 620 V | - | - | 25 | mA |
| $R_{\theta JC}$ | 结点 — 壳体的热阻 | 每只二极管 | - | - | 1.62 | °C/W |
| **高端 IGBT** | | | | | | |
| **关断特性** | | | | | | |
| $BV_{CES}$ | 集电极 — 发射极击穿电压 | $V_{GE}$ = 0 V, $I_C$ = 1 mA | 620 | - | - | V |
| $I_{CES}$ | 集电极切断电流 | $V_{CE}$ = $V_{CES}$, $V_{GE}$ = 0 V | - | - | 25 | mA |
| $I_{GES}$ | 集电极 — 发射极间漏电流 | $V_{GE}$ = $V_{GES}$, $V_{CS}$ = 0 V | - | - | 2.5 | mA |
| **导通特性** | | | | | | |
| $V_{GE(th)}$ | 栅极 — 发射极阈值电压 | $V_{GE}$ = $V_{CE}$, $I_C$ = 30 mA | 4 | 5.7 | 7 | V |
| $V_{CE(sat)}$ | 集电极 — 发射极间饱和电压 | $I_C$ =30 A, VGE=15 V | - | 1.1 | 1.6 | V |
| | | $I_C$ = 30 A, $V_{GE}$ = 15 V @$T_C$ = 125°C | - | 1.0 | - | V |
| | | $I_C$ = 60 A, $V_{GE}$ = 15 V | - | 1.4 | - | V |
| **开关特性** | | | | | | |
| $Q_g$ | 总栅极电荷 | $V_{DS}$ = 380 V, $V_{GS}$ = 0 V...+15 V, $I_C$ = 30 A | - | 214 | - | nC |
| $R_{\theta JC}$ | 结点 — 壳体的热阻 | 每只 IGBT | - | - | 0.54 | °C/W |

* 注：上端 IGBT 为工频开关频率例如 50/60 Hz 做了优化

| 上端续流二极管 | | | | | | |
|---|---|---|---|---|---|---|
| $V_{FM}$ | 二极管正向电压 | $I_F$= 15 A, $V_{GS}$ = 0 V | - | 1.75 | 2.25 | V |
| $t_{rr}$ | 反向恢复时间 | $I_F$= 15 A<br>$dI_F/dt$ = 1650 A/µs | - | 30 | - | ns |
| $I_{rr}$ | 反向恢复电流 | | - | 27 | - | A |
| $Q_{rr}$ | 反向恢复电荷 | | - | 405 | - | nC |
| $t_{rr}$ | 反向恢复时间 | $I_F$= 15 A<br>$dI_F/dt$ = 1500 A/µs @$T_C$ = 125°C | - | 43 | | ns |
| $I_{rr}$ | 反向恢复电流 | | - | 38 | - | A |
| $Q_{rr}$ | 反向恢复电荷 | | - | 814 | - | nC |
| $R_{\theta JC}$ | 结点 — 壳体的热阻 | 每只二极管 | - | - | 1.61 | °C/W |

