CL74AUP1G14 Low-Power Single Schmitt-Trigger Inverter

General Description

This single Schmitt-trigger inverter is designed for 0.8-V to 3.6-V V_{CC} operation.

The CL74AUP1G14 device contains one inverter and performs the Boolean function $Y = \overline{A}$. The device functions as an independent inverter with Schmitt-trigger inputs, so the device has different input threshold levels for positive-going (V_{T+}) which makes the device tolerant to slow or noisy input signals.

This device is fully specified for partial-power-down applications using I_{off}. The I_{off} circuitry disables the outputs when the device is powered down. This inhibits current backflow into the device which prevents damage to the device.

Ordering Information

Part Number	Marking	Package
CL74AUP1G14_235	P14XW	SOT-23-5
CL74AUP1G14_70	PGXW	SC70

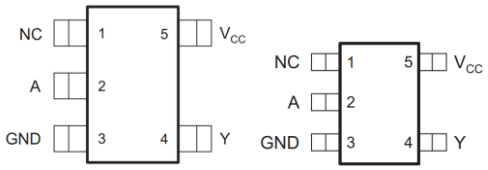
Features

- Inputs Accept Voltages 0.8V to 3.6 V
- Includes Schmitt-Trigger inputs
- Max Tpd of 6.1 ns at 3.3 V
- Low Static-Consumption, 0.9-µA Max I_{CC}
- Low Noise Overshoot and Undershoot<10% of V_{CC}
- Ioff Supports Live Insertion, Partial-Power-Down Mode, and Back-Drive Protection
- Input Hysteresis Allows Slow Input Transition and Better Switching Noise Immunity at Input(V_{hys}= 250mV Typical 3.3V)
- 3.6V I/O Tolerant to Support Mixed-Mode Signal Operation
- Suitable for Point-to-Point Applications
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22
  - 2000-V Human-Body Model (A114-A)
  - 1000-V Charged-Device Model (C101)

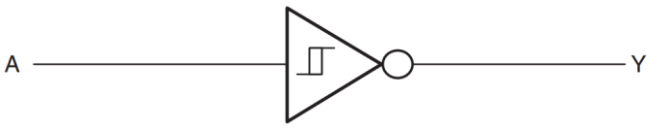
Applications

- AV Receiver
- Smartphones
- Blu-ray Player and Home Theater
- DVD Recorders and Players
- Desktop or Notebook PCs
- Embedded PCs
- GPS: Personal Navigation Devices
- Mobile Internet Devices
- Portable Media Players
- Smoke Detectors
- Solid State Drive (SSD): Enterprise
- High-Definition (HDTV)

Pin Configuration



Simplified Schematic



Pin Assignment

Pin Name	Pin No.	Pin Function
NC	1	No connect
A	2	Input
GND	3	Ground
Y	4	Output
V_{CC}	5	Power pin

Absolute Maximum Ratings (Note1)

- V_{CC} ---------- -0.5V to +4.6V
- V_I ---------- -0.5V to +4.6V
- V_O (Voltage range applied to any output in the high-impedance or power-off state) ---------- -0.3V to +4.6V
- V_O (Voltage range applied to any output in the high or slow state) ---------- -0.3V to V_{CC}+0.3V
- Input clamp current ---------- -50mA
- Output clamp current ---------- -50mA
- Continuous output current ---------- ±20mA
- Storage Temperature ---------- –65°C to 150°C

Recommended Operating Conditions

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Supply voltage	V_{CC}	Operating	0.8		3.6	V
Input voltage	V_I		0		3.6	V
Output voltage	V_O		0		VCC	V
High- level output current	I_{OH}	V_{CC} = 0.8V			-20	uA
		V_{CC} = 1.1V			-1.1	mA
		V_{CC} = 1.4V			-1.7	
		V_{CC} = 1.65V			-1.9	
		V_{CC} = 2.3V			-3.1	
		V_{CC} = 3V			-4	
Low- level output current	I_{OL}	V_{CC} = 0.8V			20	uA
		V_{CC} = 1.1V			1.1	mA
		V_{CC} = 1.4V			1.7	
		V_{CC} = 1.65V			1.9	
		V_{CC} = 2.3V			3.1	
		V_{CC} = 3V			4	
Operating temperature	T_A		-40		85	℃

