

# HD29050

## Dual Differential Line Drivers/Receivers With 3 State Outputs

REJ03D0304-0300Z  
 (Previous ADE-205-034A (Z))  
 Rev.3.00  
 Jul.16.2004

### Description

The HD29050 features differential line drivers/receivers with three state output designed to meet the spec of EIA RS-422A and 423A. Each device has two drivers/receivers in a 16 pin package.

The device becomes in enable state when active high for a driver and active low for a receiver.

### Features

#### Driver

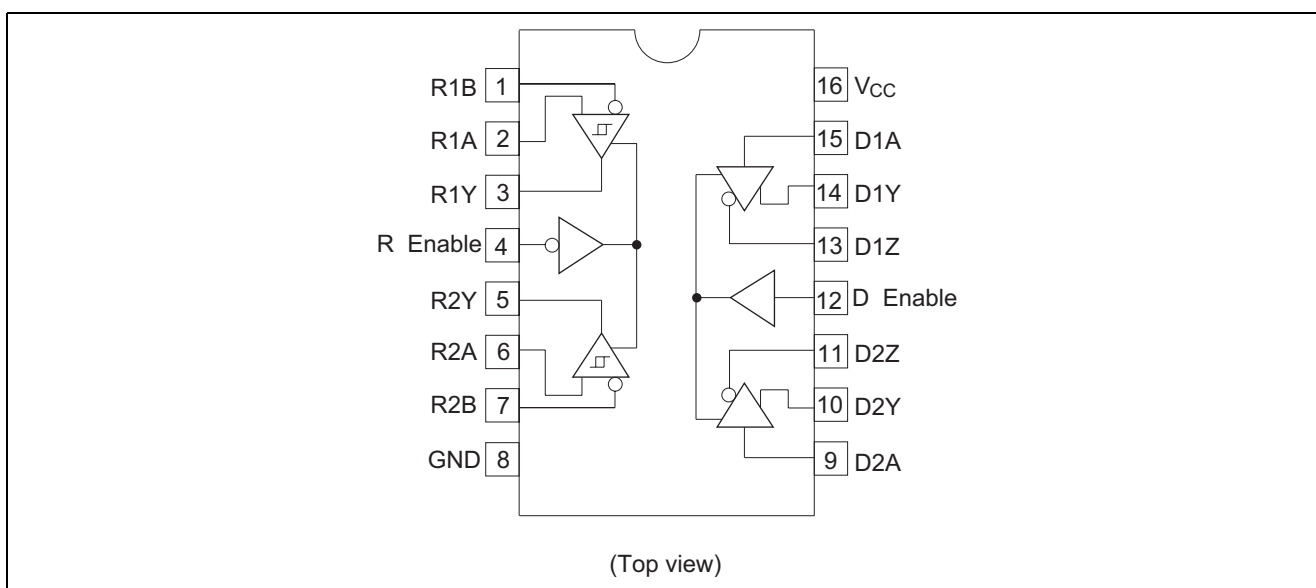
- Built in current restriction when short circuit
- Power up/down protection.
- High output current  $I_{OH} = -40 \text{ mA}$   
 $I_{OL} = 40 \text{ mA}$

#### Receiver

- Input hysteresis (Typ. 50 mV)
- In phase input voltage  $\pm 200 \text{ mV}$  of input sensitivity in the range  $-7$  to  $+12 \text{ V}$ .
- Ordering Information

Part Name	Package Type	Package Code	Package Abbreviation	Taping Abbreviation (Quantity)
HD29050P	DILP-16 pin	DP-16E, -16FV	P	—

### Pin Arrangement



## Function Table

Drivers				Receivers		
Input A	Enable	Output Y	Output Z	Differential Input A – B	Enable	Output Y
L	H	L	H	$V_{ID} \geq 0.2 \text{ V}$	L	H
H	H	H	L	$-0.2 \text{ V} < V_{ID} < 0.2 \text{ V}$	L	?
X	L	Z	Z	$V_{ID} \leq -0.2 \text{ V}$	H	Z
				X	H	Z

H : High level

L : Low level

Z : High impedance

X : Immaterial

? : Irrelevant

## Absolute Maximum Ratings

Item	Symbol	Ratings	Unit
Supply Voltage*1	$V_{CC}$	7	V
Input Voltage A, B*3	$V_{IN}$	$\pm 25$	V
Differential Input Voltage*2*3	$V_{ID}$	$\pm 25$	V
Output Current*3	$I_O$	50	mA
Enable Input Voltage	$V_{IE}$	5.5	V
Input Voltage*4	$V_{IN}$	5.5	V
Output Applied Voltage*4*5	$V_O$	-1.0 to 7.0	V
Operating Temperature Range	$T_{opr}$	0 to 70	°C
Storage Temperature Range	$T_{stg}$	-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 input.

