



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

## IDT74AUC16245 ADVANCE INFORMATION

### 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, 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 AUC16245 is designed specifically for asynchronous communications between data buses. The control function implementation minimizes external timing requirements.

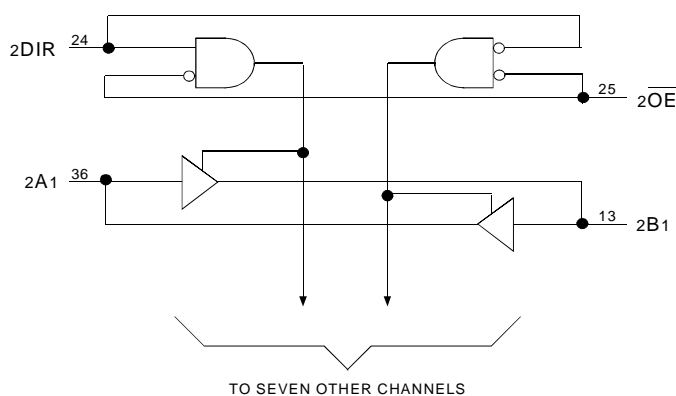
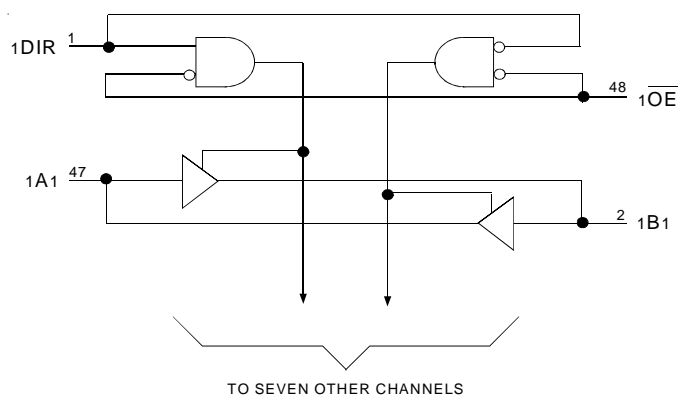
This device can be used as one 16-bit transceiver or two 8-bit transceivers. It allows data transmission from A bus to B bus or from B bus to A bus, depending on the logic level at the direction-control (DIR) input. The output-enable ( $\overline{OE}$ ) input can be used to disable the device so that 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 AUC16245 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.

