NCP4421, NCP4422

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.

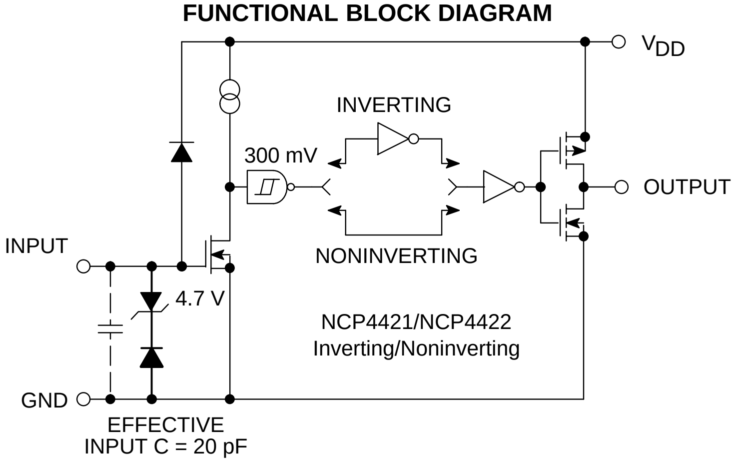
Features

- Tough CMOS™ 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 Ω Typ)

Applications

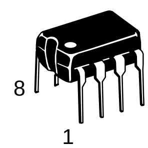
- Line Drivers for Extra–Heavily–Loaded Lines
- Pulse Generators
- Driving the Largest MOSFETs and IGBTs
- Local Power ON/OFF Switch
- Motor and Solenoid Driver

FUNCTIONAL BLOCK DIAGRAM

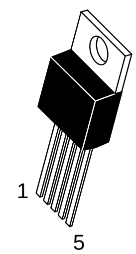


ON Semiconductor

http://onsemi.com



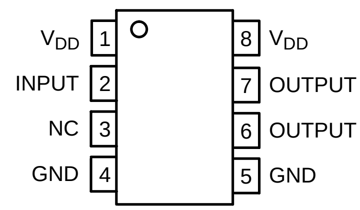
PDIP–8
P SUFFIX
CASE 626



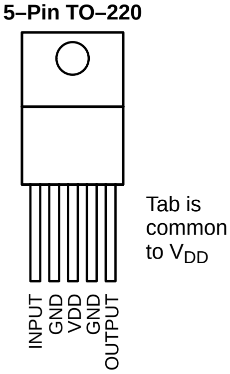
TO–220
T SUFFIX
CASE 314D

PIN CONNECTIONS

8–Pin Plastic DIP



5–Pin TO–220



NOTE: Duplicate pins must *both* be connected for proper operation.
NC = No connection

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 ($T_A \leq 70°C$) PDIP 5–Pin TO–220	–	 730 1.6	W
Power Dissipation ($T_C \leq 25°C$) 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 $R_{\theta JC}$	–	10	°C/W
Storage Temperature	T_{stg}	–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_{CC}	20	V
Input Voltage	–	V_{DD} +3.0 to GND –5.0	V
Input Current ($V_{IN} > V_{DD}$)	–	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_A = 25°C with 4.5 V $\leq V_{DD} \leq$ 18 V unless otherwise specified.)

Characteristics	Test Conditions	Symbol	Min	Typ	Max	Unit
Input						
Logic 1 Input Voltage	–	V_{IH}	2.4	1.8	–	V
Logic 0 Input Voltage	–	V_{IL}	–	1.3	0.8	V
Input Current	0 V $\leq V_{IN} \leq V_{DD}$	I_{IN}	–10	–	10	µA
Output						
High Output Voltage	See Figure 1	V_{OH}	V_{DD} – 0.025	–	–	V
Low Output Voltage	See Figure 1	V_{OL}	–	–	0.025	V
Output Resistance, High	V_{DD} = 18 V, I_O = 10 mA	R_O	–	1.4	–	Ω
Output Resistance, Low	V_{DD} = 18 V, I_O = 10 mA	R_O	–	0.9	1.7	Ω
Peak Output Current	V_{DD} = 18 V	I_{PK}	–	9.0	–	A
Continuous Output Current	10 V $\leq V_{DD} \leq$ 18 V, T_C = 25° (TC4421/22 CAT only)	I_{DC}	2.0	–	–	A
Latch–Up Protection	Duty Cycle $\leq$ 2% Withstand Reverse Current	I_{REV}	> 1500 t $\leq$ 300 µs	–	–	mA
Switching Time (Note 1.)						
Rise Time	Figure 1, C_L = 10,000 pF	t_R	–	60	75	nsec
Fall Time	Figure 1, C_L = 10,000 pF	t_F	–	60	75	nsec
Delay Time	Figure 1	t_{D1}	–	30	60	nsec
Delay Time	Figure 1	t_{D2}	–	33	60	nsec

