HD26LS32

Quadruple Differential Line Receivers With 3 State Outputs

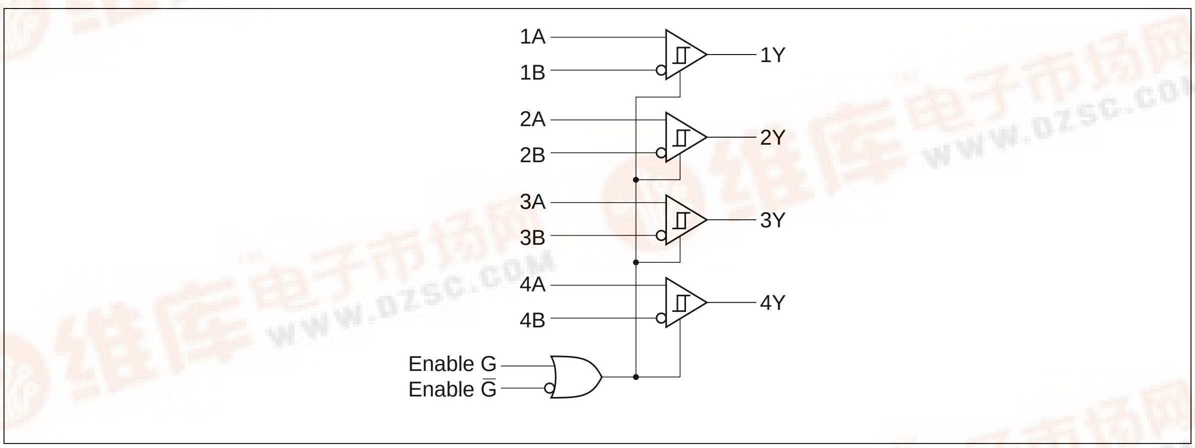
HITACHI

ADE-205-577 (Z)
1st. Edition
Dec. 2000

Description

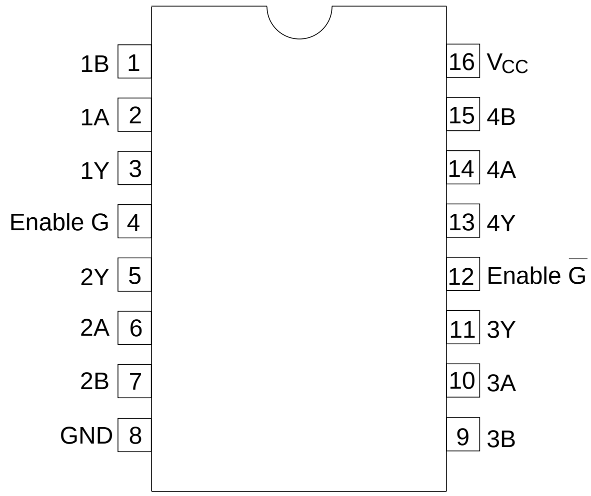
The HD26LS32 features quadruple line receivers designed to meet the specs of EIA standard RS-422A and RS-423. This device operates from a single 5 V power supply. The enable function is common to all four receivers and offers a choice of active high or active low input. Fail safe design ensures that if the inputs are open, the outputs will always be high.

Logic Diagram



Hitachi semiconductor

Pin Arrangement



(Top view)

Function Table

Differential Input	Enable		Output
A – B	**G**	**$\overline{G}$**	**Y**
$V_{ID} \geq V_{TH}$	H	X	H
	X	L	H
$V_{TL} < V_{ID} < V_{TH}$	H	X	?
	X	L	?
$V_{ID} \leq V_{TL}$	H	X	L
	X	L	L
X	L	H	Z

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

Absolute Maximum Ratings

Item	Symbol	Ratings	Unit
Supply Voltage	V_{CC}*[1]	7.0	V
In Phase Input Voltage	V_{IC}	±25	V
Differential Input Voltage	V_{ID}*[2]	±25	V
Enable Input Voltage	V_{IN}	7	V
Output Sink Current	Iout	50	mA
Continuous Total Dissipation	P_T	1	W
Operating Temperature Range	Topr	0 to +70	°C
Storage Temperature Range	Tstg	–65 to 150	°C

Notes:
1. All voltage values except for differential input voltage are with respect to network ground terminal.
2. Differential input voltage is measured at the noninverting input with respect to the corresponding inverting onput.
3. 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
In Phase Input Voltage	V_{IC}	—	—	±7.0	V
Output Current	I_{OH}	—	—	–440	µA
	I_{OL}	—	—	8	mA
Operating Temperature	Topr	0	—	70	°C

