



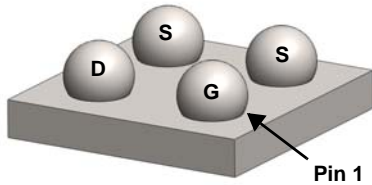
ON Semiconductor®

# FDZ451PZ

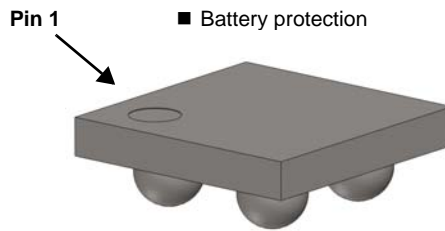
## P-Channel 1.5 V Specified PowerTrench® Thin WL-CSP MOSFET -20 V, -2.6 A, 140 mΩ

### Features

- Max  $r_{DS(on)}$  = 140 mΩ at  $V_{GS} = -4.5$  V,  $I_D = -2$  A
- Max  $r_{DS(on)}$  = 182 mΩ at  $V_{GS} = -2.5$  V,  $I_D = -1.5$  A
- Max  $r_{DS(on)}$  = 231 mΩ at  $V_{GS} = -1.8$  V,  $I_D = -1$  A
- Max  $r_{DS(on)}$  = 315 mΩ at  $V_{GS} = -1.5$  V,  $I_D = -1$  A
- Occupies only 0.64 mm<sup>2</sup> of PCB area. Less than 16% of the area of 2 x 2 BGA
- Ultra-thin package: less than 0.4 mm height when mounted to PCB
- HBM ESD protection level > 2 kV (Note3)
- RoHS Compliant



BOTTOM



TOP

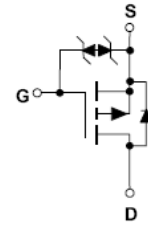
WL-CSP 0.8X0.8 Thin

### General Description

Designed on ON Semiconductor advanced 1.5 V PowerTrench® process with state of the art "fine pitch" Thin WLCSP packaging process, the FDZ451PZ minimizes both PCB space and  $r_{DS(on)}$ . This advanced WLCSP MOSFET embodies a breakthrough in packaging technology which enables the device to combine excellent thermal transfer characteristics, ultra-low profile (0.4 mm) and small (0.8x0.8 mm<sup>2</sup>) packaging, low gate charge, and low  $r_{DS(on)}$ .

### Applications

- Battery management
- Load switch
- Battery protection



### MOSFET Maximum Ratings $T_A = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Rated	Units
$V_{DS}$	Drain to Source Voltage	-20	V
$V_{GS}$	Gate to Source Voltage	±8	V
$I_D$	-Continuous $T_A = 25^\circ\text{C}$ (Note 1a)	-2.6	A
	-Pulsed	-10	
$P_D$	Power Dissipation $T_A = 25^\circ\text{C}$ (Note 1a)	1.3	W
	Power Dissipation $T_A = 25^\circ\text{C}$ (Note 1b)	0.4	
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	-55 to +150	°C

### Thermal Characteristics

$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	(Note 1a)	93	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	(Note 1b)	311	

### Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
EH	FDZ451PZ	WL-CSP 0.8X0.8 Thin	7"	8 mm	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	$I_D = -250\text{ }\mu\text{A}$ , $V_{GS} = 0\text{ V}$	-20			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = -250\text{ }\mu\text{A}$ , referenced to $25\text{ }^\circ\text{C}$		-13		mV/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = -16\text{ V}$ , $V_{GS} = 0\text{ V}$			-1	$\mu\text{A}$
$I_{GSS}$	Gate to Source Leakage Current	$V_{GS} = \pm 8\text{ V}$ , $V_{DS} = 0\text{ V}$			$\pm 10$	$\mu\text{A}$

### On Characteristics

$V_{GS(th)}$	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}$ , $I_D = -250\text{ }\mu\text{A}$	-0.3	-0.7	-1.2	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 $25\text{ }^\circ\text{C}$		2.5		mV/ $^\circ\text{C}$
$r_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = -4.5\text{ V}$ , $I_D = -2\text{ A}$		108	140	m $\Omega$
		$V_{GS} = -2.5\text{ V}$ , $I_D = -1.5\text{ A}$		129	182	
		$V_{GS} = -1.8\text{ V}$ , $I_D = -1\text{ A}$		159	231	
		$V_{GS} = -1.5\text{ V}$ , $I_D = -1\text{ A}$		201	315	
		$V_{GS} = -4.5\text{ V}$ , $I_D = -2\text{ A}$ , $T_J = 125\text{ }^\circ\text{C}$		143	204	
$g_{FS}$	Forward Transconductance	$V_{DD} = -5\text{ V}$ , $I_D = -2\text{ A}$		7.8		S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = -10\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1\text{ MHz}$		416	555	pF
$C_{oss}$	Output Capacitance			61	80	pF
$C_{rss}$	Reverse Transfer Capacitance			53	70	pF

