



May 1994

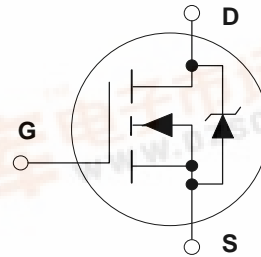
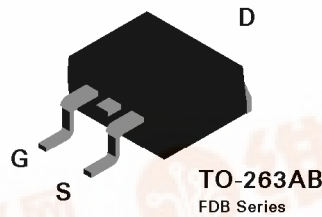
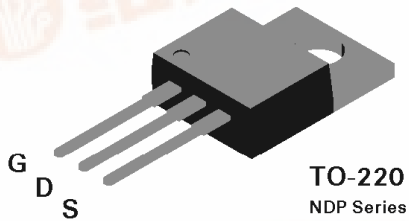
NDP610A / NDP610AE / NDP610B / NDP610BE NDB610A / NDB610AE / NDB610B / NDB610BE N-Channel Enhancement Mode Field Effect Transistor

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

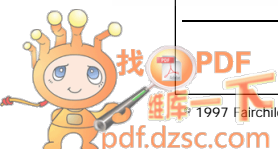
- 26 and 24A, 100V. $R_{DS(ON)} = 0.065$ and 0.080Ω .
- Critical DC electrical parameters specified at elevated temperature.
- Rugged internal source-drain diode can eliminate the need for an external Zener diode transient suppressor.
- 175°C maximum junction temperature rating.
- High density cell design (3 million/in²) for extremely low $R_{DS(ON)}$.
- TO-220 and TO-263 (D²PAK) package for both through hole and surface mount applications.



