



3.3V CMOS 18-BIT UNIVERSAL BUS TRANSCEIVER WITH 3-STATE OUTPUTS AND BUS-HOLD

IDT74ALVCHR16501

FEATURES:

- 0.5 MICRON CMOS Technology
- Typical $t_{SK(0)}$ (Output Skew) < 250ps
- ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)
- 0.635mm pitch SSOP, 0.50mm pitch TSSOP, and 0.40mm pitch TVSOP packages
- Extended commercial range of -40°C to $+85^{\circ}\text{C}$
- $V_{CC} = 3.3\text{V} \pm 0.3\text{V}$, Normal Range
- $V_{CC} = 2.7\text{V}$ to 3.6V , Extended Range
- $V_{CC} = 2.5\text{V} \pm 0.2\text{V}$
- CMOS power levels ($0.4\mu\text{W}$ typ. static)
- Rail-to-Rail output swing for increased noise margin

Drive Features for ALVCHR16501:

- Balanced Output Drivers: $\pm 12\text{mA}$
- Low switching noise

APPLICATIONS:

- 3.3V High Speed Systems
- 3.3V and lower voltage computing systems

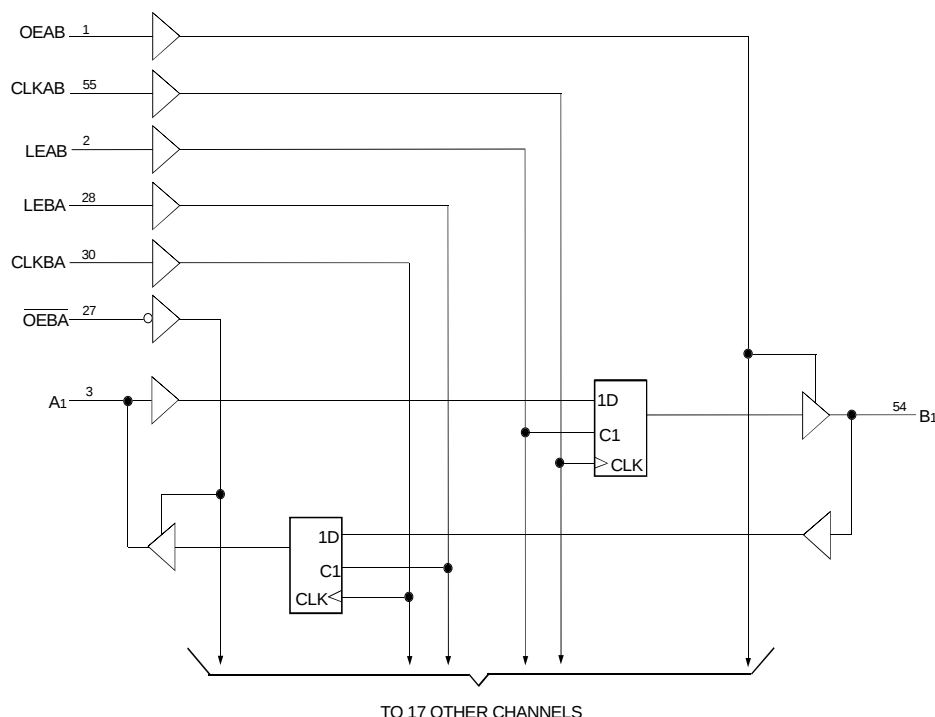
DESCRIPTION:

This 18-bit universal bus transceiver is built using advanced dual metal CMOS technology. Data flow in each direction is controlled by output-enable ($\overline{\text{OEAB}}$ and $\overline{\text{OEBA}}$), latch enable ($\overline{\text{LEAB}}$ and $\overline{\text{LEBA}}$) and clock (CLKAB and CLKBA) inputs. For A-to-B data flow, the device operates in the transparent mode when $\overline{\text{LEAB}}$ is high. When $\overline{\text{LEAB}}$ is low, the A data is latched if CLKAB is held at a high or low logic level. If $\overline{\text{LEAB}}$ is low, the A data is stored in the latch/flip-flop on the low-to-high transition of CLKAB . When $\overline{\text{OEAB}}$ is high, the outputs are active. When $\overline{\text{OEAB}}$ is low, the outputs are in the high-impedance state. Data flow from B to A is similar to that of A to B but uses $\overline{\text{OEBA}}$, $\overline{\text{LEBA}}$, and CLKBA . The output enables are complementary ($\overline{\text{OEAB}}$ is active high and $\overline{\text{OEBA}}$ is active low).

