

74HC21

Dual 4-input AND gate

Product data sheet

1. General description

The 74HC21 is a high-speed Si-gate CMOS device and is pin compatible with low-power Schottky TTL (LSTTL). The 74HC21 is specified in compliance with JEDEC standard no. 7A.

The 74HC21 provide the 4-input AND function.

2. Features

- Low-power dissipation
- Complies with JEDEC standard no. 7A
- ESD protection:
 - ◆ HBM EIA/JESD22-A114-B exceeds 2000 V
 - ◆ MM EIA/JESD22-A115-A exceeds 200 V.
- Multiple package options
- Specified from $-40\text{ }^{\circ}\text{C}$ to $+80\text{ }^{\circ}\text{C}$ and from $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$.

3. Quick reference data

Table 1: Quick reference data

$GND = 0\text{ V}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$; $t_r = t_f = 6\text{ ns}$.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
t_{PHL} , t_{PLH}	propagation delay nA, nB, nC, nD to nY	$C_L = 15\text{ pF}$; $V_{CC} = 5\text{ V}$	-	10	-	ns
C_I	input capacitance		-	3.5	-	pF
C_{PD}	power dissipation capacitance	$V_I = GND\text{ to }V_{CC}$	[1] -	15	-	pF

[1] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).

$$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum(C_L \times V_{CC}^2 \times f_o) \text{ where:}$$

f_i = input frequency in MHz;

f_o = output frequency in MHz;

C_L = output load capacitance in pF;

V_{CC} = supply voltage in V;

N = number of inputs switching;

$\sum(C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

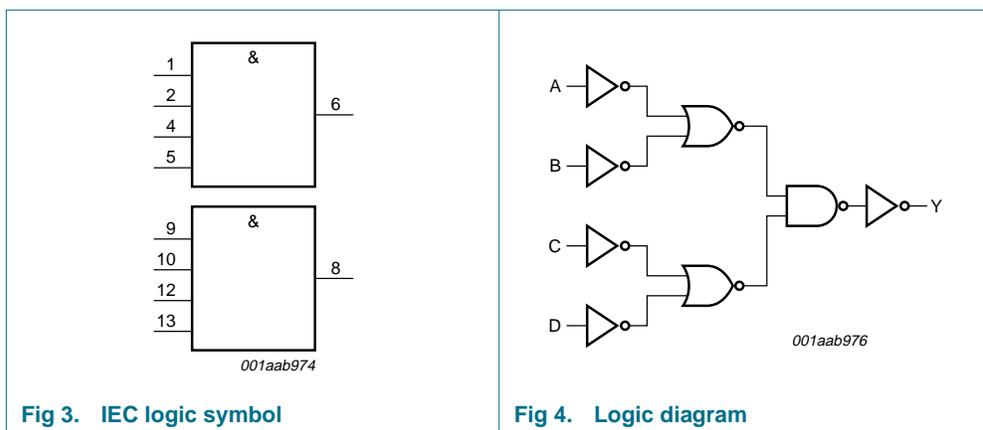
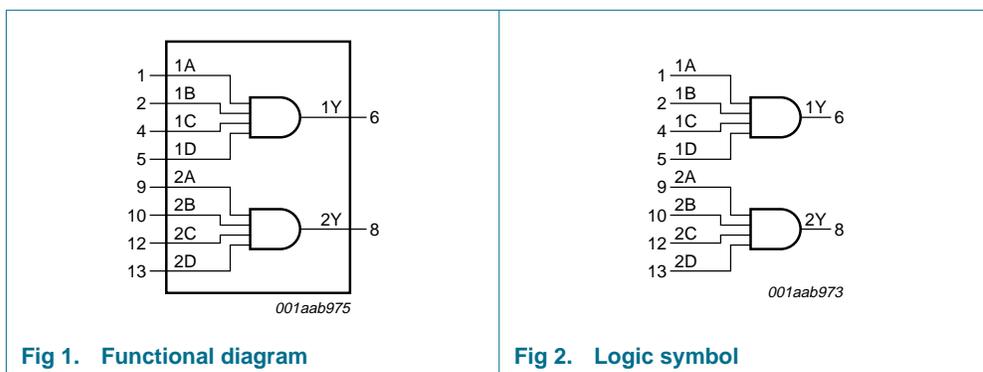
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4. Ordering information

Table 2: Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
74HC21N	-40 °C to +125 °C	DIP14	plastic dual in-line package; 14 leads (300 mil)	SOT27-1
74HC21D	-40 °C to +125 °C	SO14	plastic small outline package; 14 leads; body width 3.9 mm	SOT108-1
74HC21DB	-40 °C to +125 °C	SSOP14	plastic shrink small outline package; 14 leads; body width 5.3 mm	SOT337-1

5. Functional diagram



7. Functional description

7.1 Function table

Table 4: Function table [1]

Input				Output
nA	nB	nC	nD	nY
L	X	X	X	L
X	L	X	X	L
X	X	L	X	L
X	X	X	L	L
H	H	H	H	H

[1] H = HIGH voltage level;
L = LOW voltage level;
X = don't care.

