

NDP406A / NDP406B

NDB406A / NDB406B

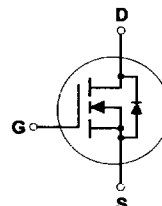
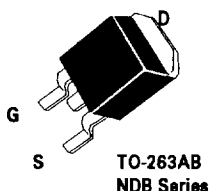
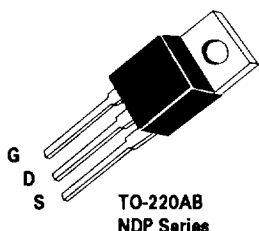
N-Channel Enhancement Mode Field Effect Transistor

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 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

- 15 and 12A, 60V. $R_{DS(ON)}$ = 0.10 and 0.15 Ω .
- 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 (D²PAK) package for both through hole and surface mount applications.



Absolute Maximum Ratings $T_c = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	NDP406A NDB406A	NDP406B NDB406B	Units
V _{DS}	Drain-Source Voltage	60		V
V _{DGR}	Drain-Gate Voltage (R _{GS} ≤ 1 MΩ)	60		V
V _{GSS}	Gate-Source Voltage - Continuous	±20		V
	- Nonrepetitive (t _p < 50 μs)	±40		
I _b	Drain Current - Continuous	15	12	A
	- Pulsed	45	36	
P _D	Total Power Dissipation @ T _C = 25°C	50		W
	Derate above 25°C	0.33		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	Type	Min	Typ	Max	Units
OFF CHARACTERISTICS							
BV _{DS}	Drain-Source Breakdown Voltage	V _{GS} = 0 V, I _D = 250 μA	All	60			V
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} = 60 V, V _{GS} = 0 V	All			250	μA
		T _J = 125°C				1	mA
I _{GSSF}	Gate - Body Leakage, Forward	V _{GS} = 20 V, V _{DS} = 0 V	All			100	nA
I _{GSSR}	Gate - Body Leakage, Reverse	V _{GS} = -20 V, V _{DS} = 0 V	All			-100	nA
ON CHARACTERISTICS (Note 1)							
V _{GS(th)}	Gate Threshold Voltage	V _{DS} = V _{GS} , I _D = 250 μA	All	2	3	4	V
		T _J = 125°C		1.4	2.3	3.6	
R _{DS(on)}	Static Drain-Source On-Resistance	V _{GS} = 10 V, I _D = 7.5 A	NDP406A		0.072	0.1	Ω
		T _J = 125°C	NDB406A		0.12	0.165	
		V _{GS} = 10 V, I _D = 6 A	NDP406B			0.15	
		T _J = 125°C	NDB406B			0.25	
I _{D(on)}	On-State Drain Current	V _{GS} = 10 V, V _{DS} = 10 V	NDP406A NDB406A	15			A
			NDP406B NDB406B	12			
g _{FS}	Forward Transconductance	V _{DS} = 10 V, I _D = 7.5 A	All	3	5		S
DYNAMIC CHARACTERISTICS							
C _{iss}	Input Capacitance	V _{DS} = 25 V, V _{GS} = 0 V, f = 1.0 MHz	All		360	450	pF
C _{oss}	Output Capacitance		All		154	200	pF
C _{rss}	Reverse Transfer Capacitance		All		50	100	pF

Electrical Characteristics (T _c = 25°C unless otherwise noted)							
Symbol	Parameter	Conditions	Type	Min	Typ	Max	Units
SWITCHING CHARACTERISTICS (Note 1)							
t _{Don}	Turn - On Delay Time	V _{DD} = 30 V, I _b = 15 A, V _{GS} = 10 V, R _{GEN} = 25 Ω	All		8	20	nS
t _r	Turn - On Rise Time		All		50	100	nS
t _{Doff}	Turn - Off Delay Time		All		16	30	nS
t _f	Turn - Off Fall Time		All		25	50	nS
Q _g	Total Gate Charge	V _{DS} = 48 V, I _b = 15 A, V _{GS} = 10 V	All		12.4	17	nC
Q _{gs}	Gate-Source Charge		All		2.5		nC
Q _{gd}	Gate-Drain Charge		All		7.5		nC
DRAIN-SOURCE DIODE CHARACTERISTICS							
I _S	Maximum Continuous Drain-Source Diode Forward Current	NDP406A NDB406A				15	A
		NDP406B NDB406B				12	
I _{SM}	Maximum Pulsed Drain-Source Diode Forward Current	NDP406A NDB406A				45	A
		NDP406B NDB406B				36	
V _{SD} (Note 1)	Drain-Source Diode Forward Voltage	V _{GS} = 0 V, I _S = 7.5 A	All		0.86	1.3	V
		T _J = 125°C			0.74	1.2	
t _{rr}	Reverse Recovery Time	V _{GS} = 0V, I _f = 15 A, di/dt = 100 A/μs	All	25	52	100	ns
I _{rr}	Reverse Recovery Current		All	1.5	3.3	7	A
THERMAL CHARACTERISTICS							
R _{θJC}	Thermal Resistance, Junction-to-Case		All			3	°C/W
R _{θJA}	Thermal Resistance, Junction-to-Ambient		All			62.5	°C/W
Note:							
1. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.							