1. Switching times guaranteed by design.

ELECTRICAL CHARACTERISTICS (continued) (T_A = 25°C with 4.5 V ≤ V_{DD} ≤ 18 V unless otherwise specified.)

Characteristics	Test Conditions	Symbol	Min	Typ	Max	Unit
Power Supply						
Power Supply Current	V_{IN} = 3.0 V V_{IN} = 0 V	I_S	– –	0.2 55	1.5 150	mA μA
Operating Input Voltage	–	V_{DD}	4.5	–	18	V
Input						
Logic 1 Input Voltage	–	V_{IH}	2.4	–	–	V
Logic 0 Input Voltage	–	V_{IL}	–	–	0.8	V
Input Current	0 V ≤ V_{IN} ≤ V_{DD}	I_{IN}	–10	–	10	μA

ELECTRICAL CHARACTERISTICS (Measured over operating temperature range with 4.5 V ≤ V_S ≤ 18 V unless otherwise specified.)

Characteristics	Test Conditions	Symbol	Min	Typ	Max	Unit
Input						
Logic 1 Input Voltage	–	V_{IH}	2.4	–	–	V
Logic 0 Input Voltage	–	V_{IL}	–	–	0.8	V
Input Current	0 V ≤ V_{IN} ≤ V_{DD}	I_{IN}	–10	–	10	μA
Output						
High Output Voltage	See Figure 1	V_{OH}	V_{DD} – 0.025	–	–	V
Low Output Voltage	See Figure 1	V_{OL}	–	–	0.025	V
Output Resistance, High	V_{DD} = 18 V, I_O = 10 mA	R_O	–	2.4	3.6	W
Output Resistance, Low	V_{DD} = 18 V, I_O = 10 mA	R_O	–	1.8	2.7	W
Switching Time (Note 1.)						
Rise Time	Figure 1, C_L = 10,000 pF	t_R	–	60	120	nsec
Fall Time	Figure 1, C_L = 10,000 pF	t_F	–	60	120	nsec
Delay Time	Figure 1	t_{D1}	–	50	80	nsec
Delay Time	Figure 1	t_{D2}	–	65	80	nsec
Power Supply						
Power Supply Current	V_{IN} = 3.0 V V_{IN} = 0 V	I_S	– –	0.45 0.06	3.0 0.2	mA
Operating Input Voltage	–	V_{DD}	4.5	–	18	V

