CL74AUP1G240 Low-Power Single Inverter With 3-State Output

General Description

This single buffer/driver is designed for 0.8-V to 3.6-V VCC operation.

The CL74AUP1G240 device is a single line driver with a 3-state output. The output is disabled when the output-enable ($\overline{OE}$) input is high.

To assure the high-impedance state during power up or power down, $\overline{OE}$ should be tied to Vcc through a pullup resistor；the minimum value of the resistor is determined by the current-sinking capability of the driver.

This device is fully specified for partial-power-down application using I_{off}. The I_{off} circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

The CL74AUP1G240 device is available in a variety of packages, including SOT23-5, SC70.

Ordering Information

Part Number	Marking	Package
CL74AUP1G240_235	P0PXW	SOT-23-5
CL74AUP1G240_70	PPXW	SC70

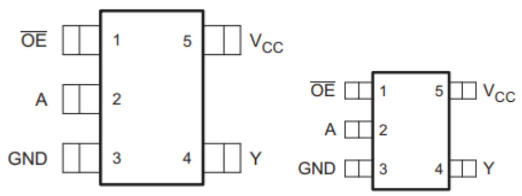
Features

- Inputs Accept Voltages 0.8V to 3.6 V
- Max Tpd of 4.5 ns at 3.3 V
- Low Static-Consumption, 0.9-µA Max I_{CC}
- Low Noise Overshoot and Undershoot<10% of V_{CC}
- Input-Disable Feature Allows Floating Input Conditions
- 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)

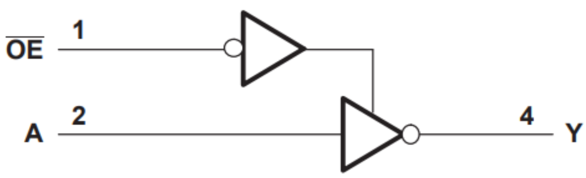
Applications

- Grid Infrastructure
- Telecon Infrastructure
- Medical, Healthcare, and Fitness
- Factory Automation and Control
- Printers and Other Peripherals

Pin Configuration



Simplified Schematic



Pin Assignment

Pin Name	Pin No.	Pin Function
$\overline{OE}$	1	Input
A	2	Input
GND	3	Ground
Y	4	Output
VCC	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 input voltage	V_{IH}	V_{CC} = 0.8V	V_{CC}			V
		V_{CC} = 1.1V to 1.95V	0.65 xV_{CC}			
		V_{CC} = 2.3V to 2.7V	1.6			
		V_{CC} = 3V to 3.6V	2			
Low- level input voltage	V_{IL}	V_{CC} = 0.8V			0	V
		V_{CC} = 1.1V to 1.95V			0.35 x V_{CC}	
		V_{CC} = 2.3V to 2.7V			0.7	
		V_{CC} = 3V to 3.6V			0.9	

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	
Input transition rise or fall rate	△T/△V	V_{CC} = 0.8V to 3.6V			200	ns/V
Operating temperature	T_A		-40		85	℃

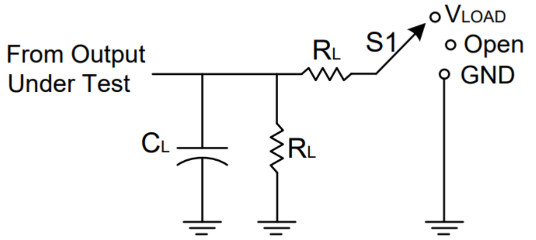
Electrical Characteristics

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
High- level output voltage	V_{OH}	V_{CC} = 0.8~3.6V, I_{OH}= -20uA	V_{CC}-0.1			V
		V_{CC} = 1.1V, I_{OH}= -1.1mA	0.75 xV_{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			0.3 xV_{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	△I_{CC}	V_I= V_{CC}-0.6V, I_{OUT}=0			40	uA

