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FAIRCHILD SEMICONDUCTOR®

July 2010

# FDZ3N513ZT

## Integrated NMOS and Schottky Diode

### Features

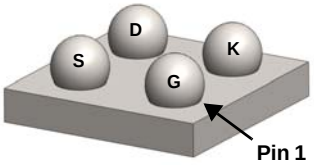
- Monolithic NMOS and Schottky Diode
- Ultra-small form factor 1mm x 1mm WLCSP
- Max $r_{DS(on)}$ = 462 mΩ at $V_{GS}$ = 4.5 V, $I_D$ = 0.3 A
- Max $r_{DS(on)}$ = 520 mΩ at $V_{GS}$ = 3.2 V, $I_D$ = 0.3 A
- HBM ESD protection level > 2000V (Note3)
- RoHS Compliant

### General Description

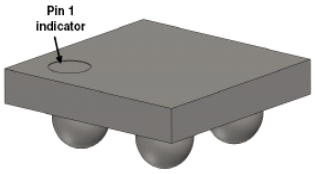
The FDZ3N513ZT is a monolithic NMOS/ Schottky combination (FETky) and is designed and wired to function as a discontinuous conduction mode (DCM) boost LED power train for mobile LED backlighting applications.

### Application

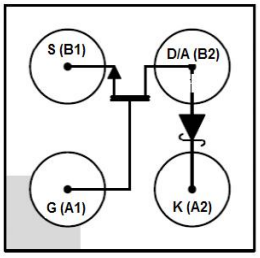
- Boost Converter Power Train for single cell Li-ion LED backlighting




WL-CSP 3D Bumps Facing Up View




WL-CSP 3D Bumps Facing Down View




WL-CSP 1.0X1.0 Bumps Facing Up View

### Absolute Maximum Ratings

| Symbol | Parameter | | Ratings | Units |
|---|---|---|---|---|
| $V_{DS}$ | NMOS Drain to Source Voltage | | 30 | V |
| $V_{GS}$ | NMOS Gate to Source Voltage | | -0.3/5.5 | V |
| $P_D$ | Power Dissipation @ $T_A$ = 25°C | (Note 1a) | 1 | W |
| $I_D$ | Maximum Continuous NMOS Drain Current | (Note 1a) | 1.1 | A |
| $V_{RRM}$ | Schottky Repetitive Peak Reverse Voltage | | 25 | V |
| $I_O$ | Schottky Average Forward Current | | 0.3 | A |
| $T_J$, $T_{STG}$ | Operating Junction and Storage Temperature | | -55/125 | °C |
| ESD | Electrostatic Discharge Protection | CDM | 2000 | V |

### Thermal Characteristics

| | | | | |
|---|---|---|---|---|
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient - 1in$^2$, 2oz. Copper | (Note 1a) | 100 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient - Minimum Pad | (Note 1b) | 260 | °C/W |

### Package Marking and Ordering Information

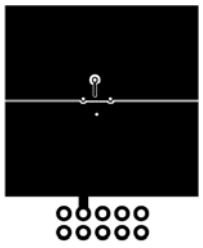
| Part Number | Device Marking | Package | Reel Size | Tape Width | Quantity |
|---|---|---|---|---|---|
| FDZ3N513ZT | Z3 | WL-CSP 1.0X1.0 | 7” | 8mm | 5000 units |

