1 Humidity measurement using a frequency output signal

The following schematic delivers a frequency output signal with a periodic time that is proportional to the relative humidity. An established time reference must be provided (e.g. quartz crystal) to determine this periodic time accurately.

1.1 Schematic circuit diagram

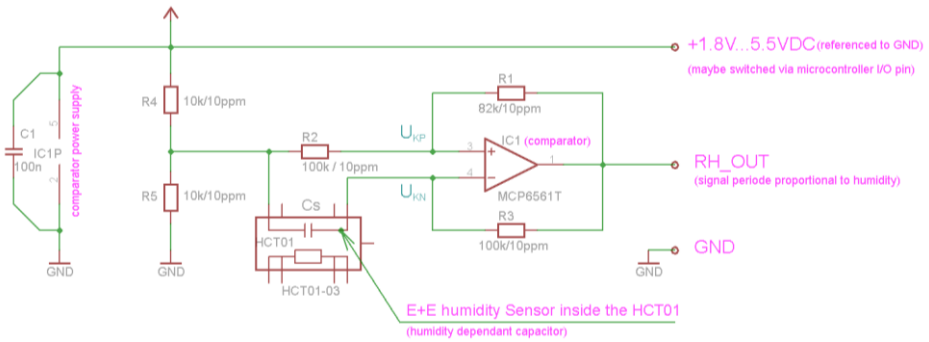

Figure 1: Circuit layout

1.2 Bill of Material

1 pcs .....HCT01-03xTR1 (E+E Elektronik)
1 pcs .....IC1; MCP6561T (Microchip)
1 pcs .....C1; 100n, ceramic
1 pcs .....R1; 82k // 0.1% // 10ppm/°C
2 pcs .....R2,R3; 100k // 0.1% // 10ppm/°C
2 pcs .....R4,R5; 10k // 0.1% // 10ppm/°C

1.3 Simplified correlation between humidity and cycle duration

- Humidity Sensor HCT01 (approx.): **70pF@0%RH** - **95pF@100%RH**
- Period at RH_OUT: **70pF ➔ 19.0µs cycle duration** - **95pF ➔ 25.4µs cycle duration**

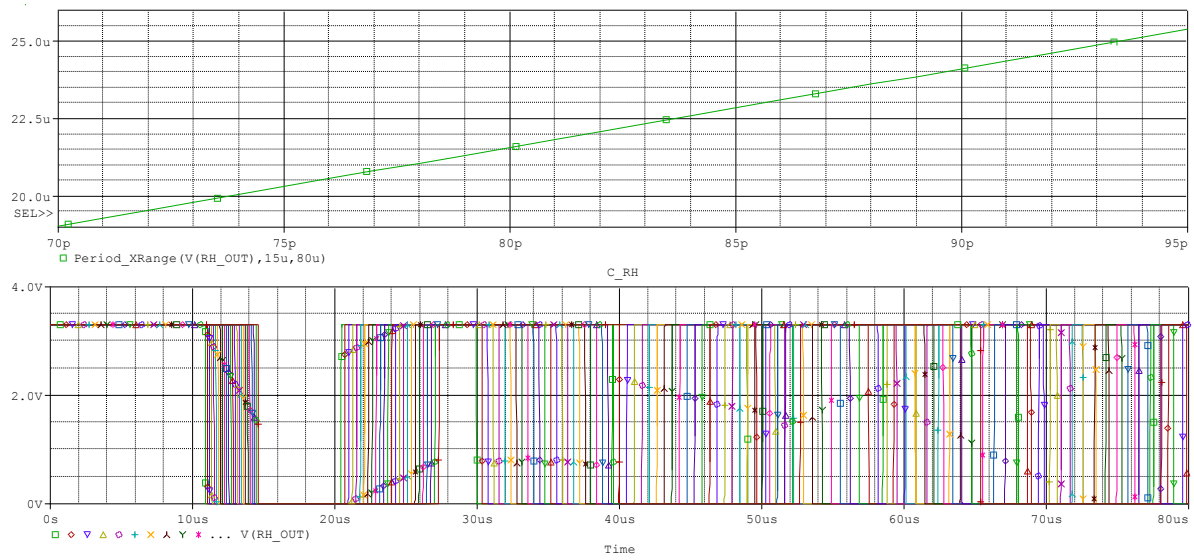

Figure 2: The sensitivity is approx. 0,064µs/%RH / 0.25pF/%RH

2 Development procedure

2.1 Evaluation of resistor values to reach the desired output frequency

The output frequency (RH_OUT), depending on resistor R3, should be in the range of 10kHz to 100kHz. A recommended value of R3 is 100kOhm. The tolerances of the resistors influence the initial accuracy of the electronic and therefore the accuracy of the humidity measurement.

