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# FDZ3N513ZT

## Integrated NMOS and Schottky Diode

### Features

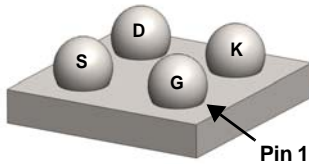
- Monolithic NMOS and Schottky Diode
- Ultra-small form factor 1mm x 1mm WLCSP
- Max  $r_{DS(on)}$  = 462 mΩ at  $V_{GS} = 4.5$  V,  $I_D = 0.3$  A
- Max  $r_{DS(on)}$  = 520 mΩ at  $V_{GS} = 3.2$  V,  $I_D = 0.3$  A
- HBM ESD protection level > 2000V (Note3)
- RoHS Compliant

### General Description

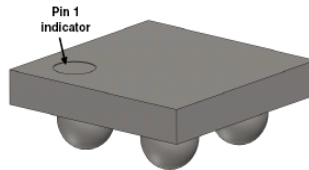
The FDZ3N513ZT is a monolithic NMOS/ Schottky combination (FETky) and is designed and wired to function as a discontinuous conduction mode (DCM) boost LED power train for mobile LED backlighting applications.

### Application

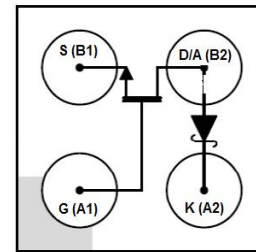
- Boost Converter Power Train for single cell Li-ion LED backlighting



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 @ $T_A = 25^\circ\text{C}$ (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	$^\circ\text{C}$
ESD	Electrostatic Discharge Protection	CDM 2000	V

### Thermal Characteristics

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

### 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 $T_J = 25\text{ }^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
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### Off Characteristics

$BV_{DSS}$	Drain to Source Breakdown Voltage	$I_D = 250\text{ }\mu\text{A}$ , $V_{GS} = 0\text{ V}$	30			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\text{ }\mu\text{A}$ , referenced to $25\text{ }^\circ\text{C}$		47		mV/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 24\text{ V}$ , $V_{GS} = 0\text{ V}$			1	$\mu\text{A}$
$I_{GSS}$	Gate to Source Leakage Current	$V_{GS} = +5\text{ V}/-0.3\text{ V}$ , $V_{DS} = 0\text{ V}$			$\pm 10$	$\mu\text{A}$

### On Characteristics

$V_{GS(th)}$	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}$ , $I_D = 250\text{ }\mu\text{A}$	0.5	0.7	1.5	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate to Source Threshold Voltage Temperature Coefficient	$I_D = 250\text{ }\mu\text{A}$ , referenced to $25\text{ }^\circ\text{C}$		-1.6		mV/ $^\circ\text{C}$
$r_{DS(on)}$	Drain to Source On Resistance	$V_{GS} = 4.5\text{ V}$ , $I_D = 0.3\text{ A}$ $V_{GS} = 3.2\text{ V}$ , $I_D = 0.3\text{ A}$		384 410	462 520	m $\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 5\text{ V}$ , $I_D = 0.3\text{ A}$		0.5		S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = 15\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1\text{ MHz}$		45	85	pF
$C_{oss}$	Output Capacitance			45	85	pF
$C_{rss}$	Reverse Transfer Capacitance			10	25	pF
$R_g$	Gate Resistance			2.0		$\Omega$

### Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 15\text{ V}$ , $I_D = 0.3\text{ A}$ $V_{GS} = 5\text{ V}$ , $R_{GEN} = 6\text{ }\Omega$		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 ( $V_{GS} = 4.5\text{ V}$ )		$V_{DD} = 15\text{ V}$ $I_D = 0.3\text{ A}$		1.0	
$Q_{gs}$	Gate to Source Gate Charge			0.1		nC
$Q_{gd}$	Gate to Drain "Miller" Charge			0.3		nC

### Drain-Source Diode Characteristics

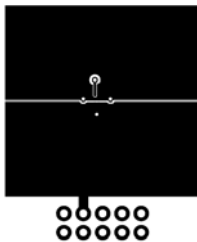
$V_{SD}$	Source to Drain Diode Forward Voltage	$V_{GS} = 0\text{ V}$ , $I_S = 0.3\text{ A}$ (Note 2)		0.75	1.2	V
$t_{rr}$	Reverse Recovery Time	$I_F = 0.3\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$		16	29	ns
$Q_{rr}$	Reverse Recovery Charge			6.0	10	nC

