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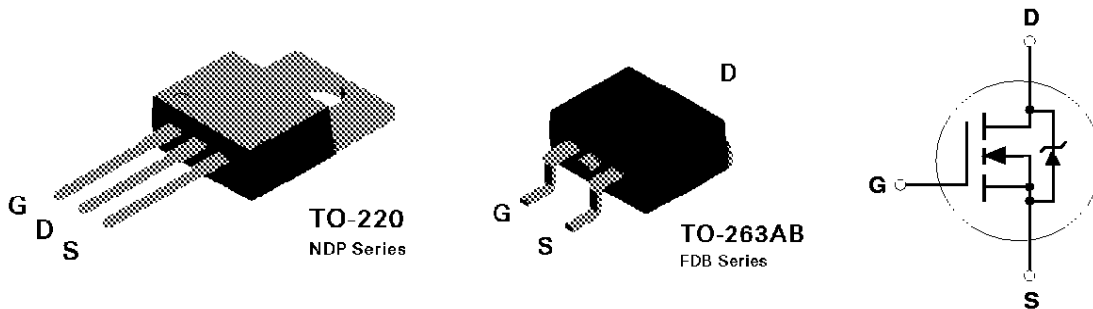
NDP5060L / NDB5060L
N-Channel Logic Level Enhancement Mode Field Effect Transistor

General Description

These logic level 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

- 26 A, 60 V. $R_{DS(ON)} = 0.05 \Omega @ V_{GS} = 5 V$
 $R_{DS(ON)} = 0.035 \Omega @ V_{GS} = 10 V$.
- 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 $T_c = 25^\circ C$ unless otherwise noted

Symbol	Parameter	NDP5060L	NDB5060L	Units
V_{DSS}	Drain-Source Voltage		60	V
V_{DGR}	Drain-Gate Voltage ($R_{GS} \leq 1 M\Omega$)		60	V
V_{GSS}	Gate-Source Voltage - Continuous		± 16	V
	- Nonrepetitive ($t_p < 50 \mu s$)		± 25	
I_D	Drain Current - Continuous		26	A
	- Pulsed		78	
P_D	Total Power Dissipation @ $T_c = 25^\circ C$		68	W
	Derate above $25^\circ C$		0.45	
T_J, T_{STG}	Operating and Storage Temperature Range		-65 to 175	$^\circ C$

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units	
DRAIN-SOURCE AVALANCHE RATINGS (Note 1)							
W_{DSS}	Single Pulse Drain-Source Avalanche Energy	$V_{DD} = 30\text{ V}$, $I_D = 26\text{ A}$			100	mJ	
I_{AR}	Maximum Drain-Source Avalanche Current				26	A	
OFF CHARACTERISTICS							
BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}$, $I_D = 250\text{ }\mu\text{A}$	60			V	
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 60\text{ V}$, $V_{GS} = 0\text{ V}$			250	μA	
			$T_J = 125\text{ }^\circ\text{C}$		1	mA	
I_{GSSF}	Gate - Body Leakage, Forward	$V_{GS} = 16\text{ V}$, $V_{DS} = 0\text{ V}$			100	nA	
I_{GSSR}	Gate - Body Leakage, Reverse	$V_{GS} = -16\text{ V}$, $V_{DS} = 0\text{ V}$			-100	nA	
ON CHARACTERISTICS (Note 1)							
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$	1	1.4	2	V	
			$T_J = 125\text{ }^\circ\text{C}$	0.65	1		1.5
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 5\text{ V}$, $I_D = 13\text{ A}$		0.042	0.05	Ω	
			$T_J = 125\text{ }^\circ\text{C}$		0.07		0.08
			$V_{GS} = 10\text{ V}$, $I_D = 13\text{ A}$		0.031		0.035
$I_{D(on)}$	On-State Drain Current	$V_{GS} = 5\text{ V}$, $V_{DS} = 10\text{ V}$	26			A	
g_{FS}	Forward Transconductance	$V_{DS} = 10\text{ V}$, $I_D = 13\text{ A}$		16		S	
DYNAMIC CHARACTERISTICS							
C_{iss}	Input Capacitance	$V_{DS} = 30\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 1.0\text{ MHz}$		840		pF	
C_{oss}	Output Capacitance			230		pF	
C_{rss}	Reverse Transfer Capacitance			75		pF	
SWITCHING CHARACTERISTICS (Note 1)							
$t_{D(on)}$	Turn - On Delay Time	$V_{DD} = 30\text{ V}$, $I_D = 26\text{ A}$, $V_{GS} = 5\text{ V}$, $R_{GEN} = 30\text{ }\Omega$, $R_{GS} = 30\text{ }\Omega$		13	20	nS	
t_r	Turn - On Rise Time			200	400	nS	
$t_{D(off)}$	Turn - Off Delay Time			45	80	nS	
t_f	Turn - Off Fall Time			102	200	nS	
Q_g	Total Gate Charge		$V_{DS} = 24\text{ V}$, $I_D = 26\text{ A}$, $V_{GS} = 5\text{ V}$		17	24	nC
Q_{gs}	Gate-Source Charge			4		nC	
Q_{gd}	Gate-Drain Charge			10		nC	

