



July 1997  
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## 74VHCT374A Octal D-Type Flip-Flop with 3-STATE Outputs

### General Description

The VHCT374A is an advanced high speed CMOS octal flip-flop 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 flip-flop is controlled by a clock input (CP) and an output enable input (OE). When the OE input is HIGH, the eight outputs are in a high impedance state.

Protection circuits ensure that 0V to 7V can be applied to the input and output (Note 1) pins without regard to the supply voltage. This device can be used to interface 3V to 5V systems and two supply systems such as battery back

up. This circuit prevents device destruction due to mismatched supply and input voltages.

**Note 1:** Outputs in OFF-State.

### Features

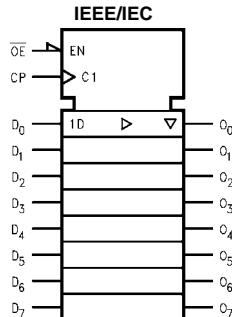
- High speed:  $f_{MAX} = 140$  MHz (typ) at  $T_A = 25^\circ C$
- High noise immunity:  $V_{IH} = 2.0V$ ,  $V_{IL} = 0.8V$
- Power down protection is provided on all inputs and outputs
- Low power dissipation:  
 $I_{CC} = 4 \mu A$  (max) @  $T_A = 25^\circ C$
- Pin and function compatible with 74HCT374

### Ordering Code:

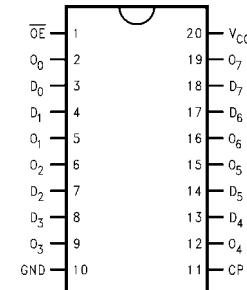
| Order Number  | Package Number | Package Description   |
|---------------|----------------|---|
| 74VHCT374AM   | M20B           | 20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300 Wide   |
| 74VHCT374ASJ  | M20D           | 20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide               |
| 74VHCT374AMTC | MTC20          | 20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide |
| 74VHCT374AN   | 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.

### Logic Symbol



### Connection Diagram



### Pin Descriptions

| Pin Names       | Description                 |
|-----------------|-----------------------------|
| $D_0-D_7$       | Data Inputs                 |
| CP              | Clock Pulse Input 3-STATE   |
| $\overline{OE}$ | Output Enable Input 3-STATE |
| $O_0-O_7$       | Outputs                     |

## 74VHCT374A

### Functional Description

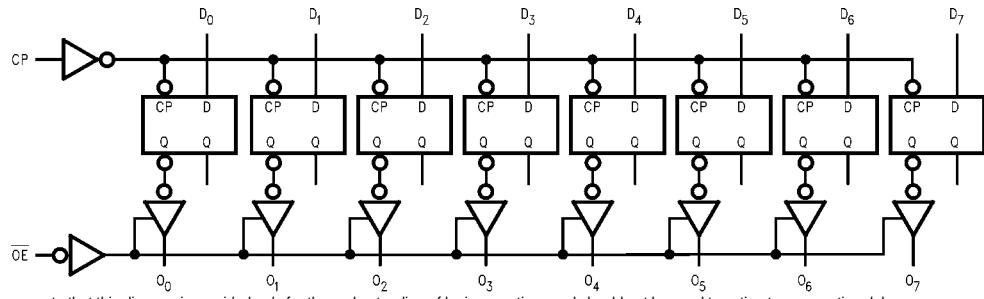
The VHCT374A consists of eight edge-triggered flip-flops with individual D-type inputs and 3-STATE true outputs. The buffered clock and buffered Output Enable are common to all flip-flops. The eight flip-flops will store the state of their individual D inputs that meet the setup and hold time requirements on the LOW-to-HIGH Clock (CP) transition. With the Output Enable ( $\overline{OE}$ ) LOW, the contents of the eight flip-flops are available at the outputs. When the  $\overline{OE}$  is HIGH, the outputs go to the high impedance state. Operation of the  $\overline{OE}$  input does not affect the state of the flip-flops.

