



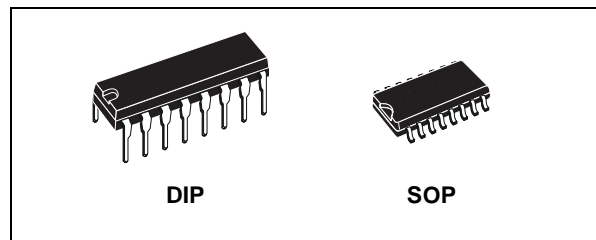
HCF40162B

SYNCHRONOUS PROGRAMMABLE 4-BIT DECADE COUNTER WITH SYNCHRONOUS CLEAR

- INTERNAL LOOK-AHEAD FOR FAST COUNTING
- CARRY OUTPUT FOR CASCADING
- SYNCHRONOUSLY PROGRAMMABLE
- LOW-POWER TTL COMPATIBILITY
- STANDARDIZED SYMMETRICAL OUTPUT CHARACTERISTICS
- QUIESCENT CURRENT SPECIF. 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"

DESCRIPTION

HCF40162B is a monolithic integrated circuit fabricated in Metal Oxide Semiconductor technology available in DIP and SOP packages. HCF40162B is a 4-bit synchronous programmable counter. The CLEAR function is synchronous. A low level at the CLEAR input sets all four outputs low on the next positive CLOCK edge. A low level at the LOAD inputs disables the counter and causes the output to agree with the set-up data after the following CLOCK pulse regardless of the condition of the ENABLE inputs. The carry

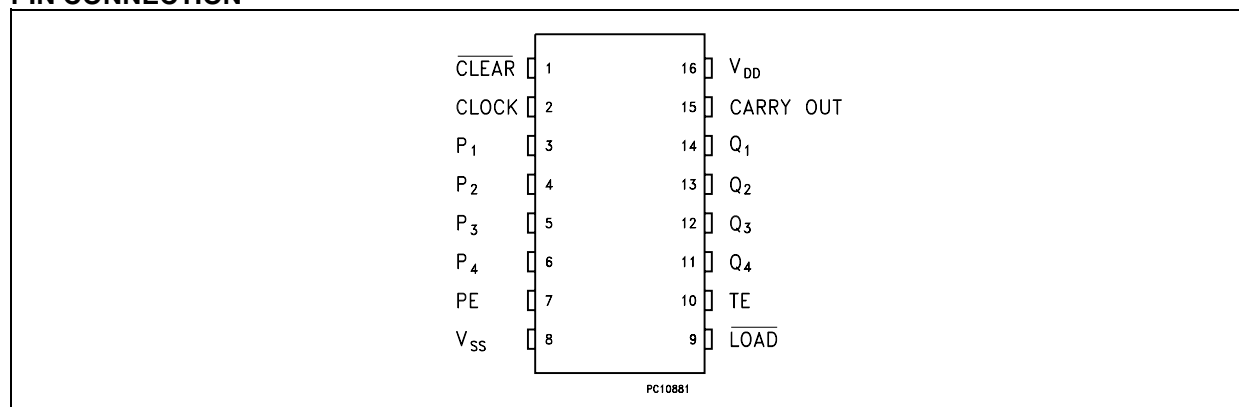


ORDER CODES

| PACKAGE | TUBE | T & R |
|---------|-------------|----------------|
| DIP | HCF40162BEY | |
| SOP | HCF40162BM1 | HCF40162M013TR |

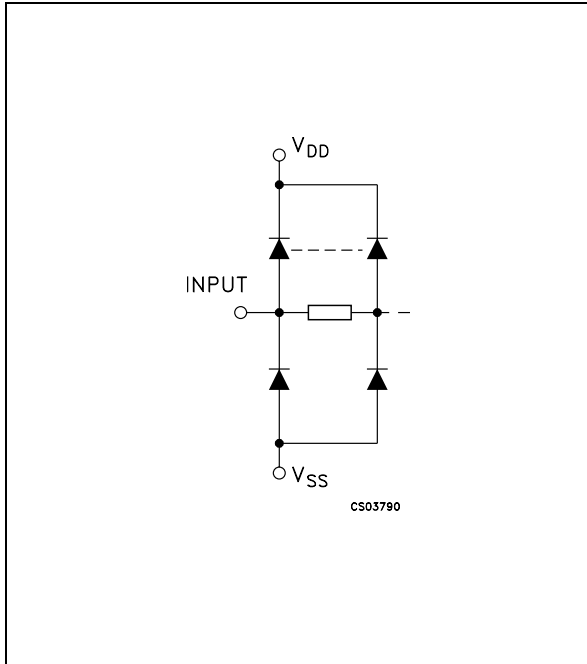
look-ahead circuitry provides for cascading counter for n-bit synchronous application without additional gating. Counting is enabled when both the PE and TE inputs are high. The TE input is fed forward to enable COUT. This enable output produces a positive output pulse with a duration approximately equal to the positive portion of the Q1 output. This positive overflow carry pulse can be used to enable successive cascaded stages. Logic transitions at the PE and TE inputs may occur when the clock is either high or low.

