

## 74LVT16646 • 74LVTH16646

### Low Voltage 16-Bit Transceiver/Register with 3-STATE Outputs

#### General Description

The LVT16646 and LVTH16646 contains sixteen non-inverting bidirectional registered bus transceivers providing multiplexed transmission of data directly from the input bus or from the internal storage registers. Each byte has separate control inputs which can be shorted together for full 16-bit operation. The DIR inputs determine the direction of data flow through the device. The CPAB and CPBA inputs load data into the registers on the LOW-to-HIGH transition (see Functional Description).

The LVTH16646 data inputs include bushold, eliminating the need for external pull-up resistors to hold unused inputs.

These transceivers are designed for low-voltage (3.3V)  $V_{CC}$  applications, but with the capability to provide a TTL interface to a 5V environment. The LVT16646 and LVTH16646 are fabricated with an advanced BiCMOS technology to achieve high speed operation similar to 5V ABT while maintaining low power dissipation.

#### Features

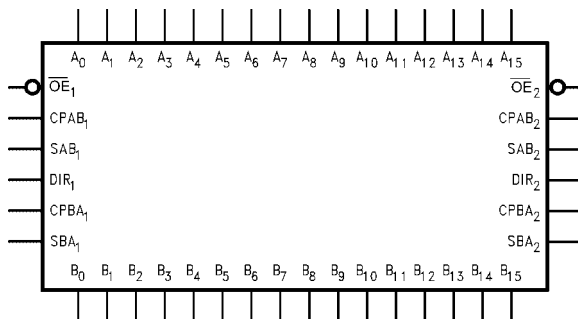
- Input and output interface capability to systems at 5V  $V_{CC}$
- Bushold data inputs eliminate the need for external pull-up resistors to hold unused inputs (74LVTH16646)
- Also available without bushold feature (74LVT16646)
- Live insertion/extraction permitted
- Power Up/Down high impedance provides glitch-free bus loading
- Outputs source/sink -32 mA/+64 mA
- Latch-up conforms to JEDEC JED78
- ESD performance:
  - Human-body model > 2000V
  - Machine model > 200V
  - Charged-device model > 1000V

#### Ordering Code:

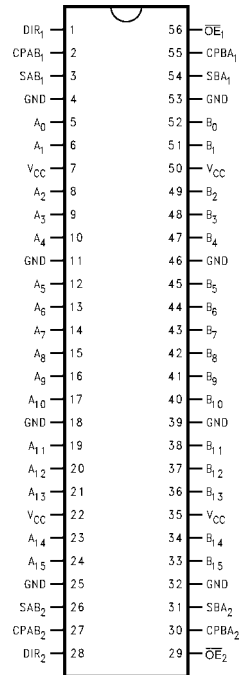
| Order Number                   | Package Number | Package Description                                                         |
|--------------------------------|----------------|-----------------------------------------------------------------------------|
| 74LVT16646MEA<br>(Preliminary) | MS56A          | 56-Lead Shrink Small Outline Package (SSOP), JEDEC MO-118, 0.300" Wide      |
| 74LVT16646MTD<br>(Preliminary) | MTD56          | 56-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide |
| 74LVTH16646MEA                 | MS56A          | 56-Lead Shrink Small Outline Package (SSOP), JEDEC MO-118, 0.300" Wide      |
| 74LVTH16646MTD                 | MTD56          | 56-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide |

Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

#### Logic Symbol



## Connection Diagram



## Pin Descriptions

| Pin Names                             | Description                            |
|---------------------------------------|----------------------------------------|
| A <sub>0</sub> –A <sub>15</sub>       | Data Register A Inputs/3-STATE Outputs |
| B <sub>0</sub> –B <sub>15</sub>       | Data Register B Inputs/3-STATE Outputs |
| CPAB <sub>n</sub> , CPBA <sub>n</sub> | Clock Pulse Inputs                     |
| SAB <sub>n</sub> , SBA <sub>n</sub>   | Select Inputs                          |
| $\overline{OE}_1$ , $\overline{OE}_2$ | Output Enable Inputs                   |
| DIR <sub>n</sub>                      | Direction Control Inputs               |

