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April 2015

74LCX157

Low Voltage Quad 2-Input Multiplexer with 5 V Tolerant Inputs

Features

- 5 V Tolerant Inputs
- 2.3 V – 3.6 V, V_{CC} Specifications Provided
- 5.8 ns t_{PD} max. ($V_{CC} = 3.3$ V), 10 μ A I_{CC} max.
- Power Down High Impedance Inputs and Outputs
- ± 24 mA Output Drive ($V_{CC} = 3.0$ V)
- Implements Patented Noise/EMI Reduction Circuitry
- Latch-Up Performance Exceeds 500 mA
- ESD Performance:
 - Human Body Model > 2000 V
 - Machine Model > 200 V

General Description

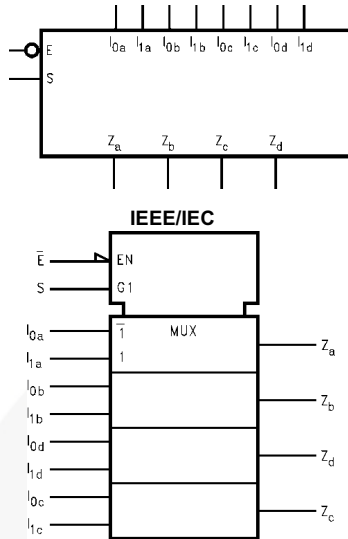
The LCX157 is a high-speed quad 2-input multiplexer. Four bits of data from two sources can be selected using the common Select and Enable inputs. The four outputs present the selected data in the true (noninverted) form. The LCX157 can also be used as a function generator. The 74LCX157 is fabricated with advanced CMOS technology to achieve high speed operation while maintaining CMOS low power dissipation.

Ordering Information

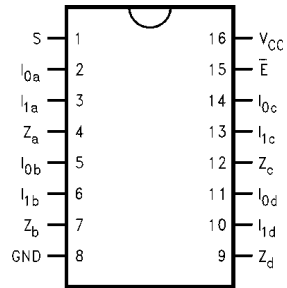
| Part Number | Top Mark | Package | Packing Method |
|--------------|----------|-----------|----------------|
| 74LCX157M | LCX157 | SOIC 16L | Rail |
| 74LCX157MX | LCX157 | SOIC 16L | Tape and Reel |
| 74LCX157MTC | LCX157 | TSSOP 16L | Rail |
| 74LCX157MTCX | LCX157 | TSSOP 16L | Tape and Reel |

74LCX157 — Low Voltage Quad 2-Input Multiplexer with 5 V Tolerant Inputs

Logic Symbols



Connection Diagram



Pin Descriptions

| Pin Names | Description |
|----------------------------------|----------------------|
| I _{0a} -I _{0d} | Source 0 Data Inputs |
| I _{1a} -I _{1d} | Source 1 Data Inputs |
| \bar{E} | Enable Input |
| S | Select Input |
| Z _a -Z _d | Outputs |

Functional Description

The LCX157 is a quad 2-input multiplexer. It selects four bits of data from two sources under the control of a common Select input (S). The Enable input (\bar{E}) is active-LOW. When \bar{E} is HIGH, all of the outputs (Z) are forced LOW regardless of all other inputs. The LCX157 is the logic implementation of a 4-pole, 2-position switch where the position of the switch is determined by the logic levels supplied to the Select input. The logic equations for the outputs are shown below:

