
**Is Now Part of**


**ON Semiconductor®**

**To learn more about ON Semiconductor, please visit our website at**
**www.onsemi.com**

Please note: As part of the Fairchild Semiconductor integration, some of the Fairchild orderable part numbers will need to change in order to meet ON Semiconductor's system requirements. Since the ON Semiconductor product management systems do not have the ability to manage part nomenclature that utilizes an underscore (_), the underscore (_) in the Fairchild part numbers will be changed to a dash (-). This document may contain device numbers with an underscore (_). Please check the ON Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at www.onsemi.com. Please email any questions regarding the system integration to Fairchild_questions@onsemi.com.

March 2015

# FDD5680

## N-Channel, PowerTrench™ MOSFET

### General Description

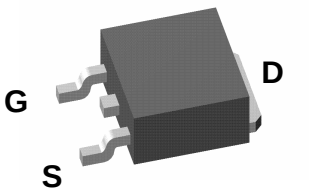
This N-Channel MOSFET is produced using Fairchild Semiconductor's advanced PowerTrench process that has been especially tailored to minimize the on-state resistance and yet maintain low gate charge for superior switching performance.

### Applications

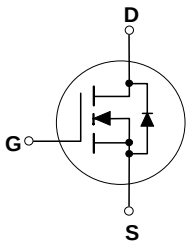
- DC/DC converter
- Motor drives

### Features

- 38 A, 60 V. $R_{DS(on)}$ = 0.021 Ω @ $V_{GS}$ = 10 V
  $R_{DS(on)}$ = 0.025 Ω @ $V_{GS}$ = 6 V.
- Low gate charge (33nC typical).
- Fast switching speed.
- High performance trench technology for extremely low $R_{DS(on)}$.




TO-252




## Absolute Maximum Ratings

$T_A$=25°C unless otherwise noted

| Symbol | Parameter | | Ratings | Units |
|---|---|---|---|---|
| $V_{DSS}$ | Drain-Source Voltage | | 60 | V |
| $V_{GSS}$ | Gate-Source Voltage | | ±20 | V |
| $I_D$ | Maximun Drain Current - Continuous | (Note 1) | 38 | A |
| | | (Note 1a) | 8.5 | |
| | Maximum Drain Current - Pulsed | | 100 | |
| $P_D$ | Maximum Power Dissipation @ $T_C$ = 25°C | (Note 1) | 60 | W |
| | $T_A$ = 25°C | (Note 1a) | 2.8 | |
| | $T_A$ = 25°C | (Note 1b) | 1.3 | |
| $T_J$, $T_{stg}$ | Operating and Storage Junction Temperature Range | | -55 to +150 | °C |

## Thermal Characteristics

| | | | | |
|---|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to- Case | (Note 1) | 2.1 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to- Ambient | (Note 1b) | 96 | °C/W |

## Package Marking and Ordering Information

| Device Marking | Device | Reel Size | Tape width | Quantity |
|---|---|---|---|---|
| FDD5680 | FDD5680 | 13" | 16mm | 2500 |

