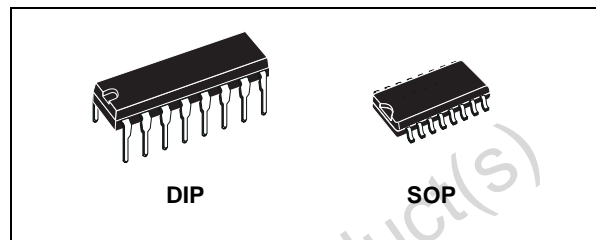




## 4-BIT MAGNITUDE COMPARATOR

- EXPANSION TO 8, 12, 16...4 N BITS BY CASCADING UNIT
- MEDIUM SPEED OPERATION : COMPARES TWO 4-BIT WORDS IN 180ns (Typ.) at 10V
- STANDARDIZED SYMMETRICAL OUTPUT CHARACTERISTICS
- QUIESCENT CURRENT SPECIFIED UP TO 20V
- 5V, 10V AND 15V PARAMETRIC RATINGS
- INPUT LEAKAGE CURRENT  
 $I_l = 100\text{nA (MAX) AT } V_{DD} = 18\text{V } T_A = 25^\circ\text{C}$
- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC JESD13B "STANDARD SPECIFICATIONS FOR DESCRIPTION OF B SERIES CMOS DEVICES"



### ORDER CODES

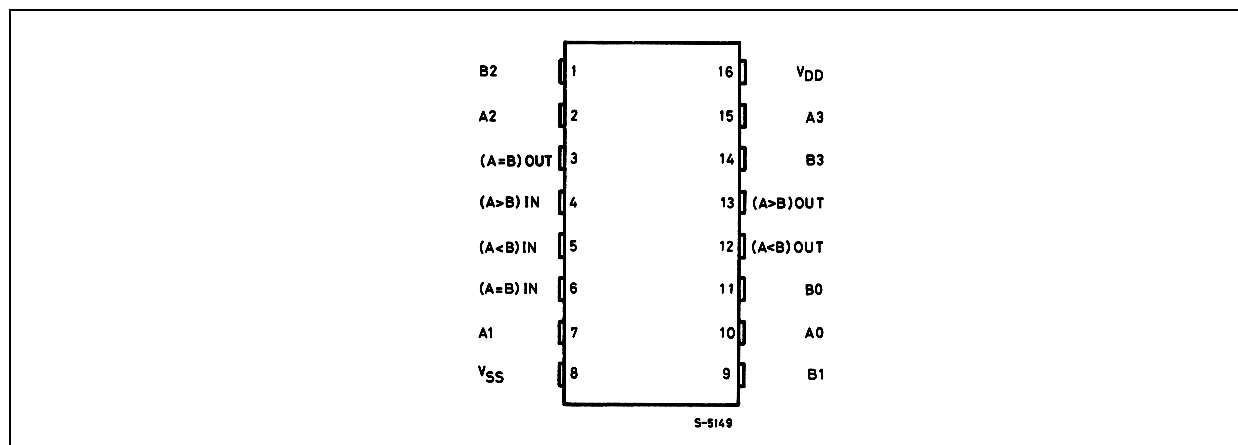
| PACKAGE | TUBE       | T & R         |
|---------|------------|---------------|
| DIP     | HCF4585BEY |               |
| SOP     | HCF4585BM1 | HCF4585M013TR |

### DESCRIPTION

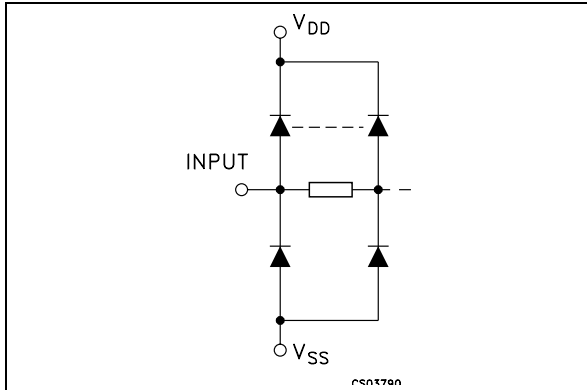
HCF4585B is a monolithic integrated circuit fabricated in Metal Oxide Semiconductor technology available in DIP and SOP packages. HCF4585B is a 4-bit magnitude comparator designed for use in computer and logic applications that require the comparison of two 4-bit words. This logic circuit determines whether one 4-bit word (Binary or BCD) is "less than", "equal to" or "greater than" a second 4-bit word.

HCF4585B has eight comparing inputs (A3, B3 through A0, B0), three outputs (A<B, A=B, A>B) and three cascading inputs (A<B, A=B, A>B) that permit system designers to expand the comparator function to 8, 12, 16...4N bits. When a single HCF4585B is used, the cascading inputs are connected as follows: (A<B) = low, (A=B) = high, (A>B) = high. Cascading these units for comparison of more than 4 bits is accomplished as shown in Typical application.

