

# Eddy Covariance System Operation and Maintenance

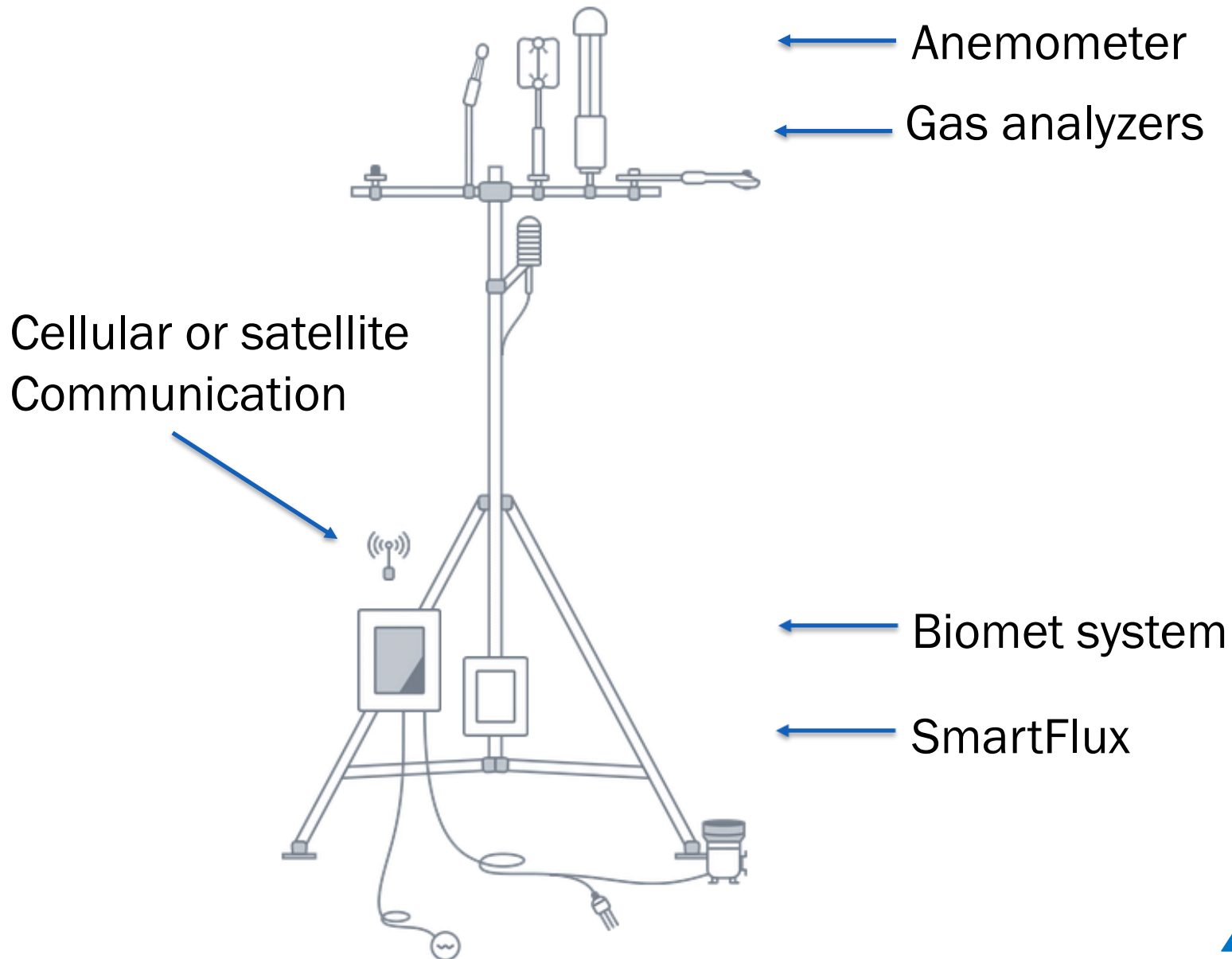


Jiahong Li  
China, Aug. 2024

# Outline

- Instruments for eddy covariance (EC) systems
- EC system operation
- EC system maintenance

# Instruments for an EC system



# Sonic Anemometer Manufacturers and Models Supported by LI-COR EC System

## Available from LI-COR

### ➤ Gill

- WindMaster
- WindMaster Pro
- R3-50, R3-100
- HS-50, HS-100

### ➤ Metek

- uSonic Multi-Path Cage
- uSonic Multi-Path Class A

### ➤ RM Young

- 81000V, 81000RE, 81000VRE

### ➤ Campbell Scientific Instruments

- CSAT3
- CSAT3B

# LI-7500DS



# LI-7200RS

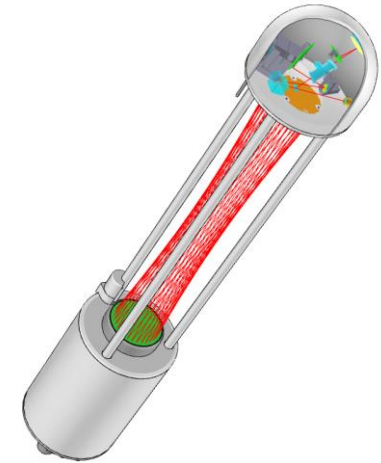
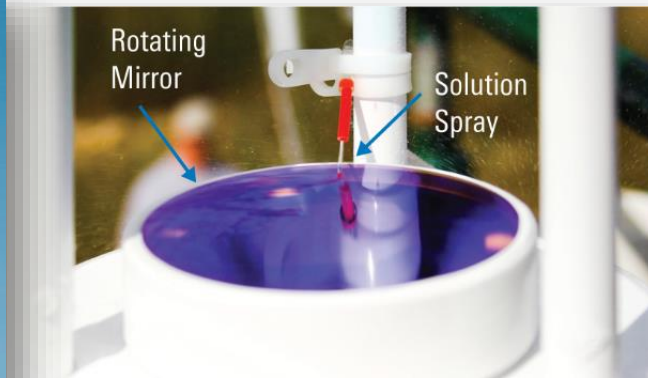


