CMOS 16-BIT 3.3V TO 5V LEVEL SHIFTING TRANSCEIVER WITH 3-STATE OUTPUTS

IDT74ALVC164245

FEATURES:

- **0.5 MICRON CMOS Technology**
- **Typical $t_{SK(o)}$ (Output Skew) < 250ps**
- **ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)**
- **V_{CCA} = 2.7V to 3.6V**
- **V_{CCB} = 5V ± 0.5V**
- **CMOS power levels (0.4µ W typ. static)**
- **Rail-to-Rail output swing for increased noise margin**
- **Available in SSOP and TSSOP packages**

DESCRIPTION:

This 16-bit 3.3V to 5V level shifting transceiver is manufactured using advanced dual metal CMOS technology. The ALVC164245 contains two separate supply rails; B port has V_{CCB}, which is set at 5V, and A port has V_{CCA}, which is set to operate at 3.3V. This allows for translation from a 3.3V to 5V environment and vice-versa. This device is designed for asynchronous communication between data buses.

The ALVC164245 has been designed with a ±24mA output driver. This driver is capable of driving a moderate to heavy load while maintaining speed performance.

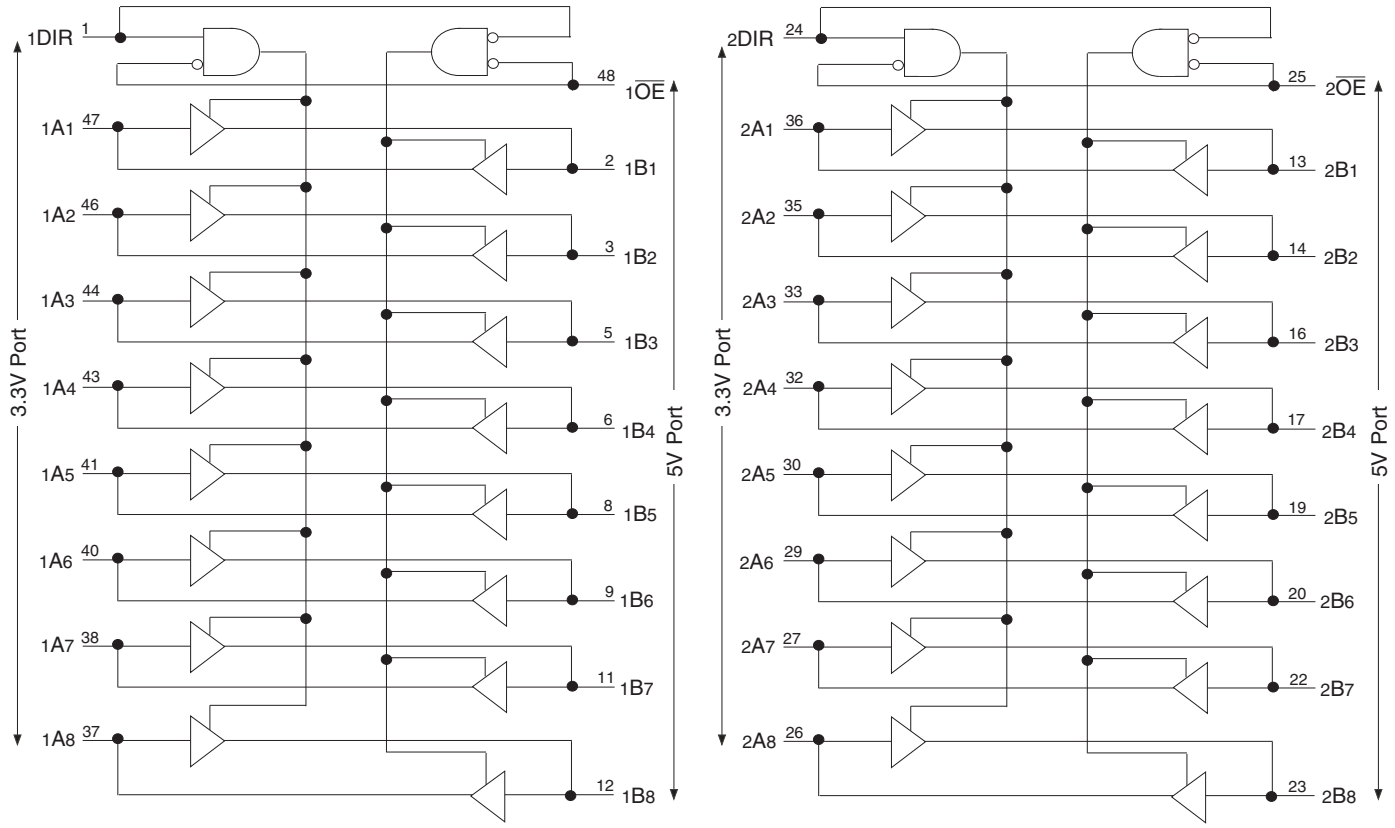
DRIVE FEATURES:

- **High Output Drivers: ±24mA**
- **Suitable for heavy loads**

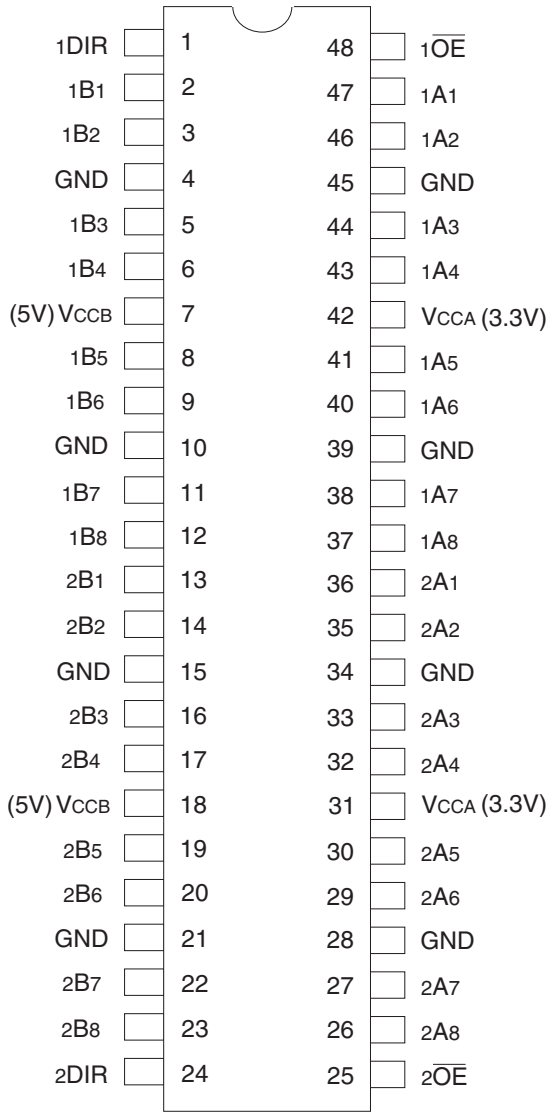
APPLICATIONS:

- **Mixed 3.3V and 5V High Speed Systems**
- **5V PCI Interface to 3.3V PC Bus Structures**
- **Telecommunication Legacy Systems with transitions from 5V to 3.3V**

FUNCTIONAL BLOCK DIAGRAM



PIN CONFIGURATION



TOP VIEW

Package Type	Package Code	Order Code
TSSOP	PAG48	PAG
SSOP	PVG48	PVG

PIN DESCRIPTION

Pin Names	Description
$\overline{xOE}$(1)	Output Enable Inputs (Active LOW)
xDIR(1)	Direction Output Controls
xAx	Port A Inputs or 3-State Outputs
xBx	Port B Inputs or 3-State Outputs

NOTE:
1. All control inputs are powered off V_{CCA}.

ABSOLUTE MAXIMUM RATINGS(1)

Symbol	Description	Max	Unit
V_{TERM}(2)	Terminal Voltage with Respect to GND	–0.5 to +6	V
V_{TERM}(3)	Terminal Voltage with Respect to GND	–0.5 to +6	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} I_{SS}	Continuous Current through each V_{CC} or GND	±100	mA

NOTES:
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.
2. V_{CC} terminals.
3. All terminals except V_{CC}.

