FAIRCHILD SEMICONDUCTOR®

March 1993
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# 74VHC573
# Octal D-Type Latch with 3-STATE Outputs

## General Description

The VHC573 is an advanced high speed CMOS octal latch with 3-STATE output fabricated with silicon gate CMOS technology. It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation. This 8-bit D-type latch is controlled by a latch enable input (LE) and an Output Enable input ($\overline{OE}$). When the $\overline{OE}$ input is HIGH, the eight outputs are in a high impedance state.

An input protection circuit ensures that 0V to 7V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5V to 3V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input voltages.

## Features

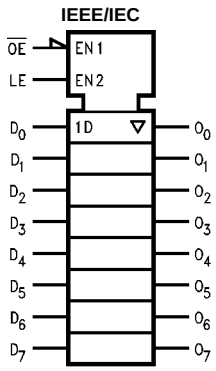
- High Speed: $t_{PD}$ = 5.0 ns (typ) at $V_{CC}$ = 5V
- High Noise Immunity: $V_{NIH} = V_{NIL}$ = 28% $V_{CC}$ (Min)
- Power Down Protection is provided on all inputs
- Low Noise: $V_{OLP}$ = 0.6V (typ)
- Low Power Dissipation: $I_{CC}$ = 4 μA (Max) @ $T_A$ = 25°C
- Pin and function compatible with 74HC573

## Ordering Code:

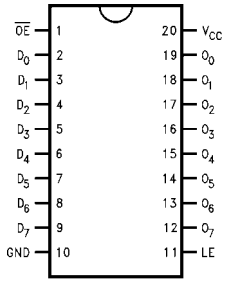
| Order Number | Package Number | Package Description |
|---|---|---|
| 74VHC573M | M20B | 20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide |
| 74VHC573SJ | M20D | Pb-Free 20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide |
| 74VHC573MTC | MTC20 | 20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide |
| 74VHC573N | N20A | 20-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide |

Surface mount packages are also available on Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.
Pb-Free package per JEDEC J-STD-020B.

## Logic Symbol




## Connection Diagram




## Pin Descriptions

| Pin Names | Description |
|---|---|
| $D_0$–$D_7$ | Data Inputs |
| LE | Latch Enable Input |
| $\overline{OE}$ | 3-STATE Output Enable Input |
| $O_0$–$O_7$ | 3-STATE Outputs |

## Functional Description

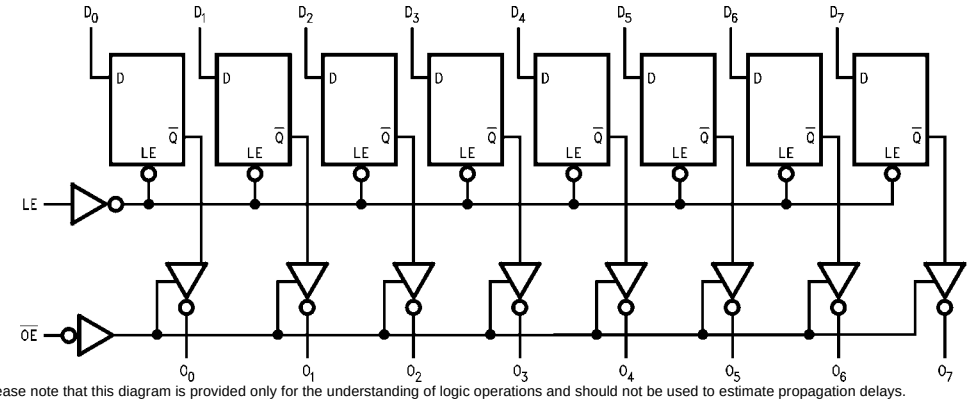
The VHC573 contains eight D-type latches with 3-STATE output buffers. When the Latch Enable (LE) input is HIGH, data on the $D_n$ inputs enters the latches. In this condition the latches are transparent, i.e., a latch output will change state each time its D input changes. When LE is LOW the latches store the information that was present on the D inputs, a setup time preceding the HIGH-to-LOW transition of LE. The 3-STATE buffers are controlled by the Output Enable ($\overline{OE}$) input. When $\overline{OE}$ is LOW, the buffers are enabled. When $\overline{OE}$ is HIGH the buffers are in the high impedance mode, but, this does not interfere with entering new data into the latches.

