

# 74ABT16501

## 18-Bit Universal Bus Transceivers with 3-STATE Outputs

### General Description

The ABT16501 18-bit universal bus transceiver combines D-type latches and D-type flip-flops to allow data flow in transparent, latched, and clocked modes.

Data flow in each direction is controlled by output-enable (OEAB and  $\overline{OEBA}$ ), latch-enable (LEAB and LEBA), and clock (CLKAB and CLKBA) inputs. For A-to-B data flow, the device operates in the transparent mode when LEAB is HIGH. When LEAB is LOW, the A data is latched if CLKAB is held at a HIGH or LOW logic level. If LEAB is LOW, the A bus data is stored in the latch/flip-flop on the LOW-to-HIGH transition of CLKAB. Output-enable OEAB is active-high. When OEAB is HIGH, the outputs are active. When OEAB is LOW, the outputs are in the high-impedance state.

Data flow for B to A is similar to that of A to B but uses  $\overline{OEBA}$ , LEBA, and CLKBA. The output enables are com-

plementary (OEAB is active HIGH and  $\overline{OEBA}$  is active LOW).

To ensure the high-impedance state during power up or power down, OE inputs should be tied to GND through a pulldown resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.

### Features

- Combines D-Type latches and D-Type flip-flops for operation in transparent, latched, or clocked mode
- Flow-through architecture optimizes PCB layout
- Guaranteed latch-up protection
- High impedance glitch free bus loading during entire power up and power down cycle
- Non-destructive hot insertion capability

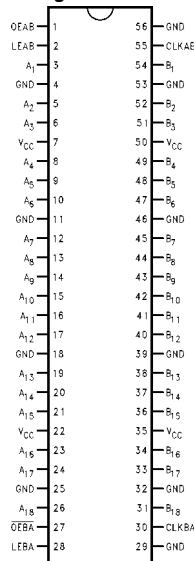
### Ordering Code:

Order Number	Package Number	Package Description
74ABT16501CSSC	MS56A	56-Lead Shrink Small Outline Package (SSOP), JEDEC MO-118, 0.300" Wide
74ABT16501CMTD	MTD56	56-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide

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

### Connection Diagram

Pin Assignment for SSOP



### Function Table (Note 1)

Inputs				Output
OEAB	LEAB	CLKAB	A	B
L	X	X	X	Z
H	H	X	L	L
H	H	X	H	H
H	L	↑	L	L
H	L	↑	H	H
H	L	H	X	B <sub>0</sub> (Note 2)
H	L	L	X	B <sub>0</sub> (Note 3)

**Note 1:** A-to-B data flow is shown; B-to-A flow is similar but uses  $\overline{OEBA}$ , LEBA, and CLKBA.

**Note 2:** Output level before the indicated steady-state input conditions were established.

**Note 3:** Output level before the indicated steady-state input conditions were established, provided that CLKAB was HIGH before LEAB went LOW.



**Absolute Maximum Ratings**(Note 4)

Storage Temperature	-65°C to +150°C
Ambient Temperature under Bias	-55°C to +125°C
Junction Temperature under Bias	-55°C to +150°C
V <sub>CC</sub> Pin Potential to Ground Pin	-0.5V to +7.0V
Input Voltage (Note 5)	-0.5V to +7.0V
Input Current (Note 5)	-30 mA to +5.0 mA
Voltage Applied to Any Output in the Disabled or Power-off State	-0.5V to 5.5V
in the HIGH State	-0.5V to V <sub>CC</sub>
Current Applied to Output in LOW State (Max)	twice the rated I <sub>OL</sub> (mA)

DC Latchup Source Current	-500 mA
Over Voltage Latchup (I/O)	10V

**Recommended Operating Conditions**

Free Air Ambient Temperature	-40°C to +85°C
Supply Voltage	+4.5V to +5.5V
Minimum Input Edge Rate ( $\Delta V/\Delta t$ )	
Data Input	50 mV/ns
Enable Input	20 mV/ns

**Note 4:** Absolute maximum ratings are values beyond which the device may be damaged or have its useful life impaired. Functional operation under these conditions is not implied.

