National Semiconductor

March 1993

NDP605A/NDP605B, NDP606A/NDP606B N-Channel Enhancement Mode Power Field Effect Transistor

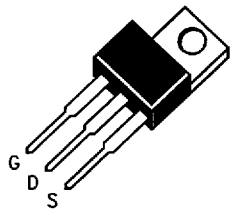
NDP605A/NDP605B, NDP606A/NDP606B
N-Channel Enhancement Mode Power Field Effect Transistor

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.

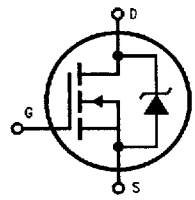
Features

- 48 and 42 Amp, 50V and 60V, $R_{DS(on)}$ = 0.025Ω and 0.028Ω
- 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/in^2) for extremely low $R_{DS(on)}$
- Lower $R_{DS(on)}$ temperature coefficient



TL/G/11112–1

TO-220AB



TL/G/11112–2

Absolute Maximum Ratings

Symbol	Parameter	NDP606A	NDP605A	NDP606B	NDP605B	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	48 144		42 126		A
P_D	Total Power Dissipation @ T_C = 25°C Derate Above 25°C	100 0.67				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

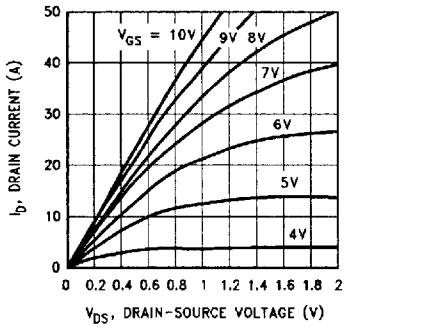
Electrical Characteristics T_C = 25°C unless otherwise noted

Symbol	Parameter	Test Conditions		Type	Min	Typ	Max	Units
OFF CHARACTERISTICS								
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} = 0V, I_D = 250 μA		NDP605A NDP605B	50			V
				NDP606A NDP606B	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 = 24A	NDP605A NDP606A		0.020	0.025	Ω
			I_D = 21A	NDP605B NDP606B			0.028	Ω
		T_J = 125°C V_{GS} = 10V	I_D = 24A	NDP605A NDP606A		0.030	0.038	Ω
			I_D = 21A	NDP605B NDP606B			0.048	Ω
g_{FS}	Forward Transconductance	V_{GS} = 10V, I_D = 0.5 Rated I_D		All	10	18		mhos
DYNAMIC CHARACTERISTICS								
C_{iss}	Input Capacitance	V_{GS} = 0V, V_{DS} = 25V f = 1 MHz		All		1375	1800	pF
C_{rss}	Reverse Transfer Capacitance			All		300	400	pF
C_{oss}	Output Capacitance			All		620	800	pF
SWITCHING CHARACTERISTICS								
$t_{D(on)}$	Turn-On Delay Time	V_{DD} = 25V, I_D = 0.5 Rated I_D, R_{GEN} = 7.5Ω V_{GS} = 10V		All		16	30	ns
t_r	Rise Time			All		80	120	ns
$t_{D(off)}$	Turn-Off Delay Time			All		30	60	ns
t_f	Fall Time			All		55	100	ns
Q_g	Total Gate Charge	V_{DS} = 0.8 Rated V_{DSS}, I_D = Rated I_D, V_{GS} = 10V		All		60		nC
Q_{gs}	Gate-Source Charge			All		6		nC
Q_{gd}	Gate-Drain Charge			All		32		nC

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

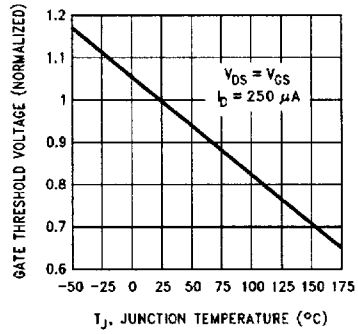
Symbol	Parameter	Test Conditions		Type	Min	Typ	Max	Units
SOURCE-DRAIN DIODE CHARACTERISTICS								
I_S	Maximum Continuous Source Current			NDP605A NDP606A			48	A
				NDP605B NDP606B			42	A
I_{SM}	Maximum Pulsed Source Current			NDP605A NDP606A			144	A
				NDP605B NDP606B			126	A
V_{SD}	Diode Forward 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, dIs/dt = 100 A/μs		All		85		ns
I_{rr}	Reverse Recovery Current			All		4.8		A
THERMAL CHARACTERISTICS								
$R_{\theta JC}$	Thermal Resistance, Junction to Case						1.50	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient						62.5	°C/W

