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# 74VHCT374A

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

### Features

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

### 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 ( $\overline{OE}$ ). When the  $\overline{OE}$  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<sup>(1)</sup> 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:

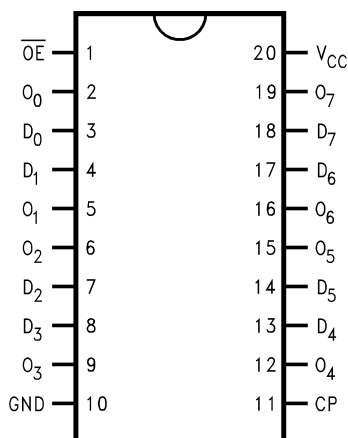
1. Outputs in OFF-State.

### Ordering Information

| 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 |

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

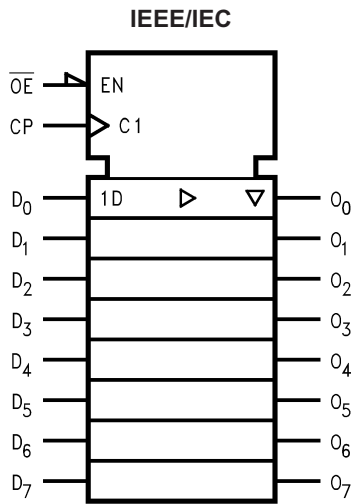
### Connection Diagram



### Pin Description

| 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                     |

### Logic Symbol



### 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      | $\nearrow$ | L               | H       |
| L      | $\nearrow$ | L               | L       |
| X      | X          | H               | Z       |

H = HIGH Voltage Level

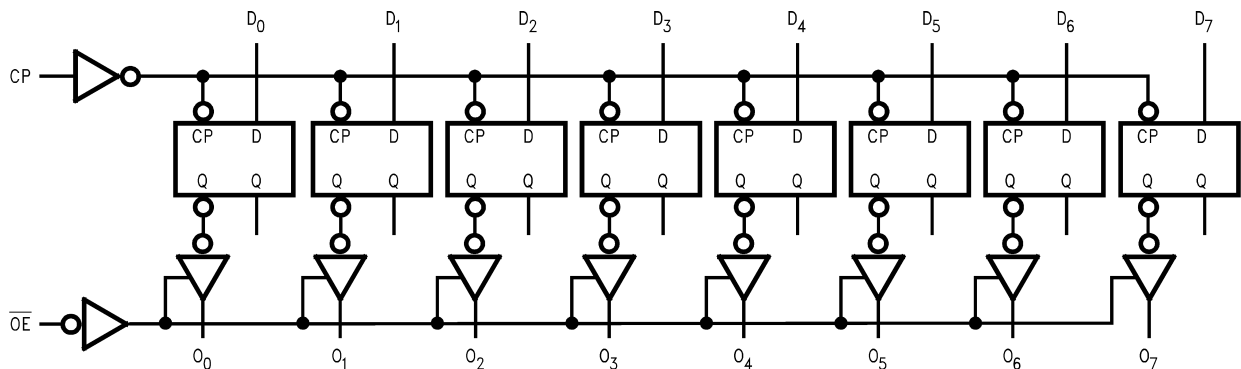
L = LOW Voltage Level

X = Immaterial

Z = High Impedance

$\nearrow$  = 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

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

| Symbol    | Parameter                                | Rating                                     |
|-----------|--|--|
| $V_{CC}$  | Supply Voltage                           | -0.5V to +7.0V                             |
| $V_{IN}$  | DC Input Voltage                         | -0.5V to +7.0V                             |
| $V_{OUT}$ | DC Output Voltage<br>Note 2<br>Note 3    | -0.5V to $V_{CC} + 0.5V$<br>-0.5V to +7.0V |
| $I_{IK}$  | Input Diode Current                      | -20mA                                      |
| $I_{OK}$  | Output Diode Current <sup>(4)</sup>      | $\pm 20mA$                                 |
| $I_{OUT}$ | DC Output Current                        | $\pm 25mA$                                 |
| $I_{CC}$  | DC $V_{CC}$ / GND Current                | $\pm 75mA$                                 |
| $T_{STG}$ | Storage Temperature                      | -65°C to +150°C                            |
| $T_L$     | Lead Temperature (Soldering, 10 seconds) | 260°C                                      |