**Note 5:** Either voltage limit or current limit is sufficient to protect inputs.

**DC Electrical Characteristics**

Symbol	Parameter	Min	Typ	Max	Units	V <sub>CC</sub>	Conditions
V <sub>IH</sub>	Input HIGH Voltage	2.0			V		Recognized HIGH Signal
V <sub>IL</sub>	Input LOW Voltage			0.8	V		Recognized LOW Signal
V <sub>CD</sub>	Input Clamp Diode Voltage			-1.2	V	Min	I <sub>IN</sub> = -18 mA
V <sub>OH</sub>	Output HIGH Voltage	2.5			V	Min	I <sub>OH</sub> = -3 mA
		2.0			V	Min	I <sub>OH</sub> = -32 mA
V <sub>OL</sub>	Output LOW Voltage			0.55	V	Min	I <sub>OL</sub> = 64 mA
I <sub>IH</sub>	Input HIGH Current			1	μA	Max	V <sub>IN</sub> = 2.7V (Note 6)
				1	μA	Max	V <sub>IN</sub> = V <sub>CC</sub>
I <sub>BVI</sub>	Input HIGH Current Breakdown Test			7	μA	Max	V <sub>IN</sub> = 7.0V
I <sub>IL</sub>	Input LOW Current			-1	μA	Max	V <sub>IN</sub> = 0.5V (Note 6)
				-1	μA	Max	V <sub>IN</sub> = 0.0V
V <sub>ID</sub>	Input Leakage Test	4.75			V	0.0	I <sub>ID</sub> = 1.9 μA All Other Pins Grounded
I <sub>IH</sub> + I <sub>OZH</sub>	Output Leakage Current			10	μA	0 - 5.5V	V <sub>OUT</sub> = 2.7V; $\overline{OE}$ , OE = 2.0V
				-10	μA	0 - 5.5V	V <sub>OUT</sub> = 0.5V; $\overline{OE}$ , OE = 2.0V
I <sub>IL</sub> + I <sub>OZL</sub>	Output Leakage Current			-10	μA	0 - 5.5V	V <sub>OUT</sub> = 0.5V; $\overline{OE}$ , OE = 2.0V
				-10	μA	0 - 5.5V	V <sub>OUT</sub> = 0.5V; $\overline{OE}$ , OE = 2.0V
I <sub>OS</sub>	Output Short-Circuit Current	-100		-275	mA	Max	V <sub>OUT</sub> = 0V
I <sub>CEX</sub>	Output HIGH Leakage Current			50	μA	Max	V <sub>OUT</sub> = V <sub>CC</sub>
I <sub>ZZ</sub>	Bus Drainage Test			100	μA	0.0	V <sub>OUT</sub> = 5.5V; All Others GND
I <sub>CCH</sub>	Power Supply Current			1.0	mA	Max	All Outputs HIGH
I <sub>CCL</sub>	Power Supply Current			68	mA	Max	An or Bn Outputs LOW
I <sub>CCZ</sub>	Power Supply Current			1.0	mA	Max	$\overline{OE}_n = V_{CC}$ , All Others at V <sub>CC</sub> or GND
I <sub>CC1</sub>	Additional I <sub>CC</sub> /Input			2.5	mA	Max	V <sub>I</sub> = V <sub>CC</sub> - 2.1V All Others at V <sub>CC</sub> or GND
I <sub>CCD</sub>	Dynamic I <sub>CC</sub> (Note 6)	No Load		0.23	mA/ MHz	Max	Outputs Open Transparent Mode One Bit Toggling, 50% Duty Cycle

**Note 6:** Guaranteed, but not tested.

## DC Electrical Characteristics

Symbol	Parameter	Min	Typ	Max	Units	V <sub>CC</sub>	Conditions
							C <sub>L</sub> = 50 pF; R <sub>L</sub> = 500Ω
V <sub>OLP</sub>	Quiet Output Maximum Dynamic V <sub>OL</sub>		0.7	1.2	V	5.0	T <sub>A</sub> = 25°C (Note 7)
V <sub>OLV</sub>	Quiet Output Minimum Dynamic V <sub>OL</sub>	-1.5	-1.0		V	5.0	T <sub>A</sub> = 25°C (Note 7)
V <sub>OHV</sub>	Minimum HIGH Level Dynamic Output Voltage	2.5	3.0		V	5.0	T <sub>A</sub> = 25°C (Note 8)
V <sub>IHD</sub>	Minimum HIGH Level Dynamic Input Voltage	2.2	1.8		V	5.0	T <sub>A</sub> = 25°C (Note 9)
V <sub>ILD</sub>	Maximum LOW Level Dynamic Input Voltage		1.2	0.8	V	5.0	T <sub>A</sub> = 25°C (Note 9)

