# NCP4413, NCP4414

# 3 A High-Speed MOSFET Drivers

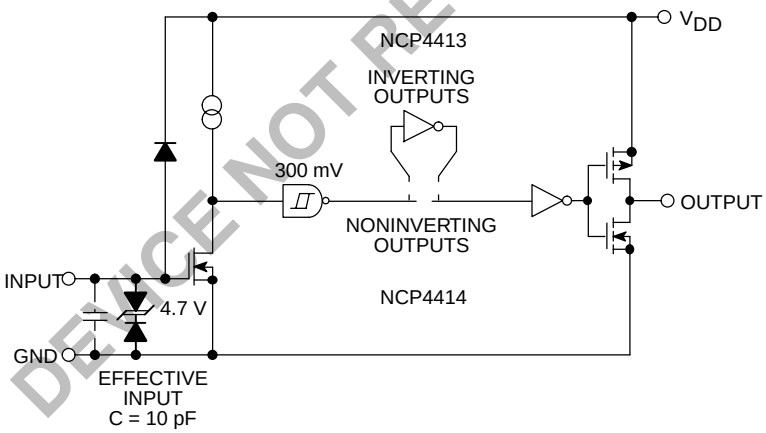
The NCP4413/4414 are 3 A CMOS buffer/drivers. They will not latch up under any conditions within their power and voltage ratings. They are not subject to damage when up to 5 V of noise spiking of either polarity that occurs on the ground pin. They can accept, without damage or logic upset, up to 500 mA of current of either polarity being forced back into their output. All terminals are fully protected against up to 4 kV of electrostatic discharge.

As MOSFET drivers, the NCP4413/4414 can easily switch 1800 pF gate capacitance in 20 nsec with matched rise and fall times, and provide low enough impedance in both the ON and the OFF states to ensure the MOSFET's intended state will not be affected, even by large transients. The rise and fall time edges are matched to allow driving short–duration inputs with greater output accuracy.

**Features**

- Latch–up Protected: Will Withstand 500 mA Reverse Current
- Input Will Withstand Negative Inputs Up to 5 V
- ESD Protected (4 kV)
- High Peak Output Current (3 A)
- Wide Operating Range (4.5 V to 16 V)
- High Capacitive Load Drive Capability (1800 pF in 20 nsec)
- Short Delay Time (35 nsec Typ)
- Consistent Delay Times with Changes in Supply Voltage
- Matched Delay Times
- Low Supply Current
  - With Logic "1" Input (500 μA)
  - With Logic "0" Input (100 μA)
- Low Output Impedance (2.7 Ω)

**Functional Block Diagram**

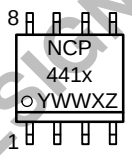



ON Semiconductor®

http://onsemi.com

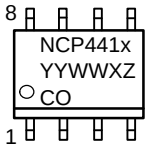
**MARKING DIAGRAM**


**SO–8**
**D SUFFIX**
**CASE 751**





**PDIP–8**
**P SUFFIX**
**CASE 626**



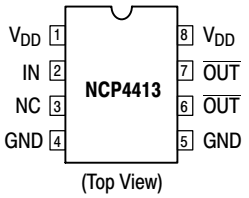

x = Device Number (3 or 4)
YY, Y = Year
WW, W = Work Week
X = Assembly ID Code
Z = Subcontractor ID Code
CO = Country of Origin

**ORDERING INFORMATION**

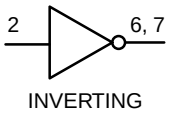
| Device | Package | Shipping |
|---|---|---|
| NCP4413DR2 Inverting | SO–8 | 2500 Tape & Reel |
| NCP4413P Inverting | PDIP–8 | 50 Units/Rail |
| NCP4414DR2 Non–Inverting | SO–8 | 2500 Tape & Reel |
| NCP4414P Non–Inverting | PDIP–8 | 50 Units/Rail |

