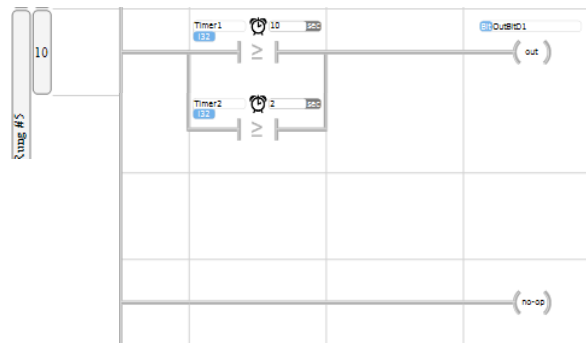


Programmable Logic Controllers: Hands On Introduction to Industrial Controls

Class 1: PLC Basics

March 27, 2017 – Don Wilcher

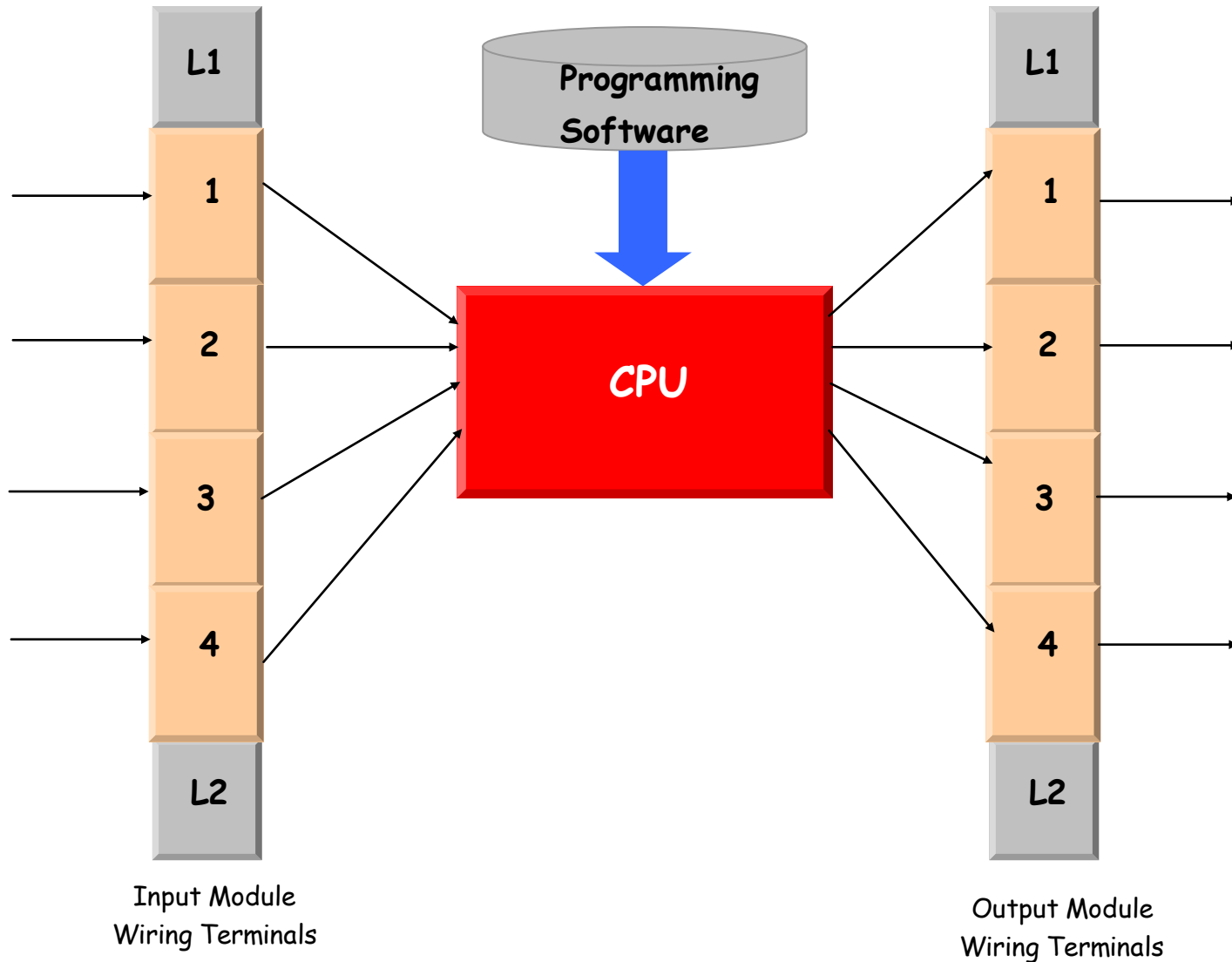


PLC Basics

Topics

- PLC Architecture
- Introduction to the Velocio PLC
- Setting up the Velocio “vBuilder” software (Flowchart)
- Hands-On Project: Build a basic ON/OFF Controller

PLC Architecture



PLC Architecture...

BASIC COMPONENTS OF A PLC CONSIST:

- CPU (Central Processing Unit)
- I/O (Input/Output) Section
