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May 1996

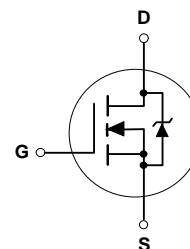
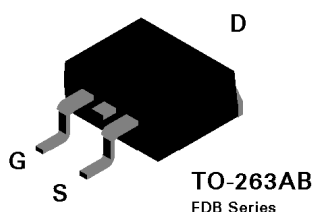
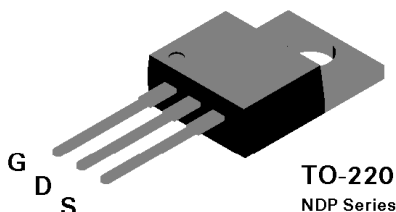
## NDP7060 / NDB7060 N-Channel Enhancement Mode Field Effect Transistor

### 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 is 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, 60V.  $R_{DS(ON)} = 0.013\Omega @ V_{GS}=10V$ .
- 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.



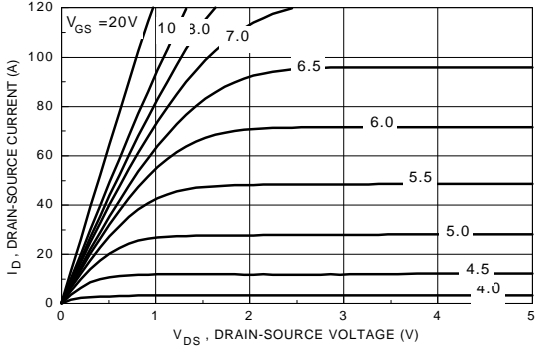
### Absolute Maximum Ratings T<sub>c</sub> = 25°C unless otherwise noted

| Symbol                            | Parameter  | NDP7060 | NDB7060    | Units |
|-----------------------------------|--|---------|------------|-------|
| V <sub>DSS</sub>                  | Drain-Source Voltage   |         | 60         | V     |
| V <sub>DGR</sub>                  | Drain-Gate Voltage (R <sub>GS</sub> ≤ 1 MΩ)                                      |         | 60         | V     |
| V <sub>GSS</sub>                  | Gate-Source Voltage - Continuous<br>- Nonrepetitive (t <sub>p</sub> < 50 μs)     |         | ± 20       | V     |
|                                   |  |         | ± 40       |       |
| I <sub>D</sub>                    | Drain Current - Continuous<br>- Pulsed   |         | 75         | A     |
|                                   |  |         | 225        |       |
| P <sub>D</sub>                    | Maximum Power Dissipation @ T <sub>c</sub> = 25°C<br>Derate above 25°C           |         | 150        | W     |
|                                   |  |         | 1          |       |
| 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,<br>1/8" from case for 5 seconds |         | 275        | °C    |

