**FAIRCHILD**

SEMICONDUCTOR ™

# NDP7050L / NDB7050L
# N-Channel Logic Level Enhancement Mode Field Effect Transistor

## General Description

These logic level 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

- 75A, 50V, $R_{DS(ON)} = 0.015\Omega$ @ $V_{GS} = 5V$

- Low drive requirements allowing operation directly from logic drivers. $V_{GS(TH)} < 2.0V$.

- 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$^2$PAK) package for both through hole and surface mount applications.



TO-220
NDP Series

TO-263AB
FDB Series
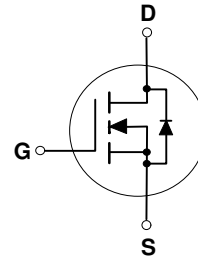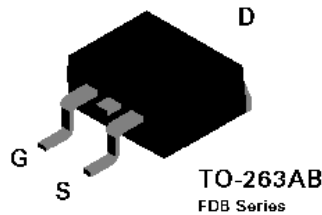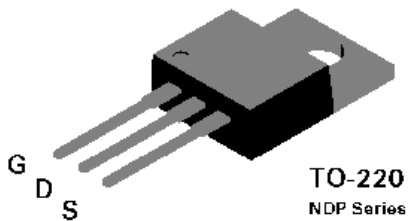
## Absolute Maximum Ratings     $T_C = 25°C$ unless otherwise noted

| Symbol | Parameter | NDP7050L | NDB7050L | Units |
|--------|-----------|----------|----------|-------|
| $V_{DSS}$ | Drain-Source Voltage | 50 | | V |
| $V_{DGR}$ | Drain-Gate Voltage ($R_{GS} \leq 1 M\Omega$) | 50 | | V |
| $V_{GSS}$ | Gate-Source Voltage - Continuous | $\pm 20$ | | V |
| | - Nonrepetitive ($t_p < 50 \mu s$) | $\pm 40$ | | |
| $I_D$ | Drain Current     - Continuous | 75 | | A |
| | - Pulsed | 225 | | |
| $P_D$ | Total Power Dissipation @ $T_C = 25°C$ | 150 | | W |
| | Derate above 25°C | 1 | | W/°C |
| $T_J, T_{STG}$ | Operating and Storage Temperature Range | -65 to 175 | | °C |

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

| Symbol | Parameter | Conditions | | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| **DRAIN-SOURCE AVALANCHE RATINGS** (Note 1) | | | | | | | |
| $W_{DSS}$ | Single Pulse Drain-Source Avalanche Energy | $V_{DD} = 25$ V, $I_D = 75$ A | | | | 550 | mJ |
| $I_{AR}$ | Maximum Drain-Source Avalanche Current | | | | | 75 | A |
| **OFF CHARACTERISTICS** | | | | | | | |
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $V_{GS} = 0$ V, $I_D = 250$ µA | | 50 | | | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS} = 50$ V, $V_{GS} = 0$ V | | | | 250 | µA |
| | | | $T_J = 125°C$ | | | 1 | mA |
| $I_{GSSF}$ | Gate - Body Leakage, Forward | $V_{GS} = 20$ V, $V_{DS} = 0$ V | | | | 100 | nA |
| $I_{GSSR}$ | Gate - Body Leakage, Reverse | $V_{GS} = -20$ V, $V_{DS} = 0$ V | | | | -100 | nA |
| **ON CHARACTERISTICS** (Note 1) | | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS} = V_{GS}$, $I_D = 250$ µA | | 1 | 1.3 | 2 | V |
| | | | $T_J = 125°C$ | 0.65 | 0.8 | 1.5 | |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance | $V_{GS} = 5$ V, $I_D = 37.5$ A | | | 0.01 | 0.015 | Ω |
| | | | $T_J = 125°C$ | | 0.016 | 0.024 | |
| $I_{D(on)}$ | On-State Drain Current | $V_{GS} = 5$ V, $V_{DS} = 10$ V | | 75 | | | A |
| $g_{FS}$ | Forward Transconductance | $V_{DS} = 10$ V, $I_D = 37.5$ A | | 15 | 67 | | S |
| **DYNAMIC CHARACTERISTICS** | | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS} = 25$ V, $V_{GS} = 0$ V, f = 1.0 MHz | | | 4200 | 4000 | pF |
| $C_{oss}$ | Output Capacitance | | | | 1100 | 1600 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | | 310 | 800 | pF |
| **SWITCHING CHARACTERISTICS** (Note 1) | | | | | | | |
| $t_{D(on)}$ | Turn - On Delay Time | $V_{DD} = 30$ V, $I_D = 75$ A, $V_{GS} = 5$ V, $R_{GEN} = 10$Ω $R_{GS} = 10$ Ω | | | 23 | 40 | nS |
| $t_r$ | Turn - On Rise Time | | | | 460 | 600 | nS |
| $t_{D(off)}$ | Turn - Off Delay Time | | | | 100 | 150 | nS |
| $t_f$ | Turn - Off Fall Time | | | | 270 | 400 | nS |
| $Q_g$ | Total Gate Charge | $V_{DS} = 48$ V, $I_D = 75$ A, $V_{GS} = 5$ V | | | 86 | 115 | nC |
| $Q_{gs}$ | Gate-Source Charge | | | | 13 | | nC |
| $Q_{gd}$ | Gate-Drain Charge | | | | 62 | | nC |

