Campbell®

SCIENTIFIC

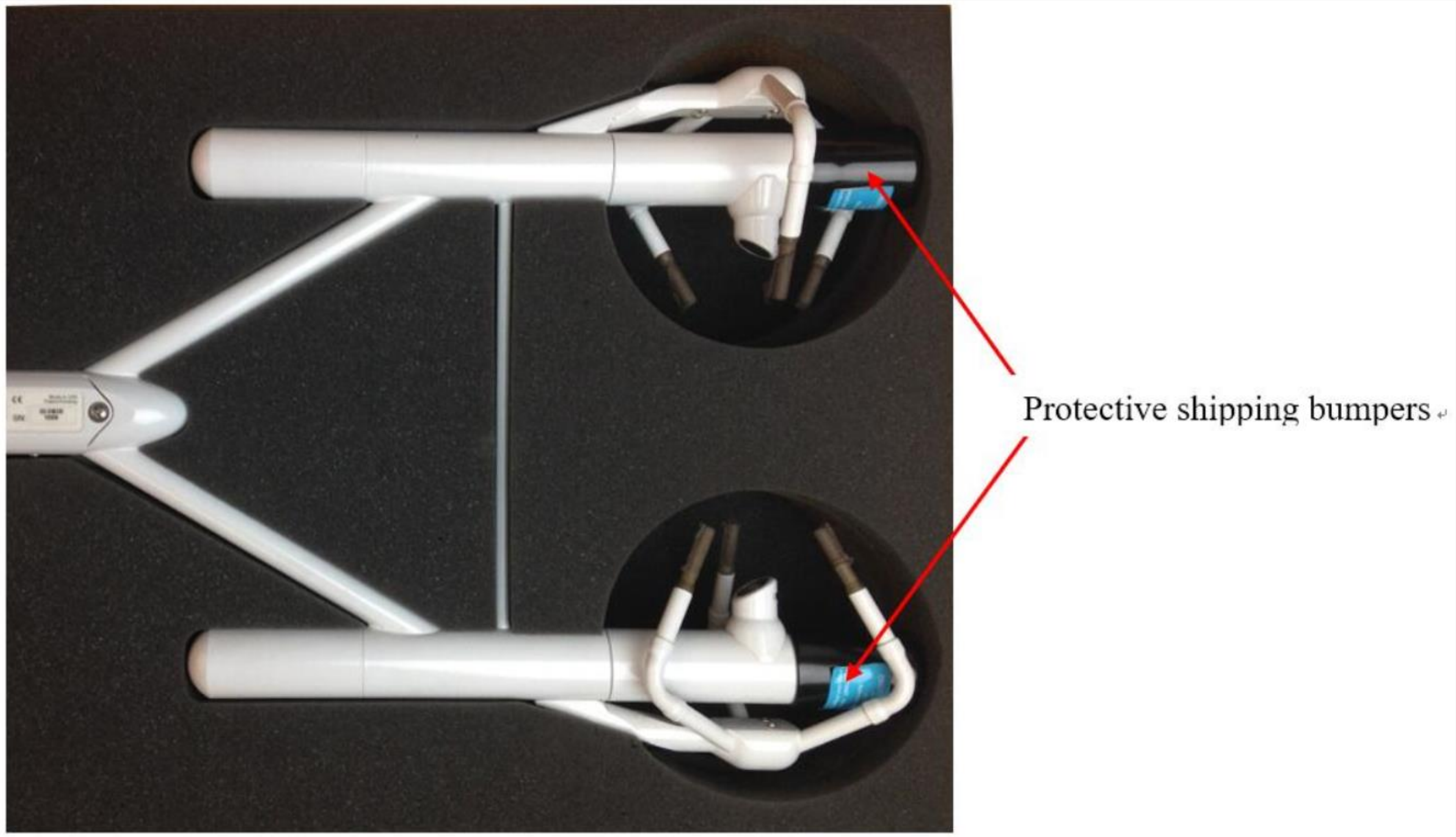
涡度通量系统常见故障、分析仪 **Zero/Span** 及复位操作

2023年8月17日

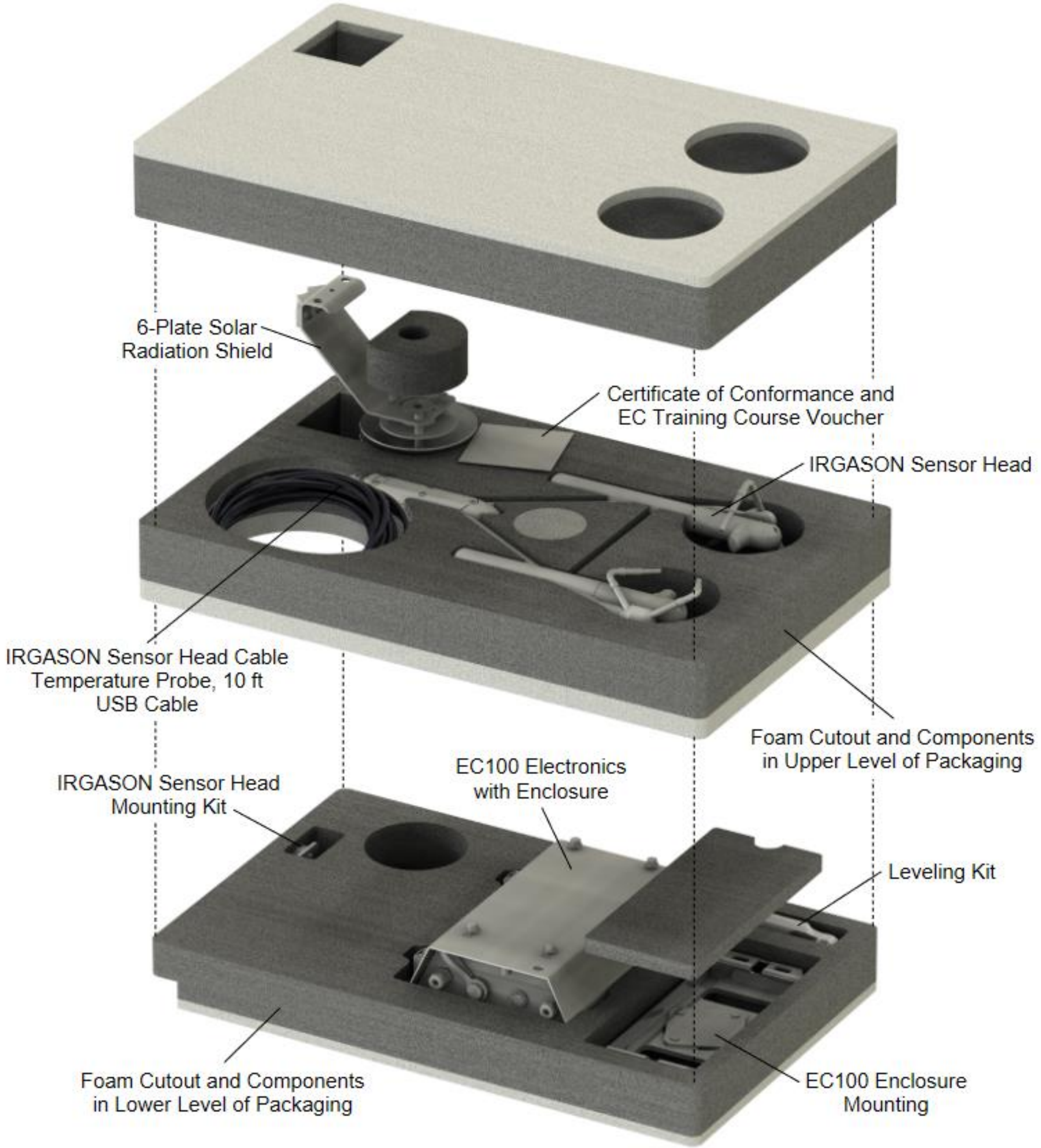
目录:

1. 涡度通量系统常见故障现象

1.1 运输安全 (老版防护泡沫)

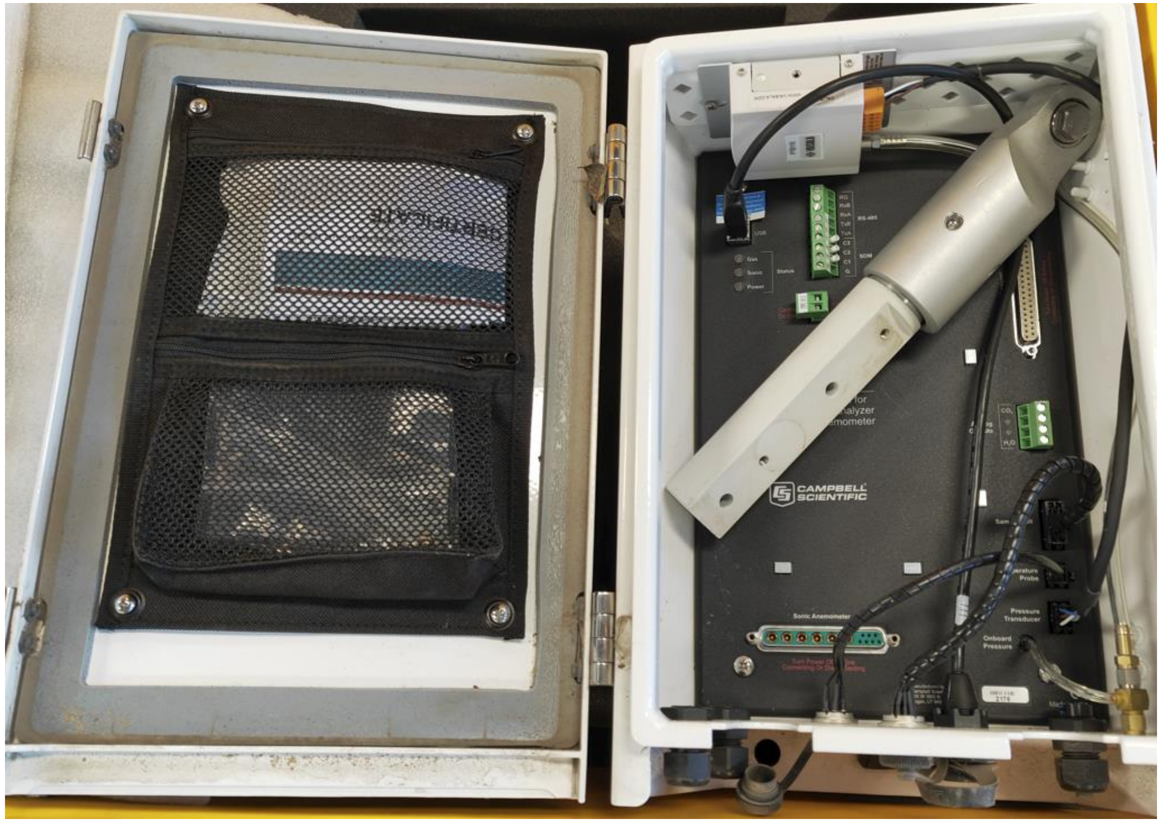


运输安全
(新版防护泡沫)


6-Plate Solar
Radiation Shield
Certificate of Conformance and
EC Training Course Voucher
IRGASON Sensor Head
IRGASON Sensor Head Cable
Temperature Probe, 10 ft
USB Cable
Foam Cutout and Components
in Upper Level of Packaging
IRGASON Sensor Head
Mounting Kit
EC100 Electronics
with Enclosure
Leveling Kit
Foam Cutout and Components
in Lower Level of Packaging
EC100 Enclosure
Mounting

运输安全（实例 1）

运输安全（实例 2）



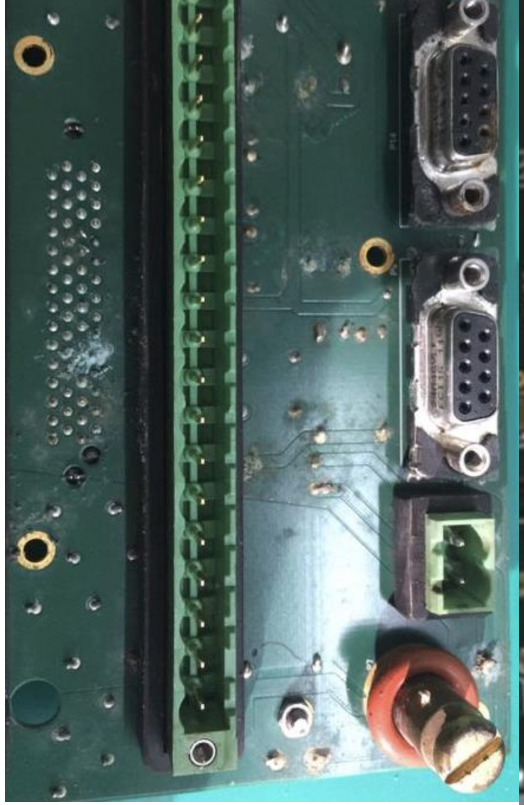
1.2 保持电子设备干燥

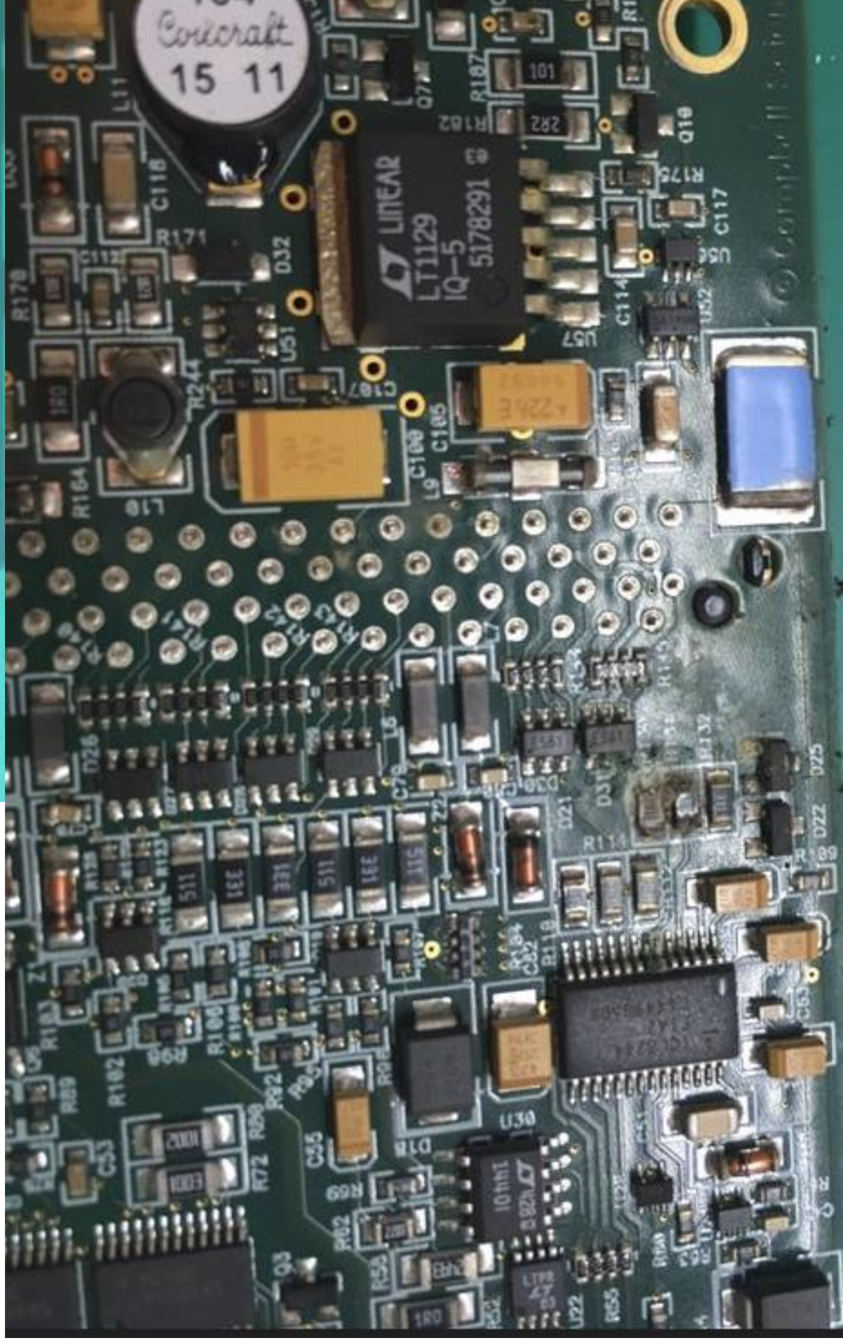

SDM-CD16S
CR6
Datalogger
CPEC310


EC100
Electronics Module for
CO2 & H2O Gas Analyzer with
3-D Sonic Anemometer
CAMPBELL SCIENTIFIC


CAMPBELL SCIENTIFIC
CR6
Datalogger

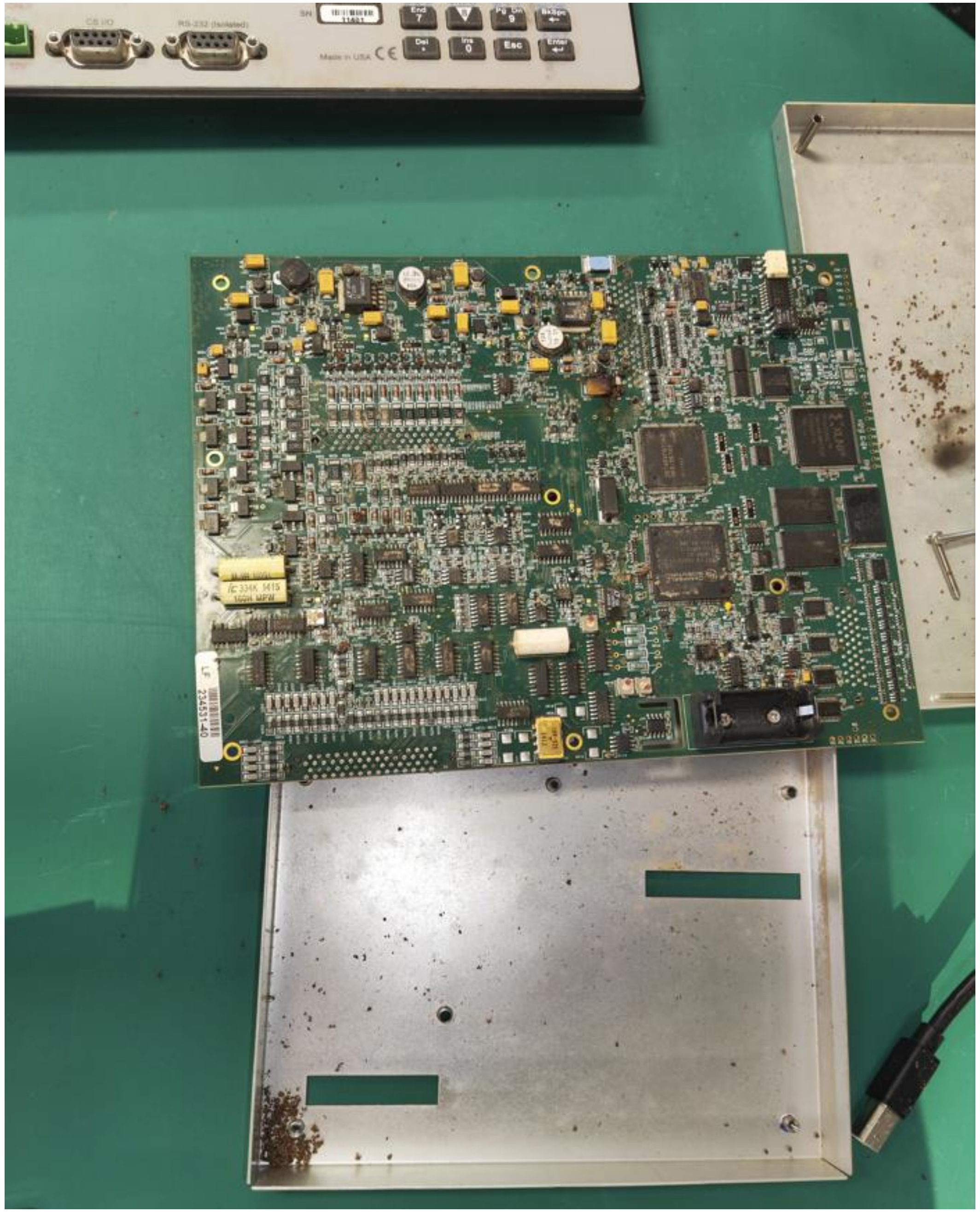
定期更换机箱内部的干燥剂





无凝结条件是保证电子设备长期安全可靠运行的重要保证!