PIN CONNECTION



HCF40162B

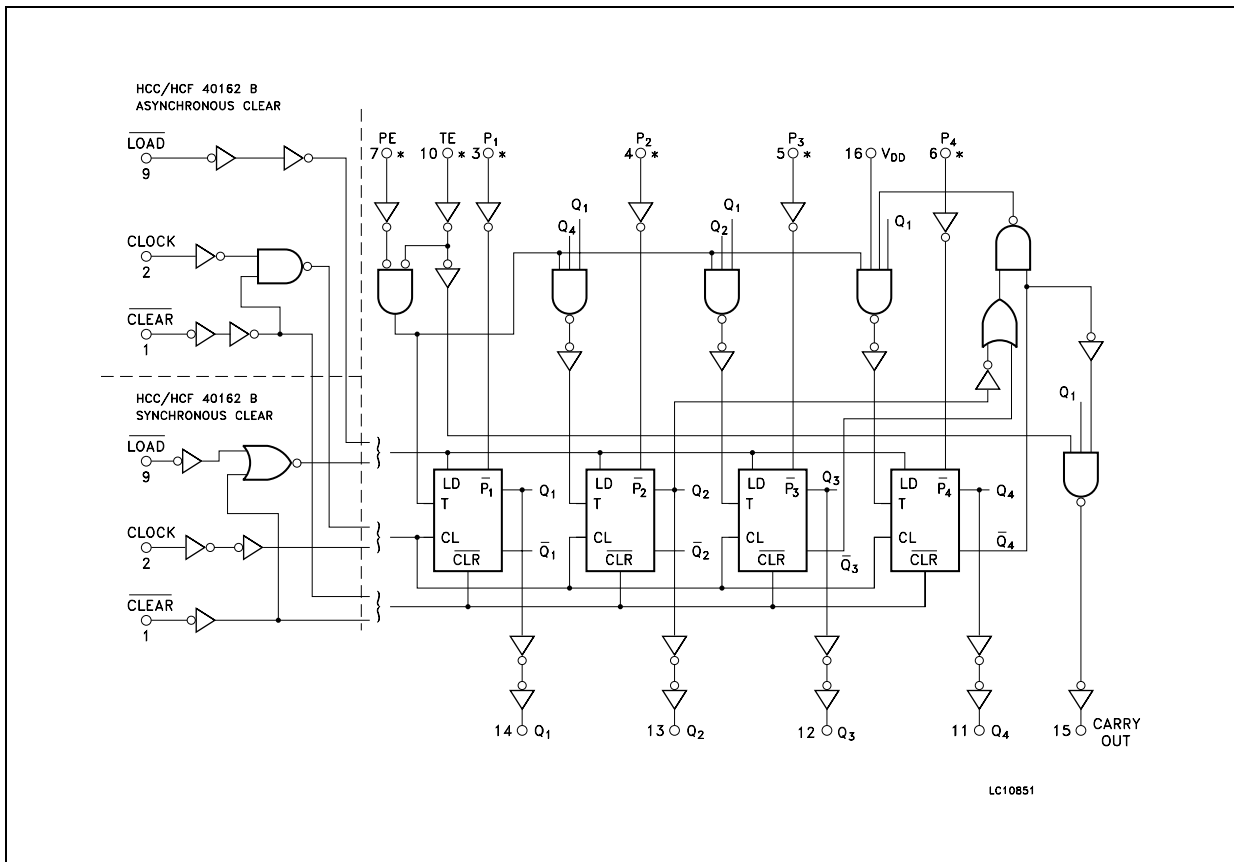
IINPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

| PIN No | SYMBOL | NAME AND FUNCTION |
|----------------|---------------------------|---|
| 1 | $\overline{\text{CLEAR}}$ | Synchronous Master Reset |
| 2 | CLOCK | Clock Input (LOW to HIGH, Edge-triggered) |
| 3, 4, 5, 6 | P1 to P4 | Data Inputs |
| 7 | PE | Count Enable Input |
| 10 | TE | Count Enable Carry Input |
| 9 | $\overline{\text{LOAD}}$ | Parallel Enable Input |
| 14, 13, 12, 11 | Q1 to Q4 | Flip Flop Outputs |
| 15 | CARRY OUT | Terminal Count Output |
| 8 | V_{SS} | Negative Supply Voltage |
| 16 | V_{DD} | Positive Supply Voltage |

LOGIC DIAGRAM

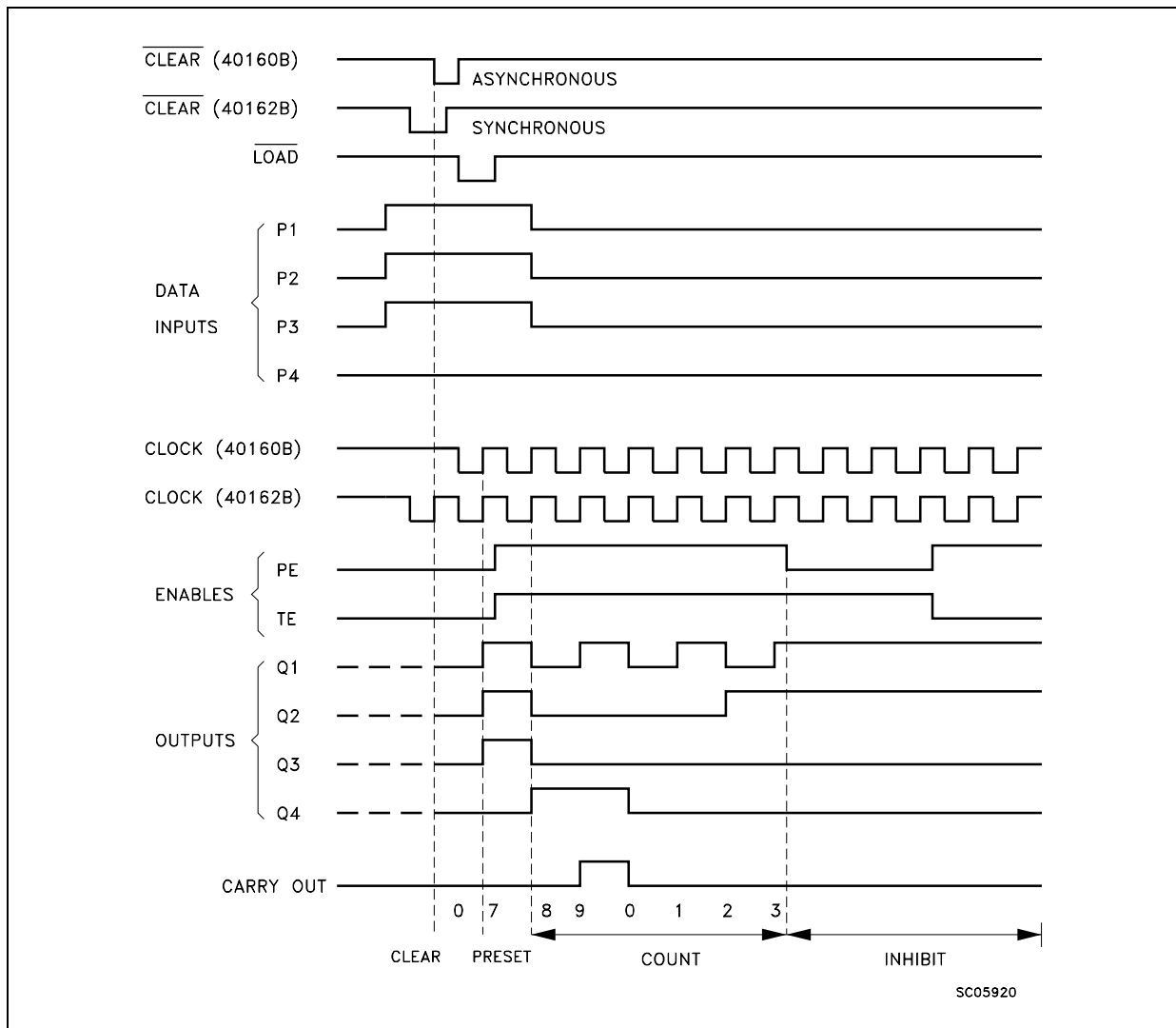


TRUTH TABLE

| CLOCK | $\overline{\text{CLR}}$ | $\overline{\text{LOAD}}$ | PE | TE | OPERATION |
|-------|-------------------------|--------------------------|----|----|-----------|
| | H | L | X | X | PRESET |
| | H | H | L | X | NC |
| | H | H | X | L | NC |
| | H | H | H | H | COUNT |
| | L | X | X | X | X |
| | H | X | X | X | X |

