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ON Semiconductor®

## FDC642P

### Single P-Channel 2.5V Specified PowerTrench® MOSFET -20 V, -4.0 A, 65 mΩ

#### Features

- Max  $r_{DS(on)}$  = 65 mΩ at  $V_{GS} = -4.5$  V,  $I_D = -4.0$  A
- Max  $r_{DS(on)}$  = 100 mΩ at  $V_{GS} = -2.5$  V,  $I_D = -3.2$  A
- Fast switching speed
- Low gate charge (11nC typical)
- High performance trench technology for extremely low  $r_{DS(on)}$
- SuperSOT™-6 package: small footprint (72% smaller than standard SO-8); low profile (1 mm thick)
- Termination is Lead-free and RoHS Compliant



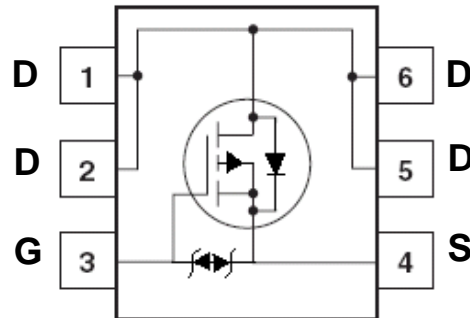
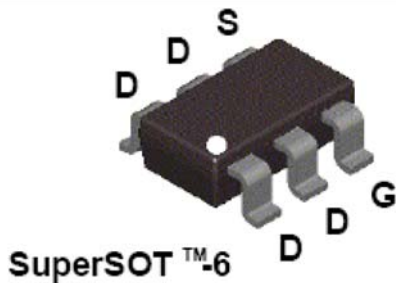
#### General Description

This P-Channel 2.5V specified MOSFET is produced using ON Semiconductor's advanced PowerTrench® process that has been especially tailored to minimize on-state resistance and yet maintain low gate charge for superior switching performance.

These devices have been designed to offer exceptional power dissipation in a very small footprint for applications where the larger packages are impractical.

#### Applications

- Load switch
- Battery protection
- Power management



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

| Symbol         | Parameter  | Ratings      | 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)   | -4.0         | A                |
|                | -Pulsed  | -20          |                  |
| $P_D$          | Power Dissipation (Note 1a)                      | 1.6          | W                |
|                | Power Dissipation (Note 1b)                      | 0.8          |                  |
| $T_J, T_{STG}$ | Operating and Storage Junction Temperature Range | -55 to + 150 | $^\circ\text{C}$ |

#### Thermal Characteristics

|                 |   |    |                    |
|-----------------|---|----|--------------------|
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient (Note 1a) | 78 | $^\circ\text{C/W}$ |
|-----------------|---|----|--------------------|

#### Package Marking and Ordering Information

| Device Marking | Device  | Package | Reel Size | Tape Width | Quantity   |
|----------------|---------|---------|-----------|------------|------------|
| .642           | FDC642P | SSOT-6™ | 7"        | 8 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            | $V_{GS} = \pm 8 \text{ V}, V_{DS} = 0 \text{ V}$            |     |     | $\pm 10$ | $\mu\text{A}$        |

### On Characteristics

|  |  |  |      |      |      |                      |
|--|--|--|------|------|------|----------------------|
| $V_{GS(th)}$                           | Gate to Source Threshold Voltage                         | $V_{GS} = V_{DS}, I_D = -250 \mu\text{A}$                                | -0.4 | -0.6 | -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 $25^\circ\text{C}$              |      | 2.5  |      | mV/ $^\circ\text{C}$ |
| $r_{DS(on)}$                           | Static Drain to Source On Resistance                     | $V_{GS} = -4.5 \text{ V}, I_D = -4.0 \text{ A}$                          |      | 45   | 65   | m $\Omega$           |
|  |  | $V_{GS} = -2.5 \text{ V}, I_D = -3.2 \text{ A}$                          |      | 55   | 100  |                      |
|  |  | $V_{GS} = -4.5 \text{ V}, I_D = -4.0 \text{ A}, T_J = 125^\circ\text{C}$ |      | 62   | 90   |                      |
| $g_{FS}$                               | Forward Transconductance                                 | $V_{DS} = -5 \text{ V}, I_D = -4.0 \text{ A}$                            |      | 15   |      | S                    |

