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January 2014

## FQD13N10L / FQU13N10L

## N-Channel QFET® MOSFET

100 V, 10 A, 180 mΩ

## **Description**

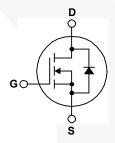
This N-Channel enhancement mode power MOSFET is produced using Fairchild Semiconductor's proprietary planar stripe and DMOS technology. This advanced MOSFET technology has been especially tailored to reduce on-state resistance, and to provide superior switching performance and high avalanche energy strength. These devices are suitable for switched mode power supplies, audio amplifier, DC motor control, and variable switching • Low Level Gate Drive Requirement Allowing power applications.

## **Features**

- 10 A, 100 V,  $R_{DS(on)}$  = 180 m $\Omega$  (Max.) @  $V_{GS}$  = 10 V,  $I_D = 5.0 A$
- Low Gate Charge (Typ. 8.7 nC)
- · Low Crss (Typ. 20 pF)
- 100% Avalanche Tested
- **Direct Operation Form Logic Drivers**







## Absolute Maximum Ratings T<sub>C</sub> = 25°C unless otherwise noted.

| Symbol                            | Parameter  |          | FQD13N10LTM / FQU13N10LTU | Unit |
|-----------------------------------|--|----------|---------------------------|------|
| $V_{DSS}$                         | Drain-Source Voltage   |          | 100                       | V    |
| I <sub>D</sub>                    | Drain Current - Continuous (T <sub>C</sub> = 25°C)                   |          | 10                        | Α    |
|                                   | - Continuous (T <sub>C</sub> = 100°C)                                |          | 6.3                       | Α    |
| I <sub>DM</sub>                   | Drain Current - Pulsed   | (Note 1) | 40                        | Α    |
| V <sub>GSS</sub>                  | Gate-Source Voltage  |          | ± 20                      | V    |
| E <sub>AS</sub>                   | Single Pulsed Avalanche Energy                                       |          | 95                        | mJ   |
| I <sub>AR</sub>                   | Avalanche Current  | (Note 1) | 10                        | Α    |
| E <sub>AR</sub>                   | Repetitive Avalanche Energy  | (Note 1) | 4.0                       | mJ   |
| dv/dt                             | Peak Diode Recovery dv/dt (Note                                      |          | 6.0                       | V/ns |
| P <sub>D</sub>                    | Power Dissipation (T <sub>A</sub> = 25°C) *                          |          | 2.5                       | W    |
|                                   | Power Dissipation (T <sub>C</sub> = 25°C)                            |          | 40                        | W    |
|                                   | - Derate above 25°C  |          | 0.32                      | W/°C |
| T <sub>J</sub> , T <sub>STG</sub> | Operating and Storage Temperature Range                              |          | -55 to +150               | °C   |
| T <sub>L</sub>                    | Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds | 300      | °C                        |      |

## **Thermal Characteristics**

| Symbol          | Parameter   | FQD13N10LTM /<br>FQU13N10LTU | Unit |  |
|-----------------|---|------------------------------|------|--|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max. 3.13                                       |                              |      |  |
|                 | Thermal Resistance, Junction to Ambient (Minimum Pad of 2-oz Copper), Max.            | 110                          | °C/W |  |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (*1 in <sup>2</sup> Pad of 2-oz Copper), Max. | 50                           |      |  |

## **Package Marking and Ordering Information**

| Part Number | Top Mark  | Package | Packing Method | Reel Size | Tape Width | Quantity   |
|-------------|-----------|---------|----------------|-----------|------------|------------|
| FQD13N10LTM | FQD13N10L | D-PAK   | Tape and Reel  | 330 mm    | 16 mm      | 2500 units |
| FQU13N10LTU | FQU13N10L | I-PAK   | Tube           | N/A       | N/A        | 70 units   |

