National Semiconductor

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NDP505A/NDP505B, NDP506A/NDP506B N-Channel Enhancement Mode Power Field Effect Transistor

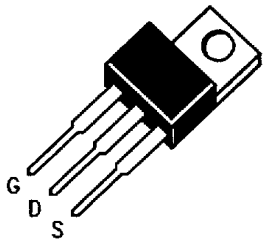
NDP505A/NDP505B, NDP506A/NDP506B
N-Channel Enhancement Mode Power Field Effect Transistor

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 and other battery powered circuits where fast switching, low in-line power loss, and resistance to transients are needed.

Features

- 26 and 24 Amp, 50V and 60V, $R_{DS(on)}$ = 0.050Ω and 0.060Ω
- Critical DC electrical parameters specified at elevated temperature
- Rugged internal source-drain diode eliminates the need for external Zener Diode Transient Suppressor
- 175°C maximum junction temperature rating
- Easily paralleled for higher current applications
- High density cell design (3 million/in²) for extremely low $R_{DS(on)}$
- Lower $R_{DS(on)}$ temperature coefficient



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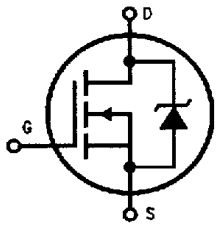

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Absolute Maximum Ratings

Symbol	Parameter	NDP506A	NDP505A	NDP506B	NDP505B	Units
V_{DSS}	Drain-Source Voltage	60	50	60	50	V
V_{DGR}	Drain-Gate Voltage (R_{GS} = 1 MΩ)	60	50	60	50	V
V_{GSS}	Gate-Source Voltage—Continuous —Non Repetitive (t_p < 50 μs)	±20 ±40				V
I_D	Drain Current—Continuous Pulsed	26 78		24 72		A
P_D	Total Power Dissipation @ T_C = 25°C Derate Above 25°C	60 0.40				W 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 sec.	275				°C

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RRD-B30M115/Printed in U. S. A.

Electrical Characteristics T_C = 25°C unless otherwise noted

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

Symbol	Parameter	Test Conditions		Type	Min	Typ	Max	Units
OFF CHARACTERISTICS								
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} = 0V, I_D = 250 μA		NDP505A NDP505B	50			V
				NDP506A NDP506B	60			V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = Rated Voltage, V_{GS} = 0V, T_J = 25°C		All			250	μA
		V_{DS} = Rated Voltage, V_{GS} = 0V, T_J = 125°C		All			1.0	mA
I_{GSSF}	Gate-Body Leakage, Forward	V_{GS} = 20V		All			100	nA
I_{GSSR}	Gate-Body Leakage, Reverse	V_{GS} = −20V		All			−100	nA
ON CHARACTERISTICS								
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS} I_D = 250 μA	T_J = 25°C	All	2.0		4.0	V
			T_J = 125°C		1.4		3.6	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	T_J = 25°C V_{GS} = 10V	I_D = 13A	NDP505A NDP506A		0.040	0.050	Ω
			I_D = 12A	NDP505B NDP506B			0.060	Ω
		T_J = 125°C V_{GS} = 10V	I_D = 13A	NDP505A NDP506A		0.060	0.075	Ω
			I_D = 12A	NDP505B NDP506B			0.090	Ω
g_{FS}	Forward Transconductance	V_{GS} = 10V, I_D = 0.5 Rated I_D		All	6	8		mhos
DYNAMIC CHARACTERISTICS								
C_{iss}	Input Capacitance	V_{GS} = 0V, V_{DS} = 25V f = 1 MHz		All		690	900	pF
C_{rss}	Reverse Transfer Capacitance			All		150	200	pF
C_{oss}	Output Capacitance			All		310	400	pF
SWITCHING CHARACTERISTICS								
$t_{D(on)}$	Turn-On Delay Time	V_{DD} = 25V, I_D = 0.5 Rated I_D, R_{GEN} = 15Ω V_{GS} = 10V		All		13	30	ns
t_r	Rise Time			All		60	100	ns
$t_{D(off)}$	Turn-Off Delay Time			All		27	60	ns
t_f	Fall Time			All		46	80	ns
Q_g	Total Gate Charge	V_{DS} = 0.8 Rated V_{DSS}, I_D = Rated I_D, V_{GS} = 10V		All		30		nC
Q_{gs}	Gate-Source Charge			All		4		nC
Q_{gd}	Gate-Drain Charge			All		16		nC