### FUNCTIONAL BLOCK DIAGRAM



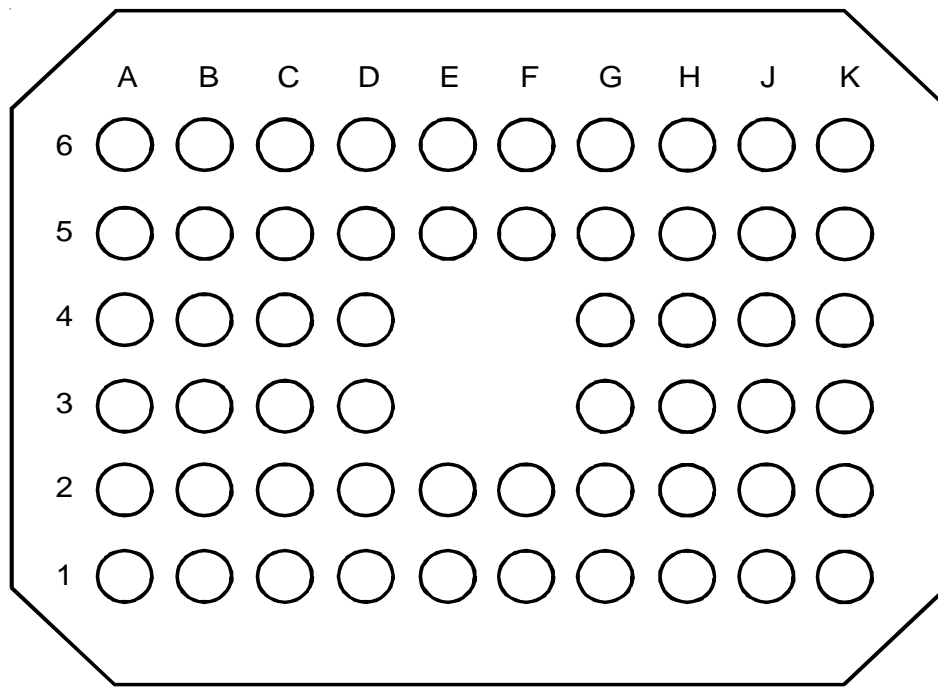
### PINOUT CONFIGURATION

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	V <sub>DD</sub>	GND			GND	V <sub>DD</sub>	GND	NC
3	NC	GND	V <sub>DD</sub>	GND			GND	V <sub>DD</sub>	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

NOTE:  
NC = No Internal Connection

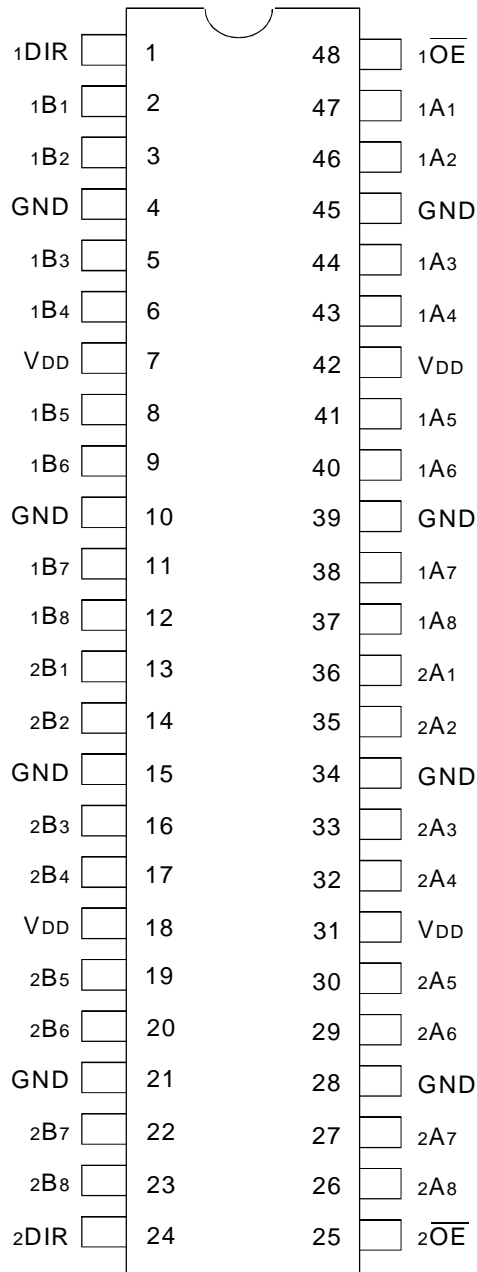
VFBGA

### 56 BALL VFBGA PACKAGE LAYOUT



TOP VIEW

PIN CONFIGURATION



TSSOP/ TVSOP  
TOP VIEW

ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

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	$V_i > V_{DD}$	+50	mA
		$V_i < 0$	-50	
Iok	Continuous Clamp Current, $V_o < 0$	-50	mA	
IDD	Continuous Current through each VDD or GND	±100	mA	
ISS				

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

Symbol	Parameter	Conditions	Typ.	Max.	Unit
CIN	Input Capacitance <sup>(1)</sup>	$V_{IN} = V_{DD}$ or GND	3		pF
C <sub>I/O</sub>	I/O Port Capacitance <sup>(2)</sup>	$V_{I/O} = V_{DD}$ or GND	7		pF

NOTES:

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

PIN DESCRIPTION

Pin Names	Description
x $\overline{\text{OE}}$	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)<sup>(1)</sup>

Inputs		Outputs
x $\overline{\text{OE}}$	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:**

- 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>							Control Inputs
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>							V <sub>O</sub> = GND
I <sub>DDL</sub>	Quiescent Power Supply Current	V <sub>DD</sub> = 0.8V to 2.7V	—	—	20	μA	
I <sub>BDDH</sub>							V <sub>IN</sub> = GND or V <sub>DD</sub>
I <sub>BDDZ</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.

