FAIRCHILD SEMICONDUCTOR®

August 2003

# FDH15N50 / FDP15N50 / FDB15N50

## 15A, 500V, 0.38 Ohm, N-Channel SMPS Power MOSFET

### Applications

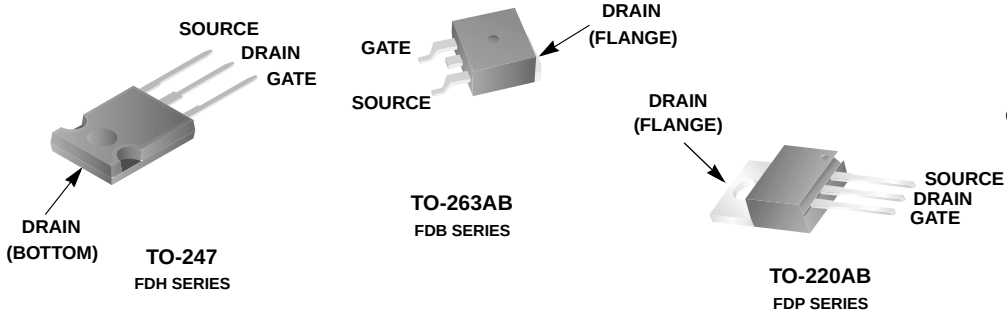
**Switch Mode Power Supplies(SMPS), such as**

- PFC Boost
- Two-Switch Forward Converter
- Single Switch Forward Converter
- Flyback Converter
- Buck Converter
- High Speed Switching

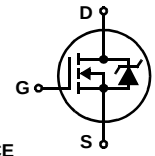
### Features

- Low Gate Charge $Q_g$ results in Simple Drive Requirement
- Improved Gate, Avalanche and High Reapplied dv/dt Ruggedness
- Reduced $r_{DS(ON)}$
- Reduced Miller Capacitance and Low Input Capacitance
- Improved Switching Speed with Low EMI
- 175°C Rated Junction Temperature

### Package




### Symbol




## Absolute Maximum Ratings $T_C = 25^oC$ unless otherwise noted

| Symbol | Parameter | Ratings | Units |
|---|---|---|---|
| $V_{DSS}$ | Drain to Source Voltage | 500 | V |
| $V_{GS}$ | Gate to Source Voltage | ±30 | V |
| $I_D$ | Drain Current | | |
| | Continuous ($T_C = 25^oC$, $V_{GS} = 10V$) | 15 | A |
| | Continuous ($T_C = 100^oC$, $V_{GS} = 10V$) | 11 | A |
| | Pulsed[1] | 60 | A |
| $P_D$ | Power dissipation | 300 | W |
| | Derate above $25^oC$ | 2 | $W/^oC$ |
| $T_J$, $T_{STG}$ | Operating and Storage Temperature | -55 to 175 | $^oC$ |
| | Soldering Temperature for 10 seconds | 300 (1.6mm from case) | $^oC$ |

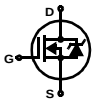
## Thermal Characteristics

| | | | |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance Junction to Case | 0.50 | $^oC/W$ |
| $R_{\theta JA}$ | Thermal Resistance Junction to Ambient (TO-247) | 40 | $^oC/W$ |
| $R_{\theta JA}$ | Thermal Resistance Junction to Ambient (TO-220, TO-263) | 62 | $^oC/W$ |

## Package Marking and Ordering Information

| Device Marking | Device | Package | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|
| FDH15N50 | FDH15N50 | TO-247 | Tube | - | 30 |
| FDP15N50 | FDP15N50 | TO-220 | Tube | - | 50 |
| FDB15N50 | FDB15N50 | TO-263 | 330mm | 24mm | 800 |