# LI-7700 Open-path CH4 Analyzer

No sampling pumps or tubing

Self-cleaning

Low power

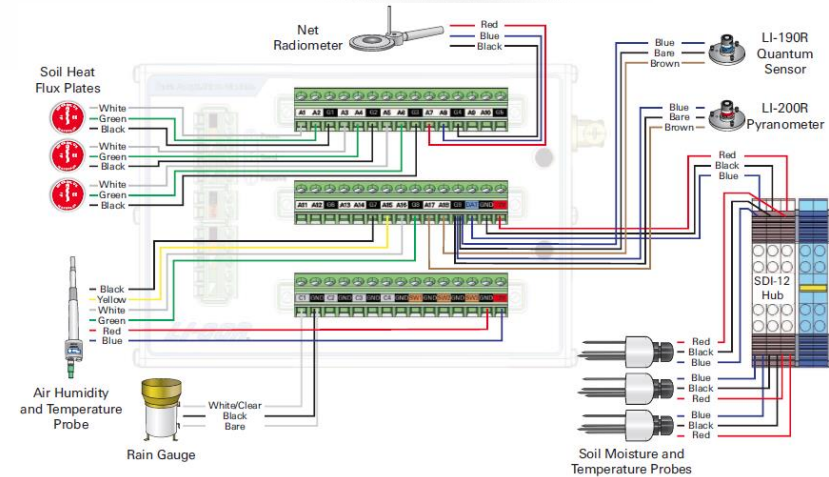
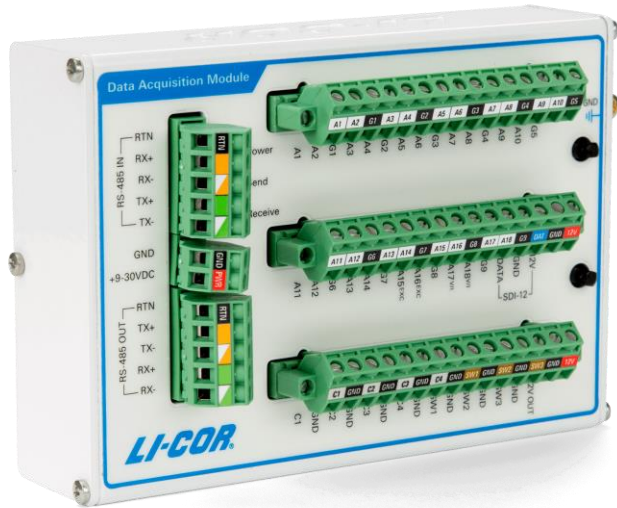


Heated mirrors



8 W  $\longrightarrow$  41 W

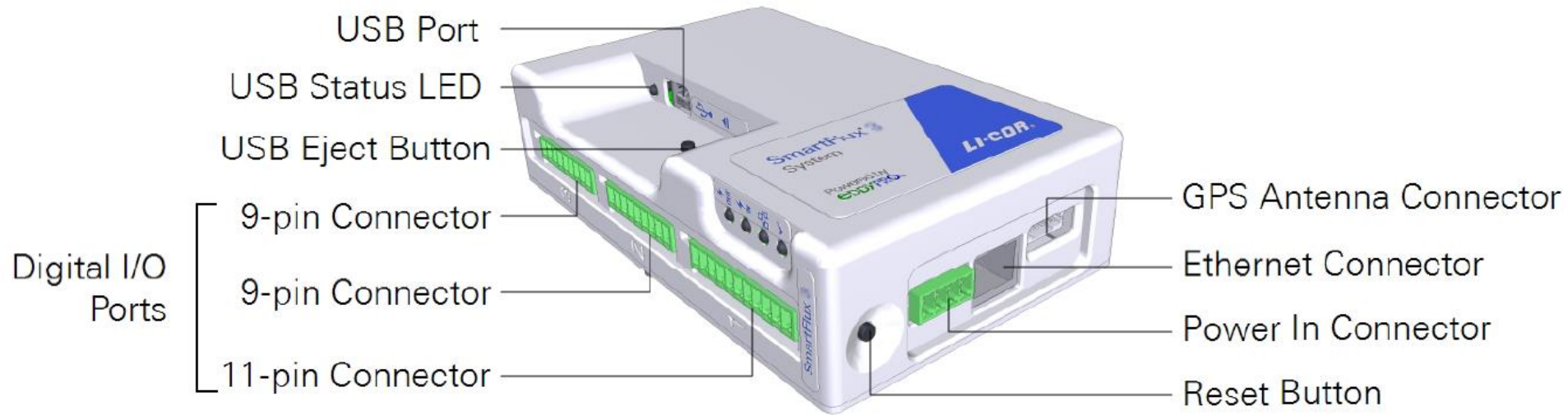
# Data Acquisition and Data Retention Modules



- Ability to daisy chain up to 4 DAqM's
- Dedicated current channels
- Power management and data back up with DRM
- Connects to SmartFlux 2/3 via RS 485



# SmartFlux 2 or 3



- GPS clock and location
- Digital sonic data logging
- Sonic, gas analyzers, and Biomet data synchronization
- Embedded EddyPro and online data processing
- 16GB USB for storing about 6 months of data

# LI-COR Basic Biomet System

## Soil Heat Flux Plates



- White
- Green
- Black
- White
- Green
- Black
- White
- Green
- Black

## Soil Moisture Probes



- Orange
- Bare
- Brown
- Orange
- Bare
- Brown

## Soil Temperature Probes



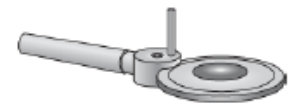
- Red
- Black
- Orange
- Red
- Black
- Orange
- Red
- Black
- Orange

## Air Humidity and Temperature Probe



- Black
- Green
- Yellow
- White
- Blue
- Red

## NR Lite 2 Net Radiometer



- Black
- Blue
- Red

## LI-190R Quantum Sensor



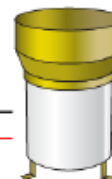
- Blue
- Bare
- Brown

## LI-200R Pyranometer

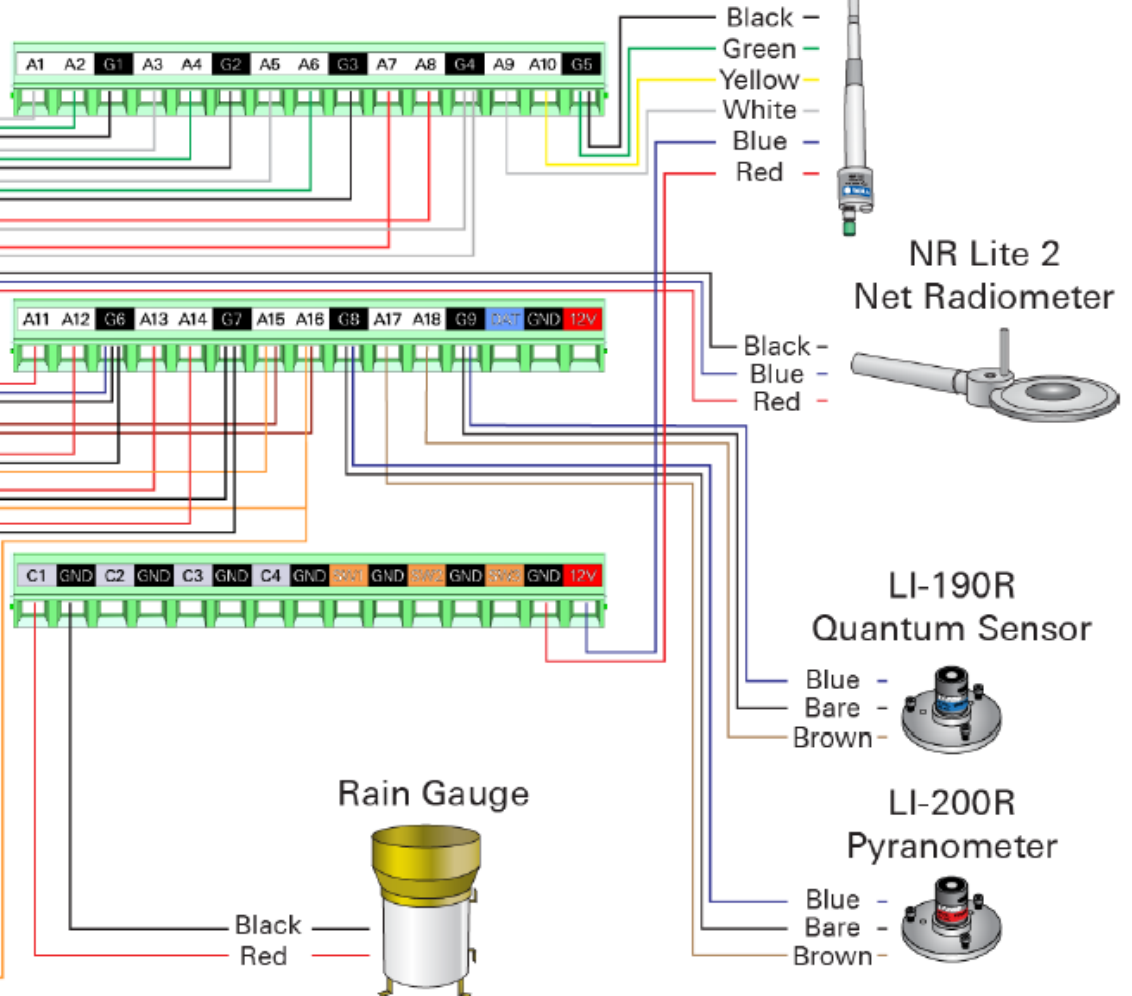
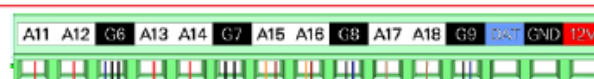
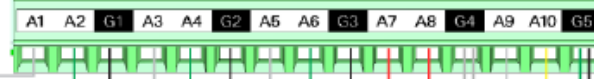


