



Meetjestad! stations repairs

electronics and firmware

by Peter Demmer

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Summary

Lecture: Peter Demmer: Meetjestad! station repairs
Duration: 45'

Meetjestad! stations were first built in 2016 and now some come back for repair.
An introduction to the faults that can occur and what can be done to fix them.



Meetkoppel 22 - repairs

1. Introducing



- electronics hobbyist since age 10



- MSEE (ir. Elektrotechniek) T.U. Delft
- Lab. for Electronic Instrumentation (sensors)
- 8080 microprocessor controlled tester (1978)

Career

- Electronic circuit designer
- ICT: UNIX systems programmer ++, telecom

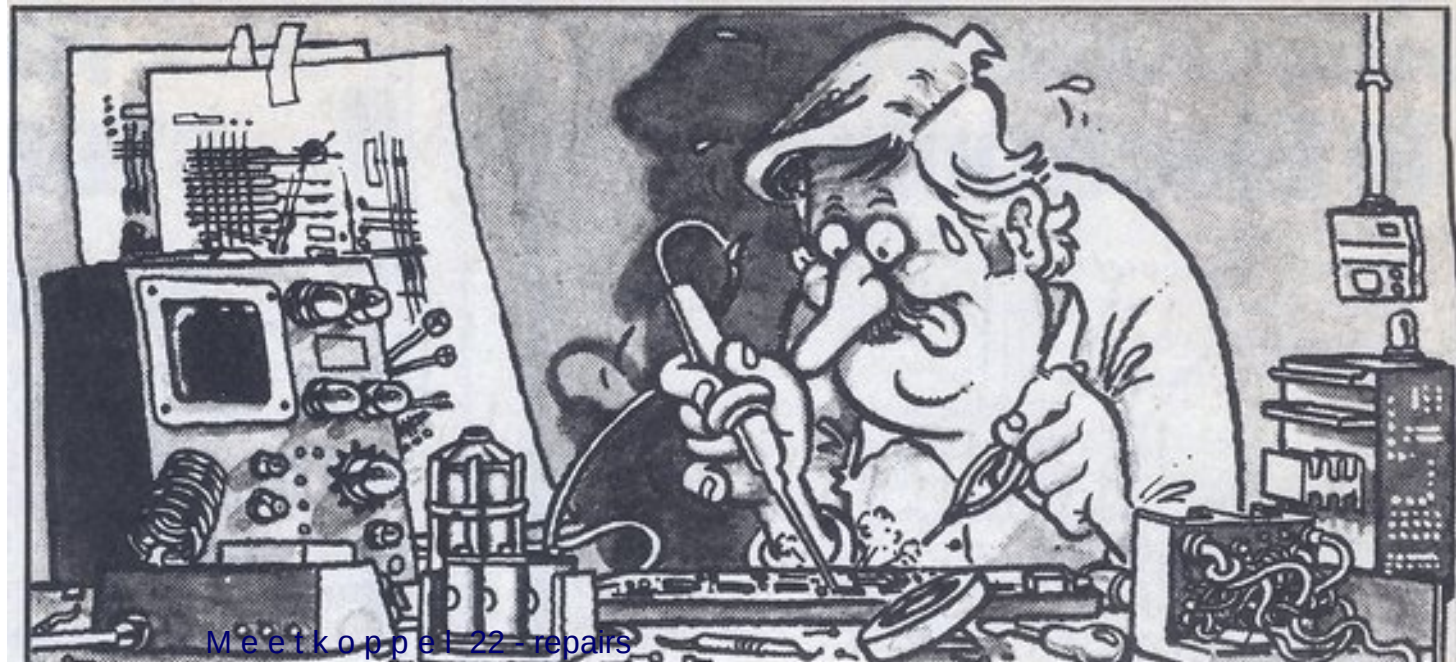
Retired



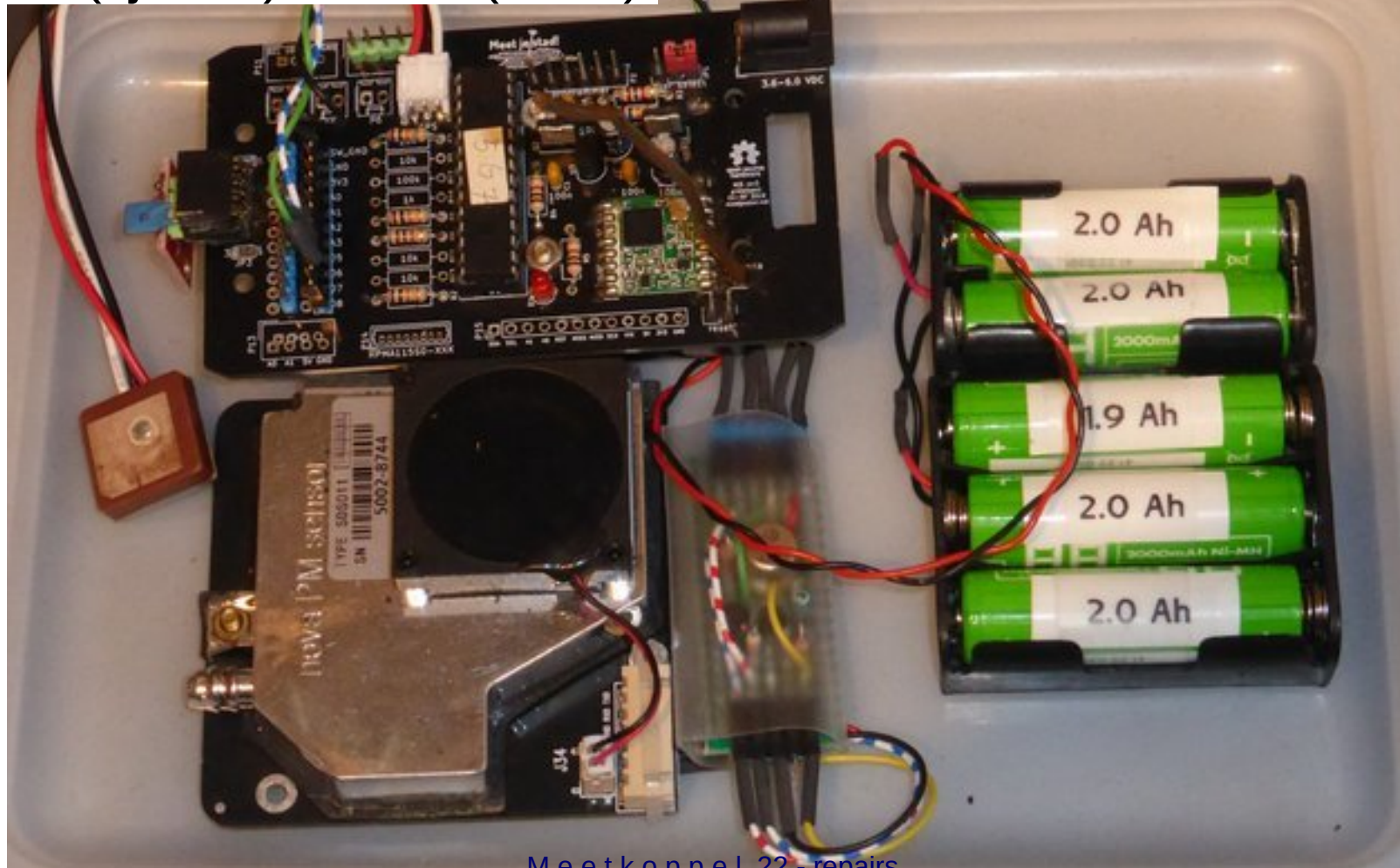
@ Meetjestad!



- electronics and firmware contributions
 - add + test sensors
- workgroup participation: soil moisture, green roofs
- graphs: <https://meetjestad.net/static/graphs>
- **repair stations**



add PM (fijnstof) sensor (2020)



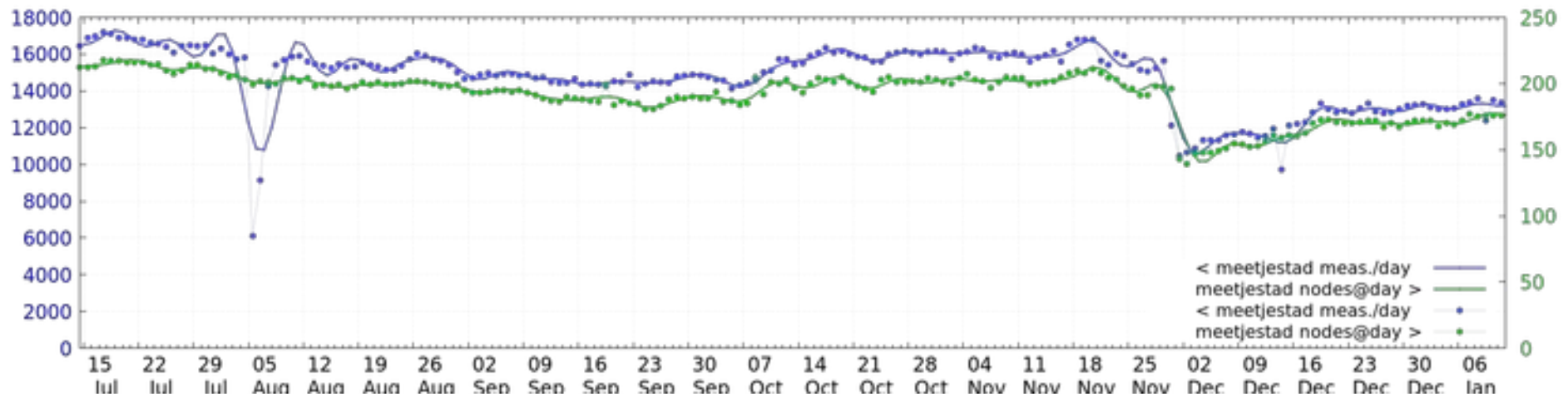
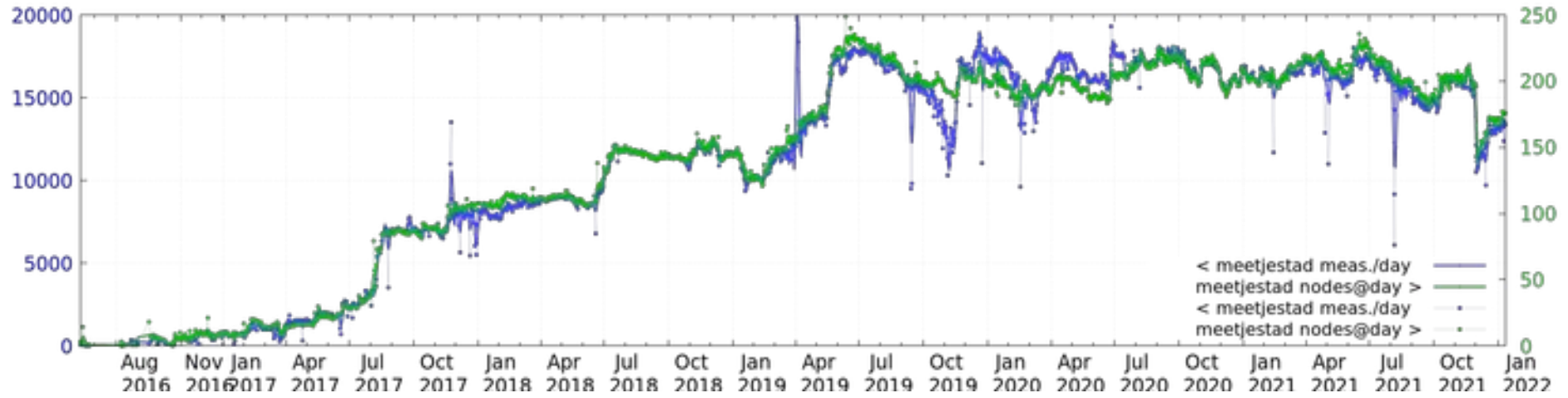
2. Meetjestad! history



