# M74HC173

## QUAD D-TYPE REGISTER  (3 STATE)

- HIGH SPEED:
  $f_{MAX}$ = 84MHz (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:
  $|I_{OH}|$ = $I_{OL}$ =6mA (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 173



DIP          SOP          TSSOP
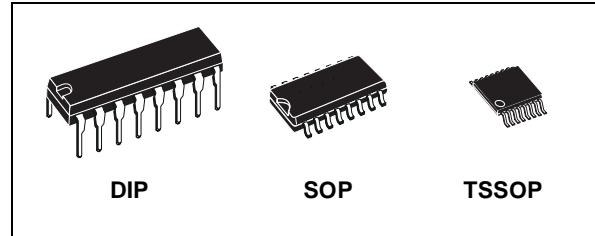
### ORDER CODES

| PACKAGE | TUBE | T & R |
|---------|------|-------|
| DIP | M74HC173B1R | |
| SOP | M74HC173M1R | M74HC173RM13TR |
| TSSOP | | M74HC173TTR |

### DESCRIPTION

The M74HC173 is an high speed CMOS QUAD D-TYPE REGISTER (3-STATE)  fabricated with silicon gate  $C^2MOS$ technology.

This device is composed of a four-bit register including D-TYPE flip-flops and 3-state buffers. The four flip-flops are controlled by a common clock input (CLOCK) and a common reset input (CLEAR). Signals applied to the data inputs ($D_1$ - $D_4$) are stored at the respective flip-flops on the positive going transition of the clock input, only

when both clock control inputs (G1 and G2) are held low.

The reset feature is asynchronous and active high. The stored data are provided on each output only when both output control inputs (M and N) are held low, otherwise the outputs go to the high-impedance state.