- Blue
- Bare
- Brown

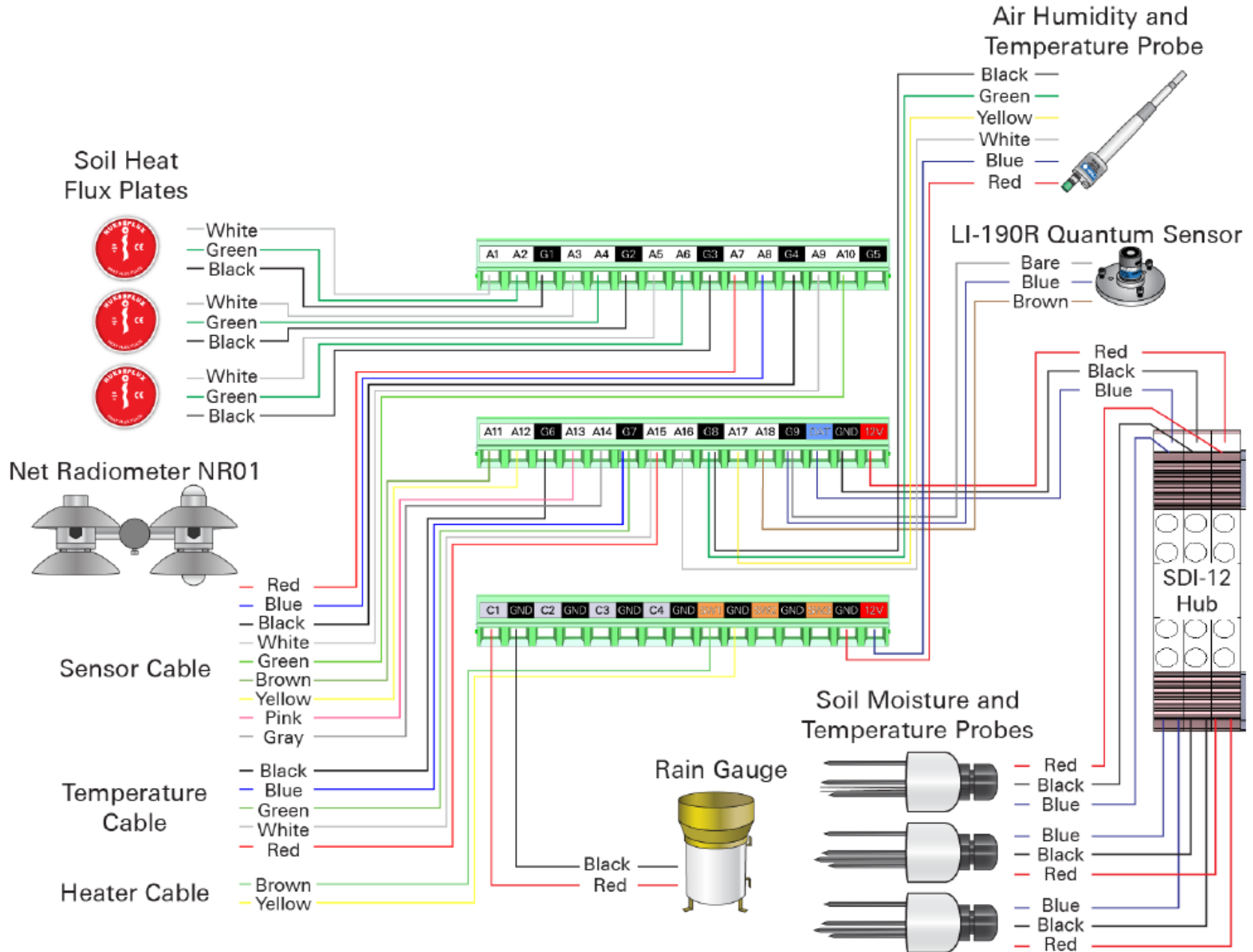
## Rain Gauge



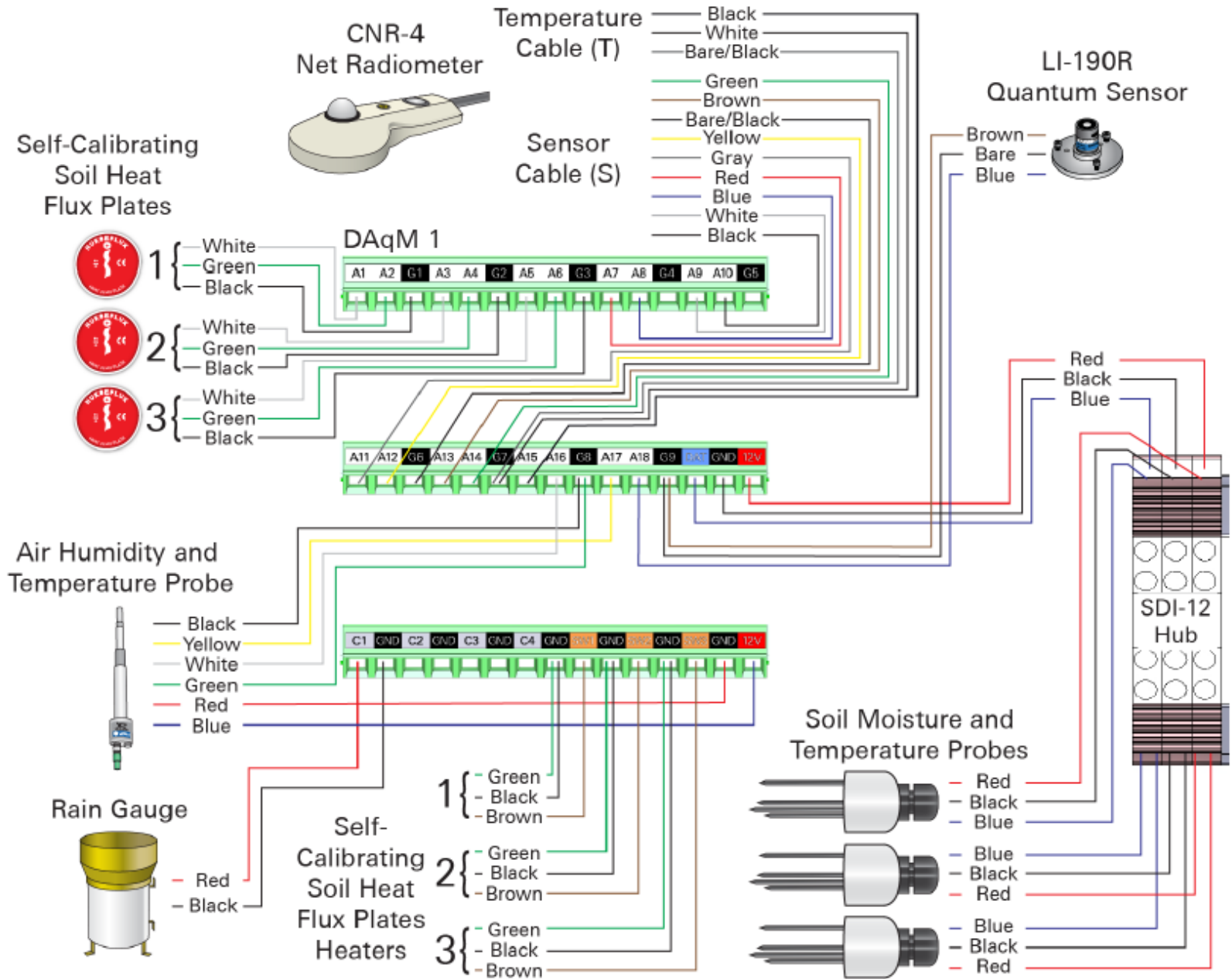