## 电气特性 $T_C$ = 25°C 除非另有说明。（续）

| 符号 | 参数 | 工作条件 | 最小值 | 典型值 | 最大值 | 单位 |
|---|---|---|---|---|---|---|
| **下端 MOSFET** | | | | | | |
| **关断特性** | | | | | | |
| $BV_{DSS}$ | 漏极－源极击穿电压 | $V_{GS}$ = 0 V, $I_D$ = 1 mA | 620 | - | - | V |
| $I_{DSS}$ | 零栅极电压漏极电流 | $V_{DS}$ = 620 V, $V_{GS}$ = 0 V | - | - | 25 | mA |
| $I_{GSS}$ | 栅极－体漏电流，正向 | $V_{GS}$ = 20 V, $V_{DS}$ = 0 V | | | 2.5 | mA |
| **导通特性** | | | | | | |
| $V_{GS(th)}$ | 栅极－源极阈值电压 | $V_{GS}$ = $V_{DS}$, $I_D$ = 250 mA | 2.7 | 3.8 | 5.3 | V |
| $R_{DS(ON)}$ | 静态漏源极导通电阻 | $I_D$ = 27 A, $V_{GS}$ = 10 V | - | - | 90 | mΩ |
| | | $I_D$ = 27 A, $V_{GS}$ = 10 V @$T_C$ = 125°C | - | 135 | - | mΩ |
| | | $I_D$ = 47 A, $V_{GS}$ = 10 V | - | 76 | - | mΩ |
| $V_{SD}$ | 源极－漏极二极管正向电压 | $I_{SD}$ = 27 A, $V_{GS}$ = 0 V | - | - | 1.5 | V |
| | | $I_{SD}$ = 47 A, $V_{GS}$ = 0 V | - | 1.3 | - | V |
| **开关特性** | | | | | | |
| $t_{d(on)}$ | 导通延迟时间 | $V_{CC}$ = 380 V<br>$I_D$ = 27 A<br>$V_{GS}$ = 10 V<br>$R_G$=10 Ω<br>感性负载<br>$T_C$ = 25°C | - | 57 | - | ns |
| $t_r$ | 上升时间 | | - | 14 | - | ns |
| $t_{d(off)}$ | 关断延迟时间 | | - | 240 | - | ns |
| $t_f$ | 下降时间 | | - | 20 | - | ns |
| $E_{ON}$ | 开通损耗每个脉冲 | | - | 440 | - | mJ |
| $E_{OFF}$ | 关断损耗每个脉冲 | | - | 113 | - | mJ |
| $t_{d(on)}$ | 导通延迟时间 | $V_{CC}$ = 380 V<br>$I_D$ = 27 A<br>$V_{GS}$ = 10 V<br>$R_G$ = 10 Ω<br>感性负载<br>$T_C$ = 125°C | - | 53 | - | ns |
| $t_r$ | 上升时间 | | - | 16 | - | ns |
| $t_{d(off)}$ | 关断延迟时间 | | - | 257 | - | ns |
| $t_f$ | 下降时间 | | - | 20 | - | ns |
| $E_{ON}$ | 开通损耗每个脉冲 | | - | 719 | - | mJ |
| $E_{OFF}$ | 关断损耗每个脉冲 | | - | 124 | - | mJ |
| $Q_g$ | 总栅极电荷 | $V_{DS}$ = 380 V, $V_{GS}$ = 0V...+10 V,<br>$I_D$ = 27 A | - | 155 | - | nC |
| $R_{\theta JC}$ | 结点－壳体的热阻 | 每个芯片 | - | - | 0.5 | °C/W |