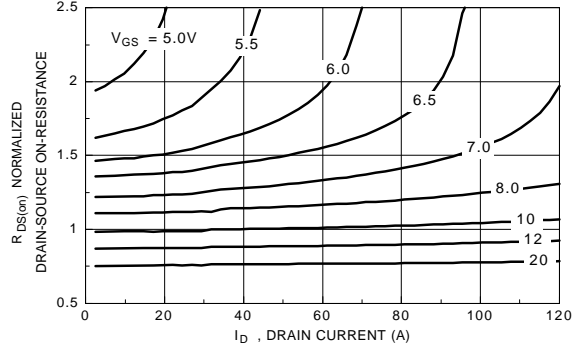
| <b>Electrical Characteristics</b> ( $T_C = 25^\circ\text{C}$ unless otherwise noted) |  |   |                           |      |       |               |
|--|--|---|---------------------------|------|-------|---------------|
| Symbol   | Parameter                                  | Conditions  | Min                       | Typ  | Max   | Units         |
| <b>DRAIN-SOURCE AVALANCHE RATINGS</b> (Note 1)                                       |  |   |                           |      |       |               |
| $W_{DSS}$  | Single Pulse Drain-Source Avalanche Energy | $V_{DD} = 25\text{ V}, I_D = 75\text{ A}$   |                           |      | 550   | mJ            |
| $I_{AR}$   | Maximum Drain-Source Avalanche Current     |   |                           |      | 75    | A             |
| <b>OFF CHARACTERISTICS</b>   |  |   |                           |      |       |               |
| $BV_{DSS}$   | Drain-Source Breakdown Voltage             | $V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$   | 60                        |      |       | V             |
| $I_{DSS}$  | Zero Gate Voltage Drain Current            | $V_{DS} = 60\text{ V}, V_{GS} = 0\text{ V}$   |                           |      | 250   | $\mu\text{A}$ |
|  |  |   | $T_J = 125^\circ\text{C}$ |      |       | 1             |
| $I_{GSSF}$   | 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                         | 2.8  | 4     | V             |
|  |  |   | $T_J = 125^\circ\text{C}$ | 1.4  | 2.1   |               |
| $R_{DS(on)}$   | Static Drain-Source On-Resistance          | $V_{GS} = 10\text{ V}, I_D = 40\text{ A}$   |                           | 0.01 | 0.013 | $\Omega$      |
|  |  |   | $T_J = 125^\circ\text{C}$ |      | 0.015 |               |
| $I_{D(on)}$  | On-State Drain Current                     | $V_{GS} = 10\text{ V}, V_{DS} = 10\text{ V}$  | 75                        |      |       | A             |
| $g_{FS}$   | Forward Transconductance                   | $V_{DS} = 10\text{ V}, I_D = 37.5\text{ A}$   | 15                        | 39   |       | S             |
| <b>DYNAMIC CHARACTERISTICS</b>   |  |   |                           |      |       |               |
| $C_{iss}$  | Input Capacitance                          | $V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$<br>$f = 1.0\text{ MHz}$                      |                           | 2960 | 3600  | pF            |
| $C_{oss}$  | Output Capacitance                         |   |                           | 1130 | 1600  |               |
| $C_{rss}$  | Reverse Transfer Capacitance               |   |                           | 380  | 800   |               |
| <b>SWITCHING CHARACTERISTICS</b> (Note 1)  |  |   |                           |      |       |               |
| $t_{D(on)}$  | Turn - On Delay Time                       | $V_{DD} = 30\text{ V}, I_D = 75\text{ A},$<br>$V_{GS} = 10\text{ V}, R_{GEN} = 5\ \Omega$ |                           | 17   | 30    | nS            |
| $t_r$  | Turn - On Rise Time                        |   |                           | 128  | 400   |               |
| $t_{D(off)}$   | Turn - Off Delay Time                      |   |                           | 54   | 80    |               |
| $t_f$  | Turn - Off Fall Time                       |   |                           | 90   | 200   |               |
| $Q_g$  | Total Gate Charge                          | $V_{DS} = 48\text{ V},$<br>$I_D = 75\text{ A}, V_{GS} = 10\text{ V}$                      |                           | 100  | 115   | nC            |
| $Q_{gs}$   | Gate-Source Charge                         |   |                           | 14.5 |       |               |
| $Q_{gd}$   | Gate-Drain Charge                          |   |                           | 51   |       |               |