CAPACITANCE (T_A = +25°C, F = 1.0MHz, V_{CCA} = 3.3V)

Symbol	Parameter(1)	Conditions	Typ.	Max.	Unit
C_{IN}	A Port Input Capacitance	V_{IN} = 0V	6.5	—	pF
$C_{I/O}$	A Port I/O Capacitance	V_{IN} = 0V	8.5	—	pF

NOTE:
1. As applicable to the device type.

CAPACITANCE (T_A = +25°C, F = 1.0MHz, V_{CCB} = 5V)

Symbol	Parameter(1)	Conditions	Typ.	Max.	Unit
C_{IN}	B Port Input Capacitance	V_{IN} = 0V	6.5	—	pF
$C_{I/O}$	B Port I/O Capacitance	V_{IN} = 0V	6.5	—	pF

NOTE:
1. As applicable to the device type.

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

Inputs		Outputs
$\overline{xOE}$	xDIR	
L	L	Bus B Data to Bus A
L	H	Bus A Data to Bus B
H	X	High Z State

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

DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE (B PORT)(1)

Following Conditions Apply Unless Otherwise Specified:
Operating Condition: T_A = –40°C to +85°C

Symbol	Parameter	Test Conditions		Min.	Typ.(2)	Max.	Unit
V_{IH}	Input HIGH Voltage Level	V_{CCB} = 4.5V to 5.5V		2	—	—	V
V_{IL}	Input LOW Voltage Level	V_{CCB} = 4.5V to 5.5V		—	—	0.8	V
I_{IH}	Input HIGH Current	V_{CCB} = 5.5V	V_I = V_{CC}	—	—	±5	µA
I_{IL}	Input LOW Current	V_{CCB} = 5.5V	V_I = GND	—	—	±5	µA
I_{OZH}	High Impedance Output Current	V_{CCB} = 5.5V	V_O = V_{CC}	—	—	±10	µA
I_{OZL}	(3-State Output pins)		V_O = GND	—	—	±10	
V_H	Input Hysteresis	V_{CCB} = 4.5V		—	100	—	mV
I_{CCL} I_{CCH} I_{CCZ}	Quiescent Power Supply Current	V_{CCB} = 5.5V V_{IN} = GND or V_{CCB}		—	0.1	40	µA
ΔI_{CC}	Quiescent Power Supply Current Variation	One input at 3.4V, other inputs at V_{CCB} or GND		—	—	750	µA

NOTES:
1. V_{CCA} = 2.7V to 3.6V.
2. Typical values are at V_{CC} = 5V, +25°C ambient.

DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE (A PORT)(1,2)

Following Conditions Apply Unless Otherwise Specified:
Operating Condition: T_A = –40°C to +85°C

Symbol	Parameter	Test Conditions		Min.	Typ.(3)	Max.	Unit
V_{IH}	Input HIGH Voltage Level	V_{CCA} = 2.7V to 3.6V		2	—	—	V
V_{IL}	Input LOW Voltage Level	V_{CCA} = 2.7V to 3.6V		—	—	0.8	V
I_{IH}	Input HIGH Current	V_{CCA} = 3.6V	V_I = V_{CC}	—	—	±5	µA
I_{IL}	Input LOW Current	V_{CCA} = 3.6V	V_I = GND	—	—	±5	µA
I_{OZH}	High Impedance Output Current	V_{CCA} = 3.6V	V_O = V_{CC}	—	—	±10	µA
I_{OZL}	(3-State Output pins)		V_O = GND	—	—	±10	
V_H	Input Hysteresis	V_{CCA} = 3.3V		—	100	—	mV
I_{CCL} I_{CCH} I_{CCZ}	Quiescent Power Supply Current	V_{CCA} = 3.6V V_{IN} = GND or V_{CCA}		—	0.1	40	µA
ΔI_{CC}	Quiescent Power Supply Current Variation	One input at V_{CCA} - 0.6V, other inputs at V_{CCA} or GND		—	—	750	µA

NOTES:
1. V_{CCB} = 5V ± 0.5V.
2. Control inputs xDIR, $\overline{OE}$ are supplied from V_{CCA}.
3. Typical values are at V_{CC} = 3.3V, +25°C ambient.