### Schottky Diode Characteristics

$I_R$	Reverse Leakage	$V_R = 20\text{ V}$	$T_J = 25\text{ }^\circ\text{C}$		15	30	$\mu\text{A}$
			$T_J = 85\text{ }^\circ\text{C}$		300		$\mu\text{A}$
$V_F$	Forward Voltage	$I_F = 300\text{ mA}$	$T_J = 25\text{ }^\circ\text{C}$		0.72	1.2	V
			$T_J = 85\text{ }^\circ\text{C}$		0.74		

#### Notes:

1.  $R_{\theta JA}$  is determined with the device mounted on a  $1\text{ in}^2$  oz. copper pad on a  $1.5 \times 1.5\text{ in.}$  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.  $100\text{ }^\circ\text{C}/\text{W}$  when mounted on a  $1\text{ in}^2$  pad of 2 oz copper.



b.  $260\text{ }^\circ\text{C}/\text{W}$  when mounted on a minimum pad of 2 oz copper.

2. Pulse Test: Pulse Width <  $300\mu\text{s}$ , 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**  $T_J = 25^\circ\text{C}$  unless otherwise noted

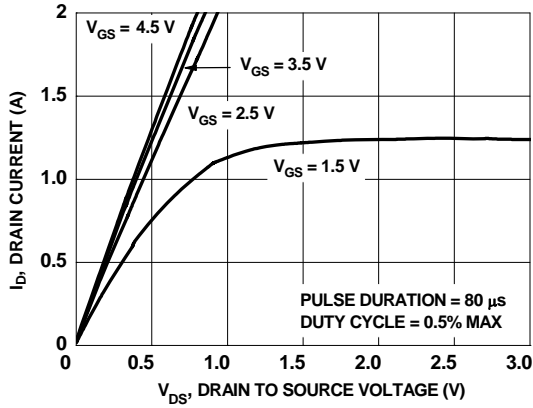


Figure 1. On Region Characteristics

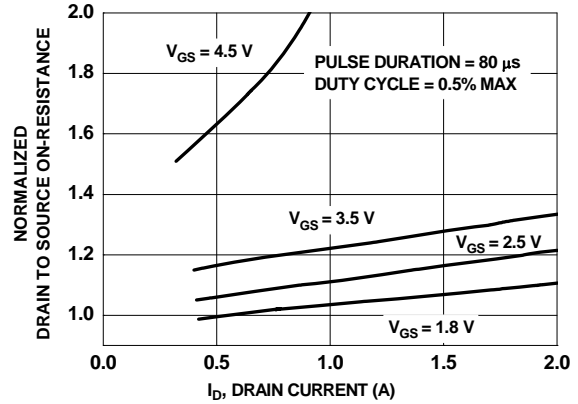


Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage

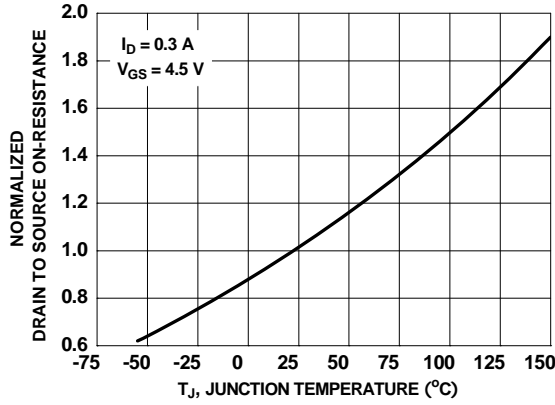


Figure 3. Normalized On Resistance vs Junction Temperature

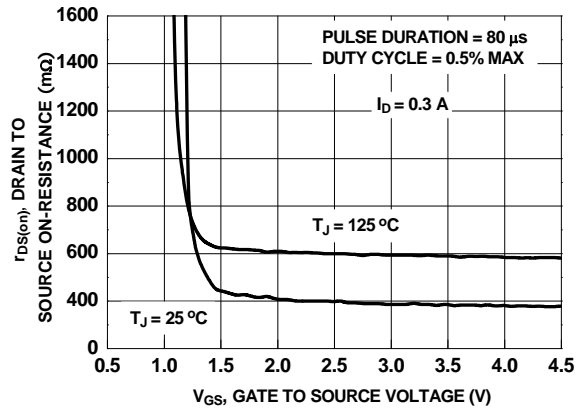


Figure 4. On-Resistance vs Gate to Source Voltage

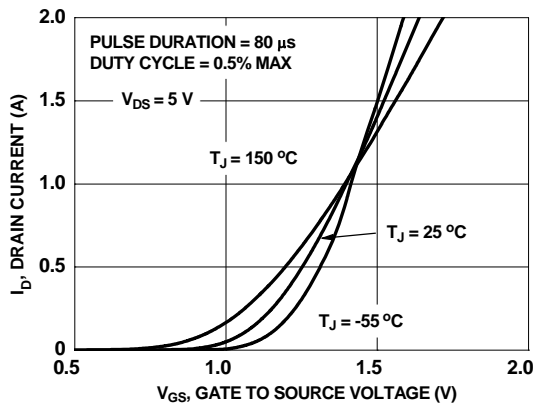


Figure 5. Transfer Characteristics

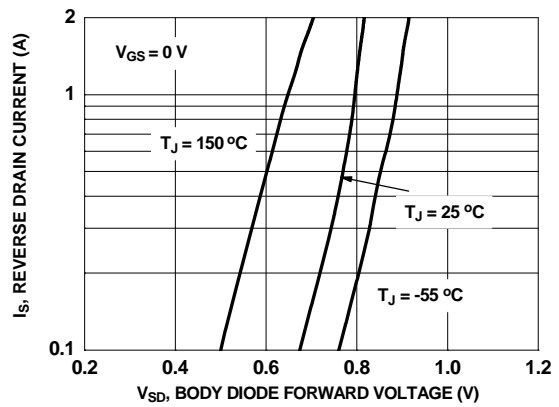
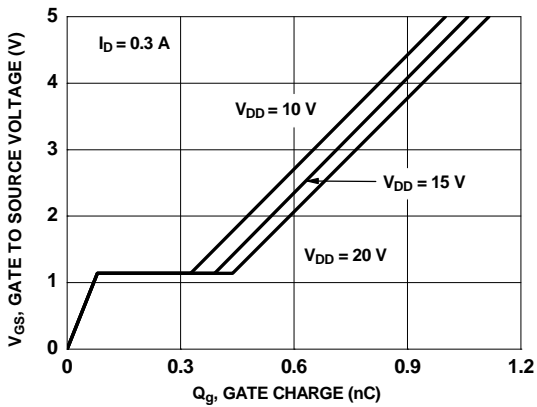
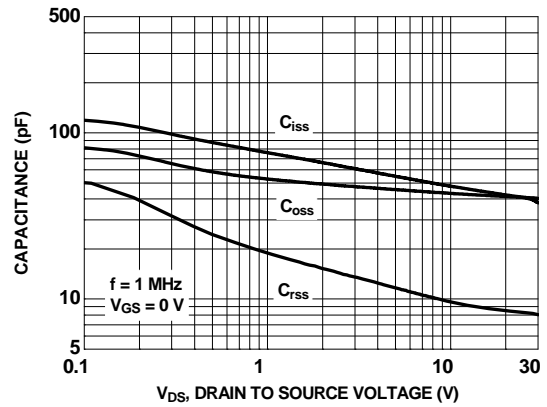


Figure 6. Source to Drain Diode Forward Voltage vs Source Current

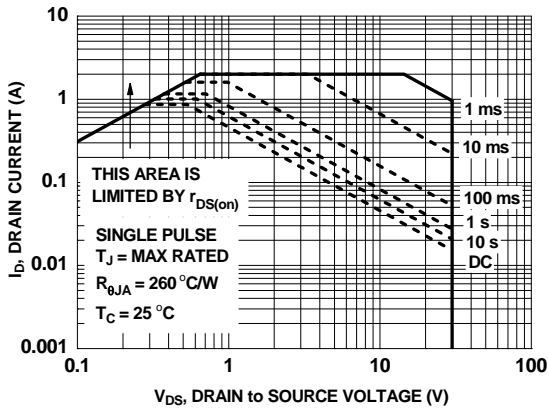
**Typical Characteristics**  $T_J = 25^\circ\text{C}$  unless otherwise noted



