



**THE DATASHEET OF
NDC651N**



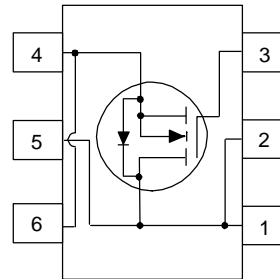
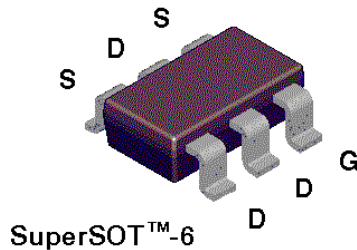
NDC651N N-Channel Logic Level Enhancement Mode Field Effect Transistor

General Description

These N-Channel logic level enhancement mode power field effect transistors are produced using Fairchild's proprietary, high cell density, DMOS technology. This very high density process is tailored to minimize on-state resistance. These devices are particularly suited for low voltage applications in notebook computers, portable phones, PCMCIA cards, and other battery powered circuits where fast switching, and low in-line power loss are needed in a very small outline surface mount package.

Features

- 3.2A, 30V. $R_{DS(ON)} = 0.09\Omega$ @ $V_{GS} = 4.5V$
 $R_{DS(ON)} = 0.06\Omega$ @ $V_{GS} = 10V$.
- Proprietary SuperSOT™-6 package design using copper lead frame for superior thermal and electrical capabilities.
- High density cell design for extremely low $R_{DS(ON)}$.
- Exceptional on-resistance and maximum DC current capability.



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

Symbol	Parameter		NDC651N	Units
V_{DSS}	Drain-Source Voltage		30	V
V_{GSS}	Gate-Source Voltage - Continuous		20	V
I_D	Drain Current - Continuous	(Note 1a)	3.2	A
	- Pulsed		15	
P_D	Maximum Power Dissipation	(Note 1a)	1.6	W
		(Note 1b)	1	
		(Note 1c)	0.8	
T_J, T_{STG}	Operating and Storage Temperature Range		-55 to 150	$^\circ\text{C}$

THERMAL CHARACTERISTICS

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

ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units	
OFF CHARACTERISTICS							
BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	30			V	
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 24\text{ V}, V_{GS} = 0\text{ V}$			1	μA	
			$T_J = 55^\circ\text{C}$		10	μA	
I_{GSSF}	Gate - Body Leakage, Forward	$V_{GS} = 20\text{ V}, V_{DS} = 0\text{ V}$			100	nA	
I_{GSSR}	Gate - Body Leakage, Reverse	$V_{GS} = -20\text{ V}, V_{DS} = 0\text{ V}$			-100	nA	
ON CHARACTERISTICS (Note 2)							
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$		1	1.7	3	V
			$T_J = 125^\circ\text{C}$	0.7	1.3	2.2	
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 4.5\text{ V}, I_D = 3.2\text{ A}$			0.068	0.09	Ω
			$T_J = 125^\circ\text{C}$		0.095	0.18	
			$V_{GS} = 10\text{ V}, I_D = 4\text{ A}$		0.042	0.06	
$I_{D(on)}$	On-State Drain Current	$V_{GS} = 4.5\text{ V}, V_{DS} = 5\text{ V}$	10			A	
g_{FS}	Forward Transconductance	$V_{DS} = 10\text{ V}, I_D = 3.2\text{ A}$		6		S	
DYNAMIC CHARACTERISTICS							
C_{iss}	Input Capacitance	$V_{DS} = 15\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$		290		pF	
C_{oss}	Output Capacitance			180		pF	
C_{rss}	Reverse Transfer Capacitance			60		pF	
SWITCHING CHARACTERISTICS (Note 2)							
$t_{D(on)}$	Turn - On Delay Time	$V_{DD} = 10\text{ V}, I_D = 1\text{ A},$ $V_{GEN} = 4.5\text{ V}, R_{GEN} = 6\ \Omega$		9	20	ns	
t_r	Turn - On Rise Time			19	30	ns	
$t_{D(off)}$	Turn - Off Delay Time			15	30	ns	
t_f	Turn - Off Fall Time			7	20	ns	
Q_g	Total Gate Charge	$V_{DS} = 15\text{ V},$ $I_D = 3.2\text{ A}, V_{GS} = 10\text{ V}$		10	20	nC	
Q_{gs}	Gate-Source Charge			1.2		nC	
Q_{gd}	Gate-Drain Charge			2.6		nC	

ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
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DRAIN-SOURCE DIODE CHARACTERISTICS

I_S	Continuous Source Diode Current				1.3	A
V_{SD}	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}$, $I_S = 1.3\text{ A}$ (Note 2)		0.8	1.2	V

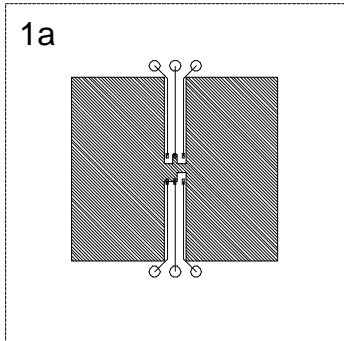
Notes:

- $R_{\theta_{JA}}$ 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.

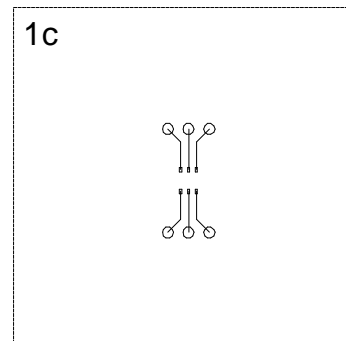
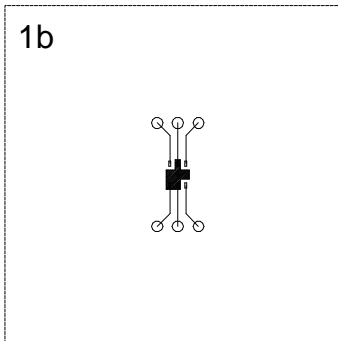
$$P_D(t) = \frac{T_J - T_A}{R_{\theta_{JA}}(t)} = \frac{T_J - T_A}{R_{\theta_{JC}} + R_{\theta_{CA}}(t)} = I_D^2(t) \times R_{DS(on)} @ T_J$$

Typical $R_{\theta_{JA}}$ using the board layouts shown below on 4.5"x5" FR-4 PCB in a still air environment:

- 78°C/W when mounted on a 1 in² pad of 2oz copper.
- 125°C/W when mounted on a 0.01 in² pad of 2oz copper.
- 156°C/W when mounted on a 0.003 in² pad of 2oz copper.