Absolute Maximum Ratings

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

| Symbol | Parameter | NDP610A NDB610A | NDP610AE NDB610AE | NDP610B NDB610B | NDP610BE NDB610BE | Units |
|----------------|---|--------------------|----------------------|--------------------|----------------------|---------------------|
| V_{DSS} | Drain-Source Voltage | 100 | | 100 | | V |
| V_{DGR} | Drain-Gate Voltage ($R_{GS} \leq 1\text{ M}\Omega$) | 100 | | 100 | | V |
| V_{GSS} | Gate-Source Voltage - Continuous | ± 20 | | ± 20 | | V |
| | - Nonrepetitive ($t_p < 50\ \mu\text{s}$) | ± 40 | | ± 40 | | V |
| I_D | Drain Current - Continuous | 26 | 24 | 26 | 24 | A |
| | - Pulsed | 104 | 96 | 104 | 96 | A |
| P_D | Total Power Dissipation @ $T_C = 25^\circ\text{C}$ | 100 | | 100 | | W |
| | Derate above 25°C | 0.67 | | 0.67 | | 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 |
|--|--|--|--|-----|-------|-------|---------------|
| DRAIN-SOURCE AVALANCHE RATINGS (Note 1) | | | | | | | |
| E_{AS} | Single Pulse Drain-Source Avalanche Energy | $V_{DD} = 25\text{ V}$, $I_D = 26\text{ A}$ | NDP610AE NDP610BE | | | 250 | mJ |
| I_{AR} | Maximum Drain-Source Avalanche Current | | NDB610AE NDB610BE | | | 26 | A |
| OFF CHARACTERISTICS | | | | | | | |
| BV_{DSS} | Drain-Source Breakdown Voltage | $V_{GS} = 0\text{ V}$, $I_D = 250\text{ }\mu\text{A}$ | ALL | 100 | | | V |
| I_{DSS} | Zero Gate Voltage Drain Current | $V_{DS} = 100\text{ V}$, $V_{GS} = 0\text{ V}$ $T_J = 125^\circ\text{C}$ | ALL | | | 250 | μA |
| | | | | | | 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 |
| ON CHARACTERISTICS (Note 2) | | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$ $T_J = 125^\circ\text{C}$ | ALL | 2 | 3 | 4 | V |
| | | | | 1.4 | 2.3 | 3.2 | V |
| $R_{DS(on)}$ | Static Drain-Source On-Resistance | $V_{GS} = 10\text{ V}$, $I_D = 13\text{ A}$ $T_J = 125^\circ\text{C}$ | NDP610A NDP610AE NDB610A NDB610AE | | 0.048 | 0.065 | Ω |
| | | | | | 0.086 | 0.13 | Ω |
| | | $V_{GS} = 10\text{ V}$, $I_D = 12\text{ A}$ $T_J = 125^\circ\text{C}$ | NDP610B NDP610BE NDB610B NDB610BE | | | 0.08 | Ω |
| | | | | | | 0.16 | Ω |
| $I_{D(on)}$ | On-State Drain Current | $V_{GS} = 10\text{ V}$, $V_{DS} = 10\text{ V}$ | NDP610A NDP610AE NDB610A NDB610AE | 26 | | | A |
| | | | NDP610B NDP610BE NDB610B NDB610BE | 24 | | | A |
| g_{FS} | Forward Transconductance | $V_{DS} = 10\text{ V}$, $I_D = 13\text{ A}$ | ALL | 10 | 16 | | S |
| DYNAMIC CHARACTERISTICS | | | | | | | |
| C_{iss} | Input Capacitance | $V_{DS} = 25\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 1.0\text{ MHz}$ | ALL | | 1430 | 1800 | pF |
| C_{oss} | Output Capacitance | | ALL | | 280 | 500 | pF |
| C_{riss} | Reverse Transfer Capacitance | | ALL | | 85 | 200 | 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} = 50 V, I _D = 26 A, V _{GS} = 10 V, R _{GEN} = 7.5 Ω | ALL | | 11 | 20 | nS |
| t _r | Turn - On Rise Time | | ALL | | 72 | 120 | nS |
| t _{D(OFF)} | Turn - Off Delay Time | | ALL | | 40 | 65 | nS |
| t _f | Turn - Off Fall Time | | ALL | | 52 | 85 | nS |
| Q _g | Total Gate Charge | V _{DS} = 80 V, I _D = 26 A, V _{GS} = 10V | ALL | | 47 | 65 | nC |
| Q _{gs} | Gate-Source Charge | | ALL | | 8 | | nC |
| Q _{gd} | Gate-Drain Charge | | ALL | | 22 | | nC |
| DRAIN-SOURCE DIODE CHARACTERISTICS | | | | | | | |
| I _S | Maximum Continuous Drain-Source Diode Forward Current | | NDP610A NDP610AE NDB610A NDB610AE | | | 26 | A |
| | | | NDP610B NDP610BE NDB610B NDB610BE | | | 24 | A |
| I _{SM} | Maximum Pulsed Drain-Source Diode Forward Current | | NDP610A NDP610AE NDB610A NDB610AE | | | 104 | A |
| | | | NDP610B NDP610BE NDB610B NDB610BE | | | 96 | A |
| V _{SD} (Note 2) | Drain-Source Diode Forward Voltage | V _{GS} = 0 V, I _S = 13 A | ALL | | 0.88 | 1.3 | V |
| | | T _J = 125°C | | | 0.83 | 1.2 | V |
| t _{rr} | Reverse Recovery Time | V _{GS} = 0 V, I _S = 26 A, di _S /dt = 100 A/μs | ALL | | 108 | 155 | ns |
| I _{rr} | Reverse Recovery Current | | ALL | | 7.4 | 11 | A |
| THERMAL CHARACTERISTICS | | | | | | | |
| R _{θJC} | Thermal Resistance, Junction-to-Case | | ALL | | | 1.5 | °C/W |
| R _{θJA} | Thermal Resistance, Junction-to-Ambient | | ALL | | | 62.5 | °C/W |

Notes:

1. NDP610A/610B and NDB610A/610B are not rated for operation in avalanche mode.
2. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

Typical Electrical Characteristics

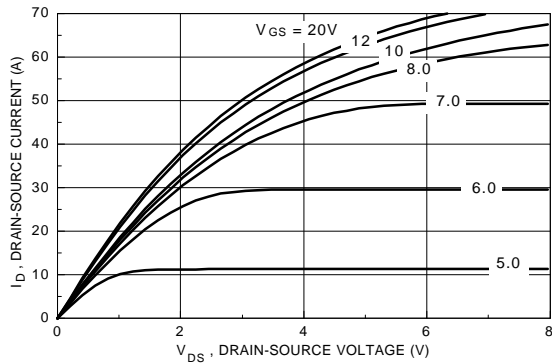


Figure 1. On-Region Characteristics.

