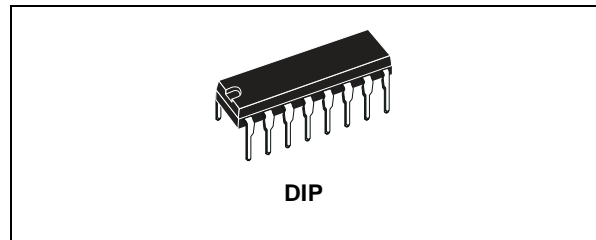




# HCF4536B

## PROGRAMMABLE TIMER

- 24 FLIP-FLOP STAGES - COUNTS FROM  $2^0$  TO  $2^{24}$
- LAST 16 STAGES SELECTABLE BY BCD SELECT CODE
- GROUP SELECT INDICATES ONE OR MORE PRIORITY INPUTS
- QUIESCENT CURRENT SPECIFIED UP TO 20V
- STANDARDIZED SYMMETRICAL OUTPUT CHARACTERISTICS
- 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

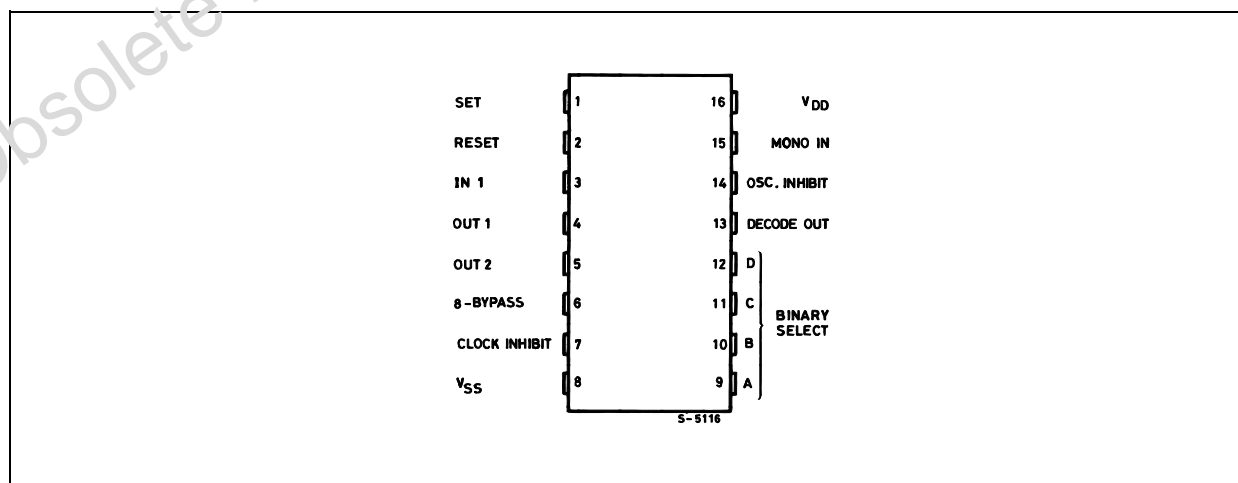
| PACKAGE | TUBE       | T & R |
|---------|------------|-------|
| DIP     | HCF4536BEY |       |

### DESCRIPTION

HCF4536B is a monolithic integrated circuit fabricated in Metal Oxide Semiconductor technology available in DIP package. HCF4536B is a programmable timer consisting of 24 ripple-binary counter stages. The salient feature of this device is its flexibility. The device can count from 1 to  $2^{24}$  or the first 3 stages can be bypassed to allow an output, selectable by a 4-bit code, from any one of the remaining 16 stages. It

can be driven by an external clock or an RC oscillator that can be constructed using on-chip components. Input IN1 serves as either the external clock input or the input to the on-chip RC oscillator. OUT1 and OUT2 are connection terminals for the external RC components. In addition, an on-chip monostable circuit is provided to allow a variable pulse width output. Various timing functions can be achieved using combinations of these capabilities. A logic "1" on the 8-BYPASS input enables a bypass of the first 8 stages and makes stage 9 the first counter stage of the last 16 stages. Selection of 1 of 16 outputs is accomplished by the decoder and the BCD inputs A, B, C, and D. MONO IN is the timing input

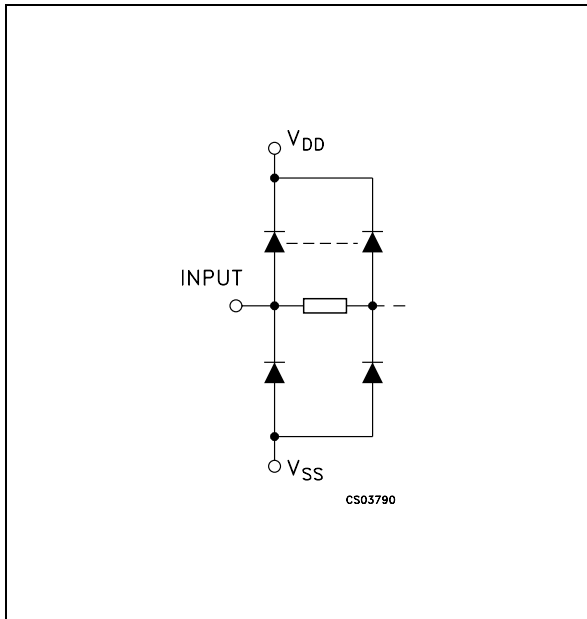
### PIN CONNECTION



for the on-chip monostable oscillator. Grounding of the MONO IN terminal through a resistor of 10 KΩ or higher, disables the one shot circuit and connects the decoder directly to the DECODE OUT terminal. A resistor to V<sub>DD</sub> and a capacitor to ground from the MONO IN terminal enables the

one-shot circuit and controls its pulse width. A fast test mode is enabled by a logic "1" on 8-BYPASS, SET, and RESET. This mode divides the 24-stage counter into three 8-stage sections to facilitate a fast test sequence.

