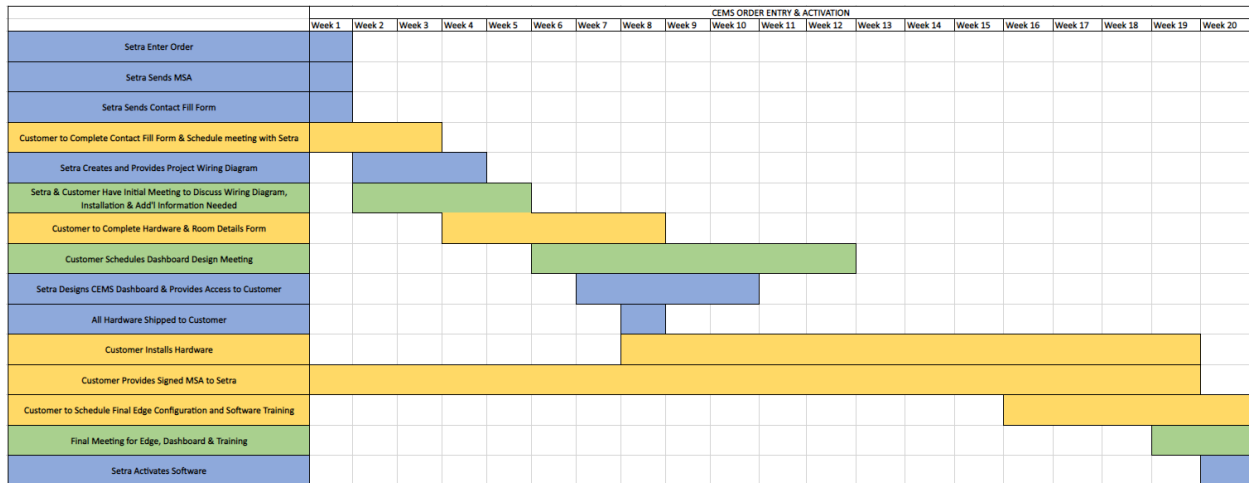


Setra CEMS™ Customer Starter Package

Before you get started

Timeline for CEMS Order Entry and Activation Execution



This is the expectation to get your system online. The blue is Setra. The yellow is you (which has variables due to constraints, workforce, and materials). The green are meetings with all stakeholders.

Installation Information

Hardware Placement Guidance

Sensor Type	Placement
Pressure Pickups (LITE)	<ul style="list-style-type: none"> Pressure pickup plates should be out of the direct path of any sources of air turbulence, and not in the immediate vicinity of heat or cold-generating equipment Pressure pickup plates should be placed fairly central to the room, avoiding immediate placement near doorways (don't want momentary fluctuations in pressure to significantly impact readings) Pressure pickup plates should be either ceiling mounted or near-ceiling wall-mount (above 6')
Temp/Humidity Sensors (SRH200 , SRF600s)	<ul style="list-style-type: none"> Temp/humidity sensors should be mounted with the same turbulence and thermal considerations as above Temp/humidity sensors should be mounted at just below 'eye level', or roughly between 5' – 5' 9" from the floor These devices are designed to be wall mounted. They need to be mounted in a benign location which best represents room conditions. Do not mount it so it becomes blocked off.
Particle Counters (SPCs)	<ul style="list-style-type: none"> Particle counters should be mounted with the same turbulence and thermal considerations as above

	<ul style="list-style-type: none"> • Particle counters should be placed near the highest-use processing area(s) mounted at a height that mirrors the height where the most critical processes are happening • All of the above should be free of obstructions (no equipment blocking any orifices/vents/etc.) • General rule: place nearest to the questionable area.
264/267	<ul style="list-style-type: none"> • Ideally mounted above the space (though not necessarily), just above the ceiling tiles for easy access.
RPS	<ul style="list-style-type: none"> • These devices are designed to be wall or ceiling mounted. They need to be mounted in a benign location which best represents room pressure. • Do not mount on the ceiling next to an exhaust duct • Do not mount on the wall next to the door • Do not mount on the wall with a fan blowing toward it. • Do not mount it so it becomes blocked off.
Room Monitors (FLEX, SRCM)	<ul style="list-style-type: none"> • Mount on wall at eye level so that information can be easily read and touch screen easily accessible.
Snubbers	<ul style="list-style-type: none"> • The snubbers need to be mounted away from any fans, exhausts, doors, and anything that could affect their readings. Something to be mindful of.