Typical Electrical Characteristics



TL/G/11112-3

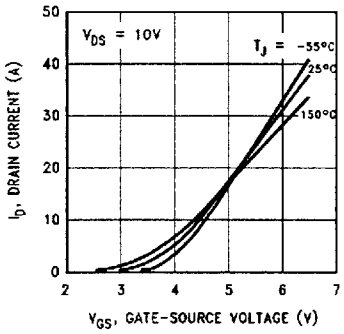
FIGURE 1. On-Region Characteristics



TL/G/11112-4

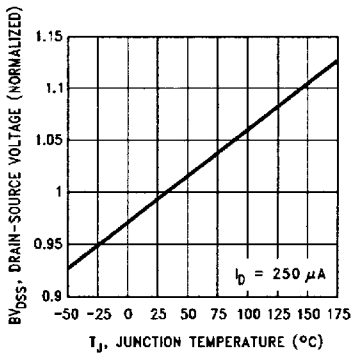
FIGURE 2. Gate Threshold Variation with Temperature

Typical Electrical Characteristics (Continued)



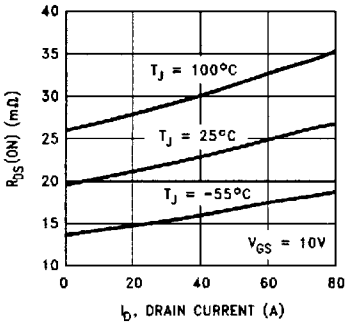
TL/G/11112–5

FIGURE 3. Transfer Characteristics



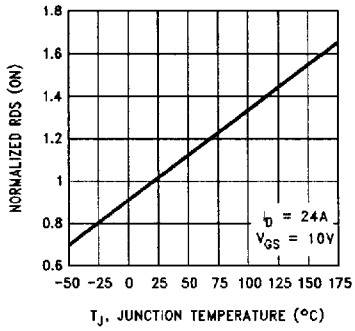
TL/G/11112–6

FIGURE 4. Breakdown Voltage Variation with Temperature



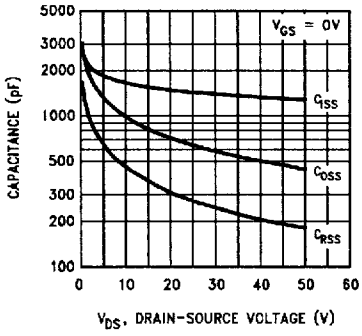
TL/G/11112–7

FIGURE 5. On-Resistance versus Drain Current



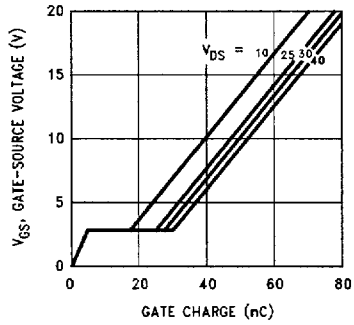
TL/G/11112–8

FIGURE 6. On-Resistance Variation with Temperature



TL/G/11112–9

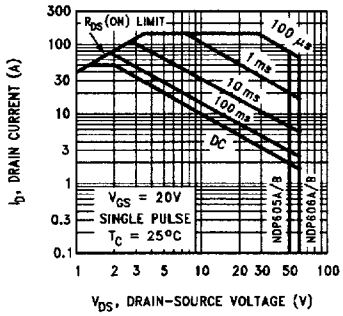
FIGURE 7. Capacitance versus Drain-Source Voltage