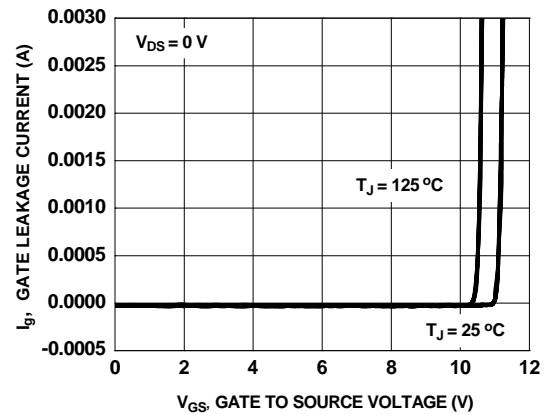
**Figure 7. Gate Charge Characteristics**



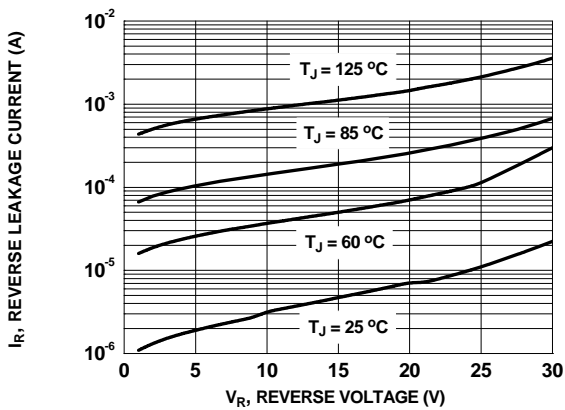
**Figure 8. Capacitance vs Drain to Source Voltage**



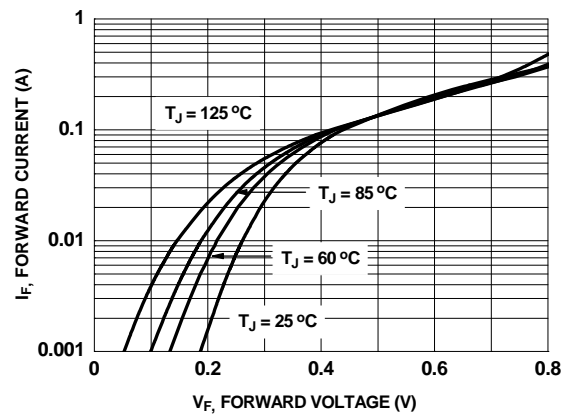
**Figure 9. Forward Bias Safe Operating Area**