1.3 防止动物侵入



1.4 分析仪故障诊断码

Gas analyzer diagnostic flags -- not connected

Flag Status	Description
N/A	No diagnostic flags are set
N/A	No general system fault
N/A	Gas analyzer is running
N/A	Motor speed within limits
N/A	TEC temperature within limits
N/A	Source power within limits
N/A	Valid source temperature
N/A	Source current within limits
N/A	Gas head powered
N/A	Gas input data in sync with home pulse
N/A	Valid ambient temperature
N/A	Valid ambient pressure
N/A	CO2 I within limits
N/A	CO2 Io within limits
N/A	H2O I within limits
N/A	H2O Io within limits
N/A	Moving variation in CO2 Io within limits
N/A	Moving variation in H2O Io within limits
N/A	CO2 signal level ok
N/A	H2O signal level ok
N/A	Gas head calibration signature ok
N/A	Heater control within limits
N/A	Differential pressure within limits

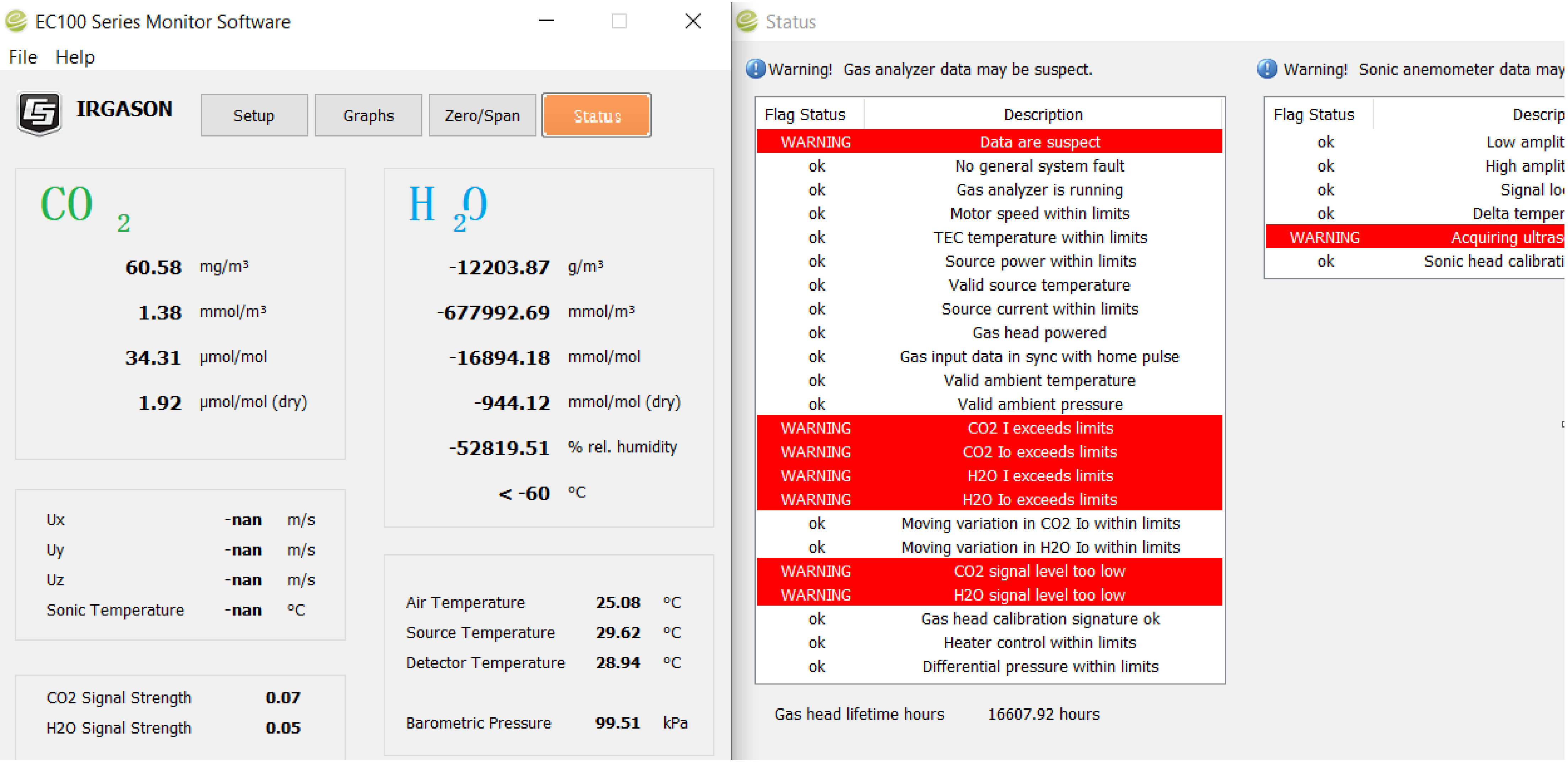
Gas head lifetime hours not connected

Gas analyzer diagnostic flags good. No warning flags set.

Flag Status	Description
ok	No diagnostic flags are set
ok	No general system fault
ok	Gas analyzer is running
ok	Motor speed within limits
ok	TEC temperature within limits
ok	Source power within limits
ok	Valid source temperature
ok	Source current within limits
ok	Gas head powered
ok	Gas input data in sync with home pulse
ok	Valid ambient temperature
ok	Valid ambient pressure
ok	CO2 I within limits
ok	CO2 Io within limits
ok	H2O I within limits
ok	H2O Io within limits
ok	Moving variation in CO2 Io within limits
ok	Moving variation in H2O Io within limits
ok	CO2 signal level ok
ok	H2O signal level ok
ok	Gas head calibration signature ok
ok	Heater control within limits
ok	Differential pressure within limits

Gas head lifetime hours 16607.75 hours

分析仪故障诊断码


EC100 Series Monitor Software
File Help
IRGASON
Setup
Graphs
Zero/Span
Status
CO_2
60.58 mg/m³
1.38 mmol/m³
34.31 μmol/mol
1.92 μmol/mol (dry)
H_2O
-12203.87 g/m³
-677992.69 mmol/m³
-16894.18 mmol/mol
-944.12 mmol/mol (dry)
-52819.51 % rel. humidity
< -60 °C
Ux -nan m/s
Uy -nan m/s
Uz -nan m/s
Sonic Temperature -nan °C
Air Temperature 25.08 °C
Source Temperature 29.62 °C
Detector Temperature 28.94 °C
CO2 Signal Strength 0.07
H2O Signal Strength 0.05
Barometric Pressure 99.51 kPa
Status
Warning! Gas analyzer data may be suspect.
Flag Status Description
WARNING Data are suspect
ok No general system fault
ok Gas analyzer is running
ok Motor speed within limits
ok TEC temperature within limits
ok Source power within limits
ok Valid source temperature
ok Source current within limits
ok Gas head powered
ok Gas input data in sync with home pulse
ok Valid ambient temperature
ok Valid ambient pressure
WARNING CO2 I exceeds limits
WARNING CO2 Io exceeds limits
WARNING H2O I exceeds limits
WARNING H2O Io exceeds limits
ok Moving variation in CO2 Io within limits
ok Moving variation in H2O Io within limits
WARNING CO2 signal level too low
WARNING H2O signal level too low
ok Gas head calibration signature ok
ok Heater control within limits
ok Differential pressure within limits
Gas head lifetime hours 16607.92 hours
Warning! Sonic anemometer data may
Flag Status Descrip
ok Low amplit
ok High amplit
ok Signal lo
ok Delta temper
WARNING Acquiring ultras
ok Sonic head calibrati

1.5 三维超声故障诊断码

Sonic anemometer diagnostic flags -- not connected

Flag Status	Description
N/A	Low amplitude ok
N/A	High amplitude ok
N/A	Signal lock ok
N/A	Delta temperature ok
N/A	Sonic is running
N/A	Sonic head calibration signature ok

Sonic anemometer diagnostic flags good. No warning flags

Flag Status	Description
ok	Low amplitude ok
ok	High amplitude ok
ok	Signal lock ok
ok	Delta temperature ok
ok	Sonic is running
ok	Sonic head calibration signature ok

Warning! Sonic anemometer data may be suspect.

Flag Status	Description
ok	Low amplitude ok
ok	High amplitude ok
ok	Signal lock ok
ok	Delta temperature ok
WARNING	Acquiring ultrasonic signals
ok	Sonic head calibration signature ok

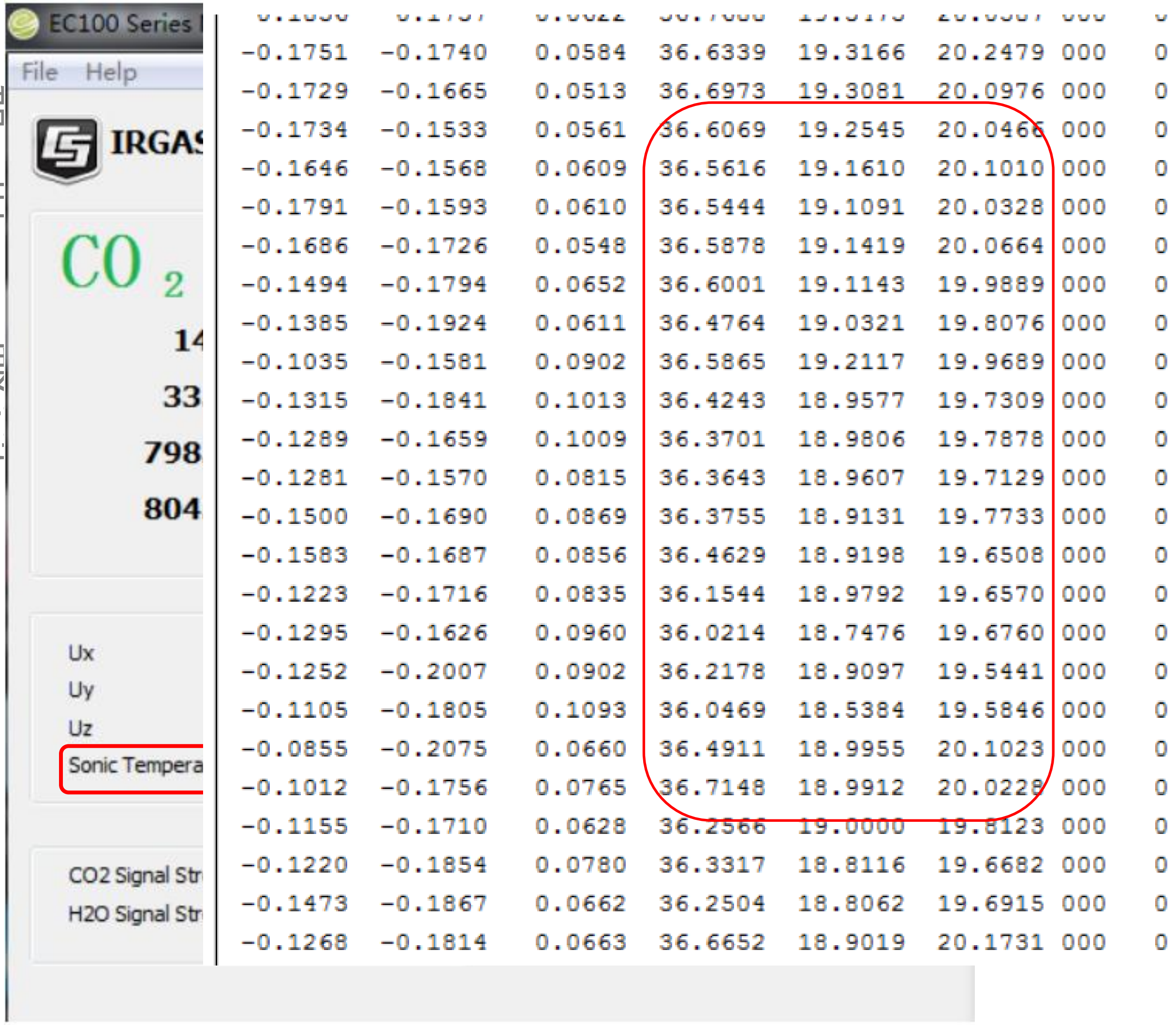
判断三维超声读数的合理范围

CSI对每一台CSAT3系列三维超声

对于Ux, Uy, Uz 三维风速数据， 可
合指标

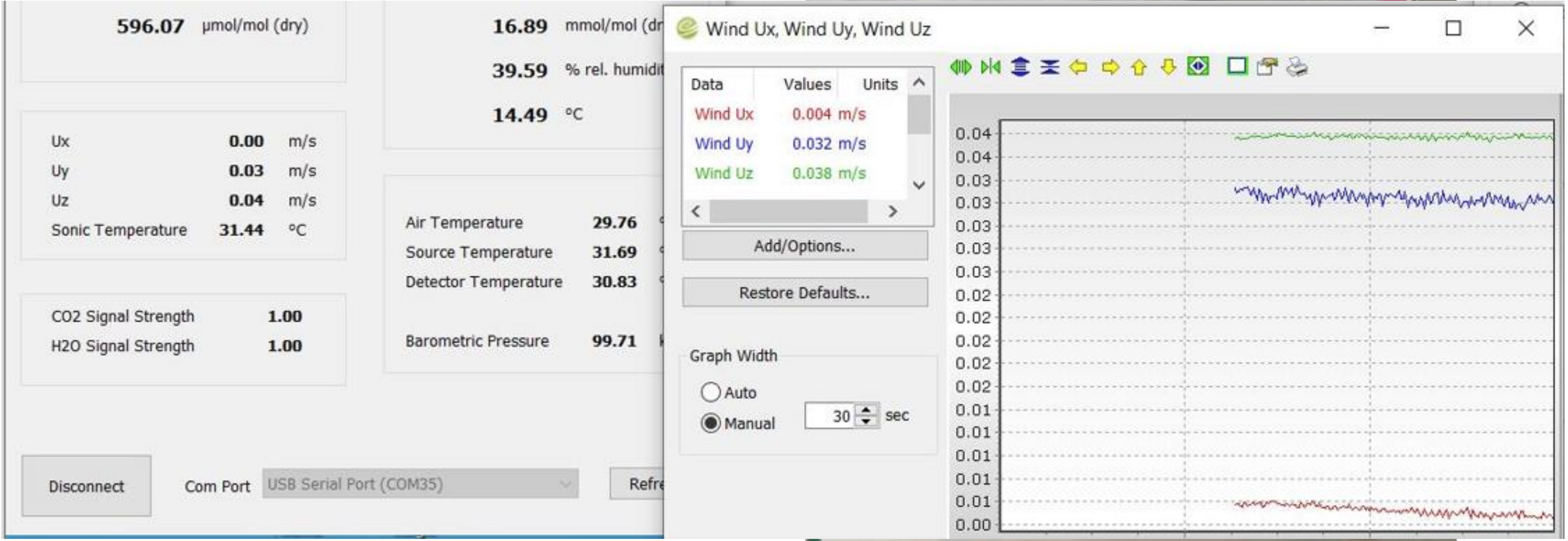
对于Ts, 可以通过与真实空气温度
值是否合理

$$T_S = T(1 + 0.51q)$$

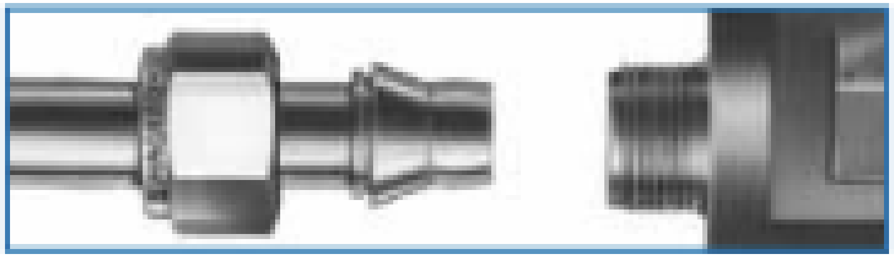


-0.1751	-0.1740	0.0584	36.6339	19.3166	20.2479	000	0
-0.1729	-0.1665	0.0513	36.6973	19.3081	20.0976	000	0
-0.1734	-0.1533	0.0561	36.6069	19.2545	20.0466	000	0
-0.1646	-0.1568	0.0609	36.5616	19.1610	20.1010	000	0
-0.1791	-0.1593	0.0610	36.5444	19.1091	20.0328	000	0
-0.1686	-0.1726	0.0548	36.5878	19.1419	20.0664	000	0
-0.1494	-0.1794	0.0652	36.6001	19.1143	19.9889	000	0
-0.1385	-0.1924	0.0611	36.4764	19.0321	19.8076	000	0
-0.1035	-0.1581	0.0902	36.5865	19.2117	19.9689	000	0
-0.1315	-0.1841	0.1013	36.4243	18.9577	19.7309	000	0
-0.1289	-0.1659	0.1009	36.3701	18.9806	19.7878	000	0
-0.1281	-0.1570	0.0815	36.3643	18.9607	19.7129	000	0
-0.1500	-0.1690	0.0869	36.3755	18.9131	19.7733	000	0
-0.1583	-0.1687	0.0856	36.4629	18.9198	19.6508	000	0
-0.1223	-0.1716	0.0835	36.1544	18.9792	19.6570	000	0
-0.1295	-0.1626	0.0960	36.0214	18.7476	19.6760	000	0
-0.1252	-0.2007	0.0902	36.2178	18.9097	19.5441	000	0
-0.1105	-0.1805	0.1093	36.0469	18.5384	19.5846	000	0
-0.0855	-0.2075	0.0660	36.4911	18.9955	20.1023	000	0
-0.1012	-0.1756	0.0765	36.7148	18.9912	20.0228	000	0
-0.1155	-0.1710	0.0628	36.2566	19.0000	19.8123	000	0
-0.1220	-0.1854	0.0780	36.3317	18.8116	19.6682	000	0
-0.1473	-0.1867	0.0662	36.2504	18.8062	19.6915	000	0
-0.1268	-0.1814	0.0663	36.6652	18.9019	20.1731	000	0

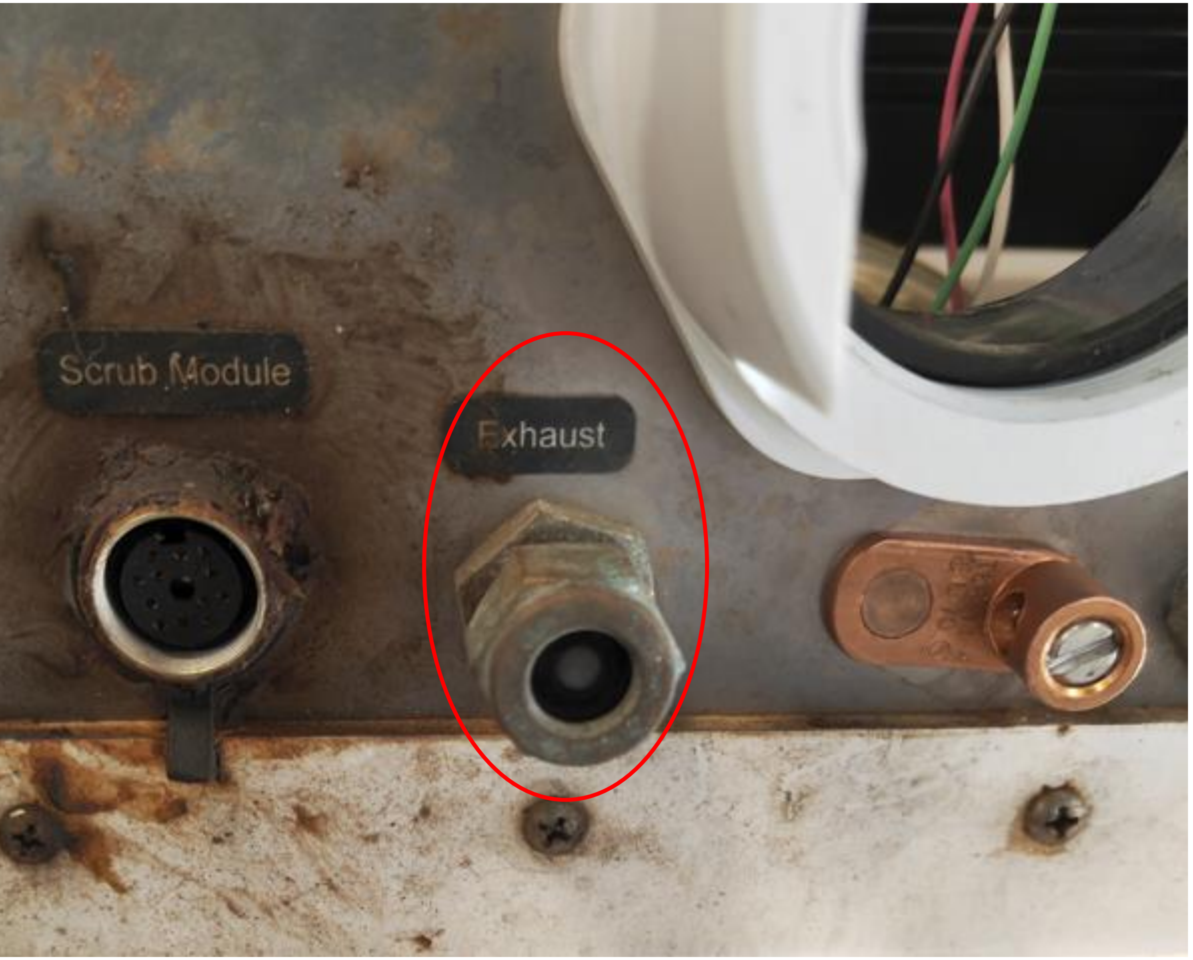
判断三维超声读数的合理范围



1.6 与闭路系统气路有关的故障现象



正确加工管接头，正确使用管接头！


Scrub Module
Exhaust


Analyzer
Zero

CR6Series_Training Numeric Display 2: Real Time Monitoring (Connected)

Add...

