

**NDF0610 / NDS0610**

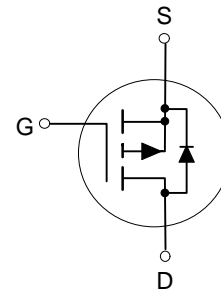
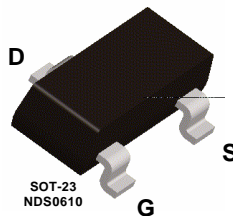
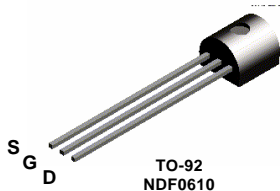
**P-Channel Enhancement Mode Field Effect Transistor**

**General Description**

These P-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 designed to minimize on-state resistance, provide rugged and reliable performance and fast switching. They can be used, with a minimum of effort, in most applications requiring up to 180mA DC and can deliver pulsed currents up to 1A. This product is particularly suited to low voltage applications requiring a low current high side switch.

**Features**

- -0.18 and -0.12A, -60V.  $R_{DS(ON)} = 10\Omega$
- Voltage controlled p-channel small signal switch
- High density cell design for low  $R_{DS(ON)}$
- TO-92 and SOT-23 packages for both through hole and surface mount applications
- High saturation current



**Absolute Maximum Ratings**

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

| Symbol         | Parameter   | NDF0610    | NDS0610  | Units |
|----------------|---|------------|----------|-------|
| $V_{DSS}$      | Drain-Source Voltage  | -60        | -60      | V     |
| $V_{DGR}$      | Drain-Gate Voltage ( $R_{GS} \leq 1\text{ M}\Omega$ )                                 | -60        | -60      | V     |
| $V_{GSS}$      | Gate-Source Voltage - Continuous<br>- Nonrepetitive ( $t_p < 50\ \mu\text{s}$ )       | $\pm 20$   | $\pm 20$ | V     |
|                |   | $\pm 30$   | $\pm 30$ | V     |
| $I_D$          | Drain Current - Continuous<br>- Pulsed  | -0.18      | -0.12    | A     |
|                |   | -1         | -1       | A     |
| $P_D$          | Maximum Power Dissipation $T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | 0.8        | 0.36     | W     |
|                |   | 5          | 2.9      | mW/°C |
| $T_J, T_{STG}$ | Operating and Storage Temperature Range   | -55 to 150 |          | °C    |
| $T_L$          | Maximum lead temperature for soldering purposes,<br>1/16" from case for 10 seconds    | 300        |          | °C    |

**THERMAL CHARACTERISTICS**

| Symbol          | Parameter                               | NDF0610 | NDS0610 | Units |
|-----------------|---|---------|---------|-------|
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | 200     | 350     | °C/W  |