## PIN CONNECTIONS

**8–Pin SOIC/PDIP–8**

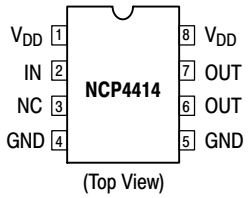



(Top View)

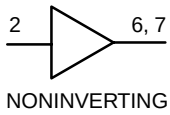



INVERTING

**8–Pin SOIC/PDIP–8**




(Top View)




NONINVERTING

NC = NO INTERNAL CONNECTION

## ABSOLUTE MAXIMUM RATINGS*

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Supply Voltage | $V_{DD}$ | +20 | V |
| Input Voltage, IN A or IN B | $V_{IN}$ | $V_{DD}$ + 0.3 to GND – 5.0 | V |
| Maximum Chip Temperature | | +150 | °C |
| Storage Temperature Range | $T_{stg}$ | –65 to +150 | °C |
| Lead Temperature (Soldering, 10 sec) | $T_{SOI}$ | +300 | °C |
| Package Thermal Resistance<br>SOIC<br>SOIC | <br>$R_{\theta JA}$<br>$R_{\theta JC}$ | <br>155<br>45 | °C/W |
| Operating Temperature Range | $T_A$ | –40 to +85 | °C |
| Power Dissipation ($T_A \leq 70°C$)<br>SOIC | <br>$P_D$ | <br>470 | <br>mW |

*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 operation section of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## ELECTRICAL CHARACTERISTICS

(Over operating temperature range with 4.5 V $\leq V_{DD} \leq$ 16 V, unless otherwise specified. Typical values are measured at $T_A$ = 25°C; $V_{DD}$ = 16 V.)

| Characteristic | Symbol | Test Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Input** | | | | | | | |
| Logic 1 High Input Voltage | $V_{IH}$ | – | | 2.0 | – | – | V |
| Logic 0 Low Input Voltage | $V_{IL}$ | – | | – | – | 0.8 | V |
| Input Current | $I_{IN}$ | $0V \leq V_{IN} \leq V_{DD}$ | $T_A$ = 25°C<br>$-40°C \leq T_A \leq 85°C$ | –1.0<br>–10 | –<br>– | 1.0<br>10 | μA |
| **Output** | | | | | | | |
| High Output Voltage | $V_{OH}$ | DC Test | | $V_{DD}$ – 0.025 | – | – | V |
| Low Output Voltage | $V_{OL}$ | DC Test | | – | – | 0.025 | v |
| Output Resistance | $R_O$ | $V_{DD}$ = 16 V, $I_O$ = 10 mA | $T_A$ = 25°C<br>$-40°C \leq T_A \leq 85°C$ | –<br>– | 2.7<br>3.3 | 4.0<br>5.0 | Ω |
| Peak Output Current | $I_{PK}$ | $V_{DD}$ = 16 V | | – | 3.0 | – | A |
| Latch–Up Protection Withstand Reverse Current | $I_{REV}$ | Duty Cycle ≤ 2%<br>t ≤ 300 μsec | $V_{DD}$ = 16 V | 0.5 | – | – | A |
| **Switching Time (Note 1)** | | | | | | | |
| Rise Time | $t_R$ | Figure 1 | $T_A$ = 25°C<br>$-40°C \leq T_A \leq 85°C$ | –<br>– | 20<br>24 | 28<br>33 | nsec |
| Fall Time | $t_F$ | Figure 1 | $T_A$ = 25°C<br>$-40°C \leq T_A \leq 85°C$ | –<br>– | 20<br>24 | 28<br>33 | nsec |
| Delay Time | $t_{D1}$ | Figure 1 | $T_A$ = 25°C<br>$-40°C \leq T_A \leq 85°C$ | –<br>– | 35<br>40 | 45<br>50 | nsec |
| Delay Time | $t_{D2}$ | Figure 1 | $T_A$ = 25°C<br>$-40°C \leq T_A \leq 85°C$ | –<br>– | 35<br>40 | 45<br>50 | nsec |
| **Power Supply** | | | | | | | |
| Power Supply Current | $I_S$ | $V_{IN}$ = 3 V<br>$V_{IN}$ = 0 V | $V_{DD}$ = 16 V | –<br>– | 0.5<br>0.1 | 1.0<br>0.15 | mA |

