



May 1994

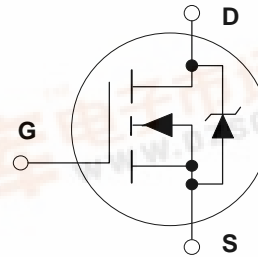
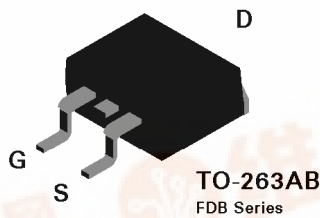
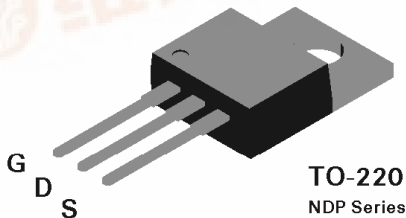
## NDP508A / NDP508AE / NDP508B / NDP508BE NDB508A / NDB508AE / NDB508B / NDB508BE N-Channel Enhancement Mode Field Effect Transistor

### 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

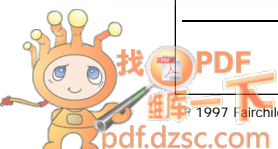
- 19 and 17A, 80V.  $R_{DS(ON)} = 0.08$  and  $0.10\Omega$ .
- Critical DC electrical parameters specified at elevated temperature.
- Rugged internal source-drain diode can eliminate the need for an external Zener diode transient suppressor.
- 175°C maximum junction temperature rating.
- High density cell design (3 million/in<sup>2</sup>) 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

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

Symbol	Parameter	NDP508A NDB508A	NDP508AE NDB508AE	NDP508B NDB508B	NDP508BE NDB508BE	Units
$V_{DSS}$	Drain-Source Voltage	80		80		V
$V_{DGR}$	Drain-Gate Voltage ( $R_{GS} \leq 1\text{ M}\Omega$ )	80		80		V
$V_{GSS}$	Gate-Source Voltage - Continuous	$\pm 20$		$\pm 20$		V
	- Nonrepetitive ( $t_p < 50\ \mu\text{s}$ )	$\pm 40$		$\pm 40$		V
$I_D$	Drain Current - Continuous	19	17	19	17	A
	- Pulsed	57	51	57	51	A
$P_D$	Total Power Dissipation @ $T_C = 25^\circ\text{C}$	75		75		W
	Derate above $25^\circ\text{C}$	0.5		0.5		W/ $^\circ\text{C}$
$T_J, T_{STG}$	Operating and Storage Temperature Range	-65 to 175		-65 to 175		$^\circ\text{C}$
$T_L$	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	275		275		$^\circ\text{C}$



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

Symbol	Parameter	Conditions	Type	Min	Typ	Max	Units
<b>DRAIN-SOURCE AVALANCHE RATINGS</b> (Note 1)							
$E_{AS}$	Single Pulse Drain-Source Avalanche Energy	$V_{DD} = 25\text{ V}$ , $I_D = 19\text{ A}$	NDP508AE NDP508BE			55	mJ
$I_{AR}$	Maximum Drain-Source Avalanche Current		NDB508AE NDB508BE			19	A
<b>OFF CHARACTERISTICS</b>							
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}$ , $I_D = 250\ \mu\text{A}$	ALL	80			V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 80\text{ V}$ , $V_{GS} = 0\text{ V}$ $T_J = 125^\circ\text{C}$	ALL			250	$\mu\text{A}$
						1	mA
$I_{GSSF}$	Gate - Body Leakage, Forward	$V_{GS} = 20\text{ V}$ , $V_{DS} = 0\text{ V}$	ALL			100	nA
$I_{GSSR}$	Gate - Body Leakage, Reverse	$V_{GS} = -20\text{ V}$ , $V_{DS} = 0\text{ V}$	ALL			-100	nA
<b>ON CHARACTERISTICS</b> (Note 2)							
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}$ , $I_D = 250\ \mu\text{A}$ $T_J = 125^\circ\text{C}$	ALL	2	2.9	4	V
				1.4	2.3	3.6	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10\text{ V}$ , $I_D = 9.5\text{ A}$ $T_J = 125^\circ\text{C}$	NDP508A NDP508AE NDB508A NDB508AE		0.057	0.08	$\Omega$
			NDP508B NDP508BE NDB508B NDB508BE		0.097	0.16	$\Omega$
		$V_{GS} = 10\text{ V}$ , $I_D = 8.5\text{ A}$ $T_J = 125^\circ\text{C}$				0.1	$\Omega$
$I_{D(on)}$	On-State Drain Current	$V_{GS} = 10\text{ V}$ , $V_{DS} = 10\text{ V}$	NDP508A NDP508AE NDB508A NDB508AE	19			A
			NDP508B NDP508BE NDB508B NDB508BE	17			A
$g_{FS}$	Forward Transconductance	$V_{DS} = 10\text{ V}$ , $I_D = 9.5\text{ A}$	ALL	6	9.6		S
<b>DYNAMIC CHARACTERISTICS</b>							
$C_{iss}$	Input Capacitance	$V_{DS} = 25\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1.0\text{ MHz}$	ALL		750	900	pF
$C_{oss}$	Output Capacitance		ALL		200	250	pF
$C_{riss}$	Reverse Transfer Capacitance		ALL		60	90	pF