Wire Specification Recommendations for BACnet MS/TP

Twisted Pair Cable Specifications
22 - 24 AWG twisted pair, shielded jacketed communication cable
Characteristic impedance of 100 - 120 Ohms
Capacitance of 17 pF/ft conductor-to-conductor or less
Braided or aluminum foil shield
Velocity of propagation of 66% or higher

Wire Recommendations for BACnet MS/TP

Part Number	Description
Belden 9841	24 AWG, 1 pair conductor
Belden 82841	24 AWG, 1 pair conductor
Belden 8723	22 AWG, 1 pair conductors
Belden 1503A	22 AWG, 1 pair conductors

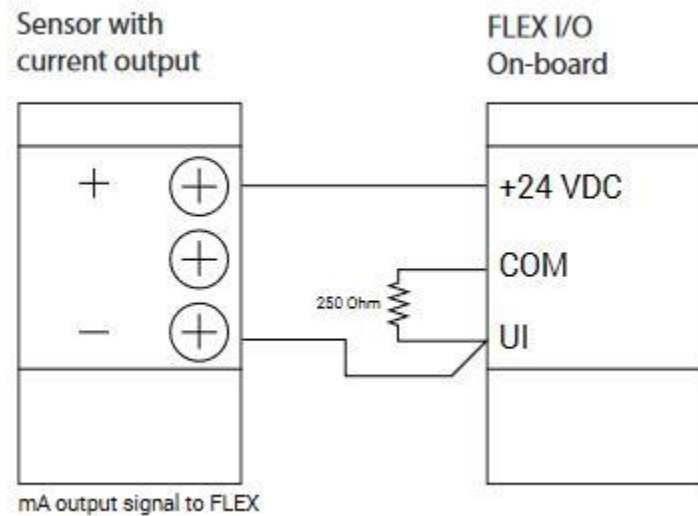
These are just suggestions and can be substituted.

Electrical Data Output

For the FLEX, you only want to bring in VDC output for sensors.

Resistor	Converted Output
250 OHM	1-5 vdc
500 OHM	2-10 vdc

Below is an example of a mA output sensor wired to a FLEX that is being converted to VDC output using a 250 Ohm resistor.



Network Information

Portal and Website Access

Product	Web Address
SetraCEMS Dashboard	http://cems.setra-cloud.com
SetraEDGE Portal	http://setraedge.local

Setra Cloud (Hosted by AWS)

