

7404, LS04, S04  
Inverters

Hex Inverter  
Product Specification

Logic Products

| TYPE   | TYPICAL PROPAGATION DELAY | TYPICAL SUPPLY CURRENT (TOTAL) |
|--------|---------------------------|--------------------------------|
| 7404   | 10ns                      | 12mA                           |
| 74LS04 | 9.5ns                     | 2.4mA                          |
| 74S04  | 3ns                       | 22mA                           |

ORDERING CODE

| PACKAGES    | COMMERCIAL RANGE<br>$V_{CC} = 5V \pm 5\%$ ; $T_A = 0^{\circ}C$ to $+70^{\circ}C$ |
|-------------|----------------------------------------------------------------------------------|
| Plastic DIP | N7404N, N74LS04N, N74S04N                                                        |
| Plastic SO  | N74LS04D, N74S04D                                                                |

FUNCTION TABLE

| INPUT | OUTPUT |
|-------|--------|
| A     | Y      |
| L     | H      |
| H     | L      |

H = HIGH voltage level  
L = LOW voltage level

NOTE:

For information regarding devices processed to Military Specifications, see the Signetics Military Products Data Manual.

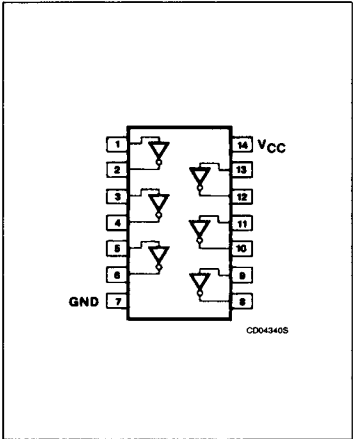
INPUT AND OUTPUT LOADING AND FAN-OUT TABLE

| PINS | DESCRIPTION | 74   | 74S   | 74LS   |
|------|-------------|------|-------|--------|
| A    | Input       | 1uI  | 1Sul  | 1LSul  |
| Y    | Output      | 10uI | 10Sul | 10LSul |

NOTE:

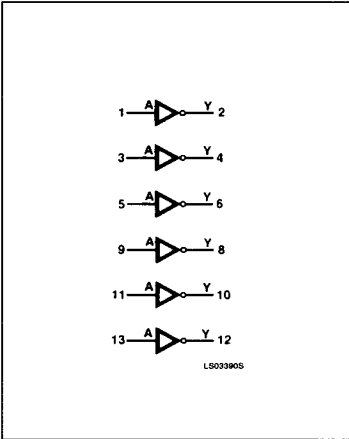
Where a 74 unit load (uI) is understood to be  $40\mu A$   $I_{IH}$  and  $-1.6mA$   $I_{IL}$ , a 74S unit load (Sul) is  $50\mu A$   $I_{IH}$  and  $-2.0mA$   $I_{IL}$ , and 74LS unit load (LSul) is  $20\mu A$   $I_{IH}$  and  $-0.4mA$   $I_{IL}$ .

PIN CONFIGURATION



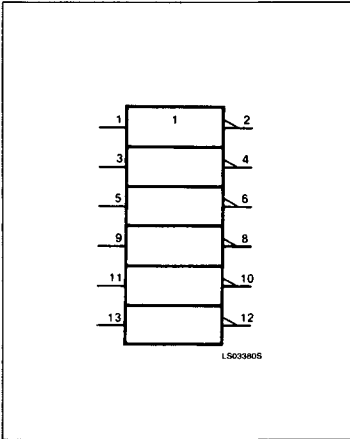
December 4, 1985

LOGIC SYMBOL



5-15

LOGIC SYMBOL (IEEE/IEC)



853-0504 81501

Inverters

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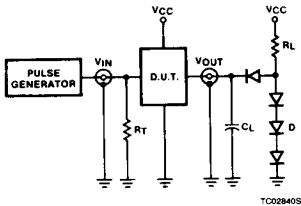
ABSOLUTE MAXIMUM RATINGS (Over operating free-air temperature range unless otherwise noted.)

| PARAMETER        |                                                | 74                       | 74LS                     | 74S                      | UNIT |
|------------------|------------------------------------------------|--------------------------|--------------------------|--------------------------|------|
| V <sub>CC</sub>  | Supply voltage                                 | 7.0                      | 7.0                      | 7.0                      | V    |
| V <sub>IN</sub>  | Input voltage                                  | −0.5 to +5.5             | −0.5 to +7.0             | −0.5 to +5.5             | V    |
| I <sub>IN</sub>  | Input current                                  | −30 to +5                | −30 to +1                | −30 to +5                | mA   |
| V <sub>OUT</sub> | Voltage applied to output in HIGH output state | −0.5 to +V <sub>CC</sub> | −0.5 to +V <sub>CC</sub> | −0.5 to +V <sub>CC</sub> | V    |
| T <sub>A</sub>   | Operating free-air temperature range           | 0 to 70                  |                          |                          | °C   |