## 典型性能特征

图 1. 典型输出特性 -IGBT

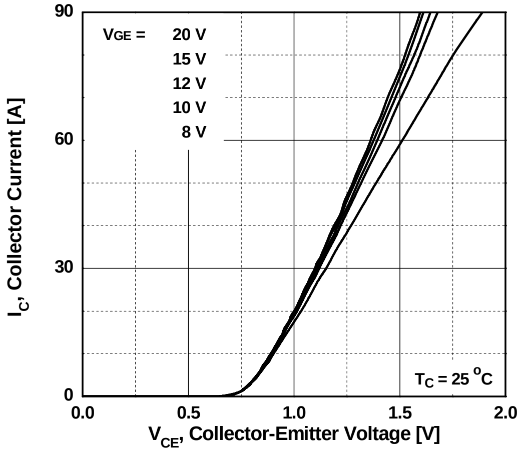



图 2. 典型输出特性 -IGBT

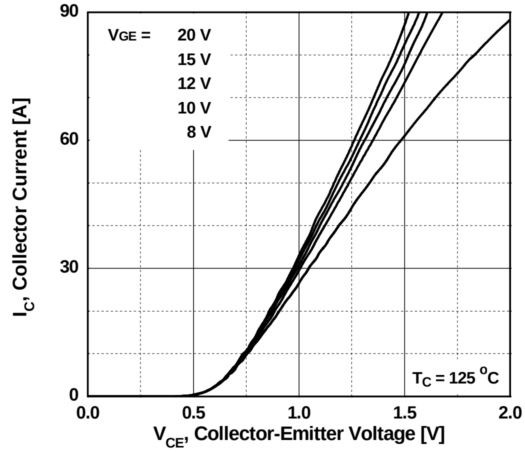



图 3. 典型饱和电压特性 -IGBT

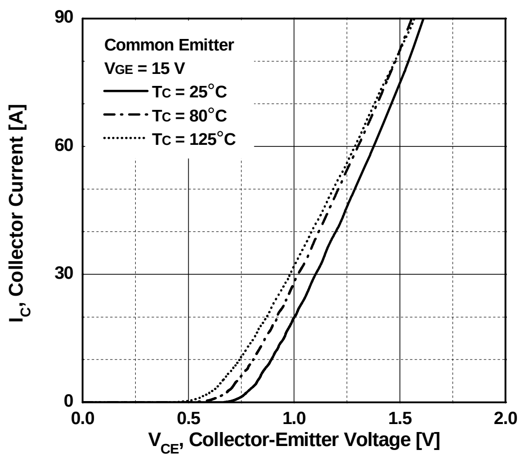



图 4. 瞬态热响应曲线 -IGBT

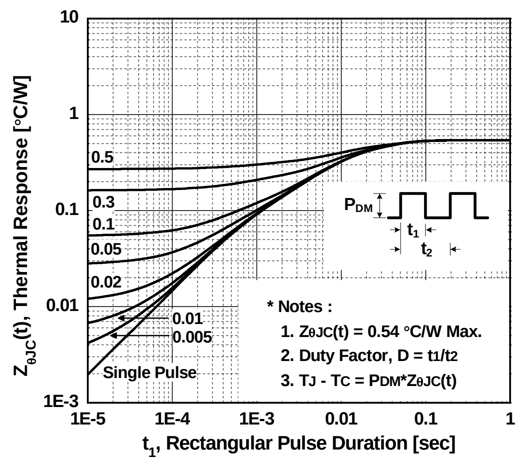



图 5. 典型正向压降 vs. 正向电流 — 上端续流二极管

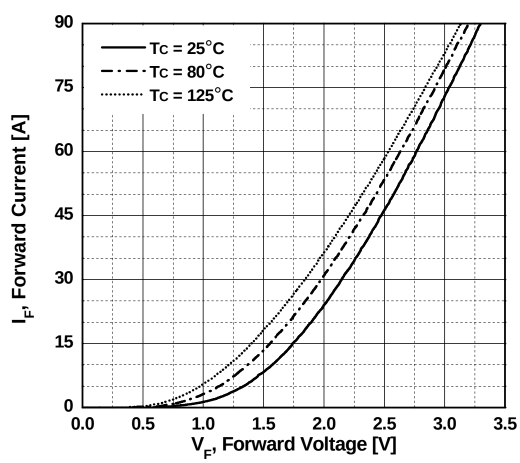
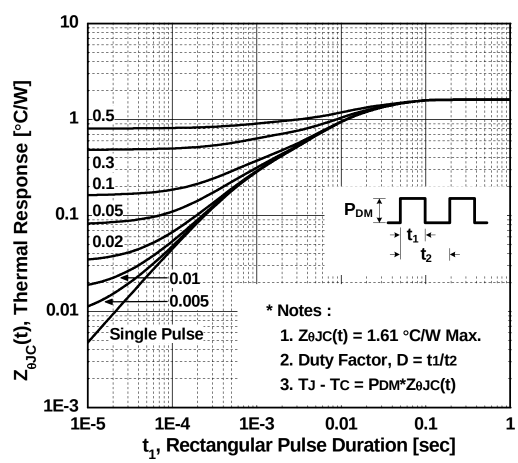