$$Z_a = \bar{E} \cdot (I_{1a} \cdot S + I_{0a} \cdot \bar{S})$$

$$Z_b = \bar{E} \cdot (I_{1b} \cdot S + I_{0b} \cdot \bar{S})$$

$$Z_c = \bar{E} \cdot (I_{1c} \cdot S + I_{0c} \cdot \bar{S})$$

$$Z_d = \bar{E} \cdot (I_{1d} \cdot S + I_{0d} \cdot \bar{S})$$

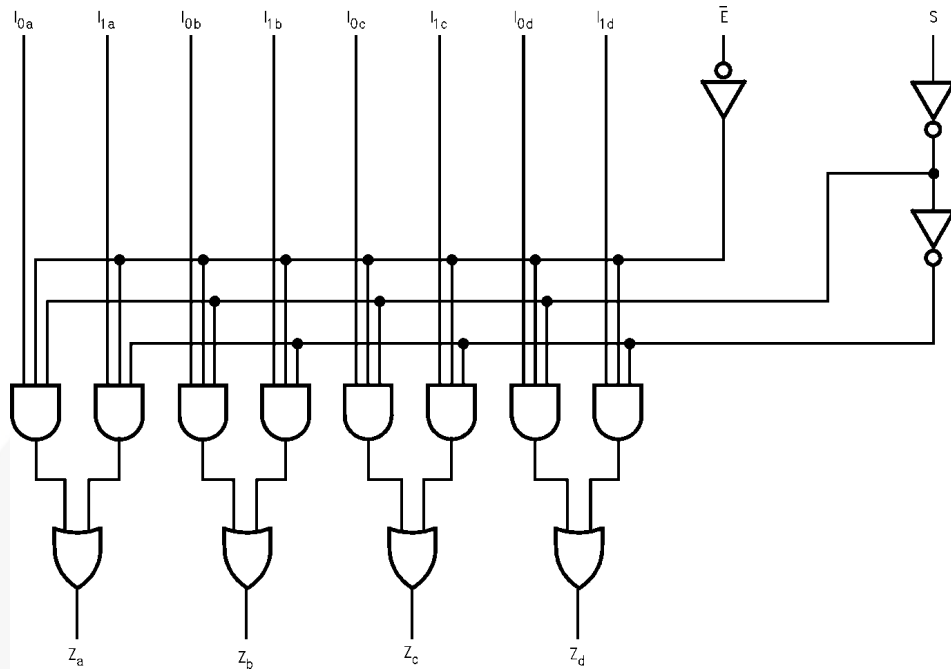
A common use of the LCX157 is the moving of data from two groups of registers to four common output busses. The particular register from which the data comes is determined by the state of the Select input. A less obvious use is as a function generator. The LCX157 can generate any four of the sixteen different functions of two variables with one variable common. This is useful for implementing gating functions.

Truth Table

| Inputs | | | | Outputs |
|-----------|---|----------------|----------------|---------|
| \bar{E} | S | I ₀ | I ₁ | Z |
| H | X | X | X | L |
| L | H | X | L | L |
| L | H | X | H | H |
| L | L | L | X | L |
| L | L | H | X | H |

H = HIGH Voltage Level
 L = LOW Voltage Level
 X = Immaterial

Logic Diagram⁽¹⁾



Note:

1. 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⁽²⁾

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 | Value | Conditions | Unit |
|-----------|----------------------------------|----------------------|--|-------------|
| V_{CC} | Supply Voltage | -0.5 to +7.0 | | V |
| V_I | DC Input Voltage | -0.5 to +7.0 | | V |
| V_O | DC Output Voltage | -0.5 to $V_{CC}+0.5$ | Output in HIGH or LOW State ⁽³⁾ | V |
| I_{IK} | DC Input Diode Current | -50 | $V_I < GND$ | mA |
| I_{OK} | DC Output Diode Current | -50 | $V_O < GND$ | mA |
| | | +50 | $V_O > V_{CC}$ | |
| I_O | DC Output Source/Sink Current | ± 50 | | mA |
| I_{CC} | DC Supply Current per Supply Pin | ± 100 | | mA |
| I_{GND} | DC Ground Current per Ground Pin | ± 100 | | mA |
| T_{STG} | Storage Temperature | -65 to +150 | | $^{\circ}C$ |

Notes:

- The Absolute Maximum Ratings are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the Absolute Maximum Ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.
- I_O Absolute Maximum Rating must be observed.

Recommended Operating Conditions⁽⁴⁾

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 | | Min. | Max. | Unit |
|---------------------|---|--|------|----------|--------------------|
| V_{CC} | Supply Voltage | Operating | 2.0 | 3.6 | V |
| V_{IN} | Input Voltage | | 0 | 5.5 | V |
| V_{OUT} | Output Voltage | HIGH or LOW State | 0 | V_{CC} | V |
| I_{OH}/I_{OL} | Output Current | $V_{CC} = 3.0\text{ V} - 3.6\text{ V}$ | | ± 24 | mA |
| | | $V_{CC} = 2.7\text{ V} - 3.0\text{ V}$ | | ± 12 | |
| | | $V_{CC} = 2.3\text{ V} - 2.7\text{ V}$ | | ± 8 | |
| T_A | Free-Air Operating Temperature | | -40 | 85 | $^{\circ}\text{C}$ |
| $\Delta t/\Delta V$ | Input Edge Rate, $V_{IN} = 0.8\text{ V} - 2.0\text{ V}$, $V_{CC} = 3.0\text{ V}$ | | 0 | 10 | ns/V |