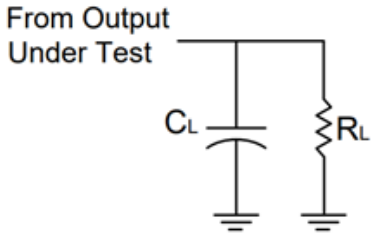
Electrical Characteristics

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Positive-going input threshold voltage	V_{T+}	V_{CC} = 0.8V	0.3		0.6	V
		V_{CC} = 1.1V	0.53		0.9	
		V_{CC} = 1.4V	0.74		1.11	
		V_{CC} = 1.65V	0.91		1.29	
		V_{CC} = 2.3V	1.37		1.77	
		V_{CC} = 3V	1.88		2.29	
Negative-going input threshold voltage	V_{T-}	V_{CC} = 0.8V	0.1		0.6	V
		V_{CC} = 1.1V	0.26		0.65	
		V_{CC} = 1.4V	0.39		0.75	
		V_{CC} = 1.65V	0.47		0.84	
		V_{CC} = 2.3V	0.69		1.04	
		V_{CC} = 3V	0.88		1.24	
Hysteresis voltage	$\triangle V_T$	V_{CC} = 0.8V	0.07		0.5	V
		V_{CC} = 1.1V	0.08		0.46	
		V_{CC} = 1.4V	0.18		0.56	
		V_{CC} = 1.65V	0.27		0.66	
		V_{CC} = 2.3V	0.53		0.92	
		V_{CC} = 3V	0.79		1.31	
High- level output voltage	V_{OH}	V_{CC} = 0.8~3.6V, I_{OH}= -20uA	VCC-0.1			V
		V_{CC} = 1.1V, I_{OH}= -1.1mA	0.75xV_{CC}			
		V_{CC} = 1.4V, I_{OH}= -1.7mA	1.11			
		V_{CC} = 1.65V, I_{OH}= -1.9mA	1.32			
		V_{CC} = 2.3V, I_{OH}= -2.3mA	2.05			
		V_{CC} = 2.3V, I_{OH}= -3.1mA	1.9			
		V_{CC} = 3V, I_{OH}= -2.7mA	2.72			
		V_{CC} = 3V, I_{OH}= -4mA	2.6			
Low- level output voltage	V_{OL}	V_{CC} = 0.8~3.6V, I_{OL}= 20uA			0.1	V
		V_{CC} = 1.1V, I_{OL}= 1.1mA			0.3xV_{CC}	
		V_{CC} = 1.4V, I_{OL}= 1.7mA			0.31	
		V_{CC} = 1.65V, I_{OL}= 1.9mA			0.31	
		V_{CC} = 2.3V, I_{OL}= 2.3mA			0.31	
		V_{CC} = 2.3V, I_{OL}= 3.1mA			0.44	
		V_{CC} = 3V, I_{OL}= 2.7mA			0.31	
		V_{CC} = 3V, I_{OL}= 4mA			0.44	
Input leakage current	I_I	V_{IN}= 3.6V or GND, V_{CC}= 0~3.6V			0.1	uA
Power off leakage current	I_{OFF}	V_I or V_O=0V to 3.6V, V_{CC}=0V			0.2	uA
Supply current	I_{CC}	V_I= GND or (V_{CC} to 3.6V), I_{OUT}=0, V_{CC}=0.8~3.6V			0.5	uA
Additional supply current per input pin	$\triangle I_{CC}$	V_I= V_{CC}-0.6V, I_{OUT}=0			40	uA

