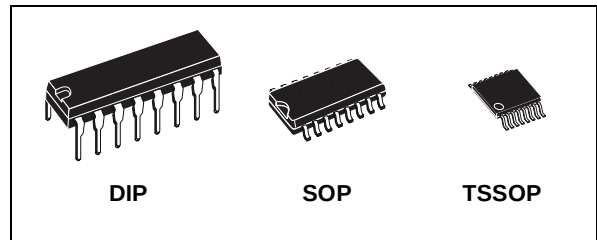


## 4-BIT MAGNITUDE COMPARATOR

- **HIGH SPEED :**  
 $t_{PD} = 20 \text{ ns (TYP.) at } V_{CC} = 6V$
- **LOW POWER DISSIPATION:**  
 $I_{CC} = 4\mu A(\text{MAX.}) \text{ at } T_A = 25^\circ C$
- **HIGH NOISE IMMUNITY:**  
 $V_{NIH} = V_{NIL} = 28 \% V_{CC} (\text{MIN.})$
- **SYMMETRICAL OUTPUT IMPEDANCE:**  
 $|I_{OH}| = I_{OL} = 4mA (\text{MIN})$
- **BALANCED PROPAGATION DELAYS:**  
 $t_{PLH} \approx t_{PHL}$
- **WIDE OPERATING VOLTAGE RANGE:**  
 $V_{CC} (\text{OPR}) = 2V \text{ to } 6V$
- **PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 85**



### ORDER CODES

| PACKAGE | TUBE       | T & R         |
|---------|------------|---------------|
| DIP     | M74HC85B1R |               |
| SOP     | M74HC85M1R | M74HC85RM13TR |
| TSSOP   |            | M74HC85TTR    |

### DESCRIPTION

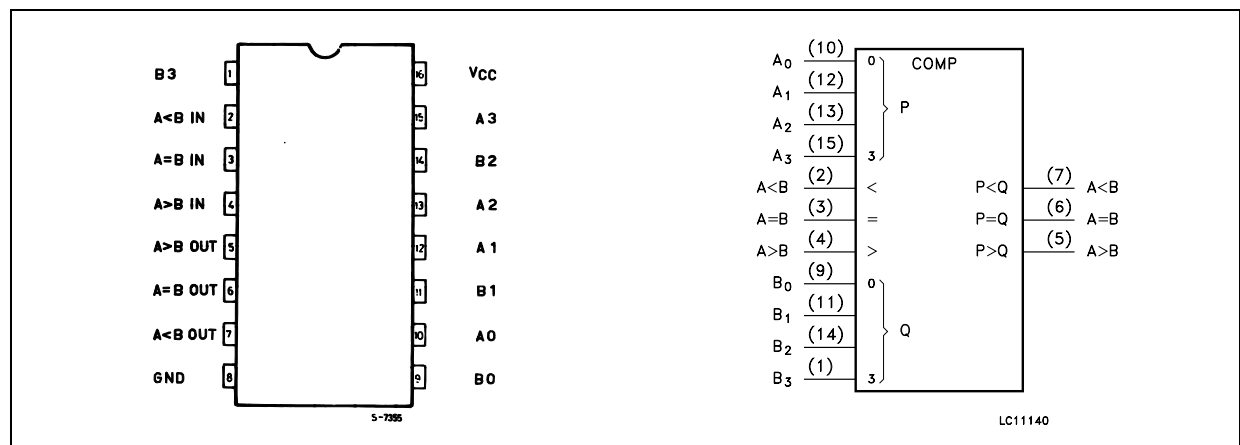
The M74HC85 is an high speed CMOS 4-BIT MAGNITUDE COMPARATOR fabricated with silicon gate C<sup>2</sup>MOS technology.

This comparator compares two 4-bit words and provides an high voltage level on one of the A>B out, A=B out and A<B out outputs. The comparing

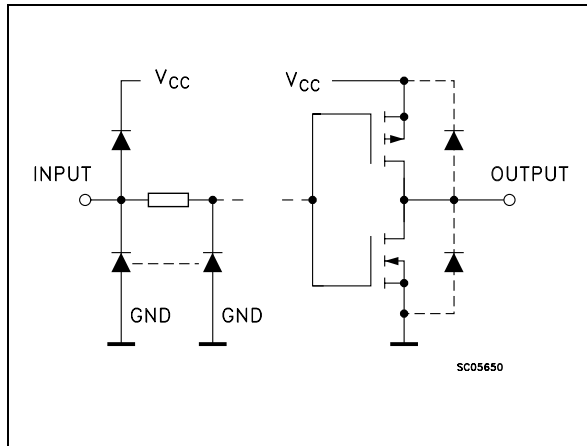
bit number is easily expanded by cascading several devices as shown in the typical application.

