

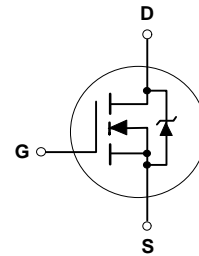
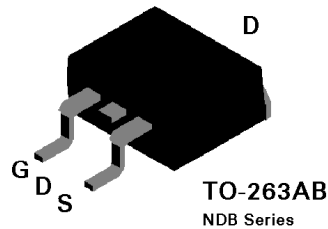
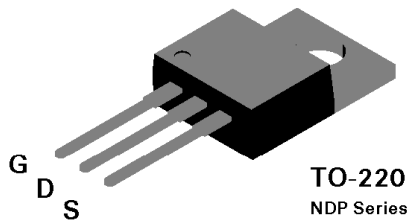
## NDP4050 / NDB4050 N-Channel Enhancement Mode Field Effect Transistor

### General Description

These N-Channel enhancement mode power field effect transistors are produced using Fairchild's proprietary, high cell density, DMOS technology. This very high density process has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulses in the avalanche and commutation modes. These devices are particularly suited for low voltage applications such as automotive, DC/DC converters, PWM motor controls, and other battery powered circuits where fast switching, low in-line power loss, and resistance to transients are needed.

### Features

- 15A, 50V.  $R_{DS(ON)} = 0.10\Omega @ V_{GS}=10V$ .
- Critical DC electrical parameters specified at elevated temperature.
- Rugged internal source-drain diode can eliminate the need for an external Zener diode transient suppressor.
- 175°C maximum junction temperature rating.
- High density cell design for extremely low  $R_{DS(ON)}$ .
- TO-220 and TO-263 (D<sup>2</sup>PAK) package for both through hole and surface mount applications.



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

Symbol	Parameter	NDP4050	NDB4050	Units
V <sub>DSS</sub>	Drain-Source Voltage	50		V
V <sub>DGR</sub>	Drain-Gate Voltage (R <sub>GS</sub> ≤ 1 MΩ)	50		V
V <sub>GSS</sub>	Gate-Source Voltage - Continuous - Nonrepetitive (t <sub>p</sub> < 50 μs)	± 20		V
		± 40		
I <sub>D</sub>	Drain Current - Continuous - Pulsed	± 15		A
		± 45		
P <sub>D</sub>	Total Power Dissipation	50		W
	Derate above 25°C	0.33		W/°C
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Temperature Range	-65 to 175		°C
T <sub>L</sub>	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	275		°C

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>DRAIN-SOURCE AVALANCHE RATINGS</b> (Note 1)						
$W_{DSS}$	Single Pulse Drain-Source Avalanche Energy	$V_{DD} = 25\text{ V}$ , $I_D = 15\text{ A}$			40	mJ
$I_{AR}$	Maximum Drain-Source Avalanche Current				15	A
<b>OFF CHARACTERISTICS</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}$ , $I_D = 250\ \mu\text{A}$	50			V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 50\text{ V}$ , $V_{GS} = 0\text{ V}$			250	$\mu\text{A}$
			$T_J = 125^\circ\text{C}$		1	mA
$I_{GSSF}$	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
<b>ON CHARACTERISTICS</b> (Note 1)						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}$ , $I_D = 250\ \mu\text{A}$	2	3	4	V
			$T_J = 125^\circ\text{C}$	1.4	2.4	3.6
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10\text{ V}$ , $I_D = 7.5\text{ A}$		0.078	0.1	$\Omega$
			$T_J = 125^\circ\text{C}$		0.12	0.165
$I_{D(on)}$	On-State Drain Current	$V_{GS} = 10\text{ V}$ , $V_{DS} = 10\text{ V}$	15			A
$g_{FS}$	Forward Transconductance	$V_{DS} = 10\text{ V}$ , $I_D = 7.5\text{ A}$	3	5.7		S
<b>DYNAMIC CHARACTERISTICS</b>						
$C_{iss}$	Input Capacitance	$V_{DS} = 25$ , $V_{GS} = 0\text{ V}$ , $f = 1.0\text{ MHz}$		370	450	pF
$C_{oss}$	Output Capacitance			165	200	pF
$C_{rss}$	Reverse Transfer Capacitance			50	100	pF
<b>SWITCHING CHARACTERISTICS</b> (Note 1)						
$t_{D(on)}$	Turn - On Delay Time	$V_{DD} = 30\text{ V}$ , $I_D = 15\text{ A}$ $V_{GS} = 10\text{ V}$ , $R_{GEN} = 25\ \Omega$		8	20	ns
$t_r$	Turn - On Rise Time			70	100	ns
$t_{D(off)}$	Turn - Off Delay Time			18	30	ns
$t_f$	Turn - Off Fall Time			37	50	ns
$Q_g$	Total Gate Charge	$V_{DS} = 48\text{ V}$ $I_D = 15\text{ A}$ , $V_{GS} = 10\text{ V}$		12.7	17	nC
$Q_{gs}$	Gate-Source Charge			3.2		nC
$Q_{gd}$	Gate-Drain Charge			7		nC