Note:

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

DC Electrical Characteristics

| Symbol | Parameter | Conditions | V_{CC} (V) | $T_A = -40$ to $+85^{\circ}\text{C}$ | | Unit |
|-----------------|--------------------------------|---|--------------|--------------------------------------|-----------|---------------|
| | | | | Min. | Max. | |
| V_{IH} | HIGH Level Input Voltage | | 2.3 - 2.7 | 1.7 | | V |
| | | | 2.7 - 3.6 | 2.0 | | |
| V_{IL} | LOW Level Input Voltage | | 2.3 - 2.7 | | 0.7 | V |
| | | | 2.7 - 3.6 | | 0.8 | |
| V_{OH} | HIGH Level Output Voltage | $I_{OH} = -100\ \mu\text{A}$ | 2.3 - 3.6 | $V_{CC} - 0.2$ | | V |
| | | $I_{OH} = -8\ \text{mA}$ | 2.3 | 1.8 | | |
| | | $I_{OH} = -12\ \text{mA}$ | 2.7 | 2.2 | | |
| | | $I_{OH} = -18\ \text{mA}$ | 3.0 | 2.4 | | |
| | | $I_{OH} = -24\ \text{mA}$ | 3.0 | 2.2 | | |
| V_{OL} | LOW Level Output Voltage | $I_{OL} = 100\ \mu\text{A}$ | 2.3 - 3.6 | | 0.2 | V |
| | | $I_{OL} = 8\ \text{mA}$ | 2.3 | | 0.6 | |
| | | $I_{OL} = 12\ \text{mA}$ | 2.7 | | 0.4 | |
| | | $I_{OL} = 16\ \text{mA}$ | 3.0 | | 0.4 | |
| | | $I_{OL} = 24\ \text{mA}$ | 3.0 | | 0.55 | |
| I_I | Input Leakage Current | $0 \leq V_I \leq 5.5\text{ V}$ | 2.3 - 3.6 | | ± 5.0 | μA |
| I_{OFF} | Power-Off Leakage Current | V_I or $V_O = 5.5\text{ V}$ | 0 | | 10 | μA |
| I_{CC} | Quiescent Supply Current | $V_I = V_{CC}$ or GND | 2.3 - 3.6 | | 10 | μA |
| | | $3.6\text{ V} \leq V_I \leq 5.5\text{ V}$ | 2.3 - 3.6 | | ± 10 | |
| ΔI_{CC} | Increase in I_{CC} per Input | $V_{IH} = V_{CC} - 0.6\text{ V}$ | 2.3 - 3.6 | | 500 | μA |

AC Electrical Characteristics

| Symbol | Parameter | $T_A = -40 \text{ to } +85^\circ\text{C}, R_L = 500 \Omega$ | | | | | | Unit |
|------------|--------------------------------------|---|------|--------------------------|------|--|------|------|
| | | $V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$ | | $V_{CC} = 2.7 \text{ V}$ | | $V_{CC} = 2.5 \text{ V} \pm 0.2 \text{ V}$ | | |
| | | $C_L = 50 \text{ pF}$ | | $C_L = 50 \text{ pF}$ | | $C_L = 30 \text{ pF}$ | | |
| | | Min. | Max. | Min. | Max. | Min. | Max. | |
| t_{PHL} | Propagation Delay | 1.5 | 7.0 | 1.5 | 8.0 | 1.5 | 8.4 | ns |
| t_{PLH} | S \rightarrow Z_n | 1.5 | 7.0 | 1.5 | 8.0 | 1.5 | 8.4 | |
| t_{PHL} | Propagation Delay | 1.5 | 7.0 | 1.5 | 8.0 | 1.5 | 8.4 | ns |
| t_{PLH} | $\bar{E} \rightarrow Z_n$ | 1.5 | 7.0 | 1.5 | 8.0 | 1.5 | 8.4 | |
| t_{PHL} | Propagation Delay | 1.5 | 5.8 | 1.5 | 6.3 | 1.5 | 7.0 | ns |
| t_{PLH} | $I_n \rightarrow Z_n$ | 1.5 | 5.8 | 1.5 | 6.3 | 1.5 | 7.0 | |
| t_{OSHL} | Output to Output Skew ⁽⁵⁾ | | 1.0 | | | | | ns |
| t_{OSLH} | | | 1.0 | | | | | |

Note:

5. Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH-to-LOW (t_{OSHL}) or LOW-to-HIGH (t_{OSLH}). Parameter guaranteed by design.

