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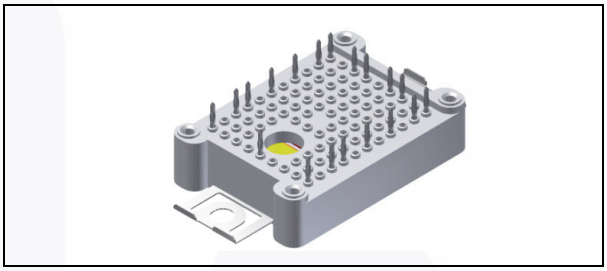
July. 2014

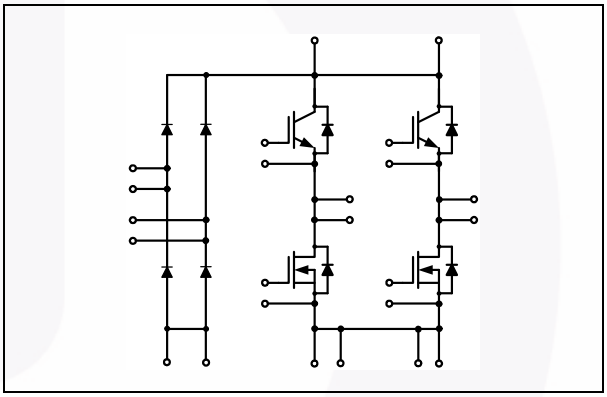
# FPF1C2P5MF07AM
# F1 Module solution for PV-Application

## General Description

Fairchild's brand-new DC-AC module is designed for a power stage that needs more compact design. And the Press-fit technology provides simple and reliable mounting. This module is optimized for the application such as solar inverter where a high efficiency and robust design are needed.



Package Code: F1



Internal Circuit Diagram

### Electrical Features

- High Efficiency
- Low Conduction and Switching losses
- Low $V_{CE(sat)}$ : 1.1 V typ. @ Ic = 30 A
- Low $R_{DS(ON)}$ : 90 mΩ max.
- Fast Recovery Body Diode

### Mechanical Features

- Compact size : F1 Package
- Press-fit contact technology

### Applications

- Solar Inverter

### Certification

- UL approved (E209204)

## Absolute Maximum Ratings $T_C$ = 25°C unless otherwise noted.

| Symbol | Description | | Rating | Units |
|---|---|---|---|---|
| **Rectifier Diode** | | | | |
| $V_{RRM}$ | Peak Repetitive Reverse Voltage | | 620 | V |
| $I_{Fav}$ | Diode Continuous Forward Current | @ $T_C$ = 80°C | 27 | A |
| $I_{FSM}$ | Diode Maximum Forward Surge Current | | 245 | A |
| $I^2t$ | $I^2t$ value | | 300 | $A^2s$ |
| $P_D$ | Maximum Power Dissipation | @ $T_C$ = 25°C | 77 | W |
| $T_J$ | Operating Junction Temperature | | -40 to +150 | °C |

