FAIRCHILD SEMICONDUCTOR®

May 2003

# FDS6162N7

## 20V N-Channel PowerTrench® MOSFET

### General Description

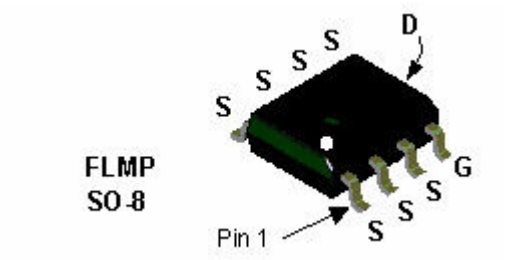
This N-Channel MOSFET has been designed specifically to improve the overall efficiency of DC/DC converters using either synchronous or conventional switching PWM controllers. It has been optimized for "low side" synchronous rectifier operation, providing an extremely low $R_{DS(ON)}$ in a small package.

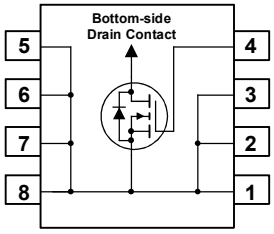
### Applications

- Synchronous rectifier
- DC/DC converter

### Features

- 23 A, 20 V $R_{DS(ON)}$ = 3.5 mΩ @ $V_{GS}$ = 4.5 V
  $R_{DS(ON)}$ = 5.0 mΩ @ $V_{GS}$ = 2.5 V
- High performance trench technology for extremely low $R_{DS(ON)}$
- High power and current handling capability
- Fast switching
- FLMP SO-8 package: Enhanced thermal performance in industry-standard package size




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

| Symbol | Parameter | | Ratings | Units |
|---|---|---|---|---|
| $V_{DSS}$ | Drain-Source Voltage | | 20 | V |
| $V_{GSS}$ | Gate-Source Voltage | | ± 12 | V |
| $I_D$ | Drain Current – Continuous | (Note 1a) | 23 | A |
| | – Pulsed | | 60 | |
| $P_D$ | Power Dissipation | (Note 1a) | 3.0 | W |
| $T_J$, $T_{STG}$ | Operating and Storage Junction Temperature Range | | –55 to +150 | °C |

## Thermal Characteristics

| | | | | |
|---|---|---|---|---|
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | (Note 1a) | 40 | °C/W |
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case | | 0.5 | |

## Package Marking and Ordering Information

| Device Marking | Device | Reel Size | Tape width | Quantity |
|---|---|---|---|---|
| FDS6162N7 | FDS6162N7 | 13'' | 12mm | 2500 units |

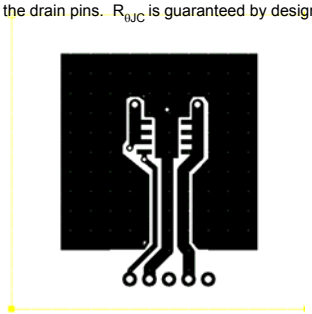
## Electrical Characteristics

$T_A$ = 25°C unless otherwise noted

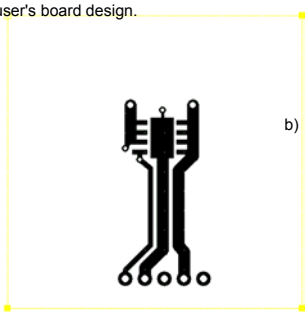
| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $BV_{DSS}$ | Drain–Source Breakdown Voltage | $V_{GS}$ = 0 V, $I_D$ = 250 μA | 20 | | | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250 μA, Referenced to 25°C | | 13 | | mV/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 16 V, $V_{GS}$ = 0 V | | | 1 | μA |
| $I_{GSSF}$ | Gate–Body Leakage, Forward | $V_{GS}$ = 12 V, $V_{DS}$ = 0 V | | | 100 | nA |
| $I_{GSSR}$ | Gate–Body Leakage, Reverse | $V_{GS}$ = –12 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 | 0.6 | 0.9 | 1.5 | V |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate Threshold Voltage Temperature Coefficient | $I_D$ = 250 μA, Referenced to 25°C | | –4 | | mV/°C |
| $R_{DS(on)}$ | Static Drain–Source On–Resistance | $V_{GS}$ = 4.5 V, $I_D$ = 23 A<br>$V_{GS}$ = 2.5 V, $I_D$ = 19 A<br>$V_{GS}$ = 4.5 V, $I_D$ = 23 A, $T_J$ = 125°C | | 2.9<br>3.6<br>4.1 | 3.5<br>5.0<br>6.2 | mΩ |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 5 V, $I_D$ = 23 A | | 119 | | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 10 V, $V_{GS}$ = 0 V, f = 1.0 MHz | | 5521 | | pF |
| $C_{oss}$ | Output Capacitance | | | 1473 | | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 706 | | 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 | $V_{DD}$ = 10 V, $I_D$ = 1 A, $V_{GS}$ = 4.5 V, $R_{GEN}$ = 6 Ω | | 20 | 32 | ns |
| $t_r$ | Turn–On Rise Time | | | 25 | 40 | ns |
| $t_{d(off)}$ | Turn–Off Delay Time | | | 85 | 136 | ns |
| $t_f$ | Turn–Off Fall Time | | | 55 | 88 | ns |
| $Q_g$ | Total Gate Charge | $V_{DS}$ = 10 V, $I_D$ = 23 A, $V_{GS}$ = 4.5 V | | 52 | 73 | nC |
| $Q_{gs}$ | Gate–Source Charge | | | 9 | | nC |
| $Q_{gd}$ | Gate–Drain Charge | | | 14.5 | | nC |
| **Drain–Source Diode Characteristics and Maximum Ratings** | | | | | | |
| $I_S$ | Maximum Continuous Drain–Source Diode Forward Current | | | | 2.5 | A |
| $V_{SD}$ | Drain–Source Diode Forward Voltage | $V_{GS}$ = 0 V, $I_S$ = 2.5 A (Note 2) | | 0.6 | 1.2 | V |
| $t_{rr}$ | Diode Reverse Recovery Time | $I_F$ = 23 A, $d_{iF}/d_t$ = 100 A/μs | | 42 | | nS |
| $Q_{rr}$ | Diode Reverse Recovery Charge | | | 52 | | 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) 40°C/W when mounted on a 1in$^2$ pad of 2 oz copper