### Switching Characteristics

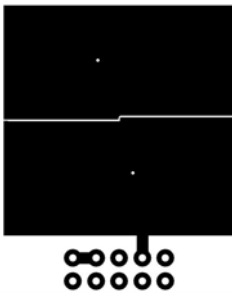
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = -10\text{ V}$ , $I_D = -2.5\text{ A}$ , $V_{GS} = -4.5\text{ V}$ , $R_{GEN} = 6\text{ }\Omega$		4.9	10	ns
$t_r$	Rise Time			6.3	13	ns
$t_{d(off)}$	Turn-Off Delay Time			68	108	ns
$t_f$	Fall Time			33	52	ns
$Q_g$	Total Gate Charge	$V_{GS} = -4.5\text{ V}$ , $V_{DD} = -10\text{ V}$ , $I_D = -2.5\text{ A}$		6.3	8.8	nC
$Q_{gs}$	Gate to Source Charge			0.6		nC
$Q_{gd}$	Gate to Drain "Miller" Charge			1.7		nC

### Drain-Source Diode Characteristics

$V_{SD}$	Source to Drain Diode Forward Voltage	$V_{GS} = 0\text{ V}$ , $I_S = -1.4\text{ A}$ (Note 2)		-0.9	-1.2	V
$t_{rr}$	Reverse Recovery Time	$I_F = -2.5\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$		29	46	ns
$Q_{rr}$	Reverse Recovery Charge			10	18	nC

#### Notes:

- $R_{\theta JA}$  is determined with the device mounted on a  $1\text{ in}^2$  pad 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  $R_{\theta CA}$  is determined by the user's board design.



a.  $93\text{ }^\circ\text{C/W}$  when mounted on a  $1\text{ in}^2$  pad of 2 oz copper.



b.  $311\text{ }^\circ\text{C/W}$  when mounted on a minimum pad of 2 oz copper.

- Pulse Test: Pulse Width <  $300\mu\text{s}$ , Duty cycle < 2.0%.

