To our customers,

Old Company Name in Catalogs and Other Documents

On April 1st, 2010, NEC Electronics Corporation merged with Renesas Technology Corporation, and Renesas Electronics Corporation took over all the business of both companies. Therefore, although the old company name remains in this document, it is a valid Renesas Electronics document. We appreciate your understanding.

Renesas Electronics website: http://www.renesas.com

April 1st, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (http://www.renesas.com)

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HD74LVC4245A

Octal Bus Transceiver and 3.3 V to 5 V shifters with 3-state Outputs

REJ03D0378–0101
Rev.1.01
Apr. 13, 2005

Description

The HD74LVC4245A has eight bus transceivers with three state outputs in a 24 pin package. When (DIR) is high, data flows from the A inputs to the B outputs, and when (DIR) is low, data flows from the B inputs to the A outputs. A and B bus are separated by making enable input ($\overline{OE}$) high level. And this product has two terminals (V_{CCA}, V_{CCB}), V_{CCA} (5V) is connected with control input and A bus side, V_{CCB} (3.3V) connected with B bus side. V_{CCA} and V_{CCB} are isolated. This allows for translation from a 3.3 V to a 5 V environment, and vice versa. Low voltage and high-speed operation is suitable at the battery drive product (note type personal computer) and low power consumption extends the life of a battery for long time operation.

Features

- This product function as level shift transceiver that change V_{CCA} input level to V_{CCB} output level, V_{CCB} input level to V_{CCA} output level by providing different supply voltage to V_{CCA} and V_{CCB}.
- This product is able to the power management: Turn on and off the supply on V_{CCB} side with providing the supply of V_{CCA}. (Enable input ($\overline{OE}$): High level)
- V_{CCA} = 4.5 V to 5.5 V, V_{CCB} = 2.7 V to 3.6 V
- All control input V_I (max) = 5.5 V (@V_{CCA} = 0 V to 5.5 V)
- All A bus side input outputs $V_{I/O}$ (max) = 5.5 V (@V_{CCA} = 0 V or output off state)
- All B bus side input outputs $V_{I/O}$ (max) = 3.6 V (@V_{CCB} = 0 V or output off state)
- High output current
  A bus side : ±24 mA (@V_{CCA} = 4.5 V to 5.5 V)
  B bus side : ±12 mA (@V_{CCB} = 2.7 V)
  ±24 mA (@V_{CCB} = 3.0 V to 3.6 V)
- Ordering Information

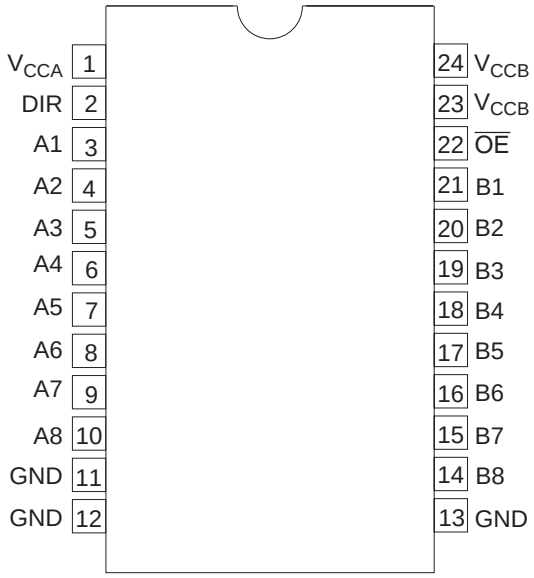
Part Name	Package Type	Package Code (Previous Code)	Package Abbreviation	Taping Abbreviation (Quantity)
HD74LVC4245ATEL	TSSOP–24 pin	PTSP0024JB–A (TTP–24DBV)	T	EL (1,000 pcs/reel)

Function Table

Inputs		Operation
$\overline{OE}$	DIR	
L	L	B data to A bus
L	H	A data to B bus
H	X	Z