**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

| Symbol                                    | Parameter                             | Conditions  | Min  | Typ   | Max   | Units         |
|---|---------------------------------------|---|------|-------|-------|---------------|
| <b>OFF CHARACTERISTICS</b>                |                                       |   |      |       |       |               |
| $BV_{DSS}$                                | Drain-Source Breakdown Voltage        | $V_{GS} = 0\text{ V}, I_D = -10\ \mu\text{A}$   | -60  |       |       | V             |
| $I_{DSS}$                                 | Zero Gate Voltage Drain Current       | $V_{DS} = -48\text{ V}, V_{GS} = 0\text{ V}$  |      |       | -1    | $\mu\text{A}$ |
|   |                                       | $T_J = 125^\circ\text{C}$   |      |       | -200  | $\mu\text{A}$ |
| $I_{GSSF}$                                | Gate - Body Leakage, Forward          | $V_{GS} = 20\text{ V}, V_{DS} = 0\text{ V}$   |      |       | 10    | nA            |
| $I_{GSSR}$                                | Gate - Body Leakage, Reverse          | $V_{GS} = -20\text{ V}, V_{DS} = 0\text{ V}$  |      |       | -10   | nA            |
| <b>ON CHARACTERISTICS</b> (Note 1)        |                                       |   |      |       |       |               |
| $V_{GS(th)}$                              | Gate Threshold Voltage                | $V_{DS} = V_{GS}, I_D = -1\text{ mA}$   | -1   | -2.4  | -3.5  | V             |
|   |                                       | $T_J = 125^\circ\text{C}$   | -0.6 | -2.1  | -3.2  |               |
| $R_{DS(on)}$                              | Static Drain-Source On-Resistance     | $V_{GS} = -10\text{ V}, I_D = -0.5\text{ A}$  |      | 3.6   | 10    | $\Omega$      |
|   |                                       | $T_J = 125^\circ\text{C}$   |      | 5.9   | 16    |               |
|   |                                       | $V_{GS} = -4.5\text{ V}, I_D = -0.25\text{ A}$  |      | 5.2   | 20    |               |
|   |                                       | $T_J = 125^\circ\text{C}$   |      | 7.9   | 30    |               |
| $I_{D(on)}$                               | On-State Drain Current                | $V_{GS} = -10\text{ V}, V_{DS} = -10\text{ V}$  | -0.6 | -1.6  |       | A             |
|   |                                       | $V_{GS} = -4.5\text{ V}, V_{DS} = -10\text{ V}$   |      | -0.35 |       |               |
| $g_{FS}$                                  | Forward Transconductance              | $V_{DS} = -10\text{ V}, I_D = -0.1\text{ A}$  | 70   | 170   |       | mS            |
| <b>DYNAMIC CHARACTERISTICS</b>            |                                       |   |      |       |       |               |
| $C_{ISS}$                                 | Input Capacitance                     | $V_{DS} = -25\text{ V}, V_{GS} = 0\text{ V},$<br>$f = 1.0\text{ MHz}$                           |      | 40    | 60    | pF            |
| $C_{OSS}$                                 | Output Capacitance                    |   |      | 11    | 25    | pF            |
| $C_{RSS}$                                 | Reverse Transfer Capacitance          |   |      | 3.2   | 5     | pF            |
| <b>SWITCHING CHARACTERISTICS</b> (Note 1) |                                       |   |      |       |       |               |
| $t_{D(on)}$                               | Turn - On Delay Time                  | $V_{DD} = -25\text{ V}, I_D = -0.18\text{ A},$<br>$V_{GS} = -10\text{ V}, R_{GEN} = 25\ \Omega$ |      | 7     | 10    | nS            |
| $t_r$                                     | Turn - On Rise Time                   |   |      | 5     | 15    | nS            |
| $t_{D(off)}$                              | Turn - Off Delay Time                 |   |      | 13    | 15    | nS            |
| $t_f$                                     | Turn - Off Fall Time                  |   |      | 10    | 20    | nS            |
| $Q_g$                                     | Total Gate Charge                     | $V_{DS} = -48\text{ V},$<br>$I_D = -0.5\text{ A}, V_{GS} = -10\text{ V}$                        |      | 1.43  |       | nC            |
| $Q_{gs}$                                  | Gate-Source Charge                    |   |      | 0.6   |       | nC            |
| $Q_{gd}$                                  | Gate-Drain Charge                     |   |      | 0.25  |       | nC            |
| <b>DRAIN-SOURCE DIODE CHARACTERISTICS</b> |                                       |   |      |       |       |               |
| $I_S$                                     | Maximum Continuous Source Current     |   |      |       | -0.18 | A             |
| $I_{SM}$                                  | Maximum Pulse Source Current (Note 1) |   |      |       | -1    | A             |
| $V_{SD}$                                  | Drain-Source Diode Forward Voltage    | $V_{GS} = 0\text{ V}, I_S = -0.5\text{ A}$<br>(Note 1)  |      | -1.2  | -1.5  | V             |
|   |                                       | $T_J = 125^\circ\text{C}$   |      | -0.98 | -1.3  |               |
| $t_{rr}$                                  | Reverse Recovery Time                 | $V_{GS} = 0\text{ V}, I_S = -0.5\text{ A},$<br>$di_F/dt = 100\text{ A}/\mu\text{s}$             |      | 40    |       | ns            |
| $I_{rr}$                                  | Reverse Recovery Current              |   |      | 2.8   |       | A             |

Note:

 1. Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

## Typical Electrical Characteristics

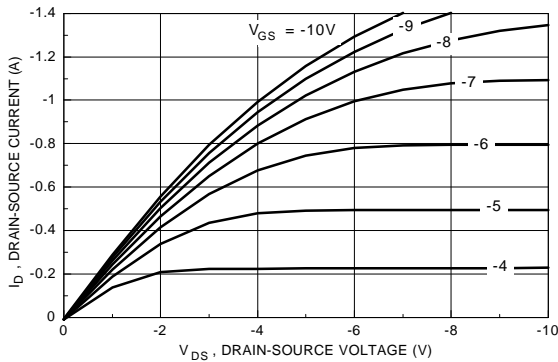


Figure 1. On-Region Characteristics

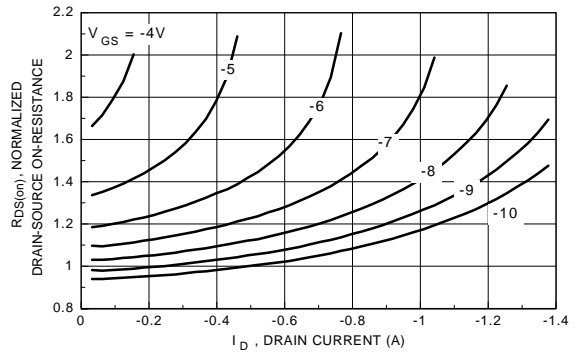


Figure 2. On-Resistance Variation with Gate Voltage and Drain Current

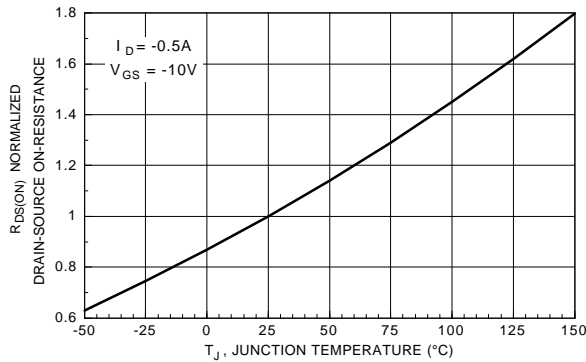


Figure 3. On-Resistance Variation with Temperature

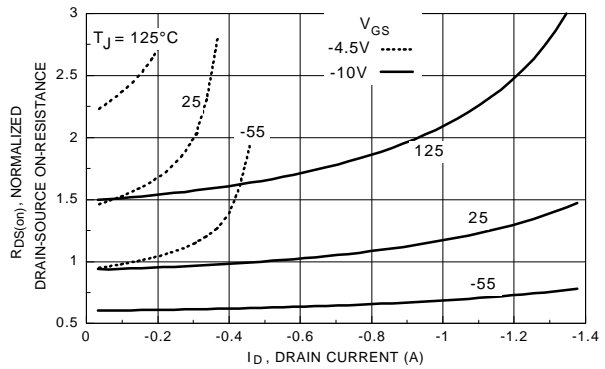


Figure 4. On-Resistance Variation with Drain Current and Temperature

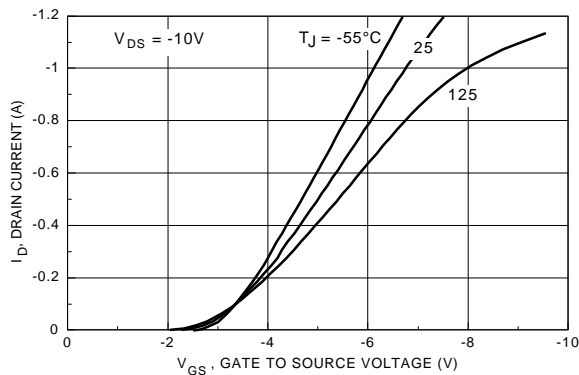


