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June 1999

FDT439N

ON Semiconductor®

FDT439N

N-Channel 2.5V Specified Enhancement Mode Field Effect Transistor

General Description

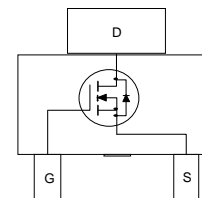
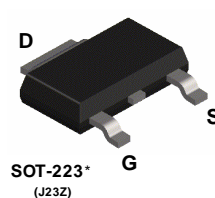
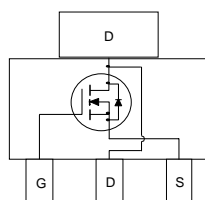
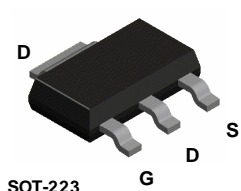
This N-Channel Enhancement mode field effect transistor is produced using Fairchild Semiconductor's proprietary, high cell density, DMOS technology. This very high density process is especially tailored to minimize on-state resistance, and provide superior switching performance. These products are well 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 $T_A = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	FDT439N	Units
V_{DSS}	Drain-Source Voltage	30	V
V_{GSS}	Gate-Source Voltage	± 8	V
I_D	Drain Current - Continuous (Note 1a) - Pulsed	6.3	A
		20	
P_D	Power Dissipation for Single Operation (Note 1a) (Note 1b) (Note 1c)	3	W
		1.3	
		1.1	
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)	42	$^\circ\text{C/W}$
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case (Note 1)	12	$^\circ\text{C/W}$

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°C		40		mV/ $^\circ\text{C}$
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 24\text{ V}, V_{GS} = 0\text{ V}$			1	μA
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°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	Ω
$I_{D(on)}$	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)

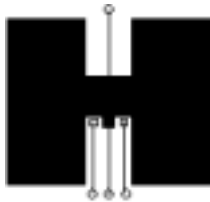
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 15\text{ V}, I_D = 1\text{ A},$ $V_{GS} = 4.5\text{ V}, R_{GEN} = 6\ \Omega$		6	12	ns
t_r	Turn-On Rise Time			10	18	ns
$t_{d(off)}$	Turn-Off Delay Time			30	48	ns
t_f	Turn-Off Fall Time			10	18	ns
Q_g	Total Gate Charge	$V_{DS} = 15\text{ V}, I_D = 6.3\text{ A},$ $V_{GS} = 4.5\text{ V},$		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°C/W when mounted on a 1 in^2 pad of 2 oz. copper.



b) 95°C/W when mounted on a 0.066 in^2 pad of 2 oz. copper.



c) 110°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

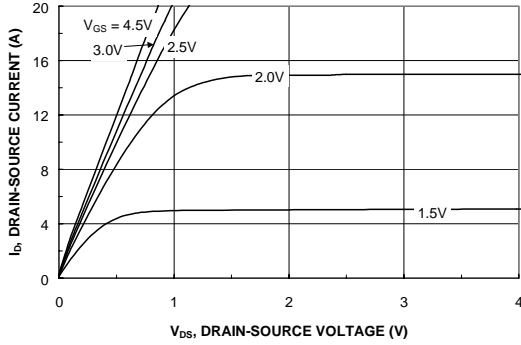


Figure 1. On-Region Characteristics.

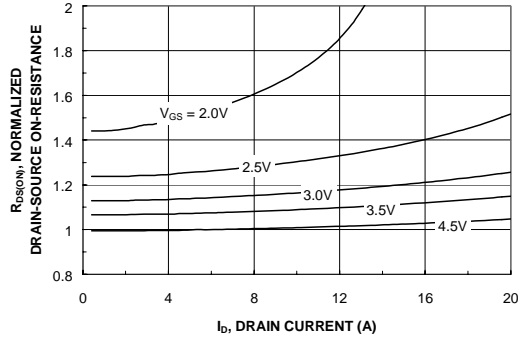


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage.

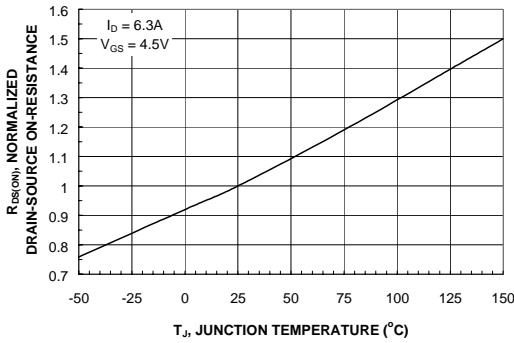


Figure 3. On-Resistance Variation with Temperature.

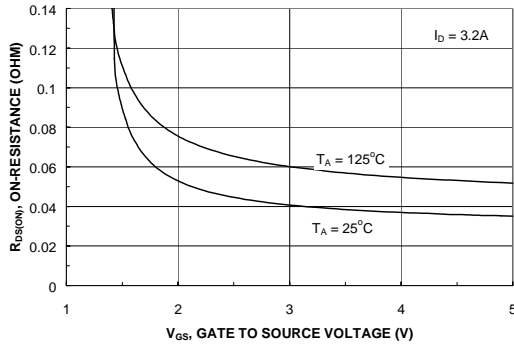


Figure 4. On-Resistance Variation with Gate-To-Source Voltage.