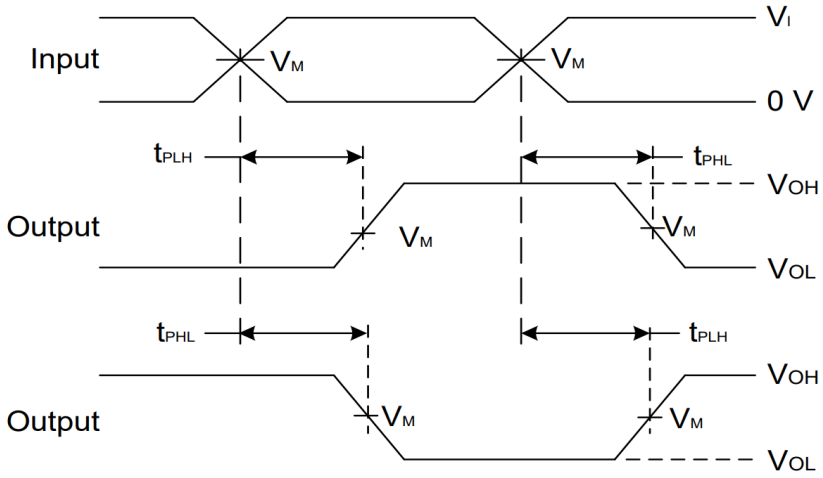
Switching Characteristics

Parameter	Symbol	Test Conditions		Min	Typ	Max	Units
Propagation delay from input(A or B) to output(Y)	T_{PD}	V_{CC} = 0.8V	C_L=15pF R_L=1MΩ		20.1		ns
		V_{CC} = 1.2V±0.1V,		5.5	8.7	14	
		V_{CC} = 1.5V±0.1V,		4.7	6.7	12.5	
		V_{CC} = 1.8V±0.15V		4.2	5.6	10.1	
		V_{CC} = 2.5V±0.2V		3.6	4.5	7.4	
		V_{CC} = 3.3V±0.3V		3.3	3.9	6.1	

Parameter Measurement Information



VCC	INPUTS		VM	CL	RL
	VI	tr/tf			
0.8V	VCC	≦2ns	VCC/2	15pF	1MΩ
1.2V ± 0.1V	VCC	≦2ns	VCC/2	15pF	1MΩ
1.5V ± 0.1V	VCC	≦2ns	VCC/2	15pF	1MΩ
1.8V ± 0.15V	VCC	≦2ns	VCC/2	15pF	1MΩ
2.5V ± 0.2V	3V	≦2.5ns	1.5V	15pF	1MΩ
3.3V ± 0.3V	VCC	≦2.5ns	VCC/2	15pF	1MΩ



Voltage Waveform Propagation Delay Times
Inverting and Non Inverting Outputs

Notes:
A. C_L includes probe and jig capacitance
B. All pulses and supplied at pulse repetition rate≦10MHz
C. The Inputs are measured separately one transition per measurement
D. t_{PLH} and t_{PHL} are the same as t_{PD}

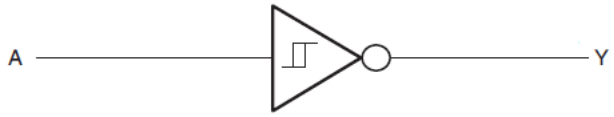
IC Operation Information

Basic Operation

This device functions as an independent gate with Schmitt-trigger inputs, which allows for slow input transition and better switching-noise immunity at the input.

This device is fully specified for partial-power-down applications using Ioff. The Ioff circuitry disables the outputs, preventing damaging current backflow through the device when it is powered.

Function Block Diagram



Feature Description

- Wide operating Vcc range of 0.8V to 3.6V.
- 3.6-V I/O tolerant to support down translation.
- Input hysteresis allows slow input transition and better switching noise immunity at the input.
- Ioff feature allows voltages on the inputs and outputs when V_{CC} is 0 V.
- Low noise due to slower edge rates.

Device Functional Table

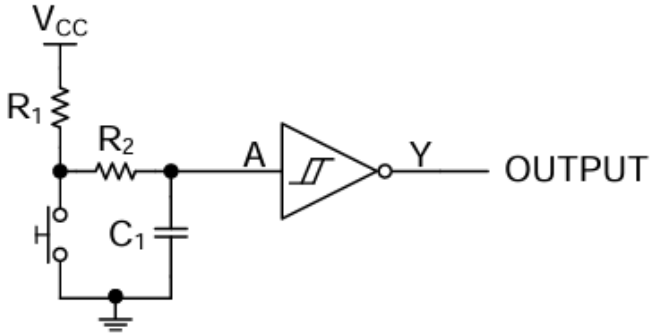
INPUT A	OUTPUT Y
H	L
L	H

IC Application Information

Mechanical input elements, such as push buttons or rotary knobs, offer simple ways to interact with electronic systems. Typically, these elements have recoil or bouncing, where the mechanical element makes and breaks contact multiple times during human interaction. This bouncing can cause one or more repeated signals to be passed, triggering multiple actions when only a single input was intended. One potential solution to mitigating these multiple inputs is by utilizing a Schmitt-trigger to create a debounce circuit. Below figure shows an example of this solution.

