

## NDF0610 / NDS0610

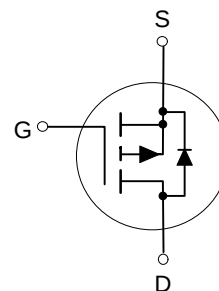
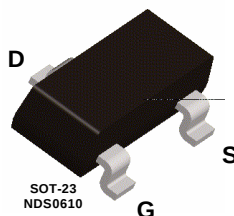
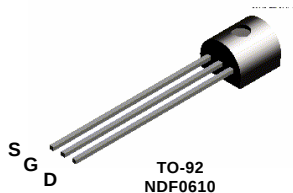
### P-Channel Enhancement Mode Field Effect Transistor

#### 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 ( $t_p < 50\text{ }\mu\text{s}$ ) | $\pm 20$   | $\pm 20$ | 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/ $^\circ\text{C}$ |
| $T_J, T_{STG}$ | Operating and Storage Temperature Range                                               | -55 to 150 |          | $^\circ\text{C}$     |
| $T_L$          | Maximum lead temperature for soldering purposes,<br>1/16" from case for 10 seconds    | 300        |          | $^\circ\text{C}$     |

#### THERMAL CHARACTERISTICS

|                 |                                         |     |     |                    |
|-----------------|-----------------------------------------|-----|-----|--------------------|
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | 200 | 350 | $^\circ\text{C/W}$ |
|-----------------|-----------------------------------------|-----|-----|--------------------|