## Absolute Maximum Ratings $T_C$ = 25°C unless otherwise noted. (Continued)

| Symbol | Description | | Rating | Units |
|---|---|---|---|---|
| **High-side IGBT** | | | | |
| $V_{CES}$ | Collector-Emitter Voltage | | 620 | V |
| $V_{GES}$ | Gate-Emitter Voltage | | ± 20 | V |
| $I_C$ | Collector Current | @ $T_C$ = 80°C | 39 | A |
| $I_{CM}$ | Pulsed Collector Current | | 90 | A |
| $I_F$ | Diode Continuous Forward Current | @ $T_C$ = 80°C | 22 | A |
| $I_{FM}$ | Diode Maximum Forward Current | | 90 | A |
| $P_D$ | Maximum Power Dissipation | @ $T_C$ = 25°C | 231 | W |
| $T_J$ | Operating Junction Temperature | | -40 to +150 | °C |
| **Low-side MOSFET** | | | | |
| $V_{DSS}$ | Drain-Source Voltage | | 620 | V |
| $V_{GSS}$ | Gate-Source Voltage | | ± 20 | V |
| $I_D$ | Continuous Drain Current | @ $T_C$ = 25°C | 36 | A |
| | | @ $T_C$ = 80°C | 27 | A |
| $I_{DM}$ | Pulsed Drain Current | Limited by $T_J$ max. | 156 | A |
| $I_S$ | Continuous Source-Drain Forward Current | | 36 | A |
| $I_{SM}$ | Maximum Pulsed Source-Drain Forward Current | | 156 | A |
| $P_D$ | Maximum Power Dissipation | @ $T_C$ = 25°C | 250 | W |
| $T_J$ | Operating Junction Temperature | | -40 to +150 | °C |
| **Module** | | | | |
| $T_{STG}$ | Storage Temperature | | -40 to +125 | °C |
| $V_{ISO}$ | Isolation Voltage | @ AC $1_{MIN}$ | 2500 | V |
| Iso._Material | Internal Isolation Material | | $Al_2O_3$ | |
| $F_{MOUNT}$ | Mounting Force per Clamp | | 20 to 50 | N |
| Weight | | Typ. | 22 | g |
| Creepage | Terminal to Heatsink | | 11.5 | mm |
| | Terminal to Terminal | | 6.3 | mm |
| Clearance | Terminal to Heatsink | | 10.0 | mm |
| | Terminal to Terminal | | 5.0 | mm |

## Package Marking and Ordering Information

| Device | Device Marking | Package | Packing Type | Quantity / Tray |
|---|---|---|---|---|
| FPF1C2P5MF07AM | FPF1C2P5MF07AM | F1 | Tray | 22 |

## Electrical Characteristics $T_C$ = 25°C unless otherwise noted.

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| **Rectifier Diode** | | | | | | |
| $V_F$ | Diode Forward Voltage | $I_F$ = 30 A | - | - | 1.9 | V |
| | | $I_F$ = 30 A @$T_C$ = 125°C | - | 1.45 | - | V |
| $I_R$ | Reverse Leakage Current | $V_R$ = 620 V | - | - | 25 | µA |
| $R_{\theta JC}$ | Thermal Resistance of Junction to Case | per Diode | - | - | 1.62 | °C/W |
| **High-side IGBT** | | | | | | |
| **Off Characteristics** | | | | | | |
| $BV_{CES}$ | Collector-Emitter Breakdown Voltage | $V_{GE}$ = 0 V, $I_C$ = 1 mA | 620 | - | - | V |
| $I_{CES}$ | Collector Cut-off Current | $V_{CE}$ = $V_{CES}$, $V_{GE}$ = 0 V | - | - | 25 | µA |
| $I_{GES}$ | Gate-Emitter Leakage Current | $V_{GE}$ = $V_{GES}$, $V_{CS}$ = 0 V | - | - | 2.5 | µA |
| | | | | | | |
| **On Characteristics** | | | | | | |
| $V_{GE(th)}$ | Gate-Emitter Threshold Voltage | $V_{GE}$ = $V_{CE}$, $I_C$ = 30 mA | 4 | 5.7 | 7 | V |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage | $I_C$ = 30 A, $V_{GE}$ = 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 |
| | | | | | | |
| **Switching Characteristics** | | | | | | |
| $Q_g$ | Total Gate Charge | $V_{DS}$ = 380 V, $V_{GS}$ = 0V...+15 V, $I_D$ = 30 A | - | 214 | - | nC |
| $R_{\theta JC}$ | Thermal Resistance of Junction to Case | per IGBT | - | - | 0.54 | °C/W |

* Note : High-side IGBT is optimized for line frequency switching such as 50/60 Hz.

