What's My Indoor Environment Like?

2015 Quantified Self Conference

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credit: techgraphs.com


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What did I do?

I used a variety of sensors and meters to measure and better understand my indoor environment.

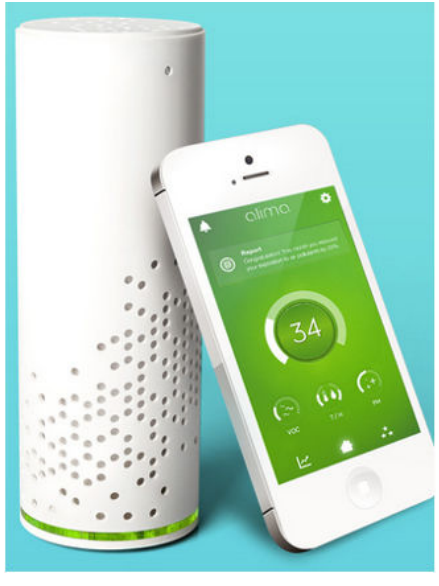
How did I do it?


Q-TRAK
TSI

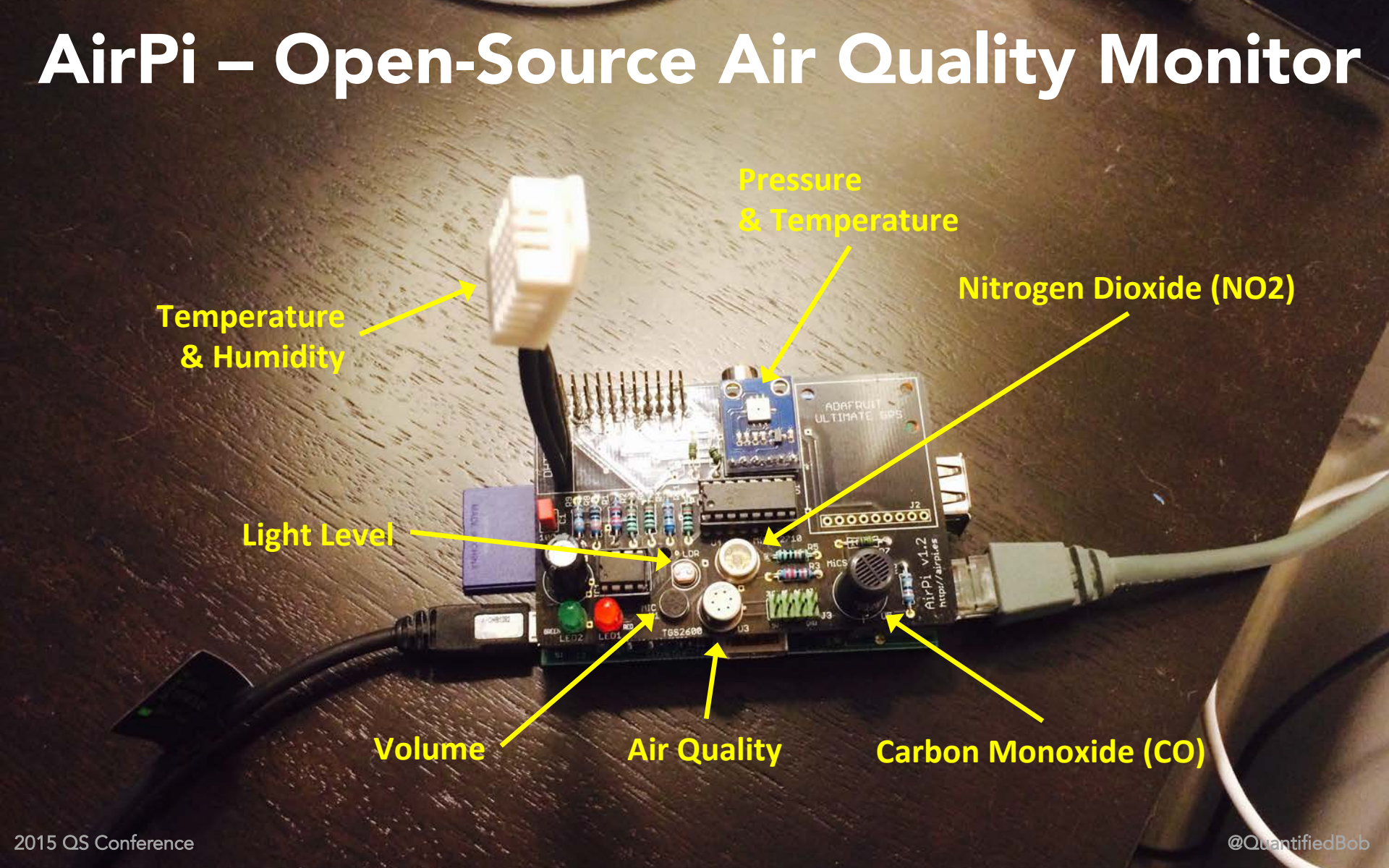

92
83
90
92
68
70


1000
1010
1020
1030
1040
990
980
hPa
BARO

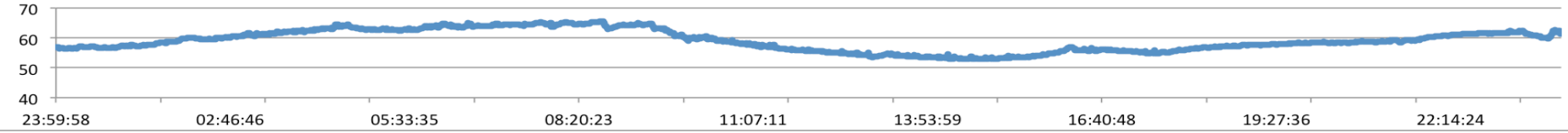

164.5


airmo
34

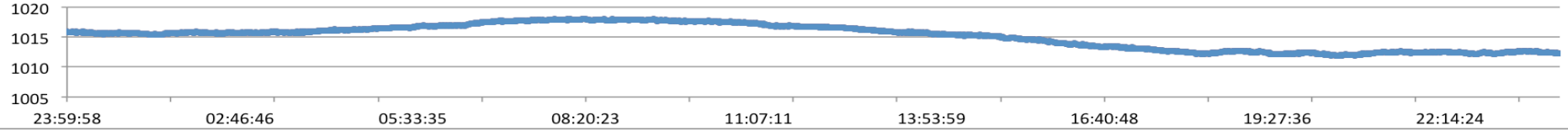
AirPi – Open-Source Air Quality Monitor



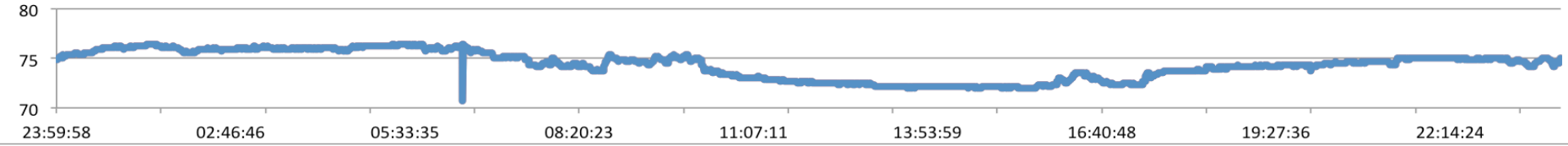
DHT22 Relative Humidity (%)



