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August 2014

FCD5N60 / FCU5N60 N-Channel SuperFET MOSFET 600 V, 4.6 A, 950 m Ω

Features

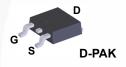
- 650 V @ T_J = 150°C
- Typ. $R_{DS(on)}$ = 810 m Ω
- Ultra Low Gate Charge (Typ. Q_q = 16 nC)
- Low Effective Output Capacitance (Typ. C_{oss(eff.)} = 32 pF)
- · 100% Avalanche Tested
- · RoHS Compliant

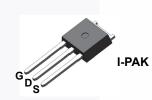
Application

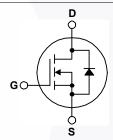
- · LCD/LED TV and Monitor
- Lighting
- · Solar Inverter
- AC-DC Power Supply

Description

SuperFET® MOSFET is Fairchild Semiconductor's first generation of high voltage super-junction (SJ) MOSFET family that is utilizing charge balance technology for outstanding low onresistance and lower gate charge performance. This technology is tailored to minimize conduction loss, provide superior switching performance, dv/dt rate and higher avalanche energy. Consequently, SuperFET MOSFET is very suitable for the switching power applications such as PFC, server/telecom power, FPD TV power, ATX power and industrial power applications.







MOSFET Maximum Ratings T_C = 25°C unless otherwise noted.

| Symbol | | Parameter | | FCD5N60TM FCD5N60TM_WS FCU5N60TU | Unit |
|-----------------------------------|--------------------------------------|--|---------|--|------|
| V_{DSS} | Drain to Source Voltage | | | 600 | V |
| . \ | - Continuous (T _C = 25°C) | | | 4.6 | Α |
| ID | Drain Current | - Continuous (T _C = 100°C) | | 2.9 | |
| I _{DM} | Drain Current | - Pulsed (N | Note 1) | 13.8 | Α |
| V_{GSS} | Gate to Source Voltage | | | ±30 | V |
| E _{AS} | Single Pulsed Avalanche Ener | gy (M | Note 2) | 159 | mJ |
| I _{AR} | Avalanche Current | 1) | Note 1) | 4.6 | Α |
| E _{AR} | Repetitive Avalanche Energy | 1) | Note 1) | 5.4 | mJ |
| dv/dt | Peak Diode Recovery dv/dt | 1) | Note 3) | 4.5 | V/ns |
| n | Davisa Dissipation | $(T_C = 25^{\circ}C)$ | | 54 | W |
| P_{D} | Power Dissipation | - Derate Above 25°C | | 0.43 | W/°C |
| T _J , T _{STG} | Operating and Storage Tempe | rature Range | | -55 to +150 | οС |
| T _L | Maximum Lead Temperature f | or Soldering, 1/8" from Case for 5 Secor | nds | 300 | °C |

Thermal Characteristics

| Symbol | Parameter | FCD5N60TM FCD5N60TM_WS FCU5N60TU | Unit |
|-----------------|---|--|------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max. | 2.3 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient, Max. | 83 | C/W |

Package Marking and Ordering Information

| Part Number | Top Mark | Package | Packing Method | Reel Size | Tape Width | Quantity |
|--------------|----------|---------|----------------|-----------|------------|------------|
| FCD5N60TM | FCD5N60 | D-PAK | Tape and Reel | 330 mm | 16 mm | 2500 units |
| FCD5N60TM_WS | FCD5N60 | D-PAK | Tape and Reel | 330 mm | 16 mm | 2500 units |
| FCU5N60TU | FCU5N60 | IPAK | Tube | N/A | N/A | 75 units |

Electrical Characteristics $T_C = 25^{\circ}C$ unless otherwise noted.

| Symbol | Parameter | Test Conditions | Min. | Тур. | Max. | Unit |
|---|--|--|------|------|------|------|
| Off Charac | cteristics | | | | | |
| D\/ | Drain to Source Breakdown Voltage | $V_{GS} = 0 \text{ V}, I_D = 250 \mu\text{A}, T_C = 25^{\circ}\text{C}$ | 600 | - | - | V |
| BV _{DSS} | Drain to Source Breakdown Voltage | $V_{GS} = 0 \text{ V}, I_D = 250 \mu\text{A}, T_C = 150^{\circ}\text{C}$ | - | 650 | - | V |
| ΔBV _{DSS} / ΔT _J | Breakdown Voltage Temperature Coefficient | I _D = 250 μA, Referenced to 25°C | - | 0.6 | - | V/°C |
| BV _{DS} | Drain to Source Avalanche Breakdown Voltage | V _{GS} = 0 V, I _D = 4.6 A | - | 700 | - | ٧ |
| | Zoro Coto Voltago Proin Current | V _{DS} = 600 V, V _{GS} = 0 V | - | - | 1 | |
| IDSS | Zero Gate Voltage Drain Current | $V_{DS} = 480 \text{ V}, T_{C} = 125^{\circ}\text{C}$ | - | - | 10 | μΑ |
| I _{GSS} | Gate to Body Leakage Current | V _{GS} = ±30 V, V _{DS} = 0 V | - | - | ±100 | nA |

