P864 Controller
Installation Guide

P864 Installation

The P864 is a BACnet programmable controller that is used in control applications.

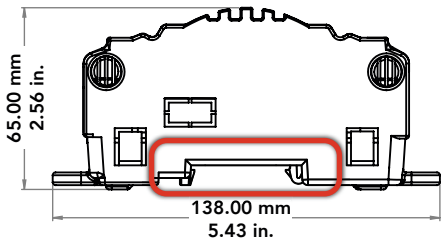
Common applications include: HVAC, Lighting and Energy Management.

Installation: Mounting

Mount the P864 in one of two ways:

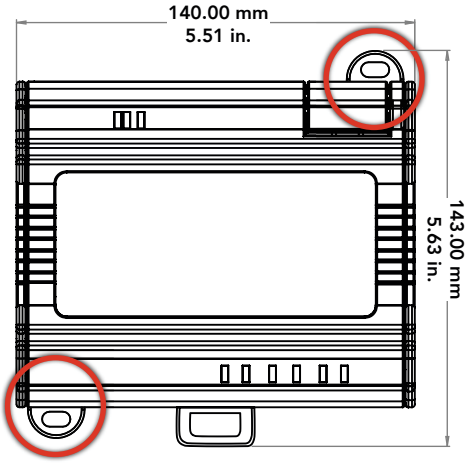
METHOD 1

Mount the controller to a DIN rail.



METHOD 2

Use the 2 screw holes to fasten with self tapping screws.



Wiring Diagrams & Product Label

Wiring

All terminals are labeled on the cover.
Refer to the wiring diagrams for details.

Power

P864 Power can be supplied by:

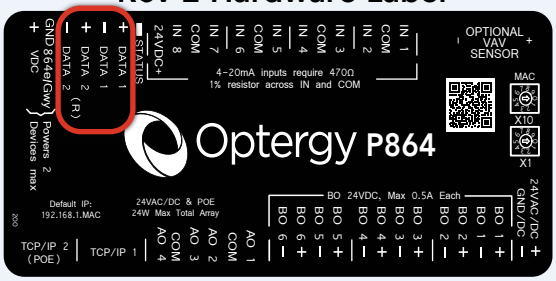
- 24 VAC ½ wave (grounded secondary) 24 W max.
- 24 VDC Power Supply 24 W max.
- PoE+ (Power over Ethernet)
  - o 802.3 at, Type 2, Mode A or B. *Refer to Note 2.*
  - o Not compatible with 802.3 af
  - o P864 PoE+ on TCP/IP 2
  - o PoE+ can be loaded up to 24 W max.

P864 has an onboard 24VDC power supply:

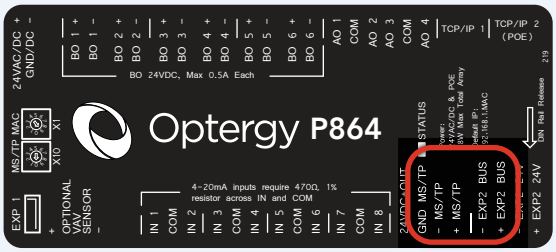
- Stay within power budget (24 W).

Note 1:
To identify your P864 hardware versions use the label images above
Rev 1 ports are labeled MS/TP & EXP2.
Rev 2 ports are labeled Data 1 & Data 2.

Rev 2 Hardware Label



Rev 1 Hardware Label



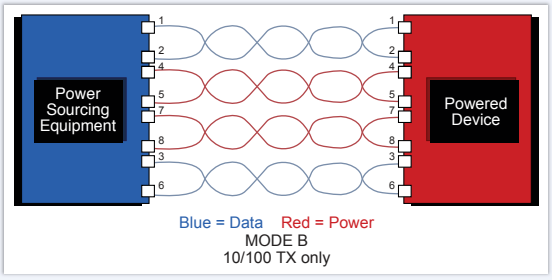
Important notes about PoE

Note 2: Choose PoE switches carefully, PoE has some differences to be aware of, there are multiple standards and different modes of operation.

The P864 supports **PoE+ (48VDC, 802.3 at, Type 2)**.

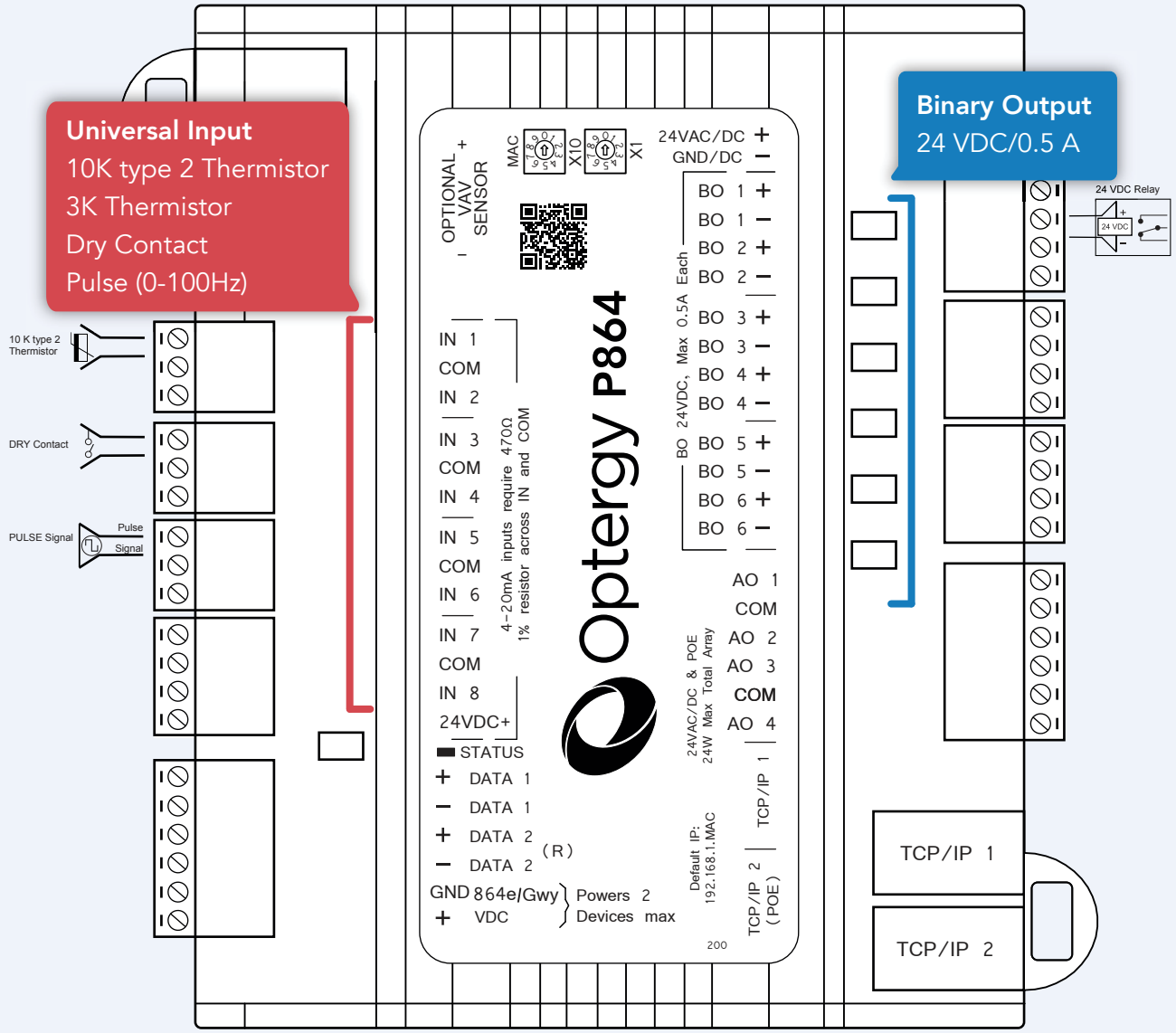
P864 Rev1	P864 Rev2
Mode A Pins 1,2+ Voltage,3,6-	

P864 Rev1	P864 Rev2
Mode B Pins 7,8+,4,5-	

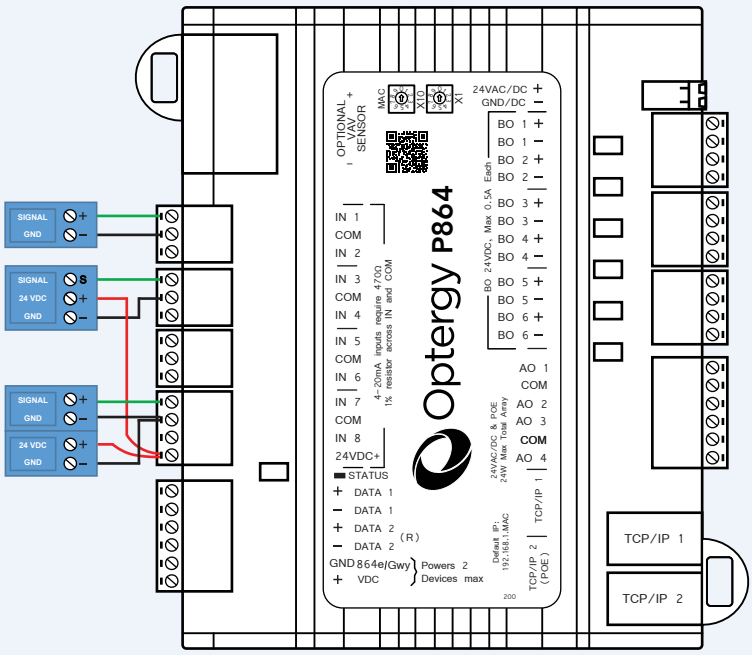


If you are unsure, ask the manufacturer for a data sheet that shows the PoE wiring to be sure its compatible.