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

| Symbol                             | Parameter                             | Conditions                                                                                          | Min  | Typ   | Max   | Units |
|------------------------------------|---------------------------------------|-----------------------------------------------------------------------------------------------------|------|-------|-------|-------|
| OFF CHARACTERISTICS                |                                       |                                                                                                     |      |       |       |       |
| BV <sub>DSS</sub>                  | Drain-Source Breakdown Voltage        | V <sub>GS</sub> = 0 V, I <sub>D</sub> = -10 μA                                                      | -60  |       |       | V     |
| I <sub>DSS</sub>                   | Zero Gate Voltage Drain Current       | V <sub>DS</sub> = -48 V, V <sub>GS</sub> = 0 V                                                      |      |       | -1    | μA    |
|                                    |                                       | T <sub>J</sub> = 125°C                                                                              |      |       | -200  | μA    |
| I <sub>GSSF</sub>                  | Gate - Body Leakage, Forward          | V <sub>GS</sub> = 20 V, V <sub>DS</sub> = 0 V                                                       |      |       | 10    | nA    |
| I <sub>GSSR</sub>                  | Gate - Body Leakage, Reverse          | V <sub>GS</sub> = -20 V, V <sub>DS</sub> = 0 V                                                      |      |       | -10   | nA    |
| ON CHARACTERISTICS (Note 1)        |                                       |                                                                                                     |      |       |       |       |
| V <sub>GS(th)</sub>                | Gate Threshold Voltage                | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -1 mA                                          | -1   | -2.4  | -3.5  | V     |
|                                    |                                       | T <sub>J</sub> = 125°C                                                                              | -0.6 | -2.1  | -3.2  |       |
| R <sub>DS(ON)</sub>                | Static Drain-Source On-Resistance     | V <sub>GS</sub> = -10 V, I <sub>D</sub> = -0.5 A                                                    |      | 3.6   | 10    | Ω     |
|                                    |                                       | T <sub>J</sub> = 125°C                                                                              |      | 5.9   | 16    |       |
|                                    |                                       | V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -0.25 A                                                  |      | 5.2   | 20    |       |
|                                    |                                       | T <sub>J</sub> = 125°C                                                                              |      | 7.9   | 30    |       |
| I <sub>D(on)</sub>                 | On-State Drain Current                | V <sub>GS</sub> = -10 V, V <sub>DS</sub> = -10 V                                                    | -0.6 | -1.6  |       | A     |
|                                    |                                       | V <sub>GS</sub> = -4.5 V, V <sub>DS</sub> = -10 V                                                   |      | -0.35 |       |       |
| g <sub>FS</sub>                    | Forward Transconductance              | V <sub>DS</sub> = -10 V, I <sub>D</sub> = -0.1 A                                                    | 70   | 170   |       | mS    |
| DYNAMIC CHARACTERISTICS            |                                       |                                                                                                     |      |       |       |       |
| C <sub>ISS</sub>                   | Input Capacitance                     | V <sub>DS</sub> = -25 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz                                         |      | 40    | 60    | pF    |
| C <sub>OSS</sub>                   | Output Capacitance                    |                                                                                                     |      | 11    | 25    | pF    |
| C <sub>RSS</sub>                   | Reverse Transfer Capacitance          |                                                                                                     |      | 3.2   | 5     | pF    |
| SWITCHING CHARACTERISTICS (Note 1) |                                       |                                                                                                     |      |       |       |       |
| t <sub>D(on)</sub>                 | Turn - On Delay Time                  | V <sub>DD</sub> = -25 V, I <sub>D</sub> = -0.18 A, V <sub>GS</sub> = -10 V, R <sub>GEN</sub> = 25 Ω |      | 7     | 10    | nS    |
| t <sub>r</sub>                     | Turn - On Rise Time                   |                                                                                                     |      | 5     | 15    | nS    |
| t <sub>D(off)</sub>                | Turn - Off Delay Time                 |                                                                                                     |      | 13    | 15    | nS    |
| t <sub>f</sub>                     | Turn - Off Fall Time                  |                                                                                                     |      | 10    | 20    | nS    |
| Q <sub>g</sub>                     | Total Gate Charge                     | V <sub>DS</sub> = -48 V, I <sub>D</sub> = -0.5 A, V <sub>GS</sub> = -10 V                           |      | 1.43  |       | nC    |
| Q <sub>gs</sub>                    | Gate-Source Charge                    |                                                                                                     |      | 0.6   |       | nC    |
| Q <sub>gd</sub>                    | Gate-Drain Charge                     |                                                                                                     |      | 0.25  |       | nC    |
| DRAIN-SOURCE DIODE CHARACTERISTICS |                                       |                                                                                                     |      |       |       |       |
| I <sub>S</sub>                     | Maximum Continuous Source Current     |                                                                                                     |      |       | -0.18 | A     |
| I <sub>SM</sub>                    | Maximum Pulse Source Current (Note 1) |                                                                                                     |      |       | -1    | A     |
| V <sub>SD</sub>                    | Drain-Source Diode Forward Voltage    | V <sub>GS</sub> = 0 V, I <sub>S</sub> = -0.5 A (Note 1)                                             |      | -1.2  | -1.5  | V     |
|                                    |                                       | T <sub>J</sub> = 125°C                                                                              |      | -0.98 | -1.3  |       |
| t <sub>rr</sub>                    | Reverse Recovery Time                 | V <sub>GS</sub> = 0 V, I <sub>S</sub> = -0.5 A, di <sub>F</sub> /dt = 100 A/μs                      |      | 40    |       | ns    |
| I <sub>rr</sub>                    | Reverse Recovery Current              |                                                                                                     |      | 2.8   |       | A     |

Note:

