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74VHC112

Dual J-K Flip-Flops with Preset and Clear

Features

- High speed: $f_{MAX} = 200\text{MHz}$ (Typ.) at $V_{CC} = 5.0\text{V}$
- Low power dissipation: $I_{CC} = 2\mu\text{A}$ (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
- Pin and function compatible with 74HC112

General Description

The VHC112 is an advanced high speed CMOS device 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 VHC112 contains two independent, high-speed JK flip-flops with Direct Set and Clear inputs. Synchronous state changes are initiated by the falling edge of the clock and is not directly related to transition time. The J and K inputs can change when the clock is in either state without affecting the flip-flop, provided that they are in the desired state during the recommended setup and hold times relative to the falling edge of the clock. The LOW signal on PR or CLR prevents clocking and forces Q and \bar{Q} HIGH, respectively. Simultaneous LOW signals on PR and CLR force both Q and \bar{Q} HIGH.

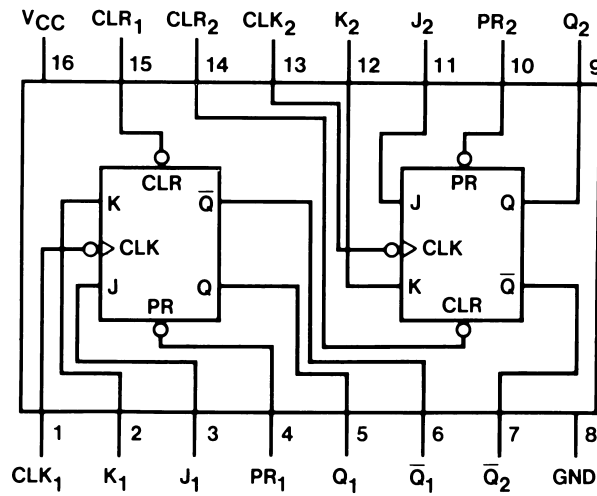
An input protection circuit ensures that 0V to 7V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5V to 3V systems and two supply systems such as battery backup. This circuit prevents device destruction due to mismatched supply and input voltages.

Ordering Information

| Order Number | Package Number | Package Description |
|--------------|----------------|--|
| 74VHC112M | M16A | 16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow |
| 74VHC112SJ | M16D | 16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide |
| 74VHC112MTC | MTC16 | 16-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.

Connection Diagram



Truth Table

| Inputs | | | | | Outputs | |
|--------|-----|-----------------|---|---|------------------|------------------|
| PR | CLR | \overline{CP} | J | K | Q | \overline{Q} |
| L | H | X | X | X | H | L |
| H | L | X | X | X | L | H |
| L | L | X | X | X | H | H |
| H | H | \sim | h | h | $\overline{Q_0}$ | Q_0 |
| H | H | \sim | l | h | L | H |
| H | H | \sim | h | l | H | L |
| H | H | \sim | l | l | Q_0 | $\overline{Q_0}$ |