1. Switching times guaranteed by design.

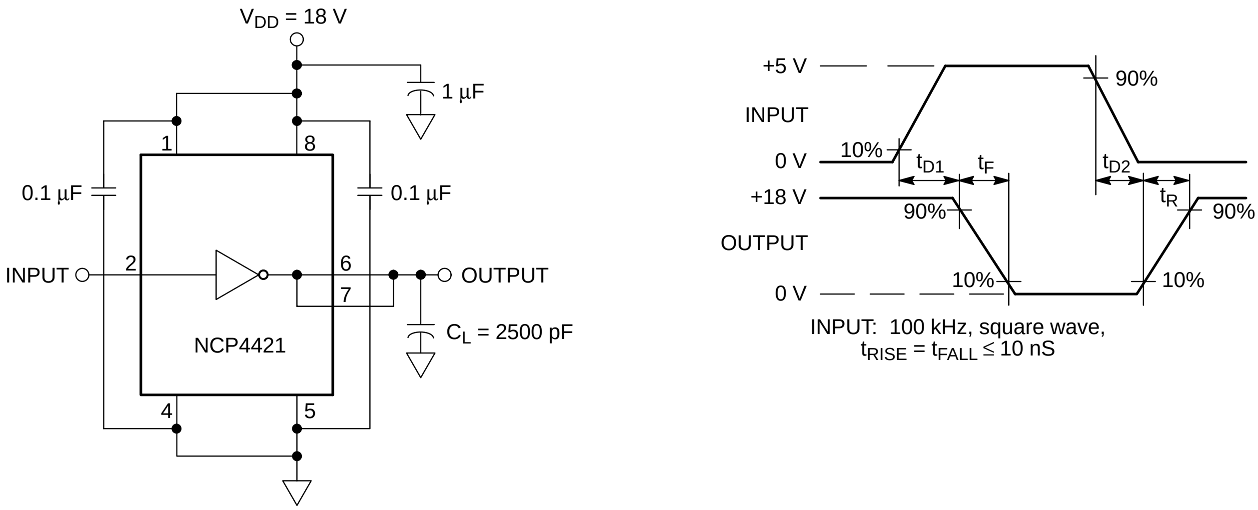


Figure 1. Switching Time Test Circuit

TYPICAL ELECTRICAL CHARACTERISTICS

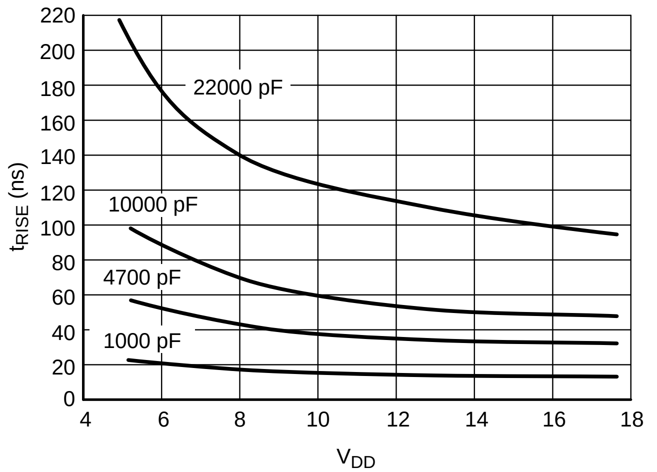


Figure 2. Rise Time vs. Supply Voltage

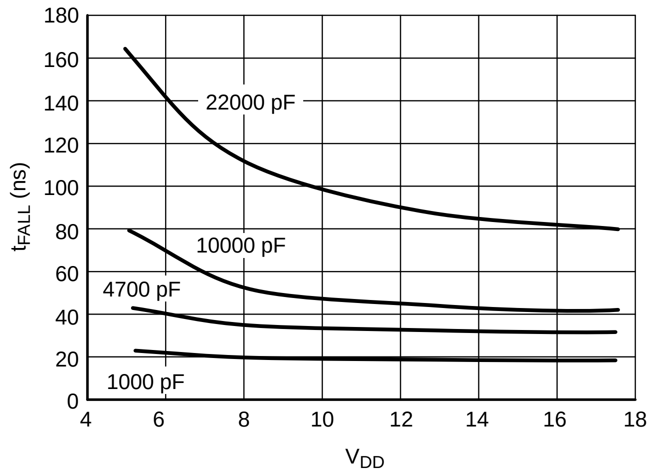


Figure 3. Fall Time vs. Supply Voltage

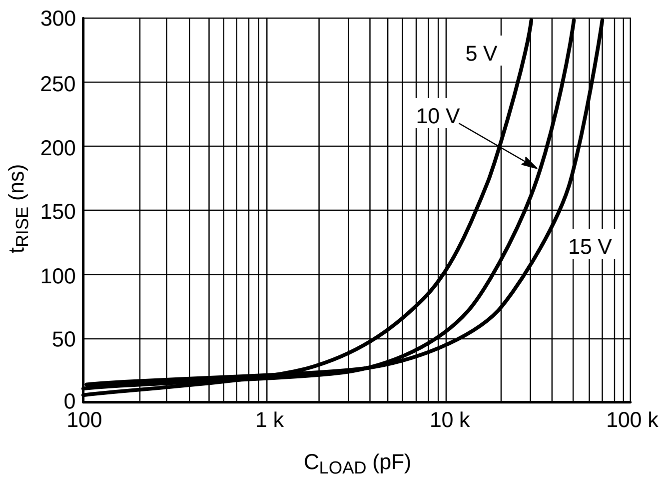