(X) : Don't Care
 NC : No Change

TIMING 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 | ± 10 | mA |
| P_D | Power Dissipation per Package | 200 | mW |
| | Power Dissipation per Output Transistor | 100 | mW |
| T_{op} | Operating Temperature | -55 to +125 | °C |
| T_{stg} | 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_{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 | °C |

DC SPECIFICATIONS

| Symbol | Parameter | Test Condition | | | | Value | | | | | | Unit | |
|-----------------|---------------------------|-----------------------|-----------------------|---------------------------------|------------------------|-----------------------|---------------|-----------|-------------|---------|--------------|---------|---------|
| | | V _I (V) | V _O (V) | I _{OL} (μ A) | V _{DD} (V) | T _A = 25°C | | | -40 to 85°C | | -55 to 125°C | | |
| | | | | | | Min. | Typ. | Max. | Min. | Max. | Min. | | Max. |
| I _L | Quiescent Current | 0/5 | | | 5 | | 0.04 | 5 | | 150 | | 150 | μ 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 _{OH} | 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 _{OL} | 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 _{IH} | 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 _{IL} | 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 _{OH} | 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 _{OL} | 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 _I | Input Leakage Current | 0/18 | Any Input | | 18 | | $\pm 10^{-5}$ | ± 0.1 | | ± 1 | | ± 1 | μ A |
| C _I | Input Capacitance | | Any Input | | | | 5 | 7.5 | | | | | pF |

The Noise Margin for both "1" and "0" level is: 1V min. with V_{DD}=5V, 2V min. with V_{DD}=10V, 2.5V min. with V_{DD}=15V

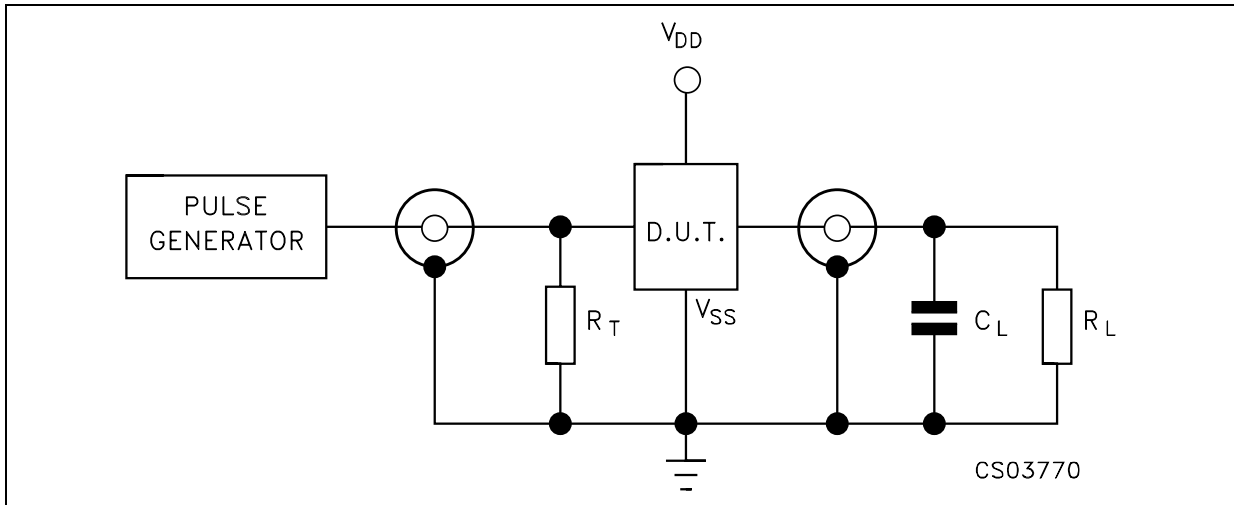
HCF40162B

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 Clock to Q | 5 | | | 200 | 400 | ns |
| | | 10 | | | 80 | 160 | |
| | | 15 | | | 60 | 120 | |
| t_{PLH} t_{PHL} | Propagation Delay Time Clock to C_{OUT} | 5 | | | 225 | 450 | ns |
| | | 10 | | | 95 | 190 | |
| | | 15 | | | 70 | 140 | |
| t_{PLH} t_{PHL} | Propagation Delay Time TE to C_{OUT} | 5 | | | 125 | 250 | ns |
| | | 10 | | | 55 | 110 | |
| | | 15 | | | 40 | 80 | |
| t_{setup} | Setup Time Data to Clock | 5 | | 240 | 120 | | ns |
| | | 10 | | 90 | 45 | | |
| | | 15 | | 60 | 30 | | |
| t_{setup} | Setup Time Load to Clock | 5 | | 240 | 120 | | ns |
| | | 10 | | 90 | 45 | | |
| | | 15 | | 60 | 30 | | |
| t_{setup} | Setup Time PE or TE to Clock | 5 | | 340 | 170 | | ns |
| | | 10 | | 140 | 70 | | |
| | | 15 | | 100 | 50 | | |
| t_{hold} | Hold Time | 5 | | 0 | | | ns |
| | | 10 | | 0 | | | |
| | | 15 | | 0 | | | |
| t_{THL} t_{TLH} | Transition Time | 5 | | | 100 | 200 | ns |
| | | 10 | | | 50 | 100 | |
| | | 15 | | | 40 | 80 | |
| t_W | Clock Input Pulse Width | 5 | | 170 | 85 | | ns |
| | | 10 | | 70 | 35 | | |
| | | 15 | | 50 | 25 | | |
| f_{CL} | Maximum Clock Input Frequency | 5 | | 2 | 3 | | MHz |
| | | 10 | | 5.5 | 8.5 | | |
| | | 15 | | 8 | 12 | | |
| t_r t_f | Clock Input Rise or Fall Time | 5 | | | | 200 | ns |
| | | 10 | | | | 70 | |
| | | 15 | | | | 15 | |
| t_{SETUP} | Proagation Delay Time Clear to Clock | 5 | | 340 | 170 | | ns |
| | | 10 | | 140 | 70 | | |
| | | 15 | | 100 | 50 | | |
| t_{hold} | Hold Time Clear to Clock | 5 | | 0 | | | ns |
| | | 10 | | 0 | | | |
| | | 15 | | 0 | | | |
| t_{rem} | Clear Removal Time | 5 | | 200 | 100 | | ns |
| | | 10 | | 100 | 50 | | |
| | | 15 | | 70 | 35 | | |