## Truth Table

(Note 1)

| Inputs            |                  |                   |                   |                  |                  | Data I/O          |                   | Output Operation Mode                                                  |
|-------------------|------------------|-------------------|-------------------|------------------|------------------|-------------------|-------------------|------------------------------------------------------------------------|
| $\overline{OE}_1$ | DIR <sub>1</sub> | CPAB <sub>1</sub> | CPBA <sub>1</sub> | SAB <sub>1</sub> | SBA <sub>1</sub> | A <sub>0</sub> –7 | B <sub>0</sub> –7 |                                                                        |
| H                 | X                | H or L            | H or L            | X                | X                | Input             | Input             | Isolation                                                              |
| H                 | X                | ↗                 | X                 | X                | X                |                   |                   | Clock A <sub>n</sub> Data into A Register                              |
| H                 | X                | X                 | ↗                 | X                | X                |                   |                   | Clock B <sub>n</sub> Data into B Register                              |
| L                 | H                | X                 | X                 | L                | X                | Input             | Output            | A <sub>n</sub> to B <sub>n</sub> —Real Time (Transparent Mode)         |
| L                 | H                | ↗                 | X                 | L                | X                |                   |                   | Clock A <sub>n</sub> Data to A Register                                |
| L                 | H                | H or L            | X                 | H                | X                |                   |                   | A Register to B <sub>n</sub> (Stored Mode)                             |
| L                 | H                | ↗                 | X                 | H                | X                | Output            | Input             | Clock A <sub>n</sub> Data into A Register and Output to B <sub>n</sub> |
| L                 | L                | X                 | X                 | X                | L                |                   |                   | B <sub>n</sub> to A <sub>n</sub> —Real Time (Transparent Mode)         |
| L                 | L                | X                 | ↗                 | X                | L                |                   |                   | Clock B <sub>n</sub> Data into B Register                              |
| L                 | L                | X                 | H or L            | X                | H                |                   |                   | B Register to A <sub>n</sub> (Stored Mode)                             |
| L                 | L                | X                 | ↗                 | X                | H                |                   |                   | Clock B <sub>n</sub> into B Register and Output to A <sub>n</sub>      |

H = HIGH Voltage Level

X = Immaterial

L = LOW Voltage Level

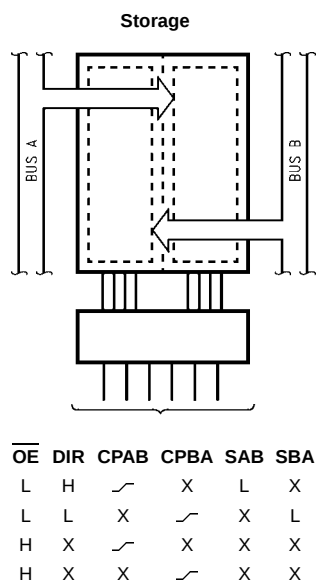
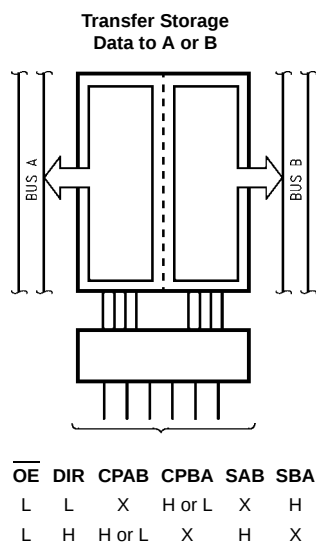
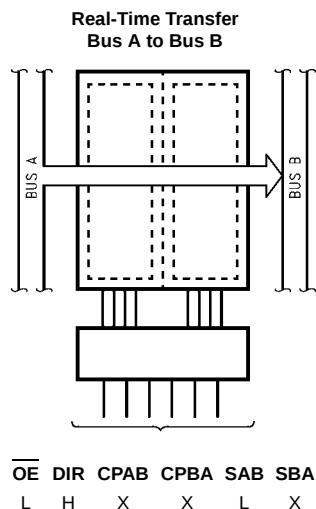
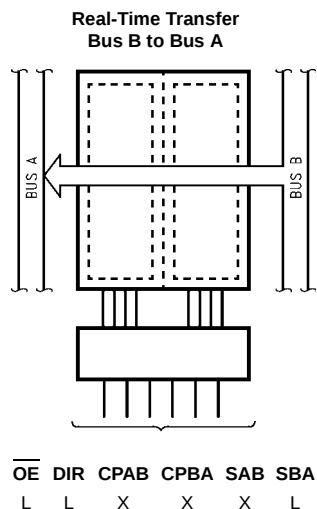
↗ = LOW-to-HIGH Transition.