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

### PIN CONNECTION AND IEC LOGIC SYMBOLS
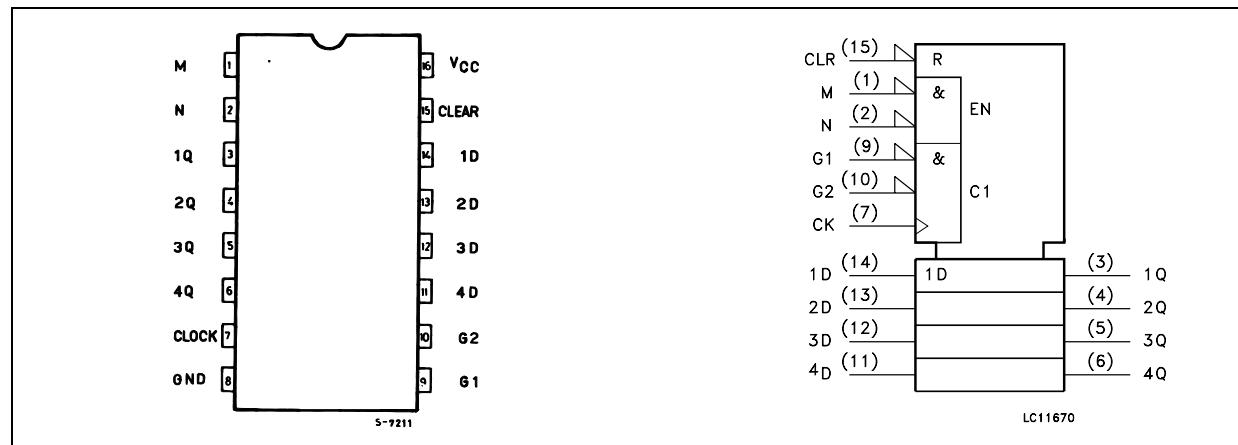
# M74HC173

## INPUT AND OUTPUT EQUIVALENT CIRCUIT



CS03580
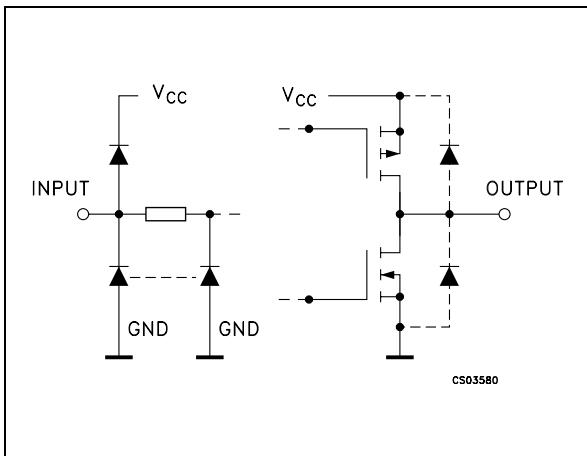
## PIN DESCRIPTION

| PIN No | SYMBOL | NAME AND FUNCTION |
|---|---|---|
| 1, 2 | M, N | Output Enable Input (Active Low) |
| 3, 4, 5, 6 | 1Q to 4Q | 3-State Flip-Flop Outputs |
| 7 | CLOCK | Clock Input (Low to HIGH, Edge-triggered) |
| 9, 10 | G1, G2 | Data Enable Inputs (Active Low) |
| 14, 13, 12, 11 | 1D to 4D | Data Inputs |
| 15 | CLEAR | Asynchronous Master Reset (Active High) |
| 8 | GND | Ground (0V) |
| 16 | V$_{CC}$ | Positive Supply Voltage |

## TRUTH TABLE

| CLEAR | CLOCK | DATA ENABLE | | Dn | OUTPUT CONTROL | | Qn |
|---|---|---|---|---|---|---|---|
| | | G1 | G2 | | M | N | |
| X | X | X | X | X | H | X | Z |
| X | X | X | X | X | X | H | Z |
| H | X | X | X | X | L | L | L |
| L | ⎍ | X | X | X | L | L | Q0 |
| L | ⎍ | H | X | X | L | L | Q0 |
| L | ⎍ | X | H | X | L | L | Q0 |
| L | ⎍ | L | L | H | L | L | H |
| L | ⎍ | L | L | L | L | L | L |

