



CMOS 16-BIT 3.3V TO 5V LEVEL SHIFTING TRANSCIEVER 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 $3.6V$
- $V_{CCB} = 5V \pm 0.5V$
- CMOS power levels (0.4μ W typ. static)
- Rail-to-Rail output swing for increased noise margin
- Available in SSOP, TSSOP, and TVSOP packages

DRIVE FEATURES:

- High Output Drivers: $\pm 24mA$
- Suitable for heavy loads

DESCRIPTION:

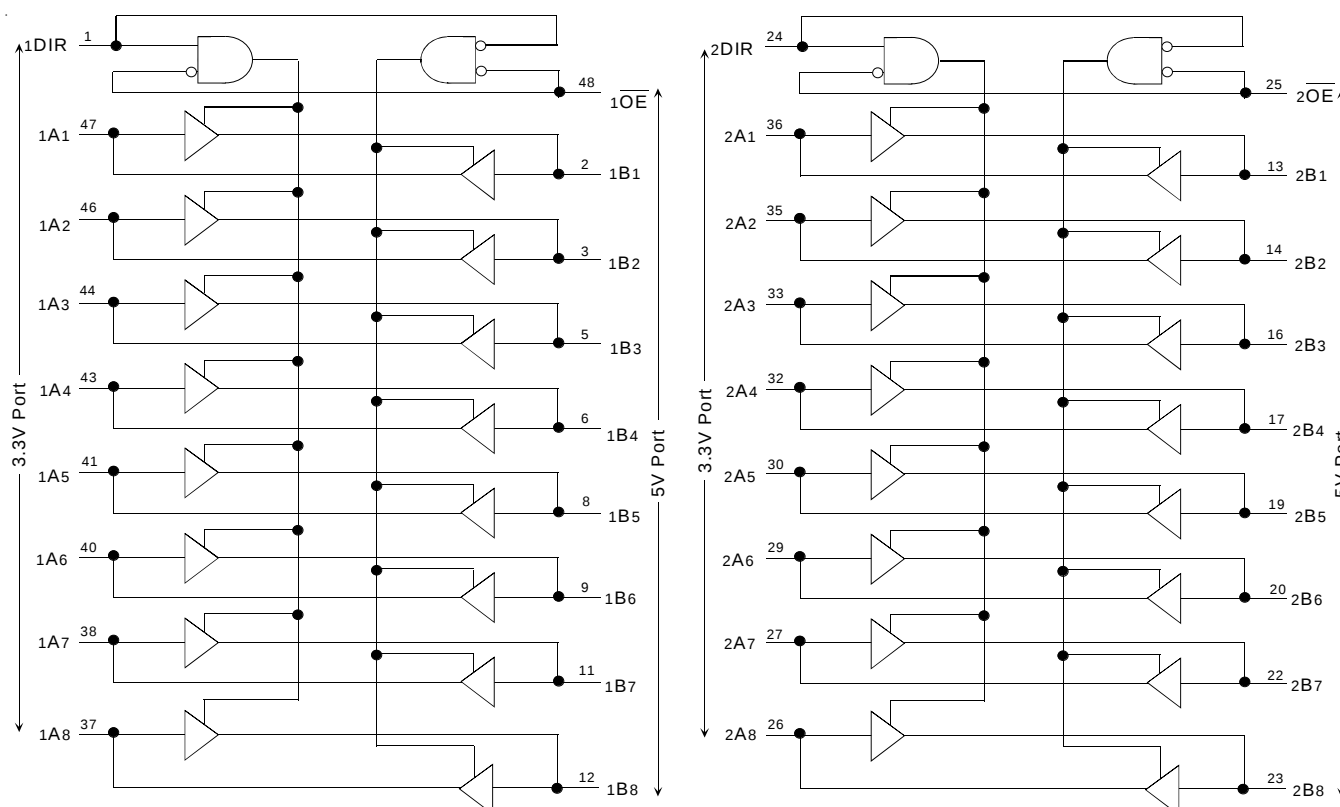
This 16-bit 3.3V to 5V level shifting transceiver is manufactured using advanced dual metal CMOS technology. The ALVC164245 contains two separate supply rails; B port has V_{CCB} , which is set at 5V, and A port has V_{CCA} , which is set to operate at 3.3V. This allows for translation from a 3.3V to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

