HD74ALVC166245A

16–Bit Dual–supply Bus Transceiver with 3–state Outputs

REJ03D0158–0201
Rev.2.01
Apr. 12, 2005

Description

The HD74ALVC166245A has 16 bus transceivers with three state outputs in a 48-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. This 16-bit non-inverting bus transceiver uses two separate power-supply rails.

And this product has two terminals (V_{CCA}, V_{CCB}), V_{CCA} is connected with A bus side, V_{CCB} is connected with control input and B bus. V_{CCA} and V_{CCB} are isolated.

The A port is designed to track V_{CCA}, which accepts voltages from 1.2 V to 2.7 V, and the B port is designed to track V_{CCB}, which operates at 1.4 V to 3.6 V. Therefore, Bidirectional broad voltage conversion is possible.

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}.
- V_{CCA} = 1.2 V to 2.7 V, V_{CCB} = 1.4 V to 3.6 V ($V_{CCA} < V_{CCB}$)
- All control input V_I (max) = 3.6 V (@V_{CCB} = 0 V to 3.6 V)
- All A bus side input outputs $V_{I/O}$ (max) = 3.6 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: ±2 mA (@V_{CCA} = 1.2 V)
  ±4 mA (@V_{CCA} = 1.5±0.1 V)
  ±6 mA (@V_{CCA} = 1.8±0.15 V)
  ±18mA (@V_{CCA} = 2.5±0.2 V)

  B bus side: ±4 mA (@V_{CCB} = 1.5±0.1 V)
  ±6 mA (@V_{CCB} = 1.8±0.15 V)
  ±18 mA (@V_{CCB} = 2.5±0.2 V)
  ±24 mA (@V_{CCB} = 3.3±0.3 V)
- Ordering Information

Part Name	Package Type	Package Code (Previous Code)	Package Abbreviation	Taping Abbreviation (Quantity)
HD74ALVC166245ATEL	TSSOP–48Pin	PTSP0048KA–A (TTP–48DBV)	T	EL (1,000pcs / Reel)

Function Table

Inputs		Operation
$1\overline{OE}$	1DIR	
L	L	1B1–1B8 data to 1A1–1A8 bus
L	H	1A1–1A8 data to 1B1–1B8 bus
H	X	Z

Inputs		Operation
$2\overline{OE}$	2DIR	
L	L	2B1–2B8 data to 2A1–2A8 bus
L	H	2A1–2A8 data to 2B1–2B8 bus
H	X	Z

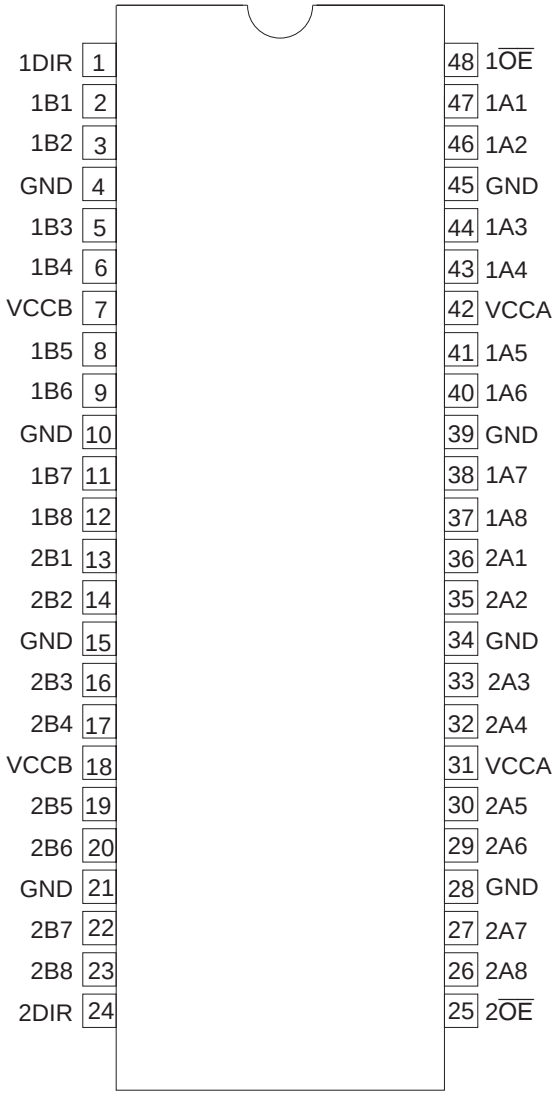
H: High level

L: Low level

X: Immaterial

Z: High impedance

Pin Arrangement



(Top view)

Absolute Maximum Ratings

Item	Symbol	Ratings	Unit	Conditions
Supply voltage	V_{CCA}, V_{CCB}	–0.5 to 4.6	V	
Input voltage[*1]	V_I	–0.5 to 4.6	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 4.6		A port output “Z” or V_{CCA} : OFF
		–0.5 to V_{CCB}+0.5		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_{CC}+0.5
Output current	I_O	±50	mA	
V_{CCA}, V_{CCB}, GND current	I_{CCA}, I_{CCB}, I_{GND}	100	mA	
Maximum power dissipation at Ta = 55°C (in still air)[*2]	P_T	850	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.

