February 2015

# FDMC6686P

## P-Channel PowerTrench® MOSFET

**-20 V, -56 A, 4 mΩ**

### Features

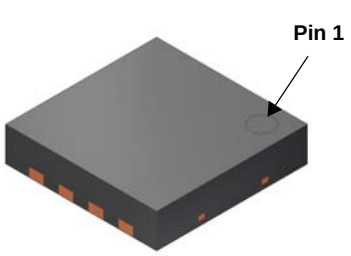
- Max $r_{DS(on)}$ = 4 mΩ at $V_{GS}$ = -4.5 V, $I_D$ = -18 A
- Max $r_{DS(on)}$ = 5.7 mΩ at $V_{GS}$ = -2.5 V, $I_D$ = -16 A
- Max $r_{DS(on)}$ =11.5 mΩ at $V_{GS}$ = -1.8 V, $I_D$ = -11 A
- High performance trench technology for extremely low $r_{DS(on)}$
- High power and current handling capability in a widely used surface mount package
- Lead-free and RoHS Compliant

### General Description

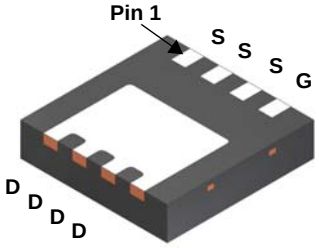
This P-Channel MOSFET is produced using Fairchild Semiconductor's advanced PowerTrench® process that has been optimized for $r_{DS(ON)}$, switching performance and ruggedness.

### Applications

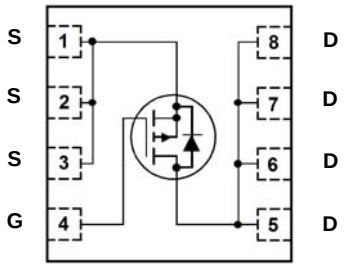
- Load Switch
- Battery Management
- Power Management
- Reverse Polarity Protection




Top




Bottom




Power 33

## MOSFET Maximum Ratings $T_A$ = 25 °C unless otherwise noted

| Symbol | Parameter | | | Ratings | Units |
|---|---|---|---|---|---|
| $V_{DS}$ | Drain to Source Voltage | | | -20 | V |
| $V_{GS}$ | Gate to Source Voltage | | | ±8 | V |
| $I_D$ | Drain Current -Continuous | $T_C$ = 25 °C | | -56 | A |
| | -Continuous | $T_A$ = 25 °C | (Note 1a) | -18 | |
| | -Pulsed | | (Note 3) | -377 | |
| $P_D$ | Power Dissipation | $T_C$ = 25 °C | | 40 | W |
| | Power Dissipation | $T_A$ = 25 °C | (Note 1a) | 2.3 | |
| $T_J$, $T_{STG}$ | Operating and Storage Junction Temperature Range | | | -55 to +150 | °C |

### Thermal Characteristics

| | | | | |
|---|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case | | 3.1 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | (Note 1a) | 53 | |

### Package Marking and Ordering Information

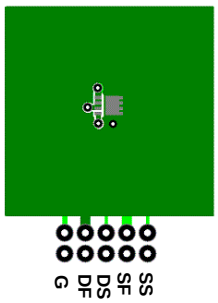
| Device Marking | Device | Package | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|
| FDMC6686P | FDMC6686P | Power 33 | 13 ” | 12 mm | 3000 units |

