



# 1.8V CMOS 16-BIT BUS TRANSCEIVER WITH 3-STATE OUTPUTS AND BUS-HOLD

**IDT74AUCH16245**

## FEATURES:

- ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)
- 1.8V Optimized
- 0.8V to 2.7V Operating Range
- Inputs/outputs tolerant up to 3.6V
- Output drivers:  $\pm 9\text{mA}$  @  $V_{DD} = 2.3\text{V}$
- Supports hot insertion
- Available in TSSOP package

## APPLICATIONS:

- High performance, low voltage communications systems
- High performance, low voltage computing systems

## DESCRIPTION:

This 16-bit bus transceiver is built using advanced CMOS technology. The AUCH16245 is designed specifically for asynchronous communications between data buses. The control function implementation minimizes external timing requirements.

This device can be used as one 16-bit transceiver or two 8-bit transceivers. It allows data transmission from A bus to B bus or from B bus to A bus, depending on the logic level at the direction-control (DIR) input. The output-enable ( $\overline{OE}$ ) input can be used to disable the device so that the buses are effectively isolated.

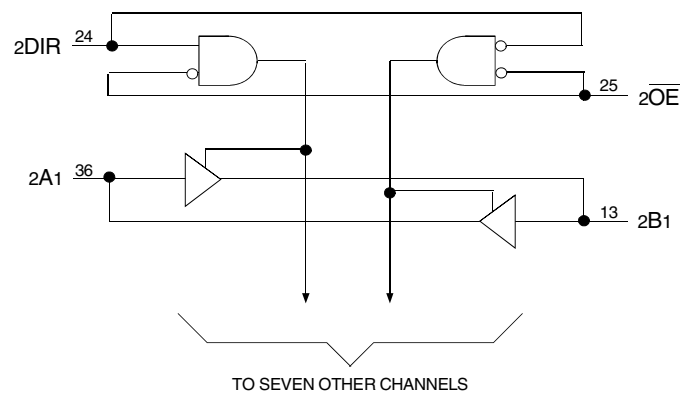
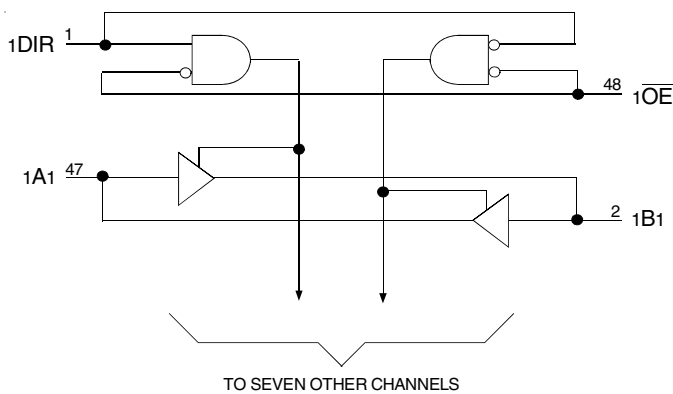
This device is fully specified for partial power-down applications using I<sub>OFF</sub>. The I<sub>OFF</sub> circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

The AUCH16245 is designed with a  $\pm 9\text{mA}$  output driver. This driver is capable of driving a moderate load while maintaining speed performance.