### Truth Table

| Inputs |    |                 | Outputs |
|--------|----|-----------------|---------|
| $D_n$  | CP | $\overline{OE}$ | $O_n$   |
| H      | —  | L               | H       |
| L      | —  | L               | L       |
| X      | X  | H               | Z       |

H = HIGH Voltage Level  
 L = LOW Voltage Level  
 X = Immaterial  
 Z = High Impedance  
 — = LOW-to-HIGH Transition

### 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 2)              |   |                          | Recommended Operating Conditions (Note 6)  |             |                  |               |  |
|--|---|--------------------------|--|-------------|------------------|---------------|--|
| Supply Voltage ( $V_{CC}$ )                    |   | -0.5V to +7.0V           | Supply Voltage ( $V_{CC}$ )  |             | 4.5V to +5.5V    |               |  |
| DC Input Voltage ( $V_{IN}$ )                  |   | -0.5V to +7.0V           | Input Voltage ( $V_{IN}$ )   |             | 0V to +5.5V      |               |  |
| DC Output Voltage ( $V_{OUT}$ )                |   |                          | Output Voltage ( $V_{OUT}$ )   |             |                  |               |  |
| (Note 3)                                       |   | -0.5V to $V_{CC}$ + 0.5V | (Note 3)   |             |                  |               |  |
| (Note 4)                                       |   | -0.5V to +7.0V           | (Note 4)   |             | 0V to $V_{CC}$   |               |  |
| Input Diode Current ( $I_{IK}$ )               |   | -20 mA                   | Operating Temperature ( $T_{OPR}$ )  |             | 0V to 5.5V       |               |  |
| Output Diode Current ( $I_{OK}$ )              |   | $\pm 20$ mA              | Input Rise and Fall Time ( $t_r, t_f$ )  |             | -40°C to +85°C   |               |  |
| (Note 5)                                       |   | $\pm 20$ mA              | $V_{CC} = 5.0V \pm 0.5V$   |             | 0 ns/V ~ 20 ns/V |               |  |
| DC Output Current ( $I_{OUT}$ )                |   | $\pm 25$ mA              | <b>Note 2:</b> 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. |             |                  |               |  |
| DC $V_{CC}$ /GND Current ( $I_{CC}$ )          |   | $\pm 75$ mA              | <b>Note 3:</b> HIGH or LOW state. $I_{OUT}$ absolute maximum rating must be observed.  |             |                  |               |  |
| Storage Temperature ( $T_{STG}$ )              |   | -65°C to +150°C          | <b>Note 4:</b> When outputs are in OFF-State or when $V_{CC} = 0V$ .   |             |                  |               |  |
| Lead Temperature ( $T_L$ )                     |   |                          | <b>Note 5:</b> $V_{OUT} < GND$ , $V_{OUT} > V_{CC}$ (Outputs Active).  |             |                  |               |  |
| (Soldering, 10 seconds)                        |   | 260°C                    | <b>Note 6:</b> Unused inputs must be held HIGH or LOW. They may not float.   |             |                  |               |  |
| DC Electrical Characteristics                  |   |                          |  |             |                  |               |  |
| Symbol   | Parameter                                 | $V_{CC}$ (V)             | $T_A = 25^\circ C$   |             | Units            | Conditions    |  |
|  |   |                          | Min  | Typ         |                  |               | Max  |
| $V_{IH}$                                       | HIGH Level Input Voltage                  | 4.5<br>5.5               | 2.0<br>2.0   |             | 2.0<br>2.0       | V             |  |
| $V_{IL}$                                       | LOW Level Input Voltage                   | 4.5<br>5.5               |  | 0.8<br>0.8  | 0.8<br>0.8       | V             |  |
| $V_{OH}$                                       | HIGH Level Output Voltage                 | 4.5                      | 4.40<br>3.94   | 4.50        | 4.40<br>3.80     | V             | $V_{IN} = V_{IH}$ or $V_{IL}$ $I_{OH} = -50 \mu A$<br>$I_{OH} = -8 mA$ |
| $V_{OL}$                                       | LOW Level Output Voltage                  | 4.5                      |  | 0.0<br>0.36 | 0.1<br>0.44      | V             | $V_{IN} = V_{IH}$ or $V_{IL}$ $I_{OL} = +50 \mu A$<br>$I_{OL} = +8 mA$ |
| $I_{OZ}$                                       | 3-STATE Output OFF-State Current          | 5.5                      |  | $\pm 0.25$  | $\pm 2.5$        | $\mu A$       | $V_{IN} = V_{IH}$ or $V_{IL}$<br>$V_{OUT} = V_{CC}$ or GND             |
| $I_{IN}$                                       | Input Leakage Current                     | 0-5.5                    |  | $\pm 0.1$   | $\pm 1.0$        | $\mu A$       | $V_{IN} = 5.5V$ or GND   |
| $I_{CC}$                                       | Quiescent Supply Current                  | 5.5                      |  | 4.0         | 40.0             | $\mu A$       | $V_{IN} = V_{CC}$ or GND   |
| $I_{CCT}$                                      | Maximum $I_{CC}$ /Input                   | 5.5                      |  | 1.35        | 1.50             | mA            | $V_{IN} = 3.4V$<br>Other Inputs = $V_{CC}$ or GND                      |
| $I_{OFF}$                                      | Output Leakage Current (Power Down State) | 0.0                      |  | 0.5         | 5.0              | $\mu A$       | $V_{OUT} = 5.5V$   |
| Noise Characteristics                          |   |                          |  |             |                  |               |  |
| Symbol   | Parameter                                 | $V_{CC}$ (V)             | $T_A = 25^\circ C$   |             | Units            | Conditions    |  |
|  |   |                          | Typ  | Limits      |                  |               |  |
| $V_{OLP}$ (Note 7)                             | Quiet Output Maximum Dynamic $V_{OL}$     | 5.0                      | 1.2  | 1.6         | V                | $C_L = 50 pF$ |  |
| $V_{OLV}$ (Note 7)                             | Quiet Output Minimum Dynamic $V_{OL}$     | 5.0                      | -1.2   | -1.6        | V                | $C_L = 50 pF$ |  |
| $V_{IHD}$ (Note 7)                             | Minimum HIGH Level Dynamic Input Voltage  | 5.0                      |  | 2.0         | V                | $C_L = 50 pF$ |  |
| $V_{ILD}$ (Note 7)                             | Maximum LOW Level Dynamic Input Voltage   | 5.0                      |  | 0.8         | V                | $C_L = 50 pF$ |  |
| <b>Note 7:</b> Parameter guaranteed by design. |   |                          |  |             |                  |               |  |

