



ON Semiconductor®

# FDC638P

## P-Channel 2.5V PowerTrench<sup>®</sup> Specified MOSFET

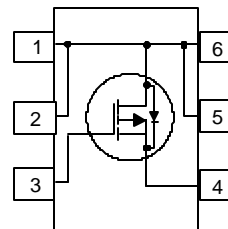
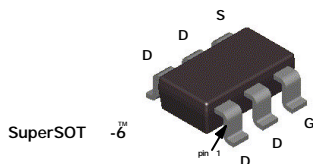
### General Description

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

These devices are well suited for battery power applications: load switching and power management, battery charging circuits, and DC/DC conversion.

### Features

- -4.5 A, -20 V.  $R_{DS(ON)} = 48\text{ m}\Omega$  @  $V_{GS} = -4.5\text{ V}$   
 $R_{DS(ON)} = 65\text{ m}\Omega$  @  $V_{GS} = -2.5\text{ V}$
- Low gate charge (10 nC typical)
- High performance trench technology for extremely low  $R_{DS(ON)}$
- SuperSOT™ -6 package: small footprint (72% smaller than standard SO-8; low profile (1mm thick))



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

Symbol	Parameter	Rated	Units
$V_{DSS}$	Drain-Source Voltage	-20	V
$V_{GSS}$	Gate-Source Voltage	$\pm 8$	V
$I_D$	Drain Current – Continuous (Note 1a)	-4.5	A
	– Pulsed	-20	
$P_D$	Power Dissipation for Single Operation (Note 1a)	1.6	W
	(Note 1b)	0.8	
$T_J, T_{STG}$	Operating and Storage Junction Temperature Range	-55 to +150	$^\circ\text{C}$

### Thermal Characteristics

Symbol	Parameter	Rated	Units
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (Note 1a)	78	$^\circ\text{C/W}$
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case (Note 1)	30	$^\circ\text{C/W}$

### Package Marking and Ordering Information

Device Marking	Device	Reel Size	Tape width	Quantity
.638	FDC638P	7"	8mm	3000 units

FDC638P

## Electrical Characteristics

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

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

$BV_{DSS}$	Drain–Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = -250\ \mu\text{A}$	-20			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = -250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$		-14		mV/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = -16\text{ V}, V_{GS} = 0\text{ V}$			-1	$\mu\text{A}$
$I_{GSSF}$	Gate–Body Leakage, Forward	$V_{GS} = 8\text{ V}, V_{DS} = 0\text{ V}$			100	nA
$I_{GSSR}$	Gate–Body Leakage, Reverse	$V_{GS} = -8\text{ V}, V_{DS} = 0\text{ V}$			-100	nA

### On Characteristics (Note 2)

$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = -250\ \mu\text{A}$	-0.4	-0.8	-1.5	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate 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–Source On–Resistance	$V_{GS} = -4.5\text{ V}, I_D = -4.5\text{ A}$ $V_{GS} = -2.5\text{ V}, I_D = -3.8\text{ A}$ $V_{GS} = -4.5\text{ V}, I_D = -4.5\text{ A}, T_J = 125^\circ\text{C}$		39 52 54	48 65 72	m $\Omega$
$I_{D(on)}$	On–State Drain Current	$V_{GS} = -4.5\text{ V}, V_{DS} = -5\text{ V}$	-20			A
$g_{FS}$	Forward Transconductance	$V_{DS} = -10\text{ V}, I_D = -4.5\text{ A}$		15		S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = -10\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$		1160		pF
$C_{oss}$	Output Capacitance			195		pF
$C_{rss}$	Reverse Transfer Capacitance			105		pF

### Switching Characteristics (Note 2)

$t_{d(on)}$	Turn–On Delay Time	$V_{DD} = -5\text{ V}, I_D = -1\text{ A},$ $V_{GS} = -4.5\text{ V}, R_{GEN} = 6\ \Omega$		12	22	ns
$t_r$	Turn–On Rise Time			9	18	ns
$t_{d(off)}$	Turn–Off Delay Time			33	53	ns
$t_f$	Turn–Off Fall Time			12	22	ns
$Q_g$	Total Gate Charge	$V_{DS} = -10\text{ V}, I_D = -4.5\text{ A},$ $V_{GS} = -4.5\text{ V}$		10	14	nC
$Q_{gs}$	Gate–Source Charge			2.2		nC
$Q_{gd}$	Gate–Drain Charge			1.5		nC