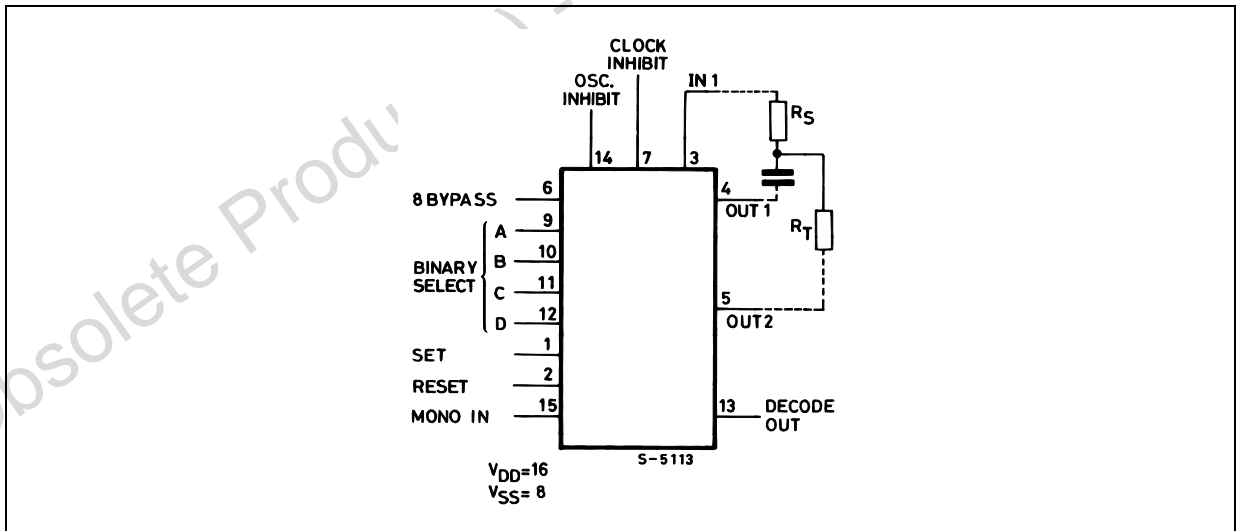
**INPUT EQUIVALENT CIRCUIT**



**PIN DESCRIPTION**

| PIN No        | SYMBOL          | NAME AND FUNCTION                           |
|---------------|-----------------|---|
| 9, 10, 11, 12 | A, B, C, D      | Binary Select Input                         |
| 1             | SET             | Set input                                   |
| 2             | RESET           | Reset Input                                 |
| 15            | MONO IN         | Monostable Oscillator Timing Input          |
| 6             | 8BYPASS         | 8Bypass input( bypass the first 8 stages)   |
| 3             | IN1             | External Clock Input or RC oscillator Input |
| 4, 5          | OUT1, OUT2      | Outputs                                     |
| 13            | DECODE OUT      | Decode Out Terminal                         |
| 7             | CLOCK INHIBIT   | Clock Inhibit Input                         |
| 14            | OSC. INHIBIT    | Oscillator Inhibit Input                    |
| 8             | V <sub>SS</sub> | Negative Supply Voltage                     |
| 16            | V <sub>DD</sub> | Positive Supply Voltage                     |

**FUNCTIONAL DIAGRAM**



TRUTH TABLE

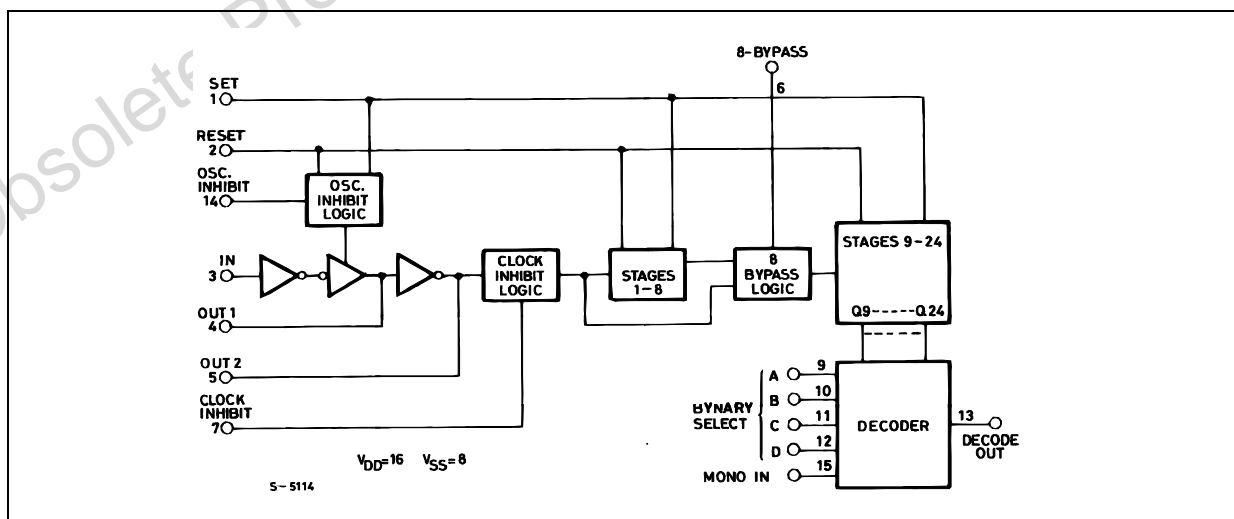
| In1 | Set | Reset | Clock Inh | Osc. Inh | Out1 | Out2 | Decode Out            |
|-----|-----|-------|-----------|----------|------|------|-----------------------|
|     | L   | L     | L         | L        |      |      | No Change             |
|     | L   | L     | L         | L        |      |      | Advance to Next State |
| X   | H   | L     | L         | L        | L    | H    | H                     |
| X   | L   | H     | L         | L        | L    | H    | L                     |
| X   | L   | L     | H         | L        |      |      | No Change             |
| L   | L   | L     | L         | X        | L    | H    | No Change             |
| H   | L   | L     | L         |          |      |      | Advance to Next State |