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

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

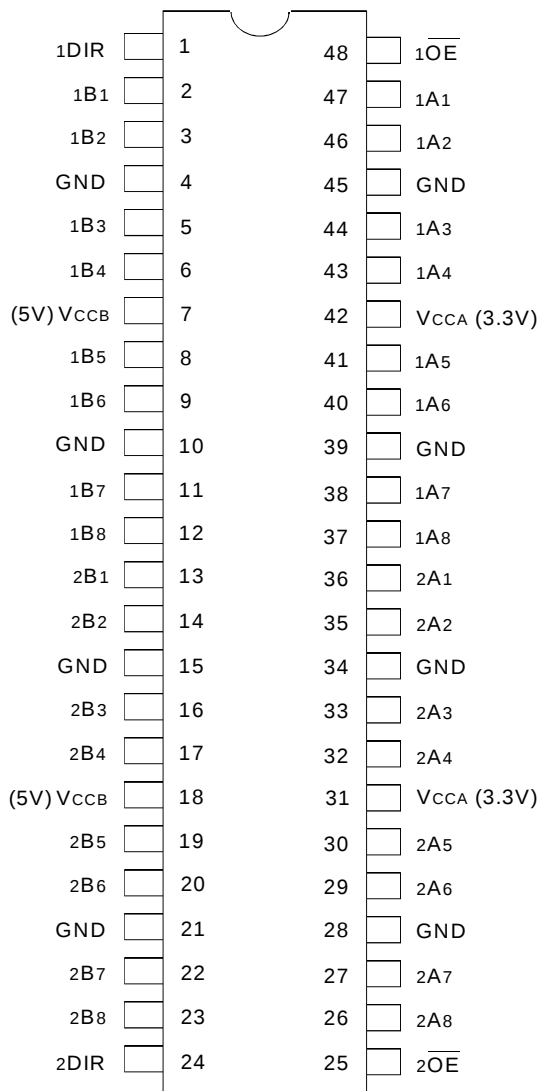


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INDUSTRIAL TEMPERATURE RANGE

FEBRUARY 2003

PIN CONFIGURATION



SSOP/ TSSOP/ TVSOP
TOP VIEW

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:

- 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°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:

- 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:

- As applicable to the device type.

PIN DESCRIPTION

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

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:

- 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: TA = -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 (3-State Output pins)	V _{CCB} = 5.5V	V _O = V _{CC}	—	—	±10	μA
I _{OZL}			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:

- V_{CCA} = 2.7V to 3.6V.
- 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: TA = -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 (3-State Output pins)	V _{CCA} = 3.6V	V _O = V _{CC}	—	—	±10	μA
I _{OZL}			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:

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

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

Symbol	Parameter	Test Conditions ⁽¹⁾		Min.	Max.	Unit
VOH	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	—	
VOL	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.
 $T_A = -40^{\circ}C$ to $+85^{\circ}C$; $V_{CCA} = 3.3V \pm 0.3V$.

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

Symbol	Parameter	Test Conditions ⁽¹⁾		Min.	Max.	Unit
VOH	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	—	
VOL	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.
 $T_A = -40^{\circ}C$ to $+85^{\circ}C$; $V_{CCB} = 5V \pm 0.5V$.

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

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

SWITCHING CHARACTERISTICS⁽¹⁾

Symbol	Parameter	VCCB = 5V ± 0.5V				Unit
		VCCA = 2.7V		VCCA = 3.3V ± 0.3V		
		Min.	Max.	Min.	Max.	
tPLH tPHL	Propagation Delay xAx to xBx	—	5.9	1	5.8	ns
tPLH tPHL	Propagation Delay xBx to xAx	—	6.7	1.2	5.8	ns
tPZH tPZL	Output Enable Time xOE to xBx	—	9.3	1	8.9	ns
tPZH tPZL	Output Enable Time xOE to xAx	—	10.2	2	9.1	ns
tPHZ tPLZ	Output Disable Time xOE to xBx	—	9.2	2.1	9.4	ns
tPHZ tPLZ	Output Disable Time xOE to xAx	—	9	2.9	8.6	ns

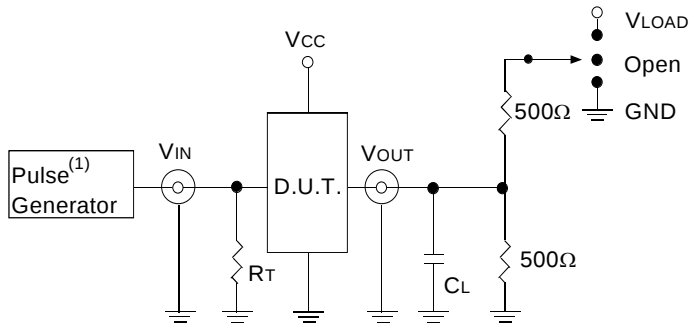
NOTE:

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

TEST CIRCUITS AND WAVEFORMS FOR $V_{CCA} = 3.3V \pm 0.3V$ AND $V_{CCA} = 2.7V$

TEST CONDITIONS

Symbol	$V_{CCA} = 3.3V \pm 0.3V$	$V_{CCA} = 2.7V$	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:

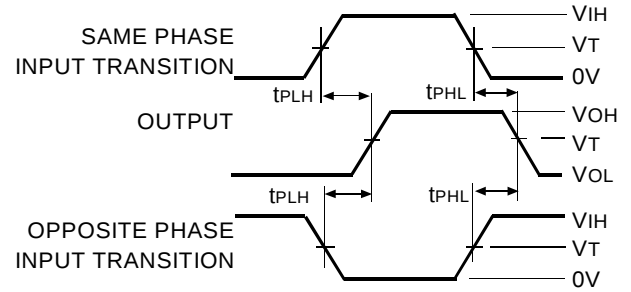
C_L = Load capacitance: includes jig and probe capacitance.
 R_T = Termination resistance: should be equal to Z_{out} of the Pulse Generator.

NOTE:

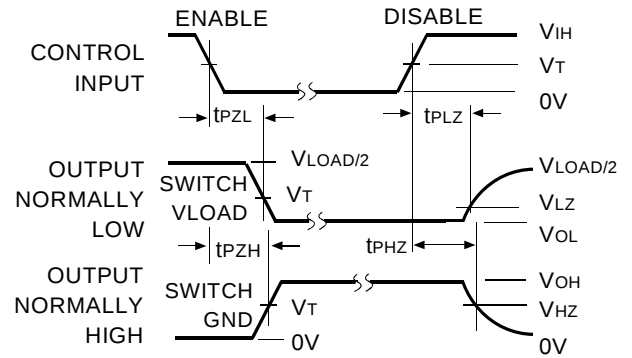
1. Pulse Generator for All Pulses: Rate $\leq 1.0\text{MHz}$; $t_r \leq 2.5\text{ns}$; $t_f \leq 2.5\text{ns}$.

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.

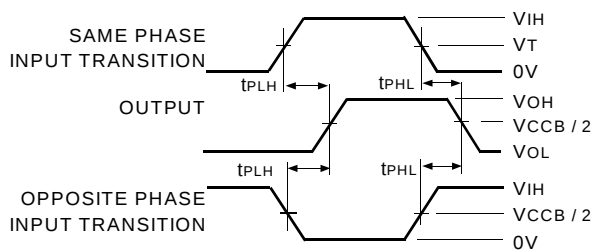
TEST CIRCUITS AND WAVEFORMS FOR $V_{CCB} = 5V \pm 0.5V$

TEST CONDITIONS (USE V_{CCA} TEST CIRCUIT)

Symbol	$V_{CCB}^{(1)} = 5V \pm 0.2V$	Unit
V_{LOAD}	$2 \times V_{CCB}$	V
V_{IH}	2.7	V
V_T	$1.5 \text{ or } V_{CCB} / 2$	V
V_{LZ}	20% of V_{CCB}	mV
V_{HZ}	80% of V_{CCB}	mV
C_L	50	pF

NOTE:

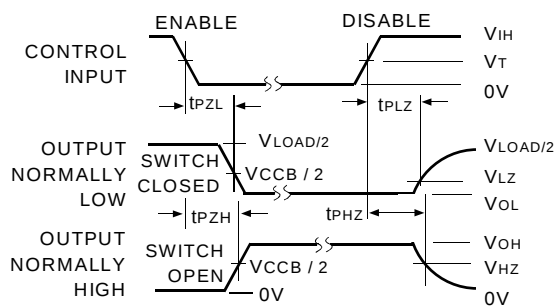
1. Pulse Generator for All Pulses: Rate $\leq 1.0\text{MHz}$; $t_f \leq 2.5\text{ns}$; $t_r \leq 2.5\text{ns}$.



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

IDT	XX	ALVC	X	XX	XXX	XX	
	Temp. Range		Bus-Hold	Family	Device Type	Package	
						PV	Shrink Small Outline Package
						PA	Thin Shrink Small Outline Package
						PF	Thin Very Small Outline Package
						245	16-Bit 3.3V to 5V Level Shifting Transceiver with 3-State Outputs
						164	Double-Density, $\pm 24\text{mA}$
						Blank	No Bus-Hold
						74	-40°C to $+85^{\circ}\text{C}$



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