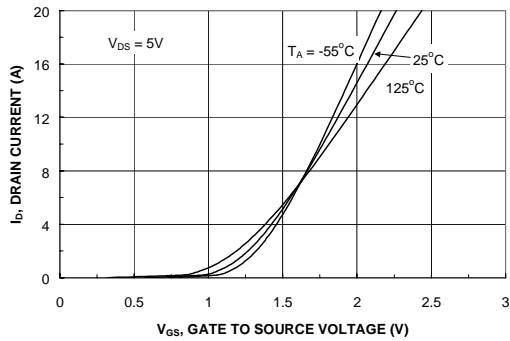


Figure 5. Transfer Characteristics.

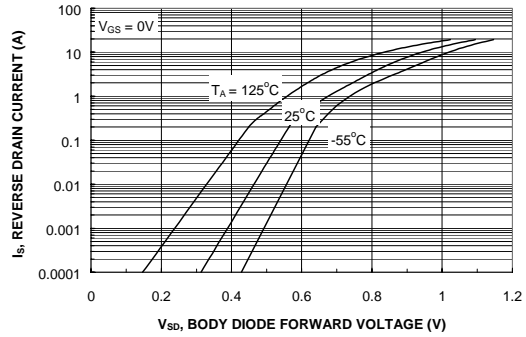


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature.

Typical Characteristics (continued)

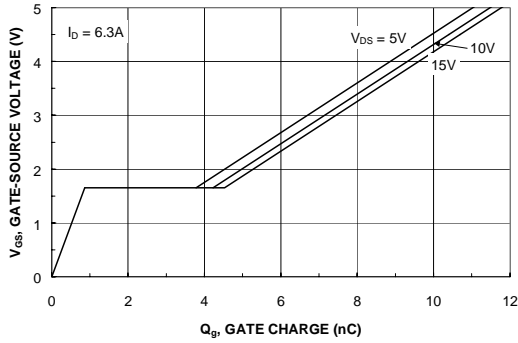


Figure 7. Gate-Charge Characteristics.

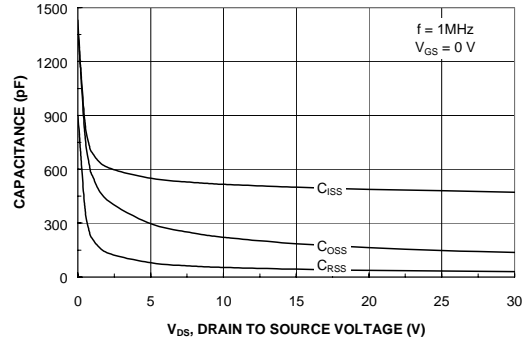


Figure 8. Capacitance Characteristics.

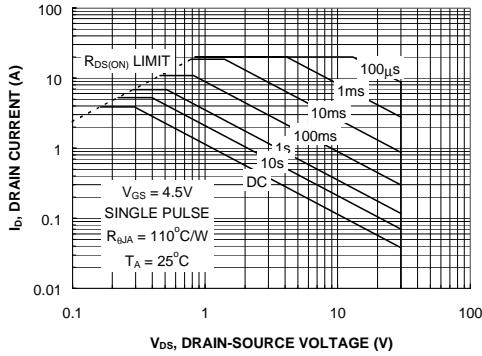


Figure 9. Maximum Safe Operating Area.

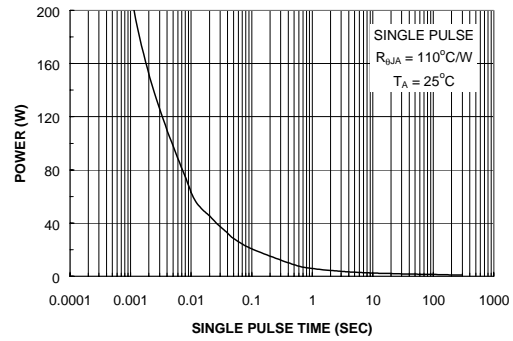


Figure 10. Single Pulse Maximum Power Dissipation.

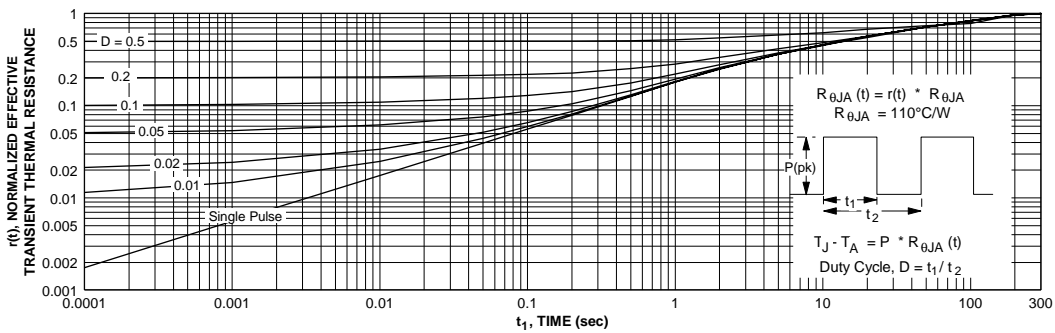


Figure 11. Transient Thermal Response Curve.

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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