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December 2014

# FDZ193P

## P-Channel 1.7V PowerTrench<sup>®</sup> WL-CSP MOSFET

-20V, -1A, 90mΩ

### Features

- Max  $r_{DS(on)}$  = 90mΩ at  $V_{GS} = -4.5V$ ,  $I_D = -1A$
- Max  $r_{DS(on)}$  = 130mΩ at  $V_{GS} = -2.5V$ ,  $I_D = -1A$
- Max  $r_{DS(on)}$  = 300mΩ at  $V_{GS} = -1.7V$ ,  $I_D = -1A$
- Occupies only 1.5 mm<sup>2</sup> of PCB area Less than 50% of the area of 2 x 2 BGA
- Ultra-thin package: less than 0.65 mm height when mounted to PCB
- RoHS Compliant

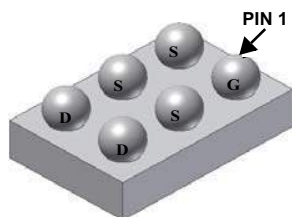


### General Description

Designed on Fairchild's advanced 1.7V PowerTrench<sup>®</sup> process with state of the art "low pitch" WLCSP packaging process, the FDZ193P 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 packaging, low gate charge, and low  $r_{DS(on)}$ .

### Application

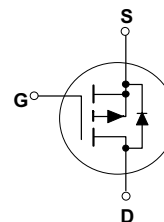
- Battery management
- Load switch
- Battery protection



BOTTOM



TOP



### 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	±12	V
$I_D$	Drain Current -Continuous	(Note 1a) -3	A
	-Pulsed	-15	
$P_D$	Power Dissipation	(Note 1a) 1.9	W
	Power Dissipation	(Note 1b) 0.9	
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	-55 to +150	°C

### Thermal Characteristics

$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	(Note 1a) 65	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	(Note 1b) 133	

### Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
2	FDZ193P	WL-CSP	7"	8mm	5000 units

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

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

$BV_{DSS}$	Drain to Source Breakdown Voltage	$I_D = -250\mu\text{A}, V_{GS} = 0\text{V}$	-20			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = -250\mu\text{A}$ , referenced to $25^\circ\text{C}$		-11		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	$V_{GS} = \pm 12\text{V}, V_{DS} = 0\text{V}$			$\pm 100$	nA

### On Characteristics

$V_{GS(th)}$	Gate to Source Threshold Voltage	$V_{GS} = V_{DS}, I_D = -250\mu\text{A}$	-0.6	-0.9	-1.5	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate to Source Threshold Voltage Temperature Coefficient	$I_D = -250\mu\text{A}$ , referenced to $25^\circ\text{C}$		3		mV/ $^\circ\text{C}$
$r_{DS(on)}$	Drain to Source On Resistance	$V_{GS} = -4.5\text{V}, I_D = -1\text{A}$		66	90	m $\Omega$
		$V_{GS} = -2.5\text{V}, I_D = -1\text{A}$		92	130	
		$V_{GS} = -1.7\text{V}, I_D = -1\text{A}$		195	300	
		$V_{GS} = -4.5\text{V}, I_D = -1\text{A}, T_J = 125^\circ\text{C}$		84	123	
$I_{D(on)}$	On to State Drain Current	$V_{GS} = -4.5\text{V}, V_{DS} = -5\text{V}$	-10			A
$g_{FS}$	Forward Transconductance	$V_{DS} = -5\text{V}, I_D = -1\text{A}$		5.6		S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = -10\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$		660		pF
$C_{oss}$	Output Capacitance			150		pF
$C_{rss}$	Reverse Transfer Capacitance			90		pF
$R_g$	Gate Resistance	$f = 1\text{MHz}$		9.5		$\Omega$

### Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = -10\text{V}, I_D = -1\text{A}, V_{GS} = -4.5\text{V}, R_{GEN} = 6\Omega$		13	23	ns
$t_r$	Rise Time			10	20	ns
$t_{d(off)}$	Turn-Off Delay Time			28	45	ns
$t_f$	Fall Time			21	34	ns
$Q_{g(TOT)}$	Total Gate Charge at 10V		$V_{GS} = 0\text{V to } 10\text{V}, V_{DD} = -10\text{V}, I_D = -1\text{A}$		7	10
$Q_{gs}$	Gate to Source Gate Charge			1		nC
$Q_{gd}$	Gate to Drain "Miller" Charge			2		nC

