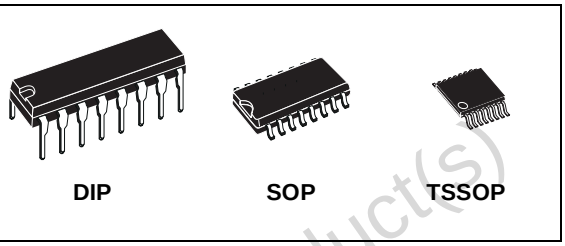
# M74HC161

## SYNCHRONOUS PRESETTABLE 4-BIT COUNTER

- HIGH SPEED :
  $f_{MAX}$ = 62 MHz (TYP.) at $V_{CC}$ = 6V
- LOW POWER DISSIPATION:
  $I_{CC}$ =4μA(MAX.) at $T_A$=25°C
- HIGH NOISE IMMUNITY:
  $V_{NIH} = V_{NIL}$ = 28 % $V_{CC}$ (MIN.)
- SYMMETRICAL OUTPUT IMPEDANCE:
  $|I_{OH}| = I_{OL}$ = 4mA (MIN)
- BALANCED PROPAGATION DELAYS:
  $t_{PLH} \cong t_{PHL}$
- WIDE OPERATING VOLTAGE RANGE:
  $V_{CC}$ (OPR) = 2V to 6V
- PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 161




### ORDER CODES

| PACKAGE | TUBE | T & R |
|---|---|---|
| DIP | M74HC161B1R | |
| SOP | M74HC161M1R | M74HC161RM13TR |
| TSSOP | | M74HC161TTR |

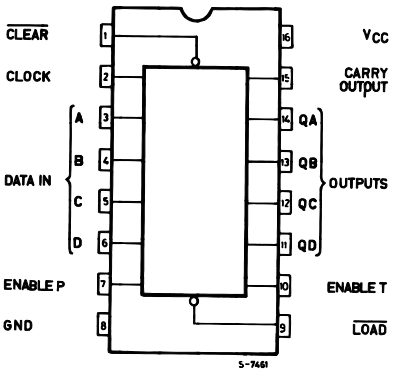
### DESCRIPTION

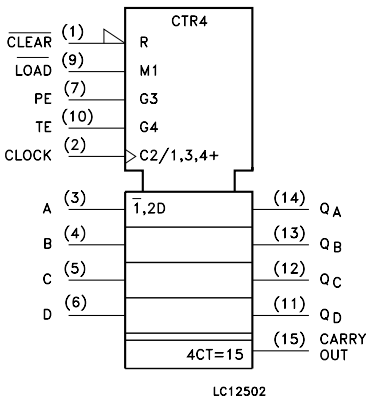
The M74HC161 is an high speed CMOS SYNCHRONOUS 4-BIT BINARY PRESETTABLE COUNTER fabricated with silicon gate $C^2MOS$ technology.
The CLOCK input is active on the rising edge. Both LOAD and CLEAR inputs are active LOW. Presetting is synchronous on the rising edge of the clock, the function is cleared asynchronously.

Two enable inputs (TE and PE) and CARRY output are provided to enable easy cascading of counters, which facilities easy implementation of N-bit counters without using external gates.
All inputs are equipped with protection circuits against static discharge and transient excess voltage.

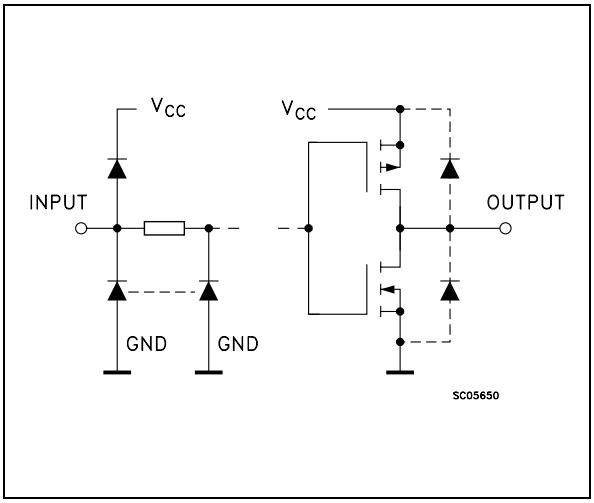
Obsolete Product(s) - Obsolete Product(s)