X : Don't Care
Z : High Impedance

## LOGIC DIAGRAM
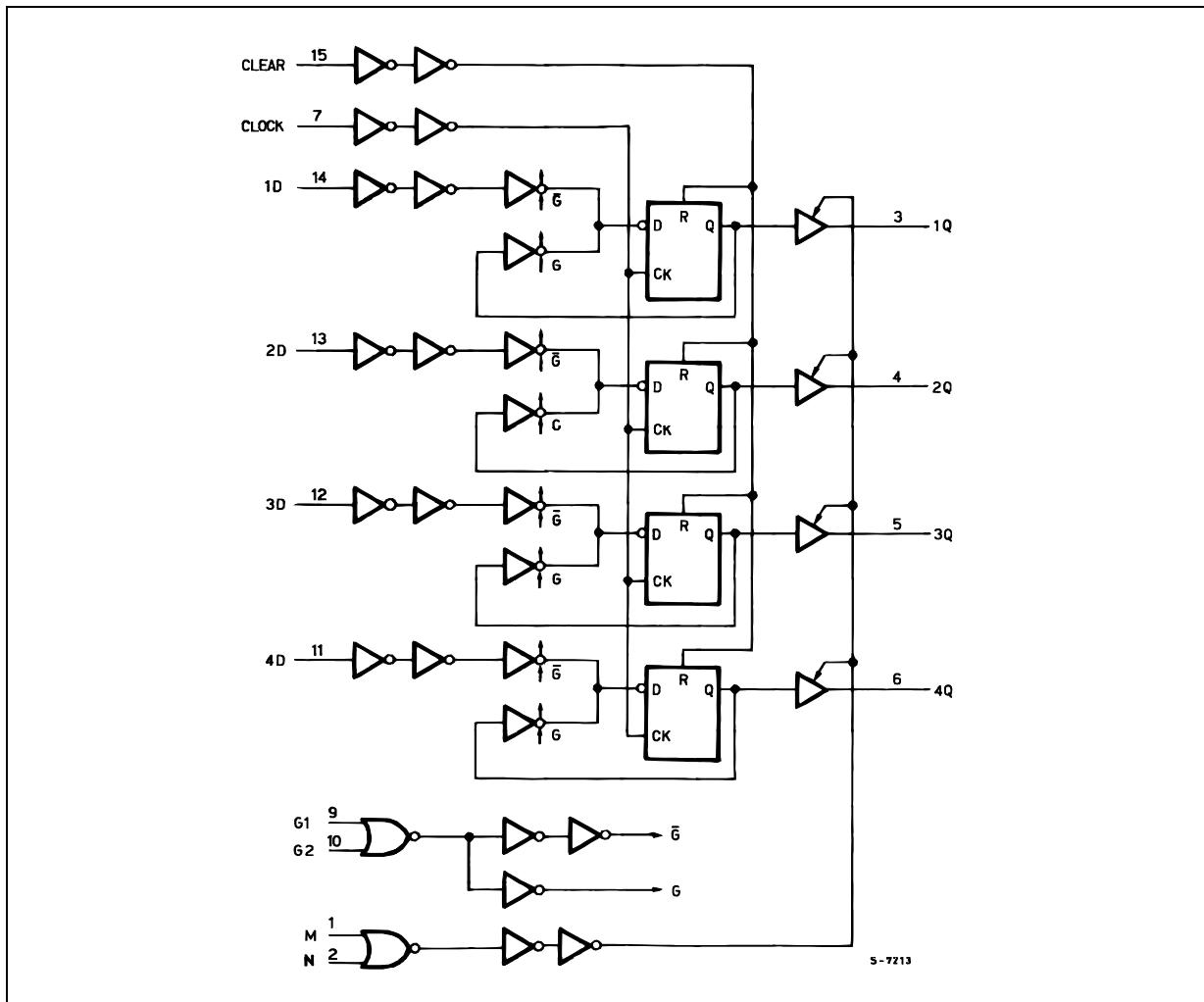


This logic diagram has not be used to estimate propagation delays

## 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 | ± 20 | mA |
| $I_{OK}$ | DC Output Diode Current | ± 20 | mA |
| $I_O$ | DC Output Current | ± 35 | mA |
| $I_{CC}$ or $I_{GND}$ | DC $V_{CC}$ or Ground Current | ± 70 | 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 |
| $I_{OZ}$ | High Impedance Output Leakage Current | 6.0 | $V_I$ = $V_{IH}$ or $V_{IL}$ $V_O$ = $V_{CC}$ or GND | | | ± 0.5 | | ± 5.0 | | ± 10 | μA |
| $I_{CC}$ | Quiescent Supply Current | 6.0 | $V_I$ = $V_{CC}$ or GND | | | 4 | | 40 | | 80 | μA |