- citizen science project: citizen build meteo measurement stations
=> larger number of temperature (and PM) sensors
- electronic design, firmware, Printed Circuit Board
- housing
- build instruction
- funding
- parts purchase
- 11-6-2016: 1st station
citizen build workshop



2. Growth



Meetkoppel 22 - repairs



3. Repair

Oldest station is >5 years old now

User brings in defective Meetjestad! station

- What can be wrong ?
- How can we fix that ?

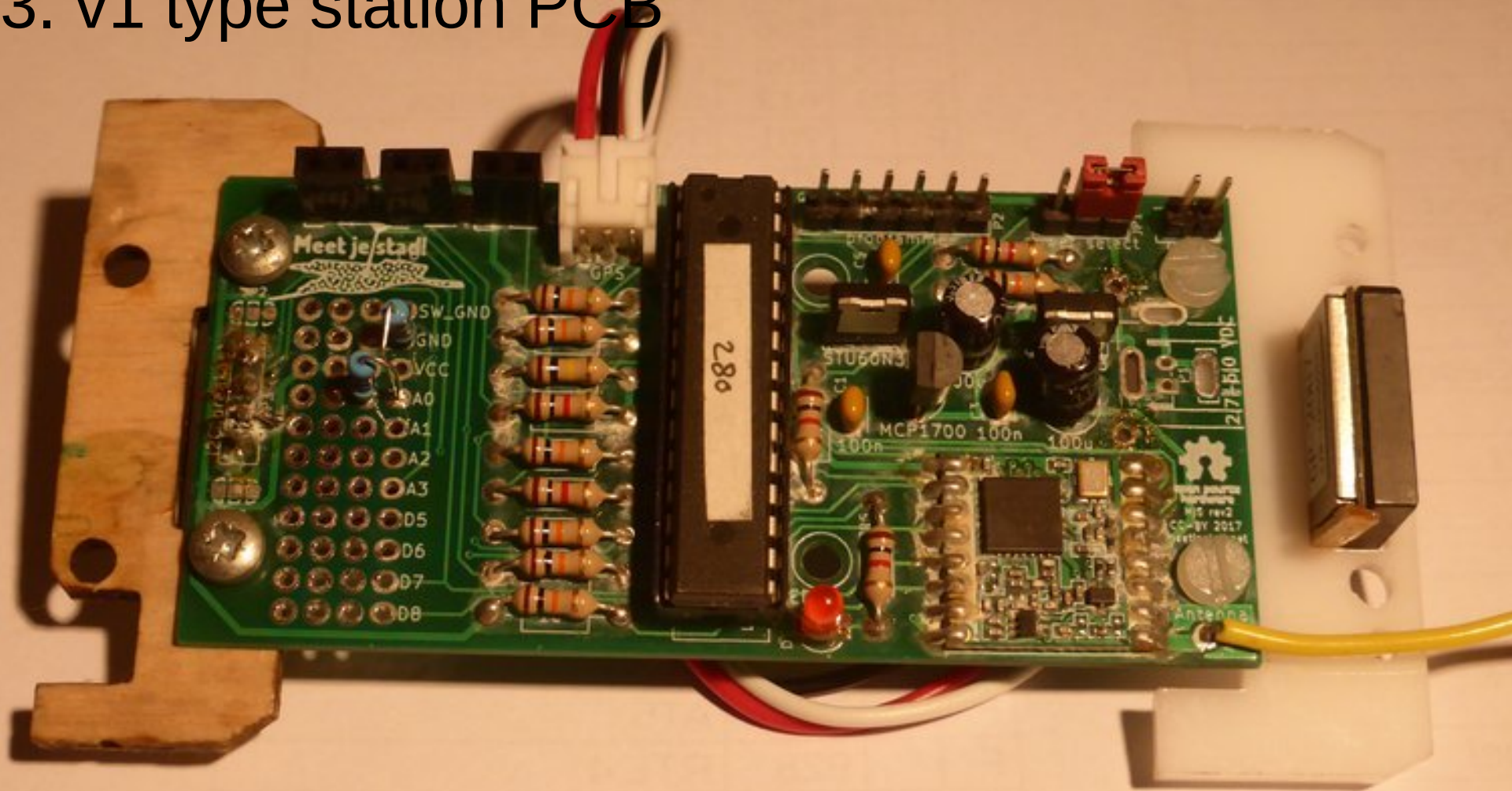
3. v1 stations



- housing:
 - white vertical tube, 8 * 20 cm, roof
