HD29050

Dual Differential Line Drivers / ReceiversWith 3 State Outputs

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

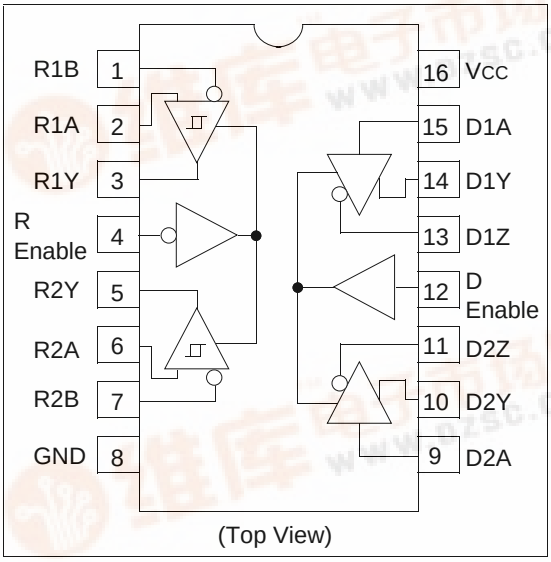
Driver

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

Receiver

- Input hysteresis (Typ. 50 mV)
- In phase input voltage ±200 mV of input sensitivity in the range –7 to +12 V.

Pin Arrangement



(Top View)

Function Table

Drivers			
Input A	Enable	Output Y	Output Z
L	H	L	H
H	H	H	L
X	L	Z	Z

Receivers		
Differential Input A – B	Enable	Output Y
$V_{ID} \geq 0.2$ V	L	H
–0.2 V < V_{ID} < 0.2 V	L	?
$V_{ID} \leq$ –0.2 V	L	L
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}	±25	V
Differential Input Voltage *2 *3	V_{ID}	±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 V I_I = –18 mA
Output Voltage	V_{OHD}	2.5	—	—	V	V_{CC} = 4.75 V I_{OH} = –20 mA
		2.4	—	—	V	V_{CC} = 4.75 V I_{OH} = –40 mA
	V_{OLD}	—	—	0.45	V	V_{CC} = 4.75 V I_{OL} = 20 mA
		—	—	0.5	V	V_{CC} = 4.75 V I_{OL} = 40 mA
Output Leak Current	I_{OZD}	–100	—	100	µA	V_{CC} = 5.25 V, V_O = 0.5 V Enable = 0.8 V
		–100	—	100	µA	V_{CC} = 5.25 V, V_O = 2.7 V Enable = 0.8 V
	$I_{O(Off)}$	—	—	–100	µA	V_{CC} = 0 V V_O = –0.25 V
		—	—	100	µA	V_{CC} = 0 V V_O = 6.0 V
Input Current	I_{ID}	—	—	100	µA	V_{CC} = 5.25 V V_I = 5.25 V
	I_{IHD}	—	—	20	µA	V_{CC} = 5.25 V V_I = 2.7 V
	I_{IHD}	—	—	–360	µA	V_{CC} = 5.25 V V_I = 0.4 V
Differential Output Voltage	$\Delta \lvert V_{OC} \rvert$	—	—	0.4	V	
	$\lvert V_{OD2} \rvert$	2.0	—	—	V	
	$\Delta \lvert V_{OD} \rvert$	—	—	0.4	V	
Short Circuit Output Current *1	I_{OSD}	–30	—	–150	mA	V_{CC} = 5.25 V V_O = 0 V