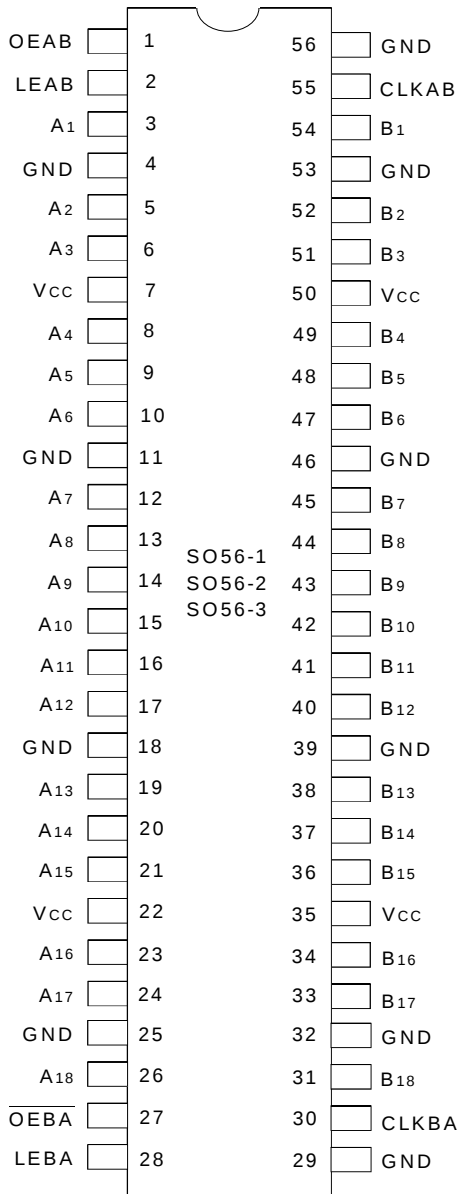
The ALVCHR16501 has series resistors in the device output structure which will significantly reduce line noise when used with light loads. This driver has been designed to drive $\pm 12\text{mA}$ at the designated threshold levels.

The ALVCHR16501 has "bus-hold" which retains the inputs' last state whenever the input bus goes to a high impedance. This prevents floating inputs and eliminates the need for pull-up/down resistors.

FUNCTIONAL BLOCK DIAGRAM



PIN CONFIGURATION



SSOP/
TSSOP/TVSOP
TOP VIEW

ABSOLUTE MAXIMUM RATING (1)

Symbol	Description	Max.	Unit
$V_{TERM}^{(2)}$	Terminal Voltage with Respect to GND	- 0.5 to + 4.6	V
$V_{TERM}^{(3)}$	Terminal Voltage with Respect to GND	- 0.5 to $V_{CC} + 0.5$	V
T_{STG}	Storage Temperature	- 65 to + 150	°C
I_{OUT}	DC Output Current	- 50 to + 50	mA
I_{IK}	Continuous Clamp Current, $V_I < 0$ or $V_I > V_{CC}$	± 50	mA
I_{OK}	Continuous Clamp Current, $V_O < 0$	- 50	mA
I_{CC}	Continuous Current through each V_{CC} or GND	±100	mA

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NOTES:

- Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.
- V_{CC} terminals.
- All terminals except V_{CC} .

CAPACITANCE ($T_A = +25^\circ\text{C}$, $f = 1.0\text{MHz}$)

Symbol	Parameter ⁽¹⁾	Conditions	Typ.	Max.	Unit
C_{IN}	Input Capacitance	$V_{IN} = 0V$	5	7	pF
C_{OUT}	Output Capacitance	$V_{OUT} = 0V$	7	9	pF
$C_{I/O}$	I/O Port Capacitance	$V_{IN} = 0V$	7	9	pF

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NOTE:

- As applicable to the device type.

FUNCTION TABLE (1, 2)

Inputs				Output
OEAB	LEAB	CLKAB	Ax	Bx
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	L	X	$B_O^{(3)}$
H	L	H	X	$B_O^{(4)}$

NOTES:

- A-to-B data flow is shown. B-to-A data flow is similar but uses $\overline{OEBA}$, $\overline{LEBA}$, and $\overline{CLKBA}$
- H = HIGH Voltage Level
L = LOW Voltage Level
X = Don't Care
Z = High-Impedance
↓ = HIGH-to-LOW Transition
- Output level before the indicated steady-state input conditions were established
- Output level before the indicated steady-state input conditions were established, provided that $\overline{CLKAB}$ was low before $\overline{LEAB}$ went low.

