LOGIC PROBE

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OBJECTIVE

Having a logic probe handy is always a must for an electronics workshop. By this project, instead of buying one, we aim to build our own logic probe for a fraction of the cost and have it working in an hour.

Oscilloscopes are extremely helpful when testing and troubleshooting digital circuits. But for many individuals, an oscilloscope may not be a solution because of the price tag (hundreds to thousands of dollars) or the space. For those without scopes, there is a simple solution-The logic Probe.

ABSTRACT

The logic probe is meant to analyse the input signal and thus categorise it into either ON, OFF, OSCILLATING or FLOATING signal. The signal can be deduced as any of the above by the means of an LED embedded in the instrument.

The advantages of a Logic Probe over an Oscilloscope are-

- Cost effective design
- Able to show floating signal while an oscilloscope cannot detect these signals as most of them have grounded potential.
- Easy to handle.
- Simple circuitry, helpful in order to debug the circuit more easily.

COMPONENTS

1. 4001 IC-
   The 4001 is a member of the 4000 Series CMOS range, and contains four independent NOR gates, each with two inputs.

2. 1K Ohm resistor

3. 2.2M Ohm resistor

4. 4.7M Ohm resistor

5. 100nF capacitor

6. LED-
   Red, yellow and green LED are required to be connected

7. Bread Board-

8. Connecting wires

9. 9V DC supply

DESIGN

The logic probe circuit consists of a single 4001 quad NOR gate. The first circuit (U1A) is an oscillator and the second circuit (U1B and U1C) is a monostable multivibrator .

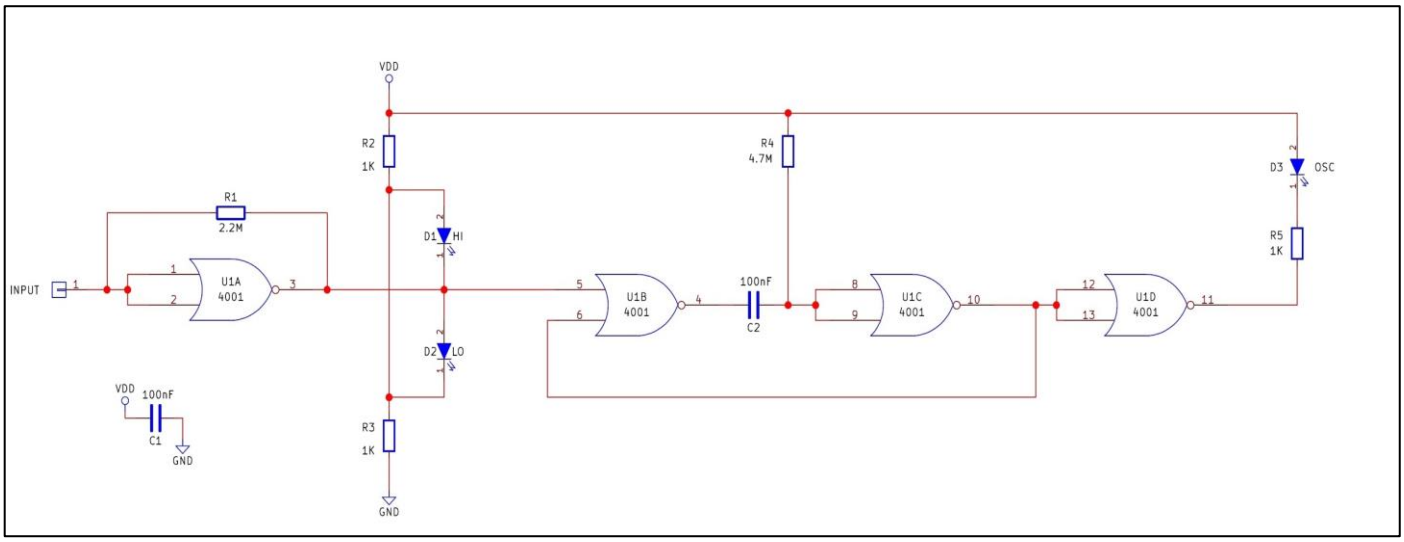


FIG 1. SCHEMATIC FOR LOGIC PROBE

Component	***Schematic Reference***
4001 IC	U1A, U1B,U1C, U1D
1K Resistor	R2, R3, R5
2.2M Resistor	R1
4.7M Resistor	R4
100nF Capacitor	C1, C2
LED Green (3mm)	D1
LED Red (3mm)	D2
LED Yellow (3mm)	D3

WORKING

Floating Input

If the input is not connected to anything (floating), the logic gate U1A will oscillate (albeit a very small oscillation centred around VCC / 2). The NOR gate is behaving as a NOT gate (as both inputs are tied together) with the output connected to the input (through R1). If the output is logic high, then the input voltage will be high as well—but if the input voltage is high, then the output voltage should be low (as it is an inverter). It is this “out of phase” setup that causes U1A to oscillate (where the frequency of oscillation is determined by the resistor R1 and the input capacitance of U1A).