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

| Symbol | Parameter | Test Conditions | | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| **Statics** | | | | | | | |
| $B_{VDSS}$ | Drain to Source Breakdown Voltage | $I_D$ = 250μA, $V_{GS}$ = 0V | | 500 | - | - | V |
| $\Delta B_{VDSS}/\Delta T_J$ | Breakdown Voltage Temp. Coefficient | Reference to 25°C, ID = 1mA | | - | 0.58 | - | V/°C |
| $r_{DS(ON)}$ | Drain to Source On-Resistance | $V_{GS}$ = 10V, $I_D$ = 7.5A | | - | 0.33 | 0.38 | Ω |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250μA | | 2.0 | 3.4 | 4.0 | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 500V | $T_C$ = 25°C | - | - | 25 | μA |
| | | $V_{GS}$ = 0V | $T_C$ = 150°C | - | - | 250 | |
| $I_{GSS}$ | Gate to Source Leakage Current | $V_{GS}$ = ±30V | | - | - | ±100 | nA |
| **Dynamics** | | | | | | | |
| $g_{fs}$ | Forward Transconductance | $V_{DD}$ = 10V, $I_D$ = 7.5A | | 10 | - | - | S |
| $Q_{g(TOT)}$ | Total Gate Charge at 10V | $V_{GS}$ = 10V, $V_{DS}$ = 400V, $I_D$ = 15A | | - | 33 | 41 | nC |
| $Q_{gs}$ | Gate to Source Gate Charge | | | - | 7.2 | 10 | nC |
| $Q_{gd}$ | Gate to Drain “Miller” Charge | | | - | 12 | 16 | nC |
| $t_{d(ON)}$ | Turn-On Delay Time | $V_{DD}$ = 250V, $I_D$ = 15A, $R_G$ = 6.2Ω, $R_D$ = 17Ω | | - | 9 | - | ns |
| $t_r$ | Rise Time | | | - | 5.4 | - | ns |
| $t_{d(OFF)}$ | Turn-Off Delay Time | | | - | 26 | - | ns |
| $t_f$ | Fall Time | | | - | 5 | - | ns |
| $C_{ISS}$ | Input Capacitance | $V_{DS}$ = 25V, $V_{GS}$ = 0V, f = 1MHz | | - | 1850 | - | pF |
| $C_{OSS}$ | Output Capacitance | | | - | 230 | - | pF |
| $C_{RSS}$ | Reverse Transfer Capacitance | | | - | 16 | - | pF |
| **Avalanche Characteristics** | | | | | | | |
| $E_{AS}$ | Single Pulse Avalanche Energy[2] | | | 760 | - | - | mJ |
| $I_{AR}$ | Avalanche Current | | | - | - | 15 | A |
| **Drain-Source Diode Characteristics** | | | | | | | |
| $I_S$ | Continuous Source Current (Body Diode) | MOSFET symbol showing the integral reverse p-n junction diode.  | | - | - | 15 | A |
| $I_{SM}$ | Pulsed Source Current[1] (Body Diode) | | | - | - | 60 | A |
| $V_{SD}$ | Source to Drain Diode Voltage | $I_{SD}$ = 15A | | - | 0.86 | 1.2 | V |
| $t_{rr}$ | Reverse Recovery Time | $I_{SD}$ = 15A, $di_{SD}/dt$ = 100A/μs | | - | 470 | 730 | ns |
| $Q_{RR}$ | Reverse Recovered Charge | $I_{SD}$ = 15A, $di_{SD}/dt$ = 100A/μs | | - | 5 | 6.6 | μC |

Notes:
1: Repetitive rating; pulse width limited by maximum junction temperature
2: Starting $T_J$ = 25°C, L = 7.0mH, $I_{AS}$ = 15A

