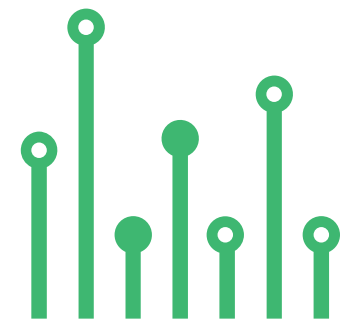


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SENSOR



# Capacitive Humidity Sensor To Analog Output Converter



SKU: EL145088

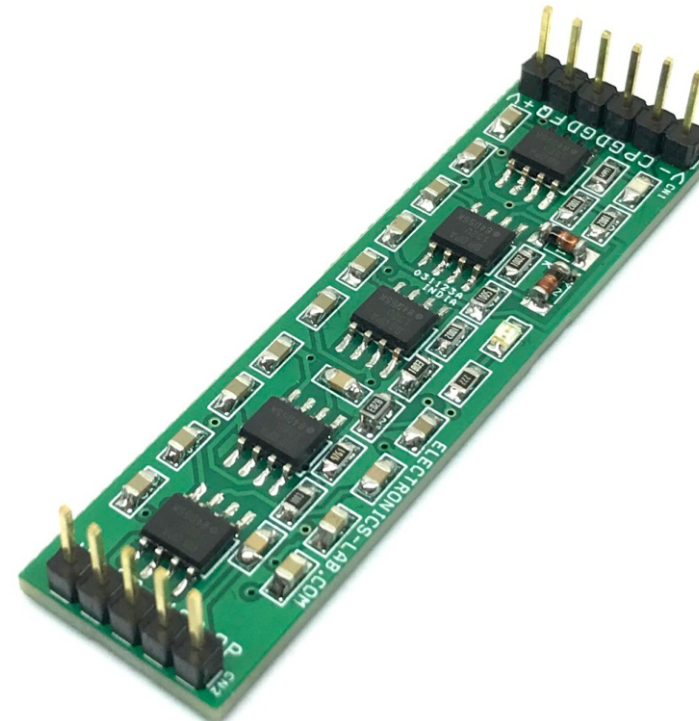
# Capacitive Humidity Sensor To Analog Output Converter



The project presented here is an analog capacitive humidity sensor converter board suitable for various humidity measurement tasks. The circuit comes from Texas Instruments application note (see below). Most conventional capacitive proximity sensors produce a digital signal, but this circuit produces a DC output voltage that is a function of the relative humidity of the environment. The oscillator input for this circuit is a 1Khz sine source (1Vpp) feed to FQ input. The low frequency and sine characteristics keep RFI problems at a minimum. This sensor output converter may prove difficult to construct because of the small capacitances involved, parasitic capacitances in the sensor circuit, and noise pickup. The circuit requires an external 1Khz sinewave with 1Vpp signal and operates with a dual 15V DC supply.

## FEATURES

- Power Supply +/-15V (Dual 15V DC)
- Header Connector for Sensor Inputs and Outputs
- On Board Power LED
- Works with various capacitive humidity sensors (see below)
- PCB Dimensions 60.17 X 16.19MM



The circuit consists of a complete charge amplifier for the detection of the capacitive sensor's capacitance change. The charge amplifier is followed by an absolute value circuit which serves as a full-wave rectifier. This part of the circuit converts the varying AC signal from the charge amplifier to a DC voltage, however this DC voltage is unfiltered and contains the carrier frequency ripple.

So the next part of the circuit takes this DC voltage and passes it through a 2-stage, 4-pole low pass filter to remove the ripple. This results in a DC voltage that is a function of the charge amplifier gain. To design the 4th order filter stage, Filter\_Pro\_v1.3 Tool is used.

The previous charge amplifier circuit produces a stable DC level for a fixed charge amplifier gain. In the diagram below the input sensor capacitance is changed to 3 different values, 160, 180 and 200pF, thus resulting in three different charge amplifier gains and corresponding DC levels.