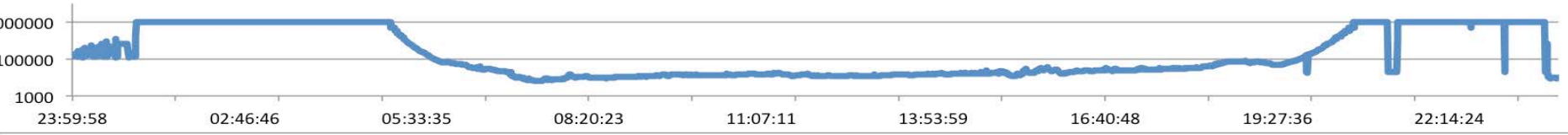
BMP085 Pressure (hPa)



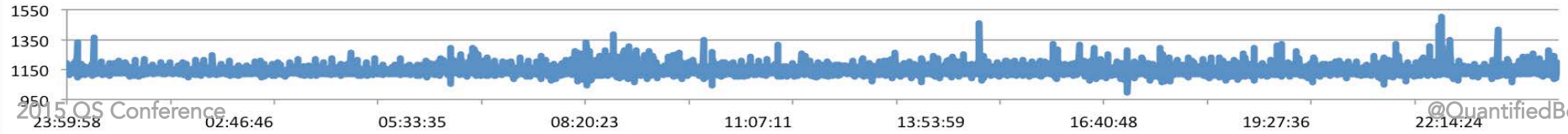
DHT22 Temperature (F)

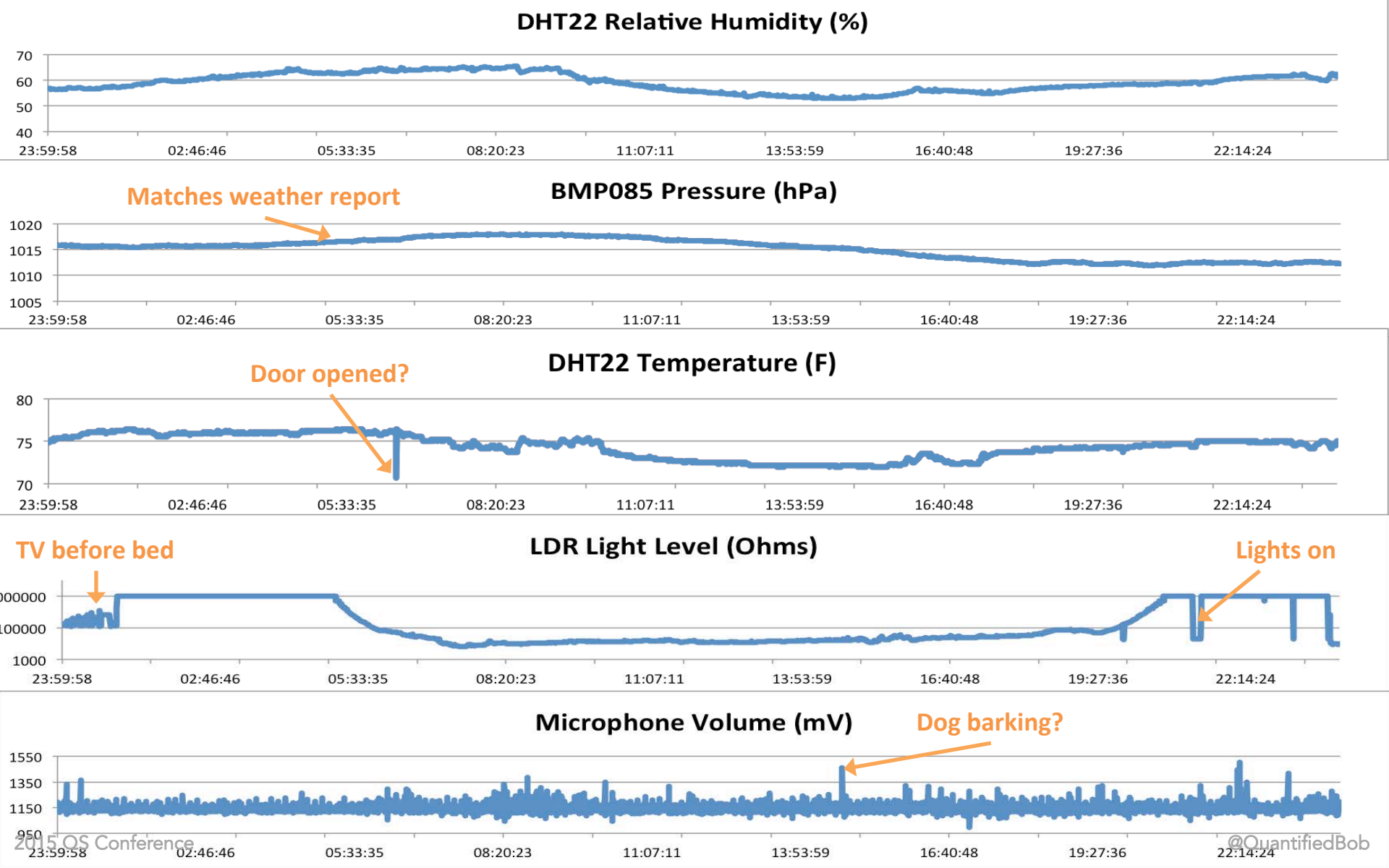


LDR Light Level (Ohms)