- Black
- Red



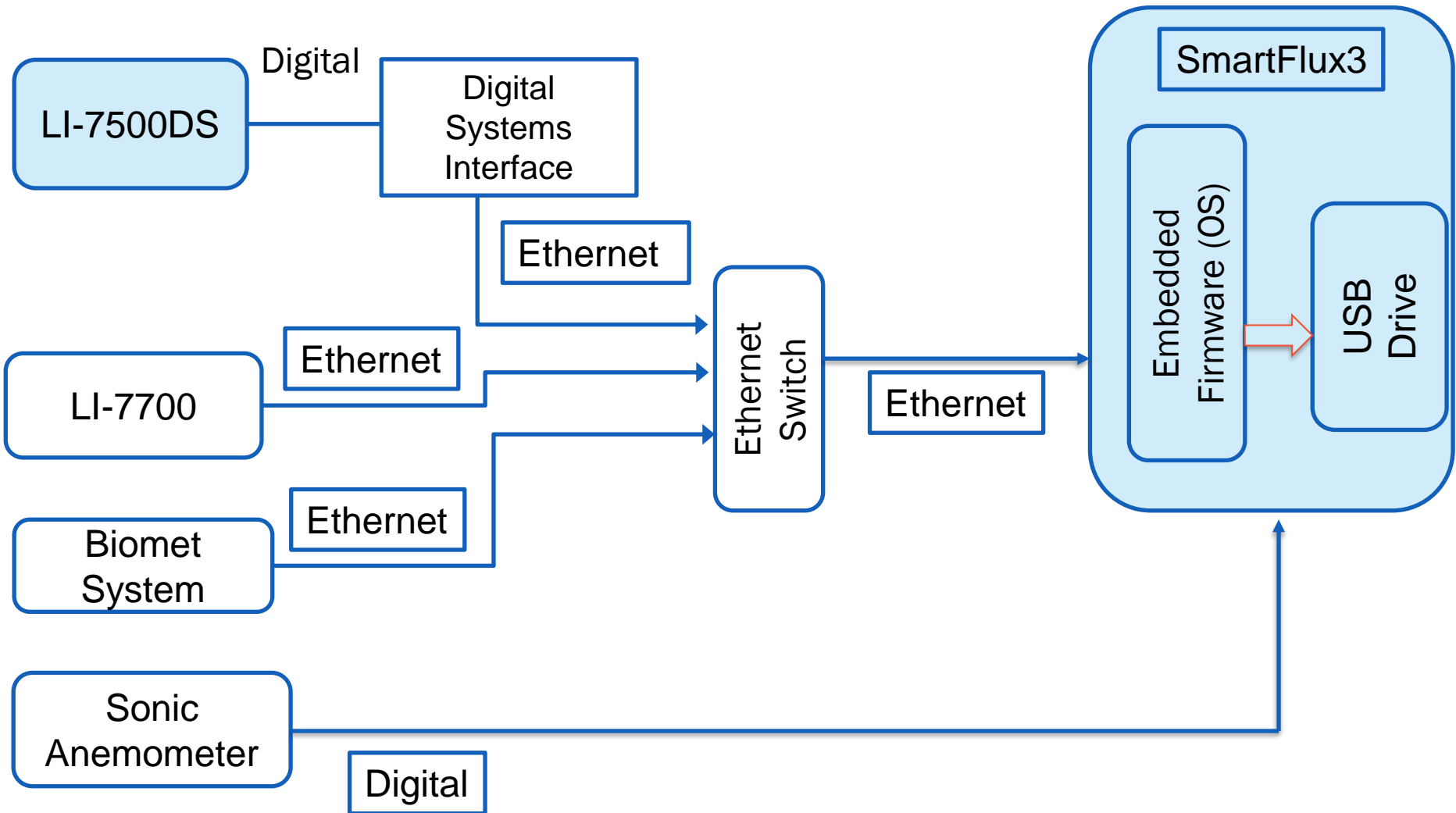
# LI-COR Standard Biomet System



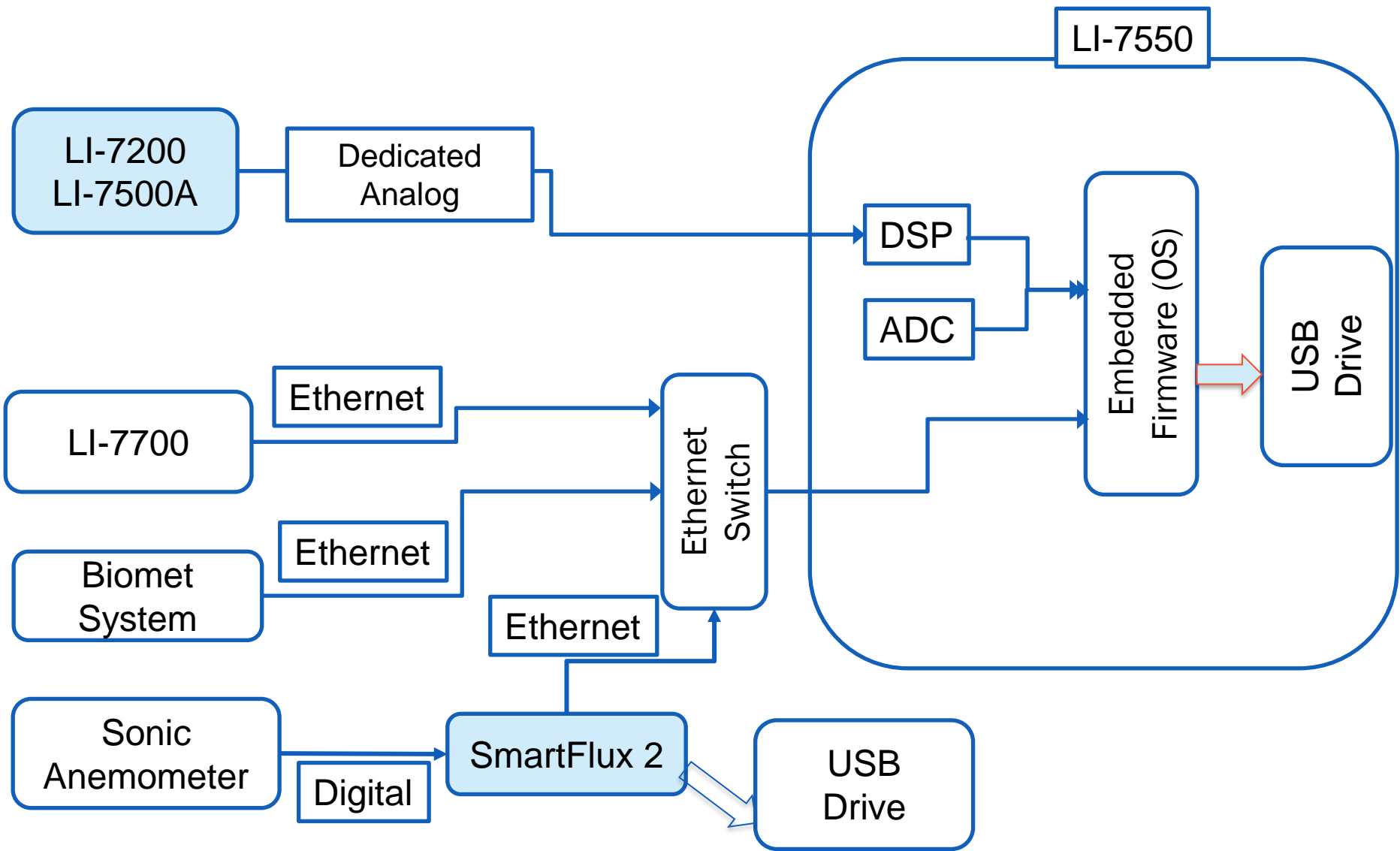
