

# FDZ2554P

## Monolithic Common Drain P-Channel 2.5V Specified Power Trench® BGA MOSFET -20V, -6.5A, 28mΩ

### Features

- Max  $r_{DS(on)}$  = 28mΩ at  $V_{GS} = -4.5V$ ,  $I_D = -6.5A$
- Max  $r_{DS(on)}$  = 45mΩ at  $V_{GS} = -2.5V$ ,  $I_D = -5A$
- Occupies only 0.10 cm<sup>2</sup> of PCB area: 1/3 the area of SO-8
- Ultra-thin package: less than 0.80 mm height when mounted to PCB
- Outstanding thermal transfer characteristics: significantly better than SO-8
- Ultra-low  $Q_g \times r_{DS(on)}$  figure-of-merit
- High power and current handling capability
- RoHS Compliant



### General Description

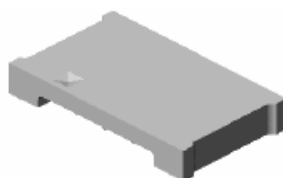
Combining Fairchild's advanced 2.5V specified PowerTrench process with state-of-the-art BGA packaging, the FDZ2554P minimizes both PCB space and  $r_{DS(on)}$ . This monolithic common drain BGA MOSFET embodies a breakthrough in packaging technology which enables the device to combine excellent thermal transfer characteristics, high current handling capability, ultra-low profile packaging, low gate charge, and low  $r_{DS(on)}$ .

### Applications

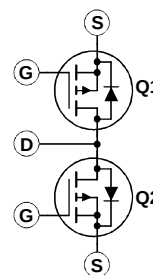
- Battery management
- Load Switch
- Battery protection



Bottom



Top



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

| Symbol         | Parameter                                        | Ratings     | Units |
|----------------|--------------------------------------------------|-------------|-------|
| $V_{DS}$       | Drain to Source Voltage                          | -20         | V     |
| $V_{GS}$       | Gate to Source Voltage                           | ±12         | V     |
| $I_D$          | Drain Current -Continuous                        | -6.5        | A     |
|                | -Pulsed                                          | -20         |       |
| $P_D$          | Power Dissipation (Steady State)                 | 2.1         | W     |
| $T_J, T_{STG}$ | Operating and Storage Junction Temperature Range | -55 to +150 | °C    |

### Thermal Characteristics

|                 |                                         |           |     |      |
|-----------------|-----------------------------------------|-----------|-----|------|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case    | (Note 1)  | 0.6 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | (Note 1a) | 60  |      |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | (Note 1b) | 108 |      |
| $R_{\theta JB}$ | Thermal Resistance, Junction to Ball    | (Note 1)  | 6.3 |      |

### Package Marking and Ordering Information

| Device Marking | Device   | Package     | Reel Size | Tape Width | Quantity   |
|----------------|----------|-------------|-----------|------------|------------|
| 2554P          | FDZ2554P | BGA 2.5X4.0 | 7"        | 12 mm      | 3000 units |

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

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|--------|-----------|-----------------|-----|-----|-----|-------|
|--------|-----------|-----------------|-----|-----|-----|-------|

**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 $25^\circ\text{C}$ |     | -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            | $V_{GS} = \pm 12\text{V}$ , $V_{DS} = 0\text{V}$           |     |     | $\pm 100$ | nA                   |

**On Characteristics**

|                                        |                                                          |                                                                            |      |      |      |                      |
|----------------------------------------|----------------------------------------------------------|----------------------------------------------------------------------------|------|------|------|----------------------|
| $V_{GS(th)}$                           | Gate to Source Threshold Voltage                         | $V_{GS} = V_{DS}$ , $I_D = -250\mu\text{A}$                                | -0.6 | -0.8 | -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/ $^\circ\text{C}$ |
| $r_{DS(on)}$                           | Static Drain to Source On Resistance                     | $V_{GS} = -4.5\text{V}$ , $I_D = -6.5\text{A}$                             |      | 21   | 28   | m $\Omega$           |
|                                        |                                                          | $V_{GS} = -2.5\text{V}$ , $I_D = -5\text{A}$                               |      | 36   | 45   |                      |
|                                        |                                                          | $V_{GS} = -4.5\text{V}$ , $I_D = -6.5\text{A}$ , $T_J = 125^\circ\text{C}$ |      | 30   | 43   |                      |
| $g_{FS}$                               | Forward Transconductance                                 | $V_{DD} = -5\text{V}$ , $I_D = -6.5\text{A}$                               |      | 24   |      | S                    |