Typical Electrical Characteristics

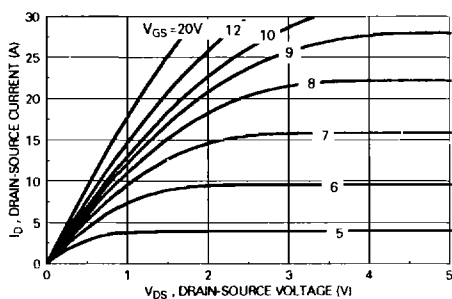


Figure 1. On-Region Characteristics.

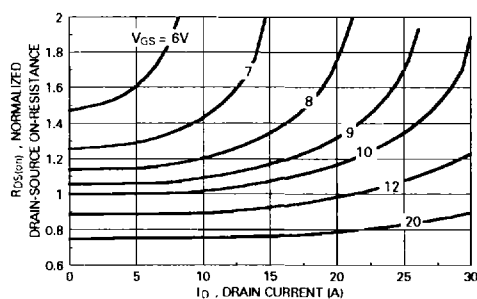


Figure 2. On-Resistance Variation with Gate Voltage and Drain Current.

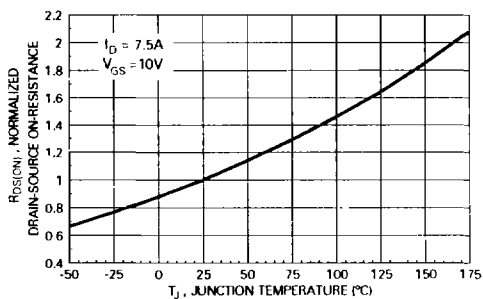


Figure 3. On-Resistance Variation with Temperature.

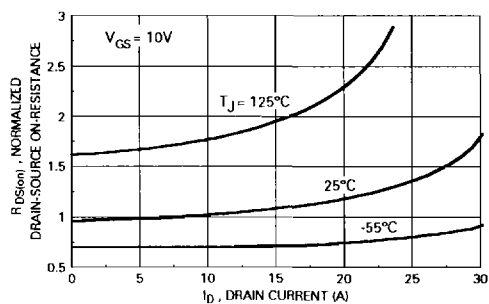


Figure 4. On-Resistance Variation with Drain Current and Temperature.

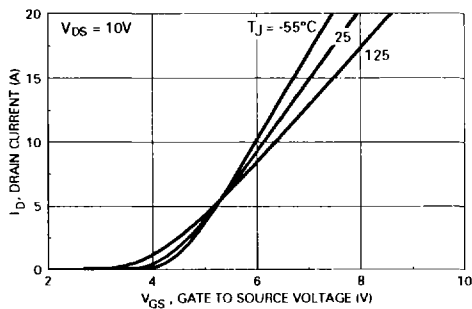


Figure 5. Transfer Characteristics.

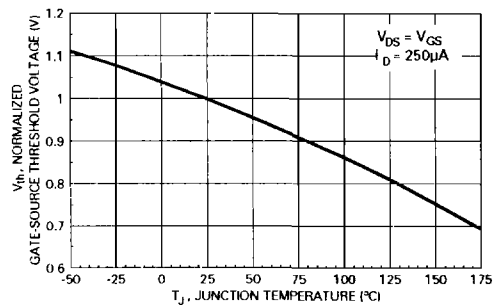


Figure 6. Gate Threshold Variation with Temperature.

Typical Electrical Characteristics (continued)

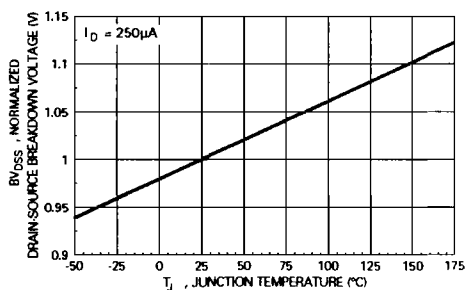


Figure 7. Breakdown Voltage Variation with Temperature.