### PIN CONNECTION AND IEC LOGIC SYMBOLS



## INPUT AND OUTPUT EQUIVALENT CIRCUIT




## PIN DESCRIPTION

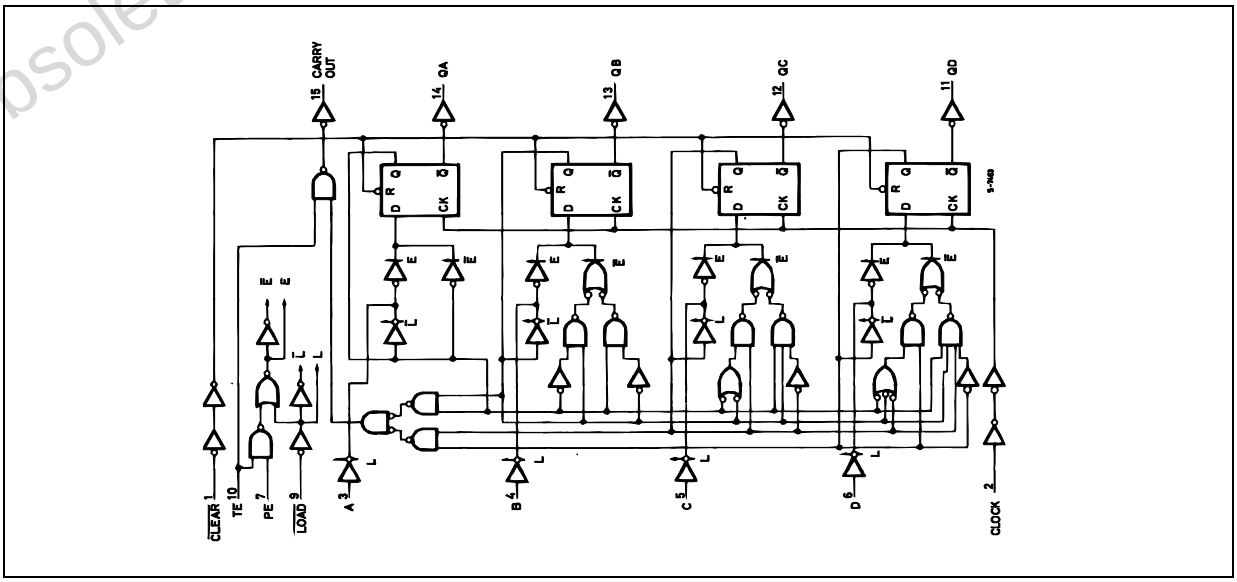
| PIN No | SYMBOL | NAME AND FUNCTION |
|---|---|---|
| 1 | $\overline{\text{CLEAR}}$ | Asynchronous Master Reset |
| 2 | CLOCK | Clock Input (LOW to HIGH, Edge-triggered) |
| 3, 4, 5, 6 | A, B, C, D | Data Inputs |
| 7 | PE | Count Enable Input |
| 10 | TE | Count Enable Carry Input |
| 9 | $\overline{\text{LOAD}}$ | Parallel Enable Input |
| 14, 13, 12, 11 | QA to QD | Flip Flop Outputs |
| 15 | CARRY | Terminal Count Output |
| 8 | GND | Ground (0V) |
| 16 | Vcc | Positive Supply Voltage |

## TRUTH TABLE

| INPUTS | | | | | OUTPUTS | | | | FUNCTION |
|---|---|---|---|---|---|---|---|---|---|
| $\overline{\text{CLEAR}}$ | $\overline{\text{LOAD}}$ | PE | TE | CLOCK | QA | QB | QC | QD | |
| L | X | X | X | X | L | L | L | L | RESET TO "0" |
| H | L | X | X | ↑ | A | B | C | D | PRESET DATA |
| H | H | X | L | ↑ | NO CHANGE | | | | NO COUNT |
| H | H | L | X | ↑ | NO CHANGE | | | | NO COUNT |
| H | H | H | H | ↑ | COUNT UP | | | | COUNT |
| H | X | X | X | ↓ | NO CHANGE | | | | NO COUNT |

X : Don't Care
A, B, C, D : Logic level of data inputs
Carry : CARRY = $TE \cdot Q_A \cdot Q_B \cdot Q_C \cdot Q_D$

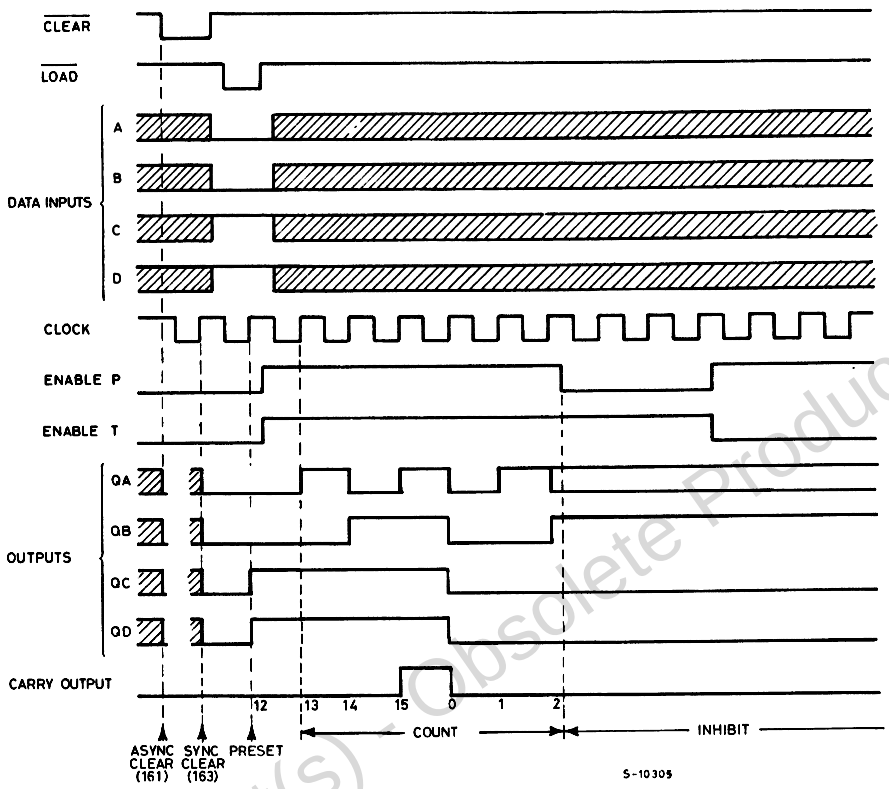
## LOGIC DIAGRAM




This logic diagram has not be used to estimate propagation delays

Obsolete Product(s) - Obsolete Product(s)

## TIMING CHART




Obsolete Product(s) - Obsolete Product(s)

