

Electronica digitala 2021-2022
Tema de casa

Am ales sa studiez:

1. un circuit integrat din seria 74LS00: 74HC08 Quad 2-input AND Gate
2. circuitul omolog din seria 74HC00: 74LS08 Quad 2-input AND Gate

Link datasheet:

74LS08 : <https://www.futurlec.com/74LS/74LS08.shtml>

74HC08 : <https://www.futurlec.com/74HC/74HC08.shtml>

Piese sunt fabricate pe scara larga de multipli producători, acestea ne fiind considerate depasite.

Cateva particularitati ale lor sunt:

- 74LS00 : LS = Low Power Schottky Transistor-Transistor Logic
- 74HC08 : HC = High-Speed Complementary Metal-Oxide-Semiconductor
- Alcatuite din 4 porti AND independente
- Configuratia pinilor este standard
- Timp rapid de comutatie
- Suporta temperaturi de pana la 70°C

Exercitiul 1.

Compar cele doua dispozitive din perspectiva principalilor parametri electrici:

	74LS08	74HC08
Tensiunea de alimentare	Min. : 4.75V Norm. : 5V Max. : 5.25V	Min. : 2V Norm. : 4.5V Max. : 6V
Nivelele logice pe iesire	V_{OH}: Min. : 2.7V Norm. : 3.4V V_{OL}: Norm. : 0.25V Max. : 0.4V	V_{OH}: Min. : 1.9V Norm. : 4.4V Max. : 5.9V V_{OL}: Min. : 0.1V Norm. : 0.1V Max. : 0.1V

	74LS08	74HC08
Nivelele logice pe intrare	V_{IL}: Max. : 0.8V V_{IH}: Min. : 2V	V_{IL}: Min. : 0.5V Norm. : 1.35V Max. : 1.8V V_{IH}: Min. : 1.5V Norm. : 3.15V Max. : 4.2V
Marginile de zgomot	M_L = V _{IL} - V _{OL} Max. : 0.8V - 0.4V = 0.4V M_H = V _{OH} - V _{IH} Min. : 2.7V - 2V = 0.7V	M_L = V _{IL} - V _{OL} Min. = 0.5V - 0.1V = 0.4V Norm. = 1.35V - 0.1V = 1.25V Max. = 1.8V - 0.1V = 1.7V M_H = V _{OH} - V _{IH} Min. = 1.9V - 1.5V = 0.4V Norm. = 4.4V - 3.15V = 1.25V Max. = 5.9V - 4.2V = 1.7V
Curentul de iesire	I_{OH}: Max. : -0.4 mA I_{OL}: Max. : 8 mA	I_{OH}: Norm. : 4 mA Max. : 5.2 mA I_{OL}: Norm. : 4 mA Max. : 5.2 mA
Curentul de intrare	I_{iH}: Max. : 20 μA I_{iL}: Max. : -0.36 mA ~ -0.4 mA	T_A = 25°C I_{iN}: +- 0.1 μA T_A = -15 to 125°C I_{iN}: +- 1.0 μA
Timpii de crestere / cadere		T_A = 25°C t_{TLH} , t_{THL} : Min. : 74 ns Norm. : 15 ns Max. : 13 ns T_A = -15 to 125°C t_{TLH} , t_{THL} : Min. : 110 ns Norm. : 22 ns Max. : 19 ns

	74LS08	74HC08
Timpii de propagare	$R_L = 2\text{ k}\Omega$, $C_L = 15\text{ pF}$ t_{PLH} : Min. : 4 ns Max. : 13 ns t_{PHL} : Min. : 3 ns Max. : 11 ns $R_L = 2\text{ k}\Omega$, $C_L = 50\text{ pF}$ t_{PLH} : Min. : 5 ns Max. : 18 ns t_{PHL} : Min. : 6 ns Max. : 18 ns	$T_A = 25^\circ\text{C}$ t_{PLH} : Min. : 90 ns Norm. : 18 ns Max. : 15 ns t_{PHL} : Min. : 121 ns Norm. : 24 ns Max. : 20 ns $T_A = -15\text{ to }125^\circ\text{C}$ t_{PLH}: Min. : 175 ns Norm. : 35 ns Max. : 30 ns t_{PHL} : Min. : 135 ns Norm. : 27 ns Max. : 23 ns

Legenda:

V_{OH} -- Minimum OUTPUT Voltage level a TTL device will provide for a HIGH signal.

V_{OL} -- Maximum OUTPUT Voltage level a device will provide for a LOW signal.

V_{IH} -- Minimum INPUT Voltage level to be considered a HIGH.

V_{IL} -- Maximum INPUT Voltage level to still be considered a LOW.

I_{OH} -- HIGH Level Output Current

I_{OL} -- LOW Level Output Current

I_{IH} -- HIGH Level Input Current

I_{IL} -- LOW Level Input Current

t_{PLH} -- Propagation Delay Time LOW-to-HIGH Level Output

t_{PHL} -- Propagation Delay Time HIGH-to-LOW Level Output

t_{TLH} , t_{THL} -- Maximum Output Rise and Fall Time

Exercitiul 2.

- Condițiile în care o ieșire TTL LS poate comanda corect o intrare CMOS.

