National Semiconductor™

January 1996

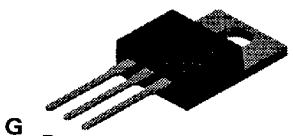
NDP603AL / NDB603AL
N-Channel Logic Level Enhancement Mode Field Effect Transistor

General Description

These N-Channel logic level enhancement mode power field effect transistors are produced using National's proprietary, high cell density, DMOS technology. This very high density process is especially tailored to minimize on-state resistance. These devices are particularly suited for low voltage applications such as DC/DC converters and high efficiency switching circuits where fast switching, low in-line power loss, and resistance to transients are needed.

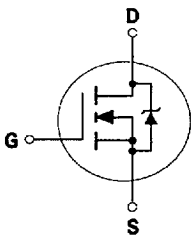
Features

- 25A, 30V. $R_{DS(ON)}$ = 0.022Ω @ 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.
- High density cell design for extremely low $R_{DS(ON)}$.
- 175°C maximum junction temperature rating.



TO-220
NDP Series

TO-263AB
NDB Series



Absolute Maximum Ratings T_C = 25°C unless otherwise noted

Symbol	Parameter	NDP603AL	NDB603AL	Units
V_{DSS}	Drain-Source Voltage	30		V
V_{GSS}	Gate-Source Voltage - Continuous	± 20		V
I_D	Drain Current - Continuous	25 (Note 1)		A
	- Pulsed	100		
P_D	Total Power Dissipation @ T_C = 25°C	50		W
	Derate above 25°C	0.4		W/°C
T_J,T_{STG}	Operating and Storage Temperature Range	-65 to 175		°C
T_L	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	275		°C
THERMAL CHARACTERISTICS				
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	2.5		°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	62.5		°C/W

Electrical Characteristics (T_c = 25°C unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
DRAIN-SOURCE AVALANCHE RATINGS (Note 2)						
W_{DSS}	Single Pulse Drain-Source Avalanche Energy	V_{DD} = 15 V, I_D = 25 A			100	mJ
I_{AR}	Maximum Drain-Source Avalanche Current				25	A
OFF CHARACTERISTICS						
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} = 0 V, I_D = 250 µA	30			V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 24 V, V_{GS} = 0 V			10	µA
I_{GSSF}	Gate - Body Leakage, Forward	V_{GS} = 20 V, V_{DS} = 0 V			100	nA
I_{GSSR}	Gate - Body Leakage, Reverse	V_{GS} = -20 V, V_{DS} = 0 V			-100	nA
ON CHARACTERISTICS (Note 2)						
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = 250 µA	1.1	1.5	3	V
		T_J = 125°C	0.7	1.1	2.2	
		V_{DS} = V_{GS}, I_D = 10 mA	1.4	1.85	3	
		T_J = 125°C	1	1.5	2.2	
$R_{DS(ON)}$	Static Drain-Source On-Resistance	V_{GS} = 10 V, I_D = 25 A		0.019	0.022	Ω
		T_J = 125°C		0.028	0.045	
		V_{GS} = 4.5 V, I_D = 10 A		0.031	0.04	
$I_{D(on)}$	On-State Drain Current	V_{GS} = 10 V, V_{DS} = 10 V	60			A
		V_{GS} = 4.5 V, V_{DS} = 10 V	15			
g_{FS}	Forward Transconductance	V_{DS} = 10 V, I_D = 25 A		18		S
DYNAMIC CHARACTERISTICS						
C_{iss}	Input Capacitance	V_{DS} = 15 V, V_{GS} = 0 V, f = 1.0 MHz		1100		pF
C_{oss}	Output Capacitance			540		pF
C_{rss}	Reverse Transfer Capacitance			175		pF
SWITCHING CHARACTERISTICS (Note 2)						
$t_{D(on)}$	Turn - On Delay Time	V_{DD} = 15 V, I_D = 25 A, V_{GS} = 10 V, R_{GEN} = 24 Ω		15	30	ns
t_r	Turn - On Rise Time			70	110	ns
$t_{D(off)}$	Turn - Off Delay Time			90	150	ns
t_f	Turn - Off Fall Time			80	130	ns
Q_g	Total Gate Charge	V_{DS} = 10 V, I_D = 25 A, V_{GS} = 10 V		28	40	nC
Q_{gs}	Gate-Source Charge			5	7	nC
Q_{gd}	Gate-Drain Charge			7	10	nC
DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS						
I_S	Maximum Continuous Drain-Source Diode Forward Current				25	A
V_{SD}	Drain-Source Diode Forward Voltage	V_{GS} = 0 V, I_S = 25 A (Note 2)			1.3	V

Note:
1. Maximum DC current limited by the package.
2. Pulse Test: Pulse Width ≤ 300µs, Duty Cycle ≤ 2.0%.