Delete

Delete All

Options...

Stop

RecNum	55141	ec155_pwr_off_	false	Ux	NAN	pump_press	100.3442
TimeStamp	3 16:04:16	ec155_vlt_low_a	false	Uy	NAN	pump_flow_raw	7.713185
card_bytes_free	Undefined	ec155_actual_p	true	Uz	NAN	pump_flow_set_	8
card_storage_av	Undefined	ec155_user_set	true	diag_sonic	-1	pump_flow_duty	1
sonic_azimuth	0	sec_snc_last_m	Undefined	CO2_mixratio	1033.839	mode	1
latitude	41.766	CO2_zero_coef	Undefined	H2O_mixratio	4.091331	site_	fld smp
hemisphere_NS	1	CO2_span_coe	Undefined	diag_irga	0	CO2_span_gas	400
longitude	-111.855	H2O_zero_coef	Undefined	cell_tmpr	24.8363	Td_span_gas	10
hemisphere_EW	1	H2O_span_coe	Undefined	cell_press	100.5529	H2O_span_gas	12.41427
altitude	10	rst_CO2_zro_cc	Undefined	CO2_sig_strgth	).9886448	e_span_gas	1.232984
height_measure	15	rst_CO2_spn_c	Undefined	H2O_sig_strgth	).9902517	valve_tmpr_ctrl_	false
surface_type	6	rst_H2O_zro_cc	Undefined	diff_press	0	valve_tmpr	25.08197
height_canopy	Undefined	rst_H2O_spn_c	Undefined	pump_flow	7.709763	valve_tmpr_ok	true
displacement_us	0	do_zero_flg	false	sampling_regim	1	valve_diff_press	0
roughness_user	0	do_CO2_span_	false	cell_e	).4097188	valve_ctrl_press	100.5523
separation_x_irg	0.1502	do_H2O_span_	false	cell_T_DP	-5.43538	valve_flow	0
separation_y_irg	-0.03218	prfrm_auto_zerc	true	cell_e_sat	3.150283	valve_flow_set_	1
dist_intrst_60_3	1500	attndnt_chck_se	Undefined	cell_RH	13.00578	valve_flow_duty_	0
dist_intrst_60_1	1500	alpha_PF_60_3	0	press	100.5529	counts_on_site	210
dist_intrst_170_	1500	beta_PF_60_30	0	Tc	24.8363	sec_on_site	20.9
dist_intrst_190_	1500	alpha_PF_60_1	0	e	).4097188		
daytime	1	beta_PF_60_17	0	T_DP	-5.43538		
volt_batt	Undefined	alpha_PF_170_	0	e_sat	3.150283		
tmpr_panel	Undefined	beta_PF_170_1	0	RH	13.00578		
volt_CDM_VOLT	Undefined	alpha_PF_190_	0	CO2_density	1839.046		
message	FLD_MEA.	beta_PF_190_3	0	H2O_density	2.97928		
press_source	0	Planar_Fit_flg	false	rho_d	1170.946		
set_press_sourc	false	d	0	rho_a	1.173925		
shadow_corr	0	z0	0.01	pump_tmpr	28.87357		
set_shadow_co	false	Ts	NAN	pump_tmpr_ok	true		

Duty Cycle:
占空比

Add...

Delete

Delete All

Options...

Stop

RecNum	2130	ec155_pwr_on_	false	Ux	NAN	pump_press	99.79984
TimeStamp	3 16:23:03	ec155_vlt_low_a	false	Uy	NAN	pump_flow_raw	7.998935
card_bytes_free	Undefined	ec155_actual_p	true	Uz	NAN	pump_flow_set_	8
card_storage_av	Undefined	ec155_user_set	true	diag_sonic	-1	pump_flow_duty	).8652391
sonic_azimuth	0	sec_snc_last_m	Undefined	CO2_mixratio	1033.977	mode	1
latitude	41.766	CO2_zero_coef	Undefined	H2O_mixratio	3.899221	site_	fld smp
hemisphere_NS	1	CO2_span_coe	Undefined	diag_irga	0	CO2_span_gas	400
longitude	-111.855	H2O_zero_coef	Undefined	cell_tmpr	24.96158	Td_span_gas	10
hemisphere_EW	1	H2O_span_coe	Undefined	cell_press	100.5279	H2O_span_gas	12.41739
altitude	10	rst_CO2_zro_cc	Undefined	CO2_sig_strgth	).9716689	e_span_gas	1.232983
height_measure	15	rst_CO2_spn_c	Undefined	H2O_sig_strgth	).9714174	valve_tmpr_ctrl_	false
surface_type	6	rst_H2O_zro_cc	Undefined	diff_press	0	valve_tmpr	25.50372
height_canopy	Undefined	rst_H2O_spn_c	Undefined	pump_flow	7.998838	valve_tmpr_ok	true
displacement_us	0	do_zero_flg	false	sampling_regim	1	valve_diff_press	0
roughness_user	0	do_CO2_span_	false	cell_e	0.390458	valve_ctrl_press	100.5314
separation_x_irg	0.1502	do_H2O_span_	false	cell_T_DP	-6.067447	valve_flow	0
separation_y_irg	-0.03218	prfrm_auto_zero	true	cell_e_sat	3.173911	valve_flow_set_	1
dist_intrst_60_3	1500	attndnt_chck_se	Undefined	cell_RH	12.30211	valve_flow_duty_	0
dist_intrst_60_1	1500	alpha_PF_60_3	0	press	100.5279	counts_on_site	805
dist_intrst_170_	1500	beta_PF_60_30	0	Tc	24.96158	sec_on_site	80.4
dist_intrst_190_	1500	alpha_PF_60_1	0	e	0.390458		
daytime	1	beta_PF_60_17	0	T_DP	-6.067447		
volt_batt	Undefined	alpha_PF_170_	0	e_sat	3.173911		
tmpr_panel	Undefined	beta_PF_170_1	0	RH	12.30211		
volt_CDM_VOLT	Undefined	alpha_PF_190_	0	CO2_density	1838.413		
message	FLD_MEA.	beta_PF_190_3	0	H2O_density	2.838032		
press_source	0	Planar_Fit_flg	false	rho_d	1170.387		
set_press_sourc	false	d	0	rho_a	1.173225		
shadow_corr	0	z0	0.01	pump_tmpr	32.37155		
set_shadow_cor	false	Ts	NAN	pump_tmpr_ok	true		

Duty Cycle:

占空比

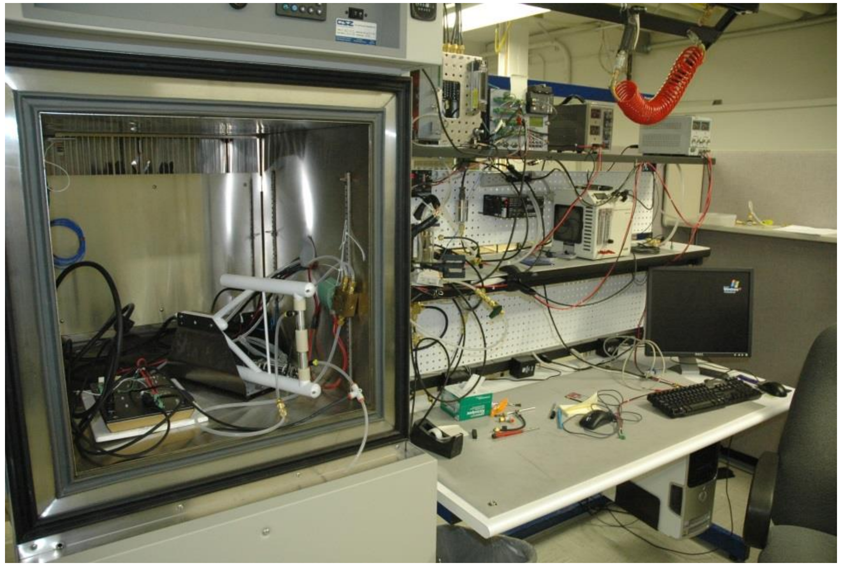
2. 分析仪 Zero/Span 操作

为什么要校准

- **验证**仪器测量的准确性、可重复性

- 分析仪校准包括两部分：
  - 工厂校准
  - Zero/Span

气体分析仪工厂校准 —— 寻找分析仪的工作曲线

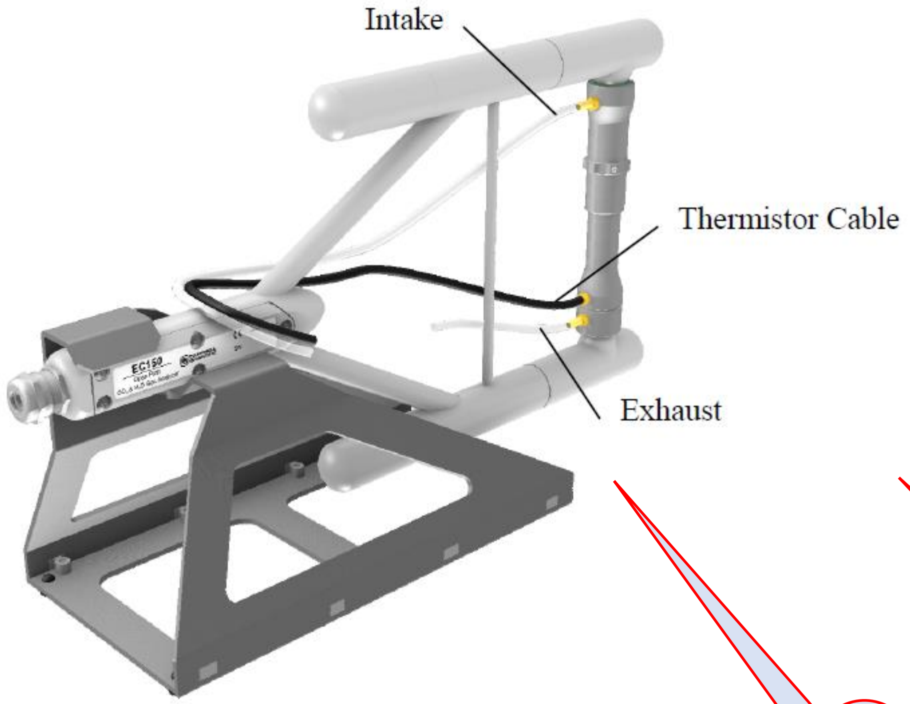


- factory calibration (CO2 concentrations， pressures，temperatures and dew points in combinations encountered in practice)

$$CO_2 = S_{CO_2} * f_{CO_2cal}\left\{ Z_{CO_2} * \left(\frac{CO_2I}{CO_2I_O} \right) \right\}$$

$$H_2O = S_{H_2O} * f_{H_2Ocal}\left\{ Z_{H_2O} * \left(\frac{H_2OI}{H_2OI_O} \right) \right\}$$

ZERO 和 SPAN —— 进一步调整零点和跨度系数



$$CO_2 = S_{CO_2} * f_{CO_2cal}\left\{Z_{CO_2} * \left(\frac{CO_2I}{CO_2I_O}\right)\right\}$$

$$H_2O = S_{H_2O} * f_{H_2Ocal}\left\{Z_{H_2O} * \left(\frac{H_2OI}{H_2OI_O}\right)\right\}$$

- 2点校准（零气 和 跨度标气）

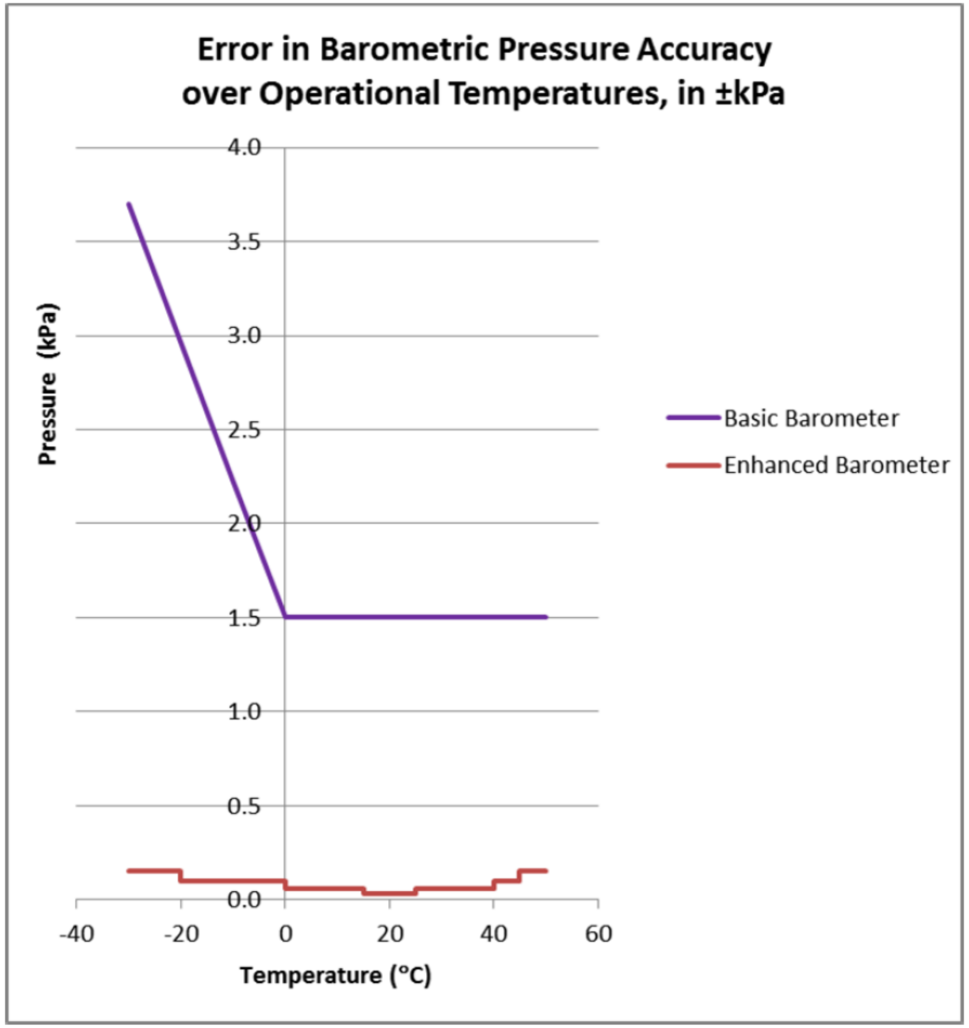
很多因素都会影响分析仪的测量准确度
Accuracy

- 温度变化 （环境温度和分析仪温度）
- 交叉干扰度 (CO_2/H_2O)
- 环境压力
- 光路的清洁程度
- 湿度
- 内部化学吸收剂的有效性
- 电子元件的老化

选择什么气压传感器？

- 基本型BB 或 增强型EB?
  - 大气压P 用于计算空气密度，1% 的气压误差会导致 1% 的显热通量误差。
  - 尽管CO_2 跨度校准是以浓度单位输入，但是需要大气压用于计算CO_2/H_2O的密度， 因此 1% 的气压误差会导致 1% 的CO_2通量误差。
  - 问题：在标况下（20℃和100kPa），1℃ 温度误差和1kPa气压误差，哪一个导致CO_2/H_2O的密度读数误差更大？

两种类型气压计的准确度Accuracy指标：

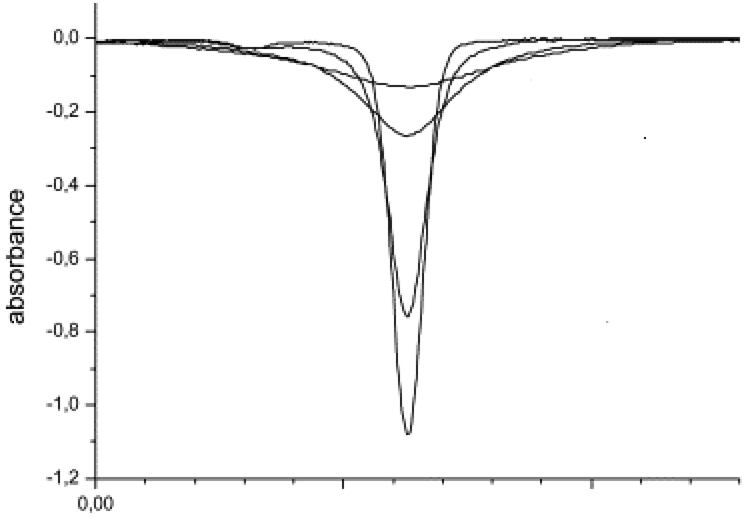


校准备件：

- 分析仪支架 —— PN 27278
- 光路气室 —— PN 26390
- 高压钢瓶减压器 和 流量计
- 铝塑管，带Swagelok接头，最好带三通 —— 21823-L20
- 零气发生器或高压零气，CO2 Span 标气，H_2O Span (露点仪)
- 其它 —— 30厘米长活动扳手、BEV管、直流电源

