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ON Semiconductor®

# FDS6680A

## Single N-Channel, Logic Level, PowerTrench® MOSFET

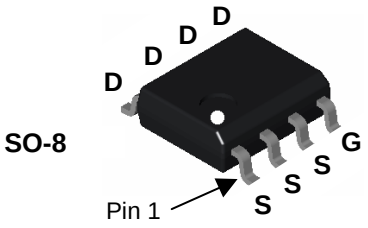
### General Description

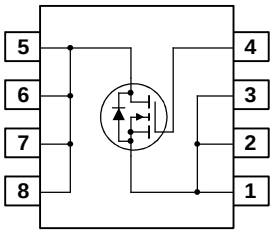
This N-Channel Logic Level MOSFET is produced using ON Semiconductor's advanced Power Trench process that has been especially tailored to minimize the on-state resistance and yet maintain superior switching performance.

These devices are well suited for low voltage and battery powered applications where low in-line power loss and fast switching are required.

### Features

- 12.5 A, 30 V $R_{DS(ON)}$ = 9.5 mΩ @ $V_{GS}$ = 10 V
  $R_{DS(ON)}$ = 13 mΩ @ $V_{GS}$ = 4.5 V
- Ultra-low gate charge
- High performance trench technology for extremely low $R_{DS(ON)}$
- High power and current handling capability




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

| Symbol | Parameter | | Ratings | Units |
|---|---|---|---|---|
| $V_{DSS}$ | Drain-Source Voltage | | 30 | V |
| $V_{GSS}$ | Gate-Source Voltage | | ±20 | |
| $I_D$ | Drain Current – Continuous | (Note 1a) | 12.5 | A |
| | – Pulsed | | 50 | |
| $P_D$ | Power Dissipation for Single Operation | (Note 1a) | 2.5 | W |
| | | (Note 1b) | 1.2 | |
| | | (Note 1c) | 1.0 | |
| $T_J$, $T_{STG}$ | Operating and Storage Junction Temperature Range | | –55 to +150 | °C |

## Thermal Characteristics

| | | | | |
|---|---|---|---|---|
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Case | (Note 1a) | 50 | °C/W |
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case | (Note 1) | 25 | |

## Package Marking and Ordering Information

| Device Marking | Device | Reel Size | Tape width | Quantity |
|---|---|---|---|---|
| FDS6680A | FDS6680A | 13'' | 12mm | 2500 units |


October-2017, Rev. 6

Publication Order Number:
FDS6680A/D

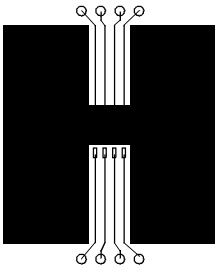
## Electrical Characteristics

$T_A$ = 25°C unless otherwise noted

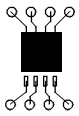
| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $BV_{DSS}$ | Drain–Source Breakdown Voltage | $V_{GS}$ = 0 V, $I_D$ = 250 μA | 30 | | | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250 μA, Referenced to 25°C | | 25 | | mV/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 24 V, $V_{GS}$ = 0 V | | | 1 | μA |
| | | $V_{DS}$ = 24 V, $V_{GS}$ = 0 V, $T_J$=55°C | | | 10 | μA |
| $I_{GSS}$ | Gate–Body Leakage | $V_{GS}$ = ±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 | 1 | 2 | 3 | V |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate Threshold Voltage Temperature Coefficient | $I_D$ = 250 μA, Referenced to 25°C | | –4.9 | | mV/°C |
| $R_{DS(on)}$ | Static Drain–Source On–Resistance | $V_{GS}$ = 10 V, $I_D$ = 12.5 A<br>$V_{GS}$ = 4.5 V, $I_D$ = 10.5 A<br>$V_{GS}$ = 10 V, $I_D$ = 12.5 A, $T_J$=125°C | | 7.8<br>9.9<br>11.0 | 9.5<br>13<br>15 | mΩ |
| $I_{D(on)}$ | On–State Drain Current | $V_{GS}$ = 10 V, $V_{DS}$ = 5 V | 25 | | | A |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 15 V, $I_D$ = 12.5 A | | 64 | | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 15 V, $V_{GS}$ = 0 V, f = 1.0 MHz | | 1620 | | pF |
| $C_{oss}$ | Output Capacitance | | | 380 | | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 160 | | pF |
| $R_G$ | Gate Resistance | $V_{GS}$ = 15 mV, f = 1.0 MHz | | 1.3 | | Ω |
| **Switching Characteristics** (Note 2) | | | | | | |
| $t_{d(on)}$ | Turn–On Delay Time | $V_{DD}$ = 15 V, $I_D$ = 1 A, $V_{GS}$ = 10 V, $R_{GEN}$ = 6 Ω | | 10 | 19 | ns |
| $t_r$ | Turn–On Rise Time | | | 5 | 10 | ns |
| $t_{d(off)}$ | Turn–Off Delay Time | | | 27 | 43 | ns |
| $t_f$ | Turn–Off Fall Time | | | 15 | 27 | ns |
| $Q_g$ | Total Gate Charge | $V_{DS}$ = 15 V, $I_D$ = 12.5 A, $V_{GS}$ = 5 V | | 16 | 23 | nC |
| $Q_{gs}$ | Gate–Source Charge | | | 5 | | nC |
| $Q_{gd}$ | Gate–Drain Charge | | | 5.8 | | nC |
| **Drain–Source Diode Characteristics and Maximum Ratings** | | | | | | |
| $I_S$ | Maximum Continuous Drain–Source Diode Forward Current | | | | 2.1 | A |
| $V_{SD}$ | Drain–Source Diode Forward Voltage | $V_{GS}$ = 0 V, $I_S$ = 2.1 A (Note 2) | | 0.73 | 1.2 | V |
| $t_{rr}$ | Diode Reverse Recovery Time | $I_F$ = 12.5 A, $d_{iF}/d_t$ = 100 A/μs | | 28 | | ns |
| $Q_{rr}$ | Diode Reverse Recovery Charge | | | 18 | | nC |