8. Limiting values

Table 5: Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	supply voltage		-0.5	+7	V
I_{IK}	input diode current	$V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$	-	± 20	mA
I_{OK}	output diode current	$V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$	-	± 20	mA
I_O	output source or sink current	$V_O = -0.5\text{ V}$ to $V_{CC} + 0.5\text{ V}$	-	± 25	mA
I_{CC}, I_{GND}	V_{CC} or GND current		-	± 50	mA
T_{stg}	storage temperature		-65	+150	°C
P_{tot}	power dissipation				
	DIP14 package		[1] -	750	mW
	SO14 and SSOP14 packages		[2] -	500	mW

[1] Above 70 °C: P_{tot} derates linearly with 12 mW/K.

[2] Above 70 °C: P_{tot} derates linearly with 8 mW/K.

9. Recommended operating conditions

Table 6: Recommended operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	supply voltage		2.0	5.0	6.0	V
V_I	input voltage		0	-	V_{CC}	V
V_O	output voltage		0	-	V_{CC}	V
t_r, t_f	input rise and fall times	$V_{CC} = 2.0\text{ V}$	-	-	1000	ns
		$V_{CC} = 4.5\text{ V}$	-	6.0	500	ns
		$V_{CC} = 6.0\text{ V}$	-	-	400	ns
T_{amb}	ambient temperature		-40	-	+125	°C

10. Static characteristics

Table 7: Static characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$T_{amb} = 25\text{ °C}$						
V_{IH}	HIGH-level input voltage	$V_{CC} = 2.0\text{ V}$	1.5	1.2	-	V
		$V_{CC} = 4.5\text{ V}$	3.15	2.4	-	V
		$V_{CC} = 6.0\text{ V}$	4.2	3.2	-	V
V_{IL}	LOW-level input voltage	$V_{CC} = 2.0\text{ V}$	-	0.8	0.5	V
		$V_{CC} = 4.5\text{ V}$	-	2.1	1.35	V
		$V_{CC} = 6.0\text{ V}$	-	2.8	1.8	V
V_{OH}	HIGH-level output voltage	$V_I = V_{IH}$ or V_{IL}				
		$I_O = -20\text{ }\mu\text{A}; V_{CC} = 2.0\text{ V}$	1.9	2.0	-	V
		$I_O = -20\text{ }\mu\text{A}; V_{CC} = 4.5\text{ V}$	4.4	4.5	-	V
		$I_O = -20\text{ }\mu\text{A}; V_{CC} = 6.0\text{ V}$	5.9	6.0	-	V
		$I_O = -4\text{ mA}; V_{CC} = 4.5\text{ V}$	3.98	4.32	-	V
V_{OL}	LOW-level output voltage	$V_I = V_{IH}$ or V_{IL}				
		$I_O = 20\text{ }\mu\text{A}; V_{CC} = 2.0\text{ V}$	-	0	0.1	V
		$I_O = 20\text{ }\mu\text{A}; V_{CC} = 4.5\text{ V}$	-	0	0.1	V
		$I_O = 20\text{ }\mu\text{A}; V_{CC} = 6.0\text{ V}$	-	0	0.1	V
		$I_O = 4\text{ mA}; V_{CC} = 4.5\text{ V}$	-	0.15	0.26	V
	$I_O = 5.2\text{ mA}; V_{CC} = 6.0\text{ V}$	-	0.16	0.26	V	
I_{LI}	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 6.0\text{ V}$	-	-	± 0.1	μA
I_{CC}	quiescent supply current	$V_I = V_{CC}$ or GND; $I_O = 0\text{ A}; V_{CC} = 6.0\text{ V}$	-	-	2.0	μA
C_I	input capacitance		-	3.5	-	pF