## 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 | ± 20 | mA |
| $I_{OK}$ | DC Output Diode Current | ± 20 | mA |
| $I_O$ | DC Output Current | ± 25 | mA |
| $I_{CC}$ or $I_{GND}$ | DC $V_{CC}$ or Ground Current | ± 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 |
|---|---|---|---|---|
| $V_{CC}$ | Supply Voltage | | 2 to 6 | V |
| $V_I$ | Input Voltage | | 0 to $V_{CC}$ | V |
| $V_O$ | Output Voltage | | 0 to $V_{CC}$ | V |
| $T_{op}$ | Operating Temperature | | -55 to 125 | °C |
| $t_r$, $t_f$ | Input Rise and Fall Time | $V_{CC}$ = 2.0V | 0 to 1000 | ns |
| | | $V_{CC}$ = 4.5V | 0 to 500 | ns |
| | | $V_{CC}$ = 6.0V | 0 to 400 | ns |

## DC SPECIFICATIONS

| Symbol | Parameter | Test Condition | | Value | | | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $V_{CC}$ (V) | | $T_A$ = 25°C | | | -40 to 85°C | | -55 to 125°C | | |
| | | | | Min. | Typ. | Max. | Min. | Max. | Min. | Max. | |
| $V_{IH}$ | 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 | | |
| $V_{IL}$ | 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 | |
| $V_{OH}$ | High Level Output Voltage | 2.0 | $I_O$=-20 µA | 1.9 | 2.0 | | 1.9 | | 1.9 | | V |
| | | 4.5 | $I_O$=-20 µA | 4.4 | 4.5 | | 4.4 | | 4.4 | | |
| | | 6.0 | $I_O$=-20 µA | 5.9 | 6.0 | | 5.9 | | 5.9 | | |
| | | 4.5 | $I_O$=-4.0 mA | 4.18 | 4.31 | | 4.13 | | 4.10 | | |
| | | 6.0 | $I_O$=-5.2 mA | 5.68 | 5.8 | | 5.63 | | 5.60 | | |
| $V_{OL}$ | Low Level Output Voltage | 2.0 | $I_O$=20 µA | | 0.0 | 0.1 | | 0.1 | | 0.1 | V |
| | | 4.5 | $I_O$=20 µA | | 0.0 | 0.1 | | 0.1 | | 0.1 | |
| | | 6.0 | $I_O$=20 µA | | 0.0 | 0.1 | | 0.1 | | 0.1 | |
| | | 4.5 | $I_O$=4.0 mA | | 0.17 | 0.26 | | 0.33 | | 0.40 | |
| | | 6.0 | $I_O$=5.2 mA | | 0.18 | 0.26 | | 0.33 | | 0.40 | |
| $I_I$ | Input Leakage Current | 6.0 | $V_I$ = $V_{CC}$ or GND | | | ± 0.1 | | ± 1 | | ± 1 | µA |
| $I_{CC}$ | Quiescent Supply Current | 6.0 | $V_I$ = $V_{CC}$ or GND | | | 4 | | 40 | | 80 | µA |

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**AC ELECTRICAL CHARACTERISTICS** ($C_L$ = 50 pF, Input $t_r = t_f$ = 6ns)

| Symbol | Parameter | Test Condition | | Value | | | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $V_{CC}$ (V) | | $T_A$ = 25°C | | | -40 to 85°C | | -55 to 125°C | | |
| | | | | Min. | Typ. | Max. | Min. | Max. | Min. | Max. | |
| $t_{TLH}$ $t_{THL}$ | Output Transition Time | 2.0 | | | 25 | 75 | | 95 | | 110 | ns |
| | | 4.5 | | | 7 | 15 | | 19 | | 22 | |
| | | 6.0 | | | 6 | 13 | | 16 | | 19 | |
| $t_{PLH}$ $t_{PHL}$ | Propagation Delay Time (CLOCK - Q) | 2.0 | | | 48 | 125 | | 155 | | 190 | ns |
| | | 4.5 | | | 16 | 25 | | 31 | | 38 | |
| | | 6.0 | | | 14 | 21 | | 26 | | 32 | |
| $t_{PLH}$ $t_{PHL}$ | Propagation Delay Time (CLOCK - CARRY) | 2.0 | | | 57 | 150 | | 190 | | 225 | ns |
| | | 4.5 | | | 19 | 30 | | 38 | | 45 | |
| | | 6.0 | | | 16 | 26 | | 32 | | 38 | |
| $t_{PLH}$ $t_{PHL}$ | Propagation Delay Time (TE - CARRY) | 2.0 | | | 39 | 100 | | 125 | | 150 | ns |
| | | 4.5 | | | 13 | 20 | | 25 | | 30 | |
| | | 6.0 | | | 11 | 17 | | 21 | | 26 | |
| $t_{PLH}$ | Propagation Delay Time ($\overline{CLEAR}$ - Q) | 2.0 | | | 60 | 150 | | 190 | | 225 | ns |
| | | 4.5 | | | 20 | 30 | | 38 | | 45 | |
| | | 6.0 | | | 17 | 26 | | 32 | | 38 | |
| $t_{PHL}$ | Propagation Delay Time ($\overline{CLEAR}$ - CARRY) | 2.0 | | | 72 | 200 | | 250 | | 300 | ns |
| | | 4.5 | | | 24 | 40 | | 50 | | 60 | |
| | | 6.0 | | | 20 | 34 | | 43 | | 51 | |
| $f_{MAX}$ | Maximum Clock Frequency | 2.0 | | 6.2 | 18 | | 5 | | 4.2 | | MHz |
| | | 4.5 | | 31 | 53 | | 25 | | 21 | | |
| | | 6.0 | | 37 | 62 | | 30 | | 25 | | |
| $t_{W(H)}$ $t_{W(L)}$ | Minimum Pulse Width (CLOCK) | 2.0 | | | 18 | 75 | | 95 | | 110 | ns |
| | | 4.5 | | | 6 | 15 | | 19 | | 22 | |
| | | 6.0 | | | 6 | 13 | | 16 | | 19 | |
| $t_{W(L)}$ | Minimum Pulse Width ($\overline{CLEAR}$) | 2.0 | | | 24 | 75 | | 95 | | 110 | ns |
| | | 4.5 | | | 7 | 15 | | 19 | | 22 | |
| | | 6.0 | | | 6 | 13 | | 16 | | 19 | |
| $t_s$ | Minimum Set-up Time ($\overline{LOAD}$, PE, TE) | 2.0 | | | 40 | 100 | | 125 | | 150 | ns |
| | | 4.5 | | | 10 | 20 | | 25 | | 30 | |
| | | 6.0 | | | 8 | 17 | | 21 | | 26 | |
| $t_s$ | Minimum Set-up Time (A, B, C, D) | 2.0 | | | 20 | 75 | | 95 | | 110 | ns |
| | | 4.5 | | | 5 | 15 | | 19 | | 22 | |
| | | 6.0 | | | 3 | 13 | | 16 | | 19 | |
| $t_h$ | Minimum Hold Time (A, B - CLOCK) | 2.0 | | | | 0 | | 0 | | 0 | ns |
| | | 4.5 | | | | 0 | | 0 | | 0 | |
| | | 6.0 | | | | 0 | | 0 | | 0 | |
| $t_{REM}$ | Minimum Removal Time | 2.0 | | | 18 | 50 | | 65 | | 75 | ns |
| | | 4.5 | | | 4 | 10 | | 13 | | 15 | |
| | | 6.0 | | | 3 | 9 | | 11 | | 13 | |