H (h) = HIGH Voltage Level

L (l) = LOW Voltage Level

X = Immaterial

\sim = HIGH-to-LOW Clock Transition

Q_0 ($\overline{Q_0}$) = Before HIGH-to-LOW Transition of Clock

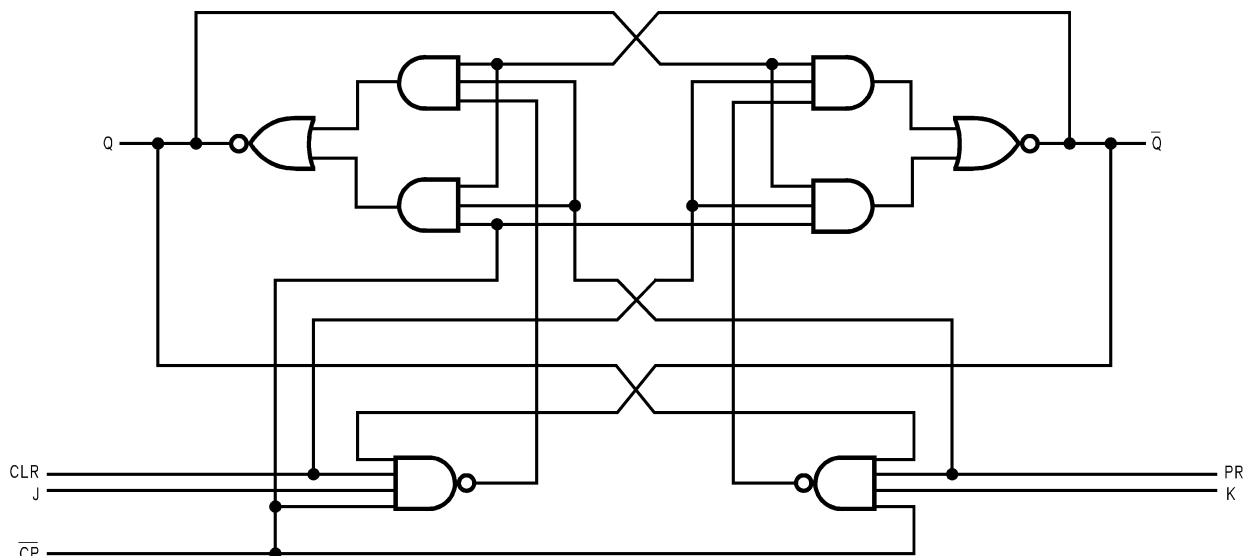
Lower case letters indicate the state of the referenced input or output one setup time prior to the HIGH-to-LOW clock transition.

Pin Description

| Pin Names | Description |
|---|--|
| J ₁ , J ₂ , K ₁ , K ₂ | Data Inputs |
| CLK ₁ , CLK ₂ | Clock Pulse Inputs (Active Falling Edge) |
| CLR ₁ , CLR ₂ | Direct Clear Inputs (Active LOW) |
| PR ₁ , PR ₂ | Direct Preset Inputs (Active LOW) |
| Q ₁ , Q ₂ , $\overline{Q_1}$, $\overline{Q_2}$ | Outputs |

Logic Diagram

(One Half Shown)



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 | $\pm 20mA$ |
| I_{OUT} | DC Output Current | $\pm 25mA$ |
| I_{CC} | DC V_{CC} / GND Current | $\pm 50mA$ |
| T_{STG} | Storage Temperature | -65°C to +150°C |
| T_L | Lead Temperature (Soldering, 10 seconds) | 260°C |

Recommended Operating Conditions⁽¹⁾

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, $V_{CC} = 3.3V \pm 0.3V$ $V_{CC} = 5.0V \pm 0.5V$ | 0ns/V ~ 100ns/V 0ns/V ~ 20ns/V |

Note:

1. Unused inputs must be held HIGH or LOW. They may not float.

DC Electrical Characteristics

| Symbol | Parameter | V_{CC} (V) | Conditions | $T_A = 25^\circ\text{C}$ | | | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ | | Units | | | |
|----------|---------------------------|--------------|----------------------------------|---------------------------|------|------------------------|---|---------------------|---------------|---|------|--|
| | | | | Min. | Typ. | Max. | Min. | Max. | | | | |
| V_{IH} | HIGH Level Input Voltage | 2.0 | | 1.50 | | | 1.50 | | V | | | |
| | | 3.0–5.5 | | $0.7 \times V_{CC}$ | | | $0.7 \times V_{CC}$ | | | | | |
| V_{IL} | LOW Level Input Voltage | 2.0 | | | | 0.50 | | 0.50 | V | | | |
| | | 3.0–5.5 | | | | $0.3 \times V_{CC}$ | | $0.3 \times V_{CC}$ | | | | |
| V_{OH} | HIGH Level Output Voltage | 2.0 | $V_{IN} = V_{IH}$ or V_{IL} | $I_{OH} = -50\mu\text{A}$ | 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 | | | | $I_{OH} = -4\text{mA}$ | 2.58 | | | | 2.48 | |
| | | 4.5 | | | | $I_{OH} = -8\text{mA}$ | 3.94 | | | | 3.80 | |
| V_{OL} | LOW Level Output Voltage | 2.0 | $V_{IN} = V_{IH}$ or V_{IL} | $I_{OL} = 50\mu\text{A}$ | | 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 | | | | $I_{OL} = 4\text{mA}$ | | 0.36 | | | 0.44 | |
| | | 4.5 | | | | $I_{OL} = 8\text{mA}$ | | 0.36 | | | 0.44 | |
| I_{IN} | Input Leakage Current | 0–5.5 | $V_{IN} = 5.5\text{V or GND}$ | | | ± 0.1 | | ± 1.0 | μA | | | |
| I_{CC} | Quiescent Supply Current | 5.5 | $V_{IN} = V_{CC}$ or GND | | | 2.0 | | 20.0 | μA | | | |