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

Item	Symbol	Min	Typ*1	Max	Unit	Conditions	
Differential Input High Threshold Voltage	V_{TH}	—	—	0.2	V	V_{IC} = –7 to +7 V	V_{OH} = 2.7 V, I_{OH} = –440 µA
Differential Input Low Threshold Voltage	V_{TL}	—	—	–0.2			V_{OL} = 0.4 V, I_{OL} = 4 mA
		—	—	–0.2			V_{OL} = 0.45 V, I_{OL} = 8 mA
Input Hysteresis*2	$V_{TH} – V_{TL}$	—	30	—	mV		
Enable Input Voltage	V_{IH}	2.0	—	—	V		
	V_{IL}	—	—	0.8			
Enable Input Clamp Voltage	V_{IK}	—	—	1.5		V_{CC} = 4.75 V, I_{IN} = –18 mA	
Output Voltage	V_{OH}	2.7	—	—		V_{CC} = 4.75 V	V_{ID} = 1 V, I_{OH} = –440 µA
	V_{OL}	—	—	0.4		V_{IL} ($\overline{G}$) = 0.8 V	V_{ID} = –1 V, I_{OL} = 4 mA
		—	—	0.45			V_{ID} = –1 V, I_{OL} = 8 mA
Off State (High Impedance) Output Current	I_{OZ}	—	—	20	µA	V_{CC} = 5.25 V	V_O = 2.4 V
		—	—	–20			V_O = 0.4 V
Line Input Current	I_I	—	—	2.3	mA	V_I = 15 V, Other Inputs –10 to +15 V	
		—	—	2.8		V_I = –15 V, Other Inputs –15 to +10 V	
Enable Input Current	I_I (EN)	—	—	100	µA	V_I = 5.5 V	
	I_{IH}	—	—	20		V_I = 2.7 V	
	I_{IL}	—	—	–0.36	mA	V_I = 0.4 V	
Input Resistance	ri	6	9.8	—	kΩ	V_{IC} = –15 to +15 V (Other Inputs AC GND)	
Short Circuit Output Current	I_{OS}*3	–15	—	–85	mA	V_{CC} = 5.25 V	
Supply Current	I_{CC}	—	52	70		V_{CC} = 5.25 V, V_I = 0 V (All Outputs Disable)	

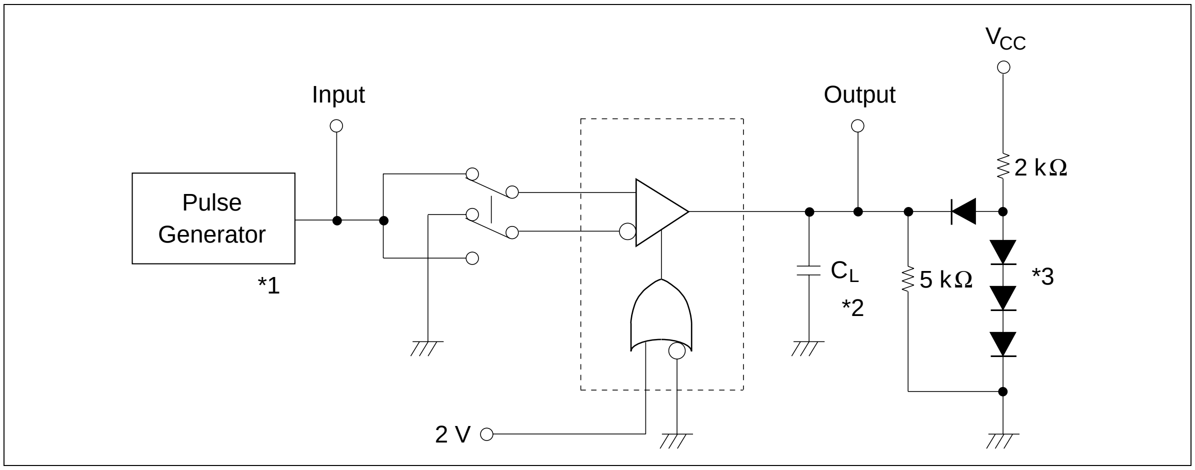
Notes: 1. All typical values are at V_{CC} = 5 V, Ta = 25°C,VIC = 0.
2. Hysteresis is the differential between the positive going input threshold voltage and the negative going input threshold voltage.
3. Not more than one output should be shorted at a time.

Switching Characteristics (V_{CC} = 5 V, Ta = 25°C)