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS</b>						
$I_s$	Maximum Continuous Drain-Source Diode Forward Current				15	A
$I_{SM}$	Maximum Pulsed Drain-Source Diode Forward Current				45	A
$V_{SD}$	Source-Drain Diode Forward Voltage	$V_{GS} = 0\text{ V}$ , $I_s = 7.5\text{ A}$ (Note 1)		0.95	1.3	V
			$T_J = 125^\circ\text{C}$	0.88	1.2	
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{ V}$ , $I_F = 15\text{ A}$ , $dI_F/dt = 100\text{ A}/\mu\text{s}$	25	46	100	ns
$I_{rr}$	Reverse Recovery Current		1.5	3.4	7	A
<b>THERMAL CHARACTERISTICS</b>						
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case				3	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient				62.5	$^\circ\text{C}/\text{W}$

Note:

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

## Typical Electrical Characteristics

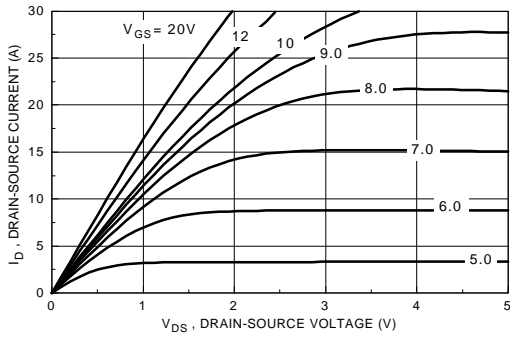


Figure 1. On-Region Characteristics.

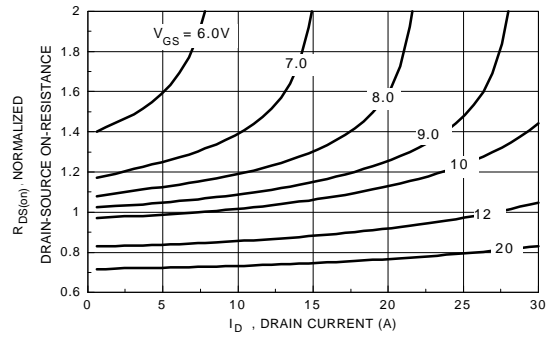


Figure 2. On-Resistance Variation with Gate Voltage and Drain Current.

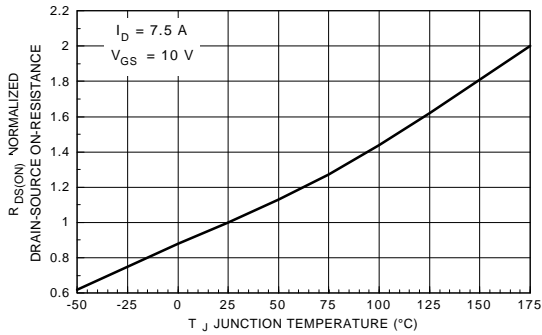


Figure 3. On-Resistance Variation with Temperature.

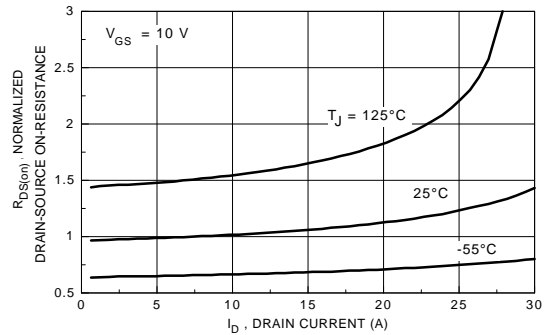


Figure 4. On-Resistance Variation with Drain Current and Temperature.

