May 1996

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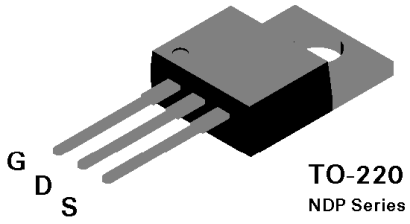
NDP7061 / NDB7061
N-Channel Enhancement Mode Field Effect Transistor

General Description

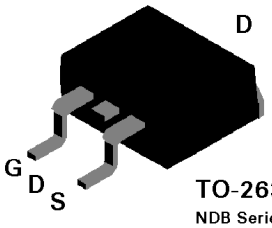
These N-Channel enhancement mode power field effect transistors are produced using National's proprietary, high cell density, DMOS technology. This very high density process is especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulses 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

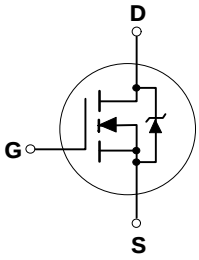
- 64A, 60V. $R_{DS(ON)}$ = 0.016Ω @ V_{GS}=10V.
- Critical DC electrical parameters specified at elevated temperature.
- Rugged internal source-drain diode can eliminate the need for an external Zener diode transient suppressor.
- 175°C maximum junction temperature rating.
- High density cell design for extremely low $R_{DS(ON)}$.
- TO-220 and TO-263 (D^2PAK) package for both through hole and surface mount applications.



TO-220
NDP Series



TO-263AB
NDB Series



Absolute Maximum Ratings

T_C = 25°C unless otherwise noted

Symbol	Parameter	NDP7061	NDB7061	Units
V_{DSS}	Drain-Source Voltage	60		V
V_{DGR}	Drain-Gate Voltage ($R_{GS} \leq$ 1 MΩ)	60		V
V_{GSS}	Gate-Source Voltage - Continuous	± 20		V
	- Nonrepetitive (t_P < 50 µs)	± 40		
I_D	Drain Current - Continuous	64		A
	- Pulsed	190		
P_D	Maximum Power Dissipation @ T_C = 25°C	130		W
	Derate above 25°C	0.87		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

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
W_{DSS}	Single Pulse Drain-Source Avalanche Energy	V_{DD} = 30 V, I_D = 64 A			500	mJ
I_{AR}	Maximum Drain-Source Avalanche Current				64	A
OFF CHARACTERISTICS						
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} = 0 V, I_D = 250 µA	60			V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 48 V, V_{GS} = 0 V			10	µA
		T_J = 125°C			1	mA
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 1)						
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = 250 µA	2	2.9	4	V
		T_J = 125°C	1.4	2.2	3.6	
$R_{DS(ON)}$	Static Drain-Source On-Resistance	V_{GS} = 10 V, I_D = 35 A		0.013	0.016	Ω
		T_J = 125°C		0.021	0.032	
$I_{D(on)}$	On-State Drain Current	V_{GS} = 10 V, V_{DS} = 10 V	60			A
g_{FS}	Forward Transconductance	V_{DS} = 10 V, I_D = 35 A		30		S
DYNAMIC CHARACTERISTICS						
C_{iss}	Input Capacitance	V_{DS} = 25 V, V_{GS} = 0 V, f = 1.0 MHz		1930		pF
C_{oss}	Output Capacitance			870		pF
C_{rss}	Reverse Transfer Capacitance			310		pF
SWITCHING CHARACTERISTICS (Note 1)						
$t_{D(on)}$	Turn - On Delay Time	V_{DD} = 25 V, I_D = 64 A, V_{GS} = 10 V, R_{GEN} = 5 Ω		13	30	nS
t_r	Turn - On Rise Time			98	200	nS
$t_{D(off)}$	Turn - Off Delay Time			36	80	nS
t_f	Turn - Off Fall Time			65	150	nS
Q_g	Total Gate Charge	V_{DS} = 48 V, I_D = 64 A, V_{GS} = 10 V		67	100	nC
Q_{gs}	Gate-Source Charge			11		nC
Q_{gd}	Gate-Drain Charge			37.5		nC

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
DRAIN-SOURCE DIODE CHARACTERISTICS						
I_S	Maximum Continuos Drain-Source Diode Forward Current				64	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current				190	A
V_{SD}	Drain-Source Diode Forward Voltage	V_{GS} = 0 V, I_S = 35 A (Note 1)		0.9	1.3	V
		T_J = 125°C		0.8	1.2	
t_{rr}	Reverse Recovery Time	V_{GS} = 0 V, I_F = 64 A, dI_F/dt = 100 A/µs	40	105	150	ns
I_{rr}	Reverse Recovery Current		2	4.5	10	A
THERMAL CHARACTERISTICS						
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case				1.15	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient				62.5	°C/W

Note:
1. Pulse Test: Pulse Width ≤ 300 µs, Duty Cycle ≤ 2.0%.