Hostname	IP Address
cems.setra.cloud	35.153.251.182

Setra Hardware

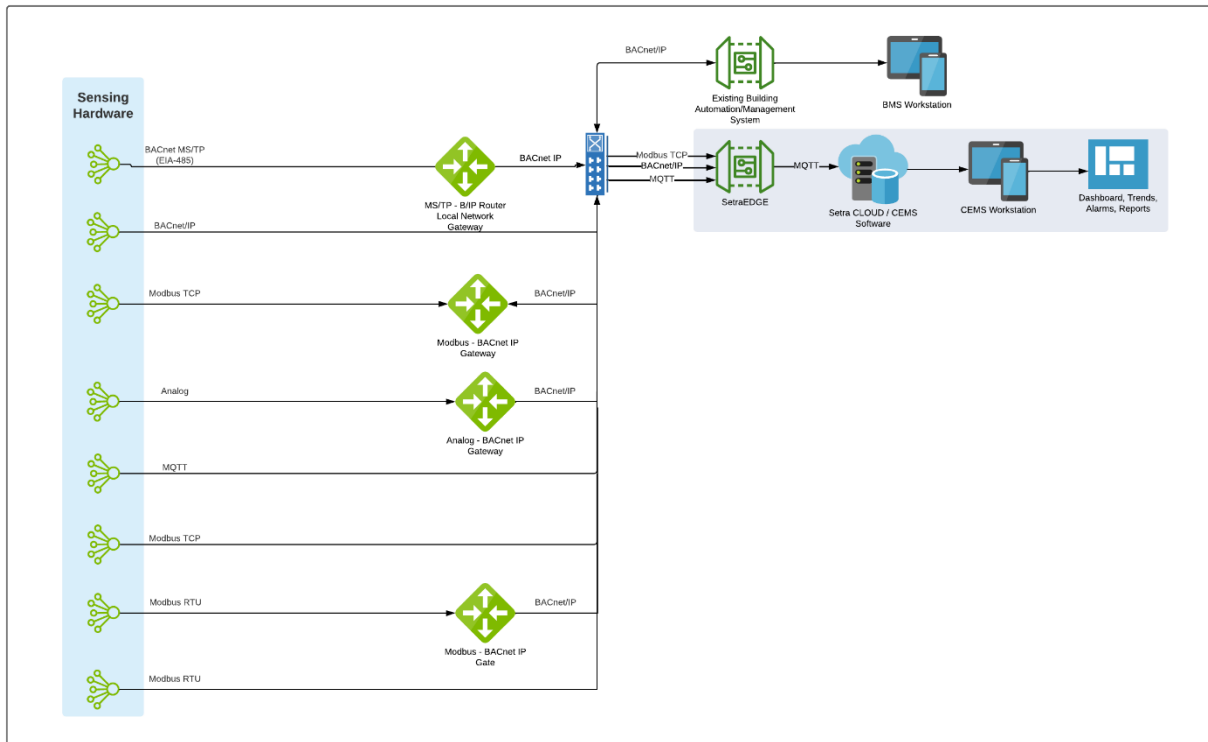
Part Number	INTRANET IP Address	Mac Address	Device Instance	Ports	Username	Password
CEMS-EDGE-W-010	192.168.92.200		3	8883 - 9293	create own	create own
NET-BRTR-07 or NET-BRTR-09	192.168.92.68	0	0		admin	admin
NET-CTLR-22	192.168.92.68		2749		admin	admin

Setra EDGE Additional Information

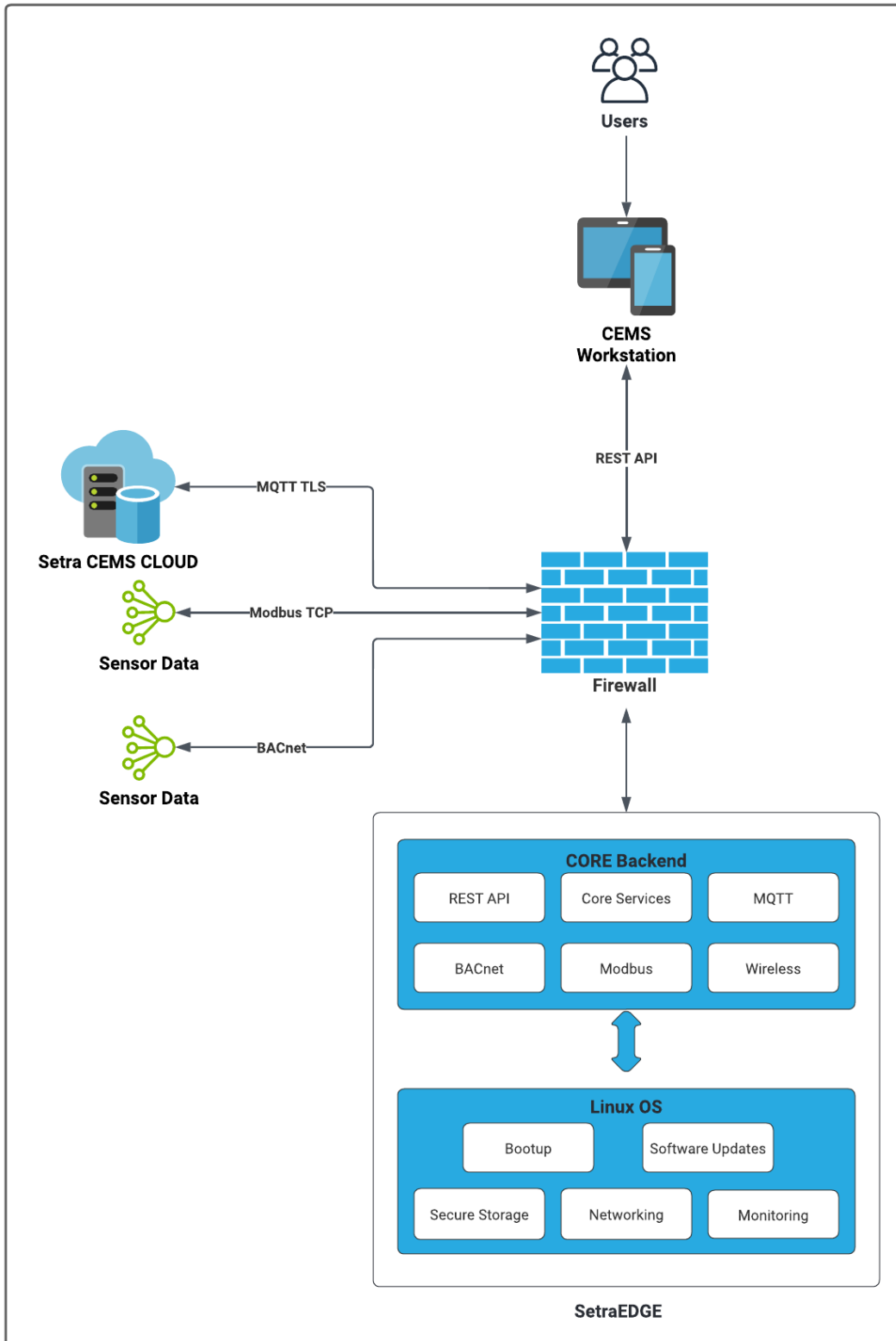
- Edge Needs unrestricted network access to the AWS
- Communicates over secure MQTT via TLS v1.2
- DNS resolution