## Electrical Characteristics

$T_A$ = 25°C unless otherwise noted

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $W_{DSS}$ | Single Pulse Drain-Source Avalanche Energy | $V_{DD}$ = 30 V, $I_D$ = 38 A | | | 140 | mJ |
| $I_{AR}$ | Maximum Drain-Source Avalanche Current | | | | 38 | A |
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$ = 0 V, $I_D$ = 250 µA | 60 | | | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250µA, Referenced to 25°C | | 60 | | mV/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 48 V, $V_{GS}$ = 0 V | | | 1 | µA |
| $I_{GSSF}$ | Gate-Body Leakage Current, Forward | $V_{GS}$ = 20V, $V_{DS}$ = 0 V | | | 100 | nA |
| $I_{GSSR}$ | Gate-Body Leakage Current, Reverse | $V_{GS}$ = -20 V, $V_{DS}$ = 0 V | | | -100 | nA |
| **On Characteristics** (Note 2) | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | 2 | 2.4 | 4 | V |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate Threshold Voltage Temperature Coefficient | $I_D$ = 250 µA,Referenced to 25°C | | -6.4 | | mV/°C |
| $R_{DS(on)}$ | Static Drain-Source On-Resistance | $V_{GS}$ = 10 V, $I_D$ = 8.5 A<br>$V_{GS}$ = 10 V, $I_D$ = 8.5 A,$T_J$=125°C<br>$V_{GS}$ = 6 V, $I_D$ = 7.5 A | | 0.017<br>0.028<br>0.019 | 0.021<br>0.042<br>0.025 | Ω |
| $I_{D(on)}$ | On-State Drain Current | $V_{GS}$ = 10 V, $V_{DS}$ = 5 V | 50 | | | A |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 5 V, $I_D$ = 8.5 A | | 30 | | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 30 V, $V_{GS}$ = 0 V, f = 1.0 MHz | | 1835 | | pF |
| $C_{oss}$ | Output Capacitance | | | 210 | | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 90 | | pF |
| **Switching Characteristics** (Note 2) | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$ = 30 V, $I_D$ = 1 A, $V_{GS}$ = 10 V, $R_{GEN}$ = 6 Ω | | 15 | 27 | ns |
| $t_r$ | Turn-On Rise Time | | | 9 | 18 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 35 | 56 | ns |
| $t_f$ | Turn-Off Fall Time | | | 16 | 26 | ns |
| $Q_g$ | Total Gate Charge | $V_{DS}$ = 30 V, $I_D$ = 8.5 A, $V_{GS}$ = 10 V, | | 33 | 46 | nC |
| $Q_{gs}$ | Gate-Source Charge | | | 6.5 | | nC |
| $Q_{gd}$ | Gate-Drain Charge | | | 7.5 | | nC |
| **Drain-Source Diode Characteristics and Maximum Ratings** | | | | | | |
| $I_S$ | Maximum Continuous Drain-Source Diode Forward Current | | | | 2.3 | A |
| $V_{SD}$ | Drain-Source Diode Forward Voltage | $V_{GS}$ = 0 V, $I_S$ = 2.3 A (Note 2) | | 0.75 | 1.2 | V |

**Notes:**

**1.** $R_{\theta JA}$ is the sum of the junction-to-case and case-to-ambient resistance where the case thermal reference is defined as the drain tab. $R_{\theta JC}$ is guaranteed by design while $R_{\theta JA}$ is determined by the user's board design.

a) $R_{\theta JA}$= 45°C/W when mounted on a 1in$^2$ pad of 2oz copper.

b) $R_{\theta JA}$= 96°C/W when mounted on a 0.076 pad of 2oz copper.