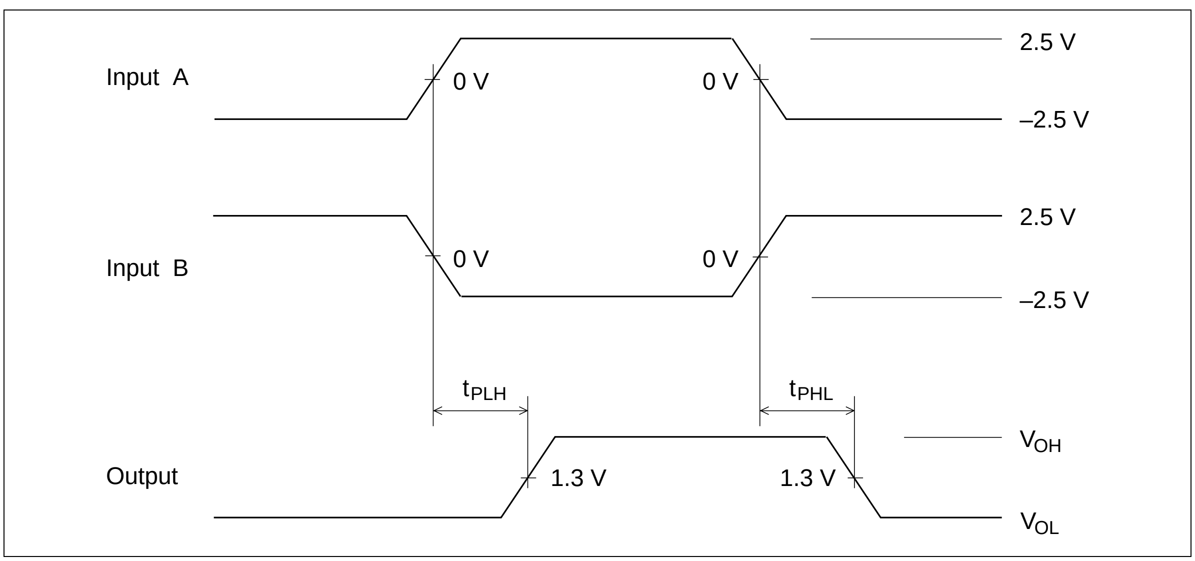
TItem	Symbol	Min	typ	Max	Unit	Conditions
Propagation Delay Time	t_{PLH}, t_{PHL}	—	17	25	ns	C_L = 15 pF
Output Enable Time	t_{ZH}, t_{ZL}	—	15	22		
Output Disable Time	t_{HZ}	—	15	22		C_L = 5 pF
	t_{LZ}	—	20	30		

