

DATA SHEET

74HC/HCT85 4-bit magnitude comparator

Product specification
File under Integrated Circuits, IC06

December 1990

4-bit magnitude comparator

74HC/HCT85

FEATURES

- Serial or parallel expansion without extra gating
- Magnitude comparison of any binary words
- Output capability: standard
- I_{CC} category: MSI

GENERAL DESCRIPTION

The 74HC/HCT85 are high-speed Si-gate CMOS devices and are pin compatible with low power Schottky TTL (LSTTL). They are specified in compliance with JEDEC standard no. 7A.

The 74HC/HCT85 are 4-bit magnitude comparators that can be expanded to almost any length. They perform comparison of two 4-bit binary, BCD or other monotonic codes and present the three possible magnitude results at the outputs (Q_{A>B}, Q_{A=B} and Q_{A<B}). The 4-bit inputs are

weighted (A₀ to A₃ and B₀ to B₃), where A₃ and B₃ are the most significant bits.

The operation of the "85" is described in the function table, showing all possible logic conditions. The upper part of the table describes the normal operation under all conditions that will occur in a single device or in a series expansion scheme. In the upper part of the table the three outputs are mutually exclusive. In the lower part of the table, the outputs reflect the feed forward conditions that exist in the parallel expansion scheme.

For proper compare operation the expander inputs (I_{A>B}, I_{A=B} and I_{A<B}) to the least significant position must be connected as follows: I_{A<B} = I_{A>B} = LOW and I_{A=B} = HIGH.

For words greater than 4-bits, units can be cascaded by connecting outputs Q_{A<B}, Q_{A>B} and Q_{A=B} to the corresponding inputs of the significant comparator.

QUICK REFERENCE DATA

GND = 0 V; T_{amb} = 25 °C; t_r = t_f = 6 ns

| SYMBOL | PARAMETER | CONDITIONS | TYPICAL | | UNIT |
|-------------------------------------|-----------------------------------------------------------------------------------------------------------|-----------------------------------------------|---------|-----|------|
| | | | HC | HCT | |
| t _{PHL} / t _{PLH} | propagation delay | C _L = 15 pF; V _{CC} = 5 V | | | |
| | A _n , B _n to Q _{A>B} , Q _{A<B} | | 20 | 22 | ns |
| | A _n , B _n to Q _{A=B} | | 18 | 20 | ns |
| | I _{A<B} , I _{A=B} , I _{A>B} to Q _{A<B} , Q _{A>B} | | 15 | 15 | ns |
| | I _{A=B} to Q _{A=B} | | 11 | 15 | ns |
| C _I | input capacitance | | 3.5 | 3.5 | pF |
| C _{PD} | power dissipation capacitance per package | notes 1 and 2 | 18 | 20 | pF |