## Electrical Characteristics $T_J$ = 25 °C unless otherwise noted

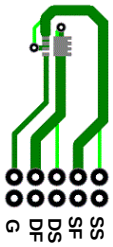
| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $BV_{DSS}$ | Drain to Source Breakdown Voltage | $I_D$ = -250 μA, $V_{GS}$ = 0 V | -20 | | | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D$ = -250 μA, referenced to 25 °C | | -15 | | mV/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = -16 V, $V_{GS}$ = 0 V | | | -1 | μA |
| $I_{GSS}$ | Gate to Source Leakage Current | $V_{GS}$ = ±8 V, $V_{DS}$ = 0 V | | | ±100 | nA |
| **On Characteristics** | | | | | | |
| $V_{GS(th)}$ | Gate to Source Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = -250 μA | -0.4 | -0.75 | -1 | V |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate to Source Threshold Voltage Temperature Coefficient | $I_D$ = -250 μA, referenced to 25 °C | | 3 | | mV/°C |
| $r_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS}$ = -4.5 V, $I_D$ = -18 A | | 3.3 | 4 | mΩ |
| | | $V_{GS}$ = -2.5 V, $I_D$ = -16 A | | 4.1 | 5.7 | |
| | | $V_{GS}$ = -1.8 V, $I_D$ = -11 A | | 6 | 11.5 | |
| | | $V_{GS}$ = -4.5 V, $I_D$ = -18 A, $T_J$ = 125 °C | | 4.3 | 6.5 | |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = -5 V, $I_D$ = -18 A | | 116 | | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = -10 V, $V_{GS}$ = 0 V, f = 1 MHz | | 8800 | 13200 | pF |
| $C_{oss}$ | Output Capacitance | | | 1520 | 2280 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 1340 | 2010 | pF |
| $R_g$ | Gate Resistance | | | 6.2 | | Ω |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$ = -10 V, $I_D$ = -18 A, $V_{GS}$ = -4.5 V, $R_{GEN}$ = 6 Ω | | 25 | 40 | ns |
| $t_r$ | Rise Time | | | 77 | 122 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 317 | 506 | ns |
| $t_f$ | Fall Time | | | 178 | 285 | ns |
| $Q_g$ | Total Gate Charge | $V_{DD}$ = -10 V, $I_D$ = -18 A, $V_{GS}$ = -4.5 V | | 87 | 122 | nC |
| $Q_{gs}$ | Gate to Source Charge | | | 14 | | nC |
| $Q_{gd}$ | Gate to Drain “Miller” Charge | | | 24 | | nC |
| **Drain-Source Diode Characteristics** | | | | | | |
| $V_{SD}$ | Source to Drain Diode Forward Voltage | $V_{GS}$ = 0 V, $I_S$ = -18 A (Note 2) | | -0.7 | -1.2 | V |
| | | $V_{GS}$ = 0 V, $I_S$ = -2 A (Note 2) | | -0.6 | -1.2 | |
| $t_{rr}$ | Reverse Recovery Time | $I_F$ = -18 A, di/dt = 100 A/μs | | 38 | 61 | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | | 24 | 39 | nC |

NOTES:

1. $R_{\theta JA}$ is determined with the device mounted on a 1 $in^2$ pad 2 oz copper pad on a 1.5 x 1.5 in. board of FR-4 material. $R_{\theta JC}$ is guaranteed by design while $R_{\theta CA}$ is determined by the user's board design.




a. 53 °C/W when mounted on a 1 $in^2$ pad of 2 oz copper.




b. 125 °C/W when mounted on a minimum pad of 2 oz copper.