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

Receiver

Item	Symbol	Min	Typ	Max	Unit	Conditions
Differential Input Threshold Voltage *2	V_{THR}	—	—	0.2	V	$V_O \geq 2.7$ V –7.0 V < V_{IC} < 12 V
		–0.2	—	—	V	$V_O \leq 0.45$ V –7.0 V < V_{IC} < 12 V
Input Current	I_{IBR}	—	—	1.0	mA	V_{IN} = 12 V 0 V ≤ V_{CC} ≤ 5.25 V
		—	—	–0.8	mA	V_{IN} = –7 V 0 V ≤ V_{CC} ≤ 5.25 V
Output Voltage	V_{OHR}	2.7	—	—	V	V_{CC} = 4.75 V, I_O = –400 µA V_{ID} = 0.4 V, –7.0 V < V_{ICM} < 12 V
	V_{OLR}	—	—	0.45	V	V_{CC} = 4.75 V, I_O = 8.0 mA V_{ID} = –0.4 V, –7.0 V < V_{ICM} < 2 V
Output Leak Current	I_{OZR}	–100	—	100	µA	V_{CC} = 5.25 V, V_O = 0.4 V V_{ID} = 3.0 V, Enable = 2.0 V
		–100	—	100	µA	V_{CC} = 5.25 V, V_O = 2.4 V V_{ID} = –3.0 V, Enable = 2.0 V
Short Circuit Output Current *1	I_{OSR}	–15	—	–85	mA	V_{CC} = 5.25 V, V_O = 0 V V_{ID} = 3.0 V
Input Voltage	V_{IHE}	2.0	—	—	V	
	V_{ILE}	—	—	0.8	V	
Input Current	I_{ILE}	—	—	–100	µA	V_{CC} = 5.25 V, V_{IL} = 0.4 V
	I_{IHE}	—	—	20	µA	V_{CC} = 5.25 V, V_{IH} = 2.7 V
	I_{IE}	—	—	100	µA	V_{CC} = 5.25 V, V_{IH} = 5.25 V
Input Clamp Voltage	V_{IKE}	—	—	–1.5	V	V_{CC} = 4.75 I_I = –18 mA

Supply

Item	Symbol	Min	Typ	Max	Unit	Conditions
Supply Current	I_{CC}	—	55 *3	80	mA	V_{CC} = 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_{CC} = 5 V, Ta = 25°C.

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

Driver

Item	Symbol	Min	Typ	Max	Unit	Conditions
Propagation Delay Time	t_{PLHD}	—	—	20	ns	C_L = 30 pF, R_L = 75 Ω to GND R_L = 180 Ω to V_{CC}
	t_{PHLD}	—	—	20	ns	C_L = 30 pF, R_L = 75 Ω to GND R_L = 180 Ω to V_{CC}
Propagation Delay Time Difference	t_{SKD} *1	—	—	4	ns	C_L = 30 pF, R_L = 75 Ω to GND R_L = 180 Ω to V_{CC}
Output Enable Time	t_{ZHD}	—	—	20	ns	C_L = 30 pF R_L = 75 Ω to GND
	t_{ZLD}	—	—	35	ns	C_L = 30 pF R_L = 180 Ω to V_{CC}
Output Disable Time	t_{HZD}	—	—	20	ns	C_L = 10 pF R_L = 75 Ω to GND
	t_{LZD}	—	—	25	ns	C_L = 10 pF

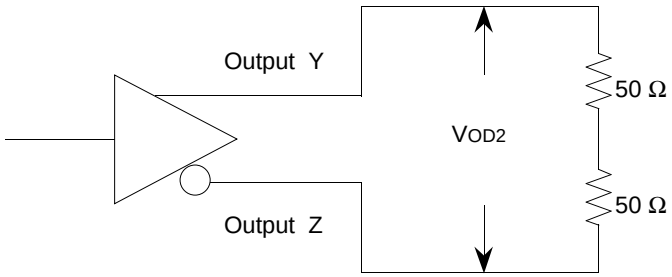
Receiver

Item	Symbol	Min	Typ	Max	Unit	Conditions
Propagation Delay Time	t_{PLHR}	—	—	40	ns	C_L = 15 pF
	t_{PHLR}	—	—	40	ns	C_L = 15 pF
Output Enable Time	t_{ZHR}	—	—	20	ns	C_L = 15 pF R_L = 5 KΩ to GND
	t_{ZLR}	—	—	25	ns	C_L = 15 pF R_L = 2 KΩ to V_{CC}
Output Disable Time	t_{HZR}	—	—	30	ns	C_L = 15 pF, R_L = 5 KΩ to GND R_L = 2 KΩ to V_{CC}
	t_{LZR}	—	—	30	ns	