### PIN CONNECTION



IINPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

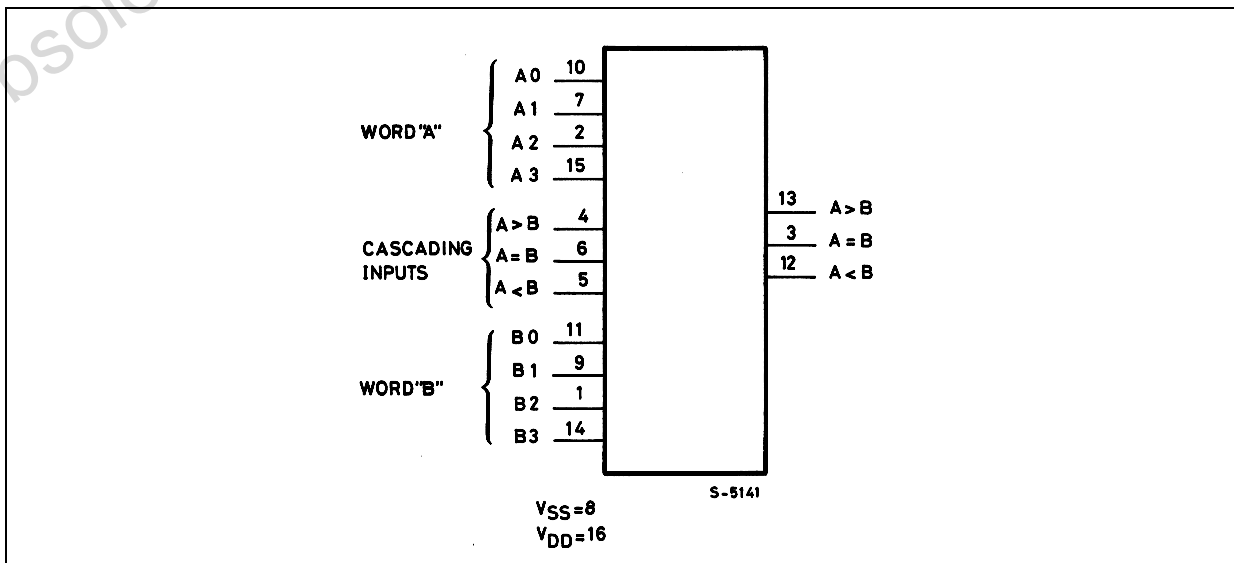
| PIN No       | SYMBOL          | NAME AND FUNCTION       |
|--------------|-----------------|-------------------------|
| 10, 7, 2, 15 | A0 to A3        | Word A Inputs           |
| 11, 9, 1, 14 | B0 to B3        | Word B Inputs           |
| 13, 3, 12    | A>B, A=B, A<B   | Outputs                 |
| 4, 6, 5      | A>B, A=B, A<B   | Cascading Inputs        |
| 8            | V <sub>SS</sub> | Negative Supply Voltage |
| 16           | V <sub>DD</sub> | Positive Supply Voltage |

