

FDD3706/FDU3706

20V N-Channel PowerTrench® MOSFET

General Description

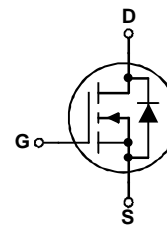
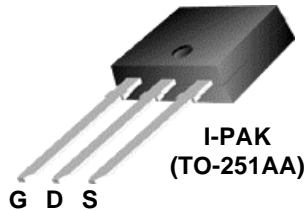
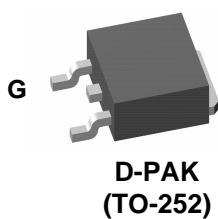
This N-Channel MOSFET has been designed specifically to improve the overall efficiency of DC/DC converters using either synchronous or conventional switching PWM controllers. It has been optimized for low gate charge, low $R_{DS(ON)}$, fast switching speed and extremely low $R_{DS(ON)}$ in a small package.

Applications

- DC/DC converter
- Motor Drives

Features

- 50 A, 20 V $R_{DS(ON)} = 9\text{ m}\Omega @ V_{GS} = 10\text{ V}$
 $R_{DS(ON)} = 11\text{ m}\Omega @ V_{GS} = 4.5\text{ V}$
 $R_{DS(ON)} = 16\text{ m}\Omega @ V_{GS} = 2.5\text{ V}$
- Low gate charge (16 nC)
- Fast Switching
- High performance trench technology for extremely low $R_{DS(ON)}$



Absolute Maximum Ratings $T_A=25^\circ\text{C}$ unless otherwise noted

| Symbol | Parameter | Ratings | Units |
|----------------|--|-------------|------------------|
| V_{DSS} | Drain-Source Voltage | 20 | V |
| V_{GSS} | Gate-Source Voltage | ± 12 | V |
| I_D | Continuous Drain Current @ $T_C=25^\circ\text{C}$ (Note 3) | 50 | A |
| | @ $T_A=25^\circ\text{C}$ (Note 1a) | 14.7 | |
| | Pulsed (Note 1a) | 60 | |
| P_D | Power Dissipation @ $T_C=25^\circ\text{C}$ (Note 3) | 44 | W |
| | @ $T_A=25^\circ\text{C}$ (Note 1a) | 3.8 | |
| | @ $T_A=25^\circ\text{C}$ (Note 1b) | 1.6 | |
| T_J, T_{STG} | Operating and Storage Junction Temperature Range | -55 to +175 | $^\circ\text{C}$ |

Thermal Characteristics

| | | | |
|-----------------|---|-----|---------------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case (Note 1) | 3.4 | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient (Note 1a) | 45 | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient (Note 1b) | 96 | $^\circ\text{C}/\text{W}$ |

Package Marking and Ordering Information

| Device Marking | Device | Package | Reel Size | Tape width | Quantity |
|----------------|---------|----------------|-----------|------------|------------|
| FDD3706 | FDD3706 | D-PAK (TO-252) | 13" | 12mm | 2500 units |
| FDU3706 | FDU3706 | I-PAK (TO-251) | Tube | N/A | 75 |

Electrical Characteristics

$T_A = 25^\circ\text{C}$ unless otherwise noted

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|--------|-----------|-----------------|-----|-----|-----|-------|
|--------|-----------|-----------------|-----|-----|-----|-------|

Drain-Source Avalanche Ratings (Note 2)

| | | | | | | |
|----------|--------------------------------|---|--|--|----|----|
| E_{AS} | Drain-Source Avalanche Energy | Single Pulse, $V_{DD} = 10\text{V}$, $I_D = 7\text{A}$ | | | 60 | mJ |
| I_{AS} | Drain-Source Avalanche Current | | | | 7 | A |

Off Characteristics

| | | | | | | |
|--------------------------------------|---|---|----|----|------|----------------------|
| BV_{DSS} | Drain-Source Breakdown Voltage | $V_{GS} = 0\text{V}$, $I_D = 250\ \mu\text{A}$ | 20 | | | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D = 250\ \mu\text{A}$, Referenced to 25°C | | 13 | | mV/ $^\circ\text{C}$ |
| I_{DSS} | Zero Gate Voltage Drain Current | $V_{DS} = 16\text{V}$, $V_{GS} = 0\text{V}$ | | | 1 | μA |
| I_{GSSF} | Gate-Body Leakage, Forward | $V_{GS} = 12\text{V}$, $V_{DS} = 0\text{V}$ | | | 100 | nA |
| I_{GSSR} | Gate-Body Leakage, Reverse | $V_{GS} = -12\text{V}$, $V_{DS} = 0\text{V}$ | | | -100 | nA |