Notes

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

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

f_i = input frequency in MHz

f_o = output frequency in MHz

∑ (C_L × V_{CC}² × f_o) = sum of outputs

C_L = output load capacitance in pF

V_{CC} = supply voltage in V

2. For HC the condition is V_I = GND to V_{CC}
For HCT the condition is V_I = GND to V_{CC} – 1.5 V

ORDERING INFORMATION

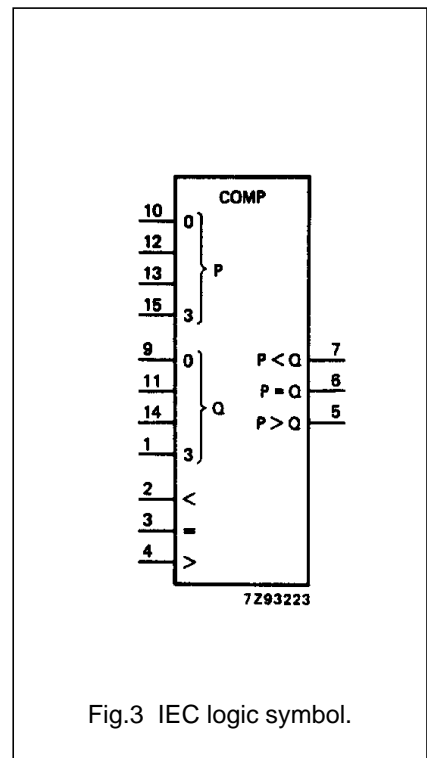
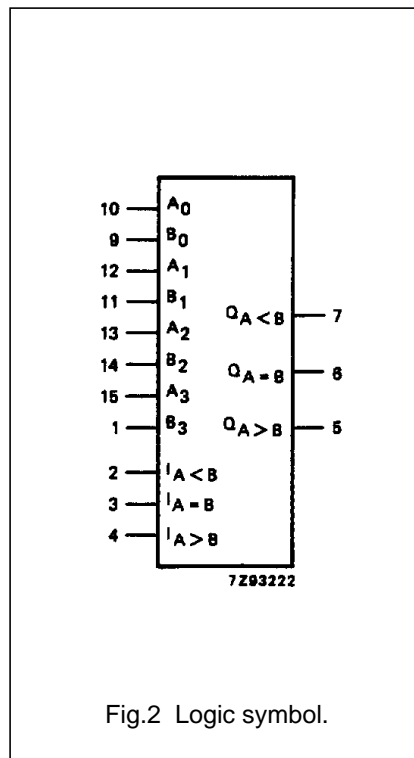
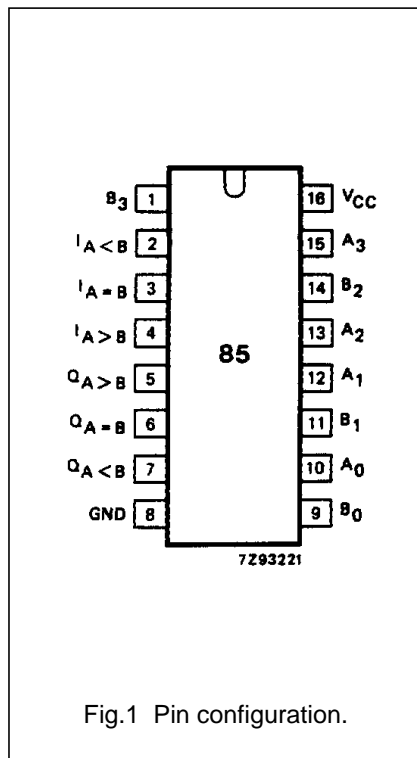
See "74HC/HCT/HCU/HCMOS Logic Package Information".

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PIN DESCRIPTION

| PIN NO. | SYMBOL | NAME AND FUNCTION |
|----------------|----------------|-------------------------|
| 2 | $I_{A<B}$ | A < B expansion input |
| 3 | $I_{A=B}$ | A = B expansion input |
| 4 | $I_{A>B}$ | A > B expansion input |
| 5 | $Q_{A>B}$ | A > B output |
| 6 | $Q_{A=B}$ | A = B output |
| 7 | $Q_{A<B}$ | A < B output |
| 8 | GND | ground (0 V) |
| 9, 11, 14, 1, | B_0 to B_3 | word B inputs |
| 10, 12, 13, 15 | A_0 to A_3 | word A inputs |
| 16 | V_{CC} | positive supply voltage |



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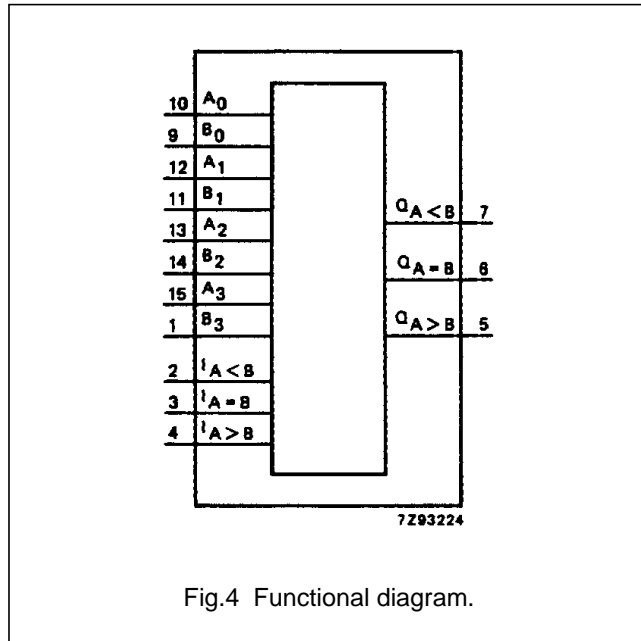


Fig.4 Functional diagram.