## Typical Characteristics

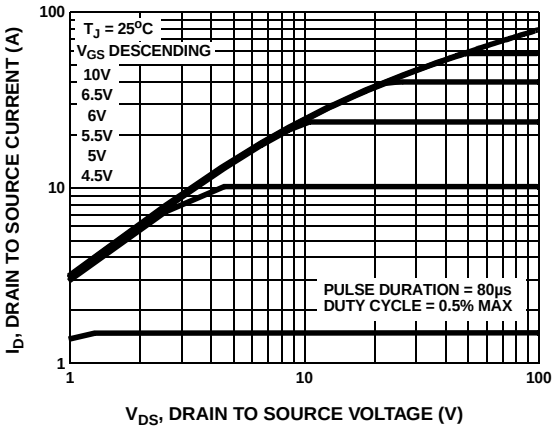



**Figure 1. Output Characteristics**

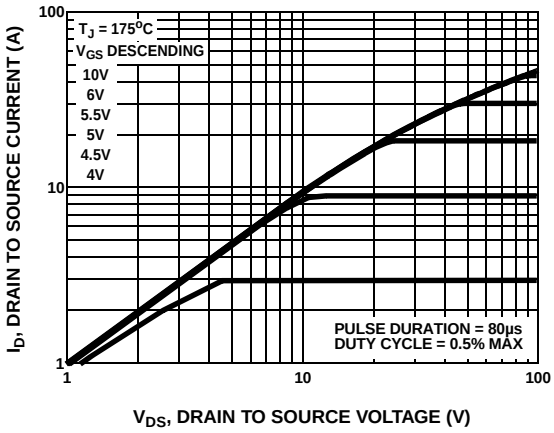



**Figure 2. Output Characteristics**

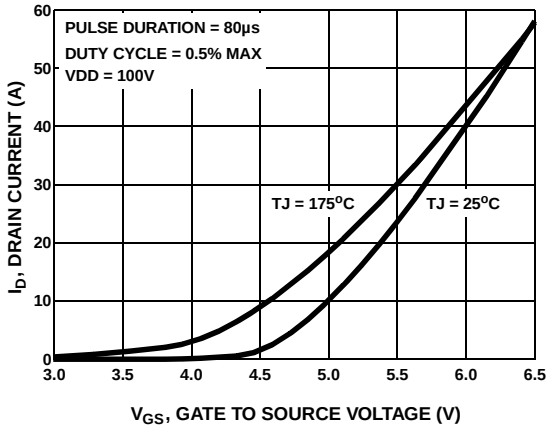



**Figure 3. Transfer Characteristics**

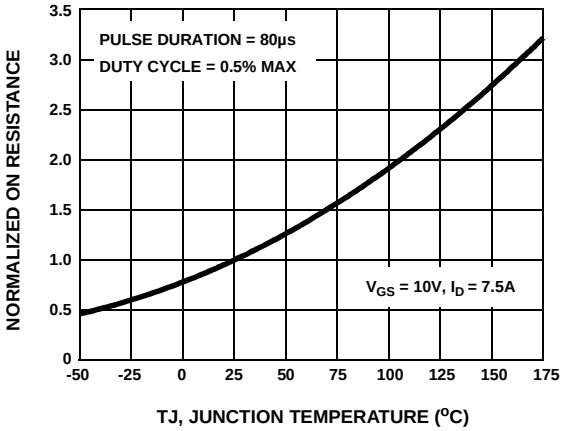



**Figure 4. Normalized Drain To Source On Resistance vs Junction Temperature**

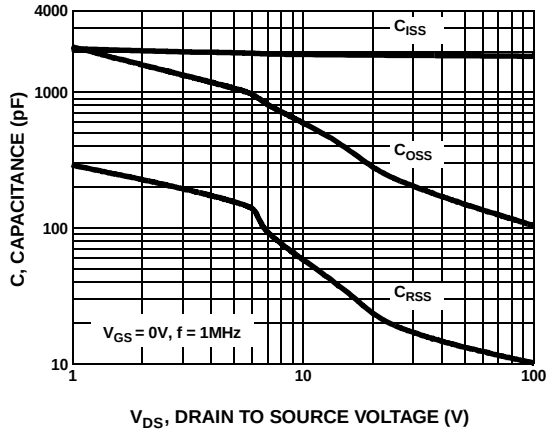



**Figure 5. Capacitance vs Drain To Source Voltage**

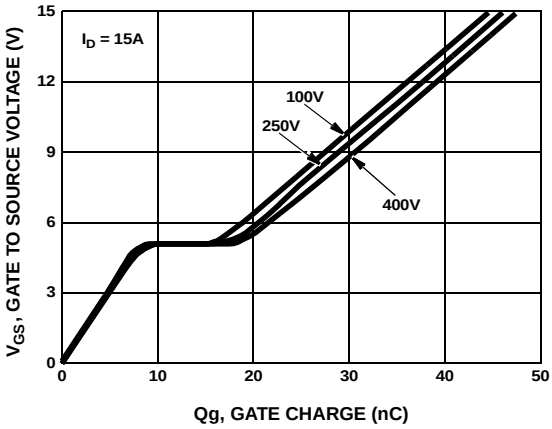