On Characteristics

| V _{GS(th)} | Gate Threshold Voltage | $V_{GS} = V_{DS}, I_{D} = 250 \mu\text{A}$ | 3.0 | - | 5.0 | V |
|---------------------|--------------------------------------|--|-----|------|------|---|
| R _{DS(on)} | Static Drain to Source On Resistance | $V_{GS} = 10 \text{ V}, I_D = 2.3 \text{ A}$ | - | 0.81 | 0.95 | Ω |
| 9 _{FS} | Forward Transconductance | $V_{DS} = 40 \text{ V}, I_{D} = 2.3 \text{ A}$ | -\ | 3.8 | - | S |

Dynamic Characteristics

| C _{iss} | Input Capacitance | V _{DS} = 25 V, V _{GS} = 0 V, f = 1 MHz | - | 470 | 600 | pF |
|------------------------|------------------------------|---|---|-----|-----|----|
| C _{oss} | Output Capacitance | | - | 250 | 320 | pF |
| C _{rss} | Reverse Transfer Capacitance | | - | 22 | - | pF |
| C _{oss} | Output Capacitance | V _{DS} = 480 V, V _{GS} = 0 V, f = 1 MHz | - | 12 | - | pF |
| C _{oss(eff.)} | Effective Output Capacitance | V _{DS} = 0 V to 400 V, V _{GS} = 0 V | - | 32 | - | pF |

Switching Characteristics

| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$ | | -/ | 12 40 | 30 90 | ns ns |
|---|----------|-----|----------|----------|----------|
| $\begin{array}{ccc} t_{d(off)} & \text{Turn-Off Delay Time} \\ \hline t_{f} & \text{Turn-Off Fall Time} \\ \end{array} \forall S_{GS} = 10 \text{ V}, \ R_{G} = 25 \ \Omega$ | | - | 40 | 90 | ne |
| t _f Turn-Off Fall Time | | | | 50 | 113 |
| 4 | | - | 47 | 95 | ns |
| C T. I.O. I. O. I. I.O. I. | (Note 4) | / - | 22 | 55 | ns |
| $Q_{g(tot)}$ Total Gate Charge at 10V $V_{DS} = 480 \text{ V}$, $I_D = 4.6 \text{ A}$ | ١. | - | 16 | - | nC |
| Q_{gs} Gate to Source Gate Charge $V_{GS} = 10 \text{ V}$ | , | - | 2.8 | - | nC |
| Q _{gd} Gate to Drain "Miller" Charge | (Note 4) | - | 7 | - | nC |

Drain-Source Diode Characteristics

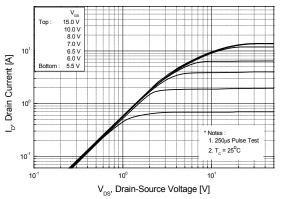
| I _S | Maximum Continuous Drain to Source Diode Forward Current | | | - | 4.6 | Α |
|-----------------|--|---|---|-----|------|----|
| I _{SM} | Maximum Pulsed Drain to Source Diode Forward Current | | | - | 13.8 | Α |
| V_{SD} | Drain to Source Diode Forward Voltage | V _{GS} = 0 V, I _{SD} = 4.6 A | - | - | 1.4 | V |
| t _{rr} | Reverse Recovery Time | $V_{GS} = 0 \text{ V}, I_{SD} = 4.6 \text{ A}$ $dI_F/dt = 100 \text{ A}/\mu\text{s}$ | - | 295 | - | ns |
| Q _{rr} | Reverse Recovery Charge | $dI_F/dt = 100 A/\mu s$ | - | 2.7 | - | μC |

Notes

- 1. Repetitive rating: pulse-width limited by maximum junction temperature.
- 2. I_{AS} = 2.3 A, V_{DD} = 50 V, R_G = 25 Ω , starting T_J = 25°C.
- 3. I $_{SD} \leq$ 4.6 A, di/dt \leq 200 A/µs, V $_{DD} \leq$ BV $_{DSS}$, starting T $_{J}$ = 25°C.
- ${\bf 4.} \ {\bf Essentially independent \ of \ operating \ temperature \ typical \ characteristics.}$

Typical Performance Characteristics

Figure 1. On-Region Characteristics



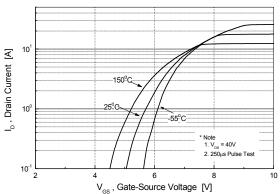
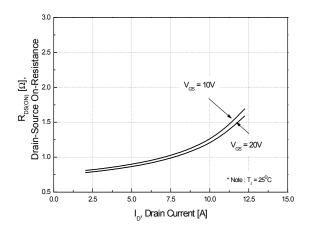