Typical Electrical Characteristics

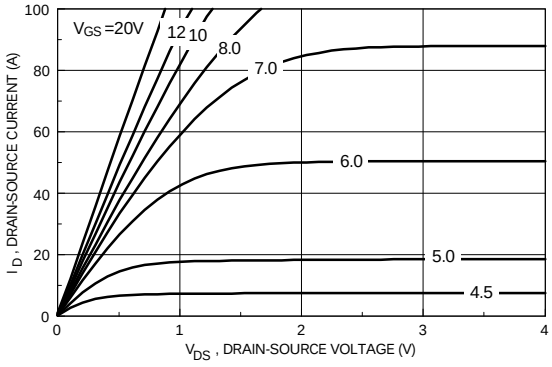


Figure 1. On-Region Characteristics

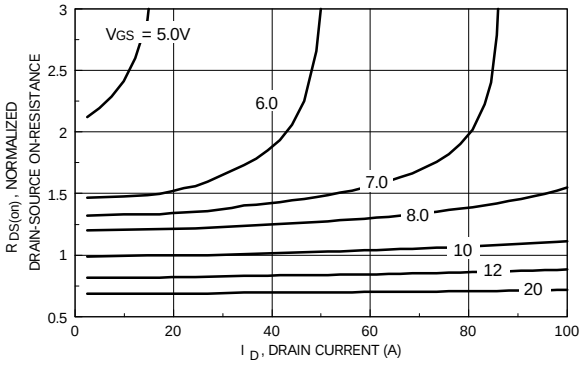


Figure 2. On-Resistance Variation with Gate Voltage and Drain Current

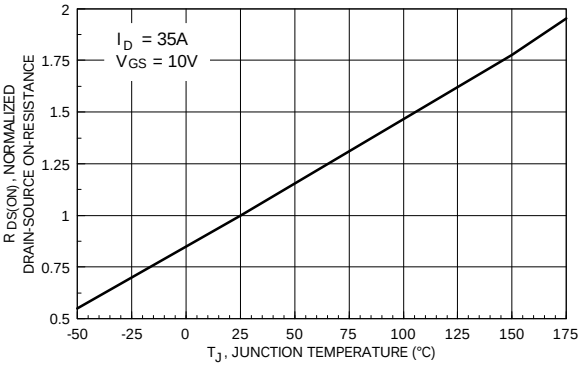


Figure 3. On-Resistance Variation with Temperature

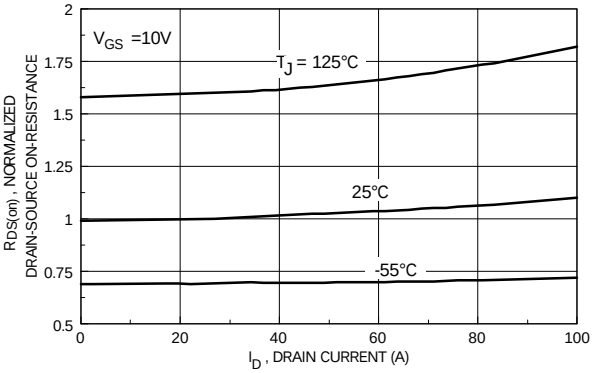


Figure 4. On-Resistance Variation with Drain Current and Temperature

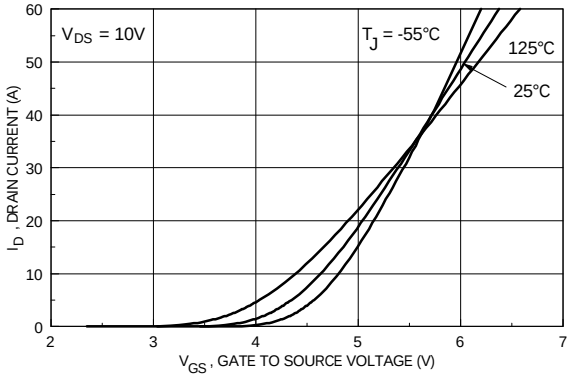


Figure 5. Transfer Characteristics

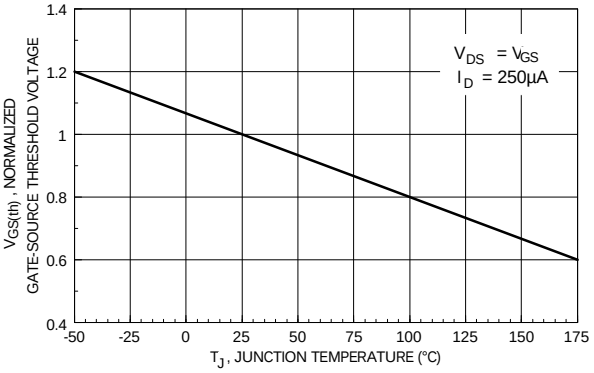


Figure 6. Gate Threshold Variation with Temperature

Typical Electrical Characteristics (continued)