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

## Typical Electrical Characteristics

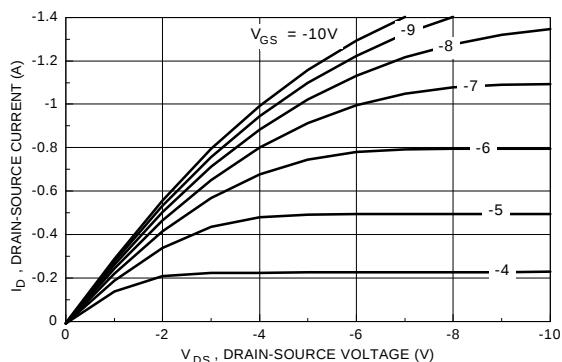


Figure 1. On-Region Characteristics

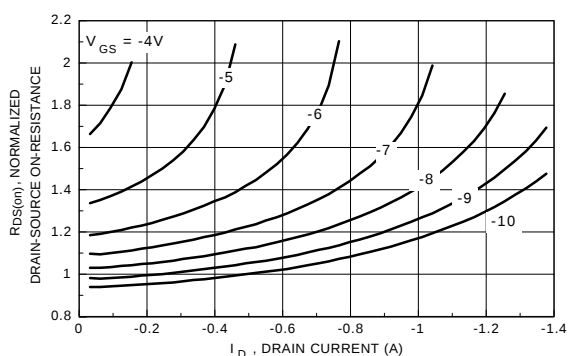


Figure 2. On-Resistance Variation with Gate Voltage and Drain Current

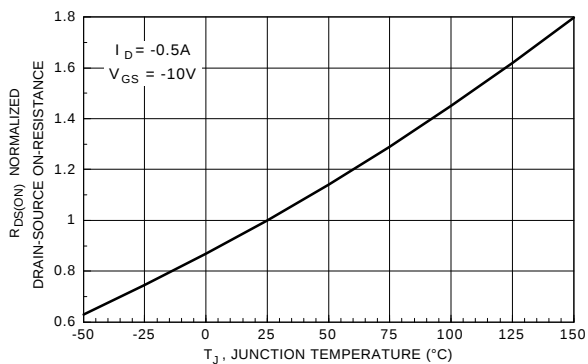


Figure 3. On-Resistance Variation with Temperature

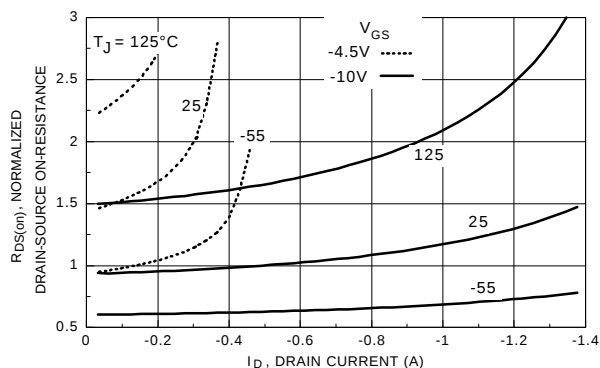


Figure 4. On-Resistance Variation with Drain Current and Temperature

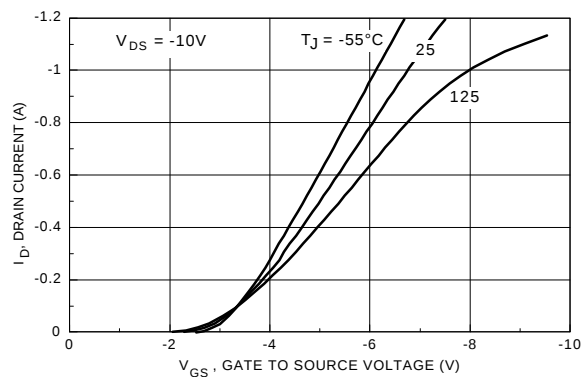


Figure 5. Transfer Characteristics

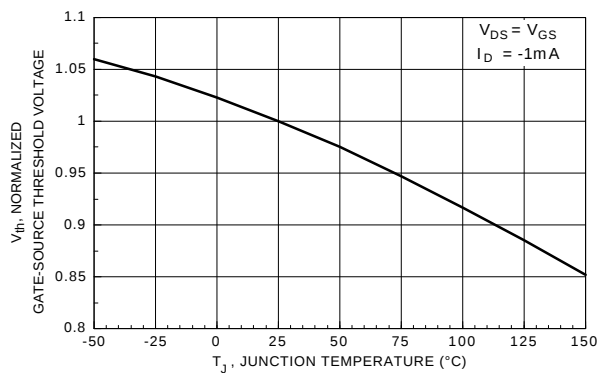
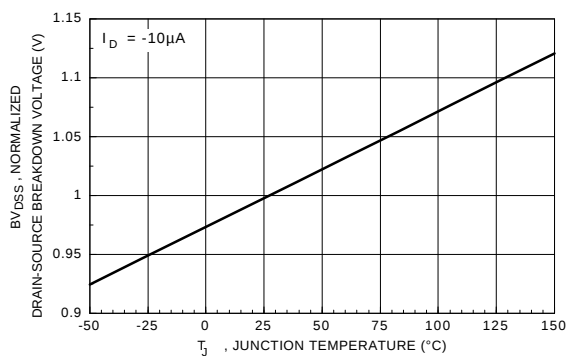
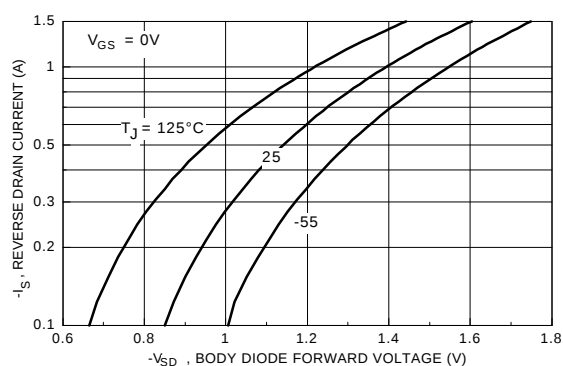