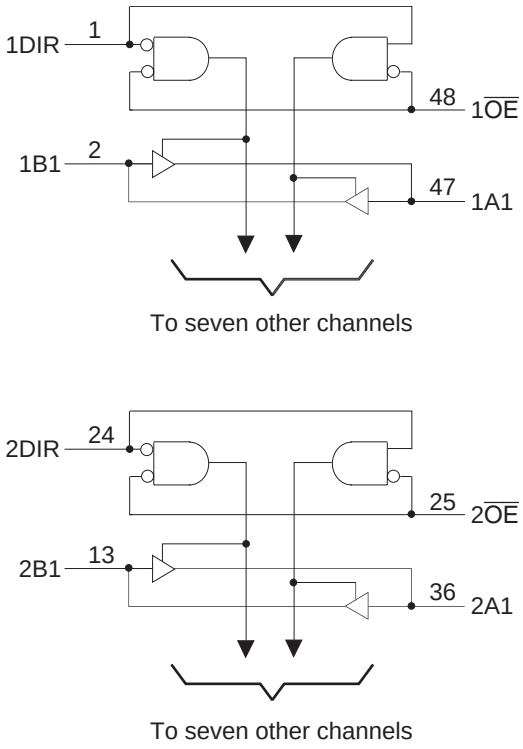
1. The input and output voltage ratings may be exceeded even if the input and output clamp-current ratings are observed.
2. The maximum package power dissipation was calculated using a junction temperature of 150°C.

Recommended Operating Conditions

Item	Symbol	Ratings	Unit	Conditions
Supply voltage	V_{CCB}	1.4 to 3.6	V	
	V_{CCA}	1.2 to 2.7		
Input / output voltage	V_I	0 to 3.6	V	DIR, $\overline{OE}$
	$V_{I/O}$	0 to V_{CCA}		A port output “H” or “L”
		0 to 3.6		A port output “Z” or V_{CCA} : OFF
		0 to V_{CCB}		B port output “H” or “L”
		0 to 3.6		B port output “Z” or V_{CCB} : OFF
output current	I_{OHB}	–4	mA	V_{CCB} = 1.5±0.1 V
		–6		V_{CCB} = 1.8±0.15 V
		–18		V_{CCB} = 2.5±0.2 V
		–24		V_{CCB} = 3.3±0.3 V
	I_{OHA}	–2		V_{CCA} = 1.2 V
		–4		V_{CCA} = 1.5±0.1 V
		–6		V_{CCA} = 1.8±0.15 V
		–18		V_{CCA} = 2.5±0.2 V
	I_{OLB}	4		V_{CCB} = 1.5±0.1 V
		6		V_{CCB} = 1.8±0.15 V
		18		V_{CCB} = 2.5±0.2 V
		24		V_{CCB} = 3.3±0.3 V
	I_{OLA}	2		V_{CCA} = 1.2 V
		4		V_{CCA} = 1.5±0.1 V
		6		V_{CCA} = 1.8±0.15 V
		18		V_{CCA} = 2.5±0.2 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_{CCB} (V)	V_{CCA} (V)	Min	Max	Unit	Test Conditions
Input voltage	V_{IHB}	1.5±0.1	1.2	V_{CCB}×0.70	—	V	B port
		1.8±0.15	1.2 to 1.6	V_{CCB}×0.65	—		Control input
		2.5±0.2	1.2 to 1.95	1.6	—		
		3.3±0.3	1.2 to 2.7	2.0	—		
	V_{IHA}	1.4 to 3.6	1.2	V_{CCA}×0.75	—	V	A port
		1.65 to 3.6	1.5±0.1	V_{CCA}×0.70	—		
		2.3 to 3.6	1.8±0.15	V_{CCA}×0.65	—		
		3.0 to 3.6	2.5±0.2	1.6	—		
	V_{ILB}	1.5±0.1	1.2	—	V_{CCB}×0.30	V	B port
		1.8±0.15	1.2 to 1.6	—	V_{CCB}×0.35		Control input
		2.5±0.2	1.2 to 1.95	—	0.7		
		3.3±0.3	1.2 to 2.7	—	0.8		
	V_{ILA}	1.4 to 3.6	1.2	—	V_{CCA}×0.25	V	A port
		1.65 to 3.6	1.5±0.1	—	V_{CCA}×0.30		
		2.3 to 3.6	1.8±0.15	—	V_{CCA}×0.35		
		3.0 to 3.6	2.5±0.2	—	0.7		

