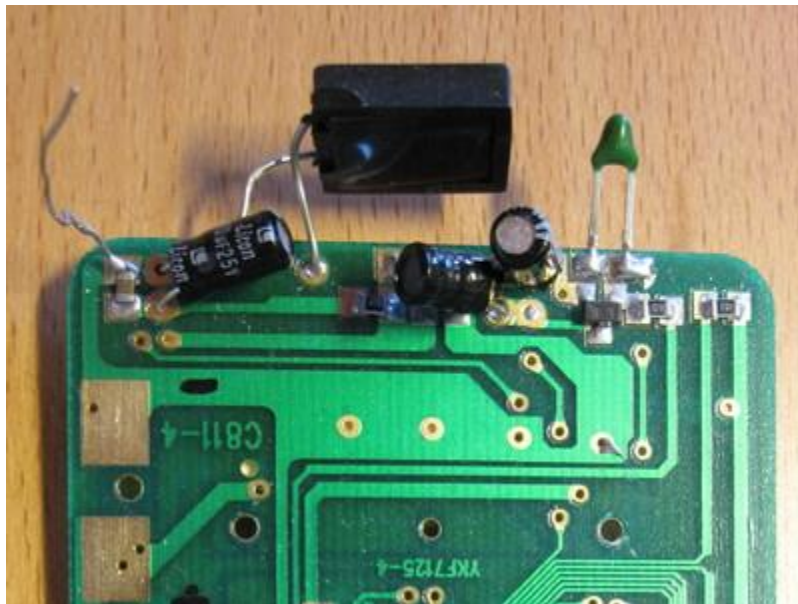


CHECKING HYGROMETER CALIBRATION

Several years ago I picked an old, wireless [temperature and humidity sensor](#) from trash. I fixed a bad solder joint on its radio transmitter and then used it many times simply as a dummy AM transmitter when playing with [433 MHz super-regenerative receivers](#) and packet decoders. Recently though, I've been using it for its original purpose: to monitor outside air temperature and humidity. I've thrown together a receiver from some old parts I had lying around, a packet decoder running on an Arduino and a Munin plug-in.

Looking at the relative air humidity measurements I gathered over the past months however I was wondering how accurate they are. The hygrometer is now probably close to 10 years old and of course hasn't been calibrated since it left the factory. Considering this is a fairly low-cost product, I doubt it was very precise even when new.



These are the sensors on the circuit board: the green bulb on the right is a thermistor and the big black box on the left is the [humidity sensor](#), probably some kind of a resistive type. There are no markings on it, but the [HR202](#) looks very similar. The sensor reports relative humidity with 1% resolution and temperature with 0.1°C resolution.

Resistive sensors are sensitive to temperature as well as humidity. Since the unit has a thermometer, I'm guessing the on-board controller compensates for the changes in resistance due to temperature variations. It shows the same value on an LCD screen as it sends over the radio, so the compensation definitely isn't left to the receiver.



To check the accuracy of the humidity measurements reported by the sensor, I made two reference environments with known humidity in small, airtight Tupperware containers:

- A 75% relative humidity above a [saturated solution](#) of sodium chloride and
- 100% relative humidity above a soaked paper towel.

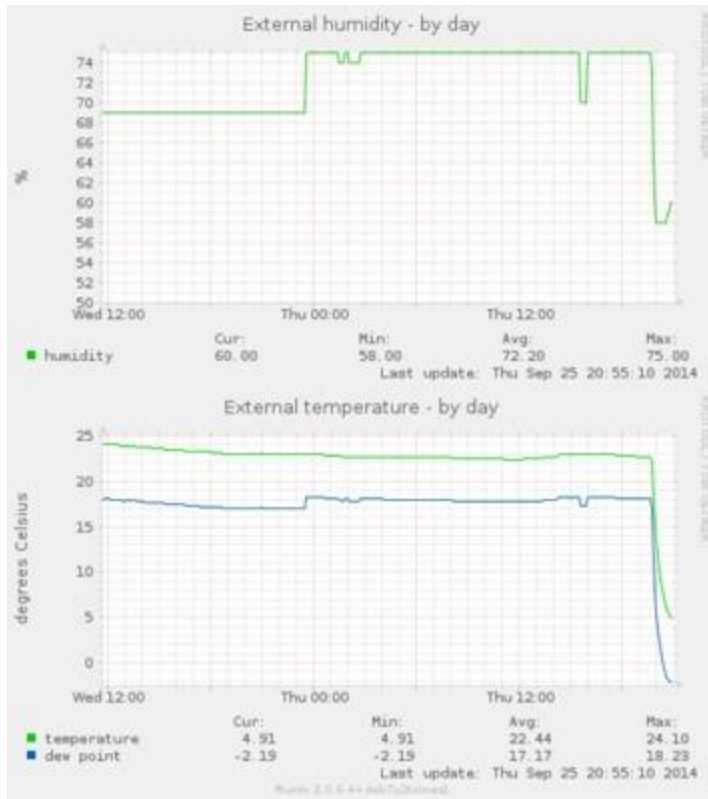
I don't have a temperature stabilized oven at home and I wanted to measure at least three different humidity and temperature points. The humidity in my containers took around 24 hours to stabilize after sealing, so I couldn't just heat them up. In the end, I decided to only take the measurements at the room temperature (which didn't change a lot) and in the fridge. Surprisingly, the receiver picked up 433 MHz transmission from within the metal fridge without any special tweaking.

Here are the measurements:

T [°C]	Rh_{reference} [%]	Rh_{measured} [%]	ΔRh [%]
24	75	69	-6
22	75	75	0
5	75	62	-13
3	75	60	-15
23	100	98	-2
21	100	98	-2

So, from this simple experiment it seems that the measurements are consistently a bit too low.

The 6% step between 22 and 24°C is interesting - it happens abruptly when the temperature sensor reading goes over 23°C. I'm pretty sure it's due to temperature compensation in the controller. Probably it does not do any interpolation between values in its calibration table.



From a quick look into various datasheets it seems these sensors typically have a $\pm 5\%$ accuracy. The range I saw here is $+0/-15\%$, so it's a bit worse. However considering its age and the fact that the sensor has been sitting on a dusty shelf for a few years without a cover, I would say it's still relatively accurate.

I've seen some cheap hygrometer calibration kits for sale that contain salt mixtures for different humidity references. It would be interesting to try that and get a better picture of how the response of the sensor changed, but I think buying a new, better calibrated sensor makes much more sense at this point.

Source :

https://www.tablix.org/~avian/blog/archives/2014/10/checking_hygrometer_calibration/