# LI-COR Premium Biomet System



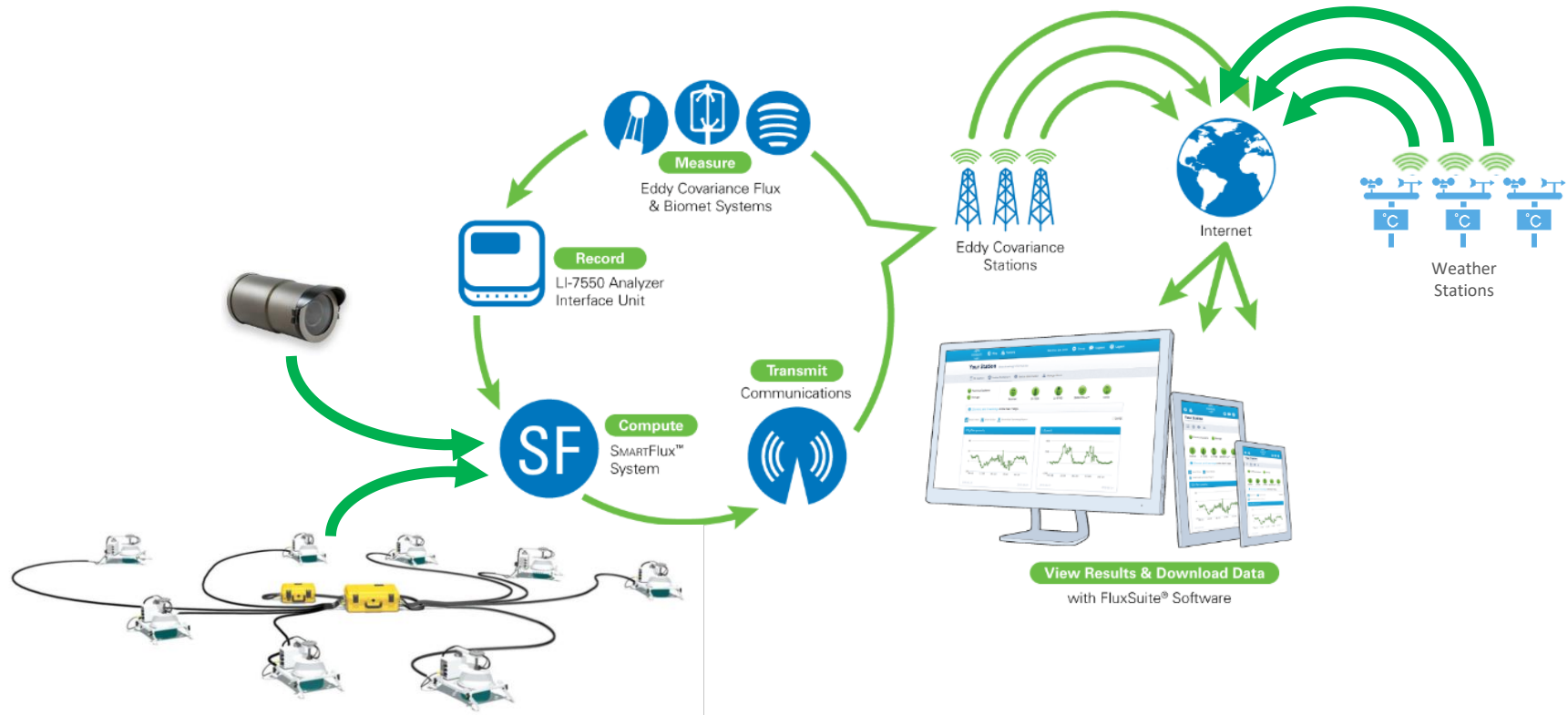
# EC System Hardware Setup with SmartFlux 3