2. Pulse Test: Pulse Width < 300 μs, Duty cycle < 2.0%.
3. Pulse Id refers to Forward Bias Safe Operation Area.

## Typical Characteristics $T_J$ = 25 °C unless otherwise noted

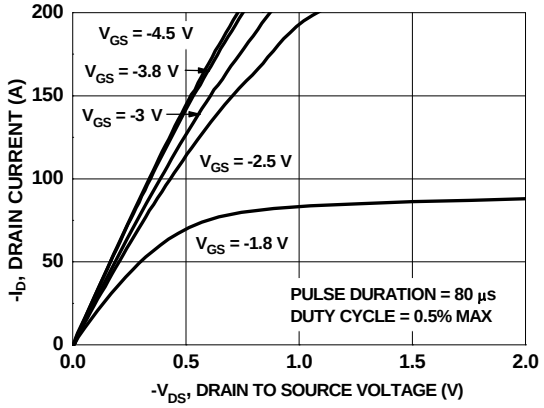



**Figure 1. On-Region Characteristics**

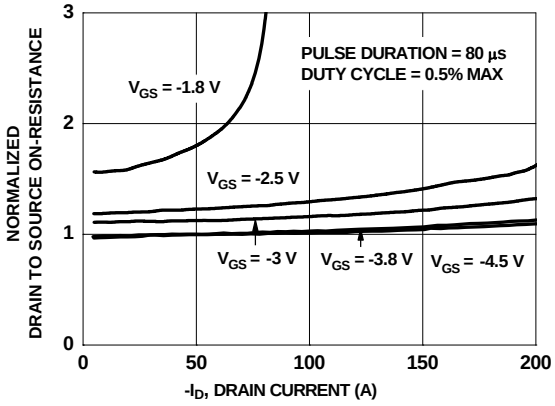



**Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage**

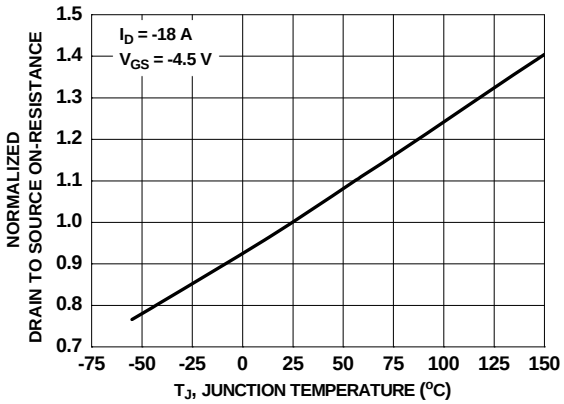



**Figure 3. Normalized On-Resistance vs Junction Temperature**

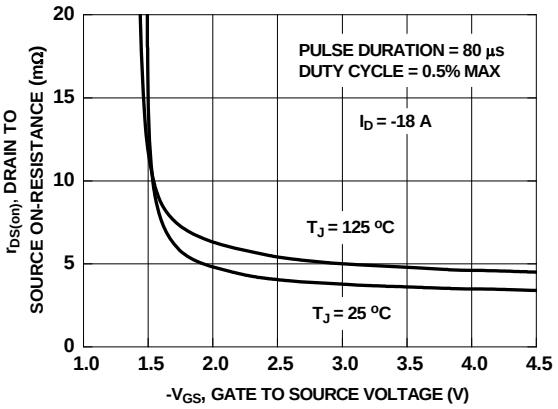



