airpointer® CO module

IR Absorption

Lambert-Beer's Law:
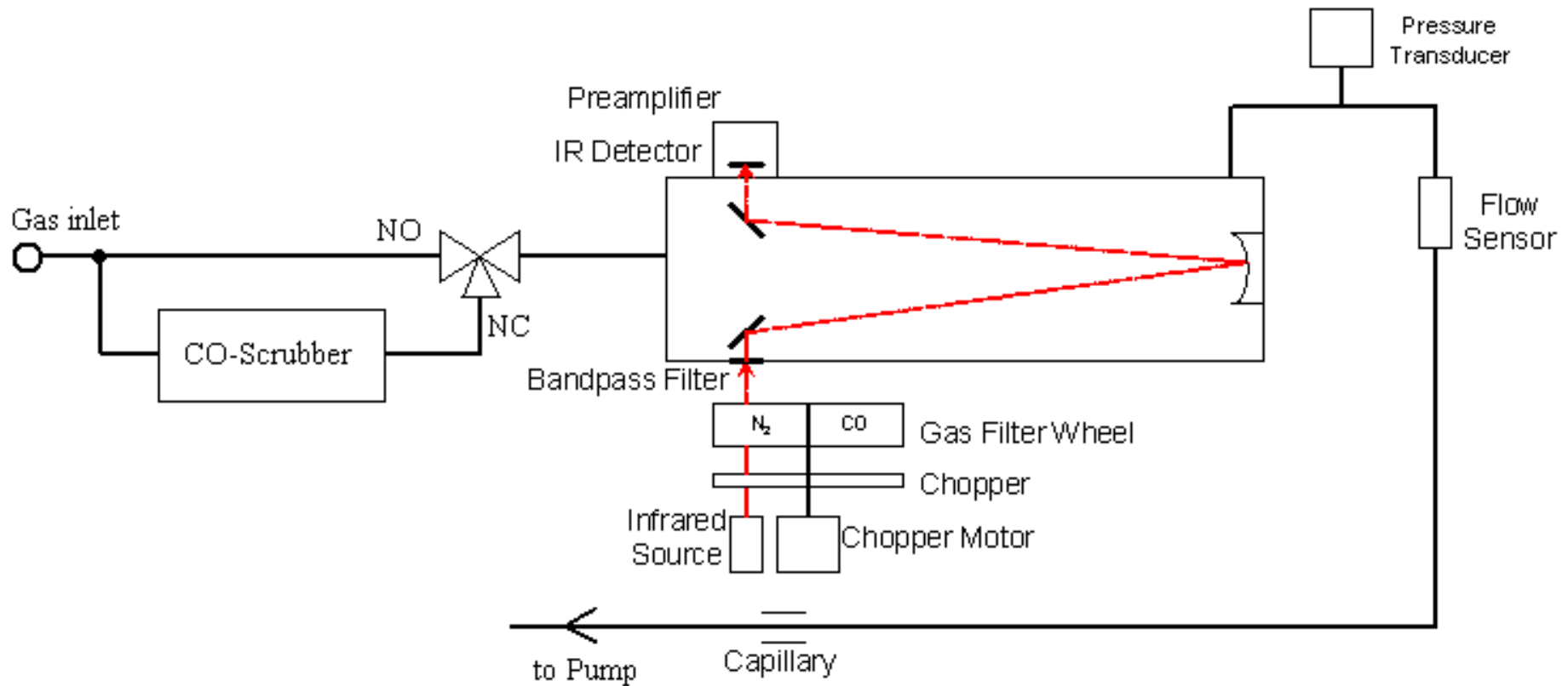
$$I = I_o \, e^{-\alpha L c}$$
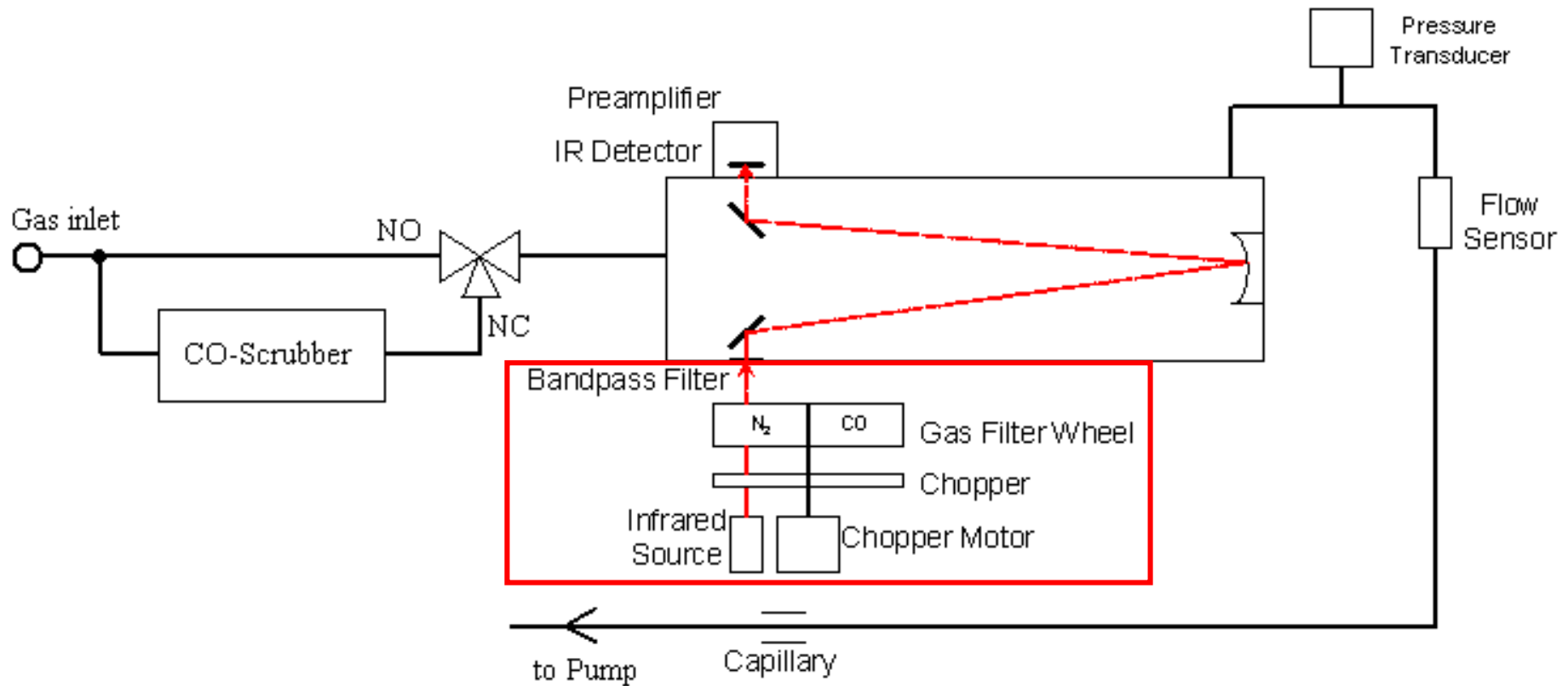
$$c = \ln(I_o/I)\,(1/\alpha L)$$

I:	Intensity of the light transmitted (after absorption)
I_o:	Intensity of the light emitted
α:	absorption coefficient of the gas (here: CO)
L:	absorption path length
c:	concentration of the absorbing gas (here: CO)

