



January 1995
Revised January 1999

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 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 OEBA, LEBA, and CLKBA. The output enables are com-

plementary (OEAB is active HIGH and 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

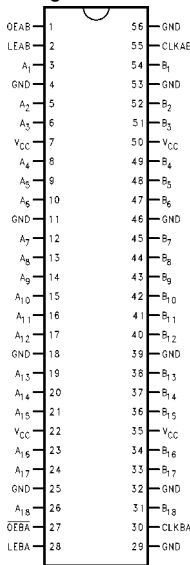
Ordering Code:

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 ₀ (Note 2)
H	L	L	X	B ₀ (Note 3)

Note 1: A-to-B data flow is shown: B-to-A flow is similar but uses OEBA, LEBA, and CLKBA.

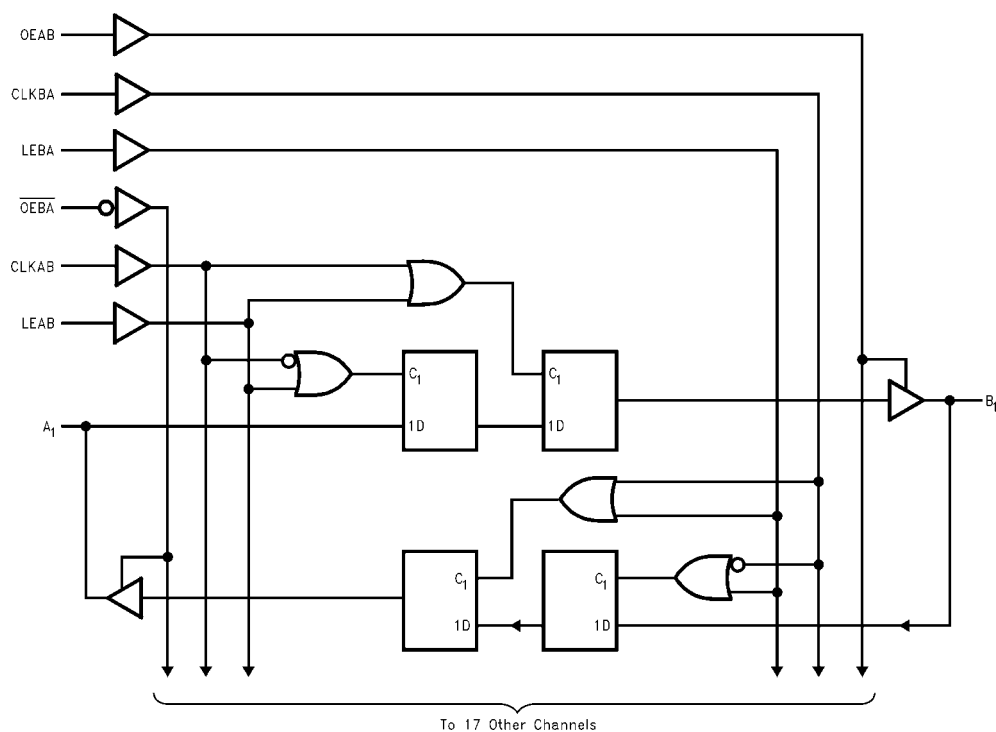
Note 2: Output level before the indicated steady-state input conditions were established.