Scale 1 : 1 on letter size paper



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

Typical Electrical Characteristics

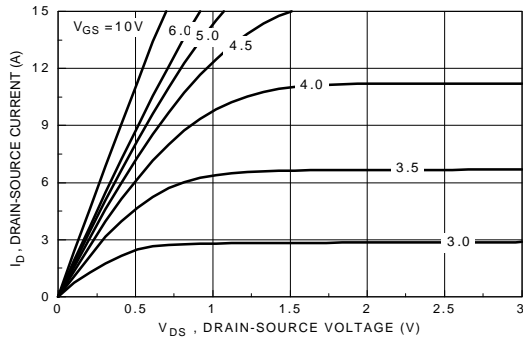


Figure 1. On-Region Characteristics

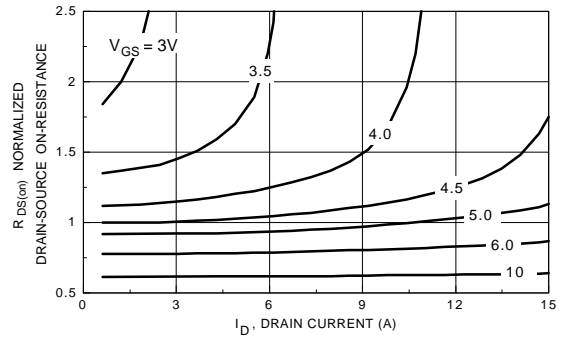


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage

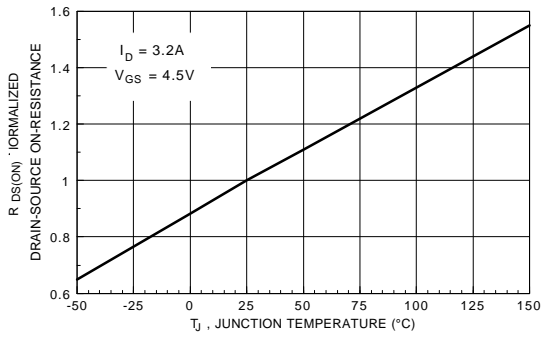


Figure 3. On-Resistance Variation with Temperature

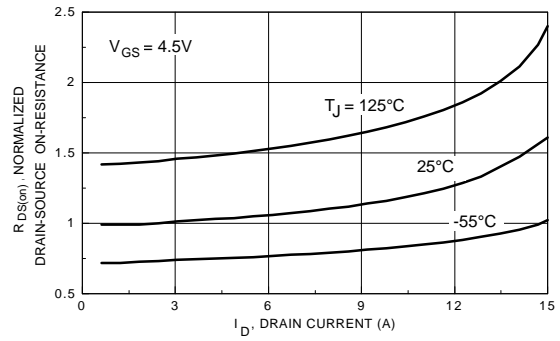


Figure 4. On-Resistance Variation with Drain Current and Temperature

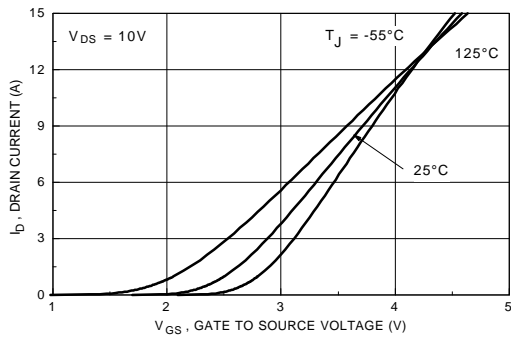


Figure 5. Transfer Characteristics

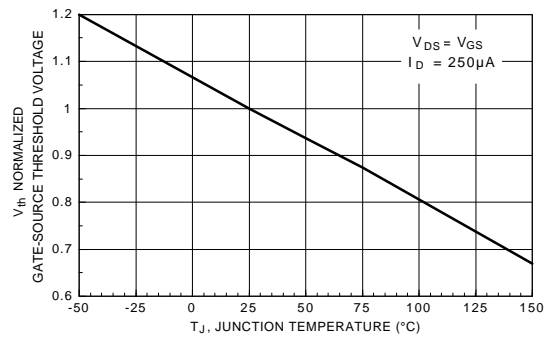


Figure 6. Gate Threshold Variation with Temperature

Typical Electrical Characteristics (continued)

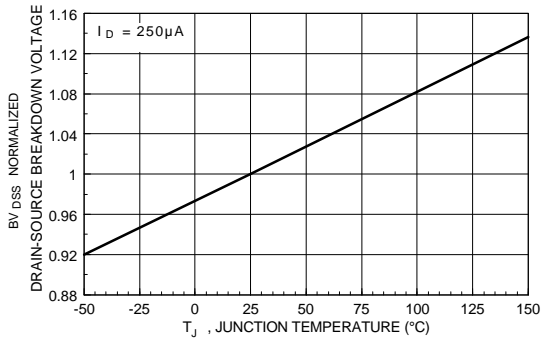


Figure 7. Breakdown Voltage Variation with Temperature

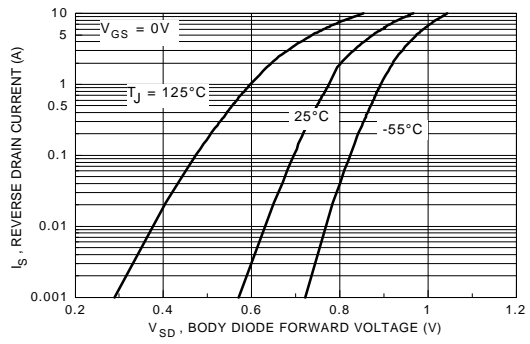


Figure 8. Body Diode Forward Voltage Variation with Source Current and Temperature