OUTPUT DRIVE CHARACTERISTICS, V_{CCA} = 3.3V ± 0.3V (A PORT)

Symbol	Parameter	Test Conditions[1]		Min.	Max.	Unit
V_{OH}	Output HIGH Voltage (B Port to A Port)	V_{CCA} = 2.7V to 3.6V	I_{OH} = – 0.1mA	V_{CCA} – 0.2	—	V
		V_{CCA} = 2.7V	I_{OH} = – 12mA	2.2	—	
		V_{CCA} = 3V		2.4	—	
		V_{CCA} = 3V	I_{OH} = – 24mA	2	—	
V_{OL}	Output LOW Voltage (B Port to A Port)	V_{CCA} = 2.7V to 3.6V	I_{OL} = 0.1mA	—	0.2	V
		V_{CCA} = 2.7V	I_{OL} = 12mA	—	0.4	
		V_{CCA} = 3V	I_{OL} = 24mA	—	0.55	

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; V_{CCA} = 3.3V ± 0.3V.

OUTPUT DRIVE CHARACTERISTICS, V_{CCB} = 5V ± 0.5V (B PORT)

Symbol	Parameter	Test Conditions[1]		Min.	Max.	Unit
V_{OH}	Output HIGH Voltage (A Port to B Port)	V_{CCB} = 4.5V	I_{OH} = – 0.1mA	4.3	—	V
		V_{CCB} = 5.5V		5.3	—	
		V_{CCB} = 4.5V	I_{OH} = – 24mA	3.7	—	
		V_{CCB} = 5.5V		4.7	—	
V_{OL}	Output LOW Voltage ((A Port to B Port)	V_{CCB} = 4.5V	I_{OL} = 0.1mA	—	0.2	V
		V_{CCB} = 5.5V		—	0.2	
		V_{CCB} = 4.5V	I_{OL} = 24mA	—	0.55	
		V_{CCB} = 5.5V		—	0.55	

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; V_{CCB} = 5V ± 0.5V.

OPERATING CHARACTERISTICS, T_A = 25°C

Symbol	Parameter	Test Conditions	V_{CCA} = 3.3V, V_{CCB} = 5V Typical	Unit
C_{PD}	Power Dissipation Capacitance, Outputs enabled (A port or B port)	C_L = 0pF, f = 10Mhz	56	pF
C_{PD}	Power Dissipation Capacitance, Outputs disabled (A port or B port)		6	

SWITCHING CHARACTERISTICS(1)

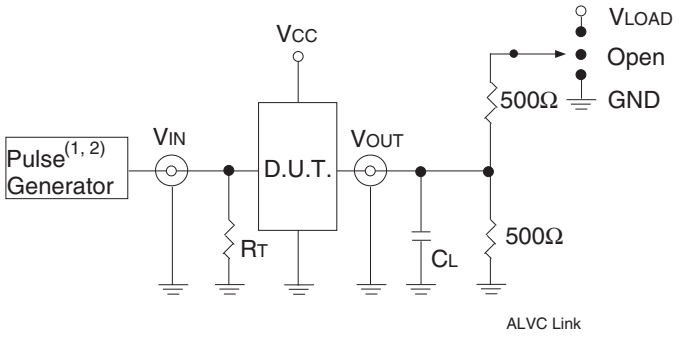
Symbol	Parameter	V_{CCB} = 5V ± 0.5V				Unit
		V_{CCA} = 2.7V		V_{CCA} = 3.3V ± 0.3V		
		Min.	Max.	Min.	Max.	
t_{PLH} t_{PHL}	Propagation Delay xAx to xBx	—	5.9	1	5.8	ns
t_{PLH} t_{PHL}	Propagation Delay xBx to xAx	—	6.7	1.2	5.8	ns
t_{PZH} t_{PZL}	Output Enable Time $\overline{xOE}$ to xBx	—	9.3	1	8.9	ns
t_{PZH} t_{PZL}	Output Enable Time $\overline{xOE}$ to xAx	—	10.2	2	9.1	ns
t_{PHZ} t_{PLZ}	Output Disable Time $\overline{xOE}$ to xBx	—	9.2	2.1	9.4	ns
t_{PHZ} t_{PLZ}	Output Disable Time $\overline{xOE}$ to xAx	—	9	2.9	8.6	ns

NOTE:
1. See TEST CIRCUITS AND WAVEFORMS. T_A = – 40°C to + 85°C.