- Power Supply
- Programming Device

Question 1

Name the 4 basic components of a PLC Architecture.

PLC Architecture...

CPU (Central Processing Unit)

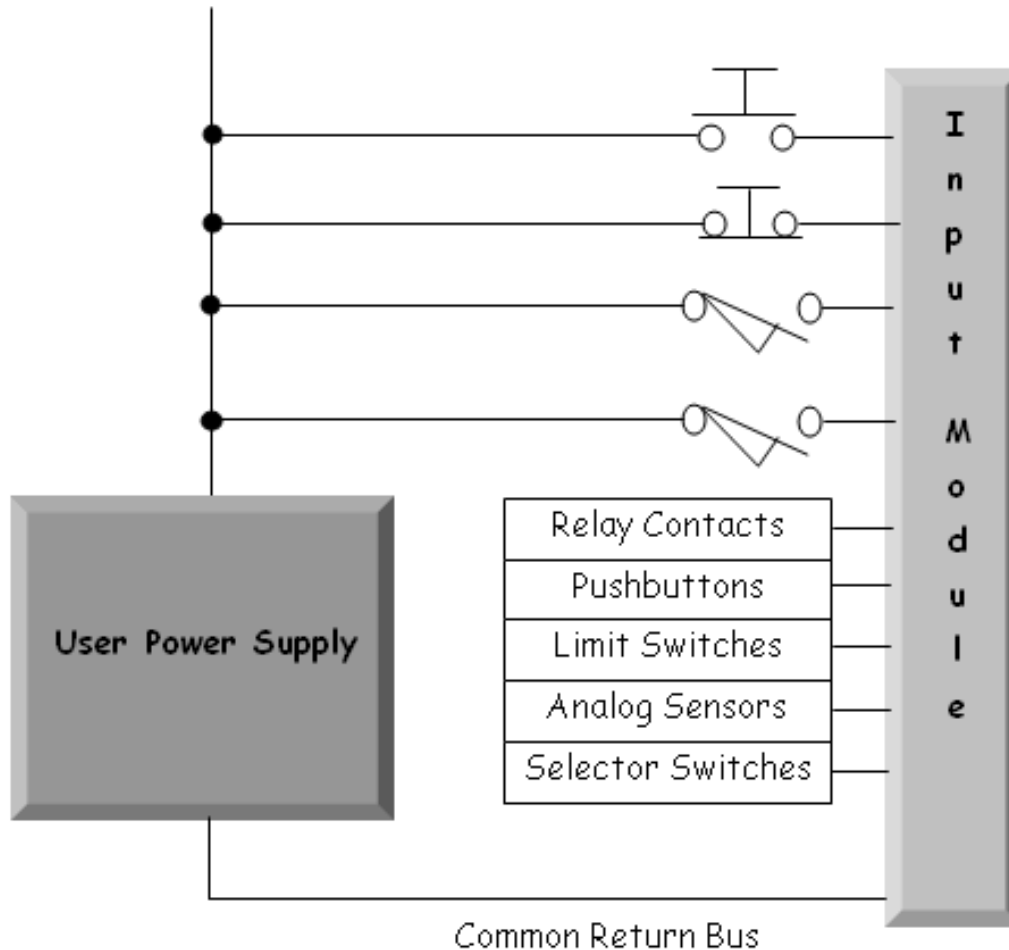
- The brain of the PLC
- Usually consists of a microprocessor for implementing the logic and controlling the communication among the modules.
- The processor requires memory for storing the results of the logical operations performed by the microprocessor.
- Memory is also required for the program EPROM or E²PROM plus RAM.