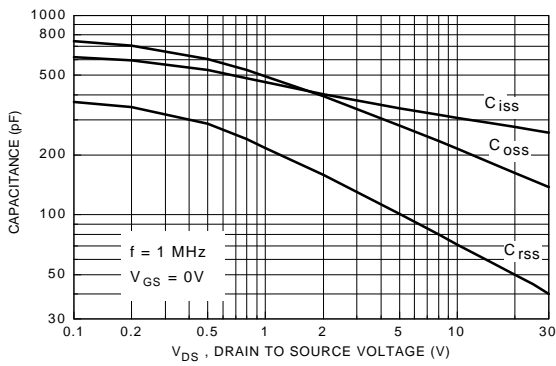


Figure 9. Capacitance Characteristics

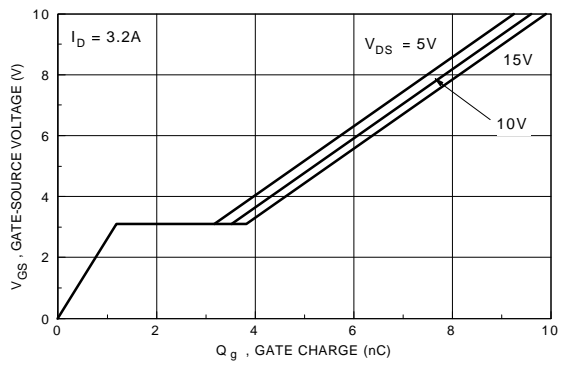


Figure 10. Gate Charge Characteristics

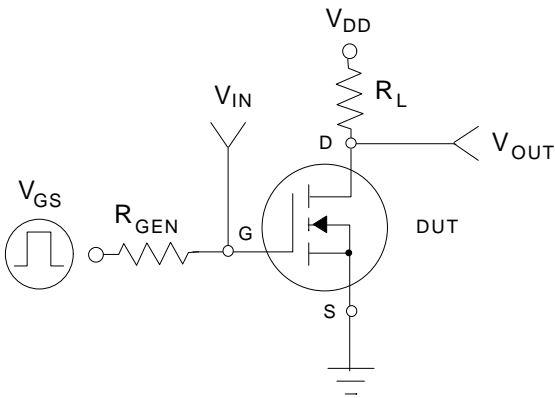


Figure 11. Switching Test Circuit

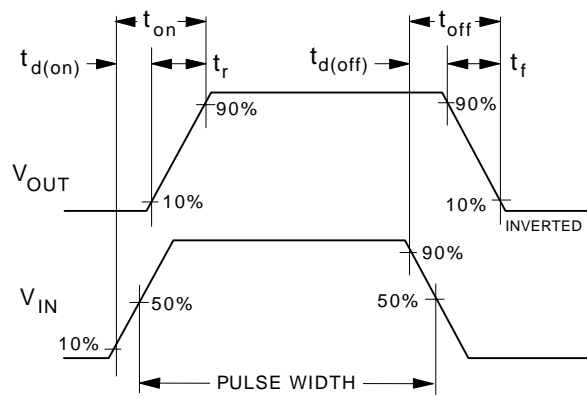


Figure 12. Switching Waveforms

Typical Electrical and Thermal Characteristics (continued)