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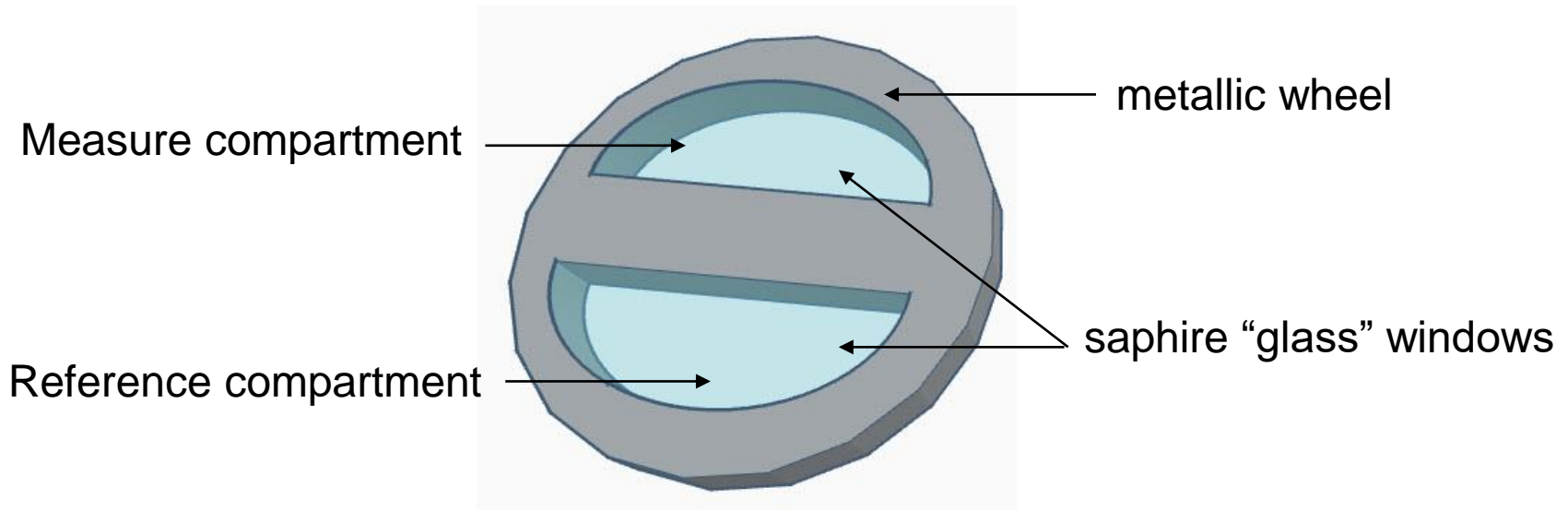Environmental Monitoring Solutions
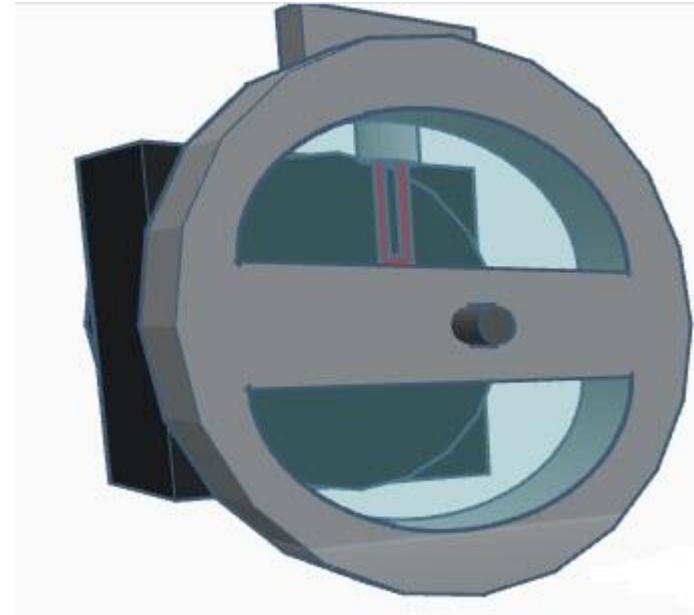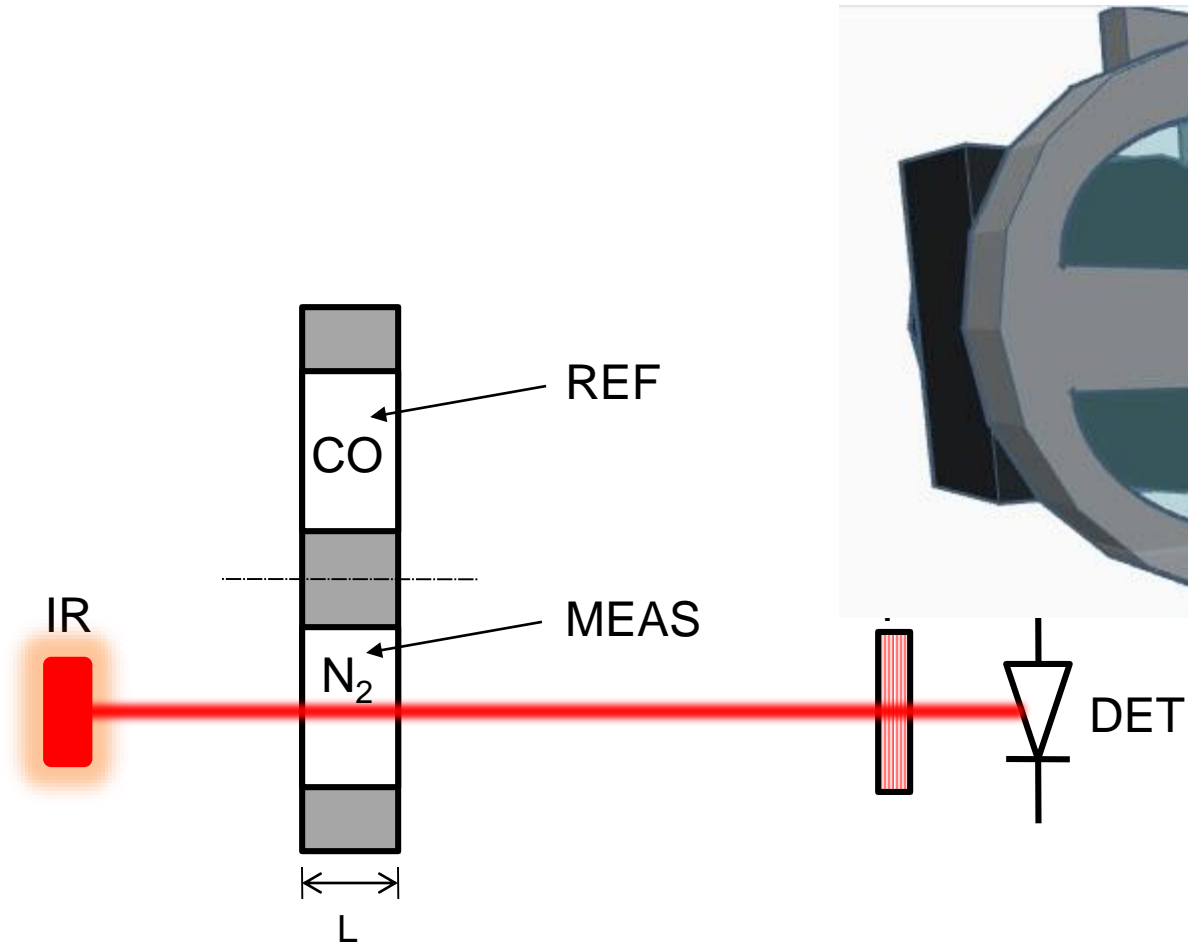
Flow Diagram