## AC ELECTRICAL CHARACTERISTICS $(C_L = 50 \text{ pF, Input } t_r = t_f = 6ns)$

| Symbol | Parameter | Test Condition | | | Value | | | | | | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $V_{CC}$ (V) | $C_L$ (pF) | | $T_A = 25°C$ | | | -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 | 60 | | 75 | | 90 | ns |
| | | 4.5 | 50 | | | 7 | 12 | | 15 | | 18 | |
| | | 6.0 | | | | 6 | 10 | | 13 | | 15 | |
| $t_{PLH}\ t_{PHL}$ | Propagation Delay Time (CLOCK - Q) | 2.0 | | | | 50 | 115 | | 145 | | 175 | ns |
| | | 4.5 | 50 | | | 14 | 23 | | 29 | | 35 | |
| | | 6.0 | | | | 12 | 20 | | 25 | | 30 | |
| | | 2.0 | | | | 65 | 145 | | 180 | | 220 | ns |
| | | 4.5 | 150 | | | 18 | 29 | | 36 | | 44 | |
| | | 6.0 | | | | 15 | 25 | | 31 | | 37 | |
| $t_{PLH}\ t_{PHL}$ | Propagation Delay Time (CLEAR - Q) | 2.0 | | | | 50 | 115 | | 145 | | 175 | ns |
| | | 4.5 | 50 | | | 14 | 23 | | 29 | | 35 | |
| | | 6.0 | | | | 12 | 20 | | 25 | | 30 | |
| | | 2.0 | | | | 65 | 145 | | 180 | | 220 | ns |
| | | 4.5 | 150 | | | 18 | 29 | | 36 | | 44 | |
| | | 6.0 | | | | 15 | 25 | | 31 | | 37 | |
| $f_{MAX}$ | Maximum Clock Frequency | 2.0 | | | 8.6 | 20 | | 6.8 | | 5.8 | | MHz |
| | | 4.5 | 50 | | 43 | 67 | | 34 | | 29 | | |
| | | 6.0 | | | 51 | 84 | | 40 | | 34 | | |
| $t_{PZL}\ t_{PZH}$ | Output Enable Time | 2.0 | | | | 50 | 115 | | 145 | | 175 | ns |
| | | 4.5 | 50 | $R_L = 1\ K\Omega$ | | 14 | 23 | | 29 | | 35 | |
| | | 6.0 | | | | 12 | 20 | | 25 | | 30 | |
| | | 2.0 | | | | 65 | 145 | | 180 | | 220 | ns |
| | | 4.5 | 150 | $R_L = 1\ K\Omega$ | | 18 | 29 | | 36 | | 44 | |
| | | 6.0 | | | | 15 | 25 | | 31 | | 37 | |
| $t_{PLZ}\ t_{PHZ}$ | Output Disable Time | 2.0 | | | | 36 | 105 | | 130 | | 160 | ns |
| | | 4.5 | 50 | $R_L = 1\ K\Omega$ | | 15 | 21 | | 26 | | 32 | |
| | | 6.0 | | | | 13 | 18 | | 22 | | 27 | |
| $t_{W(H)}$ $t_{W(L)}$ | Minimum Pulse Width (CLOCK) | 2.0 | | | | 16 | 75 | | 95 | | 110 | ns |
| | | 4.5 | 50 | | | 4 | 15 | | 19 | | 22 | |
| | | 6.0 | | | | 3 | 13 | | 16 | | 19 | |
| $t_{W(L)}$ | Minimum Pulse Width (CLEAR) | 2.0 | | | | 16 | 75 | | 95 | | 110 | ns |
| | | 4.5 | 50 | | | 4 | 15 | | 19 | | 22 | |
| | | 6.0 | | | | 3 | 13 | | 16 | | 19 | |
| $t_s$ | Minimum Set-up Time (G1, G2) | 2.0 | | | | 40 | 100 | | 125 | | 150 | ns |
| | | 4.5 | 50 | | | 10 | 20 | | 25 | | 30 | |
| | | 6.0 | | | | 9 | 17 | | 21 | | 26 | |
| $t_s$ | Minimum Set-up Time (D) | 2.0 | | | | 24 | 75 | | 95 | | 110 | ns |
| | | 4.5 | 50 | | | 6 | 15 | | 19 | | 22 | |
| | | 6.0 | | | | 5 | 13 | | 16 | | 19 | |
| $t_h$ | Minimum Hold Time (G1 ,G2, D) | 2.0 | | | | | 0 | | 0 | | 0 | ns |
| | | 4.5 | 50 | | | | 0 | | 0 | | 0 | |
| | | 6.0 | | | | | 0 | | 0 | | 0 | |
| $t_{REM}$ | Minimum Removal Time | 2.0 | | | | | 5 | | 5 | | 5 | ns |
| | | 4.5 | 50 | | | | 5 | | 5 | | 5 | |
| | | 6.0 | | | | | 5 | | 5 | | 5 | |

## 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. $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/4$ (Per Circuit)