| Symbol                                  | Parameter Test Conditions   |  | Min. | Тур.  | Max. | Unit |
|---|---|--|------|-------|------|------|
| Off Cha                                 | racteristics  |  |      |       |      |      |
| BV <sub>DSS</sub>                       | Drain-Source Breakdown Voltage  | $V_{GS} = 0 \text{ V}, I_D = 250 \mu\text{A}$  | 100  |       |      | V    |
| ΔBV <sub>DSS</sub><br>/ ΔT <sub>J</sub> | Breakdown Voltage Temperature<br>Coefficient                                      | $I_D = 250 \mu\text{A}$ , Referenced to 25°C   |      | 0.09  |      | V/°C |
| I <sub>DSS</sub>                        | Zara Cata Valtaga Drain Current   | V <sub>DS</sub> = 100 V, V <sub>GS</sub> = 0 V   |      |       | 1    | μΑ   |
|   | Zero Gate Voltage Drain Current   | V <sub>DS</sub> = 80 V, T <sub>C</sub> = 125°C   |      |       | 10   | μΑ   |
| I <sub>GSSF</sub>                       | Gate-Body Leakage Current, Forward  | V <sub>GS</sub> = 20 V, V <sub>DS</sub> = 0 V  |      |       | 100  | nA   |
| I <sub>GSSR</sub>                       | Gate-Body Leakage Current, Reverse  | V <sub>GS</sub> = -20 V, V <sub>DS</sub> = 0 V   |      |       | -100 | nA   |
| On Cha                                  | racteristics  |  |      |       |      |      |
| V <sub>GS(th)</sub>                     | Gate Threshold Voltage  | $V_{DS} = V_{GS}, I_{D} = 250 \mu\text{A}$   | 1.0  |       | 2.0  | V    |
| R <sub>DS(on)</sub>                     | Static Drain-Source   | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 5.0 A   |      | 0.142 | 0.18 | Ω    |
| - DS(0II)                               | On-Resistance   | $V_{GS} = 5 \text{ V}, I_D = 5.0 \text{ A}$  |      | 0.158 | 0.2  |      |
| 9 <sub>FS</sub>                         | Forward Transconductance  | $V_{DS} = 30 \text{ V}, I_{D} = 5.0 \text{ A}$   |      | 8.7   |      | S    |
| C <sub>iss</sub>                        | Input Capacitance   | $V_{DS} = 25 \text{ V}, V_{GS} = 0 \text{ V},$<br>f = 1.0  MHz                             |      | 400   | 520  | pF   |
| C <sub>oss</sub>                        | Output Capacitance  |  |      | 95    | 125  | pF   |
| C <sub>rss</sub>                        | Reverse Transfer Capacitance  |  |      | 20    | 25   | pF   |
| Switchi                                 | ng Characteristics  |  |      |       |      |      |
| t <sub>d(on)</sub>                      | Turn-On Delay Time  | $V_{DD} = 50 \text{ V}, I_{D} = 12.8 \text{ A},$ $R_{G} = 25 \Omega$                       |      | 7.5   | 25   | ns   |
| t <sub>r</sub>                          | Turn-On Rise Time   |  |      | 220   | 450  | ns   |
| t <sub>d(off)</sub>                     | Turn-Off Delay Time   | 11.6 - 20 32   |      | 22    | 55   | ns   |
| t <sub>f</sub>                          | Turn-Off Fall Time  | (Note 4)   |      | 72    | 150  | ns   |
| Qg                                      | Total Gate Charge   | V <sub>DS</sub> = 80 V, I <sub>D</sub> = 12.8 A,   |      | 8.7   | 12   | nC   |
| Q <sub>gs</sub>                         | Gate-Source Charge  | V <sub>GS</sub> = 5 V  | /    | 2.0   |      | nC   |
| Q <sub>gd</sub>                         | Gate-Drain Charge   | (Note 4)   |      | 5.3   |      | nC   |
| Drain S                                 | course Diede Characteristics of   | ad Maximum Datings   |      |       |      |      |
| ار<br>ا <sub>s</sub>                    |   | Diode Characteristics and Maximum Ratings  n Continuous Drain-Source Diode Forward Current |      |       | 10   | Α    |
| I <sub>SM</sub>                         |   | um Pulsed Drain-Source Diode Forward Current   |      |       | 40   | Α    |
| U.VI                                    | Drain-Source Diode Forward Voltage   V <sub>GS</sub> = 0 V, I <sub>S</sub> = 10 A |  |      |       |      |      |

## $Q_{rr}$

 $\mathsf{t}_{\mathsf{rr}}$ 

- **Notes:**1. Repetitive rating: pulse-width limited by maximum junction temperature.
  2. L = 1.43 mH,  $I_{AS}$  = 10 A,  $V_{DD}$  = 25 V,  $R_{G}$  = 25  $\Omega$ , Starting  $T_{J}$  = 25°C.
  3.  $I_{SD}$  ≤ 12.8 A, di/dt ≤ 300 A/ $\mu$ s,  $V_{DD}$  ≤ BV $_{DSS}$ , Starting  $T_{J}$  = 25°C.
  4. Essentially independent of operating temperature.