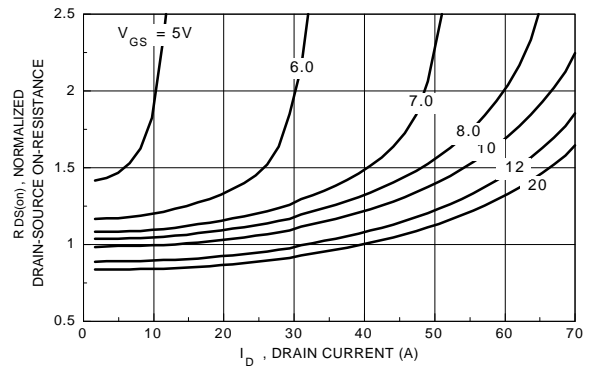


Figure 2. On-Resistance Variation with Gate Voltage and Drain Current.

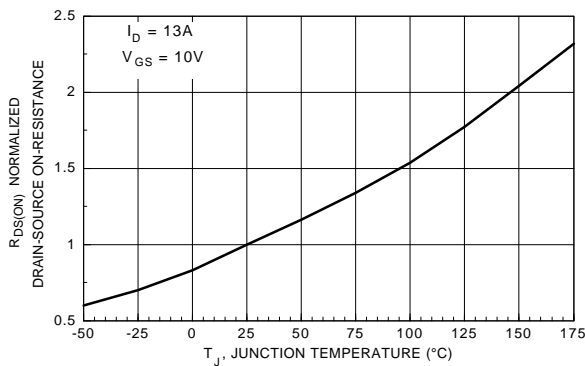


Figure 3. On-Resistance Variation with Temperature.

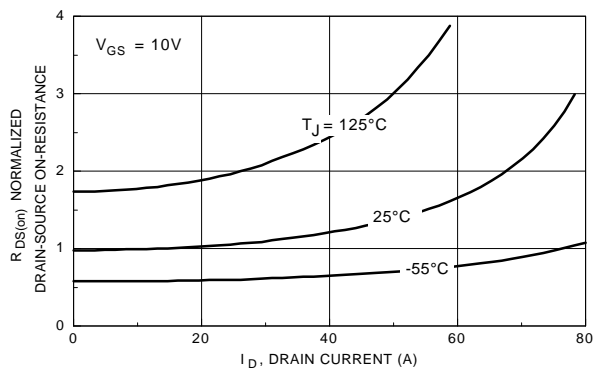


Figure 4. On-Resistance Variation with Drain Current and Temperature.

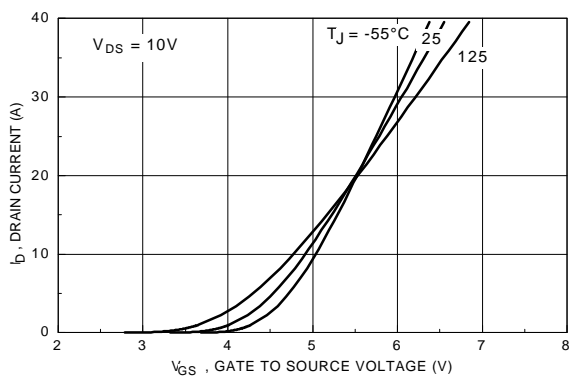


Figure 5. Transfer Characteristics.

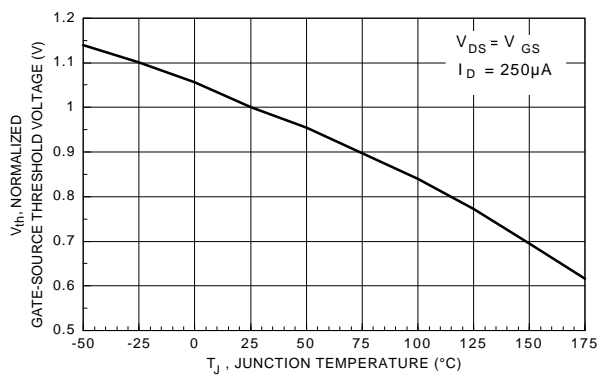


Figure 6. Gate Threshold Variation with Temperature.

