To all our customers

Regarding the change of names mentioned in the document, such as Hitachi Electric and Hitachi XX, to Renesas Technology Corp.

The semiconductor operations of Mitsubishi Electric and Hitachi were transferred to Renesas Technology Corporation on April 1st 2003. These operations include microcomputer, logic, analog and discrete devices, and memory chips other than DRAMs (flash memory, SRAMs etc.) Accordingly, although Hitachi, Hitachi, Ltd., Hitachi Semiconductors, and other Hitachi brand names are mentioned in the document, these names have in fact all been changed to Renesas Technology Corp. Thank you for your understanding. Except for our corporate trademark, logo and corporate statement, no changes whatsoever have been made to the contents of the document, and these changes do not constitute any alteration to the contents of the document itself.

Renesas Technology Home Page: http://www.renesas.com

Renesas Technology Corp.
Customer Support Dept.
April 1, 2003

Cautions

Keep safety first in your circuit designs!

1. Renesas Technology Corporation puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with semiconductors may lead to personal injury, fire or property damage.
   Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of nonflammable material or (iii) prevention against any malfunction or mishap.

Notes regarding these materials

1. These materials are intended as a reference to assist our customers in the selection of the Renesas Technology Corporation product best suited to the customer's application; they do not convey any license under any intellectual property rights, or any other rights, belonging to Renesas Technology Corporation or a third party.
2. Renesas Technology Corporation assumes no responsibility for any damage, or infringement of any third-party's rights, originating in the use of any product data, diagrams, charts, programs, algorithms, or circuit application examples contained in these materials.
3. All information contained in these materials, including product data, diagrams, charts, programs and algorithms represents information on products at the time of publication of these materials, and are subject to change by Renesas Technology Corporation without notice due to product improvements or other reasons. It is therefore recommended that customers contact Renesas Technology Corporation or an authorized Renesas Technology Corporation product distributor for the latest product information before purchasing a product listed herein.
   The information described here may contain technical inaccuracies or typographical errors.
   Renesas Technology Corporation assumes no responsibility for any damage, liability, or other loss rising from these inaccuracies or errors.
   Please also pay attention to information published by Renesas Technology Corporation by various means, including the Renesas Technology Corporation Semiconductor home page (http://www.renesas.com).
4. When using any or all of the information contained in these materials, including product data, diagrams, charts, programs, and algorithms, please be sure to evaluate all information as a total system before making a final decision on the applicability of the information and products. Renesas Technology Corporation assumes no responsibility for any damage, liability or other loss resulting from the information contained herein.
5. Renesas Technology Corporation semiconductors are not designed or manufactured for use in a device or system that is used under circumstances in which human life is potentially at stake. Please contact Renesas Technology Corporation or an authorized Renesas Technology Corporation product distributor when considering the use of a product contained herein for any specific purposes, such as apparatus or systems for transportation, vehicular, medical, aerospace, nuclear, or undersea repeater use.
6. The prior written approval of Renesas Technology Corporation is necessary to reprint or reproduce in whole or in part these materials.
7. If these products or technologies are subject to the Japanese export control restrictions, they must be exported under a license from the Japanese government and cannot be imported into a country other than the approved destination.
   Any diversion or reexport contrary to the export control laws and regulations of Japan and/or the country of destination is prohibited.
8. Please contact Renesas Technology Corporation for further details on these materials or the products contained therein.

HD74ALVC162244

16-bit Buffer / Driver with 3-state Outputs

ADE-205-204 (Z)
Preliminary
1st. Edition
January 1998

Description

The HD74ALVC162244 is designed specifically to improve both the performance and density of 3-state memory address drivers, clock drivers, and bus oriented receivers and transmitters. The device can be used as four 4-bit buffers, two 8-bit buffers, or one 16-bit buffer. It provides true outputs and symmetrical $\overline{OE}$ (active-low output-enable) inputs.

To ensure the high impedance state during power up or power down, $\overline{OE}$ should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current sinking capability of the driver.

All outputs, which are designed to sink up to 12 mA, include equivalent 26 Ω resistors to reduce overshoot and undreshoot.