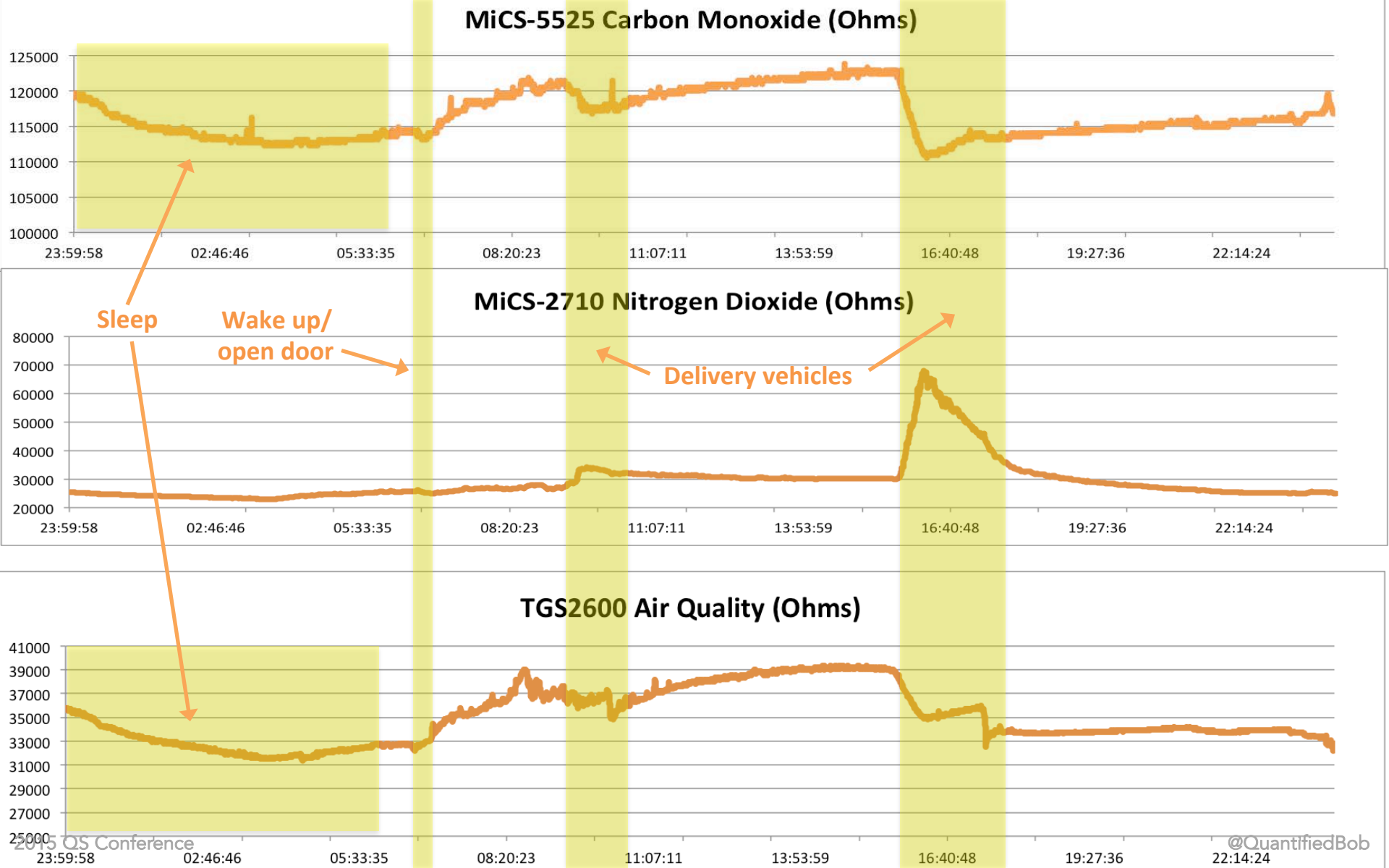


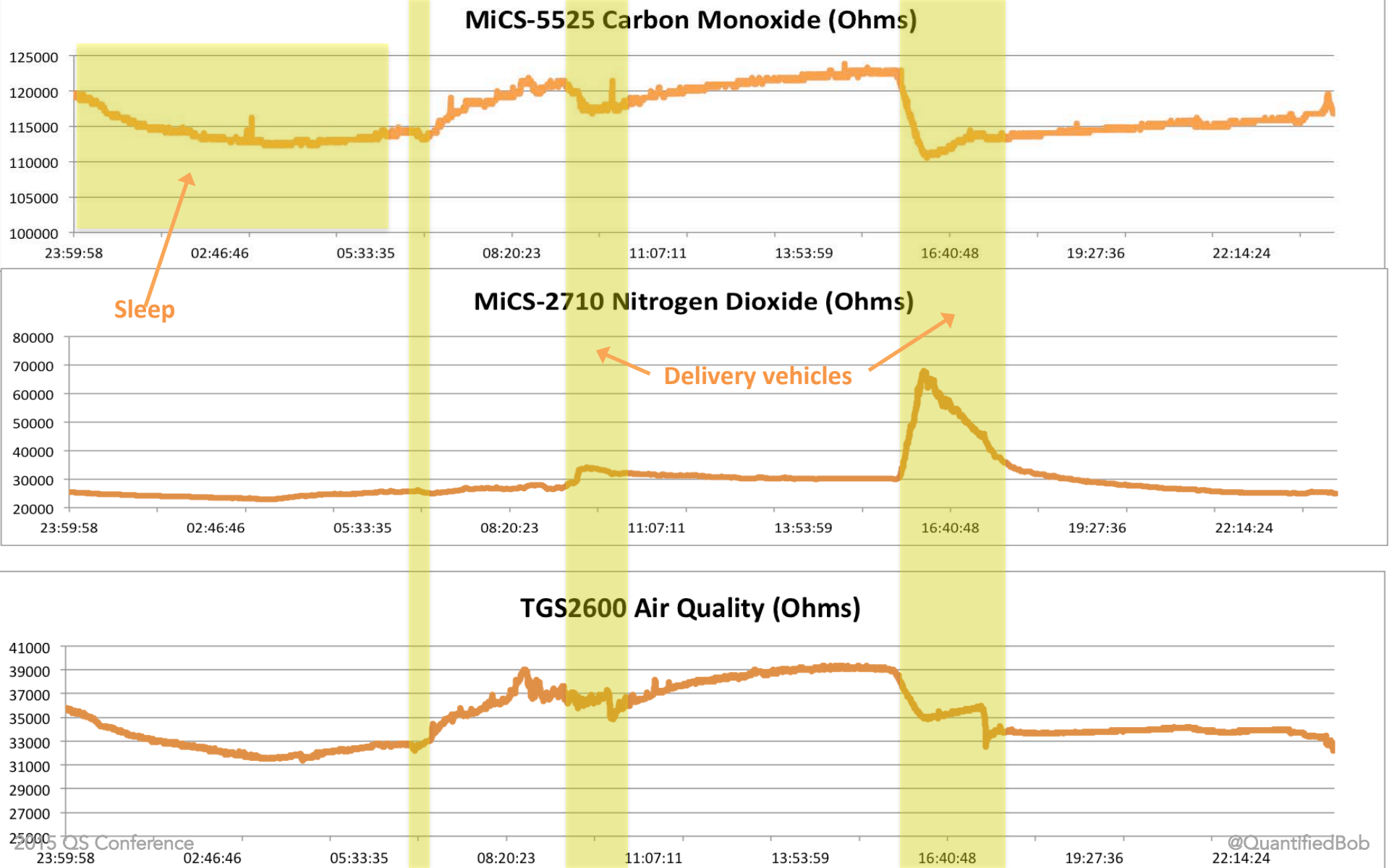
Microphone Volume (mV)