On Characteristics (Note 2)

| | | | | | | |
|--|--|---|-----|------------------------|---------------------|----------------------|
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS} = V_{GS}$, $I_D = 250\ \mu\text{A}$ | 0.5 | 1 | 1.5 | V |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate Threshold Voltage Temperature Coefficient | $I_D = 250\ \mu\text{A}$, Referenced to 25°C | | -3.5 | | mV/ $^\circ\text{C}$ |
| $R_{DS(on)}$ | Static Drain-Source On-Resistance | $V_{GS} = 10\text{V}$, $I_D = 16.2\text{A}$ $V_{GS} = 4.5\text{V}$, $I_D = 14.7\text{A}$ $V_{GS} = 2.5\text{V}$, $I_D = 12.2\text{A}$ $V_{GS} = 4.5\text{V}$, $I_D = 14.7\text{A}$, $T_J = 125^\circ\text{C}$ | | 7.5 8 11 12.6 | 9 11 16 19 | m Ω |
| $I_{D(on)}$ | On-State Drain Current | $V_{GS} = 4.5\text{V}$, $V_{DS} = 5\text{V}$ | 30 | | | A |
| g_{FS} | Forward Transconductance | $V_{DS} = 5\text{V}$, $I_D = 14.7\text{A}$ | | 65 | | S |

Dynamic Characteristics

| | | | | | | |
|-----------|------------------------------|---|--|------|--|----|
| C_{iss} | Input Capacitance | $V_{DS} = 10\text{V}$, $V_{GS} = 0\text{V}$, $f = 1.0\text{MHz}$ | | 1882 | | pF |
| C_{oss} | Output Capacitance | | | 430 | | pF |
| C_{rss} | Reverse Transfer Capacitance | | | 201 | | pF |

Switching Characteristics (Note 2)

| | | | | | | |
|--------------|---------------------|---|--|-----|----|----|
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD} = 10\text{V}$, $I_D = 1\text{A}$, $V_{GS} = 4.5\text{V}$, $R_{GEN} = 6\ \Omega$ | | 11 | 20 | ns |
| t_r | Turn-On Rise Time | | | 15 | 27 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 35 | 56 | ns |
| t_f | Turn-Off Fall Time | | | 16 | 29 | ns |
| Q_g | Total Gate Charge | $V_{DS} = 10\text{V}$, $I_D = 14.7\text{A}$, $V_{GS} = 4.5\text{V}$ | | 16 | 23 | nC |
| Q_{gs} | Gate-Source Charge | | | 3.7 | | nC |
| Q_{gd} | Gate-Drain Charge | | | 4 | | nC |

Drain-Source Diode Characteristics and Maximum Ratings

| | | | | | | |
|----------|---|---|--|-----|-----|---|
| I_S | Maximum Continuous Drain-Source Diode Forward Current | | | | 3.2 | A |
| V_{SD} | Drain-Source Diode Forward Voltage | $V_{GS} = 0\text{V}$, $I_S = 3.2\text{A}$ (Note 2) | | 0.7 | 1.2 | V |

Notes:

- $R_{\theta JA}$ 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) $R_{\theta JA} = 40^\circ\text{C/W}$ when mounted on a 1in^2 pad of 2 oz copper



b) $R_{\theta JA} = 96^\circ\text{C/W}$ when mounted on a minimum pad.

Scale 1 : 1 on letter size paper

- Pulse Test: Pulse Width < 300 μs , Duty Cycle < 2.0%

- Maximum current is calculated as:
$$I_{D(max)} = \sqrt{\frac{P_D}{R_{DS(on)}}}$$

where P_D is maximum power dissipation at $T_C = 25^\circ\text{C}$ and $R_{DS(on)}$ is at $T_{J(max)}$ and $V_{GS} = 10\text{V}$. Package current limitation is 21A