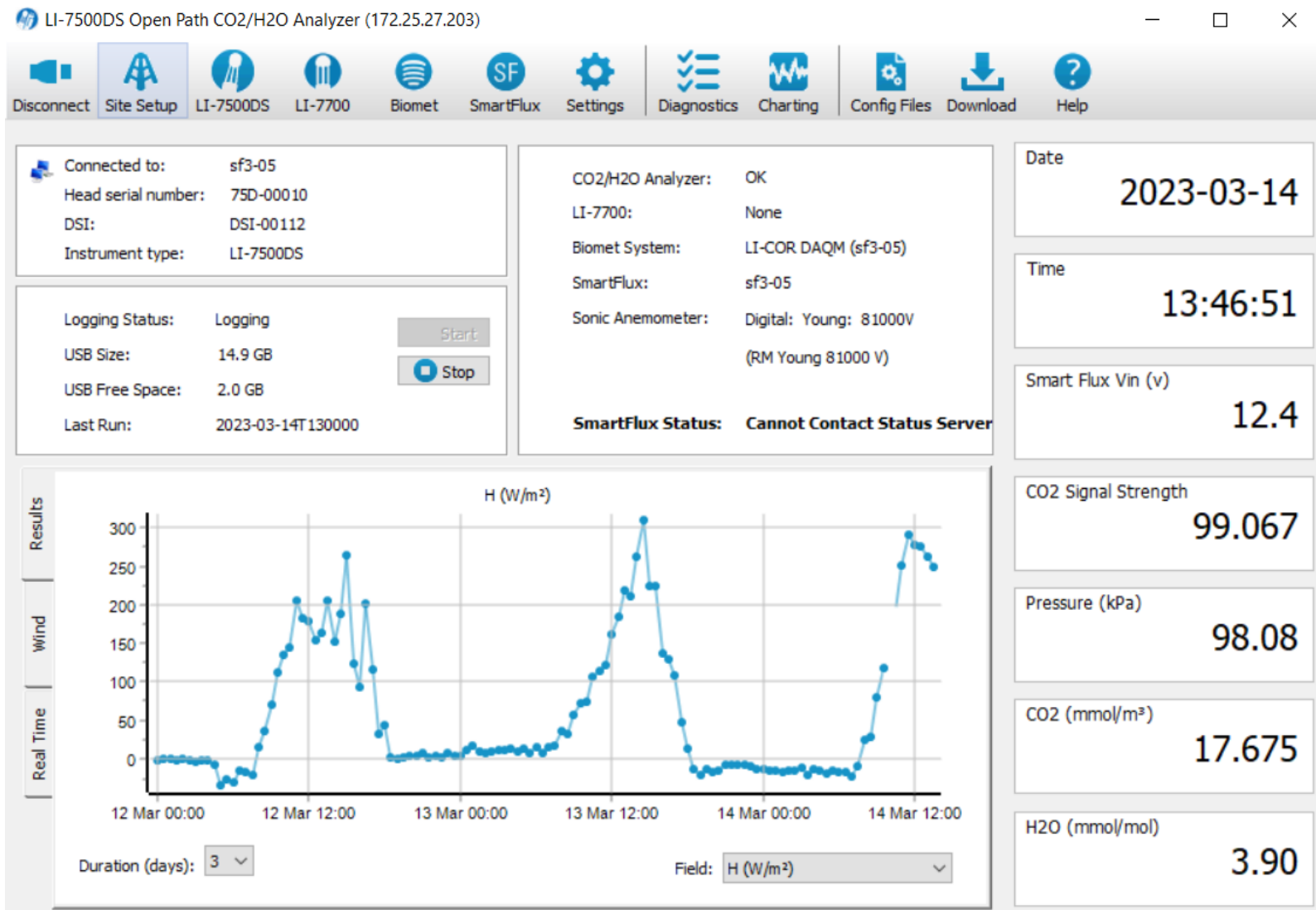
# EC System Hardware Setup with SmartFlux 2



# System Integration and Data Collection



# System configuration, data monitoring and download





# FLUXSUITE



# LI-7500/A/RS/DS Checklist

Every Site Visit	Seasonally
Check readings	Check calibration
Check diagnostics	Check/Replace Internal Chemicals
Check and tighten cables	
Clean optical windows	

# LI-7200/RS Checklist

Every Site Visit	Seasonally
Check readings	Check calibration
Check diagnostics	Check and replace filters (intake, pump)
Check and tighten cables	Check/Replace Internal Chemicals
Clean optical windows/cell/tube	
Check tubing (intake, exhaust)	

# LI-7700 Checklist

Every Site Visit	Seasonally
Check readings	Check calibration
Check diagnostics	Check/Replace Internal Chemicals
Check and tighten cables	
Clean optical mirrors	
Check washer accessory and refill	

# Smartflux Checklist

LI-7500DS Open Path CO2/H2O Analyzer (172.25.27.203)

Disconnect Site Setup LI-7500DS LI-7700 Biomet SmartFlux Settings Diagnostics Charting Config Files Download Help

Diagnosics

Status Waveform SmartFlux Advanced

**Clock:**

GPS Firmware Version:	GPS 18x-LVC software ver. 4.00	FluxSuite URL Configured?	No
Time Source:	Primary Time Source		
Reading GPS Receiver Time?	Yes		
Synced To GPS Satellite Time?	Yes		
GPS Satellites Detected:	6		
Time sources consistent?	Unknown		

**FluxSuite:**

FluxSuite URL Configured? No

**Data Repository:**

Upload to Data Repository Enabled? No

**Sonic Data Collection:**

Connection State:	active
Receiving Data?	Yes
Recorded to GHG File?	<a href="#">Yes</a>
Digital Sonic Files Storage Capacity:	Good

**System Database**

Database Size: Good

**EddyPro:**

Most Recent File Processed Without Errors?	<a href="#">Yes</a>
Last File Successfully Processed:	2023-10-04T073000_sf3-05.ghg
Last File Copied to USB Storage:	2023-10-04T073000_sf3-05.ghg
CO2 Raw file Storage Capacity:	Good

**SmartFlux USB Storage:**

Present?	Yes
Writable?	Yes

Status Refresh Rate: Once Every 15 seconds

Close

# Biomet Checklist

Disconnect Site Setup LI-7500DS LI-7700 **Biomet** SmartFlux Settings Diagnostics Charting Config Files Download Help

Connected to: **Biomet System** Date

Head serial nu  
DSI:  
Instrument ty

Logging Status  
USB Size:  
USB Free Spa  
Last Run:

Results  
Wind  
Time

CO2 ( $\mu\text{mol/mol}$ )

Instrument **Data**

Sensor Name	Type	Units	Value
ABSURD_1_1_1	other	W/m <sup>2</sup>	-9999
ADC_1_1_1_1	other	other	-0.000244173
ADC_2_1_1_1	other	other	-0.000256931
CHK_1_1_1	other	other	125
DAQM_T_1_1_1	other	C	10.5391
DAQM_V_MAIN_1_1_1	other	V	12.2933
DRM_POWER_STATUS_1_...	other	other	15
DRM_V_BATTERY_1_1_1	other	V	12.4342
DRM_V_MAIN_1_1_1	other	V	11.4594
EVI_RoX_1_1_1	other	other	0.1736

Auto Refresh every 60 seconds Refresh

# Cleaning the windows and mirrors

## **Normal conditions:**

- Mild detergent
- Glass cleaner
- Distilled or deionized water
- Glass cleaning cloths
- Lens cleaning tissue

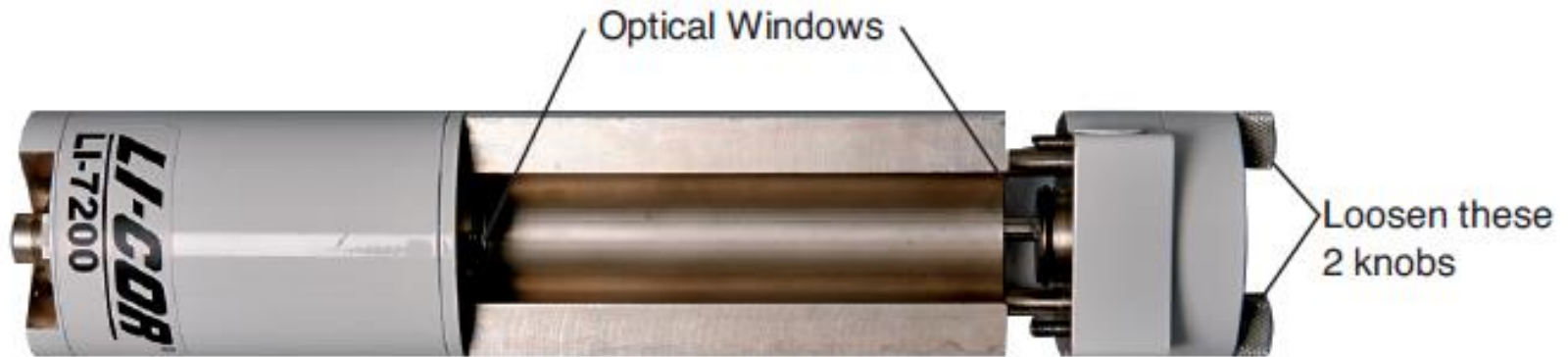
## **Special conditions – chemical or water deposits:**

- Vinegar
- Soak and then wipe with cloths
- Rinse with distilled or deionized water

## **DO NOT USE**

- Abrasive: Polishing compound, toothpaste, etc.
- Corrosive Acid: Hydrochloric acid, HydroFloric acid, etc.