APPLICATIONS

- Process controllers
- Servo-motor control

FUNCTION TABLE

| COMPARING INPUTS | | | | CASCADING INPUTS | | | OUTPUTS | | |
|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------|---------------------|------------------|---------------------|---------------------|------------------|
| A ₃ , B ₃ | A ₂ , B ₂ | A ₁ , B ₁ | A ₀ , B ₀ | I _{A>B} | I _{A<B} | I _{A=B} | Q _{A>B} | Q _{A<B} | Q _{A=B} |
| A ₃ >B ₃ | X | X | X | X | X | X | H | L | L |
| A ₃ <B ₃ | X | X | X | X | X | X | L | H | L |
| A ₃ =B ₃ | A ₂ >B ₂ | X | X | X | X | X | H | L | L |
| A ₃ =B ₃ | A ₂ <B ₂ | X | X | X | X | X | L | H | L |
| A ₃ =B ₃ | A ₂ =B ₂ | A ₁ >B ₁ | X | X | X | X | H | L | L |
| A ₃ =B ₃ | A ₂ =B ₂ | A ₁ <B ₁ | X | X | X | X | L | H | L |
| A ₃ =B ₃ | A ₂ =B ₂ | A ₁ =B ₁ | A ₀ >B ₀ | X | X | X | H | L | L |
| A ₃ =B ₃ | A ₂ =B ₂ | A ₁ =B ₁ | A ₀ <B ₀ | X | X | X | L | H | L |
| A ₃ =B ₃ | A ₂ =B ₂ | A ₁ =B ₁ | A ₀ =B ₀ | H | L | L | H | L | L |
| A ₃ =B ₃ | A ₂ =B ₂ | A ₁ =B ₁ | A ₀ =B ₀ | L | H | L | L | H | L |
| A ₃ =B ₃ | A ₂ =B ₂ | A ₁ =B ₁ | A ₀ =B ₀ | L | L | H | L | L | H |
| A ₃ =B ₃ | A ₂ =B ₂ | A ₁ =B ₁ | A ₀ =B ₀ | X | X | H | L | L | H |
| A ₃ =B ₃ | A ₂ =B ₂ | A ₁ =B ₁ | A ₀ =B ₀ | H | H | L | L | L | L |
| A ₃ =B ₃ | A ₂ =B ₂ | A ₁ =B ₁ | A ₀ =B ₀ | L | L | L | H | H | L |