ZERO 和 CO2 SPAN

- 零气：不含CO2的干空气 或 高纯N2
- Span 标气：以**<u>干空气</u>**为平衡气的CO2标气不含 其它杂质气体



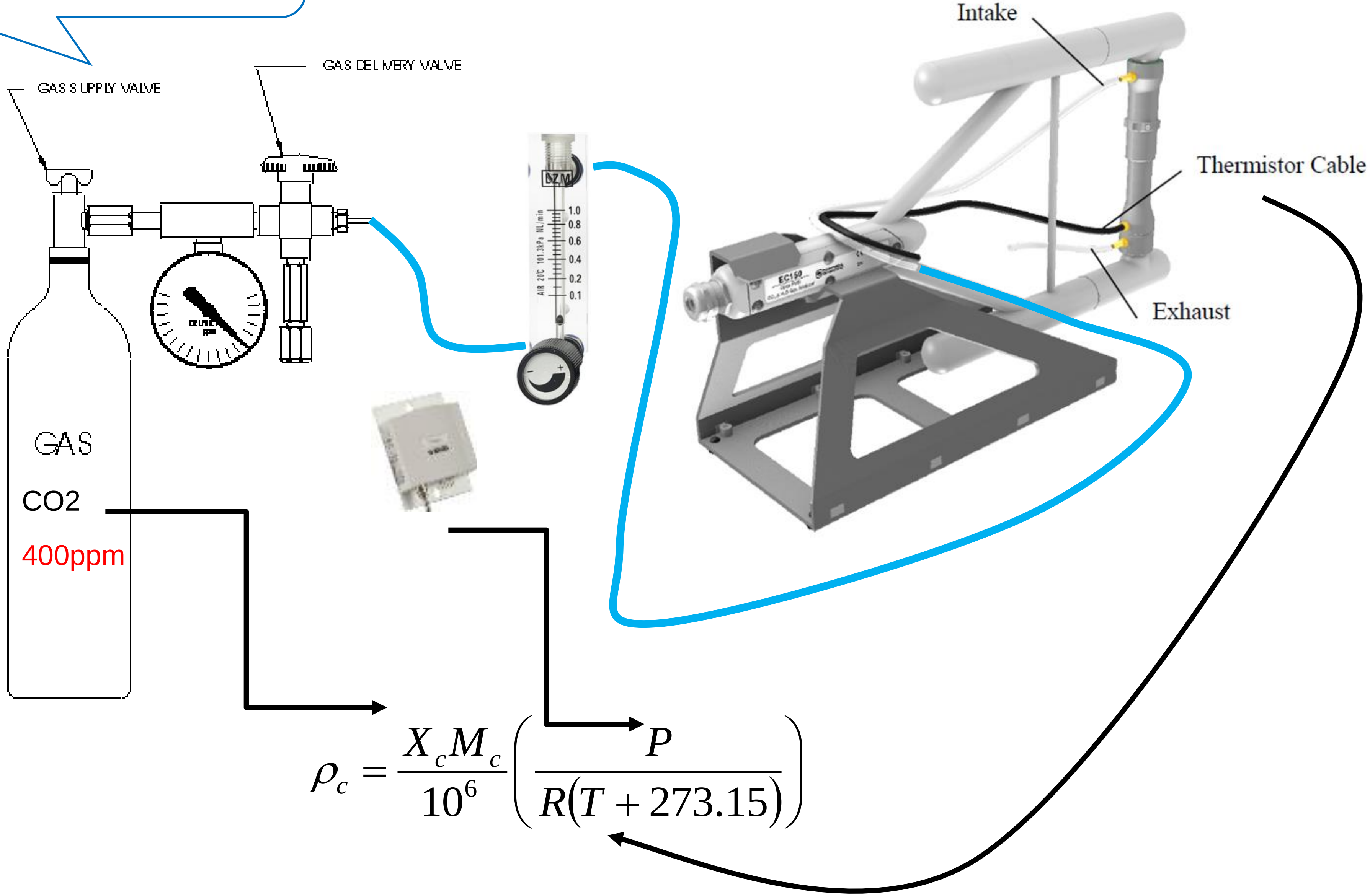
标气、零气与CO_2标气

- 标气：已知组分浓度的标准气体源，或已知红外吸收特征的标准气体源
- 零气：不吸收红外辐射的标准气体源（例如惰性气体，高纯N_2，或干空气等）
- CO_2标气：已知CO_2浓度的标准气体源（在通量研究中，因为测量对象是大气中的CO_2浓度，CO_2标气需要以干空气为平衡气，或N_2/O_2混合配比接近干空气）

- 红外光谱是分子能选择性吸收某些波长的红外线，而引起分子中振动能级和转动能级的跃迁，检测红外线被吸收的情况可得到物质的红外吸收光谱，又称分子振动光谱或振转光谱。（转自《百度百科》）
- 分子存在能使自己的偶极矩改变的振动模式,就有红外吸收.
具体地说,极性分子都有红外吸收.非极性分子中,单原子分子和同核双原子分子都没有红外吸收,三原子以上的非极性分子一般也有红外吸收. (来自网络)

正确的操作顺序，避免污染标气。

CO2 SPAN

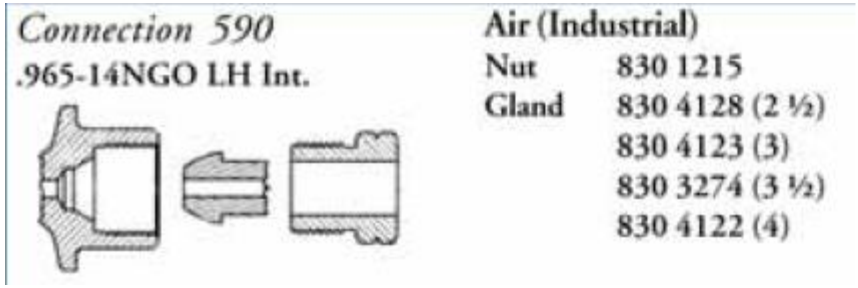


$$\rho_c = \frac{X_c M_c}{10^6}\left(\frac{P}{R(T+273.15)}\right)$$

高质量的气瓶减压器

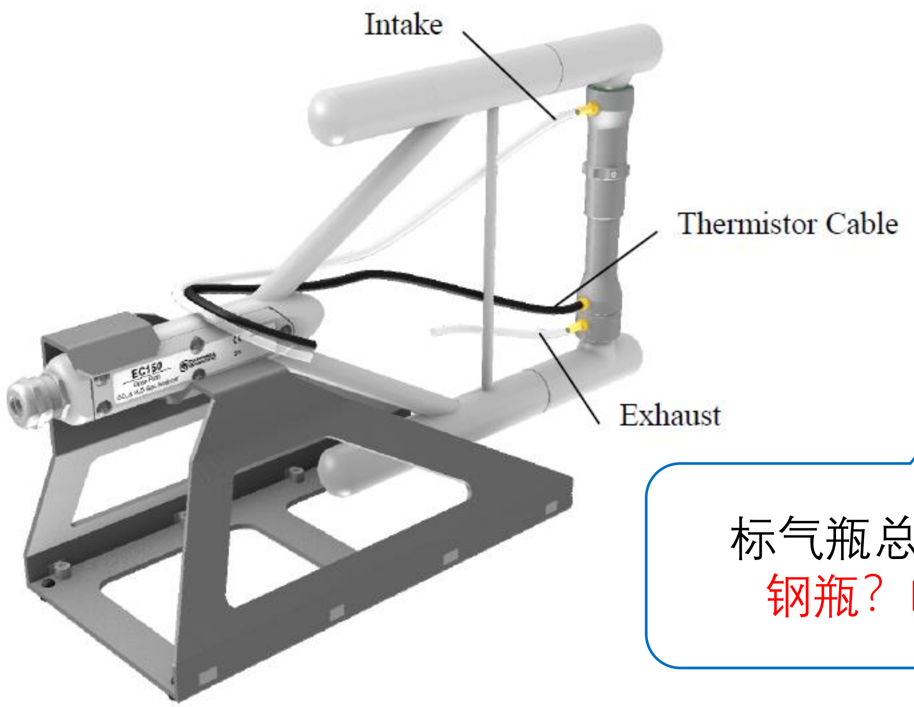
CYLINDER VALVE CONNECTIONS

CGA Connections



- Designed for use with ultra high purity gasses
- Clean
- Corrosion resistant materials
- Low internal volumes

ZERO 和 SPAN



标气瓶总开关
钢瓶？No!

- 2点校准（零气 和 跨度标气）

$$CO_2 = S_{CO_2} * f_{CO_2cal}\left\{Z_{CO_2} * \left(\frac{CO_2I}{CO_2I_O}\right)\right\}$$

$$H_2O = S_{H_2O} * f_{H_2Ocal}\left\{Z_{H_2O} * \left(\frac{H_2OI}{H_2OI_O}\right)\right\}$$

CO_2标气中的平衡气应该与大气成分比接近

$A=\log(I/I_o)=\varepsilon c L$

ε = f(gas composition)

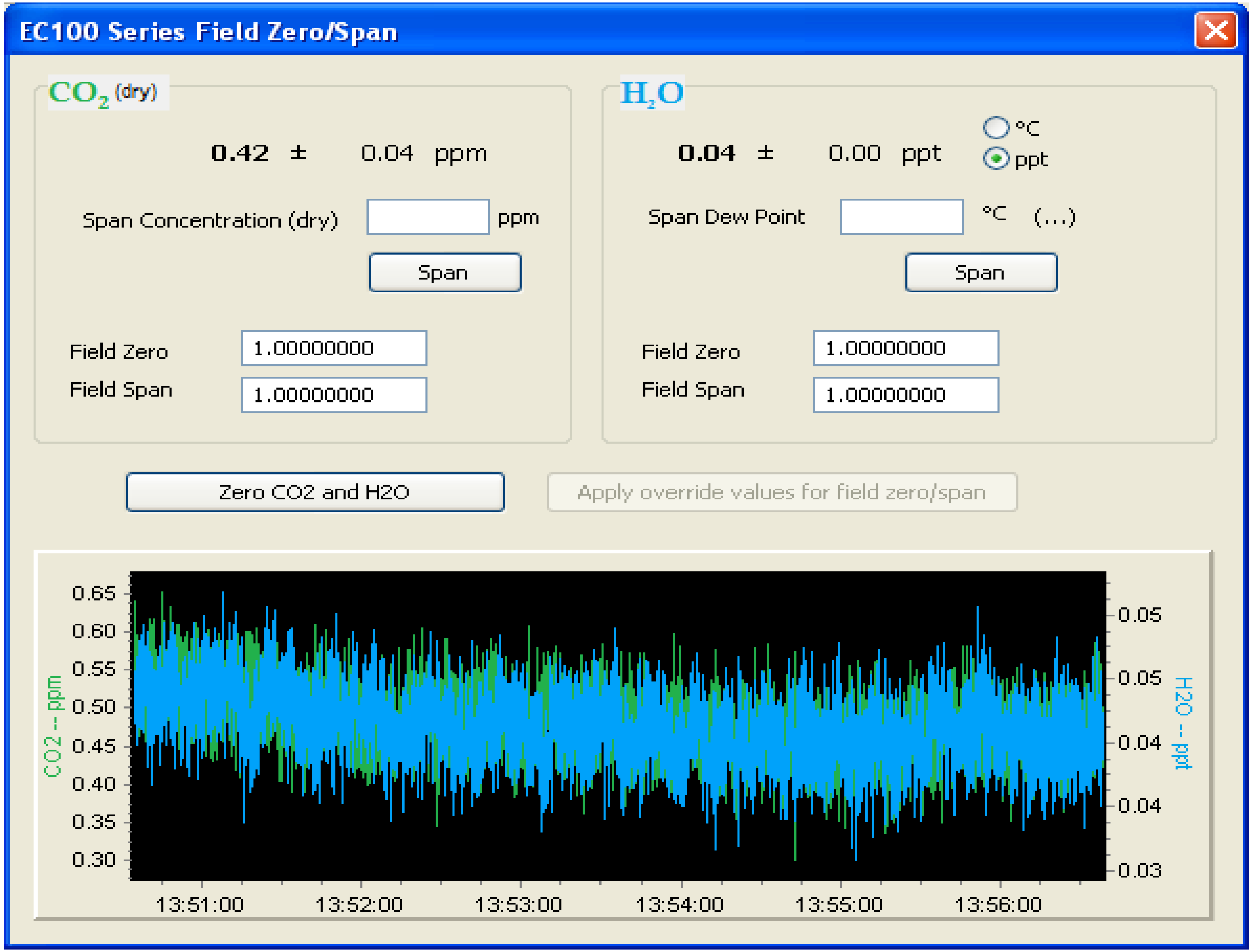
gas composition = 20.94% O_2 + 78.08% N_2 + 0.0004% CO_2

- Use air as a balance gas, NOT nitrogen. The presence of oxygen changes the absorption coefficient
- Low levels of other contaminants (CH_4, N_2O, etc.)
- Check with NIST standards

工作环境:

- 远离日光直射、加热器、电风扇、空调出风口等不利于仪器稳定工作的环境。
- 分析仪 和 露点发生器需要充分预热
- 在校准之前，先用无水乙醇或医用酒精(75% vol/vol)清洁分析仪窗口；在操作中始终监视信号强度变化

监视读数是否稳定：


EC100 Series Field Zero/Span
CO2 (dry)
0.42 ± 0.04 ppm
Span Concentration (dry)
ppm
Span
Field Zero 1.00000000
Field Span 1.00000000
H2O
°C
ppt
0.04 ± 0.00 ppt
Span Dew Point
°C (...)
Span
Field Zero 1.00000000
Field Span 1.00000000
Zero CO2 and H2O
Apply override values for field zero/span
CO2 -- ppm
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
H2O -- ppt
0.05
0.05
0.04
0.04
0.03
13:51:00
13:52:00
13:53:00
13:54:00
13:55:00
13:56:00

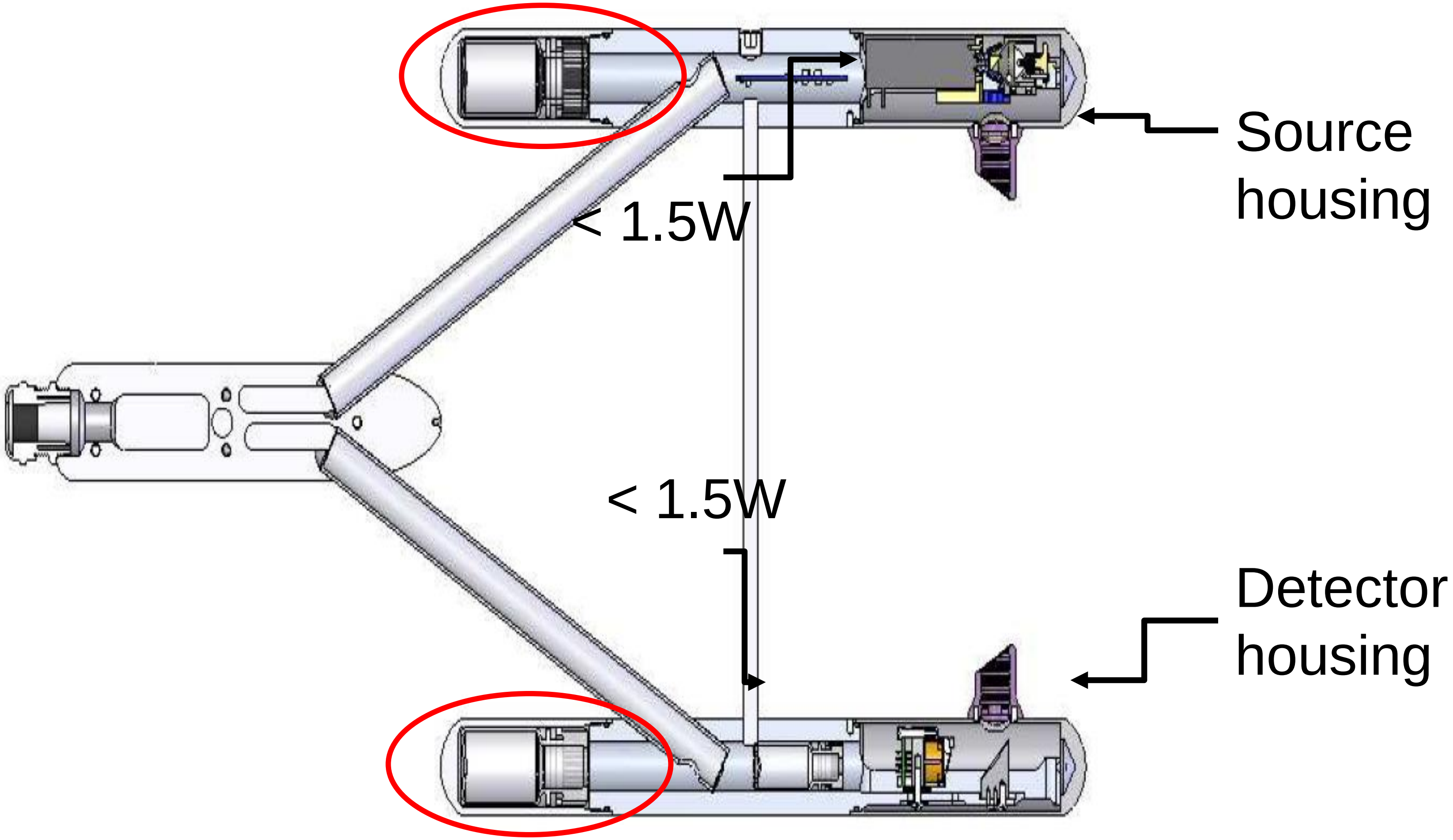
检查分析仪增益（**Gain**）：

$$Gain = \frac{\text{标准CO2浓度}}{\text{标准CO2测定值} - \text{无CO2测定值}}$$

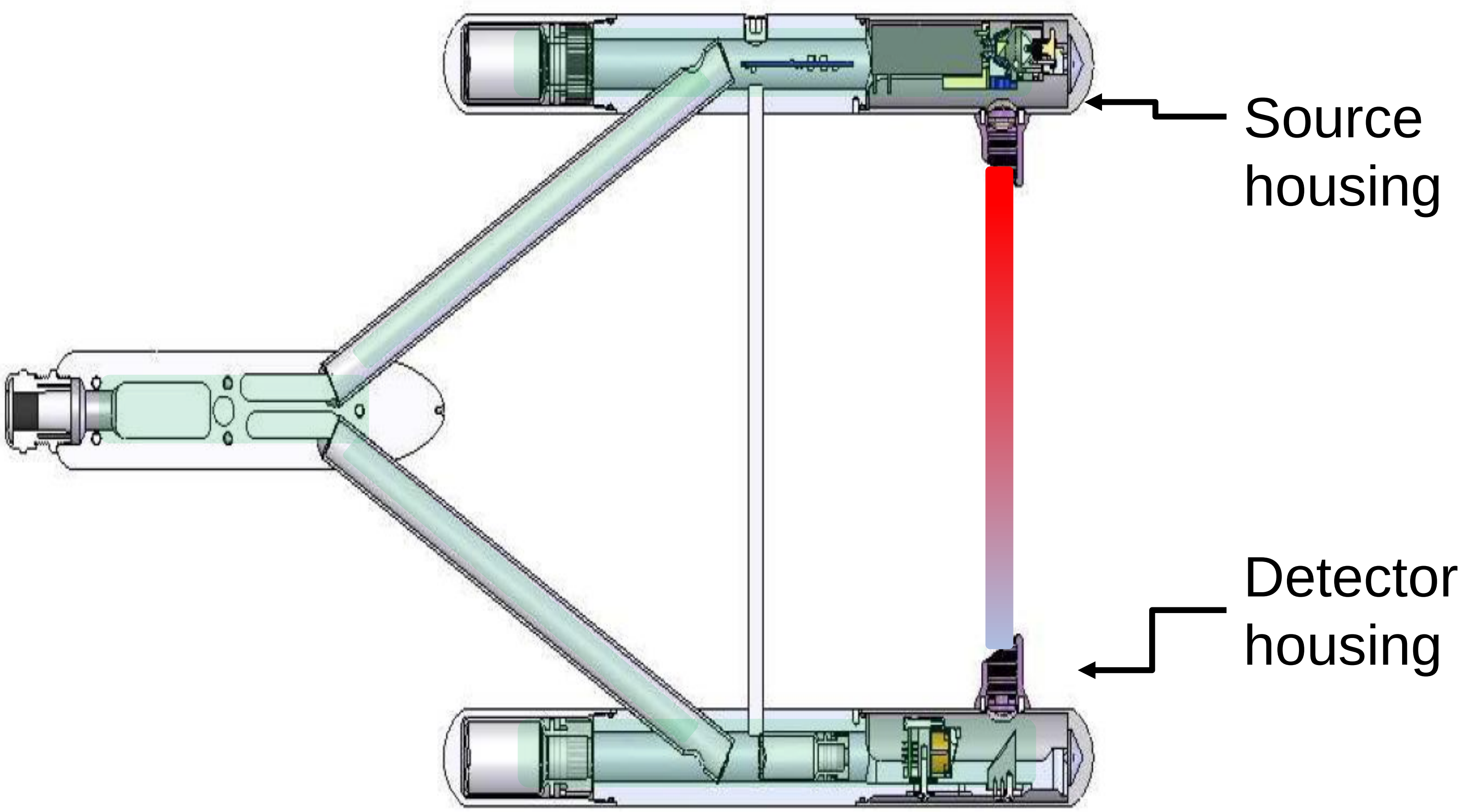
- 如Gain=1，且无CO_2时气体分析的CO_2测定值为0，则无需进行CO_2的零点和跨度重置。

- 如Gain < 0.95 或Gain > 1.05，应检查CO_2吸收剂，并跟据吸收剂的已工作时间考虑更换。（若更换，等待3天）

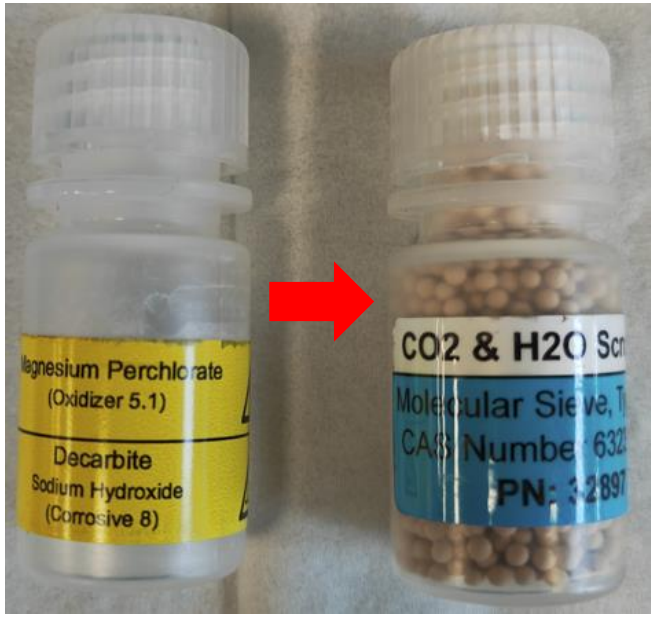
为什么要更换CO2/H2O吸收剂?