3. Only receiver

4. Only driver

5. Z state

6. 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	5.0	5.25	V
In Phase Input Voltage*1	$V_{IC}$	-7.0	—	12	V
Differential Input Voltage*1	$V_{ID}$	-6.0	—	6.0	V
Enable Input Voltage	$V_{IE}$	0	—	5.25	V
Input Voltage*2	$V_{IN}$	0	—	5.25	V
Operating Temperature	$T_{opr}$	0	25	70	°C

Notes: 1. Only receiver

2. Only driver

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

**Driver**

Item	Symbol	Min	Typ	Max	Unit	Conditions
Input Voltage	$V_{IHD}$	2.0	—	—	V	
	$V_{ILD}$	—	—	0.8	V	
Input Clamp Voltage	$V_{IKD}$	—	—	-1.5	V	$V_{CC} = 4.75\text{ V}$ , $I_I = -18\text{ mA}$
Output Voltage	$V_{OHD}$	2.5	—	—	V	$V_{CC} = 4.75\text{ V}$ , $I_{OH} = -20\text{ mA}$
		2.4	—	—	V	$V_{CC} = 4.75\text{ V}$ , $I_{OH} = -40\text{ mA}$
	$V_{OLD}$	—	—	0.45	V	$V_{CC} = 4.75\text{ V}$ , $I_{OL} = 20\text{ mA}$
		—	—	0.5	V	$V_{CC} = 4.75\text{ V}$ , $I_{OL} = 40\text{ mA}$
Output Leak Current	$I_{OZD}$	-100	—	100	$\mu\text{A}$	$V_{CC} = 5.25\text{ V}$ , $V_O = 0.5\text{ V}$ , Enable = 0.8 V
		-100	—	100	$\mu\text{A}$	$V_{CC} = 5.25\text{ V}$ , $V_O = 2.7\text{ V}$ , Enable = 0.8 V
	$I_{O(Off)}$	—	—	-100	$\mu\text{A}$	$V_{CC} = 0\text{ V}$ , $V_O = -0.25\text{ V}$
		—	—	-100	$\mu\text{A}$	$V_{CC} = 0\text{ V}$ , $V_O = 6.0\text{ V}$
Input Current	$I_{ID}$	—	—	100	$\mu\text{A}$	$V_{CC} = 5.25\text{ V}$ , $V_I = 5.25\text{ V}$
	$I_{IHD}$	—	—	20	$\mu\text{A}$	$V_{CC} = 5.25\text{ V}$ , $V_I = 2.7\text{ V}$
	$I_{ILD}$	—	—	-360	$\mu\text{A}$	$V_{CC} = 5.25\text{ V}$ , $V_I = 0.4\text{ V}$
Differential Output Voltage	$\Delta  V_{OC} $	—	—	0.4	V	
	$ V_{OD2} $	2.0	—	—	V	
	$\Delta  V_{OD} $	—	—	0.4	V	
Short Circuit Output Current*1	$I_{OSD}$	-30	—	-150	mA	$V_{CC} = 5.25\text{ V}$ , $V_O = 0\text{ V}$

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

**Receiver**

Item	Symbol	Min	Typ	Max	Unit	Conditions
Differential Input Threshold Voltage*2	V <sub>THR</sub>	—	—	0.2	V	V <sub>O</sub> ≥ 2.7 V -7.0 V < V <sub>IC</sub> < 12 V
		-0.2	—	—	V	V <sub>O</sub> ≤ 0.45 V -7.0 V < V <sub>IC</sub> < 12 V
Input Current	I <sub>IBR</sub>	—	—	1.0	mA	V <sub>IN</sub> ≤ V <sub>I2</sub> V, 0 V V <sub>CC</sub> ≤ 5.25 V
		—	—	-0.8	mA	V <sub>IN</sub> ≤ V <sub>I7</sub> V, 0 V V <sub>CC</sub> ≤ 5.25 V
Output Voltage	V <sub>OHR</sub>	2.7	—	—	V	V <sub>CC</sub> = 4.75 V, I <sub>O</sub> = -400 mA V <sub>ID</sub> = 0.4 V, -7.0 V < V <sub>ICM</sub> < 12 V
	V <sub>OLR</sub>	—	—	0.45	V	V <sub>CC</sub> = 4.75 V, I <sub>O</sub> = 8.0 mA V <sub>ID</sub> = -0.4 V, -7.0 V < V <sub>ICM</sub> < 12 V
Output Leak Current	I <sub>OZR</sub>	-100	—	100	mA	V <sub>CC</sub> = 5.25 V, V <sub>O</sub> = 0.4 V V <sub>ID</sub> = 3.0 V, Enable = 2.0 V
		-100	—	100	mA	V <sub>CC</sub> = 5.25 V, V <sub>O</sub> = 2.4 V V <sub>ID</sub> = -3.0 V, Enable = 2.0 V
Short Circuit Output Current*1	I <sub>OSR</sub>	-15	—	-85	mA	V <sub>CC</sub> = 5.25 V, V <sub>O</sub> = 0 V V <sub>ID</sub> = 3.0 V
Input Voltage	V <sub>IHE</sub>	2.0	—	—	V	
	V <sub>ILE</sub>	—	—	0.8	V	
Input Current	I <sub>IIE</sub>	—	—	-100	μA	V <sub>CC</sub> = 5.25 V, V <sub>IL</sub> = 0.4 V
	I <sub>IHE</sub>	—	—	20	μA	V <sub>CC</sub> = 5.25 V, V <sub>IH</sub> = 2.7 V
	I <sub>IE</sub>	—	—	100	μA	V <sub>CC</sub> = 5.25 V, V <sub>IH</sub> = 5.25 V
Input Clamp Voltage	V <sub>IKE</sub>	—	—	-1.5	V	V <sub>CC</sub> = 4.75, I <sub>I</sub> = -18 mA

**Supply**

Item	Symbol	Min	Typ	Max	Unit	Conditions
Supply Current	I <sub>CC</sub>	—	55*3	80	mA	V <sub>CC</sub> = 5.25 V

- Notes: 1. Not more than one output should be shorted at a time, and duration of the short circuit should not exceed one second.  
 2. In this table, only the threshold voltage is expressed in algebra.  
 3. All typical values are at V<sub>CC</sub> = 5 V, Ta = 25°C.