### Drain–Source Diode Characteristics and Maximum Ratings

$I_S$	Maximum Continuous Drain–Source Diode Forward Current				-1.3	A
$V_{SD}$	Drain–Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = -1.3\text{ A}$ (Note 2)		-0.73	-1.2	V

#### Notes:

- $R_{\theta JA}$  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

Scale 1 : 1 on letter size paper

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

## Typical Characteristics

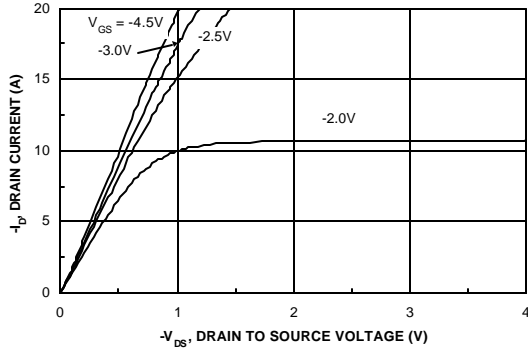


Figure 1. On-Region Characteristics.

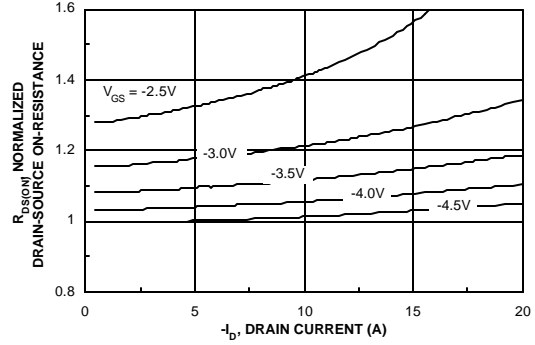


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

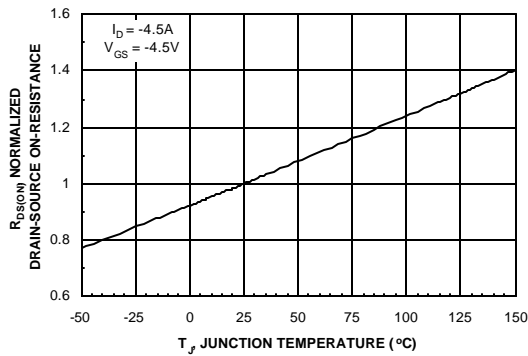


Figure 3. On-Resistance Variation with Temperature.

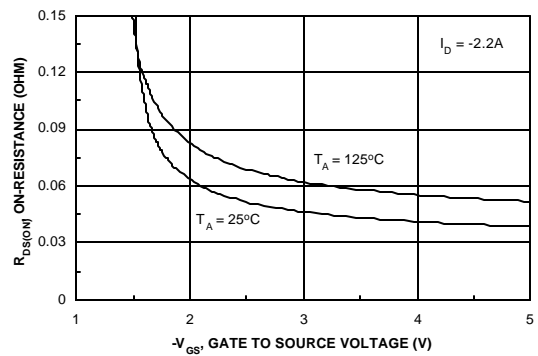


Figure 4. On-Resistance Variation with Gate-to-Source Voltage.

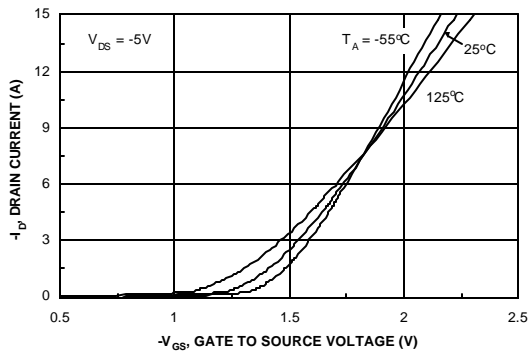


Figure 5. Transfer Characteristics.

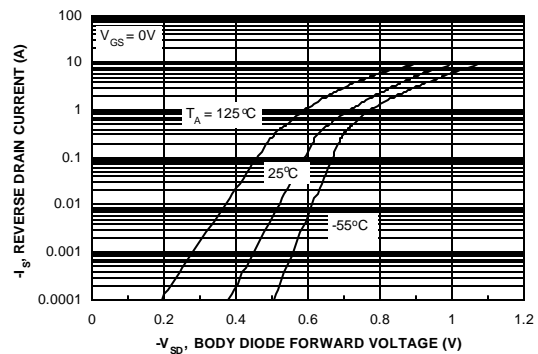


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.