DHT22 Relative Humidity (%)
70
60
50
40
23:59:58
02:46:46
05:33:35
08:20:23
11:07:11
13:53:59
16:40:48
19:27:36
22:14:24
Matches weather report
BMP085 Pressure (hPa)
1020
1015
1010
1005
23:59:58
02:46:46
05:33:35
08:20:23
11:07:11
13:53:59
16:40:48
19:27:36
22:14:24
Door opened?
DHT22 Temperature (F)
80
75
70
23:59:58
02:46:46
05:33:35
08:20:23
11:07:11
13:53:59
16:40:48
19:27:36
22:14:24
TV before bed
LDR Light Level (Ohms)
Lights on
000000
100000
1000
23:59:58
02:46:46
05:33:35
08:20:23
11:07:11
13:53:59
16:40:48
19:27:36
22:14:24
Microphone Volume (mV)
Dog barking?
1550
1350
1150
950
23:59:58
02:46:46
05:33:35
08:20:23
11:07:11
13:53:59
16:40:48
19:27:36
22:14:24

(artist approximation)


MiCS-5525 Carbon Monoxide (Ohms)
125000
120000
115000
110000
105000
100000
23:59:58
02:46:46
05:33:35
08:20:23
11:07:11
13:53:59
16:40:48
19:27:36
22:14:24
Sleep
Wake up/
open door
MiCS-2710 Nitrogen Dioxide (Ohms)
Delivery vehicles
80000
70000
60000
50000
40000
30000
20000
23:59:58
02:46:46
05:33:35
08:20:23
11:07:11
13:53:59
16:40:48
19:27:36
22:14:24
TGS2600 Air Quality (Ohms)
41000
39000
37000
35000
33000
31000
29000
27000
25000
23:59:58
02:46:46
05:33:35
08:20:23
11:07:11
13:53:59
16:40:48
19:27:36
22:14:24


MiCS-5525 Carbon Monoxide (Ohms)
125000
120000
115000
110000
105000
100000
23:59:58
02:46:46
05:33:35
08:20:23
11:07:11
13:53:59
16:40:48
19:27:36
22:14:24
Sleep
MiCS-2710 Nitrogen Dioxide (Ohms)
80000
70000
60000
50000
40000
30000
20000
Delivery vehicles
TGS2600 Air Quality (Ohms)
41000
39000
37000
35000
33000
31000
29000
27000
25000

e2v

MiCS-2710
NO_2 Sensor

This datasheet describes the use of the MiCS-2710. The package and the mode of operation illustrated in this document target the detection of nitrogen dioxide (NO_2).

FEATURES

- Low heater current
- Wide detection range
- High sensitivity
- Fast thermal response
- Miniature dimensions
- High resistance to shocks and vibrations

IMPORTANT PRECAUTIONS

Read the following instructions carefully before using the MiCS-2710 sensor described in this document to avoid erroneous readings and to prevent the device from permanent damage.

- The sensor must not be wave soldered without protection, or exposed to high concentrations of organic solvents, ammonia, or silicone vapours, to avoid poisoning the sensitive layer.
- Heating powers above the maximum rating of 120 mW can destroy the sensor due to overheating.
- This sensor is to be placed in a filtered package that protects it against any water or dust projection.
- For any additional questions, email enquiries@e2v.com or telephone +44 (0)1245 493493.

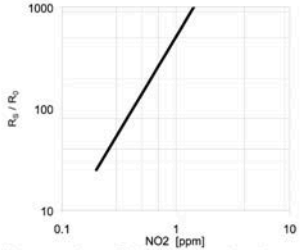
OPERATING MODE

The recommended mode of operation is a constant power mode. A heater power of P_H = 43 mW is applied. This causes the temperature of the sensing resistor (R_S) to reach about 220 °C.

Detection of the pollution gases is achieved by measuring the sensing resistor R_S during operation.

SENSOR RESPONSE

The sensor response to NO_2 in air is represented in Fig. 1.



The sensor resistance R_S is normalised to the resistance under air (R_0).

Fig. 1: R_S/R_0 as a function of gas concentration at <5% RH and 25 °C.

FIGARO

PRODUCT INFORMATION

TGS 2600 - for the detection of Air Contaminants

Features:

- Low power consumption
- High sensitivity to gaseous air contaminants
- Long life and low cost
- Uses simple electrical circuit
- Small size

Applications:

- Air cleaners
- Ventilation control
- Air quality monitors

The sensing element is comprised of a metal oxide semiconductor layer formed on an alumina substrate of a sensing chip together with an integrated heater. In the presence of a detectable gas, the sensor's conductivity increases depending on the gas concentration in the air. A simple electrical circuit can convert the change in conductivity to an output signal which corresponds to the gas concentration.

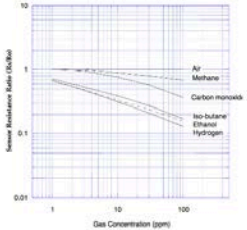
The **TGS 2600** has high sensitivity to low concentrations of gaseous air contaminants such as hydrogen and carbon monoxide which exist in cigarette smoke. The sensor can detect hydrogen at a level of several ppm. Figaro also offers a microprocessor (FIC02667) which contains special software for handling the sensor's signal for appliance control applications.

Due to miniaturization of the sensing chip, TGS 2600 requires a heater current of only 42mA and the device is housed in a standard TO-5 package.