Electrical Characteristics (Cont)

(Ta = –40 to 85°C)

Item	Symbol	V_{CCB} (V)	V_{CCA} (V)	Min	Max	Unit	Test Conditions
Output voltage	V_{OHB}	1.5±0.1	1.2	V_{CCB}–0.2	—	V	I_{OH} = –100 µA
				1.1	—		I_{OH} = –4 mA
		1.8±0.15	1.2 to 1.6	V_{CCB}–0.2	—		I_{OH} = –100 µA
				1.25	—		I_{OH} = –6 mA
		2.5±0.2	1.2 to 1.95	V_{CCB}–0.2	—		I_{OH} = –100 µA
				1.70	—		I_{OH} = –18 mA
		3.3±0.3	1.2 to 2.7	V_{CCB}–0.2	—		I_{OH} = –100 µA
				2.20	—		I_{OH} = –24 mA
	V_{OHA}	1.4 to 3.6	1.2	V_{CCA}–0.2	—	V	I_{OH} = –100 µA
				0.90	—		I_{OH} = –2 mA
		1.65 to 3.6	1.5±0.1	V_{CCA}–0.2	—		I_{OH} = –100 µA
				1.10	—		I_{OH} = –4 mA
		2.3 to 3.6	1.8±0.15	V_{CCA}–0.2	—		I_{OH} = –100 µA
				1.25	—		I_{OH} = –6 mA
		3.0 to 3.6	2.5±0.2	V_{CCA}–0.2	—		I_{OH} = –100 µA
				1.70	—		I_{OH} = –18 mA
	V_{OLB}	1.5±0.1	1.2	—	0.2	V	I_{OL} = 100 µA
				—	0.3		I_{OL} = 4 mA
		1.8±0.15	1.2 to 1.6	—	0.2		I_{OL} = 100 µA
				—	0.3		I_{OL} = 6 mA
		2.5±0.2	1.2 to 1.95	—	0.2		I_{OL} = 100 µA
				—	0.6		I_{OL} = 18 mA
		3.3±0.3	1.2 to 2.7	—	0.2		I_{OL} = 100 µA
				—	0.55		I_{OL} = 24 mA
	V_{OLA}	1.4 to 3.6	1.2	—	0.2	V	I_{OL} = 100 µA
				—	0.3		I_{OL} = 2 mA
		1.65 to 3.6	1.5±0.1	—	0.2		I_{OL} = 100 µA
				—	0.3		I_{OL} = 4 mA
		2.3 to 3.6	1.8±0.15	—	0.2		I_{OL} = 100 µA
				—	0.3		I_{OL} = 6 mA
		3.0 to 3.6	2.5±0.2	—	0.2		I_{OL} = 100 µA
				—	0.6		I_{OL} = 18 mA
Input current	I_{IN}	3.6	2.7	—	±5.0	µA	V_I = GND or V_{CCB} Control input
Off state output current	I_{OZ}	3.6	2.7	—	±10	µA	V_{IN} = V_{IH} or V_{IL}
Output leak current	I_{OFF}	0	0	—	10	µA	V_{IN}, V_{OUT} = 0 to 3.6 V
Quiescent supply current	I_{CCB}	3.6	2.7	—	20	µA	I_O (B port) = 0, A_{IN} = V_{CCA} or GND
	I_{CCA}	3.6	2.7	—	20		I_O (A port) = 0, B_{IN} = V_{CCB} or GND
	I_{CCB}	3.6	2.7	—	±20		V_{CCB} ≤ (V_{IN}, V_{OUT}) ≤ 3.6 V
	I_{CCA}	3.6	2.7	—	±20		V_{CCA} ≤ (V_{IN}, V_{OUT}) ≤ 3.6 V
Increase in I_{CC} per Input*[1]	ΔI_{CCB}	3.6	2.7	—	750	µA	B port or control input One input at V_{CCB}–0.6 V Other input at V_{CCB} or GND
	ΔI_{CCA}	3.6	2.7	—	750		A port One input at V_{CCA}–0.6 V Other input at V_{CCA} or 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}	2.5	3.3	—	4	—	pF	V_I = V_{CCB} or GND
Input / output capacitance	$C_{I/O}$	2.5	3.3	—	9	—	pF	A port, V_I = V_{CCA} or GND, B port, V_I = V_{CCB} or GND

Switching Characteristics

(V_{CCB} = 3.3±0.3 V, V_{CCA} = 2.5±0.2 V, Ta = –40 to 85°C)