1. t_{PLH}, t_{PHL}

Test circuit

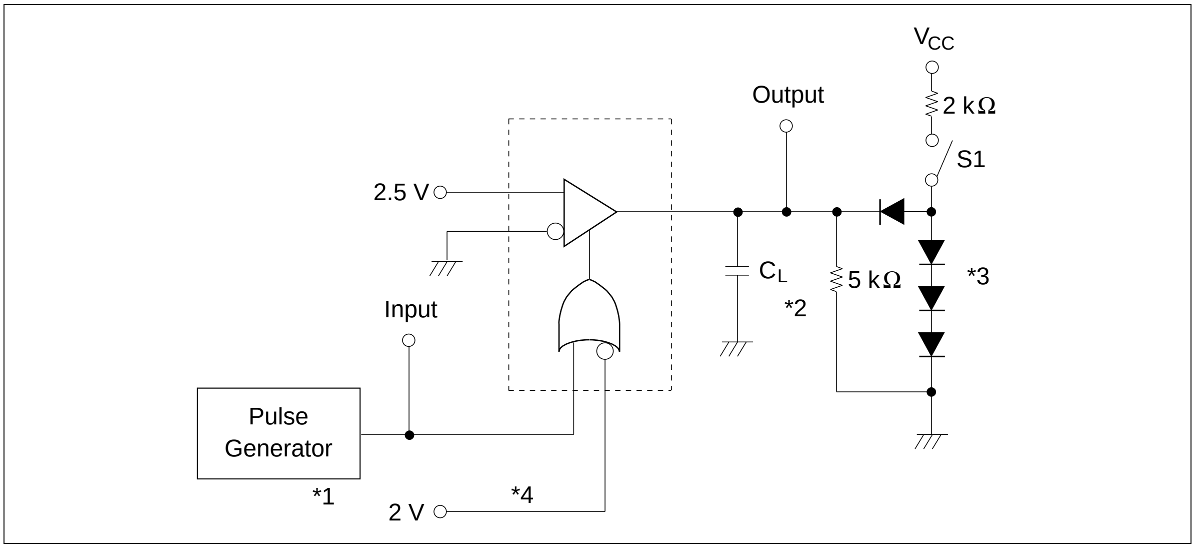


Waveforms

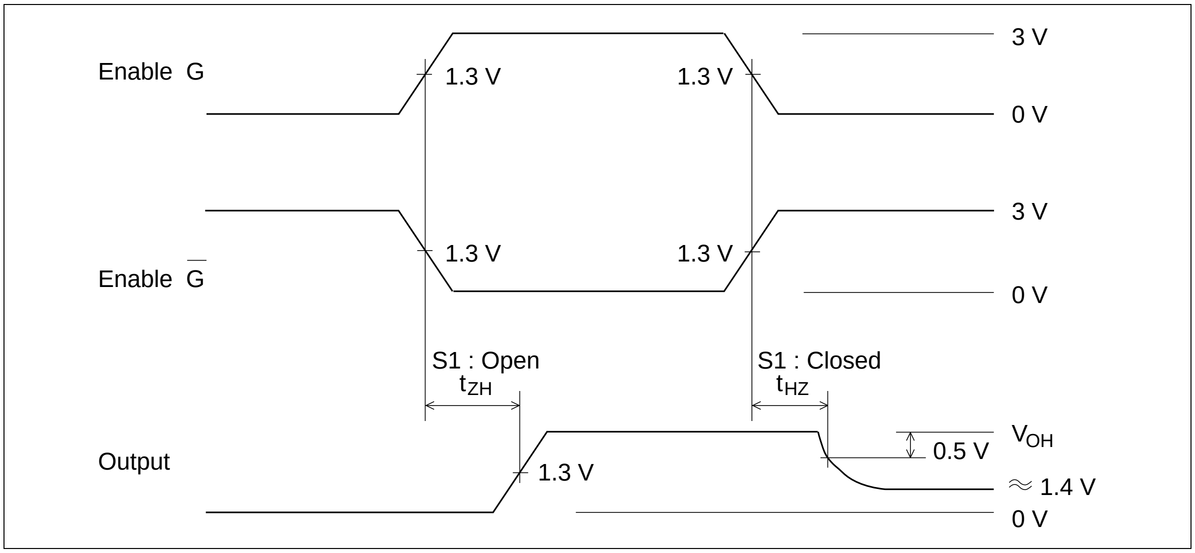


2. t_{HZ}, t_{ZH}

Test circuit

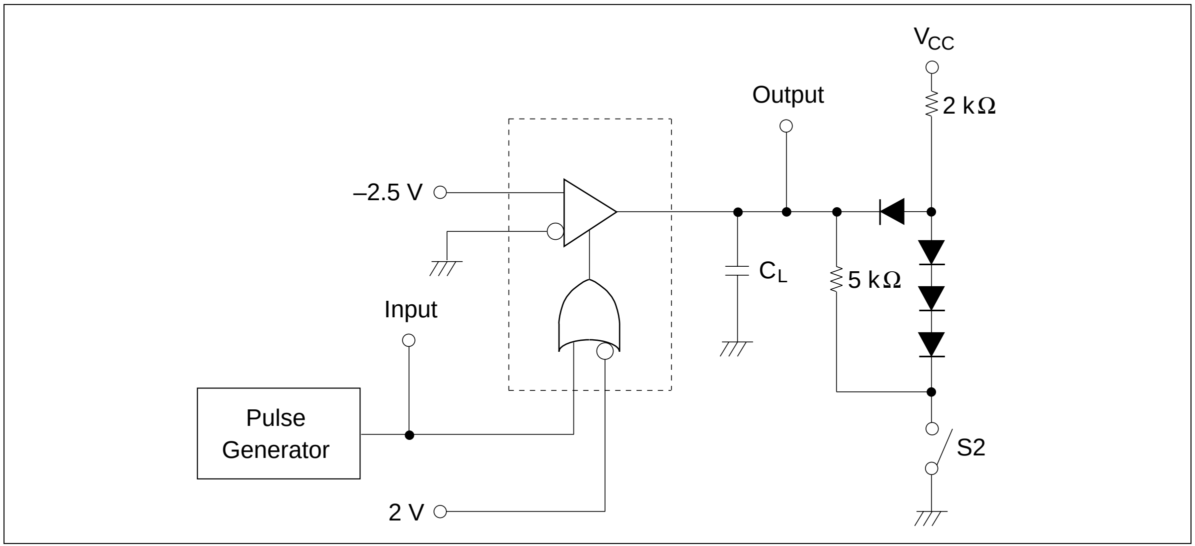


Waveforms

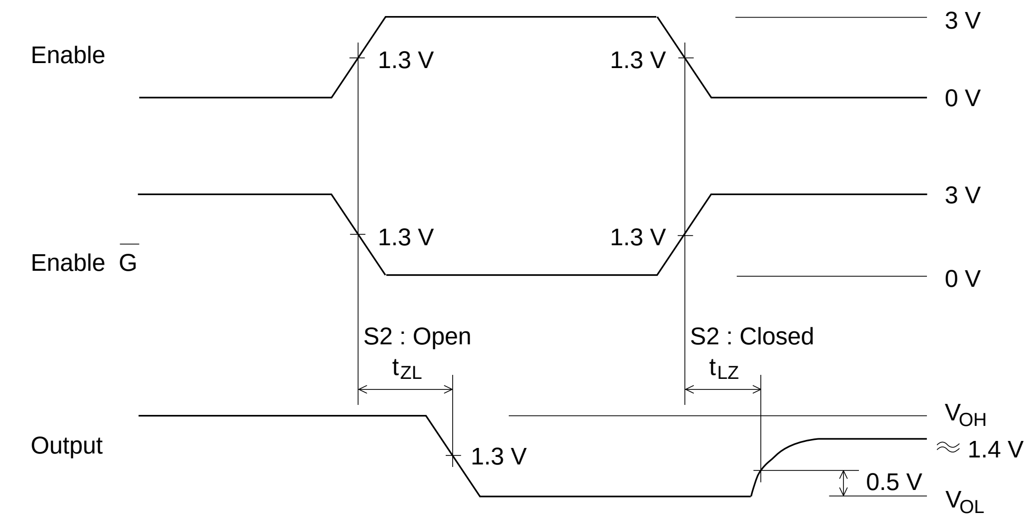


3. t_{LZ}, t_{ZL}

Test circuit



Waveforms



Notes: 1. The pulse generator has the following characteristics :
PRR = 1 MHz, 50 % duty cycle, $t_r \le 15$ ns, $t_f \le 6$ ns, Zout = 50 Ω.
2. C_L includes probe and jig capacitance.
3. All diodes are 1S2074 (H)
4. To test G input,ground G input and apply an inverted input waveform.

HD26LS32 Line Receiver Applications

The HD26LS32 is a line receiver that meets the EIA RS-422A and RS-423A conditions. It has a high in-phase input voltage range, both positive and negative, enabling highly reliable transmission to be performed even in noisy environments.

Its main features are listed below.

- Operates on a single 5 V power supply.
- Three-state output
- On-chip fail-safe circuit
- ±7 V in-phase input voltage range
- ±200 mV input sensitivity
- Minimum 6 k input resistance

A block diagram is shown in figure 1. The enable function is common to all four drivers, and either active-high or active-low input can be selected.

When exchange is carried out using a party line system, it is better to keep the receiver input bias current constituting the driver load small, as this allows more receivers to be connected.

Consequently, whereas an input resistance of 4 k or above is stipulated in RS-422A and RS-423A, the HD26LS32 has been designed to allow a greater margin, with a minimum resistance of 6 k .