| | | | | | | |
|---|---|---|---|---|---|---|
| **High-Side FWD** | | | | | | |
| $V_{FM}$ | Diode Forward Voltage | $I_F$ = 15 A, $V_{GS}$ = 0 V | - | 1.75 | 2.25 | V |
| $t_{rr}$ | Reverse Recovery Time | $I_F$ = 15 A<br>$dI_F/dt$ = 1650 A/µs | - | 30 | - | ns |
| $I_{rr}$ | Reverse Recovery Current | | - | 27 | - | A |
| $Q_{rr}$ | Reverse Recovery Charge | | - | 405 | - | nC |
| $t_{rr}$ | Reverse Recovery Time | $I_F$ = 15 A<br>$dI_F/dt$ = 1500 A/µs @$T_C$ = 125°C | - | 43 | | ns |
| $I_{rr}$ | Reverse Recovery Current | | - | 38 | - | A |
| $Q_{rr}$ | Reverse Recovery Charge | | - | 814 | - | nC |
| $R_{\theta JC}$ | Thermal Resistance of Junction to Case | per Diode | - | - | 1.61 | °C/W |

## Electrical Characteristics $T_C$ = 25°C unless otherwise noted. (Continued)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| **Low-Side MOSFET** | | | | | | |
| **Off Characteristics** | | | | | | |
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$ = 0 V, $I_D$ = 1 mA | 620 | - | - | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 620 V, $V_{GS}$ = 0 V | - | - | 25 | μA |
| $I_{GSS}$ | Gate-Body Leakage Current, Forward | $V_{GS}$ = 20 V, $V_{DS}$ = 0 V | | | 2.5 | μA |
| | | | | | | |
| **On Characteristics** | | | | | | |
| $V_{GS(th)}$ | Gate-Source Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 250 mA | 2.7 | 3.8 | 5.3 | V |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance | $I_D$ = 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 |
| $V_{SD}$ | Source-Drain Diode Forward Voltage | $I_{SD}$ = 27 A, $V_{GS}$ = 0 V | - | - | 1.5 | V |
| | | $I_{SD}$ = 47 A, $V_{GS}$ = 0 V | - | 1.3 | - | V |
| | | | | | | |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$ = 380 V<br>$I_D$ = 27 A<br>$V_{GS}$ = 10 V<br>$R_G$ = 10 Ω<br>Inductive Load<br>$T_C$ = 25°C | - | 57 | - | ns |
| $t_r$ | Rise Time | | - | 14 | - | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 240 | - | ns |
| $t_f$ | Fall Time | | - | 20 | - | ns |
| $E_{ON}$ | Turn-On Switching Loss per Pulse | | - | 440 | - | μJ |
| $E_{OFF}$ | Turn-Off Switching Loss per Pulse | | - | 113 | - | μJ |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{CC}$ = 380 V<br>$I_D$ = 27 A<br>$V_{GS}$ = 10 V<br>$R_G$ = 10 Ω<br>Inductive Load<br>$T_C$ = 125°C | - | 53 | - | ns |
| $t_r$ | Rise Time | | - | 16 | - | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | - | 257 | - | ns |
| $t_f$ | Fall Time | | - | 20 | - | ns |
| $E_{ON}$ | Turn-On Switching Loss per Pulse | | - | 719 | - | μJ |
| $E_{OFF}$ | Turn-Off Switching Loss per Pulse | | - | 124 | - | μJ |
| $Q_g$ | Total Gate Charge | $V_{DS}$ = 380 V, $V_{GS}$ = 0V...+10 V,<br>$I_D$ = 27 A | - | 155 | - | nC |
| $R_{\theta JC}$ | Thermal Resistance of Junction to Case | per Chip | - | - | 0.5 | °C/W |