Reverse Recovery Time

Reverse Recovery Charge

ns

μС

75

0.17

 $V_{GS} = 0 \text{ V}, I_{S} = 12.8 \text{ A},$ 

 $dI_F / dt = 100 A/\mu s$ 

# Typical Characteristics Top: 100 V SEA DO V SEA

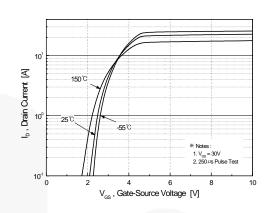
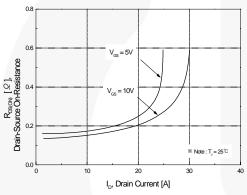


Figure 2. Transfer Characteristics



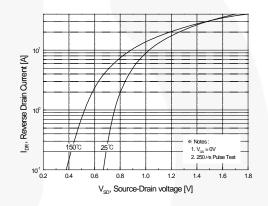
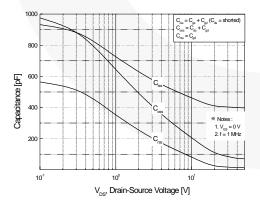


Figure 3. On-Resistance Variation vs.
Drain Current and Gate Voltage

Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperature



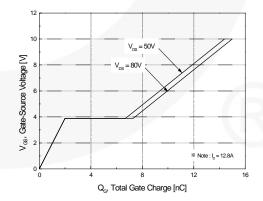
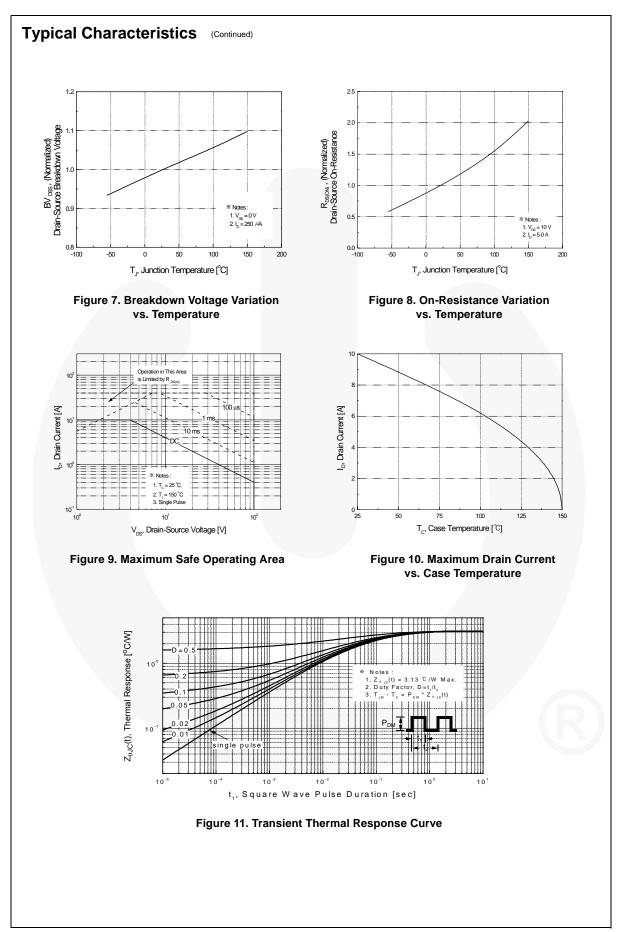