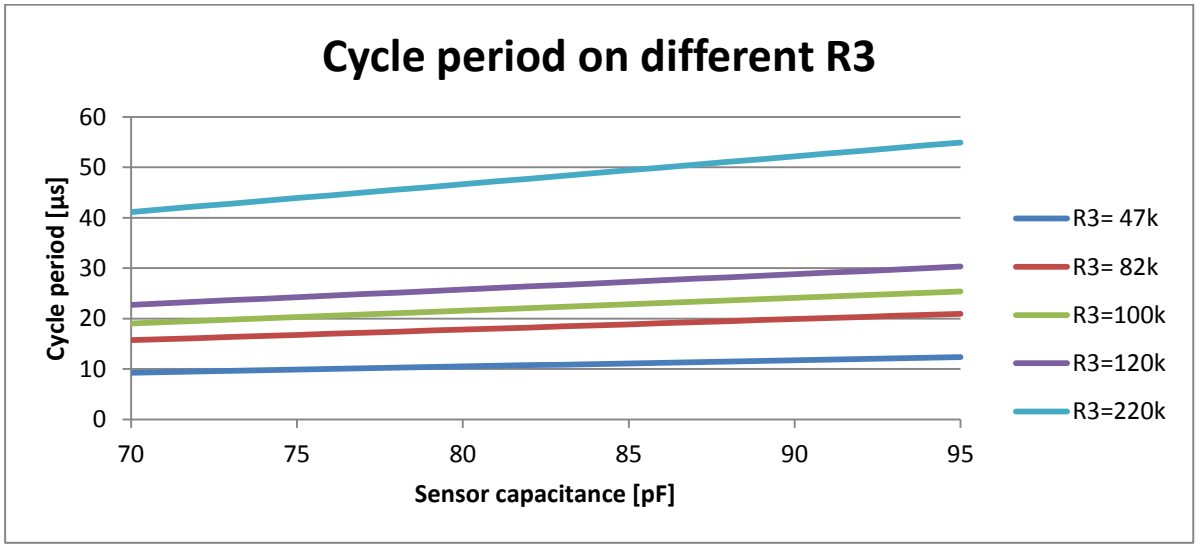

Figure 3: Cycle period on different R3

2.2 Circuit layout

This is a capacitance measurement circuit which does not differ between the humidity sensor and the PCB. Keep the PCB- and humidity sensor stray capacitance as low as possible. The simulation in Figure 2 is without PCB stray capacitances. The chosen comparator has a very low input current ➔ see comparator datasheet for layout recommendations (guard ring).

2.3 Evaluation of nominal values (only during development):

There are four options to find the nominal values:

1. Measure an appropriate amount of prototypes at defined environmental (humidity) conditions
2. Measure an appropriate amount of prototypes with defined capacitors (measure each capacitor) instead of the humidity sensor HCT01
3. Simulate the circuit without any stray capacitance
    - Layout the PCB
    - Back annotation of the layout stray capacitances
    - Re simulate the schematic circuit as accurately as possible
4. Simulate the circuit without any stray capacitance
    - Measure the PCB stray capacitances
    - Include the measured values in the designed schematics
    - Re simulate the schematic

If options three or four are used take care that the simulation is as good as the models used in the simulation. The nominal characteristics can be found at the desired operating voltage.

3 Example PCB

In the following example you can find a sample PCB with the respective characteristic curves.