Figure 5. Transfer Characteristics

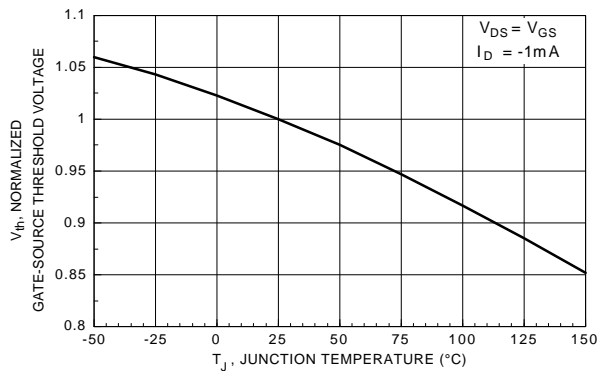
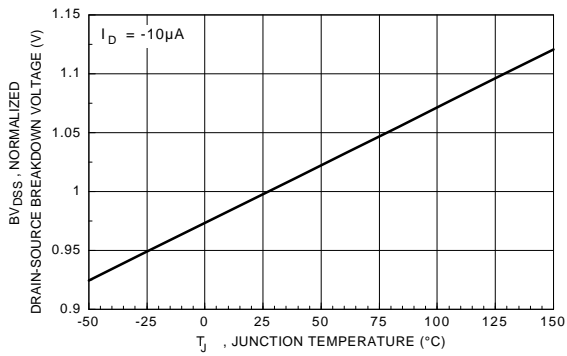
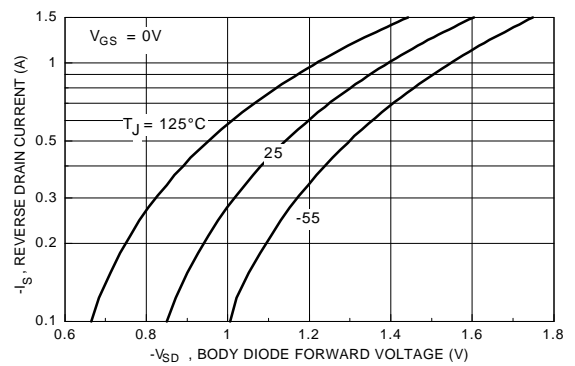


Figure 6. Gate Threshold Variation with Temperature

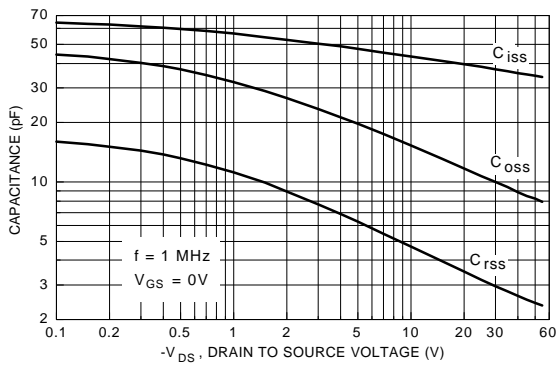
## Typical Electrical Characteristics (continued)



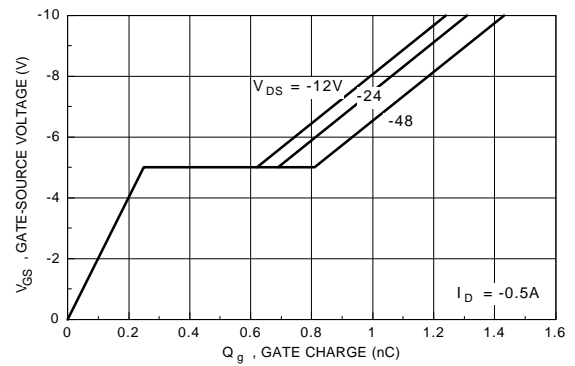
**Figure 7. Breakdown Voltage Variation with Temperature**



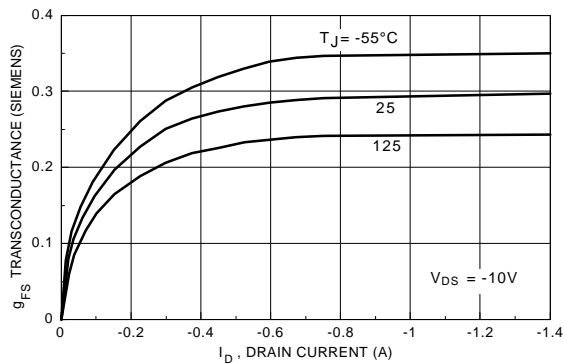
**Figure 8. Body Diode Forward Voltage Variation with Current and Temperature**