Switching Characteristics

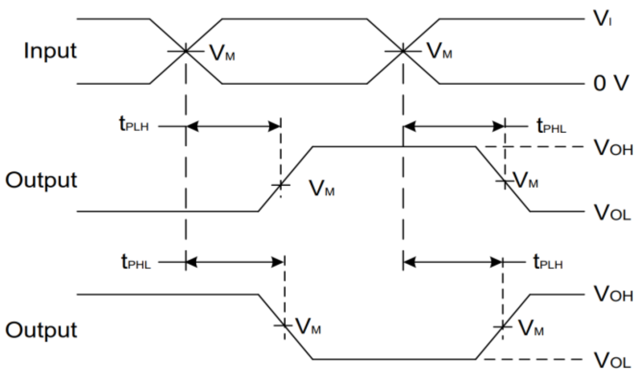
Parameter	From Input	To Output	Test Conditions	Min	Typ	Max	Units
T_{PD}	A	Y	V_{CC} = 0.8V		22.4		ns
			V_{CC} = 1.2V±0.1V,	6.4	9.7	12.9	
			V_{CC} = 1.5V±0.1V,	4.8	7.1	8.7	
			V_{CC} = 1.8V±0.15V	3.9	5.8	7.2	
			V_{CC} = 2.5V±0.2V	2.9	4.4	5.4	
			V_{CC} = 3.3V±0.3V	2.4	3.6	4.5	
T_{en}	$\overline{OE}$	Y	V_{CC} = 0.8V		23.3		ns
			V_{CC} = 1.2V±0.1V,	6	10.1	15.8	
			V_{CC} = 1.5V±0.1V,	4.9	7	9.9	
			V_{CC} = 1.8V±0.15V	4	5.5	7.5	
			V_{CC} = 2.5V±0.2V	3.2	4	4.9	
			V_{CC} = 3.3V±0.3V	2.8	3.4	4	
T_{dis}	$\overline{OE}$	Y	V_{CC} = 0.8V		11.1		ns
			V_{CC} = 1.2V±0.1V,	4.1	5.3	5.8	
			V_{CC} = 1.5V±0.1V,	2.7	4	5.5	
			V_{CC} = 1.8V±0.15V	3.1	4.5	5.4	
			V_{CC} = 2.5V±0.2V	2.4	3	3.2	
			V_{CC} = 3.3V±0.3V	3.3	4.7	5.4	

Parameter Measurement Information

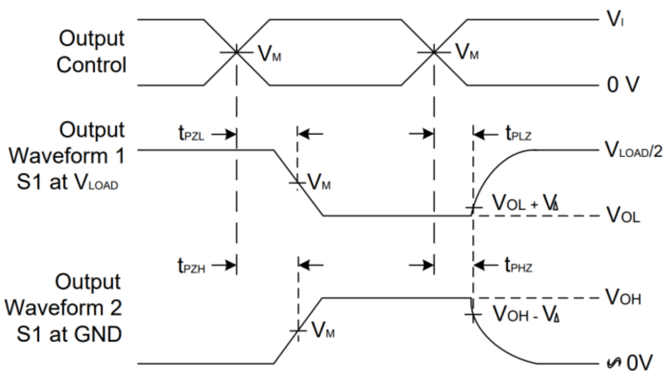


TEST	S1	R_L
t_{PLH}/t_{PHL}	Open	1MΩ
t_{PLZ}/t_{PZL}	V_{LOAD}	5KΩ
t_{PHZ}/t_{PZH}	GND	5KΩ

VCC	INPUTS		V_M	V_{LOAD}	C_L	V△
	V_I	t_r/t_f				
0.8V	V_{CC}	≦3ns	$V_{CC}/2$	2 X V_{CC}	15pF	0.1V
1.2V±0.1V,	V_{CC}	≦3ns	$V_{CC}/2$	2 X V_{CC}	15pF	0.1V
1.5V±0.1V,	V_{CC}	≦3ns	$V_{CC}/2$	2 X V_{CC}	15pF	0.1V
1.8V±0.15V	V_{CC}	≦3ns	$V_{CC}/2$	2 X V_{CC}	15pF	0.15V
2.5V±0.2V	V_{CC}	≦3ns	$V_{CC}/2$	2 X V_{CC}	15pF	0.15V
3.3V±0.3V	V_{CC}	≦3ns s	$V_{CC}/2$	2 X V_{CC}	15pF	0.3V