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

Symbol	Parameter	Conditions	Type	Min	Typ	Max	Units
<b>SWITCHING CHARACTERISTICS</b> (Note 2)							
t <sub>D(ON)</sub>	Turn - On Delay Time	V <sub>DD</sub> = 40 V, I <sub>D</sub> = 19 A, V <sub>GS</sub> = 10 V, R <sub>GEN</sub> = 15 Ω	ALL		8.5	20	nS
t <sub>r</sub>	Turn - On Rise Time		ALL		66	110	nS
t <sub>D(OFF)</sub>	Turn - Off Delay Time		ALL		31	50	nS
t <sub>f</sub>	Turn - Off Fall Time		ALL		48	80	nS
Q <sub>g</sub>	Total Gate Charge	V <sub>DS</sub> = 64 V, I <sub>D</sub> = 19 A, V <sub>GS</sub> = 10 V	ALL		23.5	34	nC
Q <sub>gs</sub>	Gate-Source Charge		ALL		4.5		nC
Q <sub>gd</sub>	Gate-Drain Charge		ALL		11.8		nC
<b>DRAIN-SOURCE DIODE CHARACTERISTICS</b>							
I <sub>S</sub>	Maximum Continuous Drain-Source Diode Forward Current		NDP508A NDP508AE NDB508A NDB508AE			19	A
			NDP508B NDP508BE NDB508B NDB508BE			17	A
I <sub>SM</sub>	Maximum Pulsed Drain-Source Diode Forward Current		NDP508A NDP508AE NDB508A NDB508AE			57	A
			NDP508B NDP508BE NDB508B NDB508BE			51	A
V <sub>SD</sub> (Note 2)	Drain-Source Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 9.5 A	ALL		0.87	1.3	V
		T <sub>J</sub> = 125°C			0.79	1.2	V
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 19 A, di <sub>S</sub> /dt = 100 A/μs	ALL		78	110	ns
I <sub>rr</sub>	Reverse Recovery Current		ALL		5.2	75	A
<b>THERMAL CHARACTERISTICS</b>							
R <sub>θJC</sub>	Thermal Resistance, Junction-to-Case		ALL			2	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction-to-Ambient		ALL			62.5	°C/W

### Notes:

1. NDP508A/508B and NDB508A/508B are not rated for operation in avalanche mode.
2. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

## Typical Electrical Characteristics

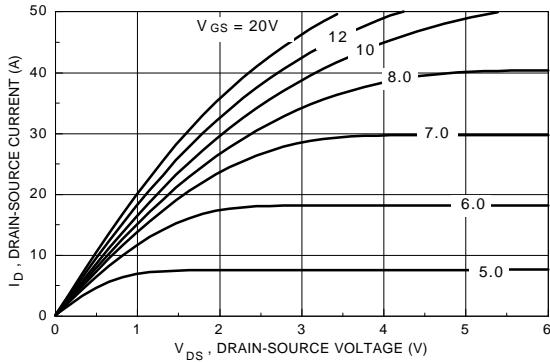


Figure 1. On-Region Characteristics.

