

N

NDP6060 / NDB6060

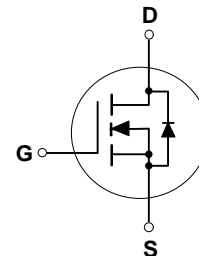
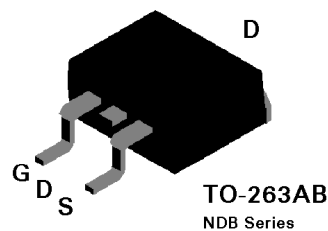
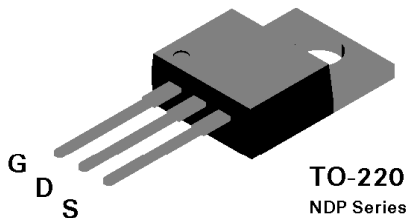
N-Channel Enhancement Mode Field Effect Transistor

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

- 48A, 60V. $R_{DS(ON)} = 0.025\Omega @ V_{GS}=10V$.
- 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 (D²PAK) package for both through hole and surface mount applications.



Absolute Maximum Ratings

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

Symbol	Parameter	NDP6060	NDB6060	Units
V_{DSS}	Drain-Source Voltage	60		V
V_{DGR}	Drain-Gate Voltage ($R_{GS} \leq 1\text{ M}\Omega$)	60		V
V_{GSS}	Gate-Source Voltage - Continuous	± 20		V
	- Nonrepetitive ($t_p < 50\ \mu\text{s}$)	± 40		
I_D	Drain Current - Continuous $T_c=25^\circ\text{C}$	48		A
	- Continuous $T_c=100^\circ\text{C}$	32		
	- Pulsed	144		
P_D	Total Power Dissipation @ $T_c = 25^\circ\text{C}$	100		W
	Derate above 25°C	0.67		W/ $^\circ\text{C}$
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
DRAIN-SOURCE AVALANCHE RATINGS (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
OFF CHARACTERISTICS						
BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}$, $I_D = 250\ \mu\text{A}$	60			V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 60\text{ V}$, $V_{GS} = 0\text{ V}$			250	μA
			$T_J = 125^\circ\text{C}$		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
ON CHARACTERISTICS (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	Ω
			$T_J = 125^\circ\text{C}$		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
DYNAMIC CHARACTERISTICS						
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	pF
C_{rss}	Reverse Transfer Capacitance			150	400	pF
SWITCHING CHARACTERISTICS (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	nS
$t_{D(off)}$	Turn - Off Delay Time			28	60	nS
t_f	Turn - Off Fall Time			77	150	nS
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		nC
Q_{gd}	Gate-Drain Charge			22		nC

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
DRAIN-SOURCE DIODE CHARACTERISTICS						
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 V, I _S = 24 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 = 48 A, dI _F /dt = 100 A/μs	35	87	140	ns
I _{rr}	Reverse Recovery Current		2	3.6	8	A
THERMAL CHARACTERISTICS						
R _{θJC}	Thermal Resistance, Junction-to-Case				1.5	°C/W
R _{θJA}	Thermal Resistance, Junction-to-Ambient				62.5	°C/W

Note:

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

Typical Electrical Characteristics

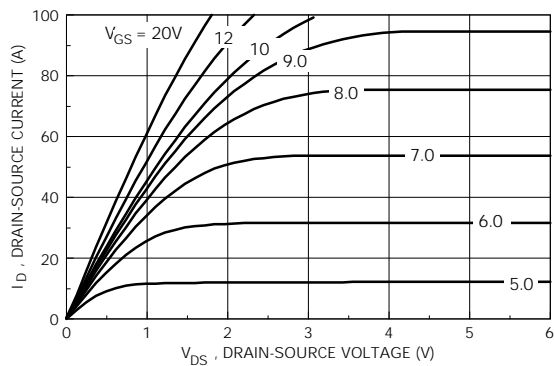


Figure 1. On-Region Characteristics

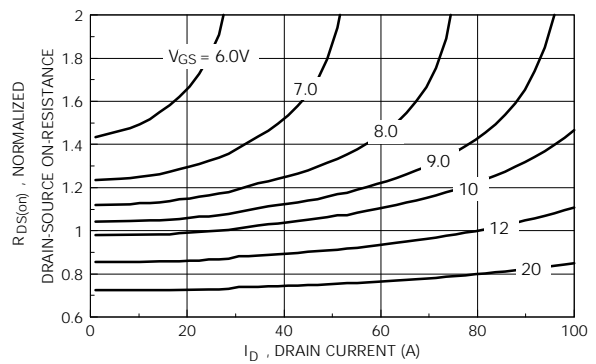


Figure 2. On-Resistance Variation with Gate Voltage and Drain Current

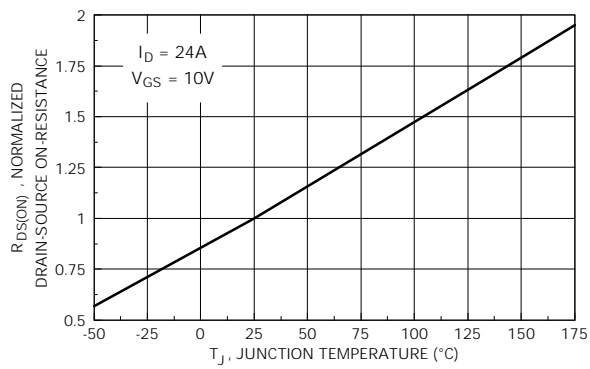


Figure 3. On-Resistance Variation with Temperature

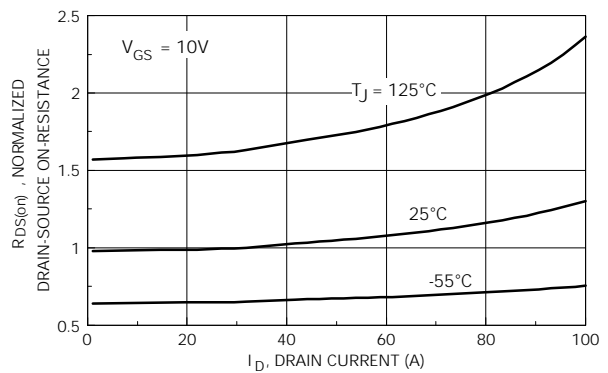


Figure 4. On-Resistance Variation with Drain Current and Temperature

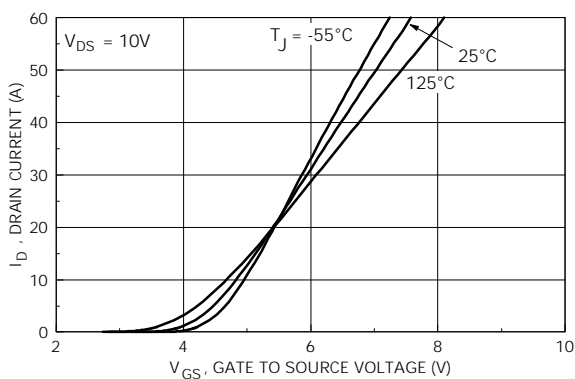


Figure 5. Transfer Characteristics

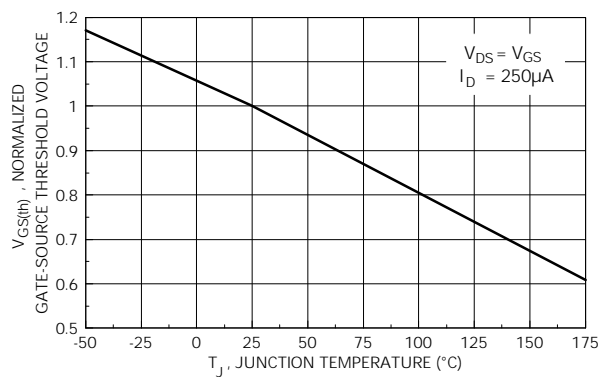


Figure 6. Gate Threshold Variation with Temperature

Typical Electrical Characteristics (continued)