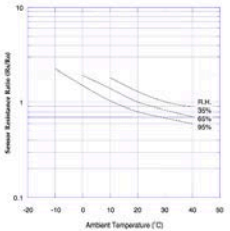
The figure below represents typical sensitivity characteristics, all data having been gathered at standard test conditions (see reverse side of this sheet). The Y-axis is indicated as *sensor resistance ratio* (Rs/Ro) which is defined as follows:
Rs = Sensor resistance in displayed gases at various concentrations

The figure below represents typical temperature and humidity dependency characteristics. Again, the Y-axis is indicated as *sensor resistance ratio* (Rs/Ro), defined as follows:
Rs = Sensor resistance in fresh air at various temperatures/humidities
Ro = Sensor resistance in fresh air

Sensitivity Characteristics:

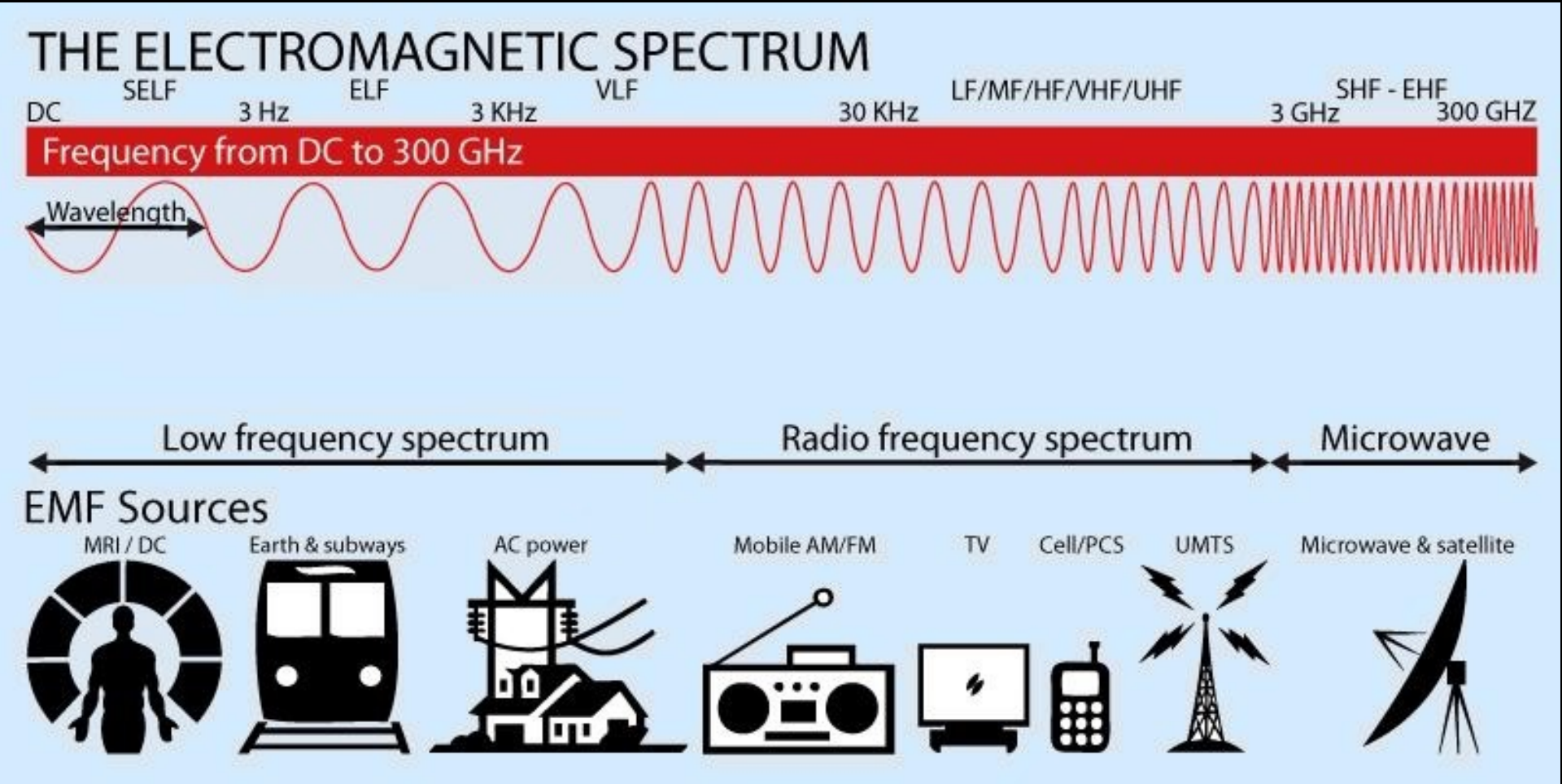


Temperature/Humidity Dependency:



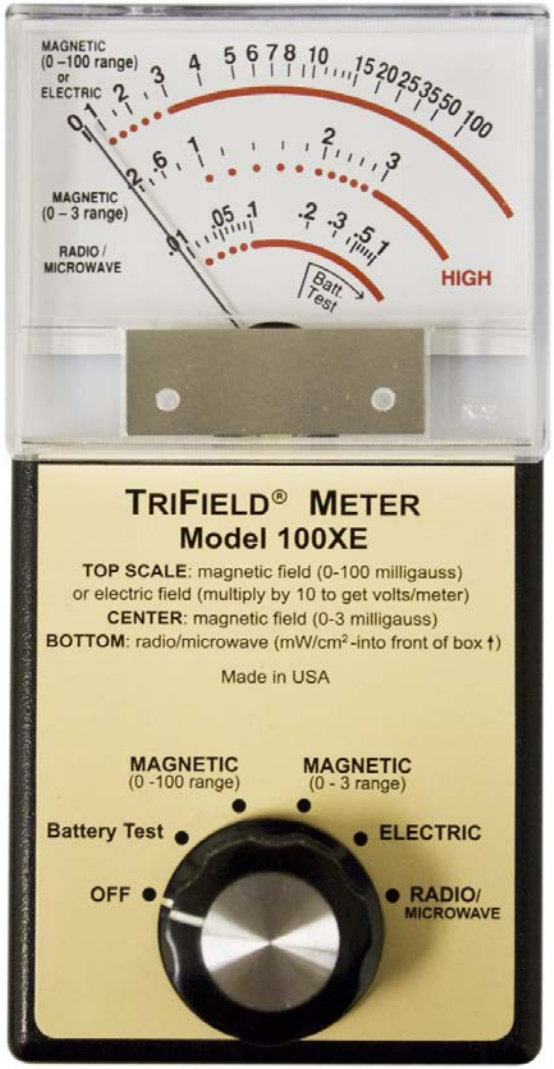

```
#rs/r0 log: polynomial best fit - RPi:
func_Nitrogen_Dioxide = -2*(10^(-0.6*((x/142686.5672)^2)))+(0.0026*(x/142686.5672))+0.1665,ppm-uncalibrated

# rs/r0 two-data-point: linear best fit - RPi:
func_Nitrogen_Dioxide = (0.0014*(x/142686.5672))+0.2857,ppm-uncalibrated

# rs/r0: polynomial best fit - RPi:
func_Nitrogen_Dioxide = (-7*10^(-7*((x/142686.5672)*(x/142686.5672))))+(0.002*(x/142686.5672))+0.2015,ppm-uncalibrated

# rs: polynomial best fit (assuming r0 = 142686) - RPi:
func_Nitrogen_Dioxide = (-4*(10^(-17*(x*x))))+(10^(-8*x))+0.2015,ppm-uncalibrated
```