Features

- V_{CC} = 2.3 V to 3.6 V
- Typical V_{OL} ground bounce < 0.8 V (@V_{CC} = 3.3 V, Ta = 25°C)
- Typical V_{OH} undershoot > 2.0 V (@V_{CC} = 3.3 V, Ta = 25°C)
- High output current ±12 mA (@V_{CC} = 3.0 V)
- All outputs have equivalent 26 Ω series resistors, so no external resistors are required

Function Table

Inputs		Output Y
$\overline{OE}$	A	
L	H	H
L	L	L
H	X	Z

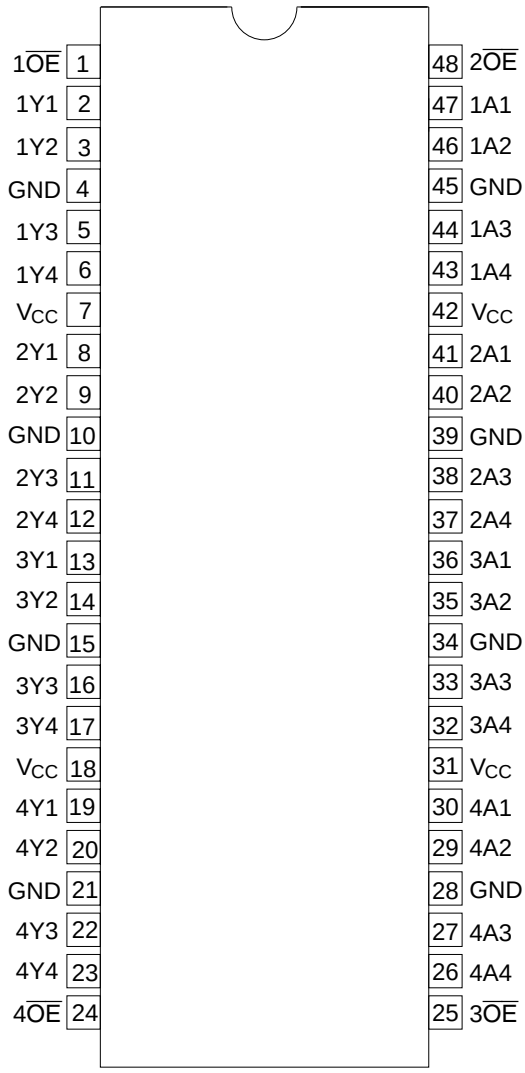
H : High level

L : Low level

X : Immaterial

Z : High impedance

Pin Arrangement



(Top view)

Absolute Maximum Ratings

Item	Symbol	Ratings	Unit	Conditions
Supply voltage	V_{CC}	–0.5 to 4.6	V	
Input voltage [*1]	V_I	–0.5 to 4.6	V	
Output voltage [*1, 2]	V_O	–0.5 to V_{CC} +0.5	V	
Input clamp current	I_{IK}	–50	mA	$V_I < 0$
Output clamp current	I_{OK}	±50	mA	$V_O < 0$ or $V_O > V_{CC}$
Continuous output current	I_O	±50	mA	V_O = 0 to V_{CC}
V_{CC}, GND current / pin	I_{CC} or I_{GND}	±100	mA	
Maximum power dissipation at Ta = 55°C (in still air) [*3]	P_T	0.85	W	TSSOP
Storage temperature	T_{stg}	–65 to 150	°C	

Notes: Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute maximum rated conditions for extended periods may affect device reliability.