PLC Architecture...

I/O (Input/Output) Section

- Consists of Input and Output Modules
- I/O System forms the interface field devices are connected to the controller.
- Purpose of the Interface is to condition the various signals received from or sent to external field devices.
- Input devices such as pushbuttons, limit switches, sensors, selector switches are hardwired to terminals on the input modules.

PLC Architecture...



Typical Input Module Wiring Diagram

PLC Architecture...

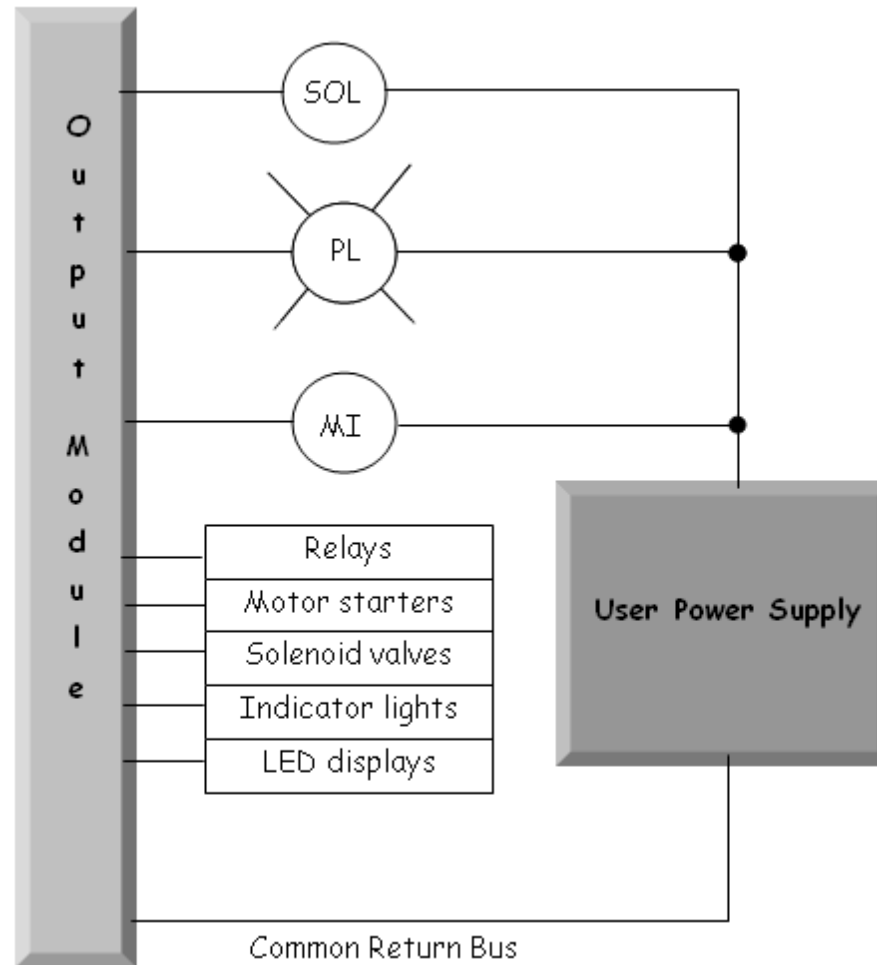
I/O (Input/Output) Section...

- Output devices such as small motors, motor starters, solenoid valves, and indicator lights are hardwired to the terminals on the output modules.
- To electrically isolate the internal components from the input and output terminals, PLCs employ an optical isolator.
- “Real World” or “Field” inputs and outputs are used to refer to devices mentioned earlier.

