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# 74VHC273

## Octal D-Type Flip-Flop

### Features

- High Speed:  $f_{MAX} = 165\text{MHz}$  (typ) at  $V_{CC} = 5\text{V}$
- Low power dissipation:  $I_{CC} = 4\mu\text{A}$  (max) at  $T_A = 25^\circ\text{C}$
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (min)
- Power down protection is provided on all inputs
- Low noise:  $V_{OLP} = 0.9\text{V}$  (max)
- Pin and function compatible with 74HC273
- Leadless DQFN Package

### General Description

The VHC273 is an advanced high speed CMOS Octal D-type flip-flop 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.

The register has a common buffered Clock (CP) which is fully edge-triggered. The state of each D input, one setup time before the LOW-to-HIGH clock transition, is transferred to the corresponding flip-flop's Q output. The Master Reset (MR) input will clear all flip-flops simultaneously. All outputs will be forced LOW independently of Clock or Data inputs by a LOW voltage level on the MR input.

An input protection circuit insures that 0V to 7V can be applied to the inputs 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 backup. This circuit prevents device destruction due to mismatched supply and input voltages.

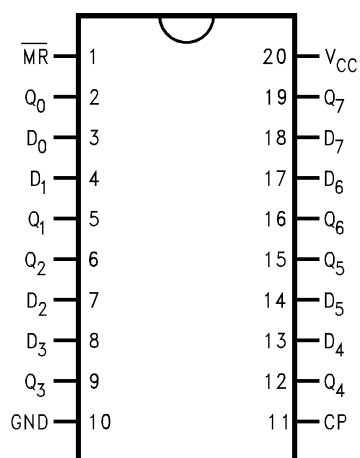
### Ordering Information

| Order Number                | Package Number           | Package Description                                                                         |
|-----------------------------|--------------------------|---------------------------------------------------------------------------------------------|
| 74VHC273M                   | M20B                     | 20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide                  |
| 74VHC273SJ                  | M20D                     | 20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide                               |
| 74VHC273BQ<br>(Preliminary) | MLP020B<br>(Preliminary) | 20-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN), JEDEC MO-241, 2.5 x 4.5mm |
| 74VHC273MTC                 | MTC20                    | 20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide                 |

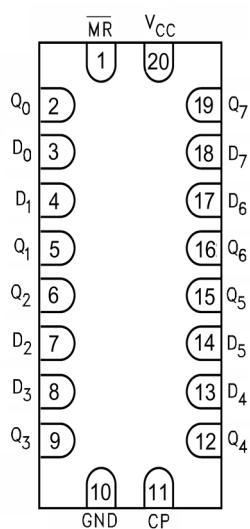
Surface mount packages are also available on Tape and Reel. Specify by appending the suffix letter "X" to the ordering number. Pb-Free package per JEDEC J-STD-020B.

## Connection Diagrams

Pin Assignments for  
PDIP, SOIC, SOP, and TSSOP



Pad Assignments for DQFN

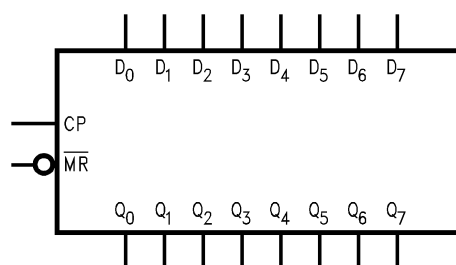


(Top Through View)

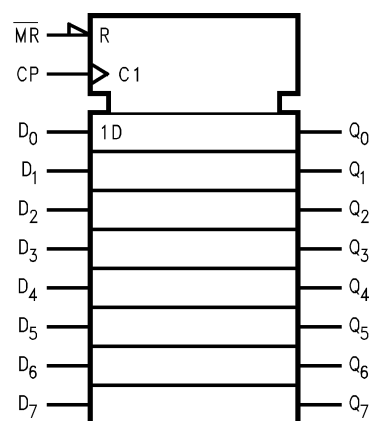
## Pin Descriptions

| Pin Names                      | Description       |
|--------------------------------|-------------------|
| D <sub>0</sub> –D <sub>7</sub> | Data Inputs       |
| MR                             | Master Reset      |
| CP                             | Clock Pulse Input |
| Q <sub>0</sub> –Q <sub>7</sub> | Data Outputs      |

## Logic Symbols



IEEE/IEC



## Function Table

| Operating Mode | Inputs |    |                | Outputs        |
|----------------|--------|----|----------------|----------------|
|                | MR     | CP | D <sub>n</sub> | Q <sub>n</sub> |
| Reset (Clear)  | L      | X  | X              | L              |
| Load '1'       | H      | ↗  | H              | H              |
| Load '0'       | H      | ↘  | L              | L              |

