

## NDP6050 / NDB6050

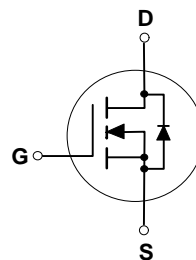
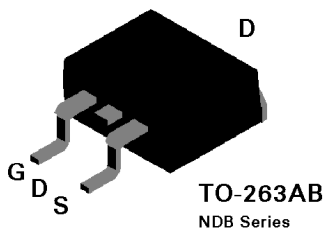
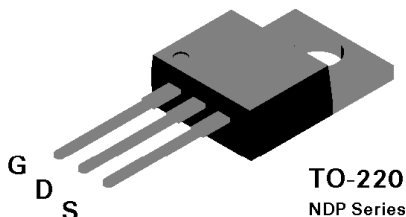
### N-Channel Enhancement Mode Field Effect Transistor

#### 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

- 48A, 50V.  $R_{DS(ON)} = 0.025\Omega$  @  $V_{GS}=10V$ .
- 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

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

Symbol	Parameter	NDP6050	NDB6050	Units
$V_{DSS}$	Drain-Source Voltage	50		V
$V_{DGR}$	Drain-Gate Voltage ( $R_{GS} \leq 1\text{ M}\Omega$ )	50		V
$V_{GSS}$	Gate-Source Voltage - Continuous	$\pm 20$		V
	- Nonrepetitive ( $t_p < 50\text{ }\mu\text{s}$ )	$\pm 40$		
$I_D$	Drain Current - Continuous	48		A
	- Pulsed	144		
$P_D$	Total Power Dissipation @ $T_C = 25^\circ\text{C}$	100		W
	Derate above $25^\circ\text{C}$	0.67		W/ $^\circ\text{C}$
$T_J, T_{STG}$	Operating and Storage Temperature Range	-65 to 175		$^\circ\text{C}$
$T_L$	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	275		$^\circ\text{C}$

**Electrical Characteristics** ( $T_c = 25^\circ\text{C}$  unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
DRAIN-SOURCE AVALANCHE RATINGS (Note 1)						
W <sub>DSS</sub>	Single Pulse Drain-Source Avalanche Energy	V <sub>DD</sub> = 25 V, I <sub>D</sub> = 48 A			200	mJ
I <sub>AR</sub>	Maximum Drain-Source Avalanche Current				48	A
OFF CHARACTERISTICS						
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	50			V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> = 50 V, V <sub>GS</sub> = 0 V			250	μA
		T <sub>J</sub> = 125°C			1	mA
I <sub>GSSF</sub>	Gate - Body Leakage, Forward	V <sub>GS</sub> = 20 V, V <sub>DS</sub> = 0 V			100	nA
I <sub>GSSR</sub>	Gate - Body Leakage, Reverse	V <sub>GS</sub> = -20 V, V <sub>DS</sub> = 0 V			-100	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> = 250 μA	2	2.9	4	V
		T <sub>J</sub> = 125°C	1.4	2.3	3.6	
R <sub>DS(on)</sub>	Static Drain-Source On-Resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 24 A		0.02	0.025	Ω
		T <sub>J</sub> = 125°C		0.032	0.04	
I <sub>D(on)</sub>	On-State Drain Current	V <sub>GS</sub> = 10 V, V <sub>DS</sub> = 10 V	48			A
g <sub>FS</sub>	Forward Transconductance	V <sub>DS</sub> = 10 V, I <sub>D</sub> = 24 A	10	19		S
DYNAMIC CHARACTERISTICS						
C <sub>iss</sub>	Input Capacitance	V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0 V, f = 1.0 MHz		1190	1800	pF
C <sub>oss</sub>	Output Capacitance			475	800	pF
C <sub>rss</sub>	Reverse Transfer Capacitance			150	400	pF
SWITCHING CHARACTERISTICS (Note 1)						
t <sub>D(on)</sub>	Turn - On Delay Time	V <sub>DD</sub> = 30 V, I <sub>D</sub> = 48 A, V <sub>GS</sub> = 10 V, R <sub>GEN</sub> = 7.5 Ω		10	20	nS
t <sub>r</sub>	Turn - On Rise Time			145	300	nS
t <sub>D(off)</sub>	Turn - Off Delay Time			28	60	nS
t <sub>f</sub>	Turn - Off Fall Time			77	150	nS
Q <sub>g</sub>	Total Gate Charge	V <sub>DS</sub> = 48 V, I <sub>D</sub> = 48 A, V <sub>GS</sub> = 10V		39	70	nC
Q <sub>gs</sub>	Gate-Source Charge			7.6		
Q <sub>gd</sub>	Gate-Drain Charge			22		