**Note 1:** The data output functions may be enabled or disabled by various signals at the  $\overline{OE}$  and DIR inputs. Data input functions are always enabled; i.e., data at the bus pins will be stored on every LOW-to-HIGH transition of the appropriate clock inputs. Also applies to data I/O (A and B: 8-15) and #2 control pins.

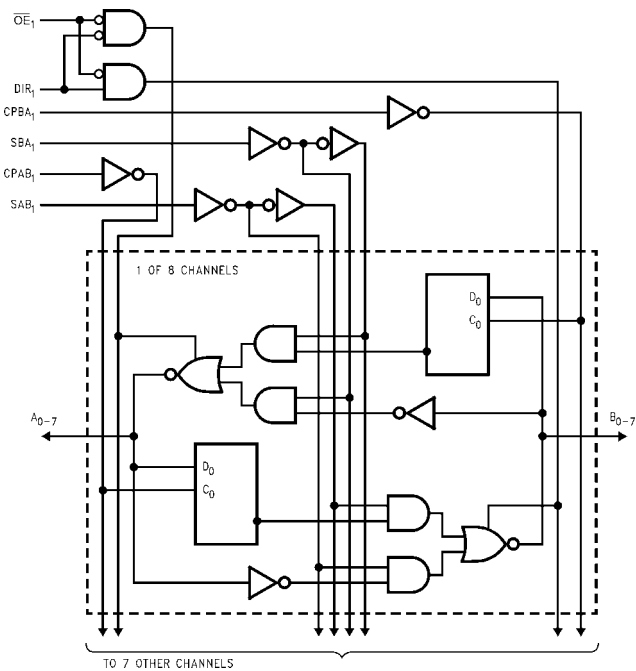
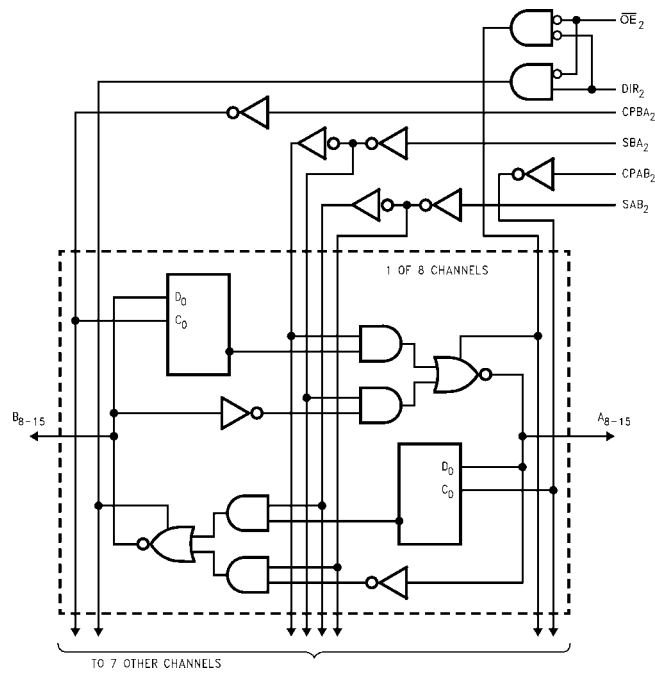
## Functional Description

In the transceiver mode, data present at the HIGH impedance port may be stored in either the A or B register or both. The select ( $SAB_n$ ,  $SBA_n$ ) controls can multiplex stored and real-time. The examples shown below demonstrate the four fundamental bus-management functions that can be performed.

The direction control ( $DIR_n$ ) determines which bus will receive data when  $\overline{OE}_n$  is LOW. In the isolation mode ( $\overline{OE}_n$  HIGH), A data may be stored in one register and/or B data may be stored in the other register. When an output function is disabled, the input function is still enabled and may be used to store and transmit data. Only one of the two busses, A or B, may be driven at a time.



