



March 1996

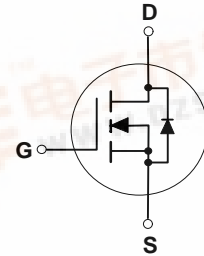
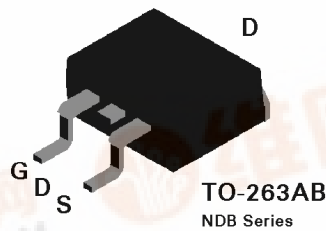
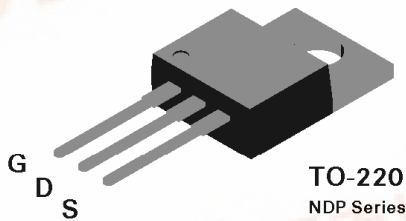
## NDP6050 / NDB6050 N-Channel Enhancement Mode Field Effect Transistor

### 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.

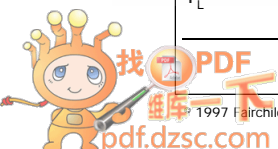
### Features

- 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 - Nonrepetitive ( $t_p < 50\ \mu\text{s}$ )		$\pm 20$	V
			$\pm 40$	
$I_D$	Drain Current - Continuous - Pulsed		48	A
			144	
$P_D$	Total Power Dissipation @ $T_c = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$		100	W
			0.67	
$T_J, T_{STG}$	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
<b>DRAIN-SOURCE AVALANCHE RATINGS</b> (Note 1)						
$W_{DSS}$	Single Pulse Drain-Source Avalanche Energy	$V_{DD} = 25\text{ V}, I_D = 48\text{ A}$			200	mJ
$I_{AR}$	Maximum Drain-Source Avalanche Current				48	A
<b>OFF CHARACTERISTICS</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	50			V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 50\text{ V}, V_{GS} = 0\text{ V}$			250	$\mu\text{A}$
			$T_J = 125^\circ\text{C}$		1	mA
$I_{GSSF}$	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	2.9	4	V
			$T_J = 125^\circ\text{C}$	1.4	2.3	
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10\text{ V}, I_D = 24\text{ A}$		0.02	0.025	$\Omega$
			$T_J = 125^\circ\text{C}$		0.032	
$I_{D(on)}$	On-State Drain Current	$V_{GS} = 10\text{ V}, V_{DS} = 10\text{ V}$	48			A
$g_{FS}$	Forward Transconductance	$V_{DS} = 10\text{ V}, I_D = 24\text{ A}$	10	19		S
<b>DYNAMIC CHARACTERISTICS</b>						
$C_{iss}$	Input Capacitance	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$		1190	1800	pF
$C_{oss}$	Output Capacitance			475	800	
$C_{rss}$	Reverse Transfer Capacitance			150	400	
<b>SWITCHING CHARACTERISTICS</b> (Note 1)						
$t_{D(on)}$	Turn - On Delay Time	$V_{DD} = 30\text{ V}, I_D = 48\text{ A},$ $V_{GS} = 10\text{ V}, R_{GEN} = 7.5\ \Omega$		10	20	nS
$t_r$	Turn - On Rise Time			145	300	
$t_{D(off)}$	Turn - Off Delay Time			28	60	
$t_f$	Turn - Off Fall Time			77	150	
$Q_g$	Total Gate Charge	$V_{DS} = 48\text{ V},$ $I_D = 48\text{ A}, V_{GS} = 10\text{ V}$		39	70	nC
$Q_{gs}$	Gate-Source Charge			7.6		
$Q_{gd}$	Gate-Drain Charge			22		

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units	
<b>DRAIN-SOURCE DIODE CHARACTERISTICS</b>							
$I_S$	Maximum Continuous Drain-Source Diode Forward Current				48	A	
$I_{SM}$	Maximum Pulsed Drain-Source Diode Forward Current				144	A	
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}$ , $I_S = 24\text{ A}$ (Note 1)			0.9	1.3	V
				$T_J = 125^\circ\text{C}$	0.8	1.2	
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{ V}$ , $I_F = 48\text{ A}$ , $di_F/dt = 100\text{ A}/\mu\text{s}$	35	87	140	ns	
$I_{rr}$	Reverse Recovery Current		2	3.6	8	A	
<b>THERMAL CHARACTERISTICS</b>							
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case				1.5	$^\circ\text{C}/\text{W}$	
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient				62.5	$^\circ\text{C}/\text{W}$	

