# HD75159

Dual Differential Line Drivers With 3 State Outputs

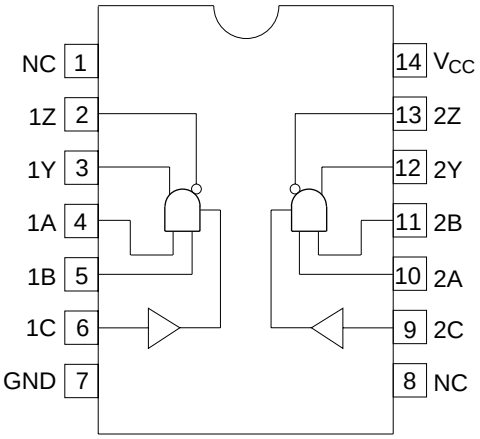
HITACHI

ADE-205-589 (Z)
1st. Edition
Dec. 2000

## Description

The HD75159 features dual differential line drivers with three state outputs, which satisfy the requirements of EIA(standard) RS-422A. Each driver has an output control. When the output control is low, the associated outputs are in a high impedance state. This permits many devices to be connected together on the same transmission line for party line applications.

## Pin Arrangement




(Top view)

Hitachi semiconductor

## Absolute Maximum Ratings

| Item | Symbol | | Rating | Unit |
|---|---|---|---|---|
| Supply Voltage | $V_{CC}$ | | 7 | V |
| Input Voltage | $V_{IN}$ | | 5.5 | V |
| Powre Dissipation (Ta = 25°C) | $P_T$*[1] | DP | 1150 | mW |
| | | FP | 785 | |
| Operating Temperature Range | Topr | | 0 to 70 | °C |
| Storage Temperature Range | Tstg | | –60 to +150 | °C |

Note: 1. The above date were taken by the $\Delta V_{BE}$ method, mounting on a glass epoxy board (40 × 40 × 1.6 mm) of 10 % wiring density.

2. 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.

## Recommended Operating Conditions

| Item | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Supply Voltage | $V_{CC}$ | 4.75 | 5.00 | 5.25 | V |
| Output Current | $I_{OH}$ | — | — | –40 | mA |
| Output Current | $I_{OL}$ | — | — | 40 | mA |
| Operating Temperature | Topr | 0 | 70 | °C | |

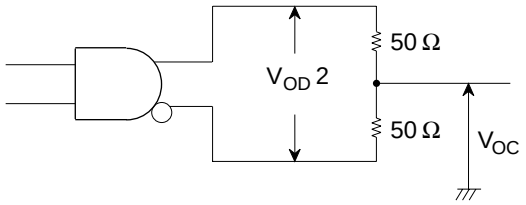
## Electrical Characteristics (Ta = 0 to 70°C)

| Item | Symbol | Min | Typ*[1] | Max | Unit | Conditions |
|---|---|---|---|---|---|---|
| Input Voltage | $V_{IH}$ | 2 | — | — | V | |
| | $V_{IL}$ | — | — | 0.8 | | |
| Input Clamp Voltage | $V_{IK}$ | — | –0.9 | -1.5 | V | $V_{CC}$ = 4.75 V, $I_I$ = –12 mA |
| Output Voltage | $V_{OH}$ | 2.5 | 3.0 | — | V | $V_{CC}$ = 4.75 V, $V_{IL}$ = 0.8 V<br>$V_{IH}$ = 2 V, $I_{OH}$ = –40 mA |
| | $V_{OL}$ | | –0.25 | 0.5 | | $V_{CC}$ = 4.75 V, $V_{IL}$ = 0.8 V<br>$V_{IH}$ = 2 V, $I_{OL}$ = 40 mA |
| Output Clamp Voltage | $V_{OK}$ | — | –1.1 | –1.5 | V | $V_{CC}$ = 5.25 V, $I_O$ = –40 mA |
| Differential Output Voltage | $V_{OD1}$ | — | 3.5 | 2 $V_{OD2}$ | V | $V_{CC}$ = 5.25 V, $I_O$ = 0 |
| | $V_{OD2}$ | — | 2 | 3.0 | | $V_{CC}$ = 4.75 V, $R_L$ = 100 Ω*[1] |
| Change In Magnitude Of Differential Output Voltage*[2] | $\Delta \lvert V_{OD} \rvert$ | — | 0.02 | 0.4 | V | $V_{CC}$ = 4.75 V, $R_L$ = 100 Ω*[1] |
| Common-mode Output | $V_{OC}$ | — | 1.8 | 3 | V | $V_{CC}$ = 5.25 V, $R_L$ = 100 Ω*[1] |
| Voltage*[3] | | — | 1.5 | 3 | | $V_{CC}$ = 4.75 V, $R_L$ = 100 Ω*[1] |