All inputs are equipped with protection circuits against static discharge and transient excess voltage.

### PIN CONNECTION AND IEC LOGIC SYMBOLS



## INPUT AND OUTPUT EQUIVALENT CIRCUIT



## PIN DESCRIPTION

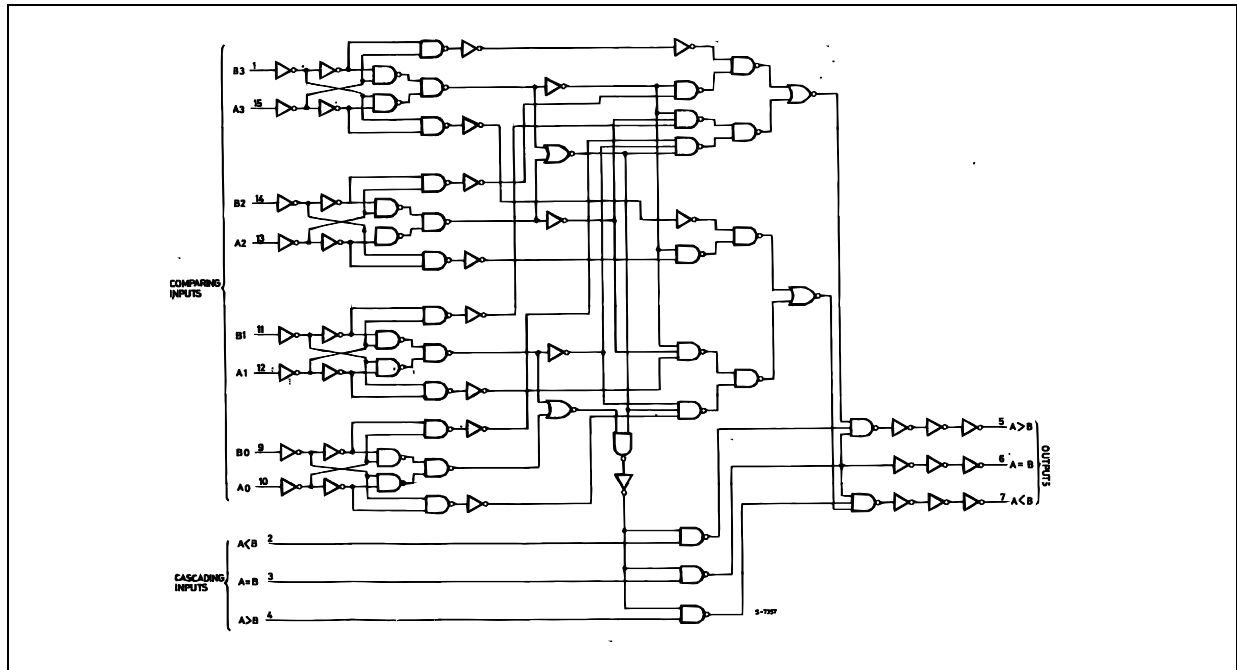
| PIN No         | SYMBOL         | NAME AND FUNCTION       |
|----------------|----------------|-------------------------|
| 2              | $IN_{A<B}$     | A<B Expansion Input     |
| 3              | $IN_{A=B}$     | A=B Expansion Input     |
| 4              | $IN_{A>B}$     | A>B Expansion Input     |
| 5              | $OUT_{A>B}$    | A>B Expansion Output    |
| 6              | $OUT_{A=B}$    | A=B Expansion Output    |
| 7              | $OUT_{A<B}$    | A<B Expansion Output    |
| 9, 11, 14, 1   | $B_0$ to $B_3$ | Word B Inputs           |
| 10, 12, 13, 15 | $A_0$ to $A_3$ | Word A Inputs           |
| 8              | GND            | Ground (0V)             |
| 16             | Vcc            | Positive Supply Voltage |