- inside a PCB with:
 - LoRa radio: RF96
 - controller: ATMEL328p (Arduino Uno)
 - location (GPS) sensor: GP20U7
 - temperature sensor: Si7021
 - 3 AAA discharge batteries
- since 2016



3. v1 type station PCB

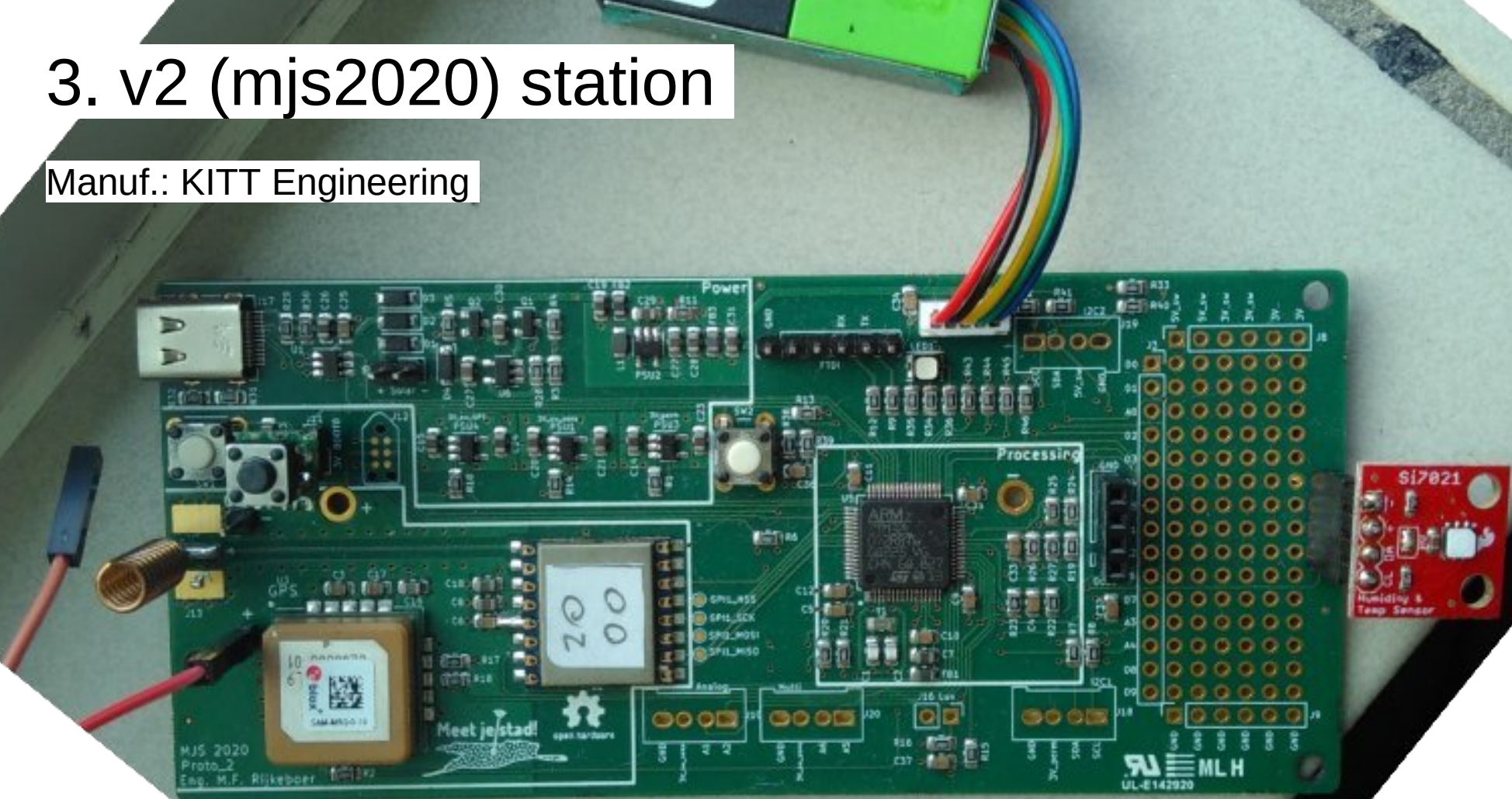


3. v2 stations (mjs2020)

- housing:
 - white vertical tube, 8 * 25 cm, roof
 - solar panel
- inside PCB with:
 - controller: STM32
 - LoRa radio
 - location (GPS) sensor: Ublox
 - temperature sensor: Si7021
 - PM (fijnstof) sensor: SPS30
 - 3 AAA recharge batteries
- since Nov. 2020