## Logic Diagrams



Please note that these diagrams are provided only for the understanding of logic operations and should not be used to estimate propagation delays.

| Absolute Maximum Ratings <sup>(Note 2)</sup>                                                                                                                                                                                                                                                                                                                                                     |                                                             |              |                                      |       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|--------------|--------------------------------------|-------|
| Symbol                                                                                                                                                                                                                                                                                                                                                                                           | Parameter                                                   | Value        | Conditions                           | Units |
| $V_{CC}$                                                                                                                                                                                                                                                                                                                                                                                         | Supply Voltage                                              | −0.5 to +4.6 |                                      | V     |
| $V_I$                                                                                                                                                                                                                                                                                                                                                                                            | DC Input Voltage                                            | −0.5 to +7.0 |                                      | V     |
| $V_O$                                                                                                                                                                                                                                                                                                                                                                                            | DC Output Voltage                                           | −0.5 to +7.0 | Output in 3-STATE                    | V     |
|                                                                                                                                                                                                                                                                                                                                                                                                  |                                                             | −0.5 to +7.0 | Output in HIGH or LOW State (Note 3) | V     |
| $I_{IK}$                                                                                                                                                                                                                                                                                                                                                                                         | DC Input Diode Current                                      | −50          | $V_I < GND$                          | mA    |
| $I_{OK}$                                                                                                                                                                                                                                                                                                                                                                                         | DC Output Diode Current                                     | −50          | $V_O < GND$                          | mA    |
| $I_O$                                                                                                                                                                                                                                                                                                                                                                                            | DC Output Current                                           | 64           | $V_O > V_{CC}$ Output at HIGH State  | mA    |
|                                                                                                                                                                                                                                                                                                                                                                                                  |                                                             | 128          | $V_O > V_{CC}$ Output at LOW State   |       |
| $I_{CC}$                                                                                                                                                                                                                                                                                                                                                                                         | DC Supply Current per Supply Pin                            | ±64          |                                      | mA    |
| $I_{GND}$                                                                                                                                                                                                                                                                                                                                                                                        | DC Ground Current per Ground Pin                            | ±128         |                                      | mA    |
| $T_{STG}$                                                                                                                                                                                                                                                                                                                                                                                        | Storage Temperature                                         | −65 to +150  |                                      | °C    |
| Recommended Operating Conditions                                                                                                                                                                                                                                                                                                                                                                 |                                                             |              |                                      |       |
| Symbol                                                                                                                                                                                                                                                                                                                                                                                           | Parameter                                                   | Min          | Max                                  | Units |
| $V_{CC}$                                                                                                                                                                                                                                                                                                                                                                                         | Supply Voltage                                              | 2.7          | 3.6                                  | V     |
| $V_I$                                                                                                                                                                                                                                                                                                                                                                                            | Input Voltage                                               | 0            | 5.5                                  | V     |
| $I_{OH}$                                                                                                                                                                                                                                                                                                                                                                                         | HIGH-Level Output Current                                   |              | −32                                  | mA    |
| $I_{OL}$                                                                                                                                                                                                                                                                                                                                                                                         | LOW-Level Output Current                                    |              | 64                                   |       |
| $T_A$                                                                                                                                                                                                                                                                                                                                                                                            | Free-Air Operating Temperature                              | −40          | 85                                   | °C    |
| $\Delta t/\Delta V$                                                                                                                                                                                                                                                                                                                                                                              | Input Edge Rate, $V_{IN} = 0.8V$ – $2.0V$ , $V_{CC} = 3.0V$ | 0            | 10                                   | ns/V  |
| <p><b>Note 2:</b> Absolute Maximum continuous ratings are those values beyond which damage to the device may occur. Exposure to these conditions or conditions beyond those indicated may adversely affect device reliability. Functional operation under absolute maximum rated conditions is not implied.</p> <p><b>Note 3:</b> <math>I_O</math> Absolute Maximum Rating must be observed.</p> |                                                             |              |                                      |       |