Typical Characteristics

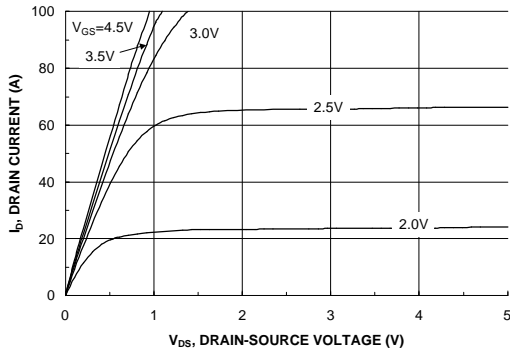


Figure 1. On-Region Characteristics

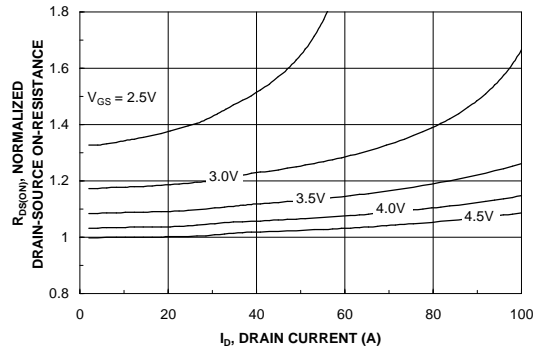


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage

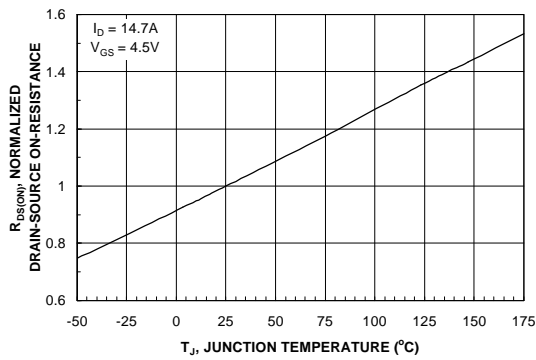


Figure 3. On-Resistance Variation with Temperature

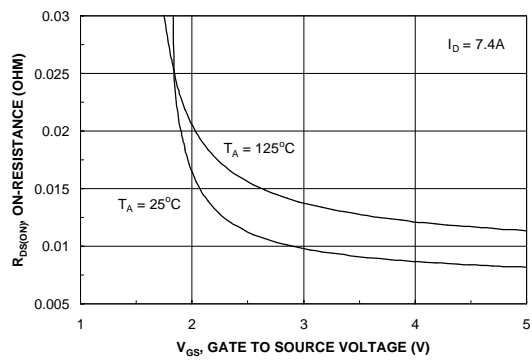


Figure 4. On-Resistance Variation with Gate-to-Source Voltage

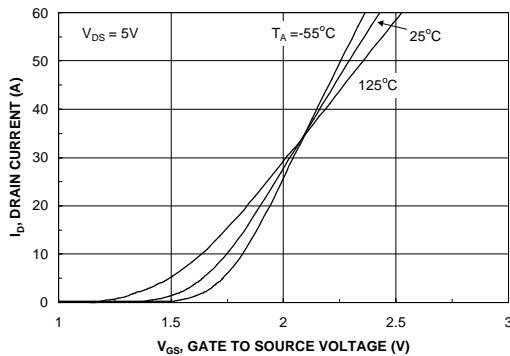


Figure 5. Transfer Characteristics

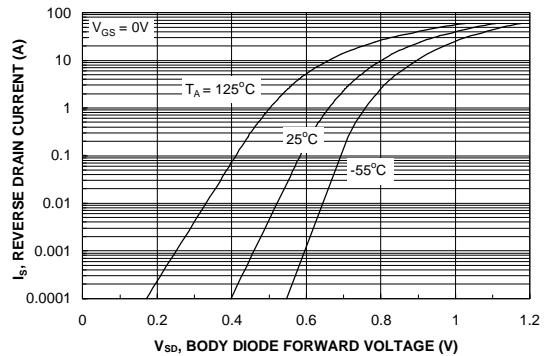


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature

Typical Characteristics

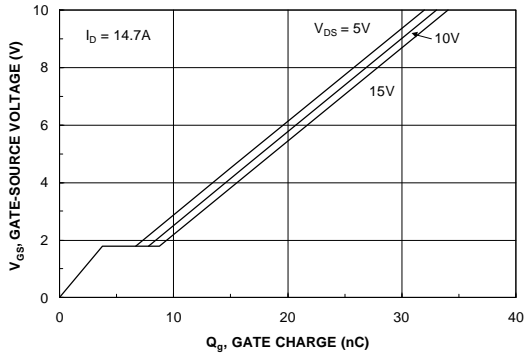


Figure 7. Gate Charge Characteristics

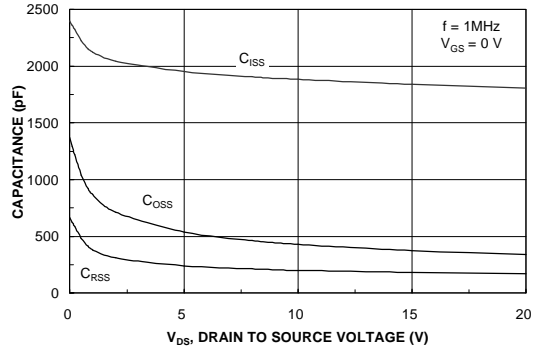


Figure 8. Capacitance Characteristics

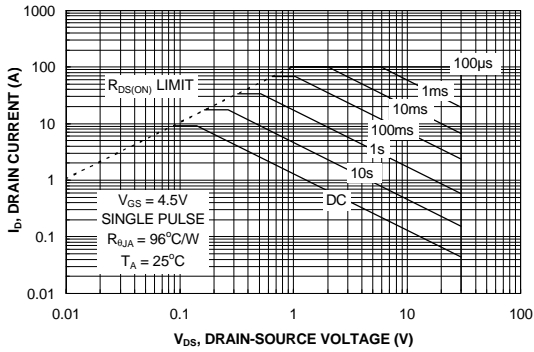


Figure 9. Maximum Safe Operating Area

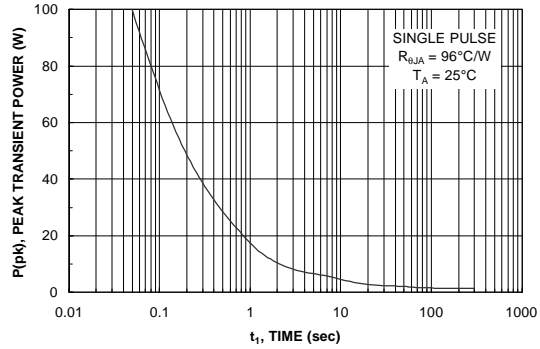


Figure 10. Single Pulse Maximum Power Dissipation

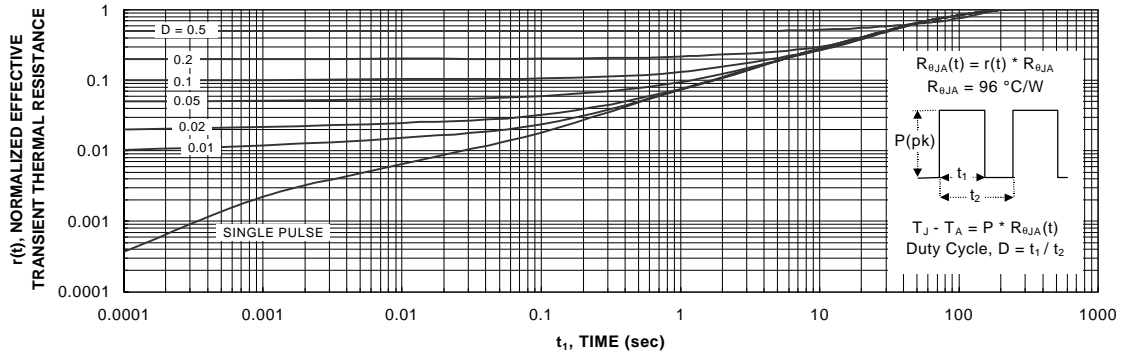


Figure 11. Transient Thermal Response Curve

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

TRADEMARKS

The following are registered and unregistered trademarks Fairchild Semiconductor owns or is authorized to use and is not intended to be an exhaustive list of all such trademarks.

| | | | | |
|--------------------------------------|---------------------|--------------------|---------------------|-----------------|
| ACEx™ | FACT™ | ImpliedDisconnect™ | PACMAN™ | SPM™ |
| ActiveArray™ | FACT Quiet Series™ | ISOPLANAR™ | POP™ | Stealth™ |
| Bottomless™ | FAST® | LittleFET™ | Power247™ | SuperSOT™-3 |
| CoolFET™ | FASTr™ | MicroFET™ | PowerTrench® | SuperSOT™-6 |