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

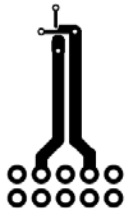
| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $BV_{DSS}$ | Drain to Source Breakdown Voltage | $I_D$ = 250 μA, $V_{GS}$ = 0 V | 30 | | | V |
| $\frac{\Delta BV_{DSS}}{\Delta T_J}$ | Breakdown Voltage Temperature Coefficient | $I_D$ = 250 μA, referenced to 25 °C | | 47 | | mV/°C |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 24 V, $V_{GS}$ = 0 V | | | 1 | μA |
| $I_{GSS}$ | Gate to Source Leakage Current | $V_{GS}$ = +5 V/-0.3 V, $V_{DS}$ = 0 V | | | ±10 | μA |
| **On Characteristics** | | | | | | |
| $V_{GS(th)}$ | Gate to Source Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 250 μA | 0.5 | 0.7 | 1.5 | V |
| $\frac{\Delta V_{GS(th)}}{\Delta T_J}$ | Gate to Source Threshold Voltage Temperature Coefficient | $I_D$ = 250 μA, referenced to 25 °C | | -1.6 | | mV/°C |
| $r_{DS(on)}$ | Drain to Source On Resistance | $V_{GS}$ = 4.5 V, $I_D$ = 0.3 A | | 384 | 462 | mΩ |
| | | $V_{GS}$ = 3.2 V, $I_D$ = 0.3 A | | 410 | 520 | |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$ = 5 V, $I_D$ = 0.3 A | | 0.5 | | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 15 V, $V_{GS}$ = 0 V, f = 1 MHz | | 45 | 85 | pF |
| $C_{oss}$ | Output Capacitance | | | 45 | 85 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 10 | 25 | pF |
| $R_g$ | Gate Resistance | | | 2.0 | | Ω |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$ = 15 V, $I_D$ = 0.3 A, $V_{GS}$ = 5 V, $R_{GEN}$ = 6 Ω | | 3.1 | 10 | ns |
| $t_r$ | Rise Time | | | 1.9 | 10 | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 9.6 | 20 | ns |
| $t_f$ | Fall Time | | | 2.7 | 10 | ns |
| $Q_g$ | Total Gate Charge ($V_{GS}$ = 4.5 V) | $V_{DD}$ = 15 V, $I_D$ = 0.3 A | | 1.0 | | nC |
| $Q_{gs}$ | Gate to Source Gate Charge | | | 0.1 | | nC |
| $Q_{gd}$ | Gate to Drain “Miller” Charge | | | 0.3 | | nC |
| **Drain-Source Diode Characteristics** | | | | | | |
| $V_{SD}$ | Source to Drain Diode Forward Voltage | $V_{GS}$ = 0 V, $I_S$ = 0.3 A (Note 2) | | 0.75 | 1.2 | V |
| $t_{rr}$ | Reverse Recovery Time | $I_F$ = 0.3 A, di/dt = 100 A/μs | | 16 | 29 | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | | 6.0 | 10 | nC |
| **Schottky Diode Characteristics** | | | | | | |
| $I_R$ | Reverse Leakage | $V_R$ = 20 V, $T_J$ = 25 °C | | 15 | 30 | μA |
| | | $T_J$ = 85 °C | | 300 | | μA |
| $V_F$ | Forward Voltage | $I_F$ = 300 mA, $T_J$ = 25 °C | | 0.72 | 1.2 | V |
| | | $T_J$ = 85 °C | | 0.74 | | |

**Notes:**

1. $R_{\theta JA}$ is determined with the device mounted on a 1 $in^2$ oz. copper pad on a 1.5 x 1.5 in. board of FR-4 material. $R_{\theta JC}$ is guaranteed by design while $R_{\theta JA}$ is determined by the user's board design.



a. 100 °C/W when mounted on a 1 $in^2$ pad of 2 oz copper.



b. 260 °C/W when mounted on a minimum pad of 2 oz copper.