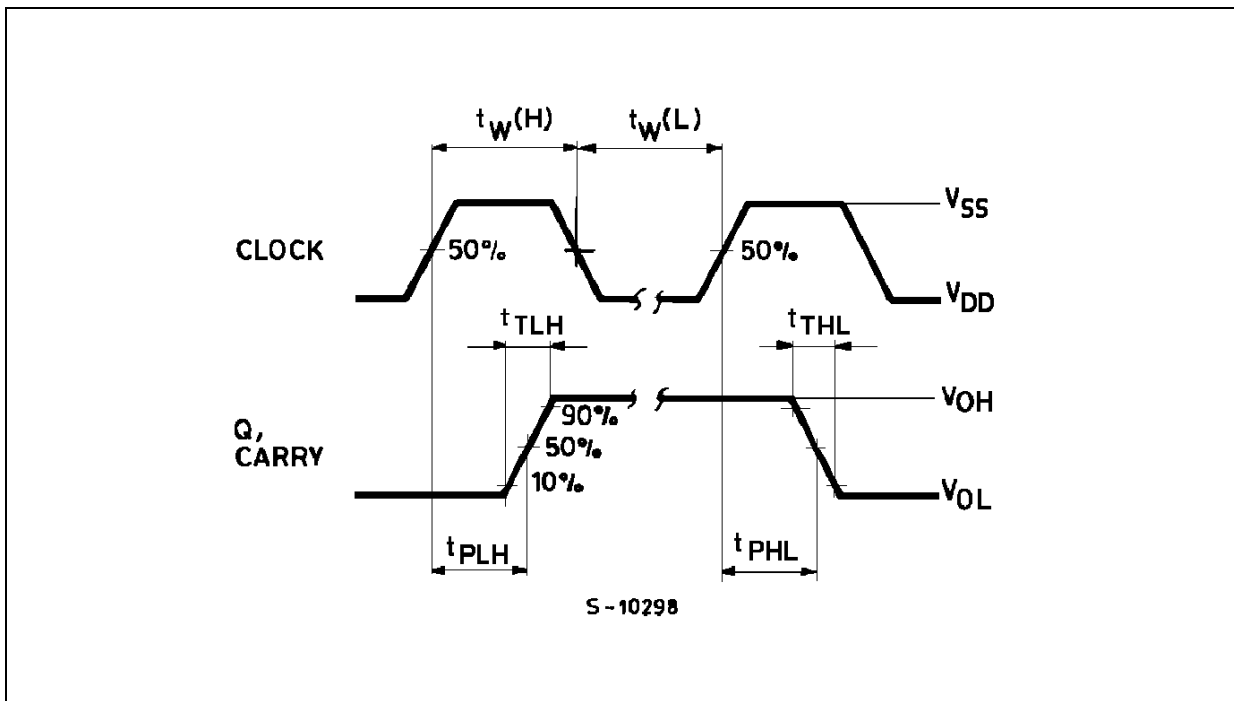
(*) Typical temperature coefficient for all V_{DD} value is 0.3 %/°C.

TEST CIRCUIT

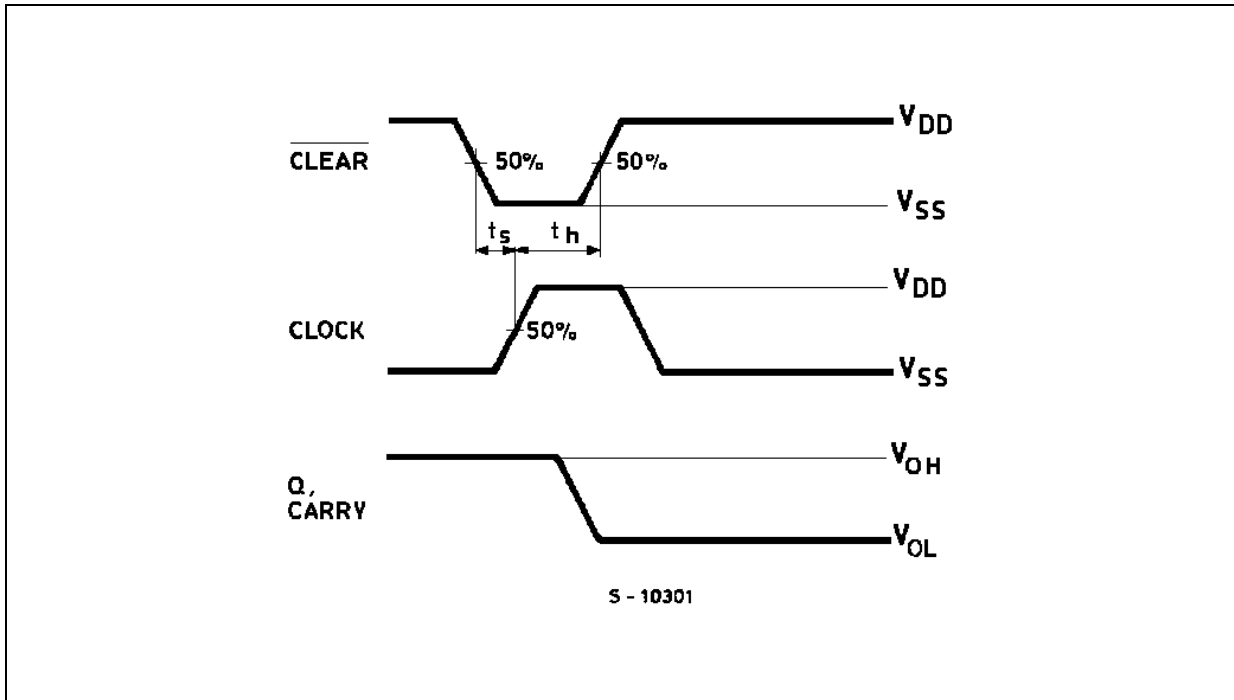


$C_L = 50\text{pF}$ or equivalent (includes jig and probe capacitance)
 $R_L = 200\text{K}\Omega$
 $R_T = Z_{OUT}$ of pulse generator (typically 50Ω)