Figure 4. Rise Time vs. Capacitive Load

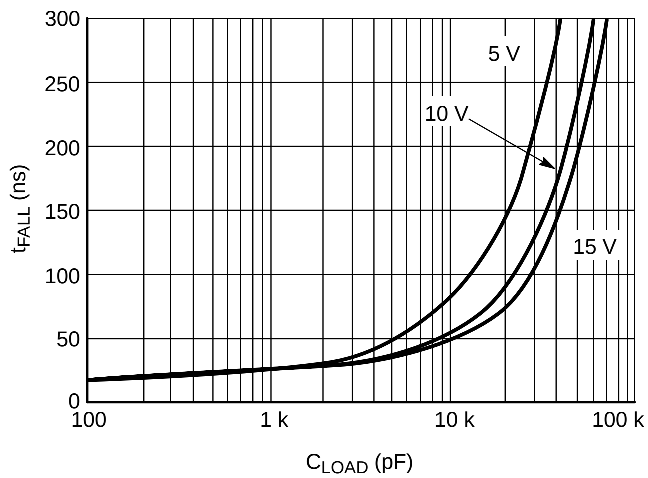


Figure 5. Fall Time vs. Capacitive Load

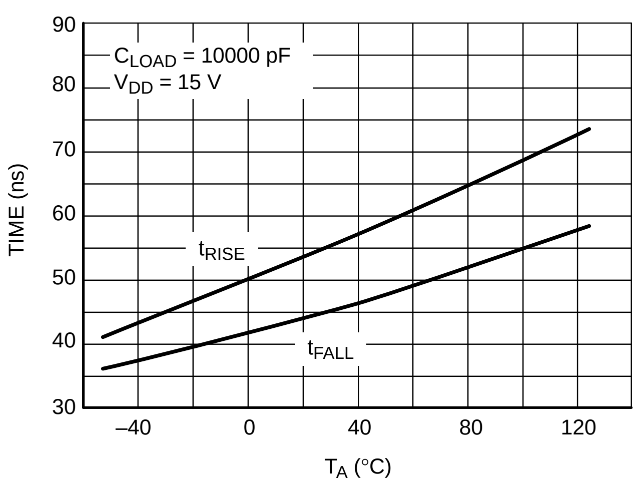


Figure 6. Rise and Fall Times vs. Temperature

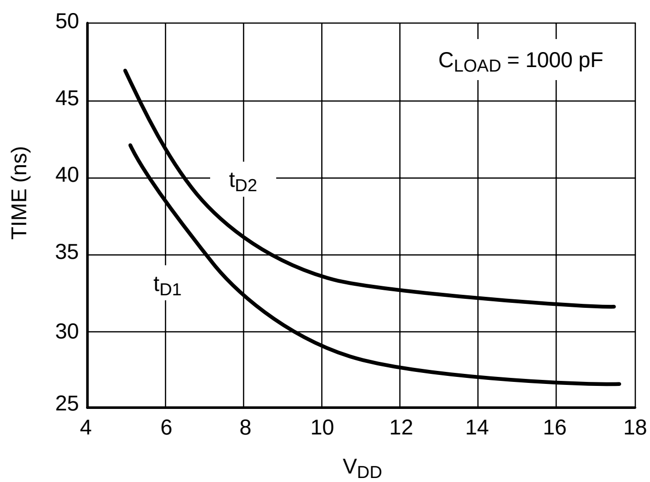


Figure 7. Propagation Delay vs. Supply Voltage

TYPICAL ELECTRICAL CHARACTERISTICS

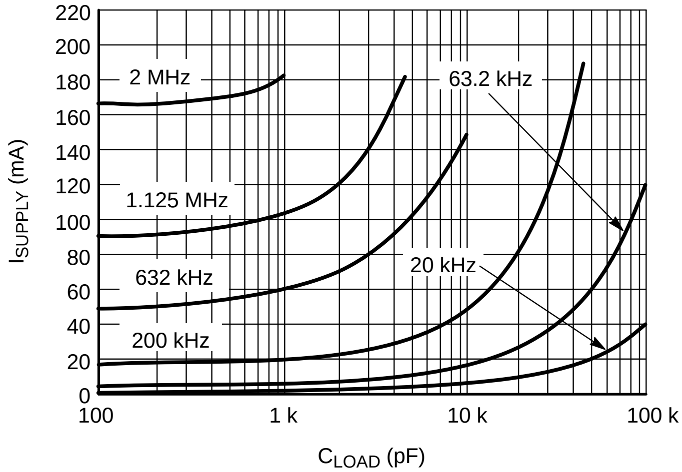