Condițiile legate de tensiunea de alimentare care trebuie satisfăcute pentru a interconecta 2 module unde 1 - TTL LS și 2 - CMOS:

$$V_{OH1} > V_{IH2}$$

$$V_{OL1} < V_{IL2}$$

Avem intervalele:

$$V_{OH1} = [2.7V, 3.4V]$$

$$V_{IH2} = [1.5V, 4.2V]$$

$$V_{OL1} = [0.25V, 0.4V]$$

$$V_{IL2} = [0.5V, 1.8V]$$

Se observa faptul ca conditiile nu sunt satisfacuate mereu.

Exemplu: $3.4V > 4.2V$ Fals

$0.5V < 0.4V$ Fals

Folosim tensiunea nominala de $V_{cc1} = 5V$.

Din relatia de mai sus rezulta ca avem ca limitările $V_{OH1} = 3.4V$ si $V_{OL1} = 0.4V$.

Putem lua cazurile (conditie ca $V_{cc1} \leq V_{cc2}$ pentru a nu distruge dispozitivul 2) :

1) $V_{cc2} = 6V, V_{OH1} = 3.4V, V_{IH2} = 4.2V, V_{OL1} = 0.4V, V_{IL2} = 1.8V$

De unde rezulta : $5V \leq 6V$ Adevarat

$$3.4V > 4.2V \text{ Fals}$$

$$0.4V < 1.8V \text{ Adevarat}$$

Condițiile nu sunt indeplinite.

2) $V_{cc2} = 4.5V, V_{OH1} = 3.4V, V_{IH2} = 3.15V, V_{OL1} = 0.4V, V_{IL2} = 1.35V$

De unde rezulta : $5V \leq 4.5V$ Aproape adevarat (interval tipic)

$$3.4V > 3.15V \text{ Adevarat}$$

$$0.4V < 1.35V \text{ Adevarat}$$

Condițiile sunt indeplinite.

3) $V_{cc2} = 2V, V_{OH1} = 3.4V, V_{IH2} = 1.5V, V_{OL1} = 0.4V, V_{IL2} = 0.5V$

De unde rezulta : $5V \leq 2V$ Fals \Rightarrow poarta 2 se poate distruge

$$3.4V > 1.5V \text{ Adevarat}$$

$$0.4V < 0.5V \text{ Adevarat}$$

Condițiile sunt indeplinite. Solutie pentru conditia $V_{cc1} \leq V_{cc2}$: utilizam un level shifter care sa limiteze iesirea la intervalul $[0V, 2V]$.

- Condițiile in care o iesire CMOS poate comanda corect o intrare TTL LS.

Condițiile legate de tensiunea de alimentare care trebuie satisfacuate pentru a interconecta 2 module unde 1 - CMOS si 2 - TTL LS:

$$V_{OH1} > V_{IH2}$$

$$V_{OL1} < V_{IL2}$$

Avem intervalele:

$$V_{OH1} = [1.9V, 5.9V]$$

$$V_{IH2} = 2V$$

$$V_{OL1} = 0.1V$$

$$V_{IL2} = 0.8V$$

Se observa faptul ca conditiile nu sunt satisfacuate mereu.

Exemplu: $5.9V > 2V$ Fals

Folosim tensiunea nominala de $V_{cc2} = 5V$.

Putem lua cazurile (conditie ca $V_{cc1} \leq V_{cc2}$) :

1) $V_{cc2} = 6V$, $V_{OH1} = 5.9V$, $V_{IH2} = 2V$, $V_{OL1} = 0.1V$, $V_{IL2} = 0.8V$

De unde rezulta : $6V \leq 5V$ Fals

$$5.9V > 2V \text{ Adevarat}$$

$$0.1V < 0.8V \text{ Adevarat}$$

Conditiiile sunt indeplinite. Solutie pentru conditia $V_{cc1} \leq V_{cc2}$: utilizam un level shifter pentru a nu depasi tensiunea maxima a intrarii.

2) $V_{cc2} = 4.5V$, $V_{OH1} = 4.4V$, $V_{IH2} = 2V$, $V_{OL1} = 0.1V$, $V_{IL2} = 0.8V$

De unde rezulta : $4.5V \leq 5V$ Aproape adevarat (interval tipic)

$$4.4V > 2V \text{ Adevarat}$$

$$0.1V < 0.8V \text{ Adevarat}$$

Conditiiile sunt indeplinite.

Numarul maxim de intrari TTL LS care pot fi conectate este:

$$N = \min (| I_{OL1} / I_{IL2} | , | I_{OH1} / I_{IH2} |)$$

$$N = \min (| 4mA / (-0.4)mA | , | (-4)mA / 20 \mu A |) = \min (10, 200) = 10$$

3) $V_{cc2} = 2V$, $V_{OH1} = 1.9V$, $V_{IH2} = 2V$, $V_{OL1} = 0.1V$, $V_{IL2} = 0.8V$

De unde rezulta : $2V \leq 5V$ Adevarat

$$1.9V > 2V \text{ Fals}$$

$$0.1V < 0.8V \text{ Adevarat}$$

Conditiiile nu sunt indeplinite.

- Numarul de intrari TTL ce pot fi comandate in paralel de o poarta CMOS este 10.