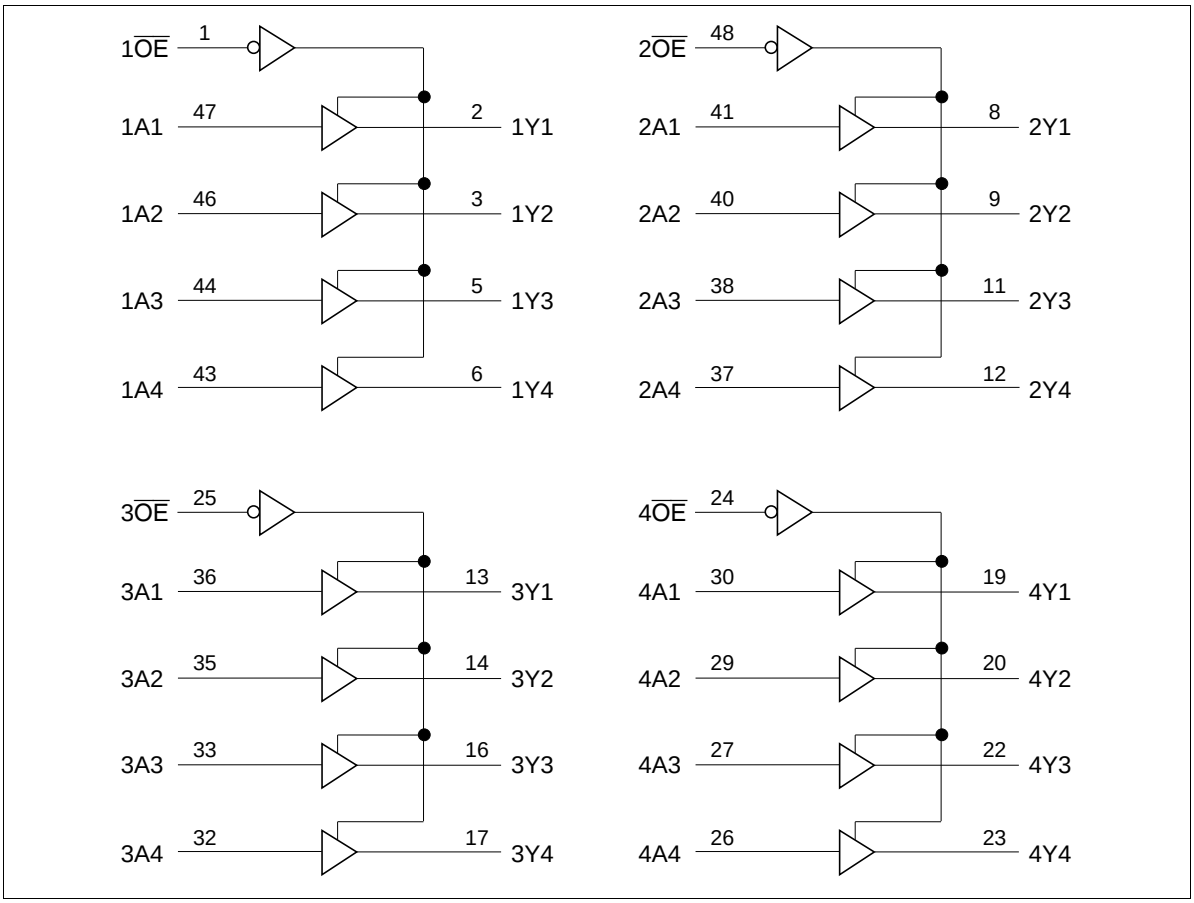
1. The input and output negative voltage ratings may be exceeded if the input and output clamp current ratings are observed.
2. This value is limited to 4.6 V maximum.
3. The maximum package power dissipation is calculated using a junction temperature of 150°C and a board trace length of 750 mils.

Recommended Operating Conditions

Item	Symbol	Min	Max	Unit	Conditions
Supply voltage	V_{CC}	2.3	3.6	V	
Input voltage	V_I	0	V_{CC}	V	
Output voltage	V_O	0	V_{CC}	V	
High level output current	I_{OH}	—	–6	mA	V_{CC} = 2.3 V
		—	–8		V_{CC} = 2.7 V
		—	–12		V_{CC} = 3.0 V
Low level output current	I_{OL}	—	6	mA	V_{CC} = 2.3 V
		—	8		V_{CC} = 2.7 V
		—	12		V_{CC} = 3.0 V
Input transition rise or fall rate	$\Delta t / \Delta v$	0	10	ns / V	
Operating temperature	T_a	–40	85	°C	

Note: Unused control inputs must be held high or low to prevent them from floating.

