WAKE TECH
Building, Engineering, & Skilled Technologies

Controller IO – Binary Lab

BAT-111: Building Automation Systems

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Name: _____ Section: _____

Controller IO – Binary Lab

BAT-111: Building Automation Systems

SYNOPSIS

In a previous lab, we configured a peer-to-peer network with our controller. In this lab, we will start to work with our controller and investigate some of the IO.

OBJECTIVES

Upon completion of this activity the student will be able to:

- Understand the power requirements of the BAScontrol22 controller.
- Restore a configuration to the BASControl22 controller.
- Illuminate an LED with the controller.
- Wire a BI & B0.

PARTS AND EQUIPMENT

- Contemporary Controls BAScontrol22 or BAScontrol22S [https://www.ccontrols.com/basautomation/bascontrol.htm]
- Ethernet cable
- Windows Laptop
- Wiring of assorted colors
- Switch

REFERENCES

- Contemporary Controls - BASbackup

MANUALS

- Contemporary Controls BAScontrol22 User Manual [https://www.ccontrols.com/pdf/um/UM-BASC22V4.pdf]

BACKGROUND

1.1 - Inputs vs Outputs

An input or output is considered from the reference of the device being discussed.

Input

An input is information coming into the device from another device. A good example of a controller input would be a switch.

Output

An output is information or a control action leaving the controller to control an end device. An example of an output is illuminating an LED.

Feedback

Often a controller input is used to verify an output is done correctly. Feedback is knowing/checking the state of the light, after you have signaled to turn the light on or off.

1.2 - Binary vs Analog

Binary

Binary only has two states. It can be referred to as the following:

- True vs False
- Closed vs Open
- On vs Off
- 1 vs 0

An example of a binary device is a SPST switch.

We will refer to binary as any of these and use them interchangeably so note that:

- True = Closed = On = 1
- False = Open = Off = 0

Analog

Analog values have a range of values. A subtle difference in an analog value might mean significant difference in what that value represents.

PROCEDURES

In a previous lab, we successfully powered the BAScontrol22 controller, set up a peer-to-peer connection with the controller and viewed the controller's webpage. This is where this lab begins.

Part 1: Controller power

1.1 - Wire Controller power

Wire the controller to use 24 VDC.

Stop! Before continuing to the next step, have your instructor inspect your wiring.
If you apply power to the controller or any other device or change any wiring

without having the instructor verify the wiring, you will lose points on this lab. This rule is also for all future labs.

1.2 - Power on controller

After the instructor has checked the wiring, apply power to the controller and wait until the startup sequence has finished.

Part 2: Peer-to-Peer network

We need to set up a -peer-to-peer network between our controller and our laptop.

2.1 - Network Configuration

In BAT-111, we are going to use the default IP address for our controller which is 192.168.92.68.

As we learned in a previous lab, we need to change the IPv4 address of the ethernet adaptor on our laptop so that it is on the same local area network as our controller.

- Laptop: 192.168.92.25
- BAScontrol22: 192.168.92.68

The IPv4 address we statically assign to out laptop is going to change every lab so we get practice setting different IP addresses on the laptop.
In BAT-111, we are going to use the default IP address for our controller which is 192.168.92.68.

2.2 - Set up Peer-to-Peer network.

Change the IP address on your computer's wired ethernet adaptor that is connected to your controller.

Refer to the previous lab, if you need help to setting up a peer-to-peer network with your controller and laptop.

What is the IP address of your computer?_____

What is the IP address of your controller?_____

2.3 - Peer-to-Peer verification

Using the ping command from the cmd window, ping the controller.

Was the destination host reachable?_____

- If you answered No, troubleshoot your peer-to-peer network.

Part 3: Controller Configuration

At the beginning of each lab, you will be given a configuration that you will have to restore to your controller.

The file is zip and will be included with the lab.

3.1 - Contemporary Controls - BASbackup - BackUp & Restore document

Utilize the companion document "Contemporary Controls - BASbackup - BackUp & Restore" to restore the lab configuration file.

Part 4: Controller Webpage

4.1 - IP address

Devices in the local area network must each have a unique IP address.