### Dynamic Characteristics

|           |                              |   |  |     |     |    |
|-----------|------------------------------|---|--|-----|-----|----|
| $C_{iss}$ | Input Capacitance            | $V_{DS} = -10 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$ |  | 700 | 925 | pF |
| $C_{oss}$ | Output Capacitance           |   |  | 110 | 150 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance |   |  | 95  | 145 | pF |

### Switching Characteristics

|              |                               |   |  |     |     |    |
|--------------|-------------------------------|---|--|-----|-----|----|
| $t_{d(on)}$  | Turn-On Delay Time            | $V_{DD} = -10 \text{ V}, I_D = -1 \text{ A}, V_{GS} = -4.5 \text{ V}, R_{GEN} = 6 \Omega$ |  | 6   | 12  | ns |
| $t_r$        | Rise Time                     |   |  | 7   | 14  | ns |
| $t_{d(off)}$ | Turn-Off Delay Time           |   |  | 120 | 190 | ns |
| $t_f$        | Fall Time                     |   |  | 52  | 83  | ns |
| $Q_g$        | Total Gate Charge             |   |  | 11  | 16  | nC |
| $Q_{gs}$     | Gate to Source Charge         | $V_{DD} = -10 \text{ V}, I_D = -4 \text{ A}, V_{GS} = -4.5 \text{ V}$                     |  | 1.1 |     | nC |
| $Q_{gd}$     | Gate to Drain "Miller" Charge |   |  | 3.0 |     | nC |

### Drain-Source Diode Characteristics

|          |   |   |  |      |      |   |
|----------|---|---|--|------|------|---|
| $I_S$    | Maximum Continuous Drain-Source Diode Forward Current |   |  |      | -1.3 | A |
| $V_{SD}$ | Source-Drain Diode Forward Voltage                    | $V_{GS} = 0 \text{ V}, I_S = -1.3 \text{ A}$ (Note 2) |  | -0.7 | -1.2 | V |

#### Notes:

1:  $R_{\theta JA}$  is the sum of the junction-to-case and case-to-ambient thermal resistance where the case thermal reference is defined as the solder mounting surface of the drain pins.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.

- a.  $78^\circ\text{C/W}$  when mounted on a  $1 \text{ in}^2$  pad of 2 oz copper.
- b.  $156^\circ\text{C/W}$  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