Table 7: Static characteristics ...continued

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
T_{amb} = -40 °C to +85 °C						
V _{IH}	HIGH-level input voltage	V _{CC} = 2.0 V	1.5	-	-	V
		V _{CC} = 4.5 V	3.15	-	-	V
		V _{CC} = 6.0 V	4.2	-	-	V
V _{IL}	LOW-level input voltage	V _{CC} = 2.0 V	-	-	0.5	V
		V _{CC} = 4.5 V	-	-	1.35	V
		V _{CC} = 6.0 V	-	-	1.8	V
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL}				
		I _O = -20 μA; V _{CC} = 2.0 V	1.9	-	-	V
		I _O = -20 μA; V _{CC} = 4.5 V	4.4	-	-	V
		I _O = -20 μA; V _{CC} = 6.0 V	5.9	-	-	V
		I _O = -4 mA; V _{CC} = 4.5 V	3.84	-	-	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL}				
		I _O = 20 μA; V _{CC} = 2.0 V	-	-	0.1	V
		I _O = 20 μA; V _{CC} = 4.5 V	-	-	0.1	V
		I _O = 20 μA; V _{CC} = 6.0 V	-	-	0.1	V
		I _O = 4 mA; V _{CC} = 4.5 V	-	-	0.33	V
I _{LI}	input leakage current	V _I = V _{CC} or GND; V _{CC} = 6.0 V	-	-	±1.0	μA
		V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 6.0 V	-	-	20.0	μA

Table 7: Static characteristics ...continued

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$T_{amb} = -40\text{ °C to }+125\text{ °C}$						
V_{IH}	HIGH-level input voltage	$V_{CC} = 2.0\text{ V}$	1.5	-	-	V
		$V_{CC} = 4.5\text{ V}$	3.15	-	-	V
		$V_{CC} = 6.0\text{ V}$	4.2	-	-	V
V_{IL}	LOW-level input voltage	$V_{CC} = 2.0\text{ V}$	-	-	0.5	V
		$V_{CC} = 4.5\text{ V}$	-	-	1.35	V
		$V_{CC} = 6.0\text{ V}$	-	-	1.8	V
V_{OH}	HIGH-level output voltage	$V_I = V_{IH}$ or V_{IL}				
		$I_O = -20\text{ }\mu\text{A}; V_{CC} = 2.0\text{ V}$	1.9	-	-	V
		$I_O = -20\text{ }\mu\text{A}; V_{CC} = 4.5\text{ V}$	4.4	-	-	V
		$I_O = -20\text{ }\mu\text{A}; V_{CC} = 6.0\text{ V}$	5.9	-	-	V
		$I_O = -4\text{ mA}; V_{CC} = 4.5\text{ V}$	3.7	-	-	V
V_{OL}	LOW-level output voltage	$V_I = V_{IH}$ or V_{IL}				
		$I_O = 20\text{ }\mu\text{A}; V_{CC} = 2.0\text{ V}$	-	-	0.1	V
		$I_O = 20\text{ }\mu\text{A}; V_{CC} = 4.5\text{ V}$	-	-	0.1	V
		$I_O = 20\text{ }\mu\text{A}; V_{CC} = 6.0\text{ V}$	-	-	0.1	V
		$I_O = 4\text{ mA}; V_{CC} = 4.5\text{ V}$	-	-	0.4	V
I_{LI}	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 6.0\text{ V}$	-	-	± 1.0	μA
		$V_I = V_{CC}$ or GND; $I_O = 0\text{ A}; V_{CC} = 6.0\text{ V}$	-	-	40.0	μA

11. Dynamic characteristics

Table 8: Dynamic characteristics
GND = 0 V; $t_r = t_f = 6$ ns; $C_L = 50$ pF; see [Figure 7](#).

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$T_{amb} = 25$ °C						
t_{PHL} , t_{PLH}	propagation delay nA, nB, nC, nD to nY	see Figure 6				
		$V_{CC} = 2.0$ V	-	33	110	ns
		$V_{CC} = 4.5$ V	-	12	22	ns
		$V_{CC} = 6.0$ V	-	10	19	ns
t_{THL} , t_{TLH}	output transition time	see Figure 6				
		$V_{CC} = 2.0$ V	-	19	75	ns
		$V_{CC} = 4.5$ V	-	7	15	ns
		$V_{CC} = 6.0$ V	-	6	13	ns
C_{PD}	power dissipation capacitance	$V_I = GND$ to V_{CC}	[1]	-	15	pF
$T_{amb} = -40$ °C to $+85$ °C						
t_{PHL} , t_{PLH}	propagation delay nA, nB, nC, nD to nY	see Figure 6				
		$V_{CC} = 2.0$ V	-	-	140	ns
		$V_{CC} = 4.5$ V	-	-	28	ns
t_{THL} , t_{TLH}	output transition time	see Figure 6				
		$V_{CC} = 2.0$ V	-	-	95	ns
		$V_{CC} = 4.5$ V	-	-	19	ns
t_{PHL} , t_{PLH}	propagation delay nA, nB, nC, nD to nY	see Figure 6				
		$V_{CC} = 2.0$ V	-	-	165	ns
		$V_{CC} = 4.5$ V	-	-	33	ns
t_{THL} , t_{TLH}	output transition time	see Figure 6				
		$V_{CC} = 2.0$ V	-	-	110	ns
		$V_{CC} = 4.5$ V	-	-	22	ns
t_{PHL} , t_{PLH}	propagation delay nA, nB, nC, nD to nY	see Figure 6				
		$V_{CC} = 6.0$ V	-	-	28	ns
t_{THL} , t_{TLH}	output transition time	see Figure 6				
		$V_{CC} = 2.0$ V	-	-	110	ns
		$V_{CC} = 4.5$ V	-	-	22	ns
t_{PHL} , t_{PLH}	propagation delay nA, nB, nC, nD to nY	see Figure 6				
		$V_{CC} = 6.0$ V	-	-	19	ns