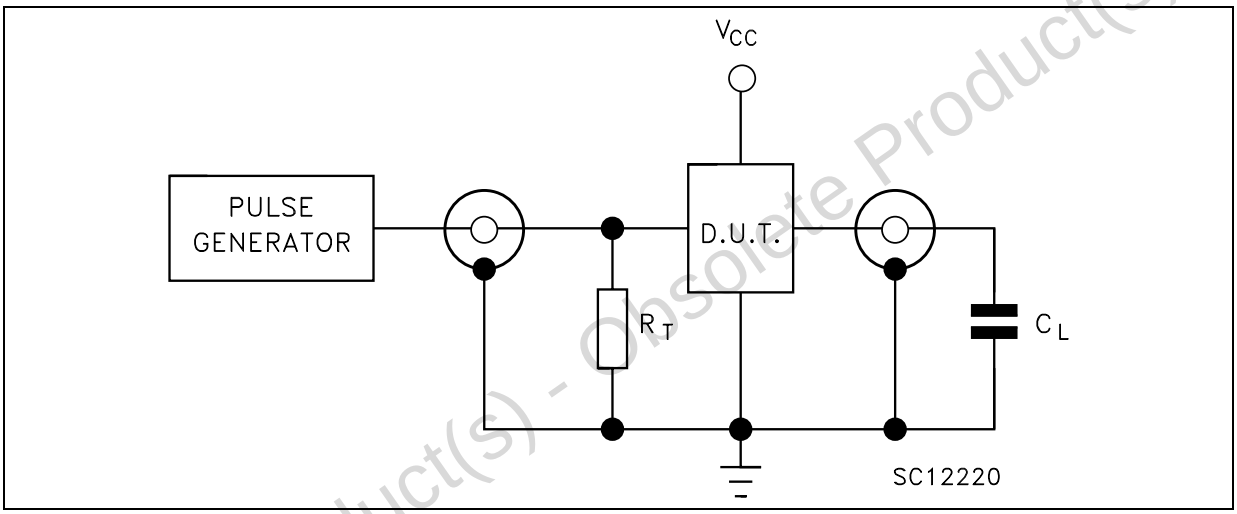
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## CAPACITIVE CHARACTERISTICS

| Symbol | Parameter | Test Condition | | Value | | | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $V_{CC}$ (V) | | $T_A$ = 25°C | | | -40 to 85°C | | -55 to 125°C | | |
| | | | | Min. | Typ. | Max. | Min. | Max. | Min. | Max. | |
| $C_{IN}$ | Input Capacitance | 5.0 | | | 5 | 10 | | 10 | | 10 | pF |
| $C_{PD}$ | Power Dissipation Capacitance (note 1) | 5.0 | | | 50 | | | | | | pF |

1) $C_{PD}$ 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. $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}$