TEST CIRCUITS AND WAVEFORMS FOR V_{CCA} = 3.3V ± 0.3V AND V_{CCA} = 2.7V

TEST CONDITIONS

Symbol	V_{CCA} = 3.3V±0.3V	V_{CCA} = 2.7V	Unit
V_{LOAD}	6	6	V
V_{IH}	3	3	V
V_T	1.5	1.5	V
V_{LZ}	300	300	mV
V_{OH} - V_{HZ}	300	300	mV
C_L	50	50	pF



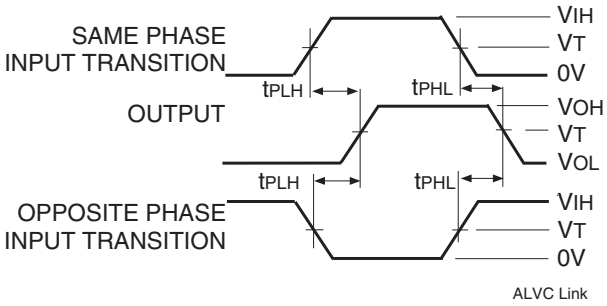
Test Circuit for All Outputs

DEFINITIONS:
C_L = Load capacitance: includes jig and probe capacitance.
R_T = Termination resistance: should be equal to Z_{OUT} of the Pulse Generator.

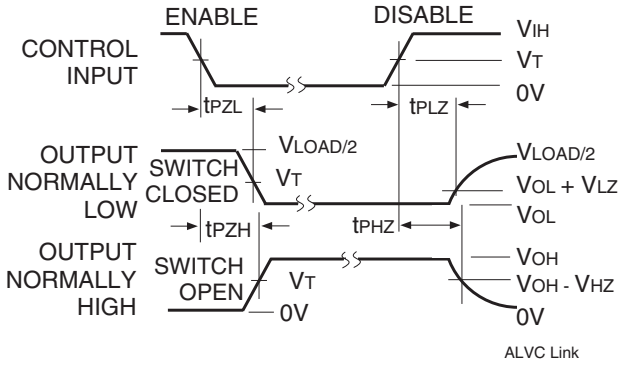
NOTE:
1. Pulse Generator for All Pulses: Rate ≤ 1.0MHz; t_F ≤ 2.5ns; t_R ≤ 2.5ns.

SWITCH POSITION

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



Propagation Delay



Enable and Disable Times

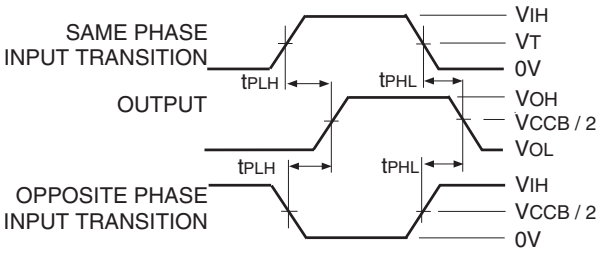
NOTE:
1. Diagram shown for input Control Enable-LOW and input Control Disable-HIGH.