## TRUTH TABLE

| COMPARING INPUTS |             |             |             | CASCADING INPUTS |     |     | OUTPUTS |     |     |
|------------------|-------------|-------------|-------------|------------------|-----|-----|---------|-----|-----|
|                  |             |             |             | A>B              | A<B | A=B | A>B     | A<B | A=B |
| $A_3 > B_3$      | X           | X           | X           | X                | X   | X   | H       | L   | L   |
| $A_3 = B_3$      | $A_2 > B_2$ | X           | X           | X                | X   | X   | H       | L   | L   |
| $A_3 = B_3$      | $A_2 = B_2$ | $A_1 > B_1$ | X           | 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   | H       | L   | L   |
| $A_3 = B_3$      | $A_2 = B_2$ | $A_1 = B_1$ | $A_0 = B_0$ | L                | L   | L   | H       | H   | L   |
|                  |             |             |             | X                | X   | H   | L       | L   | H   |
|                  |             |             |             | L                | H   | L   | L       | H   | L   |
|                  |             |             |             | H                | L   | L   | 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   |
| $A_3 = B_3$      | $A_2 = B_2$ | $A_1 > B_1$ | X           | X                | X   | X   | L       | H   | L   |
| $A_3 = B_3$      | $A_2 < B_2$ | X           | X           | X                | X   | X   | L       | H   | L   |
| $A_3 < B_3$      | X           | X           | X           | X                | X   | X   | L       | H   | L   |

X : Don't Care

## LOGIC DIAGRAM



This logic diagram has not be used to estimate propagation delays

## ABSOLUTE MAXIMUM RATINGS

| Symbol                | Parameter                     | Value                  | Unit |
|-----------------------|-------------------------------|------------------------|------|
| $V_{CC}$              | Supply Voltage                | -0.5 to +7             | V    |
| $V_I$                 | DC Input Voltage              | -0.5 to $V_{CC} + 0.5$ | V    |
| $V_O$                 | DC Output Voltage             | -0.5 to $V_{CC} + 0.5$ | V    |
| $I_{IK}$              | DC Input Diode Current        | $\pm 20$               | mA   |
| $I_{OK}$              | DC Output Diode Current       | $\pm 20$               | mA   |
| $I_O$                 | DC Output Current             | $\pm 25$               | mA   |
| $I_{CC}$ or $I_{GND}$ | DC $V_{CC}$ or Ground Current | $\pm 50$               | mA   |
| $P_D$                 | Power Dissipation             | 500(*)                 | mW   |
| $T_{stg}$             | Storage Temperature           | -65 to +150            | °C   |
| $T_L$                 | Lead Temperature (10 sec)     | 300                    | °C   |

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

(\*) 500mW at 65 °C; derate to 300mW by 10mW/°C from 65°C to 85°C

## RECOMMENDED OPERATING CONDITIONS

| Symbol                          | Parameter                |                        | Value                | Unit |
|---------------------------------|--------------------------|------------------------|----------------------|------|
| V <sub>CC</sub>                 | Supply Voltage           |                        | 2 to 6               | V    |
| V <sub>I</sub>                  | Input Voltage            |                        | 0 to V <sub>CC</sub> | V    |
| V <sub>O</sub>                  | Output Voltage           |                        | 0 to V <sub>CC</sub> | V    |
| T <sub>op</sub>                 | Operating Temperature    |                        | -55 to 125           | °C   |
| t <sub>r</sub> , t <sub>f</sub> | Input Rise and Fall Time | V <sub>CC</sub> = 2.0V | 0 to 1000            | ns   |
|                                 |                          | V <sub>CC</sub> = 4.5V | 0 to 500             | ns   |
|                                 |                          | V <sub>CC</sub> = 6.0V | 0 to 400             | ns   |