## Typical Performance Characteristic

**Fig 1. Typical Output Characteristics - IGBT**

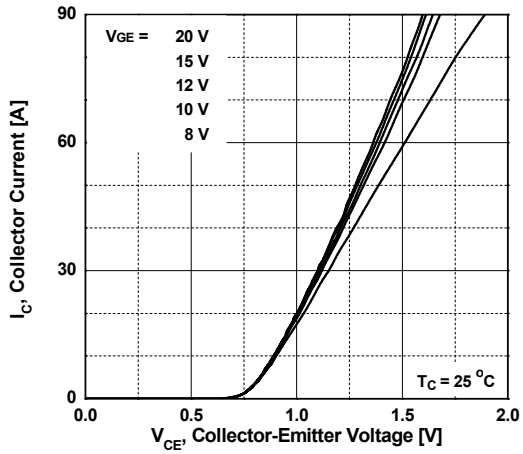



**Fig 2. Typical Output Characteristics - IGBT**

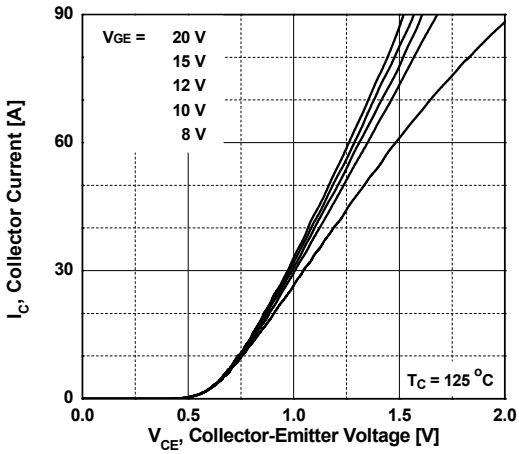



**Fig 3. Typical Saturation Voltage Characteristics - IGBT**

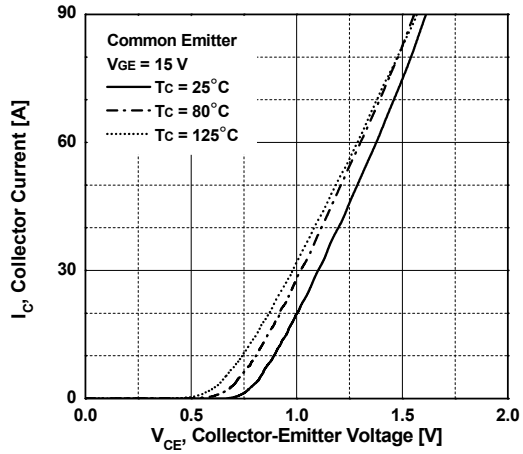



**Fig 4. Transient Thermal Response Curve - IGBT**

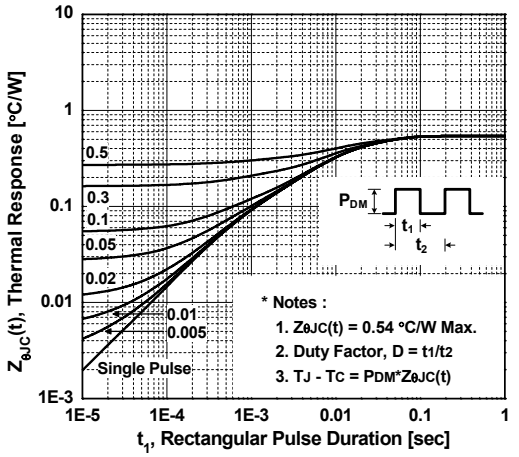



**Fig 5. Typical Forward Voltage Drop vs. Forward Current - High-Side FWD**

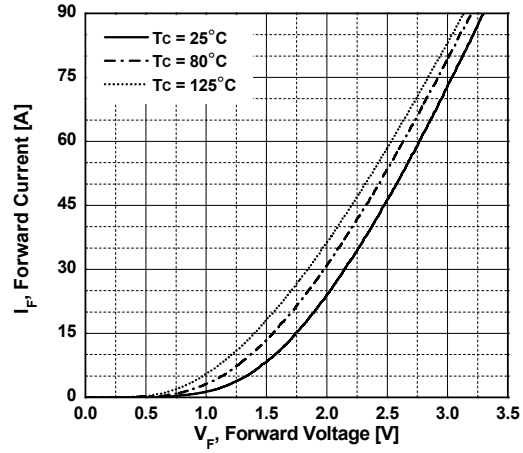
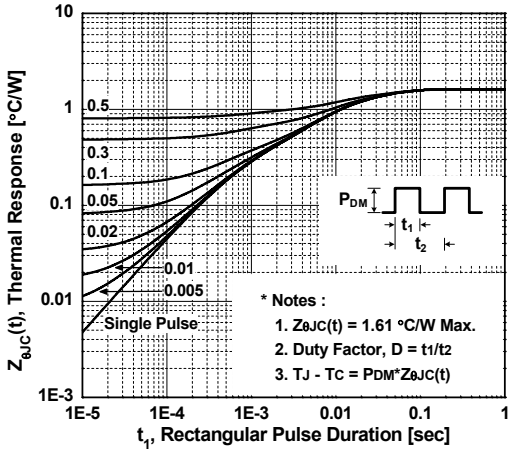