## Typical Characteristics

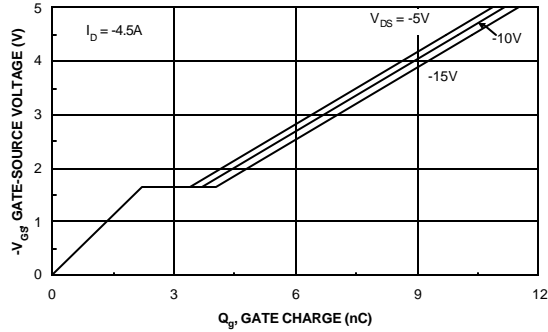


Figure 7. Gate Charge Characteristics.

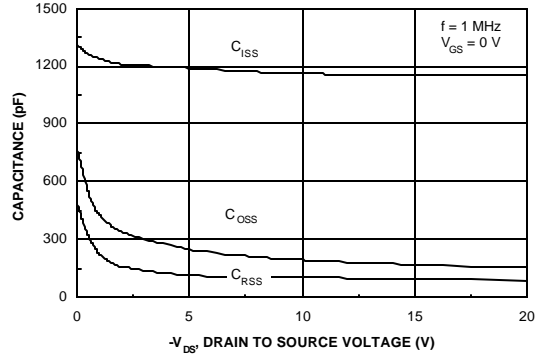


Figure 8. Capacitance Characteristics.

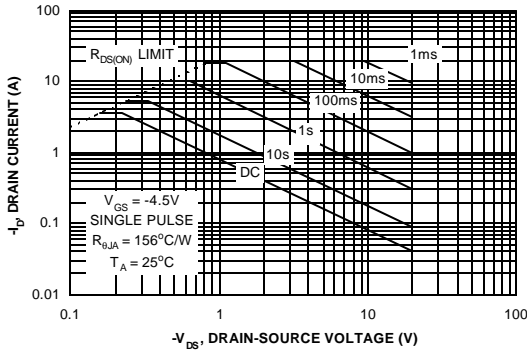


Figure 9. Maximum Safe Operating Area.

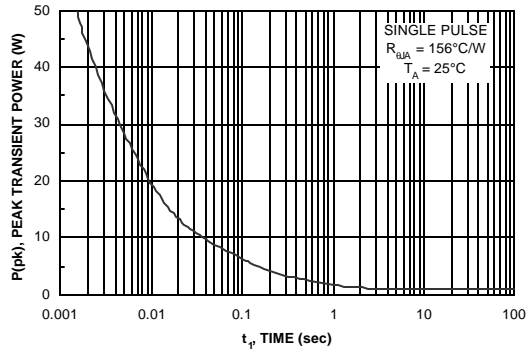


Figure 10. Single Pulse Maximum Power Dissipation.

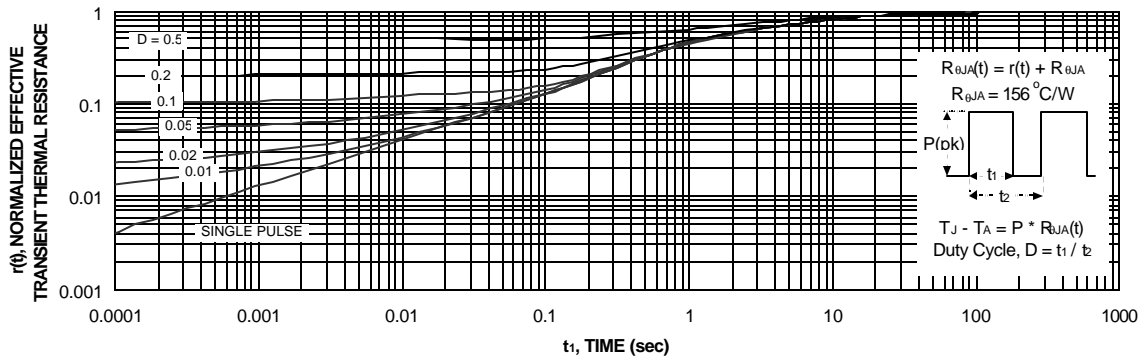


Figure 11. Transient Thermal Response Curve.

Thermal characterization performed using the conditions described in Note 1b  
 Transient thermal response will change depending on the circuit board design.

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