Flow Diagram

GFC wheel

Unfortunately, water and CO_2 also absorb light with wavelength around 4.7λm. The CO Module uses a method called Gas Filter Correlation (GFC) to overcome their interfering effect.

metallic wheel

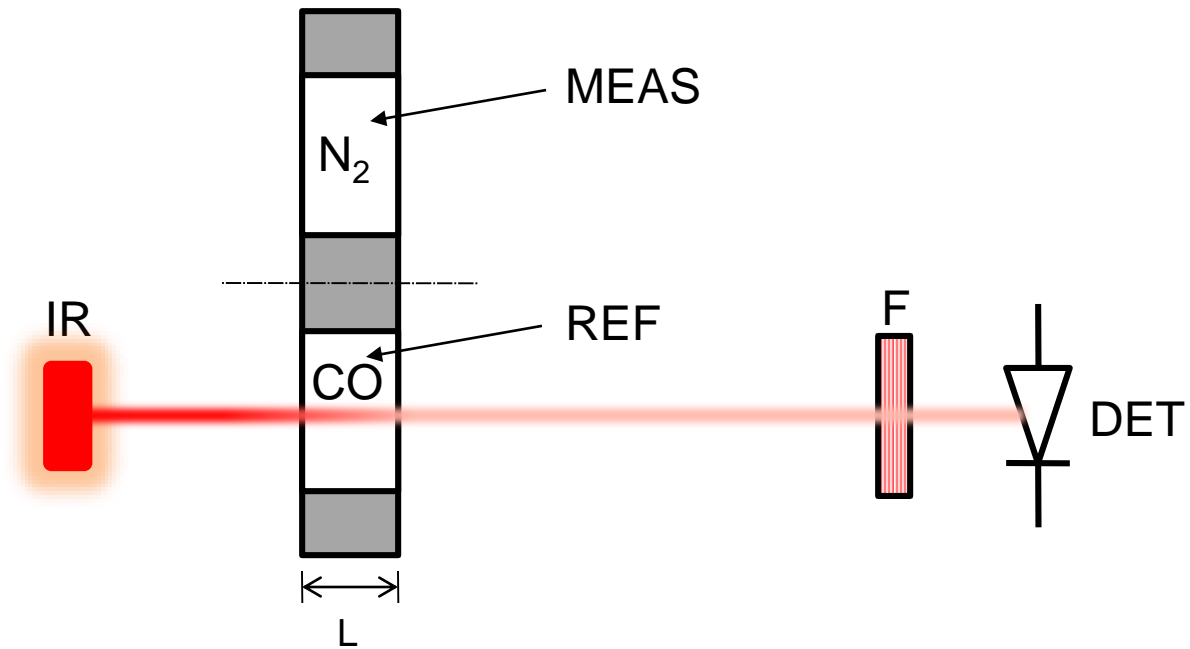Measure compartment

Reference compartment

saphire "glass" windows

NB: Saphire will pass the 4.7μm photons. Normal glass is opaque at 4.7μm.

GFC wheel

REF

CO

MEAS

IR

N$_2$

DET

L

![airpointer®]

![mlu-recordum® Environmental Monitoring Solutions]