## Truth Table

| Inputs | | | Outputs |
|---|---|---|---|
| $\overline{OE}$ | LE | D | $O_n$ |
| L | H | H | H |
| L | H | L | L |
| L | L | X | $O_0$ |
| H | X | X | Z |

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial
Z = High Impedance

## Logic Diagram




Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

## Absolute Maximum Ratings (Note 1)

| | |
|---|---|
| Supply Voltage ($V_{CC}$) | −0.5V to +7.0V |
| DC Input Voltage ($V_{IN}$) | −0.5V to +7.0V |
| DC Output Voltage ($V_{OUT}$) | −0.5V to $V_{CC}$ +0.5V |
| Input Diode Current ($I_{IK}$) | −20 mA |
| Output Diode Current | ±20 mA |
| DC Output Current ($I_{OUT}$) | ±25 mA |
| DC $V_{CC}$/GND Current ($I_{CC}$) | ±75 mA |
| Storage Temperature ($T_{STG}$) | −65°C to +150°C |
| Lead Temperature ($T_L$) | |
| (Soldering, 10 seconds) | 260°C |

## Recommended Operating Conditions (Note 2)

| | |
|---|---|
| Supply Voltage ($V_{CC}$) | 2.0V to +5.5V |
| Input Voltage ($V_{IN}$) | 0V to +5.5V |
| Output Voltage ($V_{OUT}$) | 0V to $V_{CC}$ |
| Operating Temperature ($T_{OPR}$) | −40°C to +85°C |
| Input Rise and Fall Time ($t_r$, $t_f$) | |
| $V_{CC}$ = 3.3V ± 0.3V | 0 ~ 100 ns/V |
| $V_{CC}$ = 5.0V ± 0.5V | 0 ~ 20 ns/V |

**Note 1:** Absolute Maximum Ratings are values beyond which the device may be damaged or have its useful life impaired. The databook specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables. Fairchild does not recommend operation outside databook specifications.

**Note 2:** Unused inputs must be held HIGH or LOW They may not float.

## DC Electrical Characteristics

| Symbol | Parameter | $V_{CC}$ (V) | $T_A$ = 25°C | | | $T_A$ = −40°C to +85°C | | Units | Conditions | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | Min | Max | | | |
| $V_{IH}$ | HIGH Level Input | 2.0 | 1.50 | | | 1.50 | | V | | |
| | Voltage | 3.0 – 5.5 | 0.7 $V_{CC}$ | | | 0.7 $V_{CC}$ | | | | |
| $V_{IL}$ | LOW Level Input | 2.0 | | | 0.50 | | 0.50 | V | | |
| | Voltage | 3.0 – 5.5 | | | 0.3 $V_{CC}$ | | 0.3 $V_{CC}$ | | | |
| $V_{OH}$ | HIGH Level Output | 2.0 | 1.9 | 2.0 | | 1.9 | | V | $V_{IN}$ = $V_{IH}$ | |
| | Voltage | 3.0 | 2.9 | 3.0 | | 2.9 | | | or $V_{IL}$ | $I_{OH}$ = −50 μA |
| | | 4.5 | 4.4 | 4.5 | | 4.4 | | | | |
| | | 3.0 | 2.58 | | | 2.48 | | V | | $I_{OH}$ = −4 mA |
| | | 4.5 | 3.94 | | | 3.80 | | | | $I_{OH}$ = −8 mA |
| $V_{OL}$ | LOW Level Output | 2.0 | | 0.0 | 0.1 | | 0.1 | V | $V_{IN}$ = $V_{IH}$ | |
| | Voltage | 3.0 | | 0.0 | 0.1 | | 0.1 | | or $V_{IL}$ | $I_{OL}$ = 50 μA |
| | | 4.5 | | 0.0 | 0.1 | | 0.1 | | | |
| | | 3.0 | | | 0.36 | | 0.44 | V | | $I_{OL}$ = 4 mA |
| | | 4.5 | | | 0.36 | | 0.44 | | | $I_{OL}$ = 8 mA |
| $I_{OZ}$ | 3-STATE Output | 5.5 | | | ±0.25 | | ±2.5 | μA | $V_{IN}$ = $V_{IH}$ or $V_{IL}$ | |
| | Off-State Current | | | | | | | | $V_{OUT}$ = $V_{CC}$ or GND | |
| $I_{IN}$ | Input Leakage Current | 0 – 5.5 | | | ±0.1 | | ±1.0 | μA | $V_{IN}$ = 5.5V or GND | |
| $I_{CC}$ | Quiescent Supply Current | 5.5 | | | 4.0 | | 40.0 | μA | $V_{IN}$ = $V_{CC}$ or GND | |