Logic Diagram



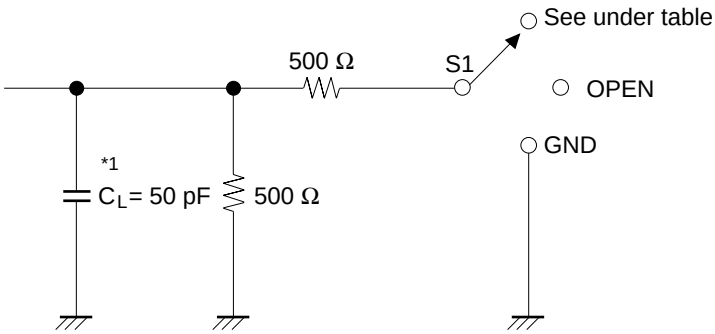
Electrical Characteristics (Ta = –40 to 85°C)

Item	Symbol	V_{CC} (V)	Min	Max	Unit	Test Conditions
Input voltage	V_{IH}	2.3 to 2.7	1.7	—	V	
		2.7 to 3.6	2.0	—		
	V_{IL}	2.3 to 2.7	—	0.7		
		2.7 to 3.6	—	0.8		
Output voltage	V_{OH}	2.3 to 3.6	V_{CC}–0.2	—	V	I_{OH} = –100 µA
		2.3	1.9	—		I_{OH} = –4 mA, V_{IH} = 1.7 V
		2.3	1.7	—		I_{OH} = –6 mA, V_{IH} = 1.7 V
		3.0	2.4	—		I_{OH} = –6 mA, V_{IH} = 2.0 V
		2.7	2.0	—		I_{OH} = –8 mA, V_{IH} = 2.0 V
		3.0	2.0	—		I_{OH} = –12 mA, V_{IH} = 2.0 V
	V_{OL}	2.3 to 3.6	—	0.2		I_{OL} = 100 µA
		2.3	—	0.4		I_{OL} = 4 mA, V_{IL} = 0.7 V
		2.3	—	0.55		I_{OL} = 6 mA, V_{IL} = 0.7 V
		3.0	—	0.55		I_{OL} = 6 mA, V_{IL} = 0.8 V
		2.7	—	0.6		I_{OL} = 8 mA, V_{IL} = 0.8 V
		3.0	—	0.8		I_{OL} = 12 mA, V_{IL} = 0.8 V
Input current	I_{IN}	3.6	—	±5	µA	V_{IN} = V_{CC} or GND
Off state output current	I_{OZ}	3.6	—	±10	µA	V_{OUT} = V_{CC} or GND
Quiescent supply current	I_{CC}	3.6	—	40	µA	V_{IN} = V_{CC} or GND
	ΔI_{CC}	3.0 to 3.6	—	750	µA	V_{IN} = one input at (V_{CC}–0.6) V, other inputs at V_{CC} or GND

Switching Characteristics (Ta = –40 to 85°C)

Item	Symbol	V_{CC} (V)	Min	Typ	Max	Unit	FROM (Input)	TO (Output)
Propagation delay time	t_{PLH}	2.5±0.2	1.0	—	4.9	ns	A	Y
	t_{PHL}	2.7	—	—	4.7			
		3.3±0.3	1.0	—	4.2			
Output enable time	t_{ZH}	2.5±0.2	1.0	—	6.8	ns	$\overline{OE}$	Y
	t_{ZL}	2.7	—	—	6.7			
		3.3±0.3	1.0	—	5.6			
Output disable time	t_{HZ}	2.5±0.2	1.0	—	6.3	ns	$\overline{OE}$	Y
	t_{LZ}	2.7	—	—	5.7			
		3.3±0.3	1.0	—	5.5			
Input capacitance	C_{IN}	3.3	—	3.0	—	pF	Control inputs	
		3.3	—	6.0	—		Data inputs	
Output capacitance	C_O	3.3	—	7.0	—	pF	Outputs	