GFC wheel

MEAS

N_2

IR

REF

F

CO

DET

L

GFC wheel

GFC wheel

GFC wheel

REF

CO

MEAS

N_2

IR

CO_2

F

DET

L
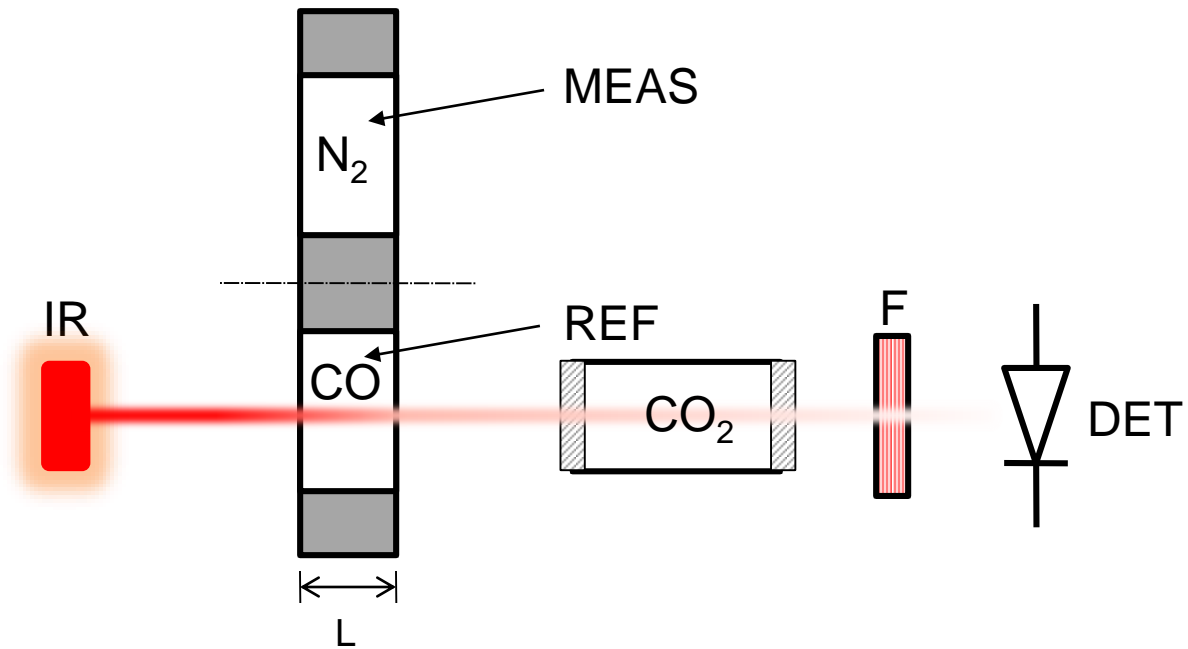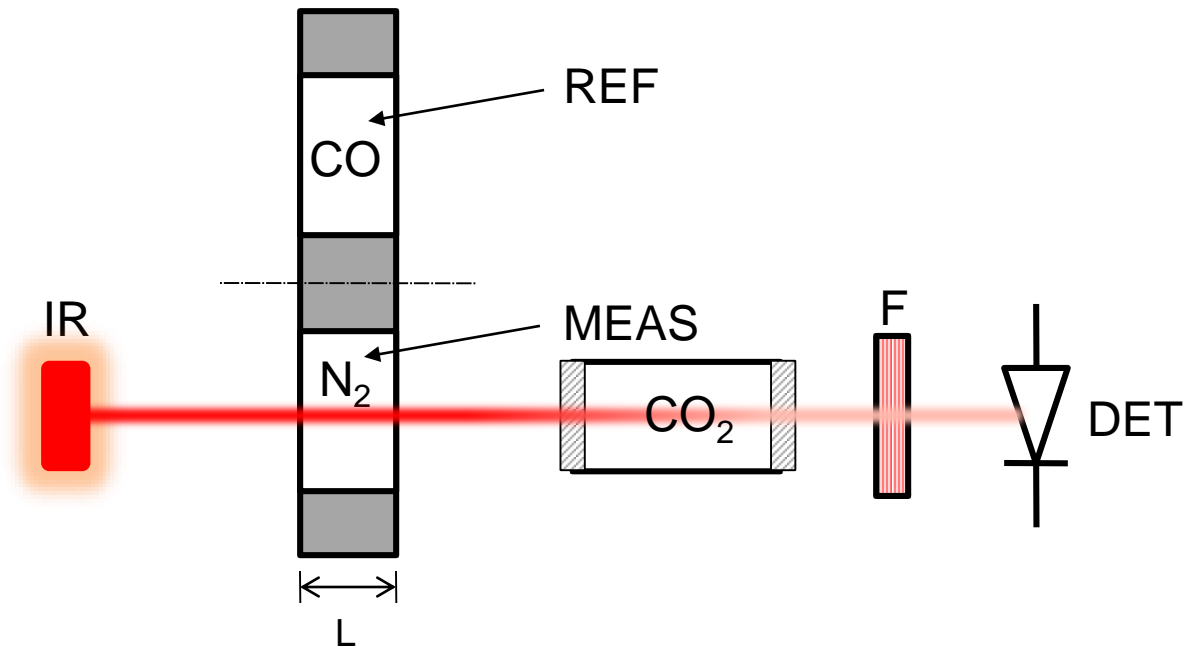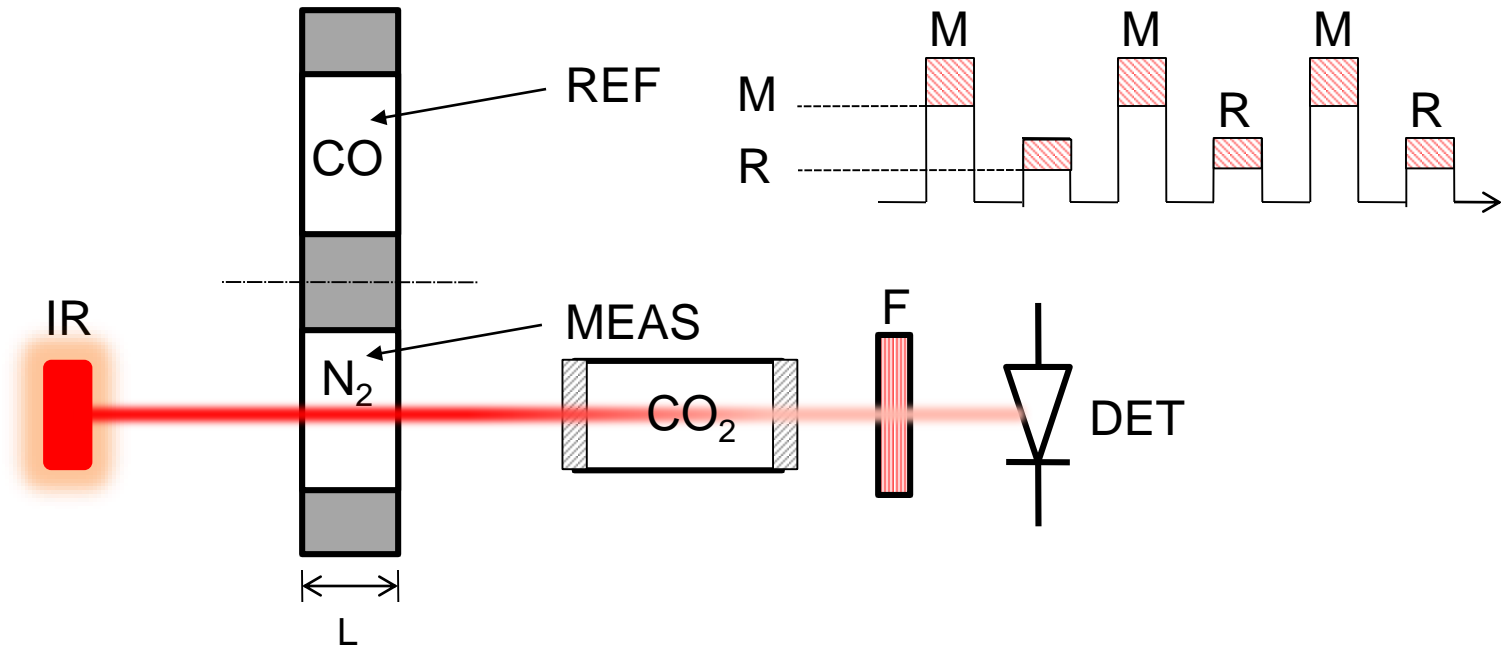
GFC wheel

A change in CO_2 or H_2O concentration will impact both M and R: the M/R ratio stays constant
→ M/R does not depend on H_2O and CO_2 concentration