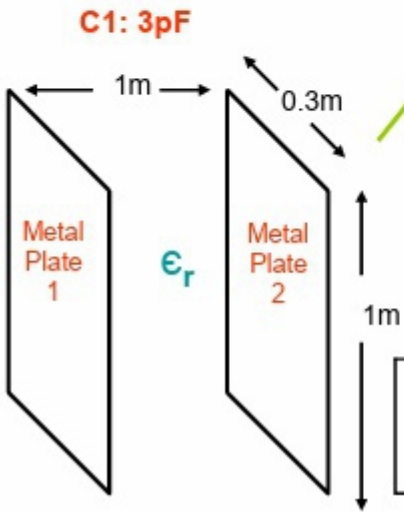
## Further Improvements

The circuit is not overly sensitive and a large DC level is present. Adding gain would help exaggerate the DC change that results from the capacitance change, but the large DC level would be gained up as well. This would have to be dealt with in a subsequent stage.

## CAPACITIVE HUMIDITY SENSOR

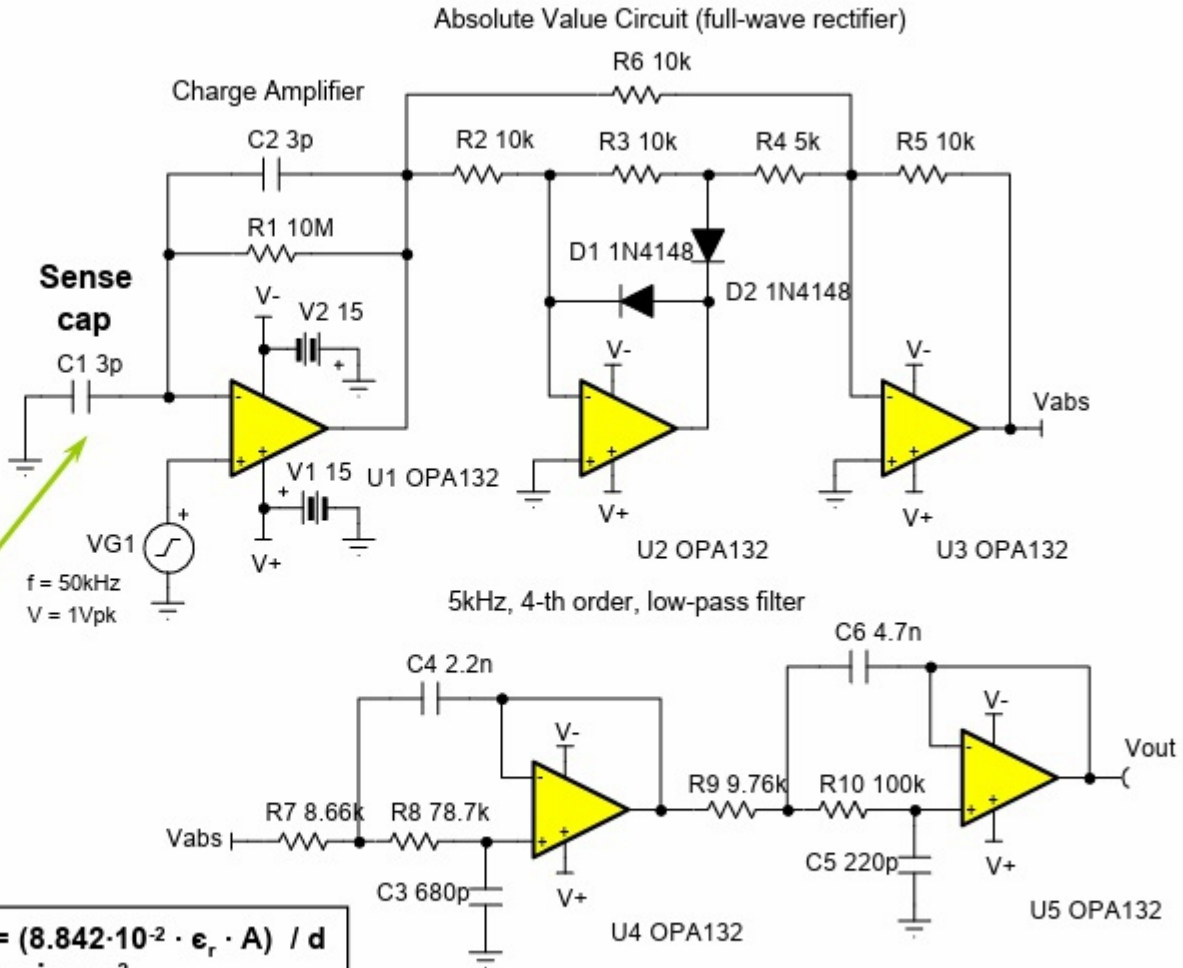
A suitable capacitive humidity sensor for this board is the P14-W from IST-AG, but any other capacitive sensor with similar specifications should work. This sensor is ideal for universal humidity measuring tasks in a wide variety of different applications. The sensor is capable of measuring 0 % RH to 100 % RH (maximal dew point +85 °C) with a capacitance of 150 pF  $\pm$ 50 pF (wired) / 180 pF  $\pm$ 50 pF (SMD) (at 30 % RH and +23 °C) and operates within a temperature range of -50 °C to +150 °C. An alternative sensor is the KFS140-D from B+B sensors.