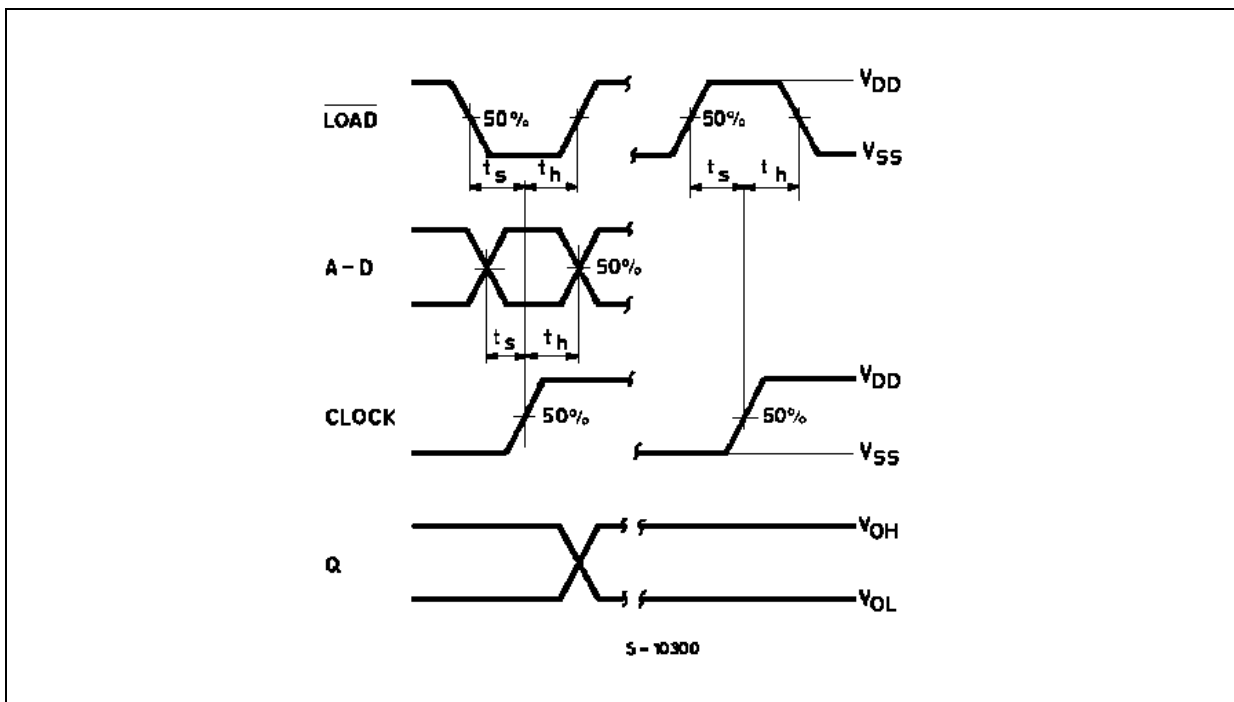
WAVEFORM 1 : PROPAGATION DELAY TIMES, MINIMUM PULSE WIDTH ($f=1\text{MHz}$; 50% duty cycle)