GFC wheel

MEAS

N$_2$

REF

IR

CO

CO

F

DET

L

GFC wheel

IR   REF   MEAS   F   DET

CO   N$_2$ CO   L
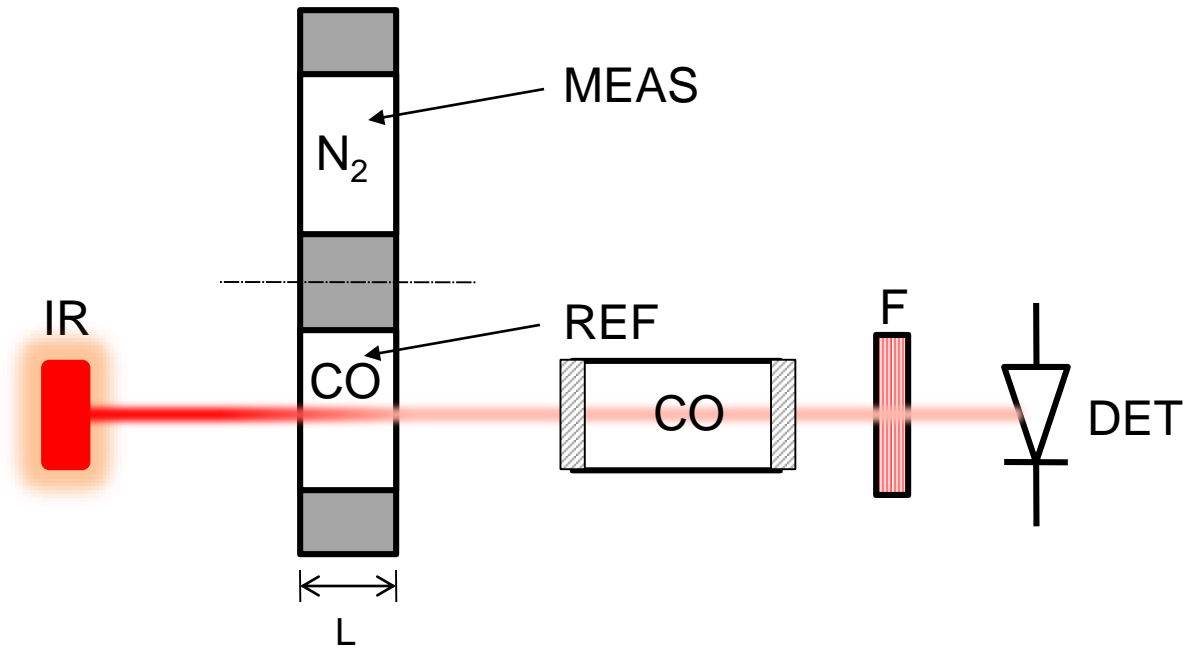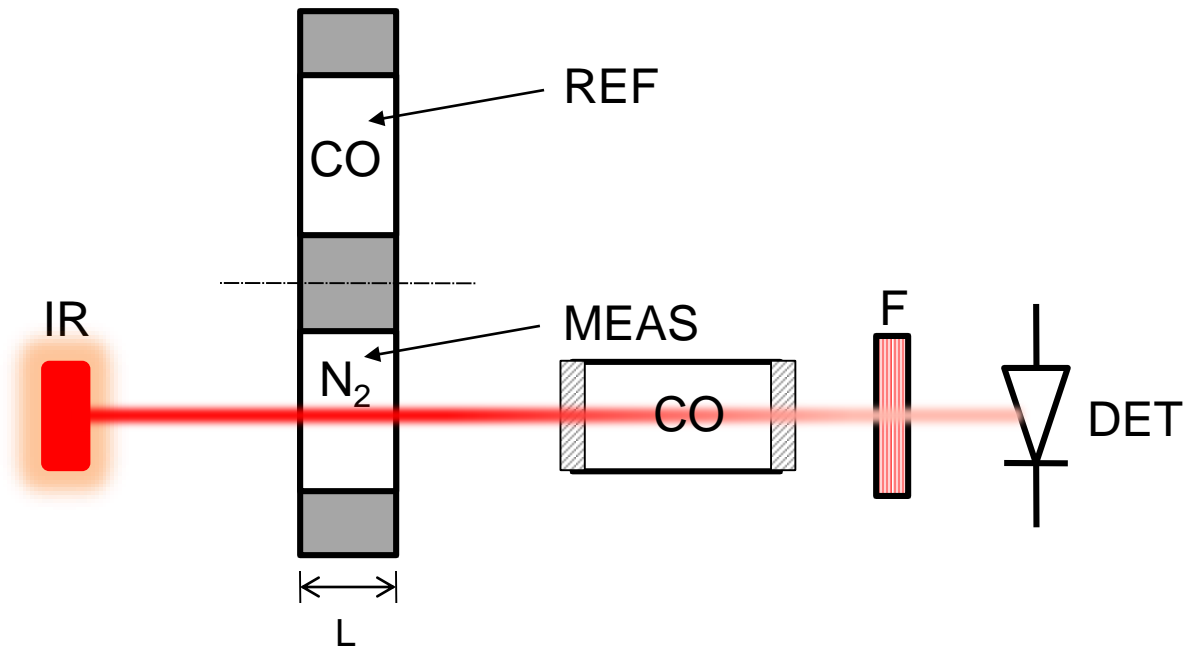
GFC wheel

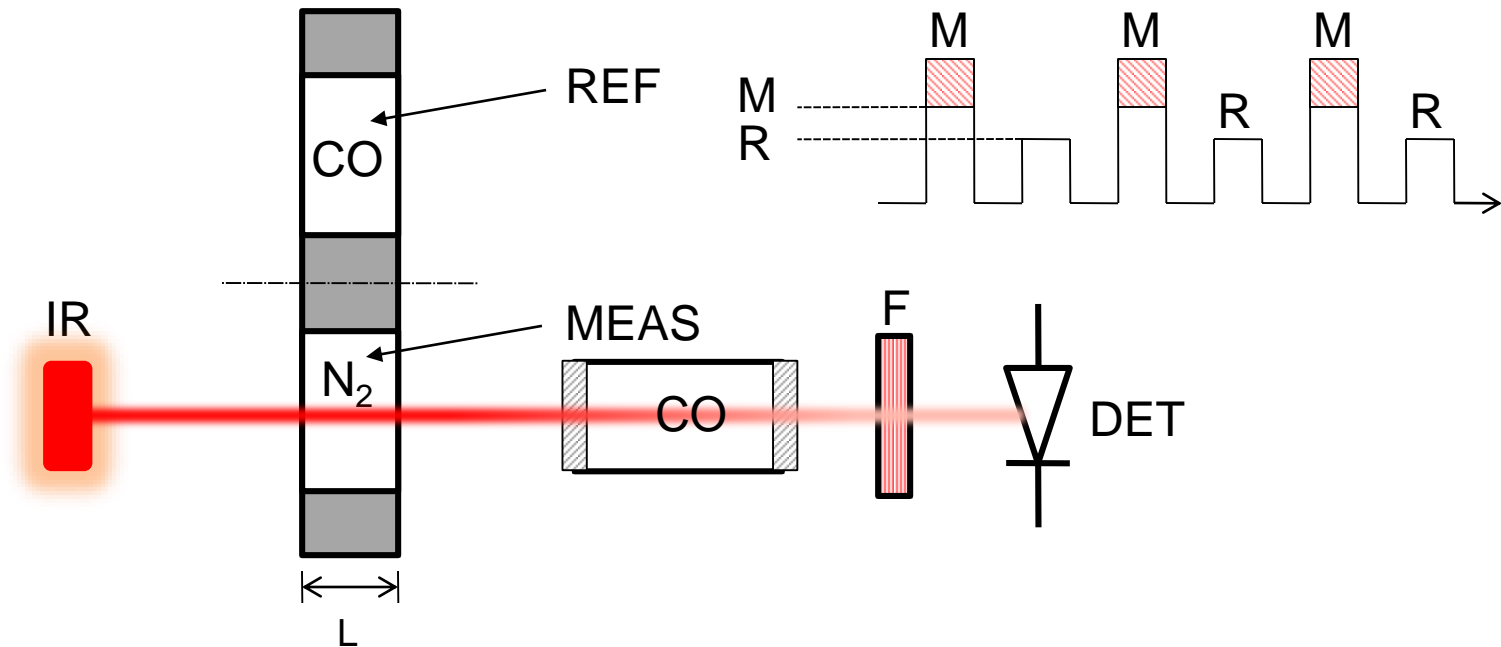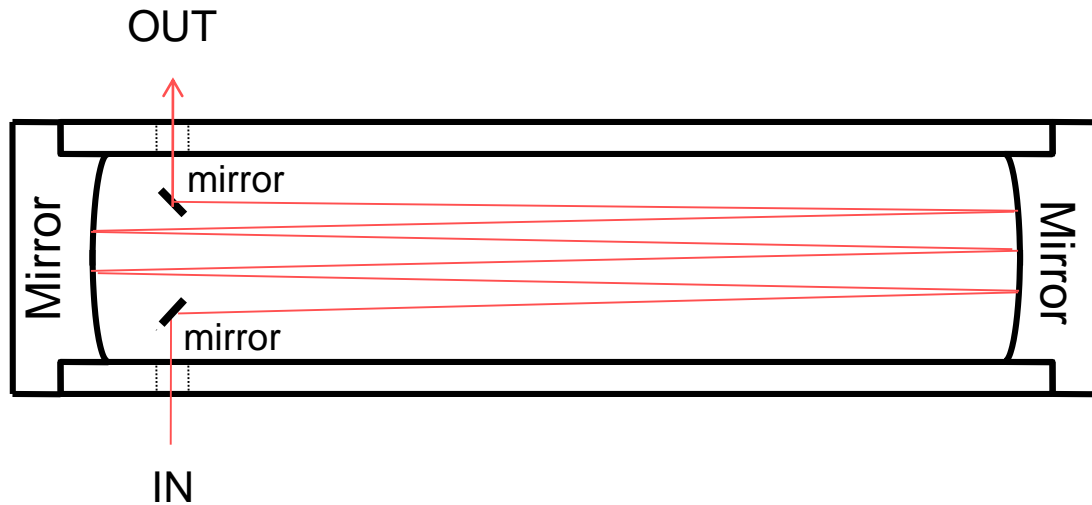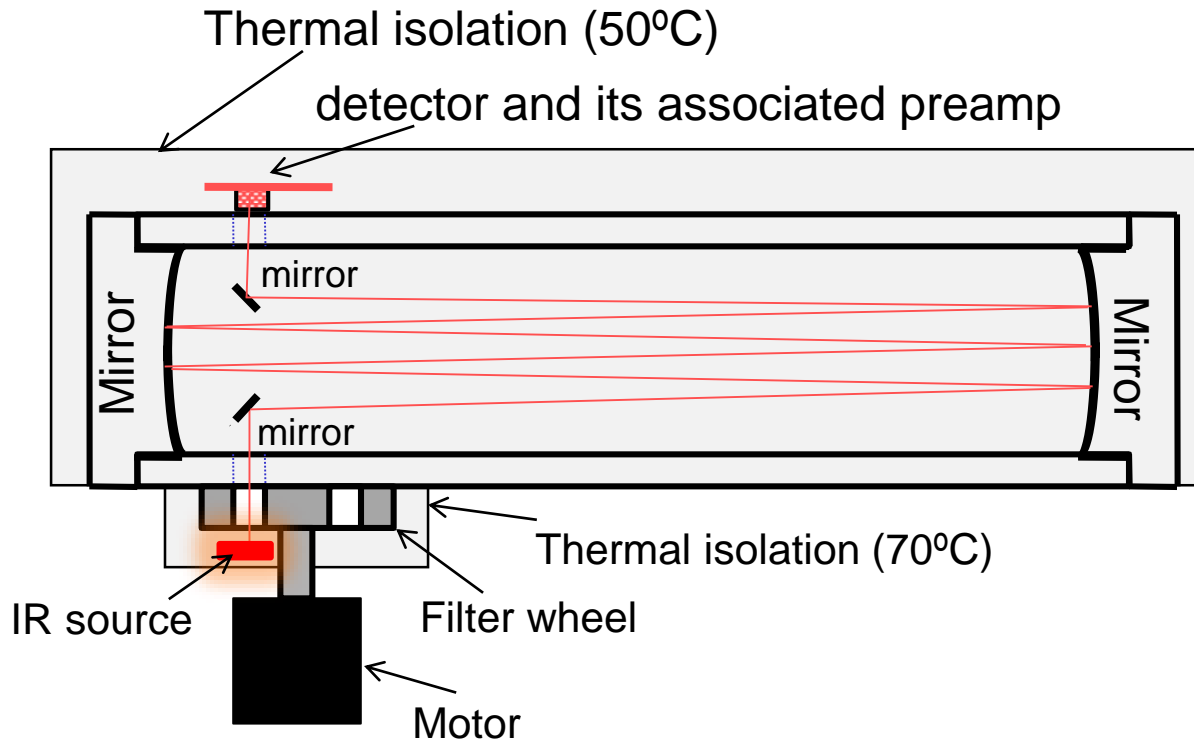A change in CO concentration will impact M, but not R: the M/R ratio changes
→ M/R depends on CO concentration