Figure 6. Gate Threshold Variation with Temperature

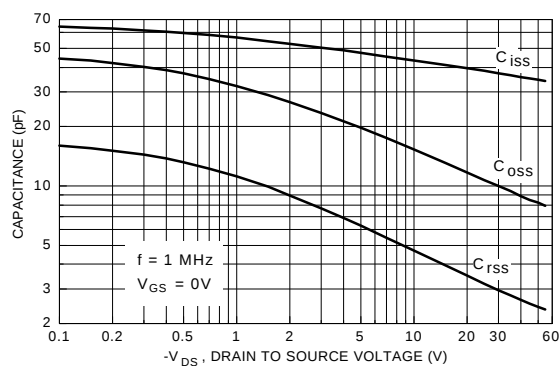
## Typical Electrical Characteristics (continued)



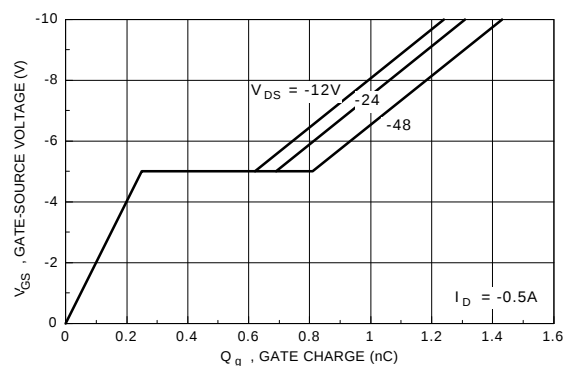
**Figure 7. Breakdown Voltage Variation with Temperature**



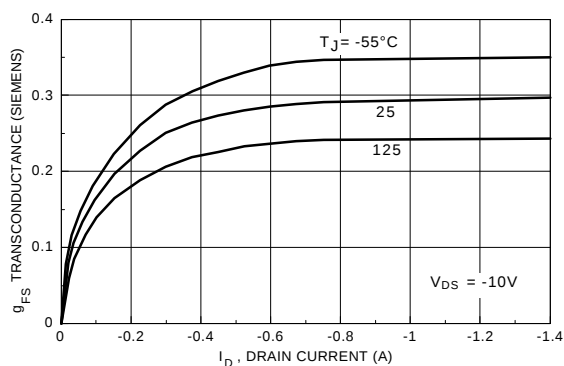
**Figure 8. Body Diode Forward Voltage Variation with Current and Temperature**