**Electrical Characteristics** ( $T_c = 25^\circ\text{C}$  unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
DRAIN-SOURCE DIODE CHARACTERISTICS						
I <sub>S</sub>	Maximum Continuous Drain-Source Diode Forward Current				48	A
I <sub>SM</sub>	Maximum Pulsed Drain-Source Diode Forward Current				144	A
V <sub>SD</sub>	Drain-Source Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>S</sub> = 24 A (Note 1)  T <sub>J</sub> = 125°C		0.9	1.3	V
				0.8	1.2	
t <sub>rr</sub>	Reverse Recovery Time	V <sub>GS</sub> = 0 V, I <sub>F</sub> = 48 A, dI <sub>F</sub> /dt = 100 A/μs	35	87	140	ns
I <sub>rr</sub>	Reverse Recovery Current		2	3.6	8	A
THERMAL CHARACTERISTICS						
R <sub>θJC</sub>	Thermal Resistance, Junction-to-Case				1.5	°C/W
R <sub>θJA</sub>	Thermal Resistance, Junction-to-Ambient				62.5	°C/W

Note:

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

## Typical Electrical Characteristics

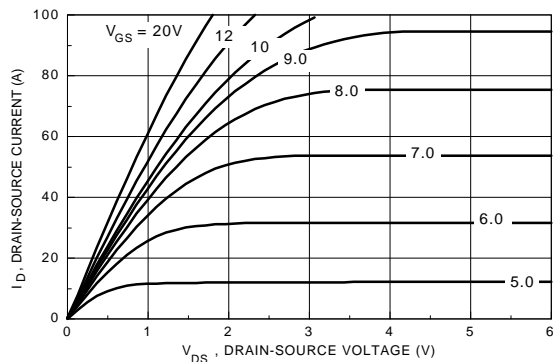


Figure 1. On-Region Characteristics

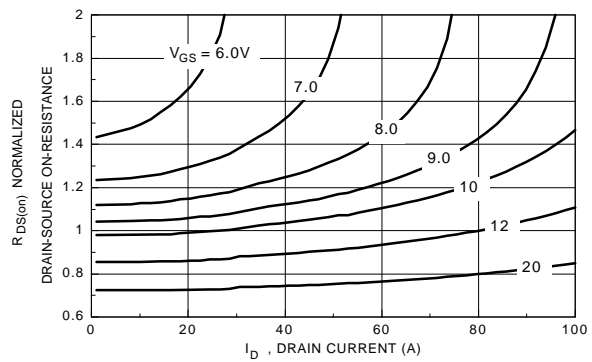


Figure 2. On-Resistance Variation with Gate Voltage and Drain Current

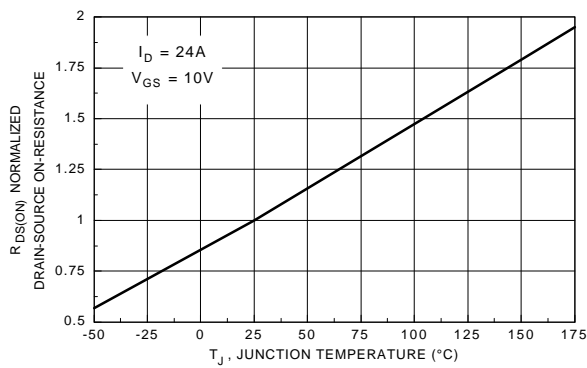


Figure 3. On-Resistance Variation with Temperature

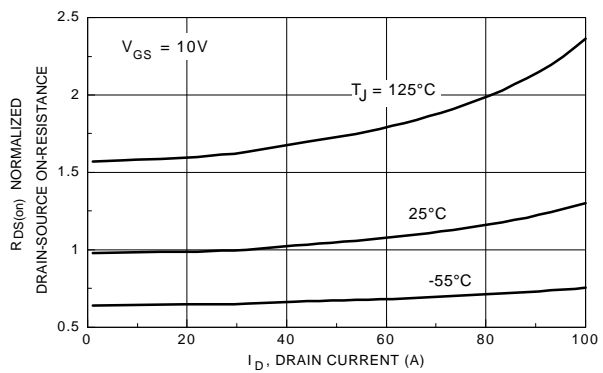


Figure 4. On-Resistance Variation with Drain Current and Temperature

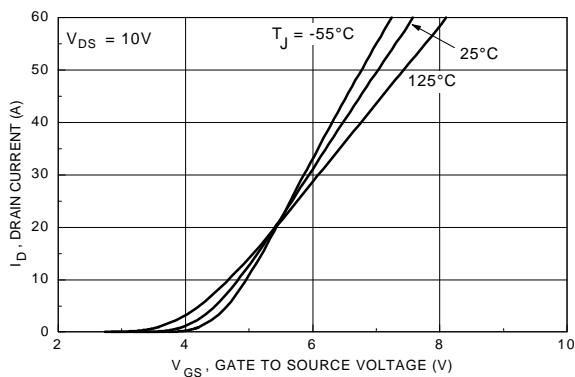


Figure 5. Transfer Characteristics

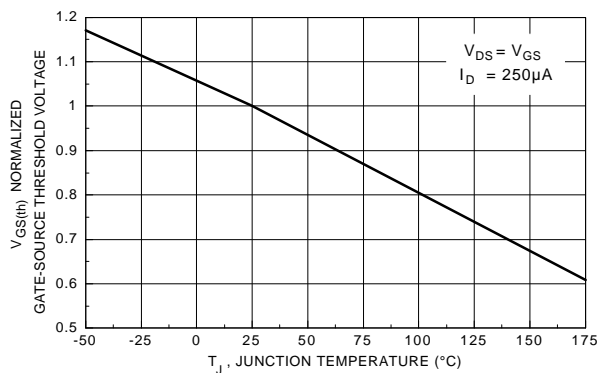


Figure 6. Gate Threshold Variation with Temperature

## Typical Electrical Characteristics (continued)

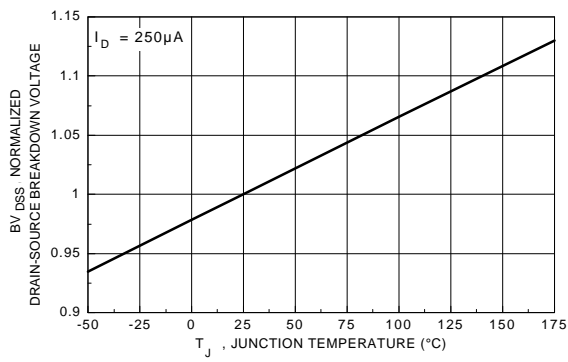