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

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Logic Diagram



Absolute Maximum Ratings (Note 4)				DC Latchup Source Current	-500 mA		
Storage Temperature	-65°C to +150°C			Over Voltage Latchup (I/O)	10V		
Ambient Temperature under Bias	-55°C to +125°C			Recommended Operating Conditions			
Junction Temperature under Bias	-55°C to +150°C			Free Air Ambient Temperature	-40°C to +85°C		
V _{CC} Pin Potential to				Supply Voltage	+4.5V to +5.5V		
Ground Pin	-0.5V to +7.0V			Minimum Input Edge Rate ($\Delta V/\Delta t$)			
Input Voltage (Note 5)	-0.5V to +7.0V			Data Input	50 mV/ns		
Input Current (Note 5)	-30 mA to +5.0 mA			Enable Input	20 mV/ns		
Voltage Applied to Any Output				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.			
in the Disabled or				Note 5: Either voltage limit or current limit is sufficient to protect inputs.			
Power-off State	-0.5V to 5.5V						
in the HIGH State	-0.5V to V _{CC}						
Current Applied to Output							
in LOW State (Max)	twice the rated I _{OL} (mA)						
DC Electrical Characteristics							
Symbol	Parameter	Min	Typ	Max	Units	V _{CC}	Conditions
V _{IH}	Input HIGH Voltage	2.0			V		Recognized HIGH Signal
V _{IL}	Input LOW Voltage			0.8	V		Recognized LOW Signal
V _{CD}	Input Clamp Diode Voltage			-1.2	V	Min	I _{IN} = -18 mA
V _{OH}	Output HIGH Voltage	2.5			V	Min	I _{OH} = -3 mA
		2.0			V	Min	I _{OH} = -32 mA
V _{OL}	Output LOW Voltage			0.55	V	Min	I _{OL} = 64 mA
I _{IH}	Input HIGH Current			1	μA	Max	V _{IN} = 2.7V (Note 6)
				1	μA	Max	V _{IN} = V _{CC}
I _{BVI}	Input HIGH Current Breakdown Test			7	μA	Max	V _{IN} = 7.0V
I _{IL}	Input LOW Current			-1	μA	Max	V _{IN} = 0.5V (Note 6)
				-1	μA	Max	V _{IN} = 0.0V
V _{ID}	Input Leakage Test	4.75			V	0.0	I _{ID} = 1.9 μA All Other Pins Grounded
I _{IH} + I _{OZH}	Output Leakage Current			10	μA	0 - 5.5V	V _{OUT} = 2.7V; $\overline{OE}$, OE = 2.0V
I _{IL} + I _{OZL}	Output Leakage Current			-10	μA	0 - 5.5V	V _{OUT} = 0.5V; $\overline{OE}$, OE = 2.0V
I _{OS}	Output Short-Circuit Current	-100		-275	mA	Max	V _{OUT} = 0V
I _{CEX}	Output HIGH Leakage Current			50	μA	Max	V _{OUT} = V _{CC}
I _{ZZ}	Bus Drainage Test			100	μA	0.0	V _{OUT} = 5.5V; All Others GND
I _{CCH}	Power Supply Current			1.0	mA	Max	All Outputs HIGH
I _{CCL}	Power Supply Current			68	mA	Max	An or Bn Outputs LOW
I _{CCZ}	Power Supply Current			1.0	mA	Max	$\overline{OE}_n$ = V _{CC} , All Others at V _{CC} or GND
I _{CC1}	Additional I _{CC} /Input			2.5	mA	Max	V _I = V _{CC} - 2.1V All Others at V _{CC} or GND
I _{CCD}	Dynamic I _{CC} No Load (Note 6)			0.23	mA/ MHz	Max	Outputs Open Transparent Mode One Bit Toggling, 50% Duty Cycle
Note 6: Guaranteed, but not tested.							