Voltage Waveform Propagation Delay Times
Inverting and Non Inverting Outputs



Voltage Waveform Enable and DisableTimes
Low- and High-Level Enabling

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_{PLZ} and t_{PHZ} are the same as t_{dis}
E. t_{PZL} and t_{PZH} are the same as t_{en}
F. t_{PLH} and t_{PHL} are the same as t_{PD}

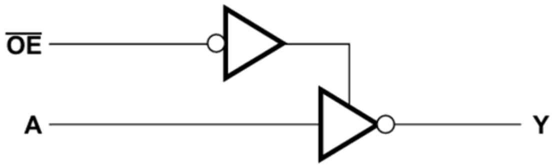
IC Operation Information

Basic Operation

This device contains one inverter gate device with active low output enable control and performs the Boolean function Y = $\overline{A}$. 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.

To assure the high-impedance state during power up or power down, $\overline{OE}$ must be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

Function Block Diagram



Feature Description

- Wide operating voltage range.
  - Operates from 1.65 V to 5.5 V.
- Allows down voltage translation.
- Inputs accept voltages to 5.5 V.
- Ioff feature allows voltages on the inputs and outputs when V_{CC} is 0 V..

Device Functional Table

INPUTS		OUTPUT
$\overline{OE}$	A	Y
L	H	L
L	L	H
H	X(1)	Z

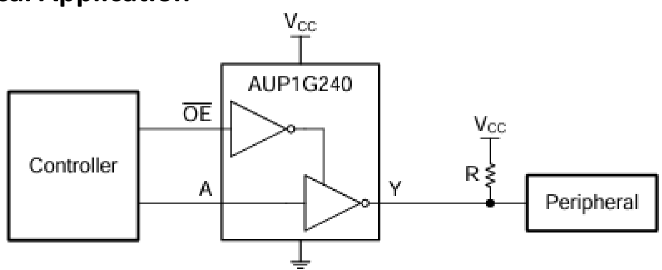
IC Application Information

The AUP family is the solution to the industry's low-power needs in battery-powered portable applications. This family assures a very low static and dynamic power consumption across the entire VCC range of 0.8 V to 3.6 V, resulting in an increased battery life. This product also maintains excellent signal integrity. It has a small amount of hysteresis built in allowing for slower or noisy input signals.

The lowered drive produces slower edges and prevents overshoot and undershoot on the outputs. The AUP family of single gate logic makes excellent translators for the new lower voltage microprocessors that typically are powered from 0.8 V to 1.2 V. They can drop the voltage of peripheral drivers and accessories that are still powered by 3.3 V to the lower voltage levels.

The CL74AUP1G240 is essentially an inverter that can be placed into a high-impedance state. In this application, the output is forced to VCC when the CL74AUP1G240's output is disabled, and when the output is enabled, the device performs the function Y = $\overline{A}$.

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 high drive 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

– Rise time and fall time specs. See (Δt/ΔV) in the Recommended Operating Conditions table.

– Specified high and low levels. See (V_{IH} and V_{IL}) in the Recommended Operating Conditions 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. Recommend Output Conditions

– Load currents should not exceed (I_O max) per output and should not exceed total current (continuous current through V_{CC} or GND) for the part. These limits are located in the Absolute Maximum Ratings table.

– Outputs should not be pulled above V_{CC}.

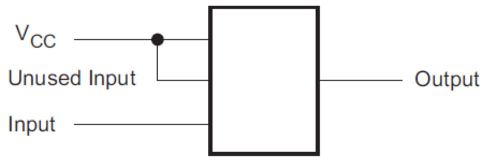
Power Supply Recommendations

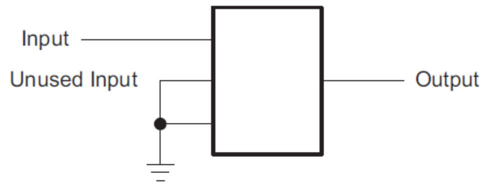
The power supply can be any voltage between the min and max supply voltage rating located in the Recommended Operating Conditions table.

The VCC pin must have a good bypass capacitor to prevent power disturbance. TI recommends to use a 0.1-μF capacitor for this device. It is ok to parallel multiple bypass caps to reject different frequencies of noise. 0.1-μF and 1-μF capacitors are commonly used in parallel. Install the bypass capacitor as close to the power pin as possible for best results.