When the output is floating, it will be a very small oscillation of about VCC / 2), the Green and Red LED (Hi and Low, respectively) will be off or dim depending on the size of R2 and R3. U1B and U1C are configured as a monostable multivibrator (the off period being determined by R4 and C2) with an inverting output stage (U1D) which is connected to an LED (D3). When the output voltage of U1A makes a low-to-high transition, the monostable is triggered and will turn on the LED (D3) to indicate that the input signal has changed. With U1A oscillating (as the input is floating and the feedback resistor R1 causes U1A to oscillate), the monostable is constantly triggered by U1A and thus the oscillating indicator (D3) will stay on.

Oscillating Signal

When the probe is connected to an oscillating signal (one that swings between VDD and GND), not only is the oscillating indicator (D3) on but so are D1 and D2.

Note: The logic probe will also give you some idea of the duty cycle of the signal under test. If the signal has a high duty signal (for example, 90% on 10% off) the HI LED (D1) will be much brighter than the LO LED (D2).

ON / OFF Signals

When the probe is connected to either an ON or OFF signal, the oscillating indicator (D3) will turn off because the monostable is not being triggered (as the input signal to the logic probe is not changing). If the input is ON, then the HI LED (D1) will turn on. If the input is OFF, then the LO LED (D2) will turn on.