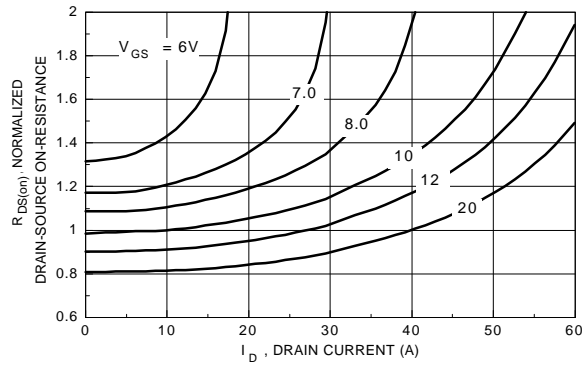


Figure 2. On-Resistance Variation with Gate Voltage and Drain Current.

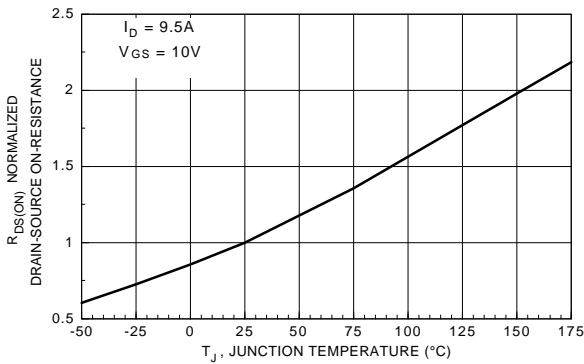


Figure 3. On-Resistance Variation with Temperature.

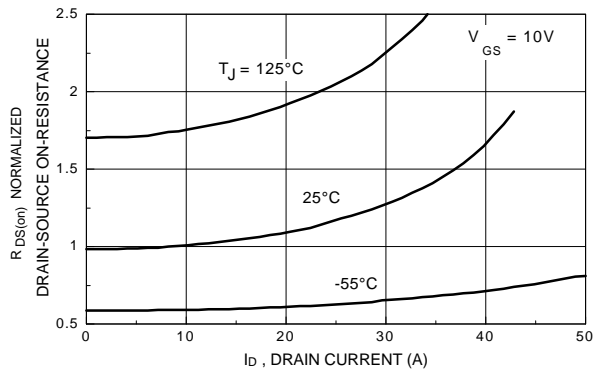


Figure 4. On-Resistance Variation with Drain Current and Temperature.

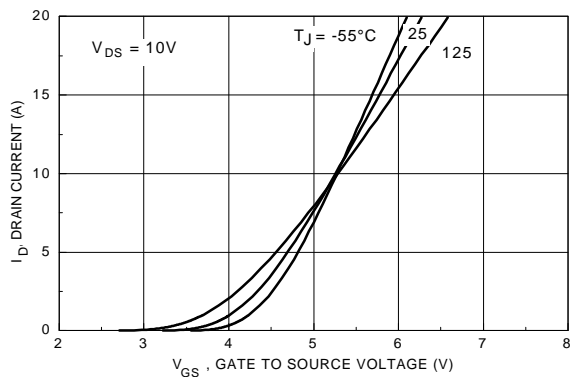


Figure 5. Transfer Characteristics.