Item	Symbol	Min	Typ	Max	Unit	Test conditions	From(Input)	To(Output)
Propagation delay time	t_{PLH}	0.8	—	4.4	ns	C_L = 30 pF, R_L = 500 Ω	B	A
	t_{PHL}	0.8	—	4.4				
	t_{PLH}	0.6	—	4.0			A	B
	t_{PHL}	0.6	—	4.0				
Output enable time	t_{ZH}	0.8	—	4.6	ns	C_L = 30 pF, R_L = 500 Ω	$\overline{OE}$	A
	t_{ZL}	0.8	—	4.6				
	t_{ZH}	0.6	—	4.0			$\overline{OE}$	B
	t_{ZL}	0.6	—	4.0				
Output disable time	t_{HZ}	0.8	—	4.4	ns	C_L = 30 pF, R_L = 500 Ω	$\overline{OE}$	A
	t_{LZ}	0.8	—	4.4				
	t_{HZ}	0.6	—	4.8			$\overline{OE}$	B
	t_{LZ}	0.6	—	4.8				

(V_{CCB} = 3.3±0.3 V, V_{CCA} = 1.8±0.15 V, Ta = –40 to 85°C)

Item	Symbol	Min	Typ	Max	Unit	Test conditions	From(Input)	To(Output)
Propagation delay time	t_{PLH}	1.5	—	6.2	ns	C_L = 30 pF, R_L = 500 Ω	B	A
	t_{PHL}	1.5	—	6.2				
	t_{PLH}	0.6	—	5.1			A	B
	t_{PHL}	0.6	—	5.1				
Output enable time	t_{ZH}	1.5	—	8.2	ns	C_L = 30 pF, R_L = 500 Ω	$\overline{OE}$	A
	t_{ZL}	1.5	—	8.2				
	t_{ZH}	0.6	—	5.1			$\overline{OE}$	B
	t_{ZL}	0.6	—	5.1				
Output disable time	t_{HZ}	0.8	—	4.5	ns	C_L = 30 pF, R_L = 500 Ω	$\overline{OE}$	A
	t_{LZ}	0.8	—	4.5				
	t_{HZ}	0.6	—	5.6			$\overline{OE}$	B
	t_{LZ}	0.6	—	5.6				

Switching Characteristics (Cont)

(V_{CCB} = 3.3±0.3 V, V_{CCA} = 1.5±0.1 V, Ta = –40 to 80°C)

Item	Symbol	Min	Typ	Max	Unit	Test conditions	From(Input)	To(Output)
Propagation delay time	t_{PLH}	1.5	—	5.5	ns	C_L = 30 pF	B	A
	t_{PHL}	1.5	—	5.5		R_L = 500 Ω		
	t_{PLH}	0.6	—	5.5			A	B
	t_{PHL}	0.6	—	5.5				
Output enable time	t_{ZH}	1.5	—	10.0	ns	C_L = 30 pF	$\overline{OE}$	A
	t_{ZL}	1.5	—	10.0		R_L = 500 Ω		
	t_{ZH}	0.6	—	6.0			$\overline{OE}$	B
	t_{ZL}	0.6	—	6.0				
Output disable time	t_{HZ}	1.5	—	6.0	ns	C_L = 30 pF	$\overline{OE}$	A
	t_{LZ}	1.5	—	6.0		R_L = 500 Ω		
	t_{HZ}	0.6	—	6.0			$\overline{OE}$	B
	t_{LZ}	0.6	—	6.0				

(V_{CCB} = 3.3±0.3 V, V_{CCA} = 1.2 V, Ta = –40 to 85°C)

Item	Symbol	Min	Typ	Max	Unit	Test conditions	From(Input)	To(Output)
Propagation delay time	t_{PLH}	—	4.0	—	ns	C_L = 30 pF	B	A
	t_{PHL}	—	4.0	—		R_L = 500 Ω		
	t_{PLH}	—	3.5	—			A	B
	t_{PHL}	—	3.5	—				
Output enable time	t_{ZH}	—	5.0	—	ns	C_L = 30 pF	$\overline{OE}$	A
	t_{ZL}	—	5.0	—		R_L = 500 Ω		
	t_{ZH}	—	2.5	—			$\overline{OE}$	B
	t_{ZL}	—	2.5	—				
Output disable time	t_{HZ}	—	3.0	—	ns	C_L = 30 pF	$\overline{OE}$	A
	t_{LZ}	—	3.0	—		R_L = 500 Ω		
	t_{HZ}	—	2.5	—			$\overline{OE}$	B
	t_{LZ}	—	2.5	—				

(V_{CCB} = 2.5±0.2 V, V_{CCA} = 1.8±0.15 V, Ta = –40 to 85°C)