为什么要更换CO2/H2O吸收剂?



早期的高危险CO2/H2O吸收剂
与目前的分子筛CO2/H2O吸收剂



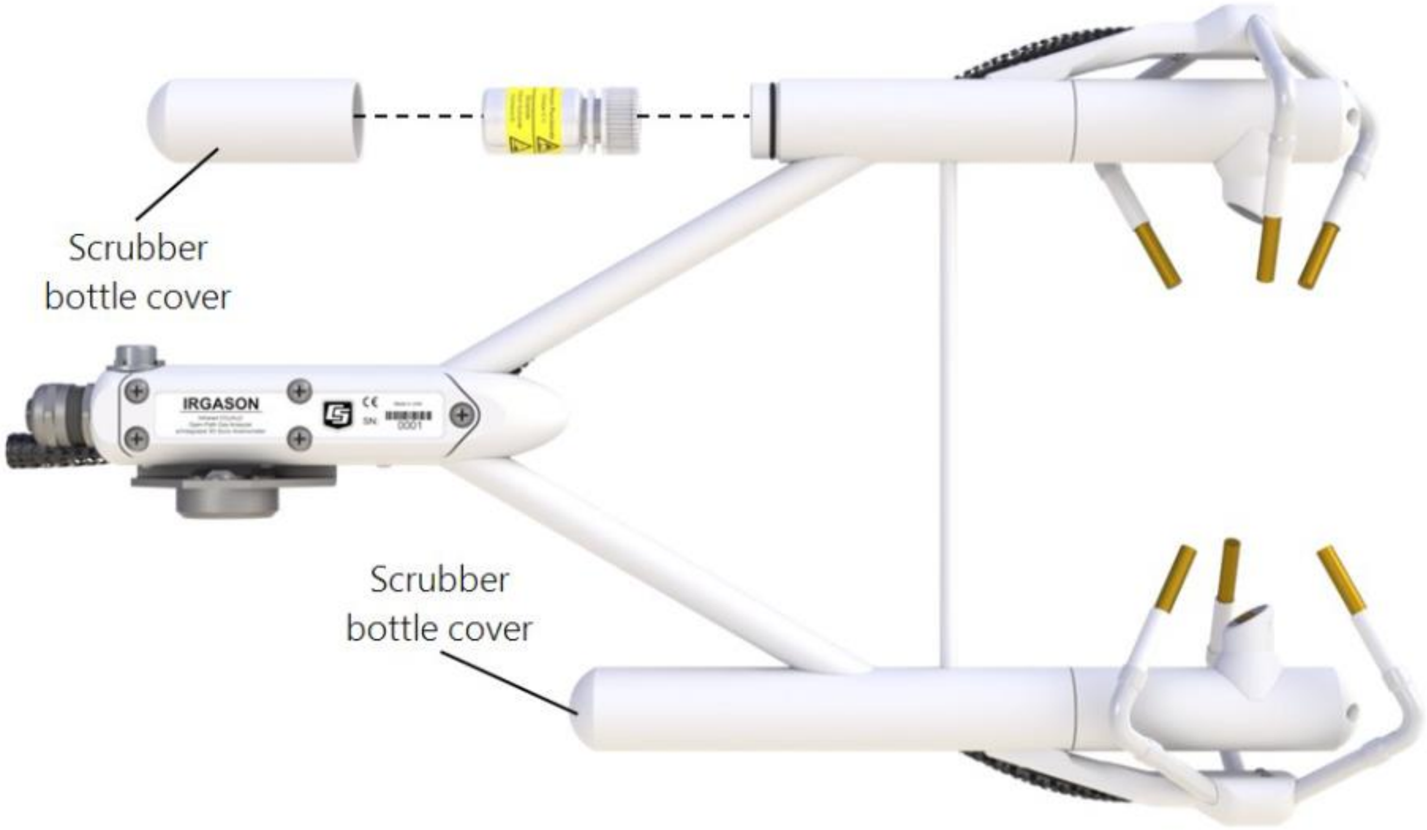


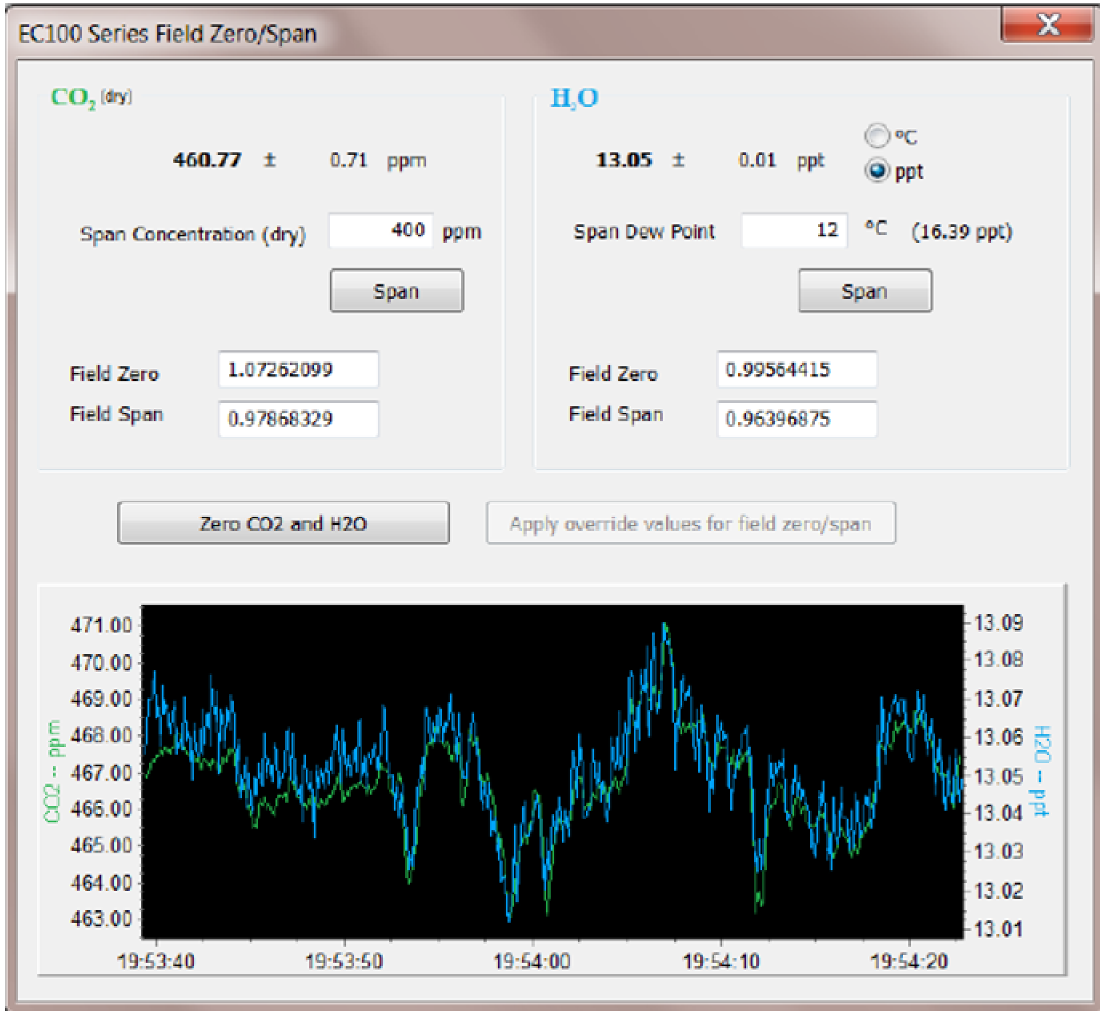
FIGURE 9-6. Replacing the desiccant and CO_2 scrubber bottles (replacement bottles purchased after July 2017 may appear different than in the figure)

多长时间更换一次吸收剂?

- Campbell Scientific 建议每年更换一次
- 不过，如果zero 和span 系数发生较大漂移，则应该及时更换CO_2/H_2O吸收剂
- 新的吸收剂成分是分子筛，**无毒无害**

› 更换吸收剂后，等待3天，再实施Zero/Span

• 在条件允许的情况下，Campbell Scientific 推荐用户在站点现场对分析仪进行Zero/Span校准。但站点现场的校准操作一般需要等待更长的时间让读数达到稳定。