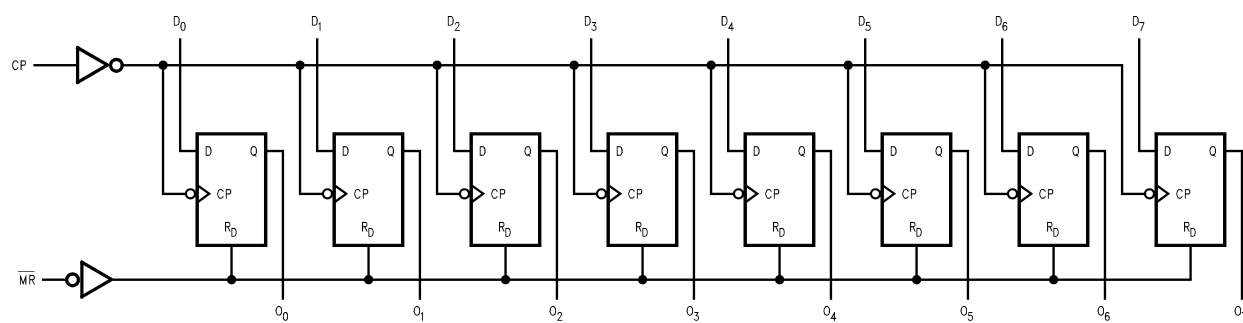
H = HIGH Voltage Level

L = LOW Voltage Level

X = Immaterial

↗ = 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.

Figure 1.

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

## Recommended Operating Conditions<sup>(1)</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                                                                    | 2.0V to +5.5V                     |
| $V_{IN}$   | Input Voltage                                                                     | 0V to +5.5V                       |
| $V_{OUT}$  | Output Voltage                                                                    | 0V to $V_{CC}$                    |
| $T_{OPR}$  | Operating Temperature                                                             | −40°C to +85°C                    |
| $t_r, t_f$ | Input Rise and Fall Time,<br>$V_{CC} = 3.3V \pm 0.3V$<br>$V_{CC} = 5.0V \pm 0.5V$ | 0ns/V ~ 100ns/V<br>0ns/V ~ 20ns/V |

### Note:

1. 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> =      |                        |                       |                       |                       | Units |      |      |
|-----------------|---------------------------|---------------------|---------------------------------------------------------|-------------------------|-----------------------|------------------------|-----------------------|-----------------------|-----------------------|-------|------|------|
|                 |                           |                     |                                                         |                         | 25°C                  |                        |                       | –40°C to +85°C        |                       |       |      |      |
|                 |                           |                     |                                                         |                         | Min.                  | Typ.                   | Max.                  | Min.                  | Max.                  |       |      |      |
| V <sub>IH</sub> | HIGH Level Input Voltage  | 2.0                 |                                                         |                         | 1.50                  |                        |                       | 1.50                  |                       | V     |      |      |
|                 |                           | 3.0–5.5             |                                                         |                         | 0.7 x V <sub>CC</sub> |                        |                       | 0.7 x V <sub>CC</sub> |                       |       |      |      |
| V <sub>IL</sub> | LOW Level Input Voltage   | 2.0                 |                                                         |                         |                       |                        | 0.50                  |                       | 0.50                  | V     |      |      |
|                 |                           | 3.0–5.5             |                                                         |                         |                       |                        | 0.3 x V <sub>CC</sub> |                       | 0.3 x V <sub>CC</sub> |       |      |      |
| V <sub>OH</sub> | HIGH Level Output Voltage | 2.0                 | V <sub>IN</sub> = V <sub>IH</sub><br>or V <sub>IL</sub> | I <sub>OH</sub> = –50μA | 1.9                   | 2.0                    |                       | 1.9                   |                       | V     |      |      |
|                 |                           | 3.0                 |                                                         |                         | 2.9                   | 3.0                    |                       | 2.9                   |                       |       |      |      |
|                 |                           | 4.5                 |                                                         |                         | 4.4                   | 4.5                    |                       | 4.4                   |                       |       |      |      |
|                 |                           | 3.0                 |                                                         |                         |                       | I <sub>OH</sub> = –4mA | 2.58                  |                       |                       |       | 2.48 |      |
|                 |                           | 4.5                 |                                                         |                         |                       | I <sub>OH</sub> = –8mA | 3.94                  |                       |                       |       | 3.80 |      |
| V <sub>OL</sub> | LOW Level Output Voltage  | 2.0                 | V <sub>IN</sub> = V <sub>IH</sub><br>or V <sub>IL</sub> | I <sub>OL</sub> = 50μA  |                       | 0.0                    | 0.1                   |                       | 0.1                   | V     |      |      |
|                 |                           | 3.0                 |                                                         |                         |                       | 0.0                    | 0.1                   |                       | 0.1                   |       |      |      |
|                 |                           | 4.5                 |                                                         |                         |                       | 0.0                    | 0.1                   |                       | 0.1                   |       |      |      |
|                 |                           | 3.0                 |                                                         |                         |                       | I <sub>OL</sub> = 4mA  |                       |                       | 0.36                  |       |      | 0.44 |
|                 |                           | 4.5                 |                                                         |                         |                       | I <sub>OL</sub> = 8mA  |                       |                       | 0.36                  |       |      | 0.44 |
| 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    |      |      |