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
DRAIN-SOURCE DIODE CHARACTERISTICS						
I_S	Maximum Continuous Drain-Source Diode Forward Current				26	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current				78	A
V_{SD}	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 13\text{ A}$ (Note 1)		0.9	1.3	V
t_{rr}	Reverse Recovery Time	$V_{GS} = 0\text{ V}, I_F = 26\text{ A},$ $di_F/dt = 100\text{ A}/\mu\text{s}$		54	120	ns
I_{rr}	Reverse Recovery Current			2.1	8	A
THERMAL CHARACTERISTICS						
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case				2.2	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	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

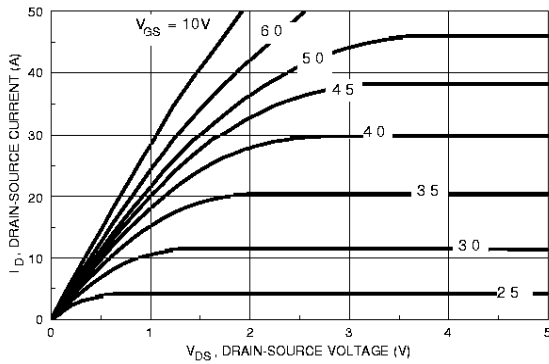


Figure 1. On-Region Characteristics.

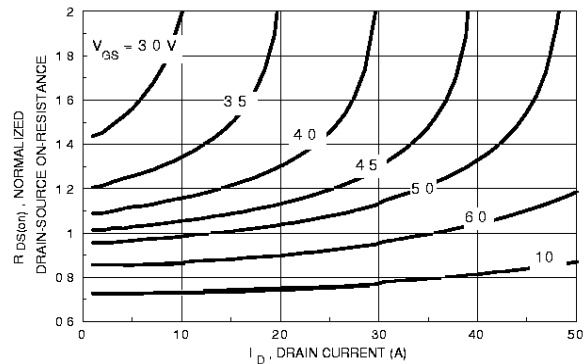


Figure 2. On-Resistance Variation with Gate Voltage and Drain Current.

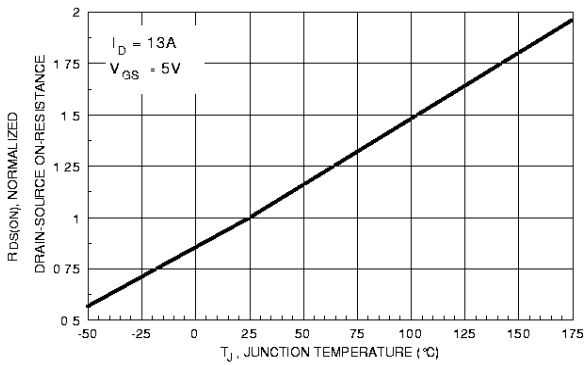


Figure 3. On-Resistance Variation with Temperature.

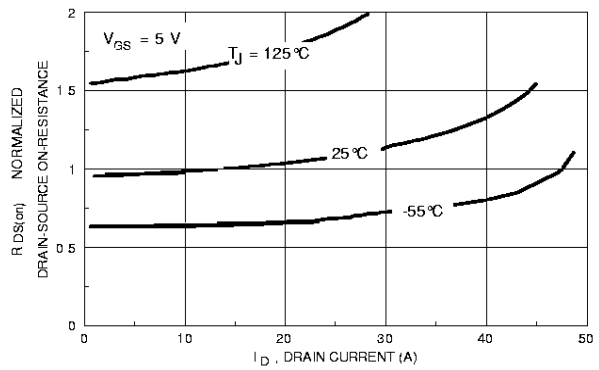


Figure 4. On-Resistance Variation with Drain Current and Temperature.