Scale 1 : 1 on letter size paper

**2.** Pulse Test: Pulse Width ≤ 300 µs, Duty Cycle ≤ 2.0%

## Typical Characteristics

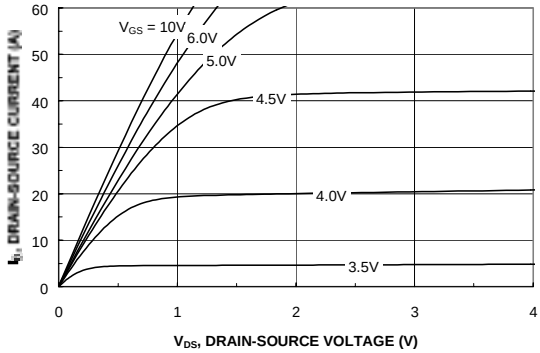



**Figure 1. On-Region Characteristics.**

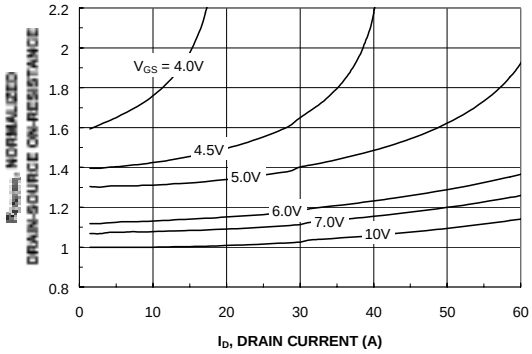



**Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.**

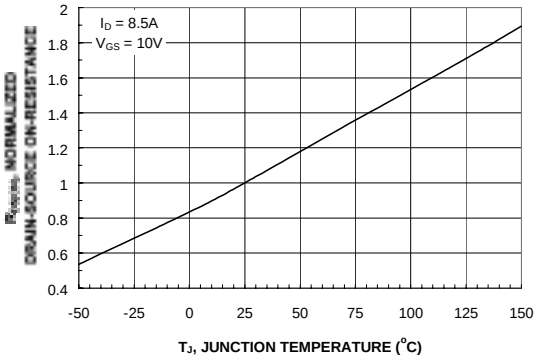



**Figure 3. On-Resistance Variation with Temperature.**

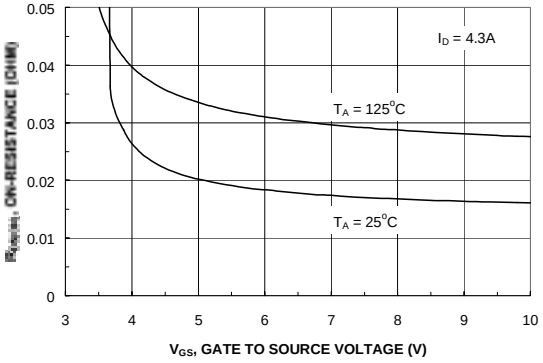



**Figure 4. On-Resistance Variation with Gate-to-Source Voltage.**

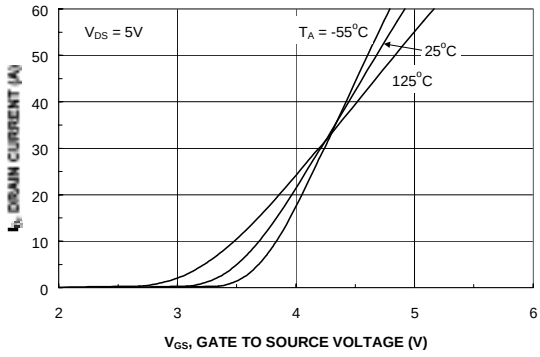



**Figure 5. Transfer Characteristics.**

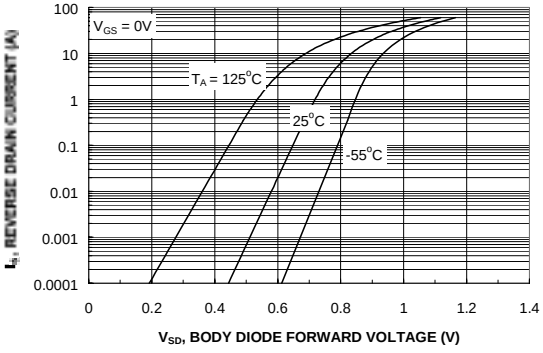



**Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.**

## Typical Characteristics (continued)

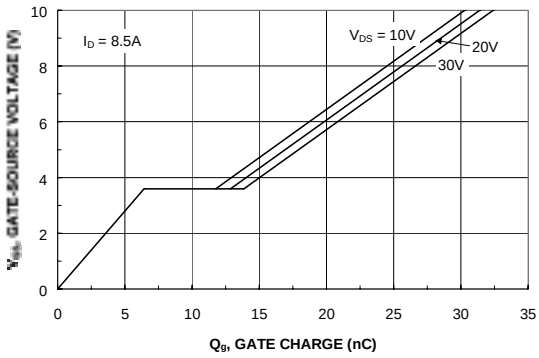