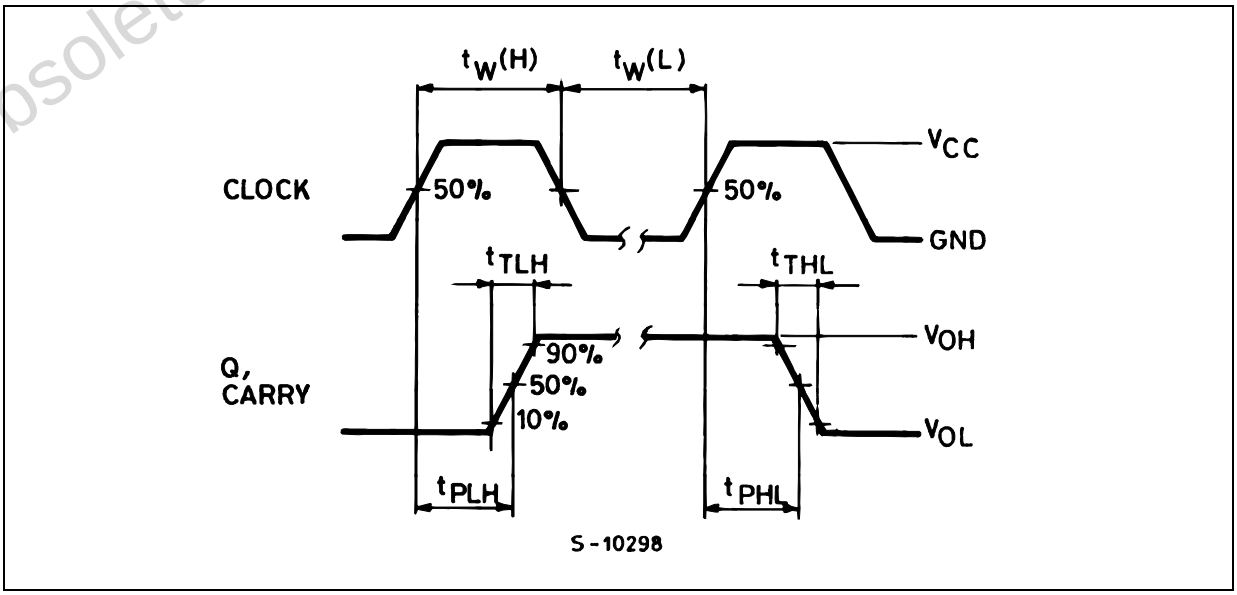
## TEST CIRCUIT




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

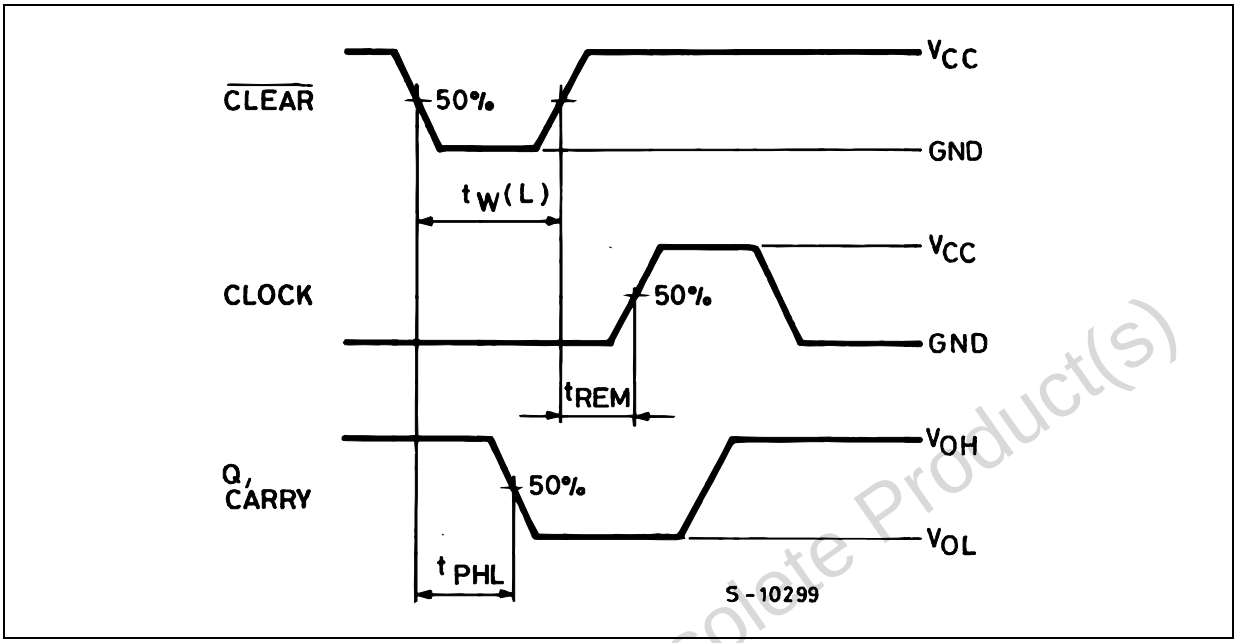
## WAVEFORM 1: PROPAGATION DELAY TIMES, CLOCK MINIMUM PULSE WIDTH

(f=1MHz; 50% duty cycle)