H: High level
L: Low level
X: Immaterial
Z: High impedance

Pin Arrangement



(Top view)

Absolute Maximum Ratings

(1) For V_{CCA}

Item	Symbol	Ratings	Unit	Conditions
Supply voltage	V_{CCA}	–0.5 to 6.0	V	
Input voltage[*1]	V_I	–0.5 to 6.0	V	DIR, $\overline{OE}$
Input / output voltage	$V_{I/O}$	–0.5 to V_{CCA}+0.5	V	A port output “H” or “L”
		–0.5 to 6.0		A port output “Z” or V_{CCA} : OFF
Input diode current	I_{IK}	–50	mA	$V_I < 0$
Output diode current	I_{OK}	–50	mA	$V_O < 0$
		50		$V_O > V_{CCA}$+0.5
Output current	I_O	±50	mA	
V_{CCA}, GND current	I_{CCA} or I_{GND}	100	mA	
Maximum power dissipation at Ta = 25°C (in still air)[*2]	P_T	862	mW	TSSOP
Storage temperature	Tstg	–65 to 150	°C	

(2) For V_{CCB}

Item	Symbol	Ratings	Unit	Conditions
Supply voltage	V_{CCB}	–0.5 to 4.6	V	
Input / output voltage[*1]	$V_{I/O}$	–0.5 to V_{CCB}+0.5	V	B port output “H” or “L”
		–0.5 to 4.6		B port output “Z” or V_{CCB} : OFF
Input diode current	I_{IK}	–50	mA	$V_I < 0$
Output diode current	I_{OK}	–50	mA	$V_O < 0$
		50		$V_O > V_{CCB}$+0.5
Output current	I_O	±50	mA	
V_{CCB},GND current	I_{CCB} or I_{GND}	100	mA	
Maximum power dissipation at Ta = 25°C (in still air)[*2]	P_T	862	mW	TSSOP
Storage temperature	Tstg	–65 to 150	°C	

Notes: The absolute maximum ratings are values, which must not individually be exceeded, and furthermore, no two of which may be realized at the same time.

1. The input and output voltage ratings may be exceeded even if the input and output clamp-current ratings are observed.
2. The maximum package power dissipation was calculated using a junction temperature of 150°C.

Recommended Operating Conditions

(1) For V_{CCA}

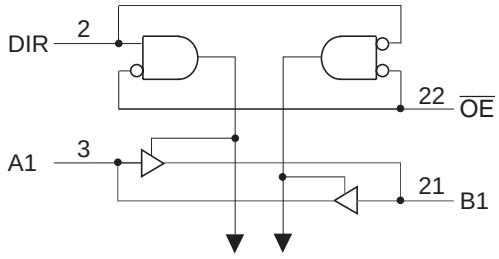
Item	Symbol	Ratings	Unit	Conditions
Supply voltage	V_{CCA}	4.5 to 5.5	V	
Input / output voltage	V_I	0 to 5.5	V	DIR, $\overline{OE}$
	$V_{I/O}$	0 to V_{CCA}		A port output “H” or “L”
		0 to 5.5		A port output “Z” or V_{CCA} : OFF
Output current	I_{OH}	–24	mA	
	I_{OL}	24		
Input transition rise or fall time	$\Delta t / \Delta v$	10	ns / V	
Operating temperature	Ta	–40 to 85	°C	

(2) For V_{CCB}

Item	Symbol	Ratings	Unit	Conditions
Supply voltage	V_{CCB}	2.7 to 3.6	V	
Input / output voltage	$V_{I/O}$	0 to V_{CCB}	V	B port output “H” or “L”
		0 to 3.6		B port output “Z” or V_{CCB} : OFF
Output current	I_{OH}	–12	mA	V_{CCB} = 2.7 V
		–24		V_{CCB} = 3.0 to 3.6 V
	I_{OL}	12		V_{CCB} = 2.7 V
		24		V_{CCB} = 3.0 to 3.6 V
Input transition rise or fall time	$\Delta t / \Delta v$	10	ns / V	
Operating temperature	Ta	–40 to 85	°C	

Note: Unused or floating inputs must be held high or low.