| <b>Electrical Characteristics</b> (T <sub>C</sub> = 25°C unless otherwise noted) |   |  |                        |      |      |       |
|--|---|--|------------------------|------|------|-------|
| Symbol   | Parameter   | Conditions   | Min                    | Typ  | Max  | Units |
| <b>DRAIN-SOURCE DIODE CHARACTERISTICS</b>  |   |  |                        |      |      |       |
| I <sub>S</sub>   | Maximum Continuous Drain-Source Diode Forward Current |  |                        |      | 75   | A     |
| I <sub>SM</sub>  | Maximum Pulsed Drain-Source Diode Forward Current     |  |                        |      | 225  | A     |
| V <sub>SD</sub>  | Drain-Source Diode Forward Voltage                    | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 37.5 A (Note 1)                      |                        | 0.9  | 1.3  | V     |
|  |   |  | T <sub>J</sub> = 125°C | 0.84 | 1.2  |       |
| t <sub>rr</sub>  | Reverse Recovery Time                                 | V <sub>GS</sub> = 0 V, I <sub>F</sub> = 75 A, di <sub>F</sub> /dt = 100 A/μs | 40                     | 76   | 150  | ns    |
| I <sub>rr</sub>  | Reverse Recovery Current                              |  | 2                      | 4.7  | 10   |       |
| <b>THERMAL CHARACTERISTICS</b>   |   |  |                        |      |      |       |
| R <sub>θJC</sub>   | Thermal Resistance, Junction-to-Case                  |  |                        |      | 1    | °C/W  |
| R <sub>θJA</sub>   | Thermal Resistance, Junction-to-Ambient               |  |                        |      | 62.5 | °C/W  |
| Note:<br>1. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.                 |   |  |                        |      |      |       |

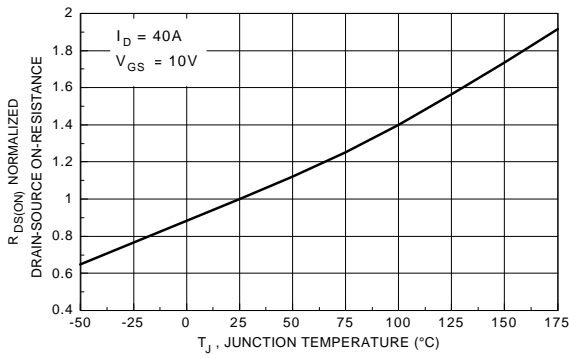
**Typical Electrical Characteristics**



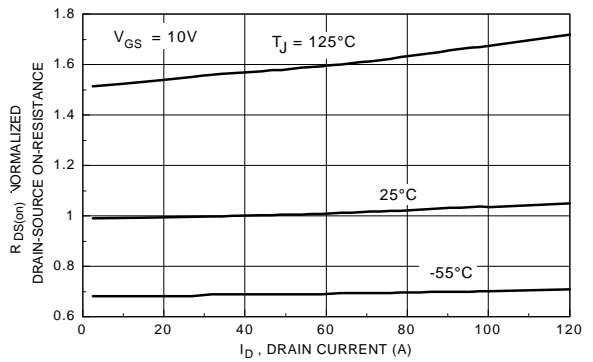
**Figure 1. On-Region Characteristics**



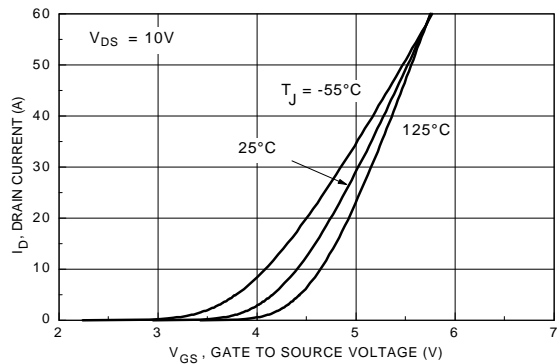
**Figure 2. On-Resistance Variation with Gate Voltage and Drain Current**



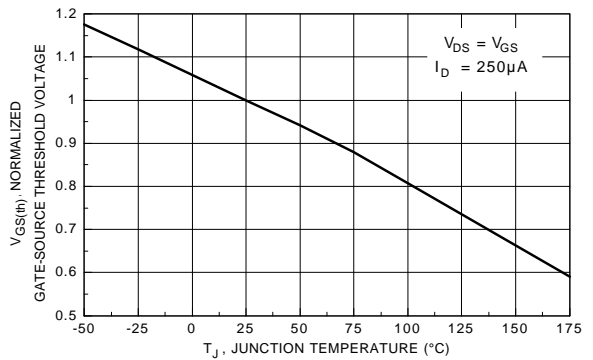
**Figure 3. On-Resistance Variation with Temperature**