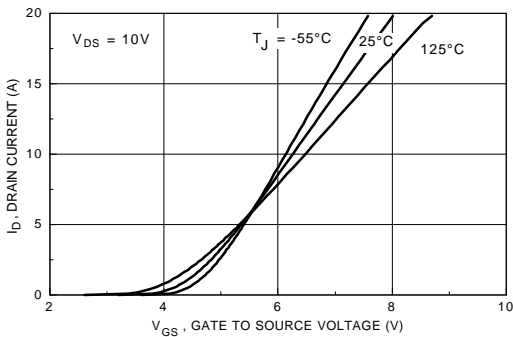


Figure 5. Drain Current Variation with Gate Voltage and Temperature.

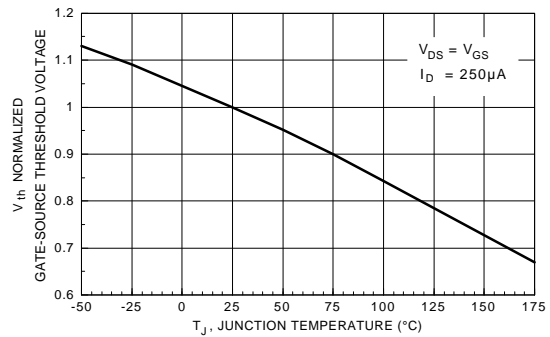
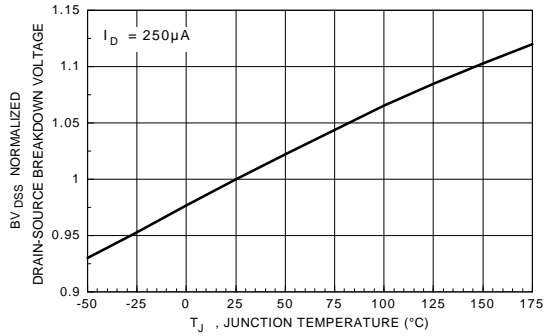
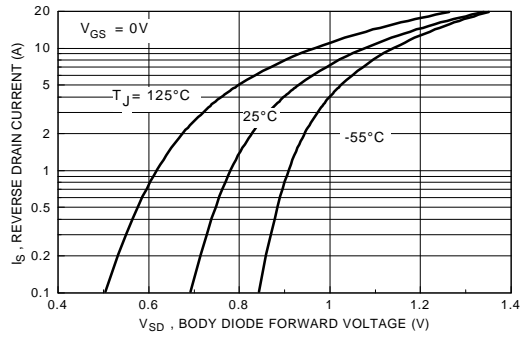


Figure 6. Gate Threshold Variation with Temperature.

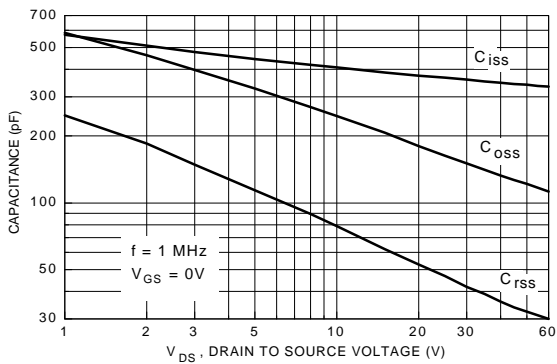
## Typical Electrical Characteristics (continued)



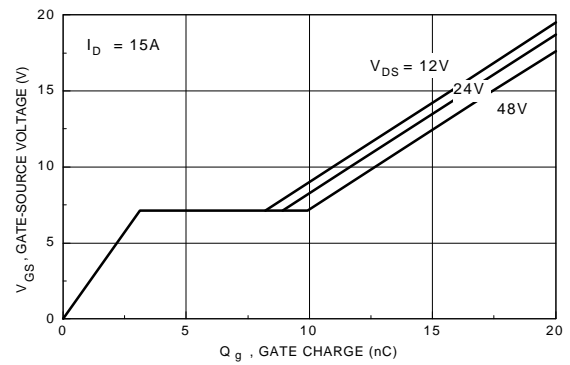
**Figure 7. Breakdown Voltage Variation with Temperature.**



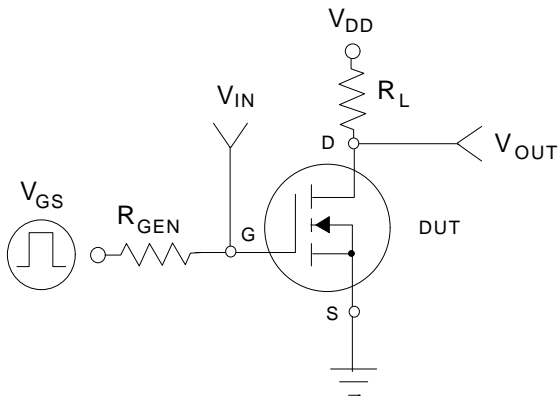
**Figure 8. Body Diode Forward Voltage Variation with Current and Temperature.**