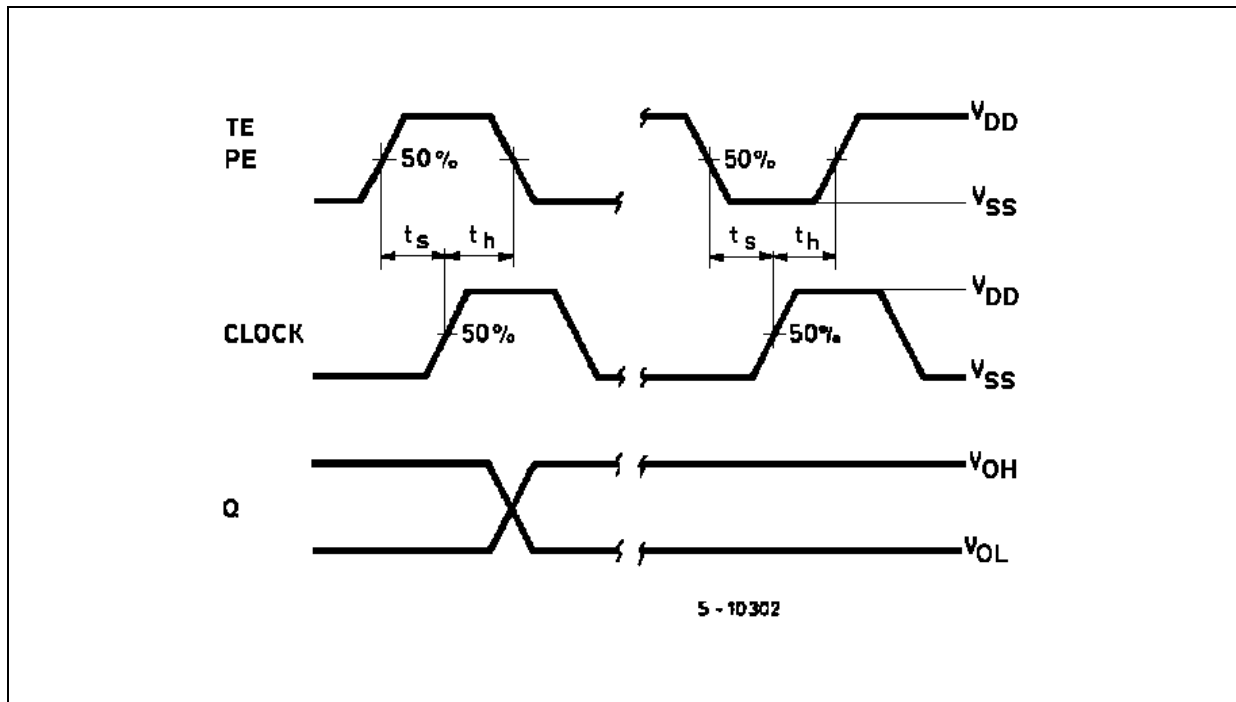
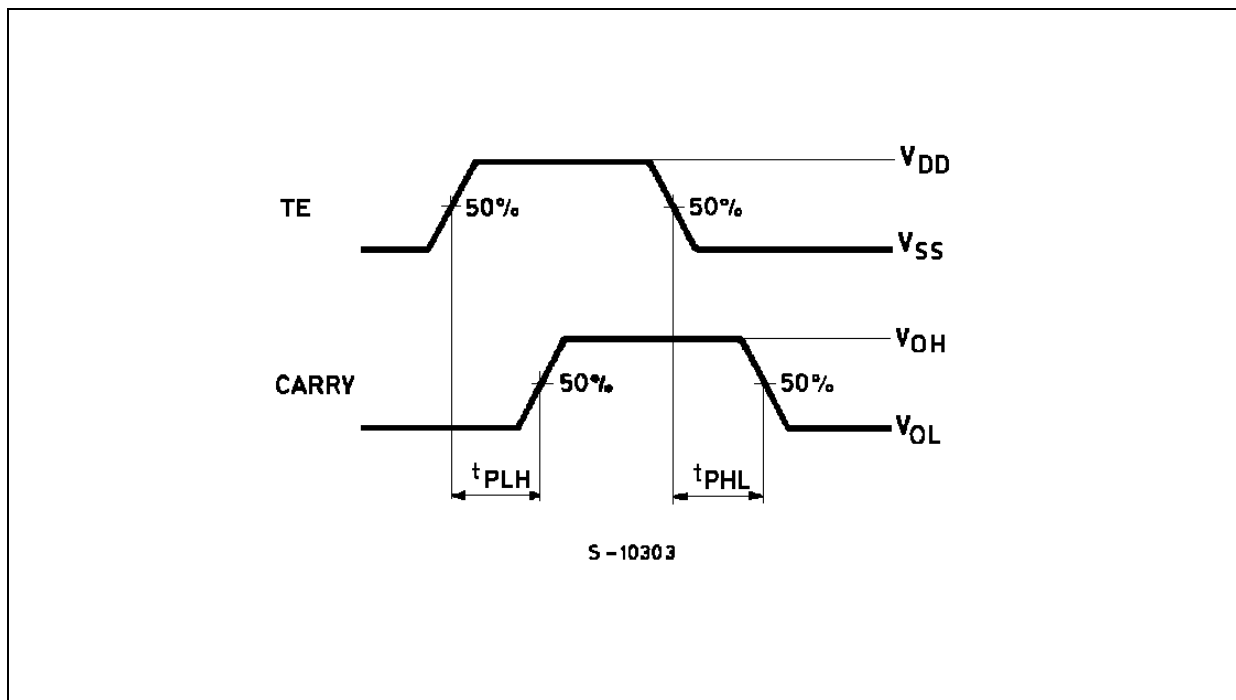


WAVEFORM 2 : MINIMUM SETUP AND HOLD TIME (f=1MHz; 50% duty cycle)

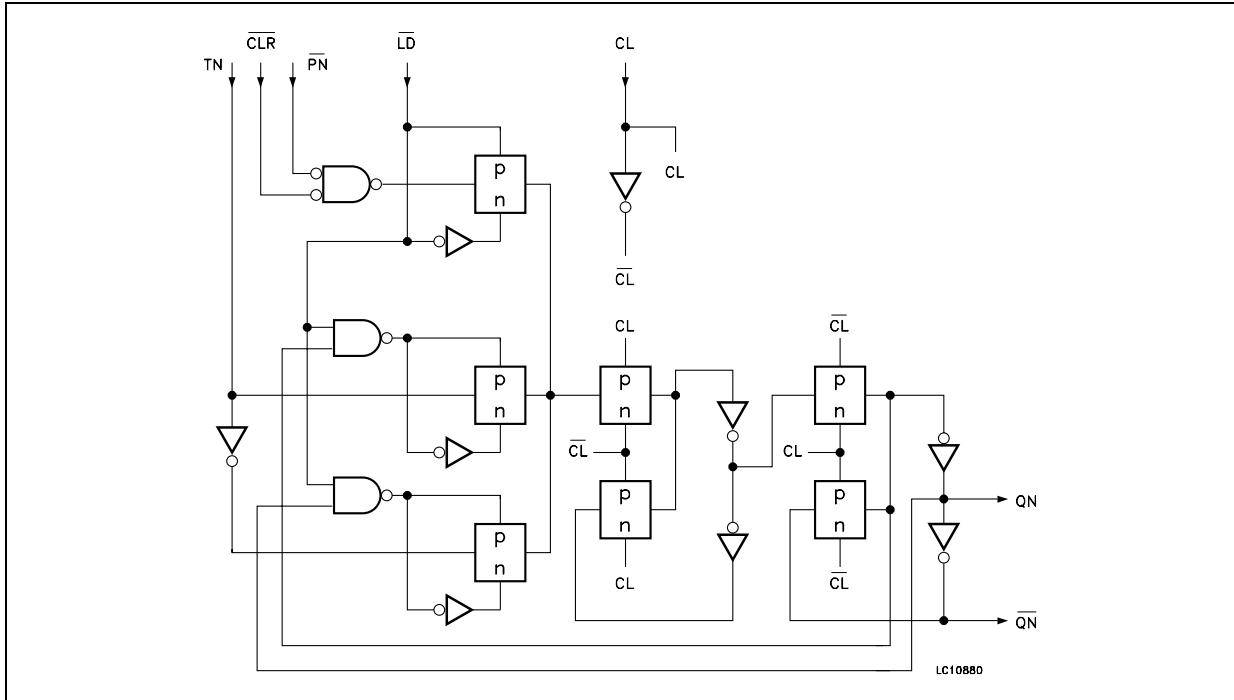


WAVEFORM 3 : MINIMUM SETUP AND HOLD TIME (f=1MHz; 50% duty cycle)