X : Don't Care

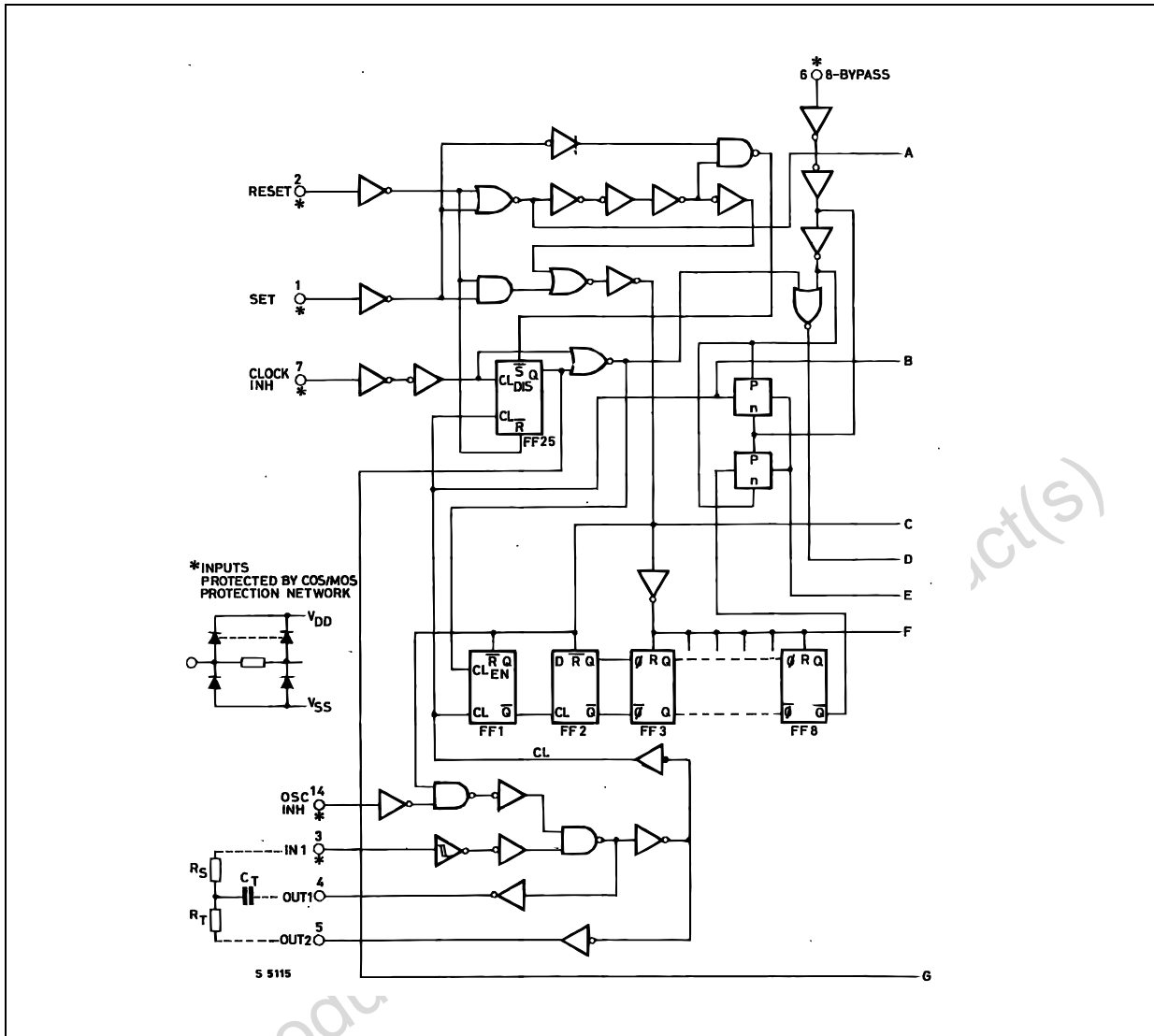
DECODE OUT SELECTION TABLE

| D | C | B | A | NUMBER OF STAGES IN DIVIDER CHAIN |              |
|---|---|---|---|-----------------------------------|--------------|
|   |   |   |   | 8-BYPASS = 0                      | 8-BYPASS = 1 |
| L | L | L | L | 9                                 | 1            |
| L | L | L | H | 10                                | 2            |
| L | L | H | L | 11                                | 3            |
| L | L | H | H | 12                                | 4            |
| L | H | L | L | 13                                | 5            |
| L | H | L | H | 14                                | 6            |
| L | H | H | L | 15                                | 7            |
| L | H | H | H | 16                                | 8            |
| H | L | L | L | 17                                | 9            |
| H | L | L | H | 18                                | 10           |
| H | L | H | L | 19                                | 11           |
| H | L | H | H | 20                                | 12           |
| H | H | L | L | 21                                | 13           |
| H | H | L | H | 22                                | 14           |
| H | H | H | L | 23                                | 15           |
| H | H | H | H | 24                                | 16           |