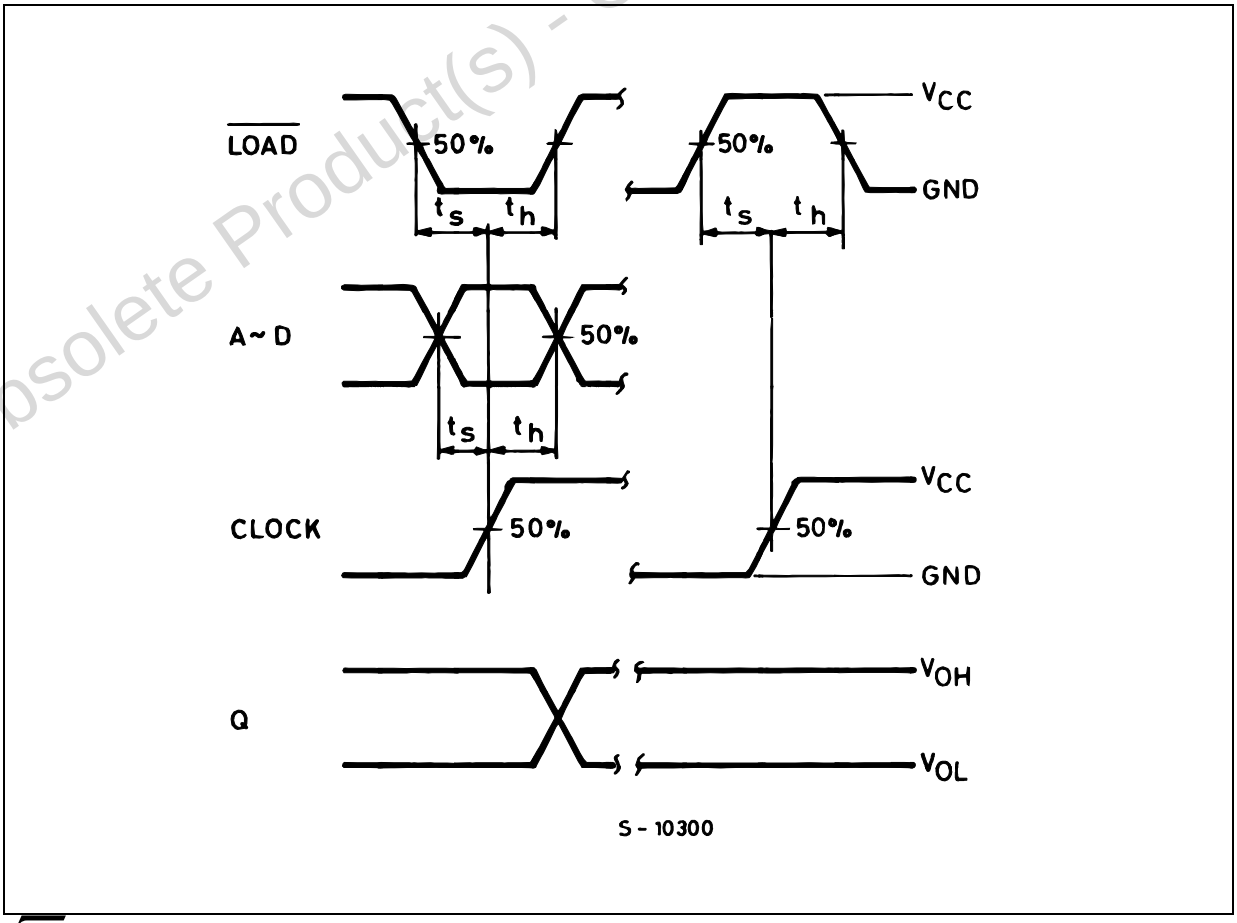



Obsolete Product(s) - Obsolete Product(s)

**WAVEFORM 2 : PROPAGATION DELAY TIMES,$\overline{\text{CLEAR}}$ MINIMUM PULSE WIDTH (CLEAR MODE)**
(f=1MHz; 50% duty cycle)