## Switching Characteristics (Ta = 25°C, V<sub>CC</sub> = 5 V)

### Driver

Item	Symbol	Min	Typ	Max	Unit	Conditions
Propagation Delay Time	t <sub>PLHD</sub>	—	—	20	ns	C <sub>L</sub> = 30 pF, R <sub>L</sub> = 75 Ω to GND R <sub>L</sub> = 180 Ω to V <sub>CC</sub>
	t <sub>PHLD</sub>	—	—	20	ns	C <sub>L</sub> = 30 pF, R <sub>L</sub> = 75 Ω to GND R <sub>L</sub> = 180 Ω to V <sub>CC</sub>
Propagation Delay Time Difference	t <sub>SKD</sub> *1	—	—	4	ns	C <sub>L</sub> = 30 pF, R <sub>L</sub> = 75 Ω to GND R <sub>L</sub> = 180 Ω to V <sub>CC</sub>
Output Enable Time	t <sub>ZHD</sub>	—	—	20	ns	C <sub>L</sub> = 30 pF, R <sub>L</sub> = 75 Ω to GND
	t <sub>ZLD</sub>	—	—	35	ns	C <sub>L</sub> = 30 pF, R <sub>L</sub> = 180 Ω to V <sub>CC</sub>
Output Disable Time	t <sub>HZD</sub>	—	—	20	ns	C <sub>L</sub> = 10 pF, R <sub>L</sub> = 75 Ω to GND
	t <sub>LZD</sub>	—	—	25	ns	C <sub>L</sub> = 10 pF

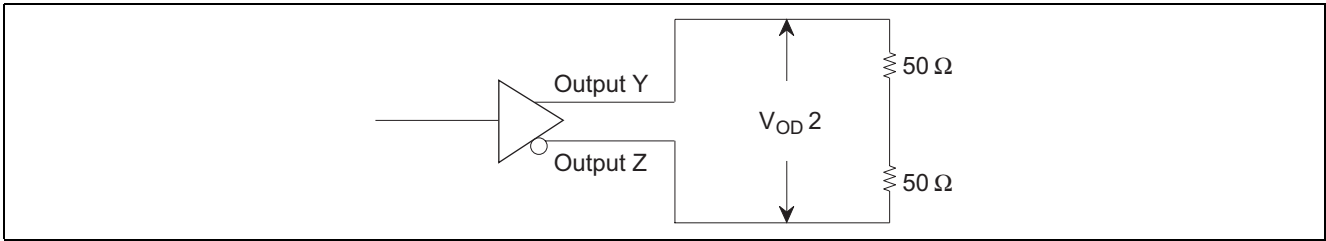
### Receiver

Item	Symbol	Min	Typ	Max	Unit	Conditions
Propagation Delay Time	t <sub>PLHR</sub>	—	—	40	ns	C <sub>L</sub> = 15 pF
	t <sub>PHLR</sub>	—	—	40	ns	C <sub>L</sub> = 15 pF
Output Enable Time	t <sub>ZHR</sub>	—	—	20	ns	C <sub>L</sub> = 15 pF, R <sub>L</sub> = 5 KΩ to GND
	t <sub>ZLR</sub>	—	—	25	ns	C <sub>L</sub> = 15 pF, R <sub>L</sub> = 2 KΩ to V <sub>CC</sub>
Output Disable Time	t <sub>HZR</sub>	—	—	30	ns	C <sub>L</sub> = 15 pF, R <sub>L</sub> = 5 KΩ to GND R <sub>L</sub> = 2 KΩ to V <sub>CC</sub>
	t <sub>LZR</sub>	—	—	30	ns	

