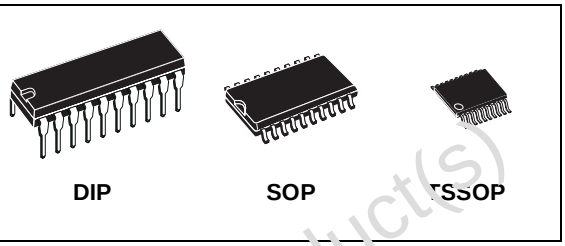
# 74AC299

## 8 BIT PIPO SHIFT REGISTER WITH ASYNCHRONOUS CLEAR

- HIGH SPEED:
- $f_{MAX}$ = 240MHz (TYP.) at $V_{CC}$ = 5V
- LOW POWER DISSIPATION: $I_{CC}$ = 8µA(MAX.) at $T_A$=25°C
- HIGH NOISE IMMUNITY: $V_{NIH} = V_{NIL}$ = 28 % $V_{CC}$ (MIN.)
- 50Ω TRANSMISSION LINE DRIVING CAPABILITY
- SYMMETRICAL OUTPUT IMPEDANCE: $|I_{OH}| = I_{OL}$ = 24mA (MIN)
- BALANCED PROPAGATION DELAYS: $t_{PLH} \cong t_{PHL}$
- OPERATING VOLTAGE RANGE: $V_{CC}$ (OPR) = 2V to 6V
- PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 299
- IMPROVED LATCH-UP IMMUNITY




**ORDER CODES**

| PACKAGE | TUBE | T & R |
|---|---|---|
| DIP | 74AC299B | |
| SOP | 74AC299M | 74AC299MTR |
| TSSOP | | 74AC299TTR |

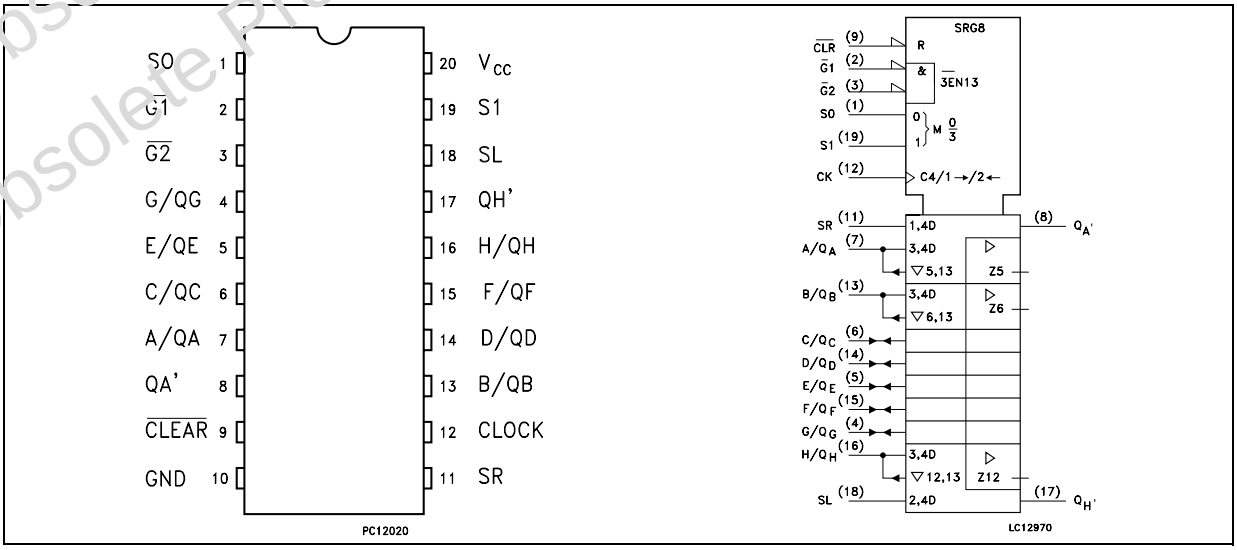
### DESCRIPTION

The 74AC299 is an advanced high-speed CMOS 8-BIT PIPO SHIFT REGISTER (3-STATE) fabricated with sub-micron silicon gate and double-layer metal wiring $C^2MOS$ technology.

These devices have four modes (HOLD, SHIFT LEFT, SHIFT RIGHT and LOAD DATA). Each mode is chosen by two function select inputs (S0, S1) as shown in the Truth Table. When one or both enable inputs, ($\overline{G1}$, $\overline{G2}$) are high, the eight input/output terminals are in the high-impedance state; however sequential operation or clearing of the register is not affected. Clear function is asynchronous to clock.

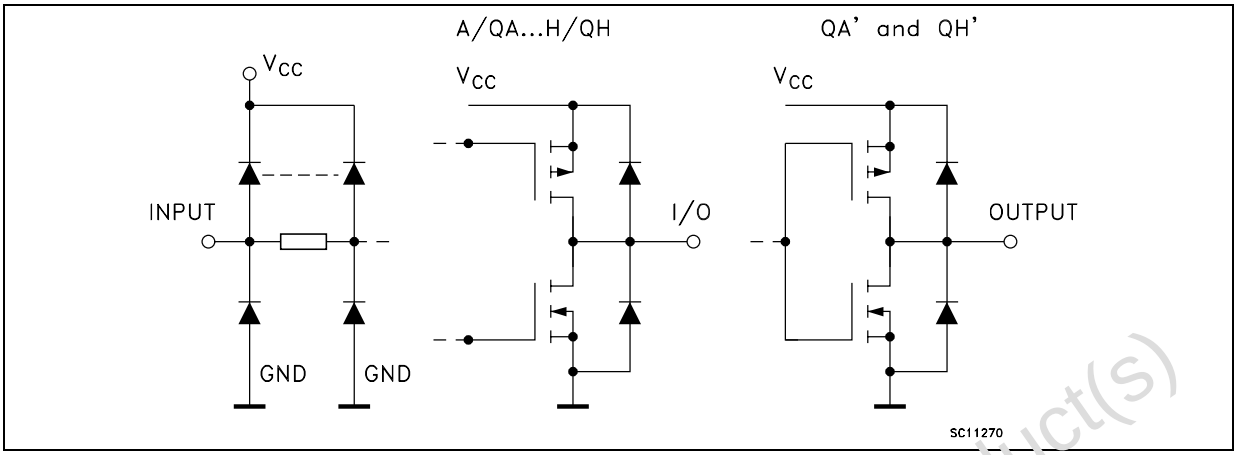
All inputs and outputs are equipped with protection circuits against static discharge, giving them 2KV ESD immunity and transient excess voltage.