**Figure 9. Capacitance Characteristics**

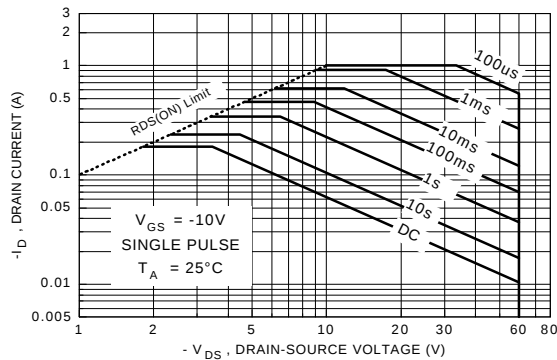


**Figure 10. Gate Charge Characteristics**

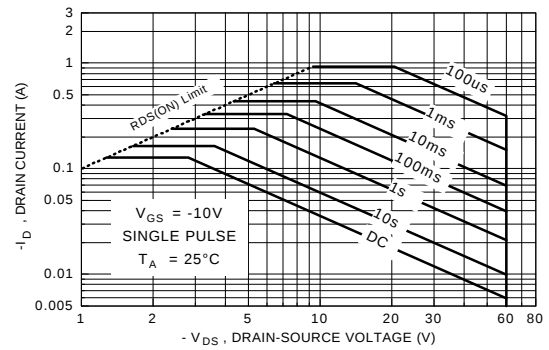


**Figure 11. Transconductance Variation with Drain Current and Temperature**

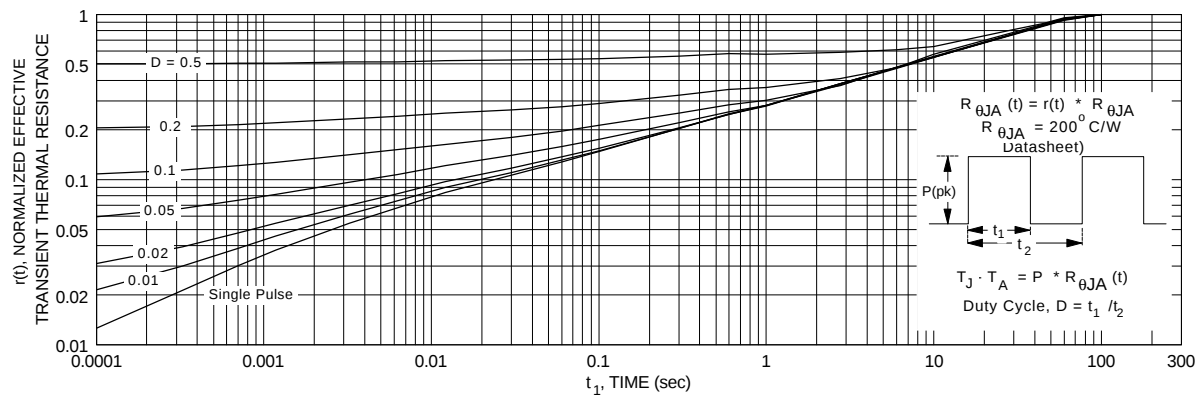
## Typical Electrical Characteristics (continued)



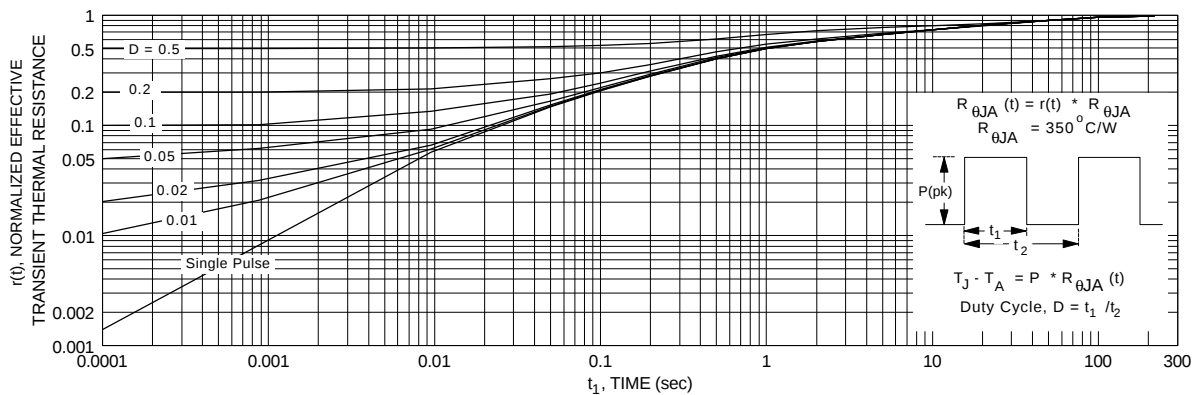
**Figure 12. NDF0610 (TO-92)  
Maximum Safe Operating Area**



**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.**