Note:

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

## Typical Electrical Characteristics

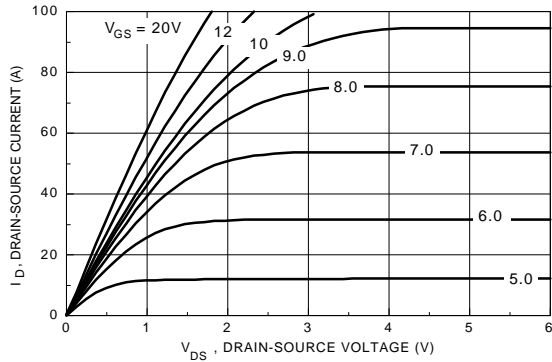


Figure 1. On-Region Characteristics

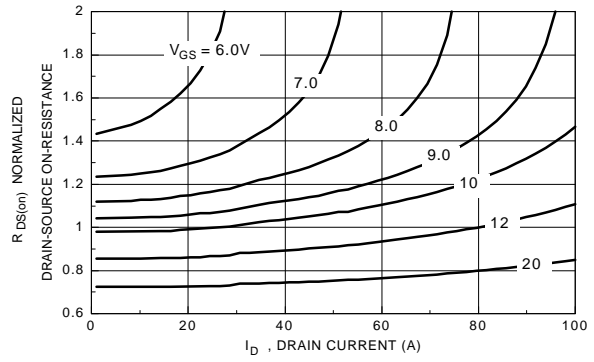


Figure 2. On-Resistance Variation with Gate Voltage and Drain Current

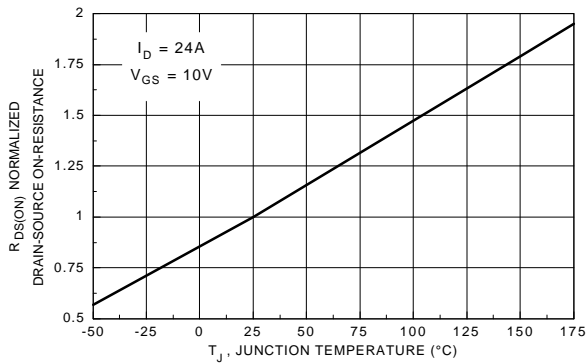


Figure 3. On-Resistance Variation with Temperature

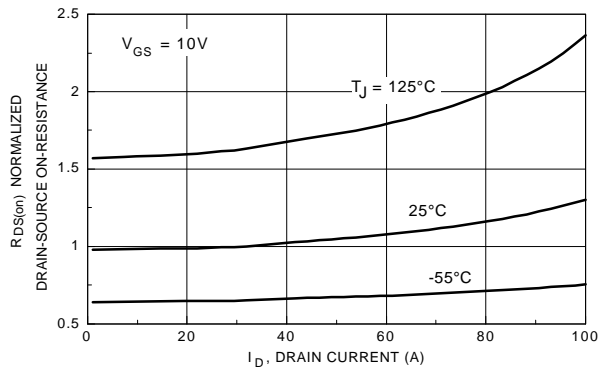


Figure 4. On-Resistance Variation with Drain Current and Temperature

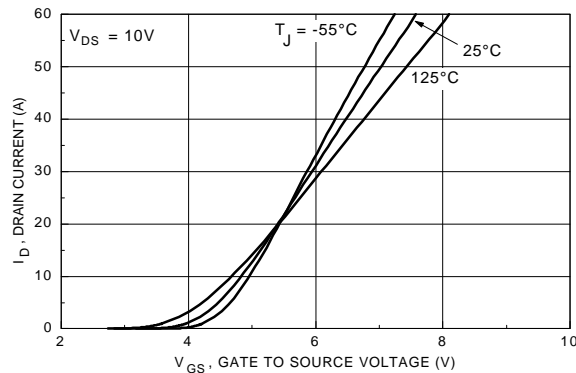