**Fig 6. Transient Thermal Response Curve - High-Side FWD**



## Typical Performance Characteristic (Continued)

**Fig 7. On-Region Characteristics - MOSFET**

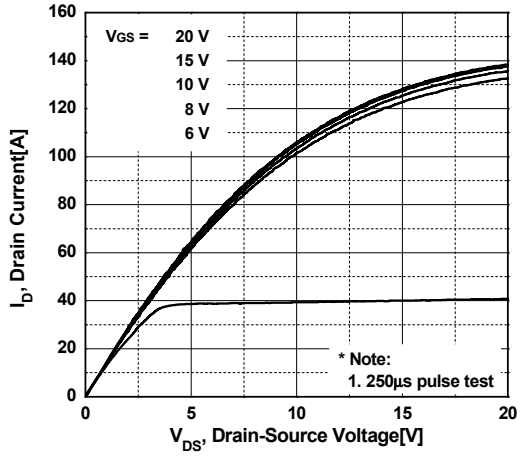



**Fig 8. On-Resistance Variation vs. Drain Current and Gate Voltage - MOSFET**

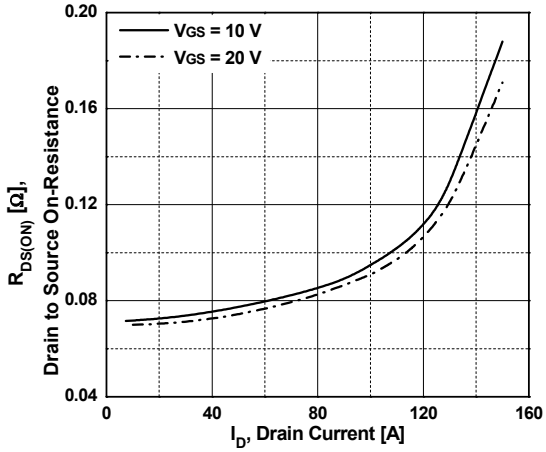