The input due to the push button switches multiple times, causing the output of a non Schmitt-trigger device to trigger multiple times, while the Schmitt-trigger input device with RC delay limits the output pulse to a single pulse desired by the user. The separated positive and negative input voltage threshold values prevent multiple triggers from occurring, see the Electrical Characteristics table for V_{T+}, V_{T-}, and V_{hys} values.

Typical Application



Design Requirements

This device uses CMOS technology and has balanced output drive. Take care to avoid bus contention because it can drive currents that would exceed maximum limits. The drive strength also creates fast edges into light loads, so routing and load conditions should be considered to prevent ringing.

Detailed Design Procedure

1. Recommended Input conditions:
   – For specified high and low levels, see (V_{T+} and V_{T-}) in the Electrical Characteristics table.
   – Inputs are overvoltage tolerant allowing them to go as high as (V_I max) in the Recommended Operating Conditions table at any valid V_{CC}.
2. Recommended output conditions:
   – Load currents should not exceed (I_O max) per output and should not exceed (Continuous current through V_{CC} or GND) total current for the part. These limits are located in the Absolute Maximum Ratings table.

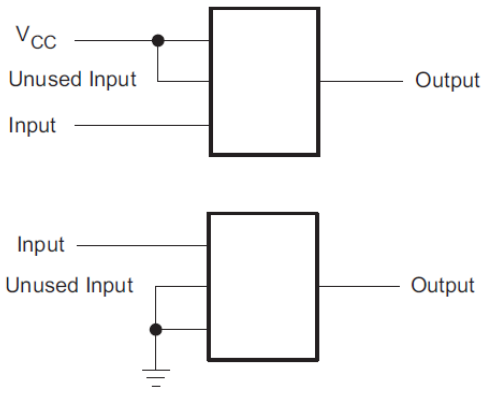
Power Supply Recommendations

The power supply can be any voltage between the Min and Max supply voltage rating located in the Recommended Operating Conditions table. Each VCC pin should have a good bypass capacitor to prevent power disturbance. For devices with a single supply, 0.1 µF is recommended; if there are multiple VCC pins, then 0.01 µF or 0.022 µF is recommended for each power pin. It is acceptable to parallel multiple bypass caps to reject different frequencies of noise. A 0.1 µF and a 1 µF are commonly used in parallel. The bypass capacitor should be installed as close to the power pin as possible for best results.

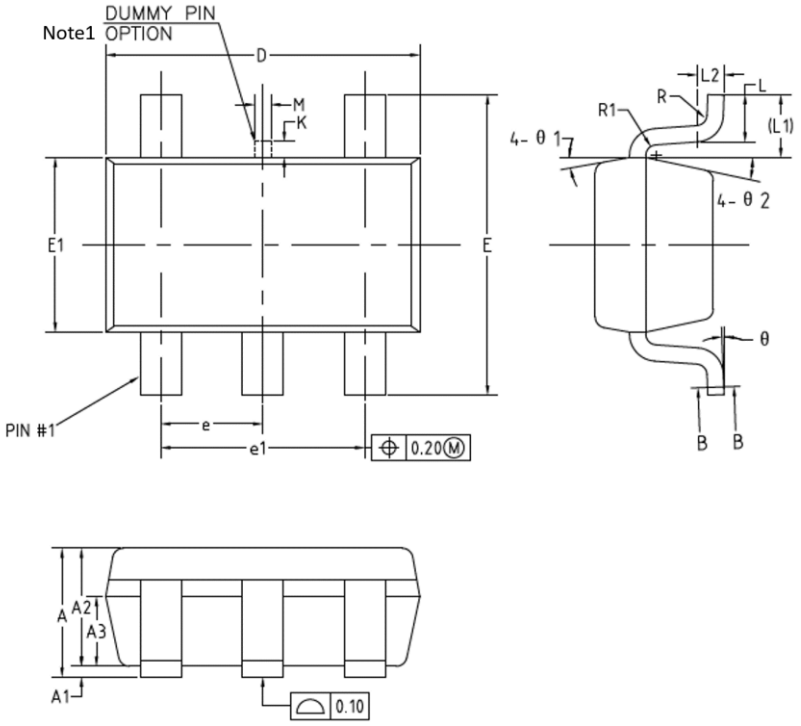
Layout Considerations

When using multiple-bit logic devices, inputs should never float.