PIN DESCRIPTION

Pin Names	Description
OEAB	A-to-B Output Enable Input
$\overline{\text{OEBA}}$	B-to-A Output Enable Input (Active LOW)
LEAB	A-to-B Latch Enable Input
LEBA	B-to-A Latch Enable Input
CLKAB	A-to-B Clock Input
CLKBA	B-to-A Clock Input
Ax	A-to-B Data Inputs or B-to-A 3-State Outputs ⁽¹⁾
Bx	B-to-A Data Inputs or A-to-B 3-State Outputs ⁽¹⁾

NOTE:

- These pins have "Bus-Hold." All other pins are standard inputs, outputs, or I/Os.

DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:

Operating Condition: TA = – 40°C to +85°C

Symbol	Parameter	Test Conditions		Min.	Typ. ⁽¹⁾	Max.	Unit
V _{IH}	Input HIGH Voltage Level	V _{CC} = 2.3V to 2.7V		1.7	—	—	V
		V _{CC} = 2.7V to 3.6V		2	—	—	
V _{IL}	Input LOW Voltage Level	V _{CC} = 2.3V to 2.7V		—	—	0.7	V
		V _{CC} = 2.7V to 3.6V		—	—	0.8	
I _{IH}	Input HIGH Current	V _{CC} = 3.6V	V _I = V _{CC}	—	—	± 5	μA
I _{IL}	Input LOW Current	V _{CC} = 3.6V	V _I = GND	—	—	± 5	
I _{OZH}	High Impedance Output Current (3-State Output pins)	V _{CC} = 3.6V	V _O = V _{CC}	—	—	± 10	μA
I _{OZL}			V _O = GND	—	—	± 10	μA
V _{IK}	Clamp Diode Voltage	V _{CC} = 2.3V, I _{IN} = – 18mA		—	– 0.7	– 1.2	V
V _H	Input Hysteresis	V _{CC} = 3.3V		—	100	—	mV
I _{CCL} I _{CCH} I _{CCZ}	Quiescent Power Supply Current	V _{CC} = 3.6V V _{IN} = GND or V _{CC}		—	0.1	40	μA
ΔI _{CC}	Quiescent Power Supply Current Variation	One input at V _{CC} – 0.6V, other inputs at V _{CC} or GND		—	—	750	μA

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NOTE:

- Typical values are at V_{CC} = 3.3V, +25°C ambient.

BUS-HOLD CHARACTERISTICS

Symbol	Parameter ⁽¹⁾	Test Conditions		Min.	Typ. ⁽²⁾	Max.	Unit
IBHH IBHL	Bus-Hold Input Sustain Current	V _{CC} = 3.0V	V _I = 2.0V V _I = 0.8V	– 75 75	— —	— —	μA
IBHH IBHL	Bus-Hold Input Sustain Current	V _{CC} = 2.3V	V _I = 1.7V V _I = 0.7V	– 45 45	— —	— —	μA
IBHHO IBHLO	Bus-Hold Input Overdrive Current	V _{CC} = 3.6V	V _I = 0 to 3.6V	—	—	± 500	μA

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NOTES:

1. Pins with Bus-hold are identified in the pin description.
2. Typical values are at V_{CC} = 3.3V, +25°C ambient.

OUTPUT DRIVE CHARACTERISTICS

Symbol	Parameter	Test Conditions ⁽¹⁾		Min.	Max.	Unit
VOH	Output HIGH Voltage	V _{CC} = 2.3V to 3.6V	I _{OH} = – 0.1mA	V _{CC} – 0.2	—	V
		V _{CC} = 2.3V	I _{OH} = – 4mA	1.9	—	
			I _{OH} = – 6mA	1.7	—	
		V _{CC} = 2.7V	I _{OH} = – 4mA	2.2	—	
			I _{OH} = – 8mA	2	—	
		V _{CC} = 3.0V	I _{OH} = – 6mA	2.4	—	
			I _{OH} = – 12mA	2	—	
VOL	Output LOW Voltage	V _{CC} = 2.3V to 3.6V	I _{OL} = 0.1mA	—	0.2	V
		V _{CC} = 2.3V	I _{OL} = 4mA	—	0.4	
			I _{OL} = 6mA	—	0.55	
		V _{CC} = 2.7V	I _{OL} = 4mA	—	0.4	
			I _{OL} = 8mA	—	0.6	
		V _{CC} = 3.0V	I _{OL} = 6mA	—	0.55	
			I _{OL} = 12mA	—	0.8	

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NOTE:

1. V_{IH} and V_{IL} must be within the min. or max. range shown in the DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE table for the appropriate V_{CC} range. T_A = – 40°C to + 85°C.