Question 2

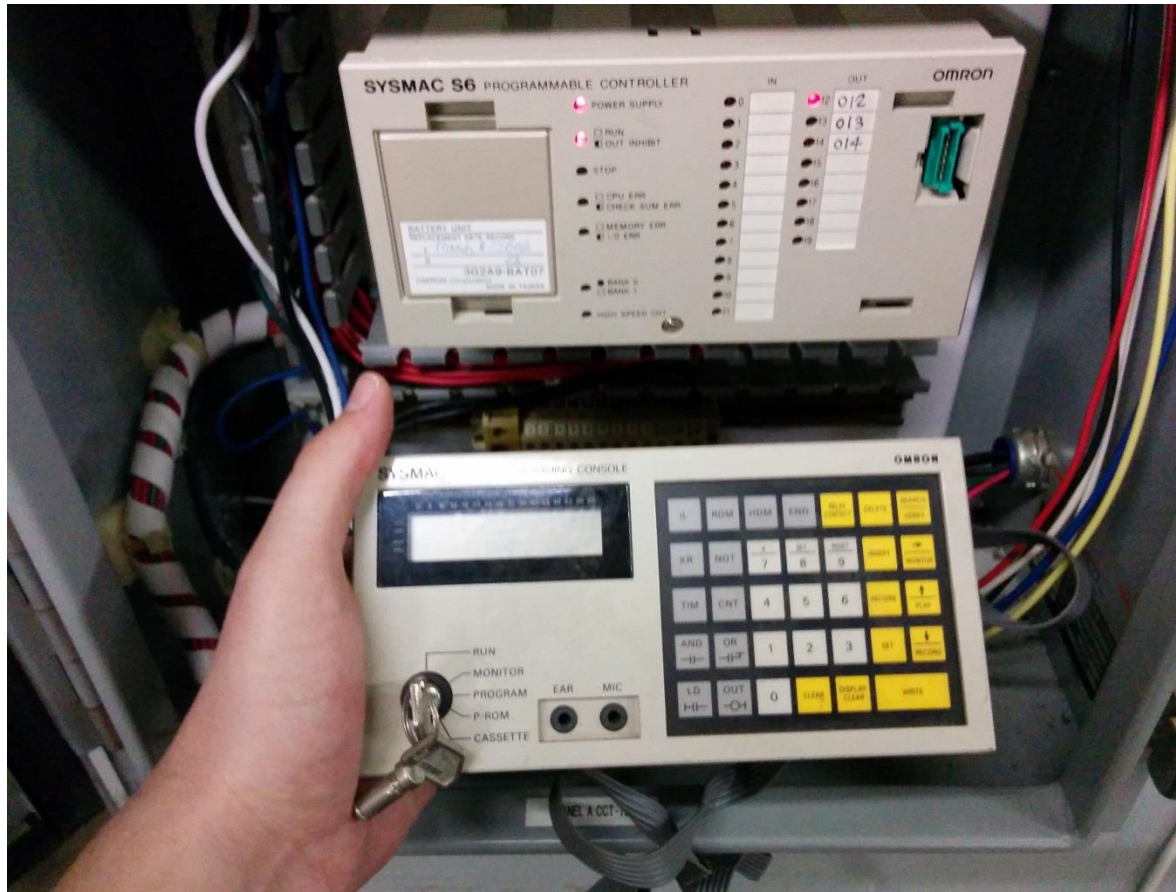
Name the two wiring methods of attaching I/O devices to a PLC.

PLC Architecture...



Typical Output Module Wiring Diagram

PLC Architecture...



PLC Handheld Terminal/Programmer

PLC Architecture...

Programming Device (or Terminal)...

- All leading brands of PLCs have software available so that a PC can be used as the programming device.
- Software allows the user to create, edit, document, store, and troubleshooting ladder logic programs and to generate printed reports.
- Computer monitor able to display more logic on the screen than handheld types (Programming Device).

PLC Architecture...

Power Supply

- Supplies DC power to other modules that plug into the rack.
- For large PLC systems, the power supply does not normally supply power to the field devices.
- With larger systems, power to field devices is provided by external AC or DC supplies.
- For small and micro PLC systems, the power supply is used to power field devices.