- 3rd party penetration testing
- Platform EDGE is running on Embedded Linux
- No outside communication to the EDGE itself (refuses any connection)
- Ephemeral ports are 32768 – 32773

High Level CEMS Architecture



In Depth Setra EDGE Architecture



BACnet Introduction

General

BACnet is an international standard and an open protocol used for communication in control networks. It's a model for creating building automation systems which can interoperate.

BACnet defines methods which a control manufacturer can use to make systems that are interoperate with other systems. BACnet is also a tool for specifying what users want (features, performance metrics, etc.)

Different BACnet Protocols

Protocol	Description	Identifiers
MS/TP	The BACnet MS/TP bus protocol is part of the BACnet® ANSI/ASHRAE™ Standard 135-2008 that uses the EIA-485 (RS-485) physical layer standard for data transmission (called the segment). Multiple segments can be logically tied together.	Network Instance MAC Address Baud Rate Polarity Two/Three Wire Bus
IP	BACnet IP is the preferred communication protocols, allowing systems to talk to each other over a network, like Internet of Things (IoT) technology—cutting out the middle man. Unlike BACnet MS/TP, requiring data to be transferred and stored in a controller, IP software stores through cloud-based software, making it much more secure.	Network Instance IP Address Subnet Mask Gateway Ethernet (CAT5/CAT6)

MS/TP

Polarity

BACnet MS/TP segment is polarity sensitive. The polarity of all devices that are connected to the two-wire BACnet MS/TP Segment must be respected. The markings to identify the polarity can vary by manufacturer.

Setra Systems Model	BACnet Polarity (+)	BACnet Polarity (-)
Setra EDGE	+ is Positive	- is Negative
Setra BACnet Router	+ is Positive	- is Negative
FLEX	B is Positive	A is Negative
SRCM	B is Positive	A is Negative
SRPM	A is Positive	B is Negative
SRH	A is Positive	B is Negative

Baud Rates

Most devices will have a range of baud rate settings, typical baud rates are 9,600, 19,200, 38,400, and 76,800. The baud rate setting determines the rate at which data is sent on the segment. All devices on the segment must be set to the same baud rate. Therefore, the chosen baud rate must be supported by all devices connected to the segment.