Universal Input (Analog, Binary & Pulse Wiring Details)

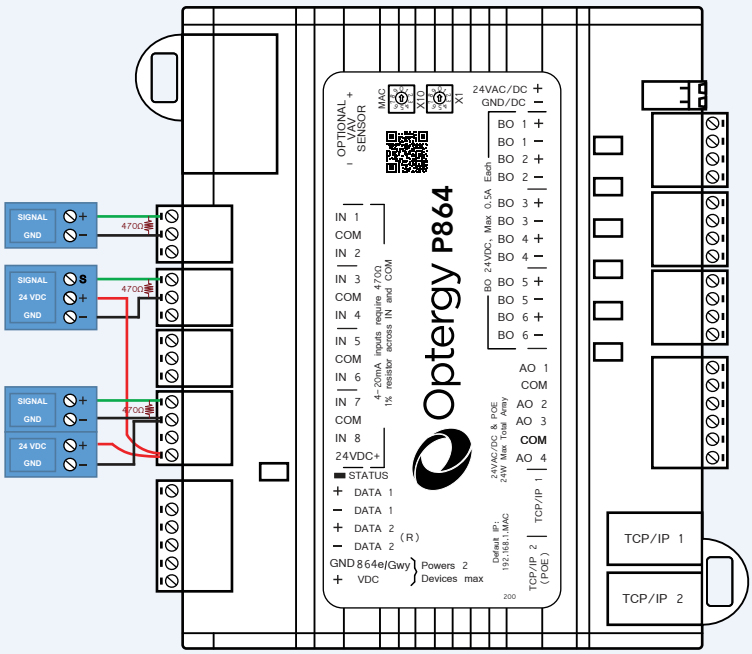


Universal Input Wiring Details



Universal Input (0-10 VDC)

2-Wire/3-Wire/4-Wire Devices



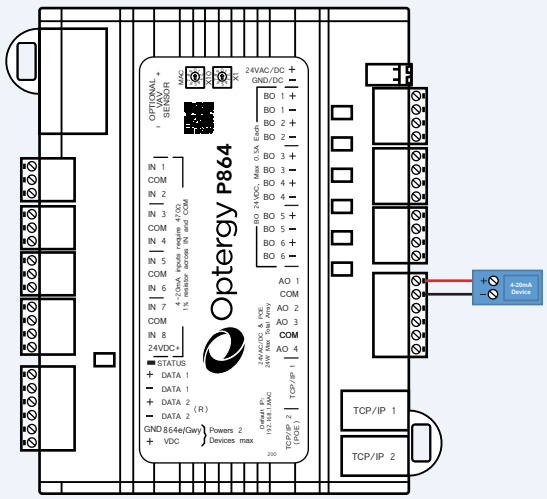
Universal Input (4-20mA)

Optergy uses 470 Ohm resistor

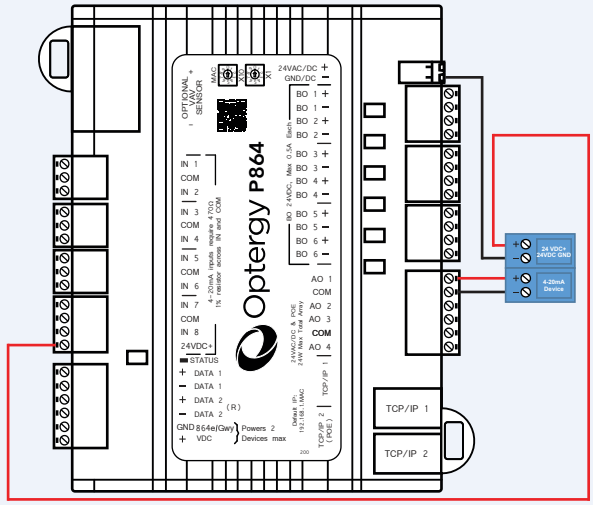
2-wire/3-Wire/4-Wire Devices

Analog Output Wiring Diagram

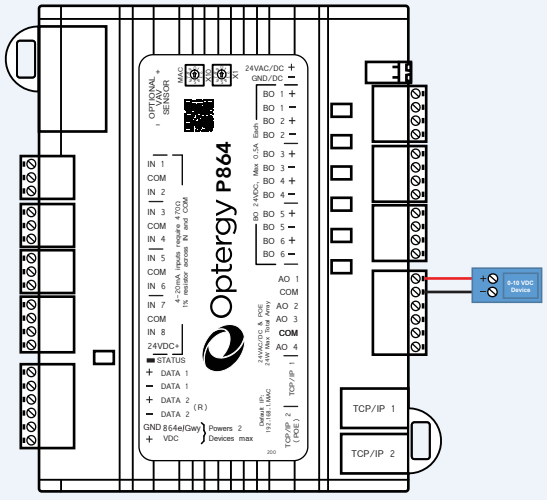
4-20mA Device (2-wire)



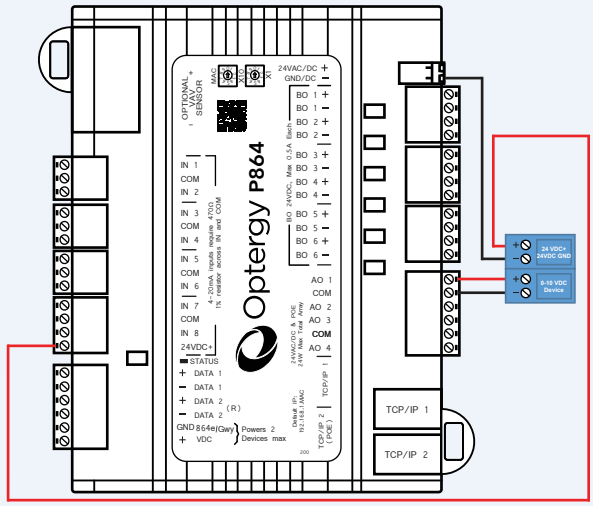
4-20mA Device (4-wire)



0-10 VDC Device (2-wire)



0-10 VDC Device (4-wire)



TCP/IP Communication

TCP/IP 2 is reserved for PoE+ , BACnet IP and the user interface.

TCP/IP 1 can be used for BACnet IP and the user interface.

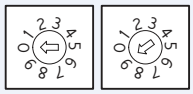
Or

It can be looped to another P864 on TCP/IP 1 or 2. (No limit to number of devices.)

Default IP address is 192.168.1.MAC

MAC can be set with rotary dials from 1-100 (TCP/IP address). Example MAC set to:

MS/TP MAC



X10 X1

0 9

Result **192.168.1.9**

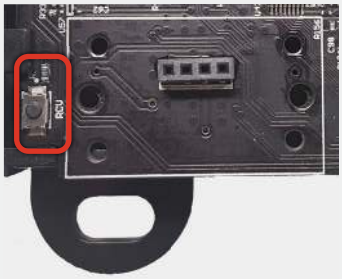
Default **Device instance** is 8640+MAC (864009)

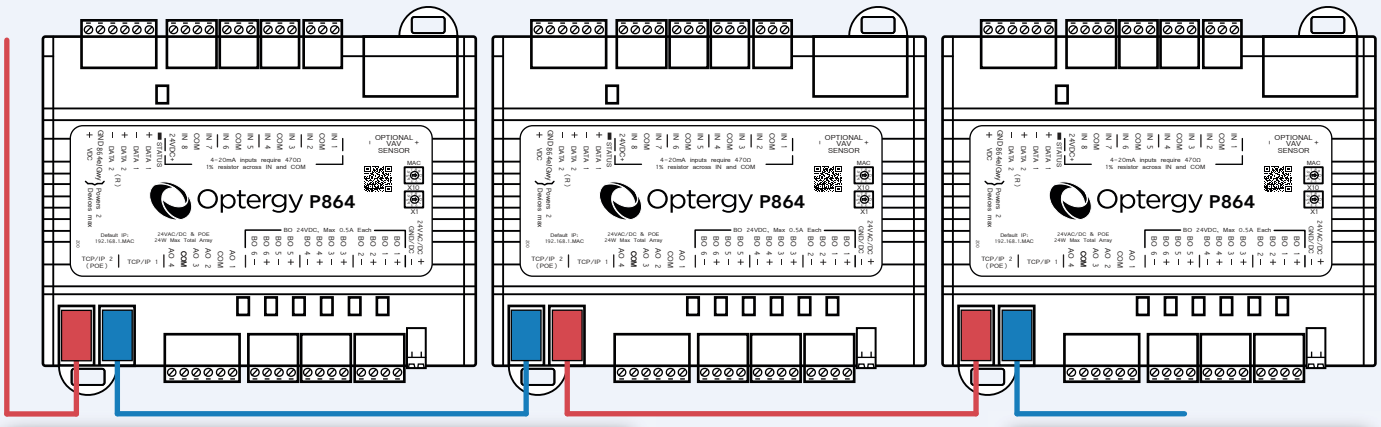
Reset P864 (IP Address and Login)

1. To reset the IP address and admin login.
2. Lift the cover and press and hold the reset button using option A or B.

Option A: Short press (approx. 5 seconds) until blue lights flash fast. This will reset the IP address to **192.168.1.MAC** and the user & password to **admin/admin**.

Option B: Long press (approx. 15 seconds) until all lights go red. This completely erases everything for full factory reset.





Connect LAN cable (CAT 5/6) into TCP/IP 1
PoE+ can only be used in TCP/IP port 2

IP cable can be looped in and looped out

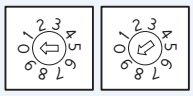
MS/TP Communication Wiring

The P864 is a 2 wire + shield MS/TP device. MS/TP controllers are always wired onto the Data 1 port (previously called MS/TP).

Shield must be carried through and single point to earth ground.

Use low capacitance cable in accordance with BACnet specification.

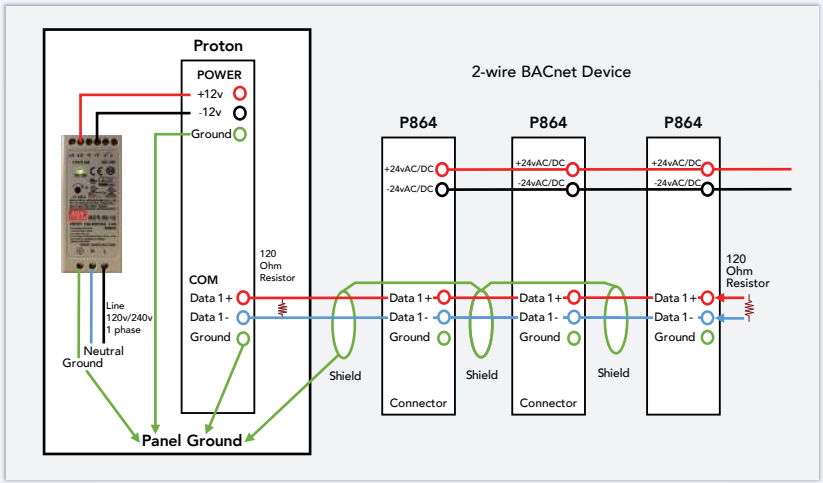
Default IP address is 192.168.1.MAC, The MAC can be set with rotary dials from 0-99 (TCP/IP address). Example MAC set to: MS/TP MAC

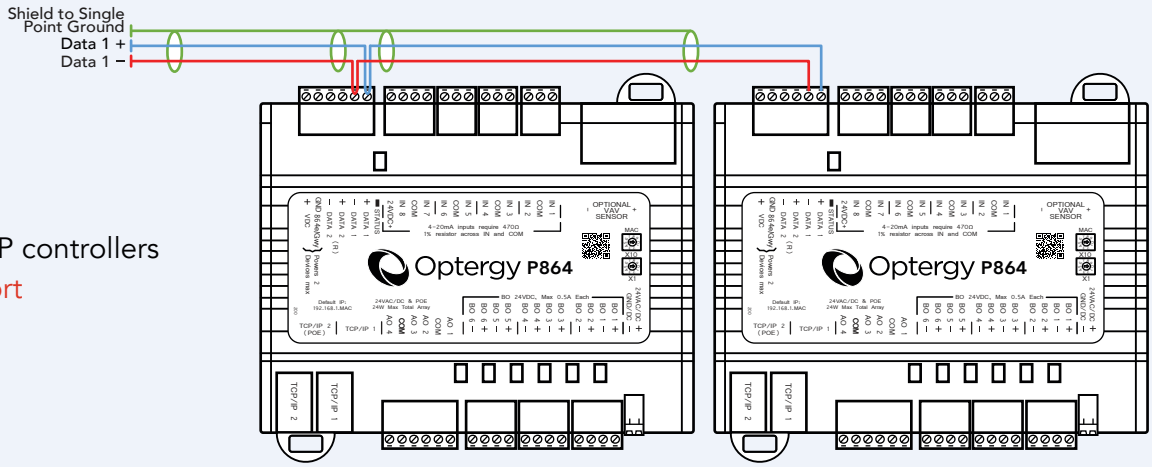


0 9

Result **MS/TP MAC ADDRESS =** 9

Default **device instance** is 8640+MAC (864009)





BACnet MS/TP controllers Use Data 1 Port

Expansion Bus (RS-485)

The P864 has an expansion network (RS-485) that can be configured for BACnet MS/TP routing. This network can be used to add sensors onto a network that is independent of the BACnet MS/TP network that is intended to use as a sensor network. The network is also intended to be a separate routed network for controllers or subnetwork. This port is labeled Data 2 (R), previous versions of this was labeled as EXP2.