TL/G/11112–10

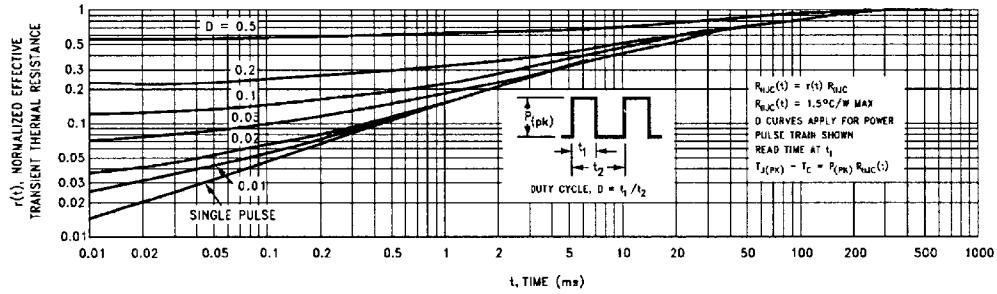
FIGURE 8. Gate Charge versus Gate-Source Voltage

Typical Electrical Characteristics (Continued)



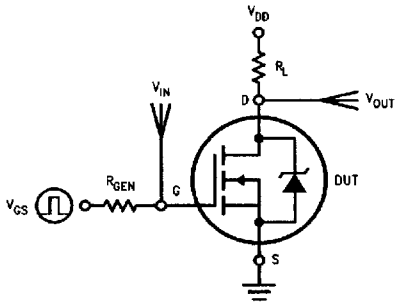
TL/G/11112–11

FIGURE 9. Maximum Rated Forward Biased Safe Operating Area



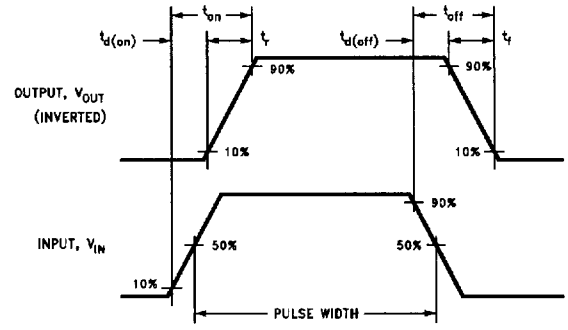
TL/G/11112–12

FIGURE 10. Thermal Response



TL/G/11112–13

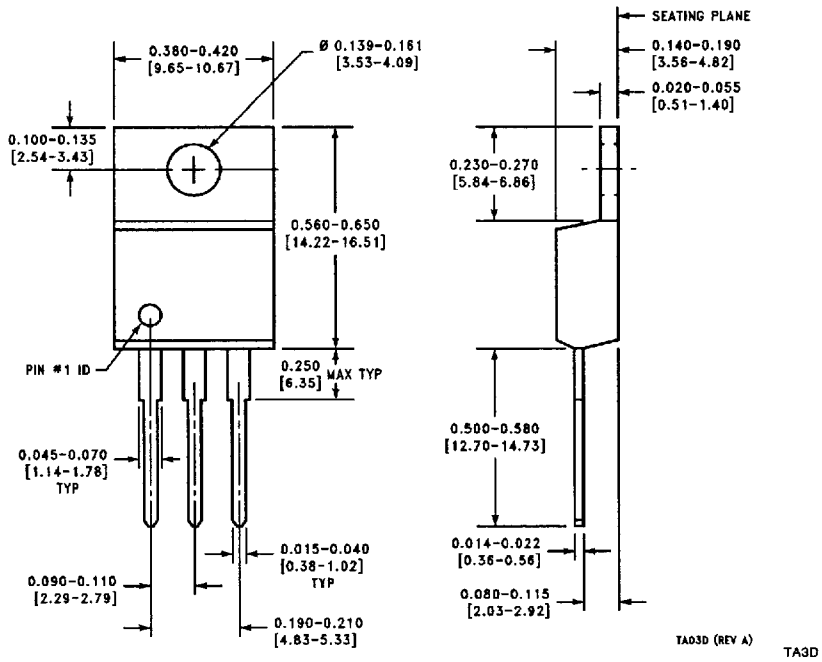
FIGURE 11. Switching Test Circuit



TL/G/11112–14

FIGURE 12. Switching Waveforms

Package Information



TA3D

Pin	TO-220
1	Gate
2	Drain
3	Source

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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