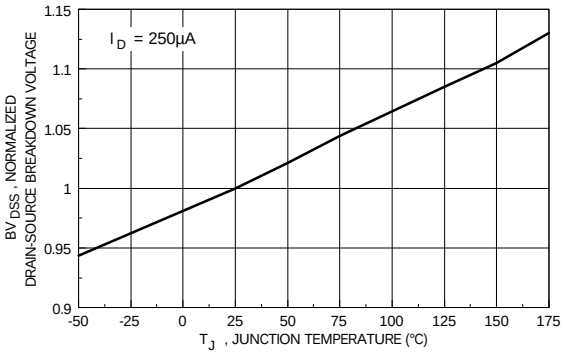


Figure 7. Breakdown Voltage Variation with Temperature

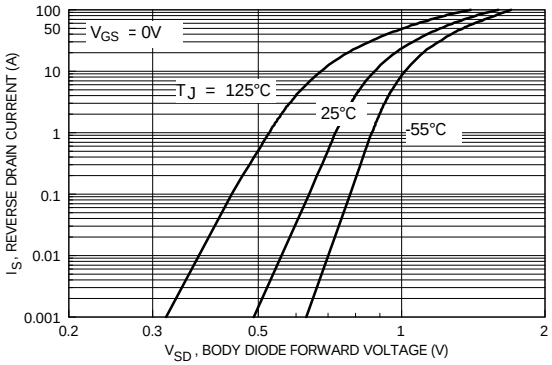


Figure 8. Body Diode Forward Voltage Variation with Current and Temperature

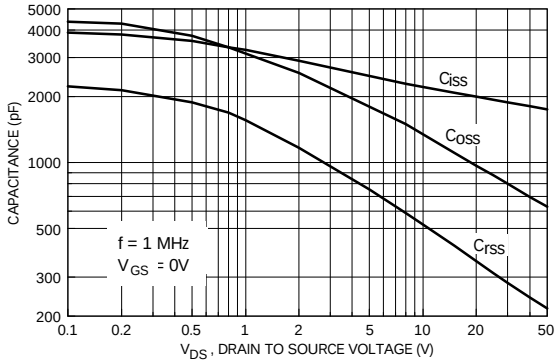


Figure 9. Capacitance Characteristics

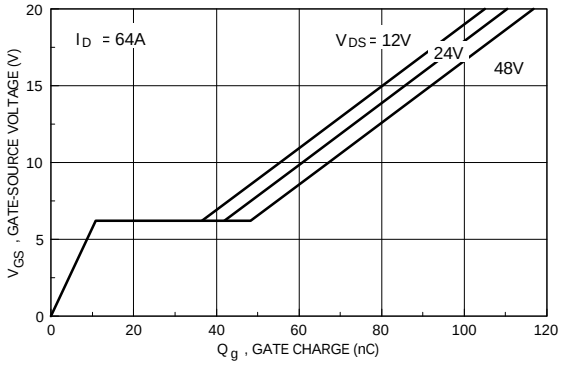


Figure 10. Gate Charge Characteristics

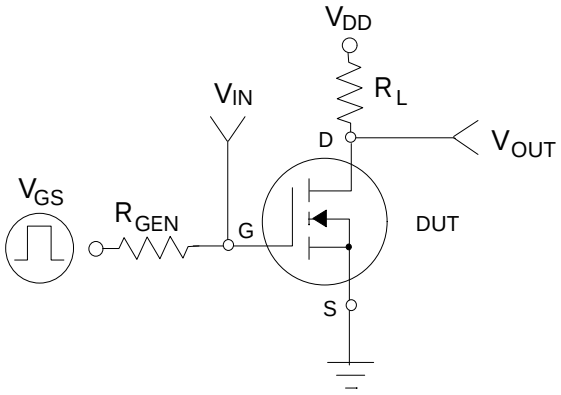