### PIN CONNECTION AND IEC LOGIC SYMBOLS




Obsolete Product(s) - Obsolete Product(s)

## INPUT AND OUTPUT EQUIVALENT CIRCUIT




## PIN DESCRIPTION

| PIN No | SYMBOL | NAME AND FUNCTION |
|---|---|---|
| 1, 19 | S0, S1 | Mode Select Inputs |
| 2, 3 | $\overline{G1}$, $\overline{G2}$ | 3-State Output Enable Inputs (Active LOW) |
| 7, 13, 6, 14, 5, 15, 4, 16 | A/QA to H/QH | Parallel Data Inputs or 3-State Parallel Outputs (Bus Driver) |
| 8, 17 | QA' to QH' | Serial Outputs (Standard Output) |
| 9 | $\overline{CLEAR}$ | Asynchronous Master Reset Input (Active LOW) |
| 11 | SR | Serial Data Shift Right Input |
| 12 | CLOCK | Clock Input (LOW to HIGH, Edge-triggered) |
| 18 | SL | Serial Data Shift Left Input |
| 10 | GND | Ground (0V) |
| 20 | $V_{CC}$ | Positive Supply Voltage |

## TRUTH TABLE

| MODE | INPUTS | | | | | | INPUTS/OUTPUTS | | | | OUTPUTS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $\overline{CLEAR}$ | FUNCTION SELECTED | | OUTPUT CONTROL | | CLOCK | SERIAL | | A/QA | H/QH | QA' | QH' |
| | | S1 | S0 | $\overline{G1}$* | $\overline{G2}$* | | SL | SR | | | | |
| Z | L | H | H | X | X | X | X | X | Z | Z | L | L |
| CLEAR | L | L | X | L | L | X | X | X | L | L | L | L |
| | L | X | L | L | L | X | X | X | L | L | L | L |
| HOLD | H | L | L | L | L | X | X | X | QA0 | QH0 | QA0 | QH0 |
| SHIFT RIGHT | H | L | H | L | L | ⎍ | X | H | H | QGn | H | QGn |
| | H | L | H | L | L | ⎍ | X | L | L | QGn | L | QGn |
| SHIFT LEFT | H | H | L | L | L | ⎍ | H | X | QBn | H | QBn | H |
| | H | H | L | L | L | ⎍ | L | X | QBn | L | QBn | L |
| LOAD | H | H | H | X | X | ⎍ | X | X | a | h | a | h |

* When one or both controls are high, the eight input/output terminals are the high impedance state: howewer sequential operation or cleaning of the register is not affected.

Z : High Impedance

Qn0 : The level of An before the indicated steady state input conditions were established.

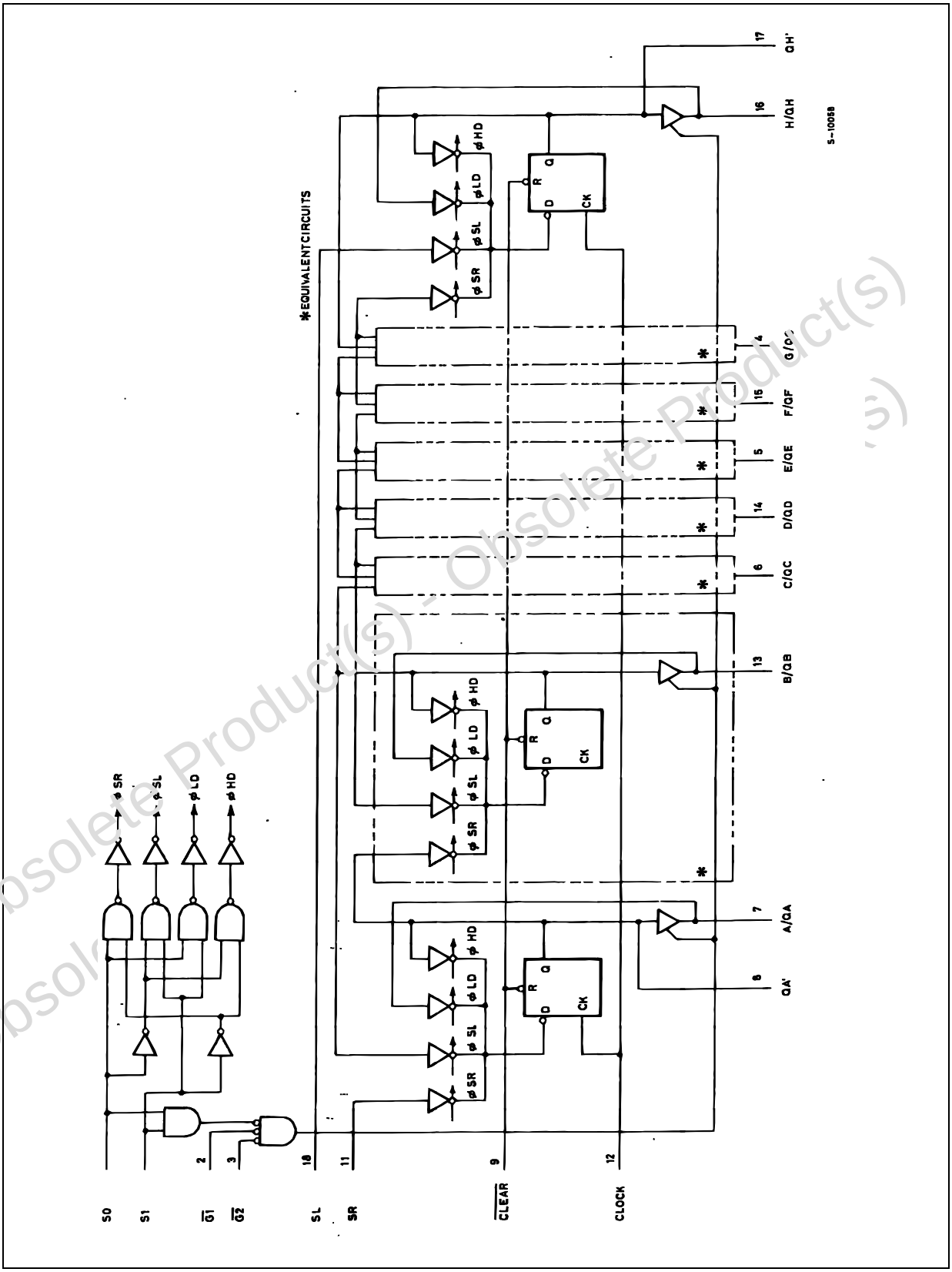
Qnn : The level of Qn before the most recent active transition indicated by OR