[1] C_{PD} is used to determine the dynamic power dissipation (P_D in μ W).

$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$ where:

f_i = input frequency in MHz;

f_o = output frequency in MHz;

C_L = output load capacitance in pF;

V_{CC} = supply voltage in V;

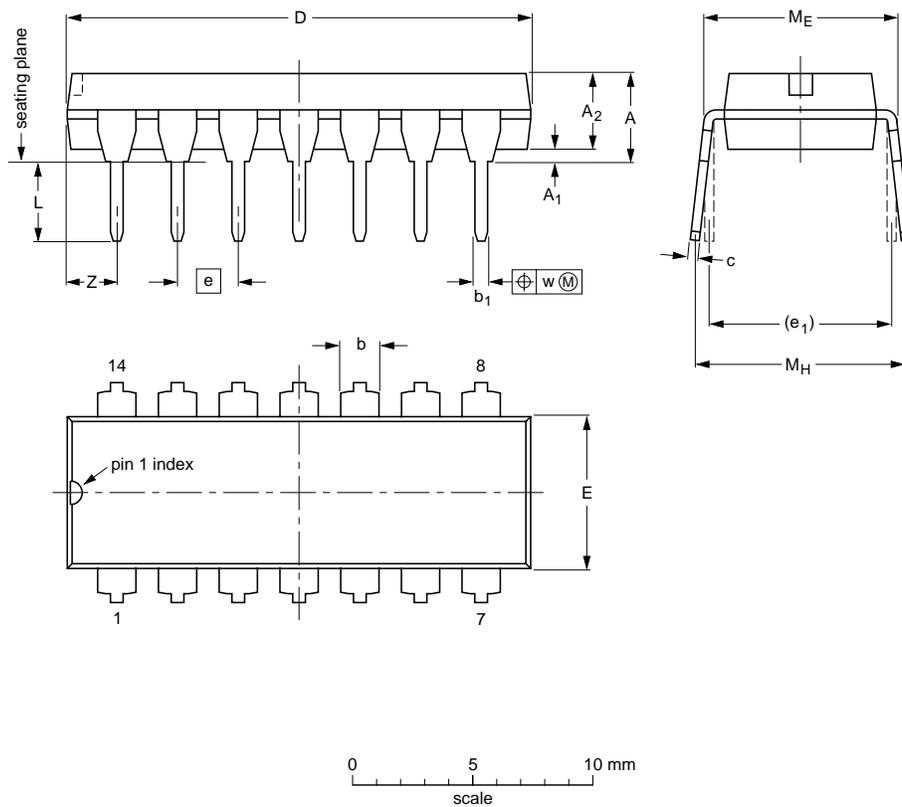
N = number of inputs switching;

$\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

13. Package outline

DIP14: plastic dual in-line package; 14 leads (300 mil)

SOT27-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A ₁ min.	A ₂ max.	b	b ₁	c	D ⁽¹⁾	E ⁽¹⁾	e	e ₁	L	M _E	M _H	w	Z ⁽¹⁾ max.
mm	4.2	0.51	3.2	1.73 1.13	0.53 0.38	0.36 0.23	19.50 18.55	6.48 6.20	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	2.2
inches	0.17	0.02	0.13	0.068 0.044	0.021 0.015	0.014 0.009	0.77 0.73	0.26 0.24	0.1	0.3	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.087

Note

1. Plastic or metal protrusions of 0.25 mm (0.01 inch) maximum per side are not included.

OUTLINE VERSION	REFERENCES			EUROPEAN PROJECTION
	IEC	JEDEC	JEITA	
SOT27-1	050G04	MO-001	SC-501-14	

Fig 8. Package outline SOT27-1 (DIP14)