Dielectric	Relative Permittivity
Vacuum	1.0
Air	1.0006
Teflon™	2.0
Glass	7.5
Water	80

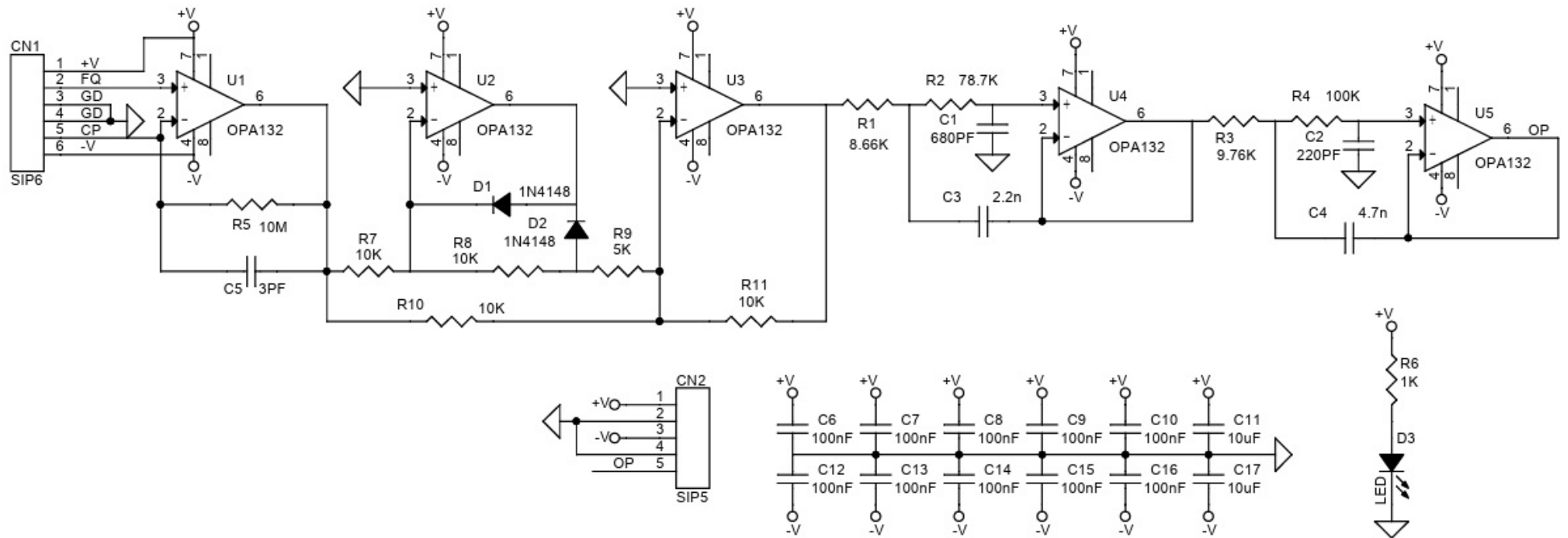


$$C_{(pF)} = (8.842 \cdot 10^{-2} \cdot \epsilon_r \cdot A) / d$$

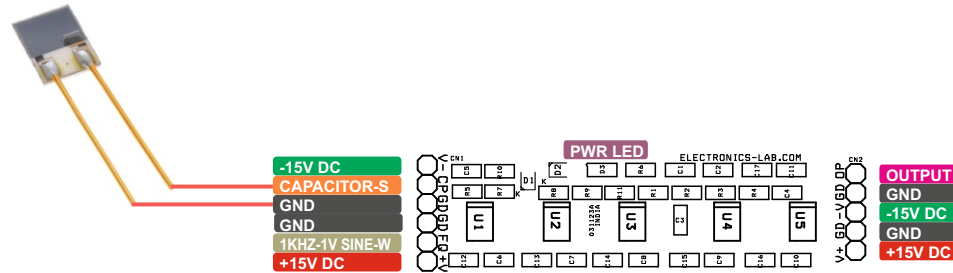