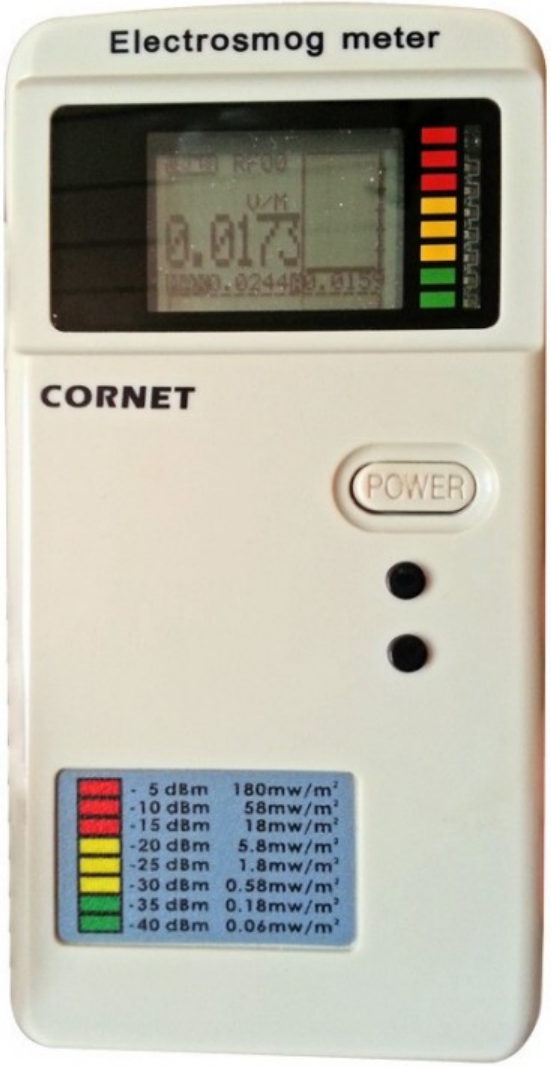
EMF (Electromagnetic Fields)



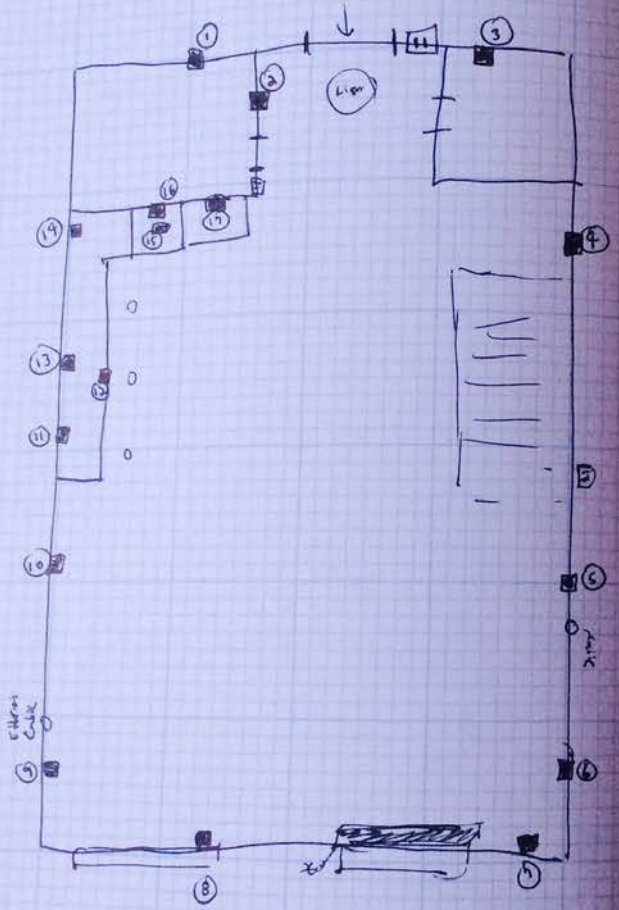
Effects of Harmful EMFs

- < 2 mG will start to develop biological stress
- Prolonged exposure to levels between 2 and 12 mG+ linked to cancer, possible immune system effects.
- Exposure to 12 mG suppresses the human hormone melatonin (critical for sleep, mood regulation, and overall health)

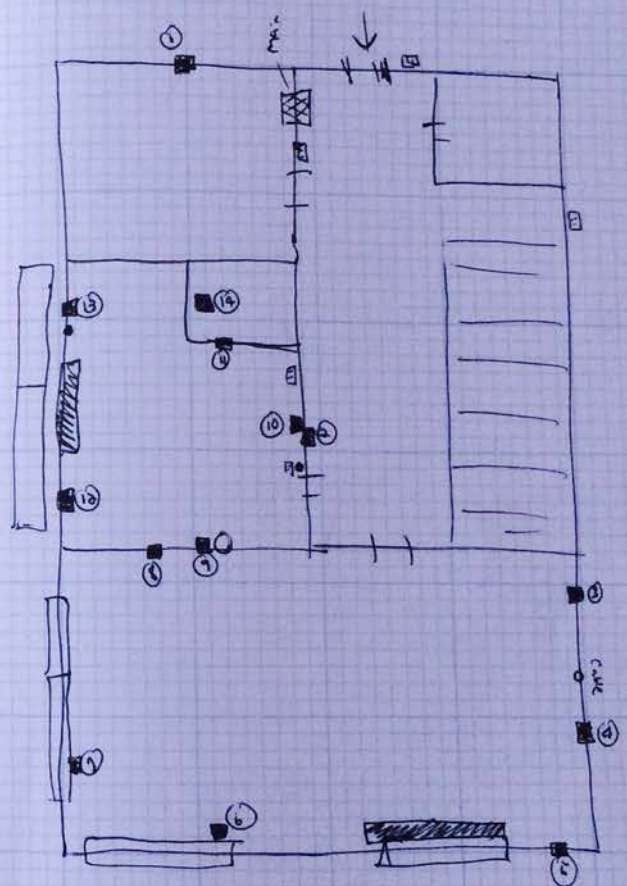

MAGNETIC
(0 –100 range)
or
ELECTRIC
MAGNETIC
(0 – 3 range)
RADIO /
MICROWAVE
HIGH
Batt.
Test
TRIFIELD® METER
Model 100XE
TOP SCALE: magnetic field (0-100 milligauss)
or electric field (multiply by 10 to get volts/meter)
CENTER: magnetic field (0-3 milligauss)
BOTTOM: radio/microwave (mW/cm²-into front of box ↑)
Made in USA
MAGNETIC
(0 -100 range)
MAGNETIC
(0 - 3 range)
Battery Test
ELECTRIC
OFF
RADIO/
MICROWAVE