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

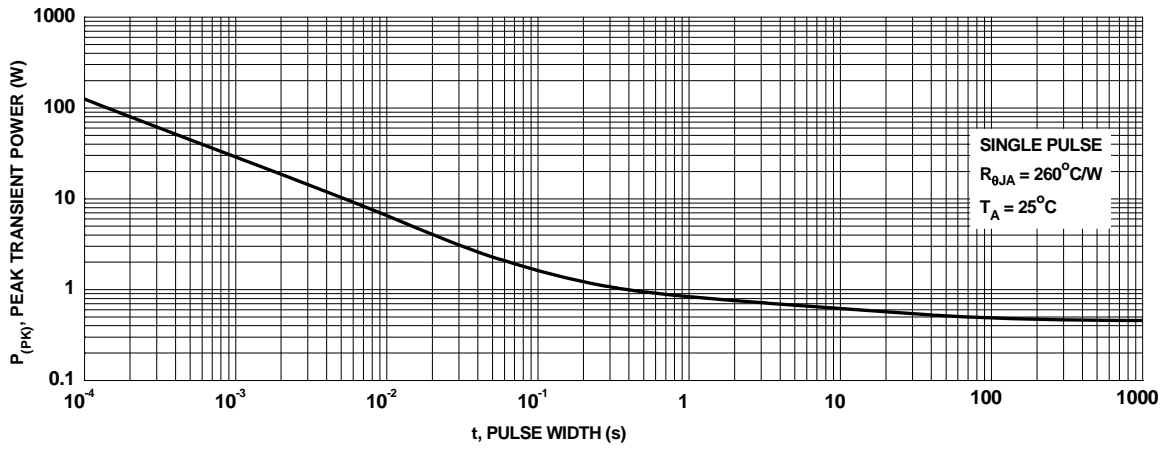


**Figure 11. Schottky Diode Reverse Current**

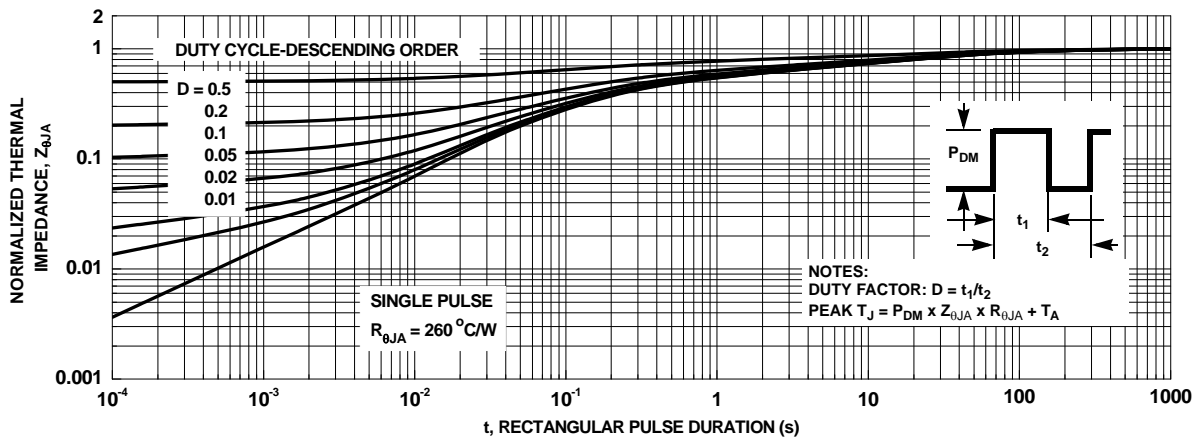


**Figure 12. Schottky Diode Forward Voltage**

**Typical Characteristics**  $T_J = 25^\circ\text{C}$  unless otherwise noted

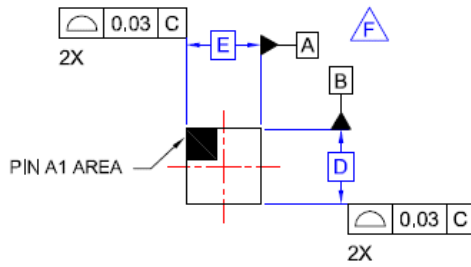


**Figure 13. Single Pulse Maximum Power Dissipation**

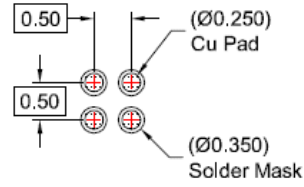


**Figure 14. Junction-to-Ambient Transient Thermal Response Curve**

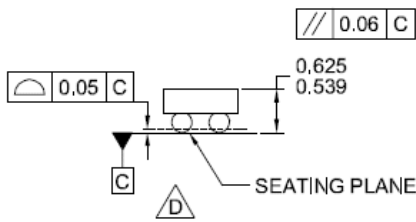
## Dimensional Outline and Pad Layout



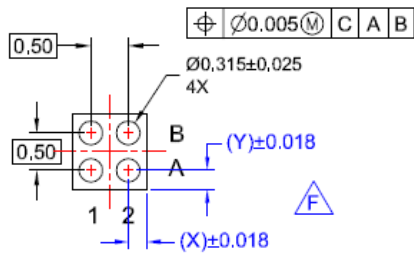
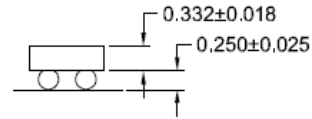
TOP VIEW



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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