Question 3

A handheld programming is capable of displaying as much logic information than a traditional computer monitor?

- a) True
- b) False

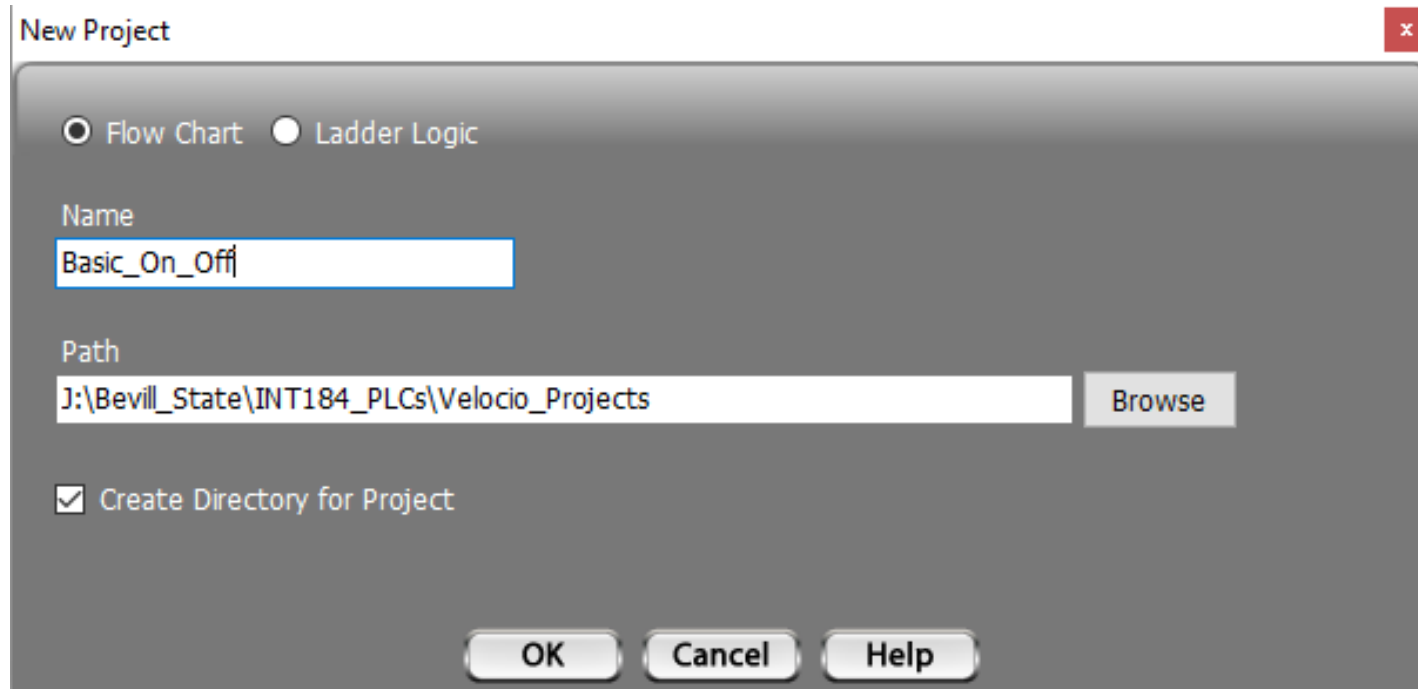
Setting Up the Velocio "vBuilder" Software (Flowchart)



Reference

<http://velocio.net/vbuilder/>

Setting Up the Velocio "vBuilder" Software...