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

Symbol	Parameter	Test Conditions		Type	Min	Typ	Max	Units
SOURCE-DRAIN DIODE CHARACTERISTICS								
I_S	Maximum Continuous Source Current			NDP505A NDP506A			26	A
				NDP505B NDP506B			24	A
I_{SM}	Maximum Pulsed Source Current			NDP505A NDP506A			78	A
				NDP505B NDP506B			72	A
V_{SD}	Diode Forward Voltage	I_S = 0.5 Rated I_S, V_{GS} = 0V	T_J = 25°C	All			1.3	V
			T_J = 125°C	All			1.2	V
t_{rr}	Reverse Recovery Time	V_{GS} = 0V, I_S = 0.5 Rated I_S, dI_S/dt = 100 A/μs		All		80		ns
I_{rr}	Reverse Recovery Current			All		4.4		A
THERMAL CHARACTERISTICS								
$R_{\theta JC}$	Thermal Resistance, Junction to Case						2.50	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient						62.5	°C/W

Typical Electrical Characteristics

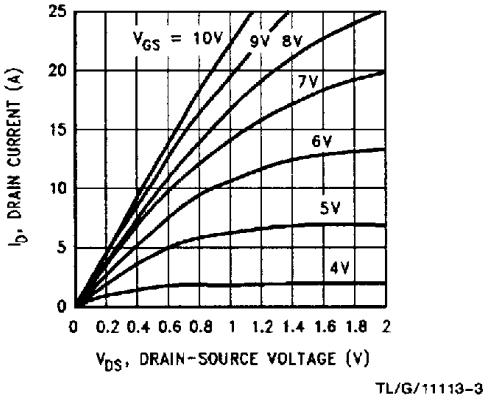

FIGURE 1. On-Region Characteristics

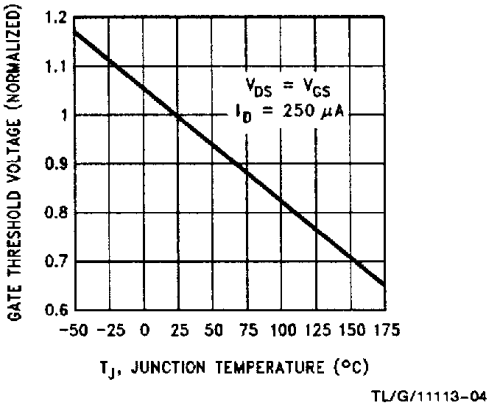

FIGURE 2. Gate Threshold Variation with Temperature

Typical Electrical Characteristics (Continued)

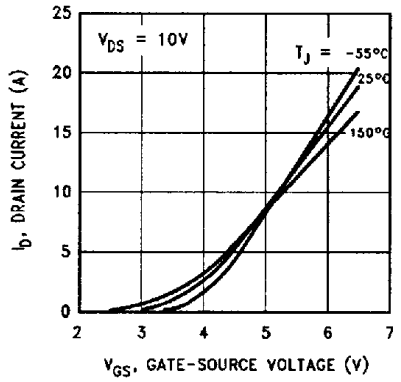

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FIGURE 3. Transfer Characteristics

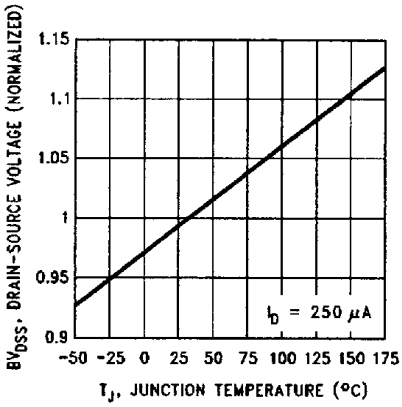

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FIGURE 4. Breakdown Voltage Variation with Temperature

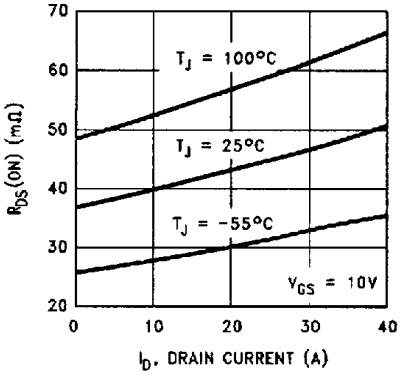

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FIGURE 5. On-Resistance versus Drain Current