Figure 5. Capacitance Characteristics

Figure 6. Gate Charge Characteristics



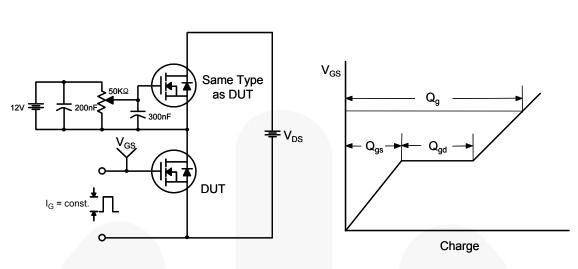


Figure 12. Gate Charge Test Circuit & Waveform

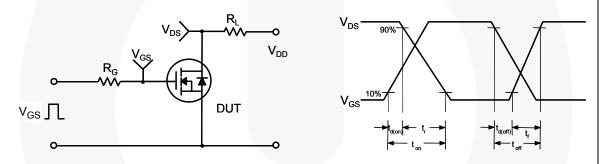


Figure 13. Resistive Switching Test Circuit & Waveforms

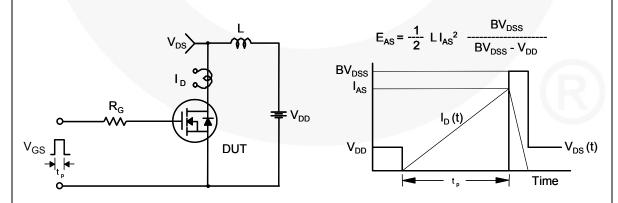
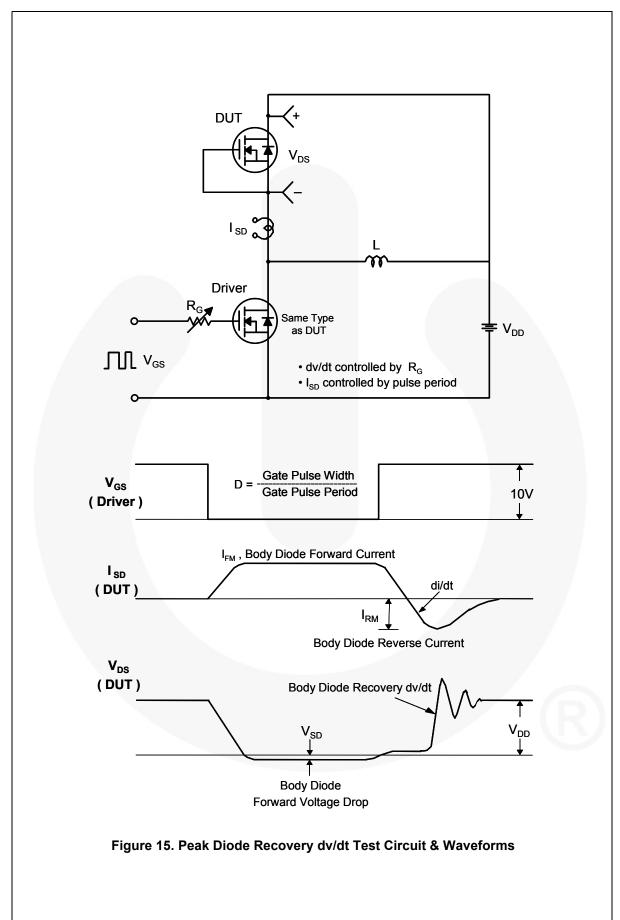


Figure 14. Unclamped Inductive Switching Test Circuit & Waveforms



## **Mechanical Dimensions** -5.55 MIN→ 1.27 6.22 5.97 6.50 MIN -1.02 MAX Ċ 2 (0.59)0.89 2.29 2.28 ⊕ 0.25 A A C 4.57 LAND PATTERN RECOMMENDATION 2.39 SEE 2.18 4.32 MIN NOTE D 0.58 0.45 5.21 MIN 10.41 9.40 SEE DETAIL A △ 0.10 B 0.51 GAGE PLANE NOTES: UNLESS OTHERWISE SPECIFIED THIS PACKAGE CONFORMS TO JEDEC, TO-252, ISSUE C, VARIATION AA. ALL DIMENSIONS ARE IN MILLIMETERS. 10 (1.54)DIMENSIONING AND TOLERANCING PER ASME Y14.5M-2009. SUPPLIER DEPENDENT MOLD LOCKING HOLES OR CHAMFERED CORNERS OR EDGE PROTRUSION. PRESENCE OF TRIMMED CENTER LEAD IS OPTIONAL. .78 0.127 MAX DIMENSIONS ARE EXCLUSSIVE OF BURSS, MOLD FLASH AND TIE BAR EXTRUSIONS. SEATING PLANE (2.90)LAND PATTERN RECOMENDATION IS BASED ON IPC7351A STD DETAIL TO228P991X239-3N. (ROTATED -90°) SCALE: 12X DRAWING NUMBER AND REVISION: MKT-T0252A03REV9. FAIRCHILD SEMICONDUCTOR.

Figure 16. TO252 (D-PAK), Molded, 3-Lead, Option AA&AB

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# **Mechanical Dimensions** C 9.65 8.90 (0.60) -2.29 ◆ 0.25M AM C 3 PLCS NOTES: UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN MILLIMETERS.

Figure 17. TO251 (I-PAK), Molded, 3-Lead

B)

THIS PACKAGE CONFORMS TO JEDEC, TO-251 ISSUE C, VARIATION AA, DATED SEP 1988.

DIMENSIONING AND TOLERANCING PER

ASME Y14.5M-1994.

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