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

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

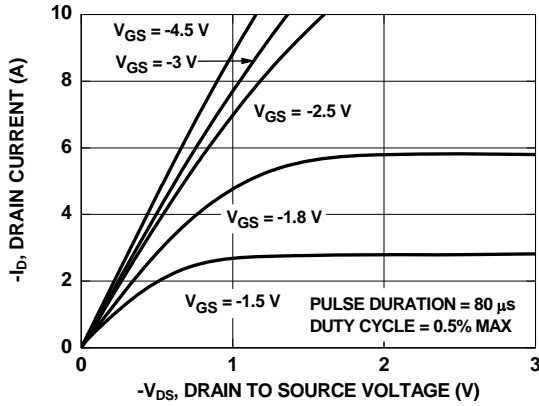


Figure 1. On-Region Characteristics

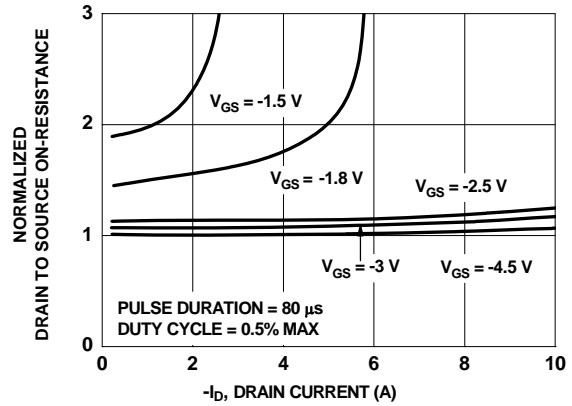


Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage

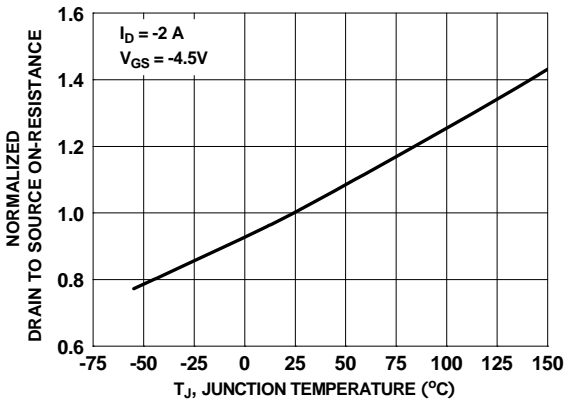


Figure 3. Normalized On-Resistance vs Junction Temperature

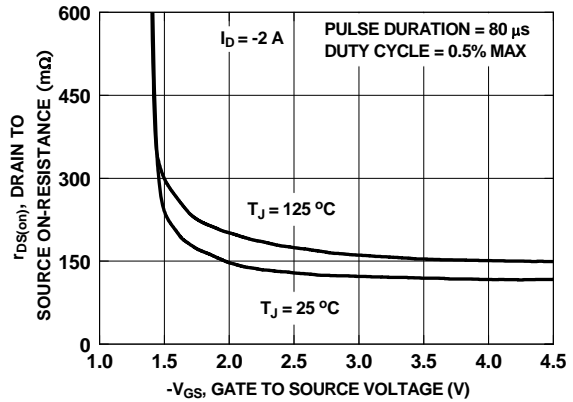


Figure 4. On-Resistance vs Gate to Source Voltage

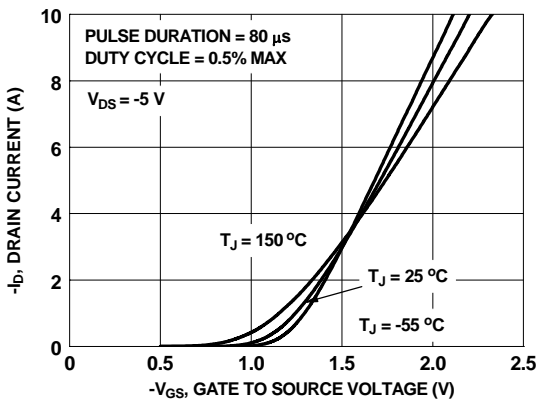


Figure 5. Transfer Characteristics

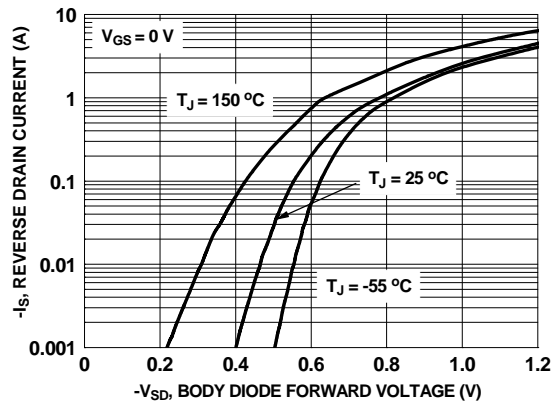
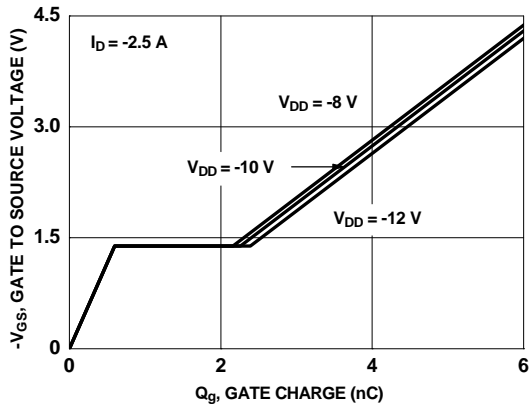
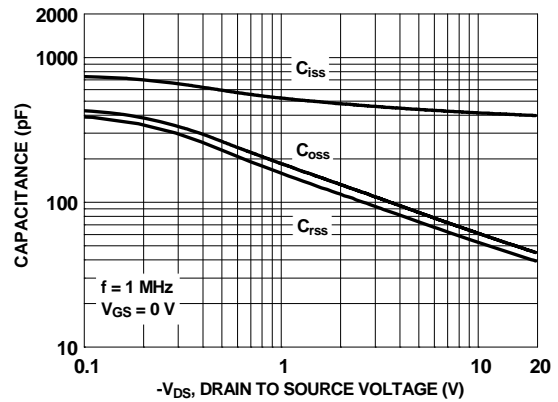