Figure 2 shows the input current characteristics of the HD26LS32.

The shaded areas in the graph indicate the input current allowable range stipulated in RS-422A and RS-423A.

HD26LS32 output is LS-TTL compatible and has a three-state function, enabling the output to be placed in the high-impedance state, and so making the device suitable for bus line type applications.

With an in-phase input voltage range of ±7 V and a ±200 mV input sensitivity, the HD26LS32 can withstand use in noisy environments.

Also, since signals sent over a long-distance transmission line require a long transition time, it also takes a long time to cross the receiver’s input threshold level.

Therefore, the input is provided with hysteresis of around 30 mV to prevent receiver output misoperation due to noise.

An example of input hysteresis is shown in figure 3.

The fail-safe function consists of resistances R connecting input A to V_{CC} and input B to GND, as shown in figure 4.

This circuit provides for the receiver input section to be pulled up or down by a high resistance that prevents it from becoming a driver load so that the output goes high in the event of a transmission line breakage or connector detachment.

When the input pin is placed in the open state by the pull-up/pull-down resistance, the differential input voltage V_{ID} is as follows:

$$V_{ID}: (V_{IA} - V_{IB}) \geq 0.2\ V$$

and the output is fixed high.

However, if the receiver-side termination resistance remains connected despite a line breakage or connector detachment, the output will be undetermined (figure 5).