AC Electrical Characteristics

| Symbol | Parameter | V _{CC} (V) | Conditions | T _A = 25°C | | | T _A = -40°C to +85°C | | Units |
|-------------------------------------|--|---------------------|------------------------|-----------------------|------|------|---------------------------------|------|-------|
| | | | | Min. | Typ. | Max. | Min. | Max. | |
| f _{MAX} | Maximum Clock Frequency | 3.3 ± 0.3 | C _L = 15pF | 110 | 150 | | 100 | | MHz |
| | | | C _L = 50pF | 90 | 120 | | 80 | | |
| | | 5.0 ± 0.5 | C _L = 15pF | 150 | 200 | | 135 | | MHz |
| | | | C _L = 50pF | 120 | 185 | | 110 | | |
| t _{PLH} , t _{PHL} | Propagation Delay Time (CP to Q _n or \bar{Q}_n) | 3.3 ± 0.3 | C _L = 15pF | | 8.5 | 11.0 | 1.0 | 13.4 | ns |
| | | | C _L = 50pF | | 10.0 | 15.0 | 1.0 | 16.5 | |
| | | 5.0 ± 0.5 | C _L = 15pF | | 5.1 | 7.3 | 1.0 | 8.8 | ns |
| | | | C _L = 50pF | | 6.3 | 10.5 | 1.0 | 12.0 | |
| t _{PLH} , t _{PHL} | Propagation Delay Time (PR or CLR to Q _n or \bar{Q}_n) | 3.3 ± 0.3 | C _L = 15pF | | 6.7 | 10.2 | 1.0 | 11.7 | ns |
| | | | C _L = 50pF | | 9.7 | 13.5 | 1.0 | 15.0 | |
| | | 5.0 ± 0.5 | C _L = 15pF | | 4.6 | 6.7 | 1.0 | 8.0 | ns |
| | | | C _L = 50pF | | 6.4 | 9.5 | 1.0 | 11.0 | |
| C _{IN} | Input Capacitance | | V _{CC} = Open | | 4 | 10 | | 10 | pF |
| C _{PD} | Power Dissipation Capacitance | | (2) | | 18 | | | | pF |

Note:

2. 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 from the equation:
 $I_{CC}(\text{opr.}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC} / 4$ (per F/F), and the total C_{PD} when n pcs of the Flip-Flop operate can be calculated by the following equation: $C_{PD}(\text{total}) = 30 + 14 \cdot n$