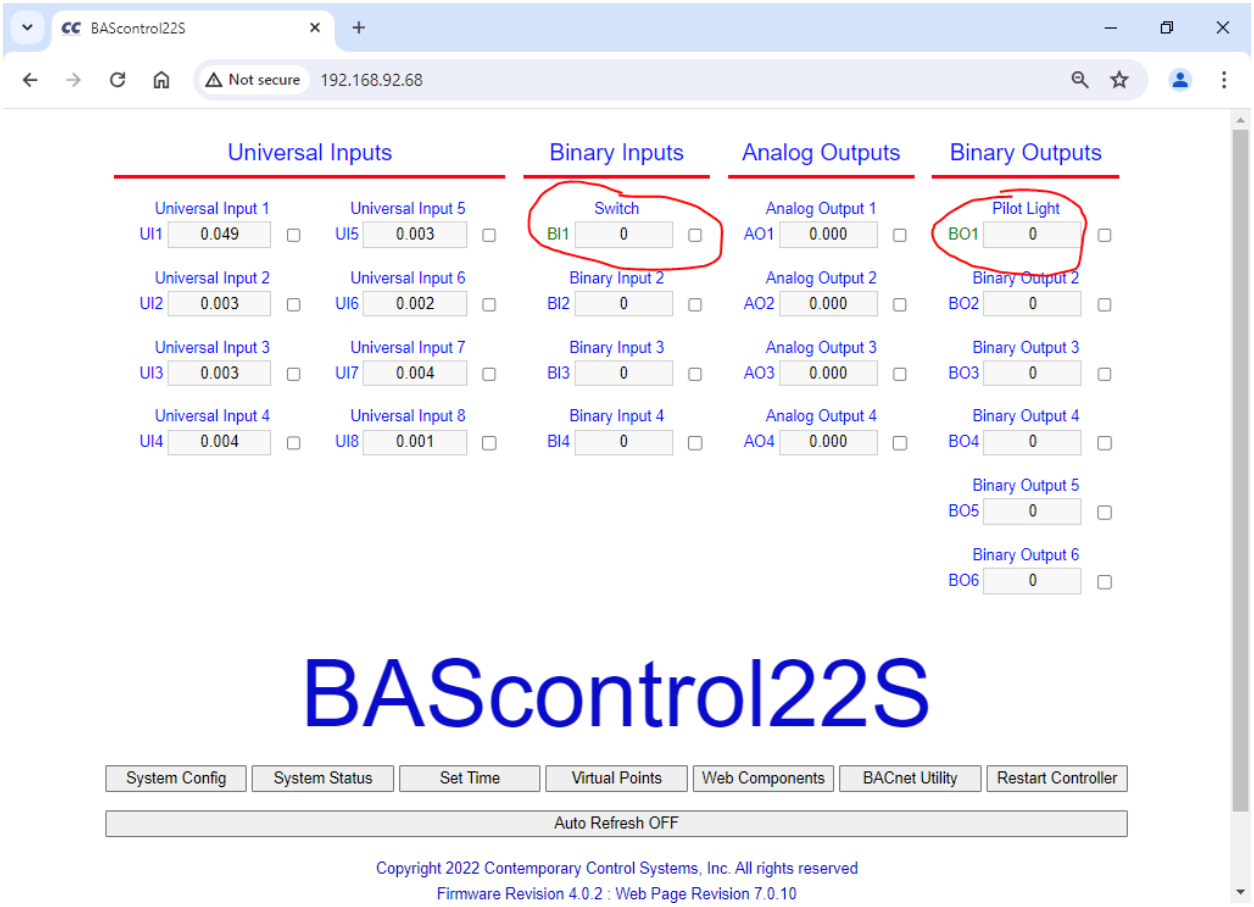
What is your laptop's IP address?_____

What is your controller's IP address?_____

- The IP addresses should not be the same.

4.2 - Webpage

Open a browser and go to the controller's webpage using the controller's IP address.



4.3 - Verify lab configuration

Looking at the webpage, what is the label for BI1?_____

- If the label for BI1 is not "Switch", then you have not properly RESTORED the configuration file. RESTORE the correct configuration file before continuing.

Looking at the webpage, what is the label for BO1?_____

- If the label for BO1 is not "Pilot Light", then you have not properly RESTORED the configuration file. RESTORE the correct configuration file before continuing.

We are going to use the webpage later in the lab, but we just want to verify that the controller is operational, the proper configuration file has been installed, and that we can access the controller's webpage.

Part 5: LED without Controller

LEDs are utilized to give feedback to humans. For example, the LED on the Power terminal of the controller tells us that the controller is receiving the correct voltage.

We are going to illuminate another external LED for our lab.