This network can be configured for BACnet and Modbus:

Data 2 - (BACnet MS/TP - or Data B)

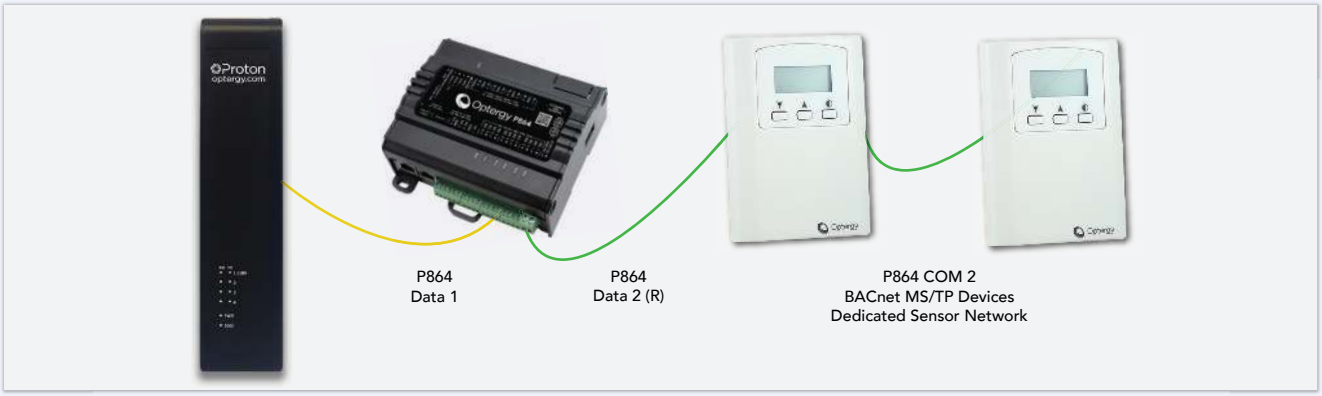
Data 2 + (BACnet MS/TP + or Data A)

GND (DC-/Ground for sensors/devices)

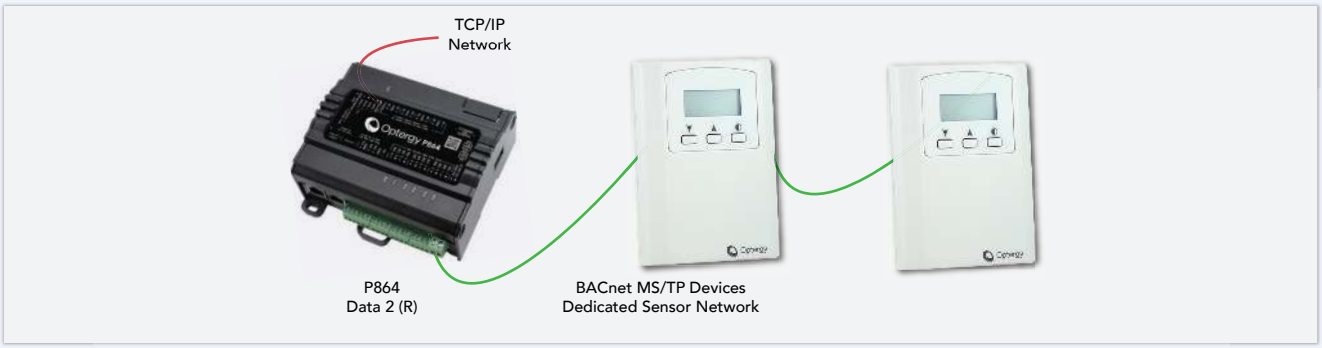
+ VDC (+24 VDC, power for sensors/devices)

Notes: Biasing is used to control network communication, many devices use a local bias resistance or have selectable in or out of circuit. Routers or router/controllers use a network bias. The Optergy 2nd RS-485 expansion network has the network bias, it should be used when routing or connecting to sensor network. Data 1 should be used only when the device is operating as a MS/TP only controller. Connecting devices to the wrong port may result in faulty communication. See the following examples.

Example 1 - P864 configured as an MS/TP only controller with connected MS/TP sensors

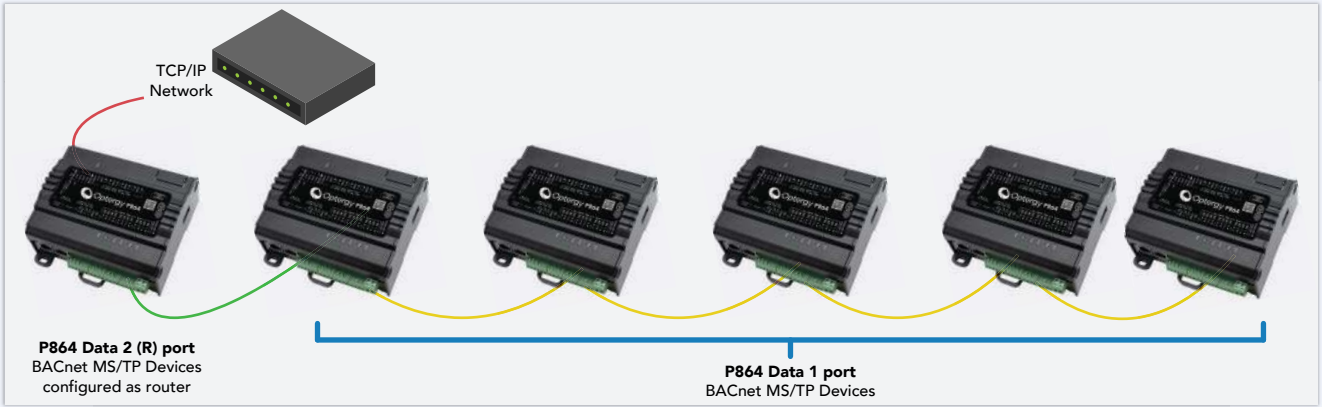


Example 2 - P864 configured as a router/controller with connected MS/TP sensors

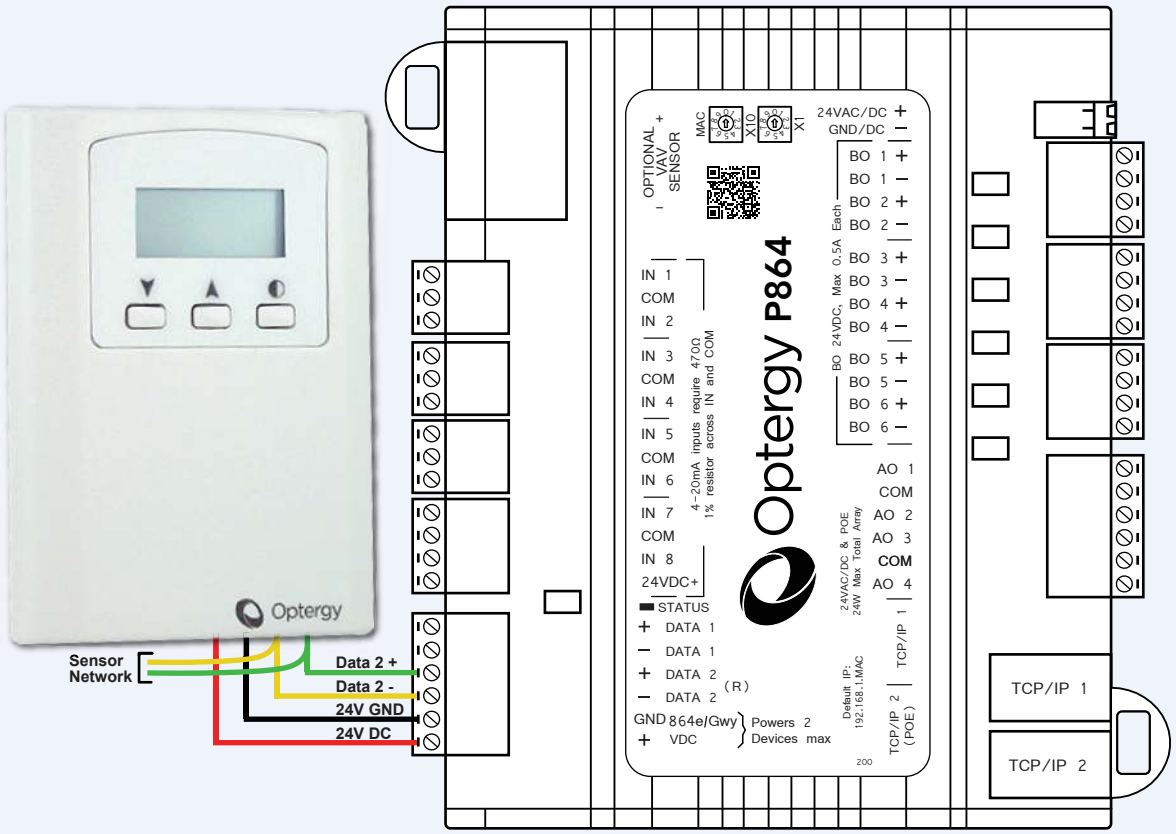


Expansion Bus (RS-485)

Example 3 - P864 configured as a router/controller with connected P864



Sensor Network Wiring Diagram



Proton Software Configuration

Proton software Version 3.0.0 features (to support P864).

- **a.** Installing new software
  - **1.** System backup
  - **2.** Update Proton to new software to support P864 (.upd file)
- **b.** New Proton features
  - **1.** BACnet re-instancing (BACnet IP & MS/TP)
  - **2.** Software update (BACnet IP & MSTP)
  - **3.** Backup DDC file (from 864)
  - **4.** Restore DDC file (to 864)
  - **5.** Setting the time (BACnet time sync)
  - **6.** Creating a new DDC project for 864
  - **7.** Creating the point setup in DDC
  - **8.** New DDC function blocks
  - **9.** Sending DDC to one or more controllers
  - **10.** New P864 diagnostic templates

Re-Instancing (BACnet IP)

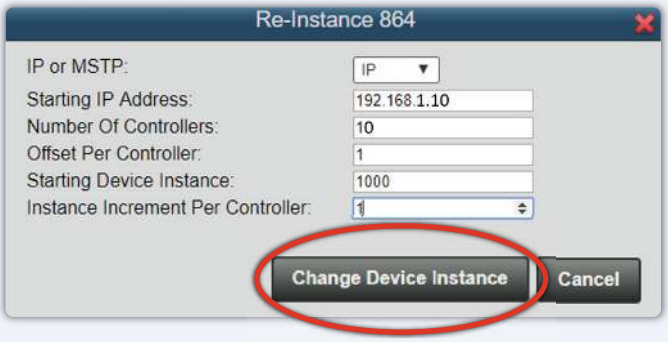
BACnet Devices Instances can be re-instanced in the BACnet Devices>BACnet Device Scan. There are 2 configuration options (BACnet IP and BACnet MS/TP).