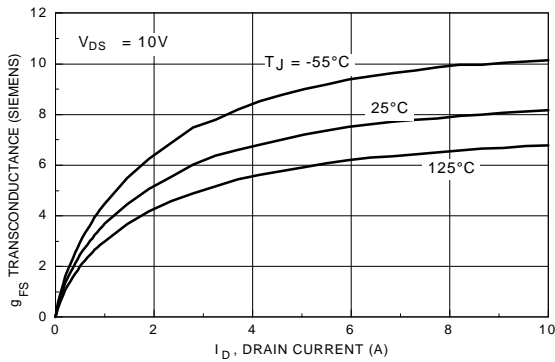


Figure 13. Transconductance Variation with Drain Current and Temperature

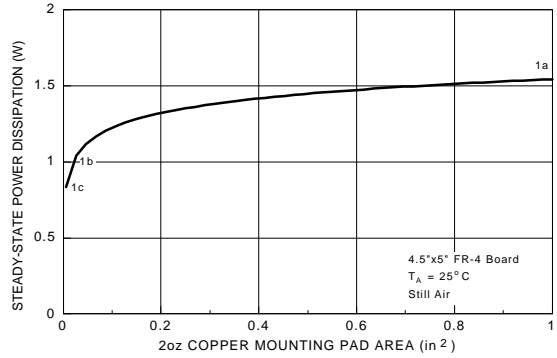


Figure 14. SOT-6 Maximum Steady-State Power Dissipation versus Copper Mounting Pad Area.

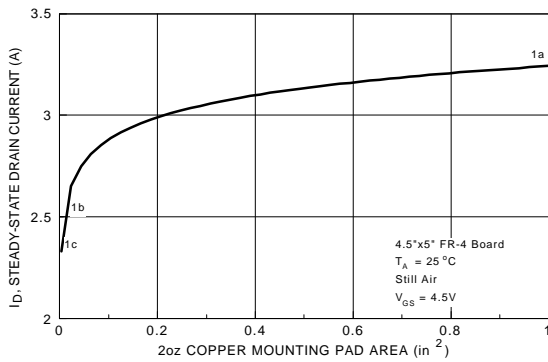


Figure 15. Maximum Steady-State Drain Current versus Copper Mounting Pad Area.

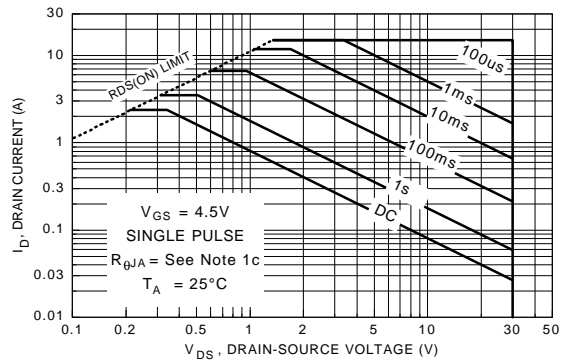


Figure 16. Maximum Safe Operating Area

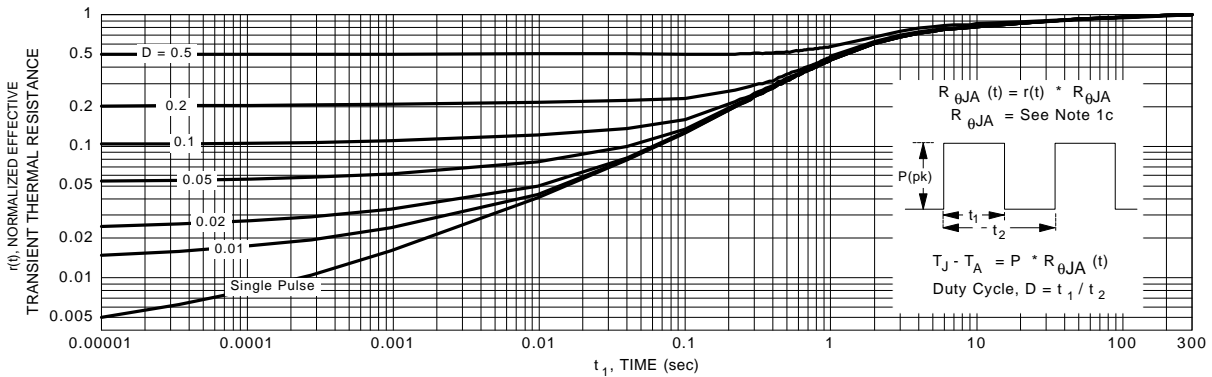


Figure 17. Transient Thermal Response Curve.

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

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