a, h : The level of the steadystate inputs A, H, respectively.

X : Don't Care

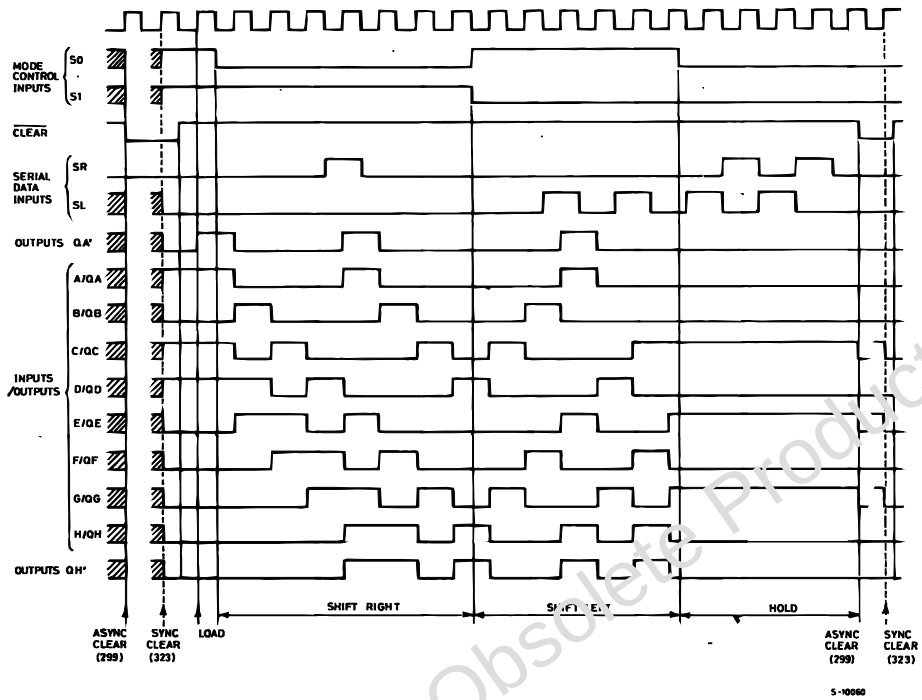
Obsolete Product(s) - Obsolete Product(s)

## LOGIC DIAGRAM




Obsolete Product(s) - Obsolete Product(s)

## TIMING CHART




## 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 | ± 50 | mA |
| $I_{CC}$ or $I_{GND}$ | DC $V_{CC}$ or Ground Current | ± 400 | mA |
| $T_{stg}$ | 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.

## 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 |
| dt/dv | Input Rise and Fall Time $V_{CC}$ = 3.0, 4.5 or 5.5V (note 1) | 8 | ns/V |

1) $V_{IN}$ from 30% to 70% of $V_{CC}$

Obsolete Product(s) - Obsolete Product(s)

## 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 | 3.0 | $V_O$ = 0.1 V or $V_{CC}$-0.1V | 2.1 | 1.5 | | 2.1 | | 2.1 | | V |
| | | 4.5 | | 3.15 | 2.25 | | 3.15 | | 3.15 | | |
| | | 5.5 | | 3.85 | 2.75 | | 3.85 | | 3.85 | | |
| $V_{IL}$ | Low Level Input Voltage | 3.0 | $V_O$ = 0.1 V or $V_{CC}$-0.1V | | 1.5 | 0.9 | | 0.9 | | 0.9 | V |
| | | 4.5 | | | 2.25 | 1.35 | | 1.35 | | 1.35 | |
| | | 5.5 | | | 2.75 | 1.65 | | 1.65 | | 1.65 | |
| $V_{OH}$ | High Level Output Voltage | 3.0 | $I_O$=-50 µA | 2.9 | 2.99 | | 2.9 | | 2.9 | | V |
| | | 4.5 | $I_O$=-50 µA | 4.4 | 4.49 | | 4.4 | | 4.4 | | |
| | | 5.5 | $I_O$=-50 µA | 5.4 | 5.49 | | 5.4 | | 5.4 | | |
| | | 3.0 | $I_O$=-12 mA | 2.56 | | | 2.46 | | 2.4 | | |
| | | 4.5 | $I_O$=-24 mA | 3.86 | | | 3.76 | | 3.7 | | |
| | | 5.5 | $I_O$=-24 mA | 4.86 | | | 4.76 | | 4.7 | | |
| $V_{OL}$ | Low Level Output Voltage | 3.0 | $I_O$=50 µA | | 0.002 | 0.1 | | 0.1 | | 0.1 | V |
| | | 4.5 | $I_O$=50 µA | | 0.001 | 0.1 | | 0.1 | | 0.1 | |
| | | 5.5 | $I_O$=50 µA | | 0.001 | 0.1 | | 0.1 | | 0.1 | |
| | | 3.0 | $I_O$=12 mA | | | 0.36 | | 0.44 | | 0.5 | |
| | | 4.5 | $I_O$=24 mA | | | 0.36 | | 0.44 | | 0.5 | |
| | | 5.5 | $I_O$=24 mA | | | 0.36 | | 0.44 | | 0.5 | |
| $I_I$ | Input Leakage Current | 5.5 | $V_I$ = $V_{CC}$ or GND | | | ± 0.1 | | ± 1 | | ± 1 | µA |
| Ioz | High Impedance Output Leakage Current | 5.5 | $V_I$ = $V_{IH}$ or $V_{IL}$<br>$V_O$ = $V_{CC}$ or GND | | | ± 0.5 | | ± 5 | | ±10 | µA |
| $I_{CC}$ | Quiescent Supply Current | 5.5 | $V_I$ = $V_{CC}$ or GND | | | 8 | | 80 | | 160 | µA |
| $I_{OLD}$ | Dynamic Output Current (note 1, 2) | 5.5 | $V_{OLD}$ = 1.65 V max | | | | | 75 | | 50 | mA |
| $I_{OHD}$ | | | $V_{OHD}$ = 3.85 V min | | | | | -75 | | -50 | mA |