Note: 1. t<sub>SKD</sub> = |t<sub>PLHD</sub> - t<sub>PHLD</sub>|

**DC Test ( $|V_{OD2}|$ ,  $\Delta |V_{OD}|$ ,  $V_{OC}$ ,  $\Delta |V_{OC}|$ )**

**$|V_{OD2}|$ ,  $\Delta |V_{OD}|$  Test**



**$V_{OC}$ ,  $\Delta |V_{OC}|$  Test**

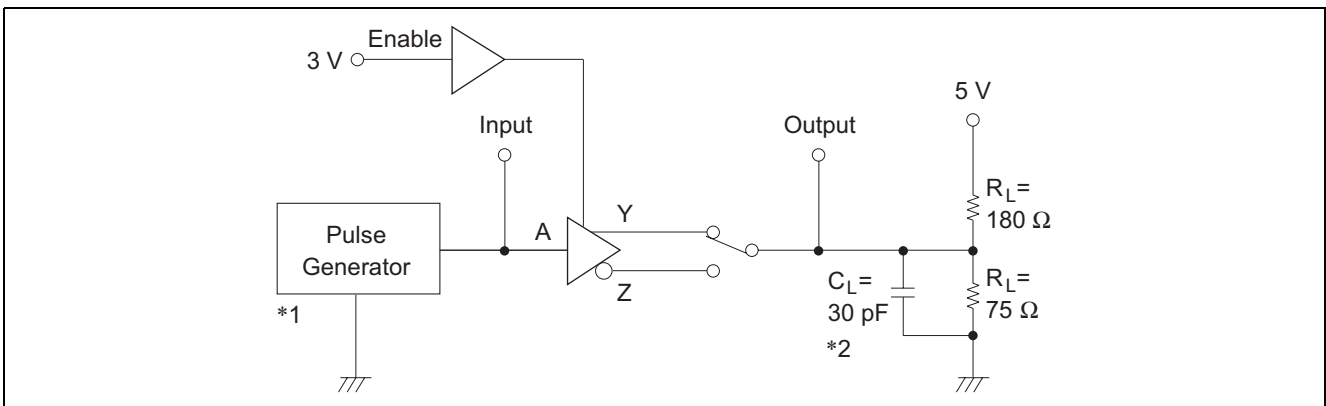
Note:  $|V_{OD}|$  and  $\Delta |V_{OC}|$  indicate the differences of voltage from the former states when Y and Z outputs are inverted.