Figure 5. Transfer Characteristics

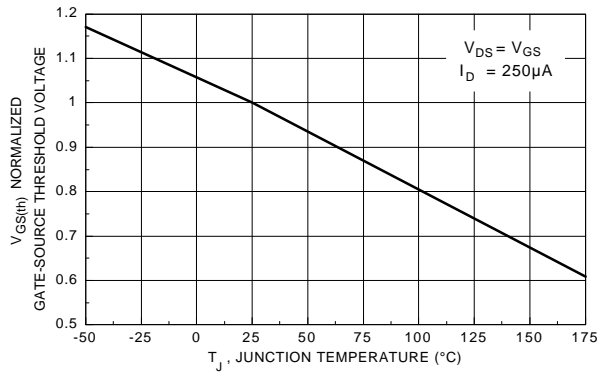
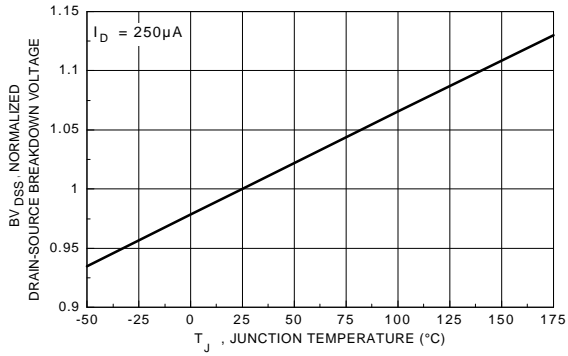
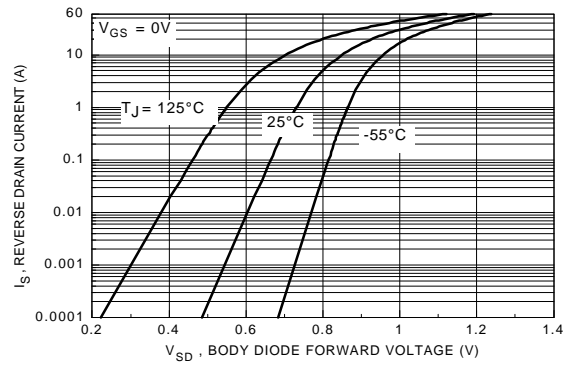


Figure 6. Gate Threshold Variation with Temperature

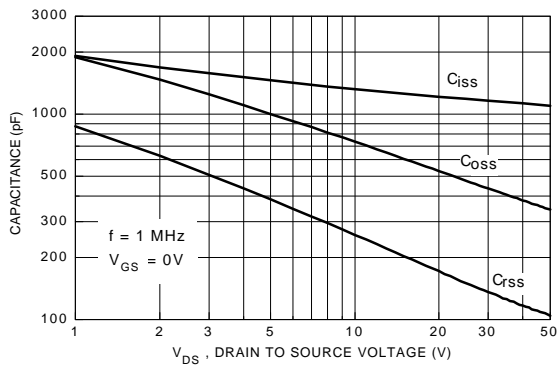
## Typical Electrical Characteristics (continued)



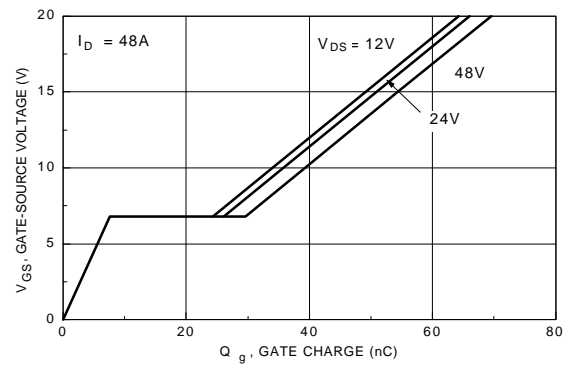
**Figure 7. Breakdown Voltage Variation with Temperature**



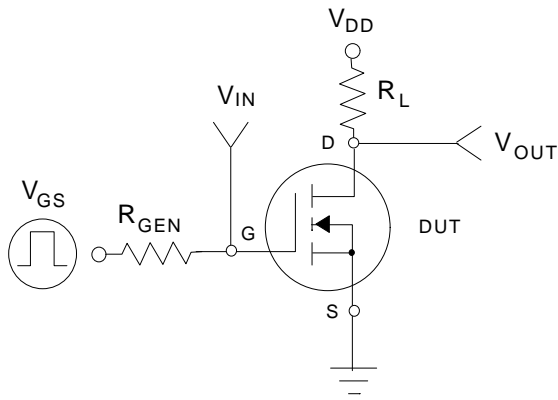
**Figure 8. Body Diode Forward Voltage Variation with Current and Temperature**