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

| Symbol | Parameter | Conditions | | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| **DRAIN-SOURCE DIODE CHARACTERISTICS** | | | | | | | |
| $I_S$ | Maximum Continuos Drain-Source Diode Forward Current | | | | | 75 | A |
| $I_{SM}$ | Maximum Pulsed Drain-Source Diode Forward Current | | | | | 225 | A |
| $V_{SD}$ | Drain-Source Diode Forward Voltage | $V_{GS}$ = 0 V, $I_S$ = 37.5 A (Note 1) | | | 0.92 | 1.3 | V |
| | | | $T_J$ = 125°C | | 0.85 | 1.2 | |
| $t_{rr}$ | Reverse Recovery Time | $V_{GS}$ = 0 V, $I_F$ = 60A, $dI_F/dt$ = 100 A/μs | | | 108 | 150 | ns |
| $I_{rr}$ | Reverse Recovery Current | | | | 4.6 | 10 | A |
| **THERMAL CHARACTERISTICS** | | | | | | | |
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case | | | | | 1 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | | | | | 62.5 | °C/W |

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

# Typical Electrical Characteristics
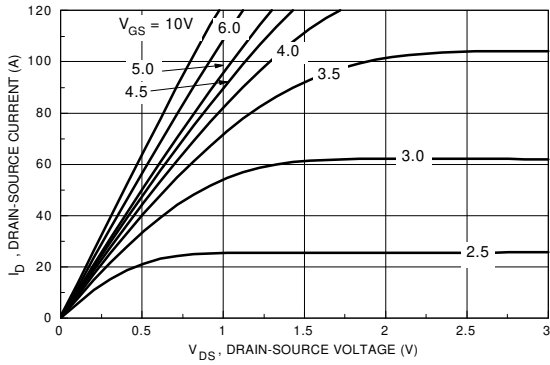


Figure 1. On-Region Characteristics
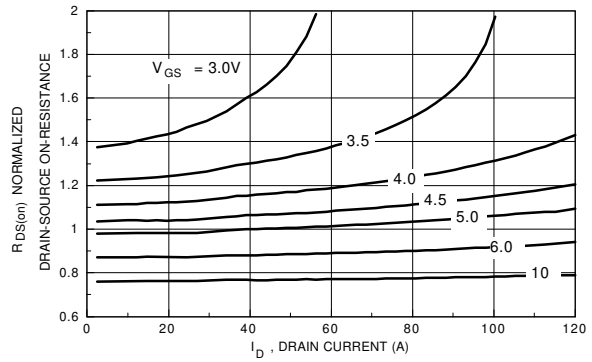


Figure 2. On-Resistance Variation with Gate Voltage and Drain Current
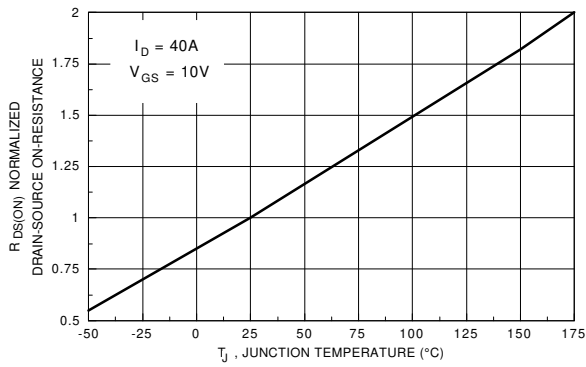


Figure 3. On-Resistance Variation with Temperature
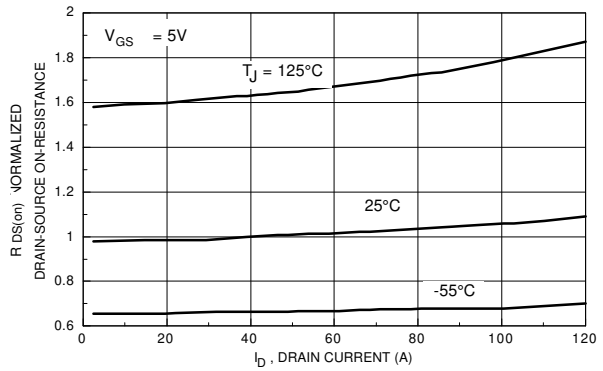