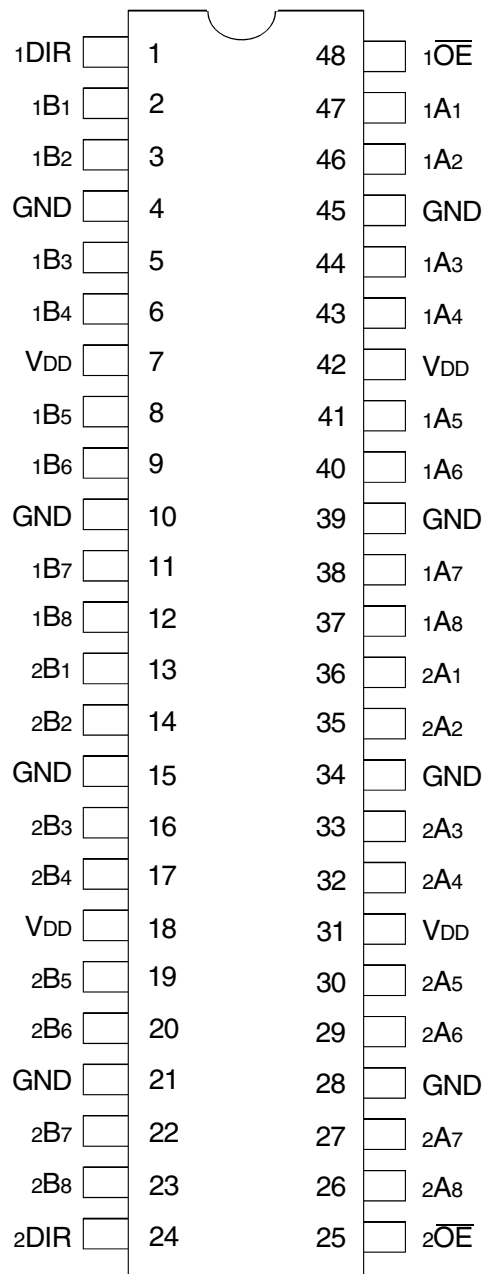
To ensure the high-impedance state during power up or power down,  $\overline{OE}$  should be tied to  $V_{DD}$  through a pull-up resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

The AUCH16245 data I/Os have bus-hold, which retains the last value whenever the I/O goes to a high impedance. This prevents floating inputs and eliminates the need for pull-up/pull-down resistors. Control inputs do not have bus-hold and should not be allowed to float.

## FUNCTIONAL BLOCK DIAGRAM



## PIN CONFIGURATION

TSSOP  
TOP VIEWABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

Symbol	Description	Max	Unit	
V <sub>TERM</sub>	Terminal Voltage with Respect to GND (all input and V <sub>DD</sub> terminals)	-0.5 to +3.6	V	
V <sub>TERM</sub>	Terminal Voltage with Respect to GND (any I/O or Output terminals in high-impedance or power-off state)	-0.5 to +3.6	V	
V <sub>TERM</sub>	Terminal Voltage with Respect to GND (any I/O or Output terminals in high or low state)	-0.5 to +3.6	V	
T <sub>STG</sub>	Storage Temperature	-65 to +150	°C	
I <sub>OUT</sub>	Continuous DC Output Current	±20	mA	
I <sub>IK</sub>	Continuous Clamp Current	V <sub>I</sub> > V <sub>DD</sub>	+50	mA
		V <sub>I</sub> < 0	-50	mA
I <sub>OK</sub>	Continuous Clamp Current, V <sub>O</sub> < 0	-50	mA	
I <sub>DD</sub>	Continuous Current through each V <sub>DD</sub> or GND	±100	mA	

## NOTE:

1. 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.

CAPACITANCE (T<sub>A</sub> = +25°C, f = 1.0MHz, V<sub>DD</sub> = 2.5V)

Symbol	Parameter	Conditions	Typ.	Max.	Unit
C <sub>IN</sub>	Input Capacitance <sup>(1)</sup>	V <sub>IN</sub> = 0V	3		pF
C <sub>I/O</sub>	I/O Port Capacitance <sup>(2)</sup>	V <sub>IN</sub> = 0V	8		pF

## NOTES:

- Applies to the Control Inputs.
- Applies to ports A and B.

## PIN DESCRIPTION

Pin Names	Description
x $\overline{OE}$	3-State Output Enable Inputs (Active Low)
xDIR	Direction Control Inputs
xAx	A Side Inputs or 3-State Outputs <sup>(1)</sup>
xBx	B Side Inputs or 3-State Outputs <sup>(1)</sup>

## NOTE:

1. These pins have "bus-hold". All other pins are standard outputs, inputs, or I/Os.

FUNCTION TABLE (EACH 8-BIT SECTION)<sup>(1)</sup>

Inputs		Outputs
x $\overline{OE}$	xDIR	
L	L	Bus B Data to Bus A
L	H	Bus A Data to Bus B
H	X	Z