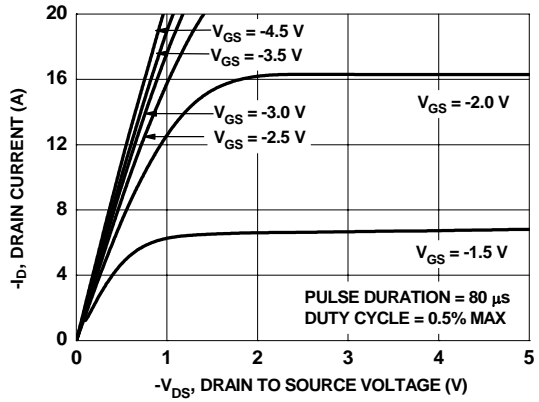


Figure 1. On Region Characteristics

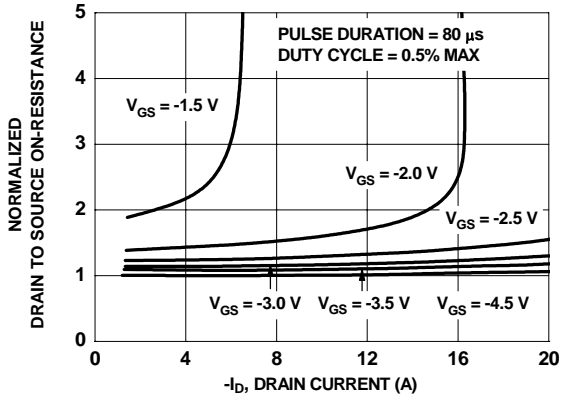


Figure 2. Normalized On-Resistance vs Drain Current and Gate Voltage

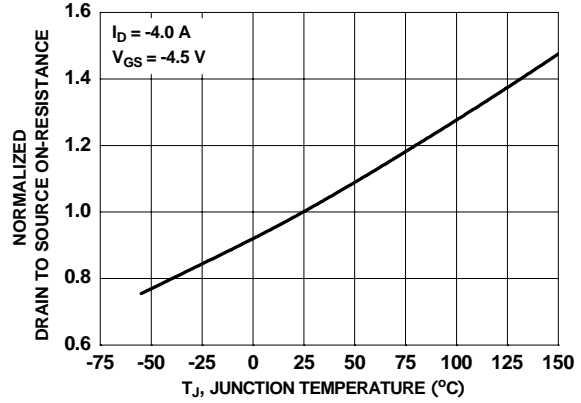


Figure 3. Normalized On Resistance vs Junction Temperature

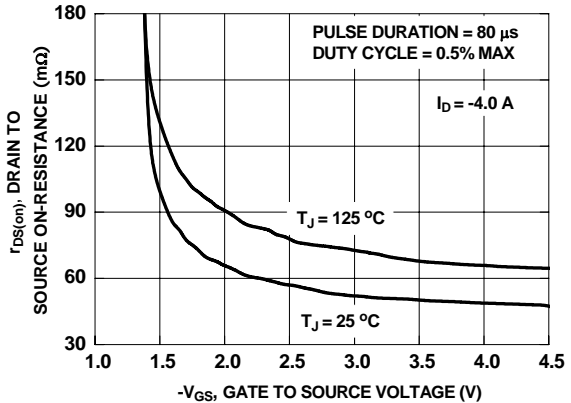


Figure 4. On-Resistance vs Gate to Source Voltage

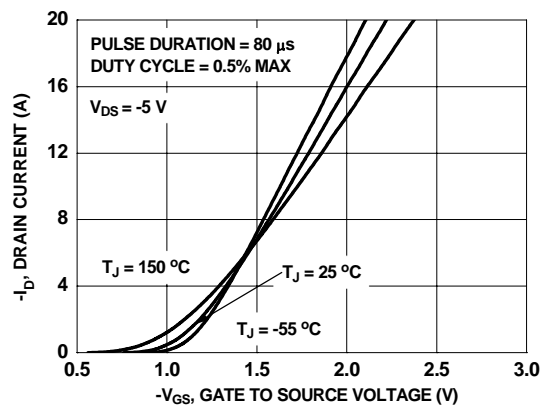


Figure 5. Transfer Characteristics

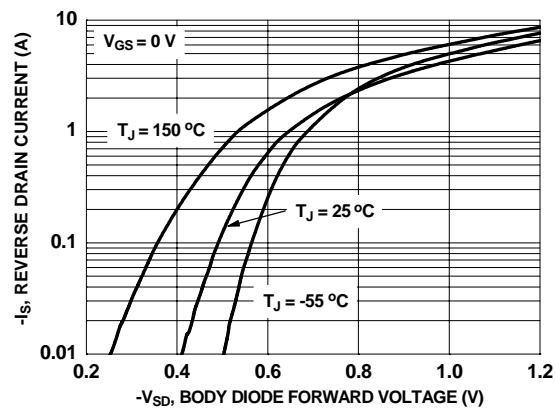
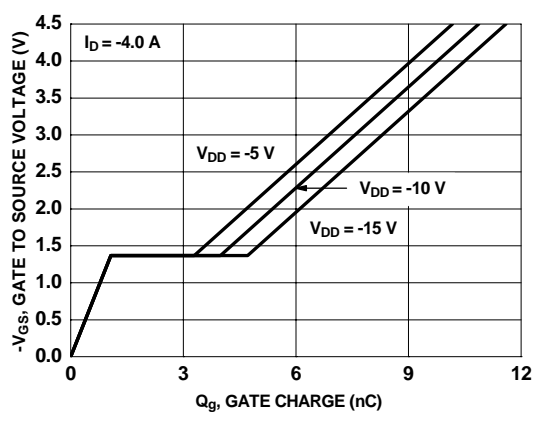
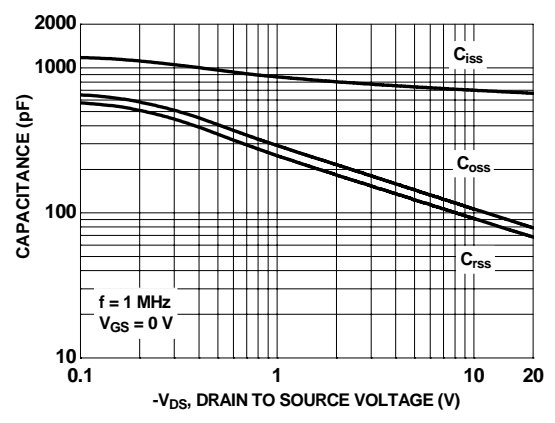