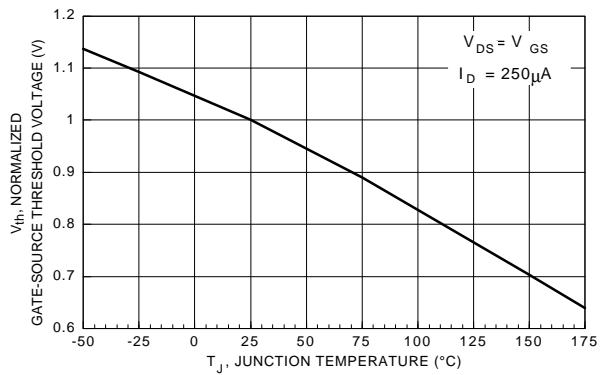
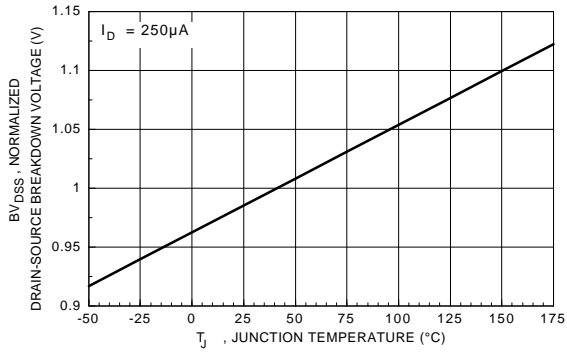
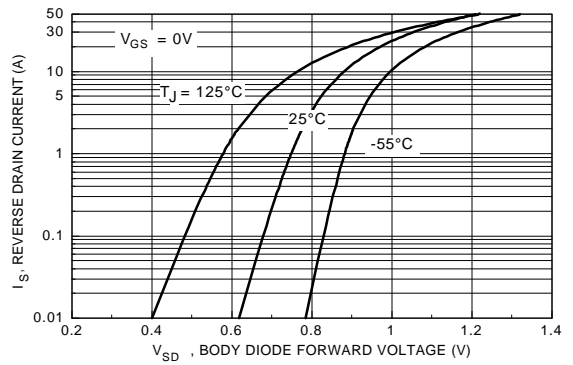


Figure 6. Gate Threshold Variation with Temperature.

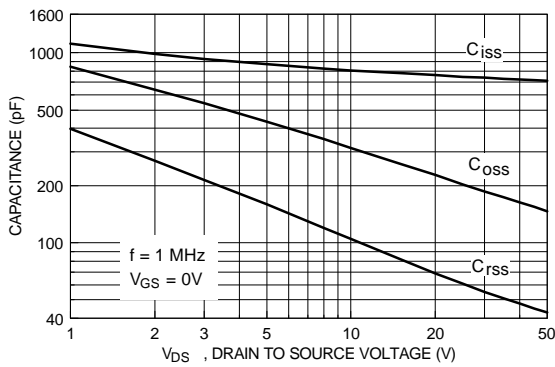
## Typical Electrical Characteristics (continued)



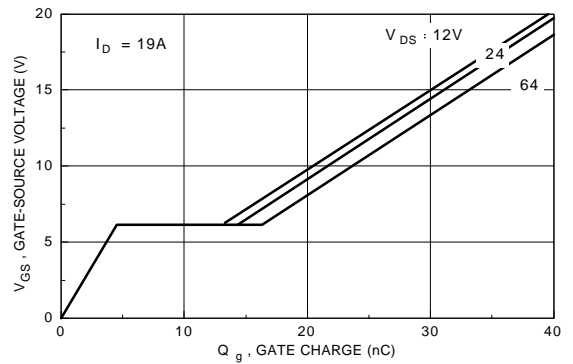
**Figure 7. Breakdown Voltage Variation with Temperature.**



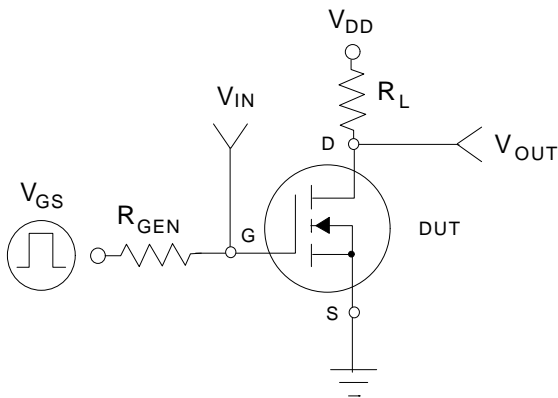
**Figure 8. Body Diode Forward Voltage Variation with Current and Temperature.**



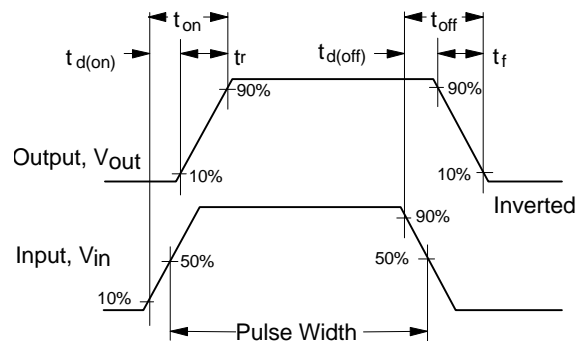
**Figure 9. Capacitance Characteristics.**