## Electrical Characteristics (Ta = 0 to 70°C) (cont)

| Item | Symbol | Min | Typ*[1] | Max | Unit | Conditions |
|---|---|---|---|---|---|---|
| Change In Magnitude Of Differential Output Voltage*[2] | $\Delta \lvert V_{OC} \rvert$ | — | 0.01 | 0.4 | V | $V_{CC}$ = 4.75 V or 5.25 V |
| Output Current With Power Off | $I_O$ | — | 0.1 | 100 | µA | $V_{CC}$ = 0 V, $V_O$ = 6 V |
| | | — | –0.1 | –100 | | $V_{CC}$ = 0 V, $V_O$ = –0.25 V |
| | | — | — | ±100 | | $V_{CC}$ = 0 V, $V_O$ = –0.25 V to 6 V |
| Off State (High Impedance State) Output Current | $I_{OZ}$ | — | — | ±10 | µA | $V_{CC}$ = 5.25 V<br>Output Control 0.8 V<br>Ta = 25°C, $V_O$ = 0 to $V_{CC}$ |
| | | — | — | –20 | | $V_{CC}$ = 5.25 V<br>Output Control 0.8 V,<br>Input Ta=70°C, $V_O$ = 0 V |
| | | — | — | ±20 | | $V_{CC}$ = 5.25 V<br>Output Control 0.8 V,<br>Input Ta=70°C, $V_O$ = 0.4 V |
| | | — | — | ±20 | | $V_{CC}$ = 5.25 V<br>Output Control 0.8 V,<br>Input Ta=70°C, $V_O$ = 2.4 V |
| | | — | — | 20 | | $V_{CC}$ = 5.25 V<br>Output Control 0.8 V,<br>Input Ta=70°C, $V_O$ = $V_{CC}$ |
| Input Current | $I_I$ | — | — | 1 | mA | $V_{CC}$ = 5.25 V, $V_I$ = 5.5 V |
| | $I_{IH}$ | — | — | 40 | µA | $V_{CC}$ = 5.25 V, $V_I$ = 2.4 V |
| | $I_{IL}$ | — | –1 | –1.6 | mA | $V_{CC}$ = 5.25 V, $V_I$ = 0.4 V |
| Short Circuit Output Current*[4] | $I_{OS}$ | –40 | –90 | –150 | mA | $V_{CC}$ = 5.25 V |
| Supply Current | $I_{CC}$ | — | 47 | 65 | mA | $V_{CC}$ = 5.25 V<br>No Load,<br>Inputs Grounded Ta = 25°C |

Notes:
1. All typical values are at $V_{CC}$ = 5 V, Ta = 25°C.
2. $\Delta \lvert V_{OD} \rvert$ and $\Delta \lvert V_{OC} \rvert$ are the changes in magnitudes of $V_{OD}$ and $V_{OC}$, respectively, that occur when the input is changed from a high level to a low level.
3. In EIA standard RS-422A, $V_{OC}$, which is the average of the two output voltages with respect to ground, is called output offset voltage, $V_{OS}$.
4. Only one output should be shorted at a time, and duration of the short circuit should not exceed one second.




Note: 1. Differential and common mode output voltages.