2. Pulse Test: Pulse Width < 300μs, Duty cycle < 2.0%.

3. The diode connected between the gate and source serves only as protection ESD. No gate overvoltage rating is implied.

## Typical Characteristics $T_J$ = 25°C unless otherwise noted

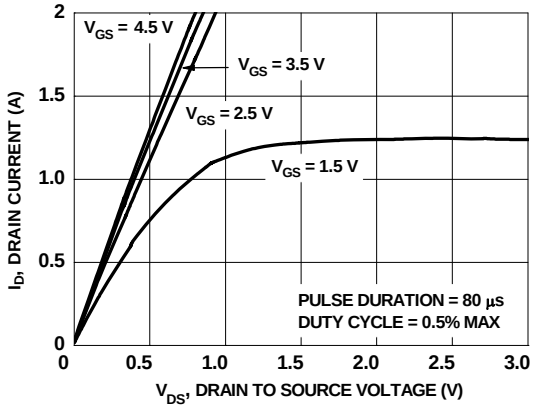



**Figure 1. On Region Characteristics**

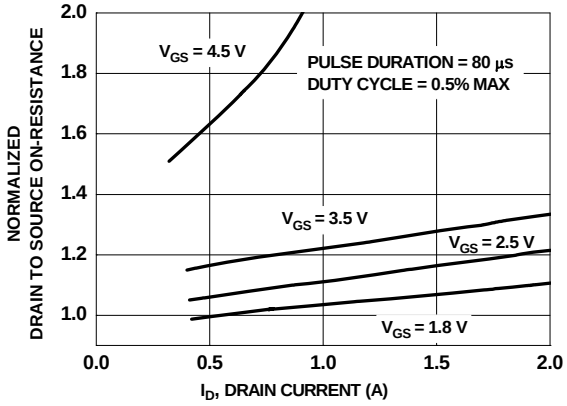



**Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage**

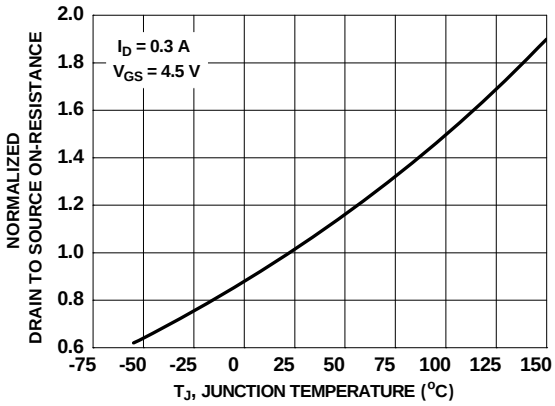



**Figure 3. Normalized On Resistance vs Junction Temperature**

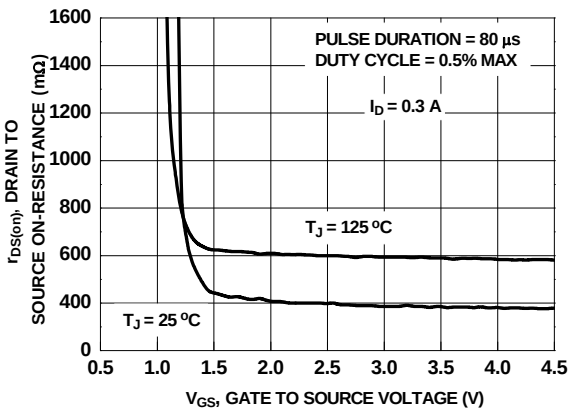



**Figure 4. On-Resistance vs Gate to Source Voltage**

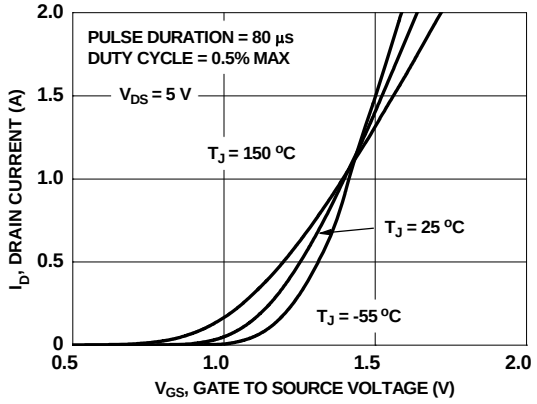