Figure 2. Transfer Characteristics

Figure 3. On-Resistance Variation vs. **Drain Current and Gate Voltage**





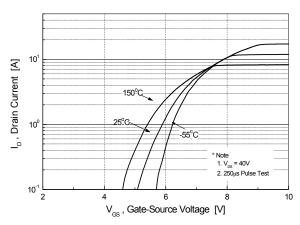


Figure 5. Capacitance Characteristics

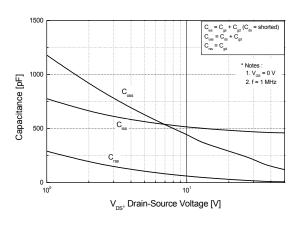
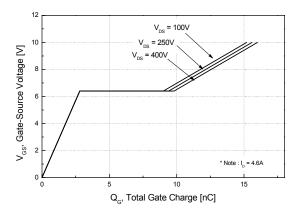


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

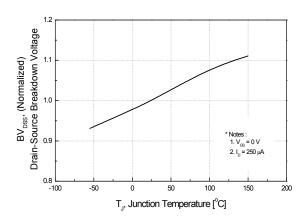


Figure 8. On-Resistance Variation vs. Temperature

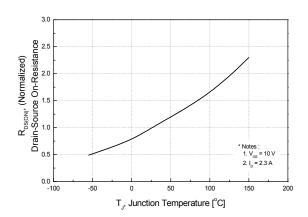


Figure 9. Maximum Safe Operating Area

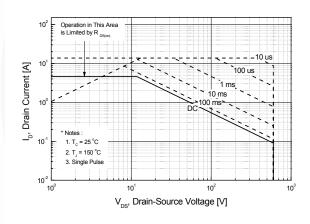


Figure 10. Maximum Drain Current vs. Case Temperature

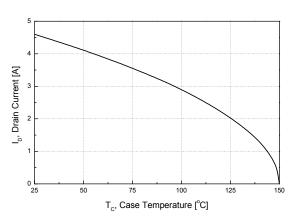
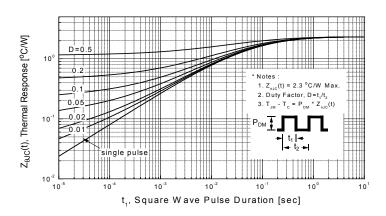


Figure 11. Transient Thermal Response Curve



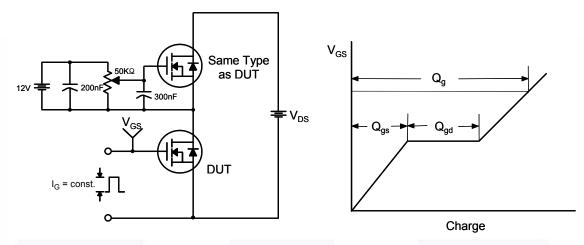


Figure 12. Gate Charge Test Circuit & Waveform

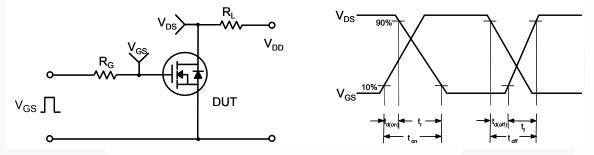


Figure 13. Resistive Switching Test Circuit & Waveforms

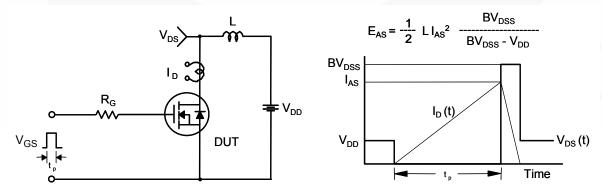


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms

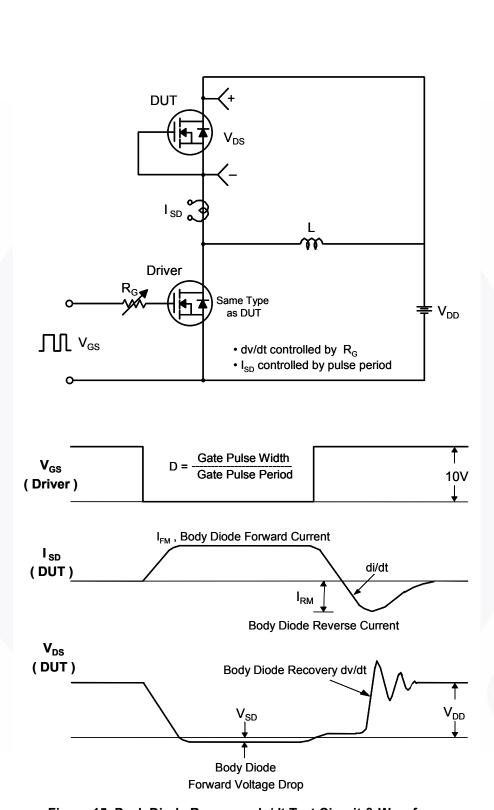


Figure 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms

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