## DC SPECIFICATIONS

| Symbol          | Parameter                 | Test Condition         |                                         | Value                 |      |       |             |      |              | Unit |      |  |
|-----------------|---------------------------|------------------------|-----------------------------------------|-----------------------|------|-------|-------------|------|--------------|------|------|--|
|                 |                           | V <sub>CC</sub><br>(V) |                                         | T <sub>A</sub> = 25°C |      |       | -40 to 85°C |      | -55 to 125°C |      |      |  |
|                 |                           |                        |                                         | Min.                  | Typ. | Max.  | Min.        | Max. | Min.         |      | Max. |  |
| V <sub>IH</sub> | High Level Input Voltage  | 2.0                    |                                         | 1.5                   |      |       | 1.5         |      | 1.5          |      | V    |  |
|                 |                           | 4.5                    |                                         | 3.15                  |      |       | 3.15        |      | 3.15         |      |      |  |
|                 |                           | 6.0                    |                                         | 4.2                   |      |       | 4.2         |      | 4.2          |      |      |  |
| V <sub>IL</sub> | Low Level Input Voltage   | 2.0                    |                                         |                       |      | 0.5   |             | 0.5  |              | 0.5  | V    |  |
|                 |                           | 4.5                    |                                         |                       |      | 1.35  |             | 1.35 |              | 1.35 |      |  |
|                 |                           | 6.0                    |                                         |                       |      | 1.8   |             | 1.8  |              | 1.8  |      |  |
| V <sub>OH</sub> | High Level Output Voltage | 2.0                    | I <sub>O</sub> =-20 μA                  | 1.9                   | 2.0  |       | 1.9         |      | 1.9          |      | V    |  |
|                 |                           | 4.5                    | I <sub>O</sub> =-20 μA                  | 4.4                   | 4.5  |       | 4.4         |      | 4.4          |      |      |  |
|                 |                           | 6.0                    | I <sub>O</sub> =-20 μA                  | 5.9                   | 6.0  |       | 5.9         |      | 5.9          |      |      |  |
|                 |                           | 4.5                    | I <sub>O</sub> =-4.0 mA                 | 4.18                  | 4.31 |       | 4.13        |      | 4.10         |      |      |  |
|                 |                           | 6.0                    | I <sub>O</sub> =-5.2 mA                 | 5.68                  | 5.8  |       | 5.63        |      | 5.60         |      |      |  |
| V <sub>OL</sub> | Low Level Output Voltage  | 2.0                    | I <sub>O</sub> =20 μA                   |                       | 0.0  | 0.1   |             | 0.1  |              | 0.1  | V    |  |
|                 |                           | 4.5                    | I <sub>O</sub> =20 μA                   |                       | 0.0  | 0.1   |             | 0.1  |              | 0.1  |      |  |
|                 |                           | 6.0                    | I <sub>O</sub> =20 μA                   |                       | 0.0  | 0.1   |             | 0.1  |              | 0.1  |      |  |
|                 |                           | 4.5                    | I <sub>O</sub> =4.0 mA                  |                       | 0.17 | 0.26  |             | 0.33 |              | 0.40 |      |  |
|                 |                           | 6.0                    | I <sub>O</sub> =5.2 mA                  |                       | 0.18 | 0.26  |             | 0.33 |              | 0.40 |      |  |
| I <sub>I</sub>  | Input Leakage Current     | 6.0                    | V <sub>I</sub> = V <sub>CC</sub> or GND |                       |      | ± 0.1 |             | ± 1  |              | ± 1  | μA   |  |
| I <sub>CC</sub> | Quiescent Supply Current  | 6.0                    | V <sub>I</sub> = V <sub>CC</sub> or GND |                       |      | 4     |             | 40   |              | 80   | μA   |  |

AC ELECTRICAL CHARACTERISTICS (C<sub>L</sub> = 50 pF, Input t<sub>r</sub> = t<sub>f</sub> = 6ns)