A: area in cm<sup>2</sup>  
d: plate distance in cm



# Schematic



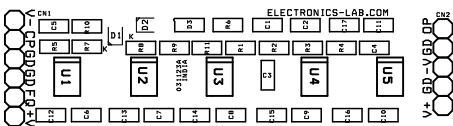
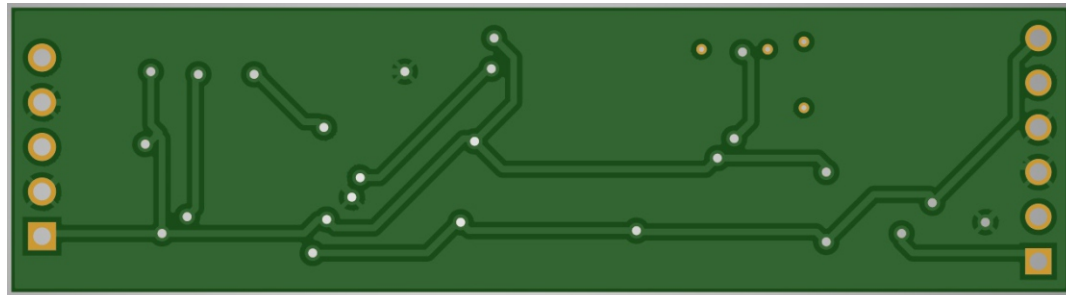
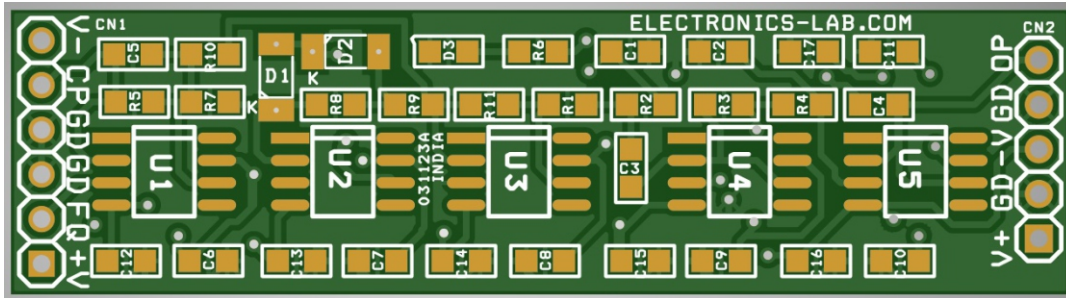
# Connections