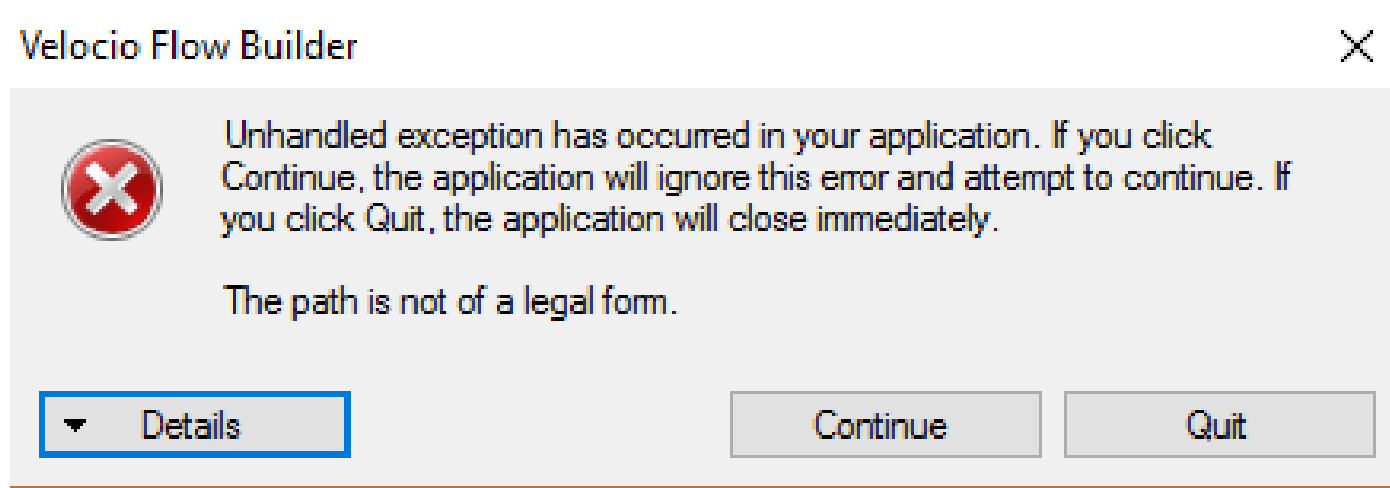


Creating the Flow Chart program for a Basic ON/OFF Controller.

Setting Up the Velocio "vBuilder" Software...

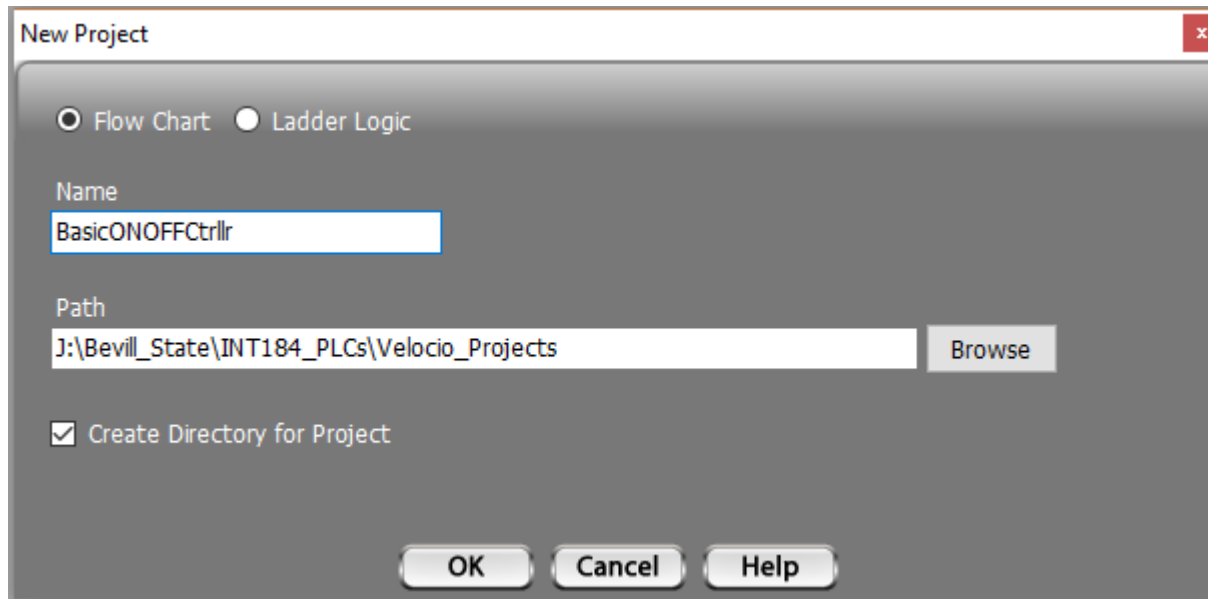
NOTE: Traditional Software Naming Convention is not recognized in Velocio vBuilder when creating the name for the Flowchart project.