Typical Electrical Characteristics

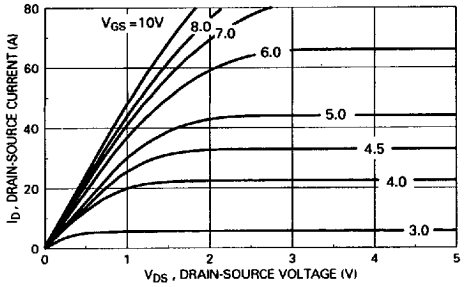


Figure 1. On-Region Characteristics.

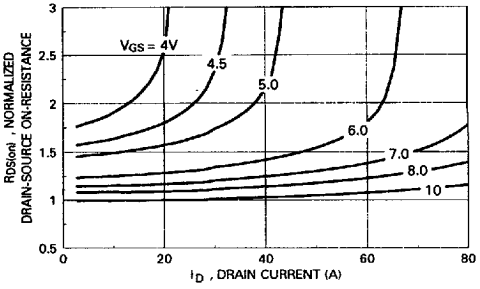


Figure 2. On-Resistance Variation with Gate Voltage and Drain Current.

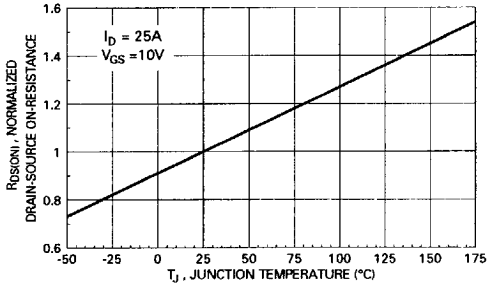


Figure 3. On-Resistance Variation with Temperature.

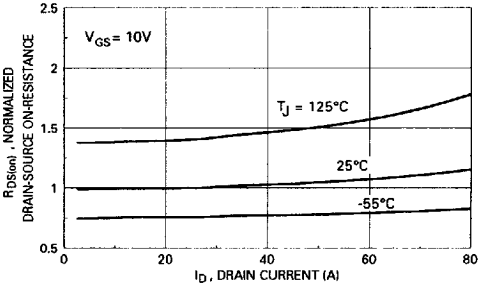


Figure 4. On-Resistance Variation with Drain Current and Temperature.

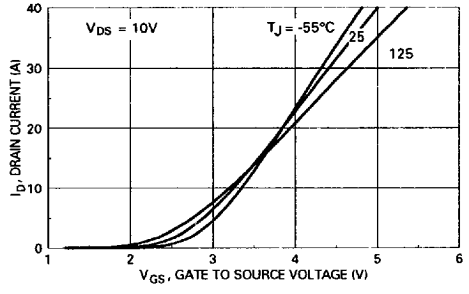


Figure 5. Drain Current Variation with Gate Voltage and Temperature.

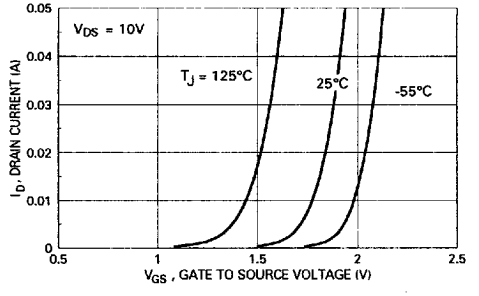


Figure 6. Sub-threshold Drain Current Variation with Gate Voltage and Temperature.

Typical Electrical Characteristics (continued)

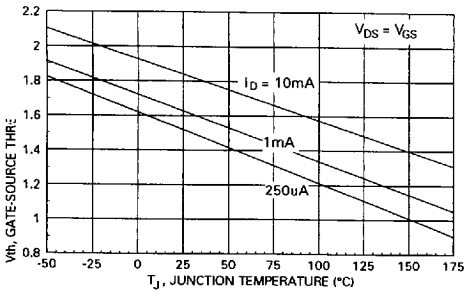


Figure 7. Gate Threshold Variation with Temperature

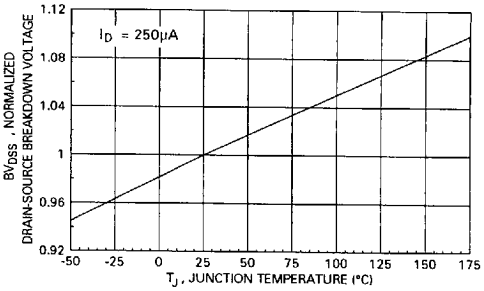


Figure 8. Breakdown Voltage Variation with Temperature.