## Noise Characteristics

| Symbol                          | Parameter                                    | V <sub>CC</sub> (V) | Conditions            | T <sub>A</sub> = 25°C |        | Units |
|---------------------------------|----------------------------------------------|---------------------|-----------------------|-----------------------|--------|-------|
|                                 |                                              |                     |                       | Typ.                  | Limits |       |
| V <sub>OLP</sub> <sup>(2)</sup> | Quiet Output Maximum Dynamic V <sub>OL</sub> | 5.0                 | C <sub>L</sub> = 50pF | 0.6                   | 0.9    | V     |
| V <sub>OLV</sub> <sup>(2)</sup> | Quiet Output Minimum Dynamic V <sub>OL</sub> | 5.0                 | C <sub>L</sub> = 50pF | –0.6                  | –0.9   | V     |
| V <sub>IHD</sub> <sup>(2)</sup> | Minimum HIGH Level Dynamic Input Voltage     | 5.0                 | C <sub>L</sub> = 50pF |                       | 3.5    | V     |
| V <sub>ILD</sub> <sup>(2)</sup> | Maximum LOW Level Dynamic Input Voltage      | 5.0                 | C <sub>L</sub> = 50pF |                       | 1.5    | V     |

**Note:**

2. 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. |       |
| f <sub>MAX</sub>                      | Maximum Clock Frequency         | 3.3 ± 0.3           | C <sub>L</sub> = 15pF     | 75                    | 120  |      | 65                              |      | MHz   |
|                                       |                                 |                     | C <sub>L</sub> = 50pF     | 50                    | 75   |      | 45                              |      |       |
|                                       |                                 | 5.0 ± 0.5           | C <sub>L</sub> = 15pF     | 120                   | 165  |      | 100                             |      | MHz   |
|                                       |                                 |                     | C <sub>L</sub> = 50pF     | 80                    | 110  |      | 70                              |      |       |
| t <sub>PLH</sub> , t <sub>PHL</sub>   | Propagation Delay Time (CK – Q) | 3.3 ± 0.3           | C <sub>L</sub> = 15pF     |                       | 8.7  | 13.6 | 1.0                             | 16.0 | ns    |
|                                       |                                 |                     | C <sub>L</sub> = 50pF     |                       | 11.2 | 17.1 | 1.0                             | 19.5 |       |
|                                       |                                 | 5.0 ± 0.5           | C <sub>L</sub> = 15pF     |                       | 5.8  | 9.0  | 1.0                             | 10.5 | ns    |
|                                       |                                 |                     | C <sub>L</sub> = 50pF     |                       | 7.3  | 11.0 | 1.0                             | 12.5 |       |
| t <sub>PHL</sub>                      | Propagation Delay Time (MR – Q) | 3.3 ± 0.3           | C <sub>L</sub> = 15pF     |                       | 8.9  | 13.6 | 1.0                             | 16.0 | ns    |
|                                       |                                 |                     | C <sub>L</sub> = 50pF     |                       | 11.4 | 17.1 | 1.0                             | 19.5 |       |
|                                       |                                 | 5.0 ± 0.5           | C <sub>L</sub> = 15pF     |                       | 5.2  | 8.5  | 1.0                             | 10.0 | ns    |
|                                       |                                 |                     | C <sub>L</sub> = 50pF     |                       | 6.7  | 10.5 | 1.0                             | 12.0 |       |
| t <sub>OSLH</sub> , t <sub>OSHL</sub> | Output to Output Skew           | 3.3 ± 0.3           | (3) C <sub>L</sub> = 50pF |                       |      | 1.5  |                                 | 1.5  | ns    |
|                                       |                                 | 5.0 ± 0.5           | C <sub>L</sub> = 50pF     |                       |      | 1.0  |                                 | 1.0  |       |
| C <sub>IN</sub>                       | Input Capacitance               |                     | V <sub>CC</sub> = Open    |                       | 4.0  | 10.0 |                                 | 10.0 | pF    |
| C <sub>PD</sub>                       | Power Dissipation Capacitance   |                     | (4)                       |                       | 31   |      |                                 |      | pF    |

## Notes:

3. Parameter guaranteed by design  $t_{OSLH} = |t_{PLHmax} - t_{PLHmin}|$ ;  $t_{OSHL} = |t_{PHLmax} - t_{PHLmin}|$ .
4. 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 from the equation:  
 $I_{CC} (opr.) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC} / 8$  (per F/F). The total C<sub>PD</sub> when n pieces of the Flip-Flop operates can be calculated by the equation: C<sub>PD</sub> (total) = 22 + 9n.