1. Switching times are guaranteed by design.

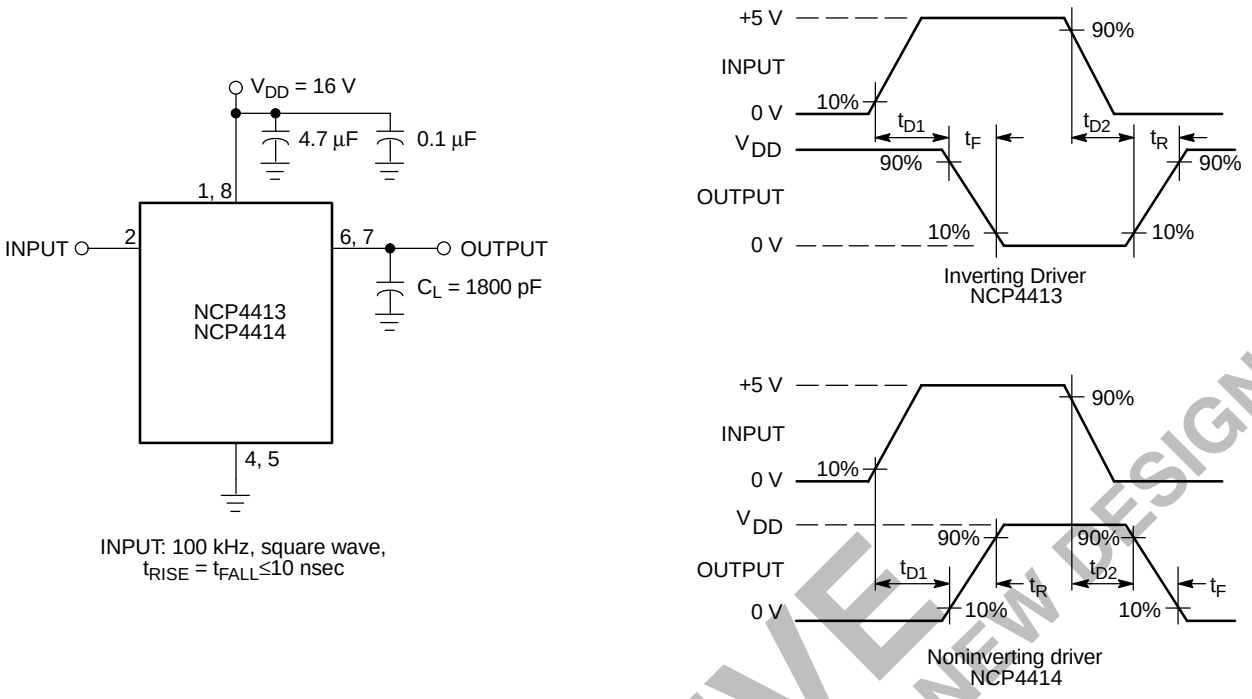



**Figure 1. Switching Time Test Circuit**

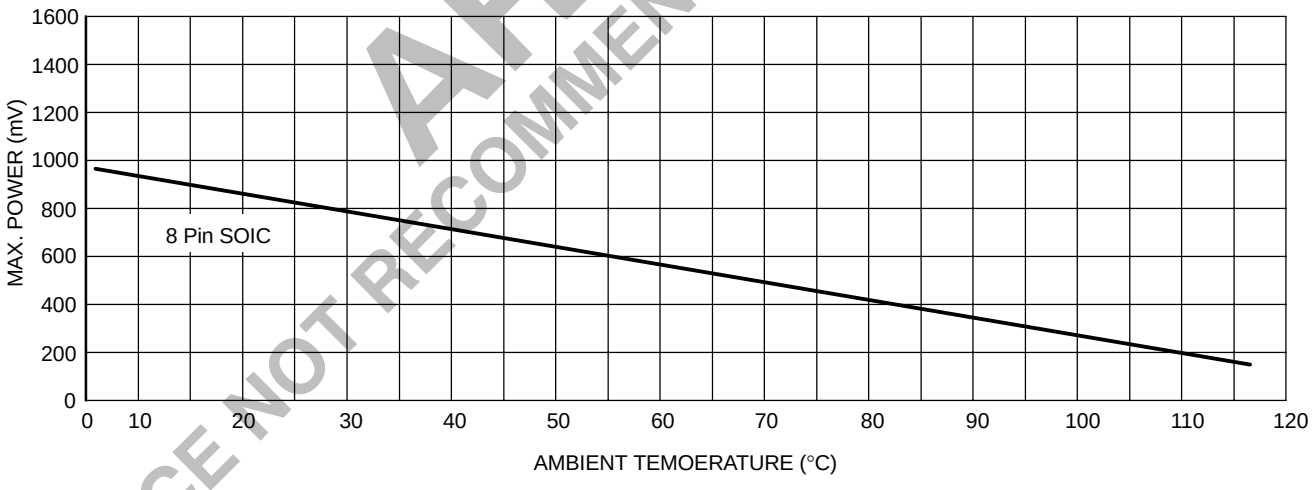



**Figure 2. Thermal Derating Curves**

## TYPICAL CHARACTERISTICS

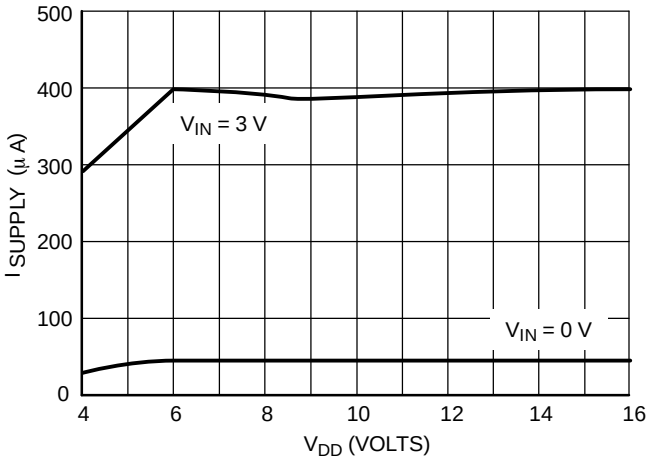



