



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

IDT74AUCR16245

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: $\pm 4.5\text{mA}$ @ $V_{DD} = 2.3\text{V}$
- Low switching noise
- Supports hot insertion
- Available in TSSOP, TVSOP, and VFBGA packages

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 AUCR16245 is designed specifically for asynchronous communications between data buses. The control function implementation minimizes external timing requirements.

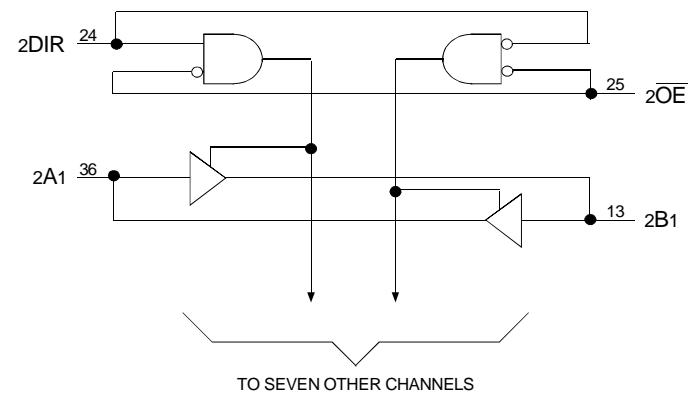
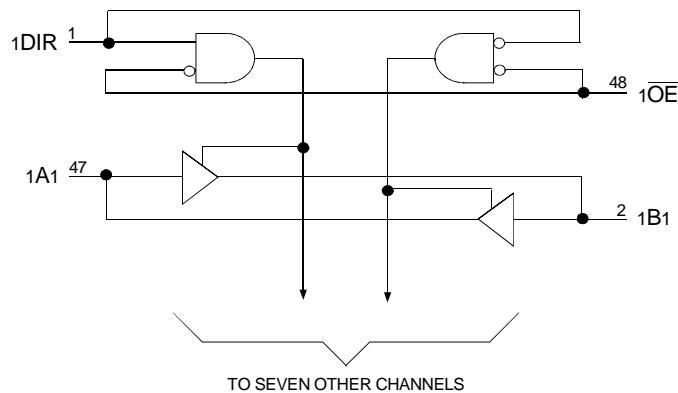
This device can be used as one 16-bit transceiver or two 8-bit transceivers. It allows data transmission from A bus to B bus or from B bus to A bus, depending on the logic level at the direction-control (DIR) input. The output-enable (\overline{OE}) input can be used to disable the device so that the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

This device is fully specified for partial power-down applications using I_{OFF} . The I_{OFF} circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

The AUCR16245 has series resistors in the device output structure which will reduce line noise when used with light loads. This driver has been designed with a $\pm 4.5\text{mA}$ output driver at the designated threshold levels.

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.

FUNCTIONAL BLOCK DIAGRAM



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INDUSTRIAL TEMPERATURE RANGE

JUNE 2003

PINOUT CONFIGURATION

6	1 \overline{OE}	1A2	1A4	1A6	1A8	2A1	2A3	2A5	2A7	2 \overline{OE}
5	NC	1A1	1A3	1A5	1A7	2A2	2A4	2A6	2A8	NC
4	NC	GND	VDD	GND			GND	VDD	GND	NC
3	NC	GND	VDD	GND			GND	VDD	GND	NC
2	NC	1B1	1B3	1B5	1B7	2B2	2B4	2B6	2B8	NC
1	1DIR	1B2	1B4	1B6	1B8	2B1	2B3	2B5	2B7	2DIR