Figure 6. Source to Drain Diode Forward Voltage vs Source Current

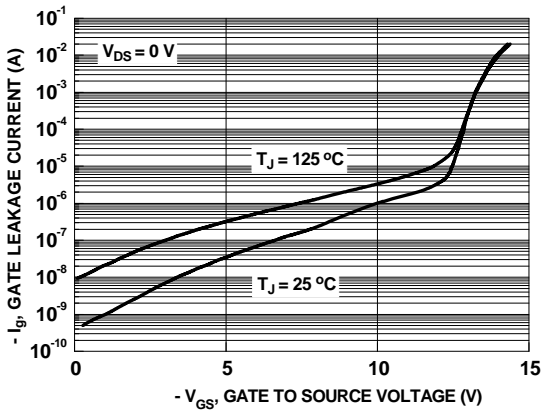
**Typical Characteristics**  $T_J = 25\text{ }^\circ\text{C}$  unless otherwise noted



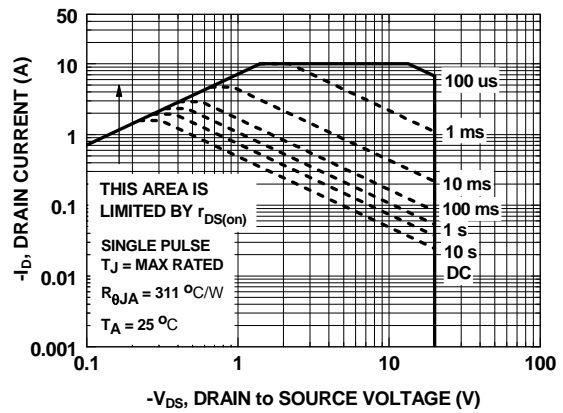
**Figure 7. Gate Charge Characteristics**



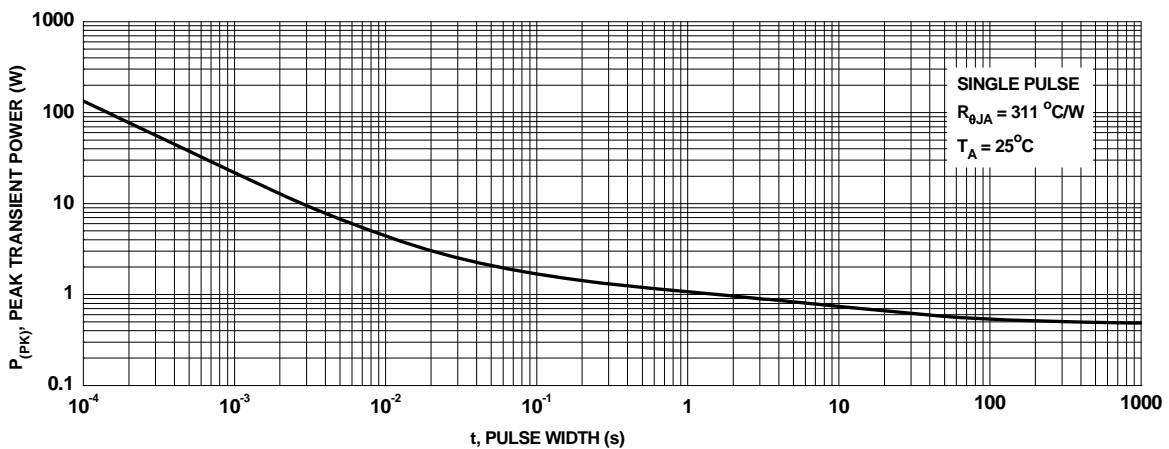
**Figure 8. Capacitance vs Drain to Source Voltage**