$$\Delta |V_{OD}| = ||V_{OD2}| - |V_{OD2}||$$

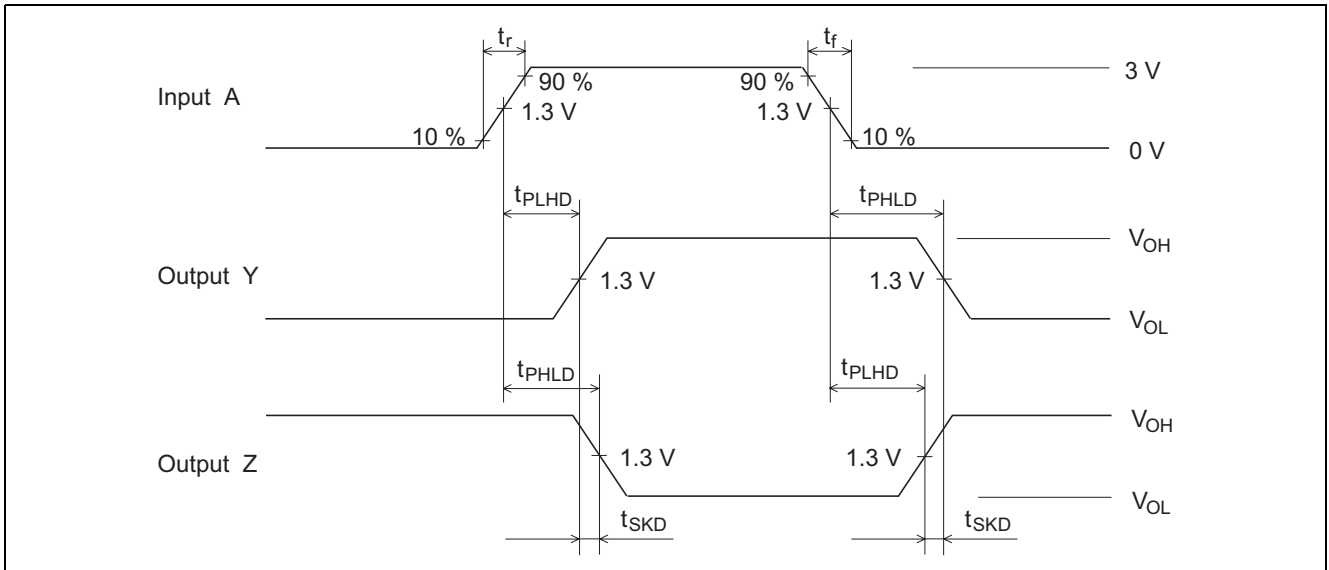
$$\Delta |V_{OC}| = |V_{OC} - V_{OC}|$$

**1.  $t_{PLHD}$ ,  $t_{PHLD}$**

**Test circuit**

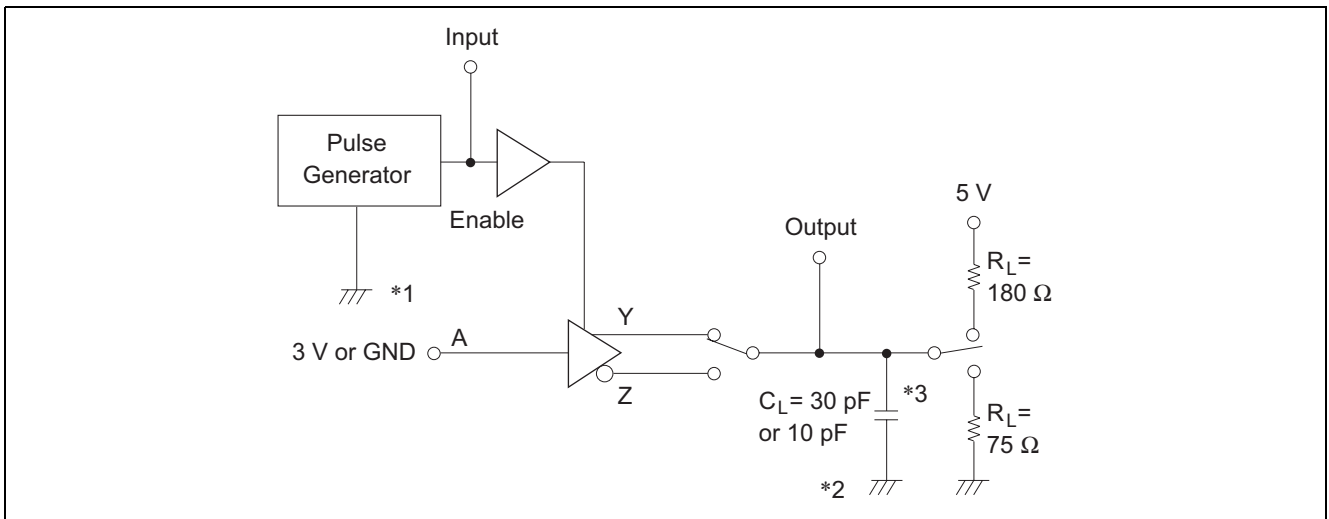


Waveforms

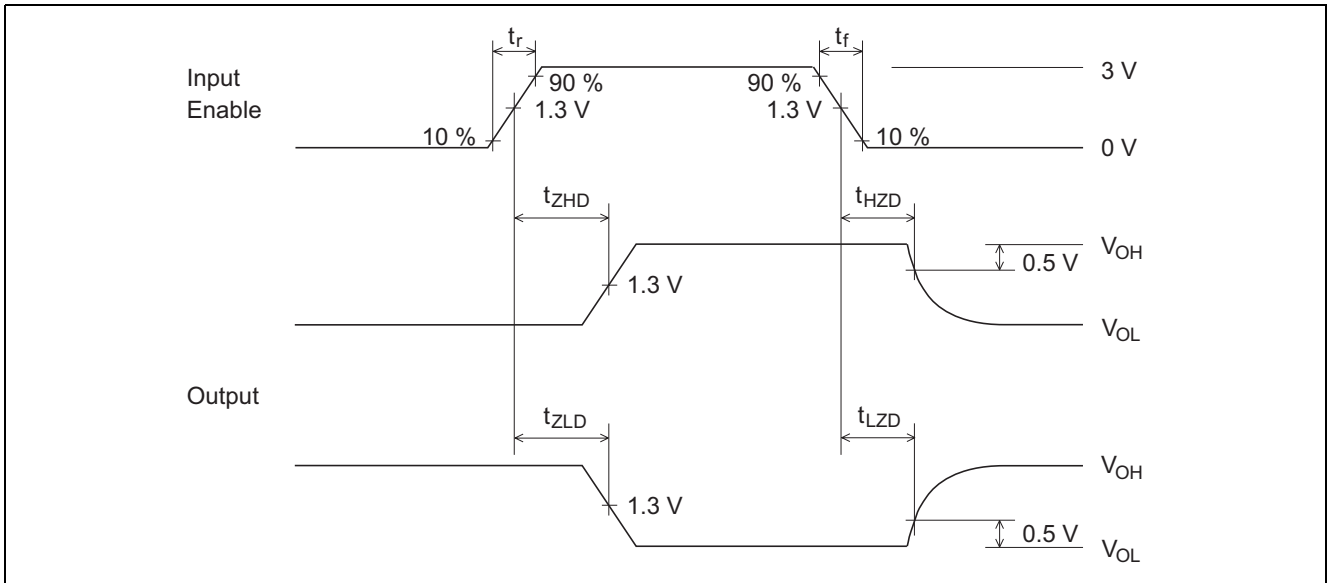


