# 9.0 A High-Speed MOSFET Drivers

The NCP4421/4422 are high current buffer/drivers capable of driving large MOSFETs and IGBTs.

They are essentially immune to any form of upset except direct overvoltage or over-dissipation – they cannot be latched under any conditions within their power and voltage ratings; they are not subject to damage or improper operation when up to 5.0 V of ground bounce is present on their ground terminals; they can accept, without either damage or logic upset, more than 1.0 A inductive current of either polarity being forced back into their outputs. In addition, all terminals are fully protected against up to 4.0 kV of electrostatic discharge.

The inputs may be driven directly from either TTL or CMOS (3.0 V to 18 V). In addition, 300 mV of hysteresis is built into the input, providing noise immunity and allowing the device to be driven from slowly rising or falling waveforms.

### Features

- Tough CMOS<sup>™</sup> Construction
- High Peak Output Current (9.0 A)
- High Continuous Output Current (2.0 A Max)
- Fast Rise and Fall Times:
  - 30 ns with 4,700 pF Load
  - 180 ns with 47,000 pF Load
- Short Internal Delays (30 nsec Typ)
- Low Output Impedance  $(1.4 \Omega \text{ Typ})$

### Applications

- Line Drivers for Extra-Heavily-Loaded Lines
- Pulse Generators
- Driving the Largest MOSFETs and IGBTs
- Local Power ON/OFF Switch
- Motor and Solenoid Driver





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#### **ORDERING INFORMATION**

See detailed ordering and shipping information in the package dimensions section on page 8 of this data sheet.

#### **DEVICE MARKING INFORMATION**

See general marking information in the device marking section on page 8 of this data sheet.

#### **ABSOLUTE MAXIMUM RATINGS\***

Rating	Symbol	Value	Unit
Power Dissipation ( $T_A \le 70^{\circ}$ C) PDIP 5–Pin TO–220	-	730 1.6	W
Power Dissipation ( $T_C \le 25^{\circ}C$ ) 5–Pin TO–220 (With Heat Sink)	-	12.5	W
Derating Factors (To Ambient) PDIP 5–Pin TO–220	_	8.0 12	mW/°C
Thermal Impedance (To Case) 5–Pin TO–220 R <sub>0JC</sub>	-	10	°C/W
Storage Temperature	T <sub>stg</sub>	-65 to +150	°C
Operating Temperature (Chip)	-	150	°C
Operating Temperature (Ambient) TO–220 Version PDIP Version	-	0 to +70 -40 to +85	°C
Lead Temperature (10 Seconds)	-	300	°C
Supply Voltage	V <sub>CC</sub>	20	V
Input Voltage	-	V <sub>DD</sub> +3.0 to GND –5.0	V
Input Current (V <sub>IN &gt;</sub> V <sub>DD</sub> )	-	50	mA

\*Static-sensitive device. Unused devices must be stored in conductive material. Protect devices from static discharge and static fields. Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions above those indicated in the operational sections of the specifications is not implied. Exposure to Absolute Maximum Rating Conditions for extended periods may affect device reliability.

### **ELECTRICAL CHARACTERISTICS** (T<sub>A</sub> = 25°C with 4.5 V $\leq$ V<sub>DD</sub> $\leq$ 18 V unless otherwise specified.)

Characteristics	Test Conditions	Symbol Min		Тур	Max	Unit
Input		•				•
Logic 1 Input Voltage	Logic 1 Input Voltage –		2.4	1.8	-	V
Logic 0 Input Voltage	-	V <sub>IL</sub>	-	1.3	0.8	V
Input Current	$0 V \leq V_{IN} \leq V_{DD}$	I <sub>IN</sub>	-10	-	10	μΑ
Output						
High Output Voltage	See Figure 1	V <sub>OH</sub>	V <sub>DD</sub> - 0.025	-	-	V
Low Output Voltage	See Figure 1	V <sub>OL</sub>	-	-	0.025	V
Output Resistance, High	V <sub>DD</sub> = 18 V, I <sub>O</sub> = 10 mA	R <sub>O</sub>	-	1.4	-	Ω
Output Resistance, Low	V <sub>DD</sub> = 18 V, I <sub>O</sub> = 10 mA	R <sub>O</sub>	-	0.9	1.7	Ω
Peak Output Current V <sub>DD</sub> = 18 V		I <sub>PK</sub>	-	9.0	-	А
$\begin{tabular}{lllllllllllllllllllllllllllllllllll$		I <sub>DC</sub>	2.0	-	-	A
Latch–Up Protection	Duty Cycle ≤ 2% Withstand Reverse Current	I <sub>REV</sub>	>1500 t ≤ 300 μs	_	-	mA
Switching Time (Note 1.)		•				•
Rise Time	Figure 1, C <sub>L</sub> = 10,000 pF	t <sub>R</sub>	-	60	75	nsec
Fall TimeFigure 1, CL = 10,000 pF		t <sub>F</sub>	-	60	75	nsec
Delay Time	Time Figure 1		-	30	60	nsec
Delay Time Figure 1		t <sub>D2</sub>	-	33	60	nsec

1. Switching times guaranteed by design.

# **ELECTRICAL CHARACTERISTICS (continued)** (T<sub>A</sub> = 25°C with 4.5 V $\leq$ V<sub>DD</sub> $\leq$ 18 V unless otherwise specified.)

