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## 74VHC574

### Octal D-Type Flip-Flop with 3-STATE Outputs

#### General Description

The VHC574 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.

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.

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#### Features

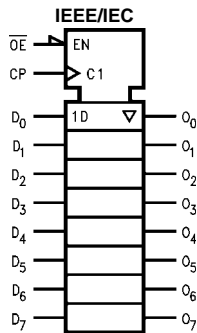
- High Speed:  $t_{PD} = 5.6$  ns (typ) at  $V_{CC} = 5V$
- High Noise Immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (Min)
- Power Down Protection is provided on all inputs
- Low Noise:  $V_{OLP} = 0.6V$  (typ)
- Low Power Dissipation:  $I_{CC} = 4 \mu A$  (Max) @  $T_A = 25^\circ C$
- Pin and Function Compatible with 74HC574

#### Ordering Code:

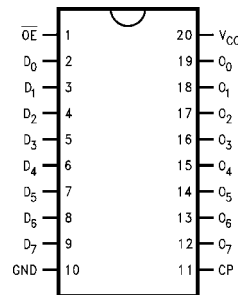
| Order Number | Package Number | Package Description   |
|--------------|----------------|---|
| 74VHC574M    | M20B           | 20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide  |
| 74VHC574SJ   | M20D           | Pb-Free 20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide       |
| 74VHC574MTC  | MTC20          | 20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide |
| 74VHC574N    | 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                 |
| CP              | Clock Pulse Input           |
| $\overline{OE}$ | 3-STATE Output Enable Input |
| $O_0$ - $O_7$   | 3-STATE Outputs             |

### Functional Description

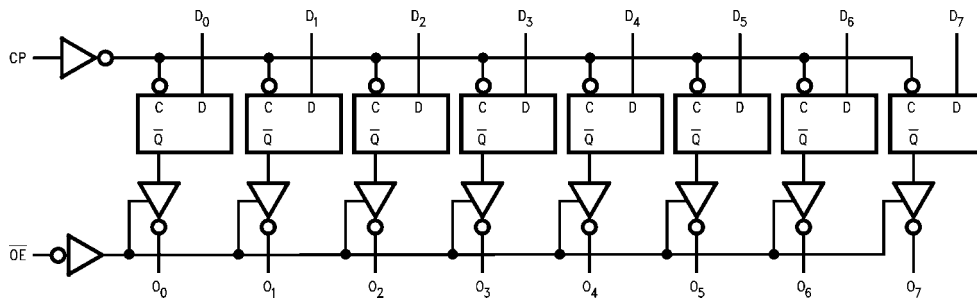
The VHC574 consists of eight edge-triggered flip-flops with individual D-type inputs and 3-STATE true outputs. The buffered clock and buffered Output Enable are common to all flip-flops. The eight flip-flops will store the state of their individual D inputs that meet the setup and hold time requirements 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 <sub>n</sub> | CP | $\overline{OE}$ | O <sub>n</sub> |
| 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 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                                  | $\pm 20$ mA              |
| DC Output Current ( $I_{OUT}$ )                       | $\pm 25$ mA              |
| DC $V_{CC}$ /GND Current ( $I_{CC}$ )                 | $\pm 75$ mA              |
| Storage Temperature ( $T_{STG}$ )                     | -65°C to +150°C          |
| Lead Temperature ( $T_L$ )<br>(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 ( $t_r, t_f$ ) |                |
| $V_{CC} = 3.3V \pm 0.3V$                | 0 ~ 100 ns/V   |
| $V_{CC} = 5.0V \pm 0.5V$                | 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                           | $V_{CC}$<br>(V) | $T_A = 25^\circ\text{C}$ |              |      | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ |      | Units         | Conditions   |  |
|----------|-------------------------------------|-----------------|--------------------------|--------------|------|---|------|---------------|--|--|
|          |                                     |                 | Min                      | Typ          | Max  | Min   | Max  |               |  |  |
| $V_{IH}$ | HIGH Level<br>Input Voltage         | 2.0             | 1.50                     |              |      | 1.50  |      | V             |  |  |
|          |                                     | 3.0 – 5.5       | $0.7 V_{CC}$             |              |      | $0.7 V_{CC}$                                    |      |               |  |  |
| $V_{IL}$ | LOW Level<br>Input Voltage          | 2.0             |                          | 0.50         |      | 0.50  |      | V             |  |  |
|          |                                     | 3.0 – 5.5       |                          | $0.3 V_{CC}$ |      | $0.3 V_{CC}$                                    |      |               |  |  |
| $V_{OH}$ | HIGH Level<br>Output Voltage        | 2.0             | 1.9                      | 2.0          |      | 1.9   |      | V             | $V_{IN} = V_{IH}$<br>or $V_{IL}$                           | $I_{OH} = -50 \mu\text{A}$                           |
|          |                                     | 3.0             | 2.9                      | 3.0          |      | 2.9   |      |               |  |  |
|          |                                     | 4.5             | 4.4                      | 4.5          |      | 4.4   |      |               |  | $I_{OH} = -4 \text{ mA}$<br>$I_{OH} = -8 \text{ mA}$ |
|          |                                     | 3.0             | 2.58                     |              |      | 2.48  |      |               |  |  |
| 4.5      | 3.94                                |                 |                          | 3.80         |      |   |      |               |  |  |
| $V_{OL}$ | LOW Level<br>Output Voltage         | 2.0             |                          | 0.0          | 0.1  |   | 0.1  | V             | $V_{IN} = V_{IH}$<br>or $V_{IL}$                           | $I_{OL} = 50 \mu\text{A}$                            |
|          |                                     | 3.0             |                          | 0.0          | 0.1  |   | 0.1  |               |  |  |
|          |                                     | 4.5             |                          | 0.0          | 0.1  |   | 0.1  |               |  | $I_{OL} = 4 \text{ mA}$<br>$I_{OL} = 8 \text{ mA}$   |
|          |                                     | 3.0             |                          |              | 0.36 |   | 0.44 |               |  |  |
| 4.5      |                                     |                 | 0.36                     |              | 0.44 |   |      |               |  |  |
| $I_{OZ}$ | 3-STATE<br>Output Off-State Current | 5.5             |                          | $\pm 0.25$   |      | $\pm 2.5$                                       |      | $\mu\text{A}$ | $V_{IN} = V_{IH}$ or $V_{IL}$<br>$V_{OUT} = V_{CC}$ or GND |  |
| $I_{IN}$ | Input Leakage<br>Current            | 0 – 5.5         |                          | $\pm 0.1$    |      | $\pm 1.0$                                       |      | $\mu\text{A}$ | $V_{IN} = 5.5V$ or GND                                     |  |
| $I_{CC}$ | Quiescent Supply<br>Current         | 5.5             |                          | 4.0          |      | 40.0  |      | $\mu\text{A}$ | $V_{IN} = V_{CC}$ or GND                                   |  |