## NOTE:

- H = HIGH Voltage Level  
L = LOW Voltage Level  
X = Don't Care  
Z = High-Impedance

RECOMMENDED OPERATING CHARACTERISTICS<sup>(1)</sup>

Symbol	Parameter	Test Conditions	Min.	Max.	Unit
V <sub>DD</sub>	Supply Voltage		0.8	2.7	V
V <sub>IH</sub>	Input HIGH Voltage Level	V <sub>DD</sub> = 0.8V	V <sub>DD</sub>	—	V
		V <sub>DD</sub> = 1.1V to 1.3V	0.65 x V <sub>DD</sub>	—	
		V <sub>DD</sub> = 1.4V to 1.6V	0.65 x V <sub>DD</sub>	—	
		V <sub>DD</sub> = 1.65V to 1.95V	0.65 x V <sub>DD</sub>	—	
		V <sub>DD</sub> = 2.3V to 2.7V	1.7	—	
V <sub>IL</sub>	Input LOW Voltage Level	V <sub>DD</sub> = 0.8V	—	0	V
		V <sub>DD</sub> = 1.1V to 1.3V	—	0.35 x V <sub>DD</sub>	
		V <sub>DD</sub> = 1.4V to 1.6V	—	0.35 x V <sub>DD</sub>	
		V <sub>DD</sub> = 1.65V to 1.95V	—	0.35 x V <sub>DD</sub>	
		V <sub>DD</sub> = 2.3V to 2.7V	—	0.7	
V <sub>I</sub>	Input Voltage		0	2.7	V
V <sub>O</sub>	Output Voltage	Active State	0	V <sub>DD</sub>	V
		3-State	0	2.7	
I <sub>OH</sub>	HIGH Level Output Current	V <sub>DD</sub> = 0.8V	—	-0.7	mA
		V <sub>DD</sub> = 1.1V	—	-3	
		V <sub>DD</sub> = 1.4V	—	-5	
		V <sub>DD</sub> = 1.65V	—	-8	
		V <sub>DD</sub> = 2.3V	—	-9	
I <sub>OL</sub>	LOW Level Output Current	V <sub>DD</sub> = 0.8V	—	0.7	mA
		V <sub>DD</sub> = 1.1V	—	3	
		V <sub>DD</sub> = 1.4V	—	5	
		V <sub>DD</sub> = 1.65V	—	8	
		V <sub>DD</sub> = 2.3V	—	9	
Δt/Δv	Input Transition Rise or Fall Time		—	5	ns/V
T <sub>A</sub>	Operating Free-Air Temperature		-40	+85	°C

## NOTE:

1. All unused inputs of the device must be held at V<sub>DD</sub> or GND to ensure proper operation.

DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE<sup>(1)</sup>

Following Conditions Apply Unless Otherwise Specified:

Operating Conditions: T<sub>A</sub> = -40°C to +85°C

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I <sub>IH</sub>	Input HIGH or LOW Current	V <sub>DD</sub> = 2.7V, V <sub>I</sub> = V <sub>DD</sub> or GND	—	—	±10	μA
I <sub>IL</sub>						
I <sub>OFF</sub>	Input/Output Power Off Leakage	V <sub>DD</sub> = 0V, V <sub>IN</sub> or V <sub>O</sub> ≤ 2.7V	—	—	±10	μA
I <sub>OZH</sub> <sup>(2)</sup>	High Impedance Output Current (3-State Output Pins)	V <sub>DD</sub> = 2.7V	—	—	±10	μA
I <sub>OZL</sub> <sup>(2)</sup>						
I <sub>DDL</sub>	Quiescent Power Supply Current	V <sub>DD</sub> = 0.8V to 2.7V V <sub>IN</sub> = GND or V <sub>DD</sub>	—	—	20	μA
I <sub>DDH</sub>						
I <sub>DDZ</sub>						

## NOTES:

- All unused inputs of the device must be held at V<sub>DD</sub> or GND to ensure proper operation.
- For the I/O ports, the parameters I<sub>OZH</sub> and I<sub>OZL</sub> include the input leakage current.