**Figure 3. Quiescent Supply Current vs. Supply Voltage $T_A$ = 25°C**

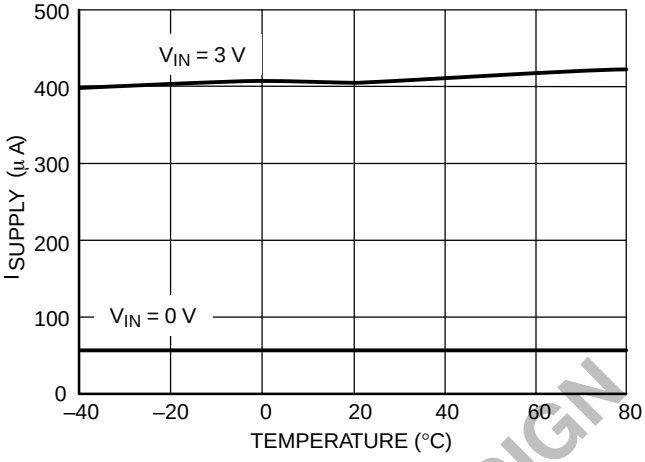



**Figure 4. Quiescent Supply Current vs. Temperature $V_{SUPPLY}$ = 16 V**

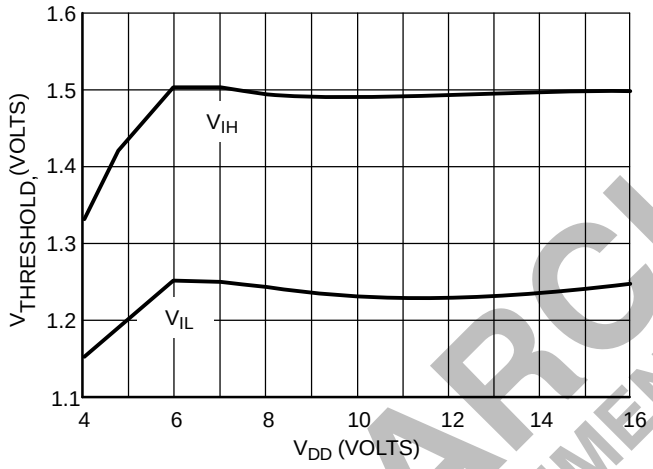



**Figure 5. Input Threshold vs. Supply Voltage TA = 25°C**

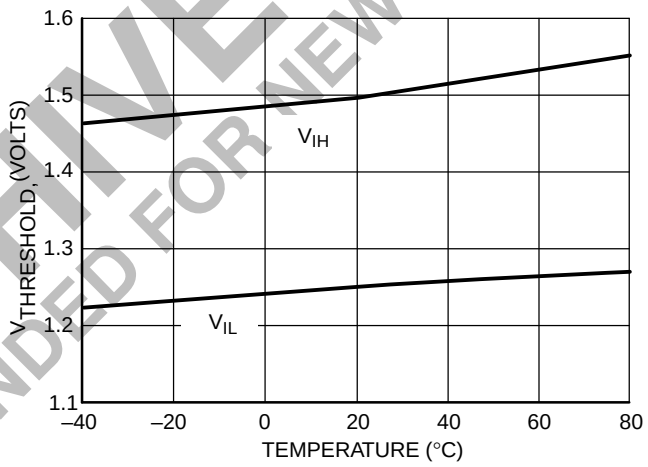