**Figure 5. Transfer Characteristics**

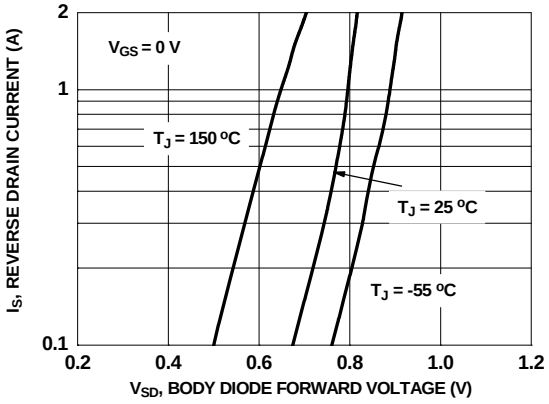



**Figure 6. Source to Drain Diode Forward Voltage vs Source Current**

## Typical Characteristics $T_J$ = 25°C unless otherwise noted

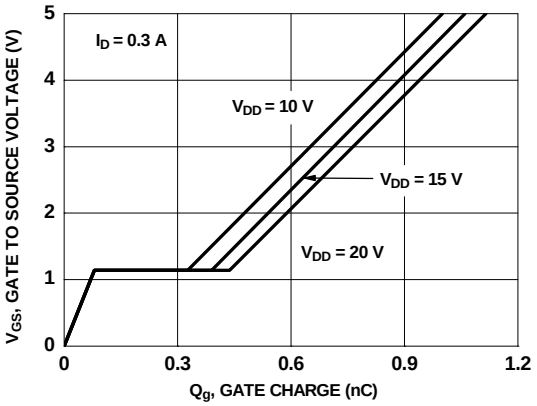



**Figure 7. Gate Charge Characteristics**

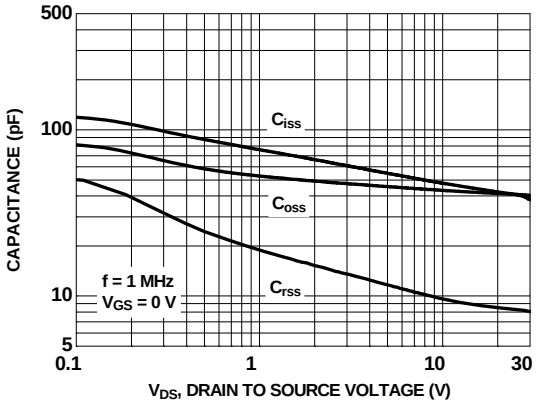



**Figure 8. Capacitance vs Drain to Source Voltage**

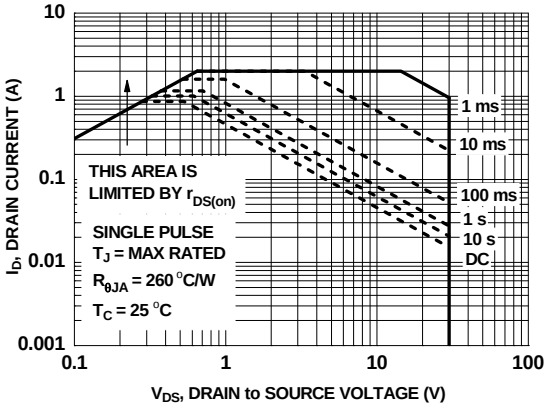



**Figure 9. Forward Bias Safe Operating Area**

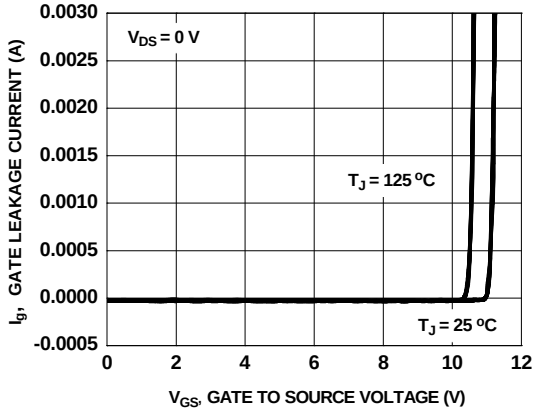



**Figure 10. Gate Leakage Current vs Gate to Source Voltage**

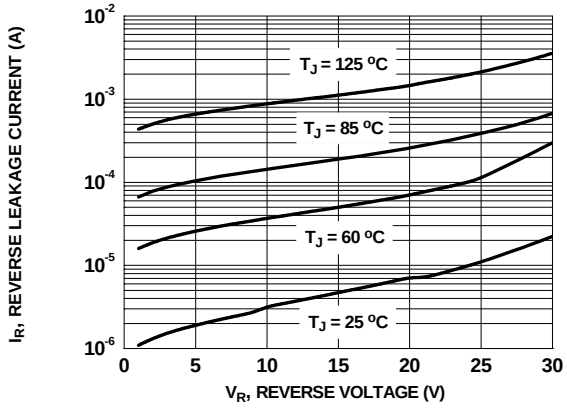