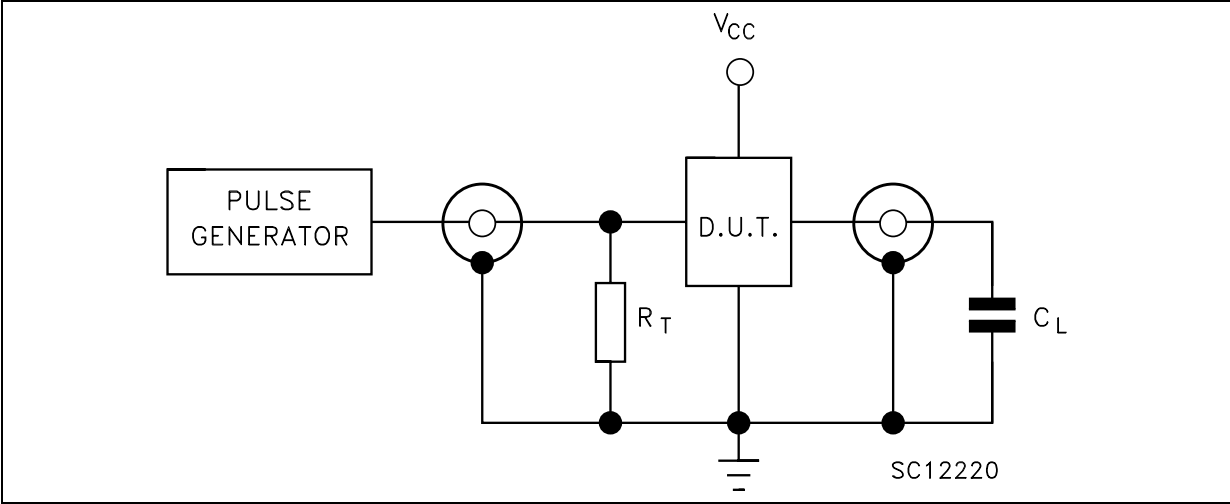
| Symbol                            | Parameter                            | Test Condition         |  | Value                 |      |      |             |      |              | Unit |      |
|-----------------------------------|--------------------------------------|------------------------|--|-----------------------|------|------|-------------|------|--------------|------|------|
|                                   |                                      | V <sub>CC</sub><br>(V) |  | T <sub>A</sub> = 25°C |      |      | -40 to 85°C |      | -55 to 125°C |      |      |
|                                   |                                      |                        |  | Min.                  | Typ. | Max. | Min.        | Max. | Min.         |      | Max. |
| t <sub>TLH</sub> t <sub>THL</sub> | Output Transition Time               | 2.0                    |  |                       | 30   | 75   |             | 95   |              | 110  | ns   |
|                                   |                                      | 4.5                    |  |                       | 8    | 15   |             | 19   |              | 22   |      |
|                                   |                                      | 6.0                    |  |                       | 7    | 13   |             | 16   |              | 19   |      |
| t <sub>PLH</sub> t <sub>PHL</sub> | Propagation Delay Time (A, B-OUT)    | 2.0                    |  |                       | 96   | 185  |             | 230  |              | 280  | ns   |
|                                   |                                      | 4.5                    |  |                       | 24   | 37   |             | 46   |              | 56   |      |
|                                   |                                      | 6.0                    |  |                       | 20   | 31   |             | 39   |              | 48   |      |
| t <sub>PLH</sub> t <sub>PHL</sub> | Propagation Delay Time (CASCADE-OUT) | 2.0                    |  |                       | 48   | 95   |             | 120  |              | 145  | ns   |
|                                   |                                      | 4.5                    |  |                       | 12   | 19   |             | 24   |              | 29   |      |
|                                   |                                      | 6.0                    |  |                       | 10   | 16   |             | 20   |              | 25   |      |

CAPACITIVE CHARACTERISTICS

| Symbol          | Parameter                              | Test Condition         |  | Value                 |      |      |             |      |              | Unit |      |
|-----------------|----------------------------------------|------------------------|--|-----------------------|------|------|-------------|------|--------------|------|------|
|                 |                                        | V <sub>CC</sub><br>(V) |  | T <sub>A</sub> = 25°C |      |      | -40 to 85°C |      | -55 to 125°C |      |      |
|                 |                                        |                        |  | Min.                  | Typ. | Max. | Min.        | Max. | Min.         |      | Max. |
| C <sub>IN</sub> | Input Capacitance                      | 5.0                    |  |                       | 5    | 10   |             | 10   |              | 10   | pF   |
| C <sub>PD</sub> | Power Dissipation Capacitance (note 1) | 5.0                    |  |                       | 23   |      |             |      |              |      | pF   |