**Notes:**

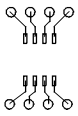
**1.** $R_{\theta JA}$ is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins. $R_{\theta JC}$ is guaranteed by design while $R_{\theta CA}$ is determined by the user's board design.



a) 50°C/W when mounted on a 1in² pad of 2 oz copper



b) 105°C/W when mounted on a .04 in² pad of 2 oz copper



c) 125°C/W when mounted on a minimum pad.

Scale 1 : 1 on letter size paper

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

## Typical Characteristics

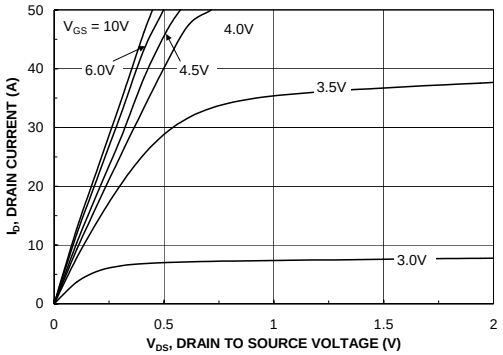



**Figure 1. On-Region Characteristics.**

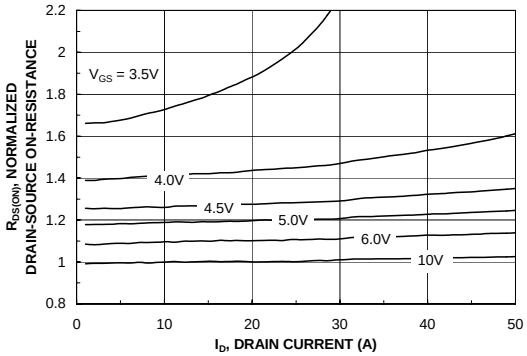



**Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.**

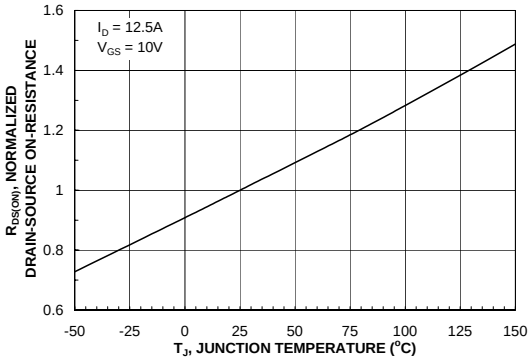



**Figure 3. On-Resistance Variation with Temperature.**

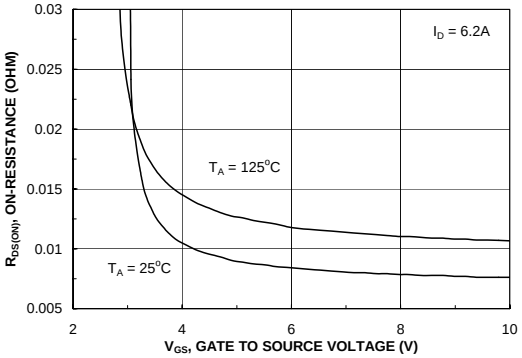