**Figure 6. Input Threshold vs. Temperature $V_{SUPPLY}$ = 16 V**

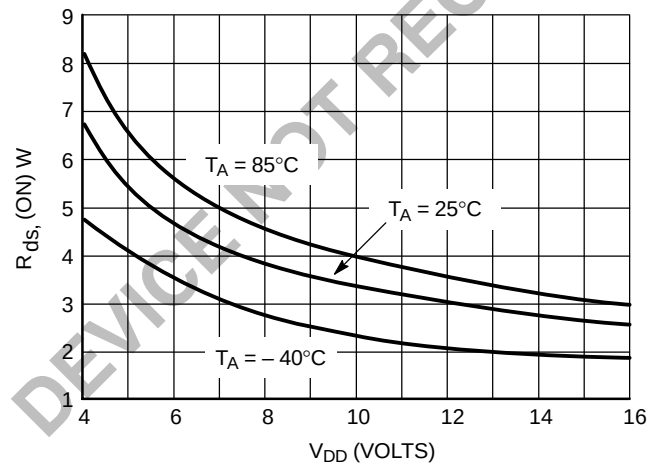



**Figure 7. High–State Output Resistance**

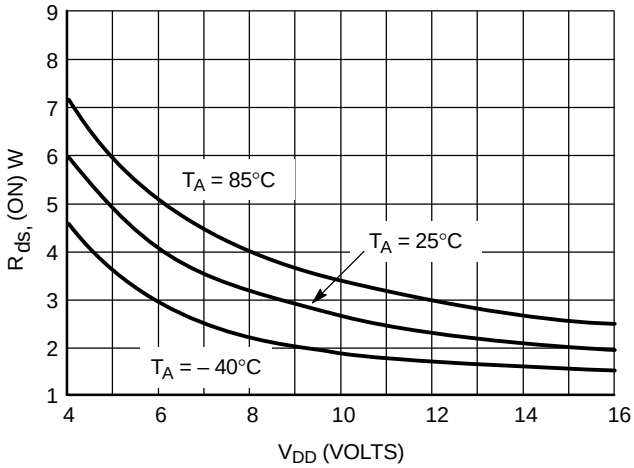



**Figure 8. Low–State Output Resistance**

## TYPICAL CHARACTERISTICS

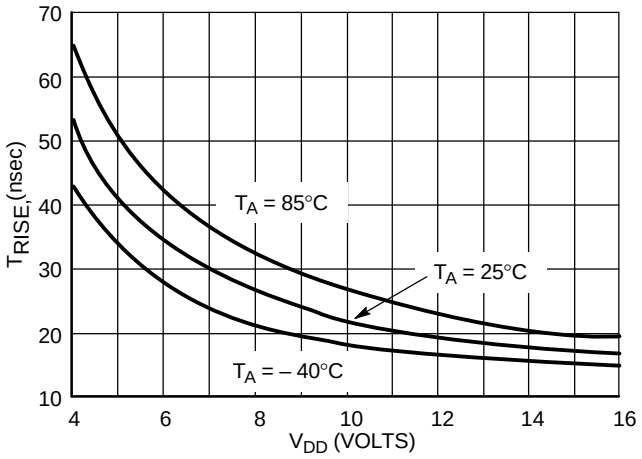