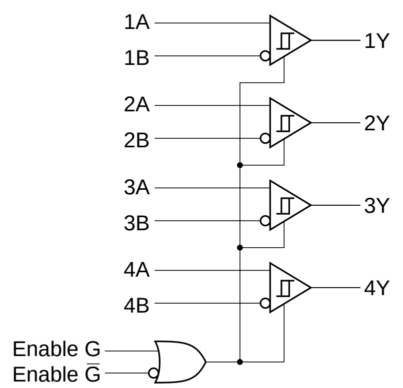


Figure 1 HD26LS32 Block Diagram

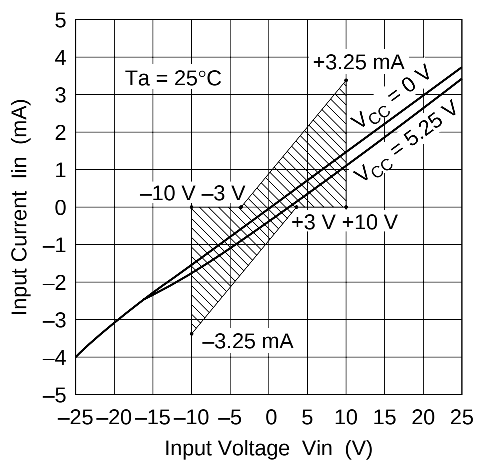


Figure 2 Input Voltage vs. Input Current Characteristics

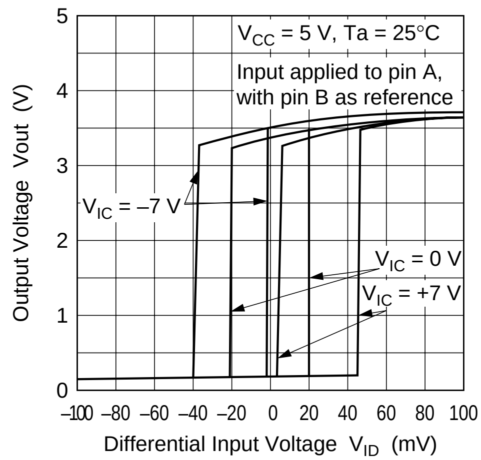


Figure 3 Differential Input Voltage vs. Output Voltage Characteristics

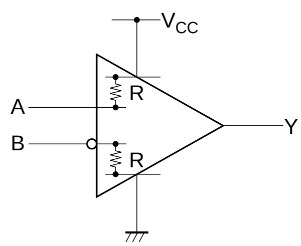


Figure 4 Fail-Safe Function

This is because, since the termination resistance is normally matched to the transmission line characteristic impedance, the value falls to several tens of hundreds of ohms, and the differential input pins are shorted by this termination resistance. That is, the differential input voltage V_{ID} comes within the range

V_{ID}: $-0.2\ V < V_{IA} - V_{IB} < 0.2\ V$

and the output becomes undetermined.

To prevent this, resistance R_1 is inserted in series with the transmission line as shown in figure 6, minimizing the effect of the termination resistance. Resistance R_2 is added to increase the current flowing between the termination resistance and R_1, enabling the value of R_1 to be kept small.

Inserting resistances R_1 and R_2 in this way provides for the differential input voltage V_{ID} to become 200 mV or higher, but the following points must be noted.

- Smallest possible R_1 value
  If this value is large, the receiver input sensitivity will fall.
- Largest possible R_2 value
  If this value is small, the load on the driver will be large.

Figure 7 shows experimental differential input voltages for variations in R_1 and R_2.