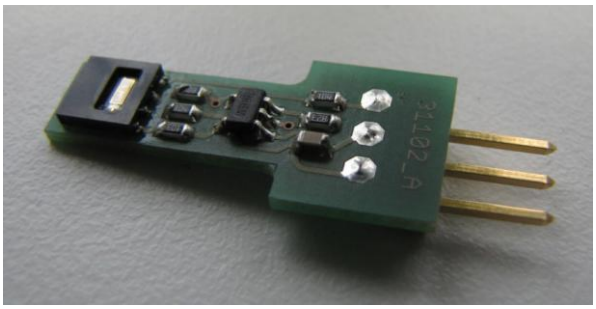

Figure 4: Sample PCB

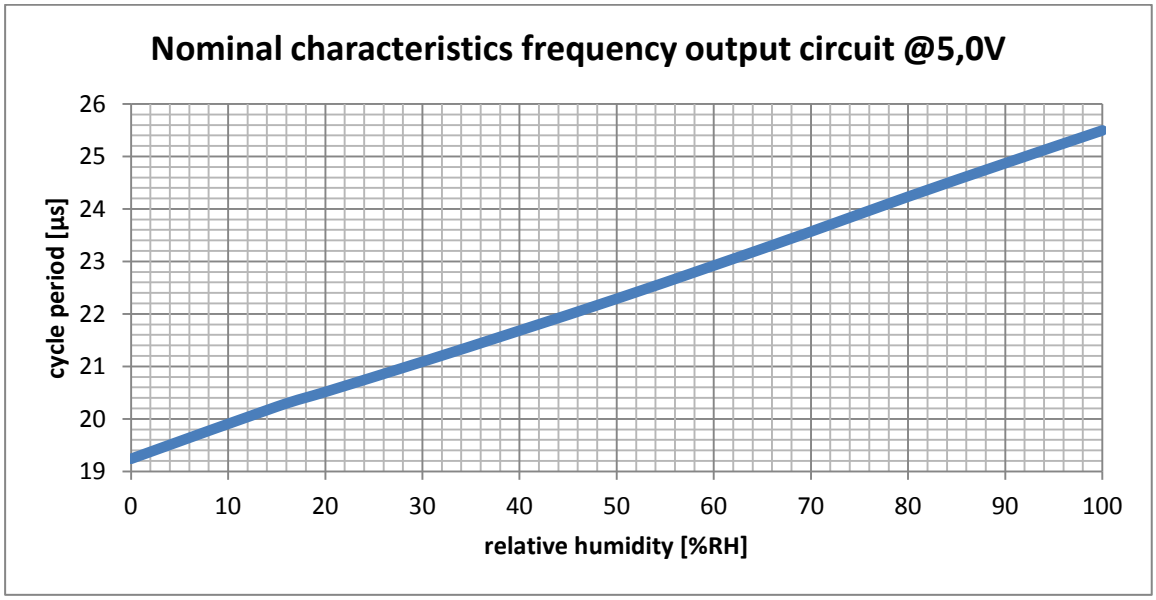

Figure 5: Nominal characteristics frequency output

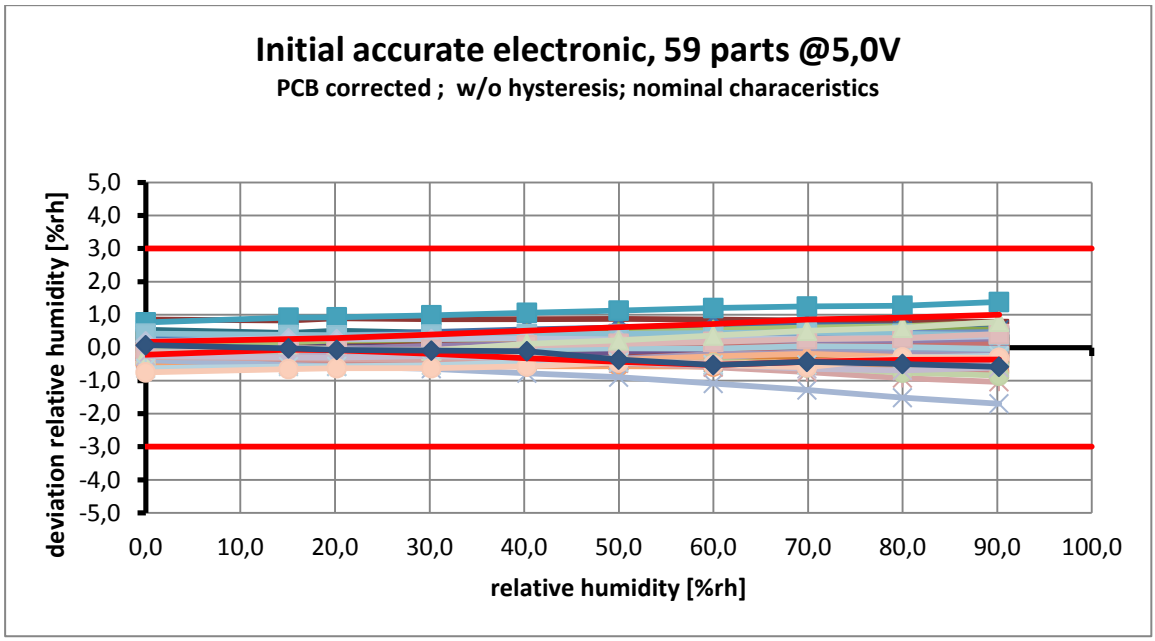

Figure 6: Deviation to nominal characteristics at 3.3 V

4 Contact information

E+E Elektronik Ges.m.b.H.
Langwiesen 7
A-4209 Engerwitzdorf
Austria
Tel.: +43 7235 605 0
Fax.: +43 7235 605 8
E-Mail: info@epluse.com
Homepage: www.epluse.com

Please visit our website to find your local contact.

Revision history

Date	Revision number	Changes
November 2011	V_0.1	Initial release