## Recommended Operating Conditions<sup>(5)</sup>

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to absolute maximum ratings.

| Symbol     | Parameter  | Rating                       |
|------------|--|------------------------------|
| $V_{CC}$   | Supply Voltage                                     | 4.5V to +5.5V                |
| $V_{IN}$   | Input Voltage                                      | 0V to +5.5V                  |
| $V_{OUT}$  | Output Voltage<br>Note 2<br>Note 3                 | 0V to $V_{CC}$<br>0V to 5.5V |
| $T_{OPR}$  | Operating Temperature                              | -40°C to +85°C               |
| $t_r, t_f$ | Input Rise and Fall Time, $V_{CC} = 5.0V \pm 0.5V$ | 0ns/V ~ 20ns/V               |

### Notes:

- HIGH or LOW state.  $I_{OUT}$  absolute maximum rating must be observed.
- When outputs are in OFF-State or when  $V_{CC} = 0V$ .
- $V_{OUT} < GND$ ,  $V_{OUT} > V_{CC}$  (Outputs Active).
- Unused inputs must be held HIGH or LOW. They may not float.

## DC Electrical Characteristics

| Symbol            | Parameter                                 | V <sub>CC</sub> (V) | Conditions   | T <sub>A</sub> = 25°C   |      |      | T <sub>A</sub> = -40°C to +85°C |      | Units |
|-------------------|---|---------------------|--|-------------------------|------|------|---------------------------------|------|-------|
|                   |   |                     |  | Min.                    | Typ. | Max. | Min.                            | Max. |       |
| V <sub>IH</sub>   | HIGH Level Input Voltage                  | 4.5                 |  | 2.0                     |      |      | 2.0                             |      | V     |
|                   |   | 5.5                 |  | 2.0                     |      |      | 2.0                             |      |       |
| V <sub>IL</sub>   | LOW Level Input Voltage                   | 4.5                 |  |                         |      | 0.8  |                                 | 0.8  | V     |
|                   |   | 5.5                 |  |                         |      | 0.8  |                                 | 0.8  |       |
| V <sub>OH</sub>   | HIGH Level Output Voltage                 | 4.5                 | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>   | I <sub>OH</sub> = -50μA | 4.40 | 4.50 |                                 | 4.40 | V     |
|                   |   |                     |  | I <sub>OH</sub> = -8mA  | 3.94 |      |                                 | 3.80 |       |
| V <sub>OL</sub>   | LOW Level Output Voltage                  | 4.5                 | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>   | I <sub>OL</sub> = +50μA |      | 0.0  | 0.1                             | 0.1  | V     |
|                   |   |                     |  | I <sub>OL</sub> = +8mA  |      |      | 0.36                            | 0.44 |       |
| I <sub>OZ</sub>   | 3-STATE Output OFF-State Current          | 5.5                 | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> , V <sub>OUT</sub> = V <sub>CC</sub> or GND |                         |      |      | ±0.25                           | ±2.5 | μA    |
| I <sub>IN</sub>   | Input Leakage Current                     | 0–5.5               | V <sub>IN</sub> = 5.5V or GND  |                         |      |      | ±0.1                            | ±1.0 | μA    |
| I <sub>CC</sub>   | Quiescent Supply Current                  | 5.5                 | V <sub>IN</sub> = V <sub>CC</sub> or GND   |                         |      |      | 4.0                             | 40.0 | μA    |
| I <sub>CCCT</sub> | Maximum I <sub>CC</sub> /Input            | 5.5                 | V <sub>IN</sub> = 3.4V, Other Inputs = V <sub>CC</sub> or GND                                    |                         |      |      | 1.35                            | 1.50 | mA    |
| I <sub>OFF</sub>  | Output Leakage Current (Power Down State) | 0.0                 | V <sub>OUT</sub> = 5.5V  |                         |      |      | 0.5                             | 5.0  | μA    |