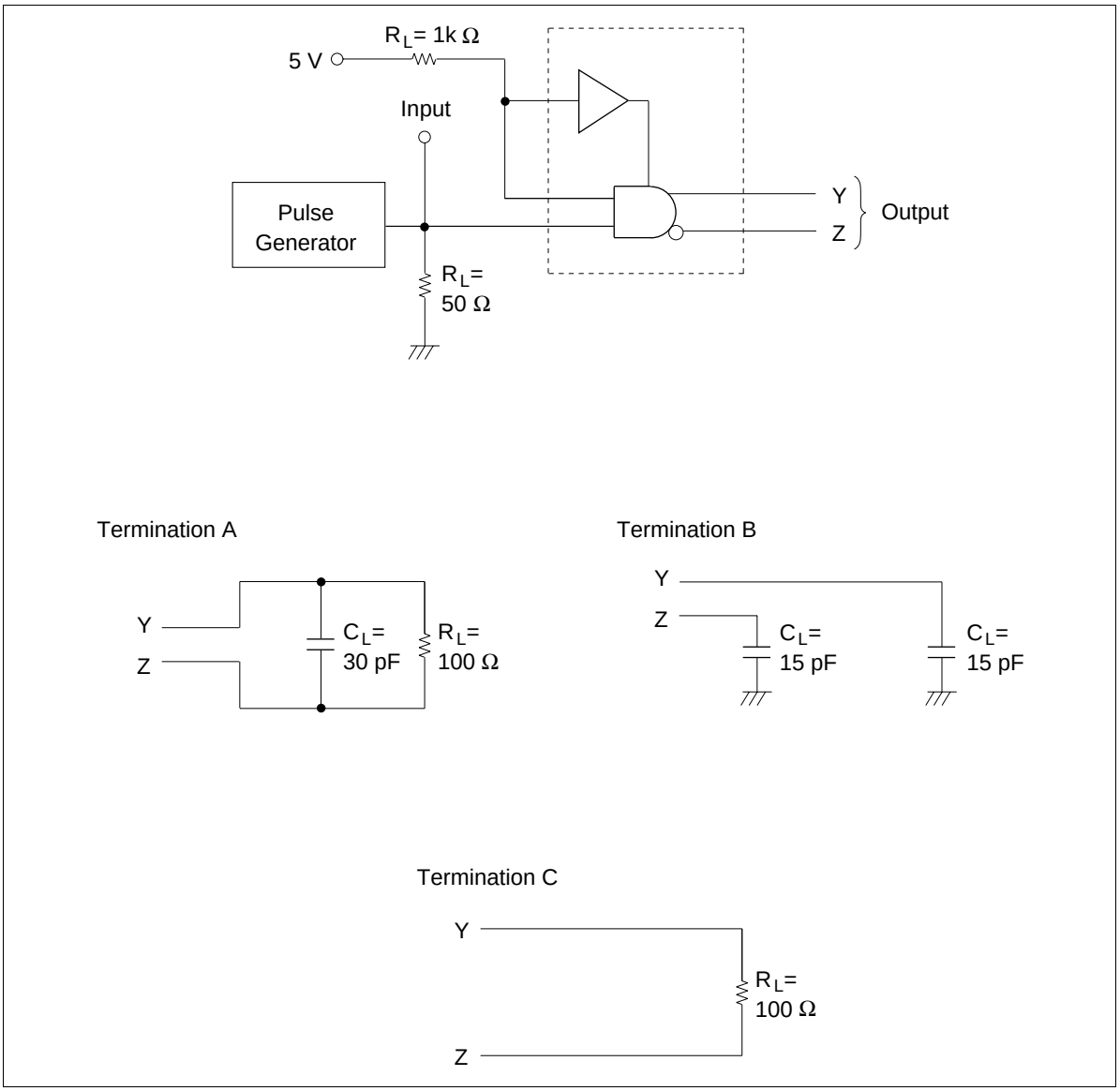
## Switching Characteristics ($V_{CC}$ = 5.0 V, Ta = 25°C)