Figure 8. Supply Current vs. Capacitive Load (V_{DD} = 18 V)

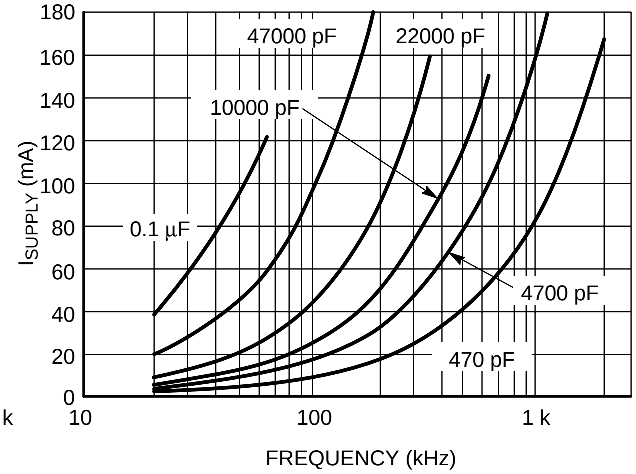


Figure 9. Supply Current vs. Frequency (V_{DD} = 18 V)

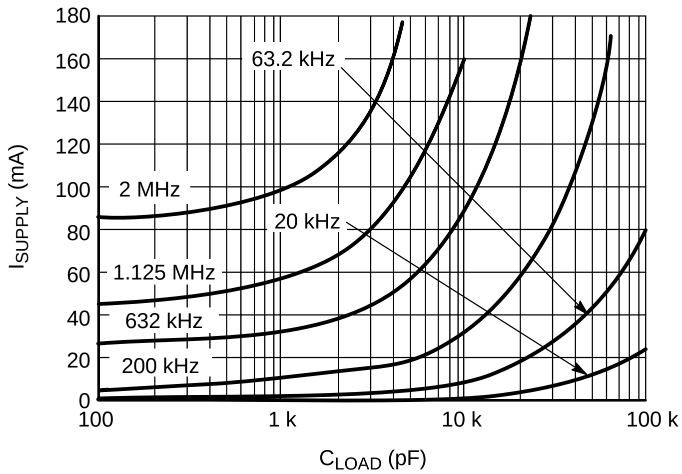


Figure 10. Supply Current vs. Capacitive Load (V_{DD} = 12 V)

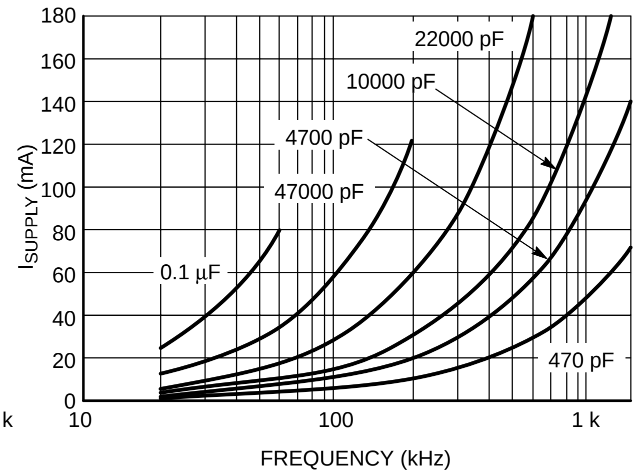


Figure 11. Supply Current vs. Frequency (V_{DD} = 12 V)