## 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:

- 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.
- Demonstrates operation for nominal V<sub>DD</sub> = 1.2V.
- Demonstrates operation for nominal V<sub>DD</sub> = 1.5V.
- Demonstrates operation for nominal V<sub>DD</sub> = 1.8V.
- Demonstrates operation for nominal V<sub>DD</sub> = 2.5V.

## OPERATING CHARACTERISTICS, T<sub>A</sub> = 25°C

Symbol	Parameter		Test Conditions	V <sub>DD</sub> = 0.8V	V <sub>DD</sub> = 1.2V	V <sub>DD</sub> = 1.5V	V <sub>DD</sub> = 1.8V	V <sub>DD</sub> = 2.5V	Unit
C <sub>PD</sub>	Power Dissipation Capacitance	Outputs Enabled	C <sub>L</sub> = 0pF f = 10MHz	22	23	24	25	29	pF
		Outputs Disabled		1	1	1	1		

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

Symbol	Parameter	V <sub>DD</sub> = 0.8V	V <sub>DD</sub> = 1.2V±0.1V			V <sub>DD</sub> = 1.5V±0.1V			V <sub>DD</sub> = 1.8V±0.15V			V <sub>DD</sub> = 2.5V±0.2V		Unit
		Typ.	Min.	Max.	Min.	Max.	Min.	Typ.	Max.	Min.	Max.			
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay xAx to xBx or xBx to xAx	5.6	0.5	3.1	0.5	2	0.5	1.5	2	0.4	1.9	ns		
t <sub>PZH</sub> t <sub>PZL</sub>	Output Enable Time xOE to xAx or xBx	10	0.7	4.6	0.7	3.1	0.7	2.1	3.1	0.7	2.6	ns		
t <sub>PHZ</sub> t <sub>PLZ</sub>	Output Disable Time xOE to xAx or xBx	12.8	0.8	6.8	0.8	5	0.8	3.4	4.8	0.5	2.9	ns		

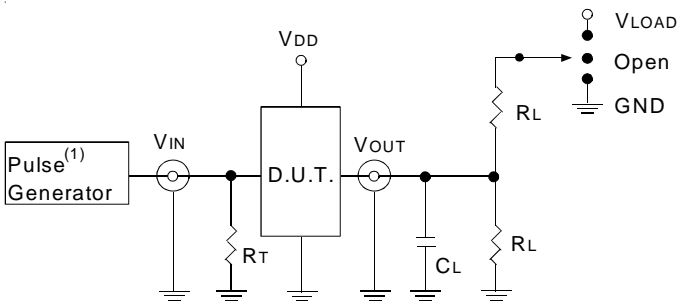
### NOTE:

- See TEST CIRCUITS AND WAVEFORMS. T<sub>A</sub> = -40°C to +85°C.

## TEST CIRCUITS AND WAVEFORMS

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

Symbol	V <sub>DD</sub> = 0.8V	V <sub>DD</sub> = 1.2V±0.1V	V <sub>DD</sub> = 1.5V±0.1V	V <sub>DD</sub> = 1.8V±0.15V	V <sub>DD</sub> = 2.5V±0.2V	Unit
V <sub>LOAD</sub>	2xV <sub>DD</sub>	2xV <sub>DD</sub>	2xV <sub>DD</sub>	2xV <sub>DD</sub>	2xV <sub>DD</sub>	V
V <sub>T</sub>	V <sub>DD</sub> /2	V <sub>DD</sub> /2	V <sub>DD</sub> /2	V <sub>DD</sub> /2	V <sub>DD</sub> /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.