# Cleaning the LI-7200/RS





# Cleaning the LI-7700

- Window contamination and cleaning
  - Edge of mirror is more important than middle of mirror
  - Don't forget the top mirror (always manually)

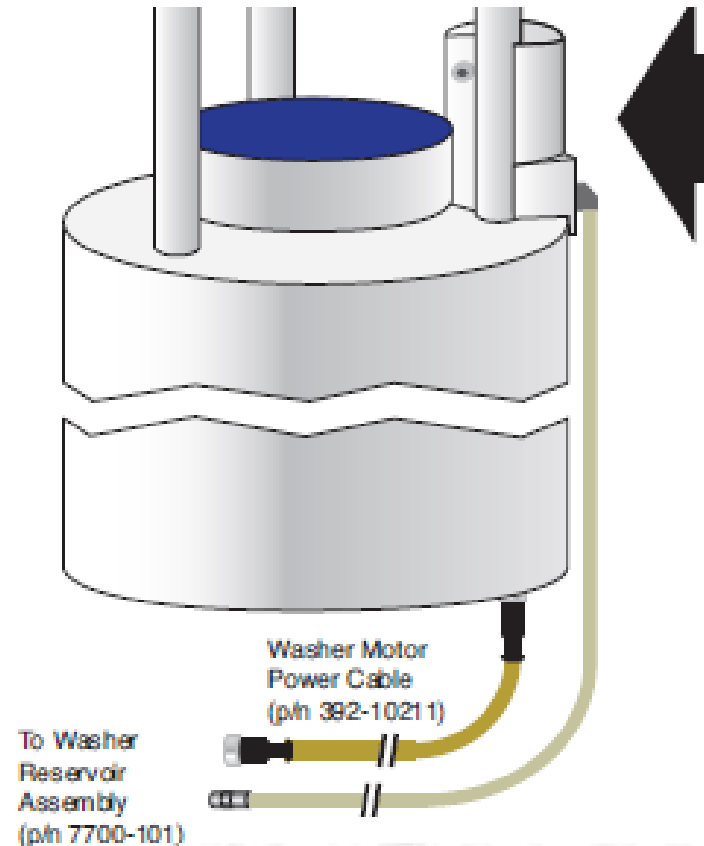


Figure 2-8. Washer nozzle assembly and washer

# Replacing the chemicals

LI-7500A/RS/DS and LI-7200/RS

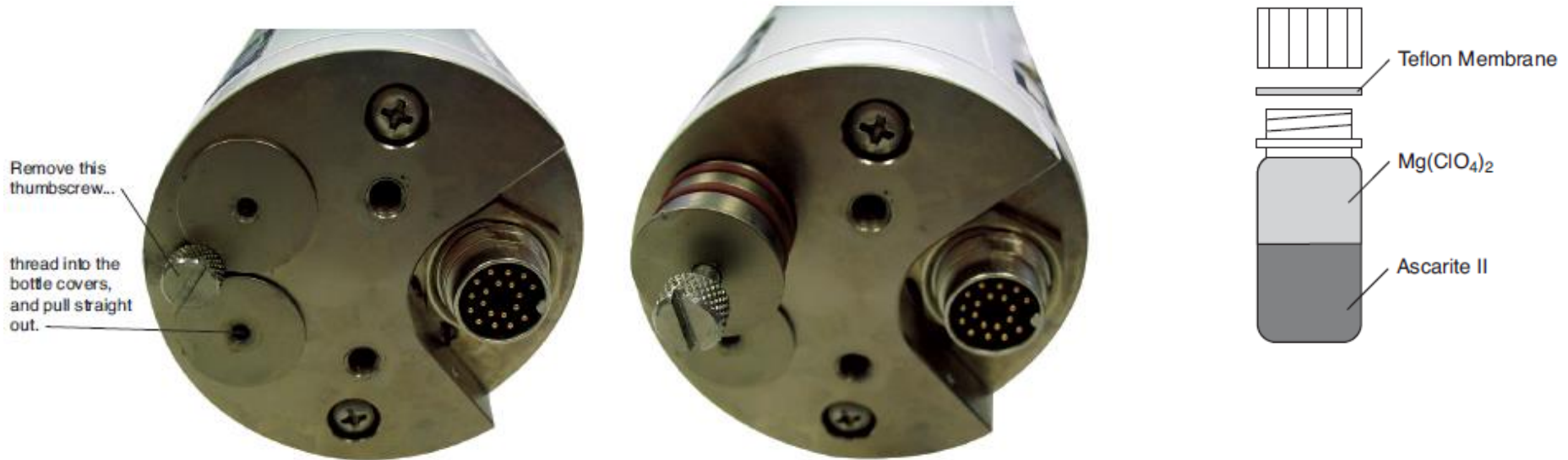


Figure 6-3. Remove the thumbscrew, thread into the bottle covers and pull straight out to access the scrubbing bottles.

Replacement requirement:


Normally, every 12 months

Hot, humid climates: every 6 months



# Replacing the chemicals

LI-7700

Calibration				
Optics RH:	12 % 			
Last Zero:	2011-07-26 22:55:13			
Last Span:	2011-07-26 23:01:23			
<input type="button" value="Factory Reset"/>	<input type="button" value="Zero CH4"/>	<input type="button" value="Span CH4"/>	<input type="text" value="10"/>	ppm

Replacement requirement:

When RH > 30%



# Calibration for Li-Cor CO<sub>2</sub>/H<sub>2</sub>O analyzers

## Factory calibration

Calibration

Zero Span Span 2 Signal Strength Coefficients Manual History

Head Serial Number: 75H-2538

CO<sub>2</sub>

A: 1.43495e+02  
B: -4.25818e+03  
C: 4.65800e+07  
D: -1.40512e+10  
E: 1.75334e+12  
XS: 0.00280  
Z: -3.000e-04  
SD1: 1.430e-02  
SD2: -1.138e-01  
SD3: 2.030e+00

H<sub>2</sub>O

A: 5.55184e+03  
B: 4.03257e+06  
C: -1.12538e+08  
XS: -0.00040  
Z: 2.870e-02  
SD1: -2.140e-02  
SD2: 1.243e-01  
SD3: 2.323e+00

Box Pressure (Absolute)

A0: 58.935  
A1: 15.529

Signal Strength

B: 0.30  
C: 2.71

Band Broadening:

A: 1.15

## User calibration

Calibration

Zero Span Span 2 Signal Strength Coefficients Manual

Calibration Constants

CO<sub>2</sub> Zero: 0.9028  
H<sub>2</sub>O Zero: 0.8071  
CO<sub>2</sub> Span: 1.0033  
H<sub>2</sub>O Span: 0.9991  
CO<sub>2</sub> Span 2: 0.0000  
H<sub>2</sub>O Span 2: 0.0000  
CX: 39671.4

# Calibration for LI-7700 CH<sub>4</sub> analyzer

## Factory calibration

LI-7700 CH<sub>4</sub> Analyzer

Performance Verification

Serial Number TG1-03

Date: 09 Aug 2013  
Code: 27777

Technician [redacted]

### Settings

Zero = -32.618 set on 2013-08-09 23:29:34  
Span = 9.70431e-05 set on 2013-08-09 23:38:41

serialnumber = TG1-0319  
lasermoddepth = 11453  
) laserstarttemp = 30.7  
blockstarttemp = 30  
blockstarttempplowrange = 5  
rssidrophthresh = 0  
pzero = 58.13  
pspan = 15.53  
samplegain = 0  
refgain = 0  
mirrorpos = 0  
offset1 = 37500

## User calibration

The screenshot shows a software window titled "Advanced Calibration:" with a help icon and a close button (X). The window contains a "CH4 Calibration" section with the following fields and buttons:

- Zero:
- Zero Time:
- Span:
- Span Gas:  ppm
- Span Time:

At the bottom of the window are three buttons: "Refresh", "Apply", and "Close".

# How often should I send the analyzer back for factory calibration?

- Not necessary except the analyzer is broken.

# How often should I do user calibration?

## ➤ Must do:

- After changing internal chemicals
- After changing the chopper housing temperature settings (summer and winter)
- If the accuracy of CO<sub>2</sub> or H<sub>2</sub>O readings is over 1%

## ➤ Optional:

- If the accuracy of CO<sub>2</sub> or H<sub>2</sub>O readings is within 1%

## ➤ Do not do:

- H<sub>2</sub>O span if you do not have an LI-610 Dew Point Generator

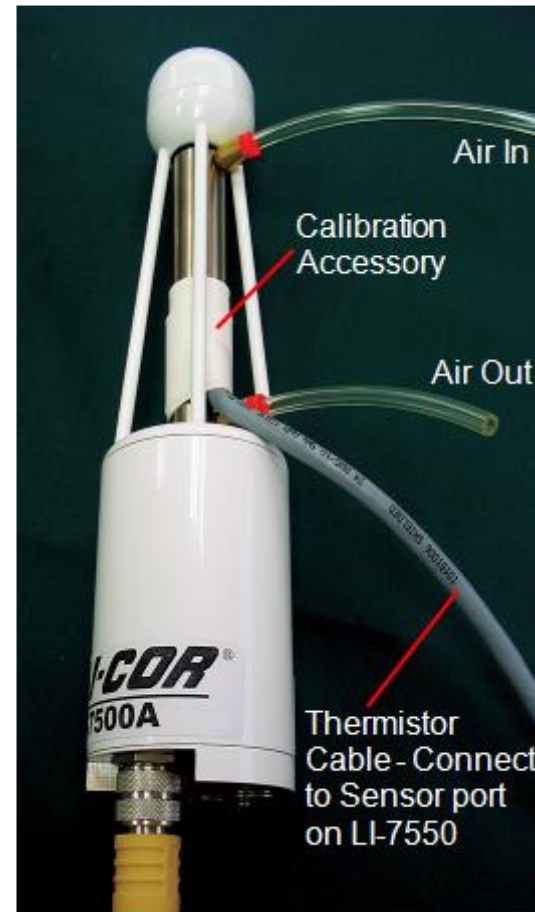
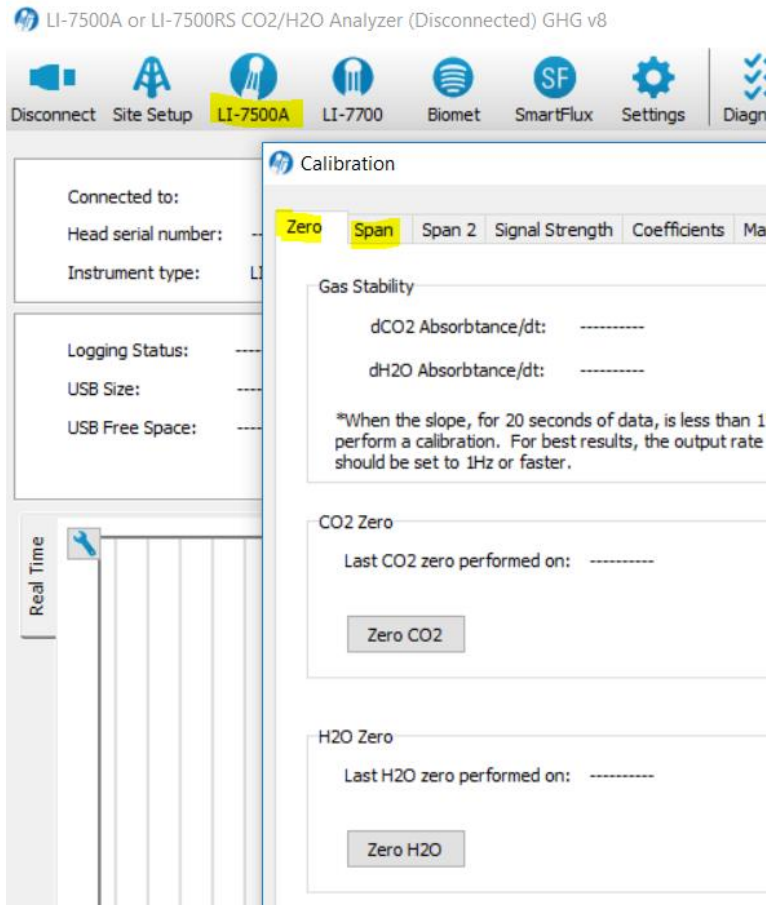
# Gas standards for a user calibration

- Span gas
  - Known concentration in a balance of **air** (1% or better)
  - Dew point generator
  - VOC (Volatile Organic Compound) free for LI-7700
- Zero gas
  - Chemicals
  - CO<sub>2</sub>-free air
  - N<sub>2</sub>
  - VOC (Volatile Organic Compound) free for LI-7700





# How to do user calibration for CO<sub>2</sub> and H<sub>2</sub>O?



- Must clean the windows first
- Must have thermistor cable connected to the LI-7550
- Watch signal strength before and after calibration shroud installation

# How to do user calibration for CH<sub>4</sub>?

LI-7700 Open Path CH<sub>4</sub> Analyzer: TG1-0455 (via TCP: fe80::21c:94ff:fe04:2c8b)

Charting: Configure...  
Data Page 1: 1 Chart  
Data Page 2: 2 Charts

Logging (LI-7550 Not Present): PC... USB...

Status:  
Signal Path is Clear:   
Laser Control:   
Heater: OFF  
Spin Motor:

Calibration:  
Optics RH: 9 %  
Last Zero: 2018-02-01 13:39:02  
Last Span: 2018-04-26 16:51:35

Zero CH<sub>4</sub> Span CH<sub>4</sub> 10 ppm

Data Page 1 Data Page 2 Diagnostics Page 1



- Must clean the mirrors first.
- Check temperature and pressure readings to make sure they are normal.
- Will take a long time due to the large volume of calibration shroud.

Thank you  
Questions?