## DC Electrical Characteristics

| Symbol                           | Parameter                                           | V <sub>CC</sub><br>(V) | T <sub>A</sub> = -40°C to +85°C |      | Units | Conditions                                                                    |
|----------------------------------|-----------------------------------------------------|------------------------|---------------------------------|------|-------|-------------------------------------------------------------------------------|
|                                  |                                                     |                        | Min                             | Max  |       |                                                                               |
| V <sub>IK</sub>                  | Input Clamp Diode Voltage                           | 2.7                    |                                 | -1.2 | V     | I <sub>I</sub> = -18 mA                                                       |
| V <sub>IH</sub>                  | Input HIGH Voltage                                  | 2.7-3.6                | 2.0                             |      | V     | V <sub>O</sub> ≤ 0.1V or<br>V <sub>O</sub> ≥ V <sub>CC</sub> - 0.1V           |
| V <sub>IL</sub>                  | Input LOW Voltage                                   | 2.7-3.6                |                                 | 0.8  | V     |                                                                               |
| V <sub>OH</sub>                  | Output HIGH Voltage                                 | 2.7-3.6                | V <sub>CC</sub> - 0.2           |      | V     | I <sub>OH</sub> = -100 μA                                                     |
|                                  |                                                     | 2.7                    | 2.4                             |      | V     | I <sub>OH</sub> = -8 mA                                                       |
|                                  |                                                     | 3.0                    | 2.0                             |      | V     | I <sub>OH</sub> = -32 mA                                                      |
| V <sub>OL</sub>                  | Output LOW Voltage                                  | 2.7                    |                                 | 0.2  | V     | I <sub>OL</sub> = 100 μA                                                      |
|                                  |                                                     | 2.7                    |                                 | 0.5  | V     | I <sub>OL</sub> = 24 mA                                                       |
|                                  |                                                     | 3.0                    |                                 | 0.4  | V     | I <sub>OL</sub> = 16 mA                                                       |
|                                  |                                                     | 3.0                    |                                 | 0.5  | V     | I <sub>OL</sub> = 32 mA                                                       |
|                                  |                                                     | 3.0                    |                                 | 0.55 | V     | I <sub>OL</sub> = 64 mA                                                       |
| I <sub>I(HOLD)</sub><br>(Note 4) | Bushold Input Minimum Drive                         | 3.0                    | 75                              |      | μA    | V <sub>I</sub> = 0.8V                                                         |
|                                  |                                                     |                        | -75                             |      | μA    | V <sub>I</sub> = 2.0V                                                         |
| I <sub>I(OD)</sub><br>(Note 4)   | Bushold Input Over-Drive<br>Current to Change State | 3.0                    | 500                             |      | μA    | (Note 5)                                                                      |
|                                  |                                                     |                        | -500                            |      | μA    | (Note 6)                                                                      |
| I <sub>I</sub>                   | Input Current                                       | 3.6                    |                                 | 10   | μA    | V <sub>I</sub> = 5.5V                                                         |
|                                  |                                                     | Control Pins           | 3.6                             | ±1   | μA    | V <sub>I</sub> = 0V or V <sub>CC</sub>                                        |
|                                  |                                                     | Data Pins              | 3.6                             | -5   | μA    | V <sub>I</sub> = 0V                                                           |
| I <sub>OFF</sub>                 | Power Off Leakage Current                           | 0                      |                                 | ±100 | μA    | V <sub>I</sub> = V <sub>CC</sub>                                              |
| I <sub>PU/PD</sub>               | Power Up/Down 3-STATE<br>Output Current             | 0-1.5V                 |                                 | ±100 | μA    | 0V ≤ V <sub>I</sub> or V <sub>O</sub> ≤ 5.5V                                  |
| I <sub>OZL</sub> (Note 4)        | 3-STATE Output Leakage Current                      | 3.6                    |                                 | -5   | μA    | V <sub>O</sub> = 0.0V                                                         |
| I <sub>OZL</sub>                 | 3-STATE Output Leakage Current                      | 3.6                    |                                 | -5   | μA    | V <sub>O</sub> = 0.5V                                                         |
| I <sub>OZH</sub> (Note 4)        | 3-STATE Output Leakage Current                      | 3.6                    |                                 | 5    | μA    | V <sub>O</sub> = 3.6V                                                         |
| I <sub>OZH</sub>                 | 3-STATE Output Leakage Current                      | 3.6                    |                                 | 5    | μA    | V <sub>O</sub> = 3.0V                                                         |
| I <sub>OZH+</sub>                | 3-STATE Output Leakage Current                      | 3.6                    |                                 | 10   | μA    | V <sub>CC</sub> < V <sub>O</sub> ≤ 5.5V                                       |
| I <sub>CCH</sub>                 | Power Supply Current                                | 3.6                    |                                 | 0.19 | mA    | Outputs HIGH                                                                  |
| I <sub>CCL</sub>                 | Power Supply Current                                | 3.6                    |                                 | 5    | mA    | Outputs LOW                                                                   |
| I <sub>CCZ</sub>                 | Power Supply Current                                | 3.6                    |                                 | 0.19 | mA    | Outputs Disabled                                                              |
| I <sub>CCZ+</sub>                | Power Supply Current                                | 3.6                    |                                 | 0.19 | mA    | V <sub>CC</sub> ≤ V <sub>O</sub> ≤ 5.5V, Outputs Disabled                     |
| ΔI <sub>CC</sub>                 | Increase in Power Supply Current<br>(Note 7)        | 3.6                    |                                 | 0.2  | mA    | One Input at V <sub>CC</sub> - 0.6V<br>Other Inputs at V <sub>CC</sub> or GND |