b) 85°C/W when mounted on a minimum pad of 2 oz copper

Scale 1 : 1 on letter size paper

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

## Typical Characteristics

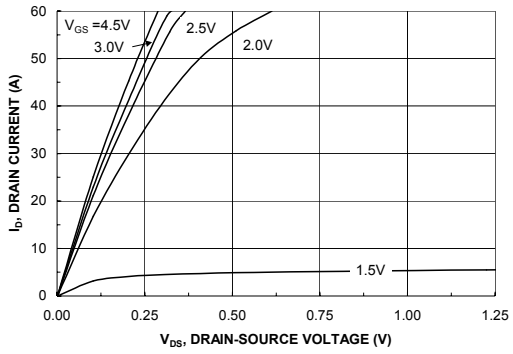



**Figure 1. On-Region Characteristics.**

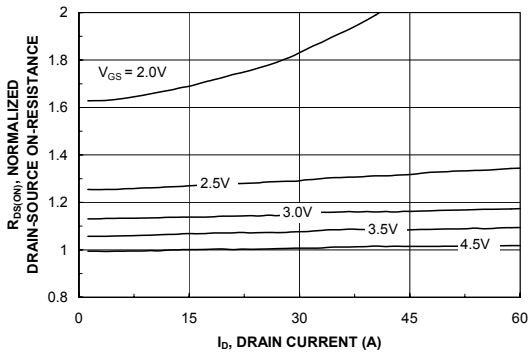



**Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.**

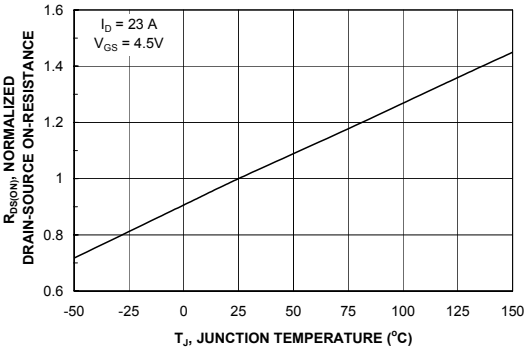



**Figure 3. On-Resistance Variation withTemperature.**

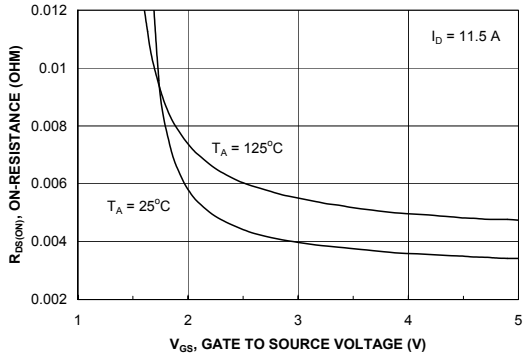