BLOCK DIAGRAM

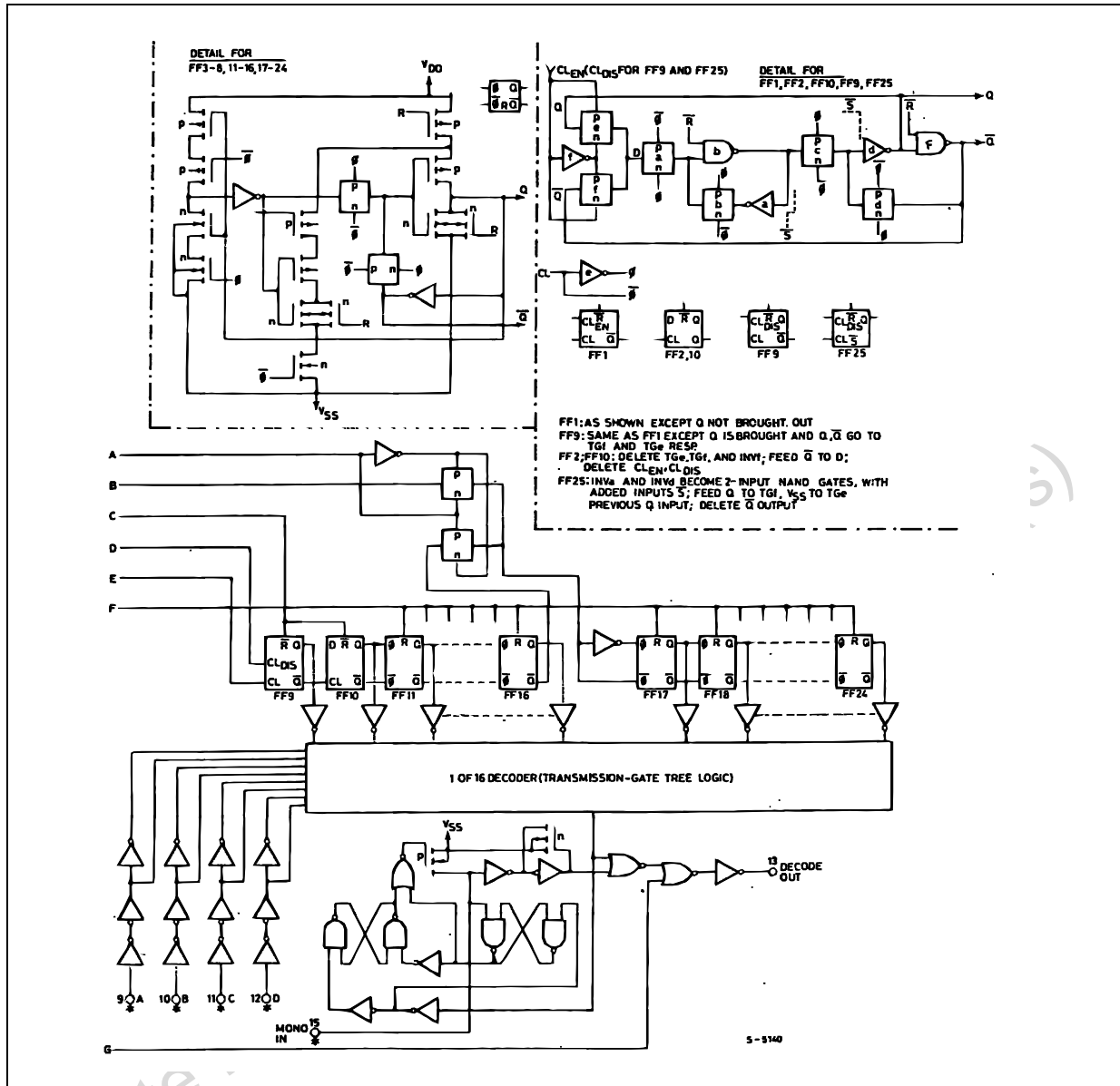


LOGIC DIAGRAM



Obsolete Product

LOGIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

| Symbol           | Parameter                               | Value                         | Unit |
|------------------|---|-------------------------------|------|
| V <sub>DD</sub>  | Supply Voltage                          | -0.5 to +22                   | V    |
| V <sub>I</sub>   | DC Input Voltage                        | -0.5 to V <sub>DD</sub> + 0.5 | V    |
| I <sub>I</sub>   | DC Input Current                        | ± 10                          | mA   |
| P <sub>D</sub>   | Power Dissipation per Package           | 200                           | mW   |
|                  | Power Dissipation per Output Transistor | 100                           | mW   |
| T <sub>op</sub>  | Operating Temperature                   | -55 to +125                   | °C   |
| T <sub>stg</sub> | Storage Temperature                     | -65 to +150                   | °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<sub>SS</sub> pin voltage.



## RECOMMENDED OPERATING CONDITIONS

| Symbol          | Parameter             | Value                | Unit |
|-----------------|-----------------------|----------------------|------|
| V <sub>DD</sub> | Supply Voltage        | 3 to 20              | V    |
| V <sub>I</sub>  | Input Voltage         | 0 to V <sub>DD</sub> | V    |
| T <sub>op</sub> | Operating Temperature | -55 to 125           | °C   |

## DC SPECIFICATIONS

| Symbol          | Parameter                 | Test Condition        |                       |                                 |                        | Value                 |               |           |             |         |              | Unit    |         |
|-----------------|---------------------------|-----------------------|-----------------------|---------------------------------|------------------------|-----------------------|---------------|-----------|-------------|---------|--------------|---------|---------|
|                 |                           | V <sub>I</sub><br>(V) | V <sub>O</sub><br>(V) | I <sub>oI</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