**Dynamic Characteristics**

|           |                              |                                                                      |  |      |      |          |
|-----------|------------------------------|----------------------------------------------------------------------|--|------|------|----------|
| $C_{iss}$ | Input Capacitance            | $V_{DS} = -10\text{V}$ , $V_{GS} = 0\text{V}$ ,<br>$f = 1\text{MHz}$ |  | 1430 | 1900 | pF       |
| $C_{oss}$ | Output Capacitance           |                                                                      |  | 319  | 425  | pF       |
| $C_{rss}$ | Reverse Transfer Capacitance |                                                                      |  | 164  | 245  | pF       |
| $R_g$     | Gate Resistance              | $V_{GS} = 15\text{mV}$ , $f = 1\text{MHz}$                           |  | 9.2  |      | $\Omega$ |

**Switching Characteristics**

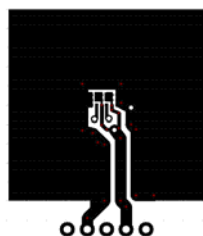
|              |                               |                                                                                                |  |    |     |    |
|--------------|-------------------------------|------------------------------------------------------------------------------------------------|--|----|-----|----|
| $t_{d(on)}$  | Turn-On Delay Time            | $V_{DD} = -10\text{V}$ , $I_D = -1\text{A}$ ,<br>$V_{GS} = -4.5\text{V}$ , $R_{GEN} = 6\Omega$ |  | 12 | 22  | ns |
| $t_r$        | Rise Time                     |                                                                                                |  | 9  | 18  | ns |
| $t_{d(off)}$ | Turn-Off Delay Time           |                                                                                                |  | 62 | 100 | ns |
| $t_f$        | Fall Time                     |                                                                                                |  | 37 | 60  | ns |
| $Q_g$        | Total Gate Charge             | $V_{GS} = -4.5\text{V}$ , $V_{DD} = -10\text{V}$ ,<br>$I_D = -6.5\text{A}$                     |  | 14 | 20  | nC |
| $Q_{gs}$     | Gate to Source Charge         |                                                                                                |  | 3  |     | nC |
| $Q_{gd}$     | Gate to Drain "Miller" Charge |                                                                                                |  | 4  |     | nC |

**Drain-Source Diode Characteristics**

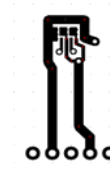
|                 |                                                       |                                                        |  |      |       |    |
|-----------------|-------------------------------------------------------|--------------------------------------------------------|--|------|-------|----|
| I <sub>S</sub>  | Maximum Continuous Drain-Source Diode Forward Current |                                                        |  |      | -1.75 | A  |
| V <sub>SD</sub> | Source to Drain Diode Forward Voltage                 | V <sub>GS</sub> = 0V, I <sub>S</sub> = -1.75A (Note 2) |  | -0.7 | -1.2  | V  |
| t <sub>rr</sub> | Reverse Recovery Time                                 | I <sub>F</sub> = -6.5A, di/dt = 100A/μs                |  | 25   | 40    | ns |
| Q <sub>rr</sub> | Reverse Recovery Charge                               |                                                        |  | 20   | 32    | nC |

## NOTES:

1.  $R_{\theta JA}$  is determined with the device mounted on a 1 in<sup>2</sup> oz. copper pad on a 1.5 x 1.5 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. 60°C/W when mounted on a 1 in<sup>2</sup> pad of 2 oz copper.