TRUTH TABLE

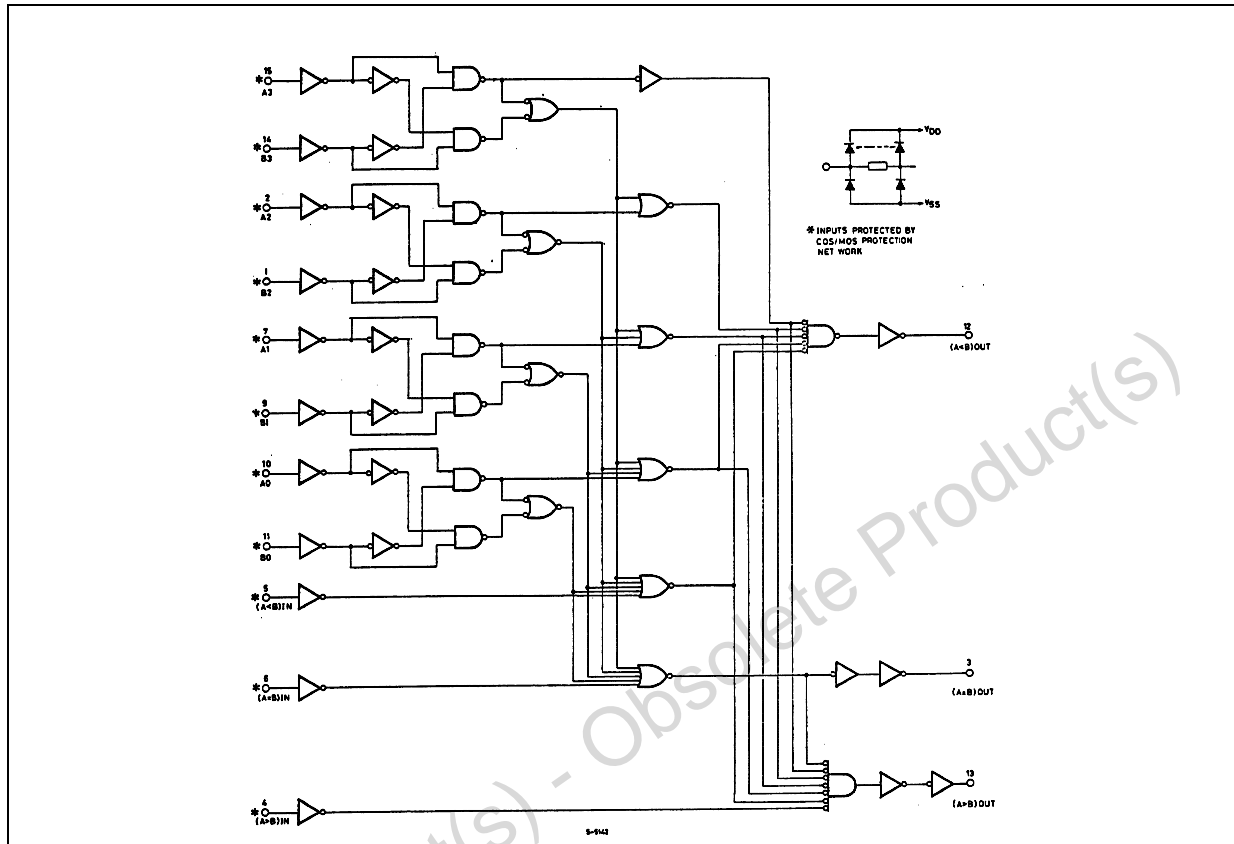
| INPUTS    |         |         |         | CASCADING |     |     | OUTPUTS |     |     |
|-----------|---------|---------|---------|-----------|-----|-----|---------|-----|-----|
| COMPARING |         |         |         | A<B       | A=B | A>B | A<B     | A=B | A>B |
| A3, B3    | A2, B2  | A1, B1  | A0, B0  |           |     |     |         |     |     |
| A3 > B3   | X       | X       | X       | X         | X   | H   | L       | L   | H   |
| A3 = B3   | A2 > B2 | X       | X       | X         | X   | H   | L       | L   | H   |
| A3 = B3   | A2 = B2 | A1 > B1 | X       | X         | X   | H   | L       | L   | H   |
| A3 = B3   | A2 = B2 | A1 = B1 | A0 > B0 | X         | X   | H   | L       | L   | H   |
| A3 = B3   | A2 = B2 | A1 = B1 | A0 = B0 | L         | L   | H   | L       | L   | H   |
| A3 = B3   | A2 = B2 | A1 = B1 | A0 = B0 | L         | H   | X   | L       | H   | L   |
| A3 = B3   | A2 = B2 | A1 = B1 | A0 = B0 | H         | L   | X   | H       | L   | L   |
| A3 = B3   | A2 = B2 | A1 = B1 | A0 < B0 | X         | X   | X   | H       | L   | L   |
| A3 = B3   | A2 < B2 | X       | X       | X         | X   | X   | H       | L   | L   |
| A3 < B3   | X       | X       | X       | X         | X   | X   | H       | L   | L   |

X : Don't Care

FUNCTIONAL DIAGRAM



## LOGIC DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

| Symbol    | Parameter                               | Value                  | Unit               |
|-----------|---|------------------------|--------------------|
| $V_{DD}$  | Supply Voltage                          | -0.5 to +22            | V                  |
| $V_I$     | DC Input Voltage                        | -0.5 to $V_{DD} + 0.5$ | V                  |
| $I_I$     | DC Input Current                        | $\pm 10$               | mA                 |
| $P_D$     | Power Dissipation per Package           | 200                    | mW                 |
|           | Power Dissipation per Output Transistor | 100                    | mW                 |
| $T_{op}$  | Operating Temperature                   | -55 to +125            | $^{\circ}\text{C}$ |
| $T_{stg}$ | Storage Temperature                     | -65 to +150            | $^{\circ}\text{C}$ |

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied.

All voltage values are referred to  $V_{SS}$  pin voltage.