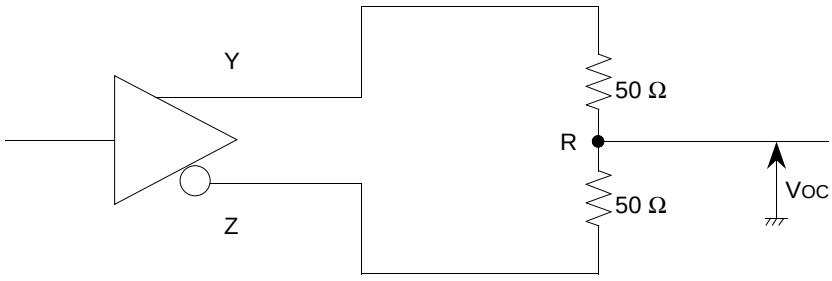
Note: 1. $t_{SKD} = |t_{PLHD} - t_{PHLD}|$

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

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



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



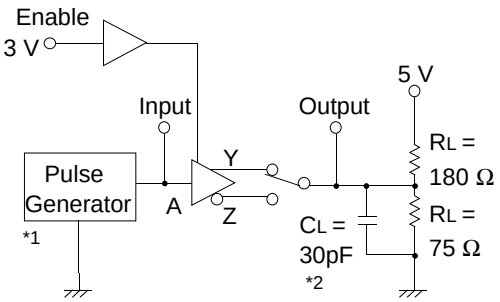
$\Delta|V_{OD}|$ and $\Delta|V_{OC}|$ indicate the differences of voltage from the former states when Y and Z outputs are inversed.

$$\Delta\,|V_{OD}| = \left|\,|V_{OD2}| - |\overline{V_{OD2}}|\,\right|$$

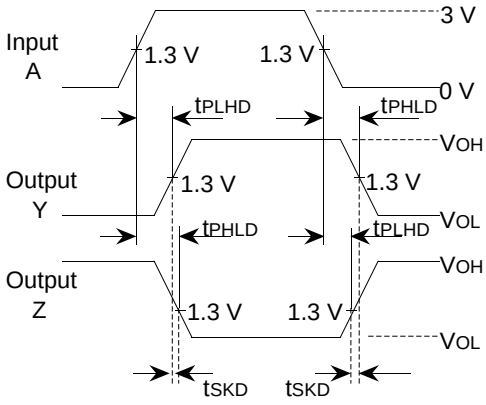
$$\Delta\,|V_{OC}| = |V_{OC} - \overline{V_{OC}}|$$