**Figure 4. On-Resistance vs Gate to Source Voltage**

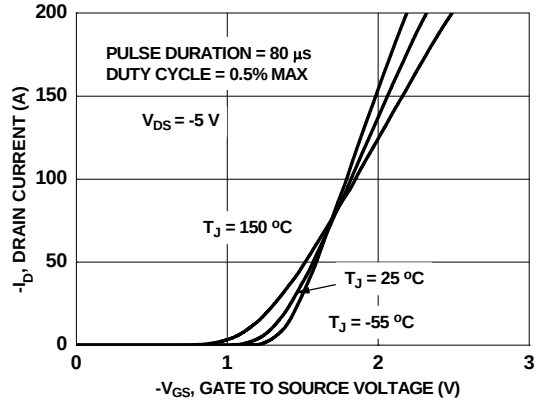



**Figure 5. Transfer Characteristics**

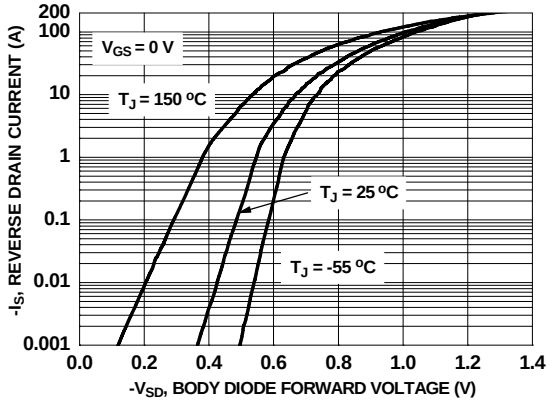



**Figure 6. Source to Drain Diode Forward Voltage vs Source Current**

## Typical Characteristics $T_J$ = 25 °C unless otherwise noted

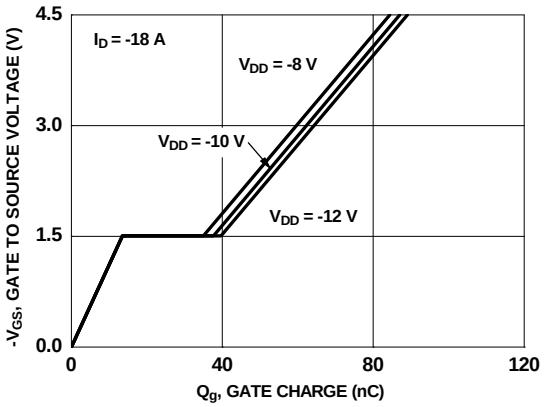



**Figure 7. Gate Charge Characteristics**

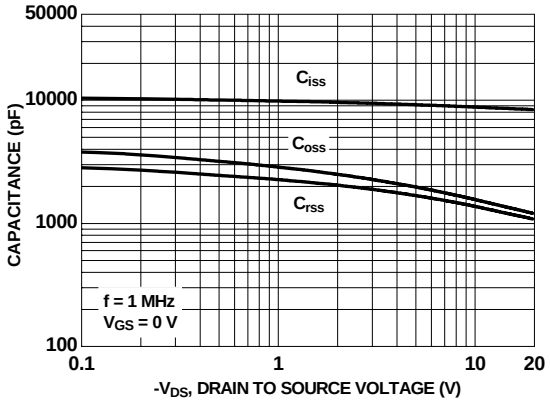



**Figure 8. Capacitance vs Drain to Source Voltage**

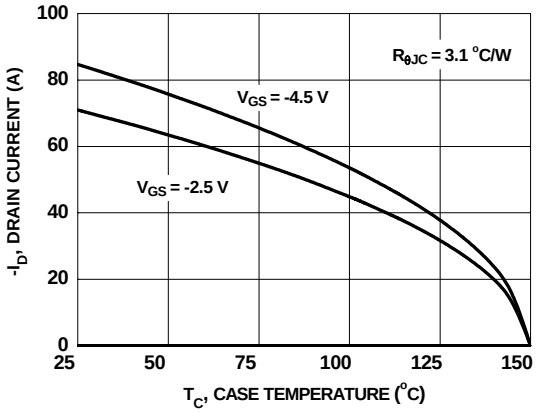