## RECOMMENDED OPERATING CONDITIONS

| Symbol   | Parameter             | Value         | Unit               |
|----------|-----------------------|---------------|--------------------|
| $V_{DD}$ | Supply Voltage        | 3 to 20       | V                  |
| $V_I$    | Input Voltage         | 0 to $V_{DD}$ | V                  |
| $T_{op}$ | Operating Temperature | -55 to 125    | $^{\circ}\text{C}$ |

DC SPECIFICATIONS

| Symbol          | Parameter                 | Test Condition        |                       |                                 |                        | Value                 |               |           |             |         |              | Unit    |         |
|-----------------|---------------------------|-----------------------|-----------------------|---------------------------------|------------------------|-----------------------|---------------|-----------|-------------|---------|--------------|---------|---------|
|                 |                           | V <sub>I</sub><br>(V) | V <sub>O</sub><br>(V) | I <sub>ol</sub>  <br>( $\mu$ A) | V <sub>DD</sub><br>(V) | T <sub>A</sub> = 25°C |               |           | -40 to 85°C |         | -55 to 125°C |         |         |
|                 |                           |                       |                       |                                 |                        | Min.                  | Typ.          | Max.      | Min.        | Max.    | Min.         |         | Max.    |
| I <sub>L</sub>  | Quiescent Current         | 0/5                   |                       |                                 | 5                      |                       | 0.04          | 5         |             | 150     |              | 150     | $\mu$ A |
|                 |                           | 0/10                  |                       |                                 | 10                     |                       | 0.04          | 10        |             | 300     |              | 300     |         |
|                 |                           | 0/15                  |                       |                                 | 15                     |                       | 0.04          | 20        |             | 600     |              | 600     |         |
|                 |                           | 0/20                  |                       |                                 | 20                     |                       | 0.08          | 100       |             | 3000    |              | 3000    |         |
| V <sub>OH</sub> | High Level Output Voltage | 0/5                   |                       | <1                              | 5                      | 4.95                  |               |           | 4.95        |         | 4.95         |         | V       |
|                 |                           | 0/10                  |                       | <1                              | 10                     | 9.95                  |               |           | 9.95        |         | 9.95         |         |         |
|                 |                           | 0/15                  |                       | <1                              | 15                     | 14.95                 |               |           | 14.95       |         | 14.95        |         |         |
| V <sub>OL</sub> | Low Level Output Voltage  | 5/0                   |                       | <1                              | 5                      |                       | 0.05          |           |             | 0.05    |              | 0.05    | V       |
|                 |                           | 10/0                  |                       | <1                              | 10                     |                       | 0.05          |           |             | 0.05    |              | 0.05    |         |
|                 |                           | 15/0                  |                       | <1                              | 15                     |                       | 0.05          |           |             | 0.05    |              | 0.05    |         |
| V <sub>IH</sub> | High Level Input Voltage  |                       | 0.5/4.5               | <1                              | 5                      | 3.5                   |               |           | 3.5         |         | 3.5          |         | V       |
|                 |                           |                       | 1/9                   | <1                              | 10                     | 7                     |               |           | 7           |         | 7            |         |         |
|                 |                           |                       | 1.5/13.5              | <1                              | 15                     | 11                    |               |           | 11          |         | 11           |         |         |
| V <sub>IL</sub> | Low Level Input Voltage   |                       | 4.5/0.5               | <1                              | 5                      |                       |               | 1.5       |             | 1.5     |              | 1.5     | V       |
|                 |                           |                       | 9/1                   | <1                              | 10                     |                       |               | 3         |             | 3       |              | 3       |         |
|                 |                           |                       | 13.5/1.5              | <1                              | 15                     |                       |               | 4         |             | 4       |              | 4       |         |
| I <sub>OH</sub> | Output Drive Current      | 0/5                   | 2.5                   | <1                              | 5                      | -1.36                 | -3.2          |           | -1.1        |         | -1.1         |         | mA      |
|                 |                           | 0/5                   | 4.6                   | <1                              | 5                      | -0.44                 | -1            |           | -0.36       |         | -0.36        |         |         |
|                 |                           | 0/10                  | 9.5                   | <1                              | 10                     | -1.1                  | -2.6          |           | -0.9        |         | -0.9         |         |         |
|                 |                           | 0/15                  | 13.5                  | <1                              | 15                     | -3.0                  | -6.8          |           | -2.4        |         | -2.4         |         |         |
| I <sub>OL</sub> | Output Sink Current       | 0/5                   | 0.4                   | <1                              | 5                      | 0.44                  | 1             |           | 0.36        |         | 0.36         |         | mA      |
|                 |                           | 0/10                  | 0.5                   | <1                              | 10                     | 1.1                   | 2.6           |           | 0.9         |         | 0.9          |         |         |
|                 |                           | 0/15                  | 1.5                   | <1                              | 15                     | 3.0                   | 6.8           |           | 2.4         |         | 2.4          |         |         |
| I <sub>I</sub>  | Input Leakage Current     | 0/18                  | Any Input             |                                 | 18                     |                       | $\pm 10^{-5}$ | $\pm 0.1$ |             | $\pm 1$ |              | $\pm 1$ | $\mu$ A |
| C <sub>I</sub>  | Input Capacitance         |                       | Any Input             |                                 |                        |                       | 5             | 7.5       |             |         |              |         | pF      |