Typical Electrical Characteristics (continued)

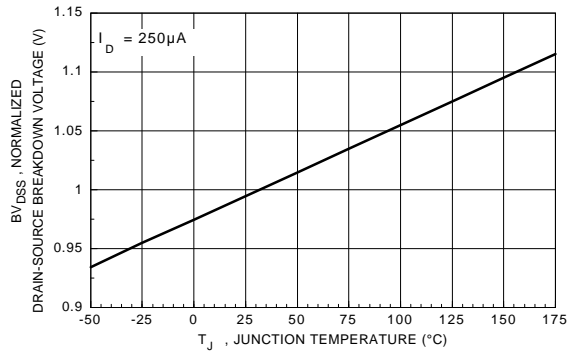


Figure 7. Breakdown Voltage Variation with Temperature.

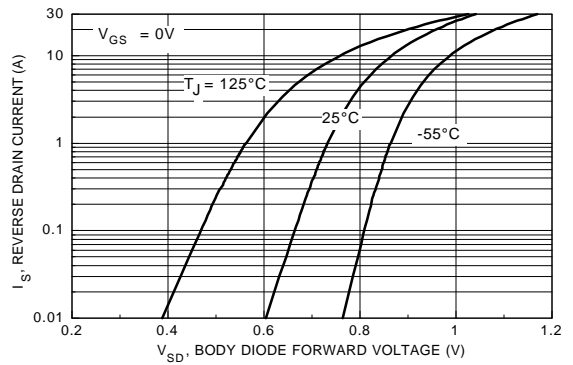


Figure 8. Body Diode Forward Voltage Variation with Current and Temperature.

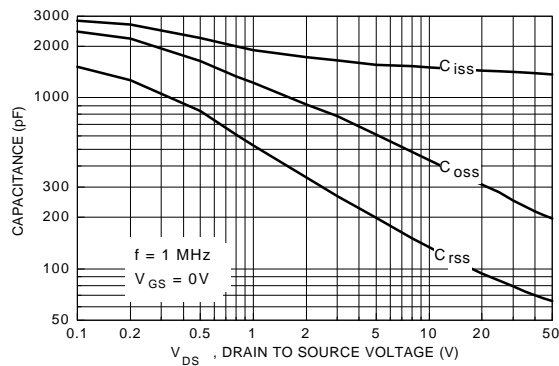


Figure 9. Capacitance Characteristics.

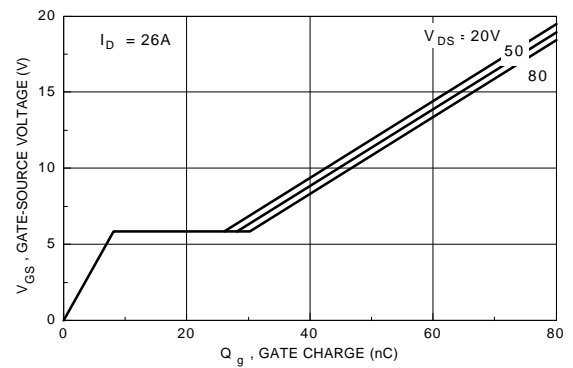


Figure 10. Gate Charge Characteristics.

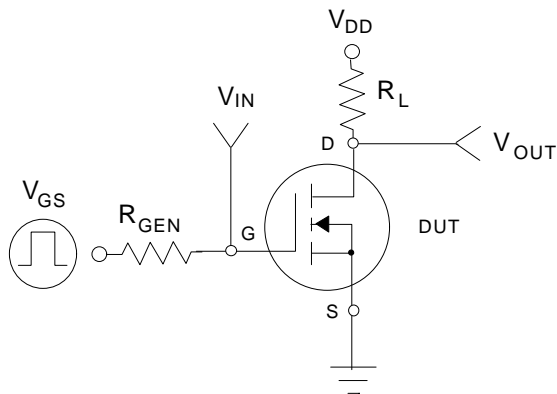


Figure 36. Switching Test Circuit.

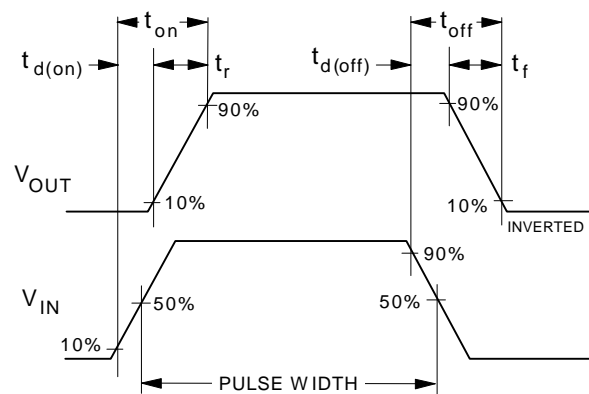


Figure 12. Switching Waveforms.