## Noise Characteristics

| Symbol                          | Parameter                                    | V <sub>CC</sub> (V) | Conditions            | T <sub>A</sub> = 25°C |        | Units |
|---------------------------------|--|---------------------|-----------------------|-----------------------|--------|-------|
|                                 |  |                     |                       | Typ.                  | Limits |       |
| V <sub>OLP</sub> <sup>(6)</sup> | Quiet Output Maximum Dynamic V <sub>OL</sub> | 5.0                 | C <sub>L</sub> = 50pF | 1.2                   | 1.6    | V     |
| V <sub>OLV</sub> <sup>(6)</sup> | Quiet Output Minimum Dynamic V <sub>OL</sub> | 5.0                 | C <sub>L</sub> = 50pF | -1.2                  | -1.6   | V     |
| V <sub>IHD</sub> <sup>(6)</sup> | Minimum HIGH Level Dynamic Input Voltage     | 5.0                 | C <sub>L</sub> = 50pF |                       | 2.0    | V     |
| V <sub>ILD</sub> <sup>(6)</sup> | Maximum LOW Level Dynamic Input Voltage      | 5.0                 | C <sub>L</sub> = 50pF |                       | 0.8    | V     |

**Note:**

6. Parameter guaranteed by design.

## AC Electrical Characteristics

| Symbol                                | Parameter                     | V <sub>CC</sub> (V) | Conditions             | T <sub>A</sub> = 25°C |      |      | T <sub>A</sub> = -40°C to +85°C |      | Units |
|---------------------------------------|-------------------------------|---------------------|------------------------|-----------------------|------|------|---------------------------------|------|-------|
|                                       |                               |                     |                        | Min.                  | Typ. | Max. | Min.                            | Max. |       |
| t <sub>PLH</sub> , t <sub>PHL</sub>   | Propagation Delay Time        | 5.0 ± 0.5           |                        | C <sub>L</sub> = 15pF | 4.1  | 9.4  | 1.0                             | 10.5 | ns    |
|                                       |                               |                     |                        | C <sub>L</sub> = 50pF | 5.6  | 10.4 | 1.0                             | 11.5 |       |
| t <sub>PZL</sub> , t <sub>PZH</sub>   | 3-STATE Output Enable Time    | 5.0 ± 0.5           | R <sub>L</sub> = 1kΩ   | C <sub>L</sub> = 15pF | 6.5  | 10.2 | 1.0                             | 11.5 | ns    |
|                                       |                               |                     |                        | C <sub>L</sub> = 50pF | 7.3  | 11.2 | 1.0                             | 12.5 |       |
| t <sub>PLZ</sub> , t <sub>PHZ</sub>   | 3-STATE Output Disable Time   | 5.0 ± 0.5           | R <sub>L</sub> = 1kΩ   | C <sub>L</sub> = 50pF | 7.0  | 11.2 | 1.0                             | 12.0 | ns    |
| t <sub>OSLH</sub> , t <sub>OSSL</sub> | Output to Output Skew         | 5.0 ± 0.5           | (7)                    |                       |      | 1.0  |                                 | 1.0  | ns    |
| f <sub>MAX</sub>                      | Maximum Clock Frequency       | 5.0 ± 0.5           |                        | C <sub>L</sub> = 15pF | 90   | 140  | 80                              |      | MHz   |
|                                       |                               |                     |                        | C <sub>L</sub> = 50pF | 85   | 130  | 75                              |      |       |
| C <sub>IN</sub>                       | Input Capacitance             |                     | V <sub>CC</sub> = Open |                       | 4    | 10   |                                 | 10   | pF    |
| C <sub>OUT</sub>                      | Output Capacitance            |                     | V <sub>CC</sub> = 5.0V |                       | 9    |      |                                 |      | pF    |
| C <sub>PD</sub>                       | Power Dissipation Capacitance |                     | (8)                    |                       | 25   |      |                                 |      | pF    |

## Notes:

7. Parameter guaranteed by design.  $t_{OSLH} = |t_{PLH \max} - t_{PLH \min}|$ ;  $t_{OSSL} = |t_{PHL \max} - t_{PHL \min}|$
8. 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:  
 $I_{CC}(\text{Opr.}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC} / 8$  (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:  $C_{PD}(\text{total}) = 20 + 12n$

## 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> , t <sub>W(L)</sub> | Minimum Pulse Width (CP) | 5.0 ± 0.5           | 6.5                   |      |      | 8.5                             |      | ns    |
| 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                             |      | ns    |

## Physical Dimensions

Dimensions are in millimeters unless otherwise noted.