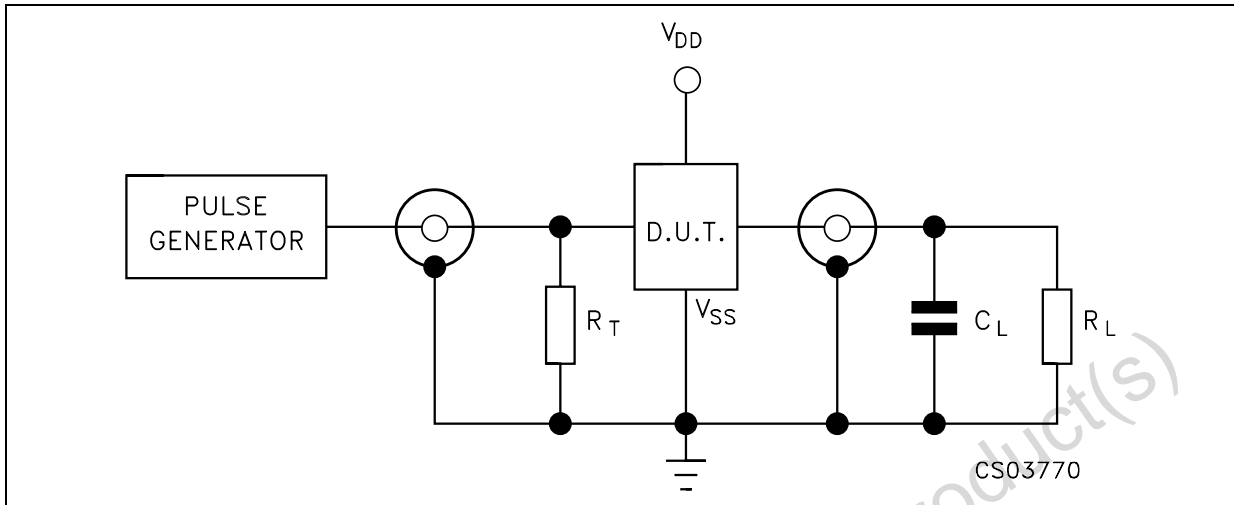
The Noise Margin for both "1" and "0" level is: 1V min. with V<sub>DD</sub>=5V, 2V min. with V<sub>DD</sub>=10V, 2.5V min. with V<sub>DD</sub>=15V

DYNAMIC ELECTRICAL CHARACTERISTICS (T<sub>amb</sub> = 25°C, C<sub>L</sub> = 50pF, R<sub>L</sub> = 200K $\Omega$ , t<sub>r</sub> = t<sub>f</sub> = 20 ns)

| Symbol                            | Parameter              | Test Condition      |                             |  | Value (*) |      |      | Unit |
|-----------------------------------|------------------------|---------------------|-----------------------------|--|-----------|------|------|------|
|                                   |                        | V <sub>DD</sub> (V) |                             |  | Min.      | Typ. | Max. |      |
| t <sub>PHL</sub> t <sub>PLH</sub> | Propagation Delay Time | 5                   | Comparing Inputs to Outputs |  |           | 300  | 600  | ns   |
|                                   |                        | 10                  |                             |  |           | 125  | 250  |      |
|                                   |                        | 15                  |                             |  |           | 80   | 160  |      |
| t <sub>PHL</sub> t <sub>PLH</sub> | Propagation Delay Time | 5                   | Cascading Inputs to Outputs |  |           | 200  | 400  | ns   |
|                                   |                        | 10                  |                             |  |           | 80   | 160  |      |
|                                   |                        | 15                  |                             |  |           | 60   | 120  |      |
| t <sub>THL</sub> t <sub>TLH</sub> | Transition Time        | 5                   |                             |  |           | 100  | 200  | ns   |
|                                   |                        | 10                  |                             |  |           | 50   | 100  |      |
|                                   |                        | 15                  |                             |  |           | 40   | 80   |      |