**Note 7:** Max number of outputs defined as (n). n – 1 data inputs are driven 0V to 3V. One output at LOW. Guaranteed, but not tested.

**Note 8:** Max number of outputs defined as (n). n – 1 data inputs are driven 0V to 3V. One output HIGH. Guaranteed, but not tested.

**Note 9:** Max number of data inputs (n) switching. n – 1 inputs switching 0V to 3V. Input-under-test switching: 3V to threshold (V<sub>ILD</sub>), 0V to threshold (V<sub>IHD</sub>). Guaranteed, but not tested.

## AC Electrical Characteristics

Symbol	Parameter	T <sub>A</sub> = +25°C V <sub>CC</sub> = +5V C <sub>L</sub> = 50 pF			T <sub>A</sub> = -40°C to +85°C V <sub>CC</sub> = 4.5V-5.5V C <sub>L</sub> = 50 pF		Units
		Min	Typ	Max	Min	Max	
		f <sub>max</sub>	Maximum Clock Frequency	150	200		
t <sub>PLH</sub>	Propagation Delay	1.0	2.7	4.6	1.0	4.6	ns
t <sub>PHL</sub>	A or B to B or A	1.0	3.2	4.6	1.0	4.6	
t <sub>PLH</sub>	Propagation Delay	1.0	3.1	5.0	1.0	5.0	ns
t <sub>PHL</sub>	LEAB or LEBA to B or A	1.0	3.6	5.5	1.0	5.5	
t <sub>PLH</sub>	Propagation Delay	1.0	3.4	5.3	1.0	5.3	ns
t <sub>PHL</sub>	CLKAB or CLKBA to B or A	1.0	3.7	5.3	1.0	5.3	
t <sub>PZH</sub>	Propagation Delay	1.5	2.7	5.6	1.5	5.6	ns
t <sub>PZL</sub>	OEAB or OEBA to B or A	1.5	3.0	5.6	1.5	5.6	
t <sub>PHZ</sub>	Propagation Delay	1.5	3.7	6.0	1.5	6.0	ns
t <sub>PLZ</sub>	OEAB or OEBA to B or A	1.5	3.2	6.0	1.5	6.0	

## AC Operating Requirements

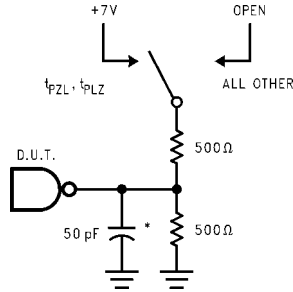
Symbol	Parameter	T <sub>A</sub> = +25°C V <sub>CC</sub> = +5V C <sub>L</sub> = 50 pF		T <sub>A</sub> = -40°C to +85°C V <sub>CC</sub> = 4.5V-5.5V C <sub>L</sub> = 50 pF		Units
		Min	Max	Min	Max	
		t <sub>S</sub> (H)	Setup Time,	4.0		
t <sub>S</sub> (L)	A to CLKAB, B to CLKBA	4.0		4.0		
t <sub>H</sub> (H)	Hold Time,	0		0		ns
t <sub>H</sub> (L)	A to CLKAB, B to CLKBA	0		0		
t <sub>S</sub> (H)	Setup Time, A to LEAB	4.0		4.0		ns
t <sub>S</sub> (L)	or B to LEBA, $\overline{\text{CLK}}$ HIGH	4.0		4.0		
t <sub>H</sub> (H)	Hold Time, A to LEAB	1.5		1.5		ns
t <sub>H</sub> (L)	or B to LEBA, $\overline{\text{CLK}}$ HIGH	1.5		1.5		
t <sub>S</sub> (H)	Setup Time, A to LEAB	1.5		1.5		ns
t <sub>S</sub> (L)	or B to LEBA, $\overline{\text{CLK}}$ LOW	1.5		1.5		
t <sub>H</sub> (H)	Hold Time, A to LEAB	1.5		1.5		ns
t <sub>H</sub> (L)	or B to LEBA, $\overline{\text{CLK}}$ LOW	1.5		1.5		
t <sub>W</sub> (H)	Pulse Width,	3.3		3.3		ns
t <sub>W</sub> (L)	LEAB or LEBA, HIGH	3.3		3.3		
t <sub>W</sub> (H)	Pulse Width, CLKAB	3.3		3.3		ns
t <sub>W</sub> (L)	or CLKBA, HIGH or LOW	3.3		3.3		