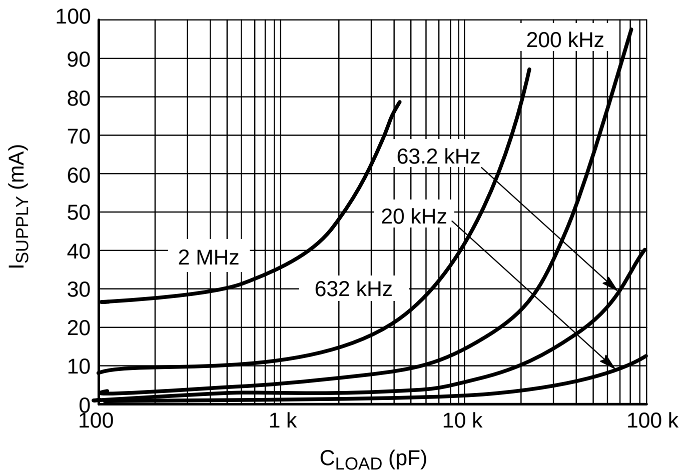


Figure 12. Supply Current vs. Capacitive Load (V_{DD} = 6 V)

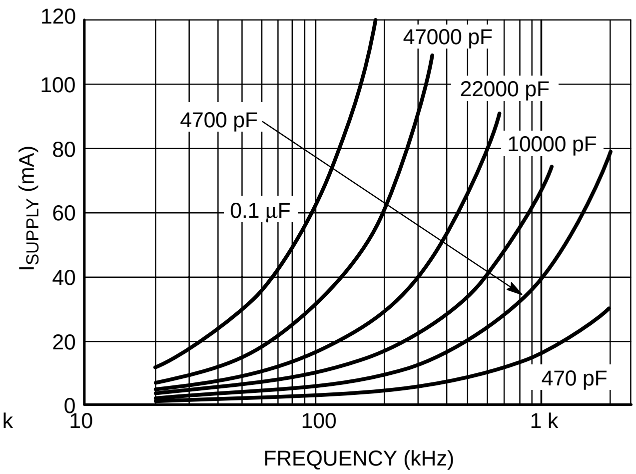


Figure 13. Supply Current vs. Frequency (V_{DD} = 6 V)