**Figure 9. Maximum Continuous Drain Current vs Case Temperature**

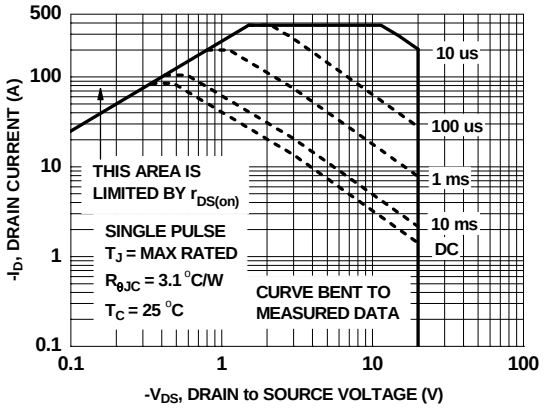



**Figure 10. Forward Bias Safe Operating Area**

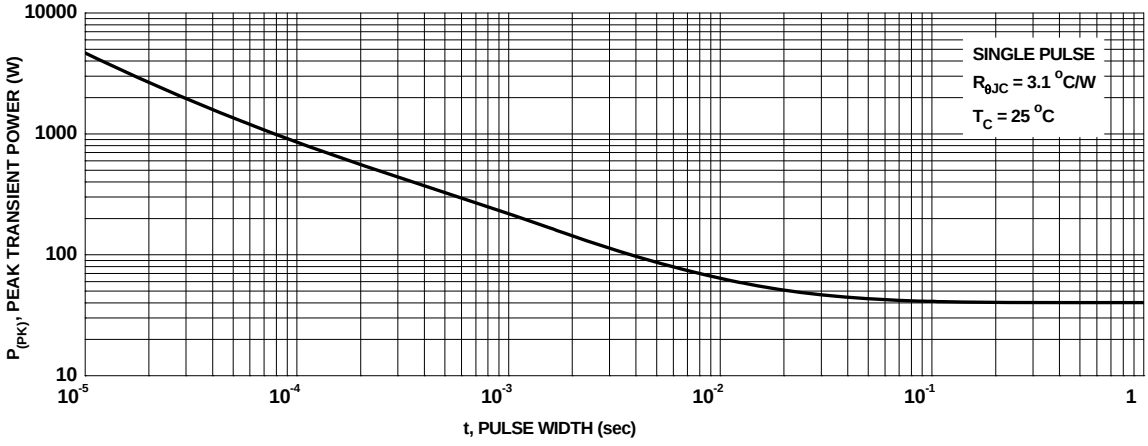



**Figure 11. Single Pulse Maximum Power Dissipation**

## Typical Characteristics $T_J$ = 25 °C unless otherwise noted

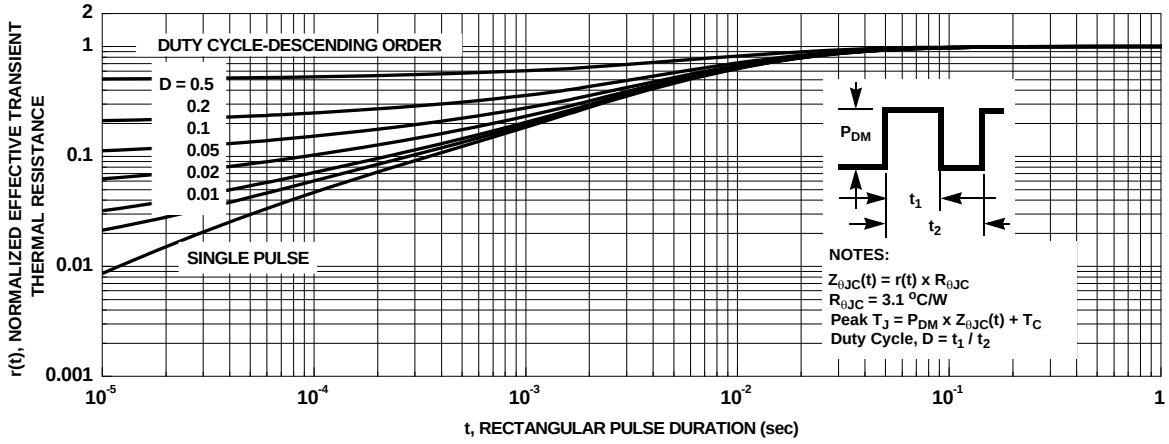
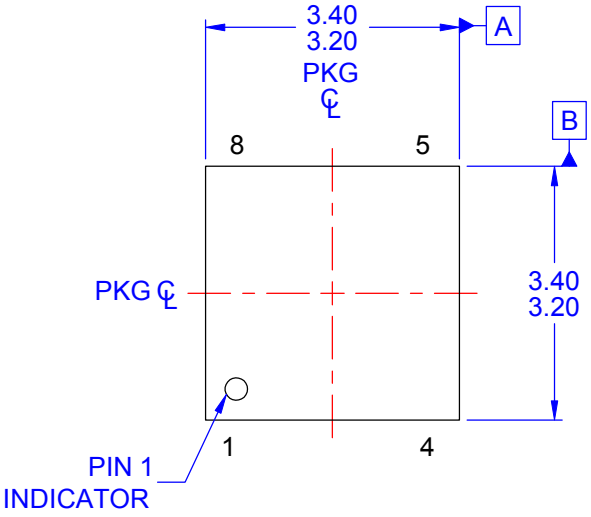
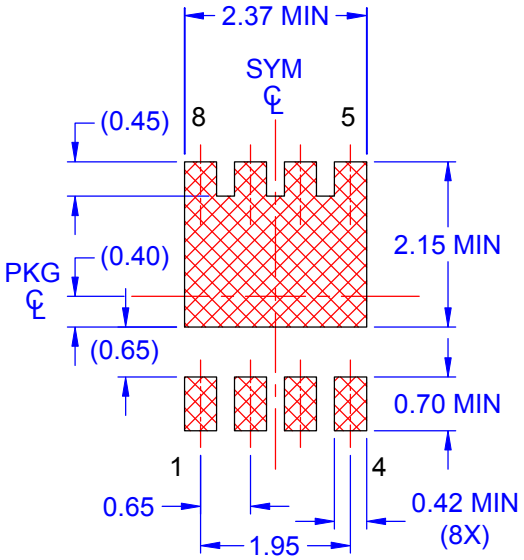
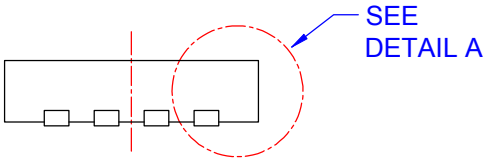


