

## NDS352P

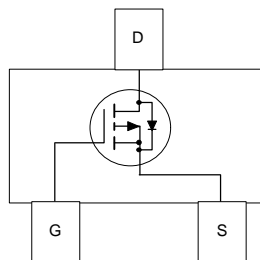
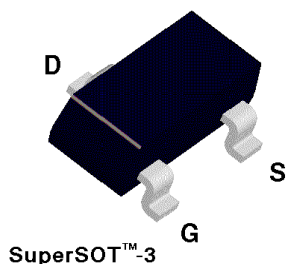
### P-Channel Logic Level Enhancement Mode Field Effect Transistor

#### General Description

These P-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 especially tailored to minimize on-state resistance. These devices are particularly suited for low voltage applications such as notebook computer power management, portable electronics, and other battery powered circuits where fast high-side switching, and low in-line power loss are needed in a very small outline surface mount package.

#### Features

- -0.85A, -20V.  $R_{DS(ON)} = 0.5\Omega$  @  $V_{GS} = -4.5V$ .
- Proprietary 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.
- Compact industry standard SOT-23 surface mount package.



#### Absolute Maximum Ratings

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

Symbol	Parameter	NDS352P	Units
$V_{DSS}$	Drain-Source Voltage	-20	V
$V_{GSS}$	Gate-Source Voltage - Continuous	$\pm 12$	V
$I_D$	Maximum Drain Current - Continuous (Note 1a)	$\pm 0.85$	A
	- Pulsed	$\pm 10$	
$P_D$	Maximum Power Dissipation (Note 1a)	0.5	W
	(Note 1b)	0.46	
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to 150	$^\circ\text{C}$

#### THERMAL CHARACTERISTICS

$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (Note 1a)	250	$^\circ\text{C/W}$
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case (Note 1)	75	$^\circ\text{C/W}$

**Electrical Characteristics** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
OFF CHARACTERISTICS						
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = -250 μA	-20			V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = -16 V, V <sub>GS</sub> = 0 V			-5	μA
		T <sub>J</sub> =125°C			-20	μA
I <sub>GSSF</sub>	Gate - Body Leakage, Forward	V <sub>GS</sub> = 12 V, V <sub>DS</sub> = 0 V			100	nA
I <sub>GSSR</sub>	Gate - Body Leakage, Reverse	V <sub>GS</sub> = -12 V, V <sub>DS</sub> = 0 V			-100	nA
ON CHARACTERISTICS (Note 2)						
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250 μA	-0.8	-1.6	-2.5	V
		T <sub>J</sub> =125°C	-0.5	-1.3	-2.2	
R <sub>DS(ON)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -0.85 A		0.46	0.5	Ω
		T <sub>J</sub> =125°C		0.59	0.7	
		V <sub>GS</sub> = -10 V, I <sub>D</sub> = -1 A			0.35	
I <sub>D(ON)</sub>	On-State Drain Current	V <sub>GS</sub> = -4.5 V, V <sub>DS</sub> = -5 V	-2			A
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = -5 V, I <sub>D</sub> = -0.85 A		1.5		S
DYNAMIC CHARACTERISTICS						
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = -10 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz		125		pF
C <sub>oss</sub>	Output Capacitance			140		pF
C <sub>rss</sub>	Reverse Transfer Capacitance			45		pF
SWITCHING CHARACTERISTICS (Note 2)						
t <sub>d(on)</sub>	Turn - On Delay Time	V <sub>DD</sub> = -10 V, I <sub>D</sub> = -1 A, V <sub>GS</sub> = -10 V, R <sub>GEN</sub> = 50 Ω		8	15	ns
t <sub>r</sub>	Turn - On Rise Time			19	30	ns
t <sub>d(off)</sub>	Turn - Off Delay Time			64	90	ns
t <sub>f</sub>	Turn - Off Fall Time			61	90	ns
Q <sub>g</sub>	Total Gate Charge	V <sub>DS</sub> = -10 V, I <sub>D</sub> = -0.85 A, V <sub>GS</sub> = -5 V		2.2	4	nC
Q <sub>gs</sub>	Gate-Source Charge				1	nC
Q <sub>gd</sub>	Gate-Drain Charge				2	nC