Setra Systems' devices must be power cycled after changing a baud rate setting for it to take effect

Cable Length

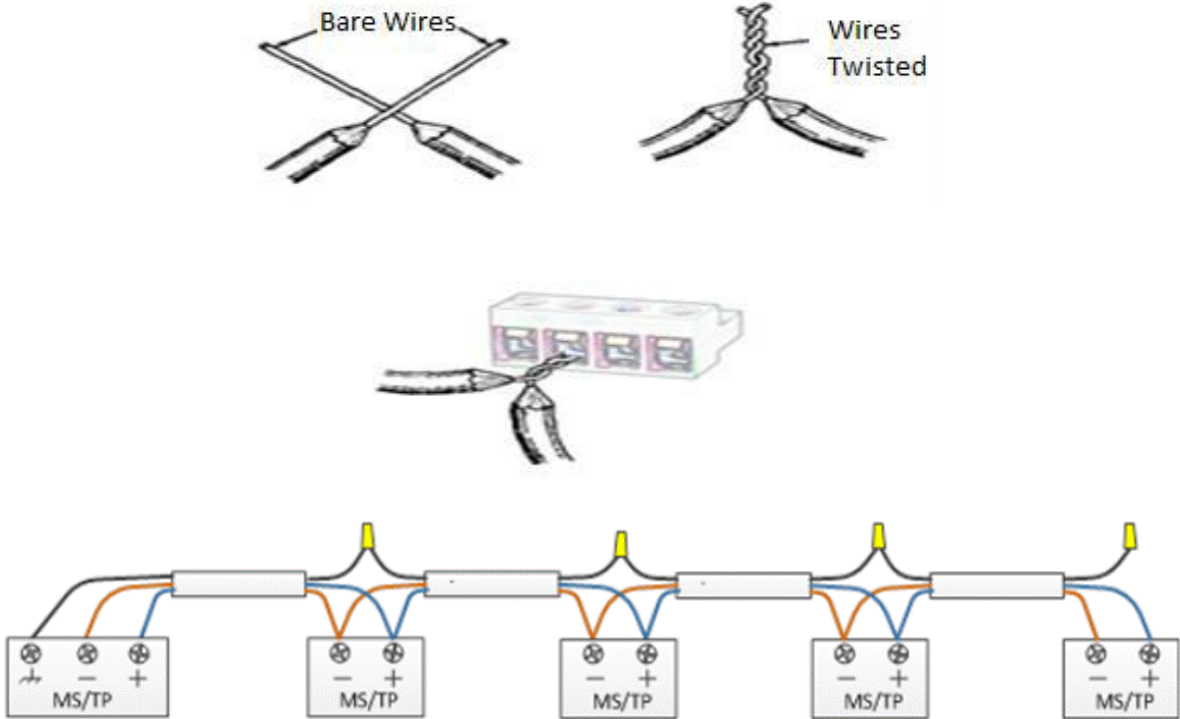
Baud Rate	Maximum Cable Length
9,600	4,000'
19,200	4,000'
38,400	4,000'
76,800	4,000'
115,000	3,280'

At higher baud rates above 76,800 the cable length will need to be reduced. Also, the higher the baud rate the more sensitive the cable becomes to quality of installation, such as how much of the wire is untwisted at each device.

Daisy Chained Topology

MS/TP uses a *daisy-chained communication segment*. The network itself uses a twisted pair plus shield type of wire. The pair is like the rails of a ladder with individual devices wired across the rails like rungs. The wires that form the rung are called *stubs*. For electrical reasons we want to make the lengths of stubs as short as possible.

That's why MS/TP specifies the use of daisy-chain wiring. Daisy-chaining means landing the network wires on screw terminals that are directly part of the device itself. Other types of topologies are not acceptable such as Star and Ring. The reason for this is the reflection of the signal may not dampen the signal enough with the EOL terminations resistors and cause information to be lost.



MAC Address

The MAC Address is a number from 0 to 255.

MAC Address Value / Range	Usage	Devices
0	Reserved by Default	Setra BACnet Router
3	Reserved by Default	Setra EDGE
4 - 127	Reserved	Master devices: All Setra Systems' devices are master devices and should be in this MAC Address range
128 - 254	Slave Range	Slave devices and network sensors
255	Broadcast	Do not apply address 255 to any device.