TYPICAL ELECTRICAL CHARACTERISTICS

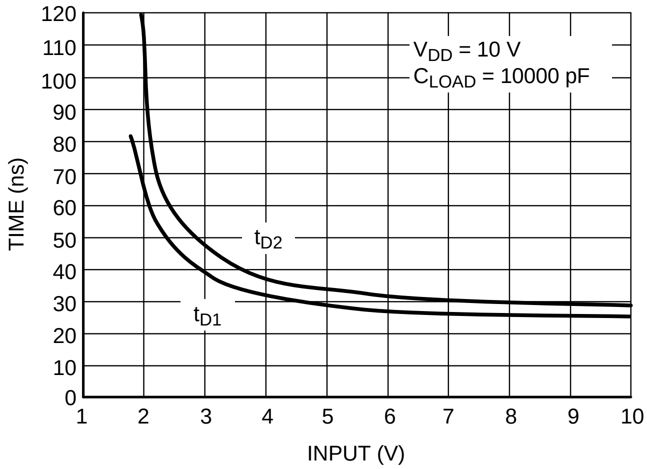


Figure 14. Propagation Delay vs. Input Amplitude

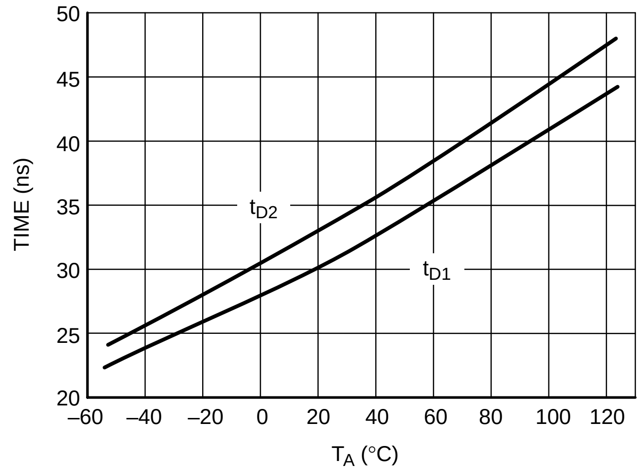


Figure 15. Propagation Delay vs. Temperature

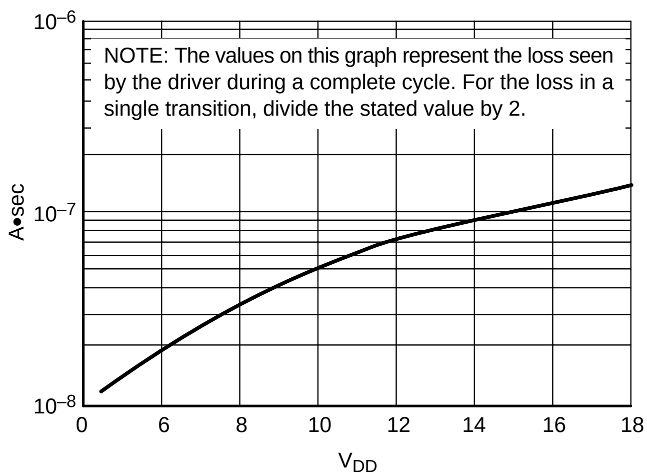


Figure 16. Crossover Energy vs. Supply Voltage

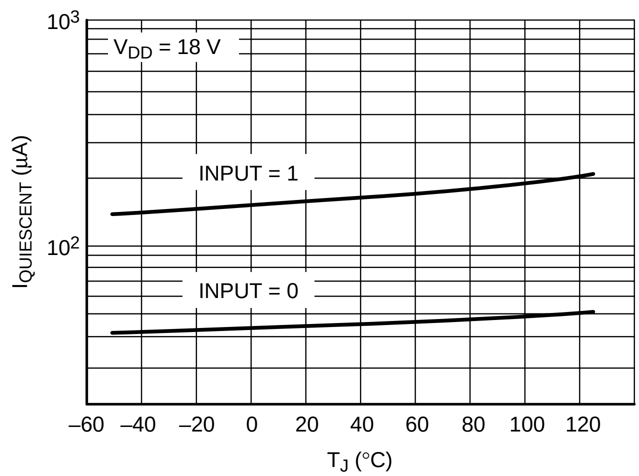


Figure 17. Quiescent Supply Current vs. Temperature

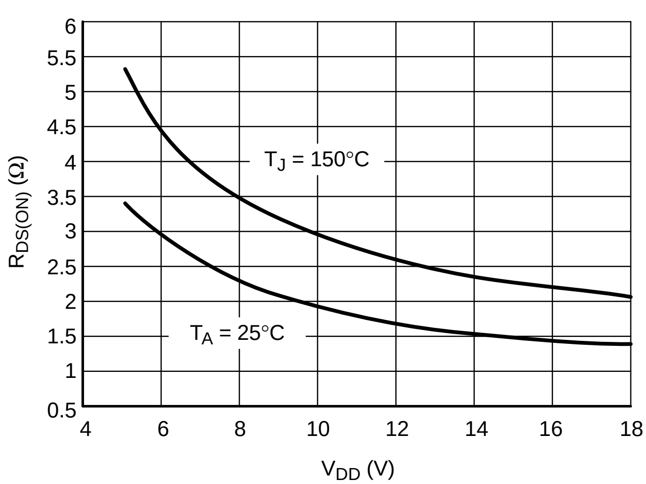


Figure 18. High–State Output Resistance vs. Supply Voltage

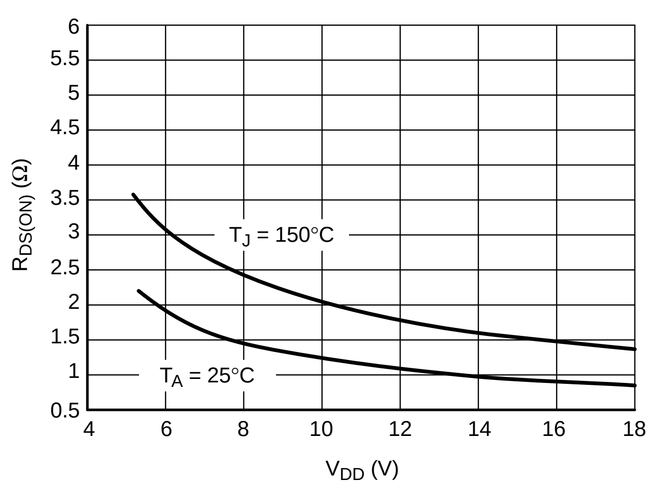
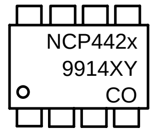
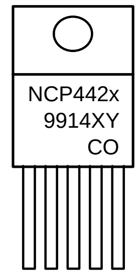


Figure 19. Low–State Output Resistance vs. Supply Voltage

MARKING DIAGRAMS





x = 1 or 2
X = Assembly ID Code
Y = Year
CO = Country of Origin

ORDERING INFORMATION

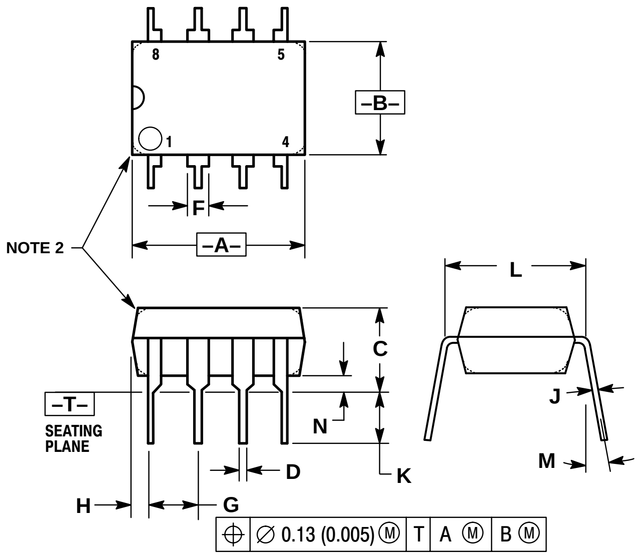
Device	Package	Temperature Range	Shipping
NCP4421T	5–Pin TO–220	0°C to + 70°C	50 Units/Rail
NCP4421P	8–Pin PDIP	–40°C to + 85°C	50 Units/Rail