Figure 7. Breakdown Voltage Variation with Temperature

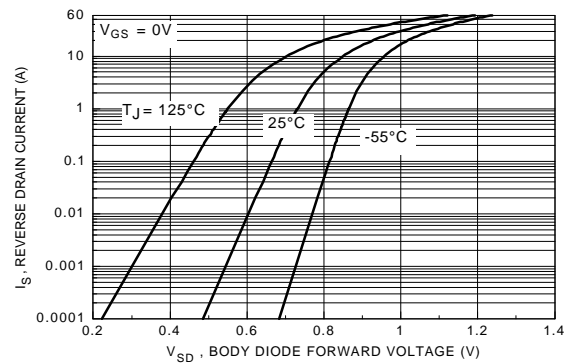


Figure 8. Body Diode Forward Voltage Variation with Current and Temperature

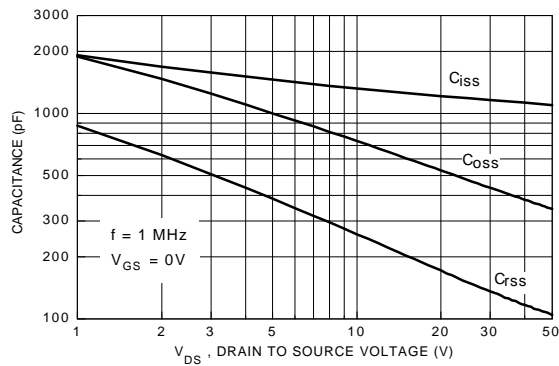


Figure 9. Capacitance Characteristics

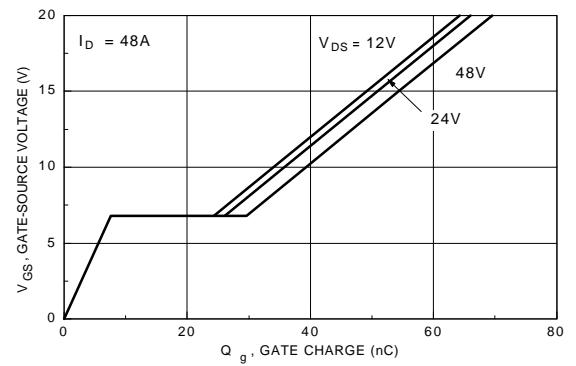


Figure 10. Gate Charge Characteristics

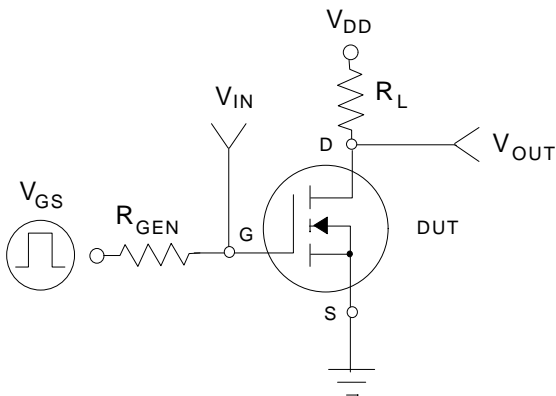


Figure 11. Switching Test Circuit

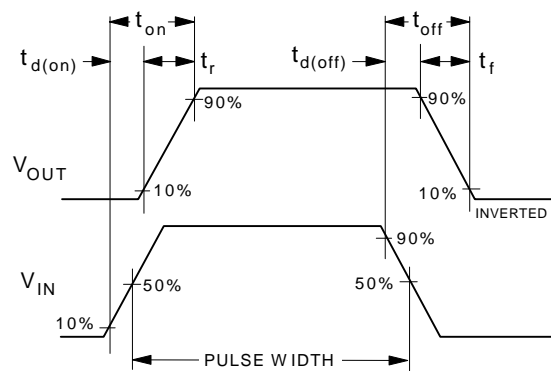


Figure 12. Switching Waveforms

## Typical Electrical Characteristics (continued)

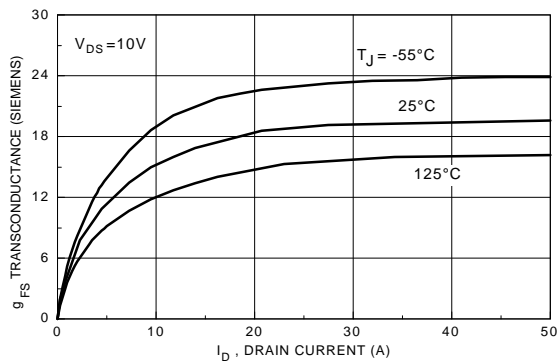


Figure 13. Transconductance Variation with Drain Current and Temperature

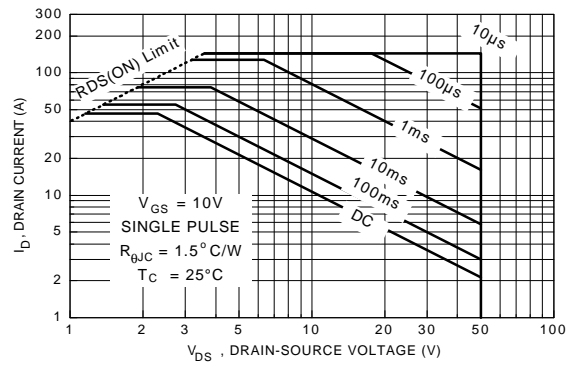


Figure 14. Maximum Safe Operating Area

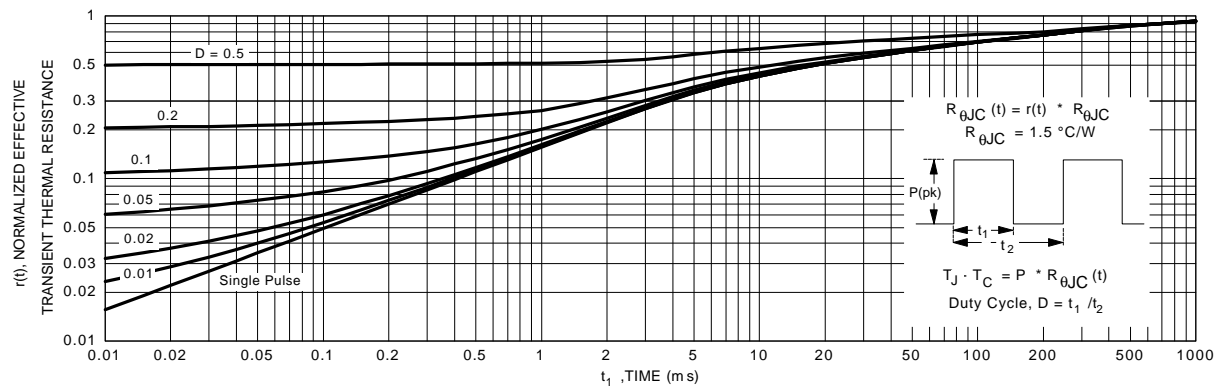


Figure 15. Transient Thermal Response Curve