1) Maximum test duration 2ms, one output loaded at time
2) Incident wave switching is guaranteed on transmission lines with impedances as low as 50Ω

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**AC ELECTRICAL CHARACTERISTICS** ($C_L$ = 50 pF, $R_L$ = 500 Ω, Input $t_r = t_f$ = 3ns)

| 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. | |
| $t_{PLH}$ $t_{PHL}$ | Propagation Delay Time CLOCK to $Q'_A$, $Q'_H$ | 3.3(*) | | | 10.6 | 18.4 | 1.0 | 21.0 | 1.0 | 21.0 | ns |
| | | 5.0(**) | | | 6.8 | 10.5 | 1.0 | 12.0 | 1.0 | 12.0 | |
| $t_{PLH}$ $t_{PHL}$ | Propagation Delay Time CLOCK to $Q_A$, $Q_H$ | 3.3(*) | | | 10.9 | 19.3 | 1.0 | 22.0 | 1.0 | 22.0 | ns |
| | | 5.0(**) | | | 7.3 | 10.5 | 1.0 | 12.0 | 1.0 | 12.0 | |
| $t_{PLH}$ $t_{PHL}$ | Propagation Delay Time $\overline{\text{CLEAR}}$ to $Q'_A$, $Q'_H$ | 3.3(*) | | | 8.1 | 14.0 | 1.0 | 16.0 | 1.0 | 16.0 | ns |
| | | 5.0(**) | | | 6.1 | 9.2 | 1.0 | 10.5 | 1.0 | 10.5 | |
| $t_{PLH}$ $t_{PHL}$ | Propagation Delay Time $\overline{\text{CLEAR}}$ to $Q_A$, $Q_H$ | 3.3(*) | | | 9.8 | 16.7 | 1.0 | 19.0 | 1.0 | 19.0 | ns |
| | | 5.0(**) | | | 6.7 | 10.9 | 1.0 | 12.4 | 1.0 | 12.4 | |
| $t_{PZL}$ $t_{PZH}$ | Output Enable Time | 3.3(*) | | | 9.9 | 17.5 | 1.0 | 20.0 | 1.0 | 20.0 | ns |
| | | 5.0(**) | | | 6.6 | 9.6 | 1.0 | 11.4 | 1.0 | 11.4 | |
| $t_{PLZ}$ $t_{PHZ}$ | Output Disable Time | 3.3(*) | | | 8.1 | 14.0 | 1.0 | 16.0 | 1.0 | 16.0 | ns |
| | | 5.0(**) | | | 6.4 | 9.6 | 1.0 | 11.0 | 1.0 | 11.0 | |
| $t_W$ | $\overline{\text{CLEAR}}$ Pulse Width LOW | 3.3(*) | | | | 7.0 | | 7.0 | | 7.0 | ns |
| | | 5.0(**) | | | | 5.0 | | 5.0 | | 5.0 | |
| $t_W$ | CLOCK Pulse Width LOW | 3.3(*) | | | | 8.0 | | 8.0 | | 8.0 | ns |
| | | 5.0(**) | | | | 5.0 | | 5.0 | | 5.0 | |
| $t_s$ | Setup Time HIGH or LOW (S0 or S1 to CLOCK) | 3.3(*) | | | | 11.9 | | 13.6 | | 13.6 | ns |
| | | 5.0(**) | | | | 7.0 | | 7.0 | | 7.0 | |
| $t_h$ | Hold Time HIGH or LOW (S0 or S1 to CLOCK) | 3.3(*) | | | | 0.0 | | 0.0 | | 0.0 | ns |
| | | 5.0(**) | | | | 0.0 | | 0.0 | | 0.0 | |
| $t_s$ | Setup Time HIGH or LOW (SR or SL to CLOCK) | 3.3(*) | | | | 6.0 | | 6.0 | | 6.0 | ns |
| | | 5.0(**) | | | | 4.0 | | 4.0 | | 4.0 | |
| $t_h$ | Hold Time HIGH or LOW (SR or SL to CLOCK) | 3.3(*) | | | | 1.0 | | 1.0 | | 1.0 | ns |
| | | 5.0(**) | | | | 1.0 | | 1.0 | | 1.0 | |
| $t_{REM}$ | Recovery Time $\overline{\text{CLEAR}}$ to CLOCK | 3.3(*) | | | | 5.0 | | 5.0 | | 5.0 | ns |
| | | 5.0(**) | | | | 3.0 | | 3.0 | | 3.0 | |
| $f_{MAX}$ | Maximum Clock Frequency | 3.3(*) | | 45 | 210 | | 45 | | 45 | | MHz |
| | | 5.0(**) | | 80 | 240 | | 80 | | 80 | | |