Item	Symbol	Min	Typ	Max	Unit	Test conditions	From(Input)	To(Output)
Propagation delay time	t_{PLH}	1.5	—	5.8	ns	C_L = 30 pF	B	A
	t_{PHL}	1.5	—	5.8		R_L = 500 Ω		
	t_{PLH}	0.8	—	5.5			A	B
	t_{PHL}	0.8	—	5.5				
Output enable time	t_{ZH}	1.5	—	8.3	ns	C_L = 30 pF	$\overline{OE}$	A
	t_{ZL}	1.5	—	8.3		R_L = 500 Ω		
	t_{ZH}	0.8	—	5.3			$\overline{OE}$	B
	t_{ZL}	0.8	—	5.3				
Output disable time	t_{HZ}	0.8	—	4.6	ns	C_L = 30 pF	$\overline{OE}$	A
	t_{LZ}	0.8	—	4.6		R_L = 500 Ω		
	t_{HZ}	0.8	—	5.2			$\overline{OE}$	B
	t_{LZ}	0.8	—	5.2				

Switching Characteristics (cont)

(V_{CCB} = 2.5±0.2 V, V_{CCA} = 1.5±0.1 V, Ta = –40 to 85°C)

Item	Symbol	Min	Typ	Max	Unit	Test conditions	From(Input)	To(Output)
Propagation delay time	t_{PLH}	1.5	—	6.0	ns	C_L = 30 pF	B	A
	t_{PHL}	1.5	—	6.0		R_L = 500 Ω		
	t_{PLH}	0.8	—	6.0			A	B
	t_{PHL}	0.8	—	6.0				
Output enable time	t_{ZH}	1.5	—	10.0	ns	C_L = 30 pF	$\overline{OE}$	A
	t_{ZL}	1.5	—	10.0		R_L = 500 Ω		
	t_{ZH}	1.5	—	7.0			$\overline{OE}$	B
	t_{ZL}	1.5	—	7.0				
Output disable time	t_{HZ}	1.5	—	6.0	ns	C_L = 30 pF	$\overline{OE}$	A
	t_{LZ}	1.5	—	6.0		R_L = 500 Ω		
	t_{HZ}	1.5	—	6.0			$\overline{OE}$	B
	t_{LZ}	1.5	—	6.0				

(V_{CCB} = 2.5±0.2 V, V_{CCA} = 1.2 V, Ta = –40 to 85°C)

Item	Symbol	Min	Typ	Max	Unit	Test conditions	From(Input)	To(Output)
Propagation delay time	t_{PLH}	—	4.0	—	ns	C_L = 30 pF	B	A
	t_{PHL}	—	4.0	—		R_L = 500 Ω		
	t_{PLH}	—	3.5	—			A	B
	t_{PHL}	—	3.5	—				
Output enable time	t_{ZH}	—	5.5	—	ns	C_L = 30 pF	$\overline{OE}$	A
	t_{ZL}	—	5.5	—		R_L = 500 Ω		
	t_{ZH}	—	3.5	—			$\overline{OE}$	B
	t_{ZL}	—	3.5	—				
Output disable time	t_{HZ}	—	3.0	—	ns	C_L = 30 pF	$\overline{OE}$	A
	t_{LZ}	—	3.0	—		R_L = 500 Ω		
	t_{HZ}	—	2.5	—			$\overline{OE}$	B
	t_{LZ}	—	2.5	—				

(V_{CCB} = 1.8±0.15 V, V_{CCA} = 1.5±0.1 V, Ta = –40 to 85°C)

Item	Symbol	Min	Typ	Max	Unit	Test conditions	From(Input)	To(Output)
Propagation delay time	t_{PLH}	1.5	—	7.0	ns	C_L = 30 pF	B	A
	t_{PHL}	1.5	—	7.0		R_L = 500 Ω		
	t_{PLH}	1.5	—	7.0			A	B
	t_{PHL}	1.5	—	7.0				
Output enable time	t_{ZH}	1.5	—	10.0	ns	C_L = 30 pF	$\overline{OE}$	A
	t_{ZL}	1.5	—	10.0		R_L = 500 Ω		
	t_{ZH}	1.5	—	8.0			$\overline{OE}$	B
	t_{ZL}	1.5	—	8.0				
Output disable time	t_{HZ}	1.5	—	6.0	ns	C_L = 30 pF	$\overline{OE}$	A
	t_{LZ}	1.5	—	6.0		R_L = 500 Ω		
	t_{HZ}	1.5	—	7.0			$\overline{OE}$	B
	t_{LZ}	1.5	—	7.0				

Switching Characteristics (cont)

(V_{CCB} = 1.8±0.15 V, V_{CCA} = 1.2 V, Ta = –40 to 80°C)