**Electrical Characteristics** (T<sub>A</sub> = 25°C unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS</b>						
I <sub>S</sub>	Maximum Continuous Drain-Source Diode Forward Current				-0.6	A
I <sub>SM</sub>	Maximum Pulsed Drain-Source Diode Forward Current				-5	A
V <sub>SD</sub>	Drain-Source Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>S</sub> = -0.85 A (Note 2)		-0.92	-1.2	V

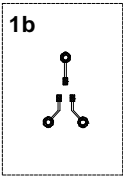
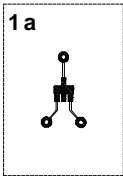
Notes:

1. R<sub>θJA</sub> 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<sub>θJC</sub> is guaranteed by design while R<sub>θCA</sub> is determined by the user's board design.

$$P_D(t) = \frac{T_J - T_A}{R_{\theta J A}(t)} = \frac{T_J - T_A}{R_{\theta J C} + R_{\theta CA}(t)} = I_D^2(t) \times R_{DS(on)} @ T_J$$

Typical R<sub>θJA</sub> using the board layouts shown below on 4.5"x5" FR-4 PCB in a still air environment:

- a. 250°C/W when mounted on a 0.02 in<sup>2</sup> pad of 2oz copper.  
b. 270°C/W when mounted on a 0.001 in<sup>2</sup> pad of 2oz copper.



Scale 1 : 1 on letter size paper

2. Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 2.0%.