(*) Voltage range is 3.3V ± 0.3V
(**) Voltage range is 5.0V ± 0.5V

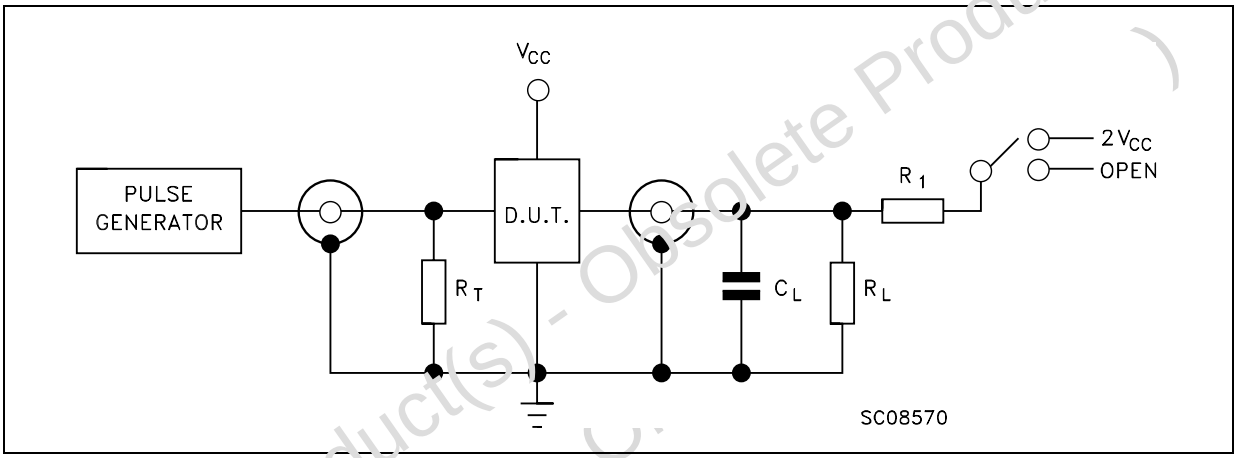
Obsolete Product(s) - Obsolete Product(s) - Obsolete Product(s)

## 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 | | | pF |
| $C_{i/O}$ | Bus Input Capacitance | 5.0 | | | 13 | | | | | | pF |
| $C_{PD}$ | Power Dissipation Capacitance (note 1) | 5.0 | $f_{IN}$ = 10MHz | | 120 | | | | | | 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. $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}$ /n (per circuit)

## TEST CIRCUIT

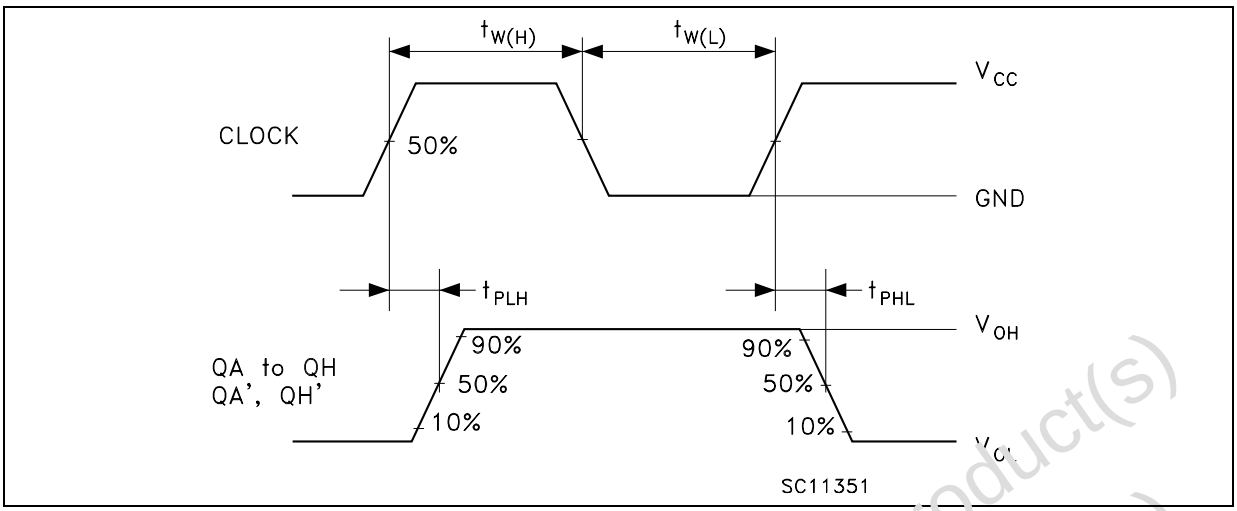



| TEST | SWITCH |
|---|---|
| $t_{PLH}$, $t_{PHL}$ | Open |
| $t_{PZL}$, $t_{PLZ}$ | $2V_{CC}$ |
| $t_{PZH}$, $t_{PHZ}$ | Open |

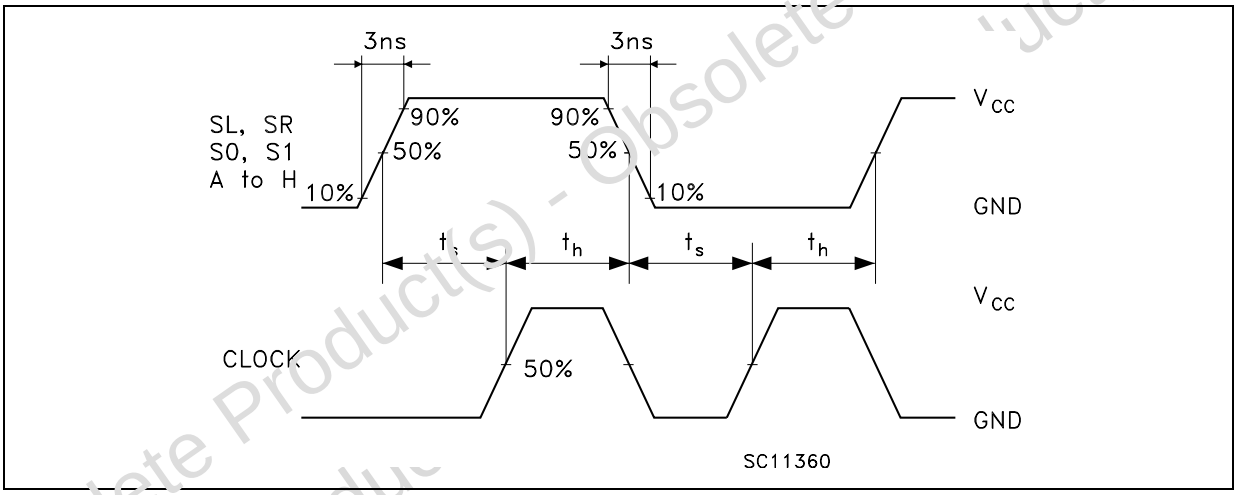
$C_L$ = 50pF or equivalent (includes jig and probe capacitance)
$R_L = R_1$ = 500Ω or equivalent
$R_T = Z_{OUT}$ of pulse generator (typically 50Ω)