Figure 11. Switching Test Circuit

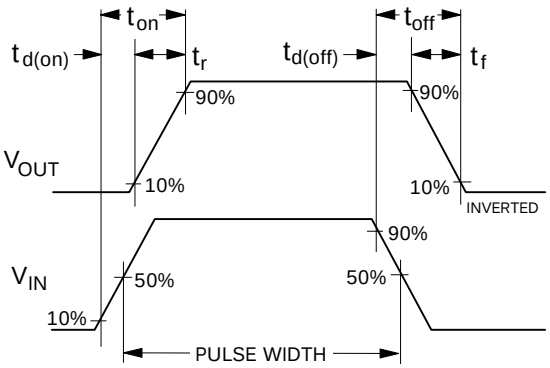


Figure 12. Switching Waveforms

Typical Electrical Characteristics (continued)

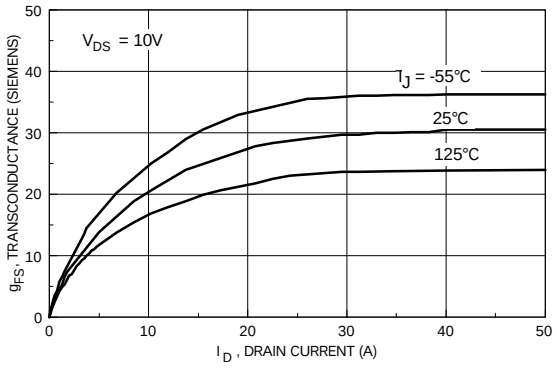


Figure 13. Transconductance Variation with Drain Current and Temperature

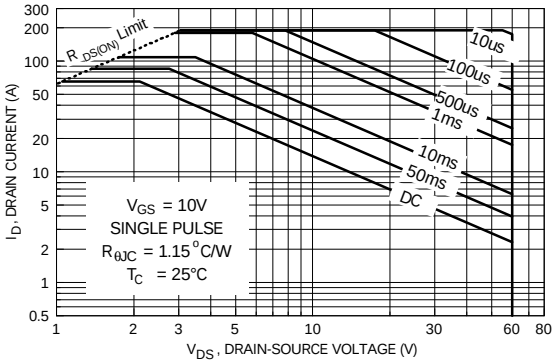


Figure 14. Maximum Safe Operating Area

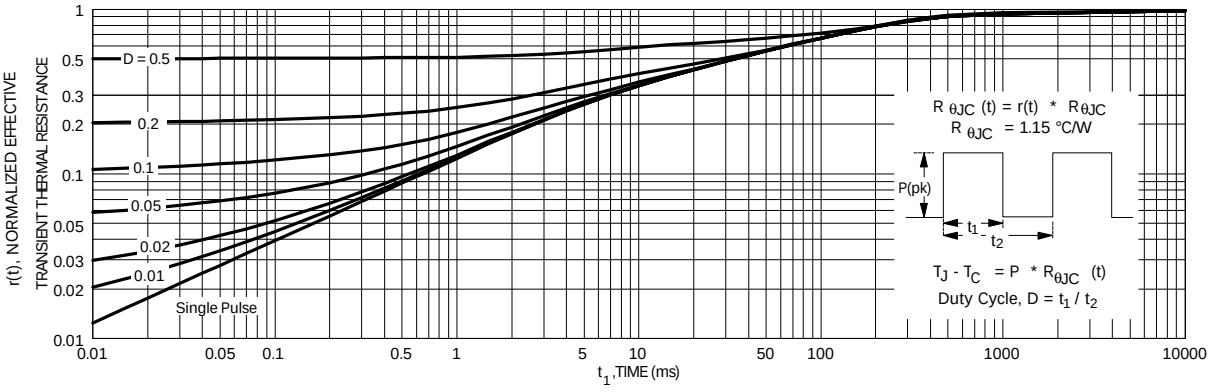


Figure 15. Transient Thermal Response Curve