In many cases, functions or parts of functions of digital logic devices are unused, for example, when only two inputs of a triple-input AND gate are used or only 3 of the 4 buffer gates are used. Such input pins should not be left unconnected because the undefined voltages at the outside connections result in undefined operational states. Below figure specifies the rules that must be observed under all circumstances. All unused inputs of digital logic devices must be connected to a high or low bias to prevent them from floating. The logic level that should be applied to any particular unused input depends on the function of the device. Generally they will be tied to GND or VCC, whichever makes more sense or is more convenient. It is generally acceptable to float outputs, unless the part is a transceiver. If the transceiver has an output enable pin, it will disable the output section of the part when asserted. This will not disable the input section of the I/Os, so they cannot float when disabled.



Package Information
SOT23-5

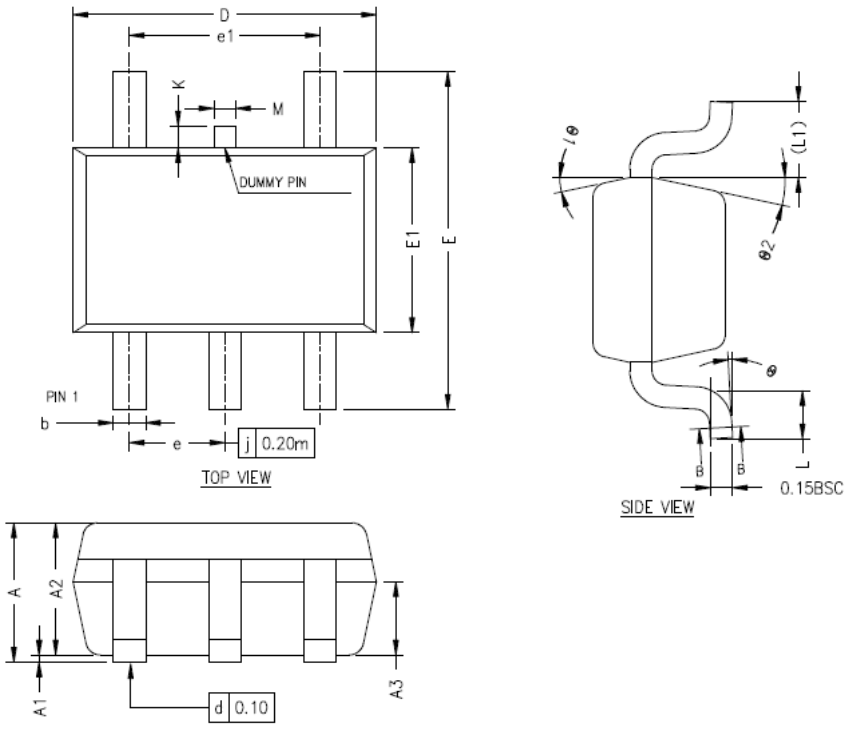


COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

	SYMBOL	MIN	NOM	MAX
	A	–	–	1.25
	A1	0	–	0.15
	A2	1.00	1.10	1.20
	A3	0.60	0.65	0.70
4	b	0.34	–	0.45
4	b1	0.34	0.38	0.41
4	c	0.12	–	0.20
4	c1	0.12	0.15	0.16
	D	2.826	2.926	3.026
	E	2.60	2.80	3.00
3	E1	1.526	1.626	1.700
	e	0.90	0.95	1.00
	e1	1.80	1.90	2.00
2	K	0	–	0.20
	L	0.30	0.40	0.60
	L1	0.59REF		
	L2	0.25BSC		
2	M	0.10	0.15	0.20
	R	0.05	–	0.20
	R1	0.05	–	0.20
	θ	0°	–	8°
	θ 1	8°	10°	12°
	θ 2	10°	12°	14°

Notes: 1. Dummy pin may differ or may not be present.

Package Information
SC70



COMMON DIMENSIONS

(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	0.80	–	1.10
A1	0	–	0.10
A2	0.80	0.90	1.00
A3	0.40	0.50	0.60
b	0.17	–	0.30
b1	0.17	0.22	0.25
3 c	0.12	–	0.20
3 c1	0.12	0.15	0.16
D	2.02	2.07	2.12
E	2.20	2.30	2.40
E1	1.21	1.26	1.31
e	0.60	0.65	0.70
e1	1.20	1.30	1.40
L	0.26	0.33	0.46
L1		0.52REF	
2 M	0.10	0.15	0.20
2 K	0	–	0.20
θ	0°	–	8°
θ1	10°	12°	14°
θ2	10°	12°	14°