## TEST CIRCUIT
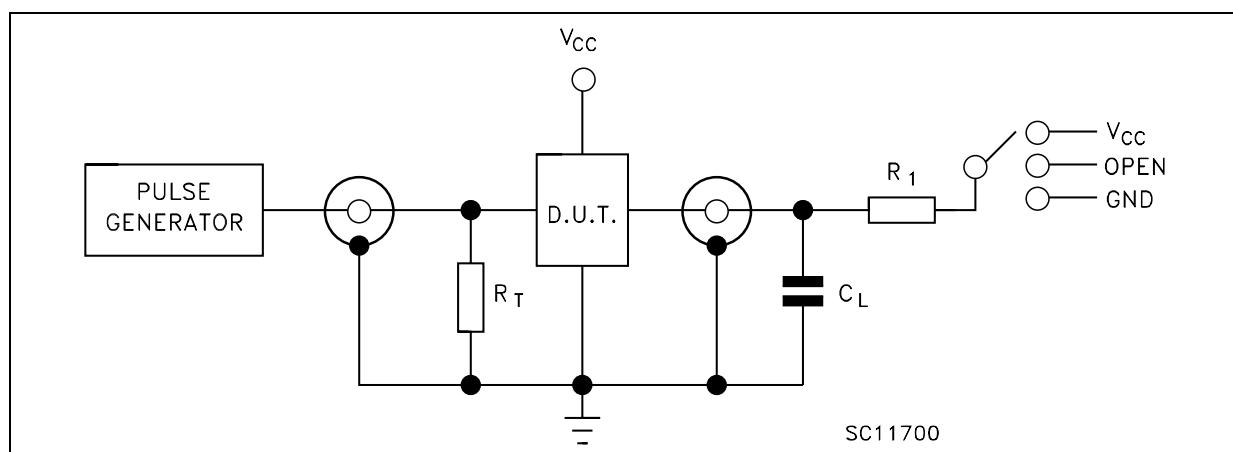


| TEST | SWITCH |
|---|---|
| $t_{PLH}$, $t_{PHL}$ | Open |
| $t_{PZL}$, $t_{PLZ}$ | $V_{CC}$ |
| $t_{PZH}$, $t_{PHZ}$ | GND |

$C_L$ = 50pF/150pF or equivalent (includes jig and probe capacitance)
$R_1$ = 1KΩ or equivalent
$R_T$ = $Z_{OUT}$ of pulse generator (typically 50Ω)

**WAVEFORM 1: PROPAGATION DELAY TIMES, MINIMUM PULSE WIDTH (CLOCK), SETUP AND HOLD TIME (Dn TO CLOCK)** (f=1MHz; 50% duty cycle)



S-10668        CLEAR = "H"
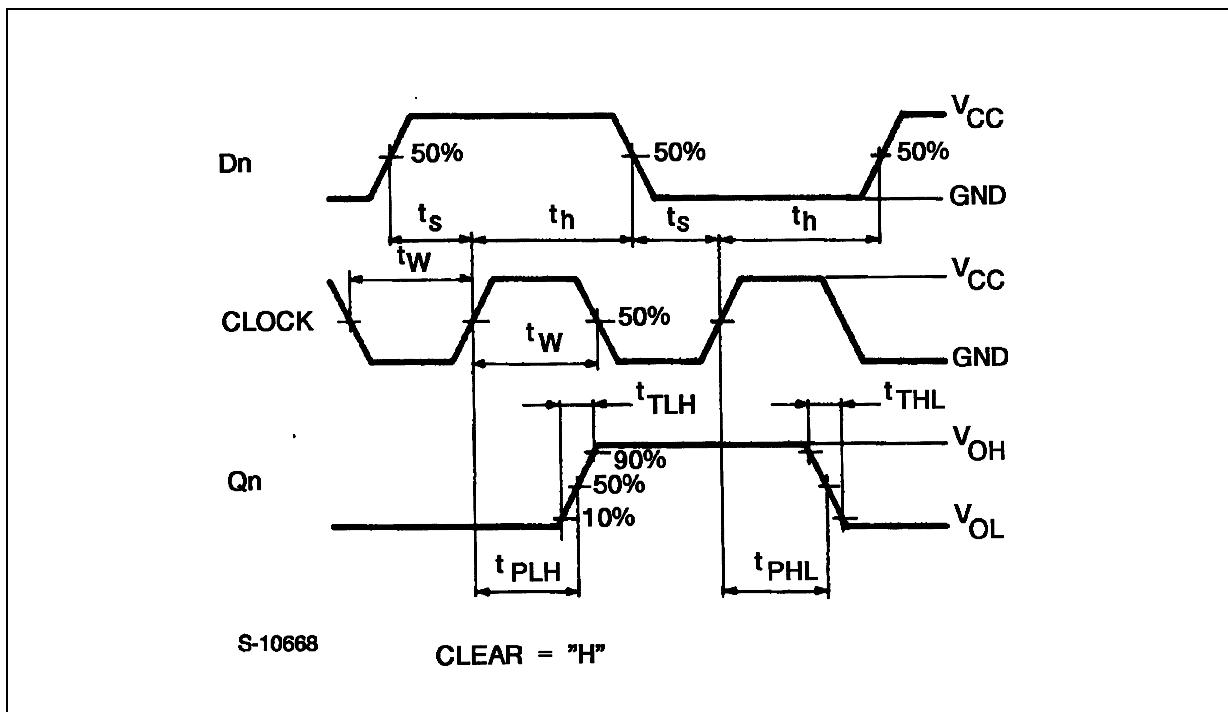
**WAVEFORM 2: MINIMUM PULSE WIDTH (CLEAR) AN DREMOVAL TIME (CLEAR TO CLOCK)**
(f=1MHz; 50% duty cycle)