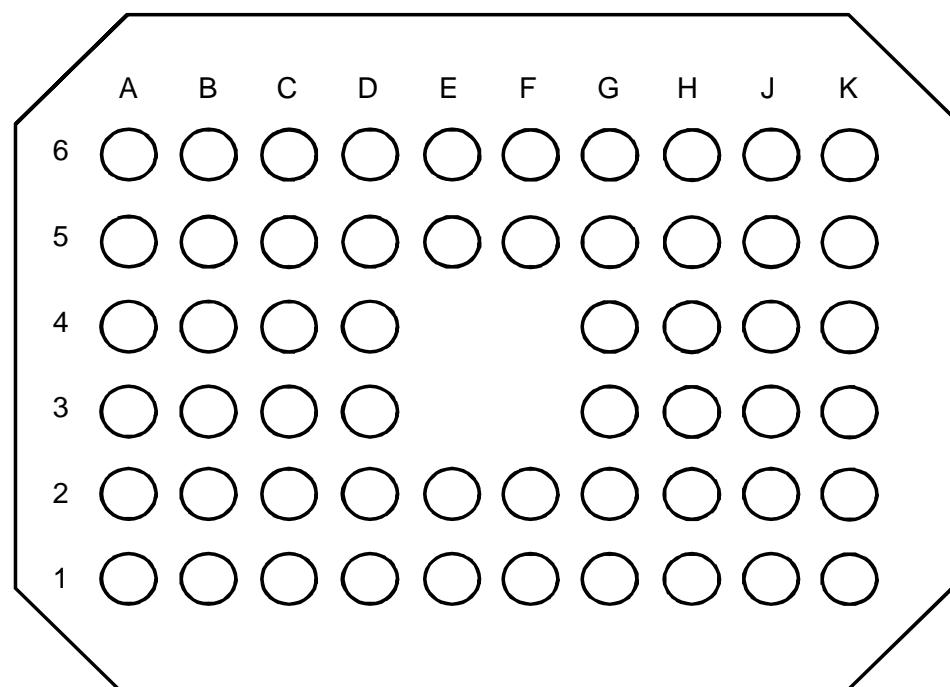
A B C D E F G H J K

VFBGA

NOTE:

NC = No Internal Connection

56 BALL VFBGA PACKAGE LAYOUT



TOP VIEW

PIN CONFIGURATION

1DIR	1	48	1OE
1B1	2	47	1A1
1B2	3	46	1A2
GND	4	45	GND
1B3	5	44	1A3
1B4	6	43	1A4
VDD	7	42	VDD
1B5	8	41	1A5
1B6	9	40	1A6
GND	10	39	GND
1B7	11	38	1A7
1B8	12	37	1A8
2B1	13	36	2A1
2B2	14	35	2A2
GND	15	34	GND
2B3	16	33	2A3
2B4	17	32	2A4
VDD	18	31	VDD
2B5	19	30	2A5
2B6	20	29	2A6
GND	21	28	GND
2B7	22	27	2A7
2B8	23	26	2A8
2DIR	24	25	2OE

TSSOP/ TVSOP
TOP VIEWABSOLUTE MAXIMUM RATINGS⁽¹⁾

Symbol	Description	Max	Unit
VTERM	Terminal Voltage with Respect to GND (all input and VDD terminals)	-0.5 to +3.6	V
VTERM	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
VTERM	Terminal Voltage with Respect to GND (any I/O or Output terminals in high or low state)	-0.5 to +3.6	V
TSTG	Storage Temperature	-65 to +150	°C
IOUT	Continuous DC Output Current	±20	mA
IIK	Continuous Clamp Current	+50	mA
	Vi > VDD	-50	
	Vi < 0	+50	
IOK	Continuous Clamp Current, Vo < 0	-50	mA
IDD	Continuous Current through	±100	mA
ISS	each VDD or GND		

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 ($T_A = +25^\circ\text{C}$, $f = 1.0\text{MHz}$, $VDD = 2.5\text{V}$)

Symbol	Parameter	Conditions	Typ.	Max.	Unit
CIN	Input Capacitance ⁽¹⁾	VIN = 0V	3		pF
CIO	I/O Port Capacitance ⁽²⁾	VIN = 0V	8		pF

NOTES:

1. Applies to the Control Inputs.
2. Applies to ports A and B.

PIN DESCRIPTION

Pin Names	Description
xOE	3-State Output Enable Inputs (Active Low)
xDIR	Direction Control Inputs
xAx	A Side Inputs or 3-State Outputs
xBx	B Side Inputs or 3-State Outputs

FUNCTION TABLE (EACH 8-BIT SECTION)⁽¹⁾

Inputs		Outputs
xOE	xDIR	
L	L	Bus B Data to Bus A
L	H	Bus A Data to Bus B
H	X	Z

NOTE:

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

RECOMMENDED OPERATING CHARACTERISTICS⁽¹⁾

Symbol	Parameter	Test Conditions	Min.	Max.	Unit
V _{DD}	Supply Voltage		0.8	2.7	V
V _{IH}	Input HIGH Voltage Level	V _{DD} = 0.8V	V _{DD}	—	V
		V _{DD} = 1.1V to 1.3V	0.65 x V _{DD}	—	
		V _{DD} = 1.4V to 1.6V	0.65 x V _{DD}	—	
		V _{DD} = 1.65V to 1.95V	0.65 x V _{DD}	—	
		V _{DD} = 2.3V to 2.7V	1.7	—	
V _{IL}	Input LOW Voltage Level	V _{DD} = 0.8V	—	0	V
		V _{DD} = 1.1V to 1.3V	—	0.35 x V _{DD}	
		V _{DD} = 1.4V to 1.6V	—	0.35 x V _{DD}	
		V _{DD} = 1.65V to 1.95V	—	0.35 x V _{DD}	
		V _{DD} = 2.3V to 2.7V	—	0.7	
V _I	Input Voltage		0	2.7	V
V _O	Output Voltage	Active State	0	V _{DD}	V
		3-State	0	2.7	
I _{OH}	HIGH Level Output Current	V _{DD} = 0.8V	—	-0.35	mA
		V _{DD} = 1.1V	—	-1.5	
		V _{DD} = 1.4V	—	-2.5	
		V _{DD} = 1.65V	—	-4	
		V _{DD} = 2.3V	—	-4.5	
I _{OL}	LOW Level Output Current	V _{DD} = 0.8V	—	0.35	mA
		V _{DD} = 1.1V	—	1.5	
		V _{DD} = 1.4V	—	2.5	
		V _{DD} = 1.65V	—	4	
		V _{DD} = 2.3V	—	4.5	
Δt/ΔV	Input Transition Rise or Fall Time		—	5	ns/V
T _A	Operating Free-Air Temperature		-40	+85	°C

NOTE:

- All unused inputs of the device must be held at V_{DD} or GND to ensure proper operation.

DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE⁽¹⁾

Following Conditions Apply Unless Otherwise Specified:

Operating Conditions: T_A = -40°C to +85°C

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I _{IH}	Input HIGH or LOW Current Data Inputs	V _{DD} = 2.7V, V _I = V _{DD} or GND	—	—	±10	μA
			—	—	±5	
I _{OFF}	Input/Output Power Off Leakage	V _{DD} = 0V, V _{IN} or V _O ≤ 2.7V	—	—	±10	μA
I _{OZH} ⁽²⁾ I _{OZL} ⁽²⁾	High Impedance Output Current (3-State Output Pins)	V _{DD} = 2.7V	V _O = V _{DD}	—	±10	μA
			V _O = GND	—	±10	
I _{DDL} I _{DDH} I _{DDZ}	Quiescent Power Supply Current	V _{DD} = 0.8V to 2.7V V _{IN} = GND or V _{DD}	—	—	20	μA

NOTES:

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

OUTPUT DRIVE CHARACTERISTICS

Symbol	Parameter	Test Conditions ⁽¹⁾		Min.	Typ.	Max.	Unit
VOH	Output HIGH Voltage	VDD = 0.8V - 2.7V	I _{OH} = -100µA	VDD - 0.1	—	—	V
		VDD = 0.8V	I _{OH} = -0.35mA	—	0.55	—	
		VDD = 1.1V ⁽²⁾	I _{OH} = -1.5mA	0.8	—	—	
		VDD = 1.4V ⁽³⁾	I _{OH} = -2.5mA	1	—	—	
		VDD = 1.65V ⁽⁴⁾	I _{OH} = -4mA	1.2	—	—	
		VDD = 2.3V ⁽⁵⁾	I _{OH} = -4.5mA	1.8	—	—	
VOL	Output LOW Voltage	VDD = 0.8V - 2.7V	I _{OH} = 100µA	—	—	0.2	V
		VDD = 0.8V	I _{OL} = 0.35mA	—	0.25	—	
		VDD = 1.1V ⁽²⁾	I _{OL} = 1.5mA	—	—	0.3	
		VDD = 1.4V ⁽³⁾	I _{OL} = 25mA	—	—	0.4	
		VDD = 1.65V ⁽⁴⁾	I _{OL} = 4mA	—	—	0.45	
		VDD = 2.3V ⁽⁵⁾	I _{OL} = 4.5mA	—	—	0.6	

NOTES:

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

OPERATING CHARACTERISTICS, T_A = 25°C

Symbol	Parameter	Test Conditions	VDD = 0.8V	VDD = 1.2V	VDD = 1.5V	VDD = 1.8V	VDD = 2.5V	Unit
CPD	Power Dissipation Capacitance Outputs Enabled	C _L = 0pF f = 10MHz	22	23	24	25	29	pF
	Power Dissipation Capacitance Outputs Disabled		1	1	1	1	1	pF

SWITCHING CHARACTERISTICS⁽¹⁾

Symbol	Parameter	VDD = 0.8V	VDD = 1.2V±0.1V		VDD = 1.5V±0.1V		VDD = 1.8V±0.15V			VDD = 2.5V±0.2V		Unit
		Typ.	Min.	Max.	Min.	Max.	Min.	Typ.	Max.	Min.	Max.	
t _{PLH}	Propagation Delay xAx to xBx or xBx to xAx	6.1	0.5	3.6	0.5	2.5	0.5	2	2.5	0.4	2.4	ns
t _{PHL}	x _{OE} to xAx or xBx	10.5	0.7	5.1	0.7	3.6	0.7	2.6	3.6	0.7	3.1	ns
t _{PZH}	Output Enable Time x _{OE} to xAx or xBx	13.3	0.8	7.3	0.8	5.5	0.8	3.9	5.3	0.5	3.4	ns
t _{PZL}	x _{OE} to xAx or xBx											