Block Diagram



Electrical Characteristics

(Ta = –40 to 85°C)

Item	Symbol	V_{CCA} (V)	V_{CCB} (V)	Min	Max	Unit	Test Conditions
Input voltage	V_{IH}	4.5 to 5.5	2.7 to 3.6	2	—	V	
	V_{IL}	4.5 to 5.5	2.7 to 3.6	—	0.8		
Output voltage	V_{OHA}	4.5 to 5.5	2.7 to 3.6	V_{CCA}–0.2	—	V	I_{OH} = –100 µA
		4.5	2.7 to 3.6	3.7	—		I_{OH} = –24 mA
		5.5	2.7 to 3.6	4.7	—		
	V_{OHB}	4.5 to 5.5	2.7 to 3.6	V_{CCB}–0.2	—	V	I_{OH} = –100 µA
		4.5 to 5.5	2.7	2.2	—		I_{OH} = –12 mA
		4.5 to 5.5	3.0	2.4	—		
		4.5 to 5.5	3.0	2	—		I_{OH} = –24 mA
	V_{OLA}	4.5 to 5.5	2.7 to 3.6	—	0.2	V	I_{OL} = 100 µA
		4.5	2.7 to 3.6	—	0.55		I_{OL} = 24 mA
		5.5	2.7 to 3.6	—	0.55		
	V_{OLB}	4.5 to 5.5	2.7 to 3.6	—	0.2	V	I_{OL} = 100 µA
		4.5 to 5.5	2.7	—	0.4		I_{OL} = 12 mA
		4.5 to 5.5	3.0	—	0.55		I_{OL} = 24 mA
Input current	I_{IN}	5.5	2.7 to 3.6	—	±1	µA	Control input
Off state output current	I_{OZA}	5.5	2.7 to 3.6	—	±5	µA	A port, V_O = V_{CCA} or GND
	I_{OZB}	4.5 to 5.5	3.6	—	±5		B port, V_O = V_{CCB} or GND
Output leak current	I_{OFF}	0	0	—	20	µA	A port, $V_{I/O}$ = 5.5 V B port, $V_{I/O}$ = 3.6 V
Quiescent supply current	I_{CCA}	5.5	2.7 to 3.6	—	80	µA	B to A, control input =V_{CCA} or GND Bn = V_{CCB} or GND, I_O (A port) = 0
	I_{CCB}	4.5 to 5.5	3.6	—	50	µA	A to B, control input =V_{CCA} or GND An = V_{CCA} or GND, I_O (B port) = 0
Increase in I_{CC} per input [*1]	ΔI_{CCA}	5.5	2.7 to 3.6	—	1.5	mA	A port or Control input, One input at 3.4 V, Other input at V_{CCA} at GND
	ΔI_{CCB}	4.5 to 5.5	2.7 to 3.6	—	0.5	mA	B port, One input at V_{CCB}–0.6V, Other input at V_{CCB} at GND

Notes: For condition shown as Min or Max, use the appropriate values under recommended operating conditions.

1. This is the increase in supply current for each input that is at the specified TTL voltage level rather than V_{CC} or GND.