**Fig 9. On-Resistance Variation vs. Temperature - MOSFET**

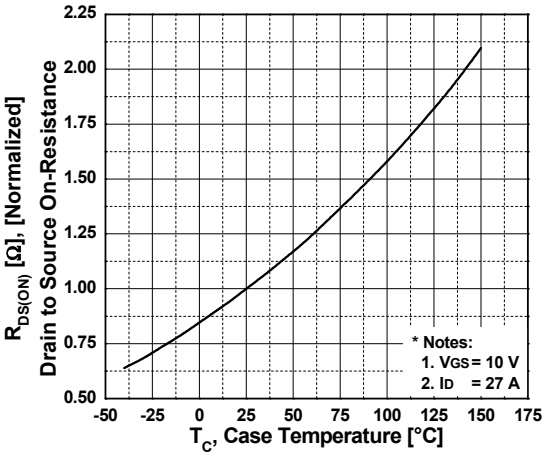



**Fig 10. Body Diode Forward Voltage Variation vs. Source Current and Temperature - MOSFET**

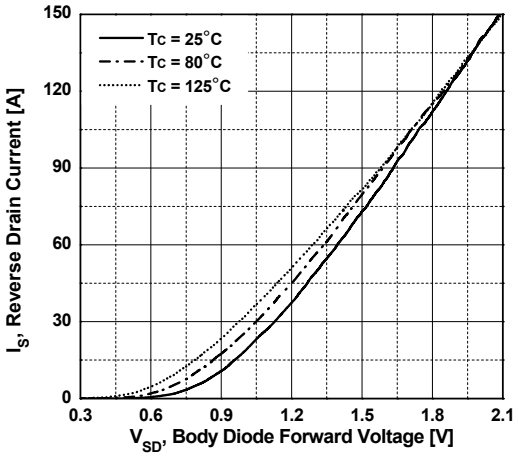



**Fig 11. Turn-Off Loss vs. Gate Resistor Values - MOSFET**

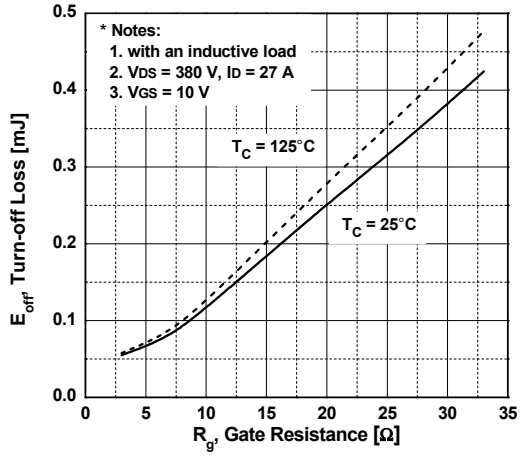
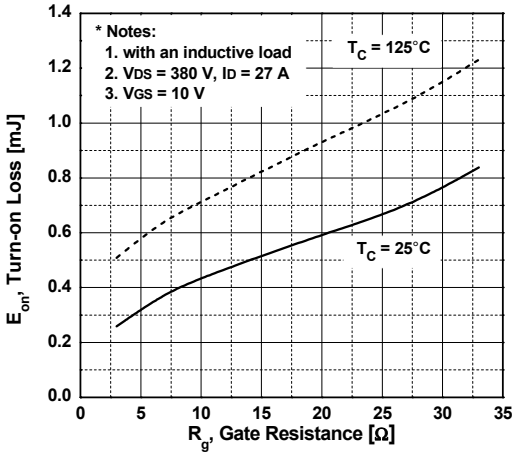