1. Scan for devices.
2. Select the device(s) to be re-instanced.
3. Press the re-instance button.
4. Complete the IP or MS/TP dialog box options.
5. Press Change Device Instance button.

Note: The user can re-instance multiple instances at once.

Example:

- 10x P864 configured as BACnet IP (192.168.1.10 to 192.168.1.19)
- Device Scans as Device instance

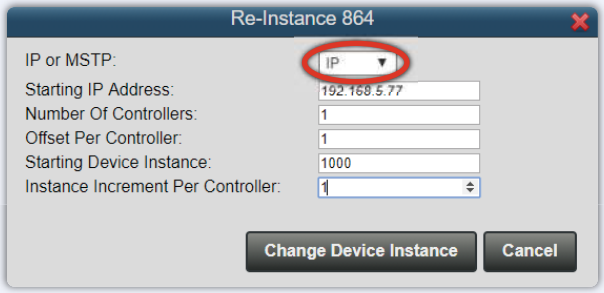


Result: Device Instance 1000-1001-1002-1003-1004-1005-1006-1007-1008-1009

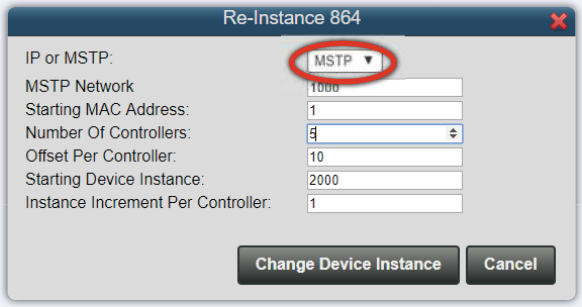
Proton Software Configuration

Re-Instancing (BACnet IP) & BACnet MS/TP

BACnet IP



BACnet MS/TP



BACnet IP example shown below:

Proton Software Configuration

Updating Firmware

Firmware can be updated as new software becomes available. This is done using the Update 864 Firmware button.

The two options are:

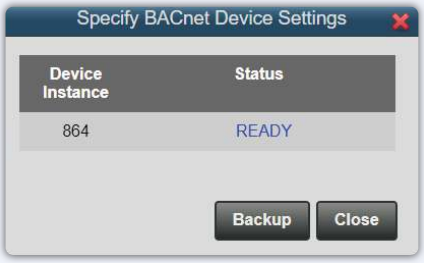
1. Use existing firmware (located in Proton or OE).
2. Upload, which permits the user to update from a recently downloaded file.
    a. The filename must be precise.

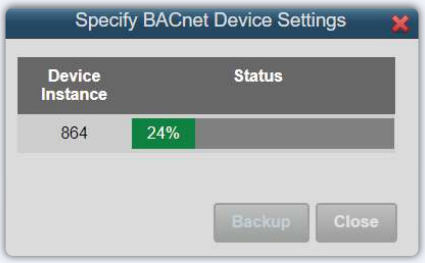
Proton Software Configuration

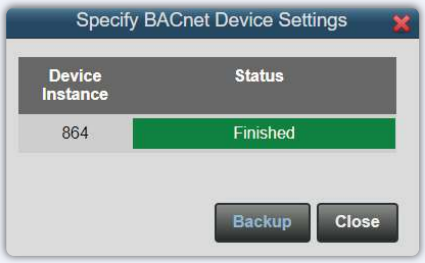
Backup 864

Once a controller is setup with data points, and BACnet objects (e.g. schedules/trends/alarms/ calendars) and a DDC program, the user can back up the entire controller and restore it to one or more controllers.

This is especially useful to create for example a cooling only VAV box (that will be repeated many times). This reduces the amount of work needed to deploy a site with many devices.





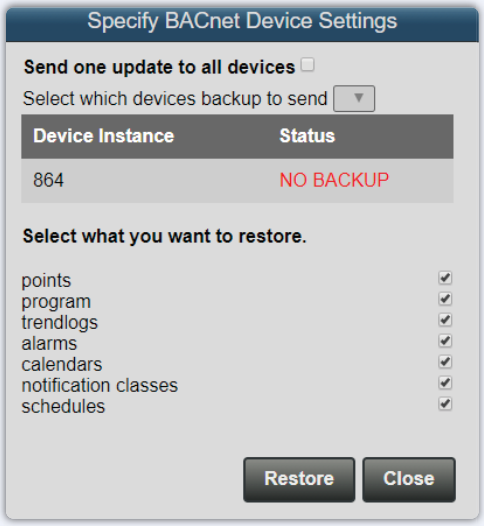


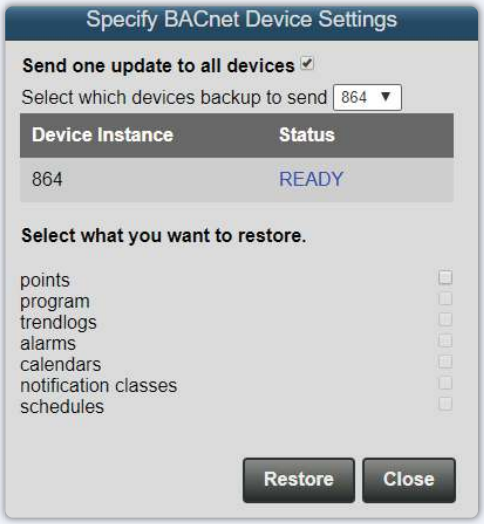
Restore 864

Restoring a backup has multiple options that may or may not be needed for an application.

To restore a backup:

1. Choose to send back up to one or more devices.
2. Select which device to restore to.
3. Select specific items to restore.
4. Press Restore.





Restore Options:

Restore all available to one controller.

- Points
- Program
- Trendlogs
- Alarms
- Calendars
- Notification classes
- Schedules

Restore to many controllers.

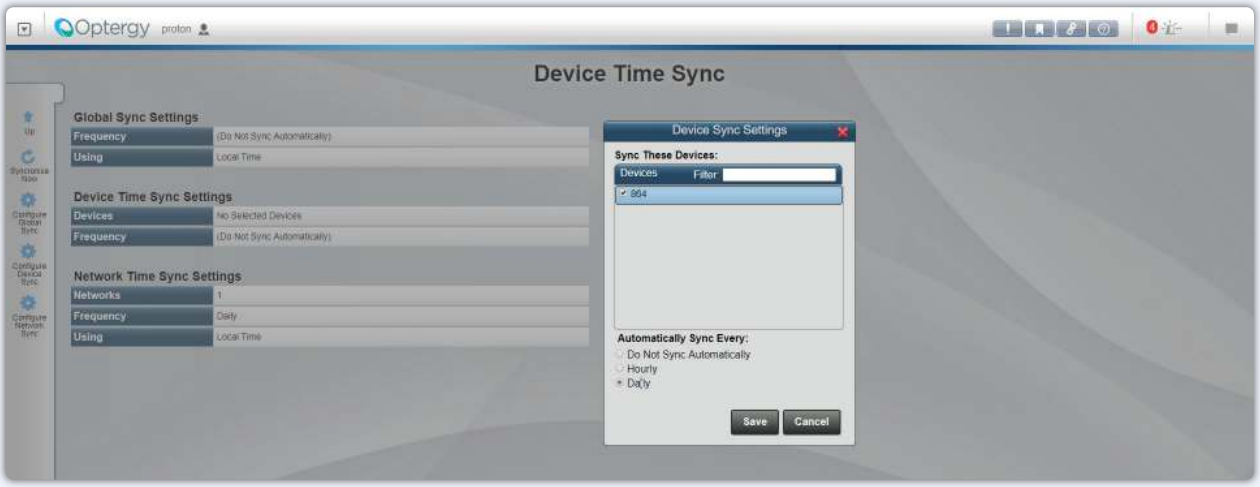
- Points

Proton Software Configuration

Sending Device Time Sync

Correct time is an essential part of unitary control application. The P864 has a real time clock with battery backup.

Use the on board BACnet Time Sync (Proton and OE).

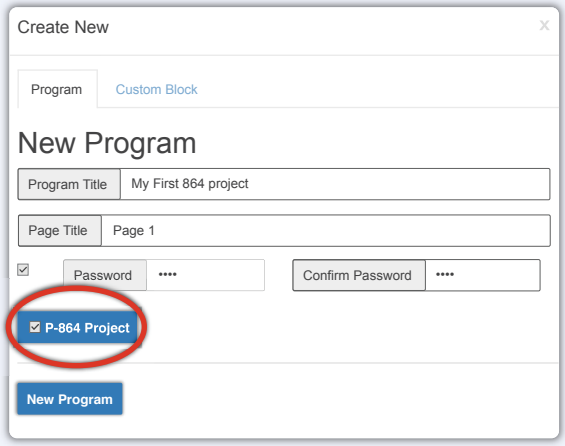


Proton Software Configuration

P864 DDC Program

P864 DDC programs are created using Proton Programming tool (supported after Proton v 3.0.0 and OE 3.0.0).

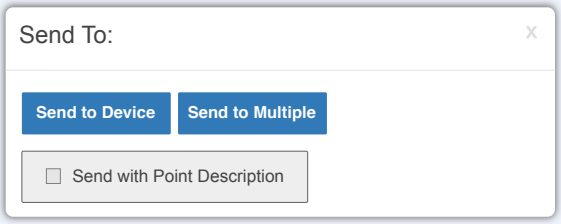
To create a file navigate to
Optergy Server > Building Management > Programming Tool > New Program



Select P864 Project

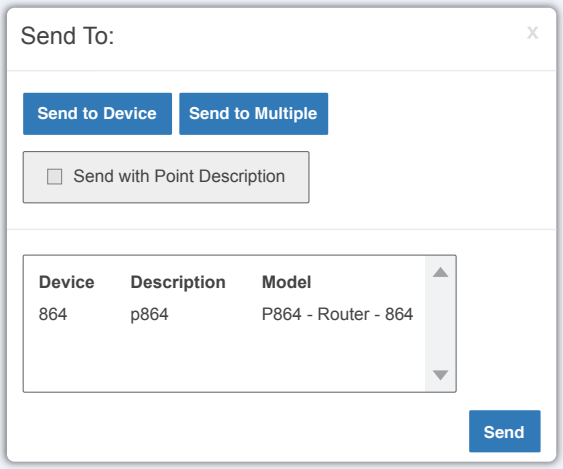
Send to controller

Program can be sent with or without Point Descriptions (BACnet Object Description Property).