Notes

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

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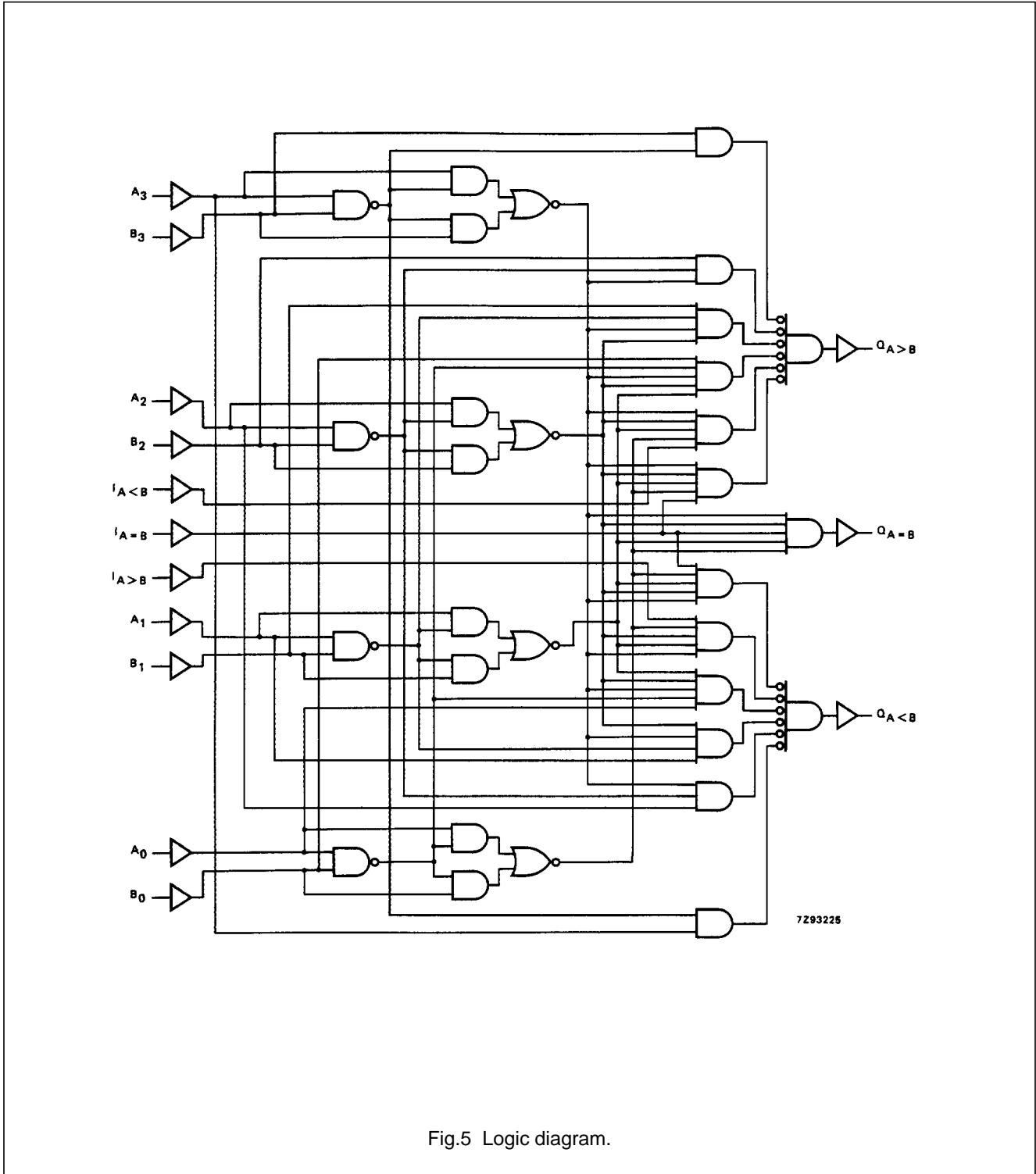


Fig.5 Logic diagram.

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DC CHARACTERISTICS FOR 74HC

For the DC characteristics see *"74HC/HCT/HCU/HCMOS Logic Family Specifications"*.

Output capability: standard

I_{CC} category: MSI

AC CHARACTERISTICS FOR 74HC

GND = 0 V; t_r = t_f = 6 ns; C_L = 50 pF

| SYMBOL | PARAMETER | T _{amb} (°C) | | | | | | | | UNIT | TEST CONDITIONS | |
|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|-----------------------|----------------|-----------------|------------|-----------------|-------------|-----------------|----|-------------------|------------------------|-----------|
| | | 74HC | | | | | | | | | V _{CC} (V) | WAVEFORMS |
| | | +25 | | | -40 to +85 | | -40 to +125 | | | | | |
| | | min. | typ. | max. | min. | max. | min. | max. | | | | |
| t _{PHL} / t _{PLH} | propagation delay A _n , B _n to Q _{A>B} or Q _{A<B} | | 63 23 18 | 195 39 33 | | 245 49 42 | | 295 59 50 | ns | 2.0 4.5 6.0 | Fig.6 | |
| t _{PHL} / t _{PLH} | propagation delay A _n , B _n to Q _{A=B} | | 58 21 17 | 175 35 30 | | 220 44 37 | | 265 53 45 | ns | 2.0 4.5 6.0 | Fig.6 | |
| t _{PHL} / t _{PLH} | propagation delay I _{A<B} , I _{A=B} , I _{A>B} to Q _{A<B} , Q _{A>B} | | 50 18 14 | 140 28 24 | | 175 35 30 | | 210 42 36 | ns | 2.0 4.5 6.0 | Fig.6 | |
| t _{PHL} / t _{PLH} | propagation delay I _{A=B} to Q _{A=B} | | 39 14 11 | 120 24 20 | | 150 30 26 | | 180 36 31 | ns | 2.0 4.5 6.0 | Fig.6 | |
| t _{THL} / t _{TLH} | output transition time | | 19 7 6 | 75 15 13 | | 95 19 16 | | 110 22 19 | ns | 2.0 4.5 6.0 | Fig.6 | |

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DC CHARACTERISTICS FOR 74HCT

For the DC characteristics see *"74HC/HCT/HCU/HCMOS Logic Family Specifications"*.