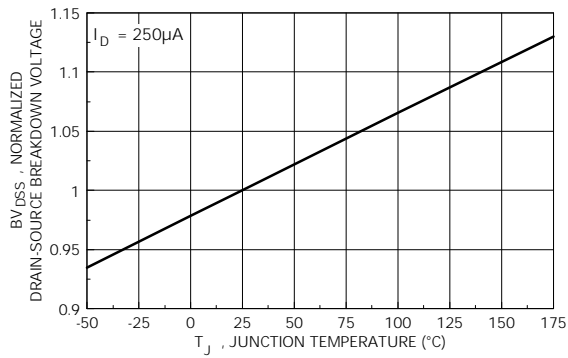


Figure 7. Breakdown Voltage Variation with Temperature

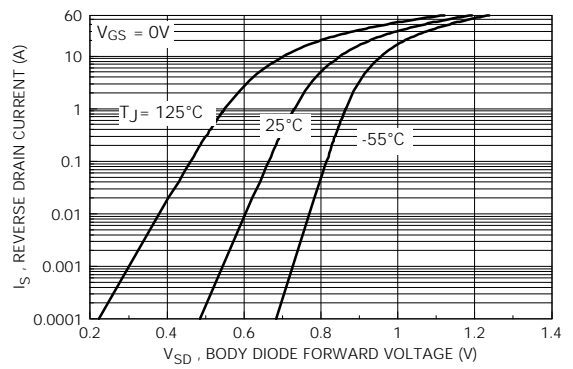


Figure 8. Body Diode Forward Voltage Variation with Current and Temperature

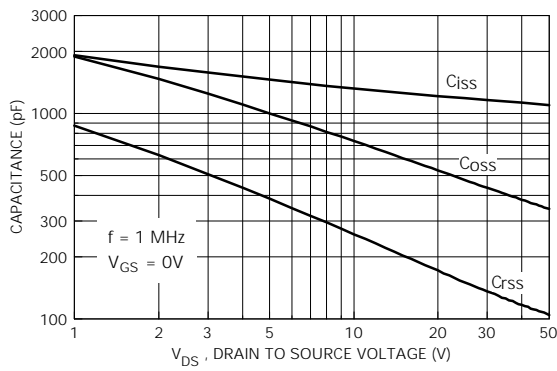


Figure 9. Capacitance Characteristics

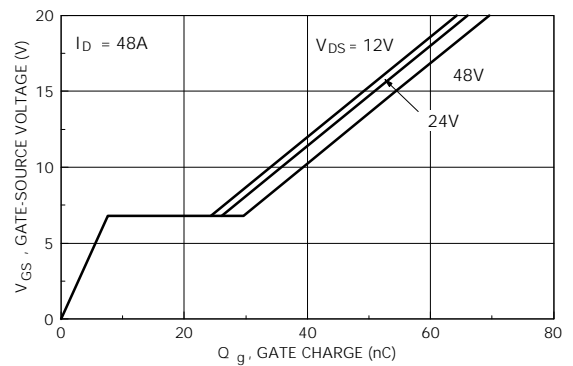


Figure 10. Gate Charge Characteristics

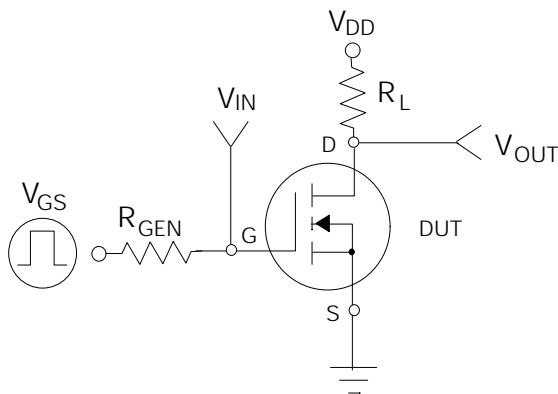