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DC Electrical Characteristics							
Symbol	Parameter	Min	Typ	Max	Units	V _{CC}	Conditions C _L = 50 pF; R _L = 500Ω
V _{OLP}	Quiet Output Maximum Dynamic V _{OL}		0.7	1.2	V	5.0	T _A = 25°C (Note 7)
V _{OLV}	Quiet Output Minimum Dynamic V _{OL}	−1.5	−1.0		V	5.0	T _A = 25°C (Note 7)
V _{OHV}	Minimum HIGH Level Dynamic Output Voltage	2.5	3.0		V	5.0	T _A = 25°C (Note 8)
V _{IHD}	Minimum HIGH Level Dynamic Input Voltage	2.2	1.8		V	5.0	T _A = 25°C (Note 9)
V _{ILD}	Maximum LOW Level Dynamic Input Voltage		1.2	0.8	V	5.0	T _A = 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 _{ILD}), 0V to threshold (V _{IHD}). Guaranteed, but not tested.							
AC Electrical Characteristics							
Symbol	Parameter	T _A = +25°C V _{CC} = +5V C _L = 50 pF			T _A = −40°C to +85°C V _{CC} = 4.5V–5.5V C _L = 50 pF		Units
		Min	Typ	Max	Min	Max	
f _{max}	Maximum Clock Frequency	150	200		150		MHz
t _{PLH}	Propagation Delay	1.0	2.7	4.6	1.0	4.6	ns
t _{PHL}	A or B to B or A	1.0	3.2	4.6	1.0	4.6	
t _{PLH}	Propagation Delay	1.0	3.1	5.0	1.0	5.0	ns
t _{PHL}	LEAB or LEBA to B or A	1.0	3.6	5.5	1.0	5.5	
t _{PLH}	Propagation Delay	1.0	3.4	5.3	1.0	5.3	ns
t _{PHL}	CLKAB or CLKBA to B or A	1.0	3.7	5.3	1.0	5.3	
t _{PZH}	Propagation Delay	1.5	2.7	5.6	1.5	5.6	ns
t _{PZL}	OEAB or OEBA to B or A	1.5	3.0	5.6	1.5	5.6	
t _{PHZ}	Propagation Delay	1.5	3.7	6.0	1.5	6.0	ns
t _{PLZ}	OEAB or OEBA to B or A	1.5	3.2	6.0	1.5	6.0	
AC Operating Requirements							
Symbol	Parameter	T _A = +25°C V _{CC} = +5V C _L = 50 pF		T _A = −40°C to +85°C V _{CC} = 4.5V–5.5V C _L = 50 pF		Units	
		Min	Max	Min	Max		
t _S (H)	Setup Time,	4.0		4.0		ns	
t _S (L)	A to CLKAB, B to CLKBA	4.0		4.0			
t _H (H)	Hold Time,	0		0		ns	
t _H (L)	A to CLKAB, B to CLKBA	0		0			
t _S (H)	Setup Time, A to LEAB	4.0		4.0		ns	
t _S (L)	or B to LEBA, $\overline{\text{CLK}}$ HIGH	4.0		4.0			
t _H (H)	Hold Time, A to LEAB	1.5		1.5		ns	
t _H (L)	or B to LEBA, $\overline{\text{CLK}}$ HIGH	1.5		1.5			
t _S (H)	Setup Time, A to LEAB	1.5		1.5		ns	
t _S (L)	or B to LEBA, $\overline{\text{CLK}}$ LOW	1.5		1.5			
t _H (H)	Hold Time, A to LEAB	1.5		1.5		ns	
t _H (L)	or B to LEBA, $\overline{\text{CLK}}$ LOW	1.5		1.5			
t _W (H)	Pulse Width,	3.3		3.3		ns	
t _W (L)	LEAB or LEBA, HIGH	3.3		3.3			
t _W (H)	Pulse Width, CLKAB	3.3		3.3		ns	
t _W (L)	or CLKBA, HIGH or LOW	3.3		3.3			

Symbol	Parameter	Typ	Units	Conditions T _A = 25°C
C _{IN}	Input Capacitance	5.0	pF	V _{CC} = 0.0V
C _{I/O} (Note 10)	Output Capacitance	11.0	pF	V _{CC} = 5.0V

AC Loading

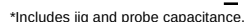


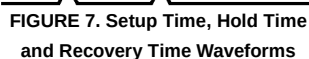
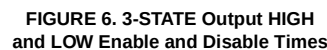
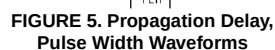
Figure 2 consists of two vertically stacked waveforms. The top waveform is labeled 'NEGATIVE PULSE' and the bottom is 'POSITIVE PULSE'. Both waveforms are plotted against 'AMP (V)' on the vertical axis, with levels marked at 90%, 10%, and 0V. The horizontal axis represents time. The pulse width is denoted as t_w . The rise time (for the negative pulse) or fall time (for the positive pulse) is denoted as t_r . The voltage levels at 90% and 10% are marked as V_M and V_{10} respectively. The waveforms show a transition from 0V to the pulse level and back to 0V, with the pulse level being either 90% or 10% of the full scale.