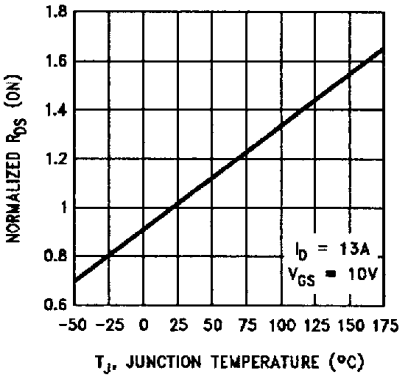

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FIGURE 6. On-Resistance Variation with Temperature

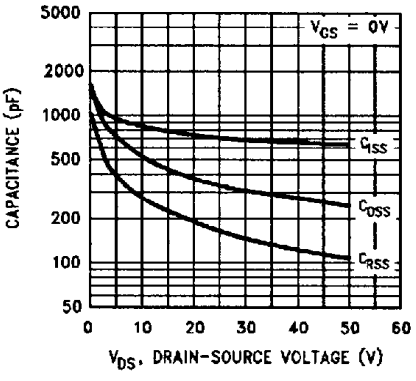

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FIGURE 7. Capacitance versus Drain-Source Voltage

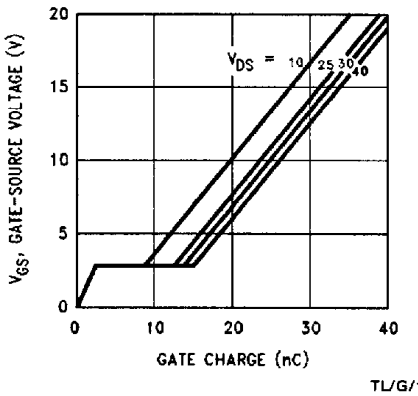

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FIGURE 8. Gate Charge versus Gate-Source Voltage

Typical Electrical Characteristics (Continued)

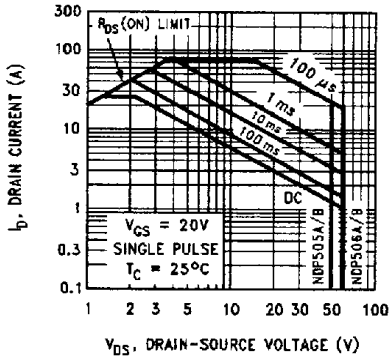

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FIGURE 9. Maximum Rated Forward Biased Safe Operating Area

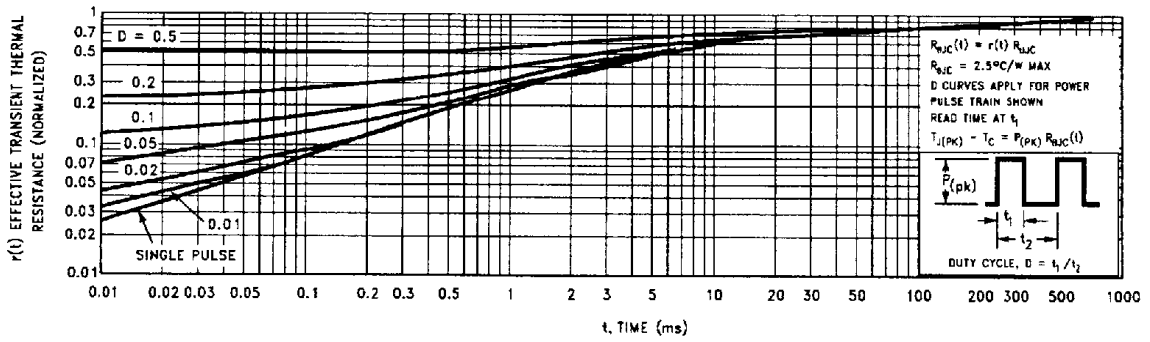

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FIGURE 10. Thermal Response

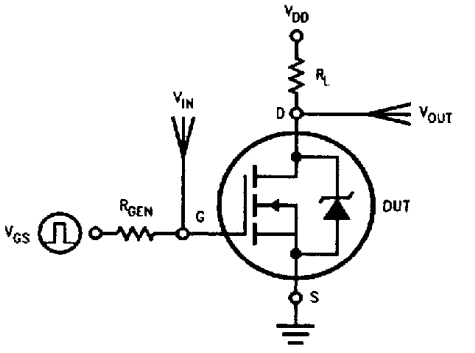

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FIGURE 11. Switching Test Circuit