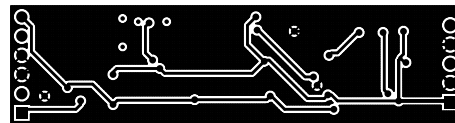
## Connections

- CN1: Pin 1 = +V 15V DC, Pin 2 = Frequency Input 50Khz Sine Wave 1V Peak to Peak, Pin 3 GND, Pin 4 = GND, Pin 5 = Sensor, Pin 6 = -V 15V
- CN2: Pin 1 = +V 15V DC, Pin 2 = GND, Pin 3 = -V 15V, Pin 4 = GND, Pin 5 = Output
- D3 Power LED

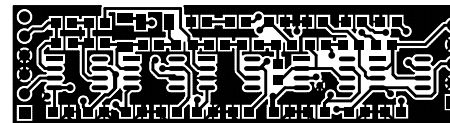
# PCB



SILK SCREEN TOP



BOTTOM LAYER



TOP LAYER

PCB DIMENSIONS 60.17 X 16.19MM





# Parts List

BOM						
NO.	QNTY.	REF	DESC	MANUFACTURER	SUPPLIER	SUPPLIER PART NO
1	1	CN1	6 PIN MALE HEADER PITCH 2.54MM	WURTH	DIGIKEY	732-5319-ND
2	1	CN2	5 PIN MALE HEADER PITCH 2.54MM	WURTH	DIGIKEY	732-5318-ND
3	1	C1	680PF/50V CERAMIC SMD SIZE 0805	YAGEO/MURATA	DIGIKEY	
4	1	C2	220PF/50V CERAMIC SMD SIZE 0805	YAGEO/MURATA	DIGIKEY	
5	1	C3	2.2nF/50V CERAMIC SMD SIZE 0805	YAGEO/MURATA	DIGIKEY	
6	1	C4	4.7nF/50V CERAMIC SMD SIZE 0805	YAGEO/MURATA	DIGIKEY	
7	1	C5	3PF/50V CERAMIC SMD SIZE 0805	YAGEO/MURATA	DIGIKEY	
8	10	C6,C7,C8,C9,C10,C12,C13,C14,C15,C16	100nF/50V CERAMIC SMD SIZE 0805	YAGEO/MURATA	DIGIKEY	
9	2	C11,C17	10uF/25V CERAMIC SMD SIZE 0805	YAGEO/MURATA	DIGIKEY	
10	2	D1,D2	1N4148 SMD	MICROCHIP	MOUSER	494-1N4148UR-1
11	1	D3	RED LED SMD SIZE 0805	OSRAM	DIGIKEY	475-1278-1-ND
12	1	R1	8.66K 1% SMD SIZE 0805	YAGEO/MURATA	DIGIKEY	
13	1	R2	78.7K 1% SMD SIZE 0805	YAGEO/MURATA	DIGIKEY	
14	1	R3	9.76K 1% SMD SIZE 0805	YAGEO/MURATA	DIGIKEY	
15	1	R4	100K 1% SMD SIZE 0805	YAGEO/MURATA	DIGIKEY	
16	1	R5	10M 1% SMD SIZE 0805	YAGEO/MURATA	DIGIKEY	
17	1	R6	1K 1% SMD SIZE 0805	YAGEO/MURATA	DIGIKEY	
18	4	R7,R8,R10,R11	10K 1% SMD SIZE 0805	YAGEO/MURATA	DIGIKEY	
19	1	R9	5K 1% SMD SIZE 0805	YAGEO/MURATA	DIGIKEY	
20	5	U1,U2,U3,U4,U5	OPA132 SOIC8	TI	MOUSER	595-OPA132UA/2K5

# Notes

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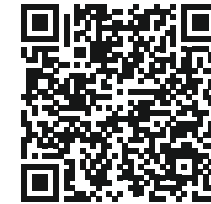
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## APP

**Android App**

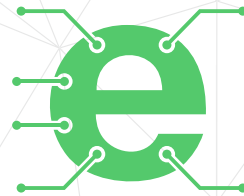
DOWNLOAD



Android App launched in 2017 and has 100k+ downloads - rated with 4.5 stars.

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