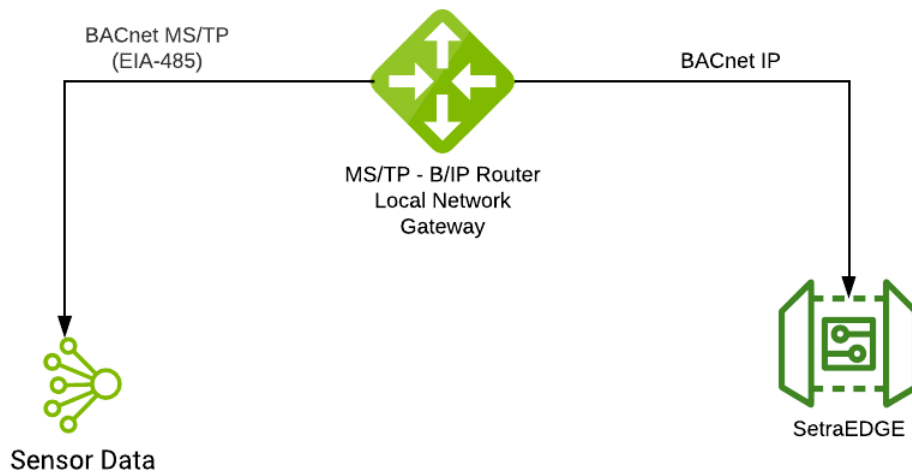
The BACnet MS/TP segment protocol is a peer-to-peer, multiple-master protocol that shares segment bandwidth by passing a token between Master devices on the segment.

The token is passed through a message from device to device on the BACnet MS/TP segment in consecutive order starting from the lowest MAC address (MAC Address = 0) to the next MAC Address. Gaps of unassigned device MAC Addresses should be avoided as this reduces bus performance.

The way MAC Addresses are assigned is not a physical requirement: Devices can be daisy-chained on the segment in any physical order regardless of their MAC Address sequence. The goal is to avoid gaps in the device MAC Address range.

Slave devices cannot accept the token, and therefore can never initiate communications. A Slave can only communicate on the segment to respond to a data request addressed to it from a Master device. Gaps in slave device MAC Addressing have no impact on BACnet MS/TP segment performance.

Combining BACnet Networks



BACnet Internetworking is required when you need to combine dissimilar physical LAN technologies. This networking is achieved using a device referred to as a BACnet router.

This is a special device that can simultaneously communicate across two dissimilar BACnet LANs. E.G. Both MS/TP and BACnet/IP.

The router listens to both segments and when it hears a message meant for another sub network, it will send that message to that the correct network.

Requires planning, because it requires the assignment of network numbers and unique MAC addresses and BACnet device instances across the entire internetwork

COV Lifetime and Poll Rate

Poll Rate is the polling interval for devices that don't support COV (Change of Value). It's how often the Edge will read the value from the device.

COV Lifetime pertains only to devices that support COV notifications. It's the amount of time the Edge will subscribe for notifications. Once that time runs out, the Edge will re-subscribe for that same lifetime. Upon every subscription, the device will provide a value regardless of the change.

The two settings are mutually exclusive and setting either one won't affect the other.

Poll rate

- Pulling from local data into the cloud
- Slowdown run charts

COV Lifetime

- Every change in 2 minutes (get a value every 2 minutes regardless of change)

Setra Hardware FAQs

Differential Pressure

Differential pressure sensors monitor the pressures in 2 spaces and let you know the differential between them.

The HIGH port always gets plumbed to the area you care most about, and the LOW/REFERENCE port is always plumbed to the space you want to compare to.

With our LITE, there is only one port that needs to be "plumbed" the other is integrated into the face of the unit (the little dots in the bottom left of the face).

How to resolve the incorrect sign

1. The tubing to the pressure unit is incorrect
2. The wiring backwards/misconfigured the scaling

How to resolve the negative sign:

1. Verify the tubing
 - The high-pressure port needs to go TO THE SPACE OF CONCERN and the low goes to the REFERENCE SPACE.
2. If the pressure sensor is reading a voltage value:

- Verify the inputs/outputs are configured correctly on the display and verify that the customer has wired the device properly
 - A difference in the values could be the fact the customer did not zero the sensors out and they are seeing a pressure offset with an accuracy difference.
3. Onboard FLEX or LITE: Open the doors between the space of concern and the reference. Then zero out the sensor. There can be a difference in values depending on the accuracies of all the pressure devices.

Resources for Software Activation and Future Troubleshooting

Software Program	Situations of When to Use
TeamViewer	Remote support and access to assist customers
YABE	Checking to see BACnet devices and overall SetraEDGE subnet
	Viewing and modifying object instances, MAC address, baud rate, device objects
	Changing temperature scales: Celsius or Fahrenheit
Wireshark	Ability to see connectivity of overall SetraEDGE subnet

These are all opensource or free versions available online.