b. 108°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

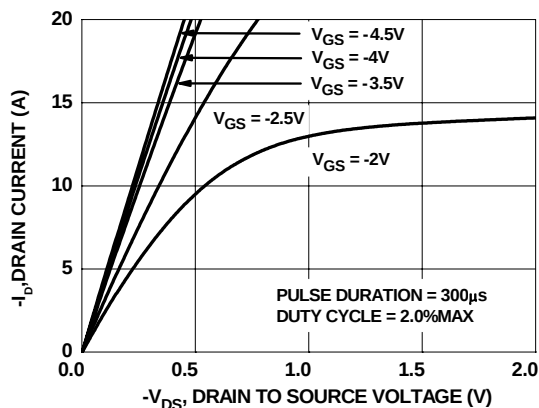


Figure 1. On-Region Characteristics

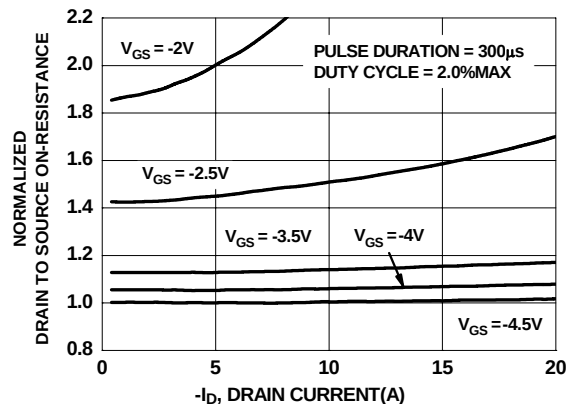


Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage

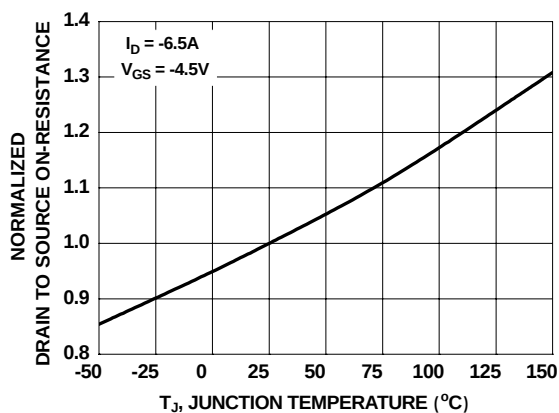


Figure 3. Normalized On-Resistance vs Junction Temperature

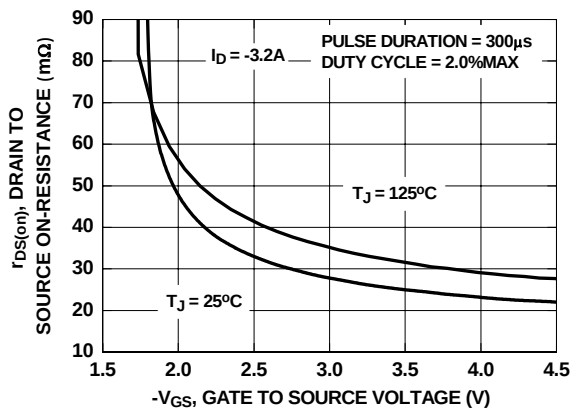


Figure 4. On-Resistance vs Gate to Source Voltage