1. t_{PLHD} , t_{PHLD}

Test circuit

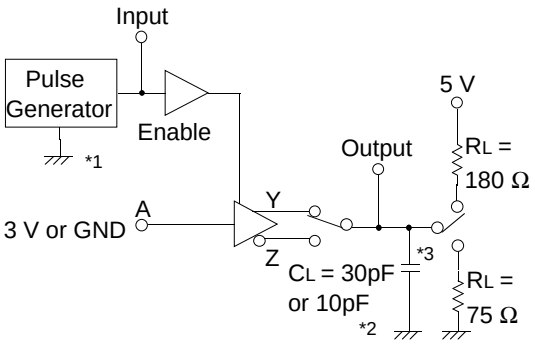


Waveforms

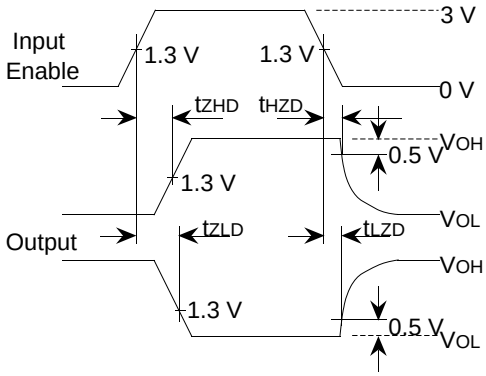


2. t_{ZHD} , t_{ZLD} , t_{HZD} , t_{LZD}

Test circuit

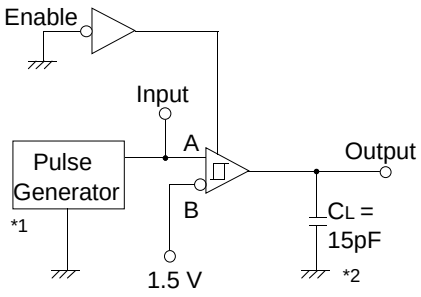


Waveforms

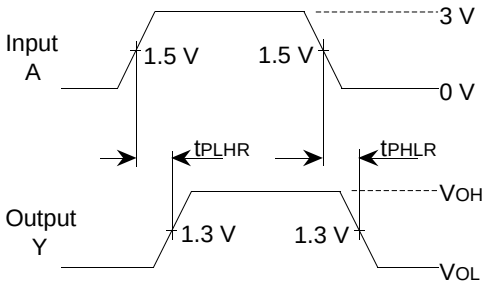


3. t_{PLHR} , t_{PHLR}

Test circuit

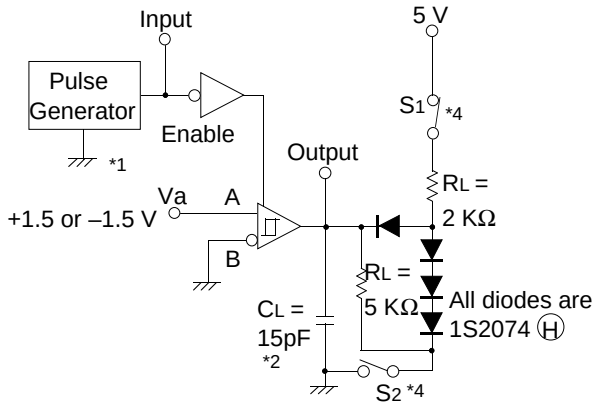


Waveforms

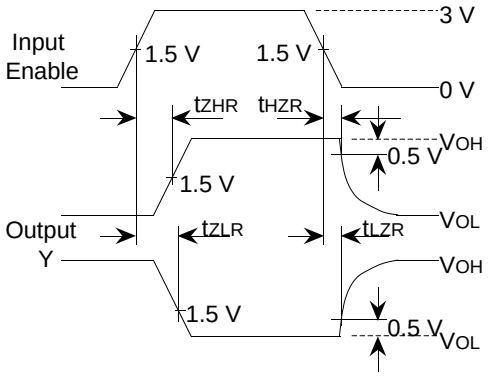


4. t_{ZHR} , t_{ZLR} , t_{HZR} , t_{LZR}

Test circuit



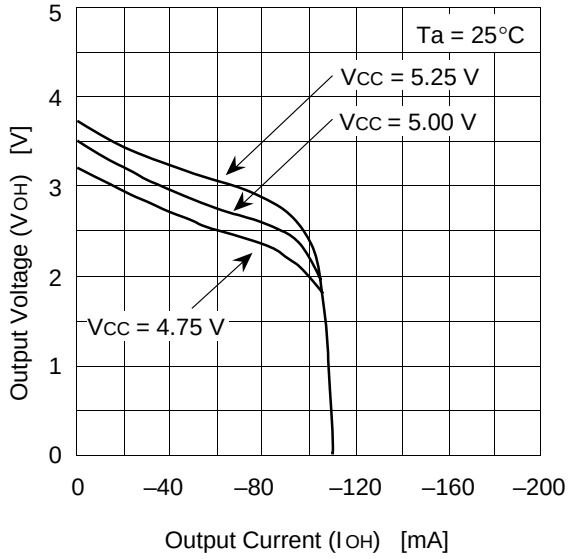
Waveforms



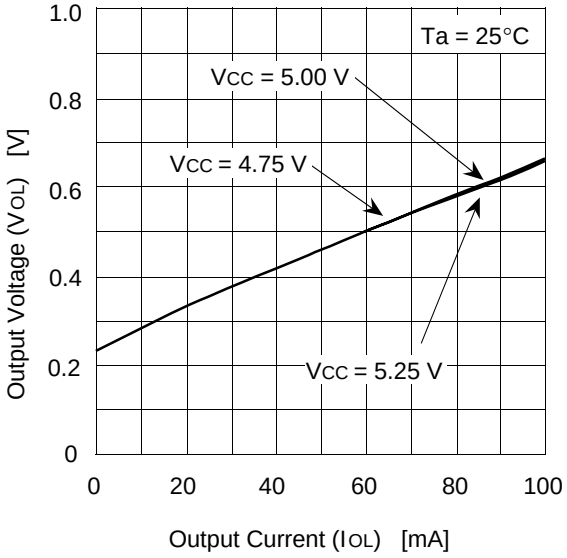
Notes: 1. The pulse generator has the following characteristics:
PRR = 1 MHz, 50 % duty cycle, t_r = t_f = 6.0 ns.
2. C_L includes probe and jig capacitance.
3. 75 Ω connected between the pin and GND at t_{ZHD} t_{HZD} test.
180 Ω connected between the pin and GND at t_{ZHD} t_{HZD} test.
4. At t_{HZR}, 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

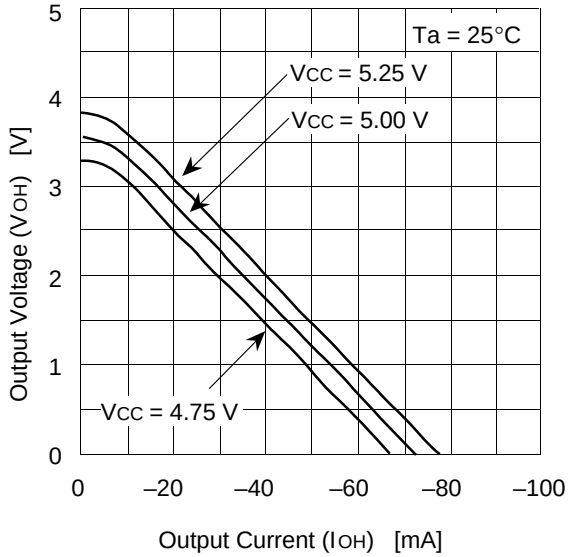
• Output Characteristics (High level) [Driver]



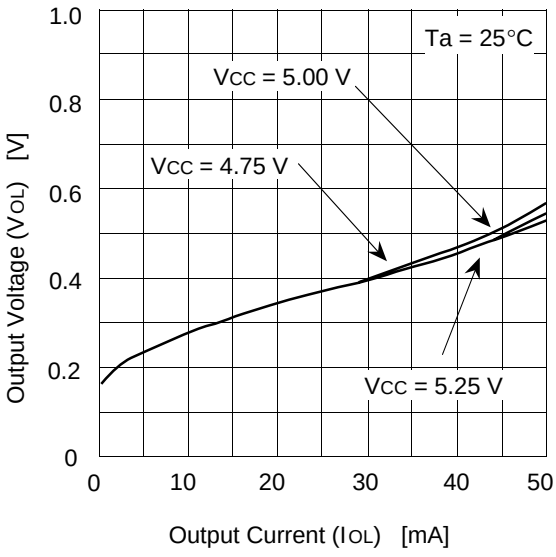
• Output Characteristics (Low level) [Driver]



• Output Characteristics (High level) [Receiver]



• Output Characteristics (Low level) [Receiver]



- Input / Output Characteristics
[Receiver]