### Drain-Source Diode Characteristics

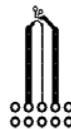
$I_S$	Maximum continuous Drain-Source Diode Forward Current			-1.1		A
$V_{SD}$	Source to Drain Diode Forward Voltage	$V_{GS} = 0\text{V}, I_S = -1.1\text{A}$ (Note 2)	-0.7	-1.2		V
$t_{rr}$	Reverse Recovery Time	$I_F = -1\text{A}, di/dt = 100\text{A}/\mu\text{s}$		19		ns
$Q_{rr}$	Reverse Recovery Charge			6		nC

#### Notes:

1:  $R_{\theta JA}$  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. The thermal resistance from the junction to the circuit board side of the solder ball,  $R_{\theta JB}$  is defined for reference. For  $R_{\theta JC}$  the thermal reference point for the case is defined as the top surface of the copper chip carrier.  $R_{\theta JC}$  and  $R_{\theta JB}$  are guaranteed by design while  $R_{\theta JA}$  is determined by the user's board design.



a.  $65^\circ\text{C/W}$  when mounted on a  $1\text{in}^2$  pad of 2 oz copper,  $1.5" \times 1.5" \times 0.062"$  thick PCB



b.  $133^\circ\text{C/W}$  when mounted on a minimum pad of 2 oz copper

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

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

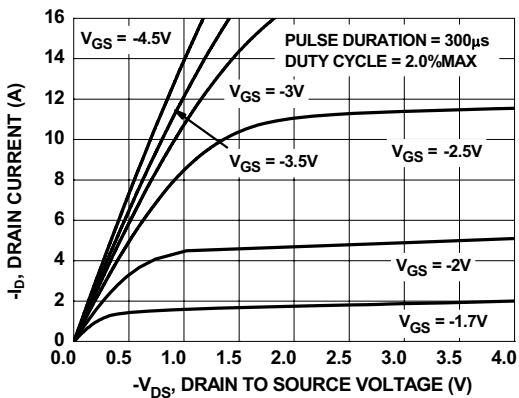


Figure 1. On Region Characteristics

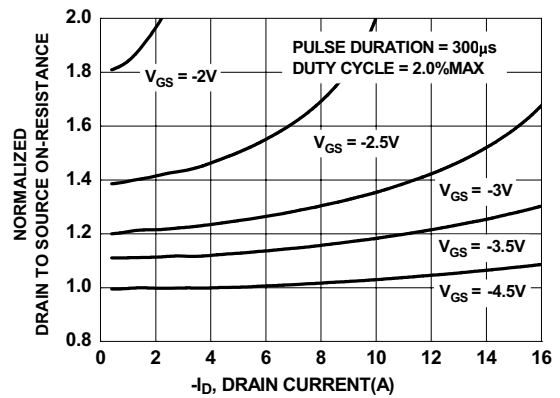


Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage

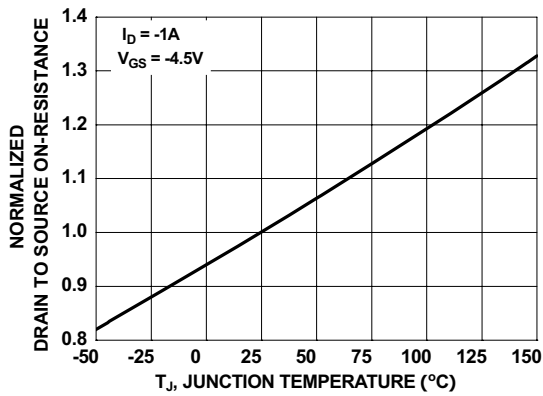


Figure 3. Normalized On Resistance vs Junction Temperature

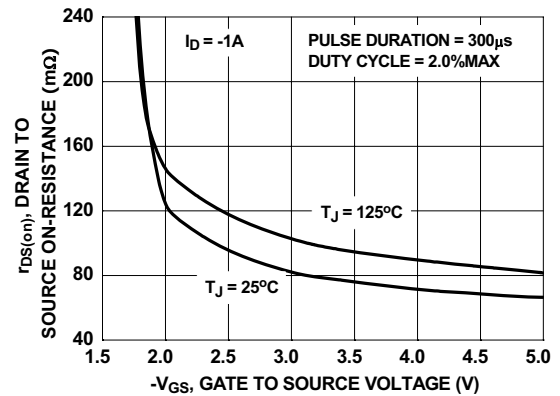


Figure 4. On-Resistance vs Gate to Source Voltage

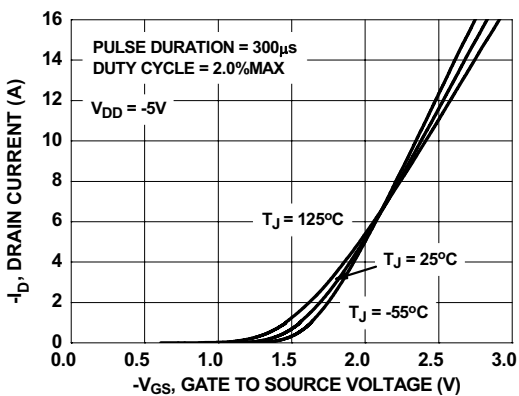


Figure 5. Transfer Characteristics

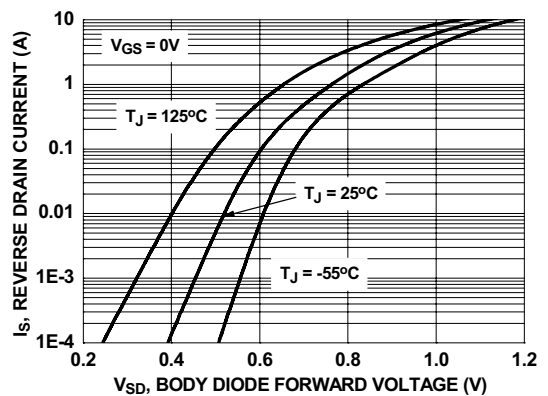


Figure 6. Source to Drain Diode Forward Voltage vs Source Current

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

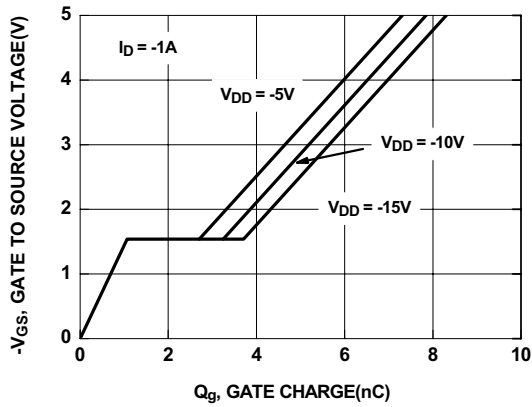


Figure 7. Gate Charge Characteristics

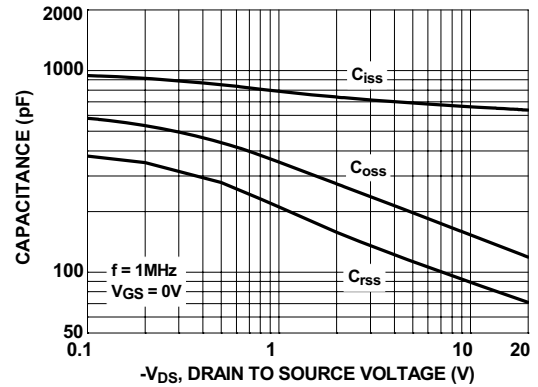


Figure 8. Capacitance vs Drain to Source Voltage