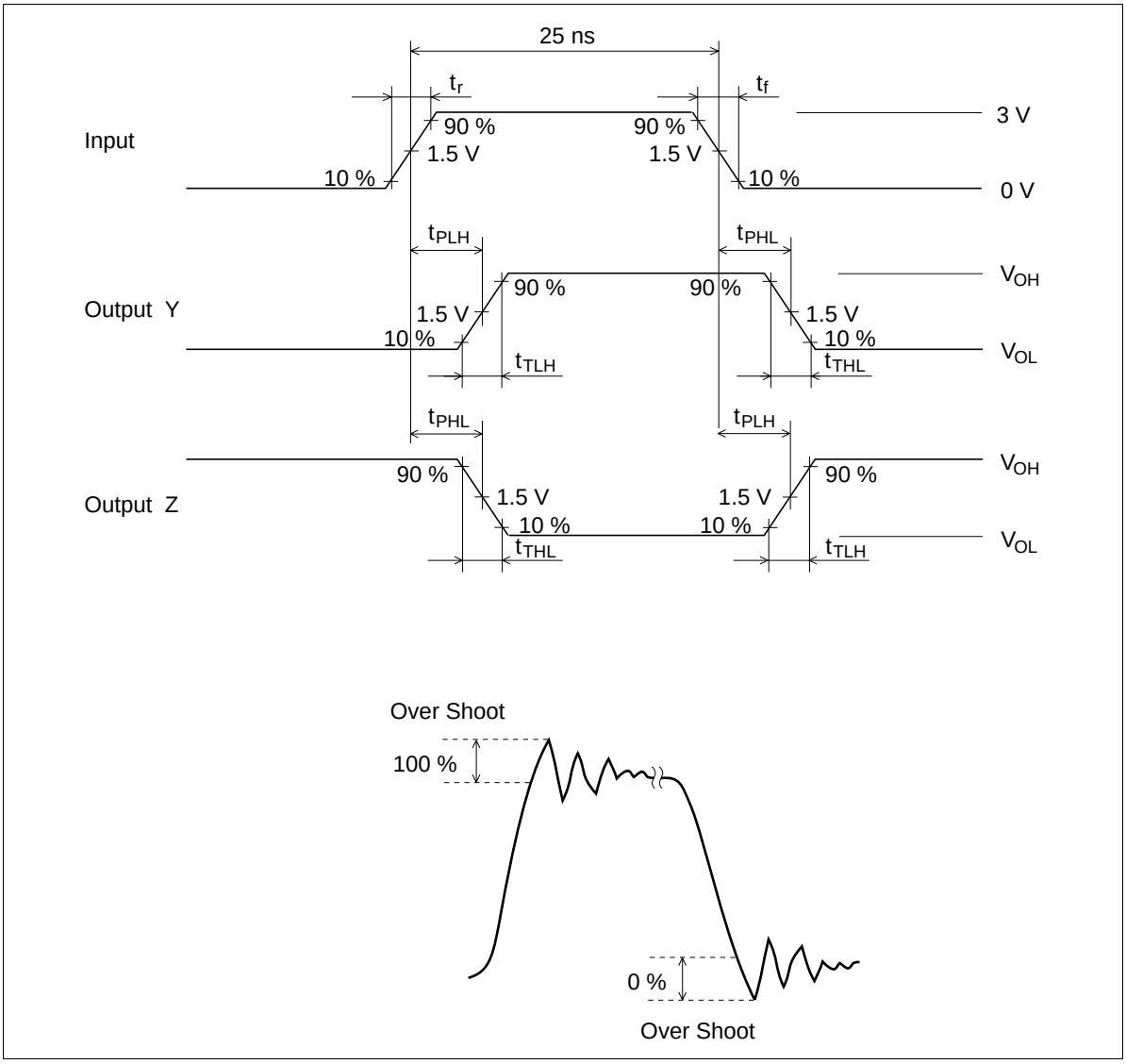
| Item | Symbol | Min | Typ | Max | Unit | Test Circuit | Conditions |
|---|---|---|---|---|---|---|---|
| Propagation Delay Time | $t_{PLH}$ | — | 16 | 25 | ns | 1 | $C_L$ = 30 pF, $R_L$ = 100 Ω |
| | $t_{PHL}$ | — | 11 | 20 | | Termination A | |
| | $t_{PLH}$ | — | 13 | 20 | | 1 | $C_L$ = 15 pF |
| | $t_{PHL}$ | — | 9 | 15 | | Termination B | |
| Transition Time | $t_{TLH}$ | — | 4 | 20 | | 1 | $C_L$ = 30 pF, $R_L$ = 100 Ω |
| | $t_{THL}$ | — | 4 | 20 | | Termination A | |
| Output Enable Time | $t_{ZH}$ | — | 7 | 20 | | 2 | $C_L$ = 30 pF, $R_L$ = 180 Ω |
| | $t_{ZL}$ | — | 14 | 40 | | 3 | $C_L$ = 30 pF, $R_L$ = 250 Ω |
| Output Disable Time | $t_{HZ}$ | — | 10 | 30 | | 2 | $C_L$ = 30 pF, $R_L$ =180 Ω |
| | $t_{LZ}$ | — | 17 | 35 | | 3 | $C_L$ = 30 pF, $R_L$ = 250 Ω |
| Overshoot Output Factor | | — | — | 10 | % | 1 Termination C | $R_L$ = 100 Ω |