CO bench

Increased path length = increased sensitivity
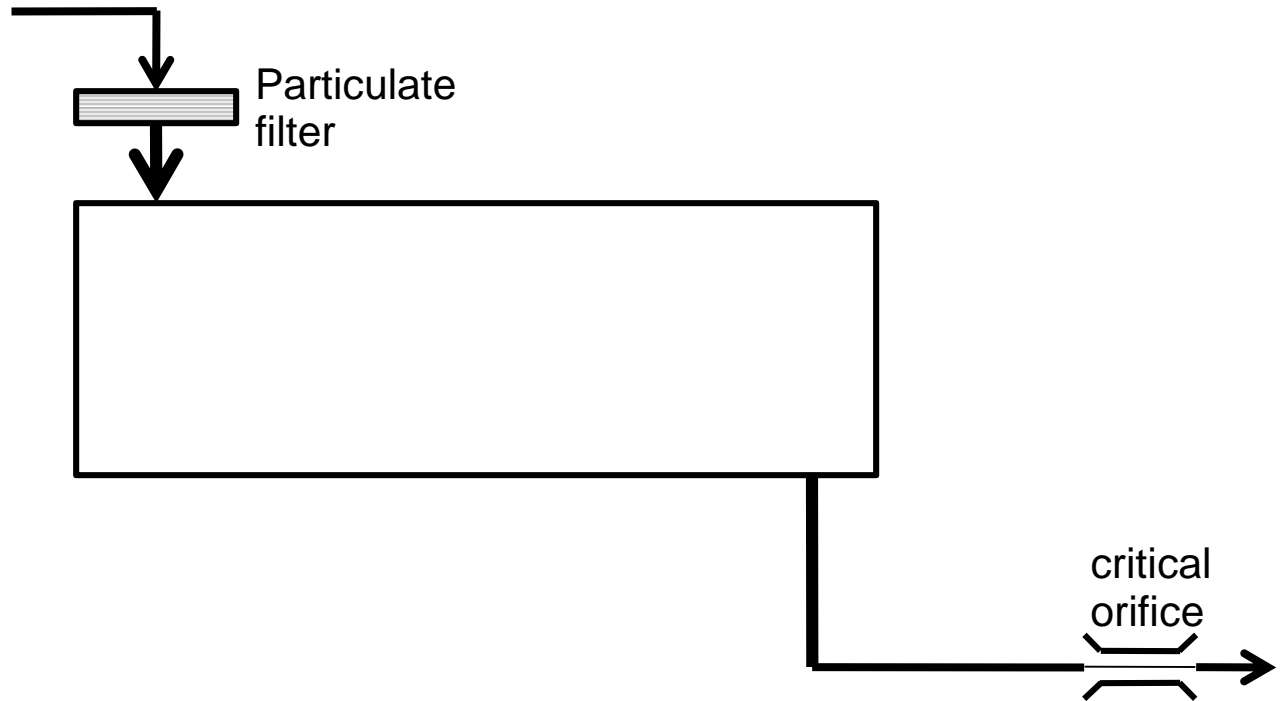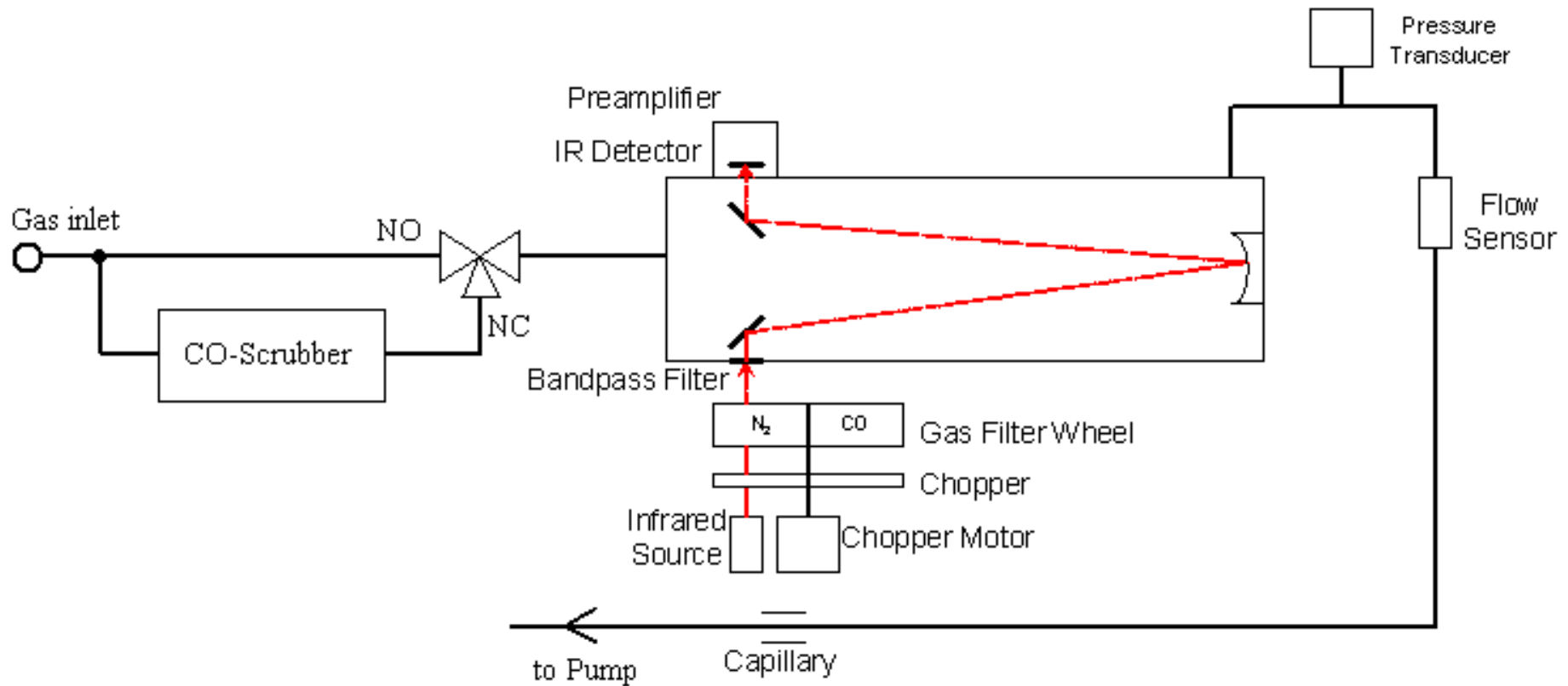
CO bench