**Noise Characteristics**

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

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

## AC Electrical Characteristics

| Symbol            | Parameter   | V <sub>CC</sub><br>(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<br>Time (CP to O <sub>n</sub> ) | 3.3 ± 0.3              | 8.5                   | 13.2 | 1.0 | 15.5                            | ns  | C <sub>L</sub> = 15 pF | C <sub>L</sub> = 50 pF |  |
| t <sub>PHL</sub>  |   |                        | 11.0                  | 16.7 | 1.0 | 19.0                            |     |                        |                        |  |
|                   |   | 5.0 ± 0.5              | 5.6                   | 8.6  | 1.0 | 10.0                            | ns  |                        |                        |  |
|                   |   |                        | 7.1                   | 10.6 | 1.0 | 12.0                            |     |                        |                        |  |
| t <sub>PZL</sub>  | 3-STATE Output<br>Enable Time                     | 3.3 ± 0.3              | 8.2                   | 12.8 | 1.0 | 15.0                            | ns  | R <sub>L</sub> = 1 kΩ  | C <sub>L</sub> = 15 pF |  |
| t <sub>PZH</sub>  |   |                        | 10.7                  | 16.3 | 1.0 | 18.5                            |     |                        |                        |  |
|                   |   | 5.0 ± 0.5              | 5.9                   | 9.0  | 1.0 | 10.5                            | ns  |                        |                        |  |
|                   |   |                        | 7.4                   | 11.0 | 1.0 | 12.5                            |     |                        |                        |  |
| t <sub>PLZ</sub>  | 3-STATE Output<br>Disable Time                    | 3.3 ± 0.3              | 11.0                  | 15.0 | 1.0 | 17.0                            | ns  | R <sub>L</sub> = 1 kΩ  | C <sub>L</sub> = 50 pF |  |
| t <sub>PHZ</sub>  |   | 5.0 ± 0.5              | 7.1                   | 10.1 | 1.0 | 11.5                            |     |                        |                        |  |
| t <sub>OSLH</sub> | Output to   | 3.3 ± 0.3              |                       | 1.5  |     | 1.5                             | ns  | (Note 4)               | C <sub>L</sub> = 50 pF |  |
| t <sub>OSSL</sub> | Output Skew                                       | 5.0 ± 0.5              |                       | 1.0  |     | 1.0                             |     |                        |                        |  |
| f <sub>MAX</sub>  | Maximum Clock<br>Frequency                        | 3.3 ± 0.3              | 80                    | 125  |     | 65                              | MHz |                        | C <sub>L</sub> = 15 pF |  |
|                   |   |                        | 50                    | 75   |     | 45                              |     |                        |                        |  |
|                   |   | 5.0 ± 0.5              | 130                   | 180  |     | 110                             |     |                        |                        |  |
|                   |   |                        | 85                    | 115  |     | 75                              |     |                        |                        |  |
| C <sub>IN</sub>   | Input<br>Capacitance                              |                        | 4                     | 10   |     | 10                              | pF  | V <sub>CC</sub> = Open |                        |  |
| C <sub>OUT</sub>  | Output<br>Capacitance                             |                        | 6                     |      |     |                                 | pF  | V <sub>CC</sub> = 5.0V |                        |  |
| C <sub>PD</sub>   | Power Dissipation<br>Capacitance                  |                        | 28                    |      |     |                                 | pF  | (Note 5)               |                        |  |