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### AC Electrical Characteristics

| Symbol            | Parameter                     | V <sub>CC</sub> (V) | T <sub>A</sub> = 25°C |     |      | T <sub>A</sub> = -40°C to +85°C |      | Units    | Conditions  |
|-------------------|-------------------------------|---------------------|-----------------------|-----|------|---------------------------------|------|----------|---|
|                   |                               |                     | Min                   | Typ | Max  | Min                             | Max  |          |   |
| t <sub>PLH</sub>  | Propagation Delay Time        | 5.0 ± 0.5           |                       | 4.1 | 9.4  | 1.0                             | 10.5 | ns       | C <sub>L</sub> = 15 pF<br>C <sub>L</sub> = 50 pF                          |
| t <sub>PHL</sub>  |                               |                     |                       | 5.6 | 10.4 | 1.0                             | 11.5 |          |   |
| t <sub>PZL</sub>  | 3-STATE Output Enable Time    | 5.0 ± 0.5           |                       | 6.5 | 10.2 | 1.0                             | 11.5 | ns       | R <sub>L</sub> = 1 kΩ<br>C <sub>L</sub> = 15 pF<br>C <sub>L</sub> = 50 pF |
| t <sub>PZH</sub>  |                               |                     |                       | 7.3 | 11.2 | 1.0                             | 12.5 |          |   |
| t <sub>PLZ</sub>  | 3-STATE Output Disable Time   | 5.0 ± 0.5           |                       | 7.0 | 11.2 | 1.0                             | 12.0 | ns       | R <sub>L</sub> = 1 kΩ<br>C <sub>L</sub> = 50 pF                           |
| t <sub>PHZ</sub>  |                               |                     |                       |     |      |                                 |      |          |   |
| t <sub>TSLH</sub> | Output to Output Skew         | 5.0 ± 0.5           |                       |     | 1.0  |                                 | 1.0  | (Note 8) |   |
| t <sub>TSHL</sub> |                               |                     |                       |     |      |                                 |      |          |   |
| f <sub>MAX</sub>  | Maximum Clock Frequency       | 5.0 ± 0.5           | 90                    | 140 |      | 80                              |      | MHz      | C <sub>L</sub> = 15 pF<br>C <sub>L</sub> = 50 pF                          |
|                   |                               |                     | 85                    | 130 |      | 75                              |      |          |   |
| C <sub>IN</sub>   | Input Capacitance             |                     |                       | 4   | 10   |                                 | 10   | pF       | V <sub>CC</sub> = Open  |
| C <sub>OUT</sub>  | Output Capacitance            |                     |                       | 9   |      |                                 |      | pF       | V <sub>CC</sub> = 5.0V  |
| C <sub>PD</sub>   | Power Dissipation Capacitance |                     |                       | 25  |      |                                 |      | pF       | (Note 9)  |