Item	Symbol	Min	Typ	Max	Unit	Test conditions	From(Input)	To(Output)
Propagation delay time	t_{PLH}	—	4.5	—	ns	C_L = 30 pF R_L = 500 Ω	B	A
	t_{PHL}	—	4.5	—				
	t_{PLH}	—	4.0	—			A	B
	t_{PHL}	—	4.0	—				
Output enable time	t_{ZH}	—	6.0	—	ns	C_L = 30 pF R_L = 500 Ω	$\overline{OE}$	A
	t_{ZL}	—	6.0	—				
	t_{ZH}	—	4.5	—			$\overline{OE}$	B
	t_{ZL}	—	4.5	—				
Output disable time	t_{HZ}	—	3.5	—	ns	C_L = 30 pF R_L = 500 Ω	$\overline{OE}$	A
	t_{LZ}	—	3.5	—				
	t_{HZ}	—	3.5	—			$\overline{OE}$	B
	t_{LZ}	—	3.5	—				

(V_{CCB} = 1.5±0.1 V, V_{CCA} = 1.2 V, Ta = –40 to 85°C)

Item	Symbol	Min	Typ	Max	Unit	Test conditions	From(Input)	To(Output)
Propagation delay time	t_{PLH}	—	5.0	—	ns	C_L = 30 pF R_L = 500 Ω	B	A
	t_{PHL}	—	5.0	—				
	t_{PLH}	—	5.0	—			A	B
	t_{PHL}	—	5.0	—				
Output enable time	t_{ZH}	—	7.0	—	ns	C_L = 30 pF R_L = 500 Ω	$\overline{OE}$	A
	t_{ZL}	—	7.0	—				
	t_{ZH}	—	6.0	—			$\overline{OE}$	B
	t_{ZL}	—	6.0	—				
Output disable time	t_{HZ}	—	4.5	—	ns	C_L = 30 pF R_L = 500 Ω	$\overline{OE}$	A
	t_{LZ}	—	4.5	—				
	t_{HZ}	—	4.0	—			$\overline{OE}$	B
	t_{LZ}	—	4.0	—				

Operating Characteristics

Item	Symbol	V_{CCA} (V)	V_{CCB} (V)	Min	Typ	Max	Unit	Test Conditions
Power dissipation capacitance	C_{PD}	2.5	3.3	—	40	—	pF	f = 10 MHz C_L = 0

Power-up considerations

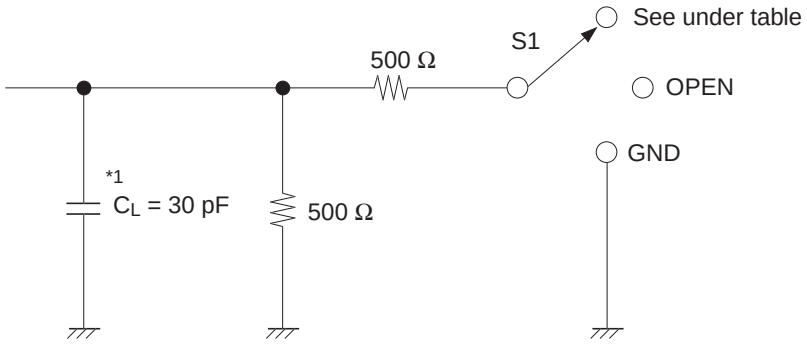
Level-translation devices offer an opportunity for successful mixed-voltage signal design.

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_{CCB} is first. Next power up is V_{CCA}.)
3. Tie $\overline{OE}$ to V_{CCB} with a pullup resistor so that it ramps with V_{CCB}.
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_{CCB}. Otherwise, DIR low is needed (B data to A bus), ramp it with GND.