## AC Operating Requirements

| Symbol                                 | Parameter                                | V <sub>CC</sub> (V) <sup>(5)</sup> | T <sub>A</sub> = 25°C |                    | T <sub>A</sub> = −40°C to +85°C | Units |
|----------------------------------------|------------------------------------------|------------------------------------|-----------------------|--------------------|---------------------------------|-------|
|                                        |                                          |                                    | Typ.                  | Guaranteed Minimum |                                 |       |
| t <sub>W</sub> (L), t <sub>W</sub> (H) | Minimum Pulse Width (CK)                 | 3.3                                |                       | 5.5                | 6.5                             | ns    |
|                                        |                                          | 5.0                                |                       | 5.0                | 5.0                             |       |
| t <sub>W</sub> (L)                     | Minimum Pulse Width ( $\overline{MR}$ )  | 3.3                                |                       | 5.0                | 6.0                             | ns    |
|                                        |                                          | 5.0                                |                       | 5.0                | 5.0                             |       |
| t <sub>S</sub>                         | Minimum Setup Time                       | 3.3                                |                       | 5.5                | 6.5                             | ns    |
|                                        |                                          | 5.0                                |                       | 4.5                | 4.5                             |       |
| t <sub>H</sub>                         | Minimum Hold Time                        | 3.3                                |                       | 1.0                | 1.0                             | ns    |
|                                        |                                          | 5.0                                |                       | 1.0                | 1.0                             |       |
| t <sub>REC</sub>                       | Minimum Removal Time ( $\overline{MR}$ ) | 3.3                                |                       | 2.5                | 2.5                             | ns    |
|                                        |                                          | 5.0                                |                       | 2.0                | 2.0                             |       |

## Note:

5. V<sub>CC</sub> is 3.3 ± 0.3V or 5.0 ± 0.5V

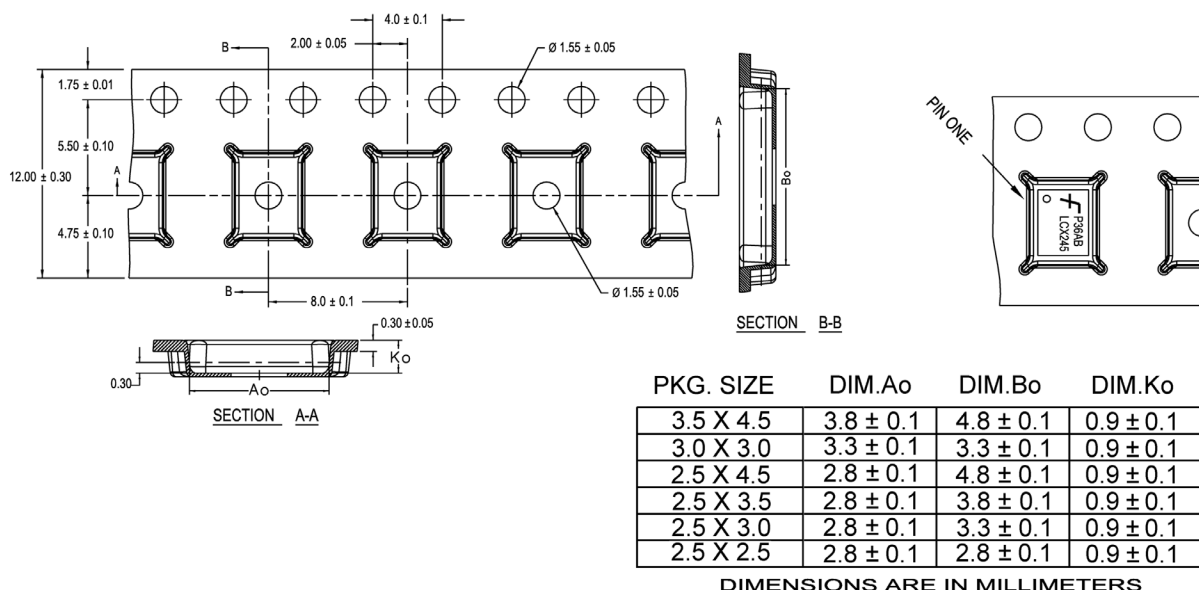
## Tape and Reel Specification

### Tape Format for DQFN

| Package Designator | Tape Section       | Number Cavities | Cavity Status | Cover Tape Status |
|--------------------|--------------------|-----------------|---------------|-------------------|
| BQ                 | Leader (Start End) | 125 (typ.)      | Empty         | Sealed            |
|                    | Carrier            | 2500/3000       | Filled        | Sealed            |
|                    | Trailer (Hub End)  | 75 (typ.)       | Empty         | Sealed            |

### Tape Dimensions

Dimensions are in millimeters unless otherwise noted.