## Switching Time Test Method

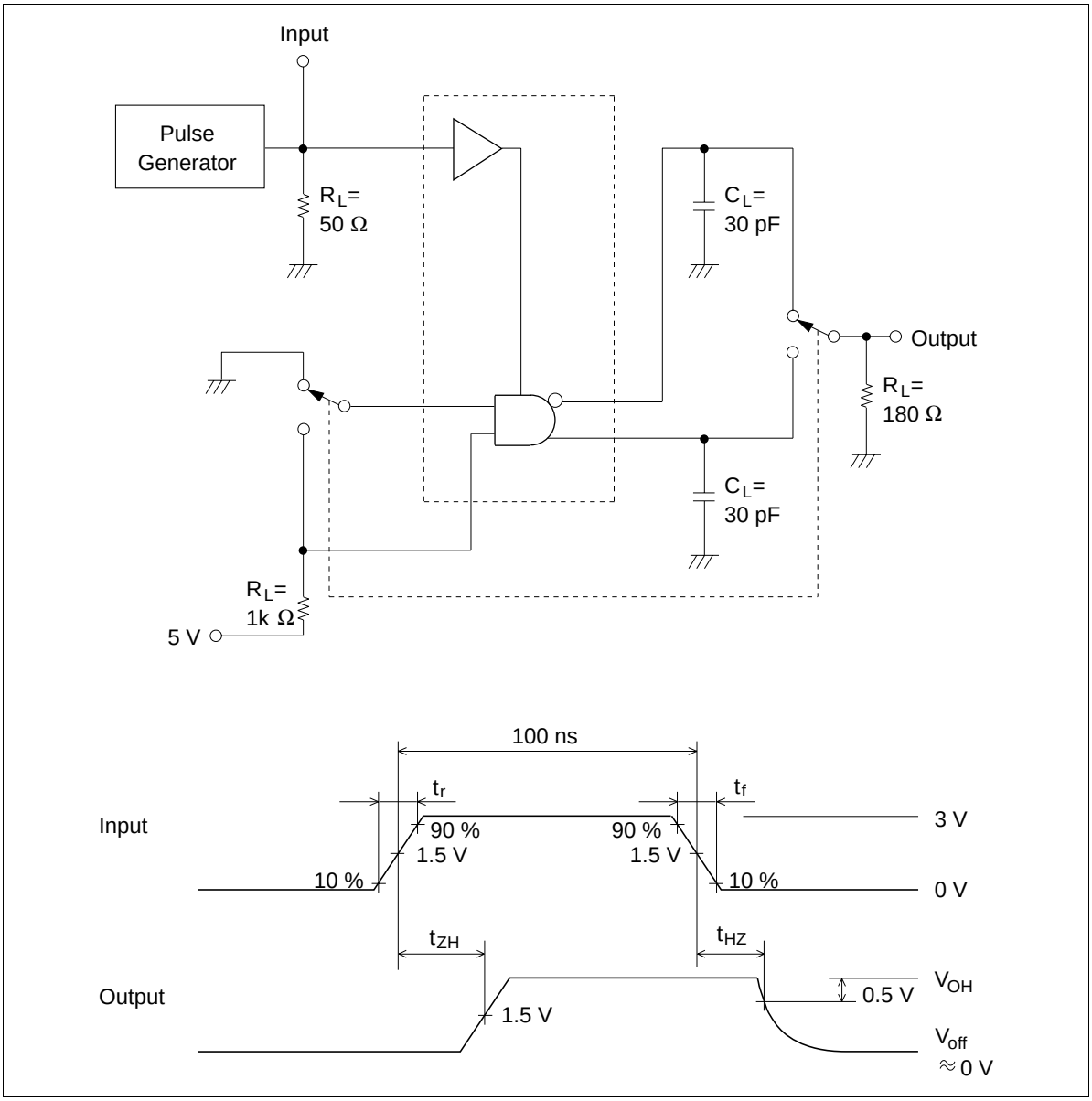
### Test Circuit

**1. $t_{PLH}$, $t_{PHL}$, $t_{TLH}$, $t_{THL}$, and overshoot factor**

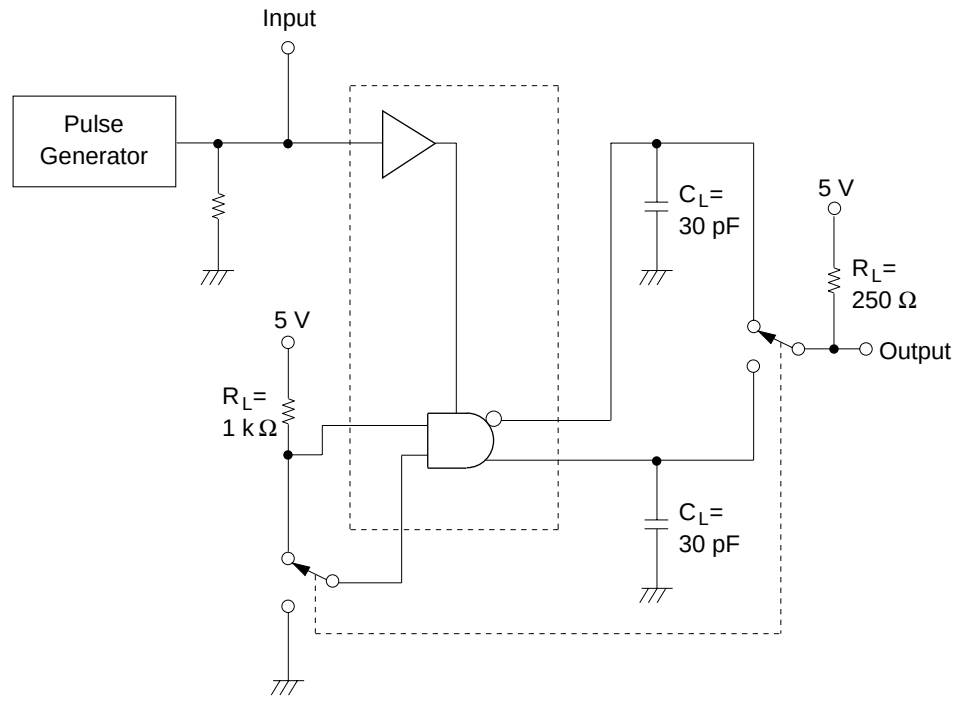


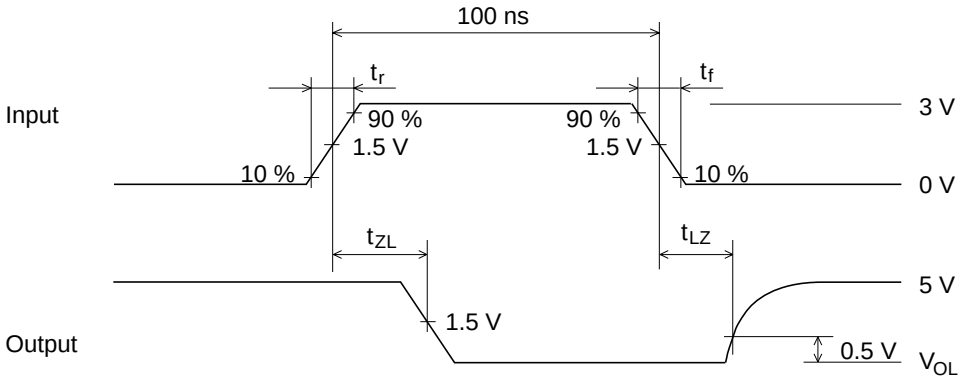