## Typical Electrical Characteristics

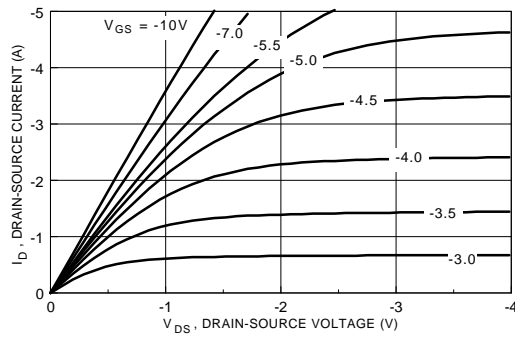


Figure 1. On-Region Characteristics

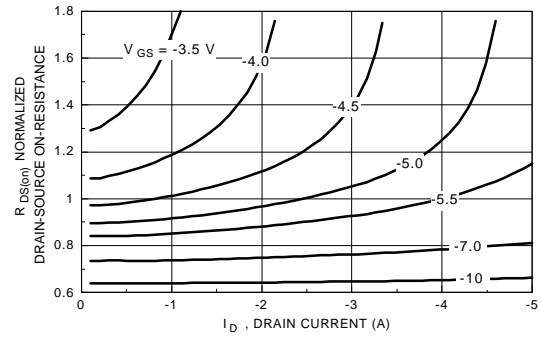


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage

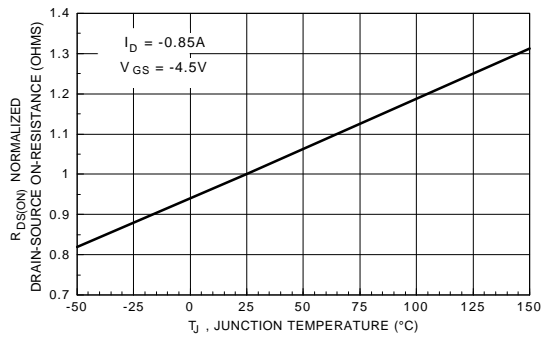


Figure 3. On-Resistance Variation with Temperature

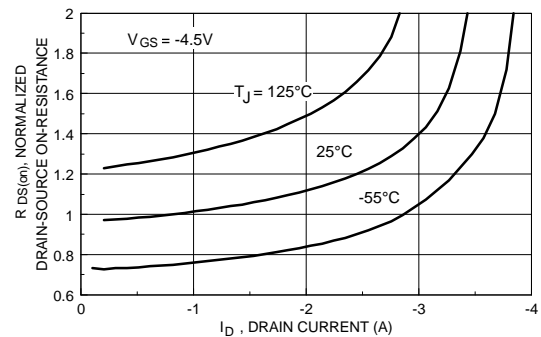


Figure 4. On-Resistance Variation with Drain Current and Temperature

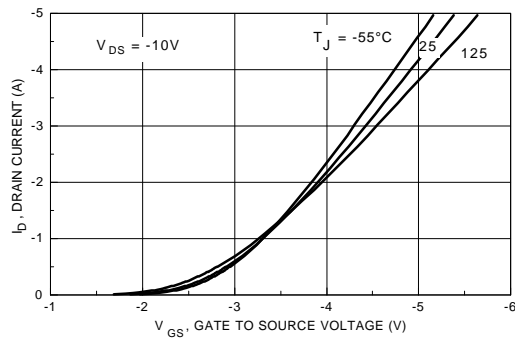


Figure 5. Transfer Characteristics

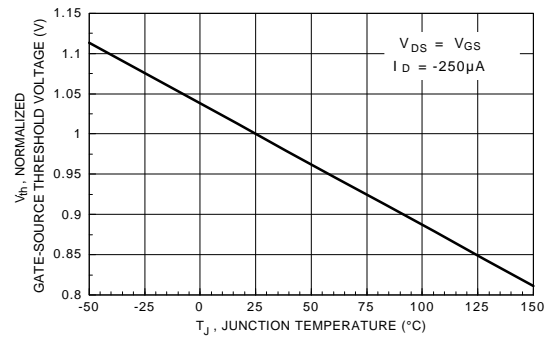
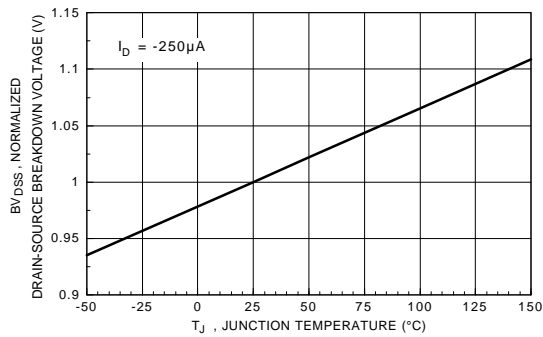
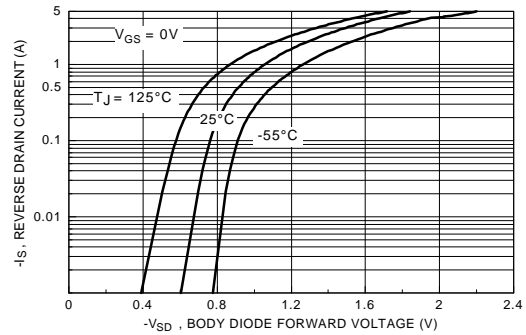


Figure 6. Gate Threshold Variation with Temperature

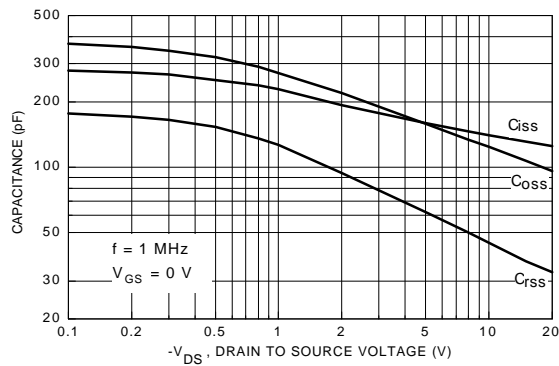
## Typical Electrical Characteristics (continued)



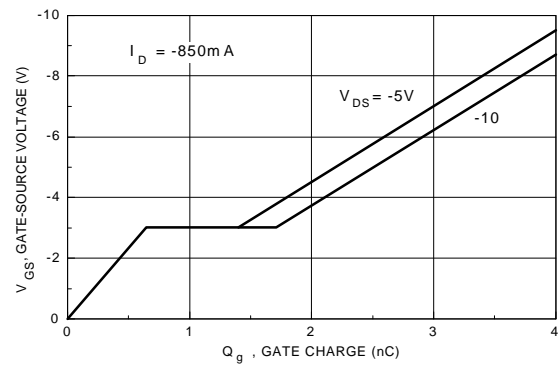
**Figure 7. Breakdown Voltage Variation with Temperature**



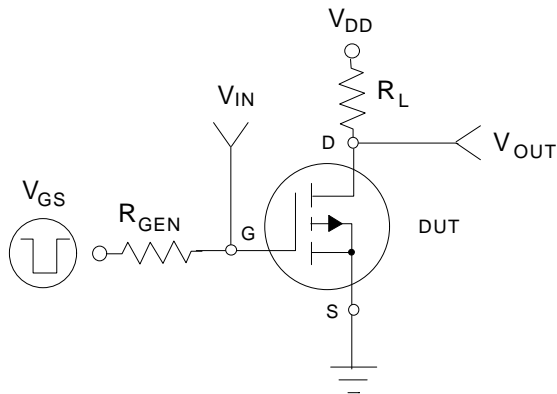
**Figure 8. Body Diode Forward Voltage Variation with Source Current and Temperature**