Send to many

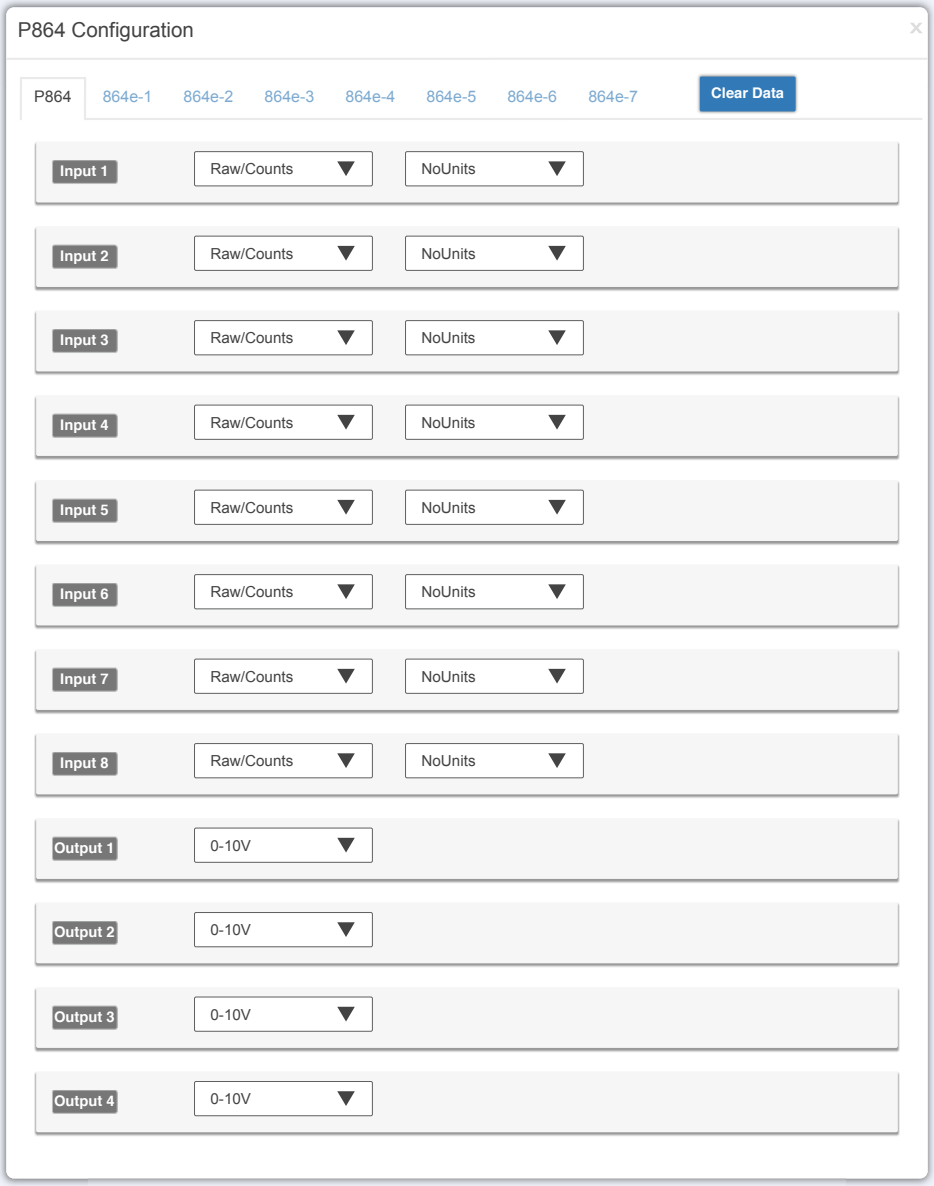
Program can be sent to one or multiple devices, simply pick while holding the control key.



Proton Software Configuration

864 Point Configuration

To setup Universal Inputs and Analog Outputs, navigate to the Proton Programming tool.
Choose from the drop down lists and select the desired function.
Binary Outputs have no configuration and output **+24VDC (MOSFET 0.5A).**



Proton Software Configuration

P864 Descriptors

Descriptors can be written to the BACnet Point "Description" property of an AV/BV/AI/BI/BO/AO/MSO/MSI/MSV.

Descriptors can also be written in the DDC program using Input and Output tags NAME property (circled in red).

New Function Blocks

1. Anti Short Cycle

Description: Filters out signals that change states too quickly.

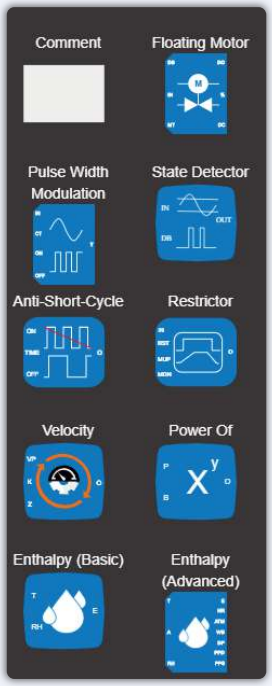
There are 3 inputs: the input signal, minimum ON, and minimum OFF.

The input signal: This is the signal that is checked, to ensure that it does not change states too quickly.

The minimum ON: This value represents the minimum amount of time that the signal should be ON for.

The minimum OFF: This value represents the minimum amount of time that the signal should be OFF for.

There is 1 output. This output is the signal, after the input signal was held to the minimum ON and OFF times.



Proton Software Configuration

New Function Blocks

2. Change of State Detector

Description: Filters out signals that change states too quickly.Description: Detects a change of state.

This block detects if the input value changes from the internal value by more than the dead band. If so, then the output will pulse momentarily.

There are 2 inputs: the input value, and the dead band.

The **input value** represents the represents the value desired to be checked. This value will be stored as an internal value when the output pulses ON.

The **dead band** represents the value that the internal variable has to change by in order to generate the output pulse.

There is 1 output which is the binary output.
The output represents the status of the internal variable in relation to the input value. If the input value is more than the dead band value away from the internal variable, the output will output a short pulse. The value of the internal variable will then be replaced by the value of the input value.

3. Enthalpy

Description: Calculates the enthalpy of the system, depending on various inputs, as well as the mode of the block.

There are 2 modes: Basic mode and Advance mode.

Basic Mode

The basic mode will calculate the enthalpy using 2 inputs.
There are 2 inputs: the temperature and the relative humidity.

The temperature: The temperature of the area. The units can be chosen to be in Celsius or Fahrenheit.

The relative humidity: This represents the relative humidity, as a percentage.

There is 1 output, which is the calculated enthalpy.
Advanced Mode

There are 3 inputs: the temperature, the altitude, and the relative humidity.

The temperature: The temperature of the area. The units can be chosen to be in Celsius or Fahrenheit.

Proton Software Configuration

New Function Blocks

The altitude: This represents the altitude, in meters.

The relative humidity: This represents the relative humidity, as a percentage.

There are 7 outputs, the enthalpy, the humidity ratio, the atmospheric pressure, the wet bulb temperature, the dew point, the partial pressure at dew point, and the partial pressure at saturation.

The enthalpy: This is the calculated enthalpy.

The atmospheric pressure: This is the calculated atmospheric pressure.

The wet bulb temperature: This is the calculated wet bulb temperature.

The dew point: This is the calculated dew point.

The partial pressure at dew point: This is the partial pressure at dew point.

The partial pressure at saturation: This is the partial pressure at saturation.

The main differences between the basic block and the advanced block are the different numbers of inputs and outputs, and the basic block is assumed to be at altitude of 0.

4) Floating Motor Controller

Description: Calculates an output percentage, an open state and a close state based on a dead band, a desired position and a fully open time.

There are 3 inputs: the dead band, the desired position, and the time to fully open.

The dead band: This is the dead band within which the open position shall be considered to be finished. It is taken as a percentage.

The desired input: This is the desired position, as a percentage.

The drive time: This is the time taken to drive the desired position from 0% to 100%. This is read in seconds(s).

There are 3 outputs: the current open position, the opening status, and the closing status.

The current open position: This is the position that is currently being outputted. It is written as a percentage.

The opening status: This is the opening status, it is true if the output is increasing, and false otherwise.

Proton Software Configuration

New Function Blocks

The closing status: This is the closing status, it is true if the output is decreasing, and false otherwise.

Note: When the floating motor controller desired input is 0% or 100%, it will over-drive the point by 10%.

5) Pulse Width Modulation

Description: Converts an analog signal as a percentage into a digital signal, based on the cycle time.

There are 4 inputs: the input signal, the cycle time, the minimum ON time and the minimum OFF time.

The input signal: This value (between 0-100) represents the percentage of the cycle time that the signal is ON.

The cycle time: This represents the period of the digital output, in milliseconds.

The minimum ON time: This represents the minimum time that the signal must be ON. If this value is larger than the calculated ON time, it will override the calculated value.

The minimum OFF time: This represents the minimum time that the signal must be OFF. If this value is larger than the calculated OFF time, it will override the calculated value.

There is 1 output, which is the converted digital output. This binary output pulses ON for a calculated amount of time, and OFF for a calculated amount of time.

6) Velocity Pressure to FPM Converter

Description: Performs an operation to convert an input that represents velocity pressure into an output that represents velocity.

There are 3 inputs: the input signal, the k factor, and the zero.

The input signal: This is the signal to be converted.

The k factor: This is the represents the multiplier.

The zero: This represents an error correction value.

There is 1 output, which is the velocity. This is the calculated output of all the inputs.

Proton Software Configuration

New Function Blocks

7) Restrictor

Description: Restrict the rate of change of an analog value.

There are 4 inputs: the input, the reset, the maximum up and the maximum down.

The input: This is the signal to be slowed down.

The reset: This signal controls whether the output is reset.

The maximum up: This is the maximum amount per second that the output signal will increase by until it reaches the input value.

The maximum down: This is the maximum amount per second that the output signal will decrease by until it reaches the input value.

The output will be immediately set to zero when the reset input is FALSE (0).

There is 1 output, the output signal. This represents the output of the block, as it increases or decreases towards the input value.