NCP4422T	5–Pin TO–220	0°C to + 70°C	50 Units/Rail
NCP4422P	8–Pin PDIP	–40°C to + 85°C	50 Units/Rail

Notes

Notes

PACKAGE DIMENSIONS

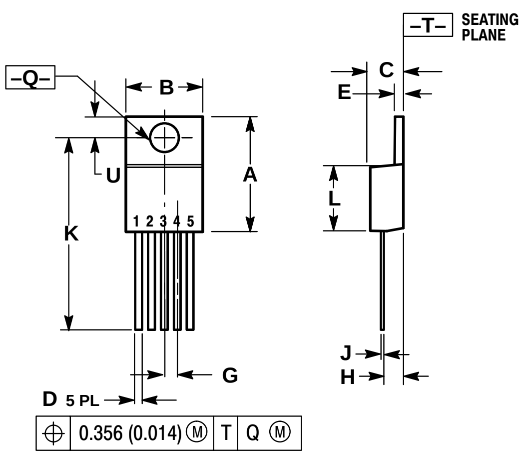
PDIP
P SUFFIX
CASE 626–05
ISSUE K



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 Y14.5M, 1982.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	9.40	10.16	0.370	0.400
B	6.10	6.60	0.240	0.260
C	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 BSC		0.100 BSC	
H	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	
M	---	10°	---	10°
N	0.76	1.01	0.030	0.040

TO–220
T SUFFIX
CASE 314D–04
ISSUE E



NOTES:
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		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.572	0.613	14.529	15.570
B	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
E	0.048	0.055	1.219	1.397
G	0.067 BSC		1.702 BSC	
H	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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