AC Operating Requirements

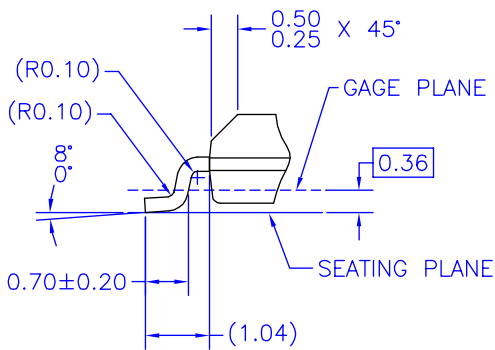
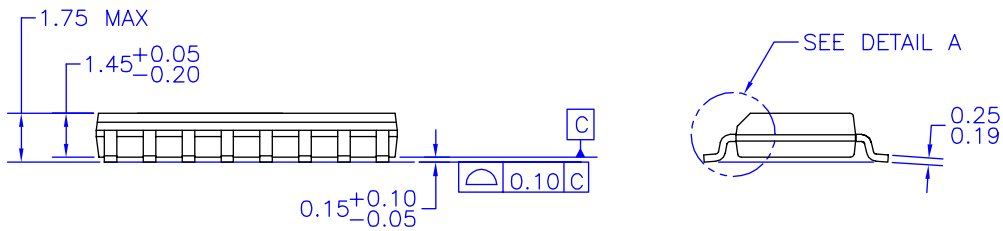
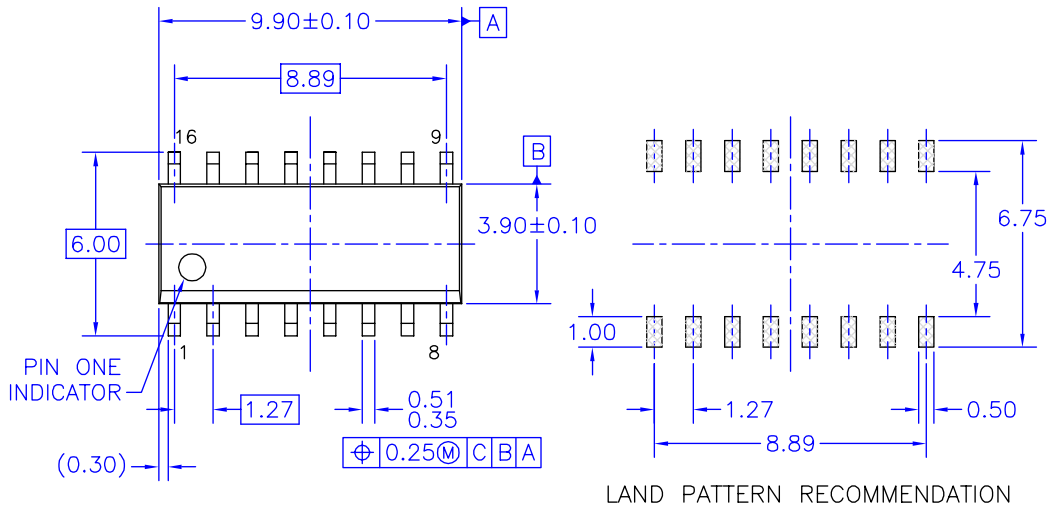
| Symbol | Parameter | V _{CC} (V) ⁽³⁾ | T _A = 25°C | | T _A = -40°C to +85°C | | Units |
|------------------|---|------------------------------------|-----------------------|--------------------|---------------------------------|----|-------|
| | | | Typ. | Guaranteed Minimum | | | |
| t _W | Minimum Pulse Width (CP or CLR or PR) | 3.3 | | 5.0 | 5.0 | ns | |
| | | 5.0 | | 5.0 | 5.0 | | |
| t _S | Minimum Setup Time (J _n or K _n to CP _n) | 3.3 | | 5.0 | 5.0 | ns | |
| | | 5.0 | | 4.0 | 4.0 | | |
| t _H | Minimum Hold Time (J _n or K _n to CP _n) | 3.3 | | 1.0 | 1.0 | ns | |
| | | 5.0 | | 1.0 | 1.0 | | |
| t _{REC} | Minimum Recovery Time (CLR or PR to CP) | 3.3 | | 6.0 | 6.0 | ns | |
| | | 5.0 | | 5.0 | 5.0 | | |

Note:

3. V_{CC} is 3.3 ± 0.3V or 5.0 ± 0.5V.

Physical Dimensions

Dimensions are in millimeters unless otherwise noted.