**Fig 12. Turn-On Loss vs. Gate Resistor Values - MOSFET**



## Typical Performance Characteristic (Continued)

**Fig 13. Turn-Off Loss vs. Drain Current - MOSFET**

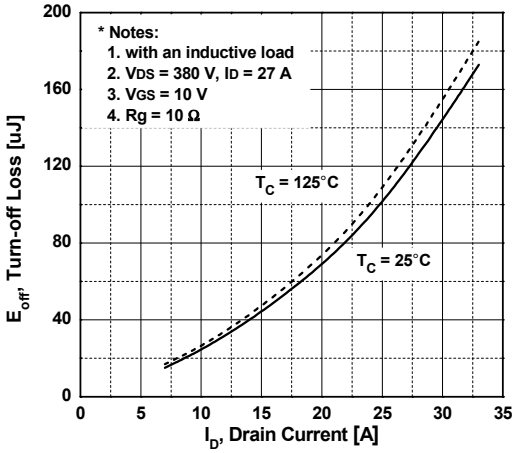



**Fig 14. Turn-On Loss vs. Drain Current - MOSFET**

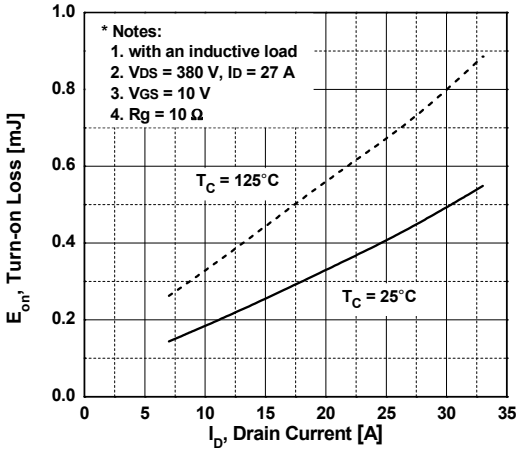



**Fig 15. Transient Thermal Response Curve - MOSFET**

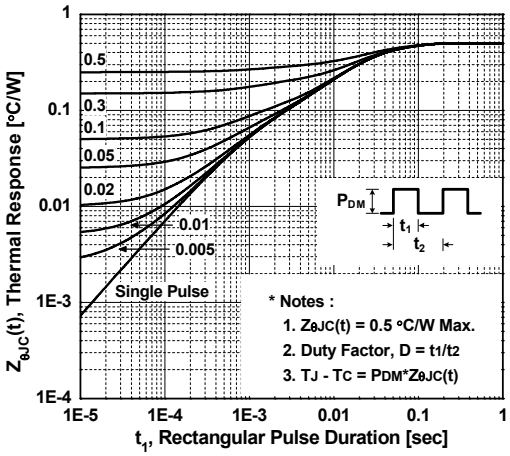



**Fig 16. Typical Forward Voltage Drop vs. Forward Current - Rectifier Diode**

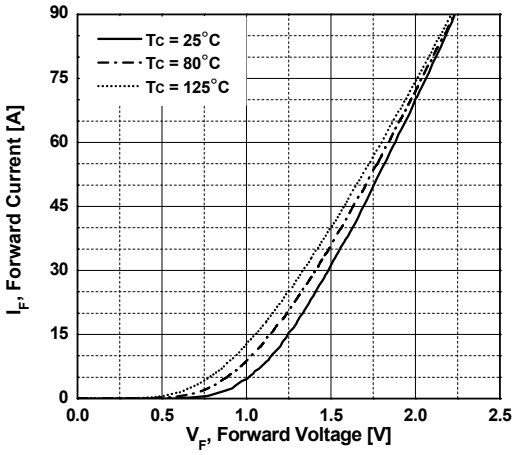
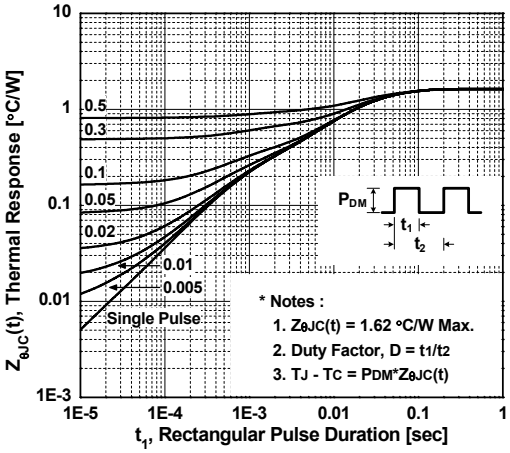
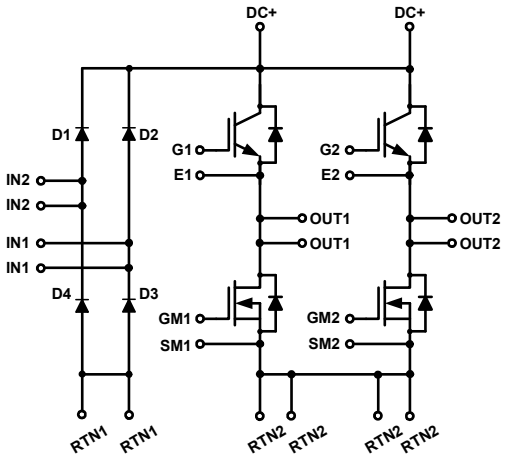