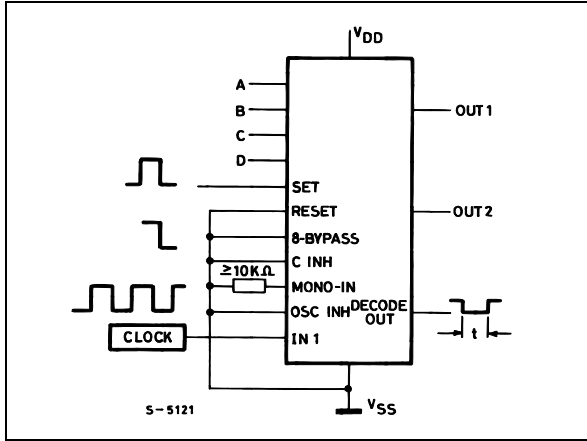
**DYNAMIC ELECTRICAL CHARACTERISTICS** ( $T_{amb} = 25^{\circ}\text{C}$ ,  $C_L = 50\text{pF}$ ,  $R_L = 200\text{K}\Omega$ ,  $t_r = t_f = 20\text{ ns}$ )

| Symbol              | Parameter   | Test Condition |  | Value (*) |      |      | Unit          |
|---------------------|---|----------------|--|-----------|------|------|---------------|
|                     |   | $V_{DD}$ (V)   |  | Min.      | Typ. | Max. |               |
| $t_{PLH}$ $t_{PHL}$ | Propagation Delay Time<br>(Clock to Q1, 8-Bypass<br>High) | 5              |  |           | 1    | 2    | $\mu\text{s}$ |
|                     |   | 10             |  |           | 0.5  | 1    |               |
|                     |   | 15             |  |           | 0.35 | 0.7  |               |
|                     | Propagation Delay Time<br>(Clock to Q1, 8-Bypass<br>Low)  | 5              |  |           | 2.5  | 5    | $\mu\text{s}$ |
|                     |   | 10             |  |           | 0.8  | 0.6  |               |
|                     |   | 15             |  |           | 0.6  | 1.2  |               |
|                     | Propagation Delay Time<br>(Clock to Q16)                  | 5              |  |           | 4    | 8    | $\mu\text{s}$ |
|                     |   | 10             |  |           | 1.5  | 3    |               |
|                     |   | 15             |  |           | 1    | 2    |               |
|                     | Propagation Delay Time<br>(Qn to Qn+1)                    | 5              |  |           | 150  | 300  | ns            |
|                     |   | 10             |  |           | 75   | 150  |               |
|                     |   | 15             |  |           | 50   | 100  |               |
| $t_{PLH}$           | Propagation Delay Time                                    | 5              |  |           | 300  | 600  | ns            |
|                     |   | 10             |  |           | 125  | 250  |               |
|                     |   | 15             |  |           | 80   | 160  |               |
| $t_{PHL}$           | Reset to Qn   | 5              |  |           | 3    | 6    | $\mu\text{s}$ |
|                     |   | 10             |  |           | 1    | 2    |               |
|                     |   | 15             |  |           | 0.75 | 1.5  |               |
| $t_{THL}$ $t_{TLH}$ | Transition Time   | 5              |  |           | 100  | 200  | ns            |
|                     |   | 10             |  |           | 50   | 100  |               |
|                     |   | 15             |  |           | 40   | 80   |               |
| $t_w$               | Pulse Width Clock   | 5              |  |           | 200  | 400  | ns            |
|                     |   | 10             |  |           | 75   | 150  |               |
|                     |   | 15             |  |           | 50   | 100  |               |
|                     | Set   | 5              |  |           | 200  | 400  | ns            |
|                     |   | 10             |  |           | 100  | 200  |               |
|                     |   | 15             |  |           | 60   | 120  |               |
|                     | Reset   | 5              |  |           | 3    | 6    | $\mu\text{s}$ |
|                     |   | 10             |  |           | 1    | 2    |               |
|                     |   | 15             |  |           | 0.75 | 1.5  |               |
|                     | Recovery Time Set   | 5              |  |           | 2.5  | 5    | $\mu\text{s}$ |
|                     |   | 10             |  |           | 1    | 2    |               |
|                     |   | 15             |  |           | 0.6  | 1.6  |               |
|                     | Reset   | 5              |  |           | 3.5  | 7    | $\mu\text{s}$ |
|                     |   | 10             |  |           | 1.5  | 3    |               |
|                     |   | 15             |  |           | 1    | 2    |               |
| $t_r$ , $t_f$       | Clock Input Rise or Fall<br>Time                          | 5              |  | Unlimited |      |      | $\mu\text{s}$ |
|                     |   | 10             |  |           |      |      |               |
|                     |   | 15             |  |           |      |      |               |
| $f_{CL}$            | Maximum Clock Input<br>Frequency                          | 5              |  | 0.5       | 1    | MHz  |               |
|                     |   | 10             |  | 1.5       | 3    |      |               |
|                     |   | 15             |  | 2.5       | 5    |      |               |

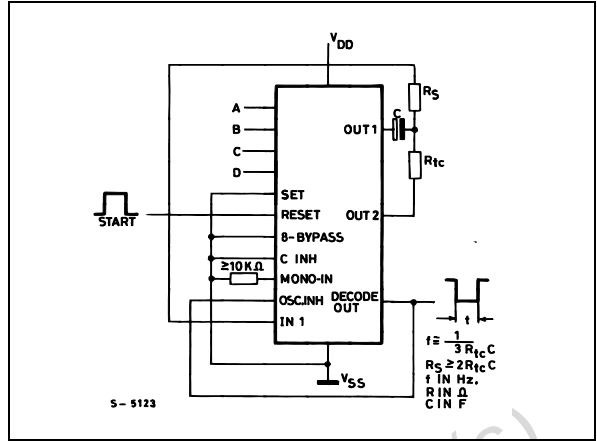
 (\*) Typical temperature coefficient for all  $V_{DD}$  value is 0.3 %/°C.