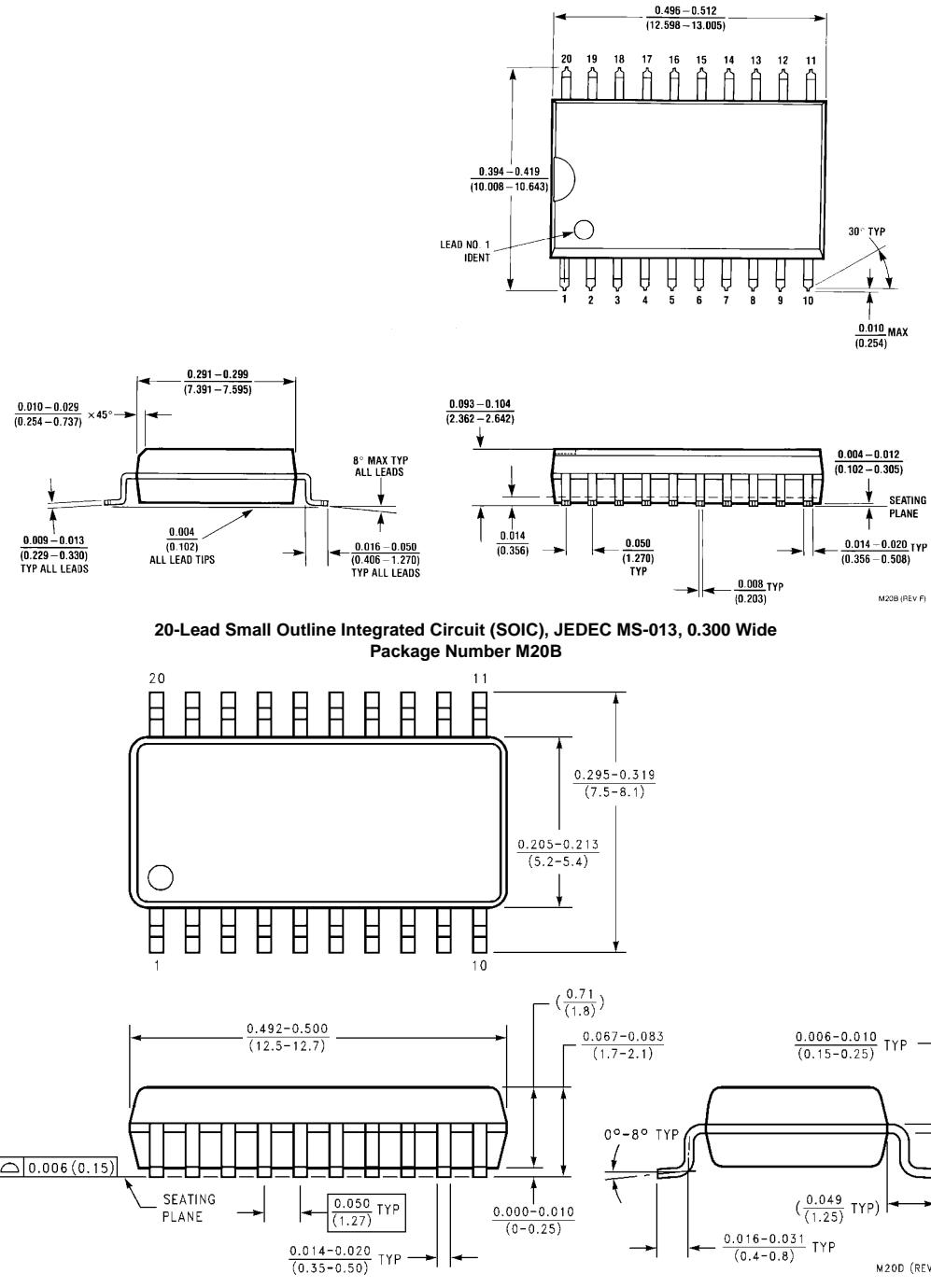
**Note 8:** Parameter guaranteed by design. t<sub>TSLH</sub> = |t<sub>PLH</sub> max - t<sub>PLH</sub> min|; t<sub>TSHL</sub> = |t<sub>PHL</sub> max - t<sub>PHL</sub> min|

**Note 9:** C<sub>PD</sub> 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<sub>CC</sub> (opr.) = C<sub>PD</sub> \* V<sub>CC</sub> \* f<sub>IN</sub> + I<sub>CC</sub>/8 (per F/F). The total C<sub>PD</sub> when n pcs. of the octal D Flip-Flop operates can be calculated by the equation: C<sub>PD</sub>(total) = 20 + 12m.