Typical Electrical Characteristics (continued)

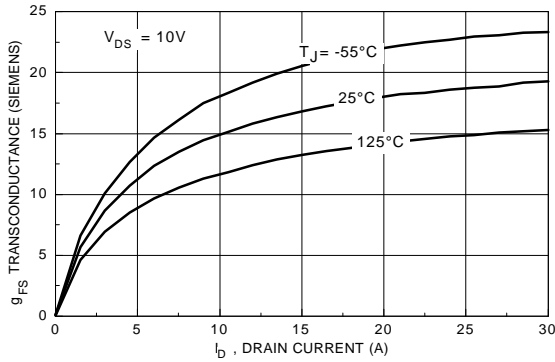


Figure 13. Transconductance Variation with Drain Current and Temperature.

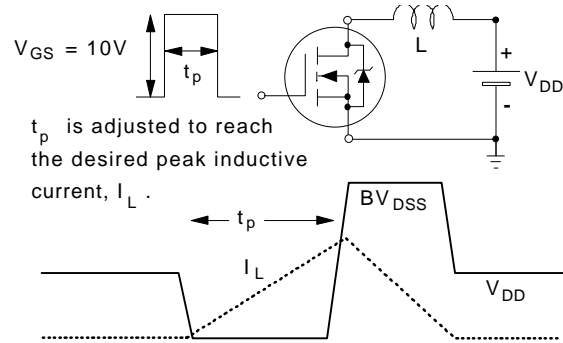


Figure 14. Unclamped Inductive Load Circuit and Waveforms.

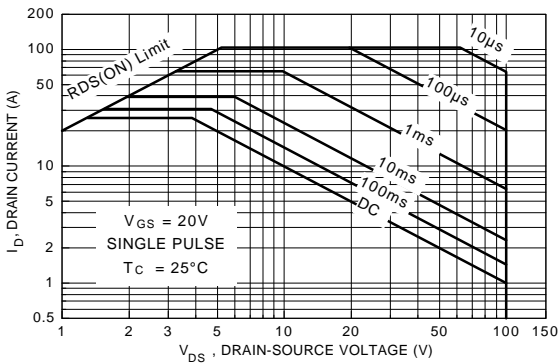


Figure 15. Maximum Safe Operating Area.

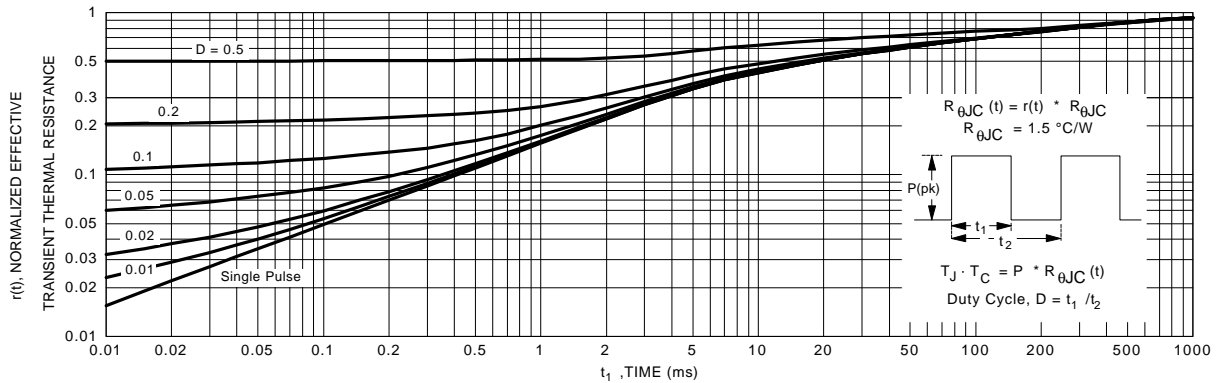


Figure 16. Transient Thermal Response Curve.