**Figure 7. Gate-Charge Characteristics.**

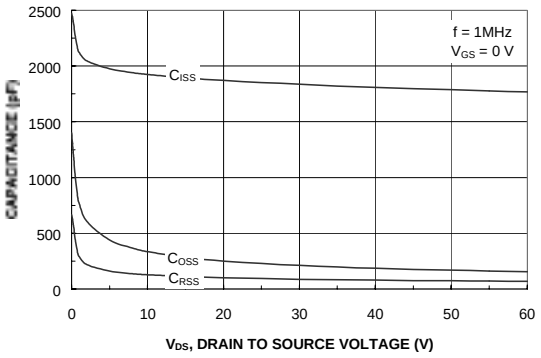



**Figure 8. Capacitance Characteristics.**

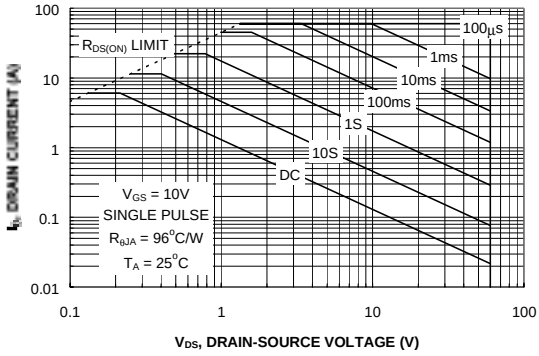



**Figure 9. Maximum Safe Operating Area.**

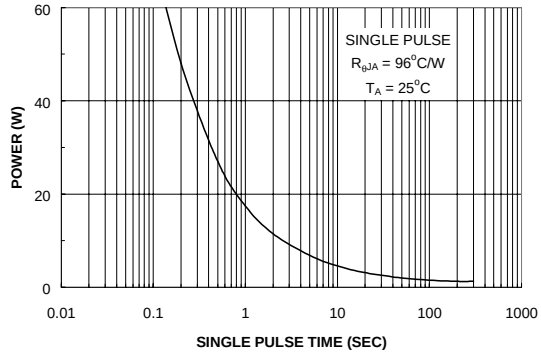



**Figure 10. Single Pulse Maximum Power Dissipation.**

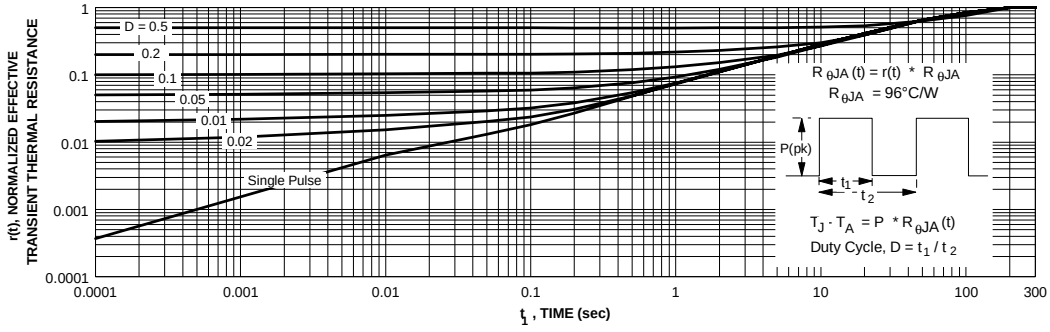
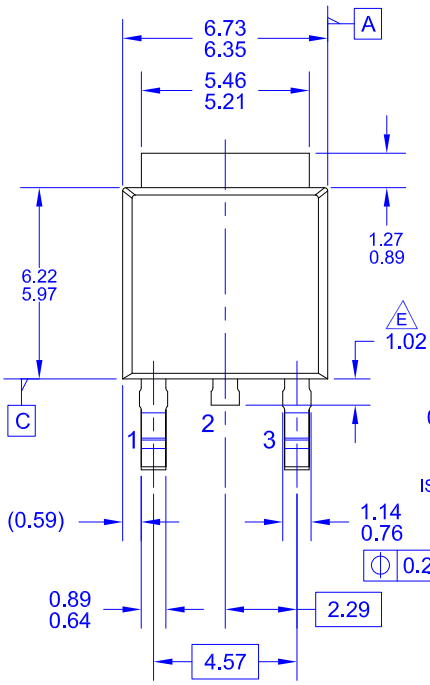
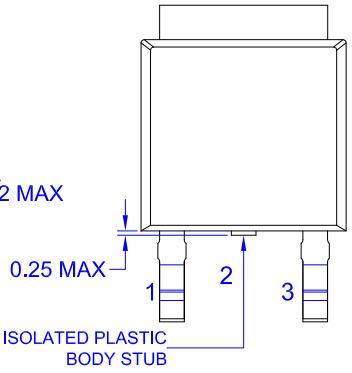



**Figure 11. Transient Thermal Response Curve.**

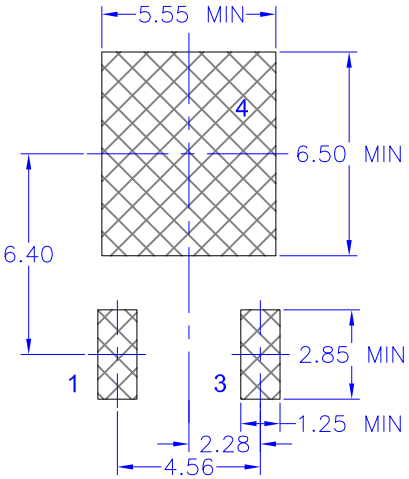
Thermal characterization performed using the conditions described in Note 1b.
Transient themal response will change depending on the circuit board design.