**Figure 9. Rise Time vs. Supply Voltage**
**$C_{LOAD}$ = 1800 pF**

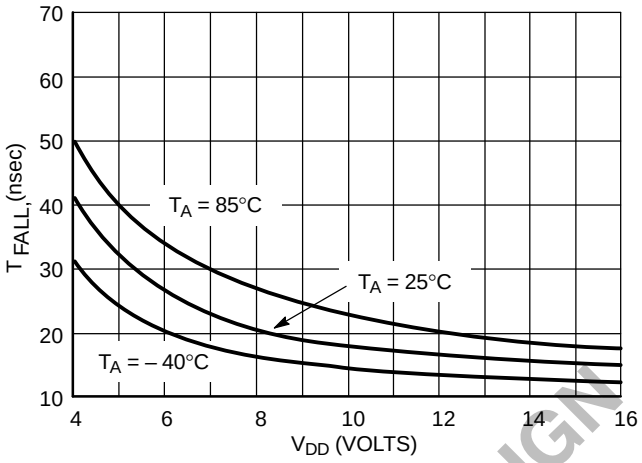



**Figure 10. Fall Time vs. Supply Voltage**
**$C_{LOAD}$ = 1800 pF**

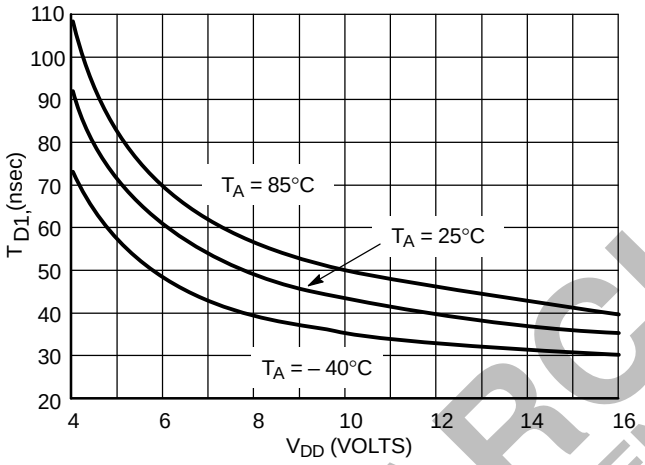



**Figure 11. $T_{D1}$ Propagation Delay vs. Supply Voltage**
**$C_{LOAD}$ = 1800 pF**

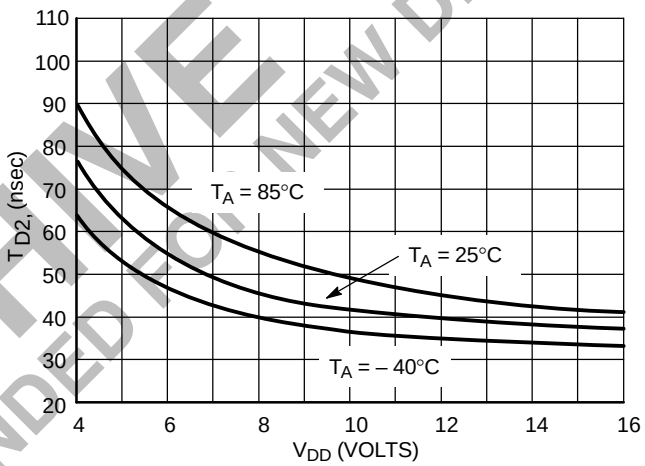