3. v2 (mjs2020) station

Manuf.: KITTE Engineering



3

- 1

- turn PCB 90°



3. Dismantle: PCB removal





4. Station basic operation

- at boot, joins over LoRa radio with T T Network
- every 15 minutes
 - makes a temperature measurement
 - (@v2) makes a PM measurement
 - sends data to Meetjestad! server
 - goes into deep sleep for almost 15 minutes to save batteries
- every 24 hours
 - makes a location (GPS) measurement as well

Measured data can be seen at the Meetjestad! website

https://meetjestad.net/data/sensors_recent.php?sensor=123

and exported <https://meetjestad.net/data>

5. Repairs: what can be wrong ?

- Batteries are empty
- Batteries are weak: can not supply sufficient current
 - contacts are corroded
- no TTN gateway (base station) nearby
- LoRa join not happening
- reset has no effect
 - header pins are corroded
 - PCB soldering is corroded
- PM-sensor cable is broken
- PM-sensor is defective
- temperature sensor is defective
- (firmware can be updated)

Check with USB supply

- If supplied from USB is working OK, it's probably the batteries

Batteries empty

- Measure batteries voltage with a multimeter
- Replace (all)

Batteries weak or contacts corroded

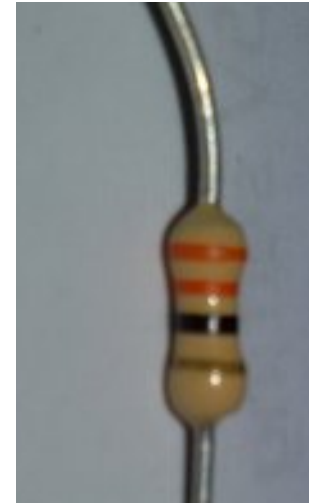
- Measure batteries voltage with 33 Ohm load or
- Measure each battery with battery tester
- Replace (all)

Batteries holder contacts corroded

- Unsolder holder from PCB
- Check other PCB soldering
- Do other tests
- Solder new holder (*pref. AA-type*)



Battery tester with built-in load



33 Ohm
resistor

Still no response:

