FAIRCHILD
SEMICONDUCTOR TM

May 1994

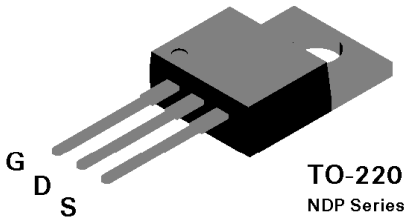
NDP508A / NDP508AE / NDP508B / NDP508BE
NDB508A / NDB508AE / NDB508B / NDB508BE
N-Channel Enhancement Mode Field Effect Transistor

General Description

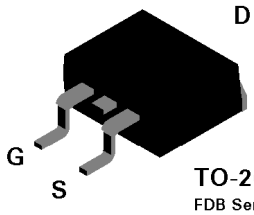
These N-channel enhancement mode power field effect transistors are produced using Fairchild's proprietary, high cell density, DMOS technology. This very high density process has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy 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

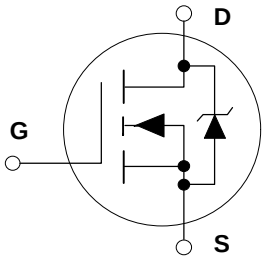
- 19 and 17A, 80V. $R_{DS(ON)}$ = 0.08 and 0.10Ω.
- Critical DC electrical parameters specified at elevated temperature.
- Rugged internal source-drain diode can eliminate the need for an external Zener diode transient suppressor.
- 175°C maximum junction temperature rating.
- High density cell design (3 million/in²) for extremely low $R_{DS(ON)}$.
- TO-220 and TO-263 (D^2PAK) package for both through hole and surface mount applications.



TO-220
NDP Series



TO-263AB
FDB Series



Absolute Maximum Ratings

T_C = 25°C unless otherwise noted

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

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Electrical Characteristics (T_C = 25°C unless otherwise noted)

Symbol	Parameter	Conditions	Type	Min	Typ	Max	Units
DRAIN-SOURCE AVALANCHE RATINGS (Note 1)							
E_{AS}	Single Pulse Drain-Source Avalanche Energy	V_{DD} = 25 V, I_D = 19 A	NDP508AE NDP508BE			55	mJ
I_{AR}	Maximum Drain-Source Avalanche Current		NDB508AE NDB508BE			19	A
OFF CHARACTERISTICS							
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} = 0 V, I_D = 250 µA	ALL	80			V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 80 V, V_{GS} = 0 V	ALL			250	µA
		T_J = 125°C				1	mA
I_{GSSF}	Gate - Body Leakage, Forward	V_{GS} = 20 V, V_{DS} = 0 V	ALL			100	nA
I_{GSSR}	Gate - Body Leakage, Reverse	V_{GS} = -20 V, V_{DS} = 0 V	ALL			-100	nA
ON CHARACTERISTICS (Note 2)							
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = 250 µA	ALL	2	2.9	4	V
		T_J = 125°C		1.4	2.3	3.6	V
$R_{DS(ON)}$	Static Drain-Source On-Resistance	V_{GS} = 10 V, I_D = 9.5 A	NDP508A NDP508AE NDB508A		0.057	0.08	Ω
		T_J = 125°C	NDB508AE		0.097	0.16	Ω
		V_{GS} = 10 V, I_D = 8.5 A	NDP508B NDP508BE NDB508B			0.1	Ω
		T_J = 125°C	NDB508BE			0.2	Ω
$I_{D(on)}$	On-State Drain Current	V_{GS} = 10 V, V_{DS} = 10 V	NDP508A NDP508AE NDB508A NDB508AE	19			A
			NDP508B NDP508BE NDB508B NDB508BE	17			A
g_{FS}	Forward Transconductance	V_{DS} = 10 V, I_D = 9.5 A	ALL	6	9.6		S
DYNAMIC CHARACTERISTICS							
C_{iss}	Input Capacitance	V_{DS} = 25 V, V_{GS} = 0 V, f = 1.0 MHz	ALL		750	900	pF
C_{oss}	Output Capacitance		ALL		200	250	pF
C_{rss}	Reverse Transfer Capacitance		ALL		60	90	pF

Electrical Characteristics (T_C = 25°C unless otherwise noted)