2.  $t_{zHD}$ ,  $t_{zLD}$ ,  $t_{HzD}$ ,  $t_{LzD}$

Test circuit

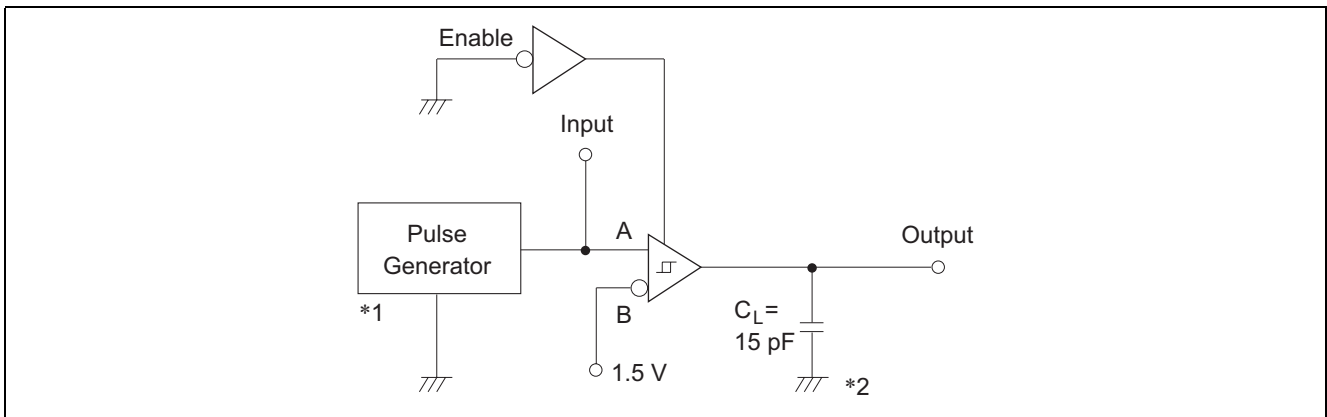


Waveforms



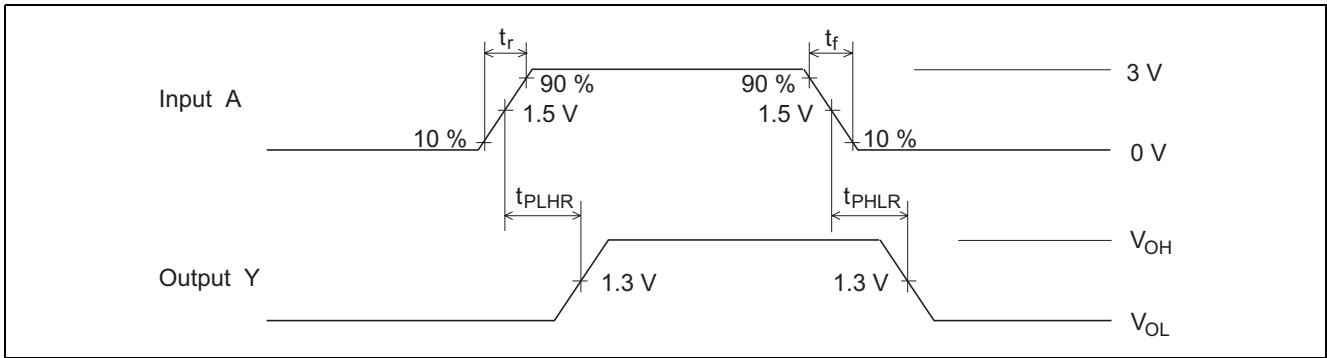
3.  $t_{PLHR}$ ,  $t_{PHLR}$

Test circuit



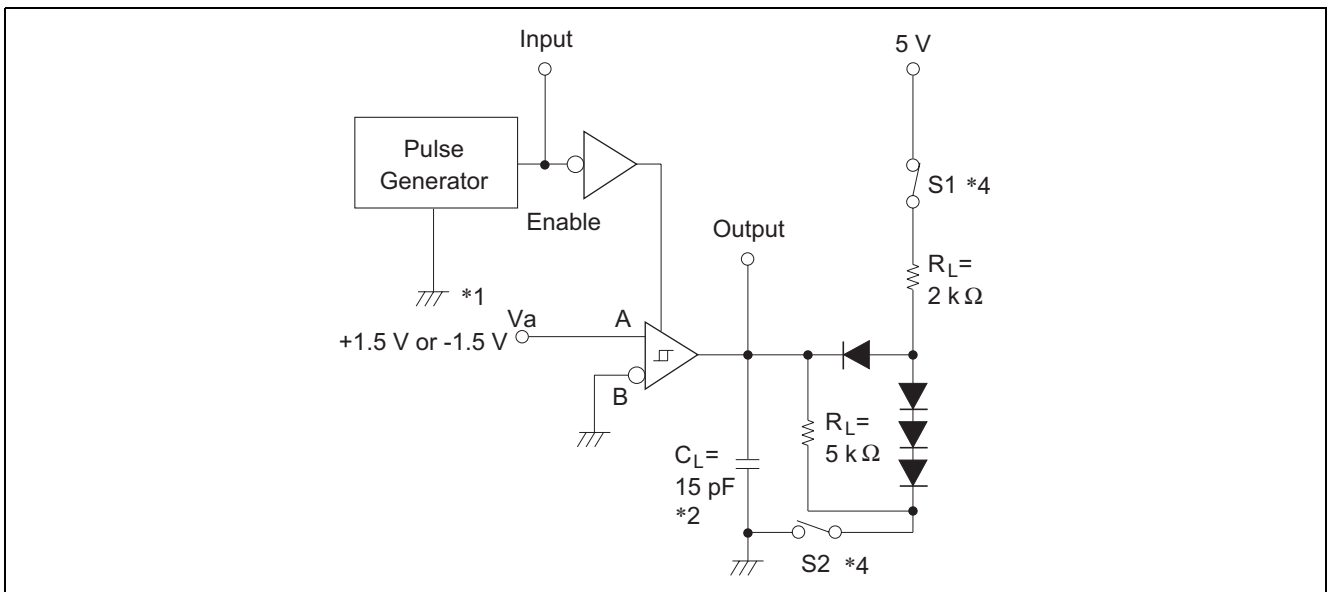


Waveforms