**Figure 9. Capacitance Characteristics**

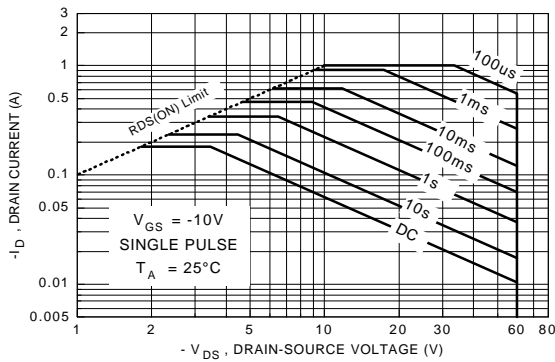


**Figure 10. Gate Charge Characteristics**

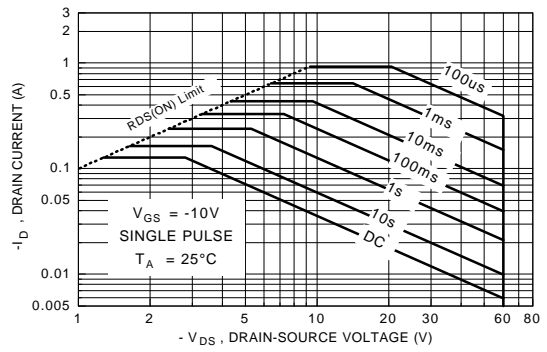


**Figure 11. Transconductance Variation with Drain Current and Temperature**

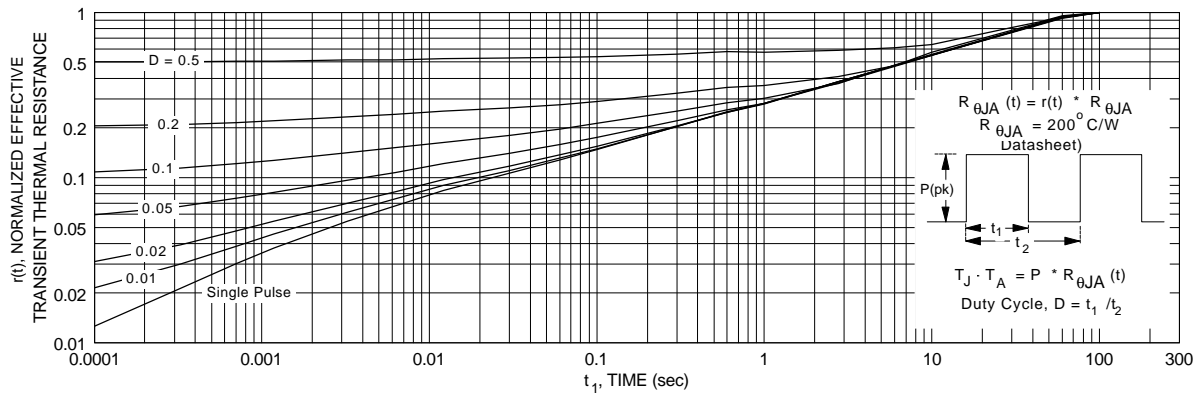
**Typical Electrical Characteristics (continued)**



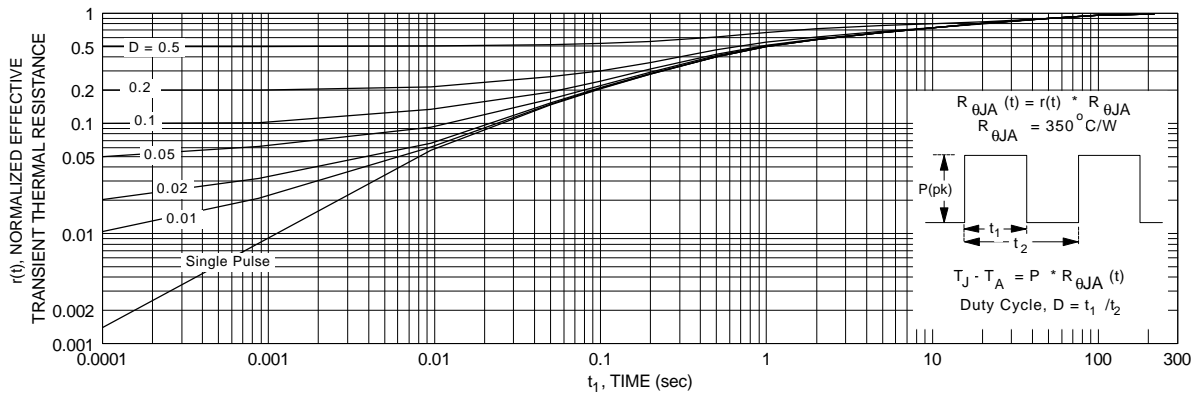
**Figure 12. NDF0610 (TO-92) Maximum Safe Operating Area**



**Figure 13. NDS0610 (SOT-23) Maximum Safe Operating Area**



**Figure 14. NDF0610 (TO-92) Transient Thermal Response Curve.**



**Figure 15. NDS0610 (SOT-23) Transient Thermal Response Curve.**