Basic_ON_OFF will produce the following error message:



Setting Up the Velocio "vBuilder" Software...

Correct Naming Convention: BasicONOFFCtrlr.



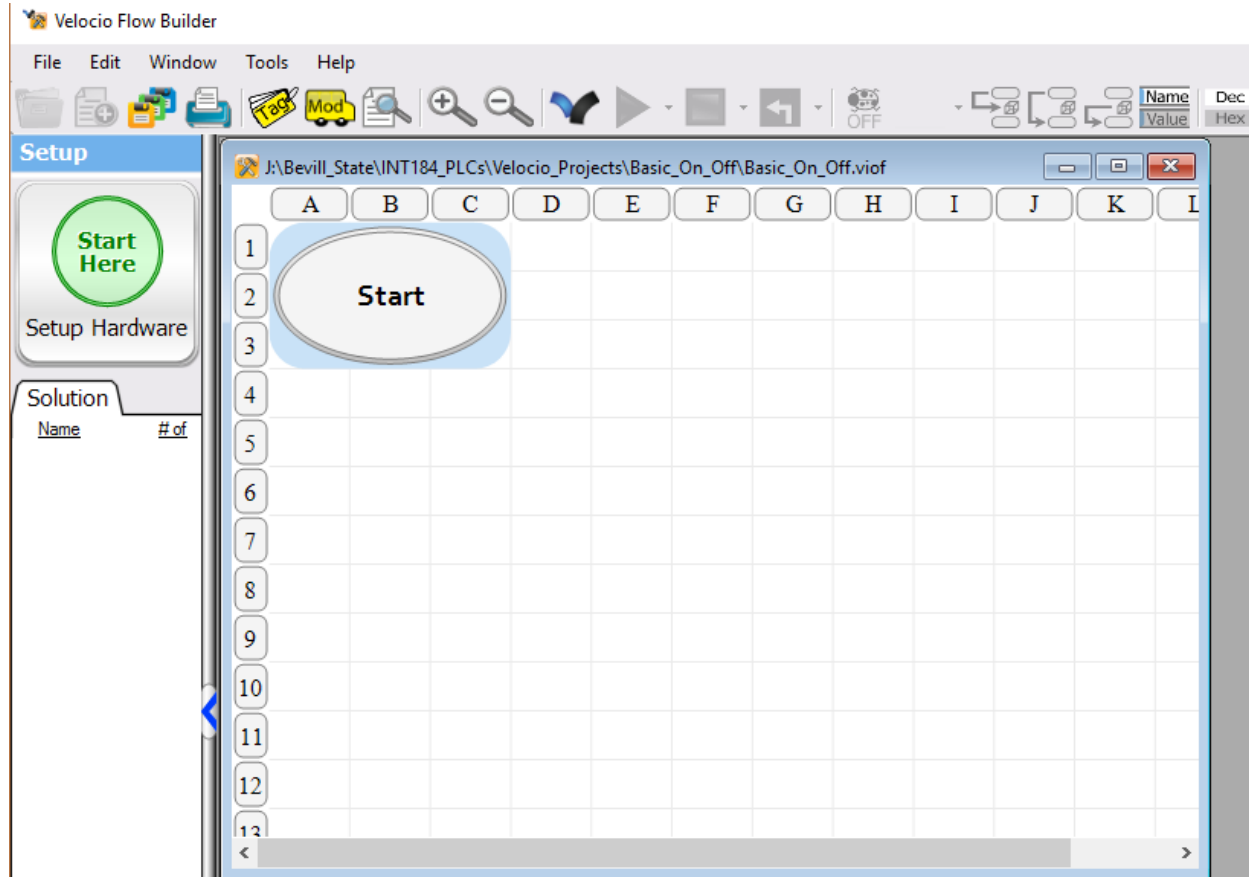
Creating the Flow Chart program for a Basic ON/OFF Controller.