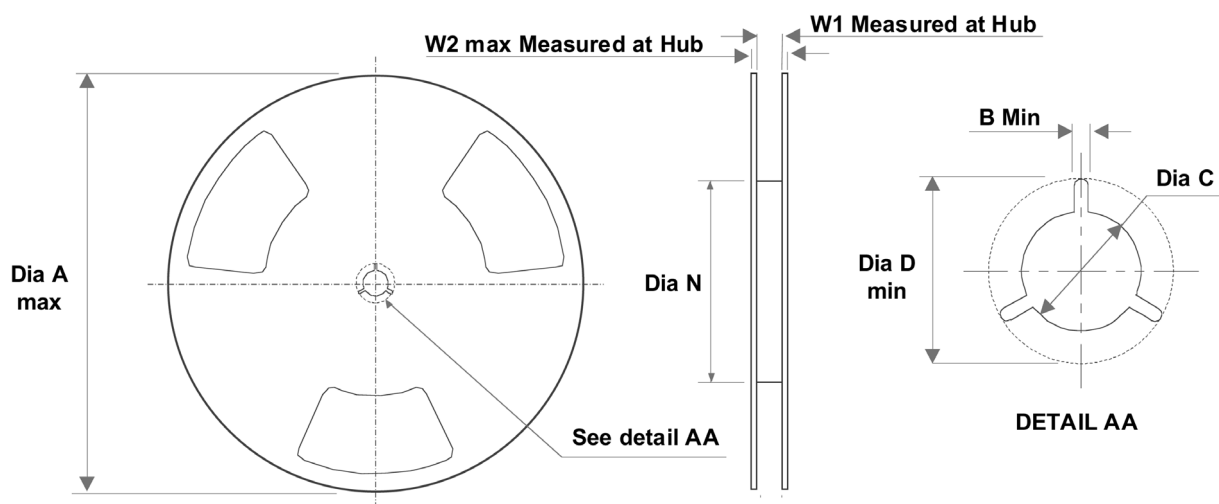
NOTES: unless otherwise specified

1. Cumulative pitch for feeding holes and cavities (chip pockets) not to exceed 0.008[0.20] over 10 pitch span.
2. Smallest allowable bending radius.
3. Thru hole inside cavity is centered within cavity.
4. Tolerance is  $\pm 0.002[0.05]$  for these dimensions on all 12mm tapes.
5. Ao and Bo measured on a plane 0.120[0.30] above the bottom of the pocket.
6. Ko measured from a plane on the inside bottom of the pocket to the top surface of the carrier.
7. Pocket position relative to sprocket hole measured as true position of pocket. Not pocket hole.
8. Controlling dimension is millimeter. Dimension in inches rounded.

Figure 2.

**Tape and Reel Specification** (Continued)**Reel Dimensions for DQFN**

Dimensions are in inches (millimeters) unless otherwise noted.

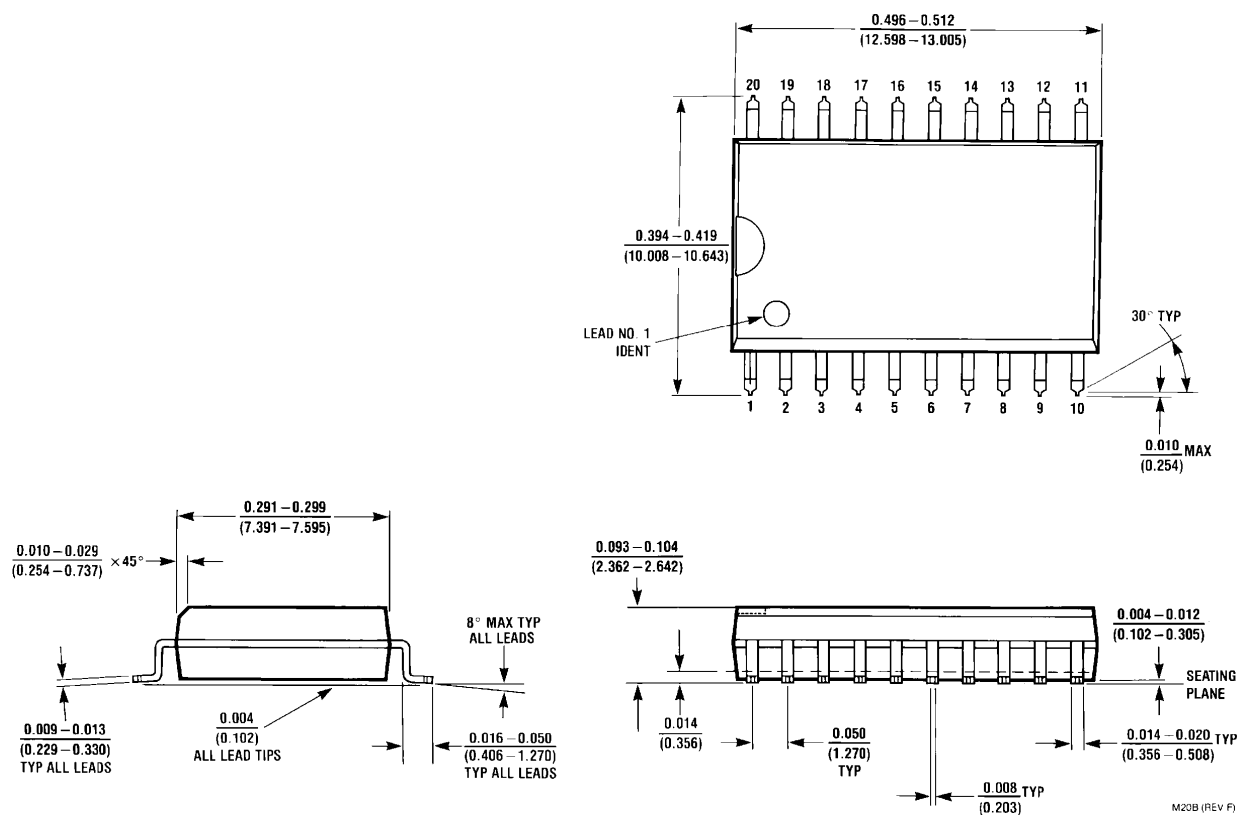


| Tape Size | A             | B               | C                | D                | N              | W1              | W2              |
|-----------|---------------|-----------------|------------------|------------------|----------------|-----------------|-----------------|
| 12mm      | 13.0<br>(330) | 0.059<br>(1.50) | 0.512<br>(13.00) | 0.795<br>(20.20) | 7.008<br>(178) | 0.488<br>(12.4) | 0.724<br>(18.4) |