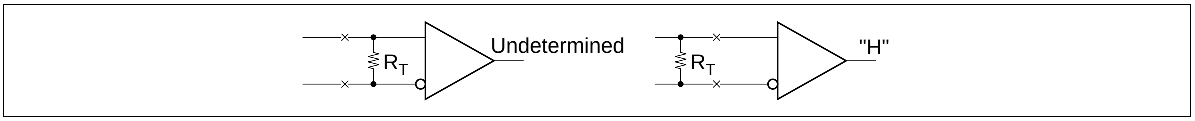


Figure 5 Examples of Transmission Line Disconnection

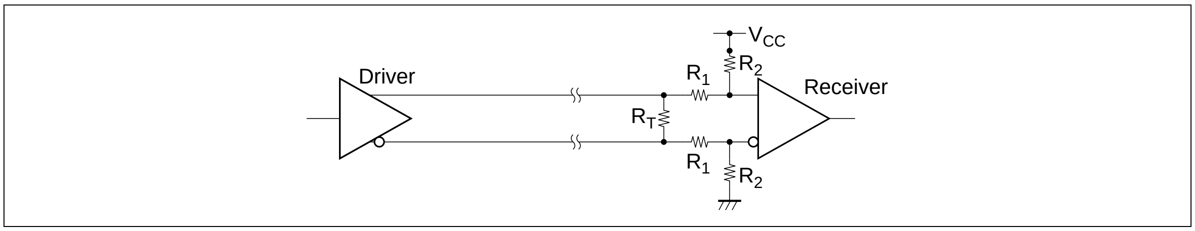


Figure 6 Method of Enhancing Fail-Safe Function

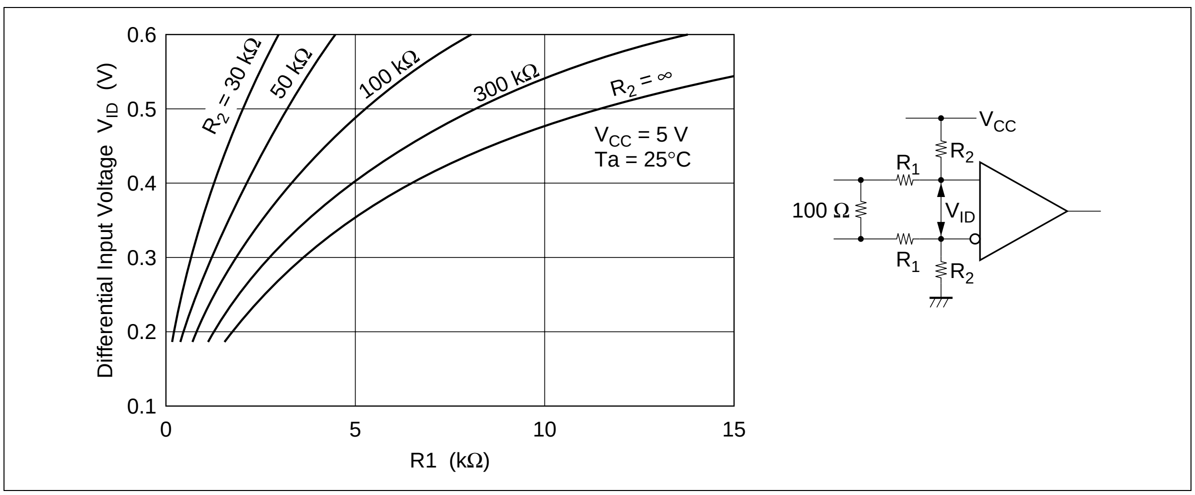


Figure 7 R_1, R_2 vs. Differential Input Voltage

RS-442A Interface Standard Applications

Figure 9 shows sample operation waveforms at various points with 1200 m and 12 m cable lengths.

1. Unidirectional Transmission (1 : 1 Configuration)

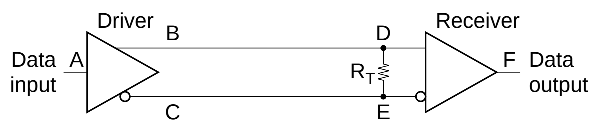


Figure 8 1 : 1 Unidirectional Transmission

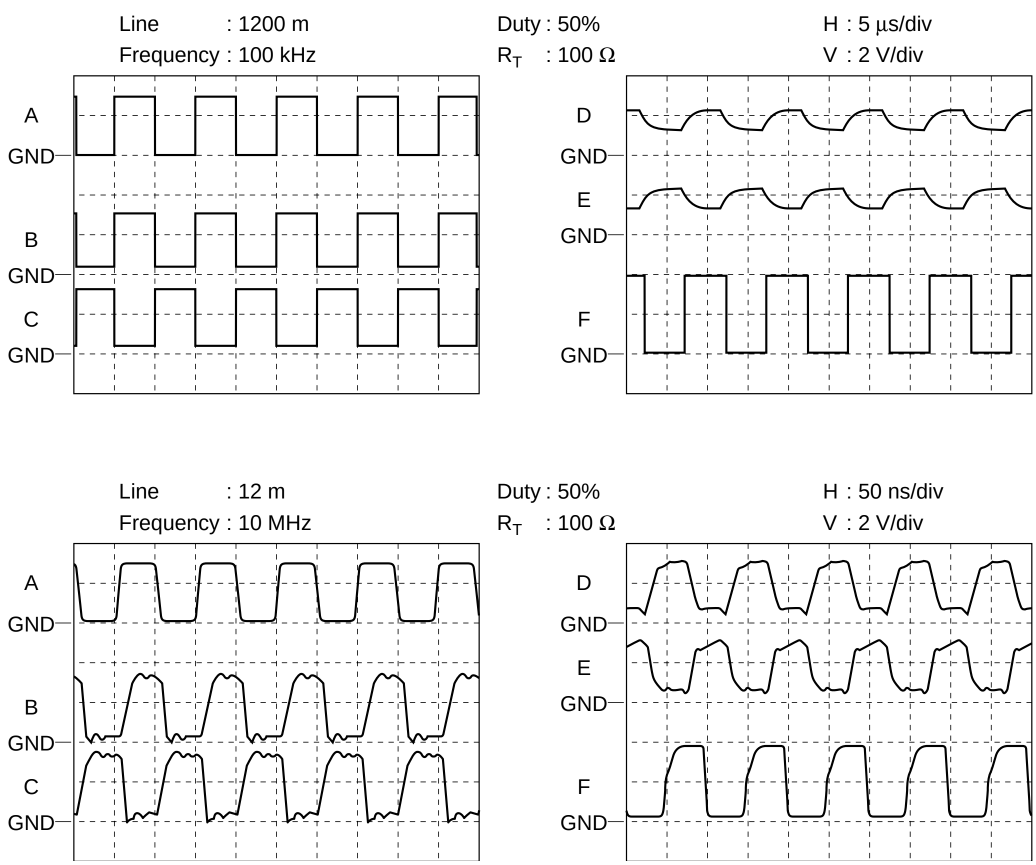


Figure 9 Sample Transmission Waveforms

2. Unidirectional Transmission (1 : n Configuration)

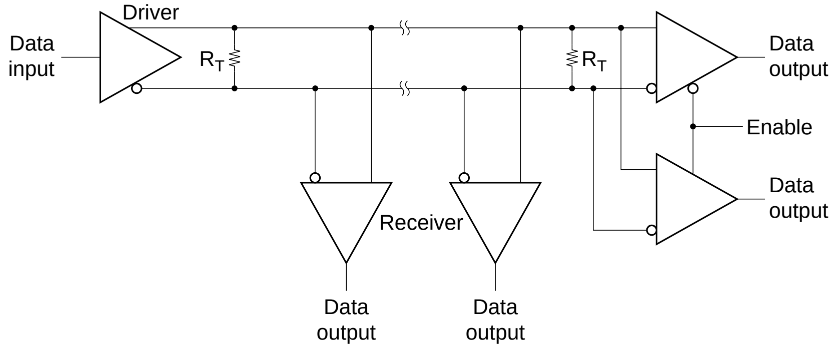


Figure 10 1 : n Unidirectional Transmission

With this connection method, n receivers are connected for one driver. In the RS-422A standard, ten receivers can be connected simultaneously for one driver.