**Note 4:** Applies to bushold version only (74LVTH16646)

**Note 5:** An external driver must source at least the specified current to switch from LOW-to-HIGH.

**Note 6:** An external driver must sink at least the specified current to switch from HIGH-to-LOW.

**Note 7:** This is the increase in supply current for each input that is at the specified voltage level rather than V<sub>CC</sub> or GND.

## Dynamic Switching Characteristics (Note 8)

| Symbol           | Parameter                                    | V <sub>CC</sub><br>(V) | T <sub>A</sub> = 25°C |      |     | Units | Conditions<br>C <sub>L</sub> = 50 pF, R <sub>L</sub> = 500Ω |
|------------------|----------------------------------------------|------------------------|-----------------------|------|-----|-------|-------------------------------------------------------------|
|                  |                                              |                        | Min                   | Typ  | Max |       |                                                             |
| V <sub>OLP</sub> | Quiet Output Maximum Dynamic V <sub>OL</sub> | 3.3                    |                       | 0.8  |     | V     | (Note 9)                                                    |
| V <sub>OLV</sub> | Quiet Output Minimum Dynamic V <sub>OL</sub> | 3.3                    |                       | -0.8 |     | V     | (Note 9)                                                    |

**Note 8:** Characterized in SSOP package. Guaranteed parameter, but not tested.

**Note 9:** Max number of outputs defined as (n). n-1 data inputs are driven 0V to 3V. Output under test held LOW.

## AC Electrical Characteristics

| Symbol            | Parameter                               |                                       | T <sub>A</sub> = −40°C to +85°C<br>C <sub>L</sub> = 50 pF, R <sub>L</sub> = 500Ω |     |                        |     | Units |
|-------------------|-----------------------------------------|---------------------------------------|----------------------------------------------------------------------------------|-----|------------------------|-----|-------|
|                   |                                         |                                       | V <sub>CC</sub> = 3.3 ± 0.3V                                                     |     | V <sub>CC</sub> = 2.7V |     |       |
|                   |                                         |                                       | Min                                                                              | Max | Min                    | Max |       |
| t <sub>MAX</sub>  | Maximum Clock Frequency                 |                                       | 150                                                                              |     | 150                    |     | MHz   |
| t <sub>PLH</sub>  | Propagation Delay                       |                                       | 1.3                                                                              | 5.4 | 1.3                    | 5.9 | ns    |
| t <sub>PHL</sub>  | CPAB or CPBA to A or B                  |                                       | 1.3                                                                              | 5.2 | 1.3                    | 5.8 |       |
| t <sub>PLH</sub>  | Propagation Delay                       |                                       | 1.0                                                                              | 4.4 | 1.0                    | 4.7 | ns    |
| t <sub>PHL</sub>  | Data to A or B                          |                                       | 1.0                                                                              | 4.6 | 1.0                    | 5.1 |       |
| t <sub>PLH</sub>  | Propagation Delay                       |                                       | 1.0                                                                              | 4.6 | 1.0                    | 5.4 | ns    |