**Figure 11. Schottky Diode Reverse Current**

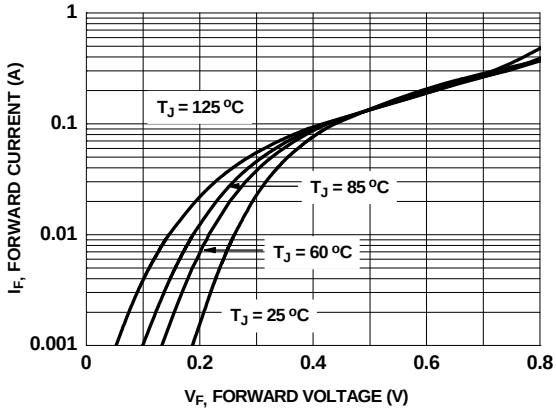



**Figure 12. Schottky Diode Forward Voltage**

## Typical Characteristics $T_J$ = 25°C unless otherwise noted

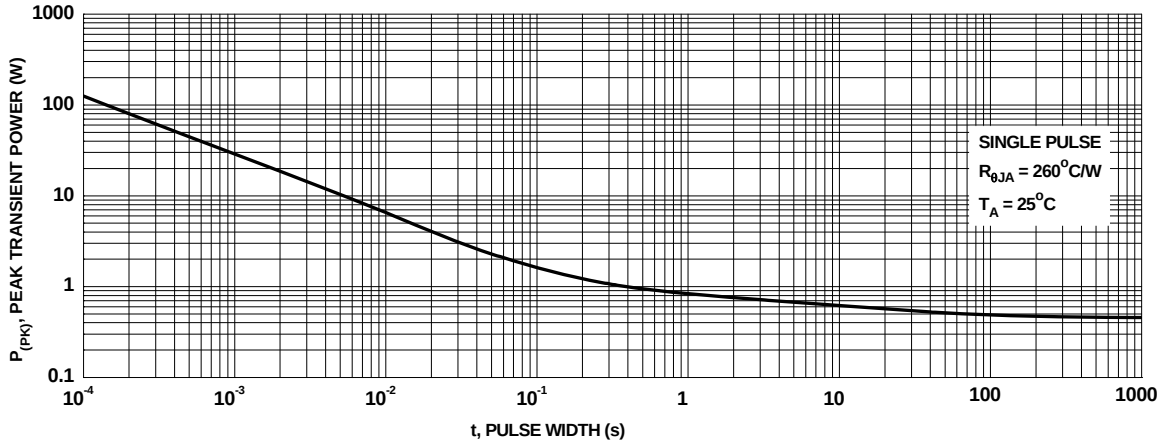



**Figure 13. Single Pulse Maximum Power Dissipation**

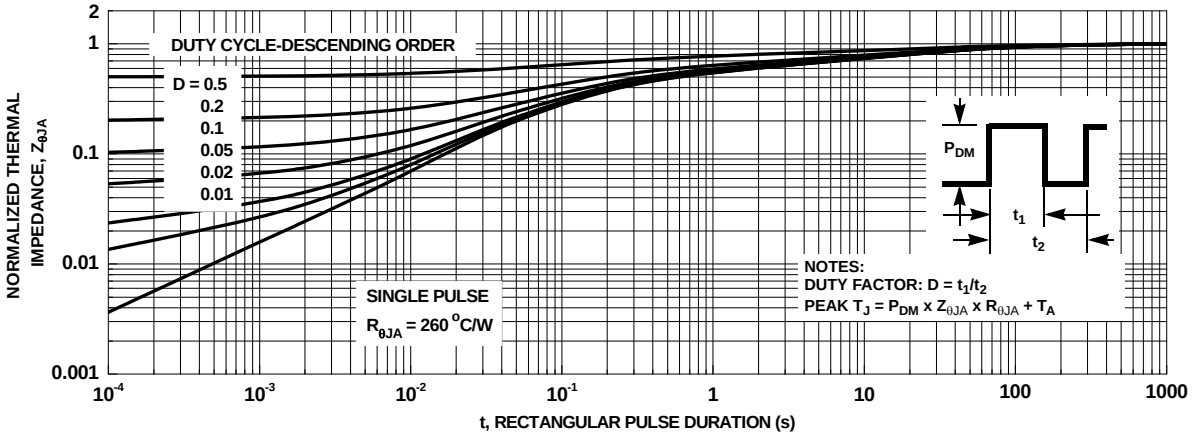
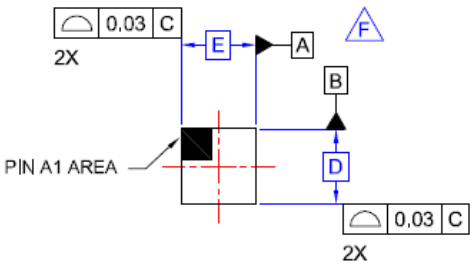
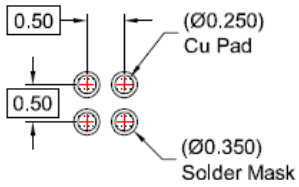



**Figure 14. Junction-to-Ambient Transient Thermal Response Curve**

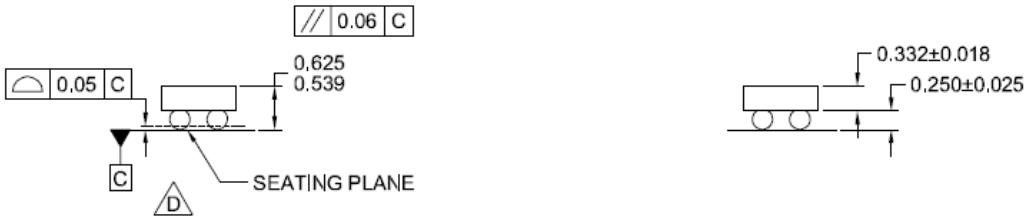
## Dimensional Outline and Pad Layout



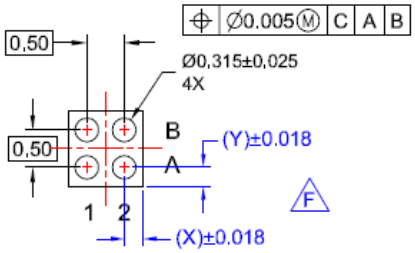

TOP VIEW




RECOMMENDED LAND PATTERN
(NSMD PAD TYPE)




SIDE VIEWS




BOTTOM VIEW

NOTES:

A. NO JEDEC REGISTRATION APPLIES.

B. DIMENSIONS ARE IN MILLIMETERS.

C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.

D. DATUM C IS DEFINED BY THE SPHERICAL CROWNS OF THE BALLS.

E. PACKAGE NOMINAL HEIGHT IS 582 MICRONS ±43 MICRONS (539-625 MICRONS).

F. FOR DIMENSIONS D, E, X, AND Y SEE PRODUCT DATASHEET.

### Product Specific Dimensions

| Product | D | E | X | Y |
|---|---|---|---|---|
| FDZ3N513ZTUCX | 1.000 +/-0.030 | 1.000 +/-0.030 | 0.018 | 0.018 |

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Rev. I48

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