Dynamic Switching Characteristics

| Symbol | Parameter | Conditions | V_{CC} (V) | $T_A = 25^\circ\text{C}$ | Unit |
|-----------|--------------------------------------|---|--------------|--------------------------|------|
| | | | | Typical | |
| V_{OLP} | Quiet Output Dynamic Peak V_{OL} | $C_L = 50 \text{ pF}, V_{IH} = 3.3 \text{ V}, V_{IL} = 0 \text{ V}$ | 3.3 | 0.8 | V |
| | | $C_L = 30 \text{ pF}, V_{IH} = 2.5 \text{ V}, V_{IL} = 0 \text{ V}$ | 2.5 | 0.6 | |
| V_{OLV} | Quiet Output Dynamic Valley V_{OL} | $C_L = 50 \text{ pF}, V_{IH} = 3.3 \text{ V}, V_{IL} = 0 \text{ V}$ | 3.3 | -0.8 | V |
| | | $C_L = 30 \text{ pF}, V_{IH} = 2.5 \text{ V}, V_{IL} = 0 \text{ V}$ | 2.5 | -0.6 | |

Capacitance

| Symbol | Parameter | Conditions | Typical | Unit |
|-----------|-------------------------------|--|---------|------|
| C_{IN} | Input Capacitance | $V_{CC} = \text{Open}, V_I = 0 \text{ V or } V_{CC}$ | 7 | pF |
| C_{OUT} | Output Capacitance | $V_{CC} = 3.3 \text{ V}, V_I = 0 \text{ V or } V_{CC}$ | 8 | pF |
| C_{PD} | Power Dissipation Capacitance | $V_{CC} = 3.3 \text{ V}, V_I = 0 \text{ V or } V_{CC}, f = 10 \text{ MHz}$ | 25 | pF |

AC Loading and Waveforms Generic for LCX Family

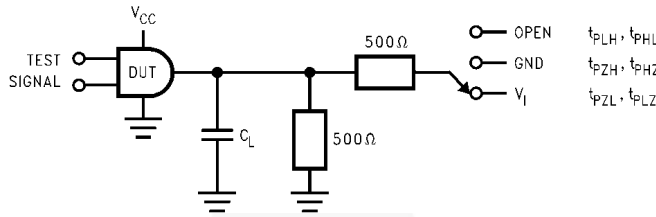
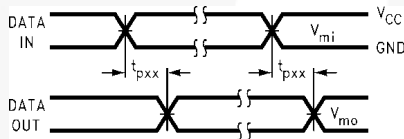
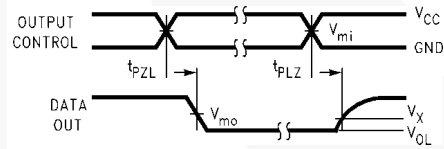


Figure 1. AC Test Circuit (C_L includes probe and jig capacitance)

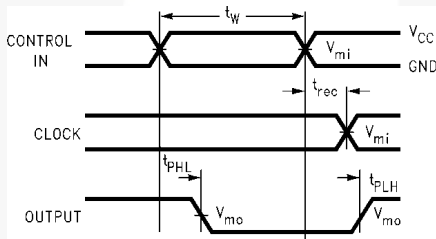
| Test | Switch |
|--------------------|---|
| t_{PLH}, t_{PHL} | Open |
| t_{PZL}, t_{PLZ} | 6V at $V_{CC} = 3.3 \pm 0.3V$ $V_{CC} \times 2$ at $V_{CC} = 2.5 \pm 0.2V$ |
| t_{PZH}, t_{PHZ} | GND |