Thermal isolation (50ºC)

detector and its associated preamp

Mirror

mirror

Mirror

mirror

Thermal isolation (70ºC)

IR source

Filter wheel

Motor

CO bench

Particulate filter

critical orifice

Flow Diagram

Parameters

Parameter	Value	Unit	Status: BS-FS-SS	
CO	1.151	ppm	0 0 0	

CO_all	1.151	ppm	CO_raw	1.250	ppm	COStdDev	0.0442	ppm	CO_Avg (300 sec)	1.190	ppm	CalRatio (300 sec)	1.12823

COMeas	2073.2	mV	CORatio	1.1282	-
CORef	1837.1	mV			
CO_AGC	5.04	V	Setpoint AGC	5.0 (+/- 0.2)	V
CO_Speed	1990	rpm	PreAmpCO	40.4	%
COIRSourceVoltage	18.7	V	COPowerToSpeed	65.2	%
PressCO	879.0	mbar	FlowCO	502.5	ml/min
BenchT	50.1	°C	PowerToCOBench	19.7	%
COScrubberTemp	69.9	°C	PowerToCOScrubber	22.1	%
CO_cylinder	1.0	bar			

CO Time Constant nr values to TC:	1200	StdDev last 10 samples:	0.001
CO Slope:	1.098	CO Offset:	-0.060498

