July 2015

# FCD5N60_F085

## N-Channel SuperFET® MOSFET

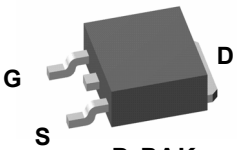
## 600 V, 4.6 A, 1.1 Ω

### Features

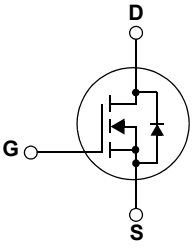
- 600V, 4.6A, typ. $R_{ds(on)}$=860mΩ@$V_{GS}$=10V
- Ultra Low Gate Charge (Typ. $Q_g$ = 16 nC)
- UIS Capability
- RoHS Compliant
- Qualified to AEC Q101

### Applications

- Automotive On Board Charger
- Automotive DC/DC Converter for HEV




D-PAK
(TO-252)




For current package drawing, please refer to the Fairchild web-site at http://www.fairchildsemi.com/package-drawings/TO/TO252A03.pdf.

### Description

SuperFETTM is Fairchild's proprietary new generation of high voltage MOSFETs utilizing an advanced charge balance mechanism for outstanding low on-resistance and lower gate charge performance.
This advanced technology has been tailored to minimize conduction loss, provide superior switching performance, and withstand extreme dv/dt rate and higher avalanche energy.
Consequently, SuperFET is suitable for various automotive DC/DC power conversion.

### MOSFET Maximum Ratings $T_J$ = 25°C unless otherwise noted.

| Symbol | Parameter | | Ratings | Units |
|---|---|---|---|---|
| $V_{DSS}$ | Drain-to-Source Voltage | | 600 | V |
| $V_{GS}$ | Gate-to-Source Voltage | | ±30 | V |
| $I_D$ | Drain Current - Continuous ($V_{GS}$=10) (Note 1) | $T_C$ = 25°C | 4.6 | A |
| | Pulsed Drain Current | $T_C$ = 25°C | See Figure 4 | |
| $E_{AS}$ | Single Pulse Avalanche Energy | (Note 1) | 29 | mJ |
| $P_D$ | Power Dissipation | | 54 | W |
| | Derate Above 25°C | | 1.56 | W/°C |
| $T_J$, $T_{STG}$ | Operating and Storage Temperature | | -55 to + 150 | °C |
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case | | 2.3 | °C/W |
| $R_{\theta JA}$ | Maximum Thermal Resistance, Junction to Ambient | (Note 2) | 83 | °C/W |

**Notes:**
1: Starting $T_J$ = 25°C, L = 10mH, $I_{AS}$ = 2.4A, $V_{DD}$ = 100V during inductor charging and $V_{DD}$ = 0V during time in avalanche.
2: $R_{\theta JA}$ 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 $R_{\theta JA}$is determined by the board design. The maximum rating presented here is based on mounting on a 1 $in^2$ pad of 2oz copper.

### Package Marking and Ordering Information

| Device Marking | Device | Package | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|
| FCD5N60 | FCD5N60_F085 | D-PAK(TO-252) | 13” | 16mm | 2500units |

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## Electrical Characteristics

$T_J$ = 25°C unless otherwise noted.

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $B_{VDSS}$ | Drain-to-Source Breakdown Voltage | $I_D$ = 250 μA, $V_{GS}$ = 0V | 600 | - | - | V |
| $I_{DSS}$ | Drain-to-Source Leakage Current | $V_{DS}$=600V, $V_{GS}$ = 0V, $T_J$ = 25°C | - | - | 1 | μA |
| | | $V_{DS}$=600V, $V_{GS}$ = 0V, $T_J$ = 150°C (Note 4) | - | - | 10 | μA |
| $I_{GSS}$ | Gate-to-Source Leakage Current | $V_{GS}$ = ±30V | - | - | ±100 | nA |
| **On Characteristics** | | | | | | |
| $V_{GS(th)}$ | Gate to Source Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 250 μA | 3.0 | - | 5.0 | V |
| $R_{DS(on)}$ | Drain to Source On Resistance | $I_D$ = 4.6A, $V_{GS}$= 10V, $T_J$ = 25°C | - | 0.86 | 1.1 | Ω |
| | | $I_D$ = 4.6A, $V_{GS}$= 10V, $T_J$ = 150°C (Note 4) | - | 2.5 | 3.2 | Ω |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 25V, $V_{GS}$ = 0V, f = 1MHz | - | 570 | - | pF |
| $C_{oss}$ | Output Capacitance | | - | 280 | - | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | - | 20 | - | pF |
| $R_g$ | Gate Resistance | f = 1MHz | - | 1.9 | - | Ω |
| $Q_{g(ToT)}$ | Total Gate Charge | $V_{GS}$ = 0 to 10V, $V_{DD}$ = 480V, $I_D$ = 4.6A | - | 16 | 21 | nC |
| $Q_{g(th)}$ | Threshold Gate Charge | $V_{GS}$ = 0 to 2V, $V_{DD}$ = 480V, $I_D$ = 4.6A | - | 1.0 | - | nC |
| $Q_{gs}$ | Gate-to-Source Gate Charge | $V_{DD}$ = 480V, $I_D$ = 4.6A | - | 3.2 | - | nC |
| $Q_{gd}$ | Gate-to-Drain “Miller“ Charge | $V_{DD}$ = 480V, $I_D$ = 4.6A | - | 7.6 | - | nC |
| **Switching Characteristics** | | | | | | |
| $t_{on}$ | Turn-On Time | $V_{DD}$ = 300V, $I_D$ = 4.6A, $V_{GS}$ = 10V, $R_{GEN}$ = 25Ω | - | - | 84 | ns |
| $t_{d(on)}$ | Turn-On Delay | | - | 18 | - | ns |
| $t_r$ | Rise Time | | - | 19 | - | ns |
| $t_{d(off)}$ | Turn-Off Delay | | - | 48 | - | ns |
| $t_f$ | Fall Time | | - | 13 | - | ns |
| $t_{off}$ | Turn-Off Time | | - | - | 178 | ns |
| **Drain-Source Diode Characteristics** | | | | | | |
| $V_{SD}$ | Source-to-Drain Diode Voltage | $I_{SD}$ = 4.6A, $V_{GS}$ = 0V | - | - | 1.25 | V |
| $t_{rr}$ | Reverse-Recovery Time | $V_{DD}$ = 480V, $I_F$ = 4.6A, $dI_{SD}/dt$ = 100A/μs | - | 190 | 250 | ns |
| $Q_{rr}$ | Reverse-Recovery Charge | | - | 1.7 | 2.2 | μC |