Output capability: standard

I_{CC} category: MSI

Note to HCT types

The value of additional quiescent supply current (ΔI_{CC}) for a unit load of 1 is given in the family specifications. To determine ΔI_{CC} per input, multiply this value by the unit load coefficient shown in the table below.

| INPUT | UNIT LOAD COEFFICIENT |
|---------------------------------|-----------------------|
| I _{A<B} | 1.00 |
| I _{A>B} | 1.00 |
| I _{A=B} | 1.50 |
| A _n , B _n | 1.50 |

AC CHARACTERISTICS FOR 74HCT

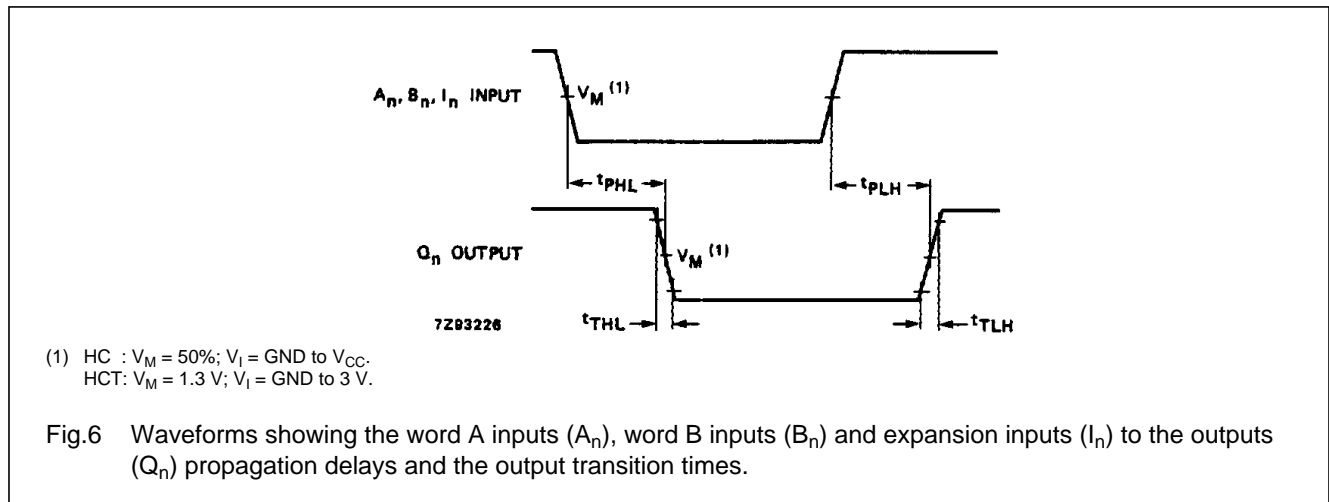
GND = 0 V; t_r = t_f = 6 ns; C_L = 50 pF

| SYMBOL | PARAMETER | T _{amb} (°C) | | | | | | UNIT | TEST CONDITIONS | | |
|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|-----------------------|------|------|------------|------|-------------|------|------------------------|-----------|-------|
| | | 74HCT | | | | | | | V _{CC} (V) | WAVEFORMS | |
| | | +25 | | | -40 to +85 | | -40 to +125 | | | | |
| | | min. | typ. | max. | min. | max. | min. | | | | max. |
| t _{PHL} / t _{PLH} | propagation delay A _n , B _n to Q _{A>B} or Q _{A<B} | | 26 | 44 | | 55 | | 66 | ns | 4.5 | Fig.6 |
| t _{PHL} / t _{PLH} | propagation delay A _n , B _n to Q _{A=B} | | 24 | 40 | | 50 | | 60 | ns | 4.5 | Fig.6 |
| t _{PHL} / t _{PLH} | propagation delay I _{A<B} , I _{A=B} , I _{A>B} to Q _{A<B} , Q _{A>B} | | 18 | 31 | | 39 | | 47 | ns | 4.5 | Fig.6 |
| t _{PHL} / t _{PLH} | propagation delay I _{A=B} to Q _{A=B} | | 18 | 31 | | 39 | | 47 | ns | 4.5 | Fig.6 |
| t _{THL} / t _{TLH} | output transition time | | 7 | 15 | | 19 | | 22 | ns | 4.5 | Fig.6 |