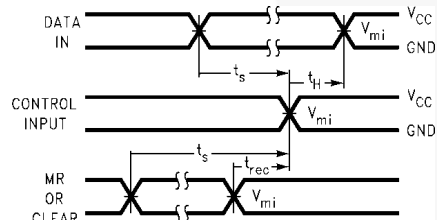
Waveform for Inverting and Non-Inverting Functions



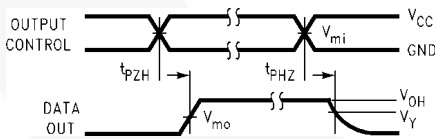
3-STATE Output Low Enable and Disable Times for Logic



Propagation Delay, Pulse Width and t_{rec} Waveforms



Setup Time, Hold Time and Recovery Time for Logic



3-STATE Output High Enable and Disable Times for Logic

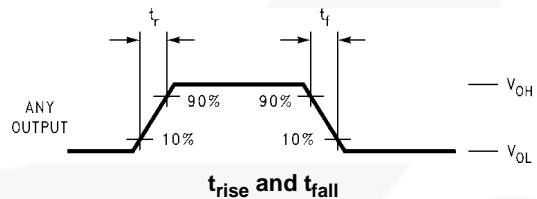
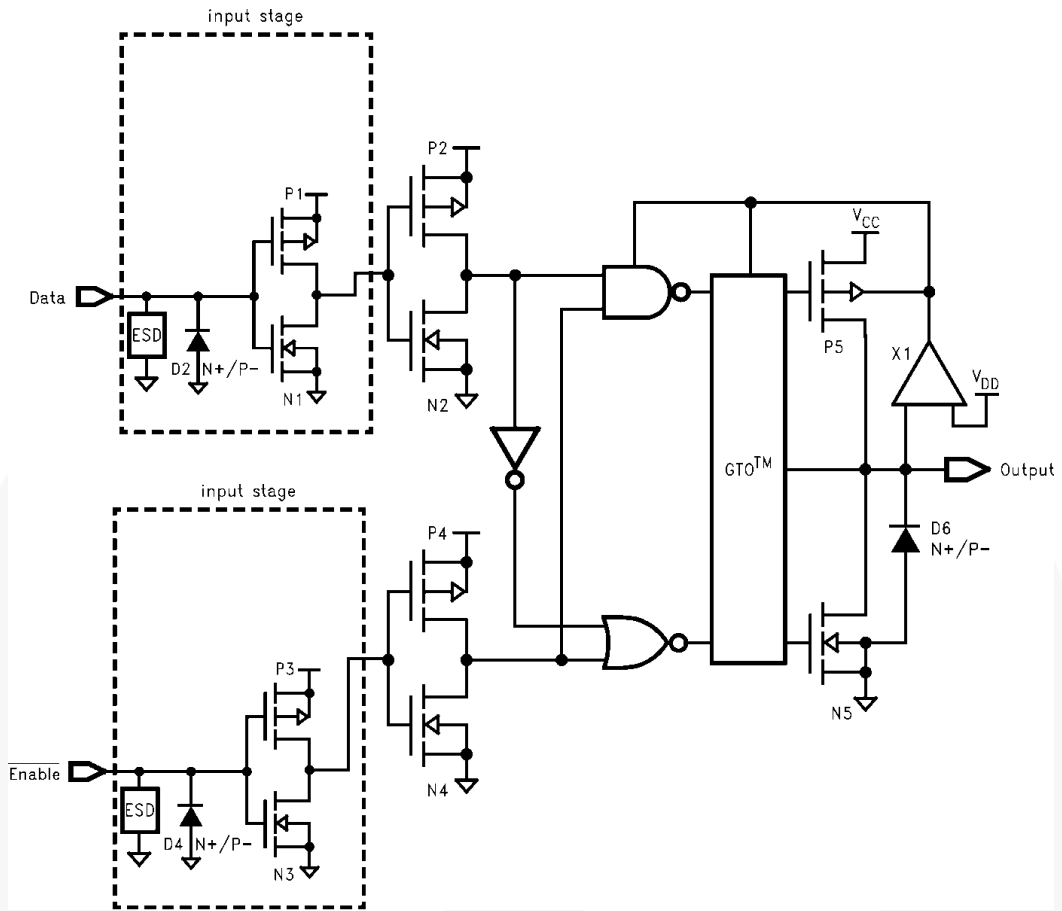