**Figure 10. Gate Charge Characteristics.**

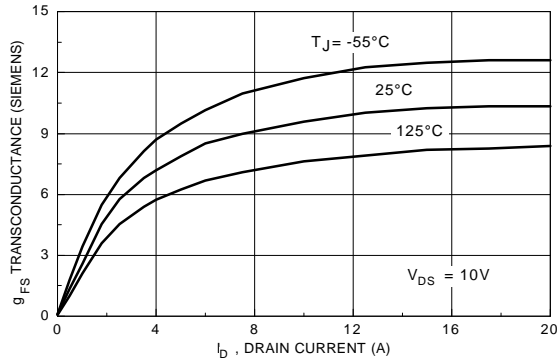


**Figure 11. Switching Test Circuit.**

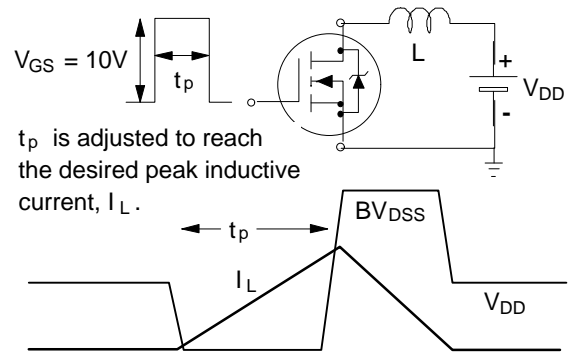


**Figure 12. Switching Waveforms.**

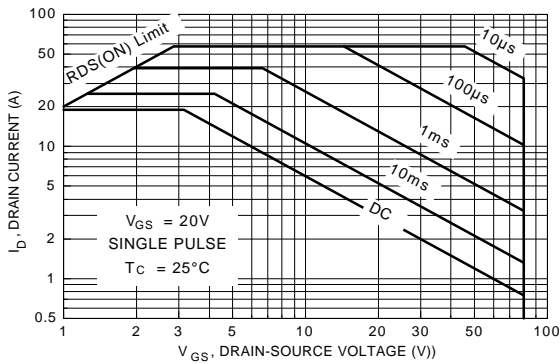
## Typical Electrical Characteristics (continued)



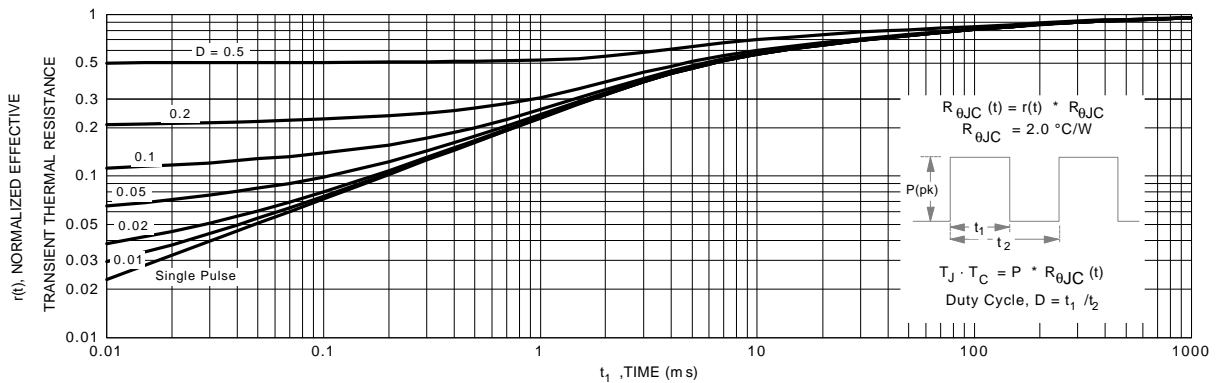
**Figure 13. Transconductance Variation with Drain Current and Temperature.**



**Figure 14. Unclamped Inductive Load Circuit and Waveforms.**



**Figure 15. Maximum Safe Operating Area.**



**Figure 16. Transient Thermal Response Curve.**