## Noise Characteristics

| Symbol | Parameter | $V_{CC}$ (V) | $T_A$ = 25°C | | Units | Conditions |
|---|---|---|---|---|---|---|
| | | | Typ | Limits | | |
| $V_{OLP}$ (Note 3) | Quiet Output Maximum Dynamic $V_{OL}$ | 5.0 | 0.9 | 1.2 | V | $C_L$ = 50 pF |
| $V_{OLV}$ (Note 3) | Quiet Output Minimum Dynamic $V_{OL}$ | 5.0 | −0.8 | −1.0 | V | $C_L$ = 50 pF |
| $V_{IHD}$ (Note 3) | Minimum HIGH Level Dynamic Input Voltage | 5.0 | | 3.5 | V | $C_L$ = 50 pF |
| $V_{ILD}$ (Note 3) | Maximum LOW Level Dynamic Input Voltage | 5.0 | | 1.5 | V | $C_L$ = 50 pF |

**Note 3:** Parameter guaranteed by design.

## AC Electrical Characteristics

| Symbol | Parameter | $V_{CC}$ (V) | $T_A = 25°C$ | | | $T_A = -40°C$ to $+85°C$ | | Units | Conditions | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | Min | Max | | | |
| $t_{PLH}$ | Propagation Delay | 3.3 ± 0.3 | | 7.6 | 11.9 | 1.0 | 14.0 | ns | | $C_L$ = 15 pF |
| $t_{PHL}$ | Time (LE to $O_n$) | | | 10.1 | 15.4 | 1.0 | 17.5 | | | $C_L$ = 50 pF |
| | | 5.0 ± 0.5 | | 5.0 | 7.7 | 1.0 | 9.0 | ns | | $C_L$ = 15 pF |
| | | | | 6.5 | 9.7 | 1.0 | 11.0 | | | $C_L$ = 50 pF |
| $t_{PLH}$ | Propagation Delay | 3.3 ± 0.3 | | 7.0 | 11.0 | 1.0 | 13.0 | | | $C_L$ = 15 pF |
| $t_{PHL}$ | Time ($D–O_n$) | | | 9.5 | 14.5 | 1.0 | 16.5 | ns | | $C_L$ = 50 pF |
| | | 5.0 ± 0.5 | | 4.5 | 6.8 | 1.0 | 8.0 | | | $C_L$ = 15 pF |
| | | | | 6.0 | 8.8 | 1.0 | 10.0 | | | $C_L$ = 50 pF |
| $t_{PZL}$ | 3-STATE Output | 3.3 ± 0.3 | | 7.3 | 11.5 | 1.0 | 13.5 | ns | $R_L$ = 1 kΩ | $C_L$ = 15 pF |
| $t_{PZH}$ | Enable Time | | | 9.8 | 15.0 | 1.0 | 17.0 | | | $C_L$ = 50 pF |
| | | 5.0 ± 0.5 | | 5.2 | 7.7 | 1.0 | 9.0 | ns | | $C_L$ = 15 pF |
| | | | | 6.7 | 9.7 | 1.0 | 11.0 | | | $C_L$ = 50 pF |
| $t_{PLZ}$ | 3-STATE Output | 3.3 ± 0.3 | | 10.7 | 14.5 | 1.0 | 16.5 | ns | $R_L$ = 1 kΩ | $C_L$ = 50 pF |
| $t_{PHZ}$ | Disable Time | 5.0 ± 0.5 | | 6.7 | 9.7 | 1.0 | 11.0 | | | $C_L$ = 50 pF |
| $t_{OSLH}$ | Output to Output Skew | 3.3 ± 0.3 | | | 1.5 | | 1.5 | ns | (Note 4) | $C_L$ = 50 pF |
| $t_{OSHL}$ | | 5.0 ± 0.5 | | | 1.0 | | 1.0 | | | $C_L$ = 50 pF |
| $C_{IN}$ | Input Capacitance | | | 4 | 10 | | 10 | pF | $V_{CC}$ = Open | |
| $C_{OUT}$ | Output Capacitance | | | 6 | | | | pF | $V_{CC}$ = 5.0V | |
| $C_{PD}$ | Power Dissipation Capacitance | | | 29 | | | | pF | (Note 5) | |