Before we control our LED with our controller, we are going to wire our LED directly to the 24 VDC power source through a physical switch to turn it on or off.

5.1 - LED indicators

The LED indicators we are utilizing can be illuminated utilizing either 24 VAC or 24 VDC. We are going to use DC to power our indicators.

If we are utilizing DC to power our LED, then the leads for the LED must have the proper polarity.

You may use any color LED indicator for this lab.

Are we going to wire our LED with 24 VDC or 24 VAC?_____

5.2 - Switch

We are going to wire a switch in series with our LED so we can turn the toggle the switch and turn the LED on and off.

While we only need a SPST switch, we might be using a DPST switch with our lab so you will have to figure out which terminals to utilize. Use the continuity checker of your multi-meter to determine how your switch terminals work.

Never use the continuity checker or take a resistance reading of a live circuit.

5.3 - Wire

Turn off the 24 VDC. Do not wire the LED and switch while the 24 VDC is hot.

Place the following wires:

- 24 VDC positive to one switch terminal
- Second switch to LED positive lead
- LED negative lead to 24 VDC negative

Stop! Before continuing to the next step, have your instructor inspect your wiring.

5.4 - Illuminate LED indicator

Power the 24 VDC and toggle the physical switch.

Does the switch toggle the illuminated LED indicator?_____

- If the indicator is not illuminated, investigate the issue.

5.5 - Remote control

The current design of our circuit allows us to illuminate an indicator based upon closing a physical switch.

With this design, can we remotely close the switch?_____

With this design, can we remotely illuminate the LED?_____

With this design, we cannot remotely close the switch or illuminate the LED.

Why can we not remotely illuminate the LED?_____

_____

_____

Part 6: Binary Output

Currently, the only decision on whether the LED indicator is illuminated, is whether the switch is closed. What happens if we want more logic besides just the switch being closed as to whether we want to illuminate the LED.

With our controller, we can separate the input of the switch and the output of the LED illumination into different pieces. The controller can read whether the switch is closed and based upon some logic then illuminate the LED.

6.1 - Binary

Binary has how many states?_____

Give an example of two states for a binary object?_____

Give another example of the two states for a binary object?_____

Give an example for something you would express in binary terms?_____

_____

_____

6.2 - Output

Output is information coming out of the device. Illuminating the LED indicator is an output.

6.3 - Binary Output

A binary output (BO) is an output that has two states. It closes or opens a virtual switch. For example, a BO can decide to illuminate an LED or not.

How many states does a BO have?_____

6.4 - Controller - BO Channels

Our controller can close or open multiple BOs (binary outputs).

Each BO channel has two connections just like our switch had two connections. Find the BO channels on your controller.

Looking at the controller, how many BO channels are there?_____

- You should see 6 BO channels.

Looking at our controller, how are the BO channels labelled?_____

- The BO channels are labelled: BO1, BO2, BO3, BO4, BO5, & BO6.

Looking at the BO1 channel, how are the connections labelled?_____

- One connection is labelled "A" and the other is labelled "B".

6.5 - Wire

We are going to change our LED circuit, so it uses a BO channel instead of the physical switch to illuminate the LED.

Move the two connections from the physical switch to BO1 – use BO1-A for one wire and BO1-B for the second wire.

Now, the illumination of the LED indicator is physically controlled by BO1.

Part 7: Binary Input

7.1 - Input

Input is information coming into the device. Whether a physical switch is open or closed is information coming into our controller.

Our controller uses inputs to make decisions and based upon those inputs and some programming, will generate some outputs.

7.2 - Binary Input

A binary input (BI) is an input that has two states. It looks to see if the BI is open or closed.

How many states does a BI have?_____

7.3 - Controller - BI Channels

Our controller can take binary devices as inputs. These channels are referred to as BI (binary inputs).

Each BI terminal has two terminal connections one labeled A and another labeled C.

Looking at our controller, how many BI channels does our controller have?_____

- The controller has 4 BI channels.

Looking at our controller, how are the BI channels labelled?_____

- The BI channels are labelled: BI1, BI2, BI3, & BI4.

Looking at the BI1 channel, how are the connections labelled?_____

- One connection is labelled "A" and the other is labelled "C".

7.4 - Wire physical switch to controller

Our physical switch has been disconnected from our LED circuit. We still want our physical switch to be part of the information (input) the controller uses to illuminate the LED. We need to have our physical switch wired to our controller as a binary input (BI)

Connect the two terminals of our physical switch to BI1.