Symbol	Parameter	Conditions	Type	Min	Typ	Max	Units
SWITCHING CHARACTERISTICS (Note 2)							
$t_{D(ON)}$	Turn - On Delay Time	V_{DD} = 40 V, I_D = 19 A, V_{GS} = 10 V, R_{GEN} = 15 Ω	ALL		8.5	20	nS
t_r	Turn - On Rise Time		ALL		66	110	nS
$t_{D(OFF)}$	Turn - Off Delay Time		ALL		31	50	nS
t_f	Turn - Off Fall Time		ALL		48	80	nS
Q_g	Total Gate Charge	V_{DS} = 64 V, I_D = 19 A, V_{GS} = 10 V	ALL		23.5	34	nC
Q_{gs}	Gate-Source Charge		ALL		4.5		nC
Q_{gd}	Gate-Drain Charge		ALL		11.8		nC
DRAIN-SOURCE DIODE CHARACTERISTICS							
I_S	Maximum Continuos Drain-Source Diode Forward Current		NDP508A NDP508AE NDB508A NDB508AE			19	A
			NDP508B NDP508BE NDB508B NDB508BE			17	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current		NDP508A NDP508AE NDB508A NDB508AE			57	A
			NDP508B NDP508BE NDB508B NDB508BE			51	A
V_{SD} (Note 2)	Drain-Source Diode Forward Voltage	V_{GS} = 0 V, I_S = 9.5 A	ALL		0.87	1.3	V
		T_J = 125°C			0.79	1.2	V
t_{rr}	Reverse Recovery Time	V_{GS} = 0 V, I_S = 19 A, dI_S/dt = 100 A/µs	ALL		78	110	ns
I_{rr}	Reverse Recovery Current		ALL		5.2	75	A
THERMAL CHARACTERISTICS							
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case		ALL			2	°C/W
$R_{\theta JA}$	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

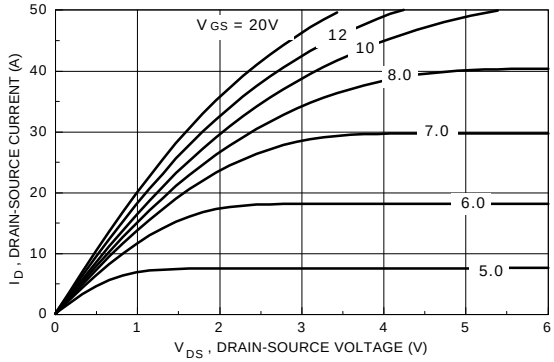


Figure 1. On-Region Characteristics.

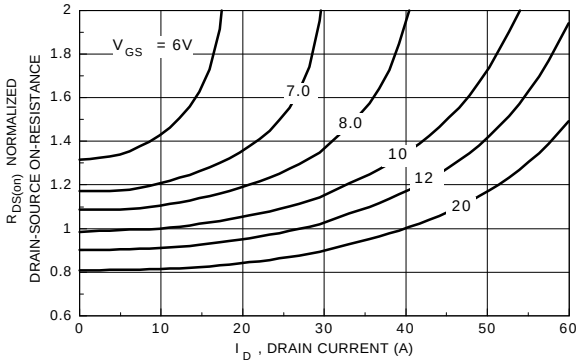


Figure 2. On-Resistance Variation with Gate Voltage and Drain Current.

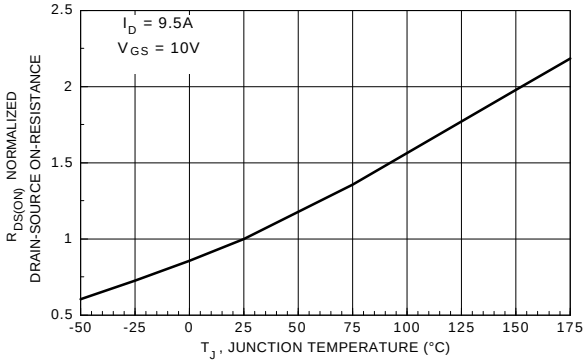


Figure 3. On-Resistance Variation with Temperature.

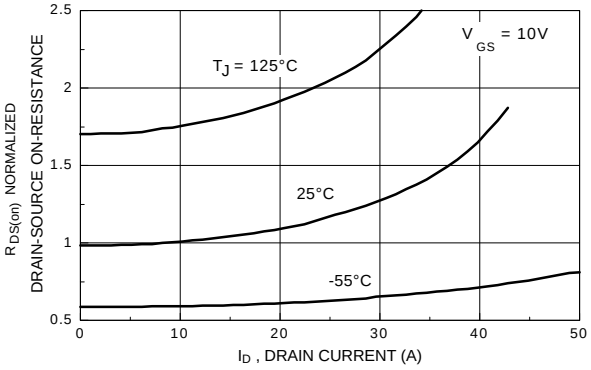


Figure 4. On-Resistance Variation with Drain Current and Temperature.

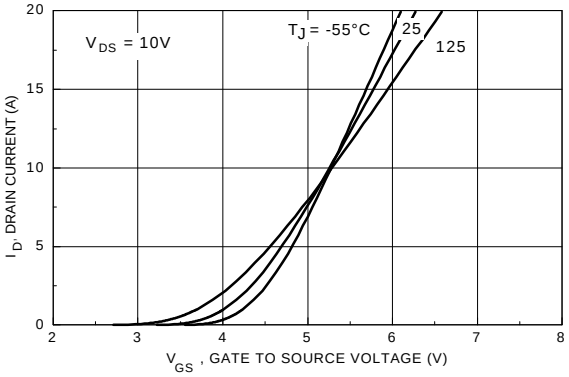


Figure 5. Transfer Characteristics.