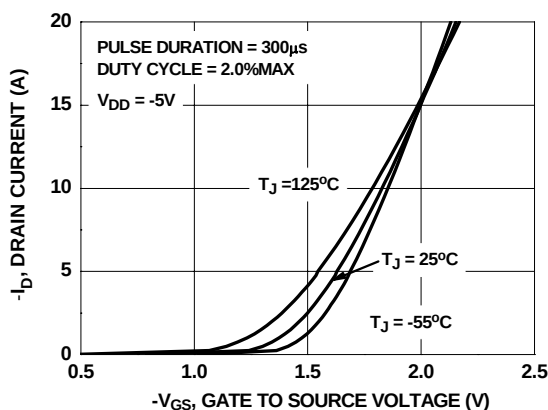


Figure 5. Transfer Characteristics

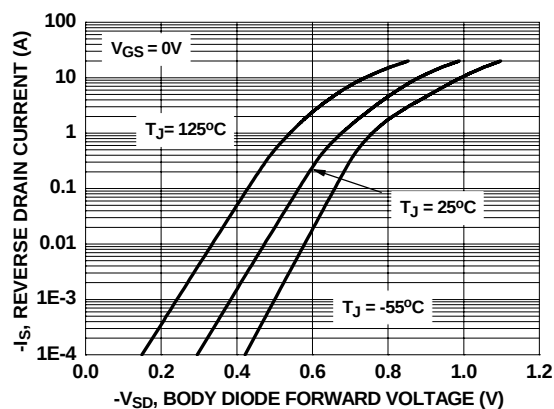


Figure 6. Source to Drain Diode Forward Voltage vs Source Current

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

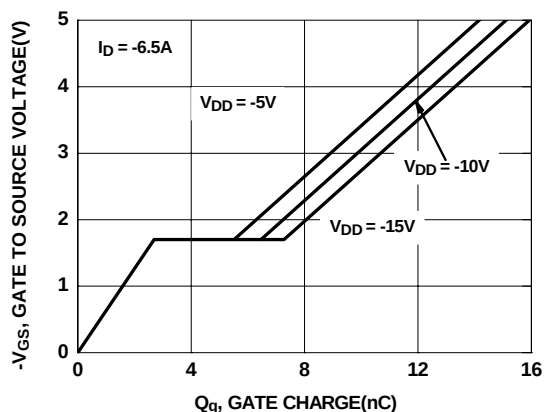


Figure 7. Gate Charge Characteristics

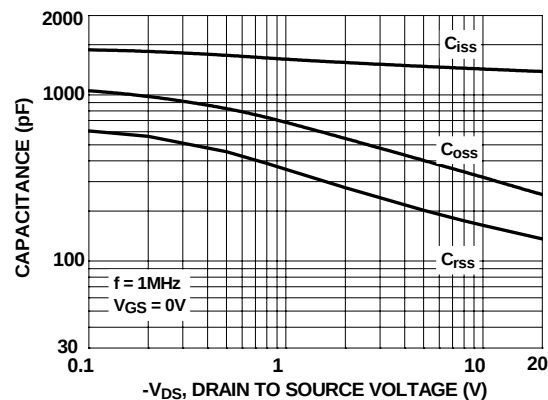


Figure 8. Capacitance vs Drain to Source Voltage

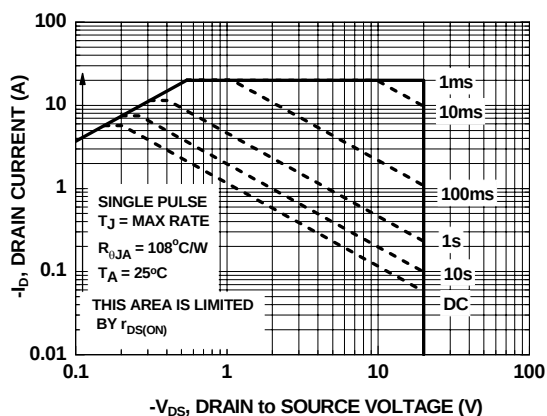