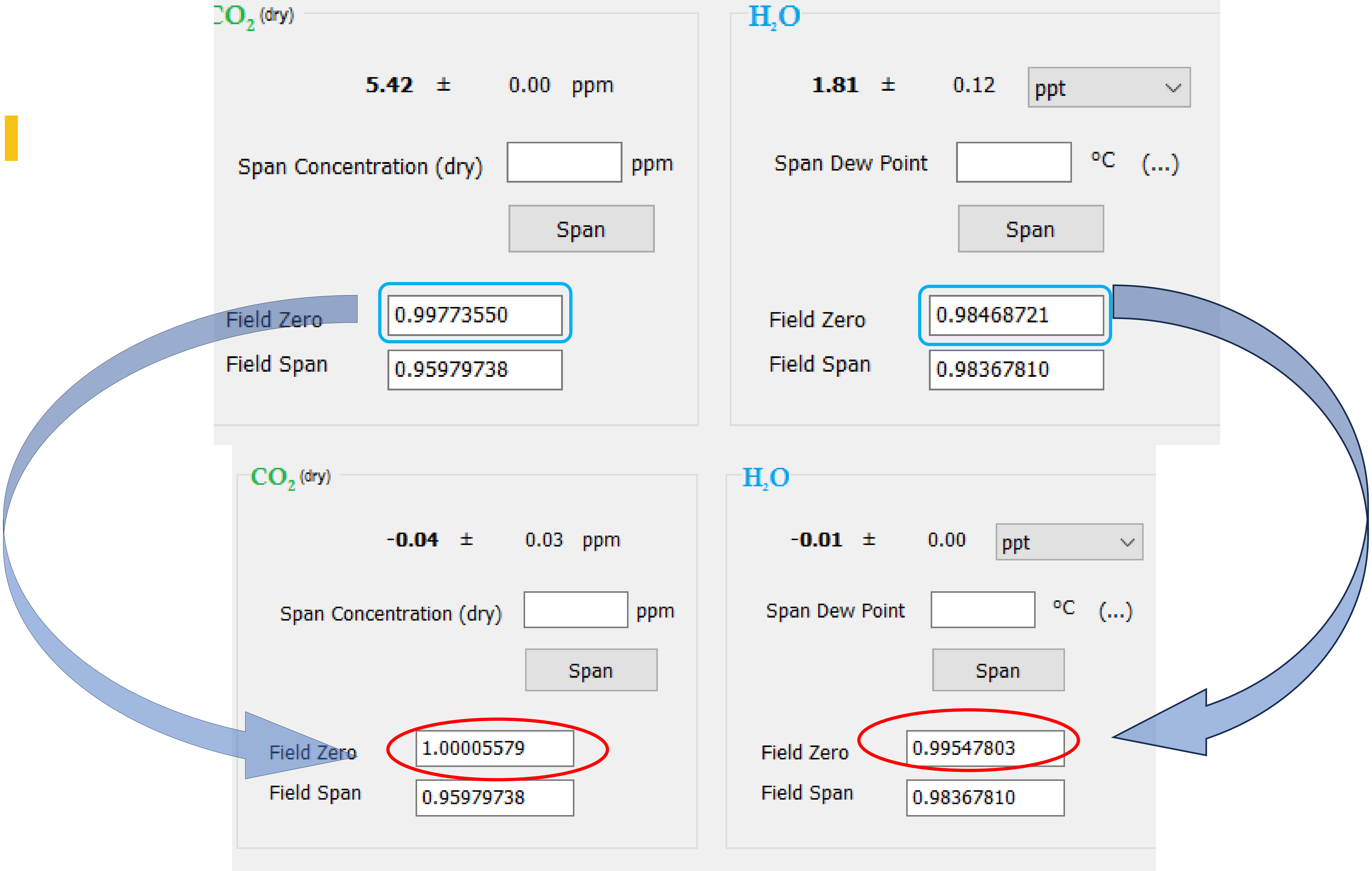


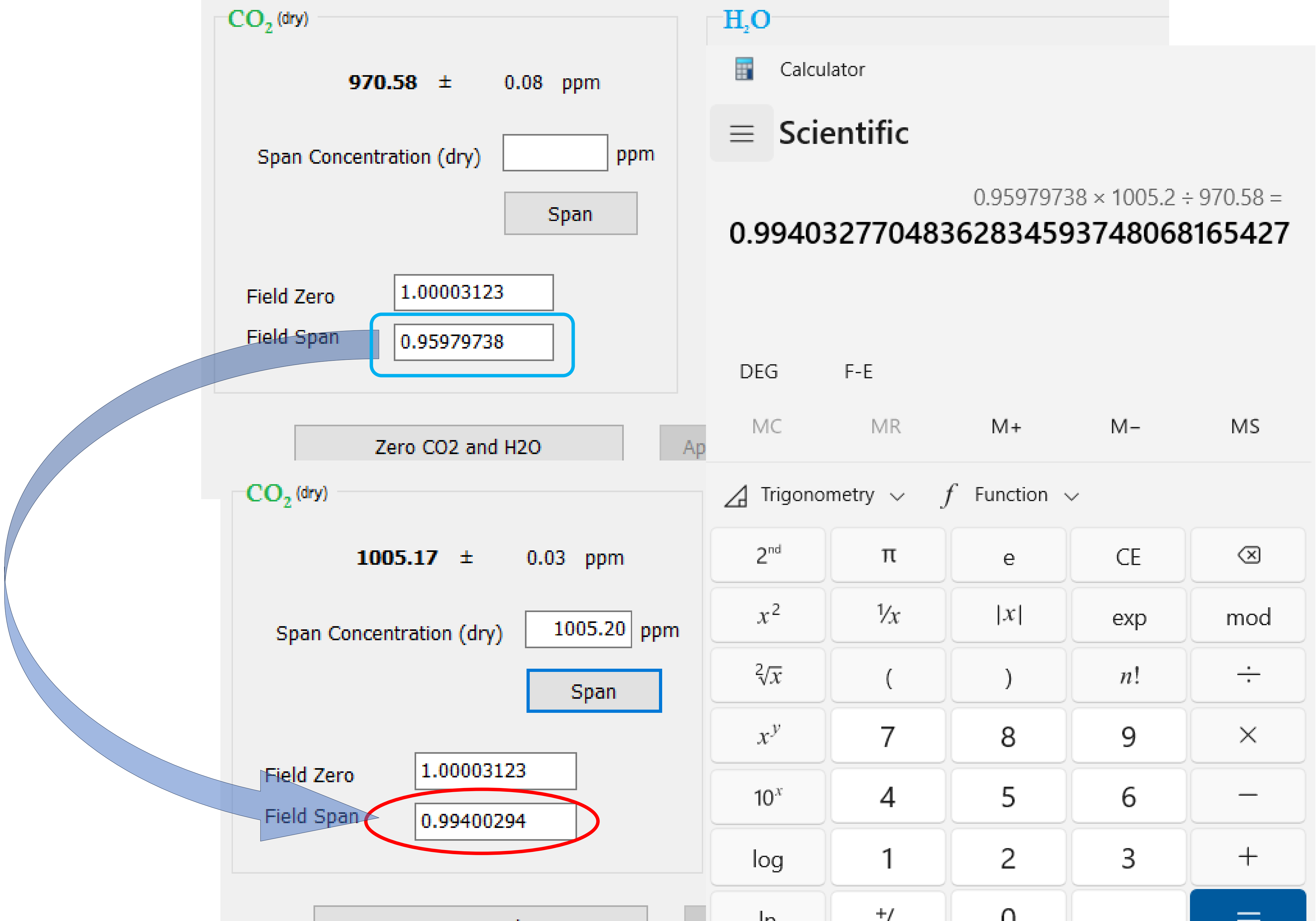
零气发生器

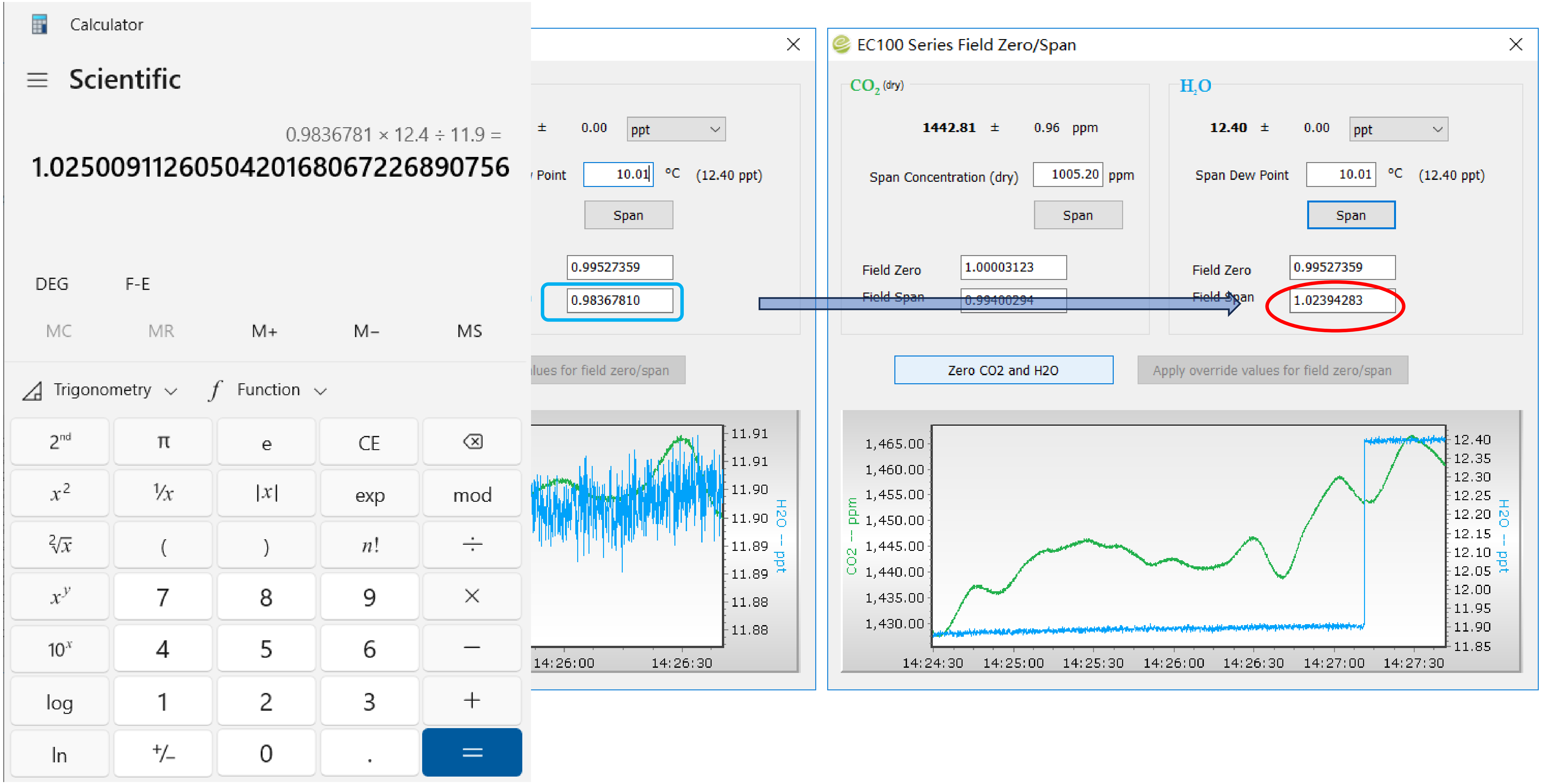
- 非常有用的一个工具
  - 用于对分析仪作零点校准
  - 方便携带

校准顺序：

- CO_2/H_2O Zero
- CO_2 Span
- H_2O Span

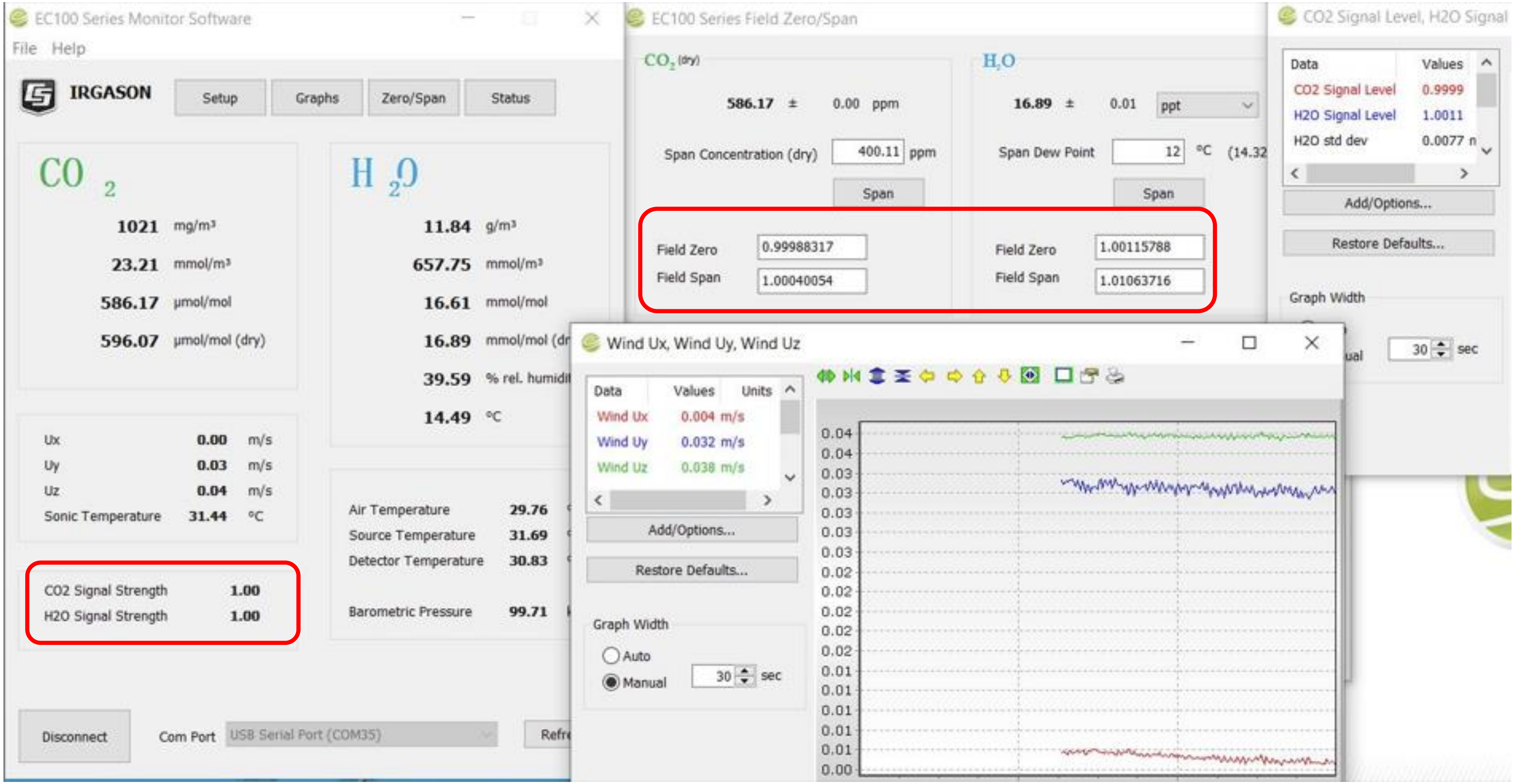

CO2 (dry)
5.42 ± 0.00 ppm
Span Concentration (dry) ppm
Span
Field Zero 0.99773550
Field Span 0.95979738
H2O
1.81 ± 0.12 ppt
Span Dew Point °C (...)
Span
Field Zero 0.98468721
Field Span 0.98367810
CO2 (dry)
-0.04 ± 0.03 ppm
Span Concentration (dry) ppm
Span
Field Zero 1.00005579
Field Span 0.95979738
H2O
-0.01 ± 0.00 ppt
Span Dew Point °C (...)
Span
Field Zero 0.99547803
Field Span 0.98367810


CO2 (dry)
970.58 ± 0.08 ppm
Span Concentration (dry) ppm
Span
Field Zero 1.00003123
Field Span 0.95979738
Zero CO2 and H2O
Ap
H2O
Calculator
Scientific
0.95979738 × 1005.2 ÷ 970.58 =
0.99403277048362834593748068165427
DEG F-E
MC MR M+ M− MS
Trigonometry
Function
2nd π e CE
x2 1/x |x| exp mod
( ) n! ÷
xy 7 8 9 ×
10x 4 5 6 −
log 1 2 3 +
CO2 (dry)
1005.17 ± 0.03 ppm
Span Concentration (dry) 1005.20 ppm
Span
Field Zero 1.00003123
Field Span 0.99400294



Calculator
Scientific
0.9836781 × 12.4 ÷ 11.9 =
1.0250091126050420168067226890756
DEG
F-E
MC
MR
M+
M−
MS
Trigonometry
Function
± 0.00 ppt
Point 10.01 °C (12.40 ppt)
Span
0.99527359
0.98367810
lues for field zero/span
EC100 Series Field Zero/Span
CO2 (dry)
1442.81 ± 0.96 ppm
Span Concentration (dry) 1005.20 ppm
Span
Field Zero 1.00003123
Field Span 0.99400294
H2O
12.40 ± 0.00 ppt
Span Dew Point 10.01 °C (12.40 ppt)
Span
Field Zero 0.99527359
Field Span 1.02394283
Zero CO2 and H2O
Apply override values for field zero/span
CO2 -- ppm
H2O -- ppt
14:24:30
14:25:00
14:25:30
14:26:00
14:26:30
14:27:00
14:27:30

Tips: 6个1


EC100 Series Monitor Software
File Help
IRGASON
Setup
Graphs
Zero/Span
Status
CO2
1021 mg/m³
23.21 mmol/m³
586.17 μmol/mol
596.07 μmol/mol (dry)
H2O
11.84 g/m³
657.75 mmol/m³
16.61 mmol/mol
16.89 mmol/mol (dr
39.59 % rel. humidit
14.49 °C
Ux 0.00 m/s
Uy 0.03 m/s
Uz 0.04 m/s
Sonic Temperature 31.44 °C
CO2 Signal Strength 1.00
H2O Signal Strength 1.00
Air Temperature 29.76
Source Temperature 31.69
Detector Temperature 30.83
Barometric Pressure 99.71
Disconnect
Com Port
USB Serial Port (COM35)
EC100 Series Field Zero/Span
CO2 (dry)
586.17 ± 0.00 ppm
Span Concentration (dry) 400.11 ppm
Span
H2O
16.89 ± 0.01 ppt
Span Dew Point 12 °C (14.32
Span
Field Zero 0.99988317
Field Span 1.00040054
Field Zero 1.00115788
Field Span 1.01063716
CO2 Signal Level, H2O Signal
Data Values
CO2 Signal Level 0.9999
H2O Signal Level 1.0011
H2O std dev 0.0077
Add/Options...
Restore Defaults...
Graph Width
30 sec
Wind Ux, Wind Uy, Wind Uz
Data Values Units
Wind Ux 0.004 m/s
Wind Uy 0.032 m/s
Wind Uz 0.038 m/s
Add/Options...
Restore Defaults...
Graph Width
Auto
Manual
30 sec

小结：**Zero/Span** 操作中可能会碰到的一些问题

- Zero/Span的操作顺序
- 温度的影响因素
- 压力的影响因素
- 校准中读数大小对Zero/Span系数的影响
- 水汽露点值大小的选取
- 冬季的Zero/Span 校准
- EC15x 分析仪在高原上的应用

3. EC15x 参数设置及复位操作

EC150/IRGASon 参数设置

- 选择合适***Bandwidth***
- ***Ambient Pressure***
  - Basic
  - Enhanced
- SDM地址（默认 1）
- Ambient Temperature
- 超声阴影订正（默认 无）
- 自动加热控制
- 加热电压（可在DevConfig中设置）

Air Temperature	24.64	°C
Source Temperature	27.03	°C
Detector Temperature	26.18	°C
Barometric Pressure	102.46	kPa

EC155 参数设置

- 选择合适***Bandwidth***
- EC100 Pressure Sensor
  - ***Basic***
  - Enhanced
- Differential Pressure
  - ***Absolute***
  - Differential
- SDM地址（默认 1）
- Temperature Sensor
  - ***Auto-detect***
  - ***Thermistor***
  - Thermocouple
- 超声阴影订正（默认 无）
- 自动加热控制
- 加热电压（可在DevConfig中设置）

EC155 没有 Detector temperature.

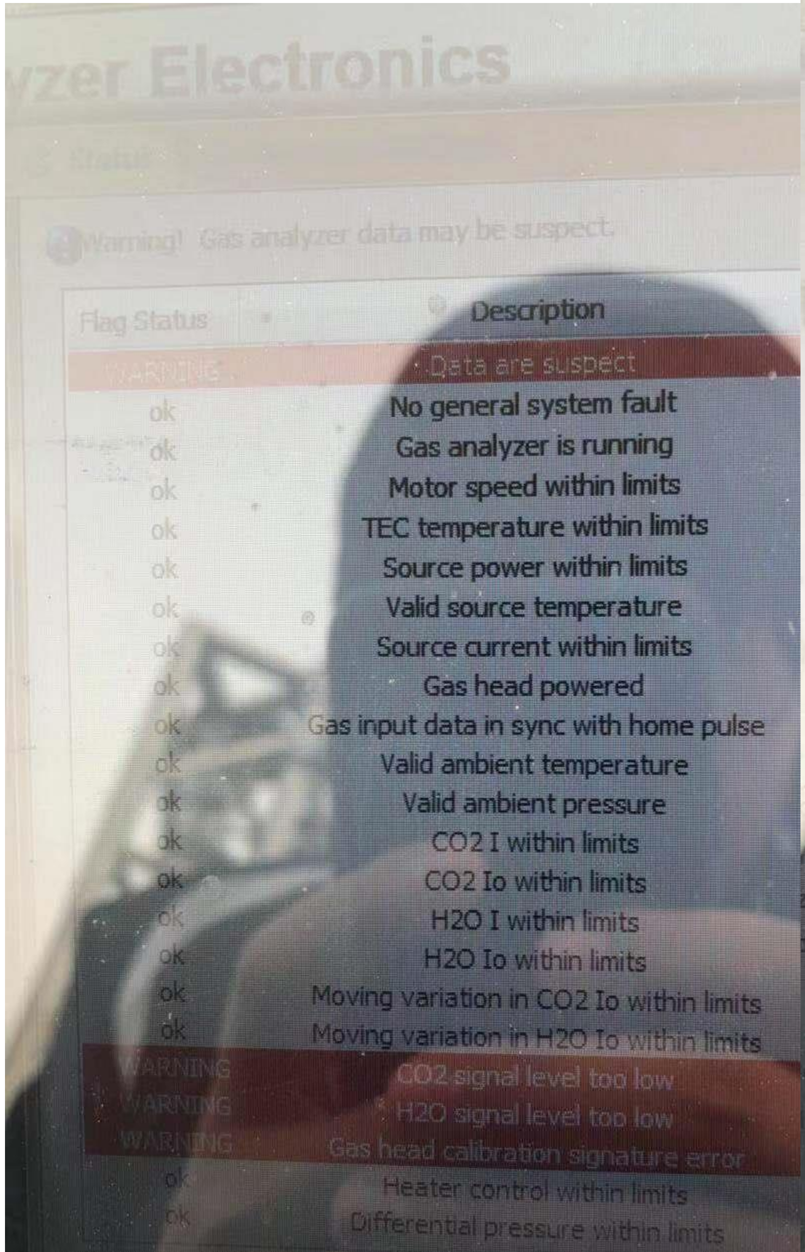
实例 —— EC100 操作系统崩溃

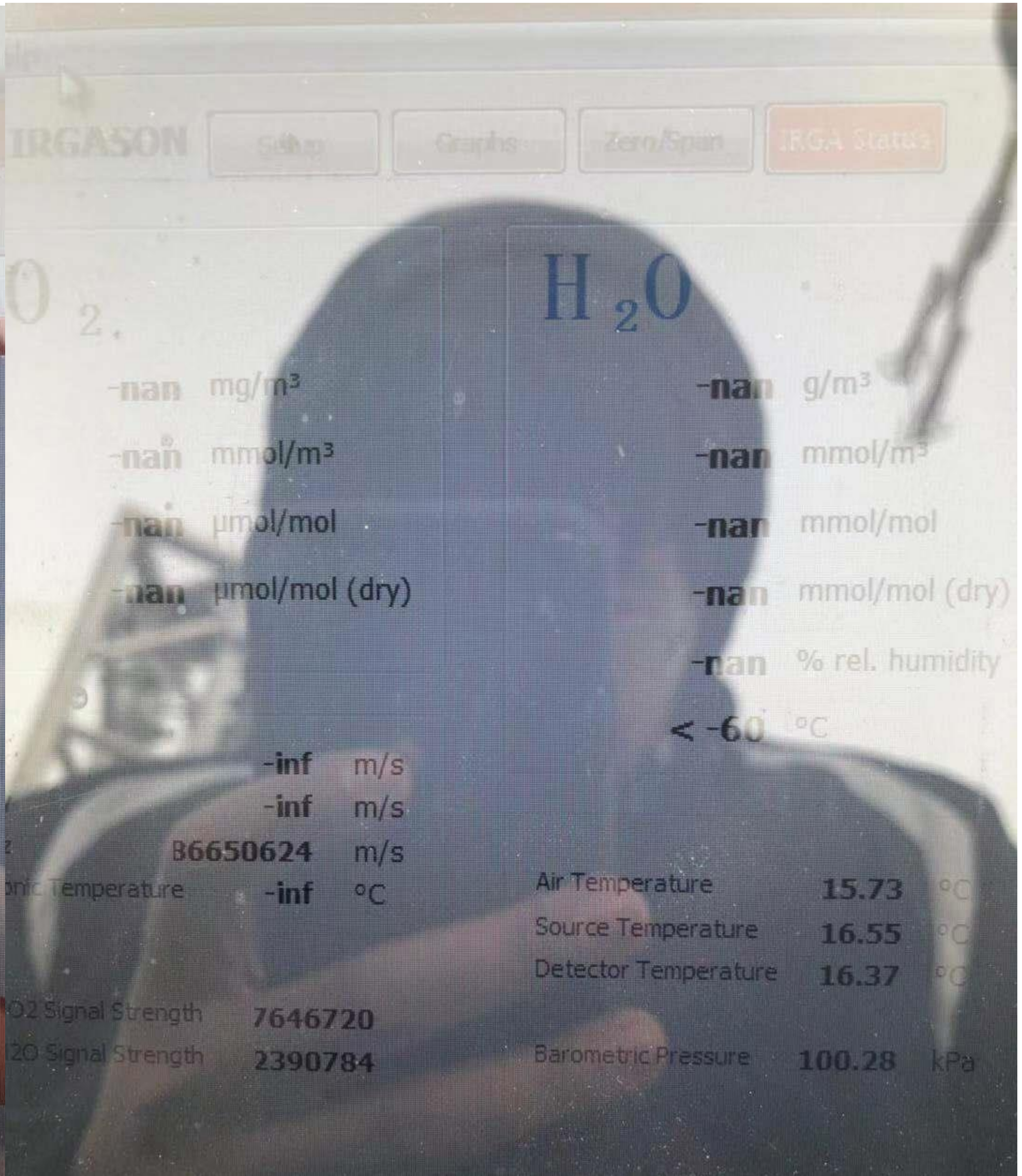

```
EC100>TERM
CSAT>^Wind0 Wind1 Wind2 Tmpr0 Tmpr1 Tmpr2 Abs/Dif- Diag
  0.0172  -0.0064   0.0031  23.6700  23.1594  23.3589 000   4

CSAT>
CSAT>^Wind0 Wind1 Wind2 Tmpr0 Tmpr1 Tmpr2 Abs/Dif- Diag
  0.0135   0.0110  -0.0035  23.9309  23.3540  26.2248 000   4
^Wind0 Wind1 Wind2 Tmpr0 Tmpr1 Tmpr2 Abs/Dif- Diag
  0.0191   0.0105   0.0000  24.0222  23.3731  23.7531 000   4
^Wind0 Wind1 Wind2 Tmpr0 Tmpr1 Tmpr2 Abs/Dif- Diag
  0.0173   0.0115   0.0033  24.1320  23.5537  26.2088 000   4
^Wind0 Wind1 Wind2 Tmpr0 Tmpr1 Tmpr2 Abs/Dif- Diag
^Wind0 Wind1 Wind2 Tmpr0 Tmpr1 Tmpr2 Abs/Dif- Diag
^Wind0 Wind1 Wind2 Tmpr0 Tmpr1 Tmpr2 Abs/Dif- Diag
  0.0277   0.0055   0.0012  25.0213  24.4417  24.6776 000   4
```