## BUS-HOLD CHARACTERISTICS

Symbol	Parameter <sup>(1)</sup>	Test Conditions		Min.	Typ.	Max.	Unit
IBHH IBHL	Bus-Hold Input Sustain Current	V <sub>DD</sub> = 1.1V	V <sub>I</sub> = 0.8V	-10	—	—	μA
			V <sub>I</sub> = 0.35V	10	—	—	
		V <sub>DD</sub> = 1.4V	V <sub>I</sub> = 0.9V	-15	—	—	
			V <sub>I</sub> = 0.47V	15	—	—	
		V <sub>DD</sub> = 1.65V	V <sub>I</sub> = 1.07V	-20	—	—	
			V <sub>I</sub> = 0.57V	20	—	—	
V <sub>DD</sub> = 2.3V	V <sub>I</sub> = 1.7V	-40	—	—			
	V <sub>I</sub> = 0.7V	40	—	—			
IBHHO IBHLO	Bus-Hold Input Overdrive Current	V <sub>DD</sub> = 1.3V	V <sub>I</sub> = 0 to V <sub>DD</sub>	—	—	±125	μA
		V <sub>DD</sub> = 1.6V		—	—	±175	
		V <sub>DD</sub> = 1.95V		—	—	±250	
		V <sub>DD</sub> = 2.7V		—	—	±400	

## NOTE:

1. Pins with Bus-hold are identified in the pin description.

## OUTPUT DRIVE CHARACTERISTICS

Symbol	Parameter	Test Conditions <sup>(1)</sup>		Min.	Typ.	Max.	Unit
V <sub>OH</sub>	Output HIGH Voltage	V <sub>DD</sub> = 0.8V - 2.7V	I <sub>OH</sub> = -100μA	V <sub>DD</sub> - 0.1	—	—	V
		V <sub>DD</sub> = 0.8V	I <sub>OH</sub> = -0.7mA	—	0.55	—	
		V <sub>DD</sub> = 1.1V <sup>(2)</sup>	I <sub>OH</sub> = -3mA	0.8	—	—	
		V <sub>DD</sub> = 1.4V <sup>(3)</sup>	I <sub>OH</sub> = -5mA	1	—	—	
		V <sub>DD</sub> = 1.65V <sup>(4)</sup>	I <sub>OH</sub> = -8mA	1.2	—	—	
		V <sub>DD</sub> = 2.3V <sup>(5)</sup>	I <sub>OH</sub> = -9mA	1.8	—	—	
V <sub>OL</sub>	Output LOW Voltage	V <sub>DD</sub> = 0.8V - 2.7V	I <sub>OH</sub> = 100μA	—	—	0.2	V
		V <sub>DD</sub> = 0.8V	I <sub>OL</sub> = 0.7mA	—	0.25	—	
		V <sub>DD</sub> = 1.1V <sup>(2)</sup>	I <sub>OL</sub> = 3mA	—	—	0.3	
		V <sub>DD</sub> = 1.4V <sup>(3)</sup>	I <sub>OL</sub> = 5mA	—	—	0.4	
		V <sub>DD</sub> = 1.65V <sup>(4)</sup>	I <sub>OL</sub> = 8mA	—	—	0.45	
		V <sub>DD</sub> = 2.3V <sup>(5)</sup>	I <sub>OL</sub> = 9mA	—	—	0.6	

## NOTES:

1. V<sub>IL</sub> and V<sub>IH</sub> must be within the min. or max. range shown in the DC ELECTRICAL CHARACTERISTICS table for the appropriate V<sub>DD</sub> range. T<sub>A</sub> = -40°C to +85°C.
2. Demonstrates operation for nominal V<sub>DD</sub> = 1.2V.
3. Demonstrates operation for nominal V<sub>DD</sub> = 1.5V.
4. Demonstrates operation for nominal V<sub>DD</sub> = 1.8V.
5. Demonstrates operation for nominal V<sub>DD</sub> = 2.5V.

