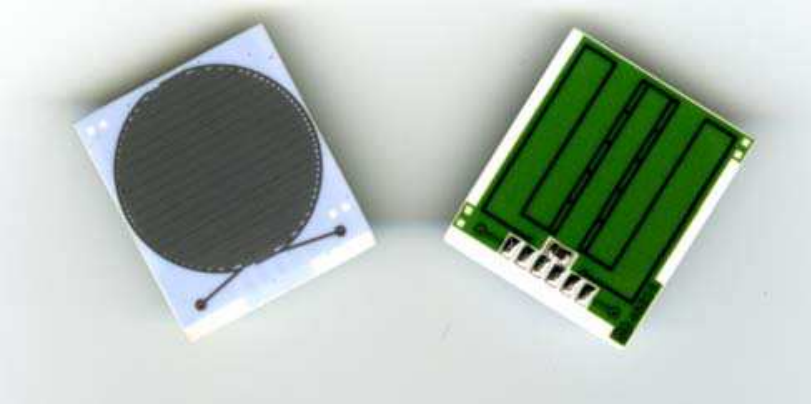
RAIN SENSOR



In this document we would describe an easy interface to use the Telecontrolli capacitive rain sensor.

Telecontrolli rain sensor is made of thick-film technology.
It is made up of three parts:

- Capacitive sensor
- Heater generator
- Temperature sensor

On the top side you can find the capacitive sensor. This side part is exposed to the natural agents (rain) while on the bottom side there are the heater generator, the temperature sensor and the connection interface (six pads).
Each function of the rain sensor has stand-alone connections compared to the other in the same mode; so the user has more flexibility in the design of hardware interface.
The capacitive sensor has a rain sensitive area, which in dry conditions assumes the nominal value.
Moreover in presence of the rain, the capacitance goes to high values compared to dry conditions and the ratio changing is over 300%.
In the table_1 is explained how the capacitance changes in the ratio of percentage of the sensitive area when covered by rain.

Sensitive area		Capacitance	Ratio Capacitance
% Dry	% water	pF	%
100	0	100	0
75	25	176	76
50	50	232	232
0	100	≥359	≥359

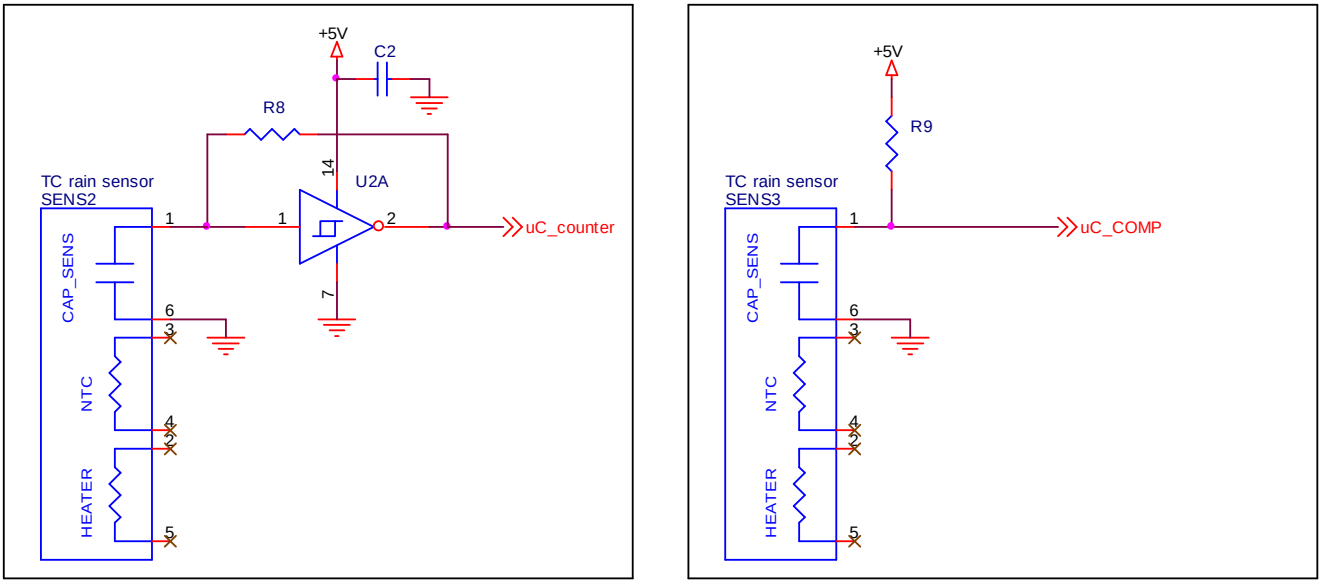
Table_1

RAIN SENSOR

To read the changing of sensor capacitance, we may adopt two strategies:

- Frequency measurements (counter mode)
- Pulse measurements (timer mode)

The simplest hardware which satisfies both strategies is a low cost microcontroller and few other parts.
In the diagrams_1 are showed the two hardware strategies for the capacitive sensor interface.



diagrams_1

On the bottom side of “rain sensor” you have one temperature sensor like NTC by Epcos p/n B57620C0102K with a nominal resistance value of 1000 Ohm @ 25°C.
This sensor may be used to monitor the environment temperature and to control the heather generator to avoid frost and dump.

RAIN SENSOR

In the table_2 is reported the Epcos R/T characteristic (resistance/temperature).

T (°C)	Rnom (Ohm)	Rmin (Ohm)	Rmax (Ohm)
-5	3564	3068	4061
0	2832	2457	3206
5	2267	1983	2552
10	1829	1611	2046
15	1486	1318	1653
20	1215	1086	1344
25	1000	900,0	1100
30	828,2	740,2	916,1
35	689,9	612,8	767,0
40	577,8	510,2	645,5
45	486,6	427,1	546,1
50	411,8	359,4	464,3
55	350,2	303,9	396,5
60	299,2	258,2	340,2
65	256,7	220,4	293,1
70	221,2	188,9	253,5
75	191,4	162,6	220,1
80	166,2	140,5	191,9
85	144,8	121,9	167,8

Table_2

RAIN SENSOR

In the diagram_2 is showed a simple method for the NTC conditioning.

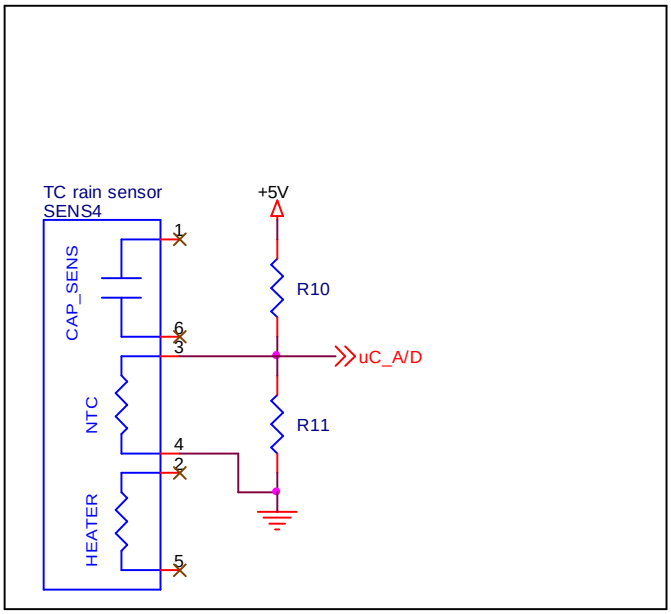


diagram_2

To drive the heather you need only one low cost NPN transistor with Ic ≤ 500mA / VCE ≥ 25V for 12V standard bus voltage.
The nominal resistance is 42 Ω and in this condition the current is I= 0.285A. It produces a power of P=3.43W. In the table_3 is reported the time that occurs to the heather to rise different temperatures of rain sensor.
The test has been done on a capacitive sensor with a dry surface.