RECOMMENDED OPERATING CONDITIONS

| PARAMETER       |                                | 74   |     |      | 74LS |     |      | 74S  |     |       | UNIT |
|-----------------|--------------------------------|------|-----|------|------|-----|------|------|-----|-------|------|
|                 |                                | Min  | Nom | Max  | Min  | Nom | Max  | Min  | Nom | Max   |      |
| V <sub>CC</sub> | Supply voltage                 | 4.75 | 5.0 | 5.25 | 4.75 | 5.0 | 5.25 | 4.75 | 5.0 | 5.25  | V    |
| V <sub>IH</sub> | HIGH-level input voltage       | 2.0  |     |      | 2.0  |     |      | 2.0  |     |       | V    |
| V <sub>IL</sub> | LOW-level input voltage        |      |     | +0.8 |      |     | +0.8 |      |     | +0.8  | V    |
| I <sub>IK</sub> | Input clamp current            |      |     | −12  |      |     | −18  |      |     | −18   | mA   |
| I <sub>OH</sub> | HIGH-level output current      |      |     | −400 |      |     | −400 |      |     | −1000 | μA   |
| I <sub>OL</sub> | LOW-level output current       |      |     | 16   |      |     | 8    |      |     | 20    | mA   |
| T <sub>A</sub>  | Operating free-air temperature | 0    |     | 70   | 0    |     | 70   | 0    |     | 70    | °C   |

TEST CIRCUITS AND WAVEFORMS



Test Circuit For 74 Totem-Pole Outputs

DEFINITIONS

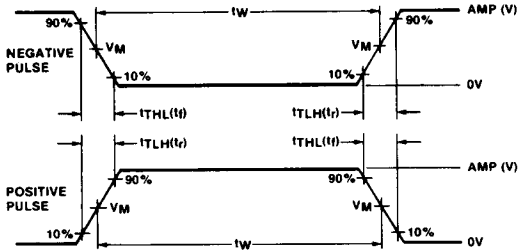
R<sub>L</sub> = Load resistor to V<sub>CC</sub>; see AC CHARACTERISTICS for value.

C<sub>L</sub> = Load capacitance includes jig and probe capacitance; see AC CHARACTERISTICS for value.

R<sub>T</sub> = Termination resistance should be equal to Z<sub>OUT</sub> of Pulse Generators.

D = Diodes are 1N916, 1N3064, or equivalent.

t<sub>TLH</sub>, t<sub>THL</sub> Values should be less than or equal to the table entries.



V<sub>M</sub> = 1.3V for 74LS; V<sub>M</sub> = 1.5V for all other TTL families.

Input Pulse Definition

| FAMILY | INPUT PULSE REQUIREMENTS |           |             |                  |                  |
|--------|--------------------------|-----------|-------------|------------------|------------------|
|        | Amplitude                | Rep. Rate | Pulse Width | t <sub>TLH</sub> | t <sub>THL</sub> |
| 74     | 3.0V                     | 1MHz      | 500ns       | 7ns              | 7ns              |
| 74LS   | 3.0V                     | 1MHz      | 500ns       | 15ns             | 6ns              |
| 74S    | 3.0V                     | 1MHz      | 500ns       | 2.5ns            | 2.5ns            |

Inverters

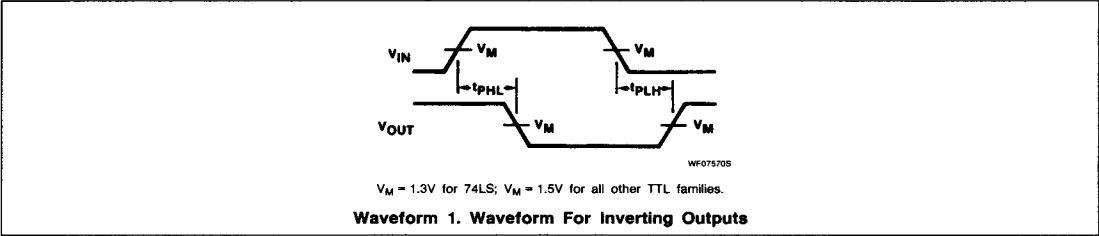
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DC ELECTRICAL CHARACTERISTICS (Over recommended operating free-air temperature range unless otherwise noted.)

