



# High Speed CMOS Logic – 74HC86

Quadruple 2-Input Exclusive OR Gate IC in bare die form

Rev 1.0  
21/11/17

## Description

The 74HC86 is fabricated using a 2.5µm 5V CMOS process and has the same high speed performance of LSTTL combined with CMOS low power consumption. Device inputs are compatible with standard CMOS outputs and with LSTTL outputs with the use of pull-up resistors. Input and Output buffers enable low noise and stable outputs. Inputs are also protected against ESD and voltage transients. The device performs the Boolean functions  $Y = A \oplus B = \bar{A}B + A\bar{B}$  in positive logic.

## Features:

- Low Input Current: 1µA
- Output Drive Capability: 10 LSTTL loads
- Outputs directly interface CMOS, NMOS and TTL
- Operating Voltage Range: 2V to 6V
- CMOS High Noise Immunity
- Function compatible with 74LS86.

## Ordering Information

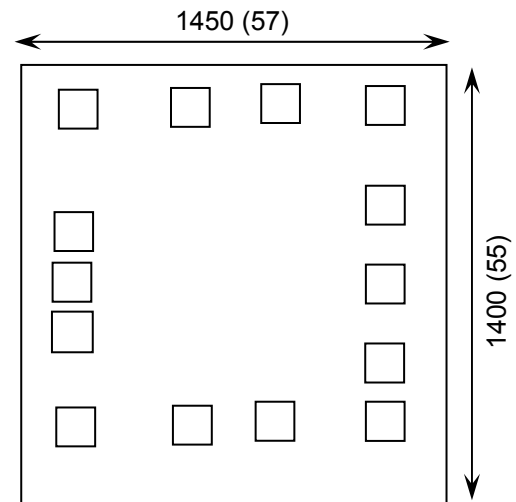
The following part suffixes apply:

- No suffix - MIL-STD-883 /2010B Visual Inspection

For High Reliability versions of this product please see

[54HC86](#)

## Die Dimensions in µm (mils)



## Supply Formats:

- Default – Die in Waffle Pack (400 per tray capacity)
- Sawn Wafer on Tape – On request
- Unsawn Wafer – On request
- Die Thickness <=> 350µm(14 Mils) – On request
- Assembled into Ceramic Package – On request

## Mechanical Specification

Die Size (Unsawn)	1450 x 1400 57 x 55	µm mils
Minimum Bond Pad Size	120 x 120 4.72 x 4.72	µm mils
Die Thickness	350 (±20) 13.78 (±0.79)	µm mils
Top Metal Composition	Al 1%Si 1.1µm	
Back Metal Composition	N/A – Bare Si	

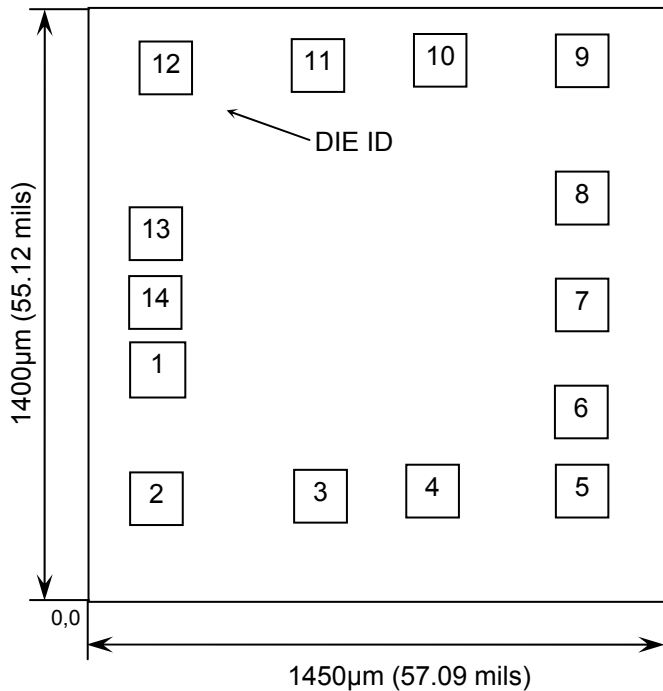




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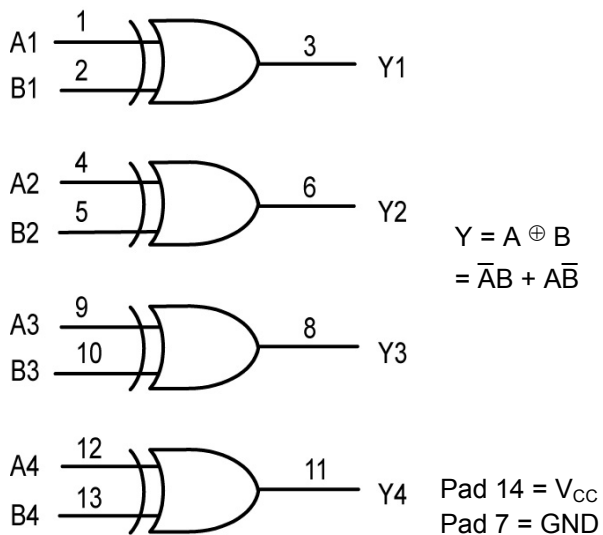
## Pad Layout and Functions