Header pins are corroded

- remove old headers
- place new headers



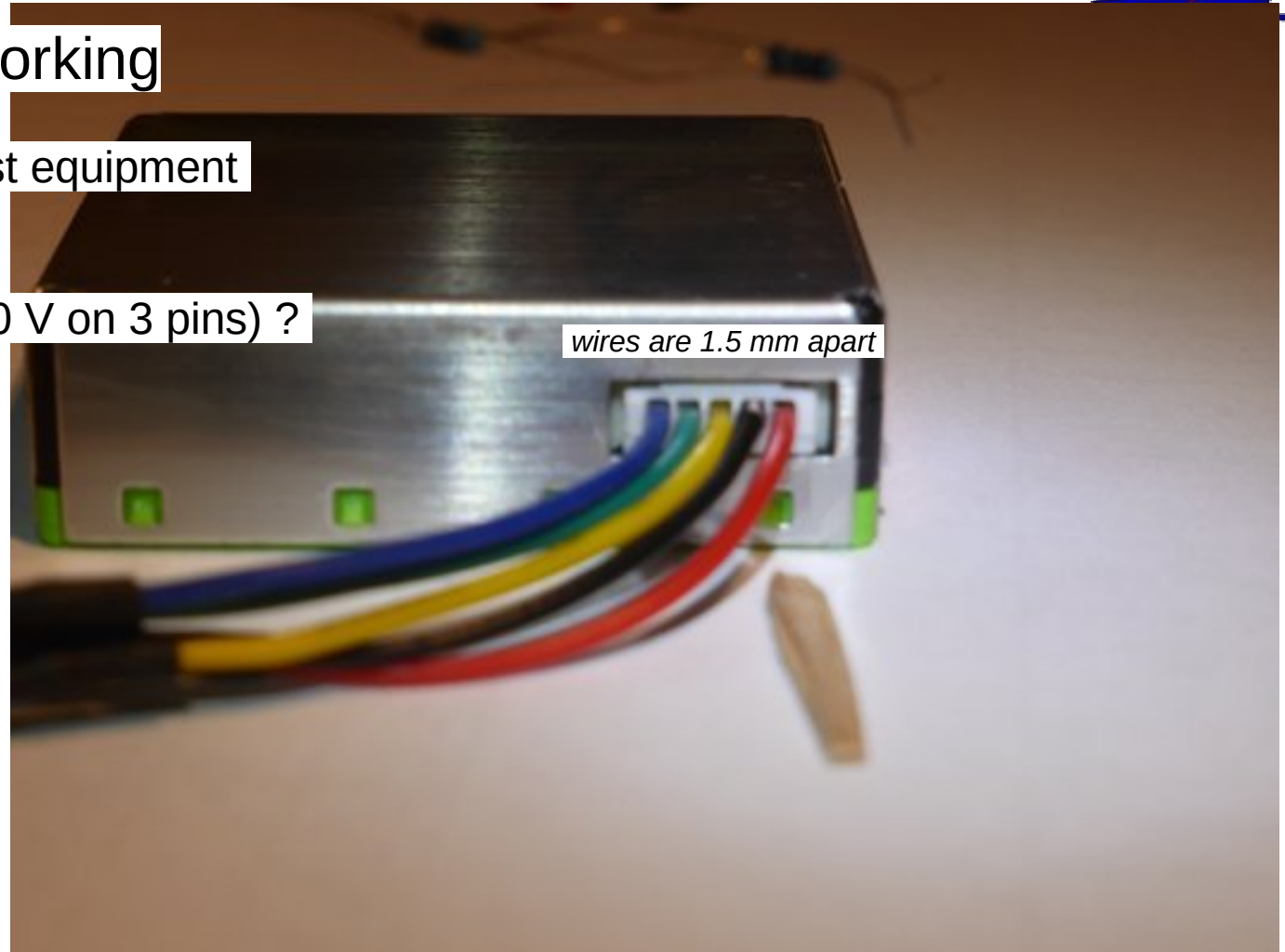
PCB solder joints are corroded

- remove batteries holder
- check soldering with strong light and magnifying glass
- suck up old solder
- apply new solder
- replace batteries holder (*pref. AA-type*)



PM-sensor not working

- check sensor with test equipment
- replace sensor
- I²C signal coming (3.0 V on 3 pins) ?
- replace cable
- bypass PCB wiring
- replace PCB





Temperature sensor not working

- check sensor with test equipment
- check sensor connector and soldering

@ broken:

- note old sensor serial-number (if possible)
- note new sensor serial-number
- replace sensor

Don't replace sensors without make a note of it !



No LoRa join

- reset the station
- check LoRa join of another nearby station
- check when this station last worked OK with LoRa before
https://meetjestad.net/data/sensors_recent.php?sensor=123
 - can also show a TTN map
- un-power for at least 15”

Note: LoRa join can take 4...8 minutes or even longer;

- be patient

6 Indicators



- https://meetjestad.net/data/sensors_recent.php?sensor=123 to see station #123's last measurements
- v1 stations have a LED that blinks on boot