| PARAMETER                                                 | TEST CONDITIONS <sup>1</sup>                                        | 7404                          |                  |      | 74LS04 |                  |      | 74S04 |                  |      | UNIT |
|-----------------------------------------------------------|---------------------------------------------------------------------|-------------------------------|------------------|------|--------|------------------|------|-------|------------------|------|------|
|                                                           |                                                                     | Min                           | Typ <sup>2</sup> | Max  | Min    | Typ <sup>2</sup> | Max  | Min   | Typ <sup>2</sup> | Max  |      |
| V <sub>OH</sub> HIGH-level output voltage                 | V <sub>CC</sub> = MIN, V <sub>IL</sub> = MAX, I <sub>OH</sub> = MAX | 2.4                           | 3.4              |      | 2.7    | 3.4              |      | 2.7   | 3.4              |      | V    |
| V <sub>OL</sub> LOW-level output voltage                  | V <sub>CC</sub> = MIN, V <sub>IH</sub> = MIN                        | I <sub>OL</sub> = MAX         |                  | 0.2  | 0.4    | 0.35             | 0.5  |       |                  | 0.5  | V    |
|                                                           |                                                                     | I <sub>OL</sub> = 4mA (74LS)  |                  |      |        | 0.25             | 0.4  |       |                  |      | V    |
| V <sub>IK</sub> Input clamp voltage                       | V <sub>CC</sub> = MIN, I <sub>I</sub> = I <sub>IK</sub>             |                               |                  | -1.5 |        |                  | -1.5 |       |                  | -1.2 | V    |
| I <sub>I</sub> Input current at maximum input voltage     | V <sub>CC</sub> = MAX                                               | V <sub>I</sub> = 5.5V         |                  | 1.0  |        |                  |      |       |                  | 1.0  | mA   |
|                                                           |                                                                     | V <sub>I</sub> = 7.0V         |                  |      |        | 0.1              |      |       |                  |      | mA   |
| I <sub>IH</sub> HIGH-level input current                  | V <sub>CC</sub> = MAX                                               | V <sub>I</sub> = 2.4V         |                  | 40   |        |                  |      |       |                  |      | μA   |
|                                                           |                                                                     | V <sub>I</sub> = 2.7V         |                  |      |        | 20               |      |       |                  | 50   | μA   |
| I <sub>IL</sub> LOW-level input current                   | V <sub>CC</sub> = MAX                                               | V <sub>I</sub> = 0.4V         |                  | -1.6 |        | -0.4             |      |       |                  |      | mA   |
|                                                           |                                                                     | V <sub>I</sub> = 0.5V         |                  |      |        |                  |      |       |                  | -2.0 | mA   |
| I <sub>OS</sub> Short-circuit output current <sup>3</sup> | V <sub>CC</sub> = MAX                                               | -18                           |                  | -55  | -20    |                  | -100 | -40   |                  | -100 | mA   |
| I <sub>CC</sub> Supply current (total)                    | V <sub>CC</sub> = MAX                                               | I <sub>CCH</sub> Outputs HIGH | 6                | 12   |        | 1.2              | 2.4  |       | 15               | 24   | mA   |
|                                                           |                                                                     | I <sub>CCL</sub> Outputs LOW  | 18               | 33   |        | 3.6              | 6.6  |       | 30               | 54   | mA   |

- NOTES:
- 1. For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable type.
  - 2. All typical values are at V<sub>CC</sub> = 5V, T<sub>A</sub> = 25°C.
  - 3. I<sub>OS</sub> is tested with V<sub>OUT</sub> = +0.5V and V<sub>CC</sub> = V<sub>CC</sub> MAX + 0.5V. Not more than one output should be shorted at a time and duration of the short circuit should not exceed one second.

AC WAVEFORM



AC ELECTRICAL CHARACTERISTICS T<sub>A</sub> = 25°C, V<sub>CC</sub> = 5.0V

| PARAMETER        |                   | TEST CONDITIONS | 74                                           |     | 74LS                                        |     | 74S                                          |     | UNIT |
|------------------|-------------------|-----------------|----------------------------------------------|-----|---------------------------------------------|-----|----------------------------------------------|-----|------|
|                  |                   |                 | C <sub>L</sub> = 15pF, R <sub>L</sub> = 400Ω |     | C <sub>L</sub> = 15pF, R <sub>L</sub> = 2kΩ |     | C <sub>L</sub> = 15pF, R <sub>L</sub> = 280Ω |     |      |
|                  |                   |                 | Min                                          | Max | Min                                         | Max | Min                                          | Max |      |
| t <sub>PLH</sub> | Propagation delay | Waveform 1      |                                              | 22  |                                             | 15  |                                              | 4.5 | ns   |
| t <sub>PHL</sub> |                   |                 |                                              | 15  |                                             | 15  |                                              | 5.0 |      |