PAD	FUNCTION	COORDINATES (mm)	
		X	Y
1	A1	0.115	0.495
2	B1	0.115	0.135
3	Y1	0.49	0.125
4	A2	0.78	0.125
5	B2	1.145	0.135
6	Y2	1.145	0.355
7	GND	1.145	0.665
8	Y3	1.145	0.975
9	A3	1.145	1.195
10	B3	0.780	1.205
11	Y4	0.490	1.205
12	A4	0.125	1.195
13	B4	0.115	1.835
14	V <sub>CC</sub>	0.115	0.665

CONNECT CHIP BACK TO V<sub>CC</sub> OR FLOAT

## Logic Diagram



## Function Table

INPUTS		OUTPUT
A	B	Y
L	L	L
L	H	H
H	L	H
H	H	L

H = High level (steady state)  
L = Low level (steady state)





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## Absolute Maximum Ratings<sup>1</sup>

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage (Referenced to GND)	$V_{CC}$	-0.5 to +7.0	V
DC Input Voltage (Referenced to GND)	$V_{IN}$	-0.5 to $V_{CC} + 0.5$	V
DC Output Voltage (Referenced to GND)	$V_{OUT}$	-0.5 to $V_{CC} + 0.5$	V
Clamp Diode Current	$I_{IK}, I_{OK}$	±20	mA
DC Output Current, per pad	$I_{OUT}$	±25	mA
DC $V_{CC}$ or GND Current, per pad	$I_{CC}$	±50	mA
Power Dissipation in Still Air <sup>2</sup>	$P_D$	750	mW
Storage Temperature Range	$T_{STG}$	-65 to 150	°C

1. Operation above the absolute maximum rating may cause device failure. Operation at the absolute maximum ratings, for extended periods, may reduce device reliability. 2. Measured in plastic DIP package, results in die form are dependent on die attach and assembly method.

## Recommended Operating Conditions<sup>3</sup> (Voltages referenced to GND)

PARAMETER	SYMBOL	MIN	MAX	UNITS	
DC Supply Voltage	$V_{CC}$	2	6	V	
DC Input or Output Voltage	$V_{IN}, V_{OUT}$	0	$V_{CC}$	V	
Operating Temperature Range	$T_J$	0	+85	°C	
Input Rise and Fall Times	$V_{CC} = 2.0V$	$t_r, t_f$	0	1000	ns
	$V_{CC} = 4.5V$		0	500	
	$V_{CC} = 6.0V$		0	400	

3. This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation,  $V_{IN}$  and  $V_{OUT}$  should be constrained to the range  $GND \leq (V_{IN} \text{ or } V_{OUT}) \leq V_{CC}$ . Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or  $V_{CC}$ ). Unused outputs must be left open.

## DC Electrical Characteristics (Voltages Referenced to GND)

PARAMETER	SYMBOL	$V_{CC}$	CONDITIONS	LIMITS			UNITS
				25°C	85°C	FULL RANGE <sup>4</sup>	
Minimum High-Level Input Voltage	$V_{IH}$	2.0V	$V_{OUT} = 0.1V \text{ or } V_{CC} - 0.1V$ $ I_{OUT}  \leq 20\mu A$	1.5	1.5	1.5	V
		3.0V		2.1	2.1	2.1	
		4.5V		3.15	3.15	3.15	
		6.0V		4.2	4.2	4.2	
Maximum Low-Level Input Voltage	$V_{IL}$	2.0V	$V_{OUT} = 0.1V \text{ or } V_{CC} - 0.1V$ $ I_{OUT}  \leq 20\mu A$	0.5	0.5	0.5	V
		3.0V		0.9	0.9	0.9	
		4.5V		1.35	1.35	1.35	
		6.0V		1.8	1.8	1.8	

4.  $0^\circ C \leq T_J \leq +85^\circ C$ .





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## DC Electrical Characteristics Continued (Voltages referenced to GND)