S-10669
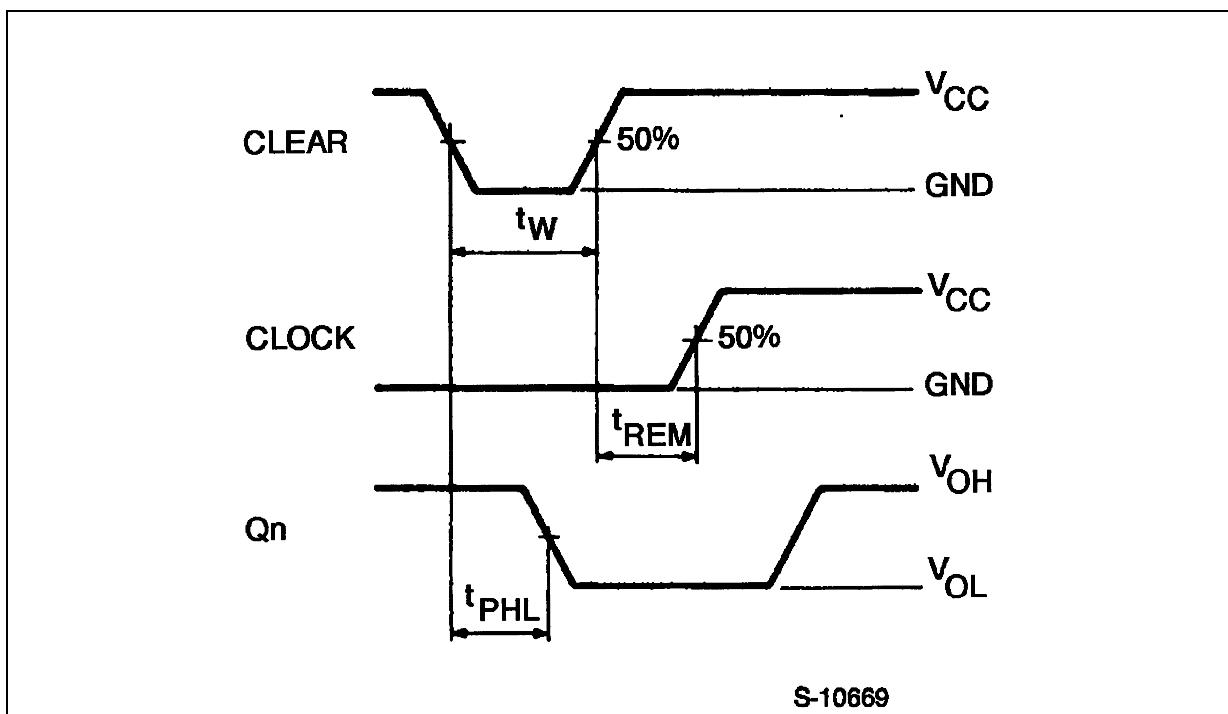
**WAVEFORM 3: OUTPUT ENABLE AND DISABLE TIME**(f=1MHz; 50% duty cycle)