Test Circuit

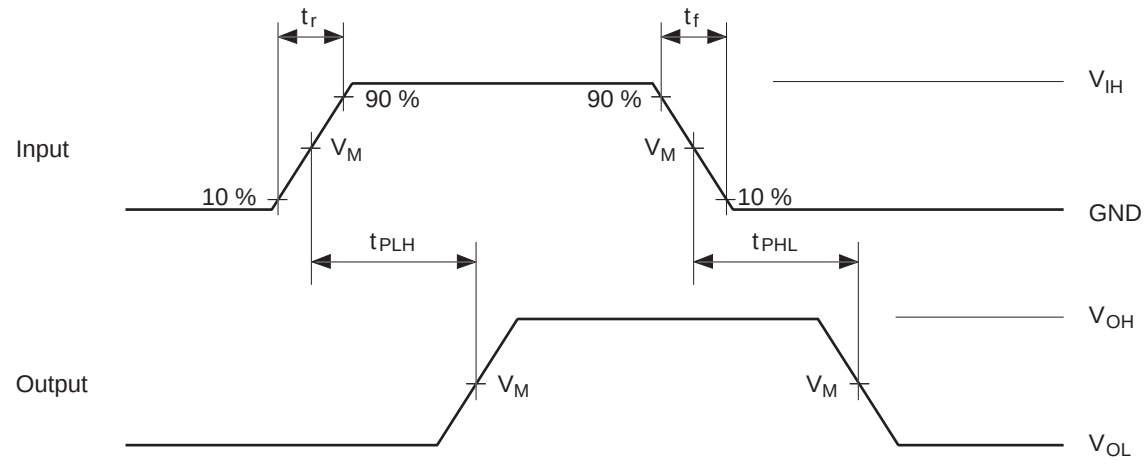


Load circuit for outputs

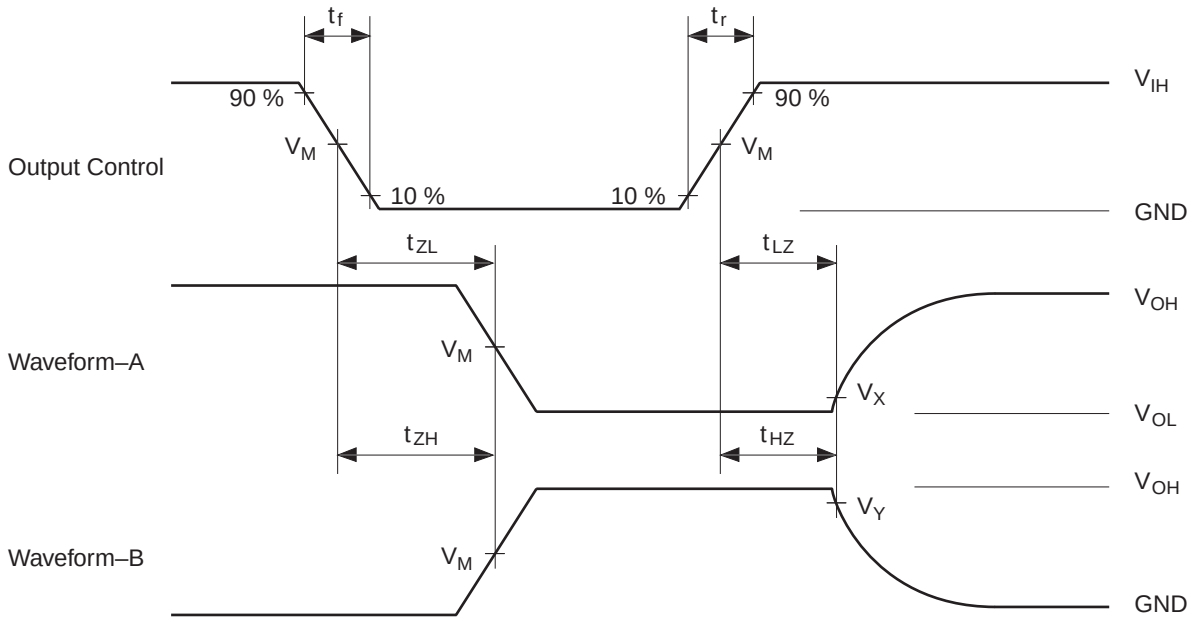
Symbol	V_{CCB} = 3.3±0.3 V V_{CCA} = 2.5±0.2 V = 1.8±0.15 V = 1.5±0.1 V = 1.2 V		V_{CCB} = 2.5±0.2 V V_{CCA} = 1.8±0.15 V = 1.5±0.1 V = 1.2 V		V_{CCB} = 1.8±0.15 V V_{CCA} = 1.5±0.1 V = 1.2 V		V_{CCB} = 1.5±0.1 V V_{CCA} = 1.2 V	
	B/$\overline{OE}$ to A	A/$\overline{OE}$ to B	B/$\overline{OE}$ to A	A/$\overline{OE}$ to B	B/$\overline{OE}$ to A	A/$\overline{OE}$ to B	B/$\overline{OE}$ to A	A/$\overline{OE}$ to B
t_{PLH}/ t_{PHL}	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN
t_{ZH} / t_{HZ}	GND	GND	GND	GND	GND	GND	GND	GND
t_{ZL} / t_{LZ}	2 × V_{CCA}	6 V	2 × V_{CCA}	2 × V_{CCB}	2 × V_{CCA}	2 × V_{CCB}	2 × V_{CCA}	2 × V_{CCB}

Note: 1. C_L includes probe and jig capacitance.