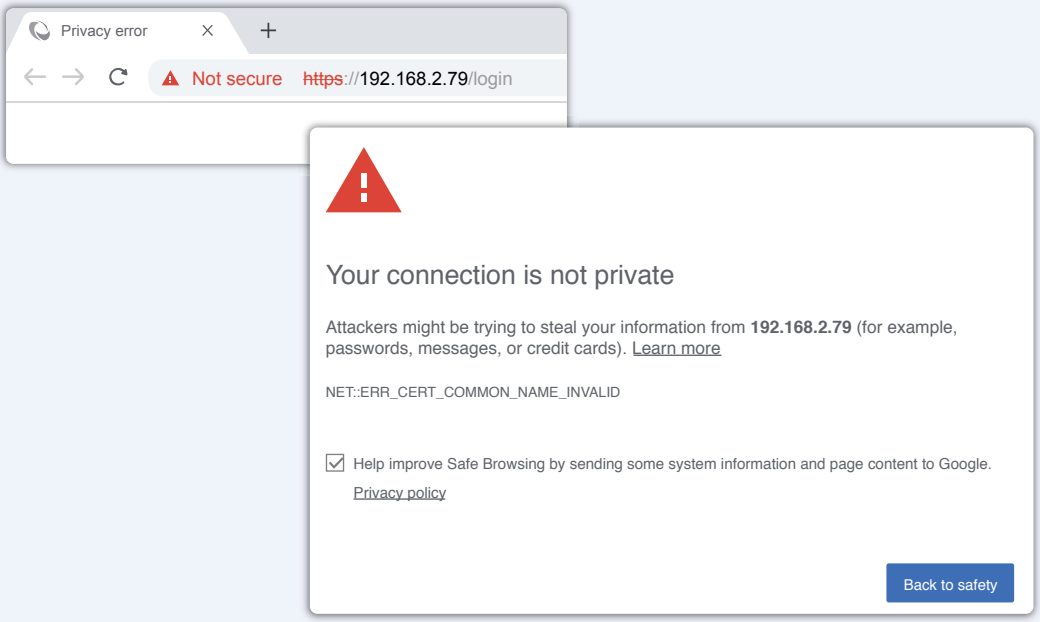
864 Web User Interface

Access and Login

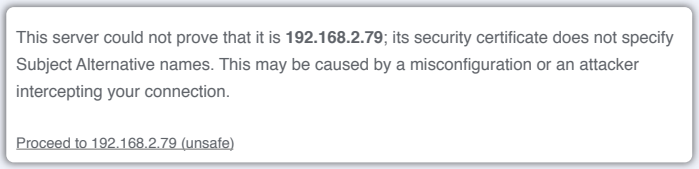
The P864 uses https or SSL encryption to assure secure communication to the web server. Optergy has issued a self signed certificate which is one that is published by Optergy. Most browsers will flag this as a security concern asking the user if this is a known and trusted publisher. The user should answer yes. While Optergy is not a known trusted publisher of certificates, like Truste, Verisign, Comodo etc. it is highly preferable to use encryption rather than not using any security. For this reason any requests made to http://<ipaddress> will be redirected to https://<ipaddress>.

To access the user interface for configuration purposes, follow these steps:

1. Plug local PC into TCP/IP port 1 or 2 on the P864.
2. Set local PC to the same IP range as the P864.
3. Open web browser on local PC and navigate to the P864 using https://IP address (192.168.1.MAC) for example https://192.168.1.79
4. You will be confronted with a message that looks like the following-



> Press the Advanced button

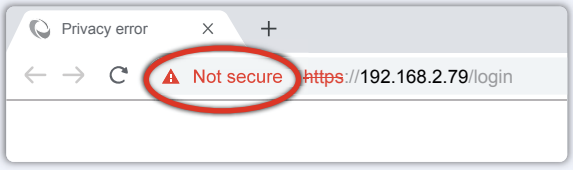


> Click proceed to <ip address>(unsafe)

864 Web User Interface

Access and Login

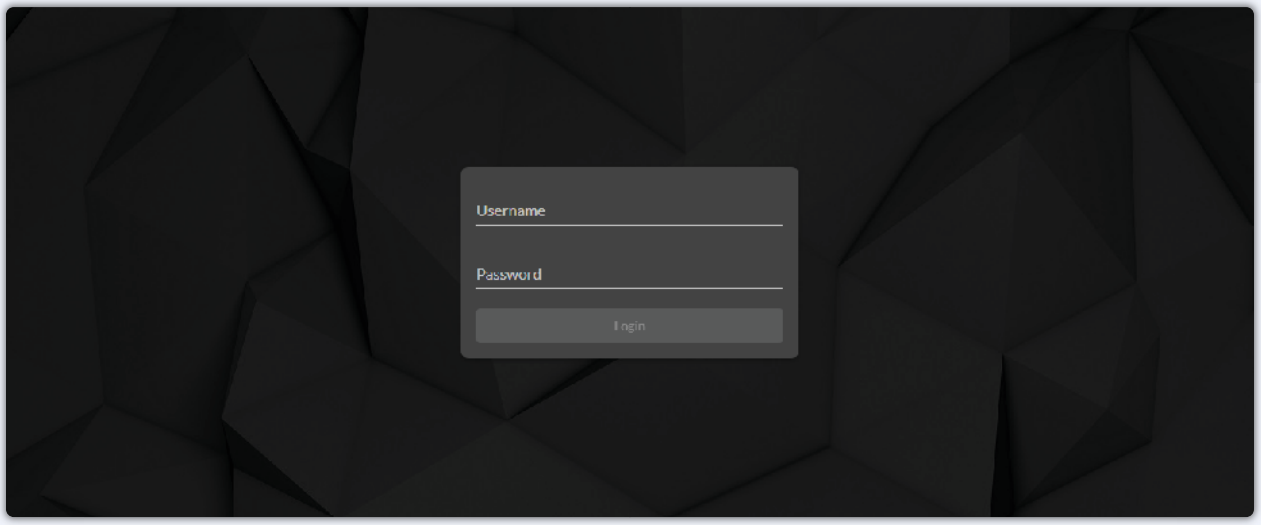
You can optionally choose to add the certificate to your browser, here is an example how to do this with Chrome.



1. Right click the "Not Secure" near browser address.
2. Right click the Certificate.
3. Click on details (tab).
4. Press Copy to file...
5. Choose Cryptographic Message Syntax Standard-PKCS #7 Certificates (.P7B). Select tickbox called “Include all certificates in the certificate path if possible”.
6. Browse to choose location, name your certificate something like P864 and click next.
7. Press finish, this export was successful is the message.

After this process you can install this certificate into your trusted root authorities, so the next time you visit the site it has the secure padlock.

5. When prompted by the login screen, login with username - "admin", password - "admin".
   a. The user will be prompted to change the password to a secure password after 5 times.
   b. Strong Passwords are > 8 characters, Capital Letter, Number and a Symbol (e.g. !@#$%^&).



Note: If the user forgets the login credentials, the push button can be used to reset the user back to admin/admin and 192.168.1.MAC see TCP/IP section for procedure.

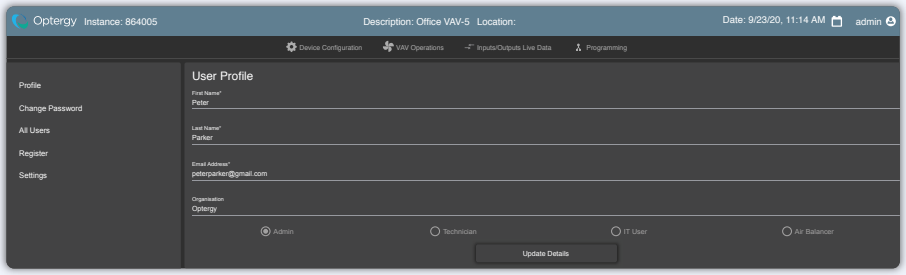
864 Web User Interface

Access and Login

Setting user profile

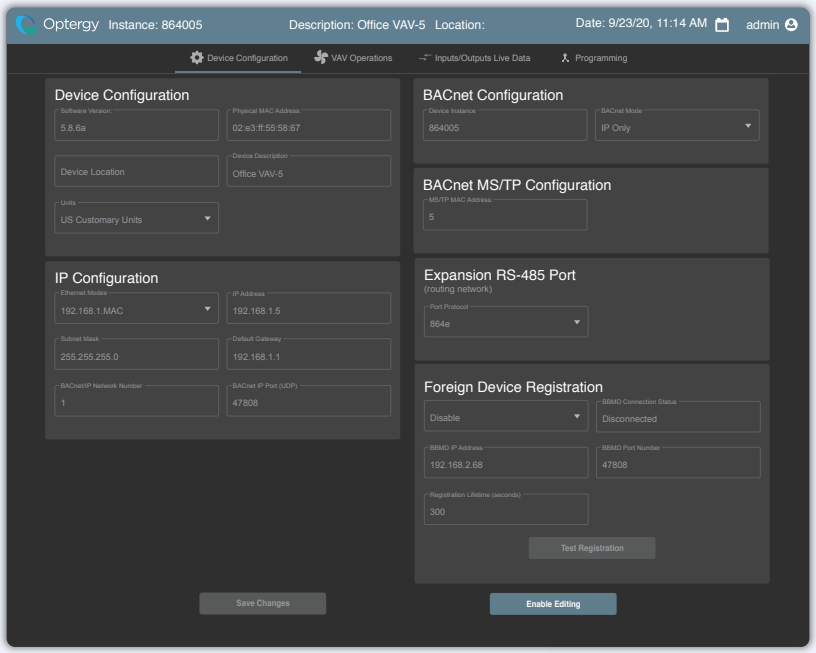
There are 4 types of user profiles:

- **a.** Admin – Unrestricted access to all functions
- **b.** Technician
- **c.** IT user
- **d.** Air Balancer



Setting device configuration

1. Device Configuration
    - **a.** Software Version
    - **b.** Device location
    - **c.** Device Description
    - **d.** Units – User Selectable Metric or US Customary
    - **e.** Expansion RS-485 Port
2. IP Configuration
    - **a.** Ethernet modes
    - **b.** IP address
    - **c.** Subnet Mask
    - **d.** Default Gateway
    - **e.** BACnet IP Network Number
    - **f.** BACnet IP Port
3. BACnet Configuration
    - **a.** Device Instance
    - **b.** BACnet Mode
4. BACnet MSTP Configuration
    - **a.** MSTP MAC Address
    - **b.** MSTP Network Number
    - **c.** MSTP Baud Rate
5. 2nd RS-485 Port
6. Port Protocol – BACnet or Modbus



864 Web User Interface

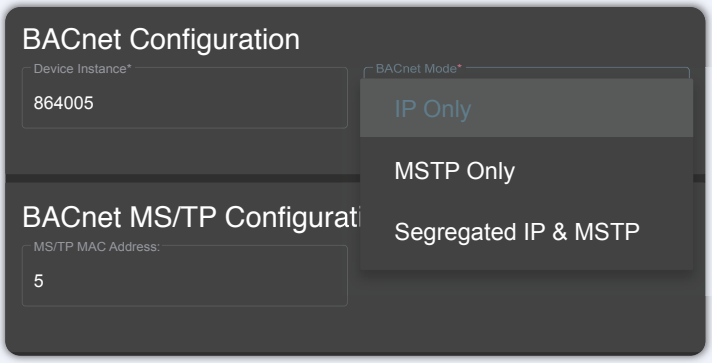
Access and Login

IP Configuration

Ethernet Modes choices include:

- **DHCP** (used only for issuing the IP address for the WEB UI).
- **Manual** (IP addressed is selected by user entry).
- **1.MAC** (IP address is determined by the switch positions and result in an IP address 192.168.1.XX mask: 255.255.255.0
- **IP Address** (IPV4 addresses can be entered here example: 192.168.1.10
- **Subnet Mask:** (IPV4 Subnet mask can be entered here example: 255.255.255.0
- **Default Gateway:** (IPV4 addresses can be entered here example: 192.168.1.1
- **BACnet IP Network Number:** any valid network number can be used, it must be set to the same as all other BACnet IP routers.
- **BACnet IP port:** default is 47808

BACnet Configuration



Device Instance: Device Instance is preset initially by concatenating the "8640 + Device MAC" this value can be entered manually from this field.