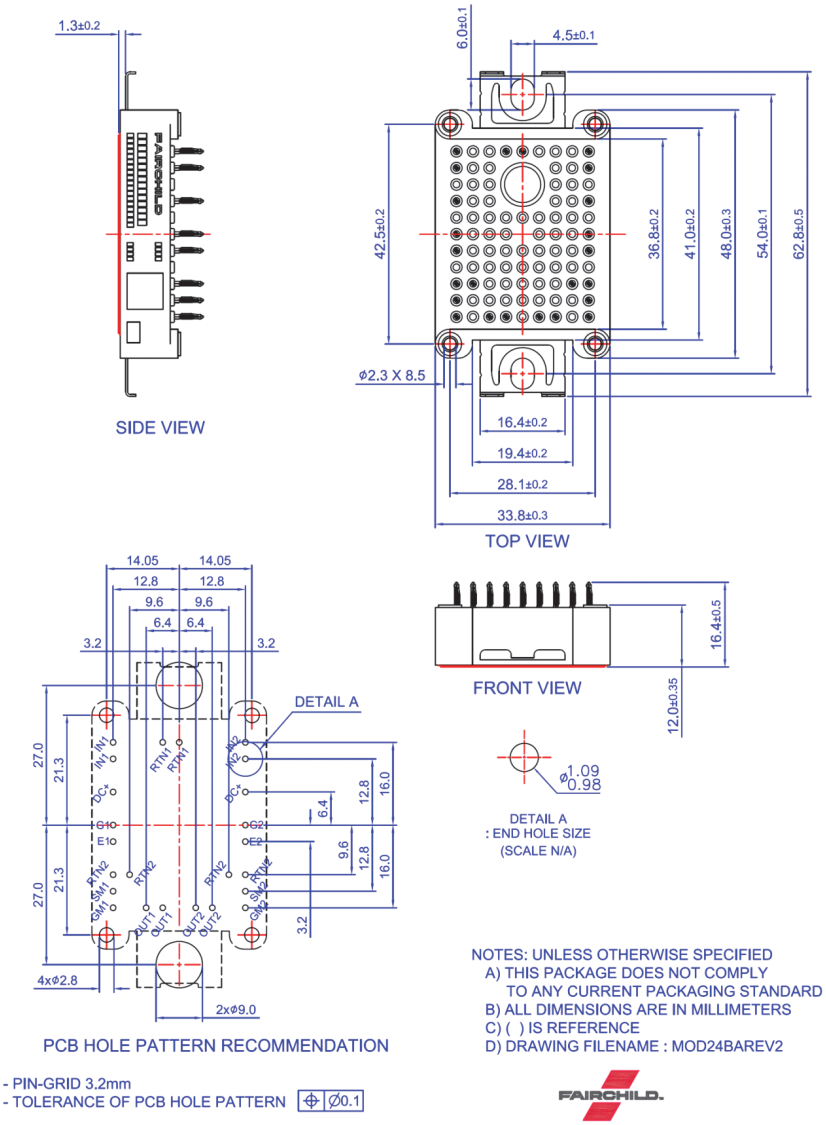

**Fig 17. Transient Thermal Response Curve - Rectifier Diode**



## Internal Circuit Diagram




## Package Outlines [mm]



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## 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. |

Rev. I66

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