## Capacitance

Symbol	Parameter	Typ	Units	Conditions $T_A = 25^\circ\text{C}$
$C_{IN}$	Input Capacitance	5.0	pF	$V_{CC} = 0.0\text{V}$
$C_{IO}$ (Note 10)	Output Capacitance	11.0	pF	$V_{CC} = 5.0\text{V}$

Note 10:  $C_{IO}$  is measured at frequency  $f = 1\text{ MHz}$  per MIL-STD-883, Method 3012.

## AC Loading



\*Includes jig and probe capacitance.

FIGURE 1. Standard AC Test Load

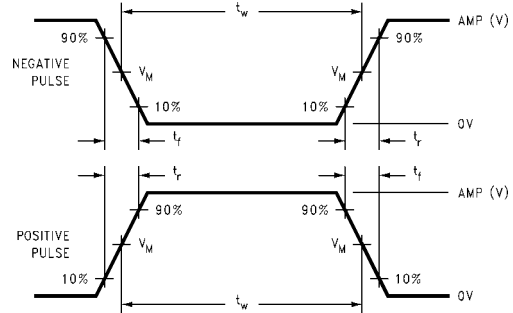


FIGURE 2.  $V_M = 1.5\text{V}$

### Input Pulse Requirements

Amplitude	Rep. Rate	$t_w$	$t_r$	$t_f$
3.0V	1 MHz	500 ns	2.5 ns	2.5 ns

FIGURE 3. Test Input Signal Requirements