OPERATING CHARACTERISTICS, T_A = 25°C

Symbol	Parameter	Test Conditions	V _{CC} = 2.5V ± 0.2V	V _{CC} = 3.3V ± 0.3V	Unit
			Typical	Typical	
CPD	Power Dissipation Capacitance Outputs enabled	C _L = 0pF, f = 10MHz	—	—	pF
CPD	Power Dissipation Capacitance Outputs disabled		—	—	pF

SWITCHING CHARACTERISTICS ⁽¹⁾

Symbol	Parameter	V _{CC} = 2.5V ± 0.2V		V _{CC} = 2.7V		V _{CC} = 3.3V ± 0.3V		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	
t _{PLH} t _{PHL}	Propagation Delay Ax to Bx or Bx to Ax	1.2	5.9	—	5.2	1	4.5	ns
t _{PLH} t _{PHL}	Propagation Delay LEBA to Ax or LEAB to Bx	1.6	6.8	—	6	1.3	5.2	ns
t _{PLH} t _{PHL}	Propagation Delay CLKBA to Ax or CLKAB to Bx	1.7	7.2	—	6.3	1.4	5.5	ns
t _{PZH} t _{PZL}	Output Enable Time OEBA to Ax	1.4	7.3	—	6.7	1.1	5.6	ns
t _{PZH} t _{PZL}	Output Enable Time OEAB to Bx	1.1	6.8	—	6	1	5.2	ns
t _{PHZ} t _{PLZ}	Output Disable Time OEBA to Ax	2	6	—	5.1	1.3	4.7	ns
t _{PHZ} t _{PLZ}	Output Disable Time OEAB to Bx	2.2	6.9	—	6.2	1.4	5.5	ns
t _{SU}	Setup Time, data before CLK [↑]	2.2	—	2.1	—	1.7	—	ns
t _H	Hold Time, data after CLK [↑]	0.6	—	0.6	—	0.7	—	ns
t _{SU}	Setup Time, data before $\overline{LE}$ [↓]	CLK HIGH	1.9	—	1.6	—	1.5	ns
		CLK	1.3	—	1.1	—	1	ns
t _H	Hold Time, data after $\overline{LE}$ [↓]	CLK HIGH or LOW	1.4	—	1.7	—	1.4	ns
t _w	Pulse Width, LE HIGH	3.3	—	3.3	—	3.3	—	ns
t _w	Pulse Width, CLK HIGH or LOW	3.3	—	3.3	—	3.3	—	ns
t _{SK(0)}	Output Skew ⁽²⁾	—	—	—	—	—	500	ps

NOTES:

1. See test circuits and waveforms. T_A = – 40°C to + 85°C.
2. Skew between any two outputs of the same package and switching in the same direction.

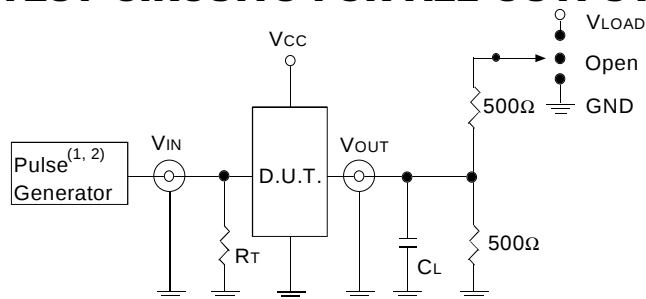
TEST CIRCUITS AND WAVEFORMS:

TEST CONDITIONS

Symbol	V _{CC} (1)= 3.3V±0.3V	V _{CC} (1)= 2.7V	V _{CC} (2)= 2.5V±0.2V	Unit
V _{LOAD}	6	6	2 x V _{CC}	V
V _{IH}	2.7	2.7	V _{CC}	V
V _T	1.5	1.5	V _{CC} / 2	V
V _{LZ}	300	300	150	mV
V _{HZ}	300	300	150	mV
C _L	50	50	30	pF

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TEST CIRCUITS FOR ALL OUTPUTS



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DEFINITIONS:

C_L = Load capacitance: includes jig and probe capacitance.

R_T = Termination resistance: should be equal to Z_{OUT} of the Pulse Generator.