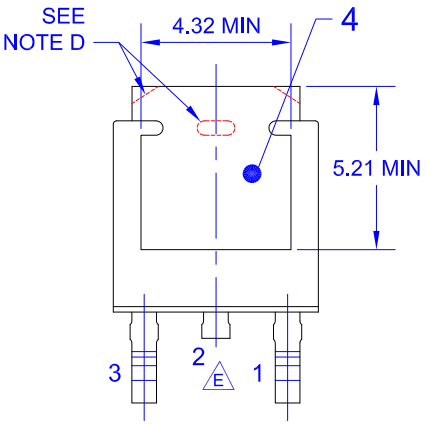

NON-DIODE PRODUCTS VERSION



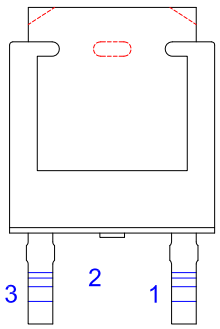

DIODE PRODUCTS VERSION



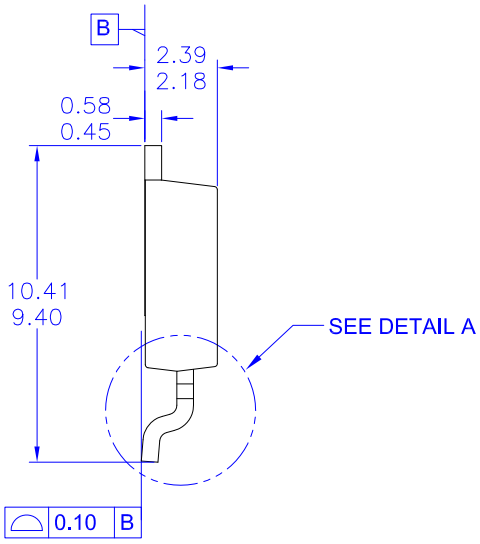

LAND PATTERN RECOMMENDATION




NON-DIODE PRODUCTS VERSION

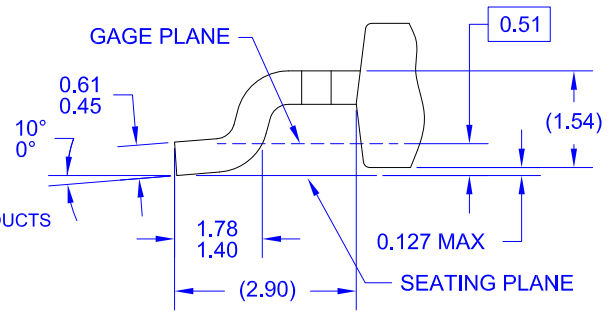



DIODE PRODUCTS VERSION




NOTES: UNLESS OTHERWISE SPECIFIED

A) THIS PACKAGE CONFORMS TO JEDEC, TO-252, ISSUE C, VARIATION AA.
B) ALL DIMENSIONS ARE IN MILLIMETERS.
C) DIMENSIONING AND TOLERANCING PER ASME Y14.5M-2009.
D) SUPPLIER DEPENDENT MOLD LOCKING HOLES OR CHAMFERED CORNERS OR EDGE PROTRUSION.
E) TRIMMED METAL CENTER LEAD IS PRESENT ON FOR NON-DIODE PRODUCTS
F) DIMENSIONS ARE EXCLUSIVE OF BURS, MOLD FLASH AND TIE BAR EXTRUSIONS.
G) LAND PATTERN RECOMMENDATION IS BASED ON IPC7351A STD TO228P991X239-3N.
H) DRAWING NUMBER AND REVISION: MKT-TO252A03REV11




DETAIL A
(ROTATED -90°)
SCALE: 12X

FAIRCHILD

## PUBLICATION ORDERING INFORMATION

**LITERATURE FULFILLMENT**:
Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
**Phone**: 303−675−2175 or 800−344−3860 Toll Free USA/Canada
**Fax**: 303−675−2176 or 800−344−3867 Toll Free USA/Canada
**Email**: orderlit@onsemi.com

**N. American Technical Support**: 800−282−9855 Toll Free USA/Canada
**Europe, Middle East and Africa Technical Support:**
Phone: 421 33 790 2910
**Japan Customer Focus Center**
Phone: 81−3−5817−1050

**ON Semiconductor Website**: **www.onsemi.com**

**Order Literature**: http://www.onsemi.com/orderlit

For additional information, please contact your local Sales Representative