## AC Waveforms

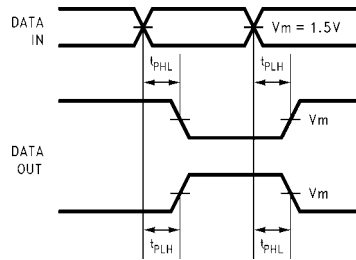


FIGURE 4. Propagation Delay Waveforms for Inverting and Non-Inverting Functions

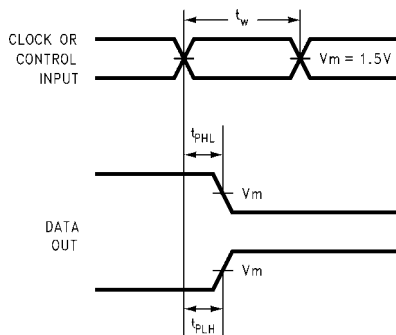


FIGURE 5. Propagation Delay, Pulse Width Waveforms

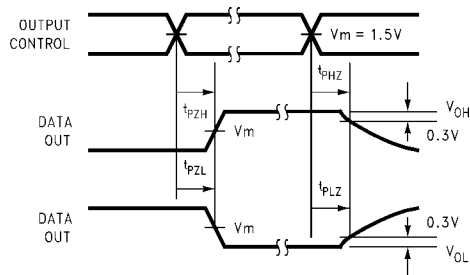


FIGURE 6. 3-STATE Output HIGH and LOW Enable and Disable Times

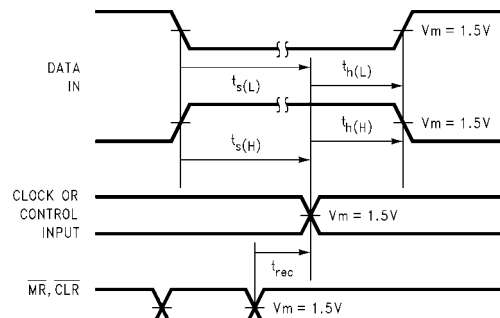
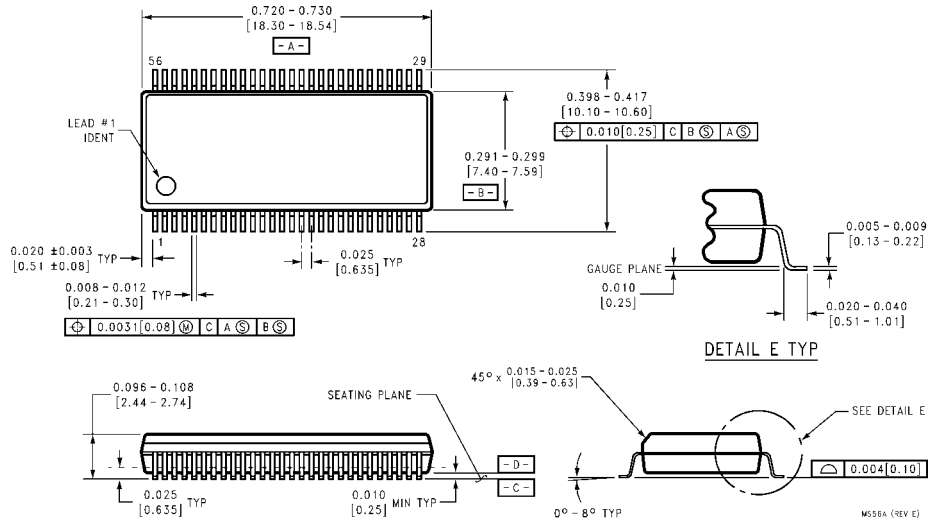


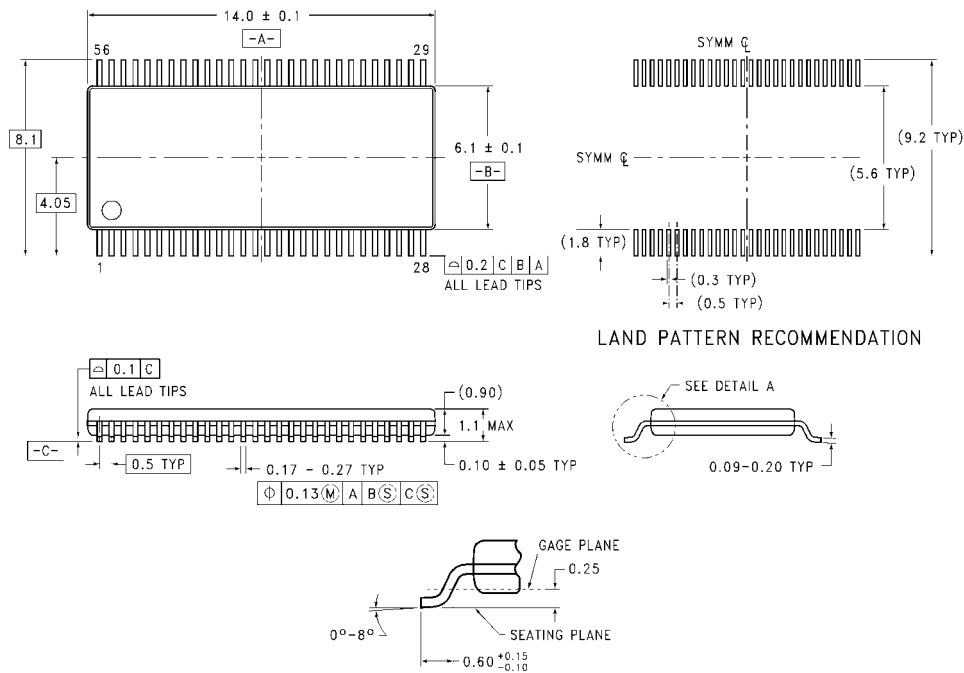
FIGURE 7. Setup Time, Hold Time and Recovery Time Waveforms

**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**

MTD56 (REV B)

**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)