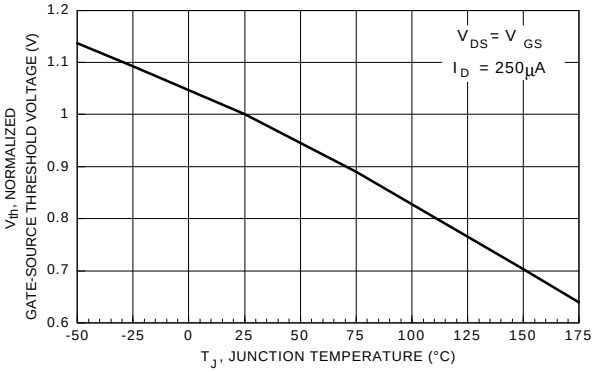


Figure 6. Gate Threshold Variation with Temperature.

Typical Electrical Characteristics (continued)

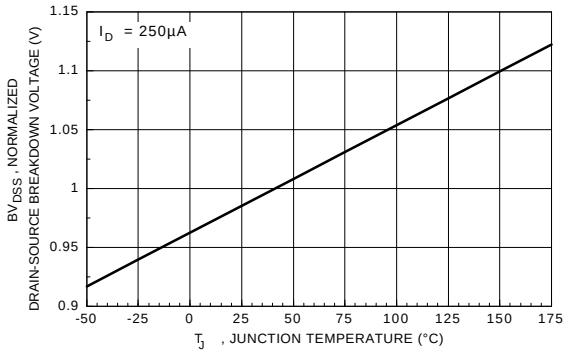


Figure 7. Breakdown Voltage Variation with Temperature.

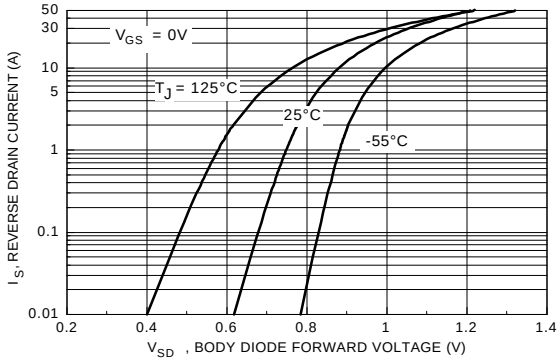


Figure 8. Body Diode Forward Voltage Variation with Current and Temperature.

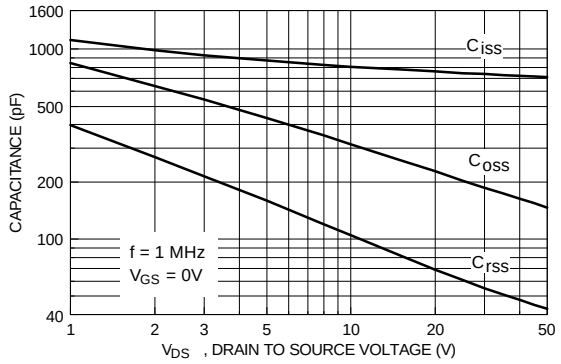


Figure 9. Capacitance Characteristics.

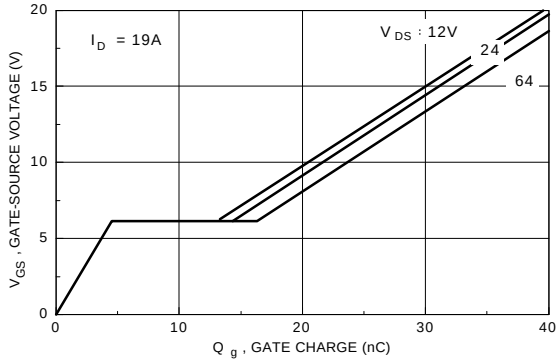


Figure 10. Gate Charge Characteristics.

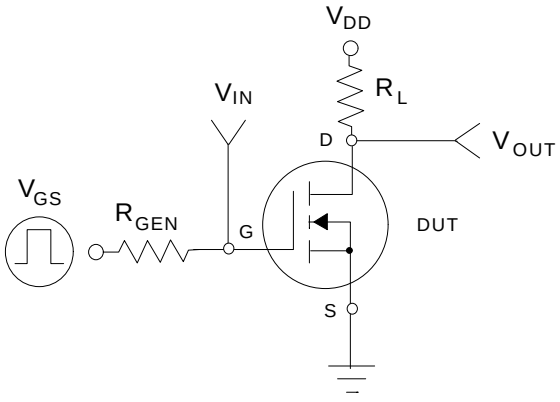


Figure 11. Switching Test Circuit.