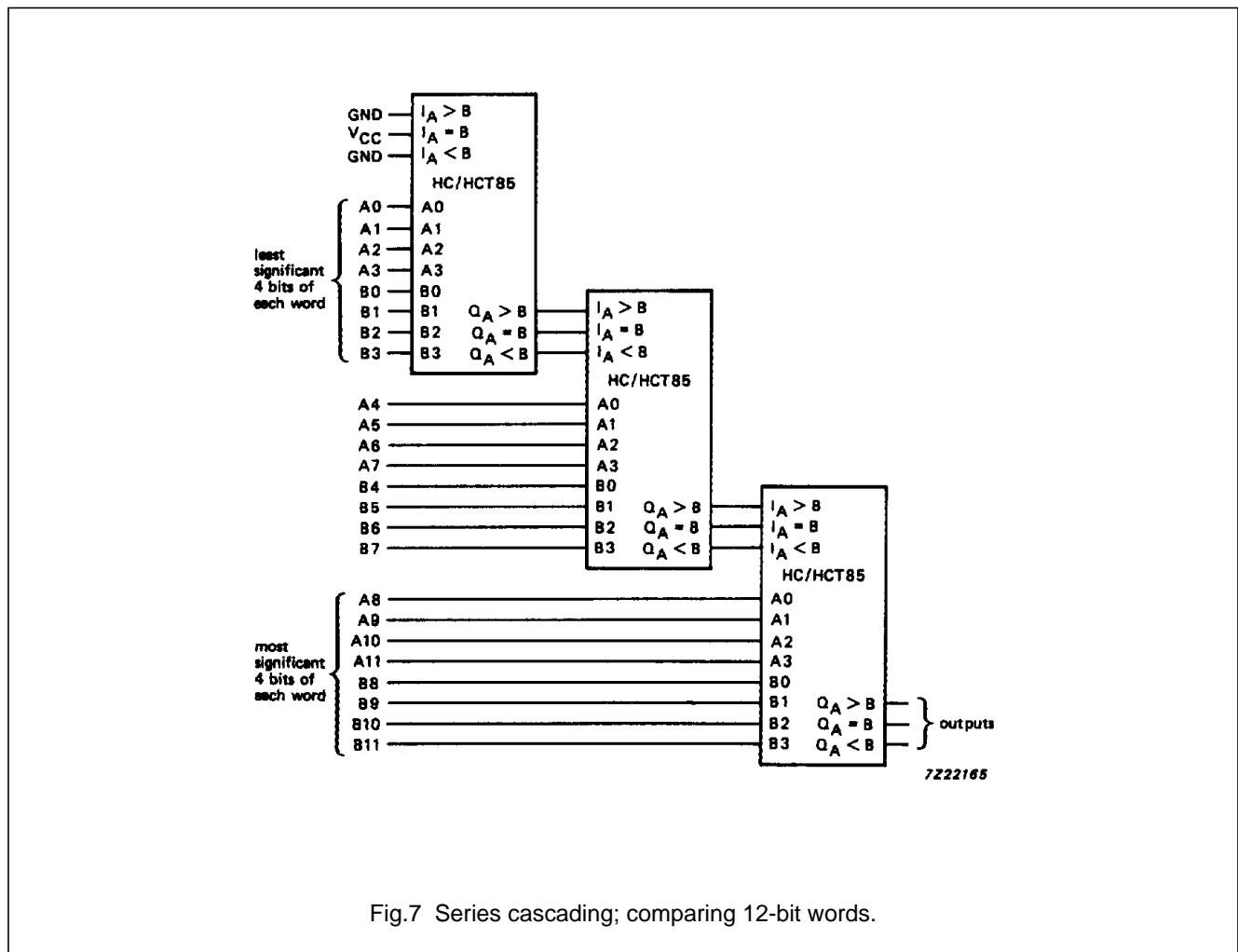
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AC WAVEFORMS