**Figure 3.**

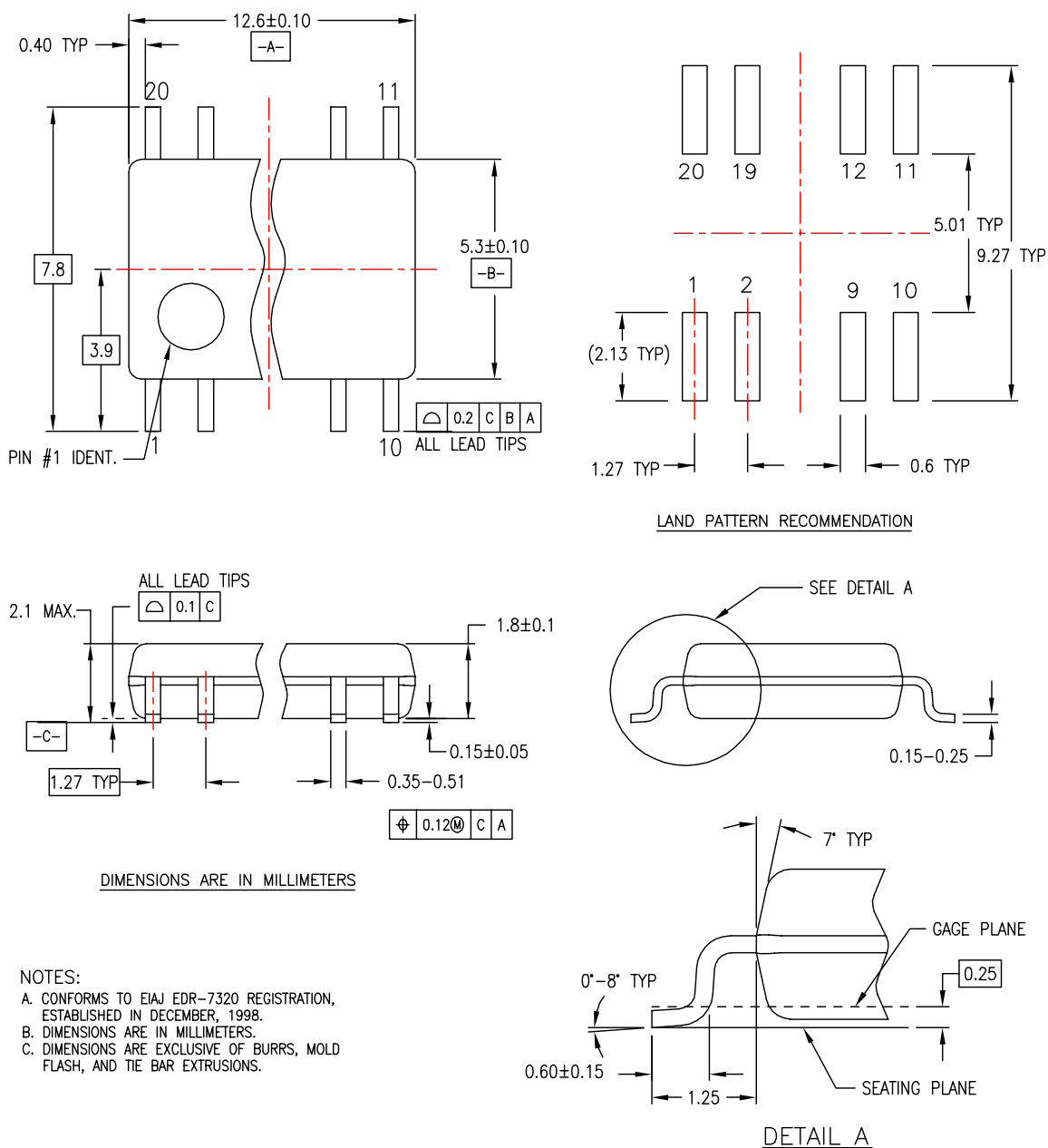
## Physical Dimensions

Dimensions are in inches (millimeters) unless otherwise noted.