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

AC Waveforms

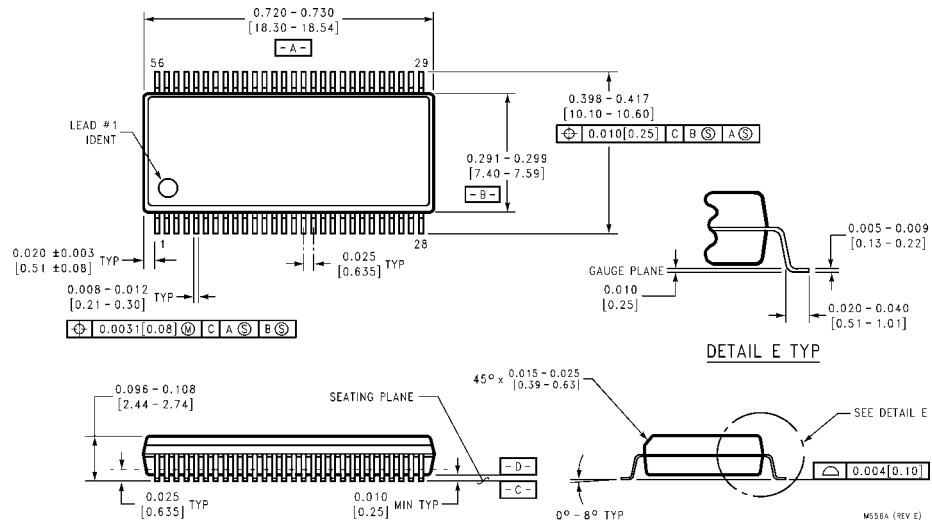


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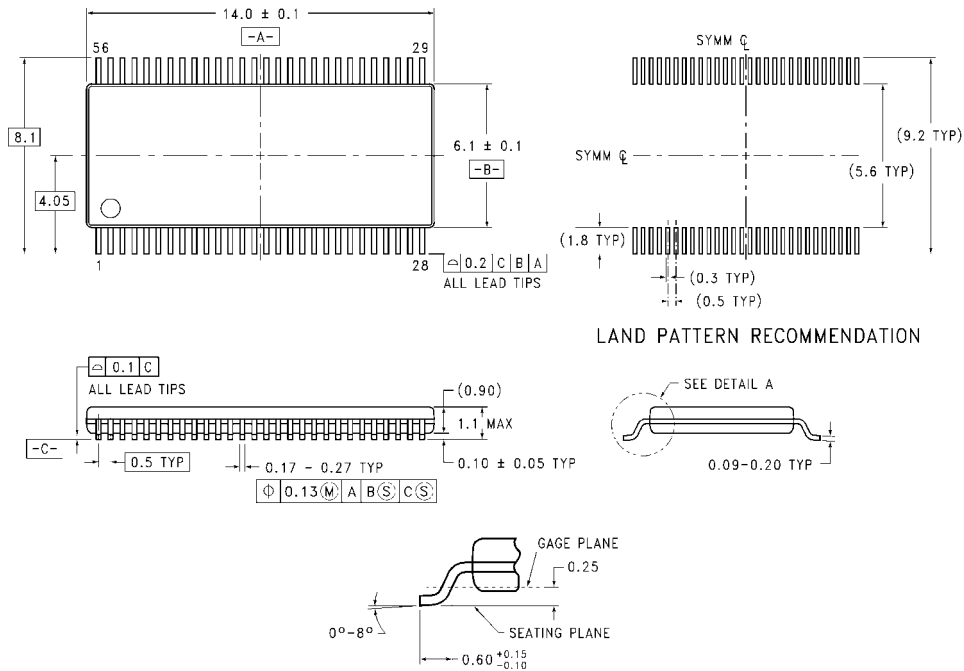
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Physical Dimensions inches (millimeters) unless otherwise noted



**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**

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