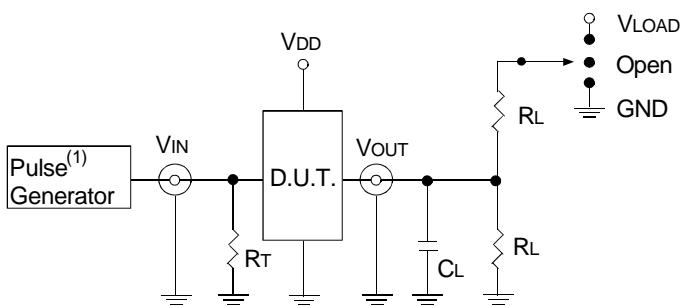
NOTE:

1. See TEST CIRCUITS AND WAVEFORMS. T_A = -40°C to +85°C.

TEST CIRCUITS AND WAVEFORMS

TEST CONDITIONS⁽¹⁾

Symbol	$V_{DD} = 0.8V$	$V_{DD} = 1.2V \pm 0.1V$	$V_{DD} = 1.5V \pm 0.1V$	$V_{DD} = 1.8V \pm 0.15V$	$V_{DD} = 2.5V \pm 0.2V$	Unit
V_{LOAD}	$2xV_{DD}$	$2xV_{DD}$	$2xV_{DD}$	$2xV_{DD}$	$2xV_{DD}$	V
V_T	$V_{DD}/2$	$V_{DD}/2$	$V_{DD}/2$	$V_{DD}/2$	$V_{DD}/2$	V
V_{LZ}	100	100	100	150	150	mV
V_{HZ}	100	100	100	150	150	mV
R_L	5	2	2	1	0.5	$K\Omega$
C_L	15	15	15	30	30	pF



Test Circuits for All Outputs

DEFINITIONS:

C_L = Load capacitance: includes jig and probe capacitance.

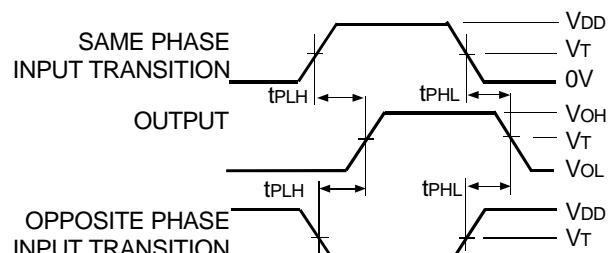
R_T = Termination resistance: should be equal to Z_{out} of the Pulse Generator.

NOTE:

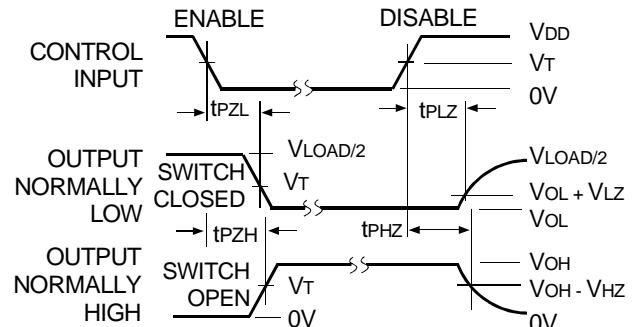
1. Pulse Generator for All Pulses: Rate $\leq 10MHz$; slew rate $\geq 1V/ns$.

SWITCH POSITION

Test	Switch
Open Drain	V_{LOAD}
Disable Low	
Enable Low	GND
Disable High	
Enable High	Open
All Other Tests	



Propagation Delay



NOTE:

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

Enable and Disable Times

ORDERING INFORMATION

IDT	XX	AUCR	X	XX	XXX	XX	Grade	
Temp. Range		Bus-Hold		Family	Device Type	Package		
						I	I	Industrial Temperature Range
						BV	BV	Very Fine Pitch Ball Grid Array
						PA	PA	Thin Shrink Small Outline Package
						PF	PF	Thin Very Small Outline Package
						245	245	16-Bit Bus Transceiver with 3-State Outputs
						16	16	Double-Density with Resistors, ±4.5mA Output Drive Capability
						Blank	Blank	No Bus-Hold
						74	74	-40°C to +85°C



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