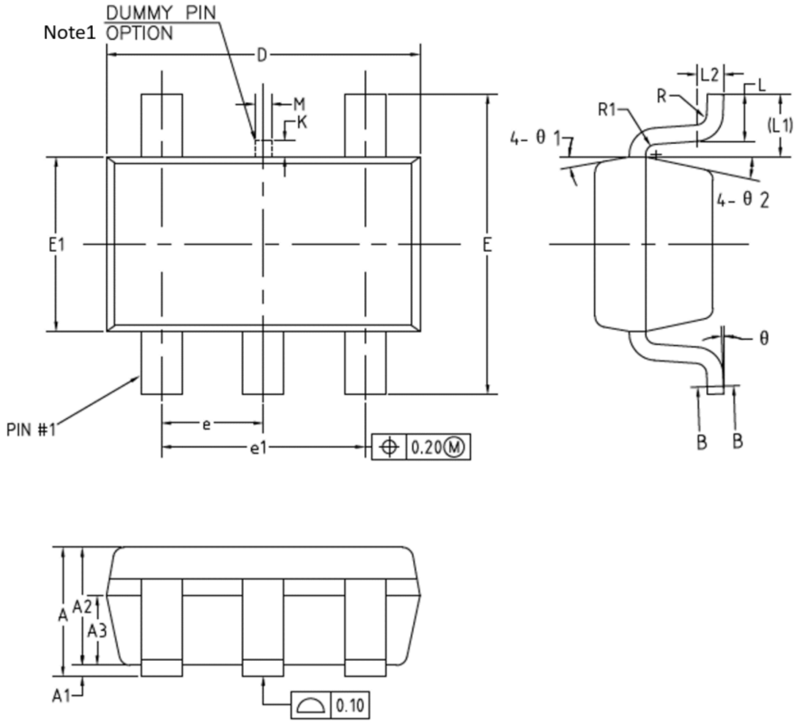
Layout Considerations

When using multiple bit logic devices inputs should not ever 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. Specified below are 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 V_{CC} whichever make more sense or is more convenient.





Package Information
SOT23-5

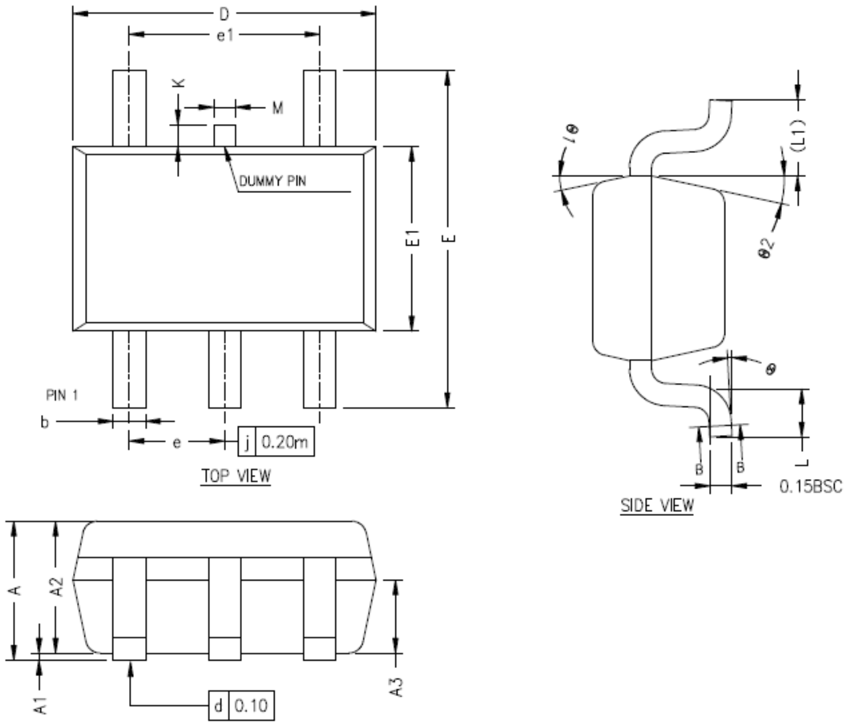


COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

	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°