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

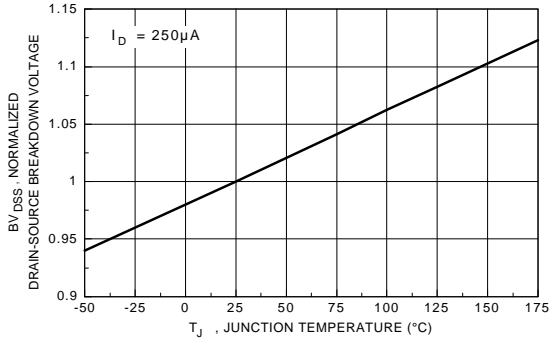


**Figure 5. Transfer Characteristics**

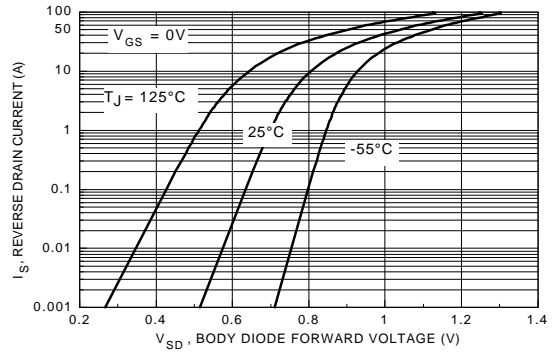


**Figure 6. Gate Threshold Variation with Temperature**

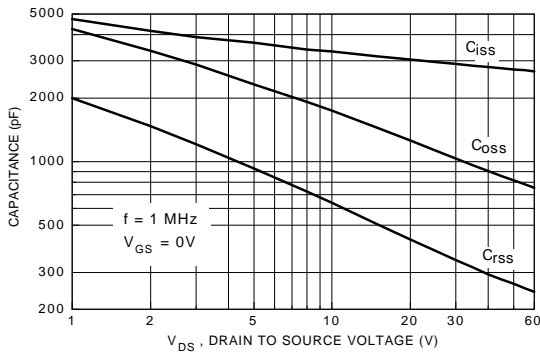
**Typical Electrical Characteristics (continued)**



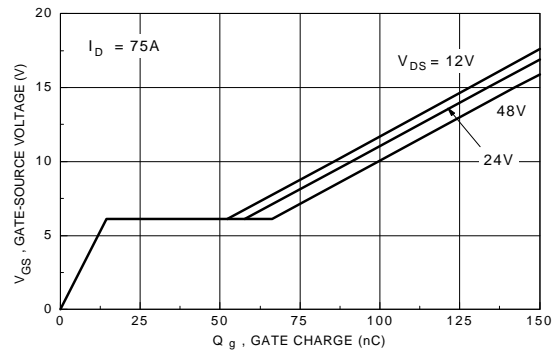
**Figure 7. Breakdown Voltage Variation with Temperature**



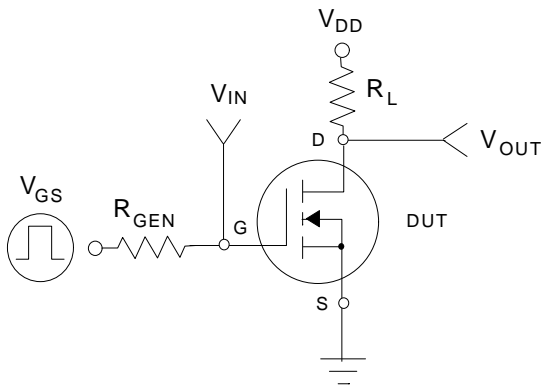
**Figure 8. Body Diode Forward Voltage Variation with Current and Temperature**