Capacitance

(Ta = 25°C)

Item	Symbol	V_{CCA} (V)	V_{CCB} (V)	Min	Typ	Max	Unit	Test Conditions
Control Input capacitance	C_{IN}	5	3.3	—	5	—	pF	V_I = V_{CCA} or GND
Input/output capacitance	$C_{I/O}$	5	3.3	—	11	—	pF	A port, V_I = V_{CCA} or GND, B port, V_I = V_{CCB} or GND

Switching Characteristics

(Ta = –40 to 85°C), V_{CCA} = 5.0±0.5 V, V_{CCB} = 2.7 V to 3.6 V)

Item	Symbol	Min	Typ	Max	Unit	Test conditions	From(Input)	To(Output)
Propagation delay time	t_{PLH}	1	—	6.7	ns	C_L = 50 pF, R_L = 500 Ω	A	B
	t_{PHL}	1	—	6.3				
	t_{PLH}	1	—	5			B	A
	t_{PHL}	1	—	6.1				
Output enable time	t_{ZH}	1	—	8.1	ns	C_L = 50 pF, R_L = 500 Ω	$\overline{OE}$	A
	t_{ZL}	1	—	9				
	t_{ZH}	1	—	9.8			$\overline{OE}$	B
	t_{ZL}	1	—	8.8				
Output disable time	t_{HZ}	1	—	5.8	ns	C_L = 50 pF, R_L = 500 Ω	$\overline{OE}$	A
	t_{LZ}	1	—	7				
	t_{HZ}	1	—	7.8			$\overline{OE}$	B
	t_{LZ}	1	—	7.7				

Operating Characteristics

Item	Symbol	V_{CCA} (V)	V_{CCB} (V)	Min	Typ	Max	Unit	Test Conditions
Power dissipation capacitance	C_{PD}	5.0	3.0	—	39.5	—	pF	f = 10 MHz, C_L = 0

Power-up considerations

Level-translation devices offer an opportunity for successful mixed-voltage signal design.

A proper power-up sequence always should be followed to avoid excessive supply current, bus contention, oscillations, or other anomalies caused by improperly biased device pins.

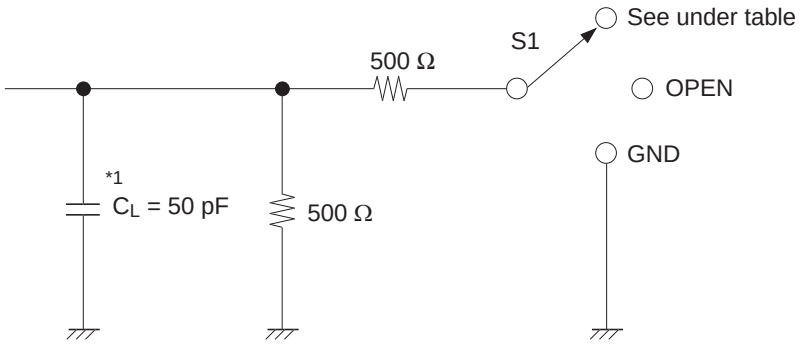
Take these precautions to guard against such power-up problems.

1. Connect ground before any supply voltage is applied.
2. Next, power up the control side of the device.

   (Power up of V_{CCA} is first. Next power up is V_{CCB}.)
3. Tie $\overline{OE}$ to V_{CCA} with a pullup resistor so that it ramps with V_{CCA}.
4. Depending on the direction of the data path, DIR can be high or low.

   If DIR high is needed (A data to B bus), ramp it with V_{CCA}. Overwise, keep DIR low.