**Figure 12. $T_{D2}$ Propagation Delay vs. Supply Voltage**
**$C_{LOAD}$ = 1800 pF**

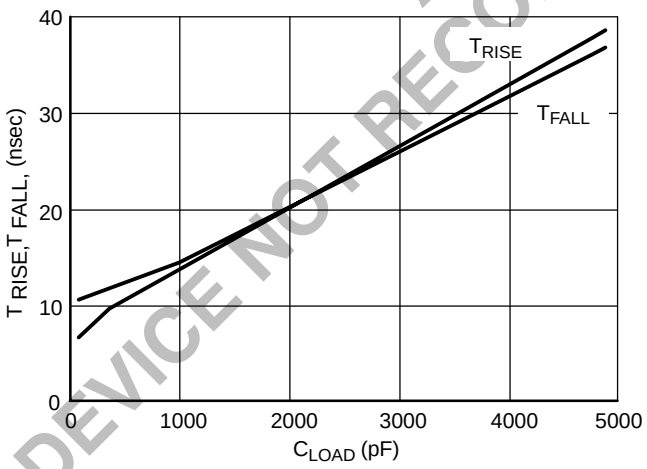



**Figure 13. Rise and Fall Times vs. Capacitive Load**
**$T_A$ = 25°C, $V_{DD}$ = 16 V**

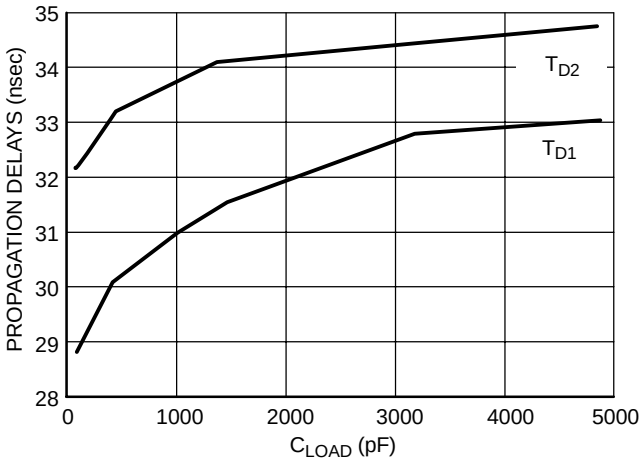
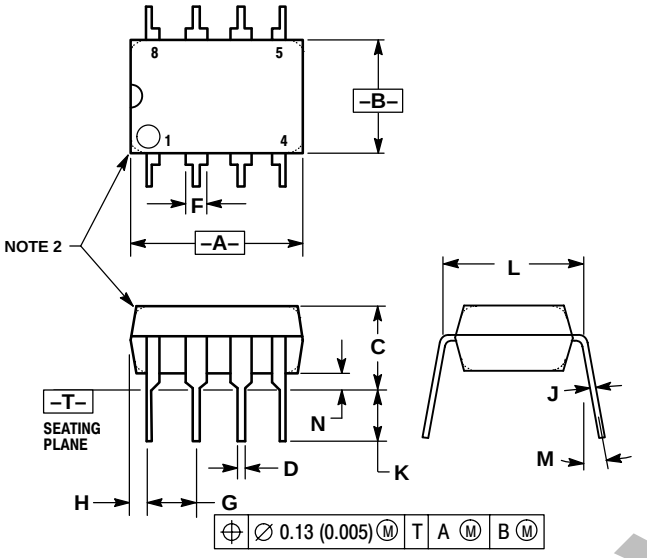