Electrosmog meter
0.0173
CORNET
POWER
- 5 dBm 180mw/m²
-10 dBm 58mw/m²
-15 dBm 18mw/m²
-20 dBm 5.8mw/m²
-25 dBm 1.8mw/m²
-30 dBm 0.58mw/m²
-35 dBm 0.18mw/m²
-40 dBm 0.06mw/m²

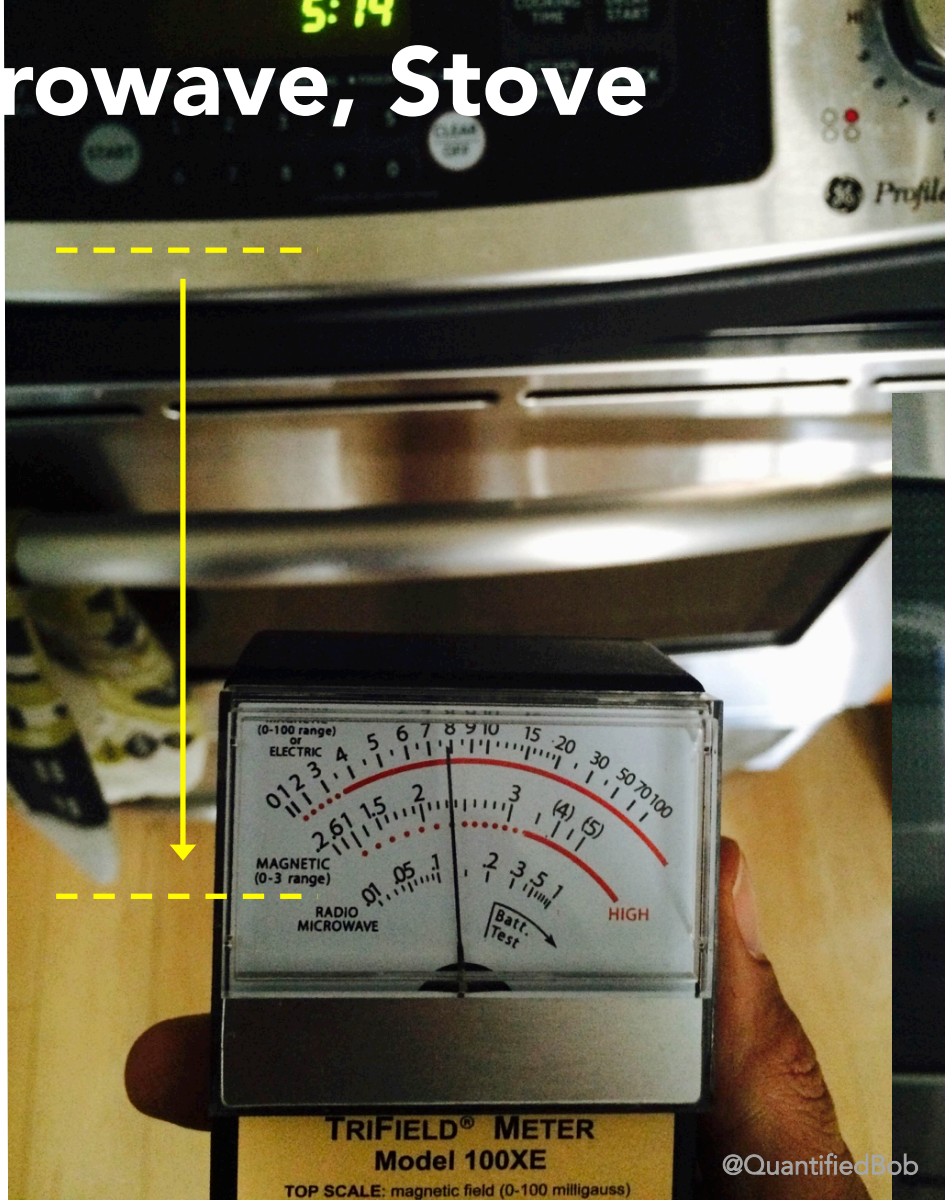
up



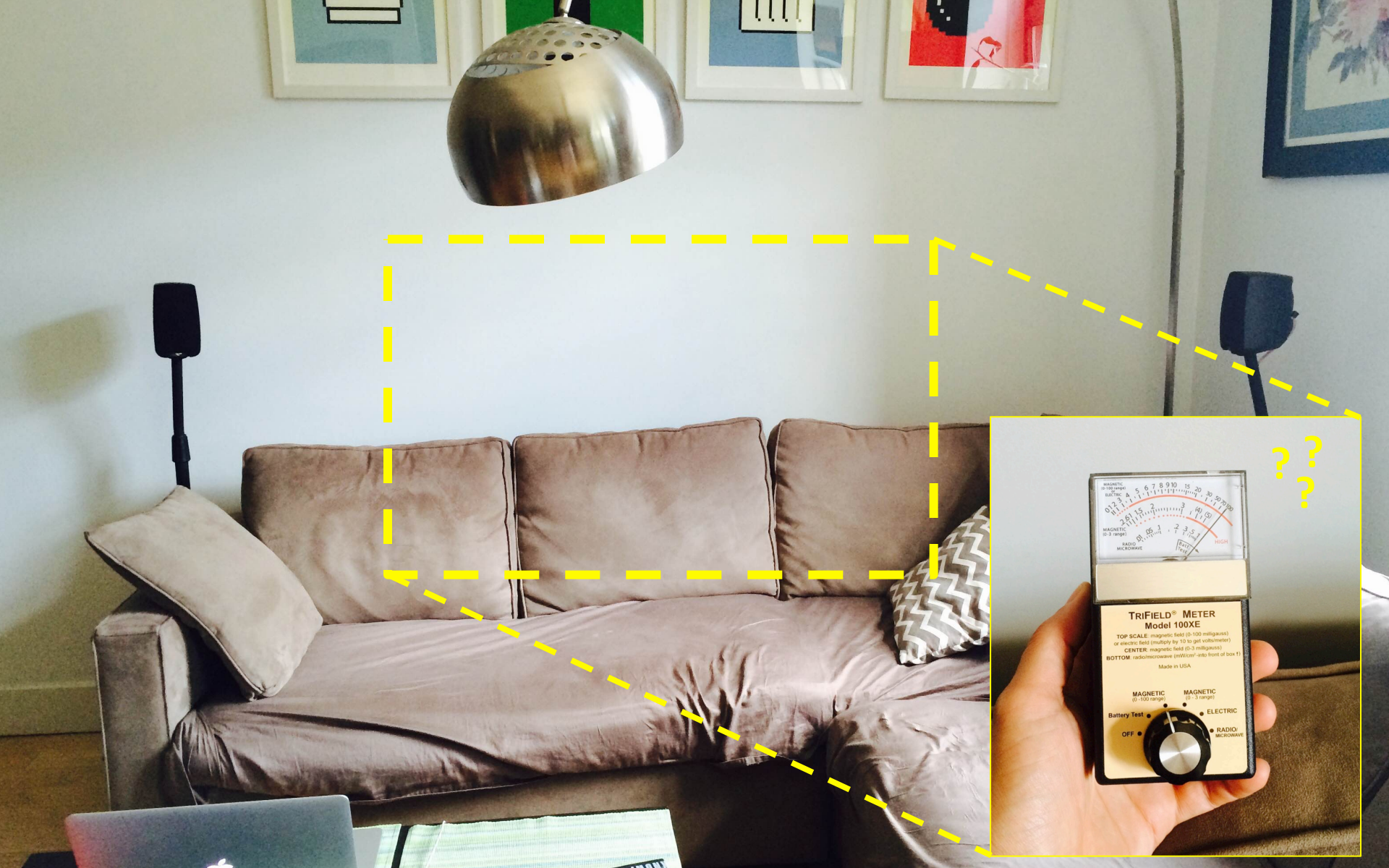
down



EMF Readings – Microwave, Stove

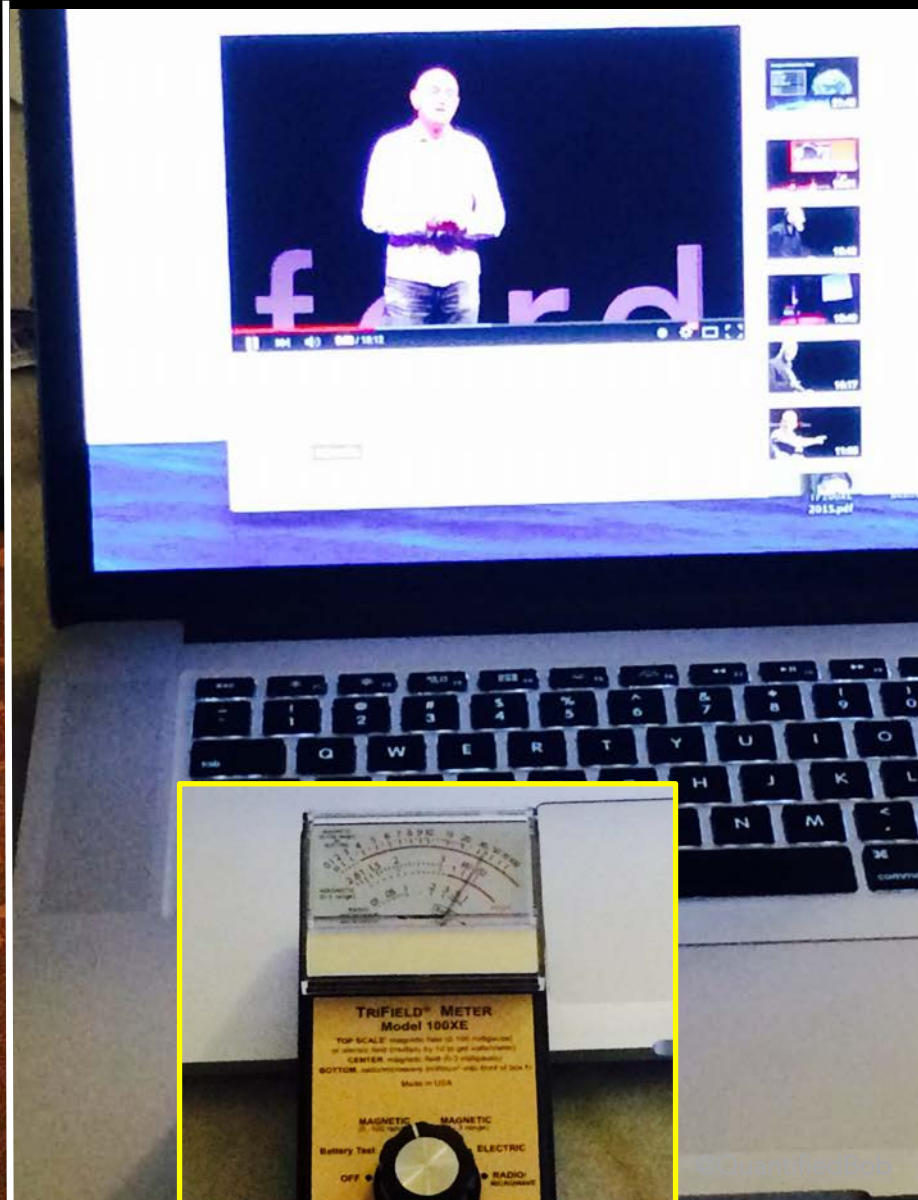


EMF Readings – Bedroom


TRIFIELD® METER
Model 100XE
TOP SCALE: magnetic field (0-100 milligauss)
or electric field (multiply by 10 to get volts/meter)
CENTER: magnetic field (0-3 milligauss)
BOTTOM: radio/microwave (mW/cm² -into front of box f)
Made in USA
MAGNETIC (0 -100 range
MAGNETIC (0 - 3 range)
Battery Test
ELECTRIC
OFF
RADIO/ MICROWAVE
???

WiFi and RF


Electrosmog meter
CORNET
RADMETERS


TRIFIELD® METER
Model 100XE
MAGNETIC
MAGNETIC
ELECTRIC
RADIO

Outdoor EMF and RF Readings

What did I learn?

- New York City is a dangerous place to live!
- Simple hacks can have a huge impact (leave door open, move bed away from wall)
- Cheap sensors ok for general trends – but may not provide desired accuracy
- Need to take consistent readings over time
- Sensor calibration is more trouble than it's worth!
- No matter what you do, can never completely eliminate external environmental issues, only minimize their effects.

What's next?

- Water quality testing (lead, etc.)
- More/better sensors (VOCs, etc.)
- Measure indoor light RGB color (f.lux for the home?)
- Link public data sets (outdoor air quality, locations of fuel tanks, cell towers, etc.)

Thanks!

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