图 6. 瞬态热响应曲线 — 上端续流二极管



## 典型性能特征 （接上页）

图 7. 输出特性 —MOSFET

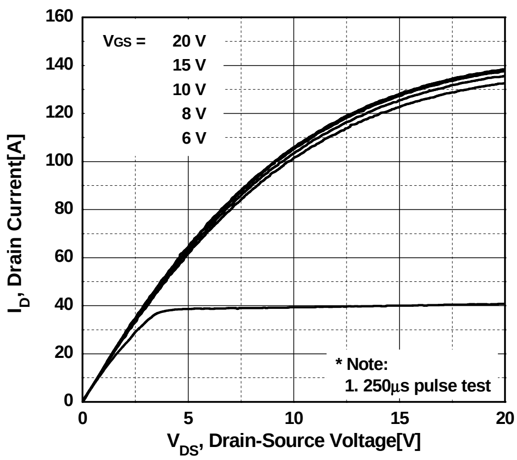



图 8. 通态电阻变化 Vs. 漏极电流和栅极电压 —MOSFET

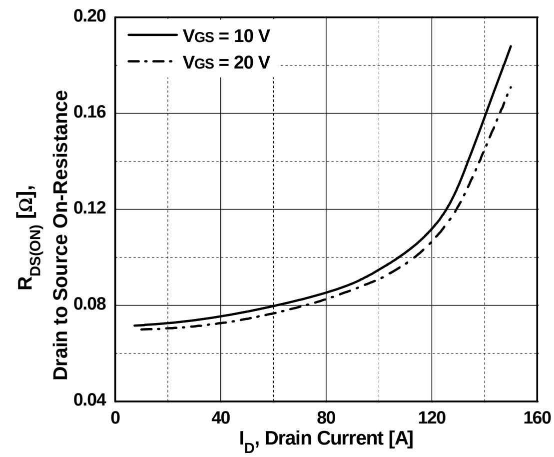



图 9. 通态电阻变化 Vs. 温度 —MOSFET

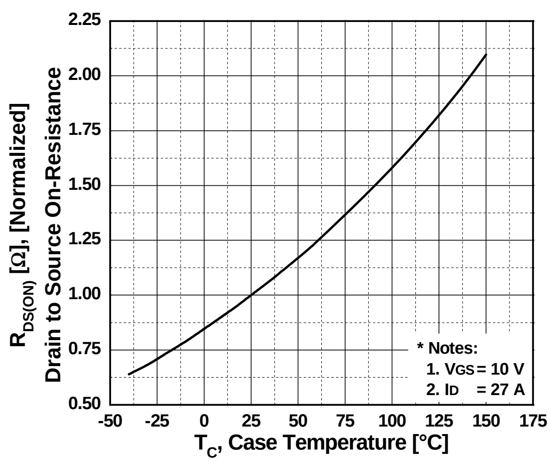



图 10. 体二极管正向电压变化 Vs. 源极电流和温度 — MOSFET

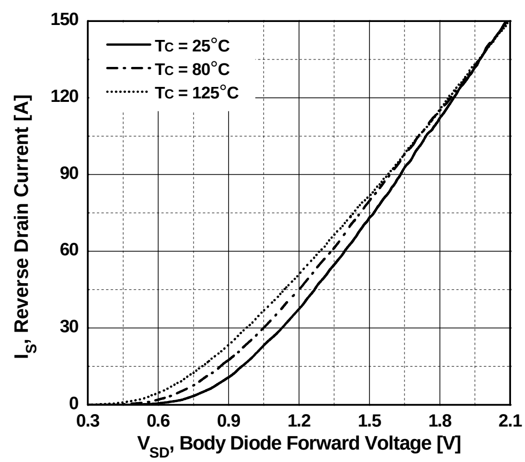



图 11. 关断损耗 Vs. 栅极电阻值 —MOSFET

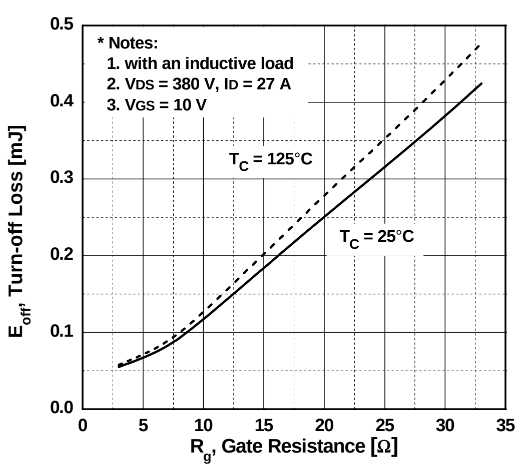
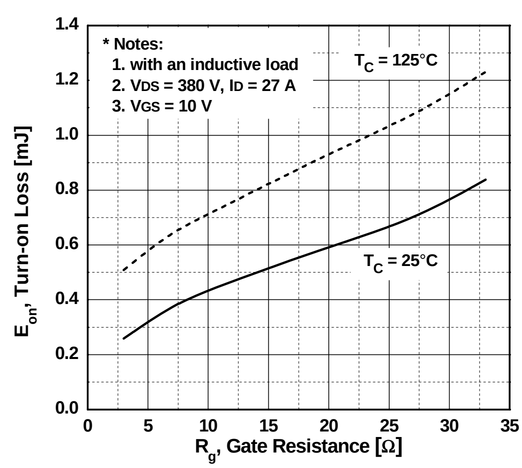