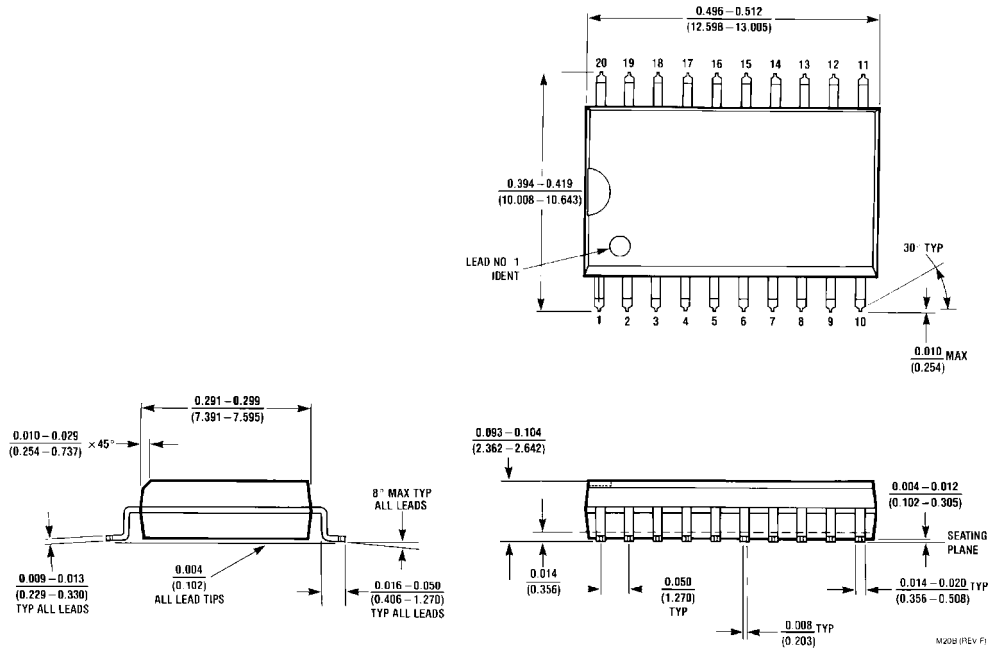
**Note 4:** Parameter guaranteed by design.  $t_{OSLH} = |t_{PLH\ max} - t_{PLH\ min}|$ ;  $t_{OSSL} = |t_{PHL\ max} - t_{PHL\ min}|$

**Note 5:** 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:  $I_{CC\ (opr.)} = C_{PD} * V_{CC} * f_{IN} + I_{CC}/8$  (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 + 8n.