**2. $t_{ZH}$, $t_{HZ}$**



**3. $t_{ZL}$, $t_{LZ}$**

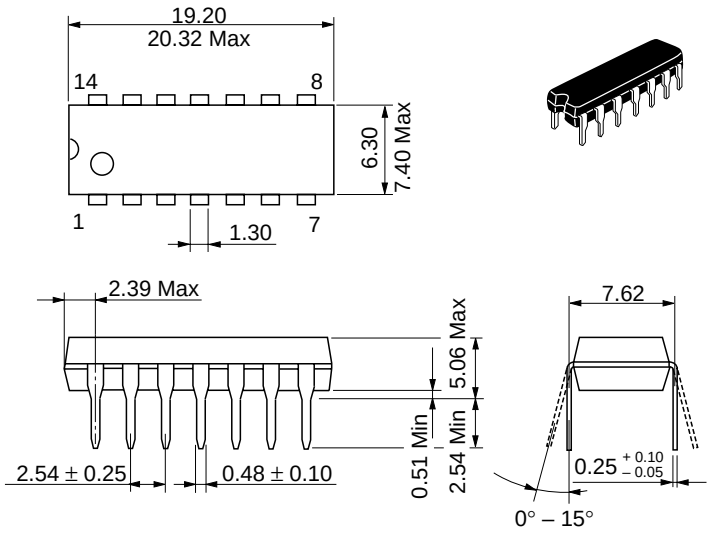



Notes:
1. The pulse generator has the following characteristics:
   Zout = 50 Ω, PRR = 500 kHz
2. $C_L$ includes probe and jig capacitance.