| t <sub>PHL</sub>  | SBA or SAB to A or B                    |                                       | 1.0                                                                              | 4.8 | 1.0                    | 5.6 |       |
| t <sub>PZH</sub>  | Output Enable Time                      |                                       | 1.0                                                                              | 4.7 | 1.0                    | 5.4 | ns    |
| t <sub>PZL</sub>  | OE to A or B                            |                                       | 1.0                                                                              | 5.1 | 1.0                    | 6.0 |       |
| t <sub>PHZ</sub>  | Output Disable Time                     |                                       | 2.0                                                                              | 5.6 | 2.0                    | 6.1 | ns    |
| t <sub>PLZ</sub>  | OE to A or B                            |                                       | 2.0                                                                              | 5.4 | 2.0                    | 6.1 |       |
| t <sub>PZH</sub>  | Output Enable Time                      |                                       | 1.0                                                                              | 4.9 | 1.0                    | 5.4 | ns    |
| t <sub>PZL</sub>  | DIR to A or B                           |                                       | 1.0                                                                              | 5.4 | 1.0                    | 6.4 |       |
| t <sub>PHZ</sub>  | Output Disable Time                     |                                       | 1.5                                                                              | 6.4 | 1.5                    | 7.1 | ns    |
| t <sub>PLZ</sub>  | DIR to A or B                           |                                       | 1.5                                                                              | 5.4 | 1.5                    | 5.9 |       |
| t <sub>W</sub>    | Pulse Duration CPAB or CPBA HIGH or LOW |                                       | 3.3                                                                              |     | 3.3                    |     | ns    |
| t <sub>S</sub>    | Setup Time                              | A or B before CPAB or CPBA, Data HIGH | 1.2                                                                              |     | 1.5                    |     | ns    |
|                   |                                         | A or B before CPAB or CPBA, Data LOW  | 2.0                                                                              |     | 2.8                    |     |       |
| t <sub>H</sub>    | Hold Time                               | A or B after CPAB or CPBA, Data HIGH  | 0.5                                                                              |     | 0.0                    |     | ns    |
|                   |                                         | A or B after CPAB or CPBA, Data LOW   | 0.5                                                                              |     | 0.5                    |     |       |
| t <sub>OSHL</sub> | Output to Output Skew (Note 10)         |                                       |                                                                                  | 1.0 |                        | 1.0 | ns    |
| t <sub>OSLH</sub> |                                         |                                       |                                                                                  | 1.0 |                        | 1.0 |       |

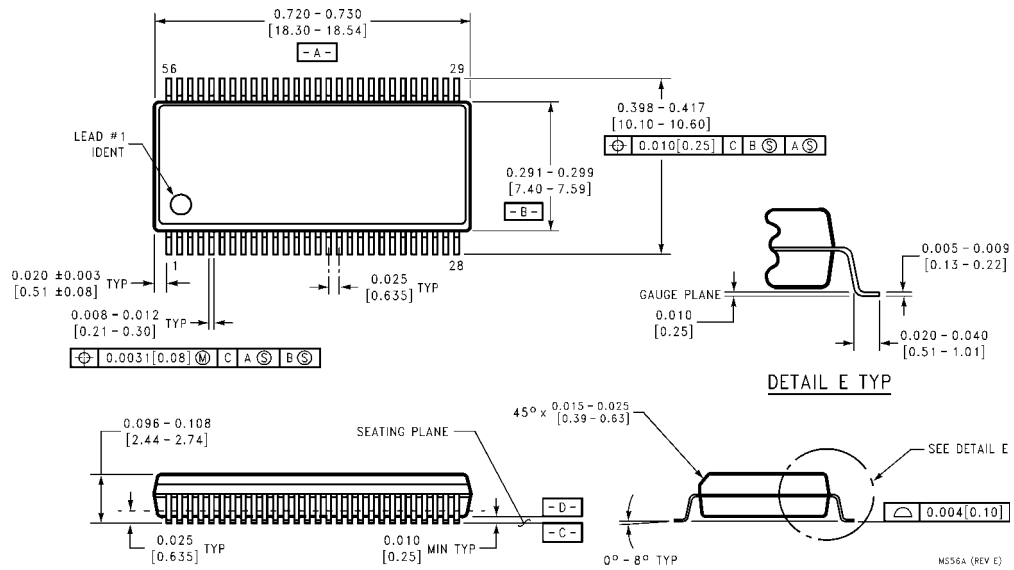
**Note 10:** Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH-to-LOW ( $t_{OSHL}$ ) or LOW-to-HIGH ( $t_{OSLH}$ ).