## AC Operating Requirements

| Symbol            | Parameter                | V <sub>CC</sub><br>(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) | 3.3 ± 0.3              | 5.0                   |     |     | 5.0                             | ns  |       |
| t <sub>W(L)</sub> |                          | 5.0 ± 0.5              | 5.0                   |     |     | 5.0                             |     |       |
| t <sub>S</sub>    | Minimum Set-Up Time      | 3.3 ± 0.3              | 3.5                   |     |     | 3.5                             | ns  |       |
|                   |                          | 5.0 ± 0.5              | 3.5                   |     |     | 3.5                             |     |       |
| t <sub>H</sub>    | 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**

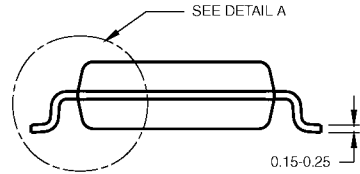
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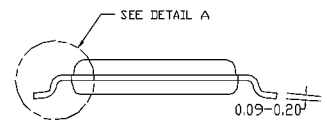
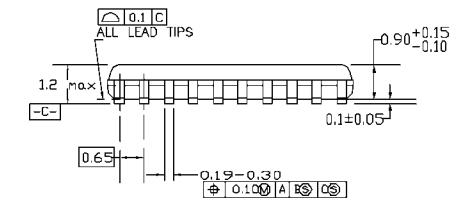
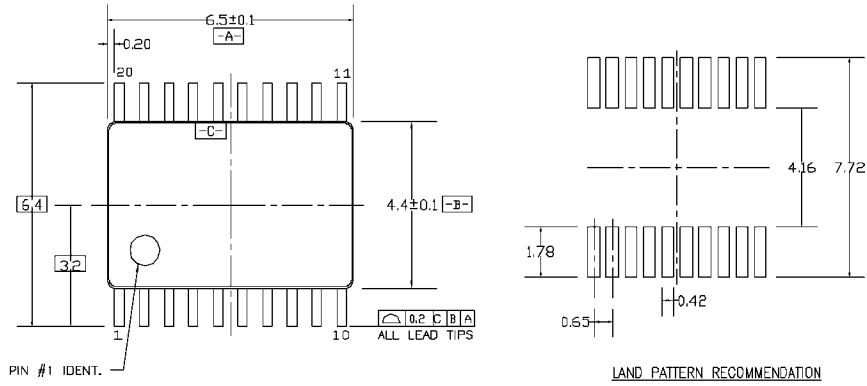
DETAIL A

- 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

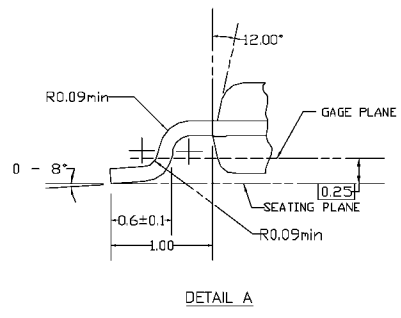
**Pb-Free 20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide Package Number M20D**

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



DIMENSIONS ARE IN MILLIMETERS

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  - C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLDS FLASH, AND TIE BAR EXTRUSIONS.
  - D. DIMENSIONS AND TOLERANCES PER ANSI Y14.5M, 1982.

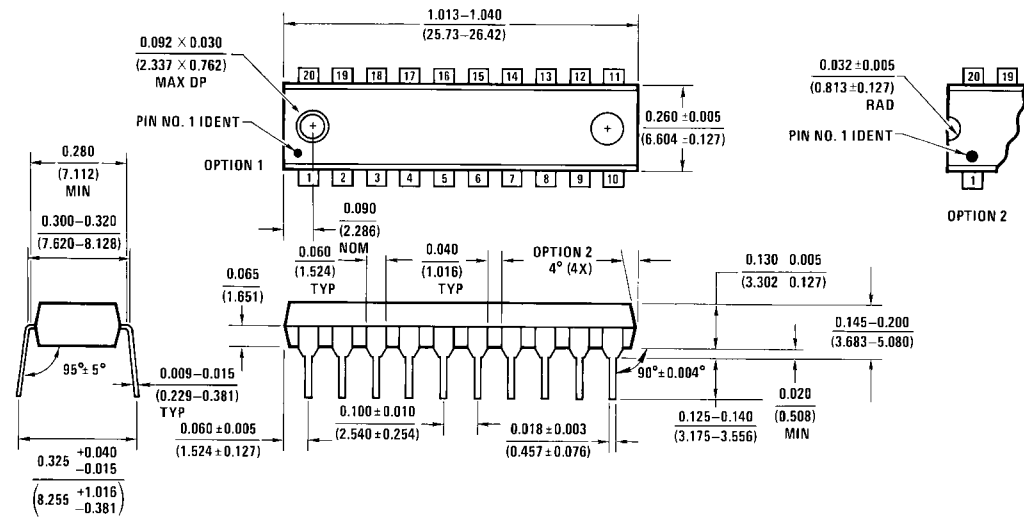


MTC20REVD1

**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**

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