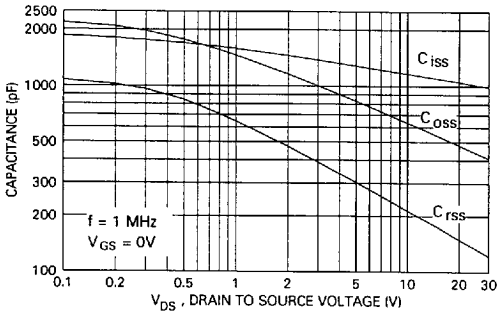


Figure 9. Capacitance Characteristics.

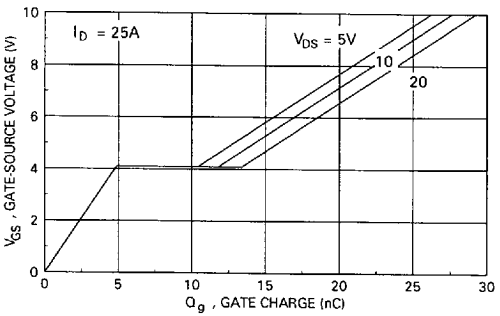


Figure 10. Gate Charge Characteristics.

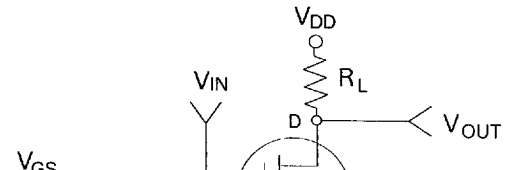


Figure 11. Switching Test Circuit

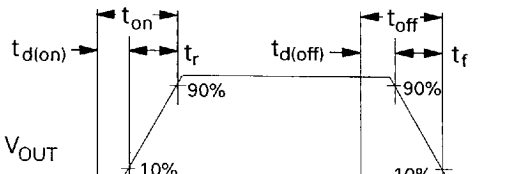


Figure 12. Switching Waveforms

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Typical Electrical Characteristics (continued)

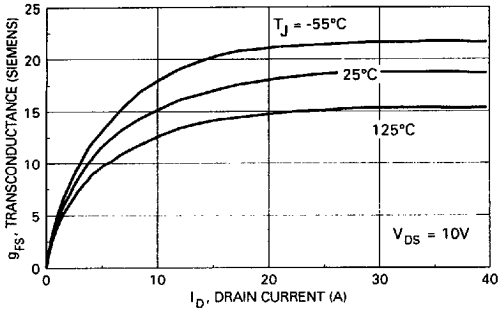

Figure 13. Transconductance Variation with Drain Current and Temperature

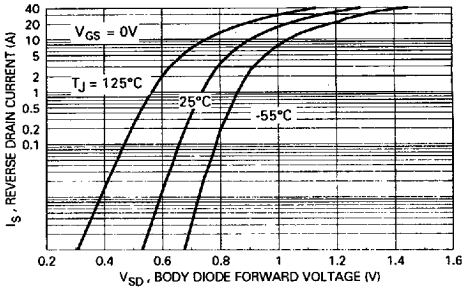

Figure 14. Body Diode Forward Voltage Variation with Current and Temperature

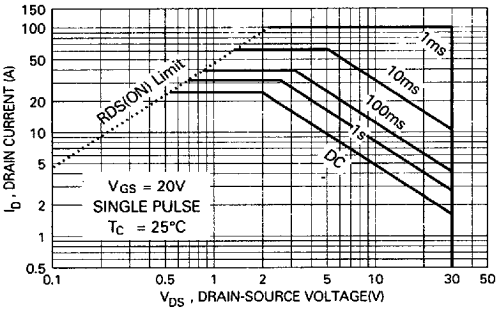

Figure 15. Maximum Safe Operating Area

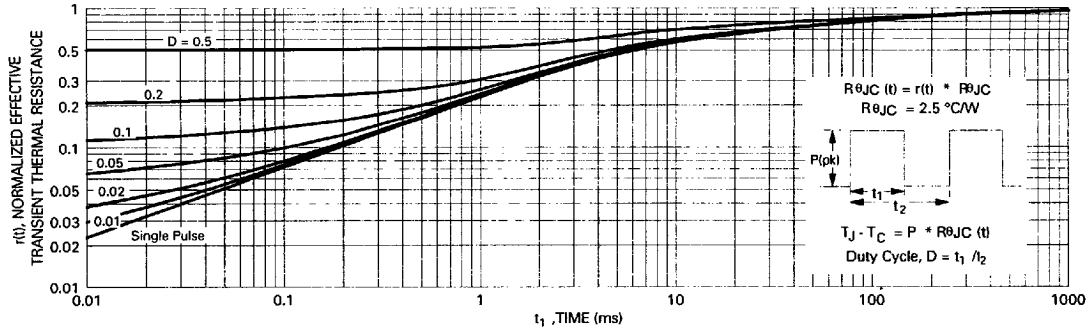

Figure 16. Transient Thermal Response Curve