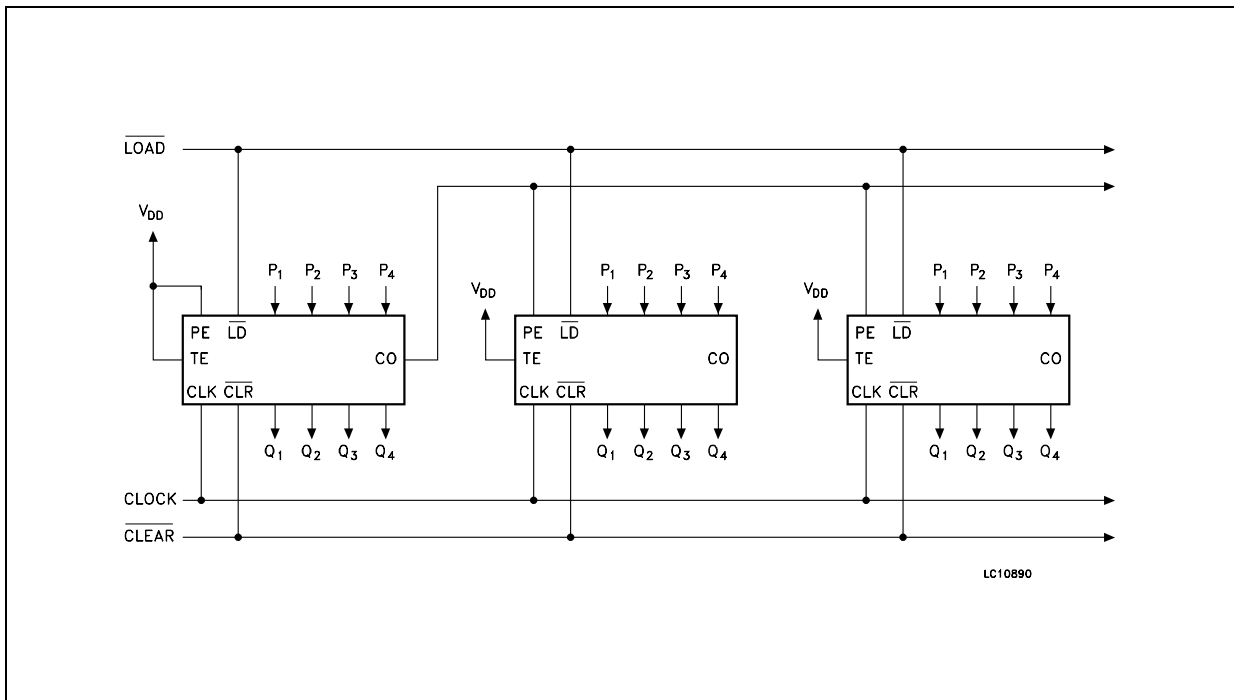


WAVEFORM 4 : MINIMUM SETUP AND HOLD TIME ($f=1\text{MHz}$; 50% duty cycle)WAVEFORM 5 : PROPAGATION DELAY TIME ($f=1\text{MHz}$; 50% duty cycle)

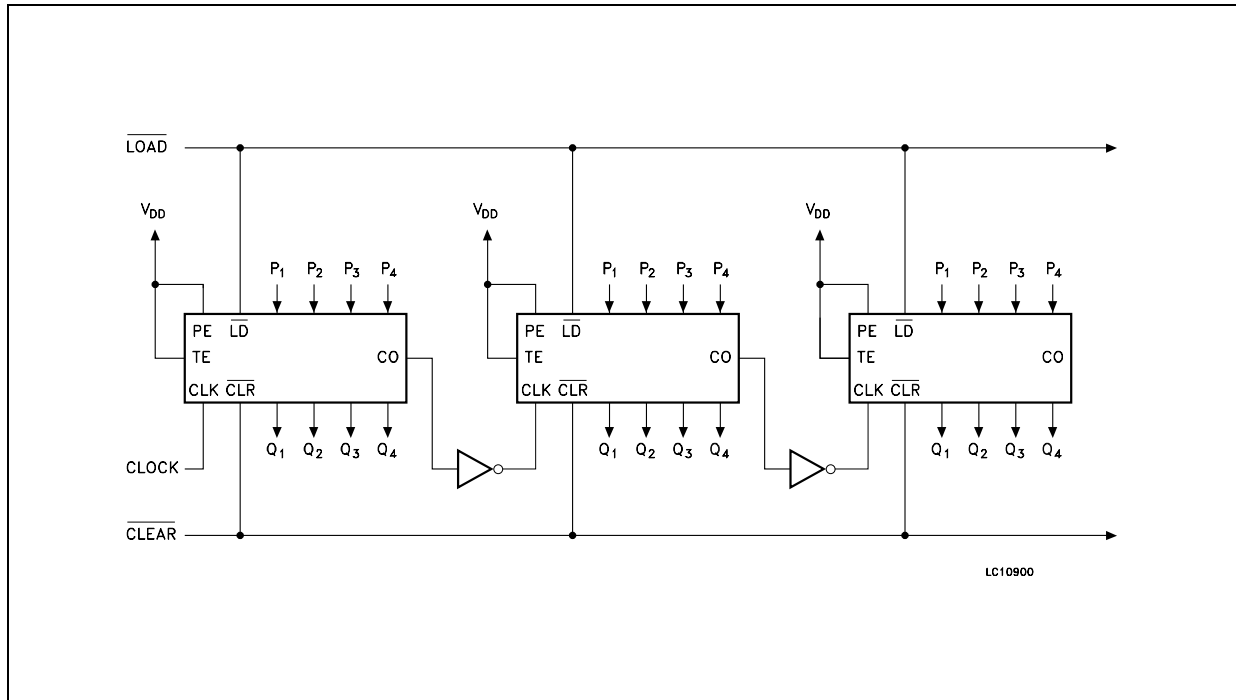
TYPICAL APPLICATION: DETAIL OF FLIP-FLOPS (Asynchronous Clear)