OPERATING CHARACTERISTICS,  $T_A = 25^\circ\text{C}$ 

Symbol	Parameter	Test Conditions	$V_{DD} = 0.8\text{V}$	$V_{DD} = 1.2\text{V}$	$V_{DD} = 1.5\text{V}$	$V_{DD} = 1.8\text{V}$	$V_{DD} = 2.5\text{V}$	Unit
CPD	Power Dissipation Capacitance Outputs Enabled	$C_L = 0\text{pF}$ $f = 10\text{MHz}$	22	23	24	25	29	pF
CPD	Power Dissipation Capacitance Outputs Disabled		1	1	1	1	1	pF

SWITCHING CHARACTERISTICS<sup>(1)</sup>

Symbol	Parameter	$V_{DD} = 0.8\text{V}$	$V_{DD} = 1.2\text{V} \pm 0.1\text{V}$		$V_{DD} = 1.5\text{V} \pm 0.1\text{V}$		$V_{DD} = 1.8\text{V} \pm 0.15\text{V}$			$V_{DD} = 2.5\text{V} \pm 0.2\text{V}$		Unit
		Typ.	Min.	Max.	Min.	Max.	Min.	Typ.	Max.	Min.	Max.	
$t_{PLH}$ $t_{PHL}$	Propagation Delay $x_{Ax}$ to $x_{Bx}$ or $x_{Bx}$ to $x_{Ax}$	5.6	0.5	3.1	0.5	2	0.5	1.5	2	0.4	1.9	ns
$t_{PZH}$ $t_{PZL}$	Output Enable Time $\overline{x_{OE}}$ to $x_{Ax}$ or $x_{Bx}$	10	0.7	4.6	0.7	3.1	0.7	2.1	3.1	0.7	2.6	ns
$t_{PHZ}$ $t_{PLZ}$	Output Disable Time $\overline{x_{OE}}$ to $x_{Ax}$ or $x_{Bx}$	12.8	0.8	6.8	0.8	5	0.8	3.4	4.8	0.5	2.9	ns

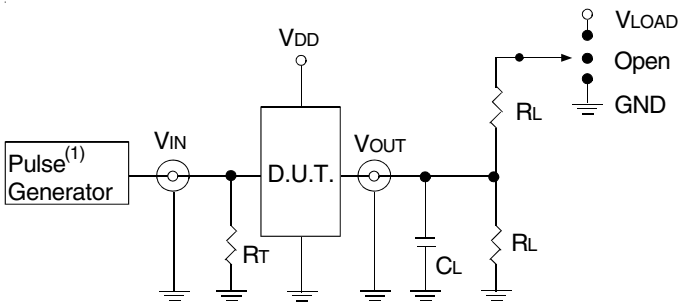
## NOTE:

1. See TEST CIRCUITS AND WAVEFORMS.  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ .

## TEST CIRCUITS AND WAVEFORMS

### TEST CONDITIONS<sup>(1)</sup>

Symbol	VDD = 0.8V	VDD = 1.2V±0.1V	VDD = 1.5V±0.1V	VDD = 1.8V±0.15V	VDD = 2.5V±0.2V	Unit
V <sub>LOAD</sub>	2xVDD	2xVDD	2xVDD	2xVDD	2xVDD	V
V <sub>T</sub>	VDD/2	VDD/2	VDD/2	VDD/2	VDD/2	V
V <sub>LZ</sub>	100	100	100	150	150	mV
V <sub>HZ</sub>	100	100	100	150	150	mV
R <sub>L</sub>	2	2	2	1	0.5	KΩ
C <sub>L</sub>	15	15	15	30	30	pF



Test Circuits for All Outputs

#### DEFINITIONS:

C<sub>L</sub> = Load capacitance: includes jig and probe capacitance.

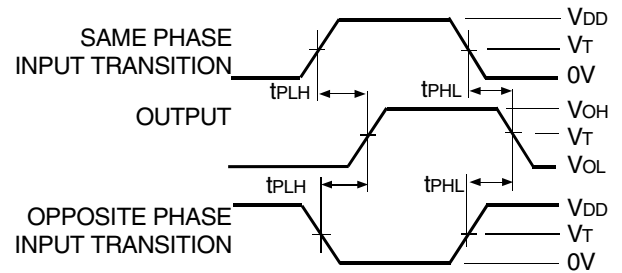
R<sub>T</sub> = Termination resistance: should be equal to Z<sub>OUT</sub> of the Pulse Generator.