Stop! Before continuing to the next step, have your instructor inspect your wiring.

Part 8: LED with Controller

After the instructor has checked the wiring, apply power to the controller and wait until the startup sequence has finished.

The controller is taking the physical switch as input and based upon logic is illuminating the LED. The current logic installed on the controller from your restore, will toggle the LED on/off for a five second time period when the physical switch is closed.

8.1 - Controller

Binary Input

Our physical switch is connected to BI1.

Each BI on the controller, has an associated LED on the controller to show whether that BI is currently true or false.

With the physical switch open, is the BI1 LED located on the controller illuminated?_____

- With the switch open, the BI1 LED should not be illuminated.

With the physical switch closed, is the BI1 LED located on the controller illuminated?_____

- With the switch closed, the BI1 LED should be illuminated.

Binary output

Our off-controller LED (BO1) that we are trying to illuminate will toggle between on & off only if the BI1 is true; otherwise, BO1 will be off.

Just like the BI, our BOs on the controller, have an associated LED on the controller to show whether that BO is currently true or false.

With the physical switch open, is the BO1 LED located on the controller illuminated?_____

- With the switch open, the BO1 LED should not be illuminated.

With the physical switch closed, is the BO1 LED located on the controller toggling?_____

- With the switch closed, the BO1 LED should be toggling on & off.

8.2 - Off-controller LED

With the physical switch open, is the LED illuminated?_____

- With the switch open, the LED should not be illuminated.

With the physical switch closed, does the LED toggle on & off?_____

- With the switch closed, if the switch does not toggle, investigate the issue.

Part 9: Controller Webpage

While we can see the BI and BO status using the controller's LEDs, we can see the same information in the controller's webpage.

Open the controller's webpage by opening a browser to http://192.168.92.68/.

9.1 - IO points used in programming.

Looking at the webpage, what color are the BI1 and BO1 labels?_____

Looking at the webpage, what color are the other BI and BO labels?_____

IO points that are currently being utilized in the controller's programming are green. IO points not being utilized in the programming are blue.

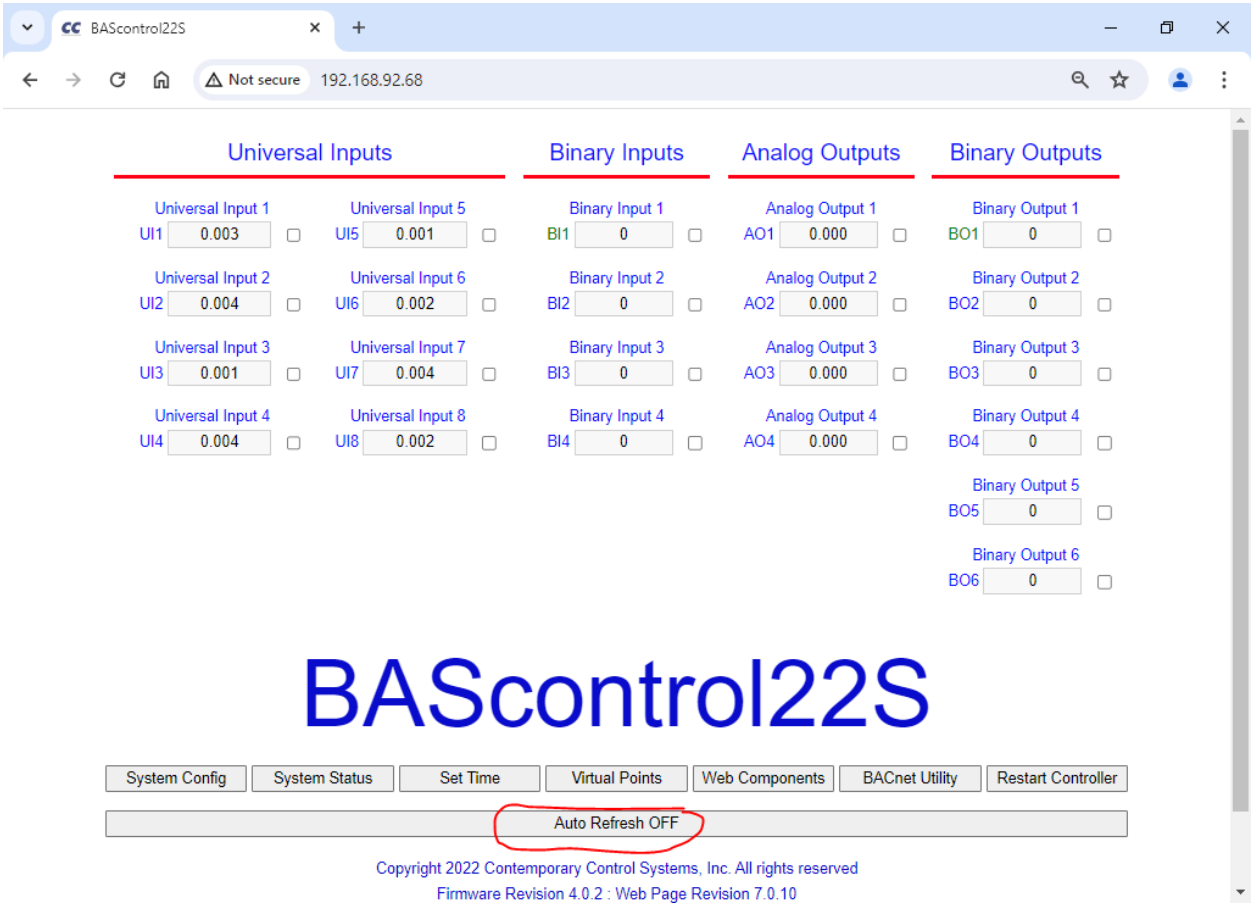
Since BI1 and BO1 are both green, they are being used in the controller's programming logic.