图 12. 开通损耗 Vs. 栅极电阻值 —MOSFET



## 典型性能特征（接上页）

图 13. 关断损耗 Vs. 漏极电流 —MOSFET

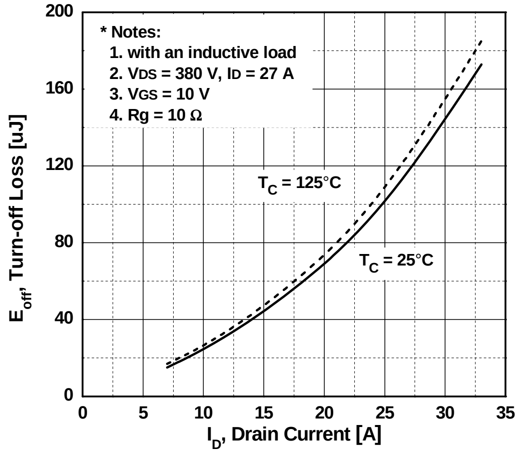



图 14. 开通损耗 Vs. 漏极电流 —MOSFET

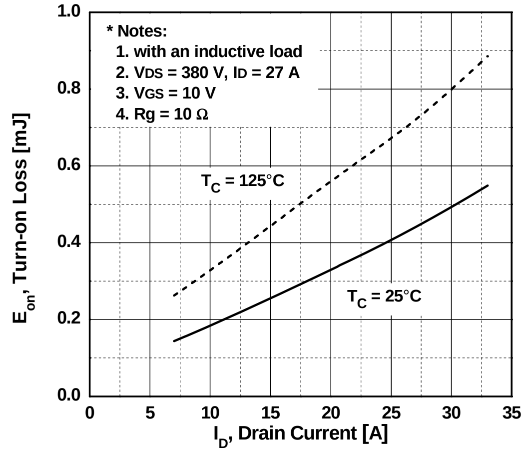



图 15. 瞬态热响应曲线 —MOSFET

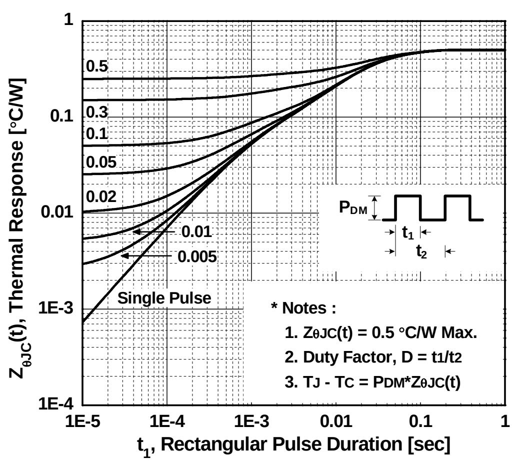



图 16. 典型正向压降 Vs. 正向电流 — 整流二极管

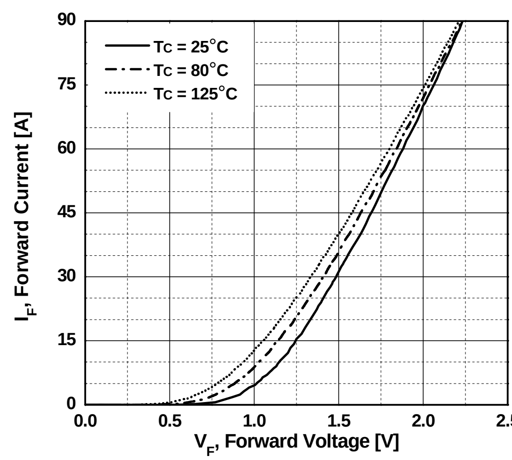
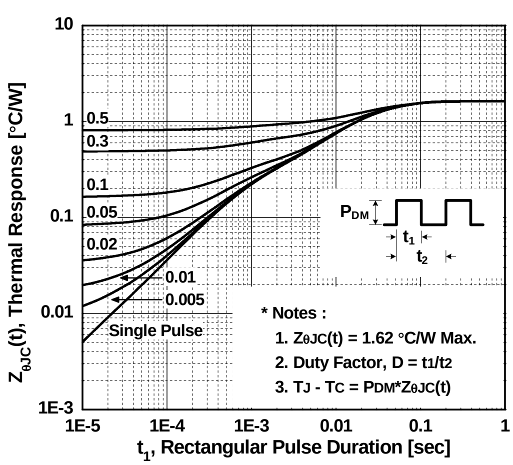
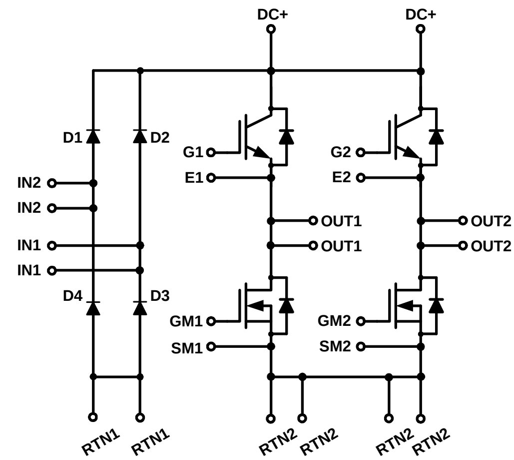