**Figure 9. Gate Leakage Current vs Gate to Source Voltage**

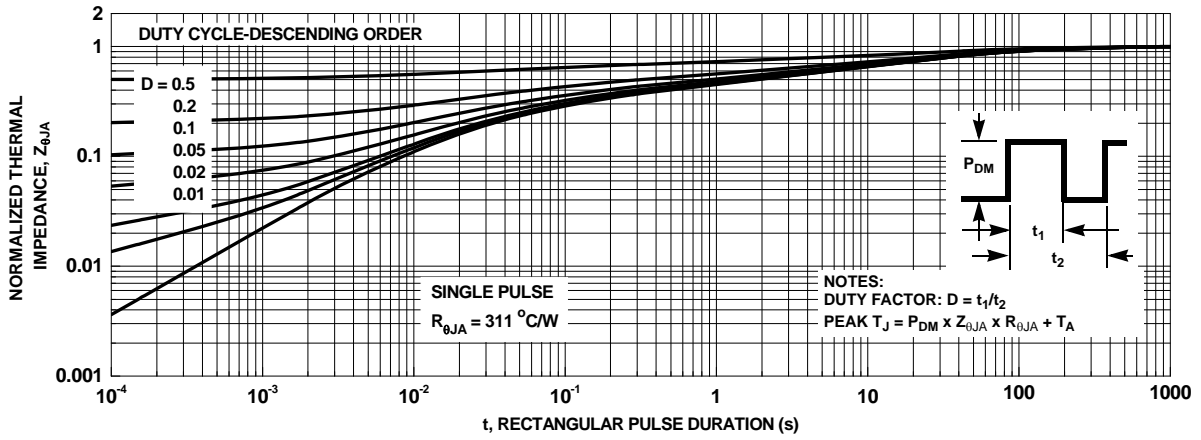


**Figure 10. Forward Bias Safe Operating Area**



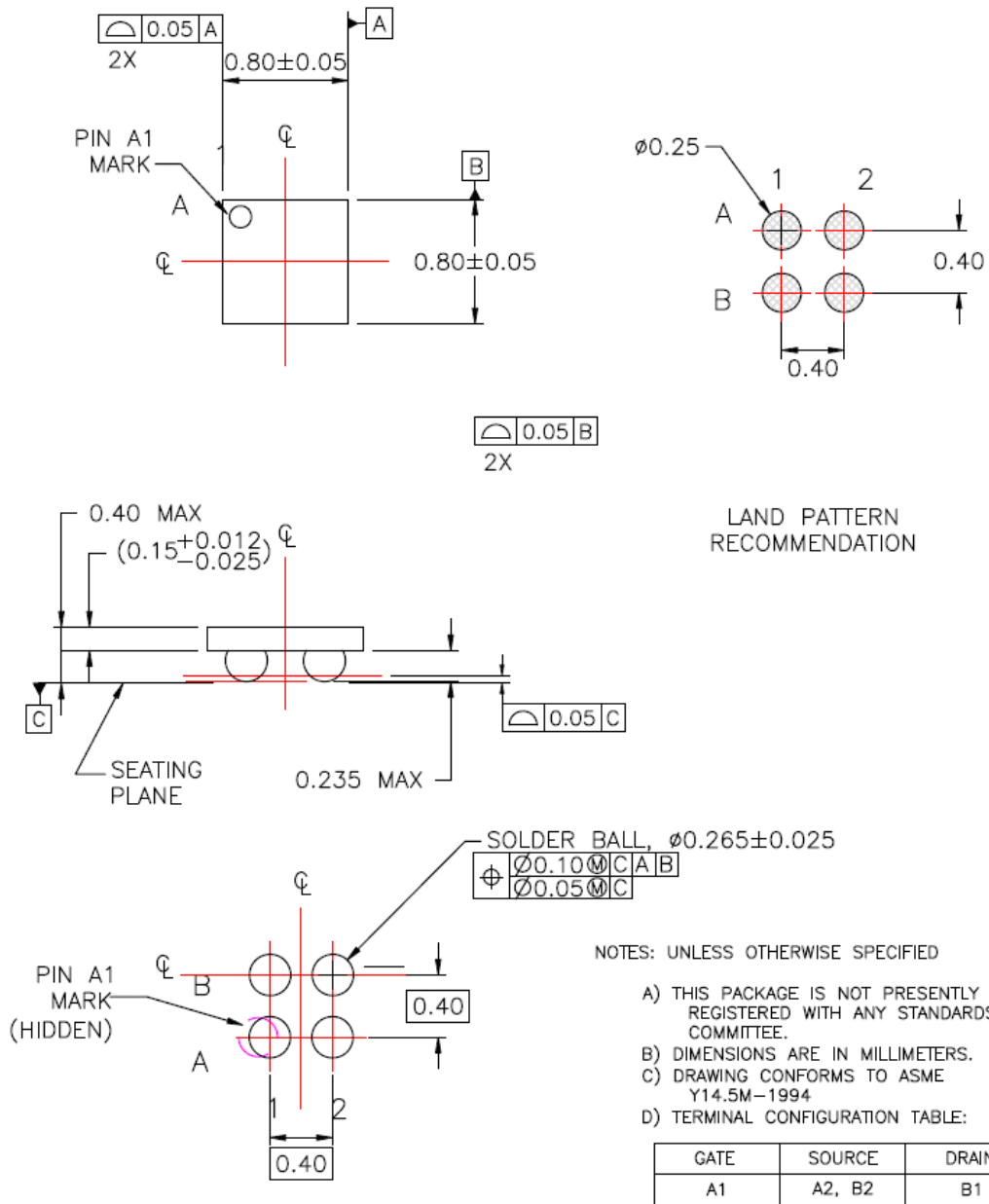
**Figure 11. Single Pulse Maximum Power Dissipation**


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



**Figure 12. Junction-to-Ambient Transient Thermal Response Curve**

## Dimensional Outline and Pad Layout



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