- v2 stations have a colored status report LED

7 Controller firmware



Arduino IDE

- to show the station's console logging
- to update the controller's firmware

```
sketch_jan14a | Arduino 1.8.15
File Edit Sketch Tools Help
sketch_jan14a
1 void setup() {
2   // put your setup code here, to run once:
3 }
4 }
5
6 void loop() {
7   // put your main code here, to run repeatedly:
8 }
9 }
1
Arduino Uno on /dev/ttyUSB0
```

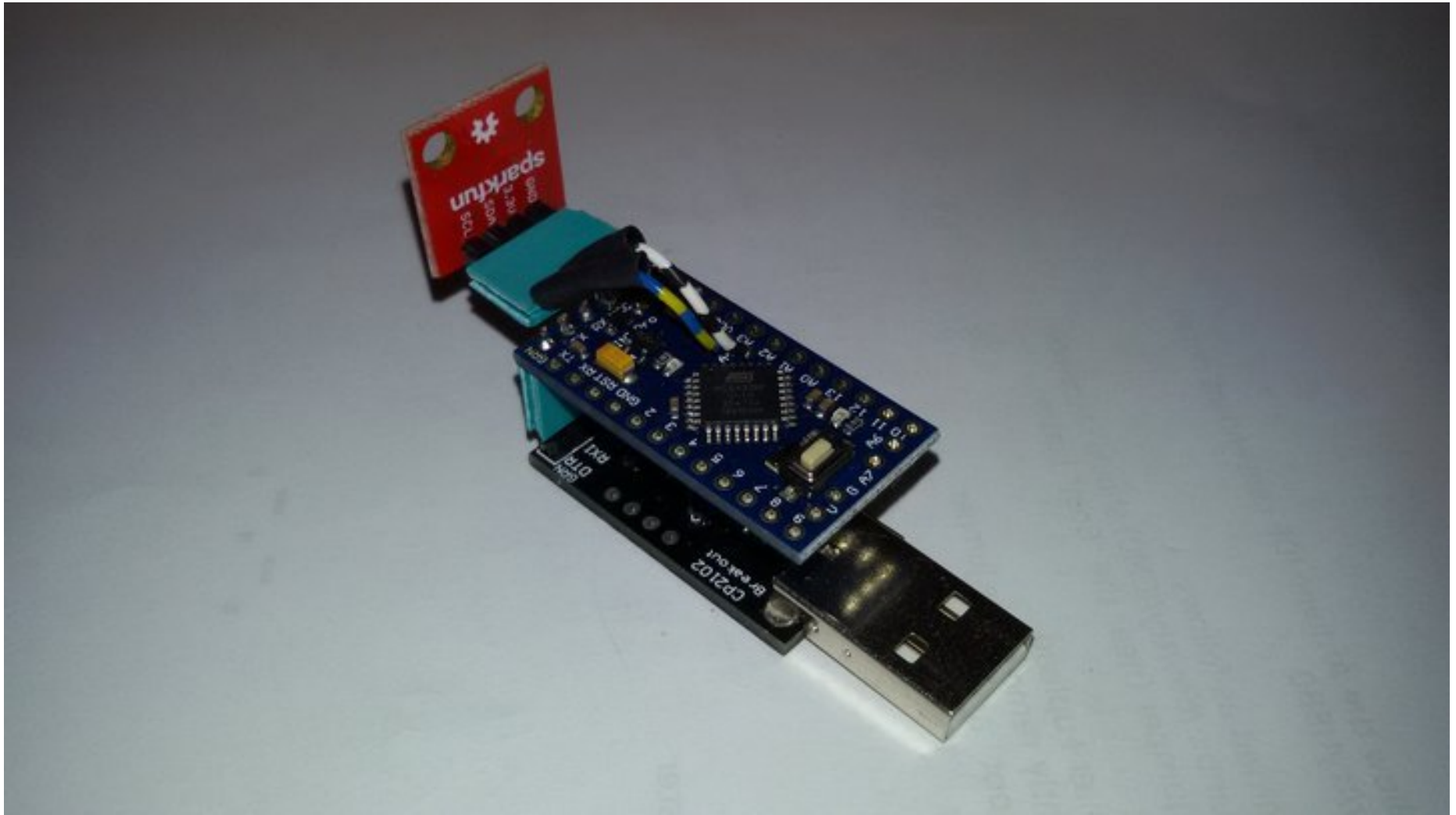
```
17:33:58.503 -> Start
17:33:58.503 -> meetstation-267
17:33:58.532 -> Dev EUI: 0B0100000000000000
17:33:58.532 -> App EUI: BA0300D07ED5B370
17:33:58.598 -> App Key: C378FB522EF7D490
17:33:58.631 -> Temperature: 21.96
17:33:58.665 -> Humidity: 60.59
17:33:58.665 -> Battery Divider Ratio: 5.70
17:33:58.698 -> Vbatt: 1520
17:33:58.731 -> Vcc: 3349
17:33:58.731 -> 13735: EV_JOINING
17:34:04.240 -> 356296: EV_JOINED
17:34:04.240 -> Battery voltage too low, skipping GPS (1387 <
3400 mV)
17:34:04.306 -> No GPS fix
17:34:04.306 -> temp=21.9, hum=59.2, vbatt=1349, vcc=3349
17:34:04.373 -> Packet queued
17:34:04.405 -> 20 FF 00 00 00 00 00 00 15 F3 B3 EA 11
17:34:09.746 -> 702081: EV_TXCOMPLETE (includes waiting for
RX windows)
17:34:09.813 -> Transmit complete
17:34:09.846 -> Sleeping for 894456ms...
```