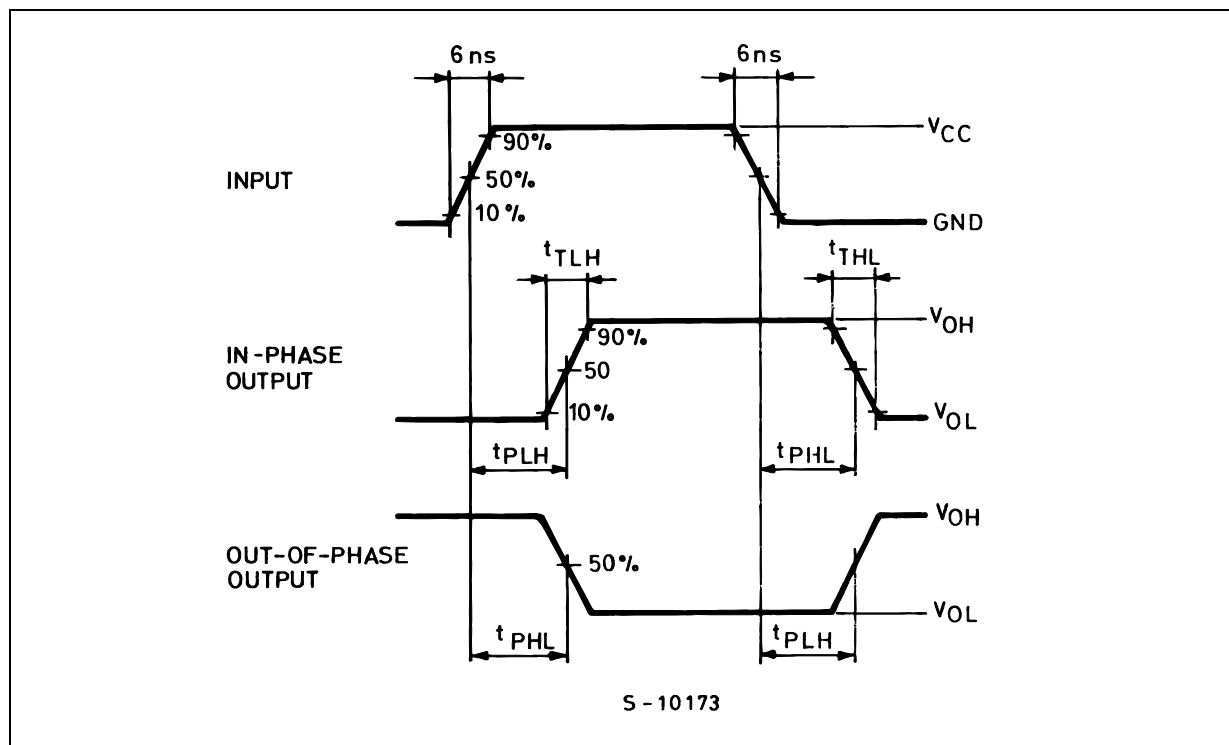
1) C<sub>PD</sub> is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation.  $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}$

TEST CIRCUIT



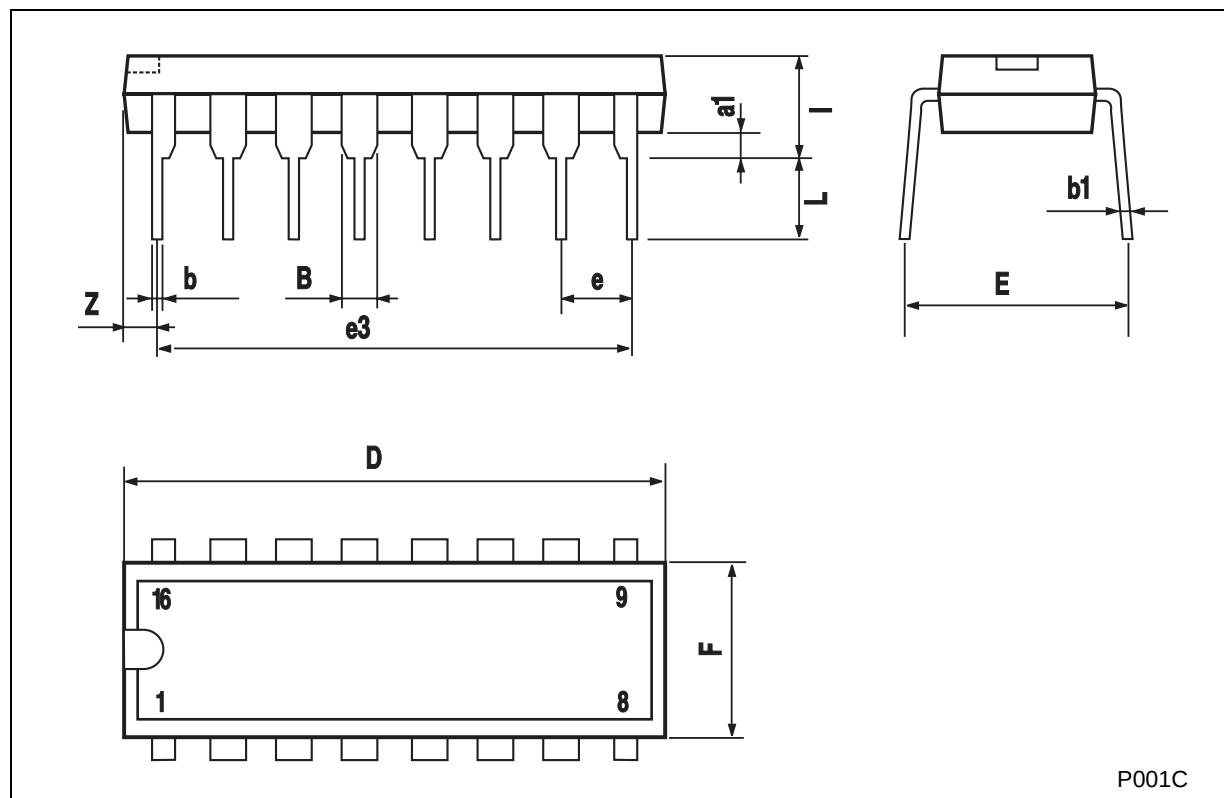
C<sub>L</sub> = 50pF or equivalent (includes jig and probe capacitance)  
R<sub>T</sub> = Z<sub>OUT</sub> of pulse generator (typically 50Ω)