**Figure 4. On-Resistance Variation with Gate-to-Source Voltage.**

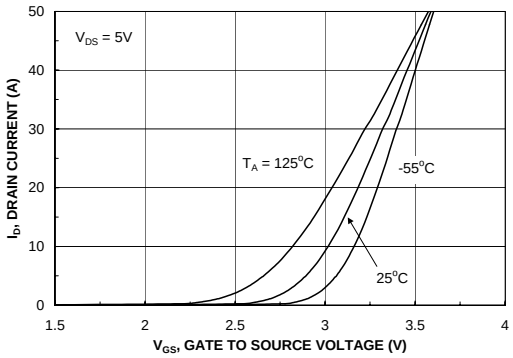



**Figure 5. Transfer Characteristics.**

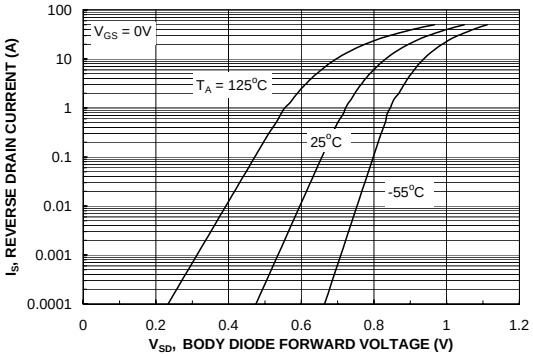



**Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.**

## Typical Characteristics

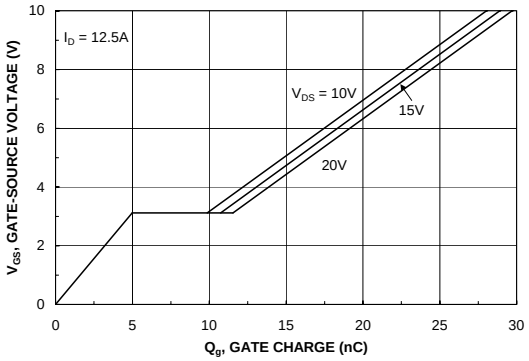



**Figure 7. Gate Charge Characteristics.**

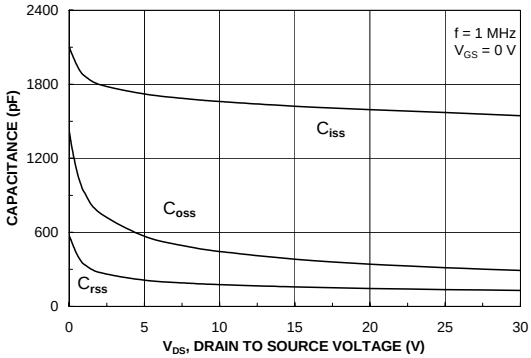



**Figure 8. Capacitance Characteristics.**

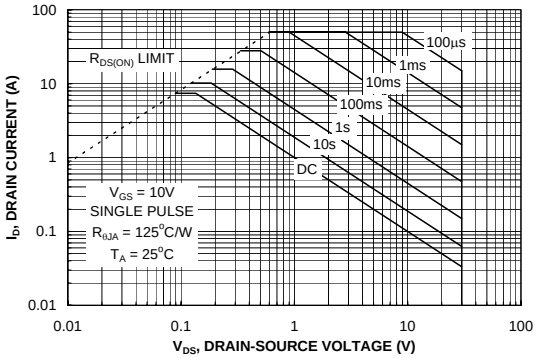



**Figure 9. Maximum Safe Operating Area.**

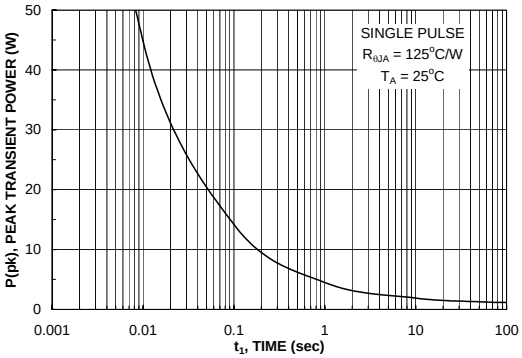



**Figure 10. Single Pulse Maximum Power Dissipation.**

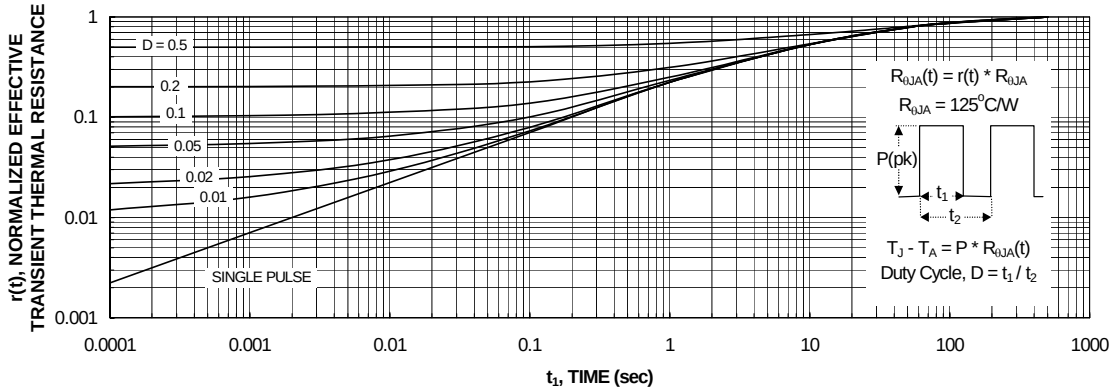



**Figure 11. Transient Thermal Response Curve.**

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

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