DETAIL A
SCALE: 2:1

NOTES: UNLESS OTHERWISE SPECIFIED

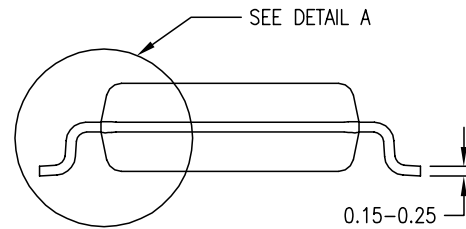
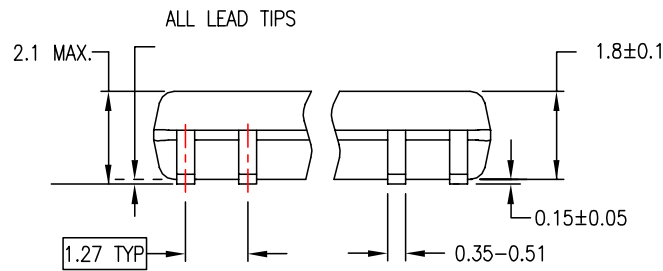
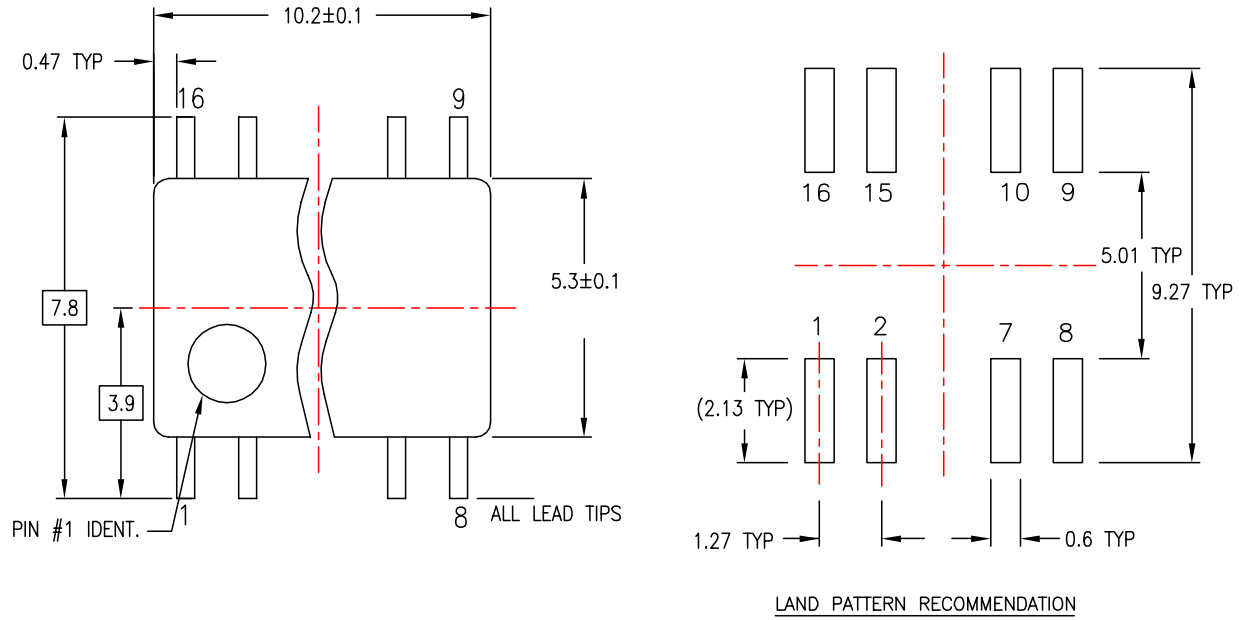
- A) THIS PACKAGE CONFORMS TO JEDEC MS-012, VARIATION AC, ISSUE C, DATED MAY 1990.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS DO NOT INCLUDE MOLD FLASH OR BURRS.
- D) STANDARD LEAD FINISH:
200 MICRONS / 5.08 MICRONS MIN.
LEAD/TIN (SOLDER) ON COPPER.

M16AREVK

Figure 1. 16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow Package Number M16A

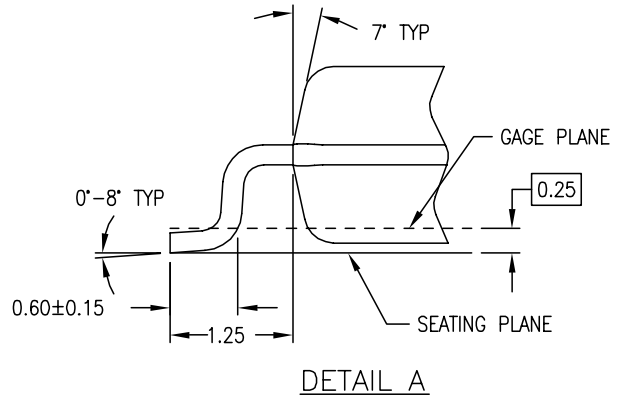
Physical Dimensions (Continued)

Dimensions are in millimeters unless otherwise noted.