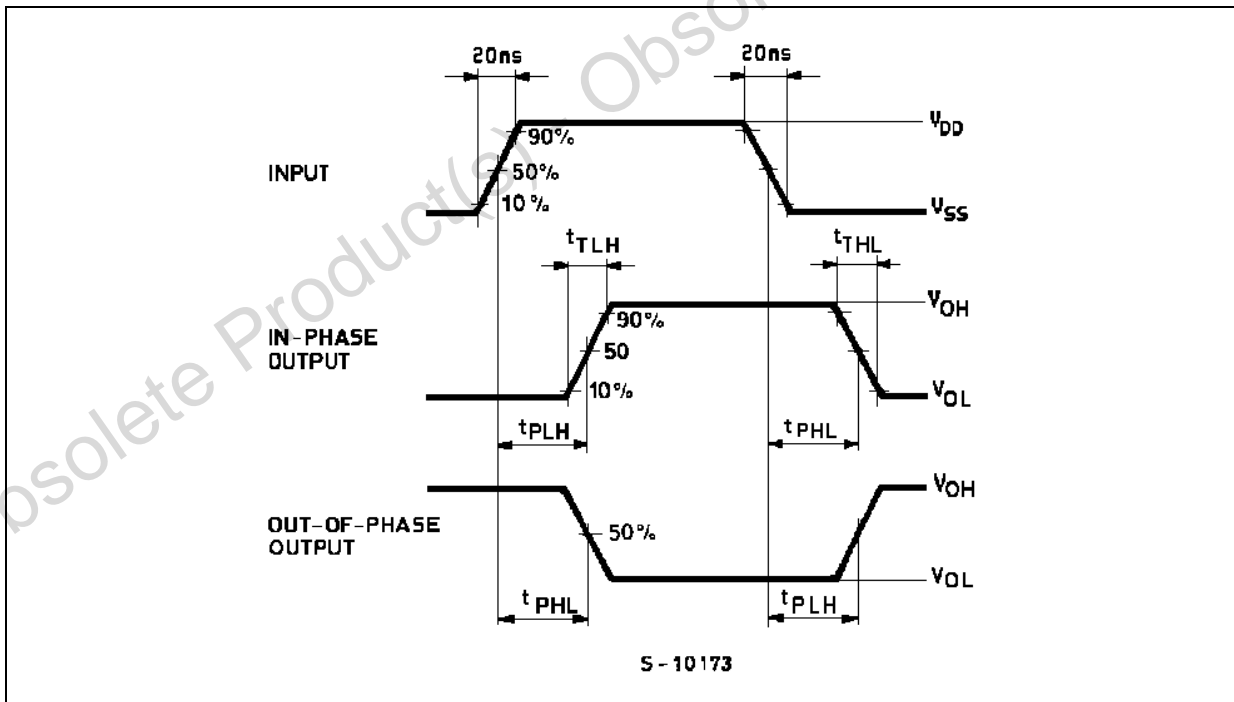
(\*) Typical temperature coefficient for all V<sub>DD</sub> value is 0.3 %/°C.

TEST CIRCUIT



$C_L = 50\text{pF}$  or equivalent (includes jig and probe capacitance)  
 $R_L = 200\text{K}\Omega$   
 $R_T = Z_{OUT}$  of pulse generator (typically  $50\Omega$ )

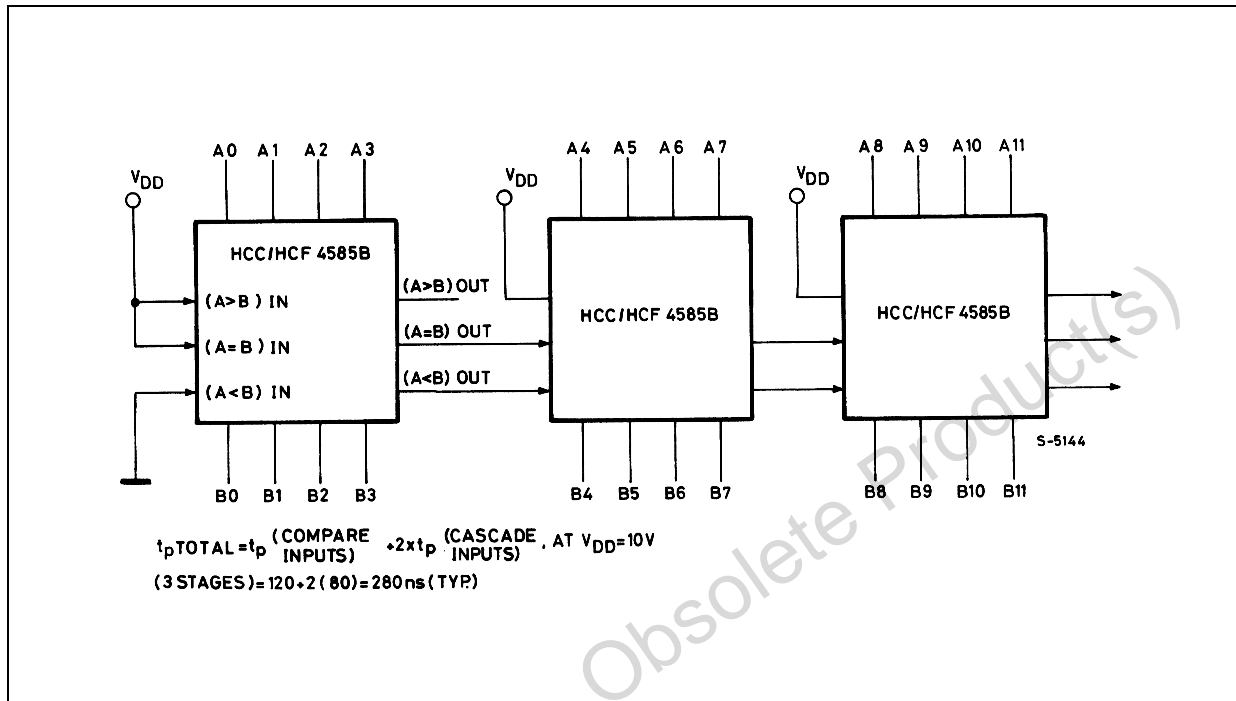
WAVEFORM : PROPAGATION DELAY TIMES ( $f=1\text{MHz}$ ; 50% duty cycle)