Figure 11. Switching Test Circuit

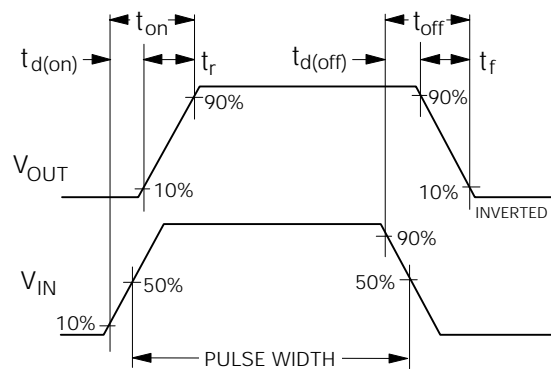


Figure 12. Switching Waveforms

Typical Electrical Characteristics (continued)

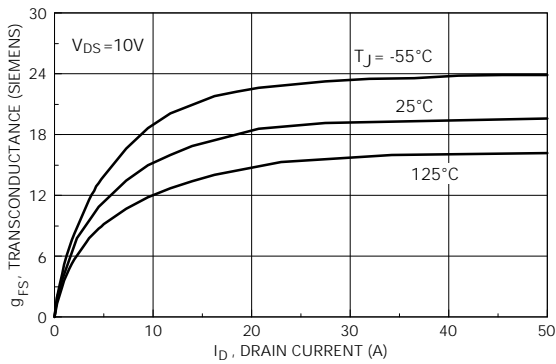


Figure 13. Transconductance Variation with Drain Current and Temperature

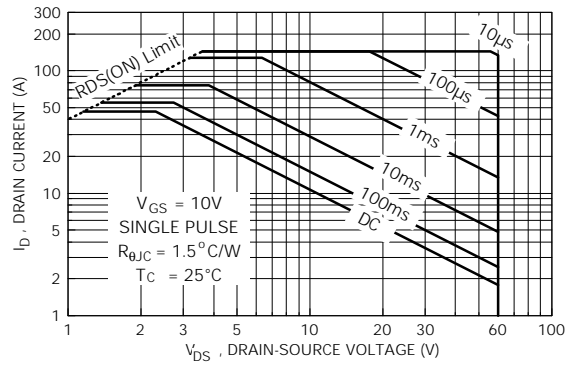


Figure 14. Maximum Safe Operating Area

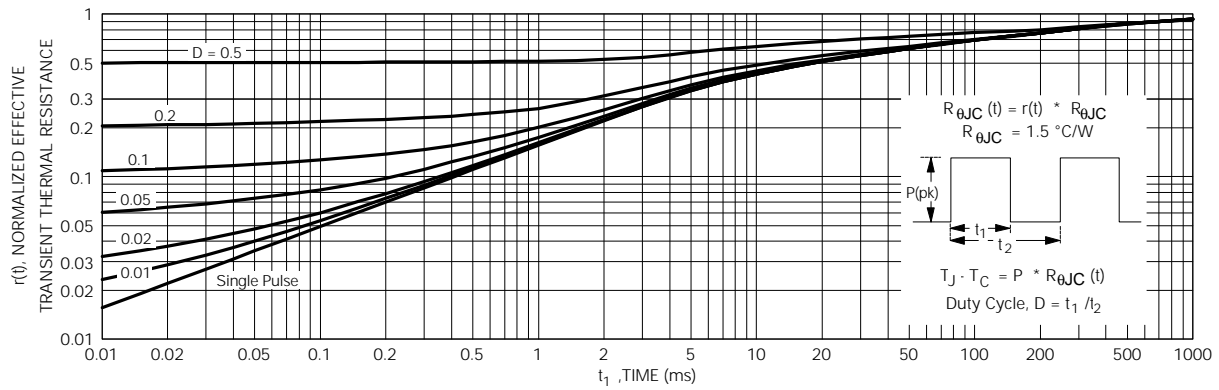


Figure 15. Transient Thermal Response Curve