Test Circuit

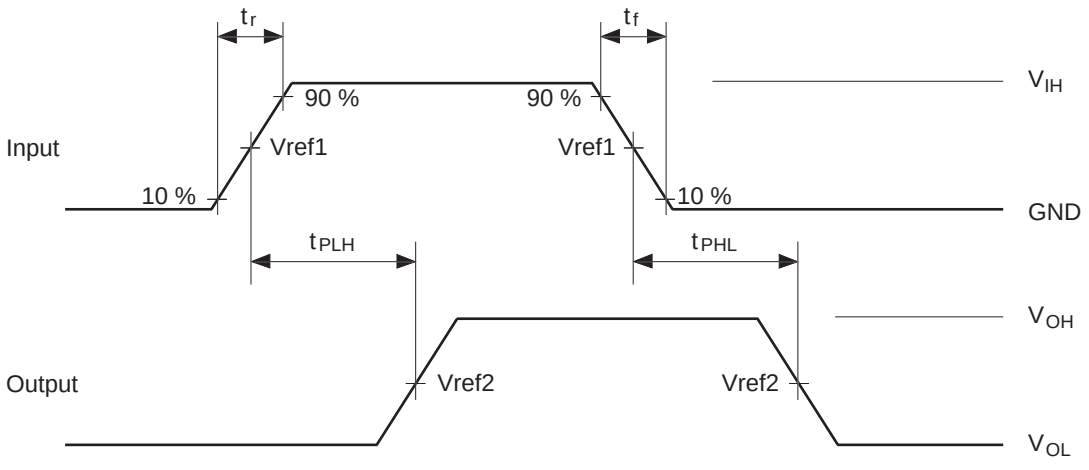


Load circuit for outputs

Symbol	S1	
	V_{CCA} = 5±0.5 V V_{CCB} = 2.7 to 3.6 V	
	A/$\overline{OE}$ to B	B/$\overline{OE}$ to A
t_{PLH} / t_{PHL}	OPEN	OPEN
t_{ZH} / t_{HZ}	GND	GND
t_{ZL} / t_{LZ}	6 V	2 × V_{CCA}

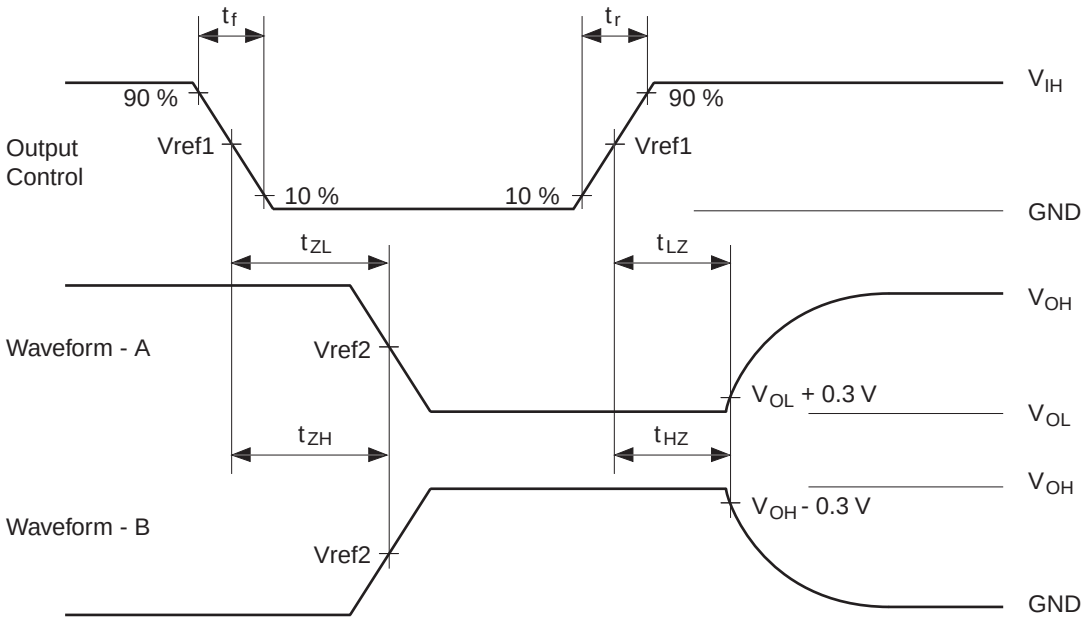
Note: 1. C_L includes probe and jig capacitance.