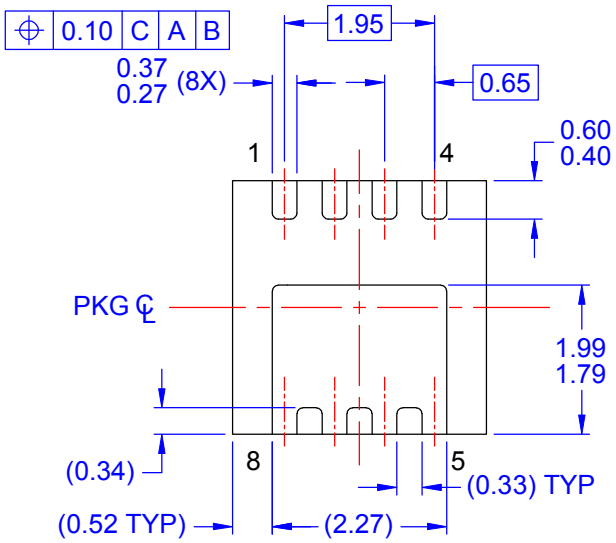

**Figure 12. Junction-to-Case Transient Thermal Response Curve**

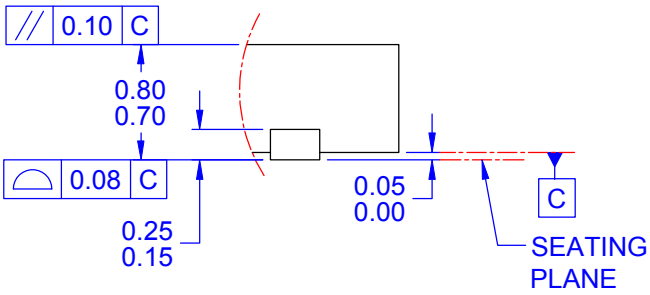



LAND PATTERN
RECOMMENDATION




**DETAIL A**
SCALE: 2X

NOTES: UNLESS OTHERWISE SPECIFIED

A) PACKAGE STANDARD REFERENCE: JEDEC MO-240, ISSUE A, VAR. BA,
B) ALL DIMENSIONS ARE IN MILLIMETERS.
C) DIMENSIONS DO NOT INCLUDE BURRS OR MOLD FLASH. MOLD FLASH OR BURRS DOES NOT EXCEED 0.10MM.
D) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-2009.
E) DRAWING FILE NAME: MKT-PQFN08SREV1