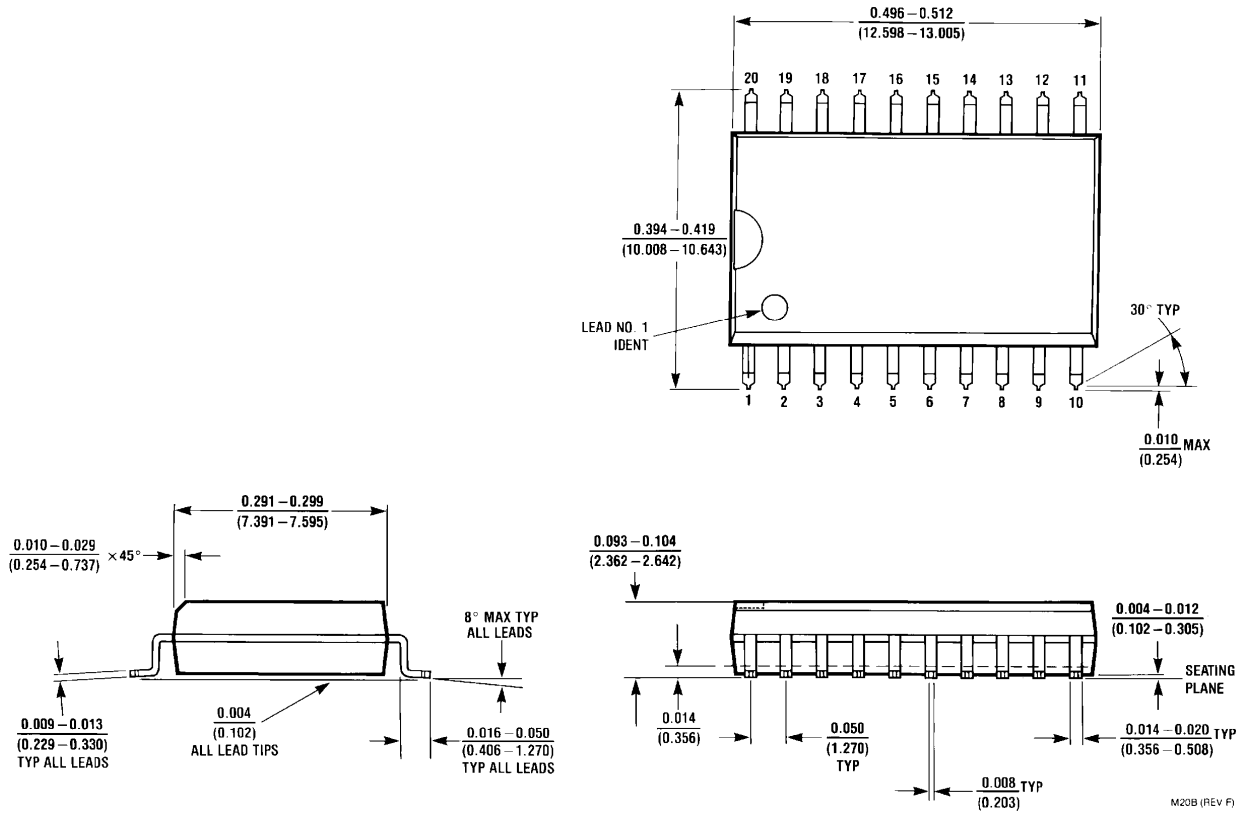
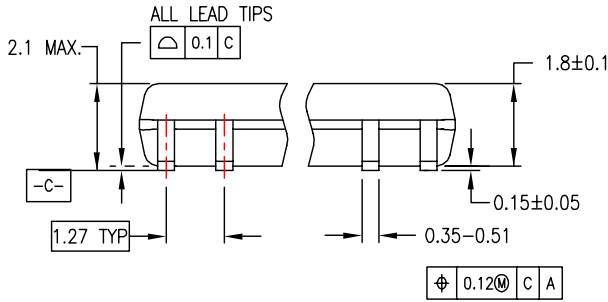
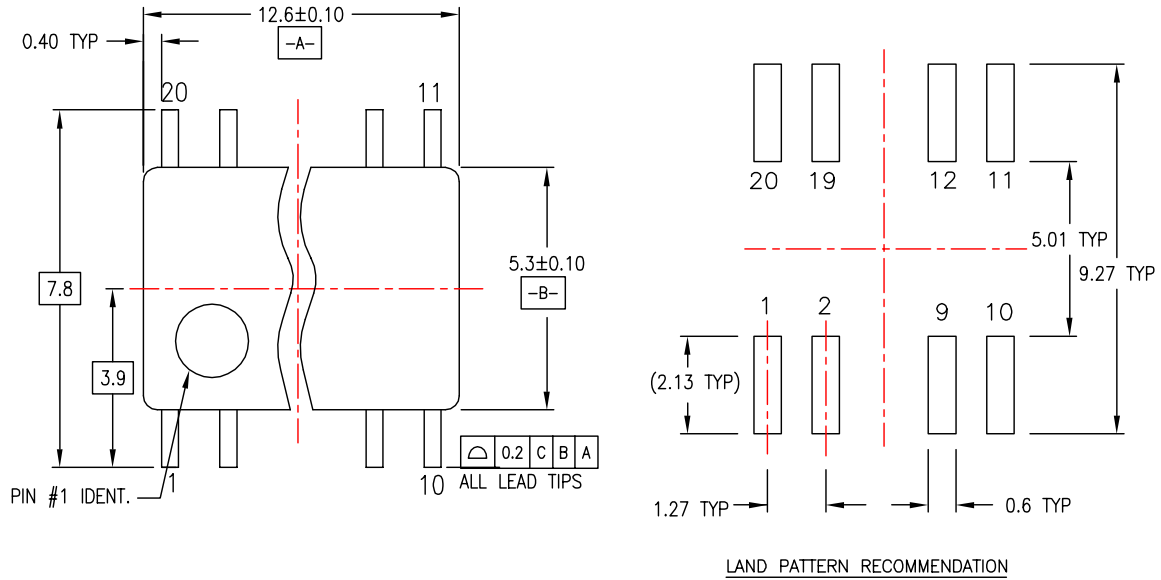