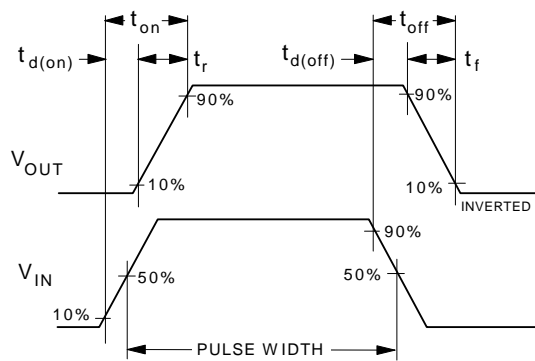
**Figure 9. Capacitance Characteristics**



**Figure 10. Gate Charge Characteristics**

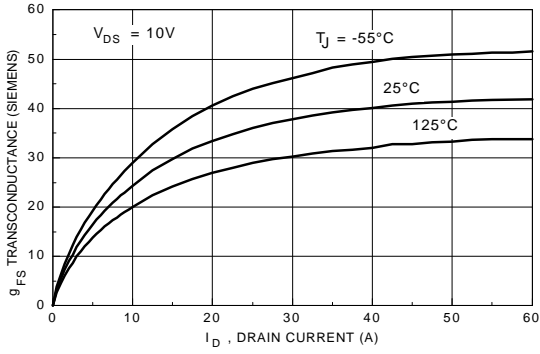


**Figure 11. Switching Test Circuit**

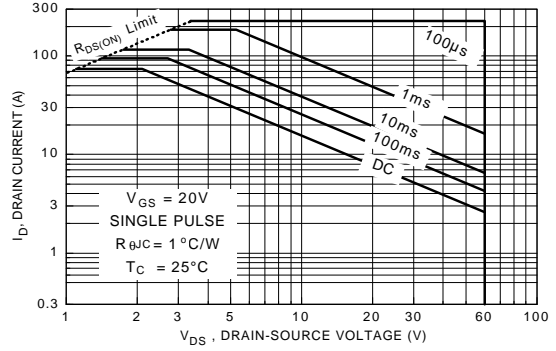


**Figure 12. Switching Waveforms**

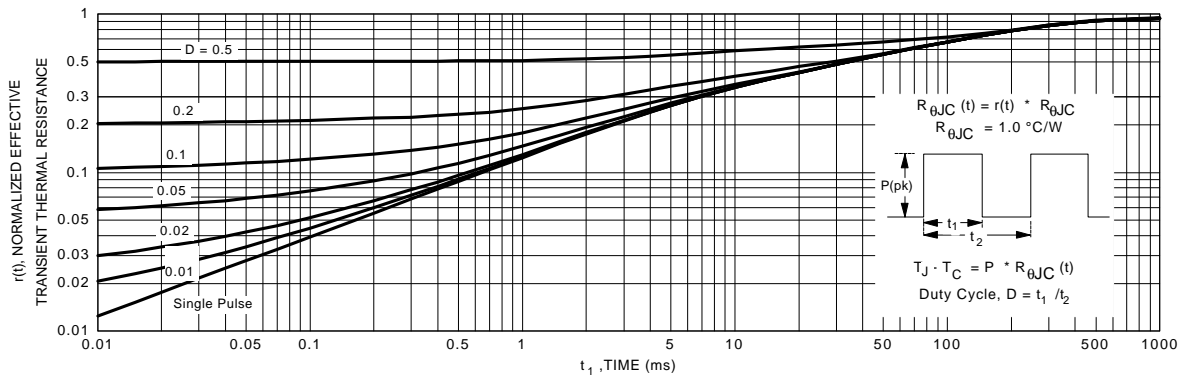
**Typical Electrical Characteristics (continued)**



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



**Figure 14. Maximum Safe Operating Area**



**Figure 15. Transient Thermal Response Curve**

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| FACT™                 | QFET™         |            |
| FACT Quiet Series™    | QS™           |            |
| FAST®                 | Quiet Series™ |            |
| FAST <sub>r</sub> ™   | SuperSOT™-3   |            |
| GTO™                  | SuperSOT™-6   |            |
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