#### NOTE:

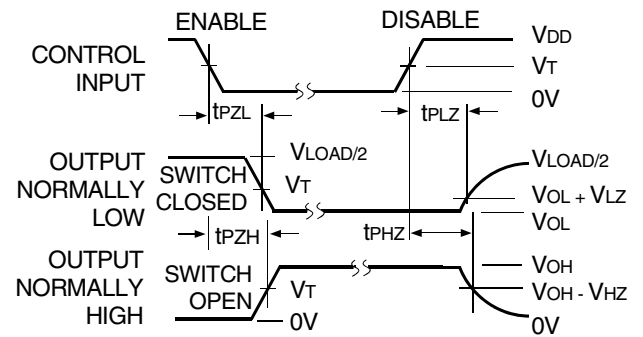
1. Pulse Generator for All Pulses: Rate ≤ 10MHz; Slew Rate ≥ 1V/ns.

### SWITCH POSITION

Test	Switch
Open Drain Disable Low Enable Low	V <sub>LOAD</sub>
Disable High Enable High	GND
All Other Tests	Open



Propagation Delay

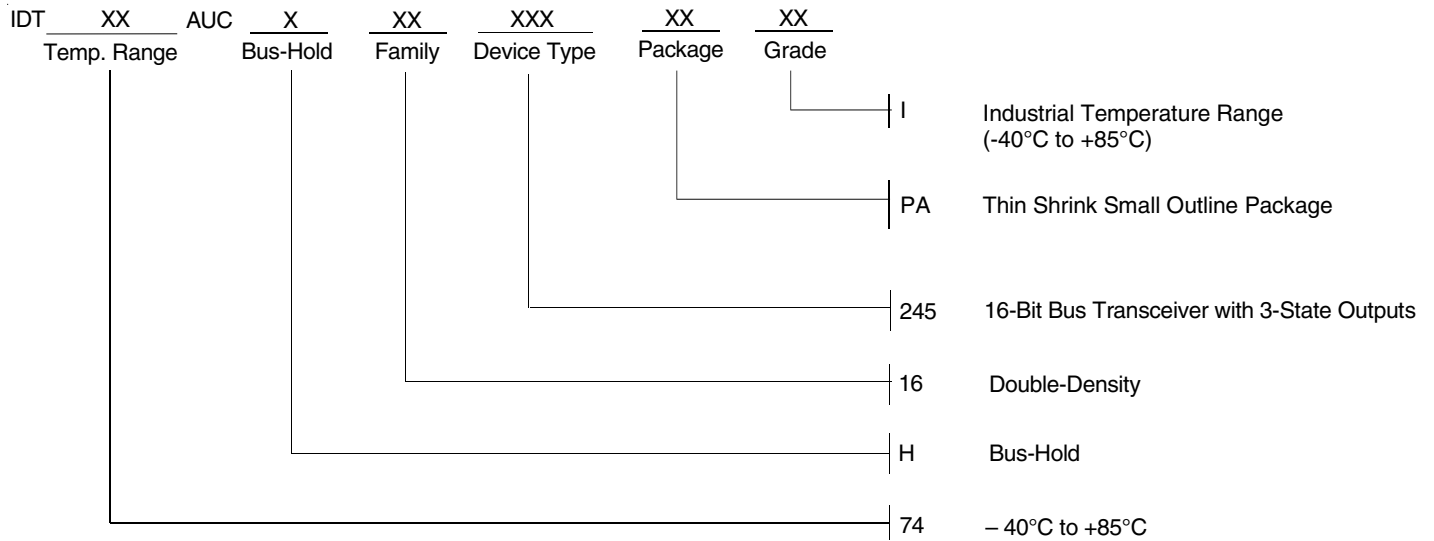


#### NOTE:

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

Enable and Disable Times

## ORDERING INFORMATION



**CORPORATE HEADQUARTERS**  
6024 Silver Creek Valley Road  
San Jose, CA 95138

**for SALES:**  
800-345-7015 or 408-284-8200  
fax: 408-284-2775  
www.idt.com

**for Tech Support:**  
logichelp@idt.com