**Figure 14. Propagation Delays vs. Capacitive Load**
**$T_A$ = 25°C, $V_{DD}$ = 16 V**

## PACKAGE DIMENSIONS

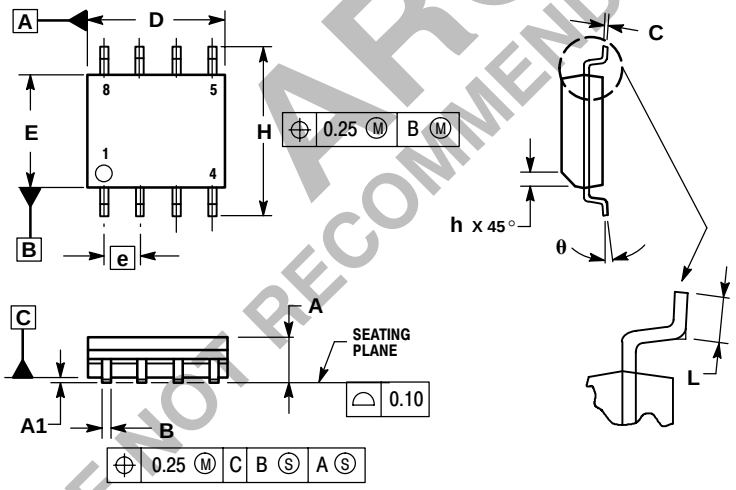
**PDIP–8**
**P SUFFIX**
CASE 626–05
ISSUE K




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 |

**SO–8**
**D SUFFIX**
CASE 751–06
ISSUE T




NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. DIMENSIONS ARE IN MILLIMETER.
3. DIMENSION D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 TOTAL IN EXCESS OF THE B DIMENSION AT MAXIMUM MATERIAL CONDITION.

| | MILLIMETERS | |
|---|---|---|
| DIM | MIN | MAX |
| A | 1.35 | 1.75 |
| A1 | 0.10 | 0.25 |
| B | 0.35 | 0.49 |
| C | 0.19 | 0.25 |
| D | 4.80 | 5.00 |
| E | 3.80 | 4.00 |
| e | 1.27 BSC | |
| H | 5.80 | 6.20 |
| h | 0.25 | 0.50 |
| L | 0.40 | 1.25 |
| θ | 0° | 7° |

## PUBLICATION ORDERING INFORMATION

**Literature Fulfillment**:
Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
**Phone**: 303–675–2175 or 800–344–3860 Toll Free USA/Canada
**Fax**: 303–675–2176 or 800–344–3867 Toll Free USA/Canada
**Email**: ONlit@hibbertco.com

**N. American Technical Support**: 800–282–9855 Toll Free USA/Canada

**JAPAN**: ON Semiconductor, Japan Customer Focus Center
2–9–1 Kamimeguro, Meguro–ku, Tokyo, Japan 153–0051
**Phone**: 81–3–5773–3850
**Email**: r14525@onsemi.com

**ON Semiconductor Website**: http://onsemi.com

For additional information, please contact your local
Sales Representative.