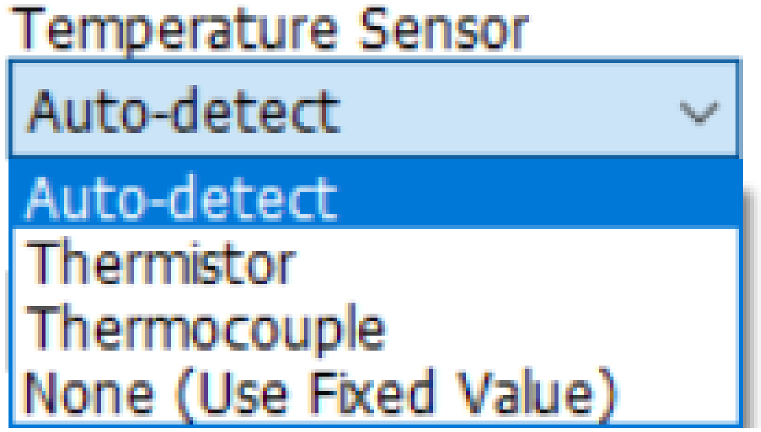
```
CSAT>??
CALFILE SN: Sn1306 Date: 09aug16 Version: 0
 &=0 AA=40 AC=1 AF=40 AH=1 ao=4800 ar=0 AS=-5
 AQ=0 BR=0 BX=0 COo= 0 0 0 COb= 0 0 0 CA=0 CD=0 CF=1 cs=0 CX=0 DC=8
 dl=15 dm=c DR=3465 duty=0 DT=16240 et=0 fa=50 FD=2880 FL=7
 fx=38 GN=121a go=0 ha=0 hg=24576 HH=49152 kt=0 lg=9830 LH=1600 MA=-20
 MS=-10 mx=0 N5=0 ND=1 NI=2 OC=0 or=1 os=0 pd=0 ra=20 RC=0 rf=18 rh=15
 RI=0 RS=0 rx=2 SD=0 SL=35 sr=0 ss=0 t0123=1000 TD=a TF=2600 2600 2600
 TK=1 TO= 0 0 0 TP=0 ts=? UF=0 ux=0 WM=o WR=6 WT=6000 XD=d xp=0 xx=0 ZZ=0
 5T=10.000000 5k=0.001667 SC=0
```

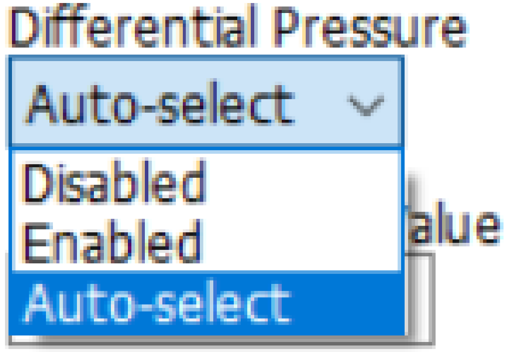
实例 —— Bandwidth 选择错误

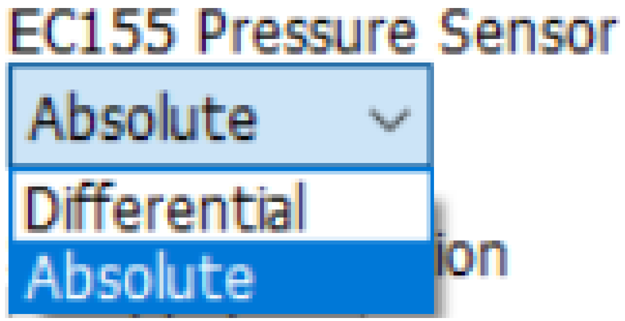




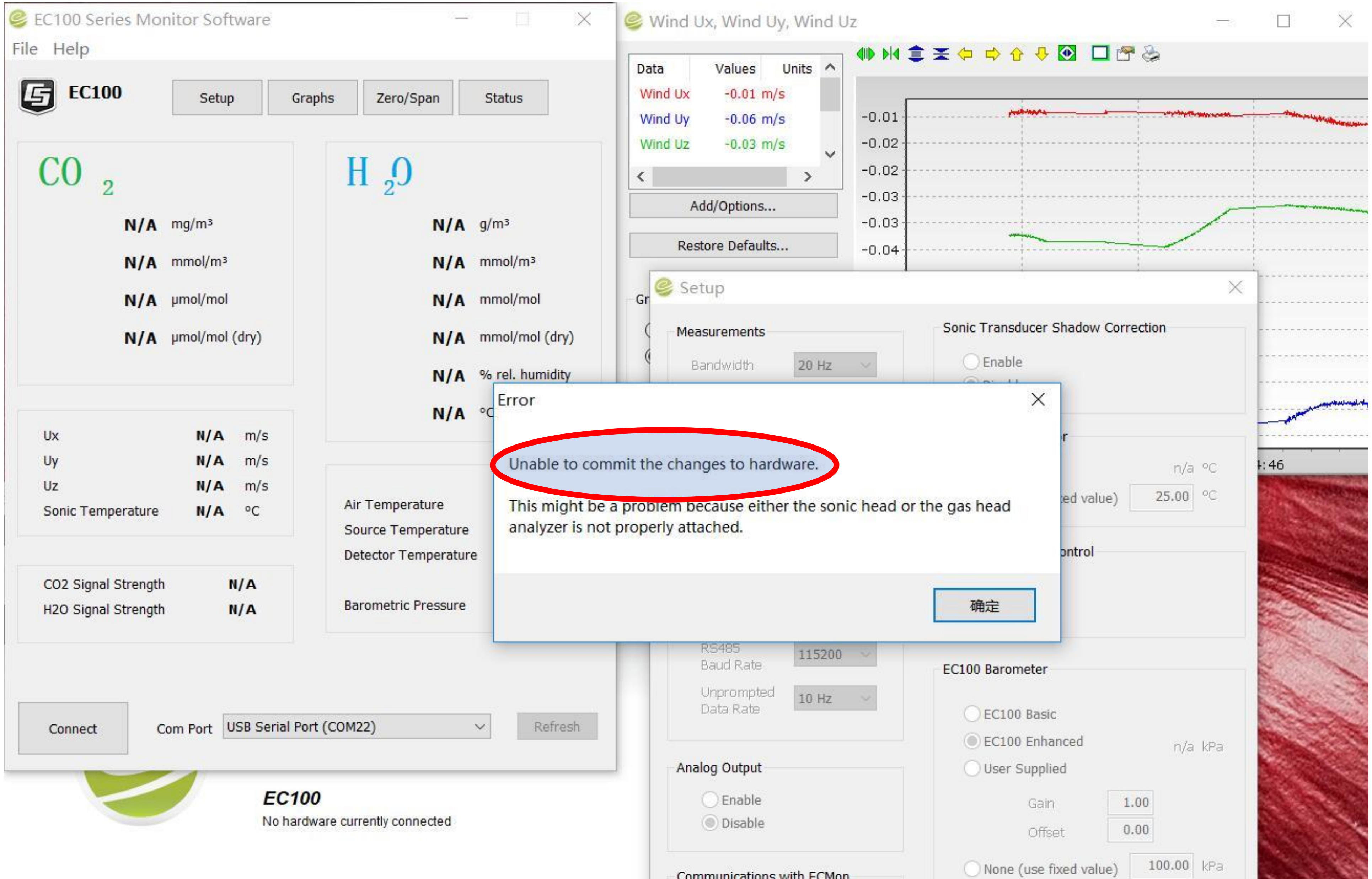
EC155 Sample Cell 参数设置错误





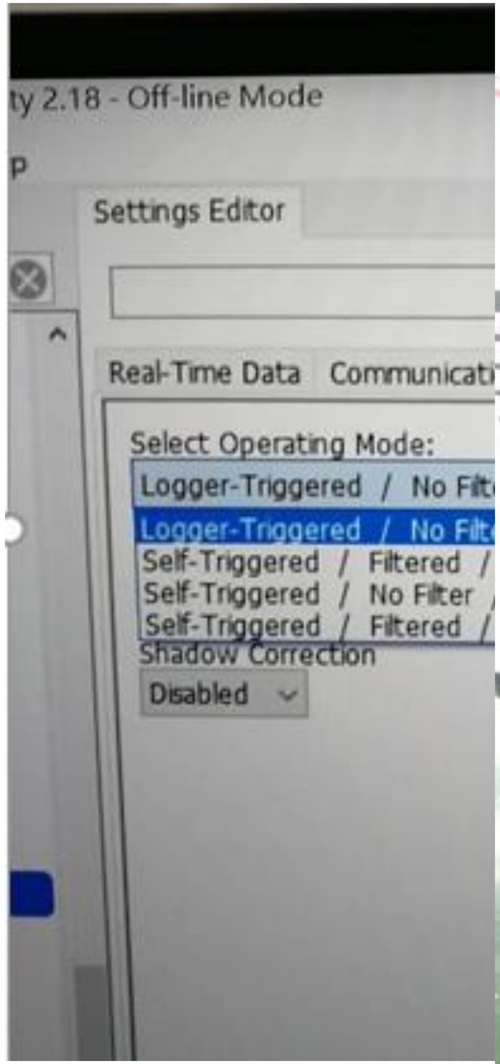


实例 —— EC100操作系统崩溃，但不可修改参数



实例 —— 不合格的供电电源


Power/SDM
CAMPBELL SCIENTIFIC
Status
CSAT3B
3-D Sonic Anemometer
USB
CPI/RS-485
Made in USA
SN:


ty 2.18 - Off-line Mode
Settings Editor
Real-Time Data
Select Operating Mode:
Logger-Triggered /
Logger-Triggered /
Self-Triggered / Filtered /
Self-Triggered / No Filter /
Self-Triggered / Filtered /
Shadow Correction
Disabled


+12V
5A
开关电源 产品编号: 17080100З
型号: T-AC-12V5A
北京天诺基业科技有限公司

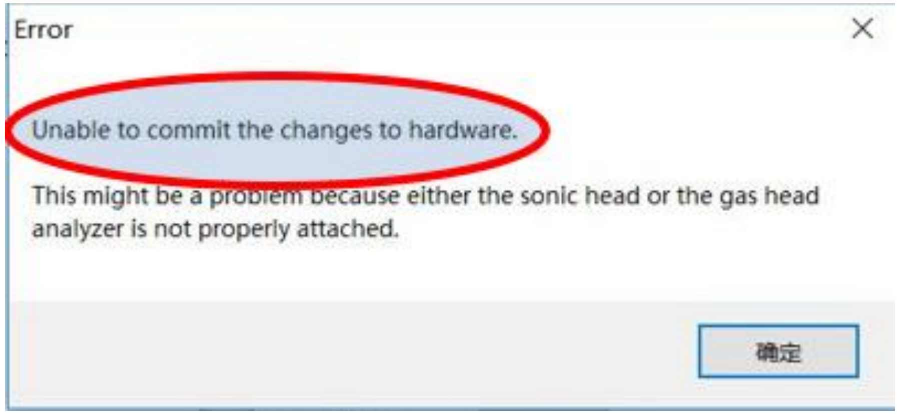
实例 —— 软件版本过低

- 3种接口可用于参数修改
  - ECMon
  - DevConfig
  - 数据采集器

- 对于版本5的超声算法，或者新一代的EC155 Sample Cell，需要：
  - ECMon 版本1.6 或更新
  - DevConfig 版本2.16 或更新

- *如果你的电脑上软件版本不够，比如ECMon 1.6 和 DevConfig 2.12 同时，可能造成EC100 操作系统崩溃*

如果碰到EC100操作系统被锁死的情形，怎么办？



- EC15X分析仪头部或三维超声头部的校准参数保存在头部
- 其它参数通常保存EC100的内存中

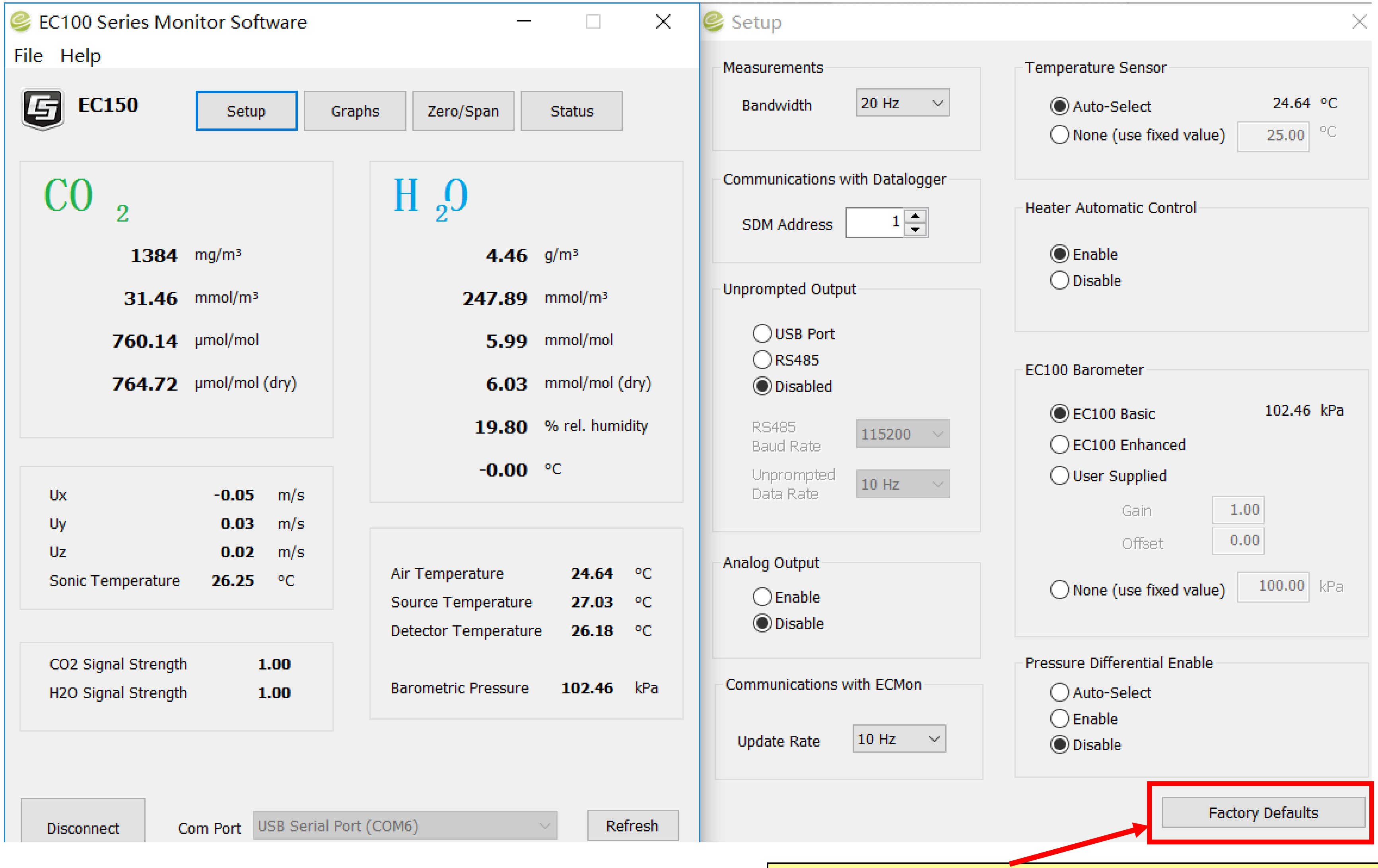
步骤1：如果有另外一台正常的EC100…

- 将分析仪头部或CSAT3A/IRGASon三维超声头部连接到正常的EC100，来确认EC15X分析仪头部或三维超声头部是否正常

步骤2： 单独升级EC100的OS

- 不连接分析仪头部或CSAT3A/IRGASon三维超声头部， 单独给EC100供电， 升级其操作系统（版本8.01或更新）

步骤3： 单独连接EC100， 恢复出厂默认设置 (ECMon)



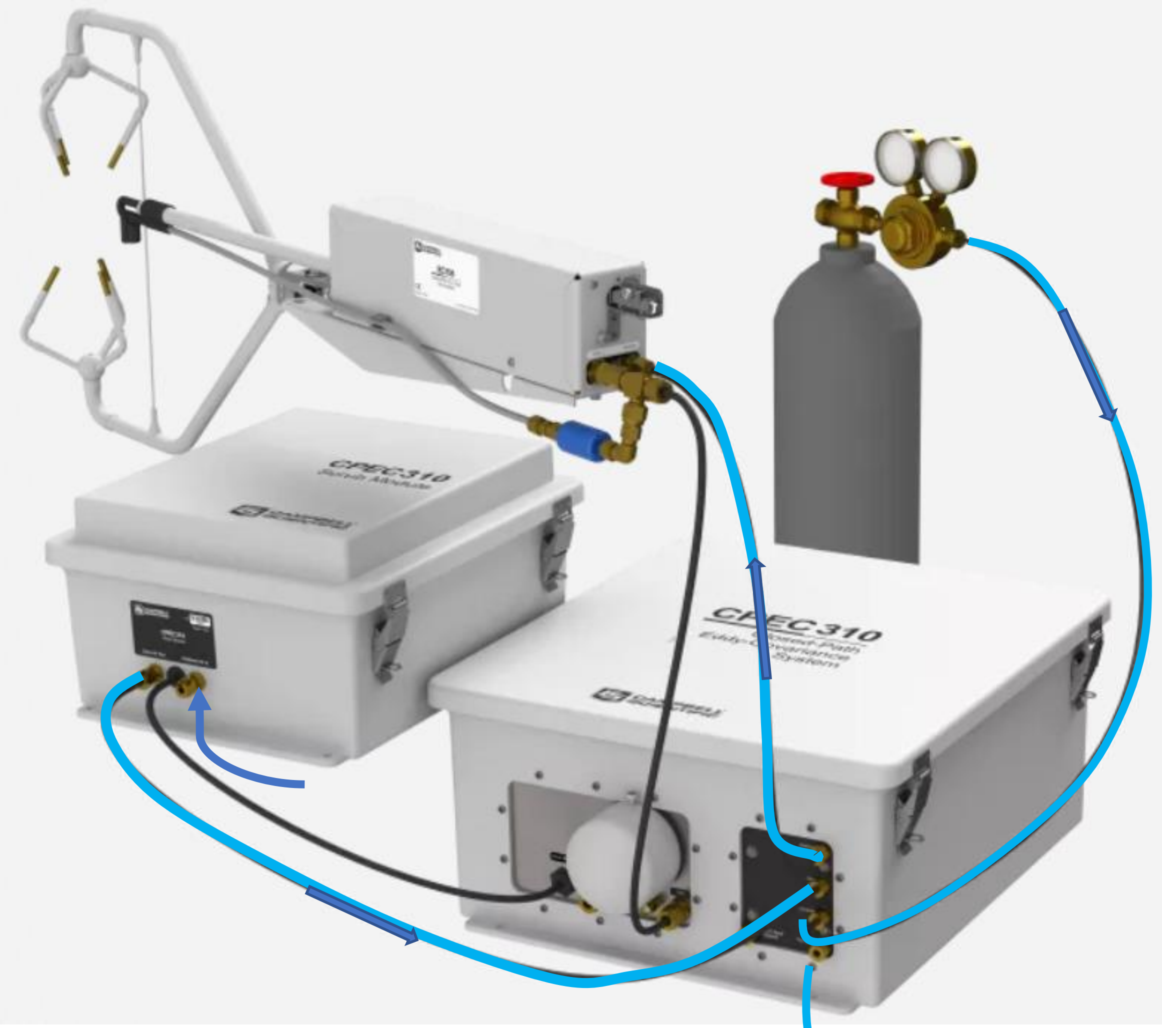
- EC100 firmware 8.01

步骤4：恢复合适的参数设置

- 断电，连接分析仪头部和三维超声头部到EC100
- 上电，使用DevConfig 连接
- 如果是开路，重点检查Bandwidth等参数，Differential Sensor 需要设为Disable
- 如果是EC155，重点检查Bandwidth, Temperature sensor, Differential sensor 等参数

4. CPEC310
在线Zero/Span操作演示

CPEC310 自动在线校准气路示意图



Valve Module

问题：在开路H2O Span中，气路中需要加一个三通，而闭路H2O Span的气路中没有三通，为什么？

CPEC310 自动在线校准

- 程序自动控制
- 含 Valve Module
- Scrub Module （默认）提供零气， CO_2 标气瓶提供CO_2 Span 标气
- 自动在线校准可实现 Zero All 和 Span CO_2，理论上也可以把 Span H_2O 包含在自动校准序列里

自动在线校准参数预设置

1. 配置初始化参数

```
System Control
Initial Configuratn  >
Site Var Settings    >
Run Station          >
Attendant Zero/Span  >
Const Table          >
System Menu          >
```

```
Initial Configuratn  >
Change Press Source  >
Shadow Correction    >
CO2 Spn Gas :400.000
H2O Span TDP:10.0000
Sample Flw  :8.00000
Zro/Spn Flw :1.00000
Zero Span Coeffs     >
```

```
Modify Value       NUM
 CO2 Spn Gas

   Current Value:
     400.000
   New Value:
     XXX.XX
```