S - 10314
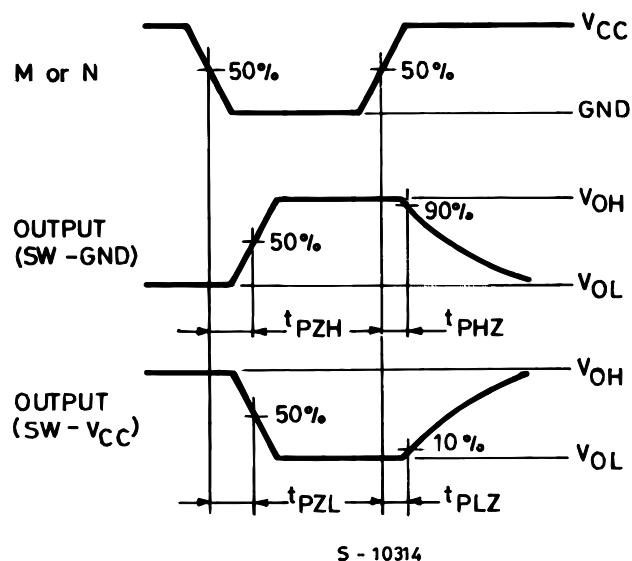
**WAVEFORM 4: INPUT WAVEFORMS**(f=1MHz; 50% duty cycle)



S-10313
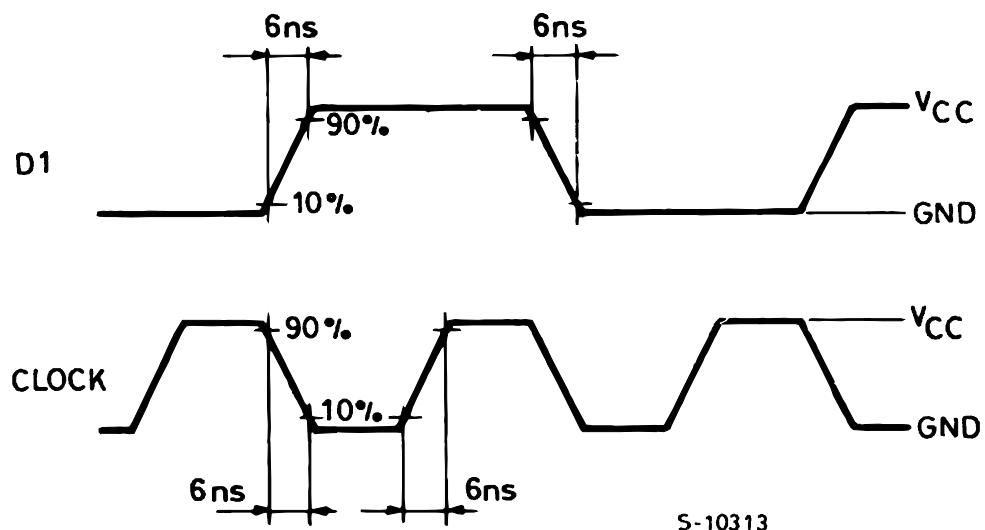
## Plastic DIP-16 (0.25) MECHANICAL DATA

| 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 |
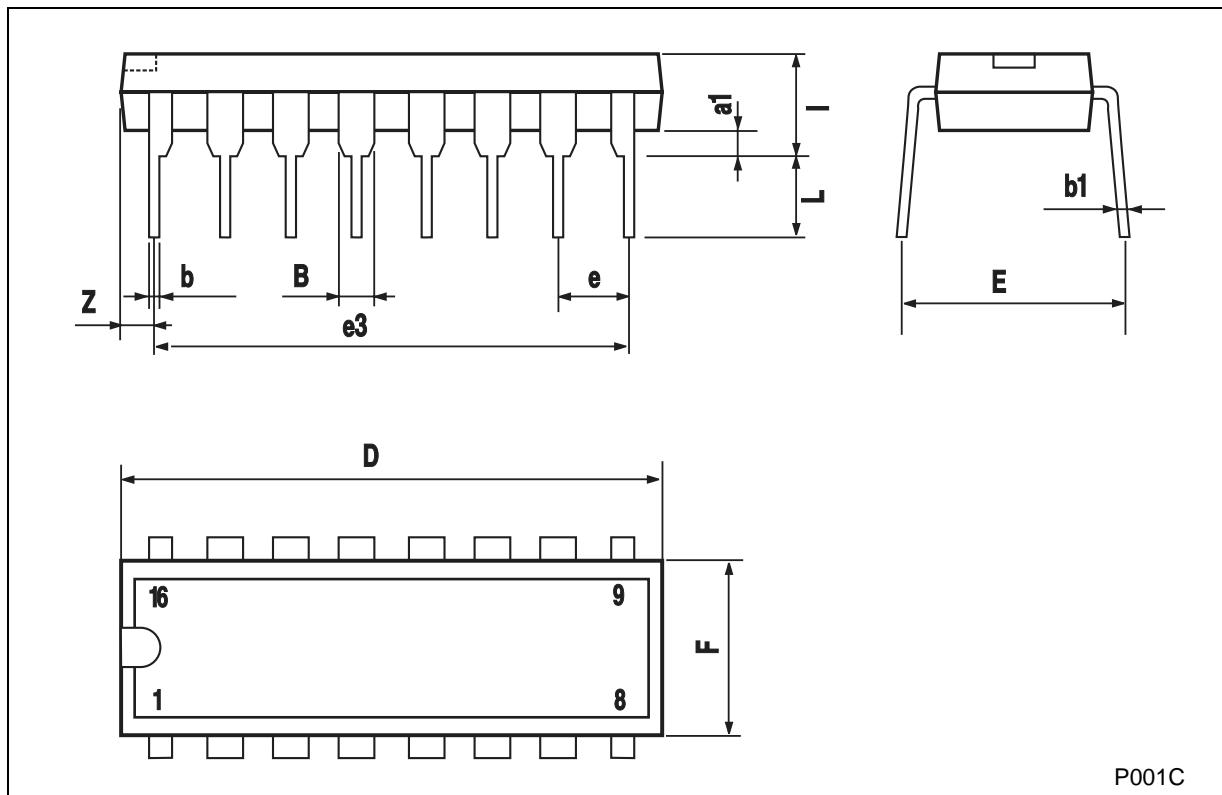