TYPICAL APPLICATION: CASCADING COUNTER PACKAGES IN THE PARALLEL-CLOCKED MODE

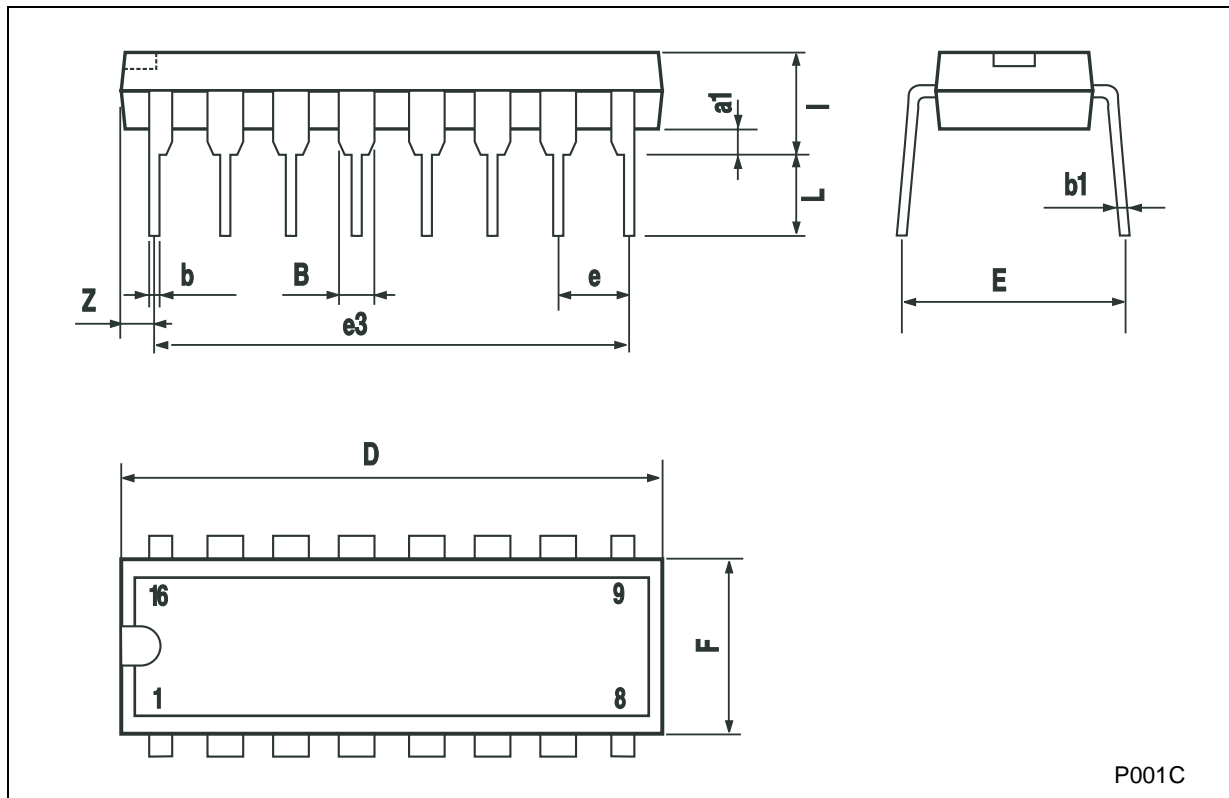


TYPICAL APPLICATION: CASCADING COUNTER PACKAGES IN THE RIPPLE-CLOCKED MODE



Plastic DIP-16 (0.25) MECHANICAL DATA

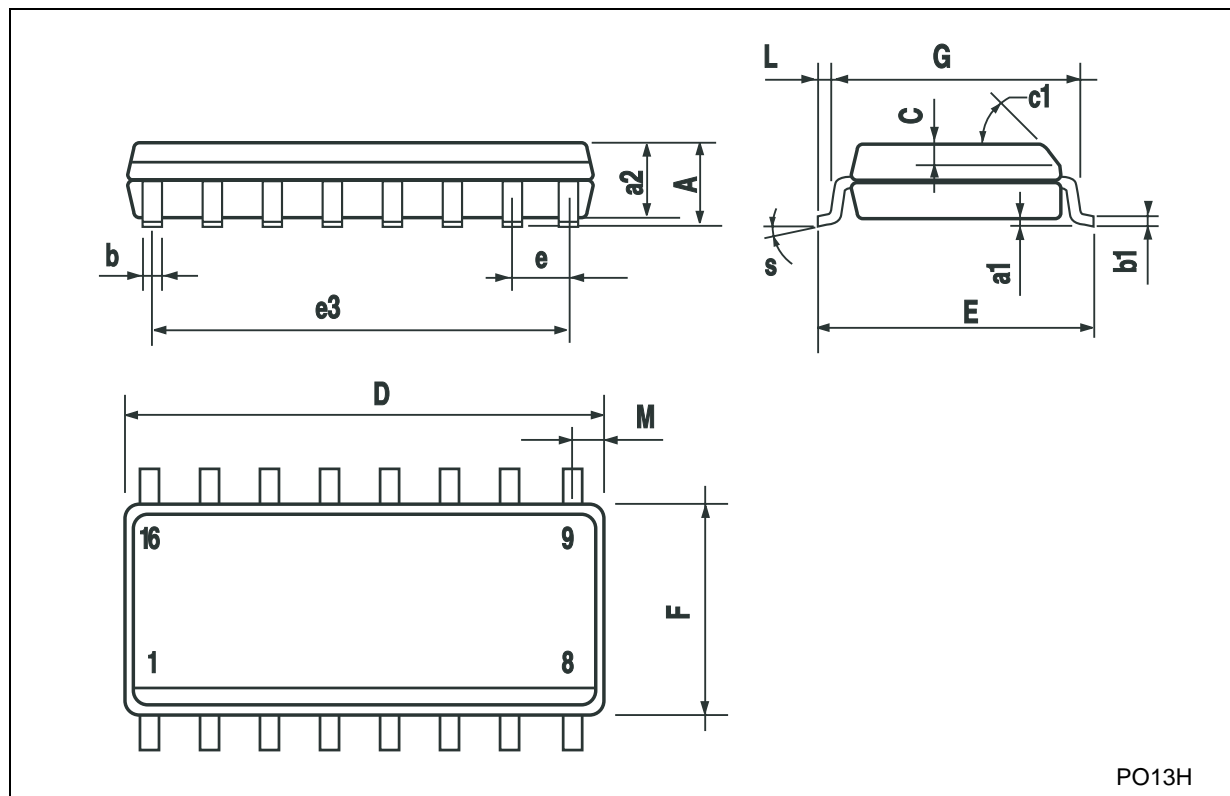
| DIM. | mm. | | | inch | | |
|------|------|-------|------|-------|-------|-------|
| | MIN. | TYP | MAX. | MIN. | TYP. | MAX. |
| a1 | 0.51 | | | 0.020 | | |
| B | 0.77 | | 1.65 | 0.030 | | 0.065 |
| b | | 0.5 | | | 0.020 | |
| b1 | | 0.25 | | | 0.010 | |
| D | | | 20 | | | 0.787 |
| E | | 8.5 | | | 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.) | | | | | |



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