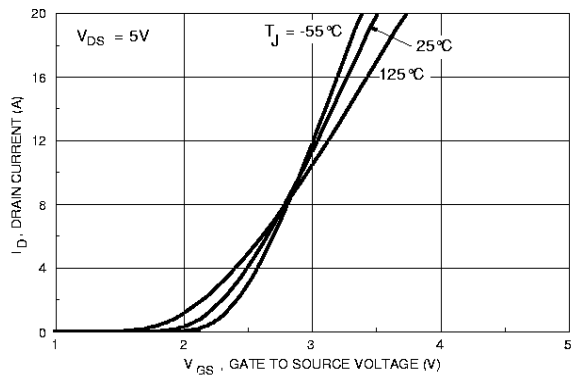


Figure 5. Transfer Characteristics.

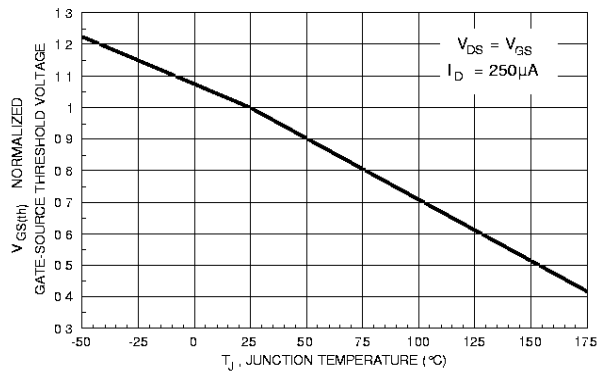


Figure 6. Gate Threshold Variation with Temperature.

Typical Electrical Characteristics (continued)

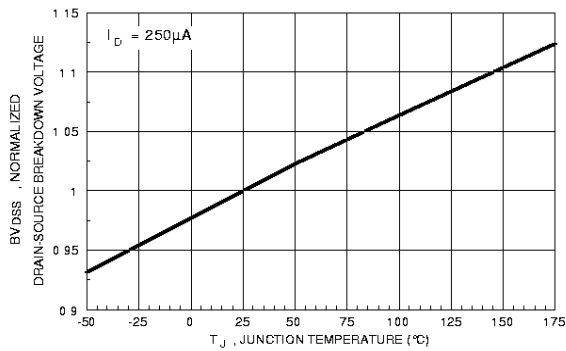


Figure 7. Breakdown Voltage Variation with Temperature.

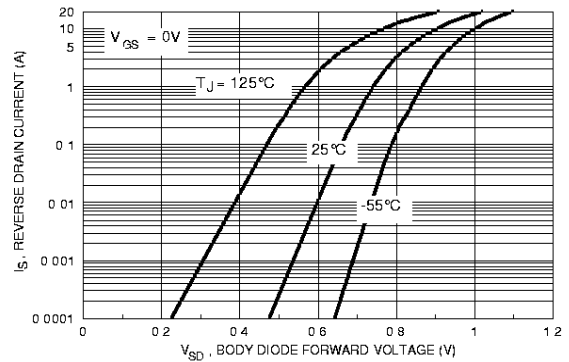


Figure 8. Body Diode Forward Voltage Variation with Current and Temperature.

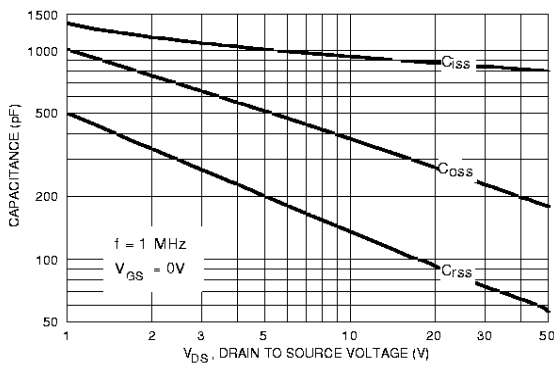


Figure 9. Capacitance Characteristics.

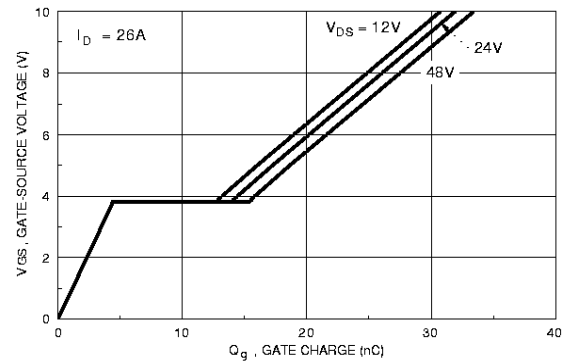


Figure 10. Gate Charge Characteristics.