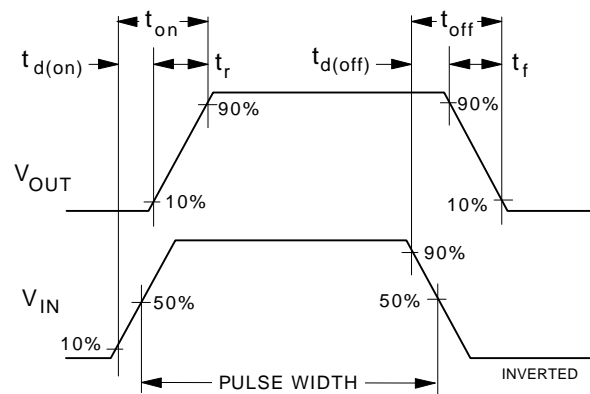
**Figure 9. Capacitance Characteristics**



**Figure 10. Gate Charge Characteristics**

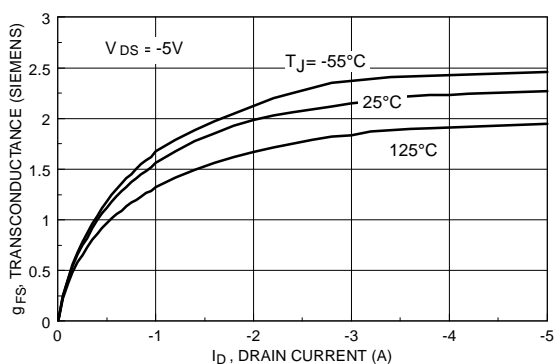


**Figure 11. Switching Test Circuit**

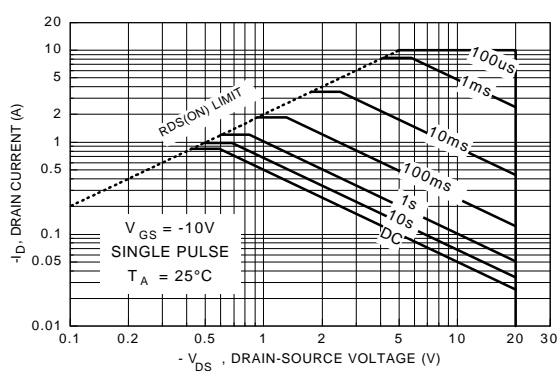


**Figure 12. Switching Waveforms**

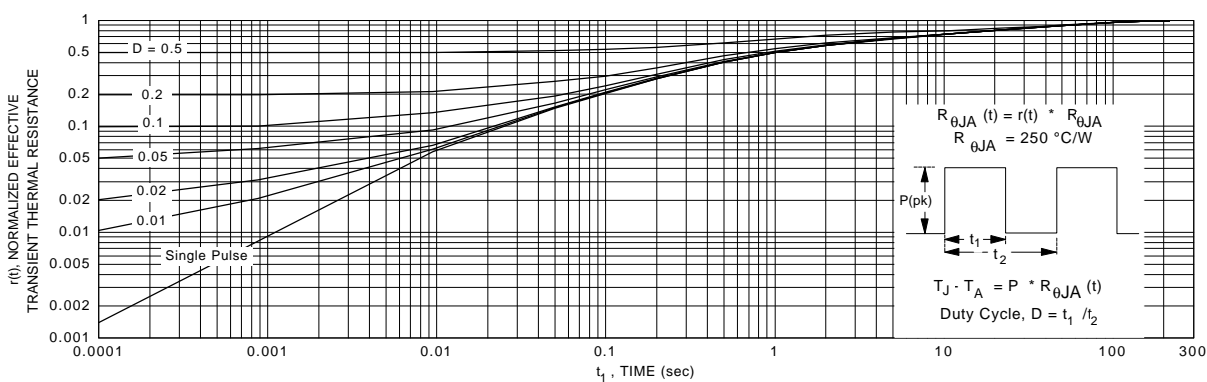
## Typical Electrical Characteristics (continued)



**Figure 13. Transconductance Variation with Drain Current and Temperature**



**Figure 14. Maximum Safe Operating Area**



**Figure 15. Transient Thermal Response Curve**

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

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