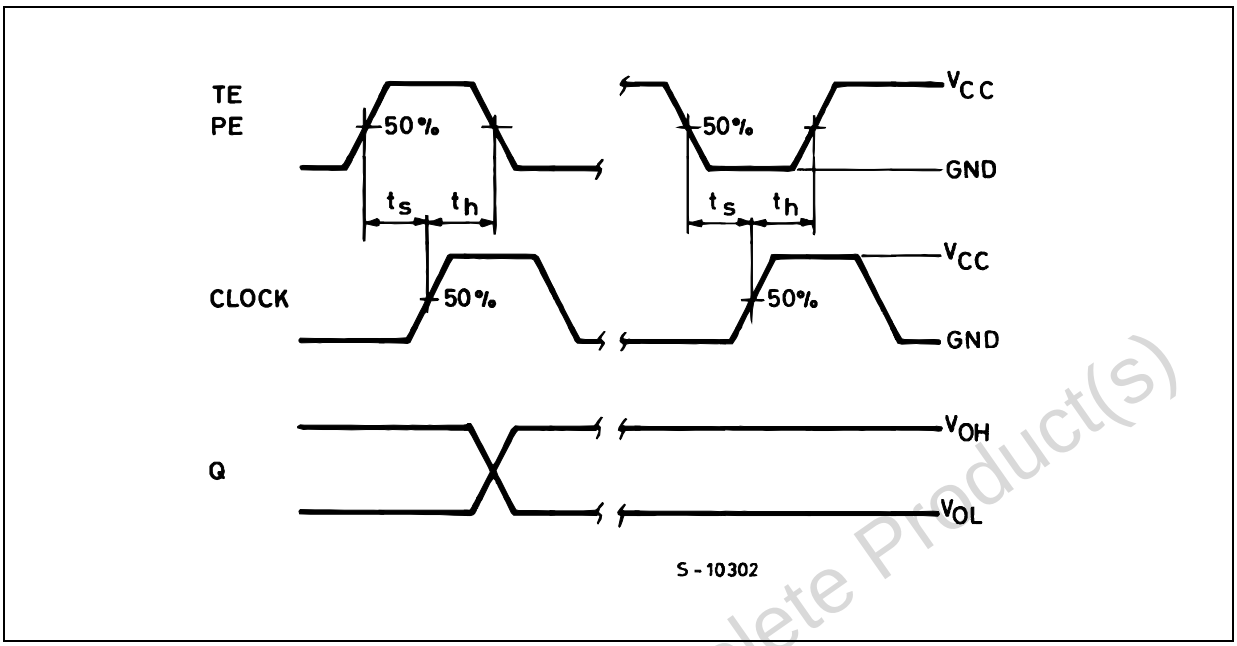



**WAVEFORM 3 : SETUP AND HOLD TIMES (PRESET MODE)** (f=1MHz; 50% duty cycle)

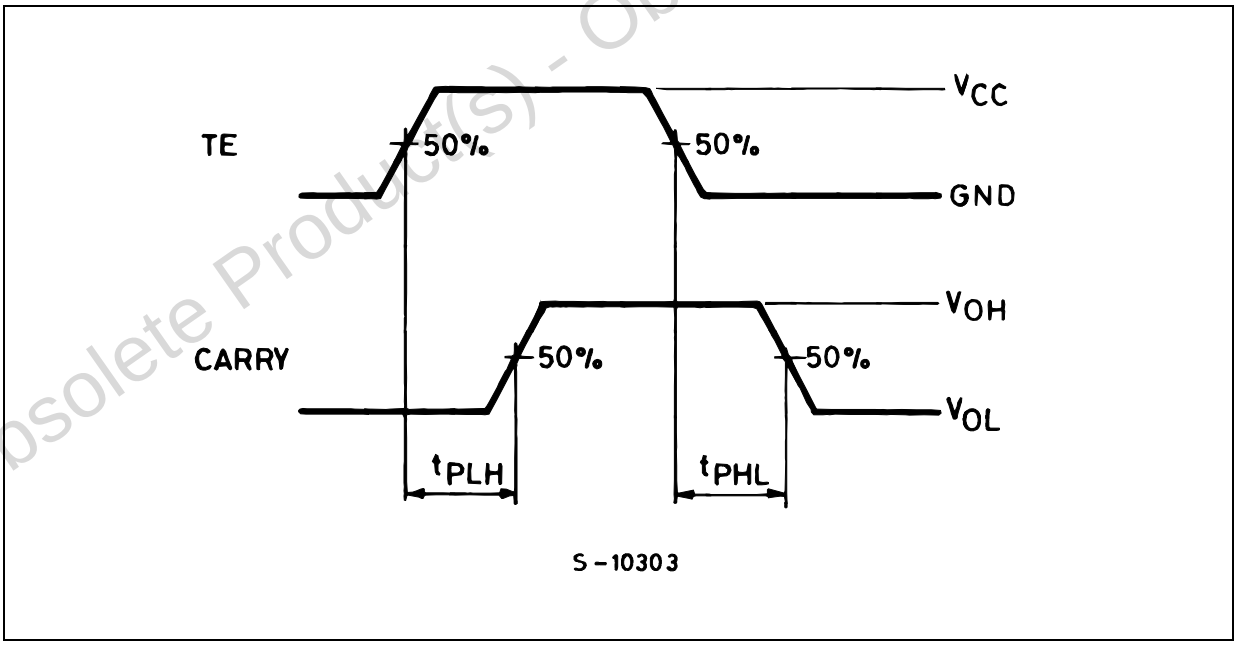



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**WAVEFORM 4 : SETUP AND HOLD TIMES (COUNTENABLE MODE)** (f=1MHz; 50% duty cycle)