**Figure 6. Gate Charge Waveforms For Constant Gate Current**

## Typical Characteristics

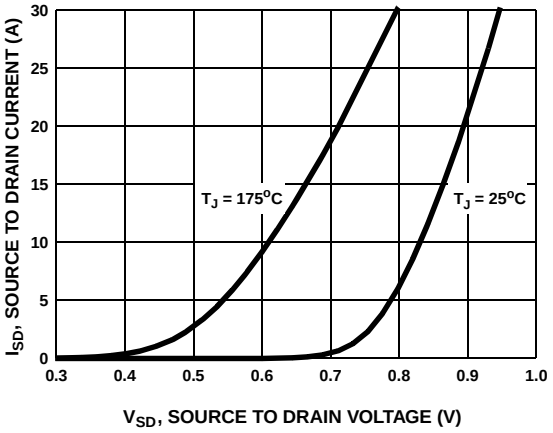



**Figure 7. Body Diode Forward Voltage vs Body Diode Current**

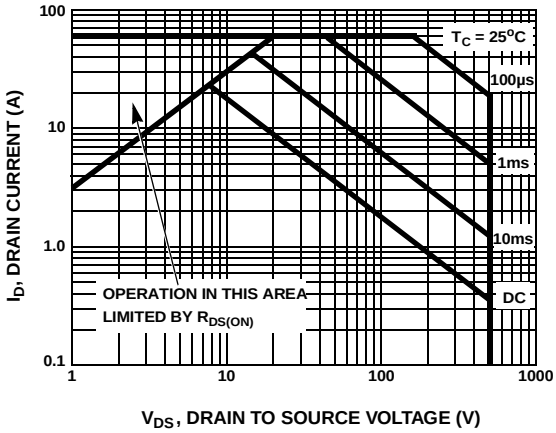



**Figure 8. Maximum Safe Operating Area**

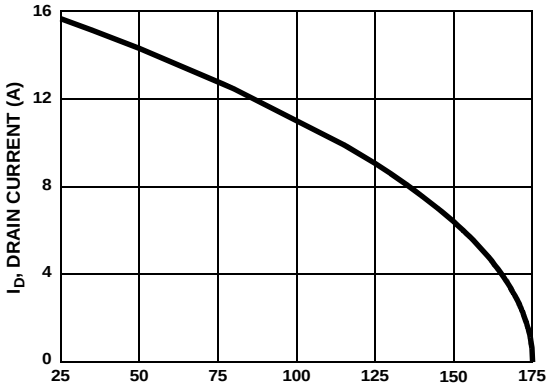



**Figure 9. Maximum Drain Current vs Case Temperature**

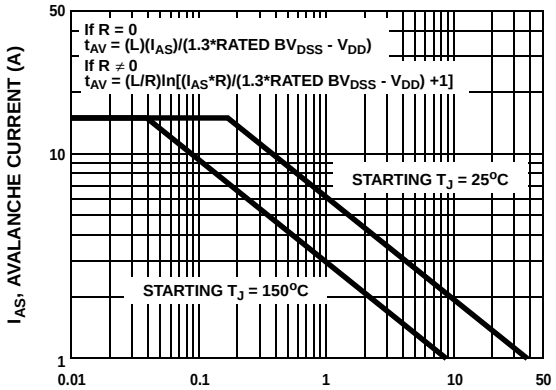



**Figure 10. Unclamped Inductive Switching Capability**

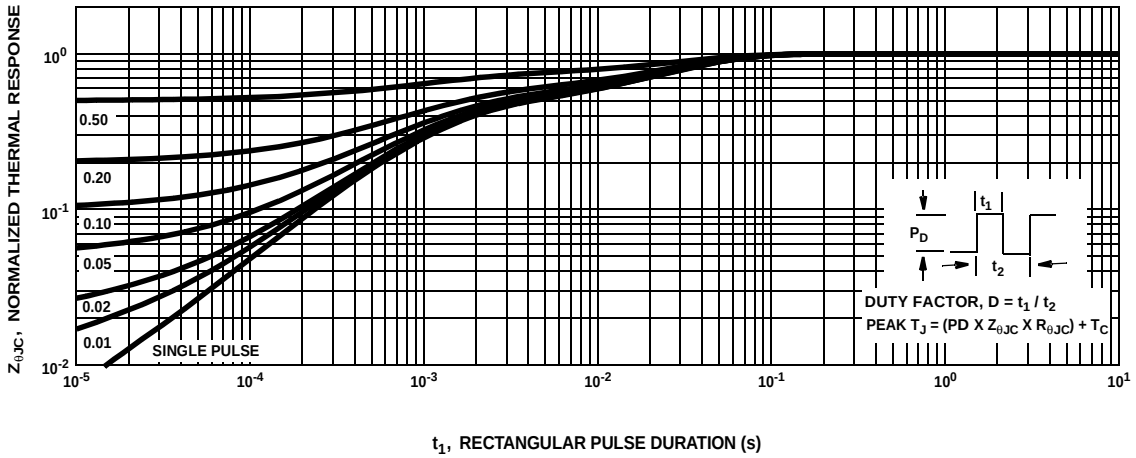



**Figure 11. Normalized Transient Thermal Impedance, Junction to Case**

## Test Circuits and Waveforms

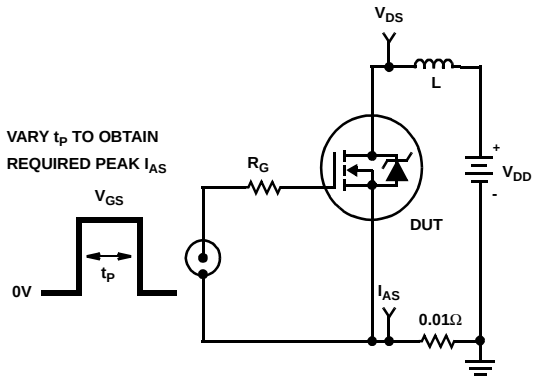