TYPICAL APPLICATIONS

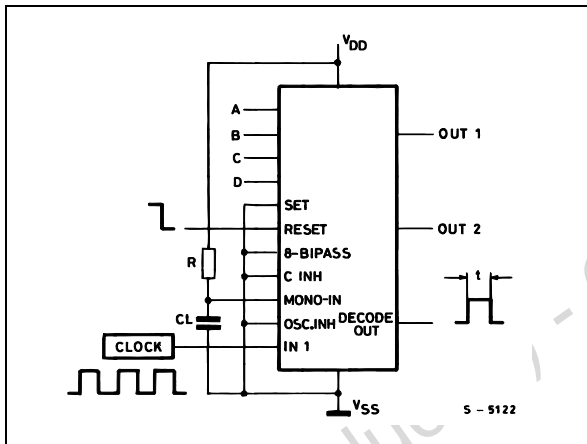
Time Interval Configuration Using External Clock; Set and Clock Inhibit Functions



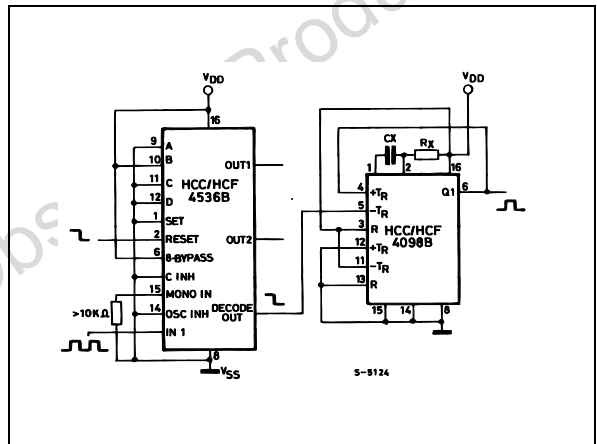
Time Interval Configuration Using On-Chip RC oscillator and Reset Input to Initiate Time Interval



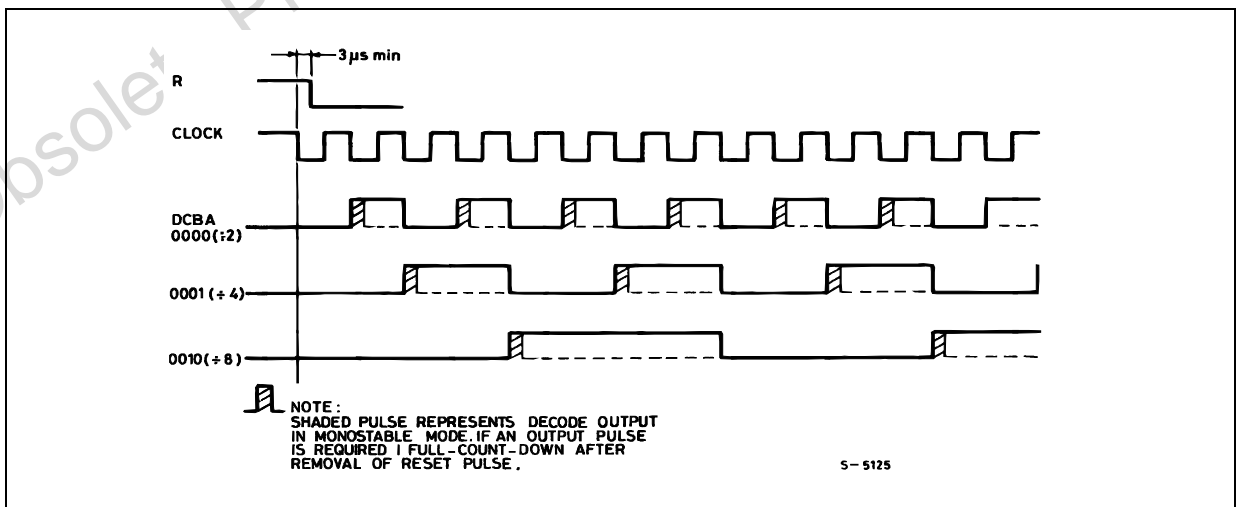
Time Interval Configuration Using Ext. Ck; Reset and Output Monostable to Achieve a Pulse Out



Use of HCF4098B and HCF4536B to get Decode Pulse 8 Clock Pulses after Reset Pulses



TIMING DIAGRAM





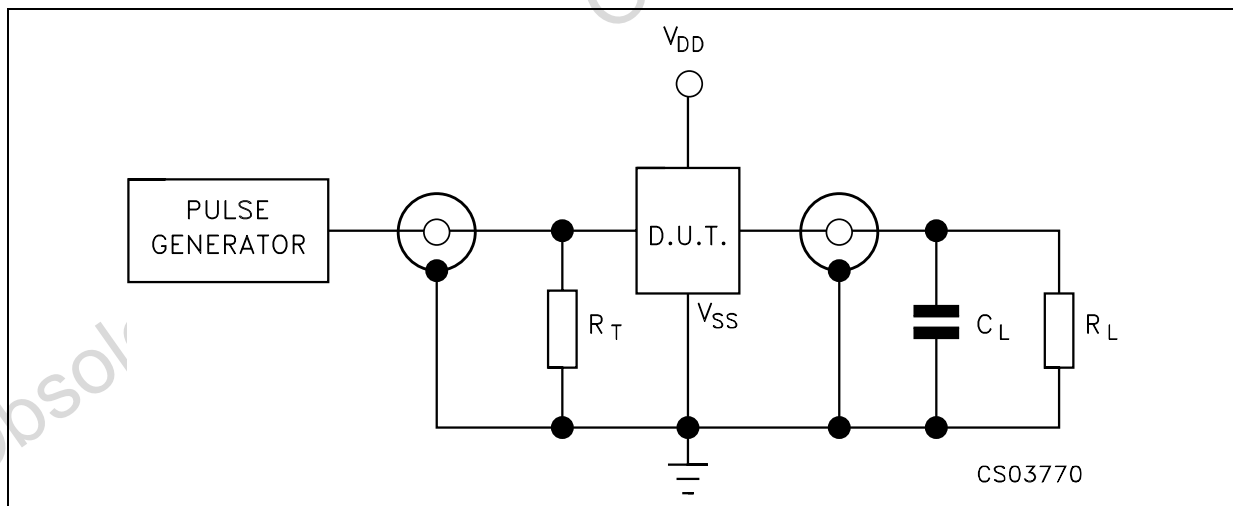
| FUNCTIONAL TEST SEQUENCE |     |       |          |                        |   |
|--------------------------|-----|-------|----------|------------------------|---|
| Inputs                   |     |       |          | Outputs                | COMMENTS  |
| In 1                     | Set | Reset | 8-Bypass | Decade Out Q1 Thru Q24 | All 24 steps are in reset mode  |
| H                        | L   | H     | H        | L                      | Counter is in three 8-stage section in parallel mode  |
| H                        | H   | H     | H        | L                      |   |
| L                        | H   | H     | H        | L                      | First "H" to "L" Transition of Clock  |
| H                        |     |       |          |                        | 255 "H" to "L" transitions are clocked in the counter   |
| L                        | H   | H     | H        |                        |   |
| L                        | H   | H     | H        | H                      | The 255 "H" to "L" Transition   |
| L                        | L   | L     | L        | H                      | Counter converted back to 24 stages in series mode.<br>Set and Reset must be connected together and simultaneously go from "H" to "L" |
| H                        | L   | L     | L        | H                      | In <sub>1</sub> switches to a "H"   |
| L                        | L   | L     | L        | L                      | Counter Ripples from an all "H" state to an all "L" state   |