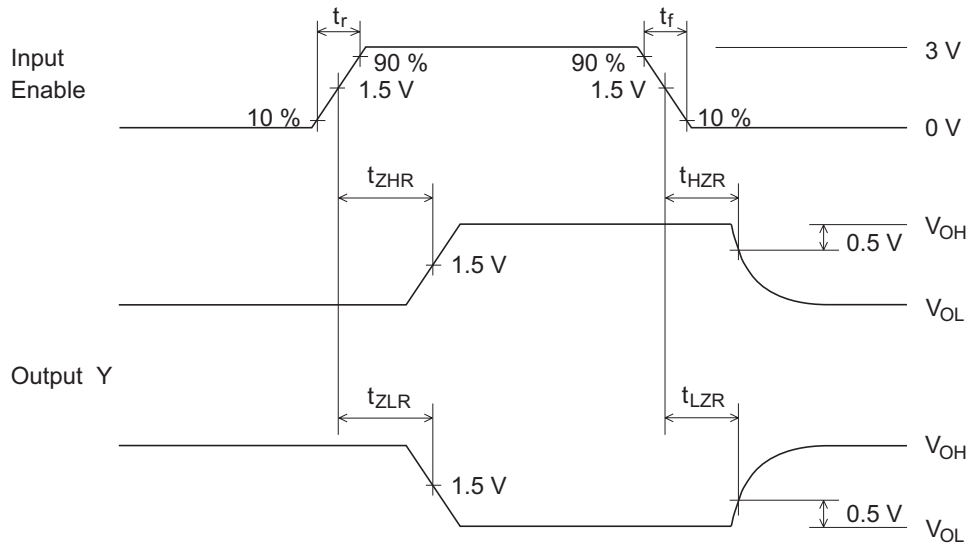


4.  $t_{ZHR}$ ,  $t_{ZLR}$ ,  $t_{HZR}$ ,  $t_{LZR}$

Test circuit

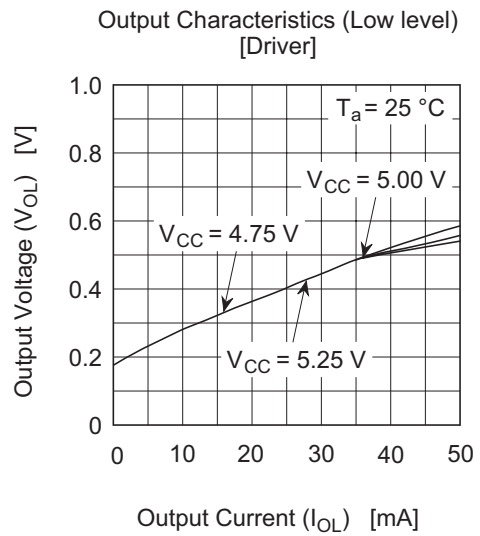
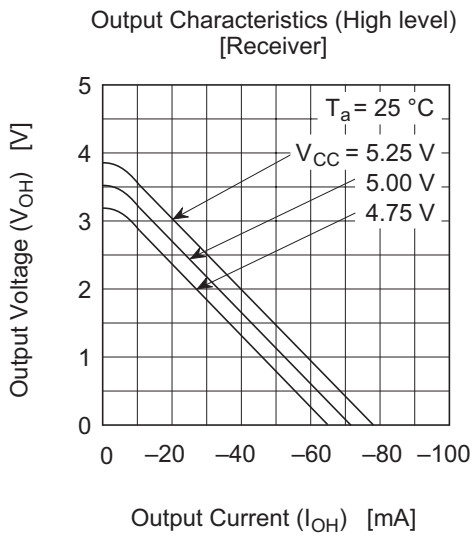
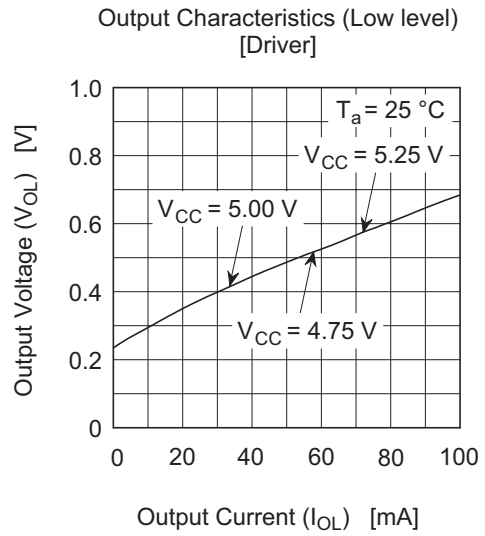
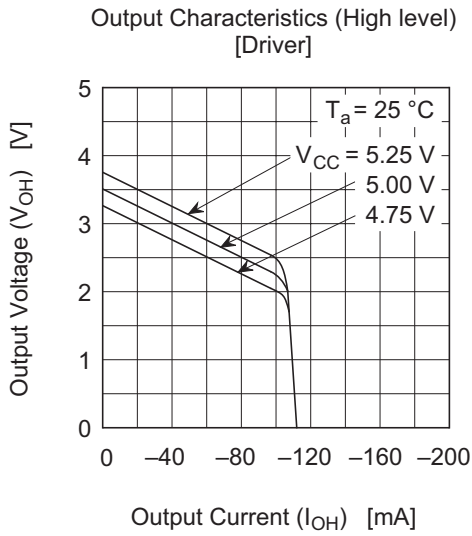