Figure 12. Unclamped Energy Test Circuit

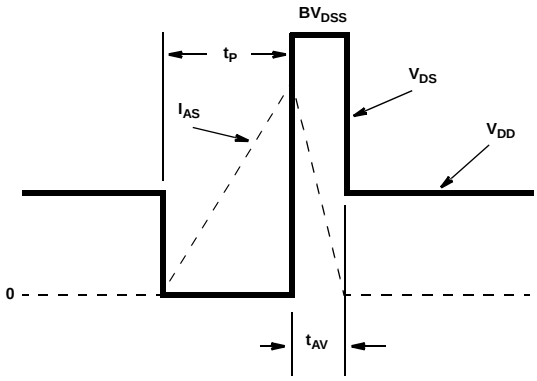



Figure 13. Unclamped Energy Waveforms

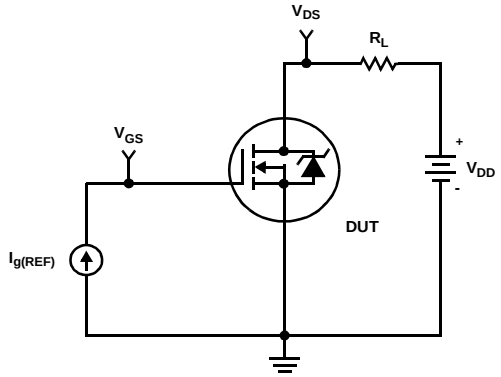



Figure 14. Gate Charge Test Circuit

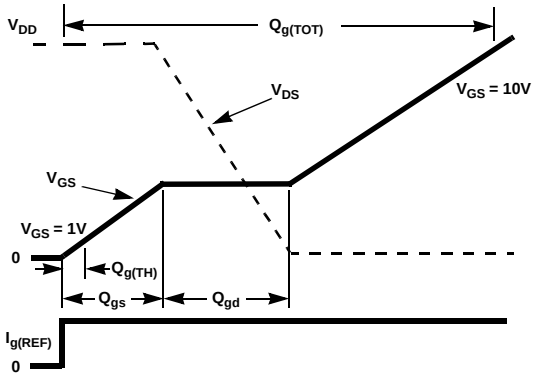



Figure 15. Gate Charge Waveforms

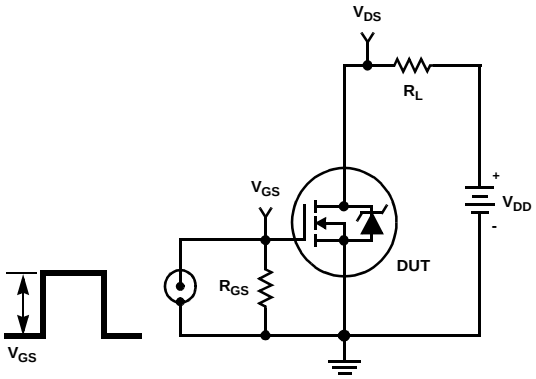



Figure 16. Switching Time Test Circuit

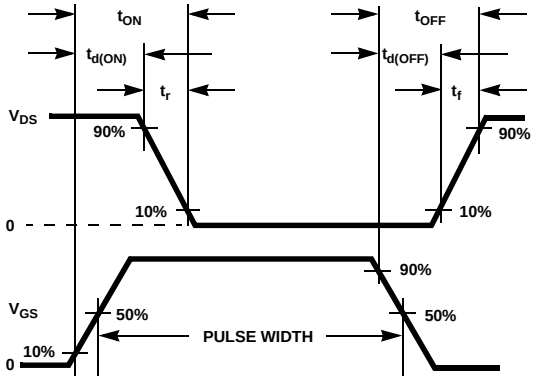



Figure 17. Switching Time Waveform

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