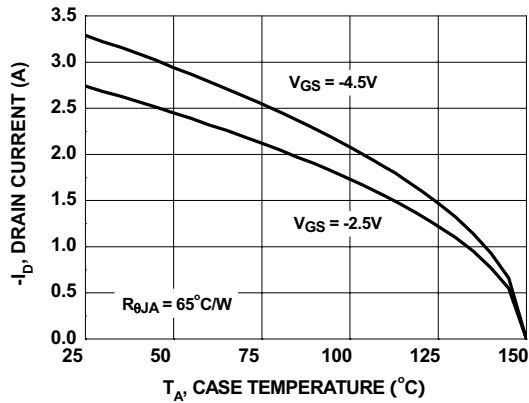


Figure 9. Maximum Continuous Drain Current vs Ambient Temperature

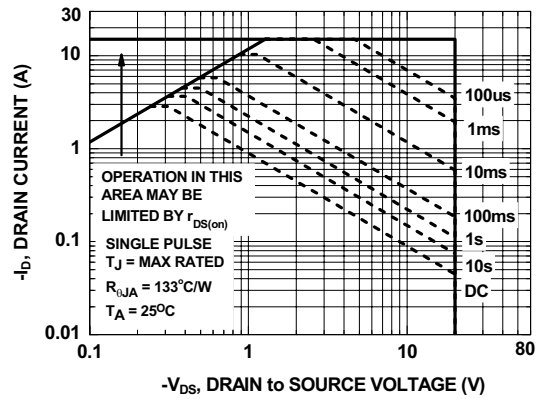


Figure 10. Forward Bias Safe Operating Area

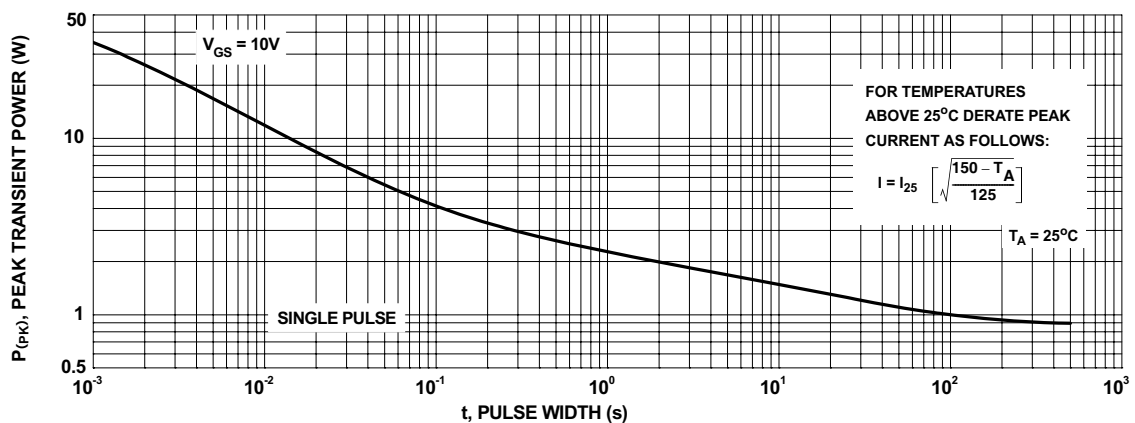


Figure 11. Single Pulse Maximum Power Dissipation

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

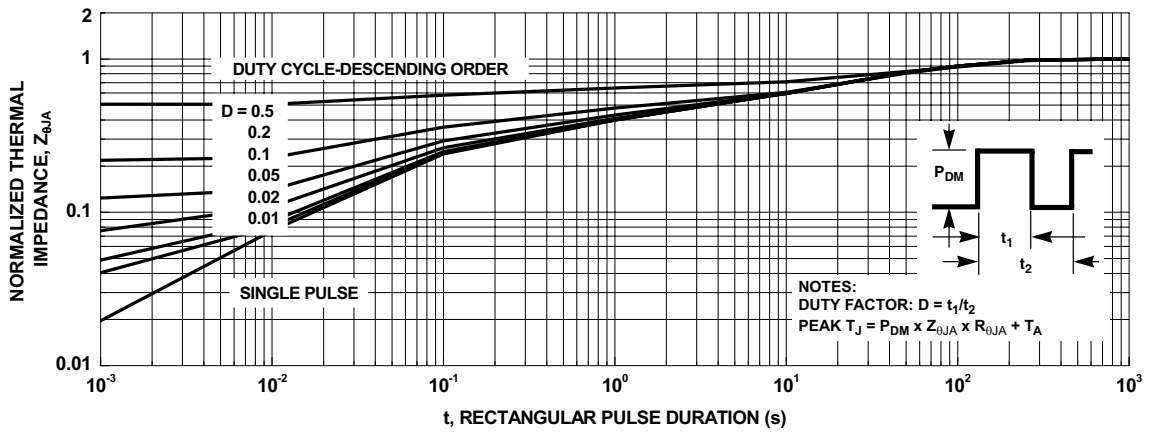
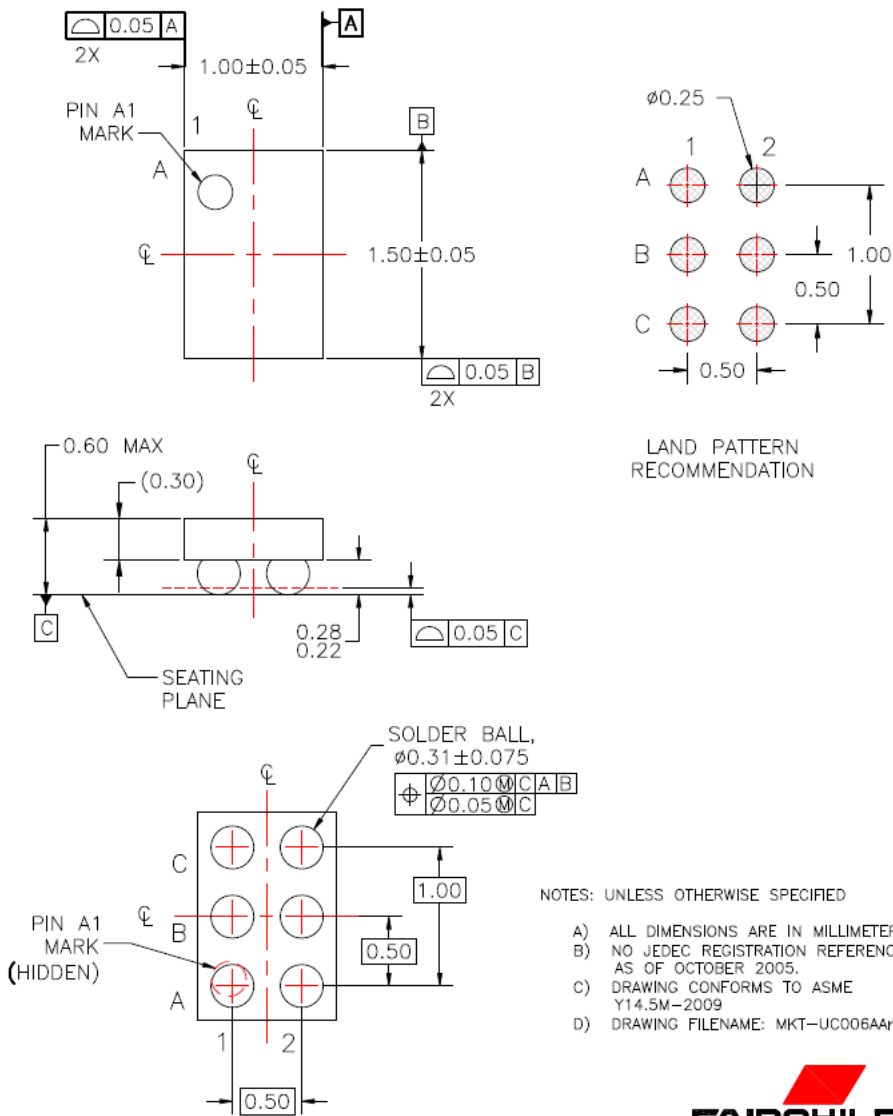


Figure 12. Transient Thermal Response Curve

### Dimensional Outline and Pad Layout



#### Pin Definitions:

Gate	Drain	Source
A1	C1, C2	A2, B1, B2






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