Waveforms – 1



Symbol	V_{CCA} = 5±0.5 V V_{CCB} = 2.7 to 3.6 V	
	A to B	B to A
V_{IH}	3.0 V	2.7 V
Vref1	1.5 V	1.5 V
Vref2	1.5 V	1/2 V_{CCA}

Waveforms – 2

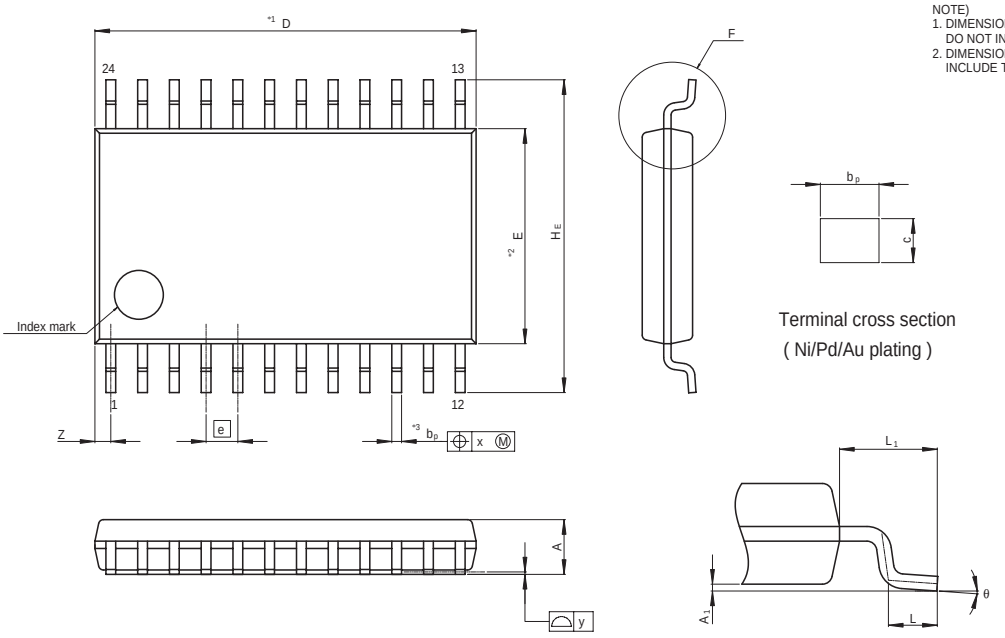


Symbol	V_{CCA} = 5±0.5 V V_{CCB} = 2.7 to 3.6 V	
	$\overline{OE}$ to B	$\overline{OE}$ to A
V_{IH}	3.0 V	3.0 V
Vref1	1.5 V	1.5 V
Vref2	1.5 V	1/2 V_{CCA}

Notes: 1. All input pulses are supplied by generators having the following characteristics :
PRR ≤ 10 MHz, Z_O = 50 Ω, t_r ≤ 2.5 ns, t_f ≤ 2.5 ns.
2. Waveform - A is for an output with internal conditions such that the output is low except when disabled by the output control.
3. Waveform - B is for an output with internal conditions such that the output is high except when disabled by the output control.
4. The output are measured one at a time with one transition per measurement.

Package Dimensions

JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-TSSOP24-4.4x7.8-0.65	PTSP0024JB-A	TTP-24DBV	0.08g



NOTE)
1. DIMENSIONS"*1 (Nom)"AND"*2" DO NOT INCLUDE MOLD FLASH.
2. DIMENSION"*3"DOES NOT INCLUDE TRIM OFFSET.

Reference Symbol	Dimension in Millimeters		
	Min	Nom	Max
D	—	7.80	8.10
E	—	4.40	—
A_2	—	—	—
A_1	0.03	0.07	0.10
A	—	—	1.10
b_p	0.15	0.20	0.25
b_1	—	—	—
c	0.10	0.15	0.20
c_1	—	—	—
θ	0°	—	8°
H_E	6.20	6.40	6.60
e	—	0.65	—
x	—	—	0.13
y	—	—	0.10
Z	—	—	0.65
L	0.4	0.5	0.6
L_1	—	1.0	—

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