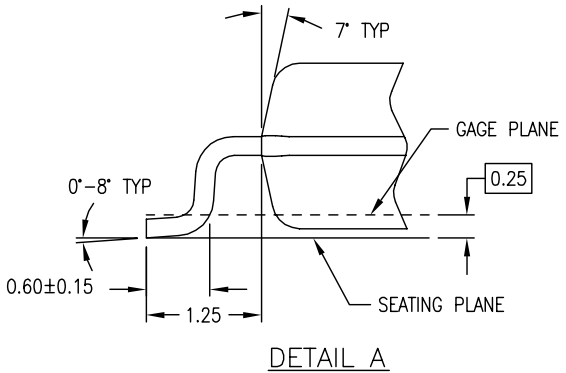
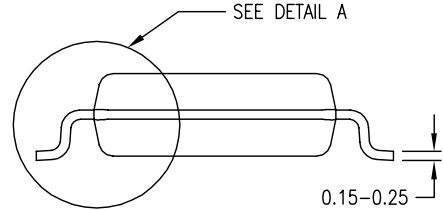
Figure 1. 20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide Package Number M20B

**Physical Dimensions** (Continued)

Dimensions are in millimeters unless otherwise noted.



DIMENSIONS ARE IN MILLIMETERS



- 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.

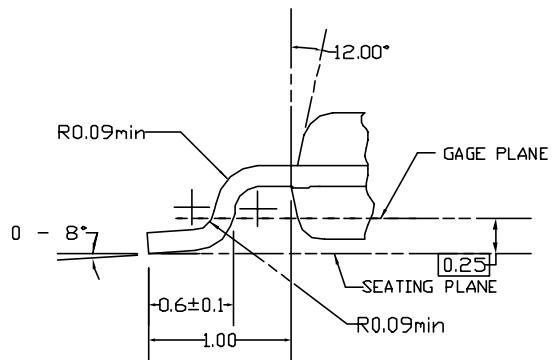
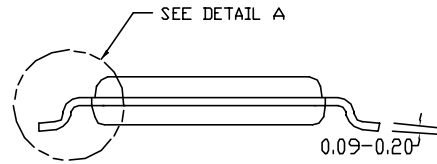
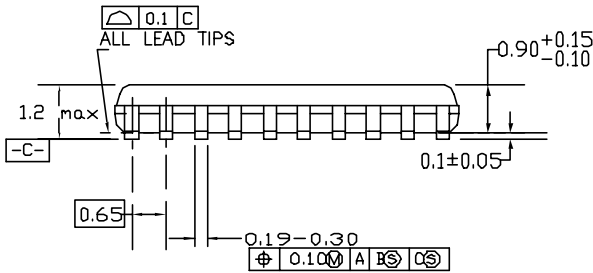
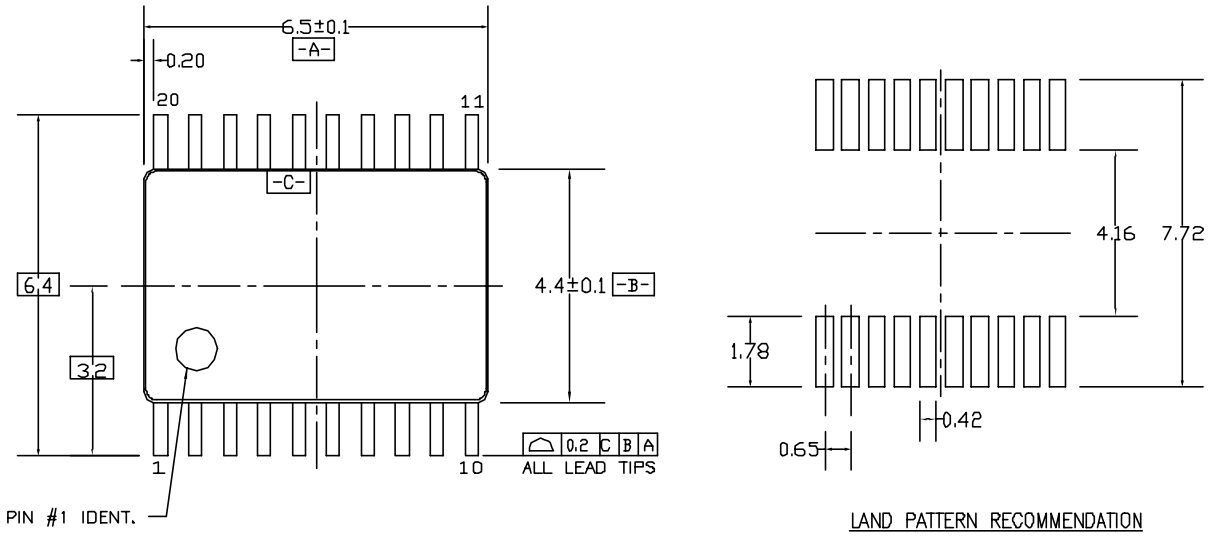
M20DREVC

**Figure 2. 20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide Package Number M20D**



**Physical Dimensions** (Continued)

Dimensions are in millimeters unless otherwise noted.



DETAIL A

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

**Figure 3. 20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide Package Number MTC20**



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| ActiveArray <sup>™</sup>                         | ImpliedDisconnect <sup>™</sup> | Programmable Active Droop <sup>™</sup>  | TINYOPTO <sup>™</sup>       |
| Bottomless <sup>™</sup>                          | IntelliMAX <sup>™</sup>        | QFET <sup>®</sup>   | TinyPower <sup>™</sup>      |
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| CoolFET <sup>™</sup>                             | MICROCOUPLER <sup>™</sup>      | QT Optoelectronics <sup>™</sup>   | TruTranslation <sup>™</sup> |
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| EcoSPARK <sup>®</sup>                            | OCXPro <sup>™</sup>            | STEALTH <sup>™</sup>  |                             |
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| FACT <sup>®</sup>                                | PACMAN <sup>™</sup>            | SuperSOT <sup>™</sup> -6  |                             |
| FAST <sup>®</sup>                                | PDP-SPM <sup>™</sup>           | SuperSOT <sup>™</sup> -8  |                             |
| FASTr <sup>™</sup>                               | POP <sup>™</sup>               | SyncFET <sup>™</sup>  |                             |
| FPS <sup>™</sup>                                 | Power220 <sup>®</sup>          | TCM <sup>™</sup>  |                             |
| FRFET <sup>®</sup>                               | Power247 <sup>®</sup>          | The Power Franchise <sup>®</sup>  |                             |
| GlobalOptoisolator <sup>™</sup>                  | PowerEdge <sup>™</sup>         |  ™ |                             |
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| Datasheet Identification | Product Status         | Definition   |
|--------------------------|------------------------|--|
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