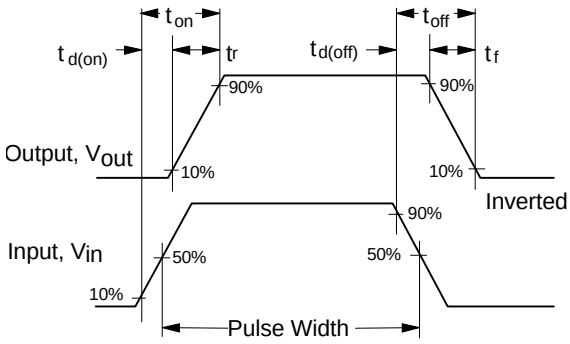


Figure 12. Switching Waveforms.

Typical Electrical Characteristics (continued)

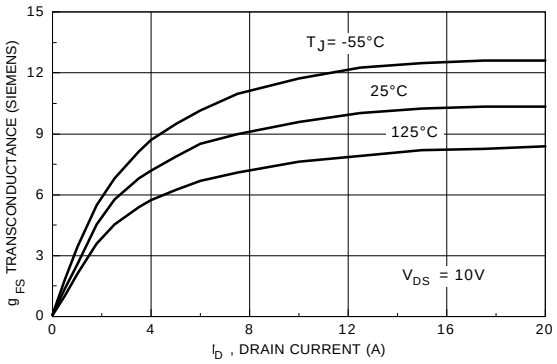


Figure 13. Transconductance Variation with Drain Current and Temperature.

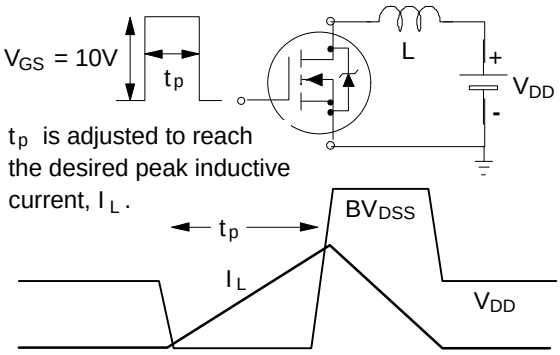


Figure 14. Unclamped Inductive Load Circuit and Waveforms.

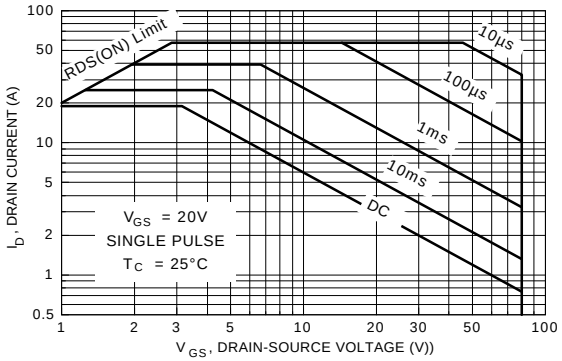


Figure 15. Maximum Safe Operating Area.

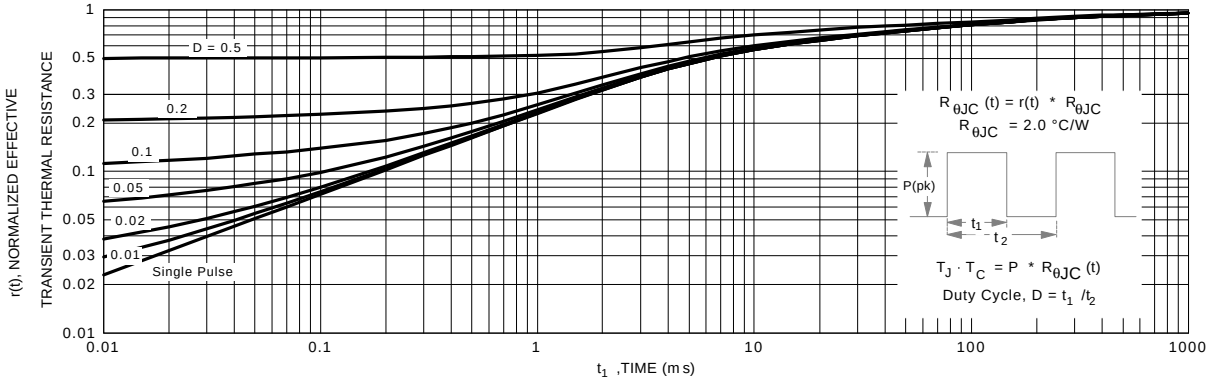


Figure 16. Transient Thermal Response Curve.