### AC Operating Requirements

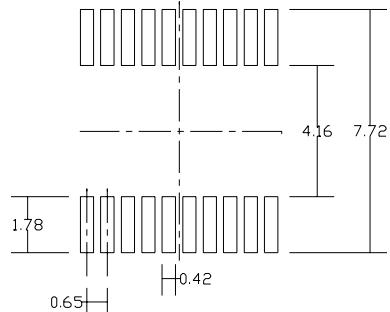
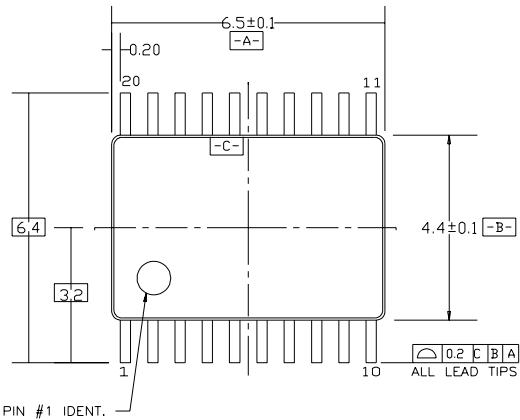
| Symbol            | Parameter                | V <sub>CC</sub> (V) | T <sub>A</sub> = 25°C |     |     | T <sub>A</sub> = -40°C to +85°C |     | Units |
|-------------------|--------------------------|---------------------|-----------------------|-----|-----|---------------------------------|-----|-------|
|                   |                          |                     | Min                   | Typ | Max | Min                             | Max |       |
| t <sub>W(H)</sub> | Minimum Pulse Width (CP) | 5.0 ± 0.5           |                       | 6.5 |     |                                 | 8.5 | ns    |
| t <sub>W(L)</sub> |                          |                     |                       |     |     |                                 |     |       |
| t <sub>S</sub>    | Minimum Set-up Time      | 5.0 ± 0.5           | 2.5                   |     |     | 2.5                             |     | ns    |
| t <sub>H</sub>    | Minimum Hold Time        | 5.0 ± 0.5           | 2.5                   |     |     | 2.5                             |     |       |

**Physical Dimensions** inches (millimeters) unless otherwise noted

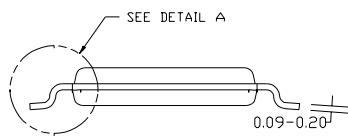
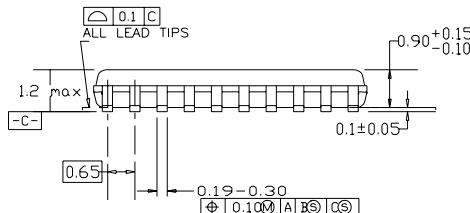


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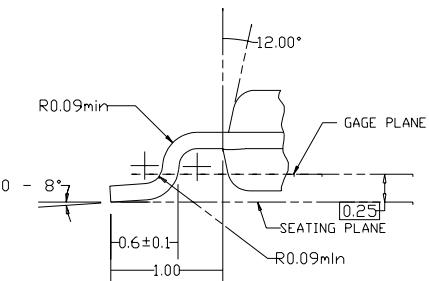
**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



LAND PATTERN RECOMMENDATION



DIMENSIONS ARE IN MILLIMETERS



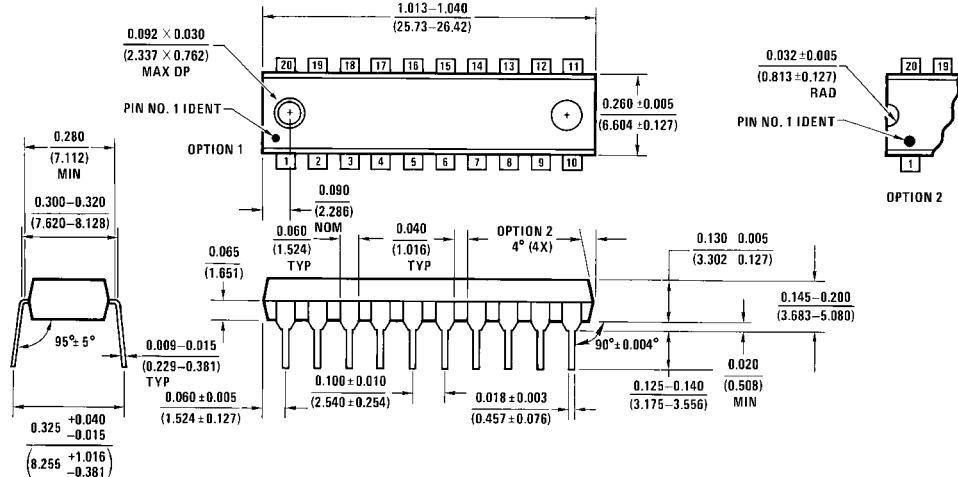
NOTES:

- 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.

DETAIL A

**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)



N20A (REV G)

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

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2. A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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