## Capacitance (Note 11)

| Symbol    | Parameter                | Conditions                                         | Typical | Units |
|-----------|--------------------------|----------------------------------------------------|---------|-------|
| $C_{IN}$  | Input Capacitance        | $V_{CC} = \text{Open}, V_I = 0\text{V or } V_{CC}$ | 4       | pF    |
| $C_{I/O}$ | Input/Output Capacitance | $V_{CC} = 3.0\text{V}, V_O = 0\text{V or } V_{CC}$ | 8       | pF    |

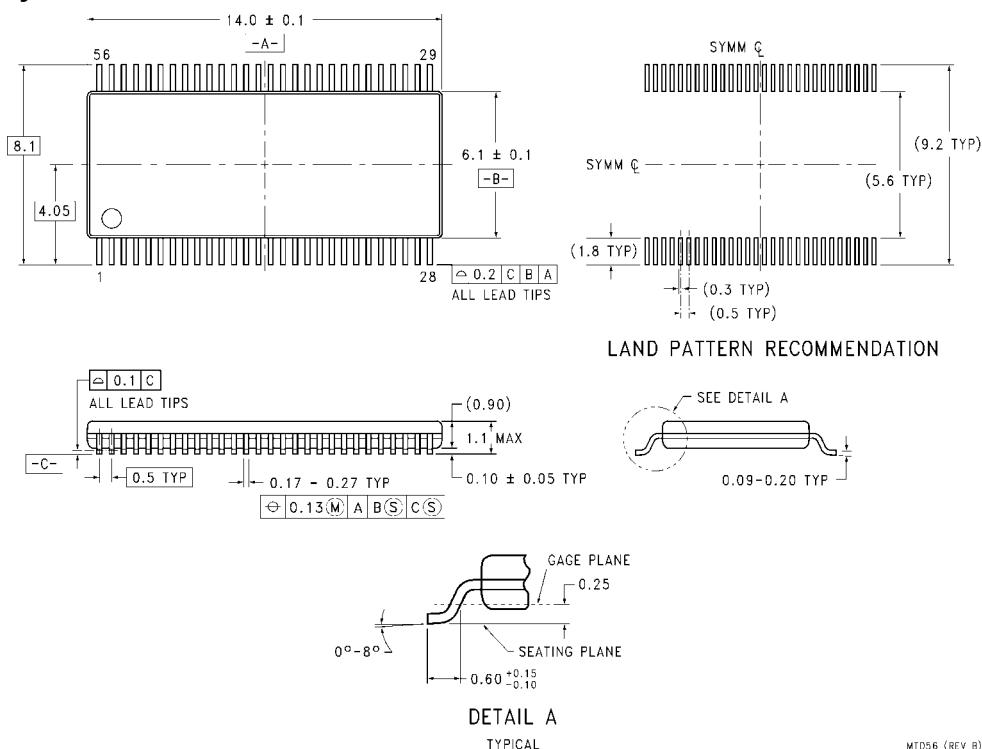
**Note 11:** Capacitance is measured at frequency  $f = 1 \text{ MHz}$ , per MIL-STD-883, Method 3012.

# Physical Dimensions inches (millimeters) unless otherwise noted



56-Lead Shrink Small Outline Package (SSOP), JEDEC MO-118, 0.300" Wide  
Package Number MS56A

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



56-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide  
Package Number MTD56

Fairchild does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and Fairchild reserves the right at any time without notice to change said circuitry and specifications.

## LIFE SUPPORT POLICY

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF FAIRCHILD SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

[www.fairchildsemi.com](http://www.fairchildsemi.com)

ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## PUBLICATION ORDERING INFORMATION

### LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor  
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA  
**Phone:** 303-675-2175 or 800-344-3860 Toll Free USA/Canada  
**Fax:** 303-675-2176 or 800-344-3867 Toll Free USA/Canada  
**Email:** [orderlit@onsemi.com](mailto:orderlit@onsemi.com)

**N. American Technical Support:** 800-282-9855 Toll Free  
USA/Canada

**Europe, Middle East and Africa Technical Support:**  
Phone: 421 33 790 2910

**Japan Customer Focus Center**  
Phone: 81-3-5817-1050

**ON Semiconductor Website:** [www.onsemi.com](http://www.onsemi.com)

**Order Literature:** <http://www.onsemi.com/orderlit>

For additional information, please contact your local  
Sales Representative