PARAMETER	SYMBOL	V <sub>CC</sub>	CONDITIONS	LIMITS			UNITS	
				25°C	85°C	FULL RANGE <sup>4</sup>		
Minimum High-Level Output Voltage	V <sub>OH</sub>	2.0V	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>  I <sub>OUT</sub>   ≤ 20μA	1.9	1.9	1.9	V	
		4.5V		4.4	4.4	4.4		
		6.0V		5.9	5.9	5.9		
		3.0V	V <sub>IN</sub> = V <sub>IH</sub>  I <sub>OUT</sub>   ≤ 2.4mA	2.48	2.34	2.34	V	
		4.5V		V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>  I <sub>OUT</sub>   ≤ 4.0mA	3.98	3.84		3.84
		6.0V		V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>  I <sub>OUT</sub>   ≤ 5.2mA	5.48	5.34		5.34
Maximum Low-Level Output Voltage	V <sub>OL</sub>	2.0V	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IL</sub>  I <sub>OUT</sub>   ≤ 20μA	0.1	0.1	0.1	V	
		4.5V		0.1	0.1	0.1		
		6.0V		0.1	0.1	0.1		
		3.0V	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IL</sub>  I <sub>OUT</sub>   ≤ 2.4mA	0.26	0.33	0.33	V	
		4.5V		V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IL</sub>  I <sub>OUT</sub>   ≤ 4.0mA	0.26	0.33		0.33
		6.0V		V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IL</sub>  I <sub>OUT</sub>   ≤ 5.2mA	0.26	0.33		0.33
Maximum Input Leakage Current	I <sub>IN</sub>	6.0V	V <sub>IN</sub> = V <sub>CC</sub> or GND	±0.1	±1.0	±1.0	μA	
Maximum Quiescent Supply Leakage Current	I <sub>CC</sub>	6.0V	V <sub>IN</sub> = V <sub>CC</sub> or GND I <sub>OUT</sub> = 0μA	1	10	10	μA	

## AC Electrical Characteristics<sup>5</sup>

PARAMETER	SYMBOL	V <sub>CC</sub>	CONDITIONS	LIMITS			UNITS
				25°C	85°C	FULL RANGE <sup>4</sup>	
Maximum Propagation Delay, Input A or B to Output Y (Figure 1,2)	t <sub>PLH</sub> , t <sub>PHL</sub>	2.0V	C <sub>L</sub> = 50pF, t <sub>r</sub> = t <sub>f</sub> = 6ns	100	125	125	ns
		3.0V		80	90	90	
		4.5V		20	25	25	
		6.0V		17	21	21	
Maximum Output Rise and Fall Time, Any Output (Figure 1,2)	t <sub>TLH</sub> , t <sub>THL</sub>	2.0V	C <sub>L</sub> = 50pF, t <sub>r</sub> = t <sub>f</sub> = 6ns	75	95	95	ns
		3.0V		30	40	40	
		4.5V		15	19	19	
		6.0V		13	16	16	

5. Not production tested in die form, characterized by chip design and tested in package.





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## AC Electrical Characteristics Continued<sup>5</sup>

PARAMETER	SYMBOL	V <sub>CC</sub>	CONDITIONS	LIMITS			UNITS
				25°C	85°C	FULL RANGE <sup>4</sup>	
Maximum Input Capacitance	C <sub>IN</sub>	-	-	10	10	10	pF
Power Dissipation Capacitance Per Gate <sup>6</sup>	C <sub>PD</sub>	-	T <sub>J</sub> = 25°C, V <sub>CC</sub> = 5.0V	TYPICAL			pF
				33			

5. Not production tested in die form, characterized by chip design and tested in package.

6. Used to determine the no-load dynamic power consumption:  $P_D = C_{PD} V_{CC}^2 f + I_{CC} V_{CC}$ .

## Switching Waveforms

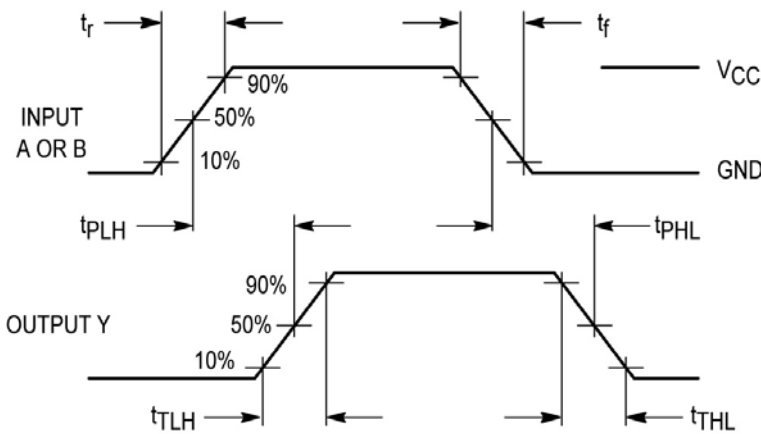
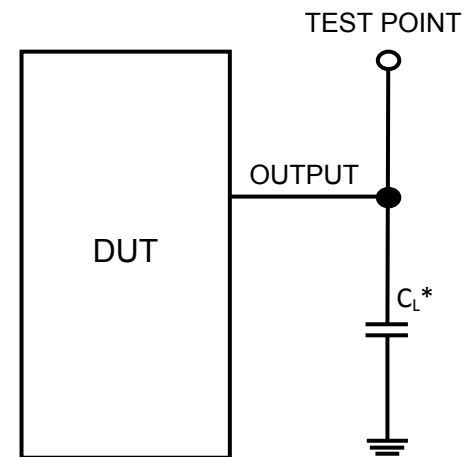


Figure 1 – Propagation Delay & Timing

## Test Circuit



\* Includes all probe and jig capacitance

Figure 2

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