APPLICATION INFORMATION



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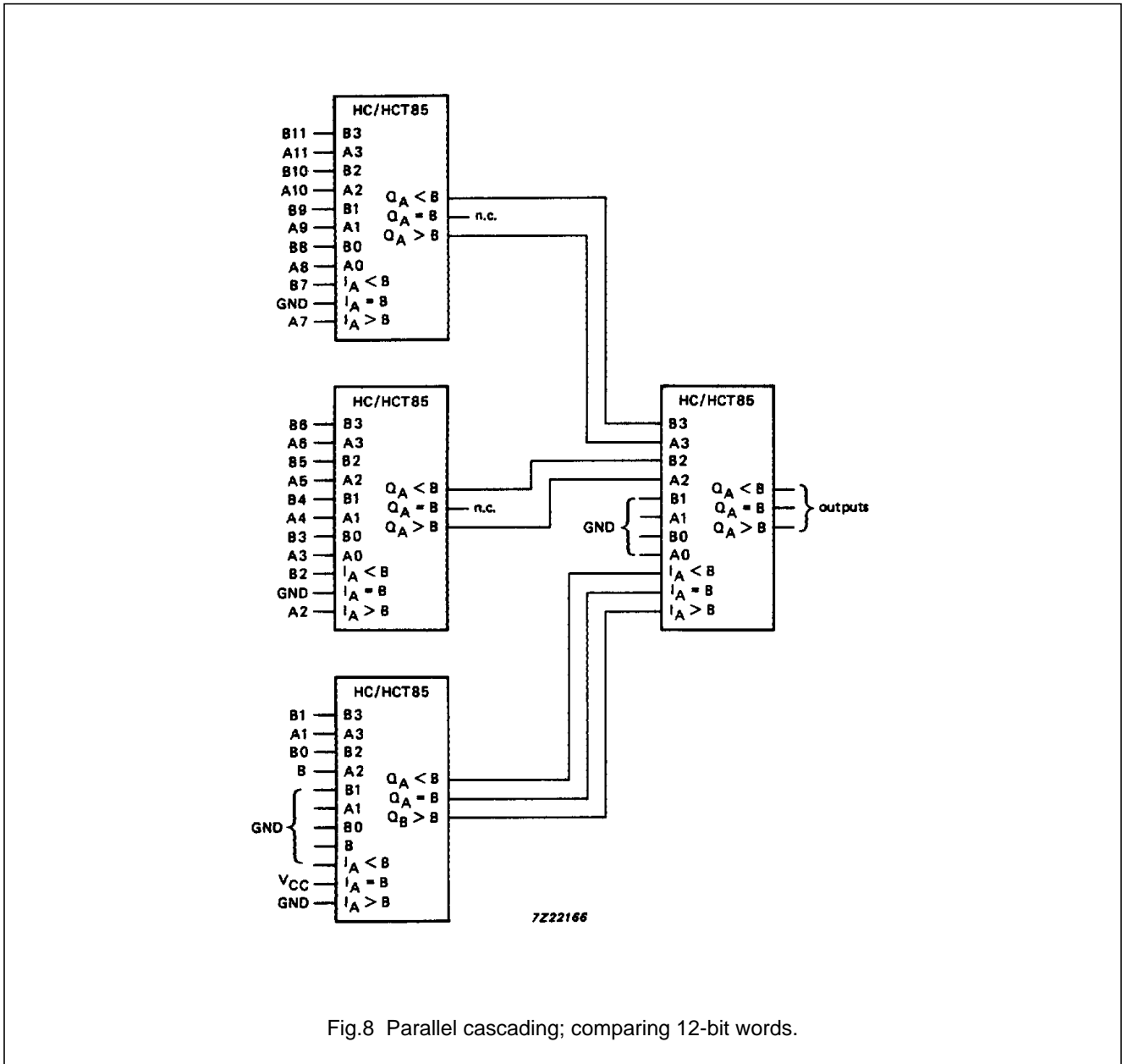


Fig.8 Parallel cascading; comparing 12-bit words.

PACKAGE OUTLINES

See "74HC/HCT/HCU/HCMOS Logic Package Outlines".