Parameters
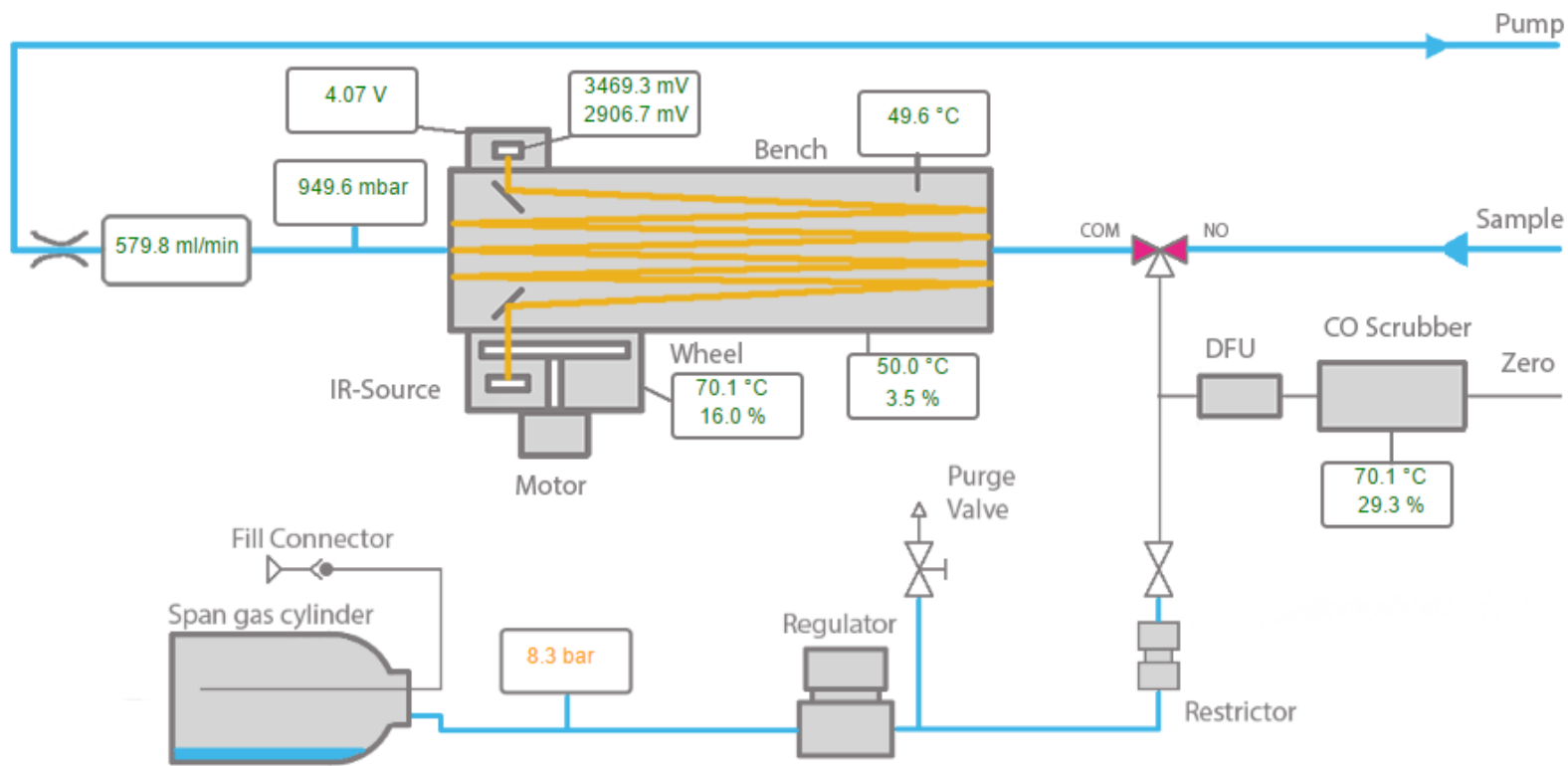
CO   1.306 ppm

Note: '-9999' is displayed for a missing value.

Span check

Calibration

- Using external zero air and external SO_2 cylinder
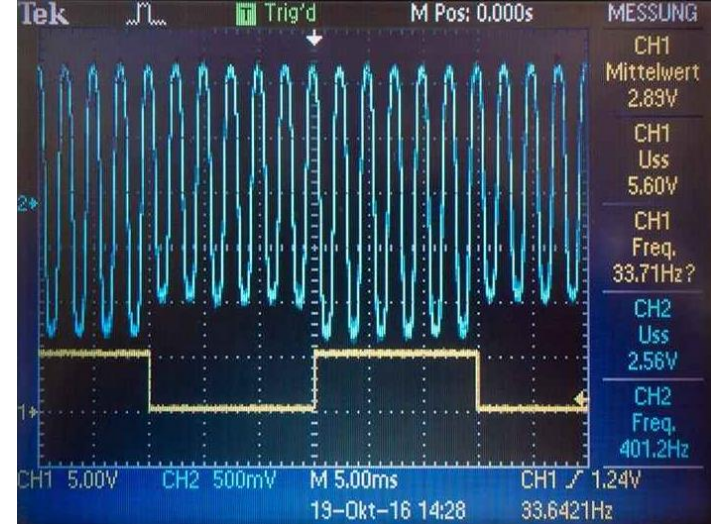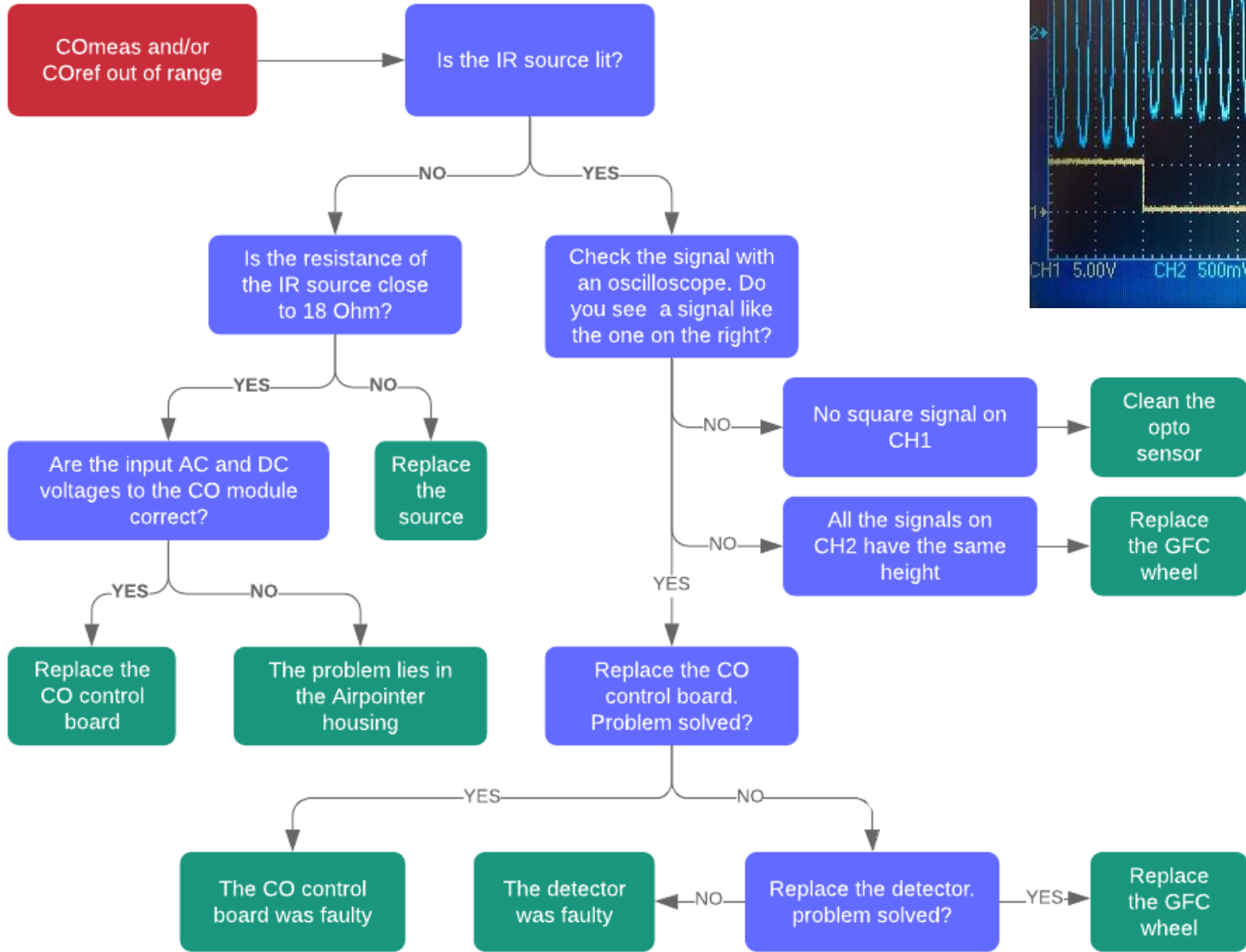
Preventive maintenance

- Change DFU filter (once a year)

- Change IR source (every 2 years)

- Never touch the mirrors inside the bench!

Full schedule available here:
https://www.airpointer.tech/maintenance-schedule/

Troubleshooting CO

COmeas and/or COref out of range → Is the IR source lit?

NO → Is the resistance of the IR source close to 18 Ohm?

- **YES** → Are the input AC and DC voltages to the CO module correct?
  - **YES** → Replace the CO control board
  - **NO** → The problem lies in the Airpointer housing
- **NO** → Replace the source

YES → Check the signal with an oscilloscope. Do you see a signal like the one on the right?

- **NO** → No square signal on CH1 → Clean the opto sensor
- **NO** → All the signals on CH2 have the same height → Replace the GFC wheel
- **YES** → Replace the CO control board. Problem solved?
  - **YES** → The CO control board was faulty
  - **NO** → Replace the detector. problem solved?
    - **NO** → The detector was faulty
    - **YES** → Replace the GFC wheel

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Thank you for your attention!