8 Custom test devices

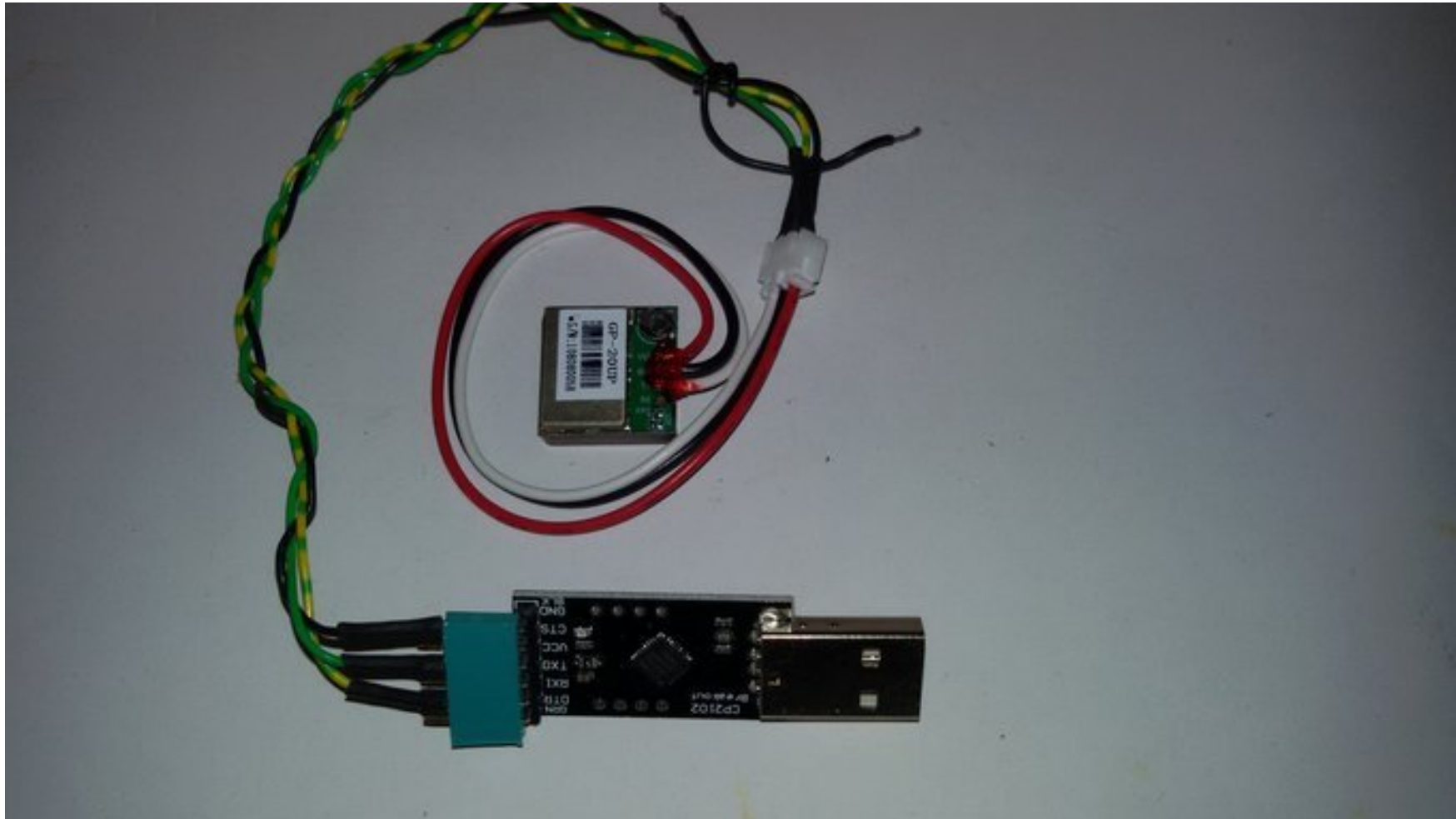


- Si7021 temperature sensor tester
- SPS30 PM sensor tester
- USB-to-serial dongle GP-20U7 GPS sensor tester

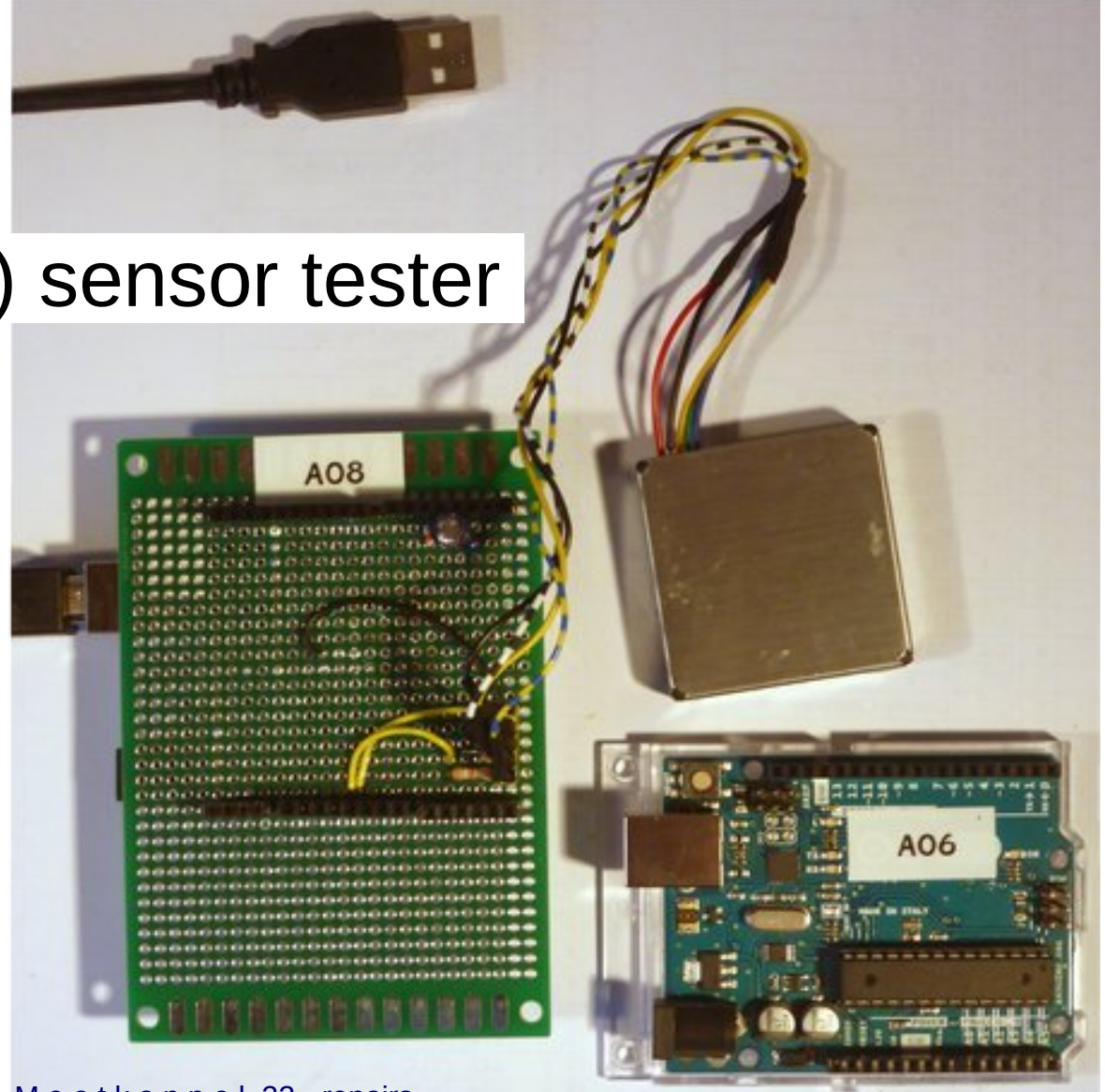
Si7021 tester



v1 GPS sensor serial tester



SPS30 PM (fijnstof) sensor tester



TO DO



- add display for each tester (*now: via serial*)
- display Si7021 serial number and log it
- write RF96 LoRa radio test firmware
- write v2 GPS sensor test firmware
- set up Si7021 calibration