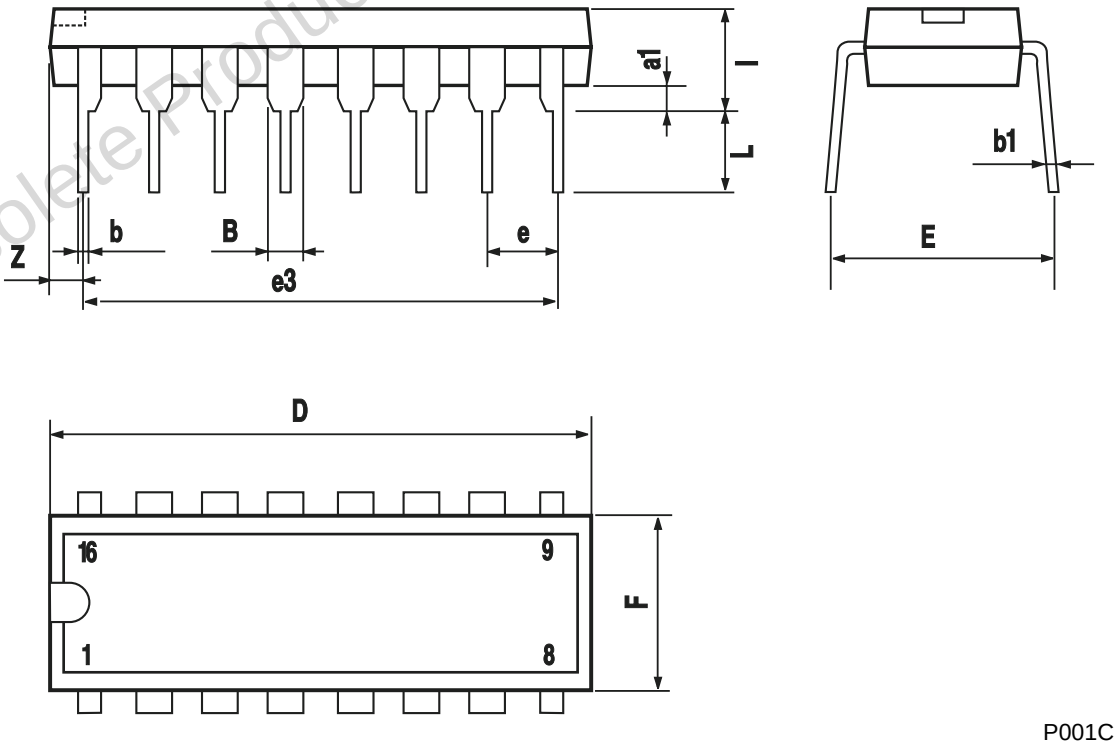

**WAVEFORM 5 : PROPAGATION DELAY TIMES (CASCADE MODE)** (f=1MHz; 50% duty cycle)




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 |

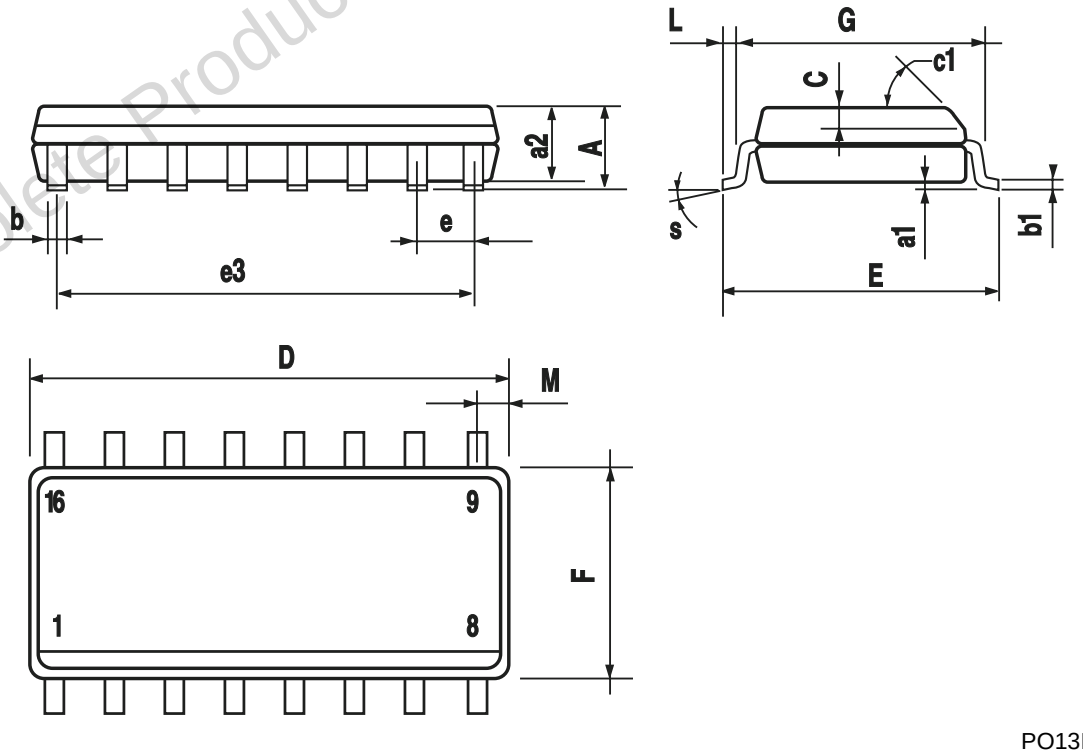



P001C

Obsolete Product(s) - Obsolete Product(s)

## 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.) | | | | | |

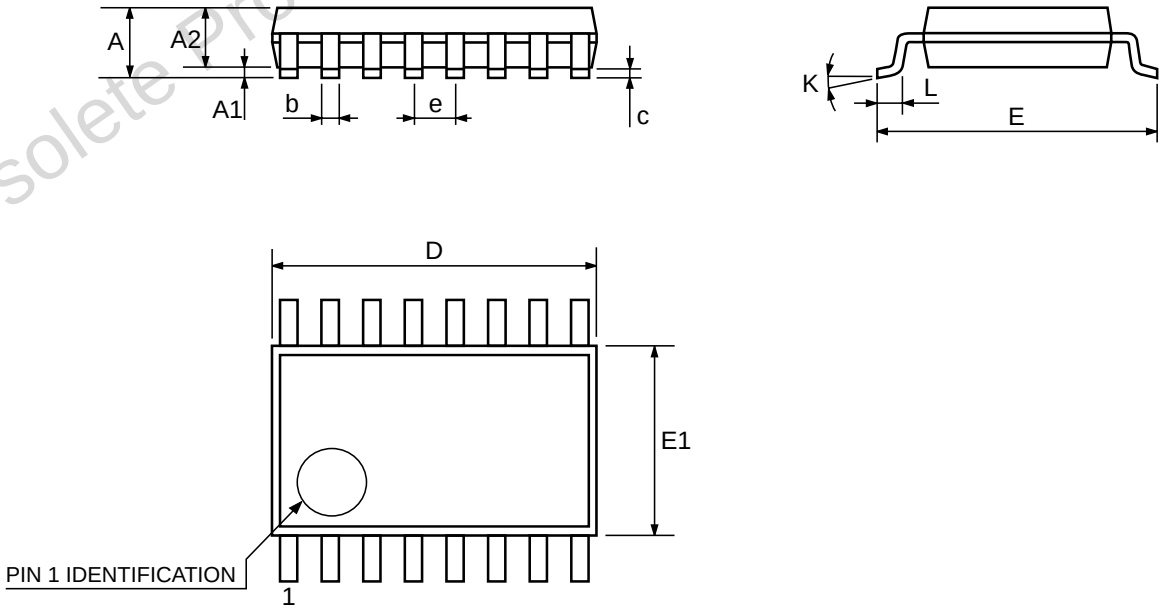



PO13H

Obsolete Product(s) - Obsolete Product(s)

## 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 |




Obsolete Product(s) - Obsolete Product(s)

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