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



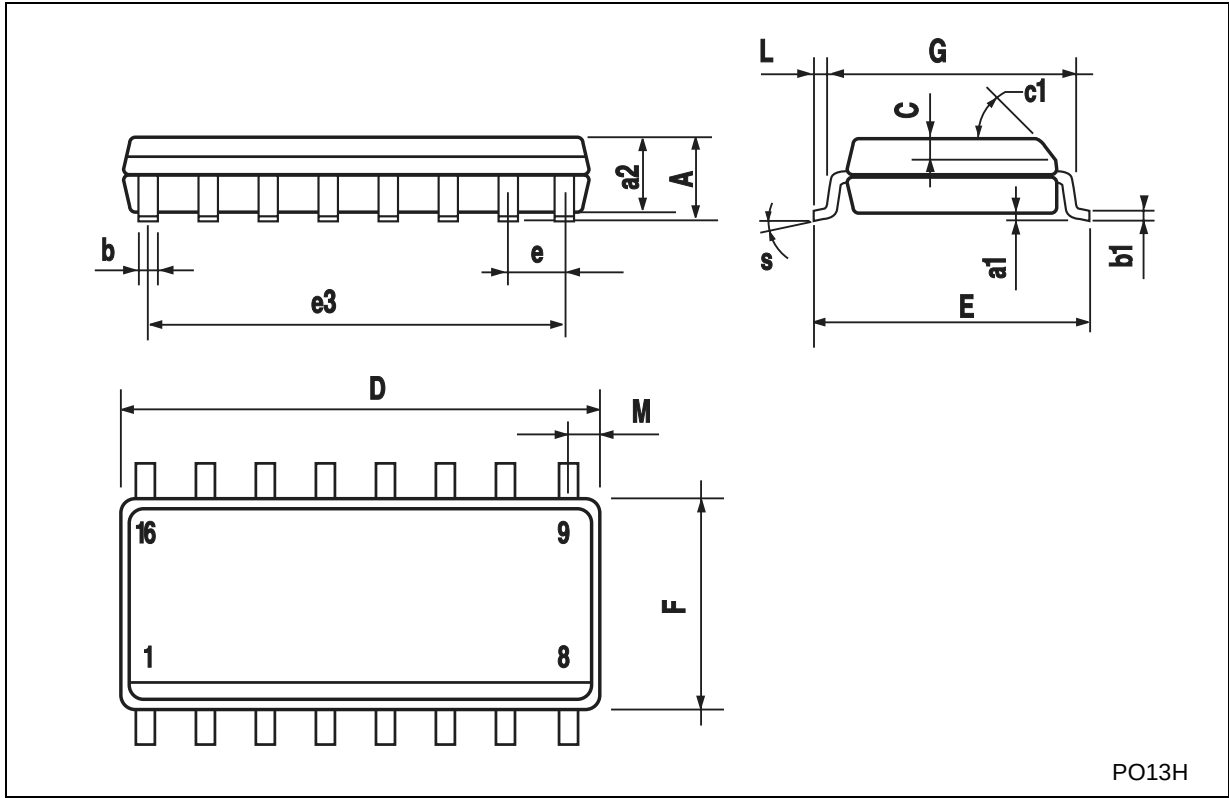
### Plastic DIP-16 (0.25) MECHANICAL DATA