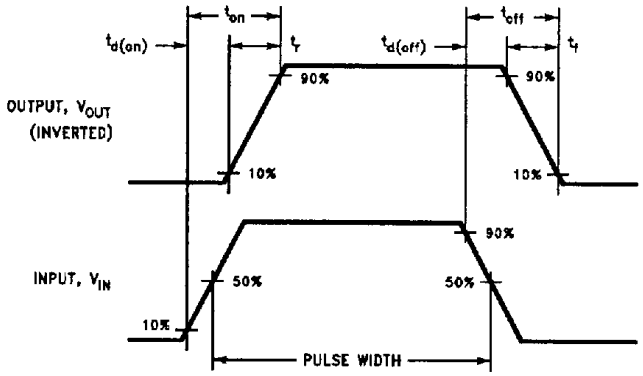

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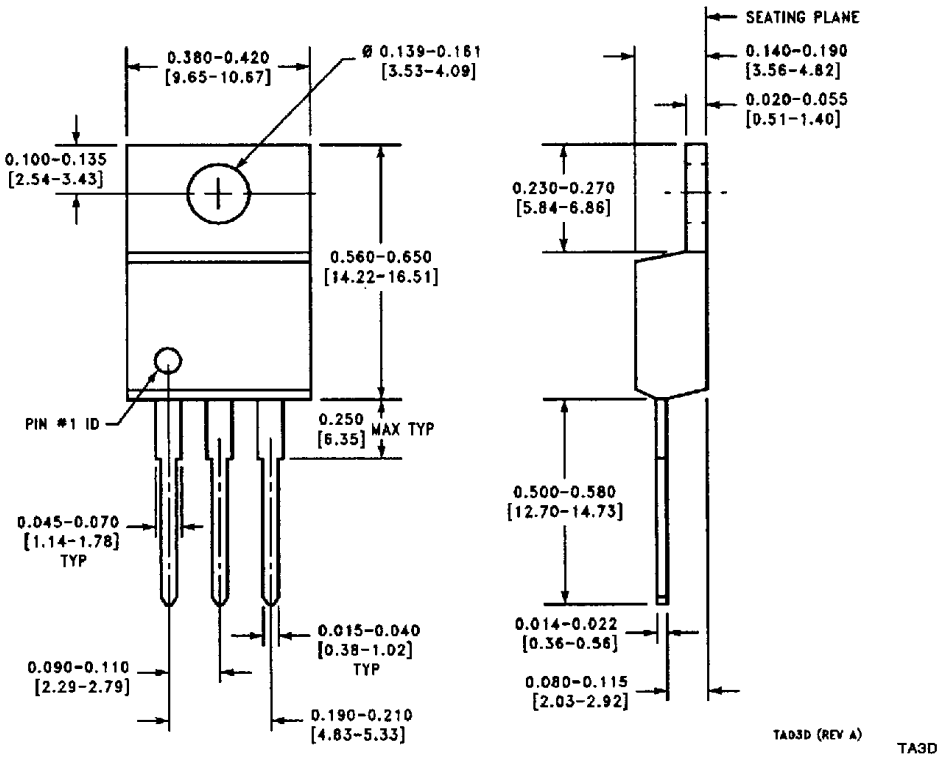
FIGURE 12. Switching Waveforms

Package Information



Pin	TO-220
1	Gate
2	Drain
3	Source

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National Semiconductor Corporation
1111 West Bardin Road
Arlington, TX 76017
Tel: 1(800) 272-9959
Fax: 1(800) 737-7018

National Semiconductor Europe
Fax: (+49) 0-180-530 85 86
Email: cnjwge@tevm2.nsc.com
Deutsch Tel: (+49) 0-180-530 85 85
English Tel: (+49) 0-180-532 78 32
Français Tel: (+49) 0-180-532 93 58
Italiano Tel: (+49) 0-180-534 16 80

National Semiconductor Hong Kong Ltd.
13th Floor, Straight Block,
Ocean Centre, 5 Canton Rd.
Tsimshatsui, Kowloon
Hong Kong
Tel: (852) 2737-1600
Fax: (852) 2736-9960

National Semiconductor Japan Ltd.
Tel: 81-043-299-2309
Fax: 81-043-299-2408