**Figure 4. On-Resistance Variation with Gate-to-Source Voltage.**

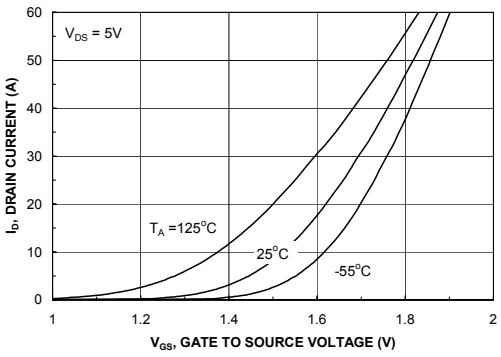



**Figure 5. Transfer Characteristics.**

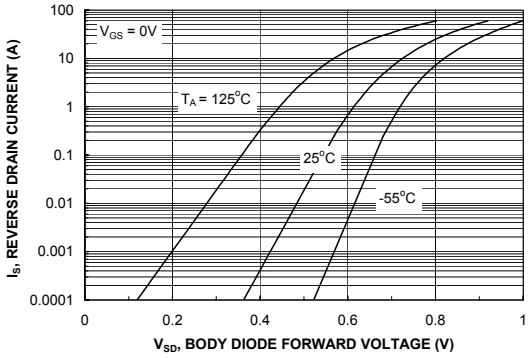



**Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.**

## Typical Characteristics

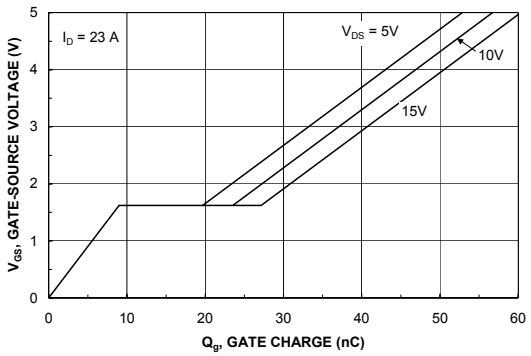



**Figure 7. Gate Charge Characteristics.**

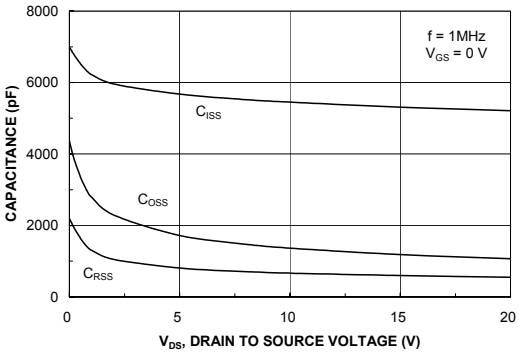



**Figure 8. Capacitance Characteristics.**

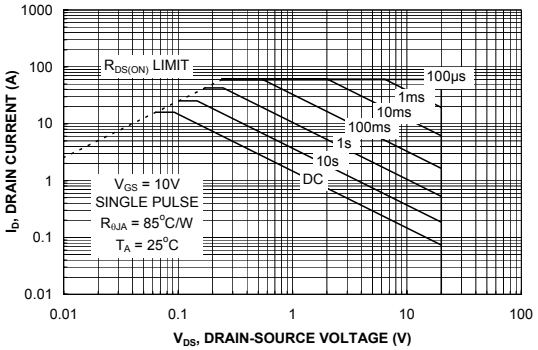



**Figure 9. Maximum Safe Operating Area.**

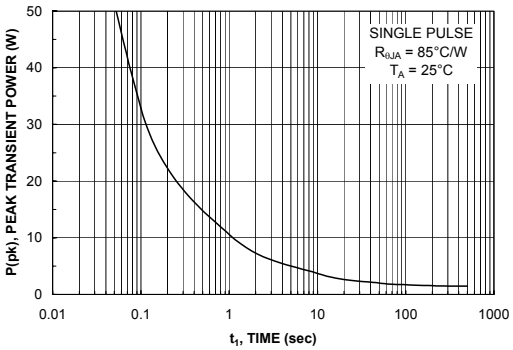