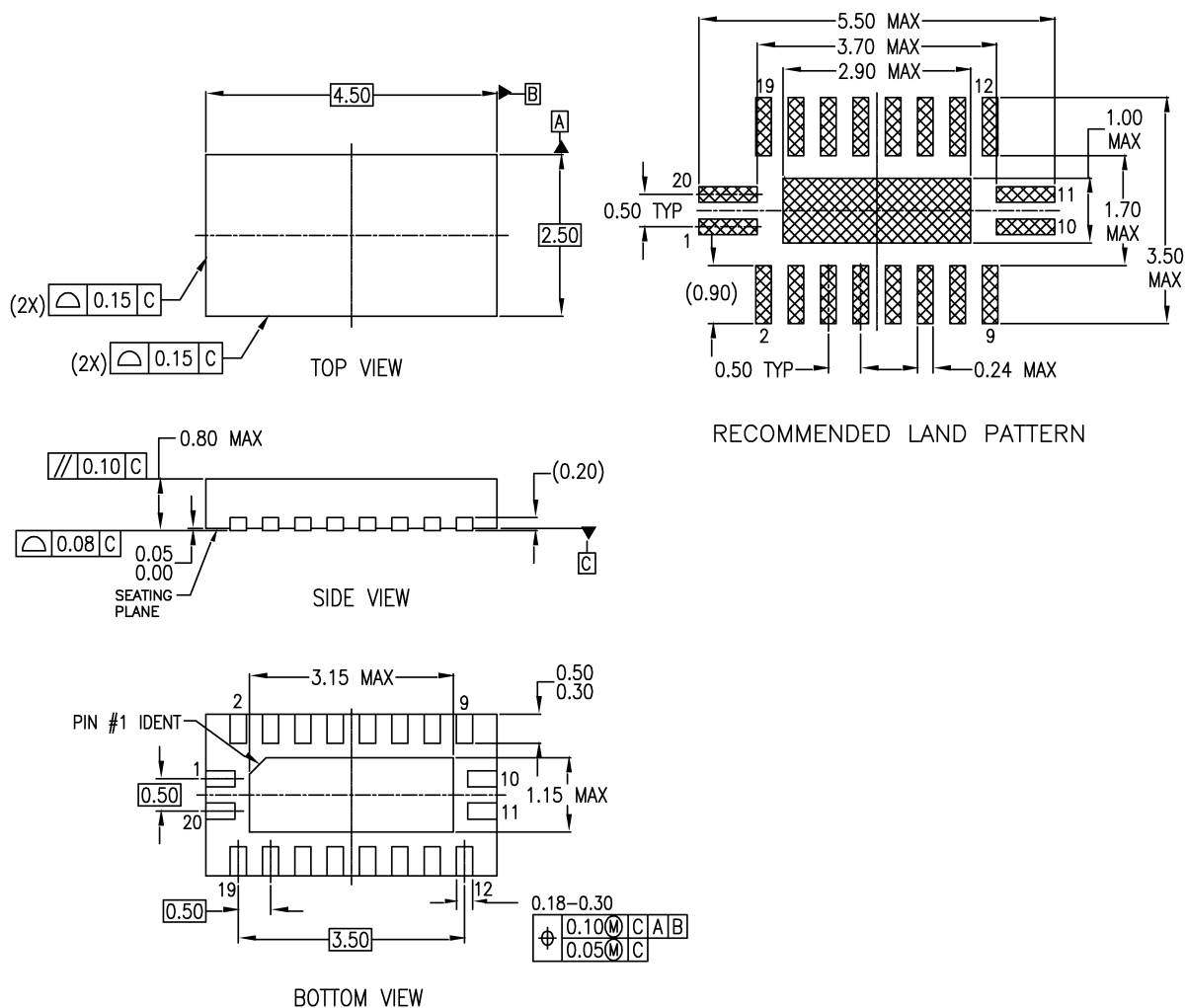
**Figure 4. 20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide  
Package Number M20B**

Dimensions are in millimeters unless otherwise noted.



### Physical Dimensions (Continued)

Dimensions are in millimeters unless otherwise noted.



NOTES:

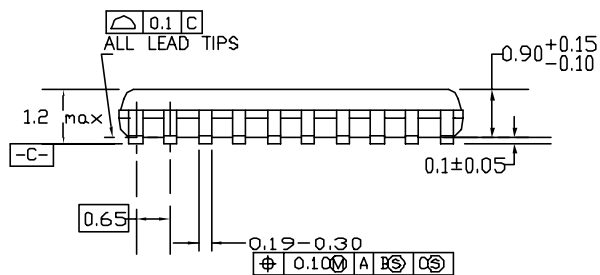
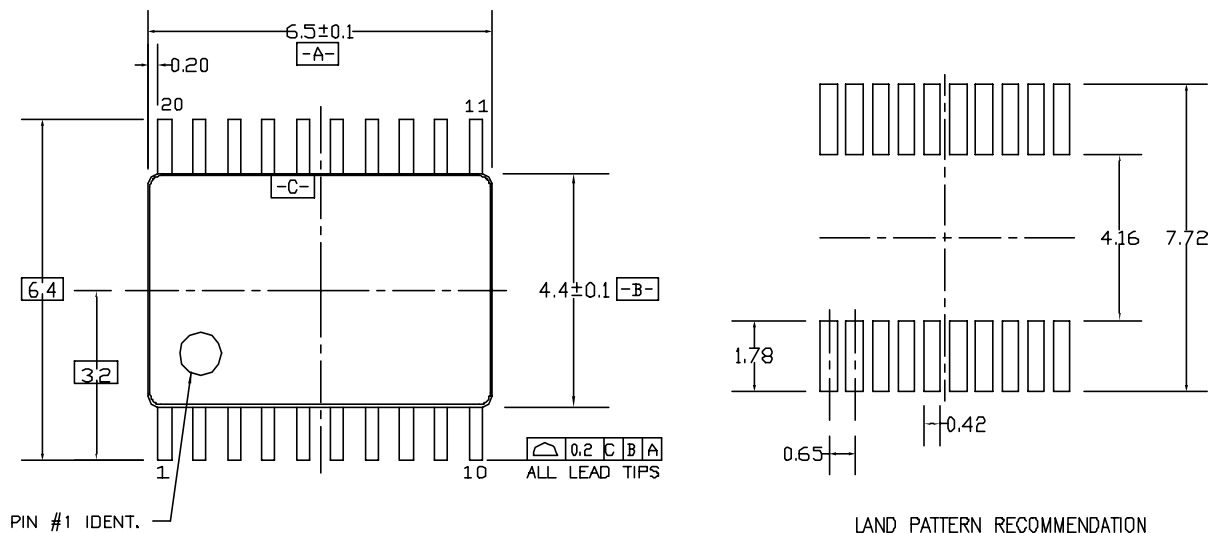
- A. CONFORMS TO JEDEC REGISTRATION  
MO-241, VARIATION AC
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS AND TOLERANCES PER  
ASME Y14.5M, 1994