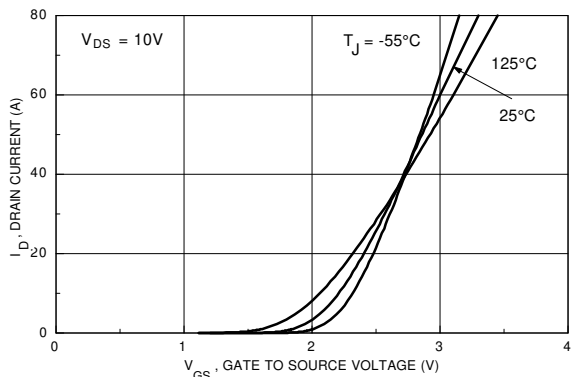Figure 4. On-Resistance Variation with Drain Current and Temperature
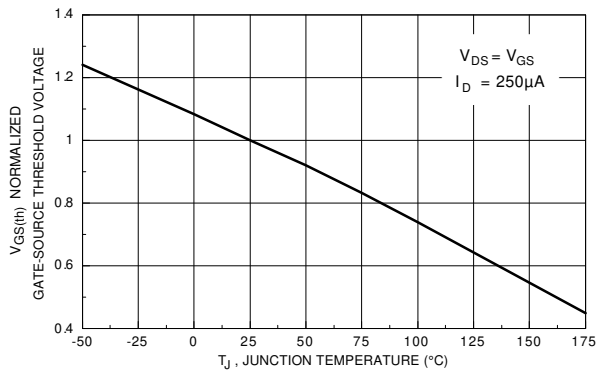


Figure 5. Transfer Characteristics



Figure 6. Gate Threshold Variation with Temperature

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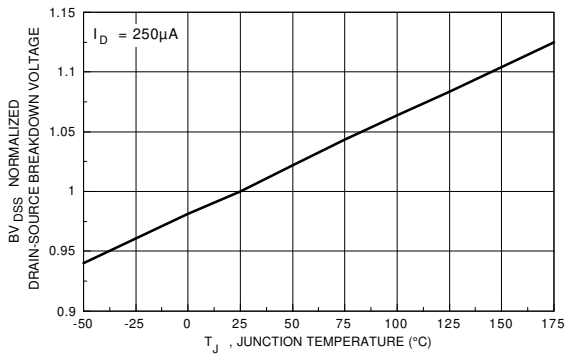## Typical Electrical Characteristics (continued)
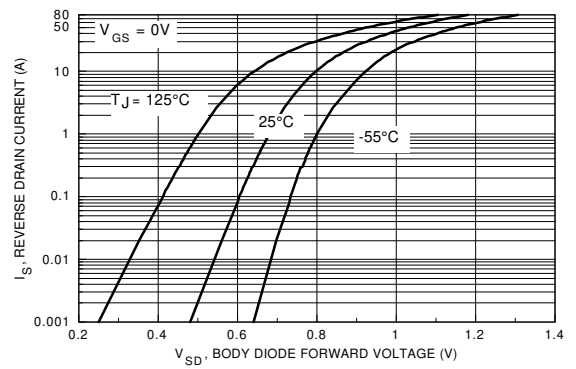


**Figure 7. Breakdown Voltage Variation with Temperature**



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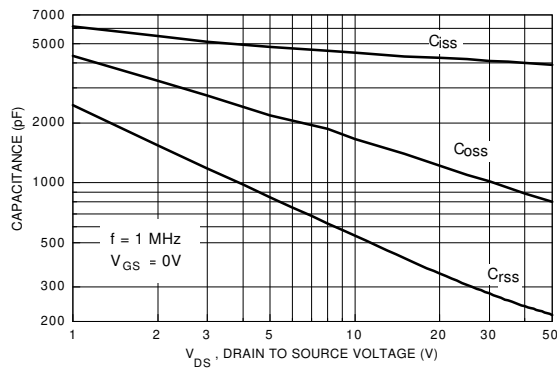