**Figure 10. Single Pulse Maximum Power Dissipation.**

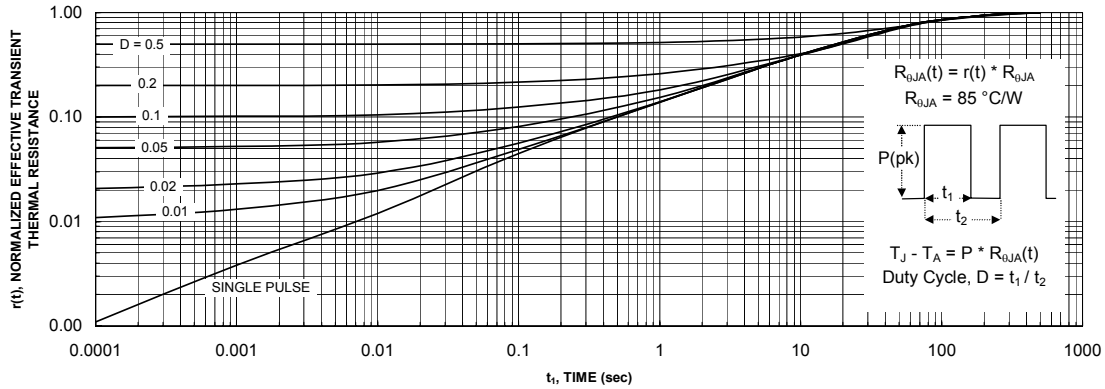
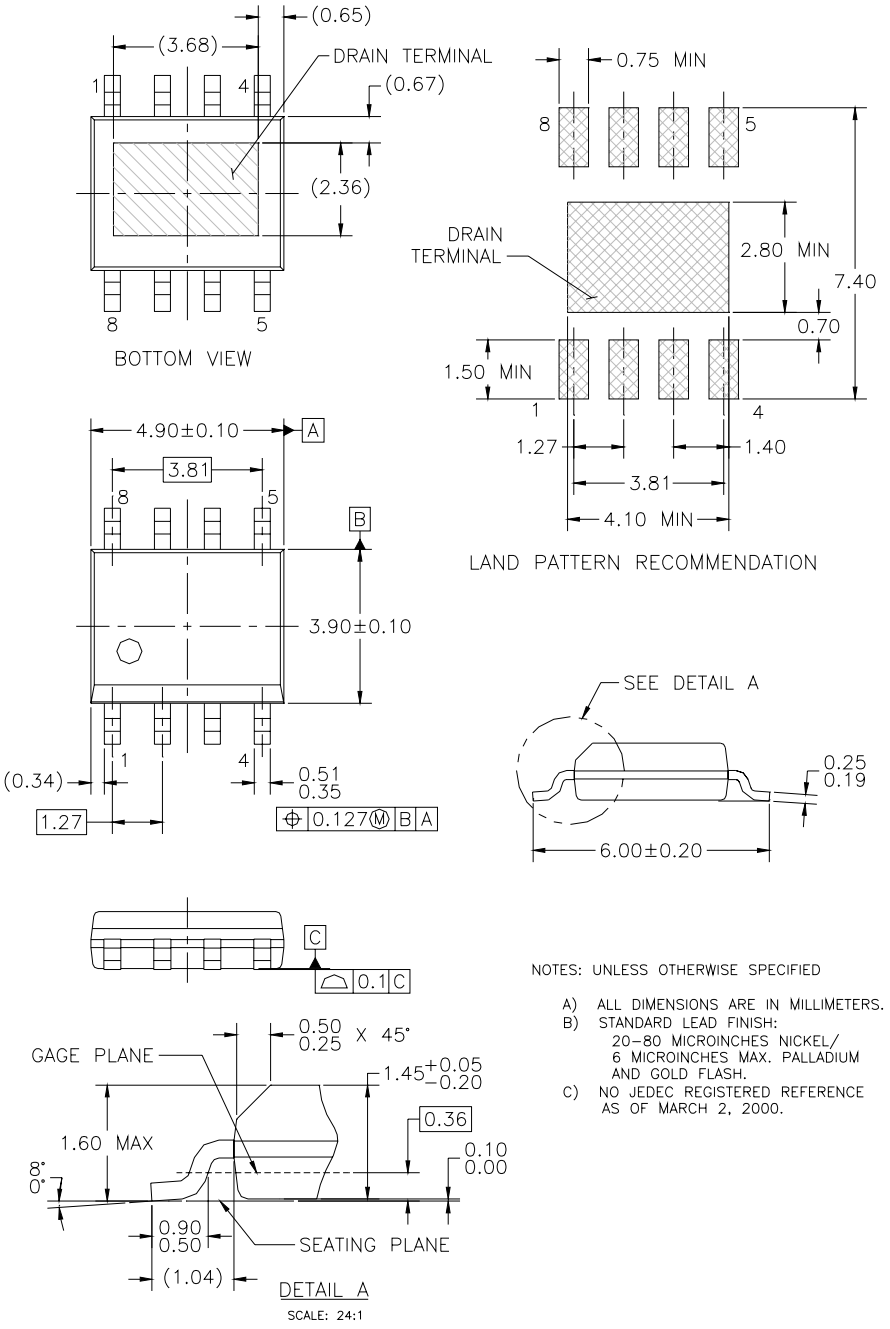



**Figure 11. Transient Thermal Response Curve.**

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

## Dimensional Outline and Pad Layout




NOTES: UNLESS OTHERWISE SPECIFIED

A) ALL DIMENSIONS ARE IN MILLIMETERS.
B) STANDARD LEAD FINISH:
20–80 MICROINCHES NICKEL/
6 MICROINCHES MAX. PALLADIUM
AND GOLD FLASH.
C) NO JEDEC REGISTERED REFERENCE
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