MLP020BrevA

**Figure 6. 20-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN), JEDEC MO-241, 2.5 x 4.5mm  
Package Number MLP020B (Preliminary)**

# Physical Dimensions (Continued)

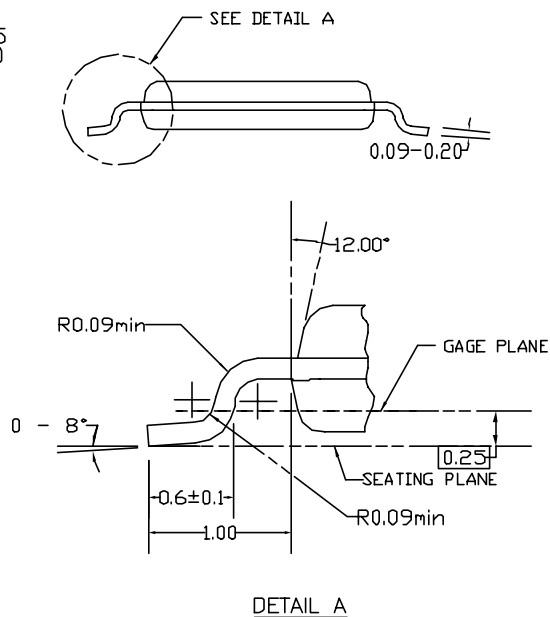
Dimensions are in millimeters unless otherwise noted.



DIMENSIONS ARE IN MILLIMETERS

## NOTES:

- CONFORMS TO JEDEC REGISTRATION MD-153, VARIATION AC, REF NOTE 6, DATE 7/93.
- DIMENSIONS ARE IN MILLIMETERS.
- DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLDS FLASH, AND TIE BAR EXTRUSIONS.
- DIMENSIONS AND TOLERANCES PER ANSI Y14.5M, 1982.



MTC20REV D1

**Figure 7. 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> | QS <sup>™</sup>                                                                     | TinyPower <sup>™</sup>      |
| Bottomless <sup>™</sup>                          | IntelliMAX <sup>™</sup>        | QT Optoelectronics <sup>™</sup>                                                     | TinyWire <sup>™</sup>       |
| Build it Now <sup>™</sup>                        | ISOPLANAR <sup>™</sup>         | Quiet Series <sup>™</sup>                                                           | TruTranslation <sup>™</sup> |
| CoolFET <sup>™</sup>                             | MICROCOUPLER <sup>™</sup>      | RapidConfigure <sup>™</sup>                                                         | μSerDes <sup>™</sup>        |
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| CTL <sup>™</sup>                                 | MICROWIRE <sup>™</sup>         | ScalarPump <sup>™</sup>                                                             | UniFET <sup>™</sup>         |
| Current Transfer Logic <sup>™</sup>              | MSX <sup>™</sup>               | SMART START <sup>™</sup>                                                            | VCX <sup>™</sup>            |
| DOVE <sup>™</sup>                                | MSXPro <sup>™</sup>            | SPM <sup>®</sup>                                                                    | Wire <sup>™</sup>           |
| E <sup>2</sup> CMOS <sup>™</sup>                 | OCX <sup>™</sup>               | STEALTH <sup>™</sup>                                                                |                             |
| EcoSPARK <sup>®</sup>                            | OCXPro <sup>™</sup>            | SuperFET <sup>™</sup>                                                               |                             |
| EnSigna <sup>™</sup>                             | OPTOLOGIC <sup>®</sup>         | SuperSOT <sup>™</sup> -3                                                            |                             |
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| FAST <sup>®</sup>                                | POP <sup>™</sup>               | SyncFET <sup>™</sup>                                                                |                             |
| FASTr <sup>™</sup>                               | Power220 <sup>®</sup>          | TCM <sup>™</sup>                                                                    |                             |
| FPS <sup>™</sup>                                 | Power247 <sup>®</sup>          | The Power Franchise <sup>®</sup>                                                    |                             |
| FRFET <sup>®</sup>                               | PowerEdge <sup>™</sup>         |  ™ |                             |
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