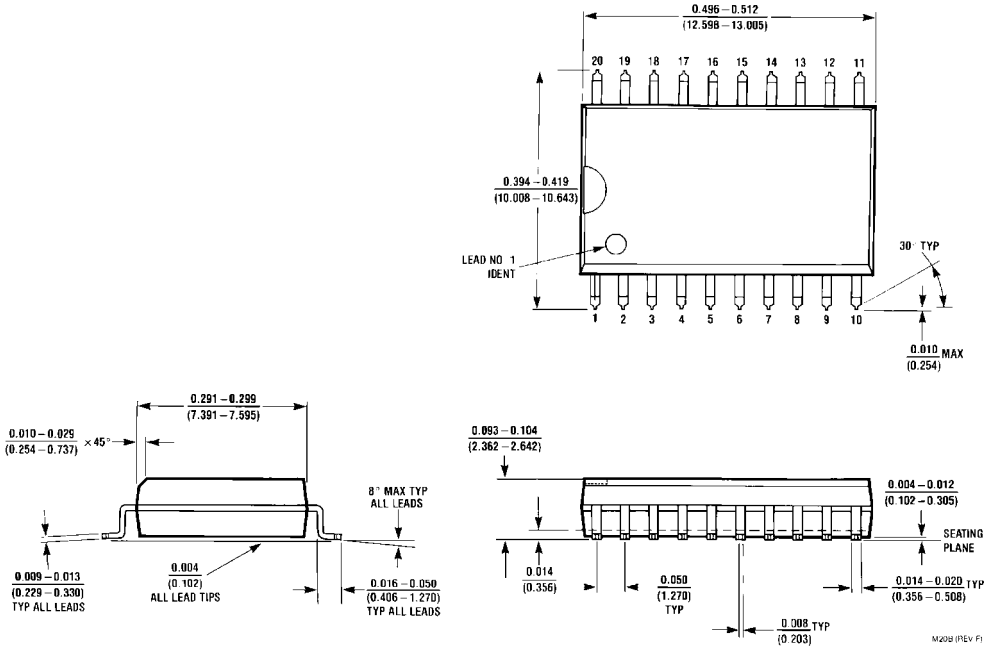
**Note 4:** Parameter guaranteed by design. $t_{OSLH} = |t_{PLH\ max} - t_{PLH\ min}|$; $t_{OSHL} = |t_{PHL\ max} - t_{PHL\ min}|$

**Note 5:** $C_{PD}$ is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation: $I_{CC}$ (opr.) = $C_{PD} * V_{CC} * f_{IN} + I_{CC}/8$ (per Latch). The total $C_{PD}$ when n pcs. of the Latch operates can be calculated by the equation: $C_{PD}$(total) = 21 + 8n.