2. 将自动校准选项设为 真

```
Run Station :
Pump Tmpr Ok:      True
Pump Tmpr   :   30.0000
Pump flow   :   8.00000
System diag :         0
Auto Z/S on        True
pump off    :   FLD_MEA
EC155_PW_on :      True
```

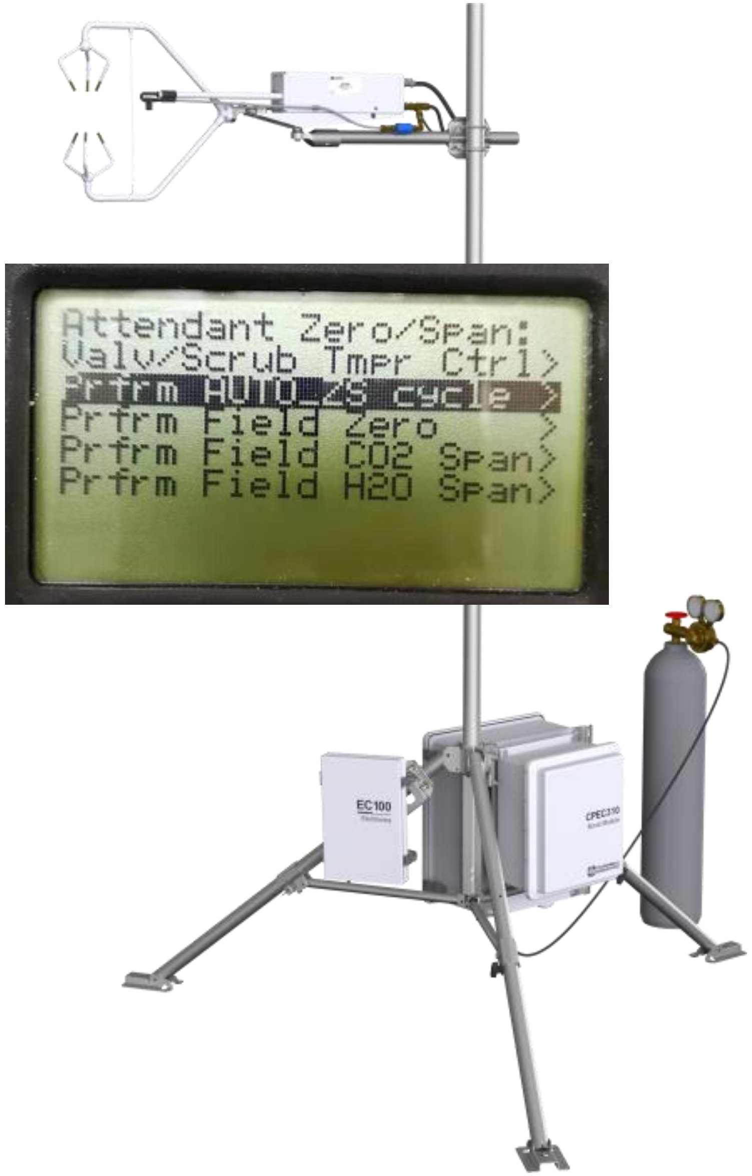
3. 配置常数(校准时长、校准间隔等)，并启动程序

```
NMBR_HFP      :       4
HFP_SNSTVT_1  : 62.0000
HFP_SNSTVT_2  : 62.0000
HFP_SNSTVT_3  : 62.0000
HFP_SNSTVT_4  : 62.0000
CAL_INTV      :    1440
Apply and Restart
```

自动在线校准典型动作序列 (**Check** 和 **Set**)

Site	Description	Duration	
SITE_1	fld smp		测量
SITE_2	offst P	10 sec	泵停止
SITE_3	chk CO2	65 sec	检查CO2
SITE_4	chk zro	85 sec	检查 Zero
SITE_5	set zro	10 sec	设定 Zero
SITE_6	set CO2	90 sec	设定 CO2
SITE_7	chk H2O	185 sec	检查 H2O
SITE_8	set H2O	10 sec	设定 H2O
SITE_9	Equilib	30 sec	平衡，泵启动
SITE_1	fld smp		测量

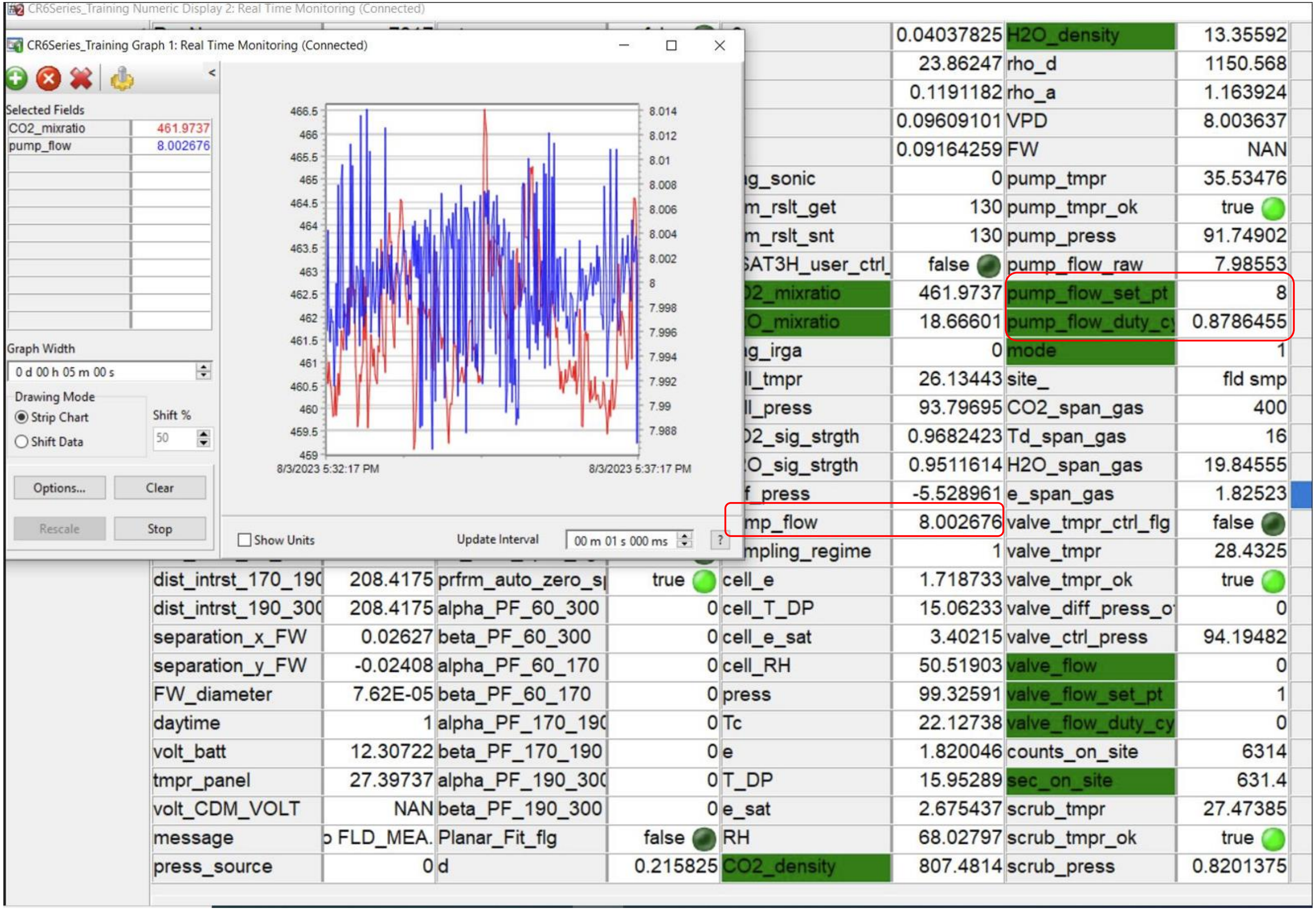
CPEC310 现场校准



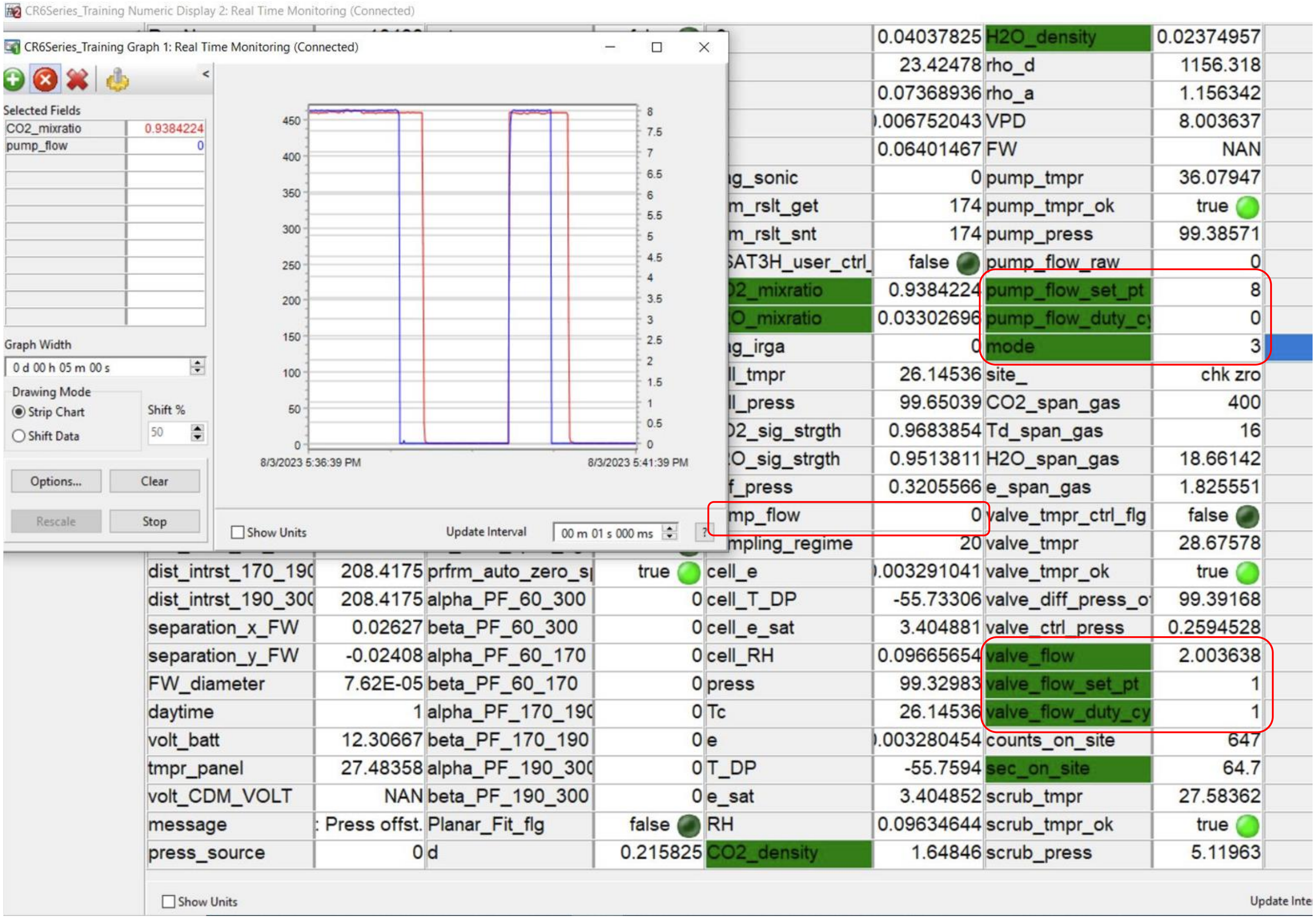
- 操作者控制 数采菜单
- 可实现：
  - Auto Zero/Span Cycle
  - Field Zero All
  - Field CO2 Span
  - Field H2O Span
- 阀控动作系列与自动在线校准类似 （Check 和 Set）

通过LoggerNet 操作现场校准

Mode	Abbreviation	Description
1	FLD_MEA	测量模式
2	PMP_OFF	泵停止
3	ZRO_ALL	零点校准
4	SPN_CO2	CO2 跨度校准
5	SPN_H2O	H2O 跨度校准
6	IRG_SLP	分析仪休眠
7	AUTO_ZS	零点/跨度 校准

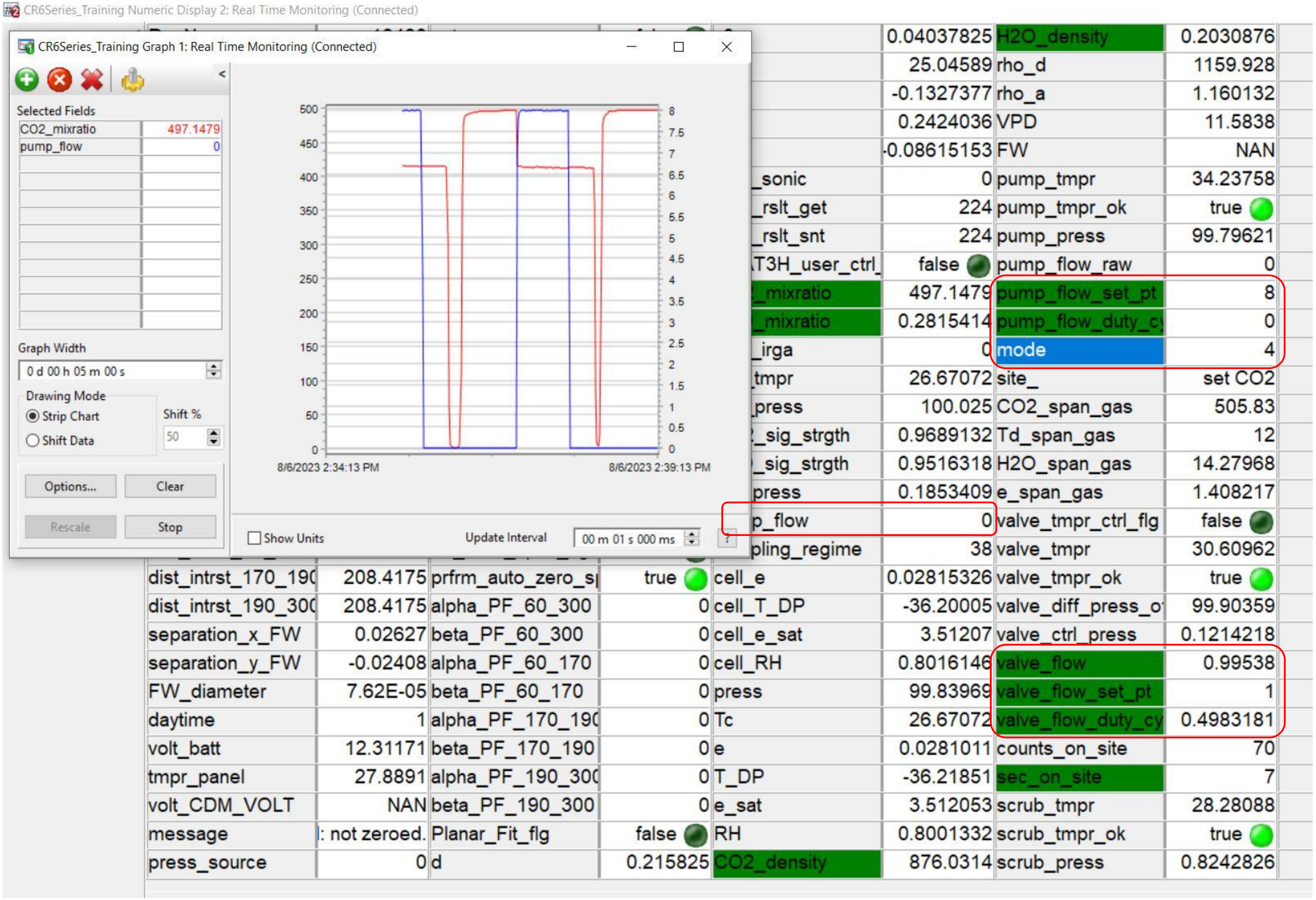


CPEC310 in FLD_MEA mode



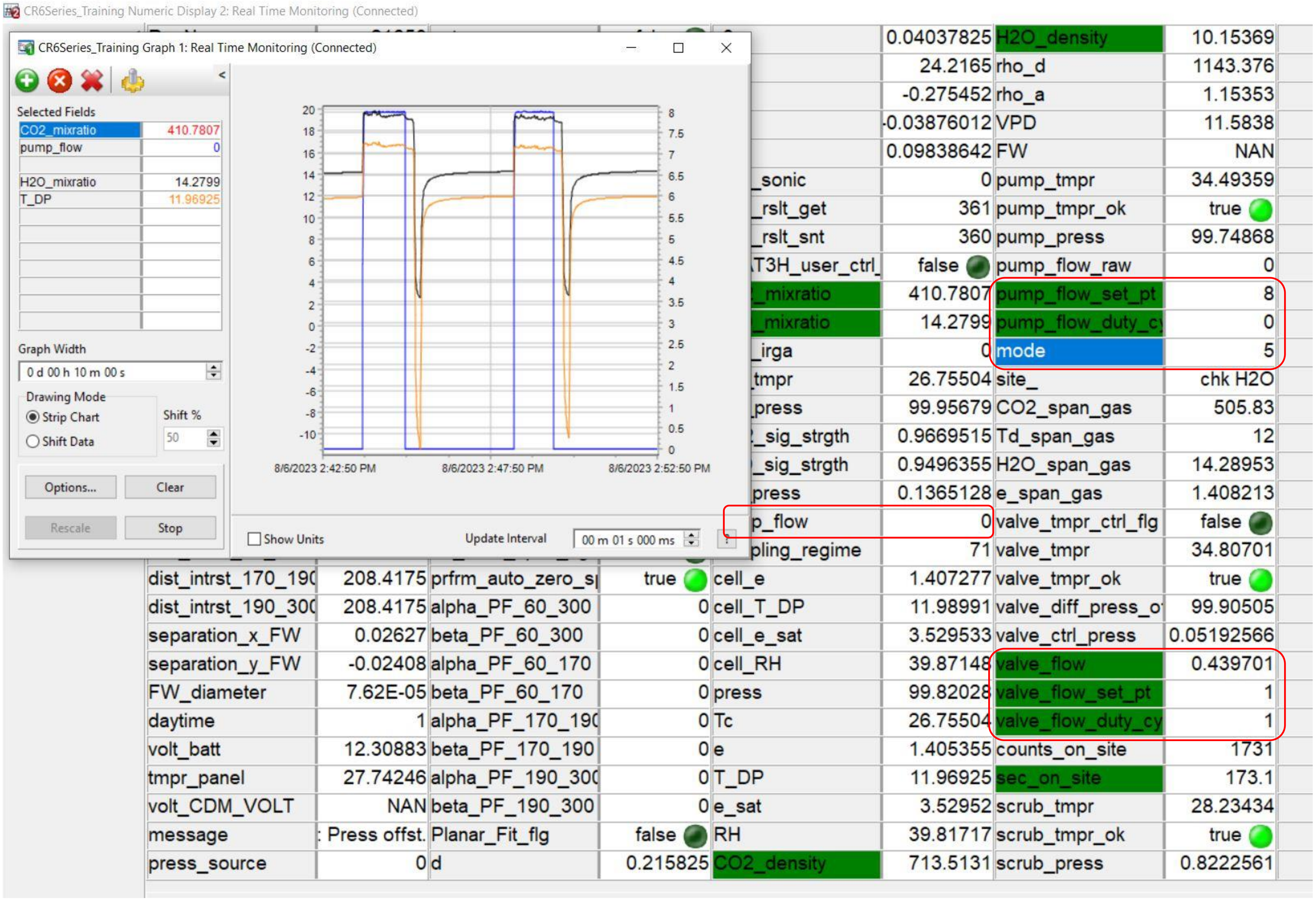
CPEC310

Zero w/ Scrub



CPEC310

CO2 Span



CPEC310

H2O Span

Thank you!