Test Circuit

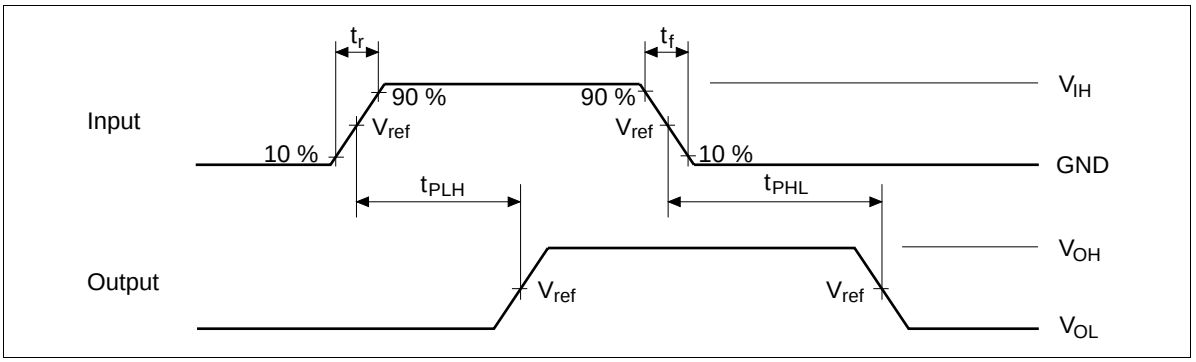


Load Circuit for Outputs

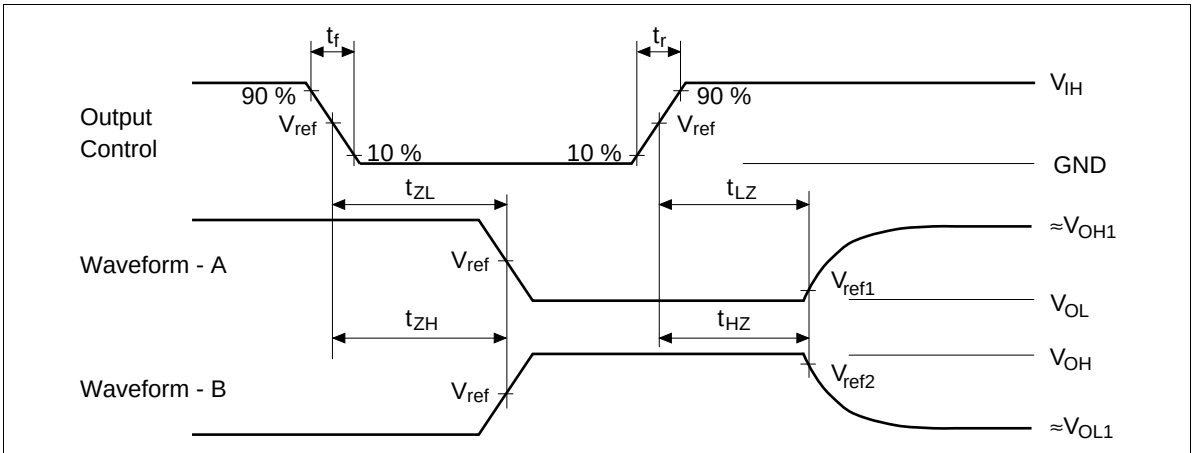
Symbol	Vcc=2.5±0.2V	Vcc=2.7V, 3.3±0.3V
t_{PLH}/ t_{PHL}	OPEN	OPEN
t_{ZH}/ t_{HZ}	GND	GND
t_{ZL}/ t_{LZ}	2 × V_{CC}	6.0 V

Note: 1. C_L includes probe and jig capacitance.

