

# ON Semiconductor

## Is Now

The logo for onsemi, featuring the word "onsemi" in a dark teal, lowercase, sans-serif font. The letter "i" is stylized with a white dot and a teal vertical bar. A small orange triangle is positioned above the top right of the "i". A trademark symbol (TM) is located to the right of the logo.

To learn more about onsemi™, please visit our website at  
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June 1999

FDT439N

ON Semiconductor®

# FDT439N

## N-Channel 2.5V Specified Enhancement Mode Field Effect Transistor

### General Description

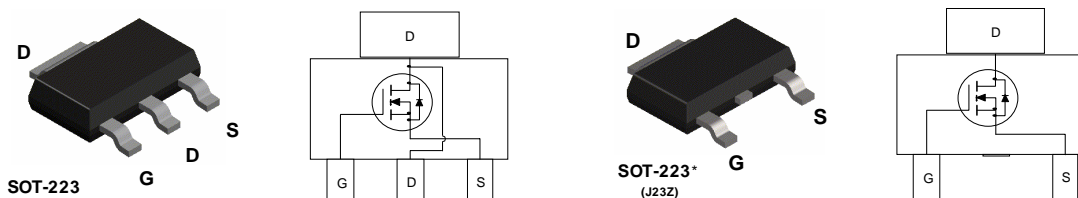
This N-Channel Enhancement mode field effect transistor is produced using Fairchild Semiconductor's proprietary, high cell density, DMOS technology. This very high density process is especially tailored to minimize on-state resistance, and provide superior switching performance. These products are well suited to low voltage, low current applications such as notebook computer power management, battery powered circuits, and DC motor control.

### Features

- 6.3 A, 30 V.  $R_{DS(on)} = 0.045 \Omega @ V_{GS} = 4.5 V$   
 $R_{DS(on)} = 0.058 \Omega @ V_{GS} = 2.5 V$
- Fast switching speed.
- High power and current handling capability in a widely used surface mount package.

### Applications

- DC/DC converter
- Load switch
- Motor driving



### Absolute Maximum Ratings T<sub>A</sub> = 25°C unless otherwise noted

Symbol	Parameter	FDT439N	Units
V <sub>DSS</sub>	Drain-Source Voltage	30	V
V <sub>GS</sub>	Gate-Source Voltage	±8	V
I <sub>D</sub>	Drain Current - Continuous (Note 1a)	6.3	A
	- Pulsed	20	
P <sub>D</sub>	Power Dissipation for Single Operation (Note 1a) (Note 1b) (Note 1c)	3	W
		1.3	
		1.1	
T <sub>J</sub> , T <sub>stg</sub>	Operating and Storage Junction Temperature Range	-55 to +150	°C

### Thermal Characteristics

R <sub>θJA</sub>	Thermal Resistance, Junction-to-Ambient (Note 1a)	42	°C/W
R <sub>θJC</sub>	Thermal Resistance, Junction-to-Case (Note 1)	12	°C/W

### Package Marking and Ordering Information

Device Marking	Device	Reel Size	Tape Width	Quantity
FDT439N	FDT439N	13"	12mm	2500 units

## 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	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	30			V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$		40		mV/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 24\text{ V}, V_{GS} = 0\text{ V}$			1	$\mu\text{A}$
$I_{GSSF}$	Gate-Body Leakage Current, Forward	$V_{GS} = 8\text{ V}, V_{DS} = 0\text{ V}$			100	nA
$I_{GSSR}$	Gate-Body Leakage Current, 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	0.67	1	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	$I_D = 250\ \mu\text{A}$ , Referenced to $25^\circ\text{C}$		-2.2		mV/ $^\circ\text{C}$
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 4.5\text{ V}, I_D = 6.3\text{ A}$ $V_{GS} = 4.5\text{ V}, I_D = 6.3\text{ A}, T_J = 125^\circ\text{C}$ $V_{GS} = 2.5\text{ V}, I_D = 5.5\text{ A}$		0.038 0.055 0.048	0.045 0.072 0.058	$\Omega$
$I_{D(on)}$	On-State Drain Current	$V_{GS} = 4.5\text{ V}, V_{DS} = 5\text{ V}$	10			A
$g_{FS}$	Forward Transconductance	$V_{DS} = 5\text{ V}, I_D = 6.3\text{ A}$		17		S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = 15\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$		500		pF
$C_{oss}$	Output Capacitance			185		pF
$C_{rss}$	Reverse Transfer Capacitance			43		pF