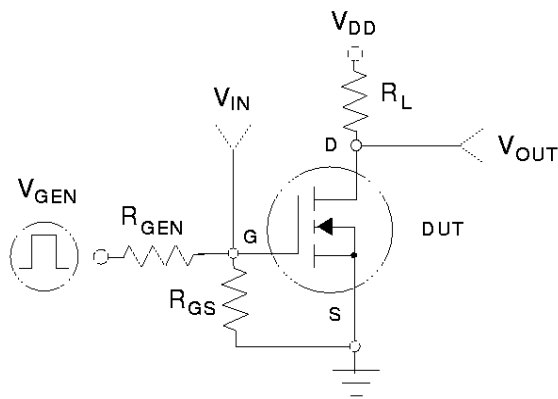


Figure 11. Switching Test Circuit.

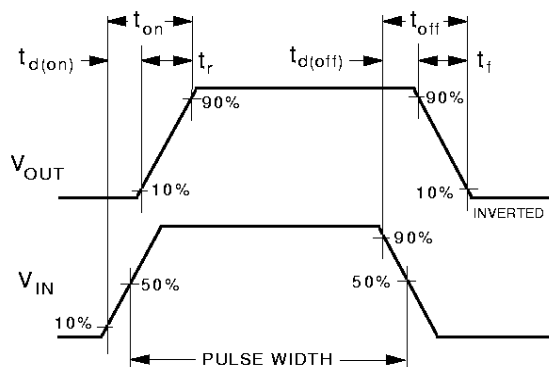


Figure 12. Switching Waveforms.

Typical Electrical Characteristics (continued)

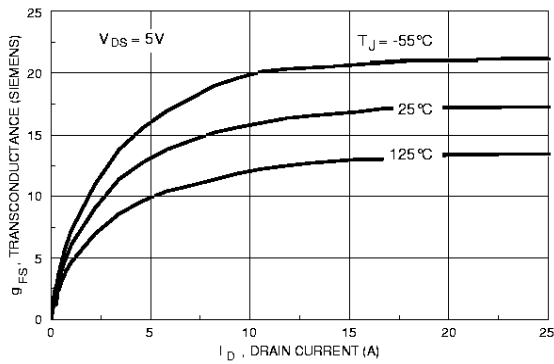


Figure 13. Transconductance Variation with Drain Current and Temperature.

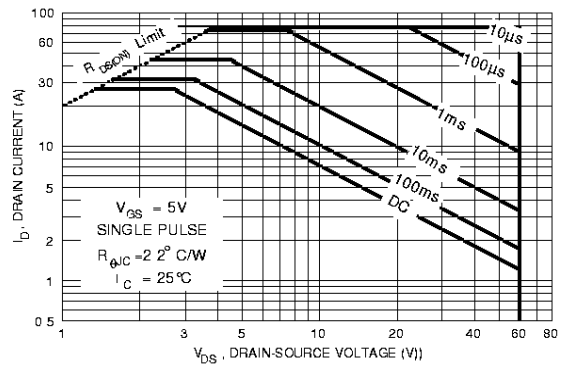


Figure 14. Maximum Safe Operating Area.

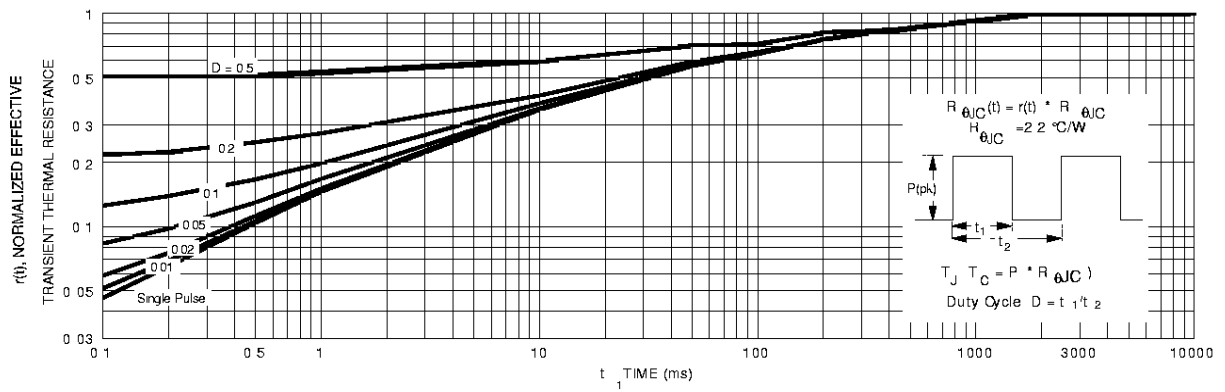


Figure 15. Transient Thermal Response Curve.