Waveforms – 1



Waveforms – 2

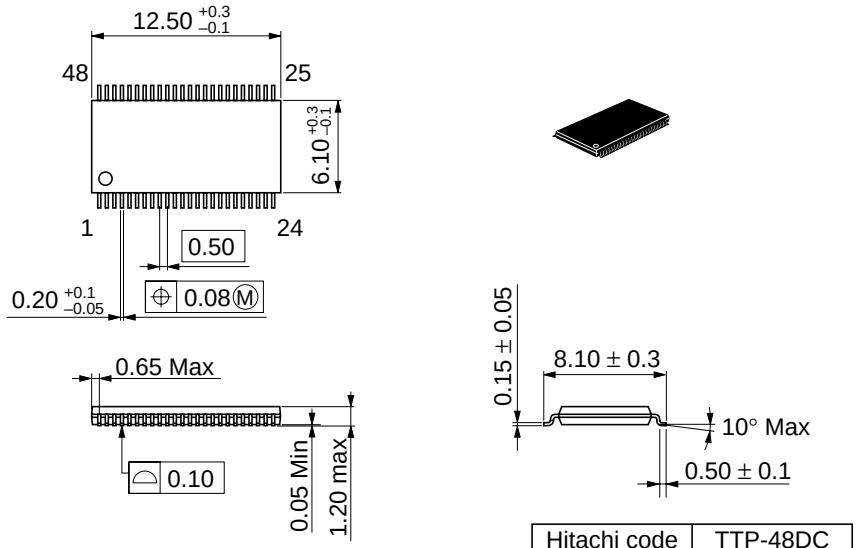


TEST	Vcc=2.5±0.2V	Vcc=2.7V, 3.3±0.3V
V_{IH}	V_{CC}	2.7 V
V_{ref}	1/2 V_{CC}	1.5 V
V_{ref1}	V_{OL} +0.15 V	V_{OL} +0.3 V
V_{ref2}	V_{OH}–0.15 V	V_{OH}–0.3 V
V_{OH1}	V_{CC}	3.0 V
V_{OL1}	GND	GND

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. (V_{CC} = 2.5±0.2 V)
   PRR ≤ 10 MHz, Zo = 50 Ω, t_r ≤ 2.5 ns, t_f ≤ 2.5 ns. (V_{CC} = 2.7 V, 3.3±0.3 V)
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

Unit : mm



Hitachi code	TTP-48DC
EIAJ code	—
JEDEC code	—

When using this document, keep the following in mind:

1. This document may, wholly or partially, be subject to change without notice.
2. All rights are reserved: No one is permitted to reproduce or duplicate, in any form, the whole or part of this document without Hitachi's permission.
3. Hitachi will not be held responsible for any damage to the user that may result from accidents or any other reasons during operation of the user's unit according to this document.
4. Circuitry and other examples described herein are meant merely to indicate the characteristics and performance of Hitachi's semiconductor products. Hitachi assumes no responsibility for any intellectual property claims or other problems that may result from applications based on the examples described herein.
5. No license is granted by implication or otherwise under any patents or other rights of any third party or Hitachi, Ltd.
6. MEDICAL APPLICATIONS: Hitachi's products are not authorized for use in MEDICAL APPLICATIONS without the written consent of the appropriate officer of Hitachi's sales company. Such use includes, but is not limited to, use in life support systems. Buyers of Hitachi's products are requested to notify the relevant Hitachi sales offices when planning to use the products in MEDICAL APPLICATIONS.

HITACHI

Hitachi, Ltd.
Semiconductor & IC Div.
Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100, Japan
Tel: Tokyo (03) 3270-2111
Fax: (03) 3270-5109

For further information write to:

Hitachi Semiconductor
(America) Inc.
2000 Sierra Point Parkway
Brisbane, CA. 94005-1897
U S A
Tel: 800-285-1601
Fax:303-297-0447

Hitachi Europe GmbH
Continental Europe
Dornacher Straße 3
D-85622 Feldkirchen
München
Tel: 089-9 91 80-0
Fax: 089-9 29 30-00

Hitachi Europe Ltd.
Electronic Components Div.
Northern Europe Headquarters
Whitebrook Park
Lower Cookham Road
Maidenhead
Berkshire SL6 8YA
United Kingdom
Tel: 01628-585000
Fax: 01628-585160

Hitachi Asia Pte. Ltd.
16 Collyer Quay #20-00
Hitachi Tower
Singapore 049318
Tel: 535-2100
Fax: 535-1533

Hitachi Asia (Hong Kong) Ltd.
Unit 706, North Tower,
World Finance Centre,
Harbour City, Canton Road
Tsim Sha Tsui, Kowloon
Hong Kong
Tel: 27359218
Fax: 27306071

Copyright © Hitachi, Ltd., 1997. All rights reserved. Printed in Japan.