Obsolete Product(s) - Obsolete Product(s)

**WAVEFORM 1: PROPAGATION DELAYS** (f=1MHz; 50% duty cycle)

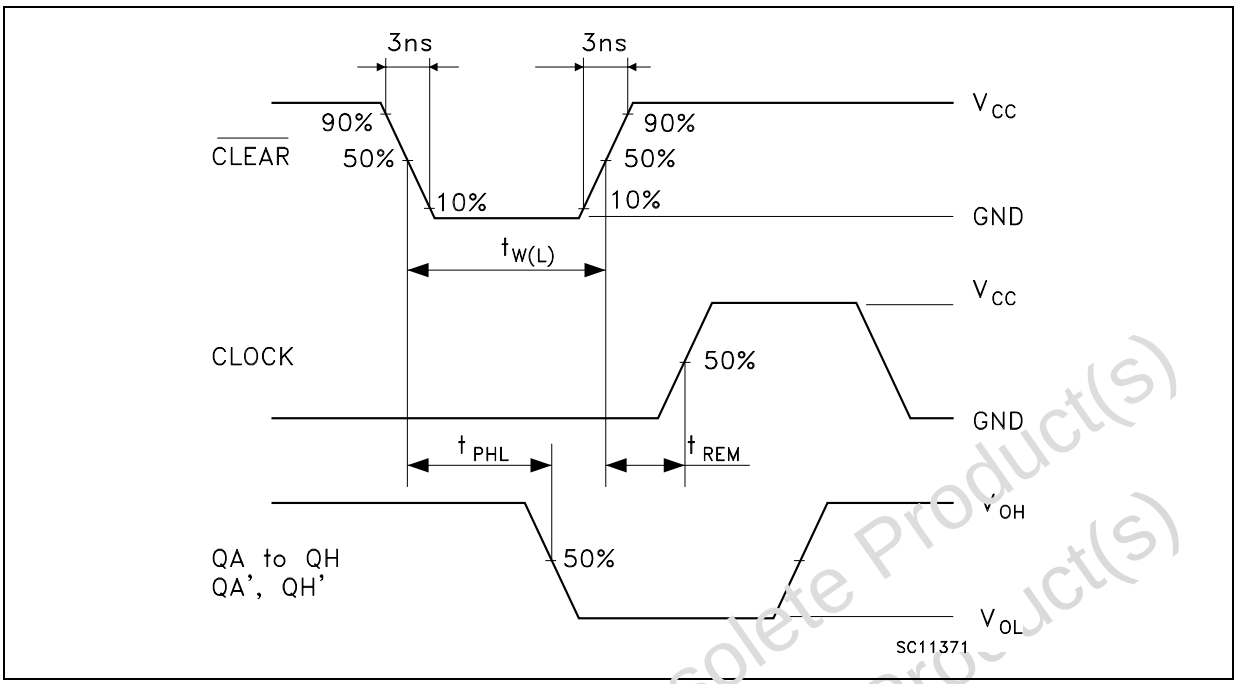



**WAVEFORM 2: PROPAGATION DELAYS** (f=1MHz; 50% duty cycle)

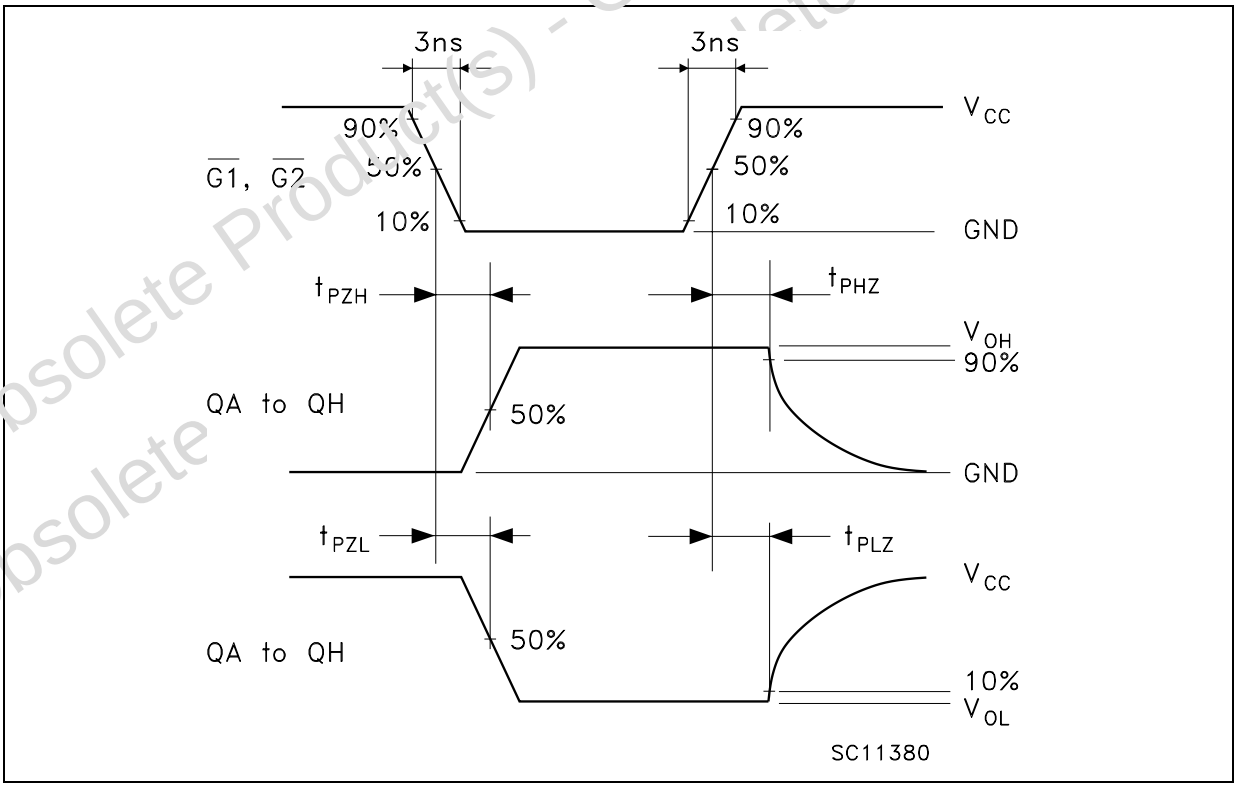



Obsolete Product(s) - Obsolete Product(s)

**WAVEFORM 3: PROPAGATION DELAYS** (f=1MHz; 50% duty cycle)



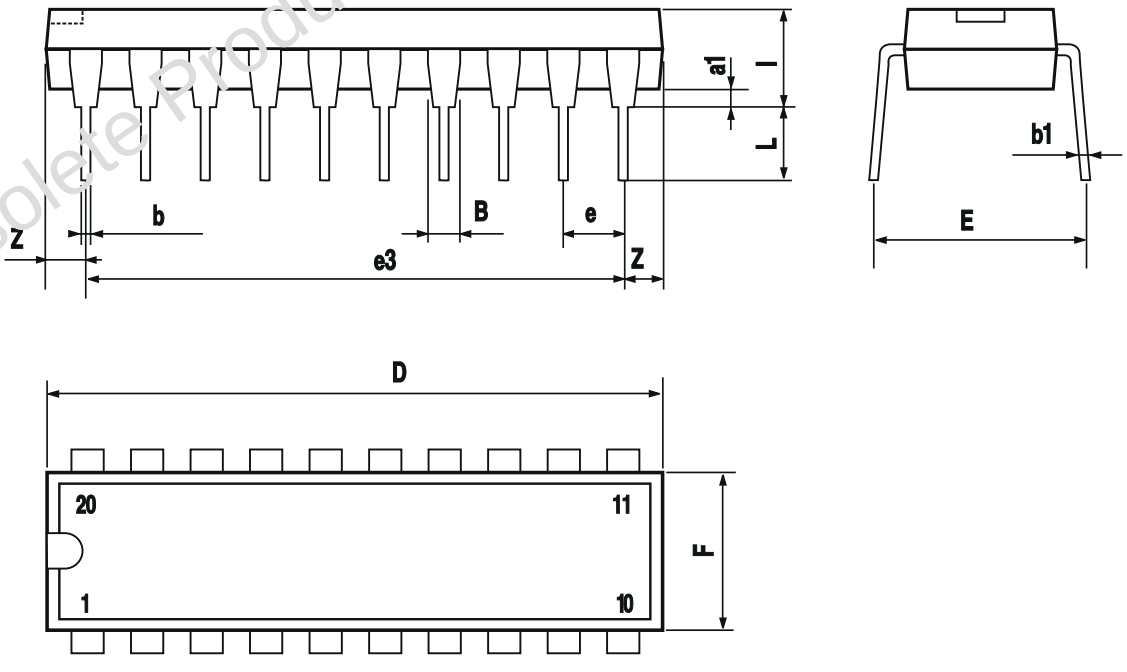

**WAVEFORM 4: PROPAGATION DELAYS** (f=1MHz, 50% duty cycle)




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## Plastic DIP-20 (0.25) MECHANICAL DATA

| DIM. | mm | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| a1 | 0.254 | | | 0.010 | | |
| B | 1.39 | | 1.65 | 0.055 | | 0.065 |
| b | | 0.45 | | | 0.018 | |
| b1 | | 0.25 | | | 0.010 | |
| D | | | 25.4 | | | 1.000 |
| E | | 8.5 | | | 0.335 | |
| e | | 2.54 | | | 0.100 | |
| e3 | | 22.86 | | | 0.900 | |
| F | | | 7.1 | | | 0.280 |
| I | | | 3.93 | | | 0.155 |
| L | | 3.3 | | | 0.130 | |
| Z | | | 1.34 | | | 0.053 |