**Figure 9. Capacitance Characteristics**
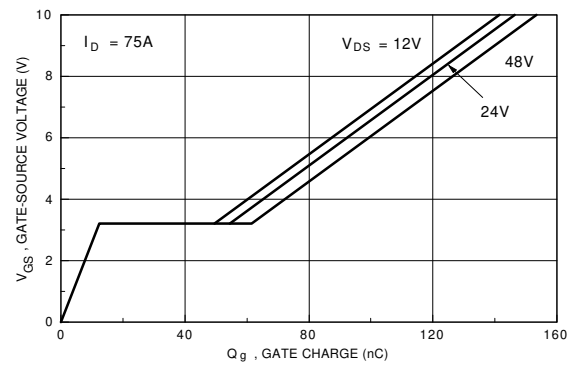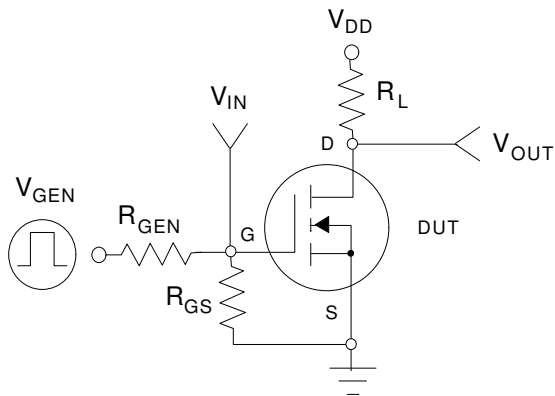


**Figure 10. Gate Charge Characteristics**



**Figure 11. Switching Test Circuit**
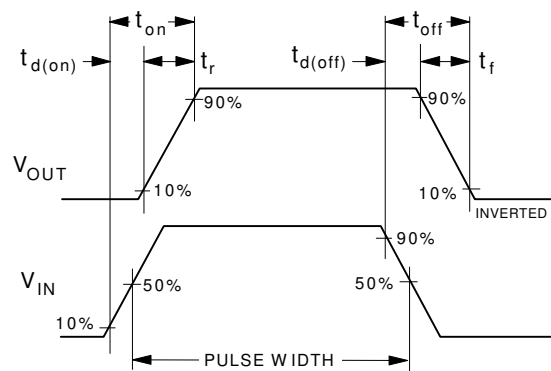


**Figure 12. Switching Waveforms**

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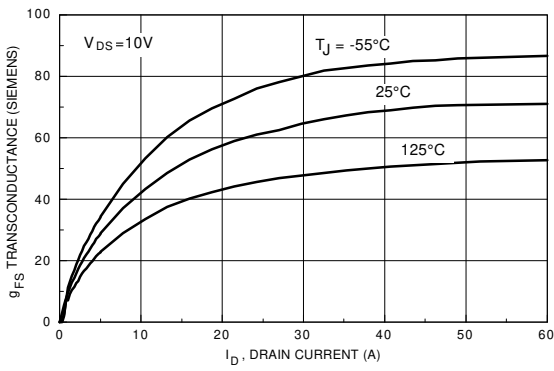## Typical Electrical Characteristics (continued)

Figure 13. Transconductance Variation with Drain Current and Temperature
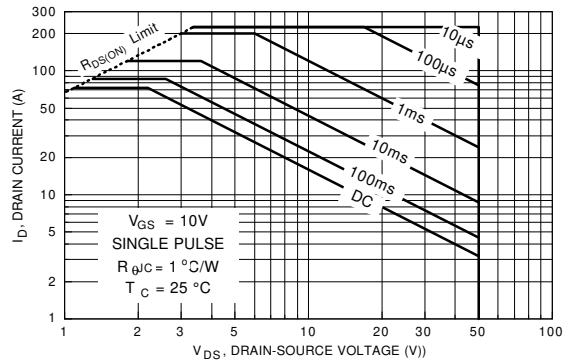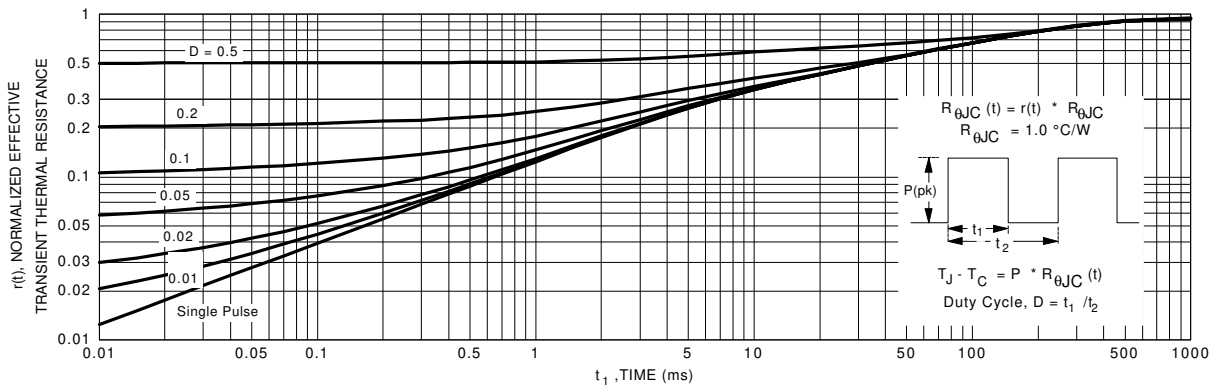
Figure 14. Maximum Safe Operating Area

Figure 15. Transient Thermal Response Curve