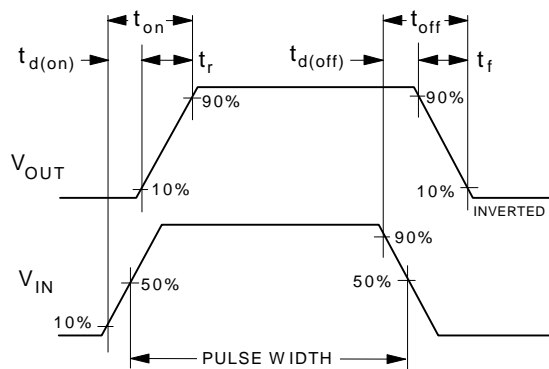
**Figure 9. Capacitance Characteristics**



**Figure 10. Gate Charge Characteristics**



**Figure 11. Switching Test Circuit**



**Figure 12. Switching Waveforms**

### Typical Electrical Characteristics (continued)

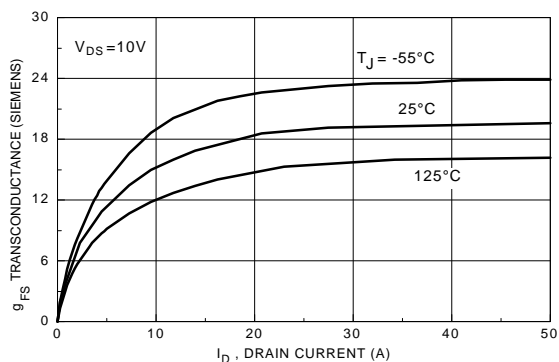


Figure 13. Transconductance Variation with Drain Current and Temperature

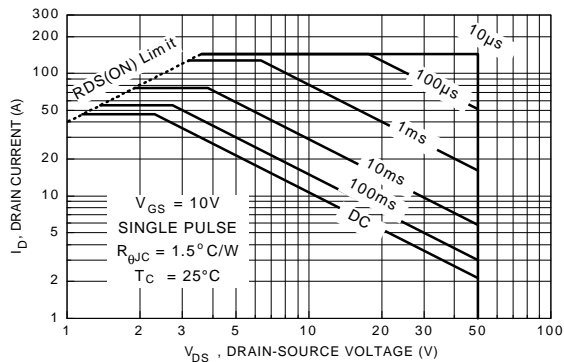


Figure 14. Maximum Safe Operating Area

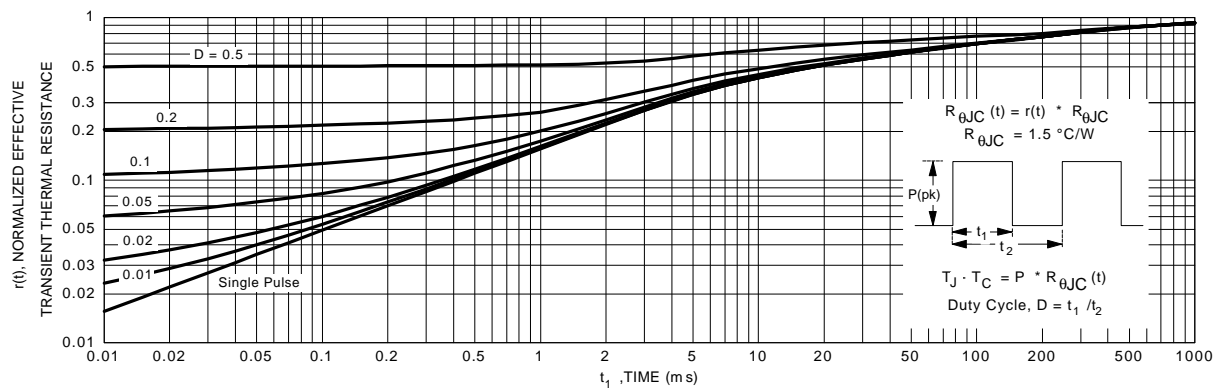


Figure 15. Transient Thermal Response Curve