Note:

4: The maximum value is specified by design at $T_J$ = 150°C. Product is not tested to this condition in production.

## Typical Characteristics

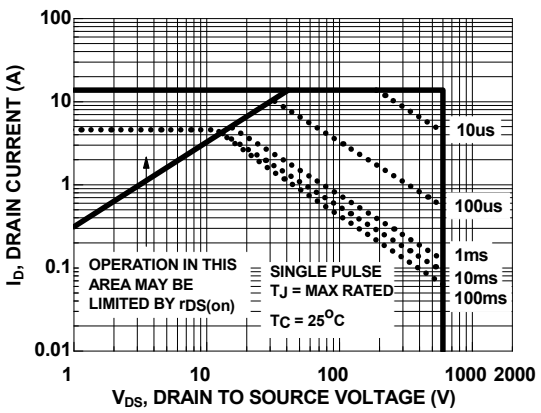


**Figure 5. Forward Bias Safe Operating Area**

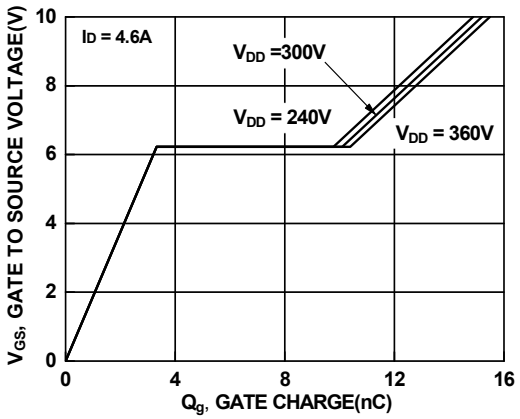


**Figure 6. Gate Charge vs. Gate to Source Voltage**

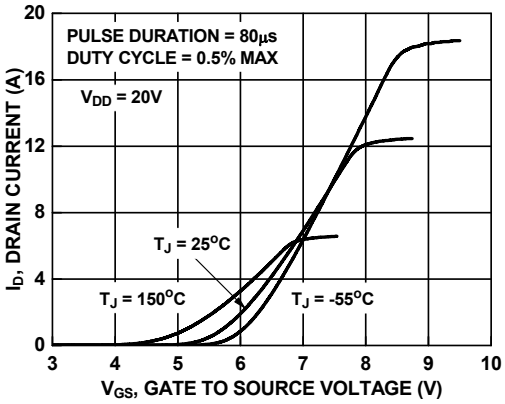


**Figure 7. Transfer Characteristics**

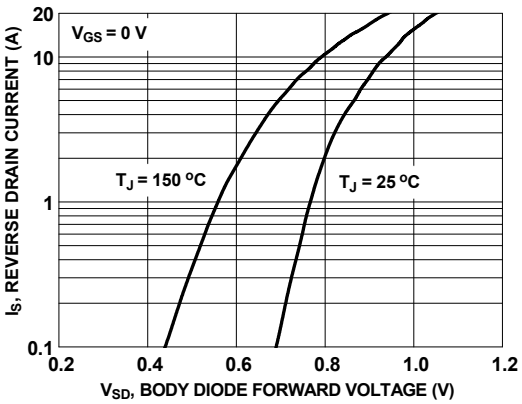


**Figure 8. Forward Diode Characteristics**

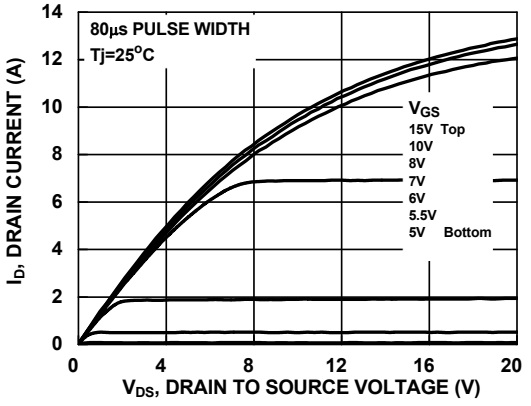


**Figure 9. Saturation Characteristics**

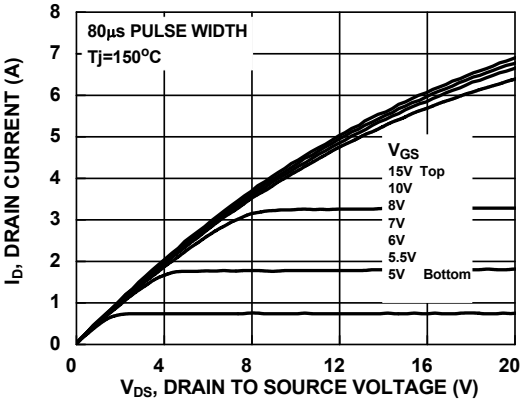


**Figure 10. Saturation Characteristics**

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