| CROSSVOLT™ | FRFET™ | MicroPak™ | QFET™ | SuperSOT™-8 |
| DOME™ | GlobalOptoisolator™ | MICROWIRE™ | QS™ | SyncFET™ |
| EcoSPARK™ | GTO™ | MSX™ | QT Optoelectronics™ | TinyLogic™ |
| E ² CMOS™ | HiSeC™ | MSXPro™ | Quiet Series™ | TruTranslation™ |
| EnSigna™ | µC™ | OCX™ | RapidConfigure™ | UHC™ |
| Across the board. Around the world.™ | | OCXPro™ | RapidConnect™ | UltraFET® |
| The Power Franchise™ | | OPTOLOGIC® | SILENT SWITCHER® | VCX™ |
| Programmable Active Droop™ | | OPTOPLANAR™ | SMART START™ | |

DISCLAIMER

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION OR DESIGN. FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS.

LIFE SUPPORT POLICY

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF FAIRCHILD SEMICONDUCTOR CORPORATION.

As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, or (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

PRODUCT STATUS DEFINITIONS

Definition of Terms

| Datasheet Identification | Product Status | Definition |
|--------------------------|------------------------|---|
| Advance Information | Formative or In Design | This datasheet contains the design specifications for product development. Specifications may change in any manner without notice. |
| Preliminary | First Production | This datasheet contains preliminary data, and supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design. |
| No Identification Needed | Full Production | This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design. |
| Obsolete | Not In Production | This datasheet contains specifications on a product that has been discontinued by Fairchild semiconductor. The datasheet is printed for reference information only. |