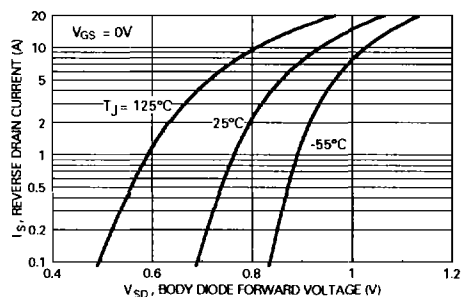


Figure 8. Body Diode Forward Voltage Variation with Current and Temperature.

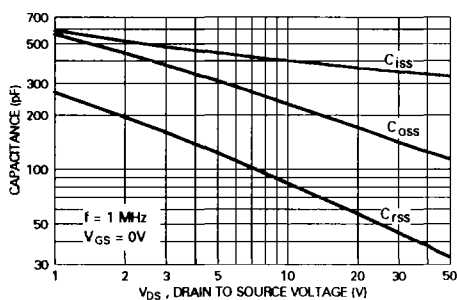


Figure 9. Capacitance Characteristics.

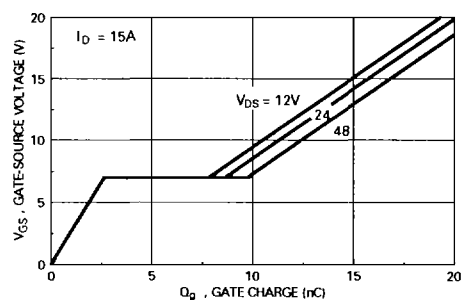


Figure 10. Gate Charge Characteristics.

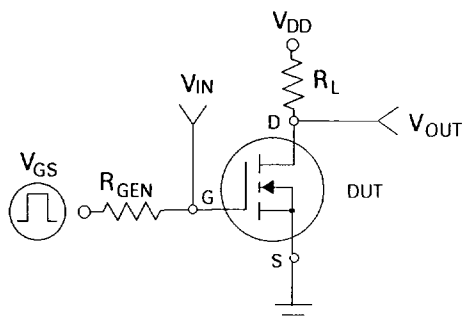


Figure 11. Switching Test Circuit.

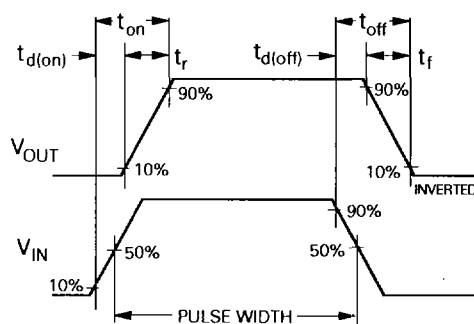


Figure 12. Switching Waveforms.

Typical Electrical Characteristics (continued)

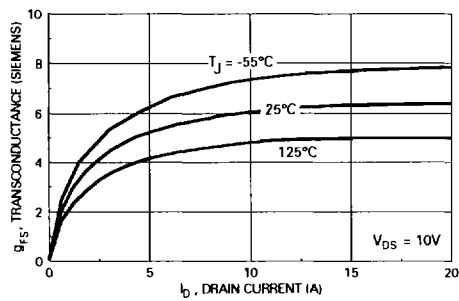


Figure 13. Transconductance Variation with Drain Current and Temperature.

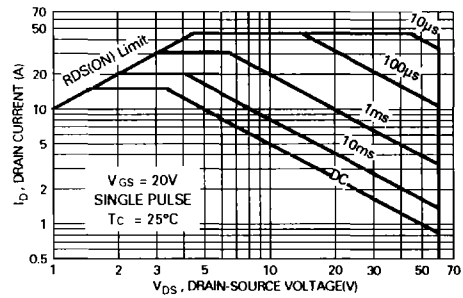


Figure 14. Maximum Safe Operating Area.

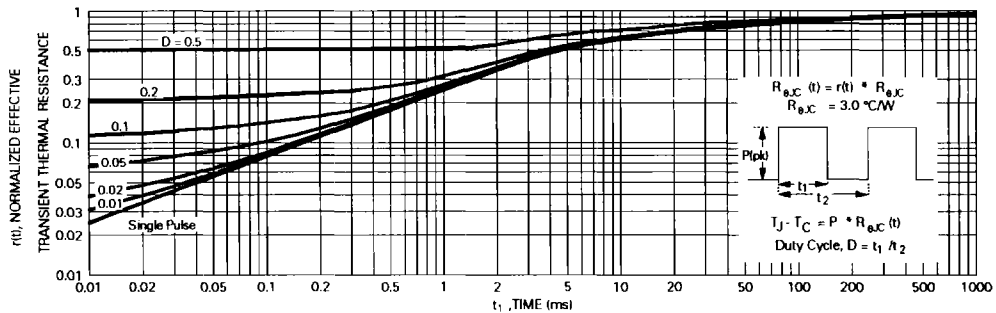


Figure 15. Transient Thermal Response Curve.