## AC Operating Requirements

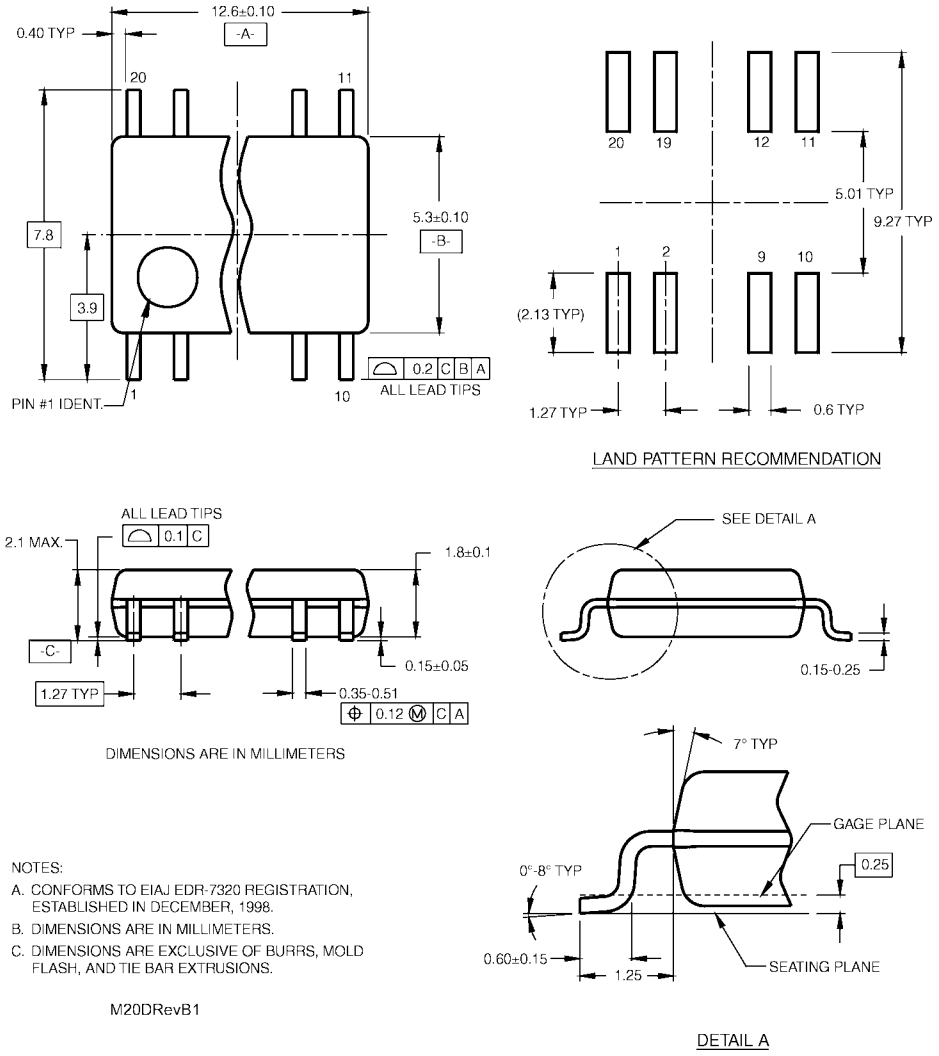
| Symbol | Parameter | $V_{CC}$ (V) | $T_A = 25°C$ | | | $T_A = -40°C$ to $+85°C$ | | Units |
|---|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | Min | Max | |
| $t_w$(H) | Minimum Pulse | 3.3 ± 0.3 | 5.0 | | | 5.0 | | ns |
| $t_w$(L) | Width (LE) | 5.0 ± 0.5 | 5.0 | | | 5.0 | | |
| $t_S$ | Minimum Setup Time | 3.3 ± 0.3 | 3.5 | | | 3.5 | | ns |
| | | 5.0 ± 0.5 | 3.5 | | | 3.5 | | |
| $t_H$ | Minimum Hold Time | 3.3 ± 0.3 | 1.5 | | | 1.5 | | ns |
| | | 5.0 ± 0.5 | 1.5 | | | 1.5 | | |

## Physical Dimensions inches (millimeters) unless otherwise noted




**20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide**
**Package Number M20B**

## Physical Dimensions inches (millimeters) unless otherwise noted (Continued)




NOTES:

A. CONFORMS TO EIAJ EDR-7320 REGISTRATION, ESTABLISHED IN DECEMBER, 1998.

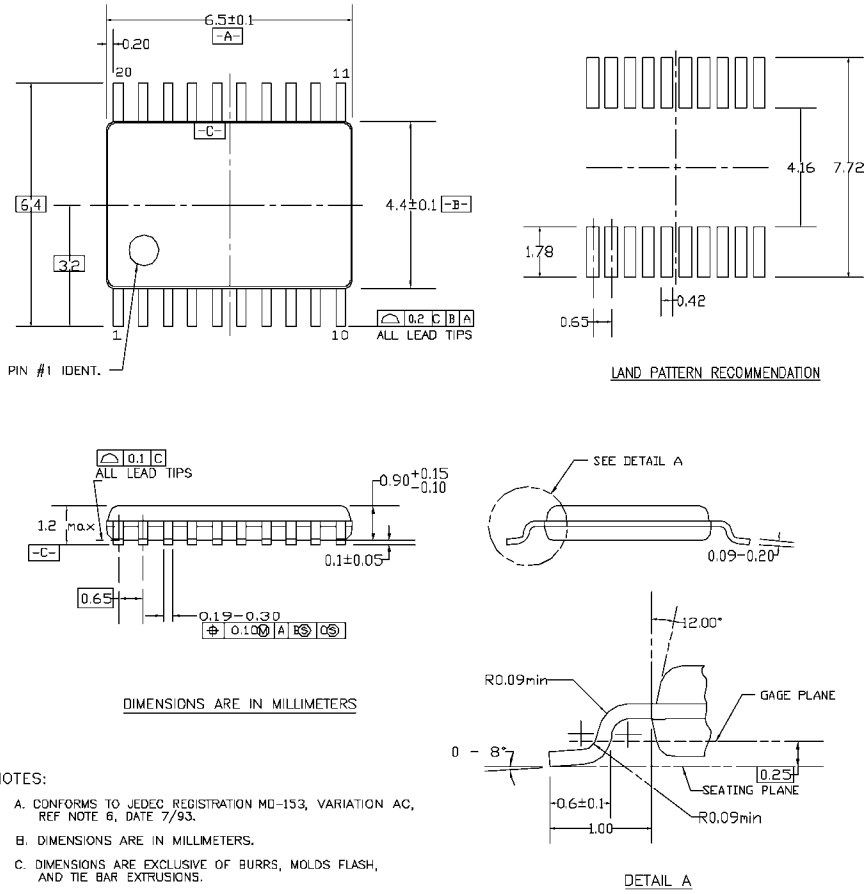
B. DIMENSIONS ARE IN MILLIMETERS.

C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

M20DRevB1

**Pb-Free 20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide**
**Package Number M20D**

## Physical Dimensions inches (millimeters) unless otherwise noted (Continued)




NOTES:

A. CONFORMS TO JEDEC REGISTRATION MO-153, VARIATION AC, REF NOTE 6, DATE 7/93.

B. DIMENSIONS ARE IN MILLIMETERS.

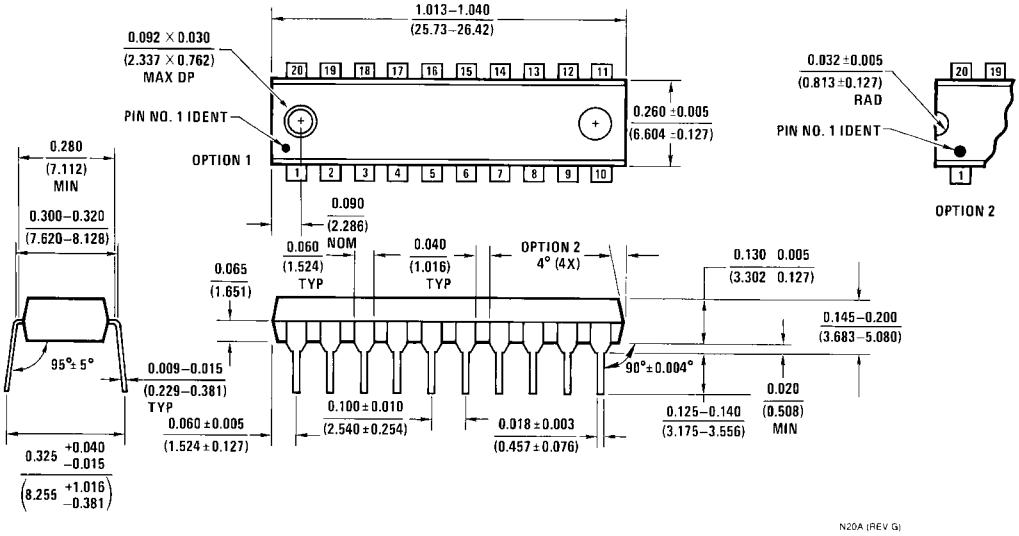
C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLDS FLASH, AND TIE BAR EXTRUSIONS.

D. DIMENSIONS AND TOLERANCES PER ANSI Y14.5M, 1982.

MTC20REVD1

**20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide**
**Package Number MTC20**

## Physical Dimensions inches (millimeters) unless otherwise noted (Continued)




**20-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide**
**Package Number N20A**