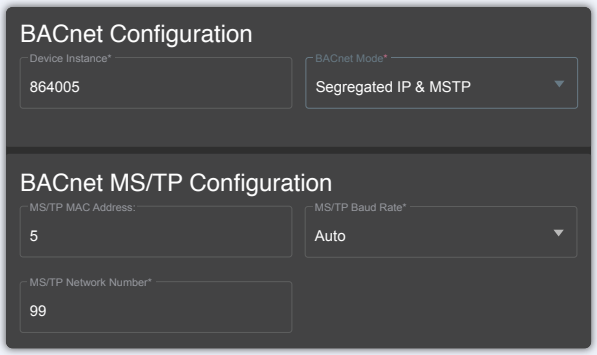
BACnet Mode choices include:

- **IP only** (BACnet IP is used to communicate to BACnet internetwork).
- **MS/TP only** (BACnet IP is disabled).
- **Segregated IP and MS/TP** (both BACnet IP and MS/TP is enabled) this is default configuration to make setup easier.

864 Web User Interface

Access and Login

BACnet MS/TP Configuration

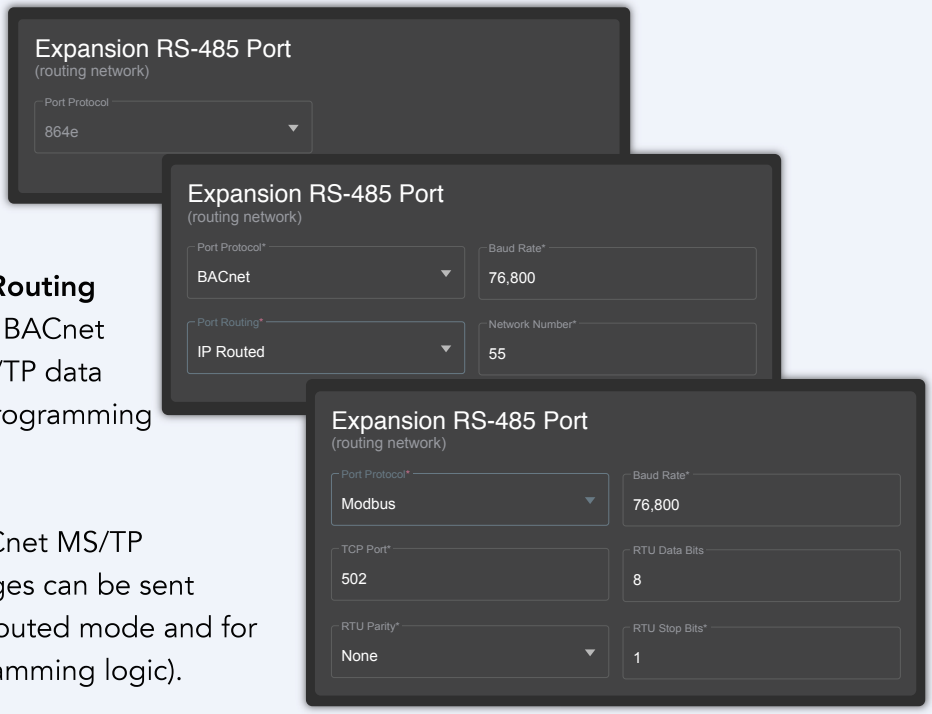


MS/TP MAC Address: The initial MAC address is set using the rotary switches, this value can be overwritten in this field, and valid MAC addresses are 0-127.

MS/TP Network Number: Enter a unique MS/TP network number, duplicate MS/TP network number can cause network conflict.

MS/TP Baud rate: The default configuration is Auto baud, fixed baud rates include 9.6, 19.2, 38.4, 57.6, 76.8. and 115.2 Kbps. Auto baud is only available in MS/TP only mode, as it is assumed the router will establish the baud rate for the connected devices.

Expansion RS-485 Port



Port Protocol choices include **BACnet** and **Modbus.**

Port Routing: choices include **Routing** (MS/TP data will route to entire BACnet network) and **Not Routing** (MS/TP data will be used by the controller Programming logic but does not get routed.

Network Number: Enter a BACnet MS/TP network number so that messages can be sent to the correct address both in routed mode and for use in non routed mode (Programming logic).

Baud Rate choices include 9.6, 19.2, 38.4, 57.6, 76.8, 115.2 Kbps.

Modbus IP Port: 502 default.

Optergy

864 Web User Interface

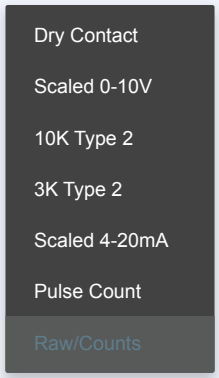
Access and Login

Setup Input/Output

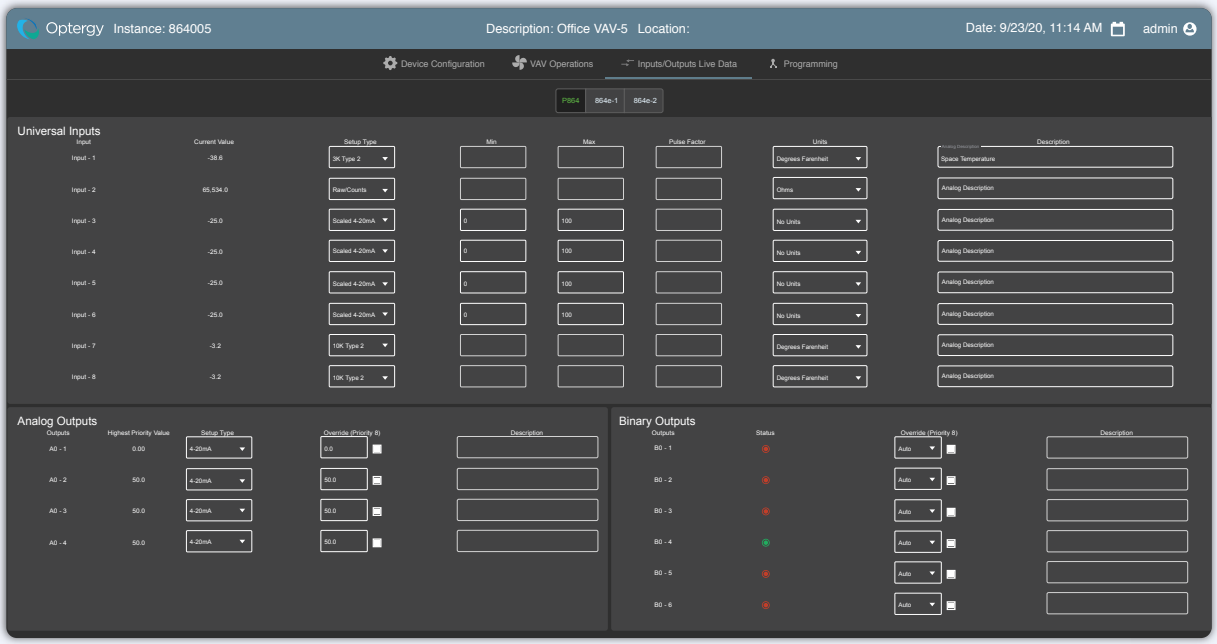
1. Universal Inputs Configuration
- **a.** Analog inputs
  - **i.** 0-10 VDC
  - **ii.** 4-20 mA
  - **iii.** 10k thermistor
  - **iv.** 3k thermistor
  - **v.** Raw counts
- **b.** Binary inputs
  - **i.** dry contact
  - **ii.** 0-100 Hz pulse

2. Binary Outputs Configuration
- **i.** 24 VDC (MOSFET)

3. Analog Outputs Configuration
- **i.** 0-10 VDC
- **ii.** 4-20 mA



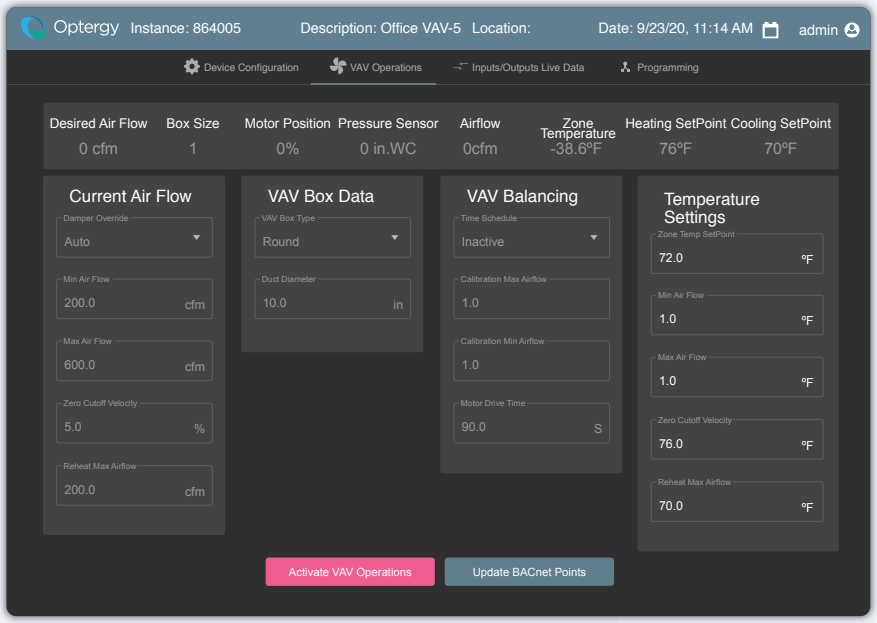
Notes:
- *Only voltage and current analog inputs can be scaled Inputs can be scaled from 0 to 100% to achieve output 0-10 VDC or 4-20 mA.*
- *Pulse factor is only for use with pulse inputs.*
- *Outputs can be driven into override manually at Priority, the user must choose the value then hit enter and refresh the page (F5).*
- *Descriptors can be entered by the fields, to commit the values click away from the field. Descriptors can also be written from DDC Programming.*



864 Web User Interface

Access and Login

Setting up VAV operations



1. Current Airflow
- **a.** Damper Override
- **b.** Min Air Flow
- **c.** Zero Cutoff Velocity
- **d.** Reheat Max Airflow

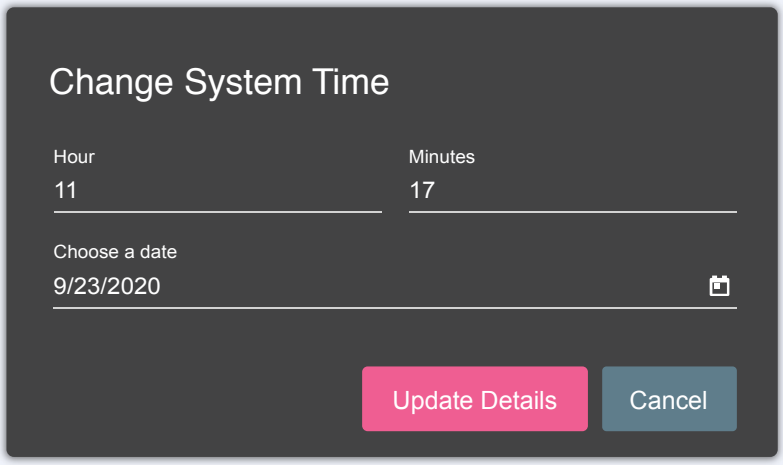
2. VAV Box Data
- **a.** VAV Box Type
- **b.** Duct Diameter

3. VAV Balancing
- **a.** Time Schedule
- **b.** Calibration Max Airflow
- **c.** Calibration Min Airflow
- **d.** Motor Drive Time

4. Temperature Settings
- **a.** Zone Temp Setpoint
- **b.** Heating Offset
- **c.** Cooling Offset
- **d.** Setpoint High limit
- **e.** Setpoint Low limit

System time settings

System time can be setup here for stand-alone applications. The time can also be set using BACnet software (Proton, OE or any BACnet Client) using BACnet Device Time Sync.