| 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 |



SO-16 MECHANICAL DATA

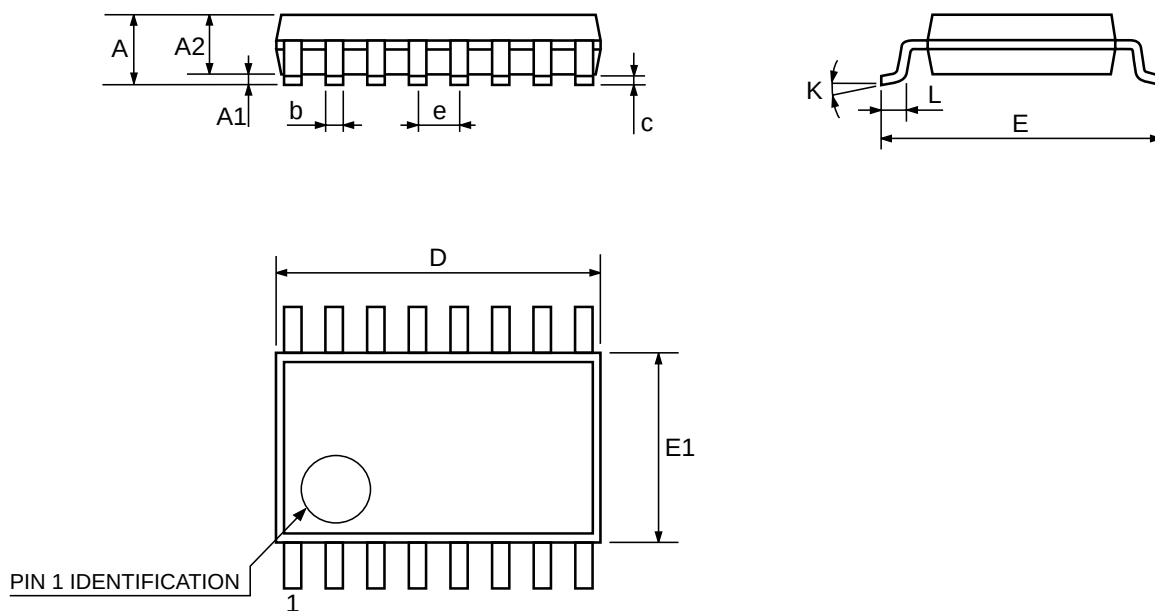
| DIM. | mm.        |      |      | inch  |       |       |
|------|------------|------|------|-------|-------|-------|
|      | MIN.       | TYP  | MAX. | MIN.  | TYP.  | MAX.  |
| A    |            |      | 1.75 |       |       | 0.068 |
| a1   | 0.1        |      | 0.2  | 0.003 |       | 0.007 |
| 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.)  |      |      |       |       |       |





## TSSOP16 MECHANICAL DATA

| DIM. | mm.  |          |      | inch  |            |        |
|------|------|----------|------|-------|------------|--------|
|      | MIN. | TYP      | MAX. | MIN.  | TYP.       | MAX.   |
| A    |      |          | 1.2  |       |            | 0.047  |
| A1   | 0.05 |          | 0.15 | 0.002 | 0.004      | 0.006  |
| A2   | 0.8  | 1        | 1.05 | 0.031 | 0.039      | 0.041  |
| b    | 0.19 |          | 0.30 | 0.007 |            | 0.012  |
| c    | 0.09 |          | 0.20 | 0.004 |            | 0.0089 |
| D    | 4.9  | 5        | 5.1  | 0.193 | 0.197      | 0.201  |
| E    | 6.2  | 6.4      | 6.6  | 0.244 | 0.252      | 0.260  |
| E1   | 4.3  | 4.4      | 4.48 | 0.169 | 0.173      | 0.176  |
| e    |      | 0.65 BSC |      |       | 0.0256 BSC |        |
| K    | 0°   |          | 8°   | 0°    |            | 8°     |
| L    | 0.45 | 0.60     | 0.75 | 0.018 | 0.024      | 0.030  |



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