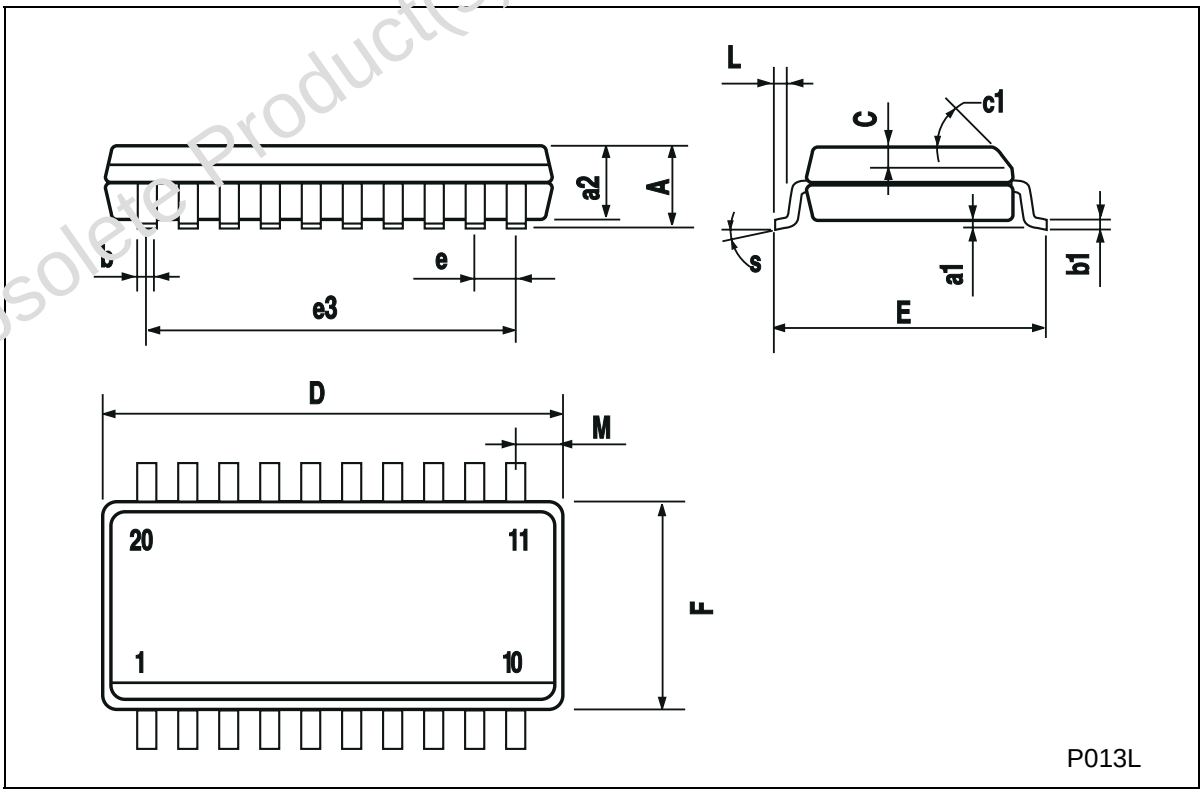



P001J

Obsolete Product(s) - Obsolete Product(s)

## SO-20 MECHANICAL DATA

| DIM. | mm | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 2.65 | | | 0.104 |
| a1 | 0.10 | | 0.20 | 0.004 | | 0.007 |
| a2 | | | 2.45 | | | 0.096 |
| b | 0.35 | | 0.49 | 0.013 | | 0.019 |
| b1 | 0.23 | | 0.32 | 0.009 | | 0.012 |
| C | | 0.50 | | | 0.020 | |
| c1 | 45 (typ.) | | | | | |
| D | 12.60 | | 13.00 | 0.496 | | 0.512 |
| E | 10.00 | | 10.65 | 0.393 | | 0.419 |
| e | | 1.27 | | | 0.050 | |
| e3 | | 11.43 | | | 0.450 | |
| F | 7.40 | | 7.60 | 0.291 | | 0.299 |
| L | 0.50 | | 1.27 | 0.19 | | 0.050 |
| M | | | 0.75 | | | 0.029 |
| S | 8 (max.) | | | | | |

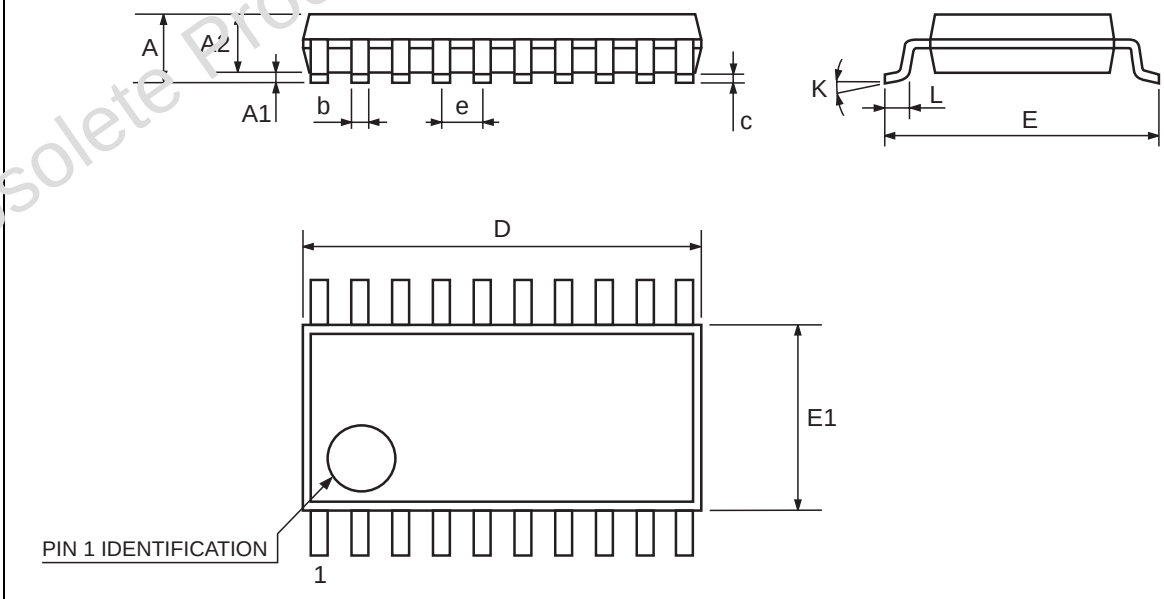



P013L

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## TSSOP20 MECHANICAL DATA

| DIM. | mm | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 1.1 | | | 0.433 |
| A1 | 0.05 | 0.10 | 0.15 | 0.002 | 0.004 | 0.006 |
| A2 | 0.85 | 0.9 | 0.95 | 0.335 | 0.354 | 0.374 |
| b | 0.19 | | 0.30 | 0.0075 | | 0.0118 |
| c | 0.09 | | 0.2 | 0.0035 | | 0.0079 |
| D | 6.4 | 6.5 | 6.6 | 0.252 | 0.256 | 0.260 |
| E | 6.25 | 6.4 | 6.5 | 0.246 | 0.252 | 0.256 |
| E1 | 4.3 | 4.4 | 4.48 | 0.169 | 0.173 | 0.176 |
| e | | 0.65 BSC | | | 0.0256 BSC | |
| K | $0^o$ | $4^o$ | $8^o$ | $0^o$ | $4^o$ | $8^o$ |
| L | 0.50 | 0.60 | 0.70 | 0.020 | 0.024 | 0.028 |




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