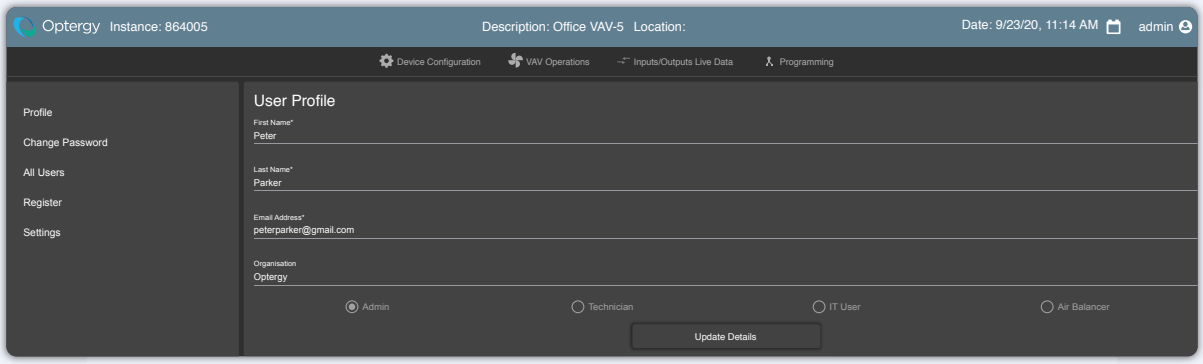
864 Web User Interface

Access and Login

User Profile

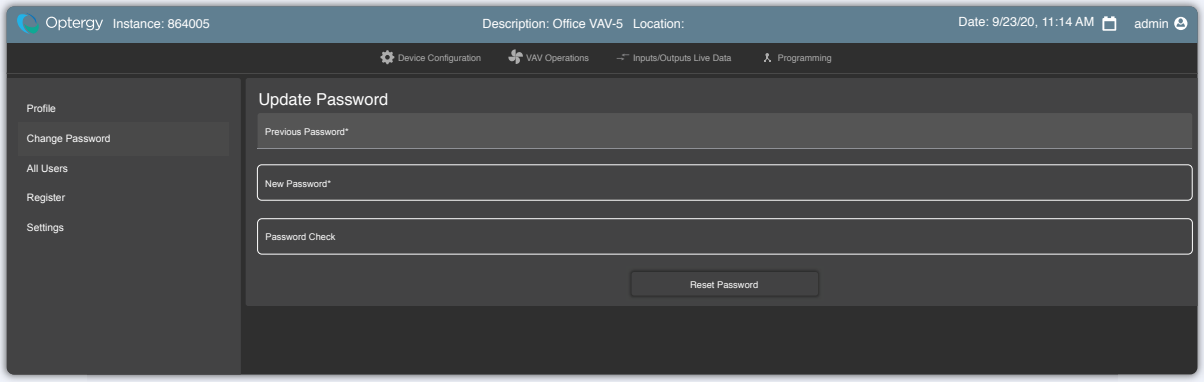
Allows the User to be created (admin= full rights, Technician= setup config but not user admin, IT User=network config, Air Balancer= VAV page).

Press the Admin icon to reveal menu



Change Password

Allows a User to change or reset password.

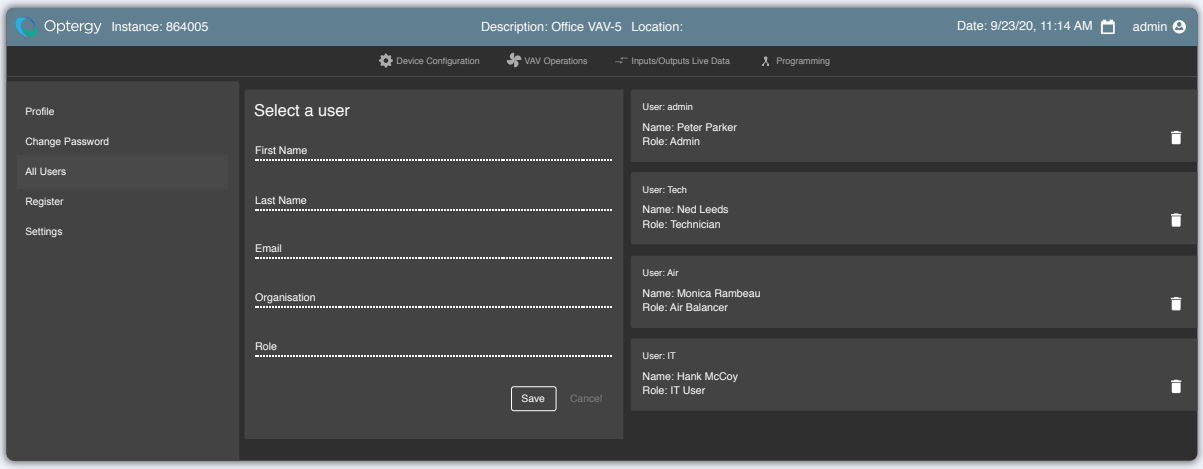


864 Web User Interface

Access and Login

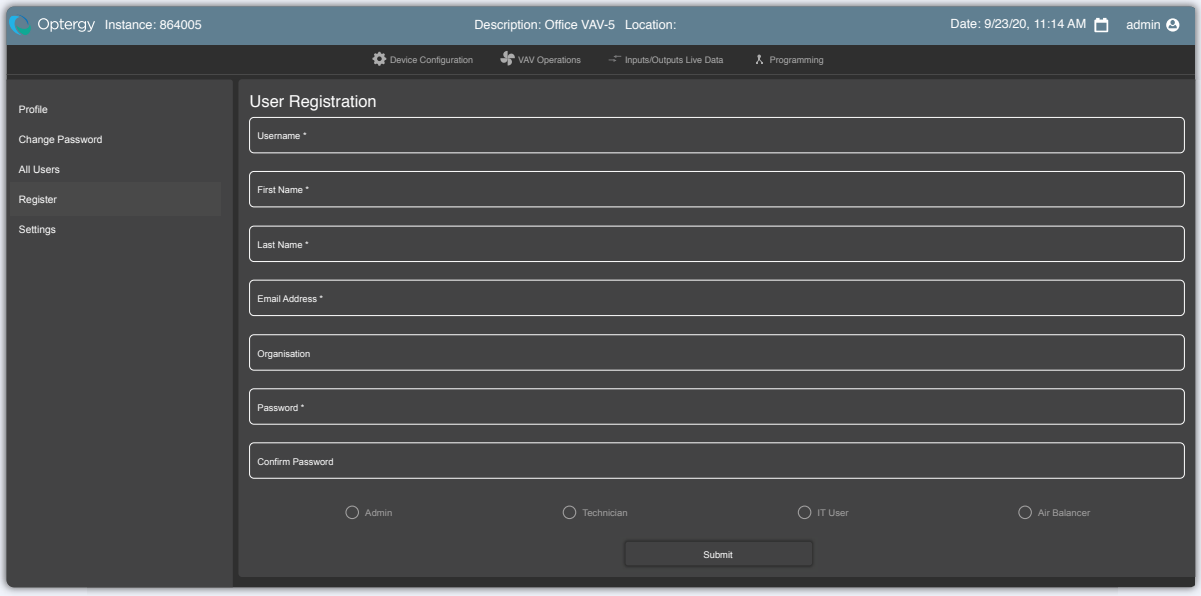
All Users

Any user created can be managed (i.e. promoted, demoted or deleted).



Registration

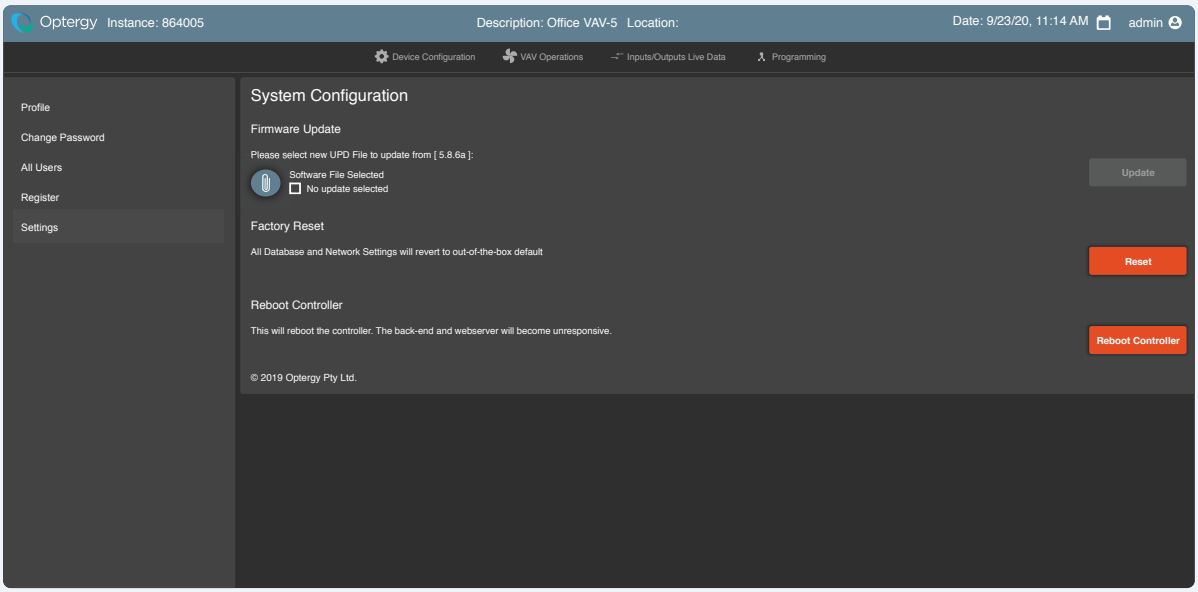
Users can be added from the user interface.



864 Web User Interface

Access and Login

System configuration settings



864 update software

The 864 can be updated from the web user interface.

1. Press the paperclip icon to choose a file from a local file location.
2. Press update.

Reset to factory calibration

The 864 can be reset to factory calibration, this means all data points, BACnet objects and DDC Program are erased. The Network settings are reverted to 192.168.1.MAC (BACnet IP and BACnet MS/TP enabled), routing disabled.

Reboot Controller

This reboots the controller, during the reboot the web user interface becomes unresponsive.

P864 Installation of Airflow Sensor (AFS-864)

The AFS-864 is a calibrated sensor that measures 0-2" w.c. or 0-500 Pa, this sensor can be added to any P864 to be used as a VAV Box Controller or filter DP sensor and more.

1. Fastening the device.

2. Fasten the screws to the plastic base.
Note: This means the circuit board cannot be removed without removing these screws first.

3. Knock out the plastic sensor area cover.

Status LED

The P864 has a status LED that indicates:

1. 1 Flash = P864 powered and operating normally
2. 2 Flash = MS/TP token passing