Conversely, it is also possible to connect one receiver for n drivers.

3. Bidirectional Transmission

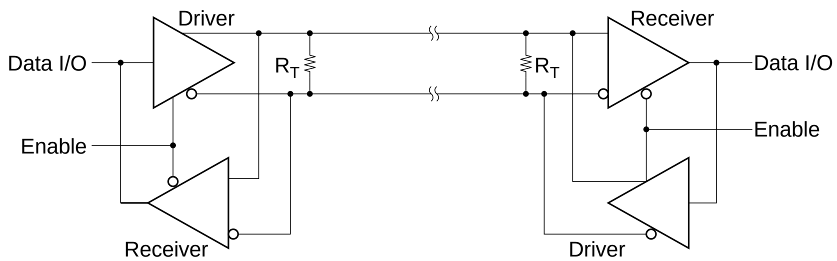


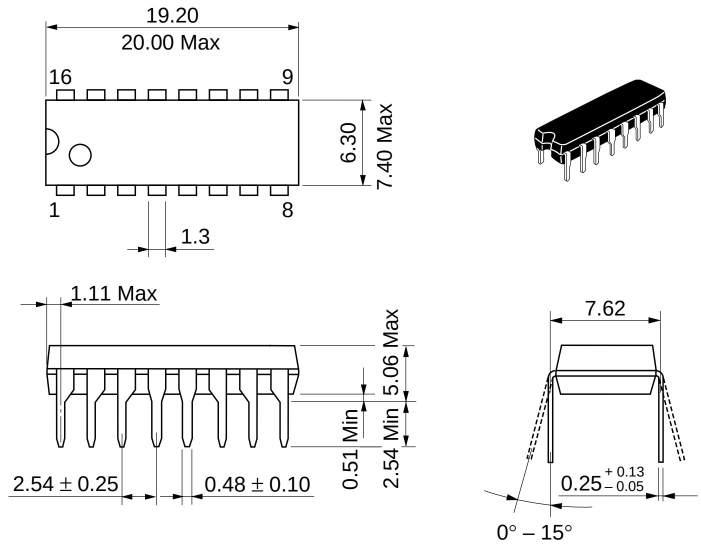
Figure 11 Bidirectional Transmission

When bidirectional data exchange is performed using a combination of the HD26LS31 and HD26LS32, since either high or low output control is possible, using complementary enable inputs for the driver and receiver makes it easy to configure the kind of combination illustrated in figure 11 .

Extending this combination makes it possible to exchange n-bit data simultaneously, and handle a party line system.

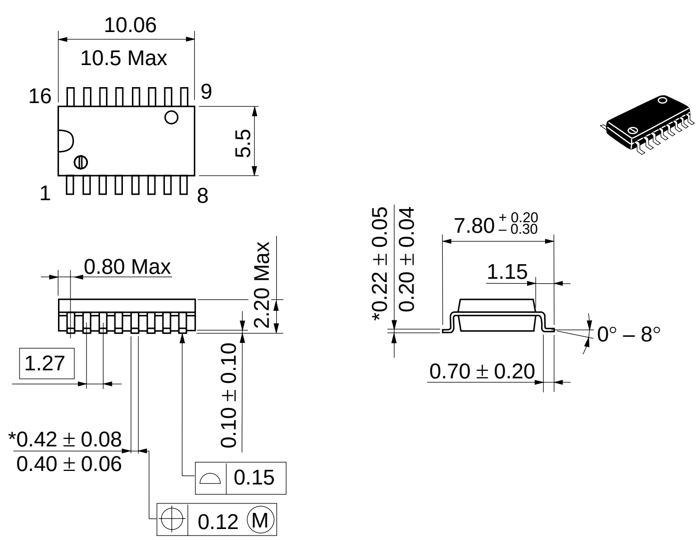
Package Dimensions

Unit: mm



Hitachi Code	DP-16
JEDEC	Conforms
EIAJ	Conforms
Mass (reference value)	1.07 g

Unit: mm



Hitachi Code	FP-16DA
JEDEC	—
EIAJ	Conforms
Mass (reference value)	0.24 g

*Dimension including the plating thickness
Base material dimension

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