### FUNCTIONAL TEST SEQUENCE

Test function has been included for the reduction of test time required to exercise all 24 counter stages. This test function divides the counter into three 8-stage section and 255 counts are loaded in each of the 8-stage sections in parallel. All

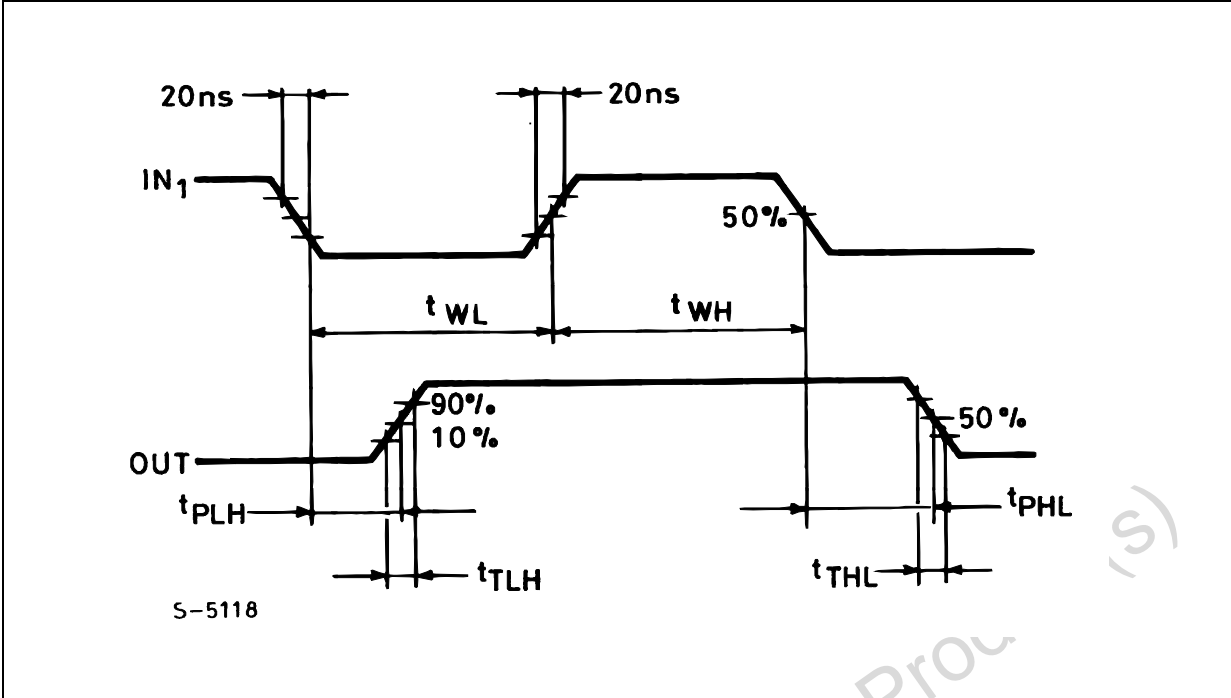
flip-flops are now at a "H". The counter is now returned to the normal 24-steps in series configuration. One more pulse is entered into In<sub>1</sub> which will cause the counter to ripple from an all "H" state to an all "L" state.