NOTES:

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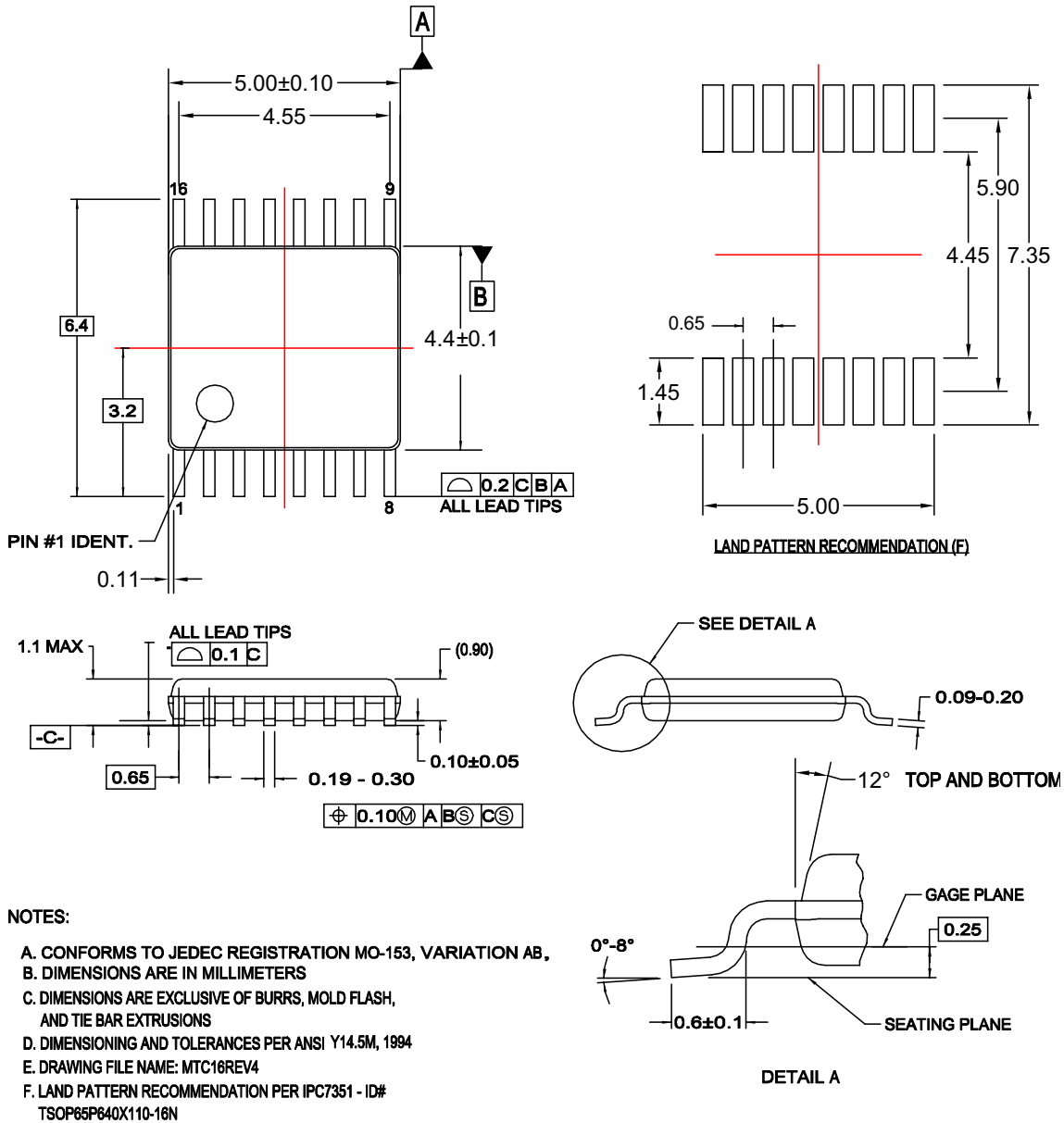


M16DREVC

Figure 2. 16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide Package Number M16D

Physical Dimensions (Continued)

Dimensions are in millimeters unless otherwise noted.




MTC16rev4

Figure 3. 16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide Package Number MTC16



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