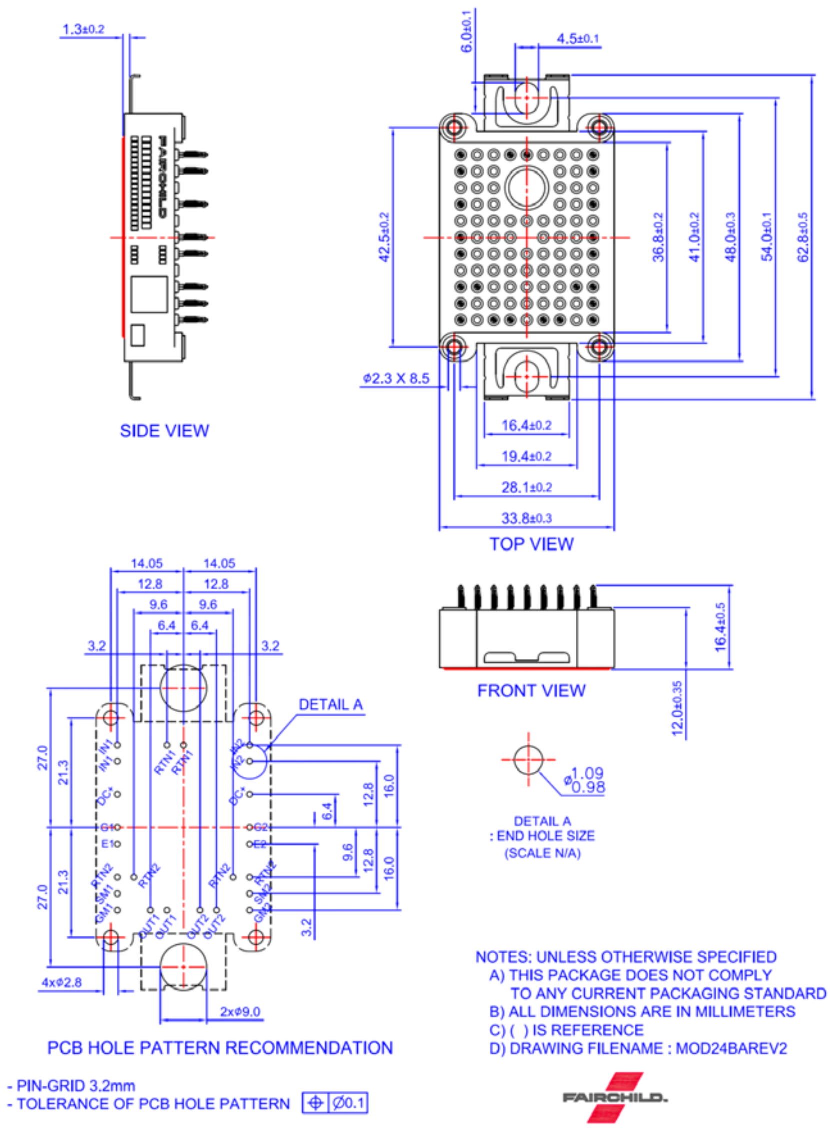

图 17. 瞬态热响应曲线整流二极管



## 内部电路图


DC+
DC+
D1
D2
G1
E1
G2
E2
IN2
IN2
IN1
IN1
OUT1
OUT1
OUT2
OUT2
D4
D3
GM1
SM1
GM2
SM2
RTN1
RTN1
RTN2
RTN2
RTN2
RTN2

## 封装轮廓图


SIDE VIEW
TOP VIEW
FRONT VIEW
DETAIL A
DETAIL A
: END HOLE SIZE
(SCALE N/A)
PCB HOLE PATTERN RECOMMENDATION
- PIN-GRID 3.2mm
- TOLERANCE OF PCB HOLE PATTERN
NOTES: UNLESS OTHERWISE SPECIFIED
A) THIS PACKAGE DOES NOT COMPLY
TO ANY CURRENT PACKAGING STANDARD
B) ALL DIMENSIONS ARE IN MILLIMETERS
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D) DRAWING FILENAME : MOD24BAREV2
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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 manufacturers 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 applications, 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 handling 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 any 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. |
| No Identification Needed | Full Production | Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design. |
| Obsolete | Not In Production | Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only. |

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