Figure 2. Waveforms
(Input Characteristics; $f = 1 \text{ MHz}$, $t_r = t_f = 3 \text{ ns}$)

| Symbol | V_{CC} | | |
|----------|-----------------|-----------------|------------------|
| | $3.3V \pm 0.3V$ | $2.7V$ | $2.5V \pm 0.2V$ |
| V_{mi} | 1.5V | 1.5V | $V_{CC}/2$ |
| V_{mo} | 1.5V | 1.5V | $V_{CC}/2$ |
| V_x | $V_{OL} + 0.3V$ | $V_{OL} + 0.3V$ | $V_{OL} + 0.15V$ |
| V_y | $V_{OH} - 0.3V$ | $V_{OH} - 0.3V$ | $V_{OH} - 0.15V$ |

Schematic Diagram Generic for LCX Family



Physical Dimensions

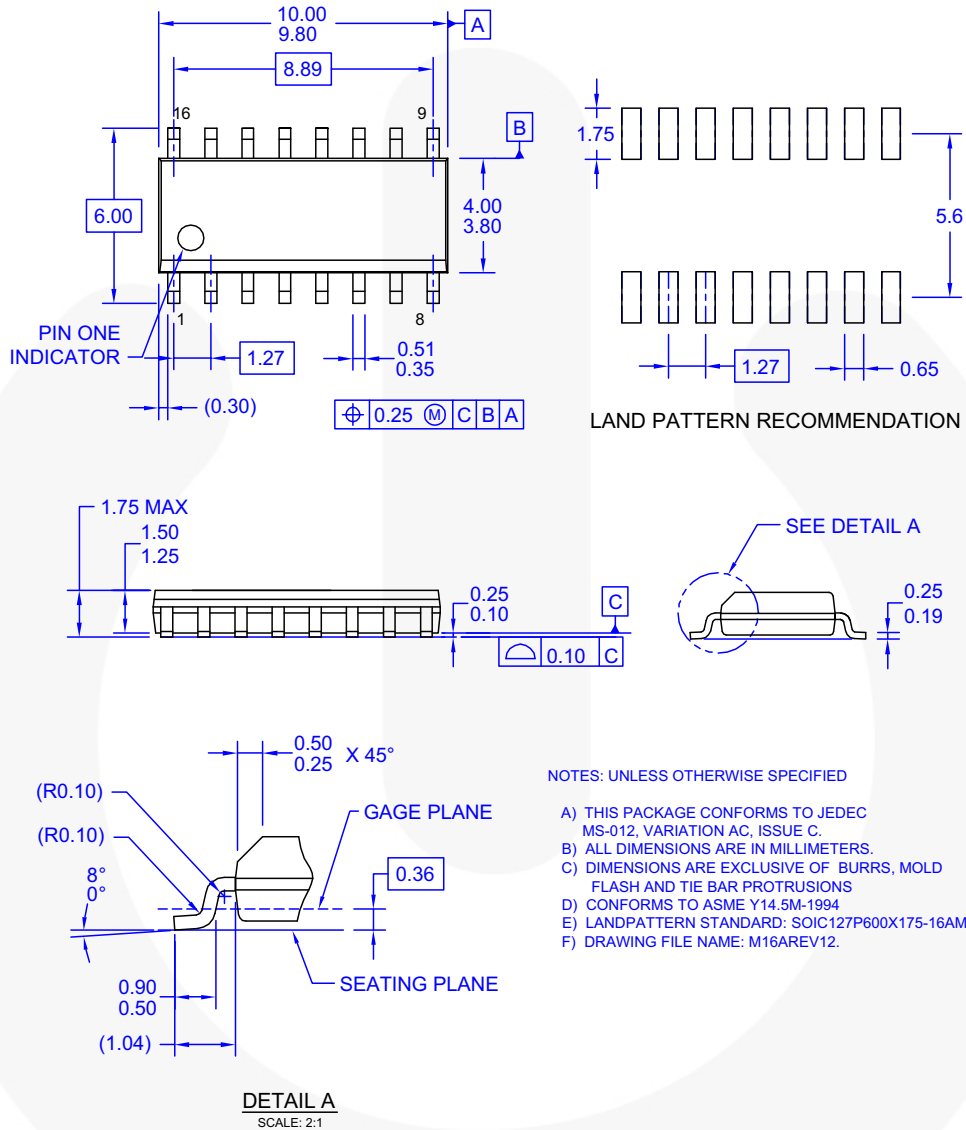
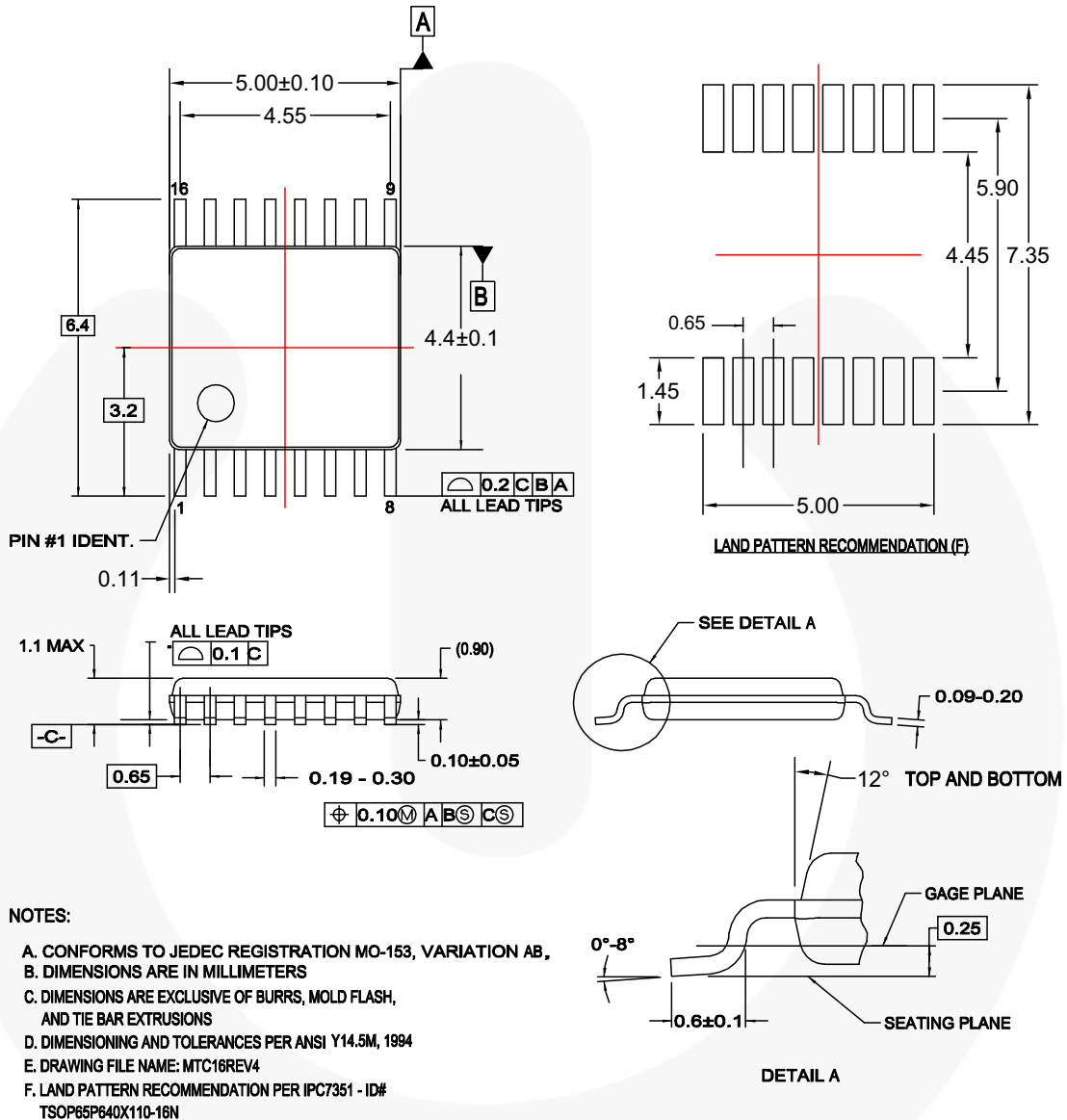


Figure 3. 16-LEAD, SOIC, JEDEC MS-012, 0.150 INCH, NARROW BODY

Physical Dimensions (Continued)




MTC16rev4

Figure 4. 16-LEAD, TSSOP, JEDEC MO-153, 4.4 MM WIDE





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