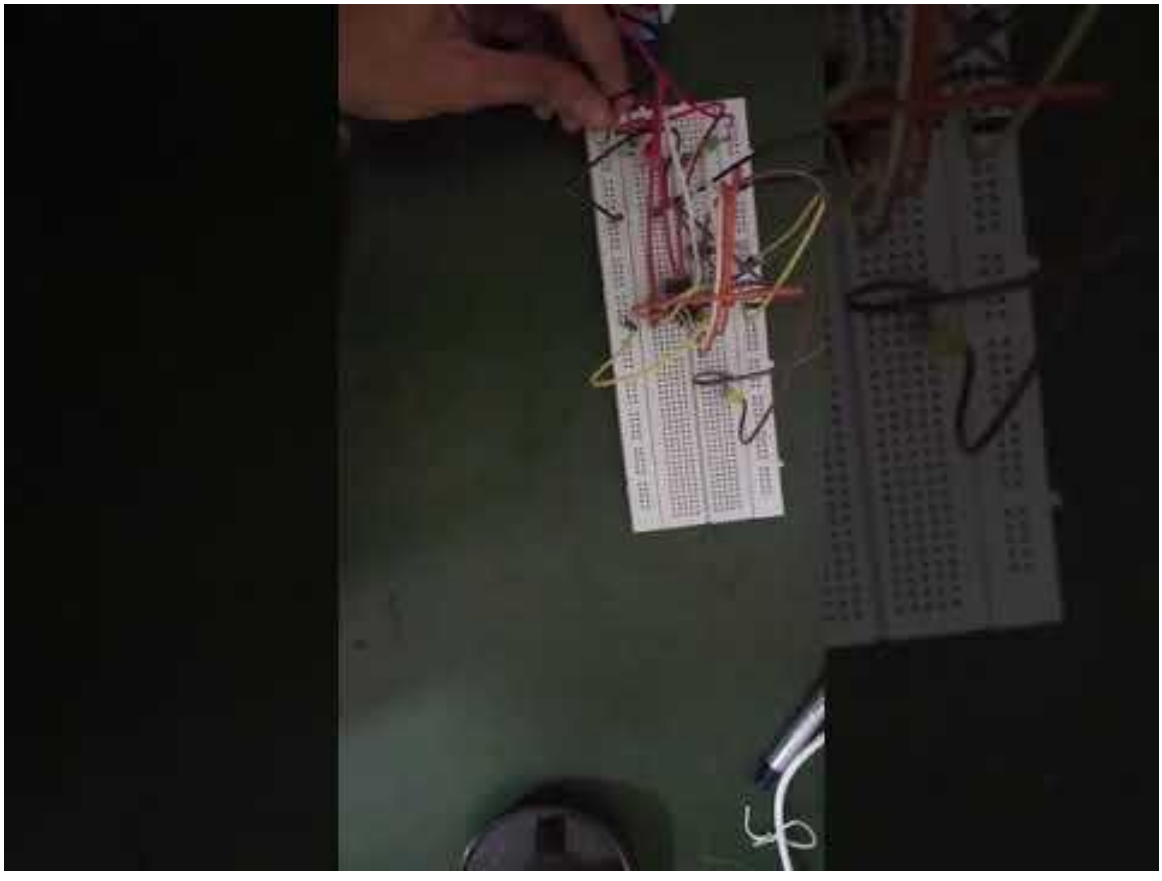
Grounding

For the probe to function correctly, the ground on the logic probe and the ground on the circuit under test must be connected. This is where the 0V ref pad comes into play. This pad gives a place to connect your probe's ground to the ground of the circuit under test.

WORKING

Function	Red LED	Yellow LED	Green LED
On	OFF	OFF	ON
Off	ON	OFF	OFF
Oscillating	ON	ON	ON
Floating	OFF	ON	OFF

VIDEO LINK



COST INVOLVED

Sr.No	Item	Cost(₹)	quantity	total
1.	4001 IC	20	1	20
2.	1K Ohm resistor	1	3	3
3.	2.2M Ohm resistor	1	1	1
4.	4.7M Ohm resistor	1	1	1
5.	100nF capacitor	1	2	2
6.	LED	1	3	3
7.	Bread board	65	1	65
8.	Connecting wires	0.5	20	10
9.	9V DC supply	10	1	10
TOTAL:				**115**

IMAGES

File info

20	17

Size
2.2 MB

Dimensions
4608 x 2176

Shot
1/15 sec. f/1.7 4.25 mm

ISO
800

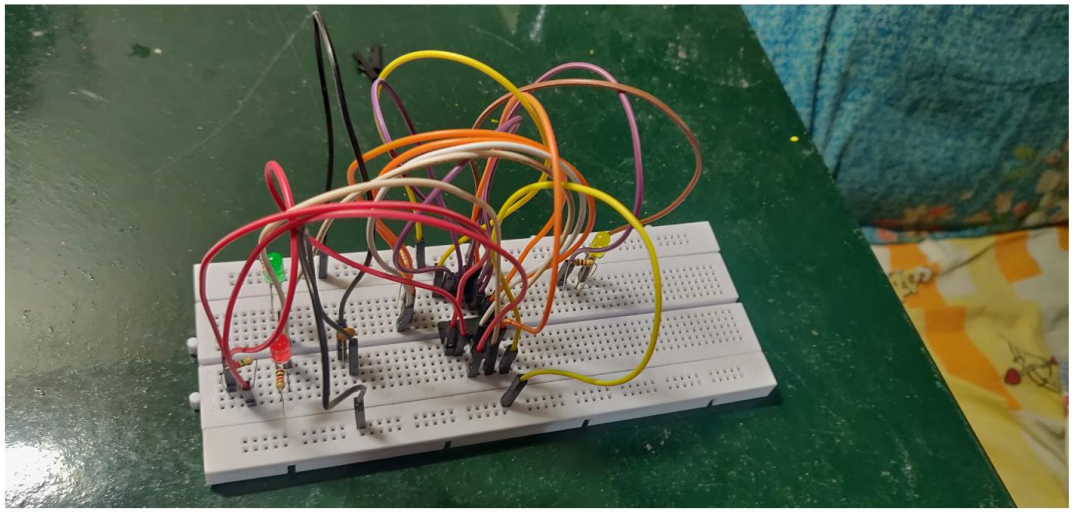
Device
ONEPLUS A6000

Folder path
C:\Users\Naveen Ravishankar\Desktop

Source
This PC

Location
12.97248, 79.16119

Open map



File info

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Size
1.5 MB

Dimensions
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Shot
1/10 sec. f/1.7 4.25 mm

ISO
2500

Device
ONEPLUS A6000

Folder path
C:\Users\Naveen Ravishankar\Desktop

Source
This PC

Location
Katpadi

Open map

REFERENCES

- https://www.allaboutcircuits.com/projects/diy-tools-build-your-own-logic-probe/

- https://maker.pro/custom/tutorial/diy-tools-series-how-to-build-a-logic-probe