TEST CIRCUITS AND WAVEFORMS FOR V_{CCB} = 5V ± 0.5V

TEST CONDITIONS (USE V_{CCA} TEST CIRCUIT)

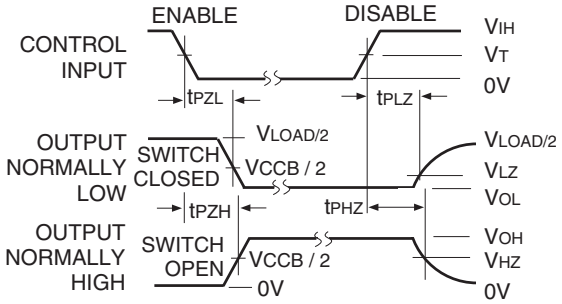
Symbol	V_{CCB}[1] = 5V±0.2V	Unit
V_{LOAD}	2 x V_{CCB}	V
V_{IH}	2.7	V
V_T	1.5 or V_{CCB} / 2	V
V_{LZ}	20% of V_{CCB}	mV
V_{HZ}	80% of V_{CCB}	mV
C_L	50	pF

NOTE:
1. Pulse Generator for All Pulses: Rate ≤ 1.0MHz; t_F ≤ 2.5ns; t_R ≤ 2.5ns.



Propagation Delay

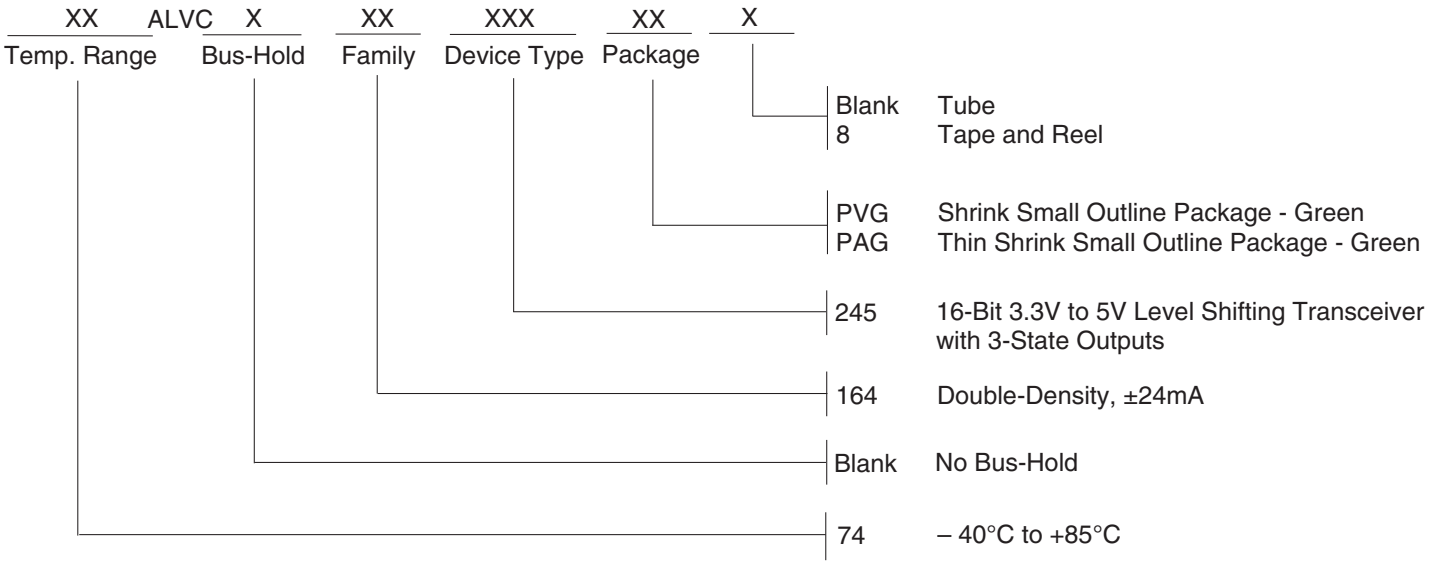
NOTES:
1. For t_{SK}(o) OUTPUT1 and OUTPUT2 are any two outputs.
2. For t_{SK}(b) OUTPUT1 and OUTPUT2 are in the same bank.



Enable and Disable Times

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

ORDERING INFORMATION



Orderable Part Information

Speed (ns)	Orderable Part ID	Pkg. Code	Pkg. Type	Temp. Grade
	74ALVC164245PAG	PAG48	TSSOP	C
	74ALVC164245PAG8	PAG48	TSSOP	C
	74ALVC164245PVG	PVG48	SSOP	C
	74ALVC164245PVG8	PVG48	SSOP	C

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