### Switching Characteristics (Note 2)

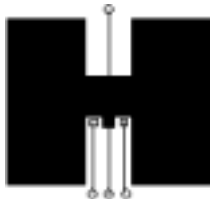
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 15\text{ V}, I_D = 1\text{ A},$ $V_{GS} = 4.5\text{ V}, R_{GEN} = 6\ \Omega$		6	12	ns
$t_r$	Turn-On Rise Time			10	18	ns
$t_{d(off)}$	Turn-Off Delay Time			30	48	ns
$t_f$	Turn-Off Fall Time			10	18	ns
$Q_g$	Total Gate Charge	$V_{DS} = 15\text{ V}, I_D = 6.3\text{ A},$ $V_{GS} = 4.5\text{ V},$		10.7	15	nC
$Q_{gs}$	Gate-Source Charge			0.9		nC
$Q_{gd}$	Gate-Drain Charge			3.7		nC

### Drain-Source Diode Characteristics and Maximum Ratings

$I_S$	Maximum Continuous Drain-Source Diode Forward Current			2.5	A	
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 2.5\text{ A}$ (Note 2)		0.8	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)  $42^\circ\text{C/W}$  when mounted on a  $1\text{ in}^2$  pad of 2 oz. copper.



b)  $95^\circ\text{C/W}$  when mounted on a  $0.066\text{ in}^2$  pad of 2 oz. copper.



c)  $110^\circ\text{C/W}$  when mounted on a minimum mounting pad.

Scale 1 : 1 on letter size paper

- Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$

## Typical Characteristics

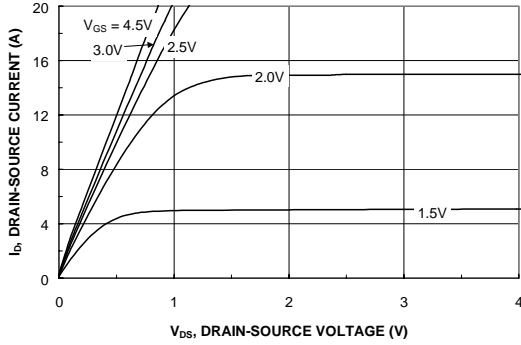


Figure 1. On-Region Characteristics.

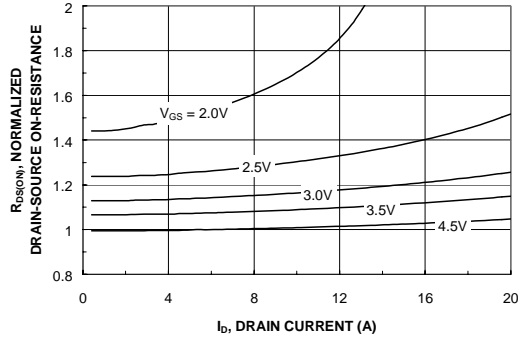


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

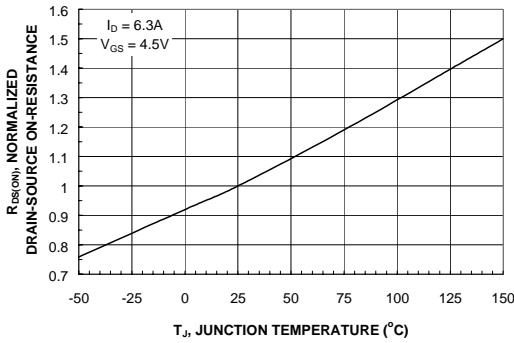


Figure 3. On-Resistance Variation with Temperature.

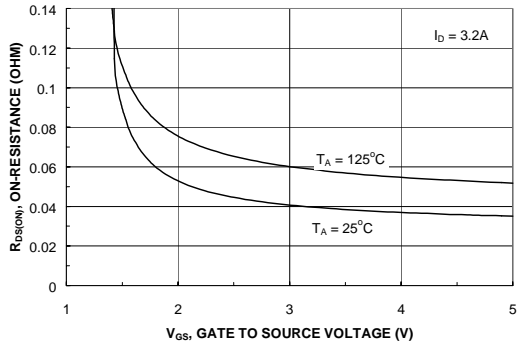


Figure 4. On-Resistance Variation with Gate-To-Source Voltage.

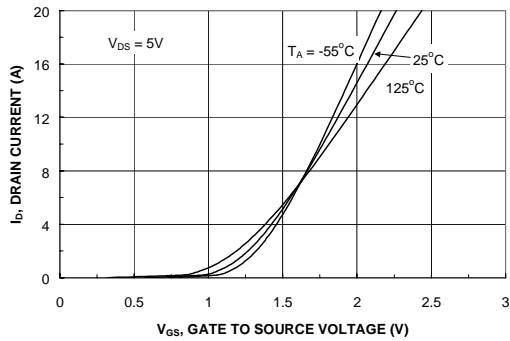


Figure 5. Transfer Characteristics.