## Package Dimensions

Unit: mm




| | |
|---|---|
| Hitachi Code | DP-14 |
| JEDEC | Conforms |
| EIAJ | Conforms |
| Mass (reference value) | 0.97 g |

## Cautions

1. Hitachi neither warrants nor grants licenses of any rights of Hitachi's or any third party's patent, copyright, trademark, or other intellectual property rights for information contained in this document. Hitachi bears no responsibility for problems that may arise with third party's rights, including intellectual property rights, in connection with use of the information contained in this document.
2. Products and product specifications may be subject to change without notice. Confirm that you have received the latest product standards or specifications before final design, purchase or use.
3. Hitachi makes every attempt to ensure that its products are of high quality and reliability. However, contact Hitachi's sales office before using the product in an application that demands especially high quality and reliability or where its failure or malfunction may directly threaten human life or cause risk of bodily injury, such as aerospace, aeronautics, nuclear power, combustion control, transportation, traffic, safety equipment or medical equipment for life support.
4. Design your application so that the product is used within the ranges guaranteed by Hitachi particularly for maximum rating, operating supply voltage range, heat radiation characteristics, installation conditions and other characteristics. Hitachi bears no responsibility for failure or damage when used beyond the guaranteed ranges. Even within the guaranteed ranges, consider normally foreseeable failure rates or failure modes in semiconductor devices and employ systemic measures such as fail-safes, so that the equipment incorporating Hitachi product does not cause bodily injury, fire or other consequential damage due to operation of the Hitachi product.
5. This product is not designed to be radiation resistant.
6. No one is permitted to reproduce or duplicate, in any form, the whole or part of this document without written approval from Hitachi.
7. Contact Hitachi's sales office for any questions regarding this document or Hitachi semiconductor products.

HITACHI

**Hitachi, Ltd.**
Semiconductor & Integrated Circuits.
Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan
Tel: Tokyo (03) 3270-2111 Fax: (03) 3270-5109

URL
NorthAmerica : http://semiconductor.hitachi.com/
Europe : http://www.hitachi-eu.com/hel/ecg
Asia : http://sicapac.hitachi-asia.com
Japan : http://www.hitachi.co.jp/Sicd/indx.htm

**For further information write to:**

Hitachi Semiconductor (America) Inc.
179 East Tasman Drive,
San Jose,CA 95134
Tel: <1> (408) 433-1990
Fax: <1>(408) 433-0223

Hitachi Europe GmbH
Electronic Components Group
Dornacher Straβe 3
D-85622 Feldkirchen, Munich
Germany
Tel: <49> (89) 9 9180-0
Fax: <49> (89) 9 29 30 00

Hitachi Europe Ltd.
Electronic Components Group.
Whitebrook Park
Lower Cookham Road
Maidenhead
Berkshire SL6 8YA, United Kingdom
Tel: <44> (1628) 585000
Fax: <44> (1628) 585160

Hitachi Asia Ltd.
Hitachi Tower
16 Collyer Quay #20-00,
Singapore 049318
Tel : <65>-538-6533/538-8577
Fax : <65>-538-6933/538-3877
URL : http://www.hitachi.com.sg

Hitachi Asia Ltd.
(Taipei Branch Office)
4/F, No. 167, Tun Hwa North Road,
Hung-Kuo Building,
Taipei (105), Taiwan
Tel : <886>-(2)-2718-3666
Fax : <886>-(2)-2718-8180
Telex : 23222 HAS-TP
URL : http://www.hitachi.com.tw

Hitachi Asia (Hong Kong) Ltd.
Group III (Electronic Components)
7/F., North Tower,
World Finance Centre,
Harbour City, Canton Road
Tsim Sha Tsui, Kowloon,
Hong Kong
Tel : <852>-(2)-735-9218
Fax : <852>-(2)-730-0281
URL : http://www.hitachi.com.hk


Colophon 2.0

HITACHI