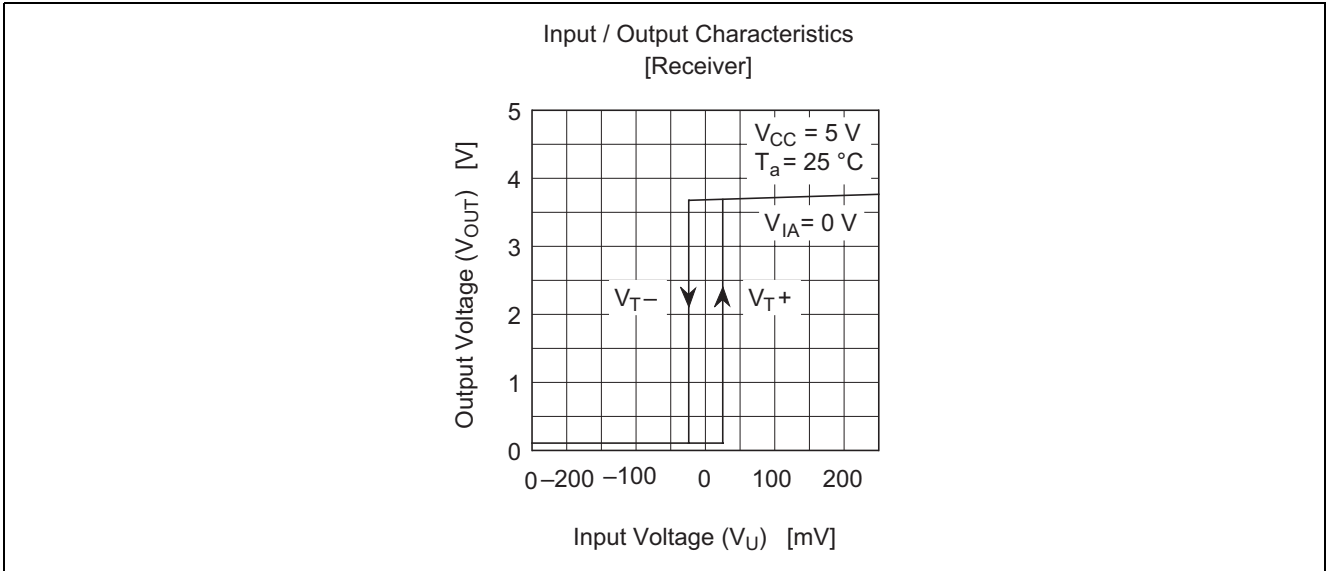
Waveforms



- Notes:
1. The pulse generator has the following characteristics:  
 PRR = 1 MHz, 50% duty cycle,  $t_r = t_f = 6.0$  ns.
  2.  $C_L$  includes probe and jig capacitance.
  3. 75  $\Omega$  connected between the pin and GND at  $t_{ZHD}$   $t_{HZD}$  test.  
 180  $\Omega$  connected between the pin and GND at  $t_{ZHD}$   $t_{HZD}$  test.
  4. At  $t_{HZR}$ ,  $t_{LZR}$  test,  $S_1$  and  $S_2$  are closed.  
 At  $t_{ZHR}$  test,  $S_1$  is open and  $S_2$  is closed.  
 At  $t_{ZLR}$  test,  $S_1$  is closed and  $S_2$  is open.

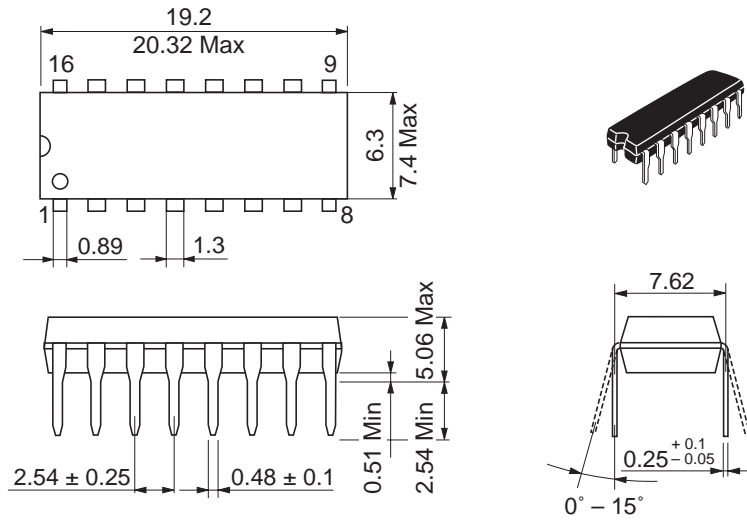
Main Characteristics





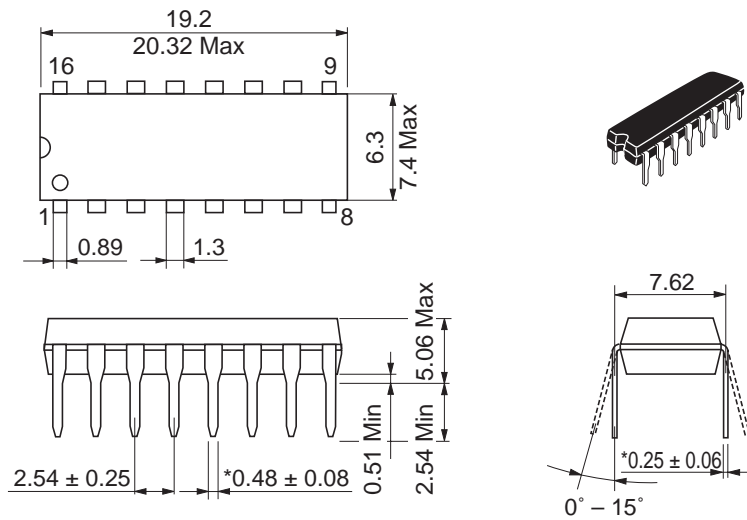
Package Dimensions

As of January, 2003  
Unit: mm



Package Code	DP-16E
JEDEC	Conforms
JEITA	Conforms
Mass (reference value)	1.05 g

Unit: mm



\*Ni/Pd/AU Plating

Package Code	DP-16FV
JEDEC	Conforms
JEITA	Conforms
Mass (reference value)	1.05 g

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