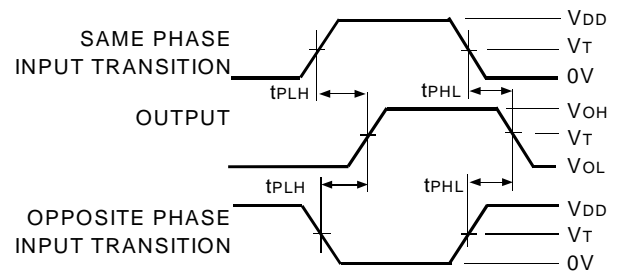
R<sub>T</sub> = Termination resistance: should be equal to Z<sub>OUT</sub> of the Pulse Generator.

#### NOTE:

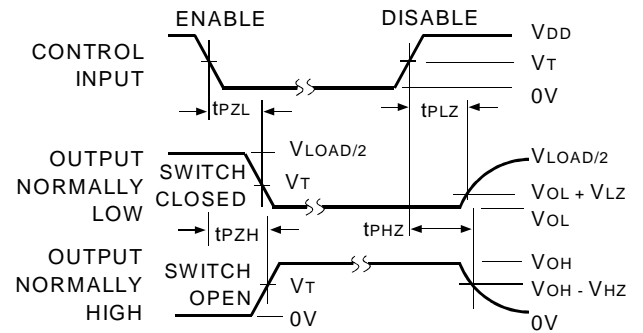
1. Pulse Generator for All Pulses: Rate ≤ 10MHz; Slew Rate ≥ 1V/ns.

### 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

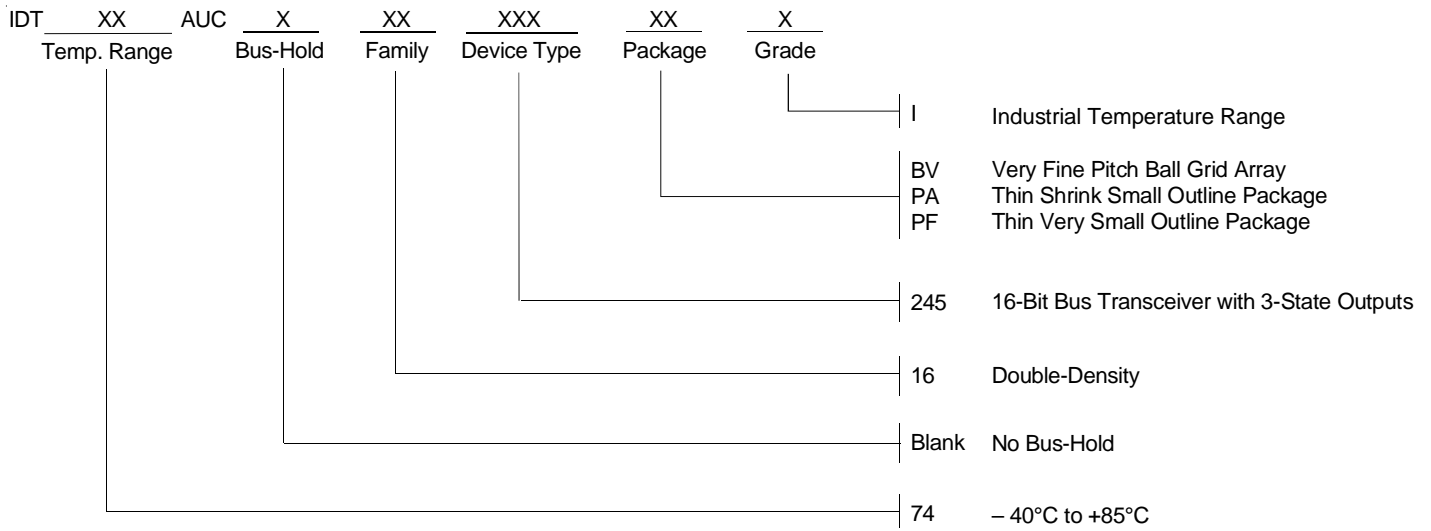


#### NOTE:

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

Enable and Disable Times

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