9.2 - Auto Refresh

When we are running our program, we want to turn on Auto Refresh. Auto Refresh allows the webpage to show the changing values of the controllers IO.

9.3 - Turn Auto Refresh On

Click the button labelled "Auto Refresh Off". The button should change to "Auto Refresh On".



9.4 - Binary Input

Toggle the physical switch and notice that BI1 changes from 0 to 1 depending on whether the physical switch is closed or open.

Does the BI1 LED match the controller's webpage value for BI1?_____

9.5 - Binary Output

Does the BO1 LED match the controller's webpage value for BO1?_____

Part 10: Points List

For every lab, we need to fill out a Points List. A Points List shows all the inputs and outputs wired to our controller.

For this lab, we are utilizing the following points on our controller:

- BO
  - BO1 – external LED indicator
- BI
  - BI1 - Switch

The LED output wired to BO1 has already been placed in the Points List below.

Add the physical switch to the points list and place the terminal it is wired to under the correct Point Type.

Go through and sum all columns to give the number of Points used per Point Type.

Point Description	Point Type						
	Universal Input		Binary Input	Analog Output	Binary Output	Virtual	
	Analog Input	Channel				Analog	Binary
LED indicator					BO1		
Point Totals:	0	0		0	1		

Part 11: Instructor Verification

Demonstrate to your instructor that you have successfully illuminated the LED indicator.

11.1 - Instructor Signature

Have the instructor sign your lab demonstrating that you have successfully illuminated the LED indicator.

Instructor Signature?_____

Part 12: Tear-down

12.1 - Controller Restore

After you have finished your lab, we must wipe the controller clean by restoring a Factory Image to the controller.

Using BASbackup, restore the following file based upon your controller type:

- BASControl22: BASC22_v4-3.1.28_factoryDefault.zip
- BASControl22S: BASC22S-4.0.2_factoryDefault.zip

After the controller restarts, show your instructor the controller's webpage.

12.2 - Laptop IP address

Using ncpa.cpl, set the ethernet adaptor to receive its IP address dynamically from the DHCP server.

Look at the proper Ethernet adaptor using the ipconfig command in the cmd window.

Make sure you are looking at the ethernet adaptor that you edited previously. You might have to scroll through the window to find your adaptor.

For the ethernet adapter:

Is DHCP Enabled?_____

- If you answered No, go back and change the IPv4 settings to the correct network adaptor and then reverify by running ipconfig again.

Instructor Signature

Show your instructor that you have successfully changed the IP address to use DHCP.

Instructor Signature:_____

12.3 - Controller Tear-down

When disassembling your work, make sure there is no power to the controller or any other device.

When removing conductors from the terminal blocks, unscrew them enough so you can gently remove the wires. Do not forcefully yank the wires out as this will damage the terminals.

After removing a conductor, please make sure the screw is seated in the threads by tightening the screw two turns.