Figure 6. Source to Drain Diode Forward Voltage vs Source Current

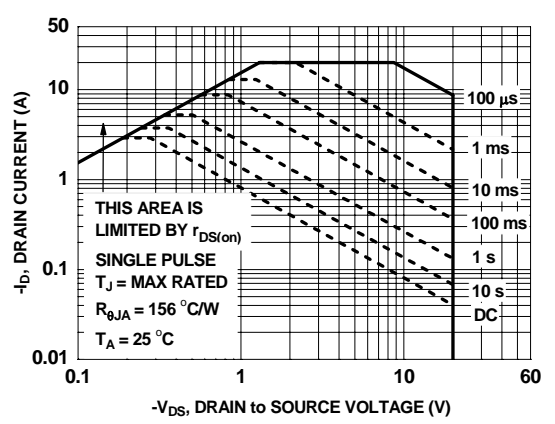
**Typical Characteristics**  $T_J = 25^\circ\text{C}$  unless otherwise noted



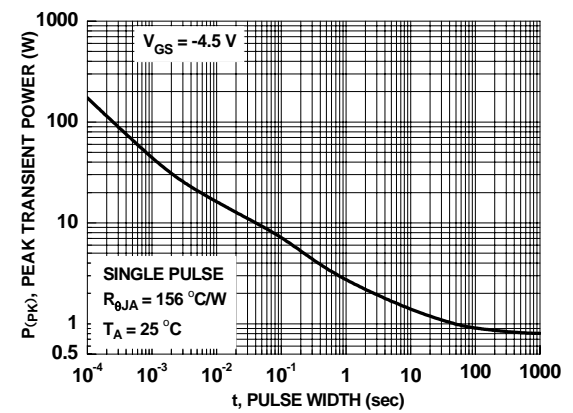
**Figure 7. Gate Charge Characteristics**



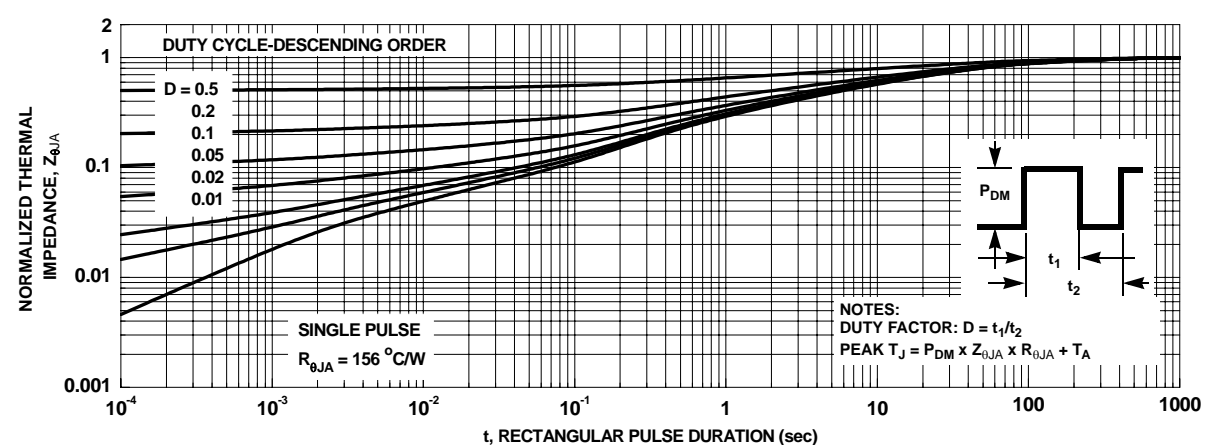
**Figure 8. Capacitance vs Drain to Source Voltage**



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



**Figure 10. Single Pulse Maximum Power Dissipation**



**Figure 11. Junction-to-Ambient Transient Thermal Response Curve**

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