Characteristics	Test Conditions	Symbol	Min	Тур	Max	Unit
Power Supply						
Power Supply Current	V <sub>IN</sub> = 3.0 V V <sub>IN</sub> = 0 V	۱ <sub>S</sub>		0.2 55	1.5 150	mA μA
Operating Input Voltage	-	V <sub>DD</sub>	4.5	-	18	V
Input						
Logic 1 Input Voltage	-	V <sub>IH</sub>	2.4	-	-	V
Logic 0 Input Voltage	-	V <sub>IL</sub>	-	-	0.8	V
Input Current	$0 V \leq V_{IN} \leq V_{DD}$	I <sub>IN</sub>	-10	-	10	μA

## **ELECTRICAL CHARACTERISTICS** (Measured over operating temperature range with 4.5 V $\leq$ V<sub>S</sub> $\leq$ 18 V unless otherwise specified.)

Characteristics	Test Conditions	Symbol	Min	Тур	Max	Unit
Input						
Logic 1 Input Voltage	-	V <sub>IH</sub>	2.4	-	-	V
Logic 0 Input Voltage	-	V <sub>IL</sub>	-	-	0.8	V
Input Current	$0 V \leq V_{IN} \leq V_{DD}$	I <sub>IN</sub>	-10	-	10	μA
Output						
High Output Voltage	See Figure 1	V <sub>OH</sub>	V <sub>DD</sub> - 0.025	-	-	V
Low Output Voltage	See Figure 1	V <sub>OL</sub>	-	-	0.025	V
Output Resistance, High	V <sub>DD</sub> = 18 V, I <sub>O</sub> = 10 mA	R <sub>O</sub>	-	2.4	3.6	W
Output Resistance, Low	V <sub>DD</sub> = 18 V, I <sub>O</sub> = 10 mA	R <sub>O</sub>	-	1.8	2.7	W
Switching Time (Note 1.)						
Rise Time	Figure 1, C <sub>L</sub> = 10,000 pF	t <sub>R</sub>	-	60	120	nsec
Fall Time	Figure 1, C <sub>L</sub> = 10,000 pF	t <sub>F</sub>	-	60	120	nsec
Delay Time	Figure 1	t <sub>D1</sub>	-	50	80	nsec
Delay Time	Figure 1	t <sub>D2</sub>	-	65	80	nsec
Power Supply		<u>.</u>				
Power Supply Current	V <sub>IN</sub> = 3.0 V	۱ <sub>S</sub>	-	0.45	3.0	mA
	V <sub>IN</sub> = 0 V		-	0.06	0.2	
Operating Input Voltage	-	V <sub>DD</sub>	4.5	-	18	V

1. Switching times guaranteed by design.





Figure 1. Switching Time Test Circuit





### **TYPICAL ELECTRICAL CHARACTERISTICS**



### **TYPICAL ELECTRICAL CHARACTERISTICS**



Figure 14. Propagation Delay vs. Input Amplitude







Figure 16. Crossover Energy vs. Supply Voltage







Figure 17. Quiescent Supply Current vs. Temperature





#### MARKING DIAGRAMS





x = 1 or 2

X = Assembly ID Code Y = Year

CO = Country of Origin

#### **ORDERING INFORMATION**

Device	Package	Temperature Range	Shipping
NCP4421T	5–Pin TO–220	0°C to + 70°C	50 Units/Rail
NCP4421P	8–Pin PDIP	-40°C to + 85°C	50 Units/Rail
NCP4422T	5–Pin TO–220	0°C to + 70°C	50 Units/Rail
NCP4422P	8–Pin PDIP	-40°C to + 85°C	50 Units/Rail

# <u>Notes</u>

# <u>Notes</u>

## PACKAGE DIMENSIONS

PDIP **P SUFFIX** CASE 626-05 ISSUE K



NOTES: 1. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL. 2. PACKAGE CONTOUR OPTIONAL (ROUND OR SQUARE CORNERS). 3. DIMENSIONING AND TOLERANCING PER ANSI VIEW 1000 Y14.5M, 1982.

	MILLIMETERS		INC	HES
DIM	MIN	MAX	MIN	MAX
Α	9.40	10.16	0.370	0.400
В	6.10	6.60	0.240	0.260
С	3.94	4.45	0.155	0.175
D	0.38	0.51	0.015	0.020
F	1.02	1.78	0.040	0.070
G	2.54	2.54 BSC		BSC
Н	0.76	1.27	0.030	0.050
J	0.20	0.30	0.008	0.012
K	2.92	3.43	0.115	0.135
L	7.62 BSC		0.300	BSC
М		10°		10°
N	0.76	1.01	0.030	0.040

TO-220 **T SUFFIX** CASE 314D-04 ISSUE E



NOTES:

IOTES: 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982. 2. CONTROLLING DIMENSION: INCH. 3. DIMENSION D DOES NOT INCLUDE INTERCONNECT BAR (DAMBAR) PROTRUSION. DIMENSION D INCLUDING PROTRUSION SHALL NOT EXCEED 10.92 (0.043) MAXIMUM.

	INCHES		MILLIN	IETERS
DIM	MIN	MAX	MIN	MAX
Α	0.572	0.613	14.529	15.570
В	0.390	0.415	9.906	10.541
C	0.170	0.180	4.318	4.572
D	0.025	0.038	0.635	0.965
Е	0.048	0.055	1.219	1.397
G	0.067	BSC	1.702	BSC
н	0.087	0.112	2.210	2.845
J	0.015	0.025	0.381	0.635
K	0.990	1.045	25.146	26.543
L	0.320	0.365	8.128	9.271
Q	0.140	0.153	3.556	3.886
U	0.105	0.117	2.667	2.972

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