Δt (sec)	°C Sensor Substrate	R_NTC (Ohm)	Δt (sec)	°C Sensor Substrate	R_NTC (Ohm)
0	27	930	90	76.5	188
15	41	550	105	78	175
30	54	360	120	79	169
45	62	280	135	81.5	163
60	68.5	238	150	82.5	160
75	73.5	206	165	83.5	156

RAIN SENSOR

table_3

To estimate the time/power (Joule) that needs to evaporate some grams of water it is possible to use the approximative formula:

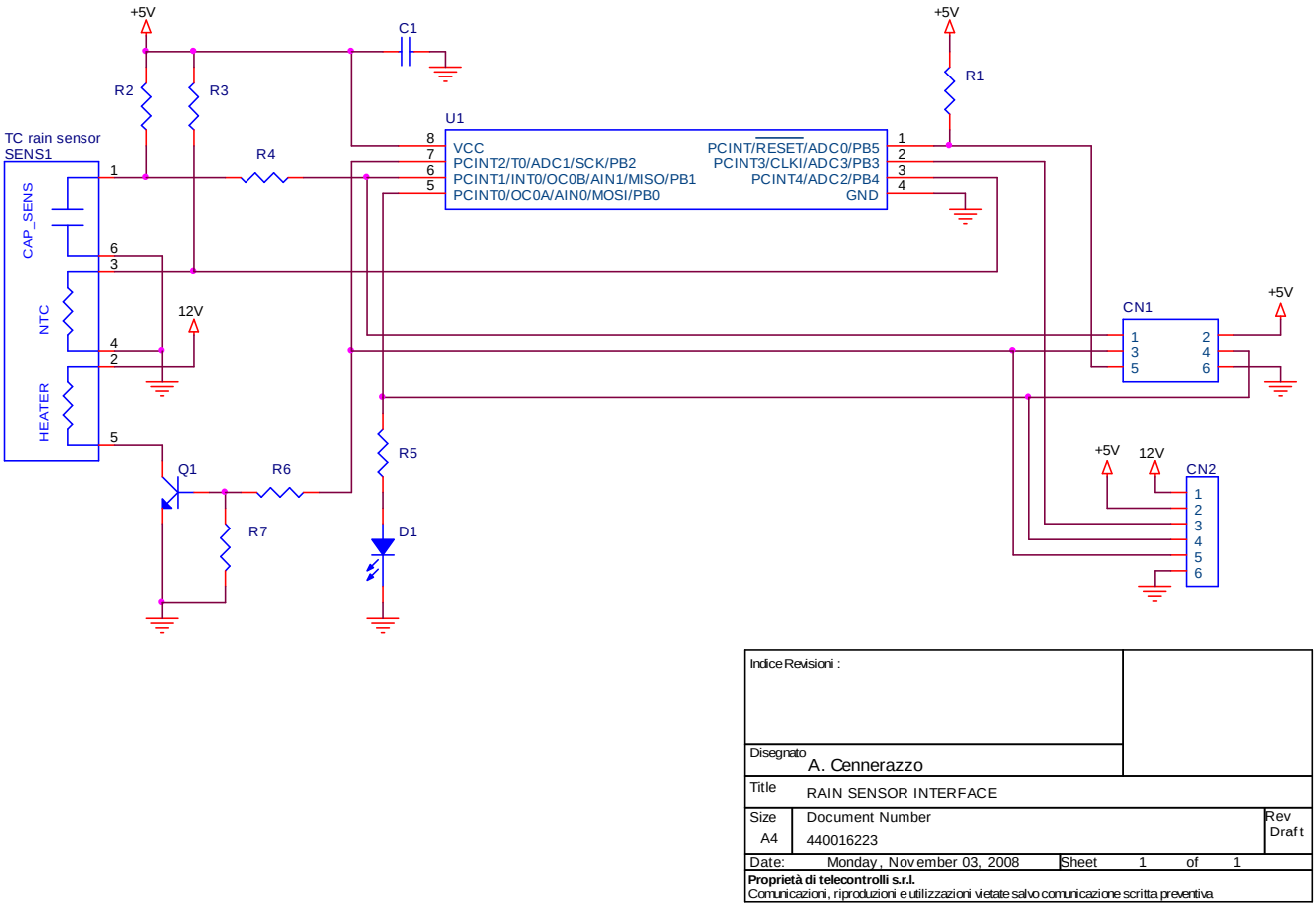
Time (sec) = grams_of_ humidity * 663

Conclusion

The use of the Telecontrolli rain sensor is the simplest way to design your own applications.

In the following diagram the whole hardware needs for the complete rain sensor management.

RAIN SENSOR



Indice Revisioni :	
Disegnato A. Cennerazzo	
Title RAIN SENSOR INTERFACE	
Size A4 / Document Number 440016223	Rev Draft
Date: Monday, November 03, 2008	Sheet 1 of 1

diagram_3