# HCF4585B

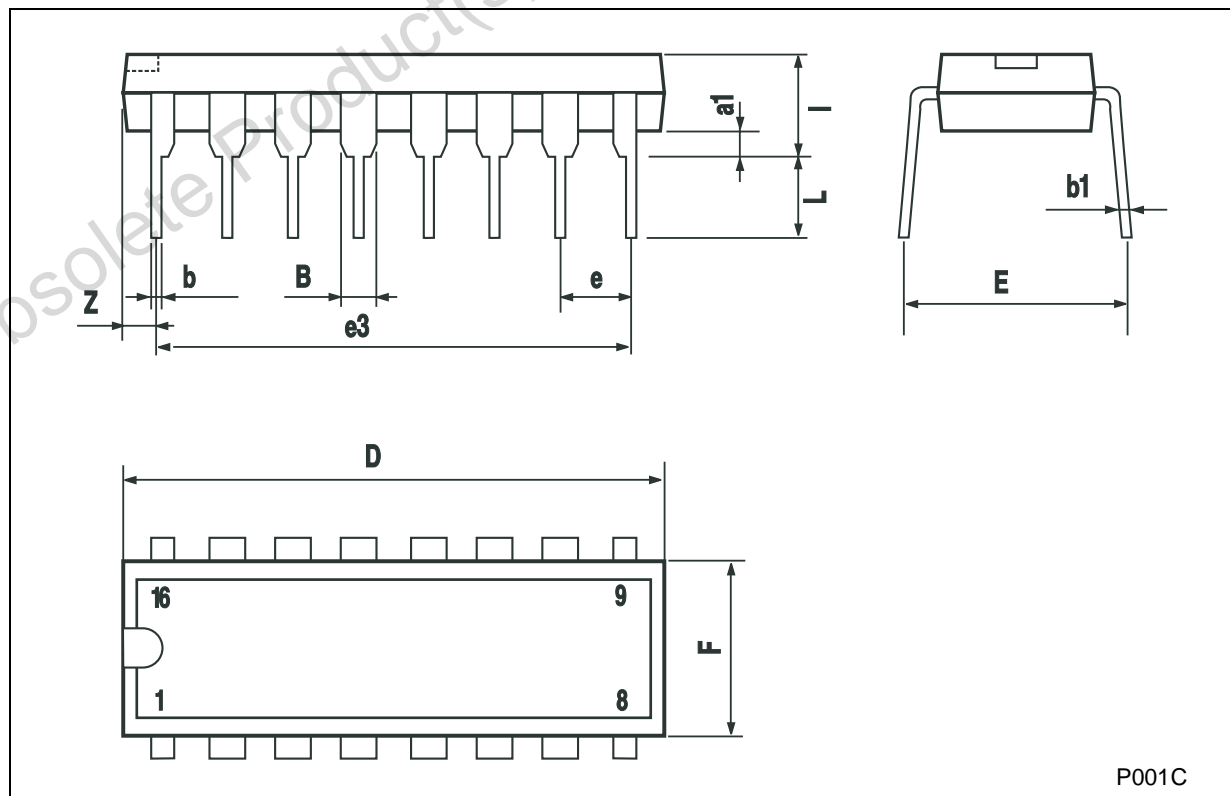
## TYPICAL APPLICATION

### TYPICAL SPEED CHARACTERISTICS OF A 12-BIT COMPARATOR



### Plastic DIP-16 (0.25) MECHANICAL DATA

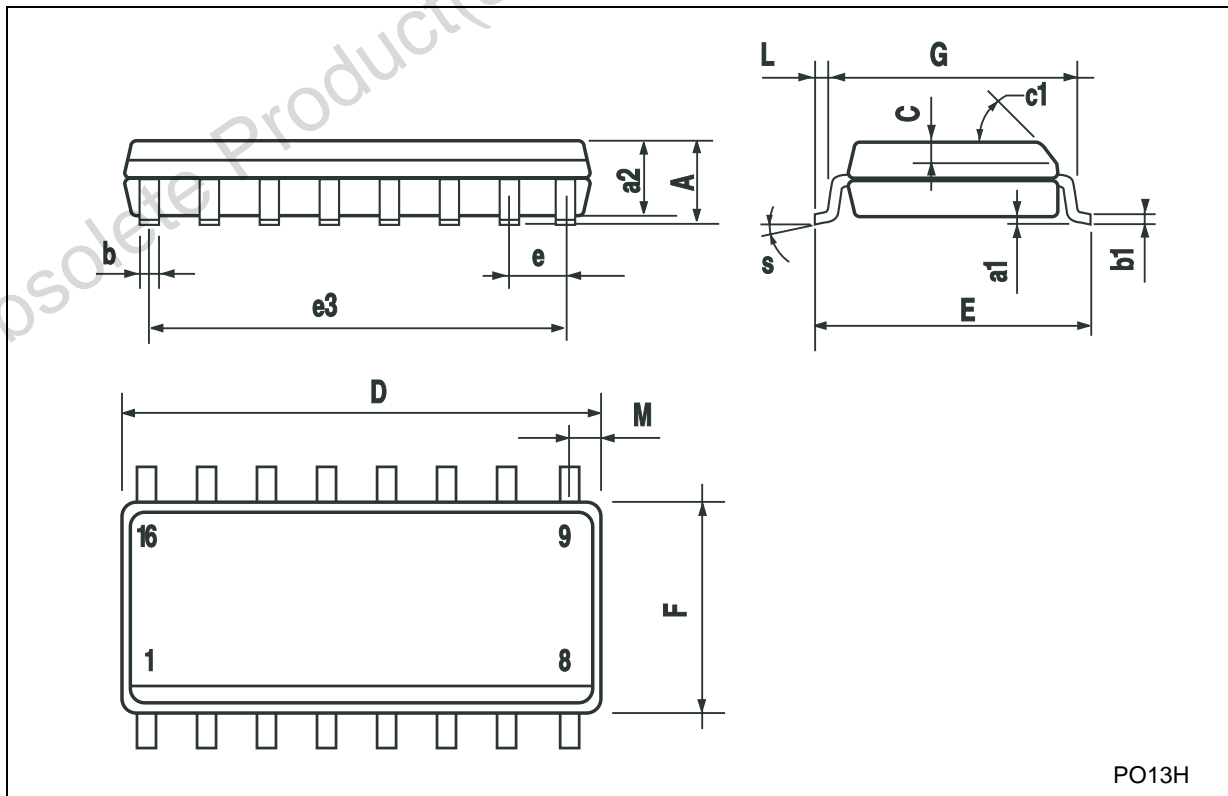
| DIM. | mm.  |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP   | MAX. | MIN.  | TYP.  | MAX.  |
| a1   | 0.51 |       |      | 0.020 |       |       |
| B    | 0.77 |       | 1.65 | 0.030 |       | 0.065 |
| b    |      | 0.5   |      |       | 0.020 |       |
| b1   |      | 0.25  |      |       | 0.010 |       |
| D    |      |       | 20   |       |       | 0.787 |
| E    |      | 8.5   |      |       | 0.335 |       |
| e    |      | 2.54  |      |       | 0.100 |       |
| e3   |      | 17.78 |      |       | 0.700 |       |
| F    |      |       | 7.1  |       |       | 0.280 |
| I    |      |       | 5.1  |       |       | 0.201 |
| L    |      | 3.3   |      |       | 0.130 |       |
| Z    |      |       | 1.27 |       |       | 0.050 |



P001C

**SO-16 MECHANICAL DATA**

| DIM. | mm.        |      |      | inch  |       |       |
|------|------------|------|------|-------|-------|-------|
|      | MIN.       | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    |            |      | 1.75 |       |       | 0.068 |
| a1   | 0.1        |      | 0.2  | 0.003 |       | 0.007 |
| a2   |            |      | 1.65 |       |       | 0.064 |
| b    | 0.35       |      | 0.46 | 0.013 |       | 0.018 |
| b1   | 0.19       |      | 0.25 | 0.007 |       | 0.010 |
| C    |            | 0.5  |      |       | 0.019 |       |
| c1   | 45° (typ.) |      |      |       |       |       |
| D    | 9.8        |      | 10   | 0.385 |       | 0.393 |
| E    | 5.8        |      | 6.2  | 0.228 |       | 0.244 |
| e    |            | 1.27 |      |       | 0.050 |       |
| e3   |            | 8.89 |      |       | 0.350 |       |
| F    | 3.8        |      | 4.0  | 0.149 |       | 0.157 |
| G    | 4.6        |      | 5.3  | 0.181 |       | 0.208 |
| L    | 0.5        |      | 1.27 | 0.019 |       | 0.050 |
| M    |            |      | 0.62 |       |       | 0.024 |
| S    | 8° (max.)  |      |      |       |       |       |



PO13H



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