Figure 9. Forward Bias Safe Operating Area

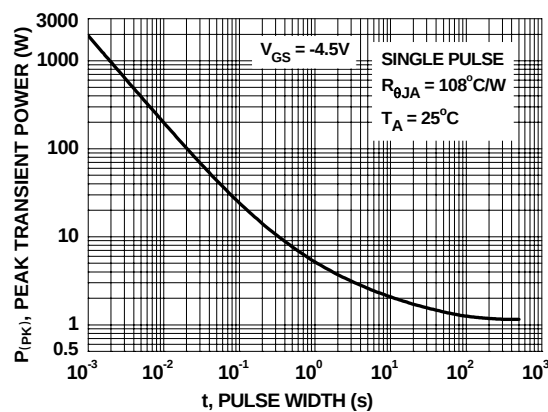


Figure 10. Single Pulse Maximum Power Dissipation

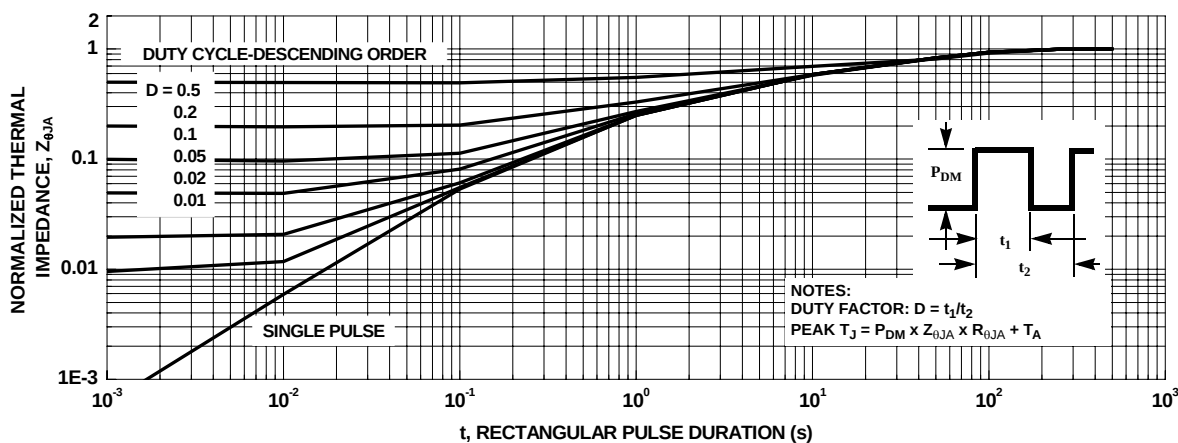
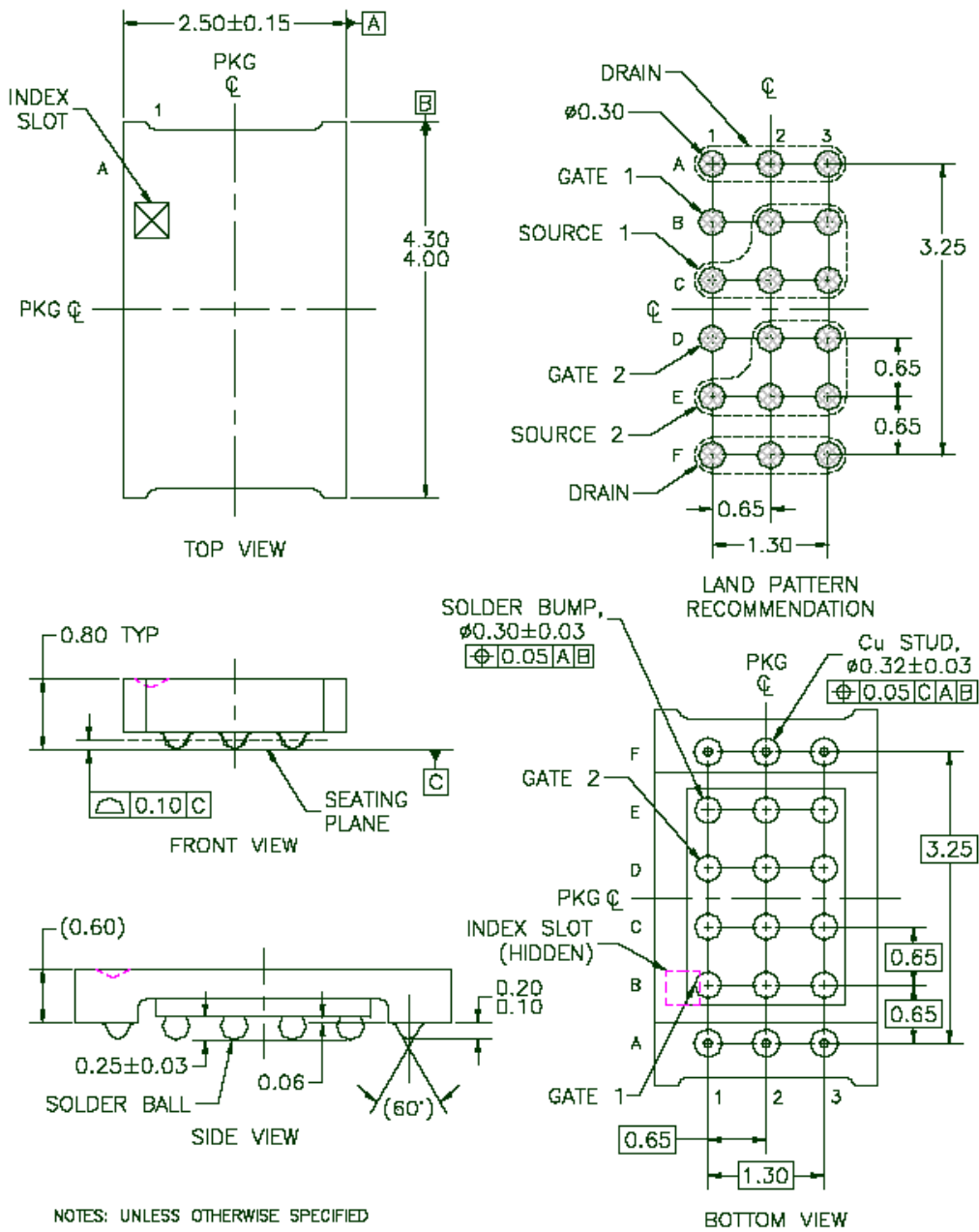


Figure 11. Transient Thermal Response Curve

# Dimensional Outline and Pad Layout





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Rev. I29



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