Waveforms – 1



Waveforms – 2



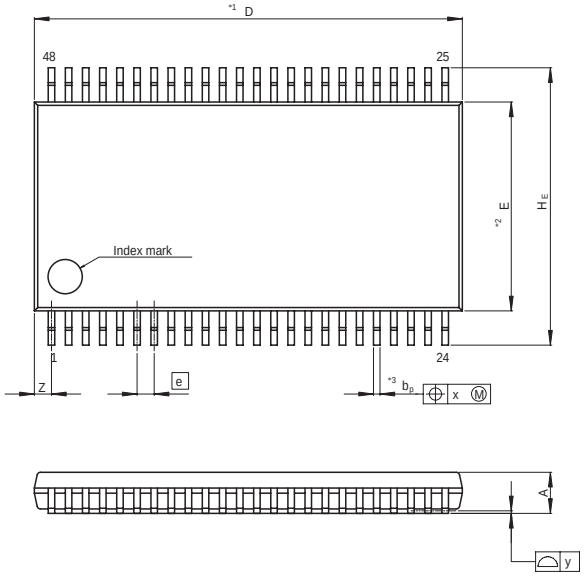
Symbol	V_{CC}				
	3.3±0.3 V	2.5±0.2 V	1.8±0.15 V	1.5±0.1 V	1.2 V
V_{IH}	2.7 V	V_{CC}	V_{CC}	V_{CC}	V_{CC}
V_M	1.5 V	1/2 V_{CC}	1/2 V_{CC}	1/2 V_{CC}	1/2 V_{CC}
V_X	V_{OL}+0.3 V	V_{OL}+0.15 V	V_{OL}+0.15 V	V_{OL}+0.1 V	V_{OL}+0.1 V
V_Y	V_{OH}–0.3 V	V_{OH}–0.15 V	V_{OH}–0.15 V	V_{OH}–0.1 V	V_{OH}–0.1 V

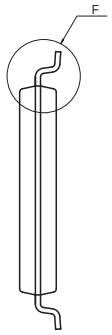
Notes: 1. All input pulses are supplied by generators having the following characteristics:
PRR ≤ 10 MHz, Zo = 50 Ω, t_r ≤ 2.0 ns, t_f ≤ 2.0 ns.
2. Waveform – A is for an output with internal conditions such that the output is low except when disabled by the output control.
3. Waveform – B is for an 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.

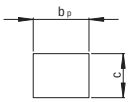
Package Dimensions

JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-TSSOP48-6.1x12.5-0.50	PTSP0048KA-A	TTP-48DBV	0.2g

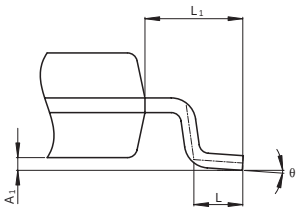
NOTE)
1. DIMENSIONS"*1 (Nom)"AND"*2"
   DO NOT INCLUDE MOLD FLASH
2. DIMENSION"*3"DOES NOT
   INCLUDE TRIM OFFSET.







Terminal cross section
(Ni/Pd/Au plating)



Detail F

Reference Symbol	Dimension in Millimeters		
	Min	Nom	Max
D	—	12.5	12.7
E	—	6.10	—
A_2	—	—	—
A_1	0.08	0.13	0.18
A	—	—	1.20
b_p	0.14	0.19	0.24
b_1	—	—	—
c	0.10	0.15	0.20
c_1	—	—	—
θ	0°	—	8°
H_E	7.90	8.10	8.30
e	—	0.50	—
x	—	—	0.08
y	—	—	0.10
Z	—	—	0.65
L	0.4	0.5	0.6
L_1	—	1.0	—

Renesas Technology Corp. Sales Strategic Planning Div. Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan

RENESAS SALES OFFICES

http://www.renesas.com

Refer to "**http://www.renesas.com/en/network**" for the latest and detailed information.

Renesas Technology America, Inc.
450 Holger Way, San Jose, CA 95134-1368, U.S.A
Tel: <1> (408) 382-7500, Fax: <1> (408) 382-7501

Renesas Technology Europe Limited
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.
Tel: <44> (1628) 585-100, Fax: <44> (1628) 585-900

Renesas Technology Hong Kong Ltd.
7th Floor, North Tower, World Finance Centre, Harbour City, 1 Canton Road, Tsimshatsui, Kowloon, Hong Kong
Tel: <852> 2265-6688, Fax: <852> 2730-6071

Renesas Technology Taiwan Co., Ltd.
10th Floor, No.99, Fushing North Road, Taipei, Taiwan
Tel: <886> (2) 2715-2888, Fax: <886> (2) 2713-2999

Renesas Technology (Shanghai) Co., Ltd.
Unit2607 Ruijing Building, No.205 Maoming Road (S), Shanghai 200020, China
Tel: <86> (21) 6472-1001, Fax: <86> (21) 6415-2952

Renesas Technology Singapore Pte. Ltd.
1 Harbour Front Avenue, #06-10, Keppel Bay Tower, Singapore 098632
Tel: <65> 6213-0200, Fax: <65> 6278-8001

Colophon .2.0