### TEST CIRCUIT



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

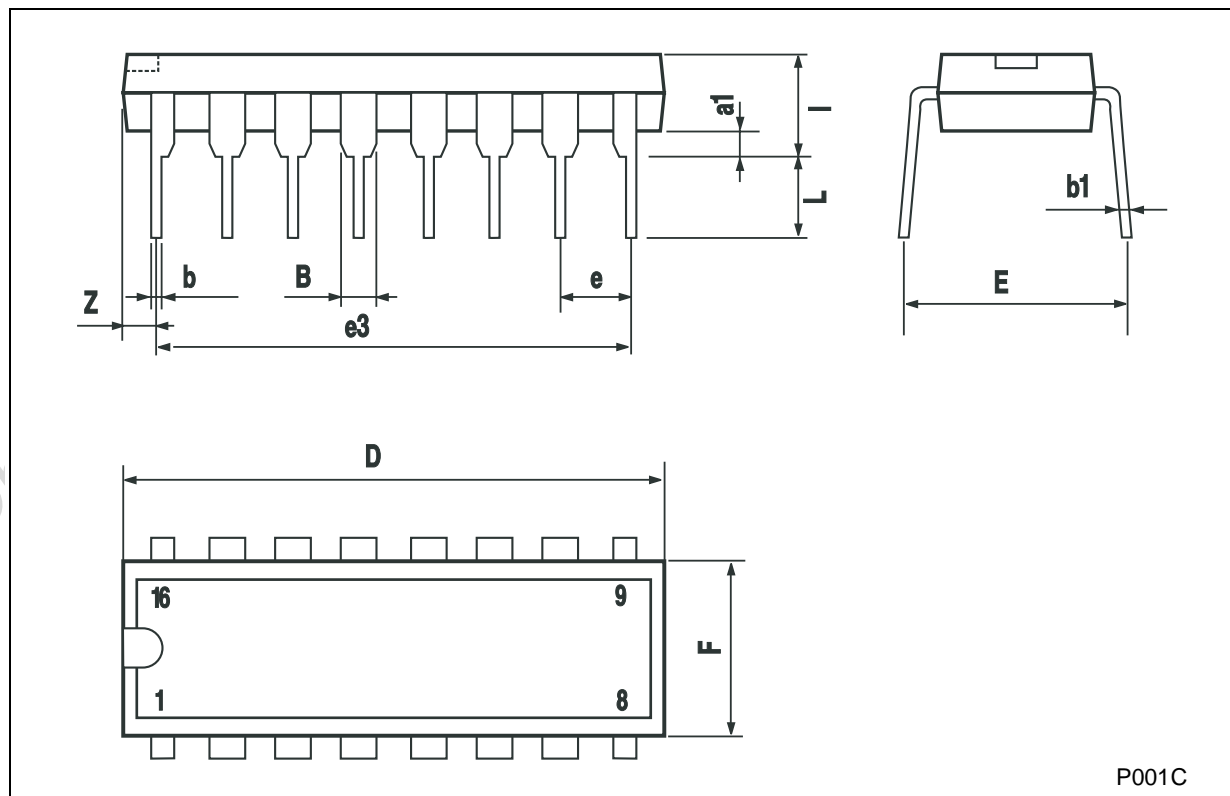
WAVEFORM : PROPAGATION DELAY TIMES, PULSE WIDTH CLOCK



Obsolete Product(s) - Obsolete Product(s)

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

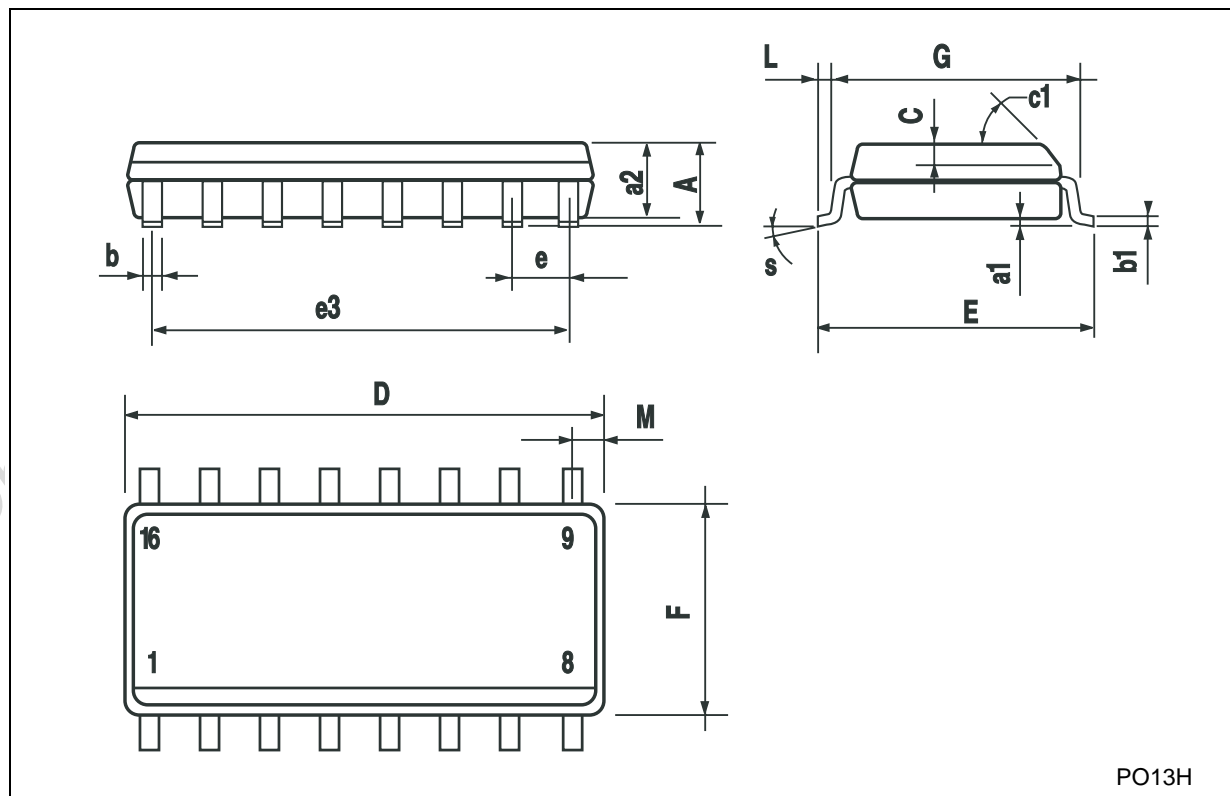
| DIM. | mm.  |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP   | MAX. | MIN.  | TYP.  | MAX.  |
| a1   | 0.51 |       |      | 0.020 |       |       |
| B    | 0.77 |       | 1.65 | 0.030 |       | 0.065 |
| b    |      | 0.5   |      |       | 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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