P001C

## 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.) | | | | | |
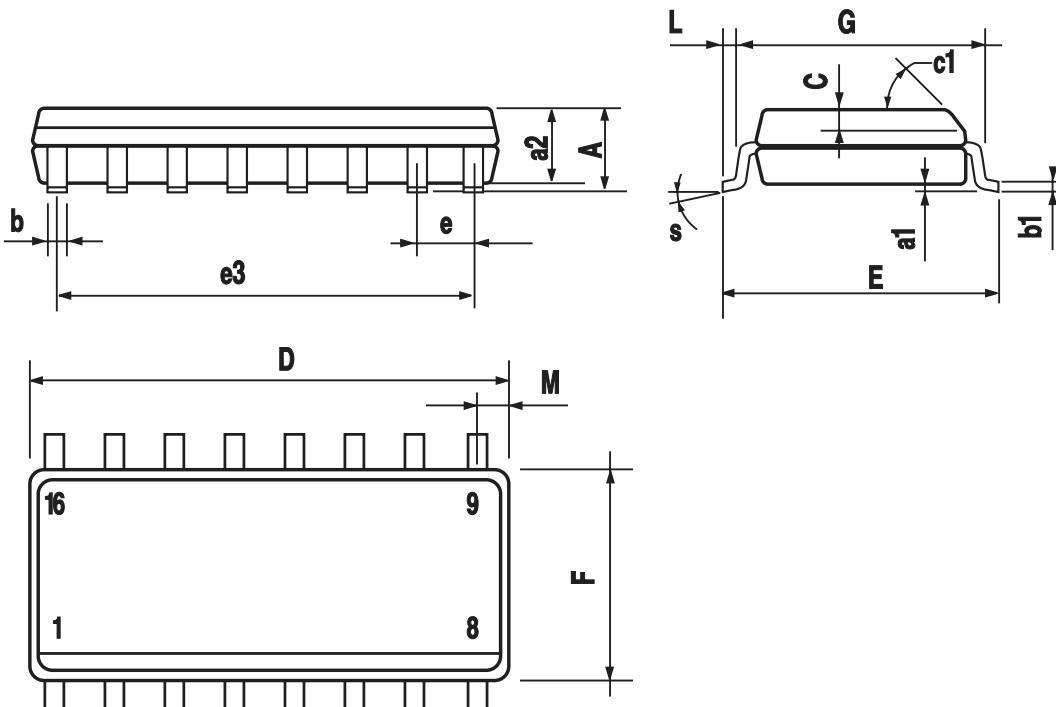
PO13H

# 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 |



PIN 1 IDENTIFICATION

0080338D