NOTES:

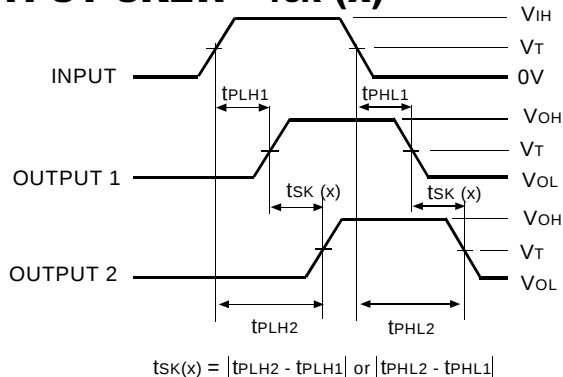
1. Pulse Generator for All Pulses: Rate ≤ 10MHz; t_r ≤ 2.5ns; t_r ≤ 2.5ns.
2. Pulse Generator for All Pulses: Rate ≤ 10MHz; t_r ≤ 2ns; t_r ≤ 2ns.

SWITCH POSITION

Test	Switch
Open Drain Disable Low Enable Low	V _{LOAD}
Disable High Enable High	GND
All Other tests	Open

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OUTPUT SKEW - t_{SK} (x)



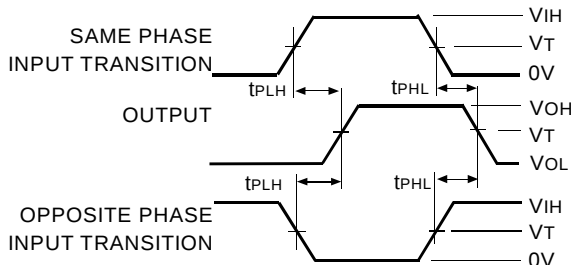
$$t_{SK}(x) = |t_{PLH2} - t_{PLH1}| \text{ or } |t_{PHL2} - t_{PHL1}|$$

ALVC Link

NOTES:

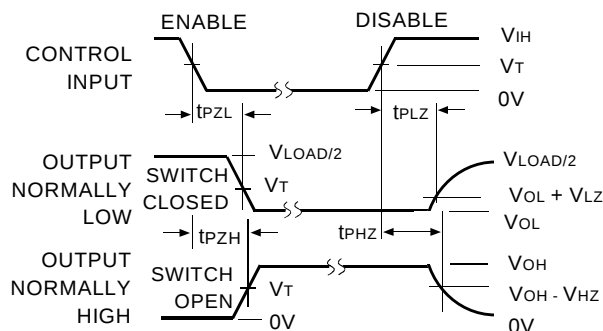
1. For t_{SK}(o) OUTPUT1 and OUTPUT2 are any two outputs.
2. For t_{SK}(b) OUTPUT1 and OUTPUT2 are in the same bank.

PROPAGATION DELAY



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ENABLE AND DISABLE TIMES

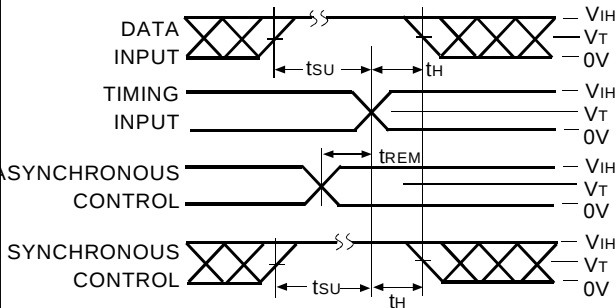


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NOTE:

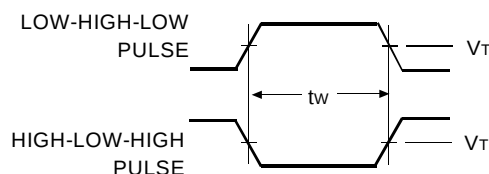
1. Diagram shown for input Control Enable-LOW and input Control Disable-HIGH.

SET-UP, HOLD, AND RELEASE TIMES



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PULSE WIDTH



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ORDERING INFORMATION

IDT	XX	ALVC	X	XXX	XXX	XX	
	Temp. Range		Bus-Hold	Family	Device Type	Package	
						PV	Shrink Small Outline Package (SO56-1)
						PA	Thin Shrink Small Outline Package (SO56-2)
						PF	Thin Very Small Outline Package (SO56-3)
					501		18-Bit Universal Bus Transceiver with 3-State Outputs
				R16			Double-Density with Resistors, $\pm 12\text{mA}$
			H				Bus-Hold
						74	-40°C to $+85^{\circ}\text{C}$



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