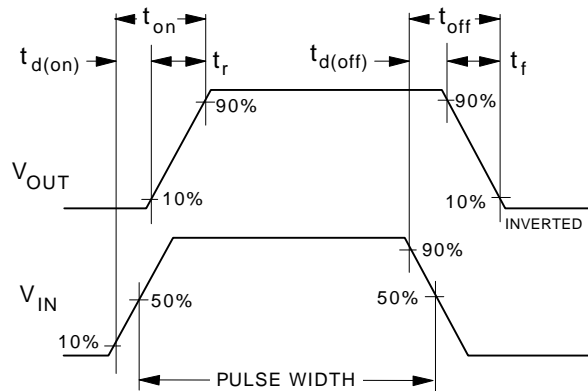
**Figure 9. Capacitance Characteristics.**



**Figure 10. Gate Charge Characteristics.**



**Figure 11. Switching Test Circuit.**



**Figure 12. Switching Waveforms.**

Typical Electrical Characteristics (continued)

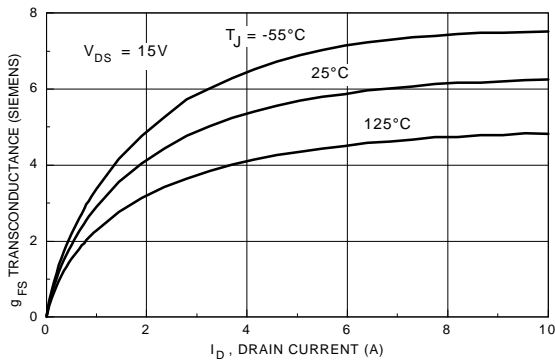


Figure 13. Transconductance Variation with Drain Current and Temperature.

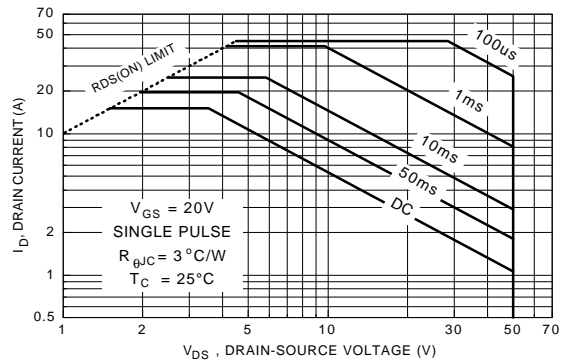


Figure 14. Maximum Safe Operating Area.

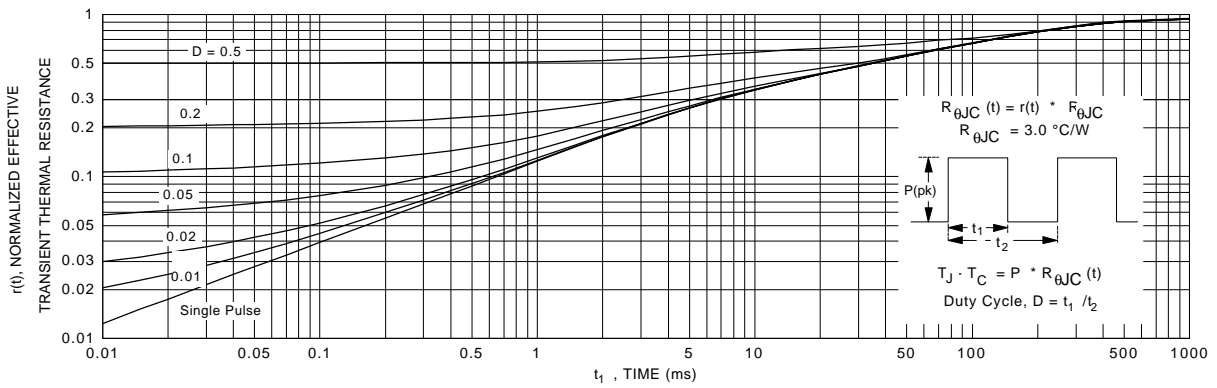


Figure 15. Transient Thermal Response Curve.