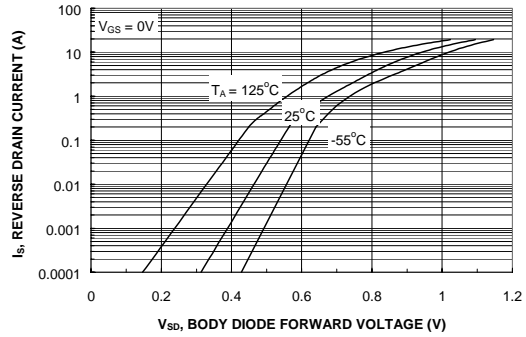
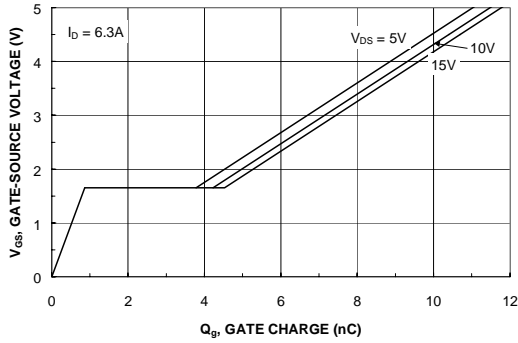
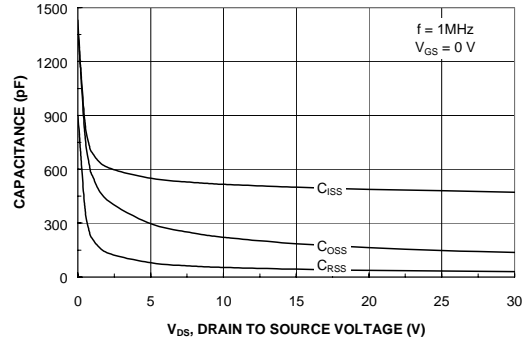


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.

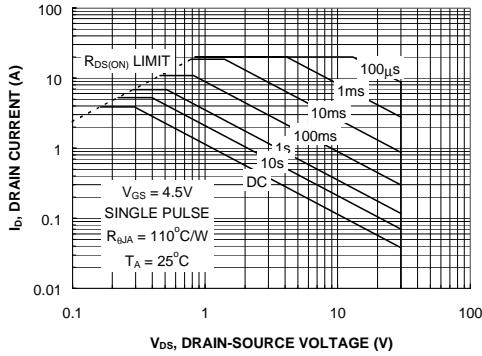
**Typical Characteristics** (continued)



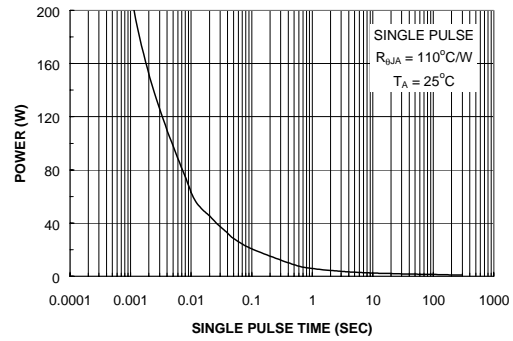
**Figure 7. Gate-Charge Characteristics.**



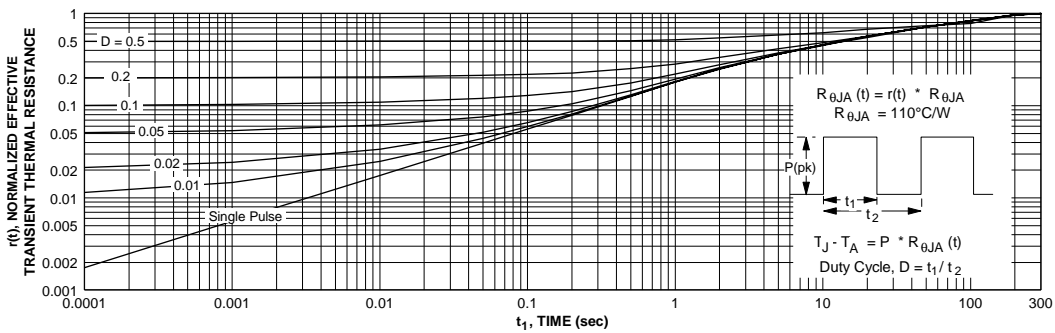
**Figure 8. Capacitance Characteristics.**



**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 1. Transient thermal response will change depending on the circuit board design.

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