Question 4

The naming convention Raw_Temp is acceptable for a vBuilder Flowchart project name.

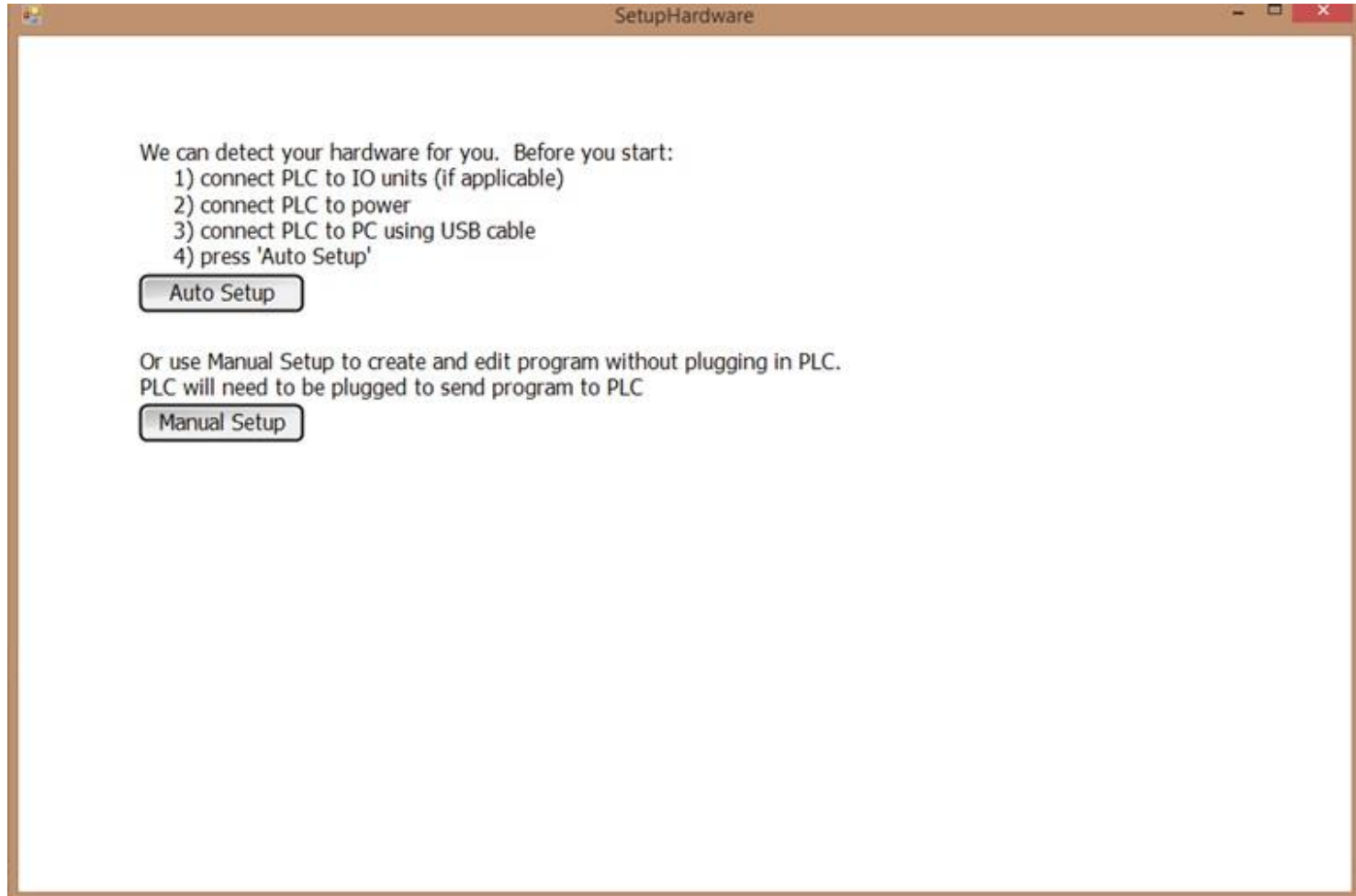
- a) False
- b) True

Setting Up the Velocio "vBuilder" Software...



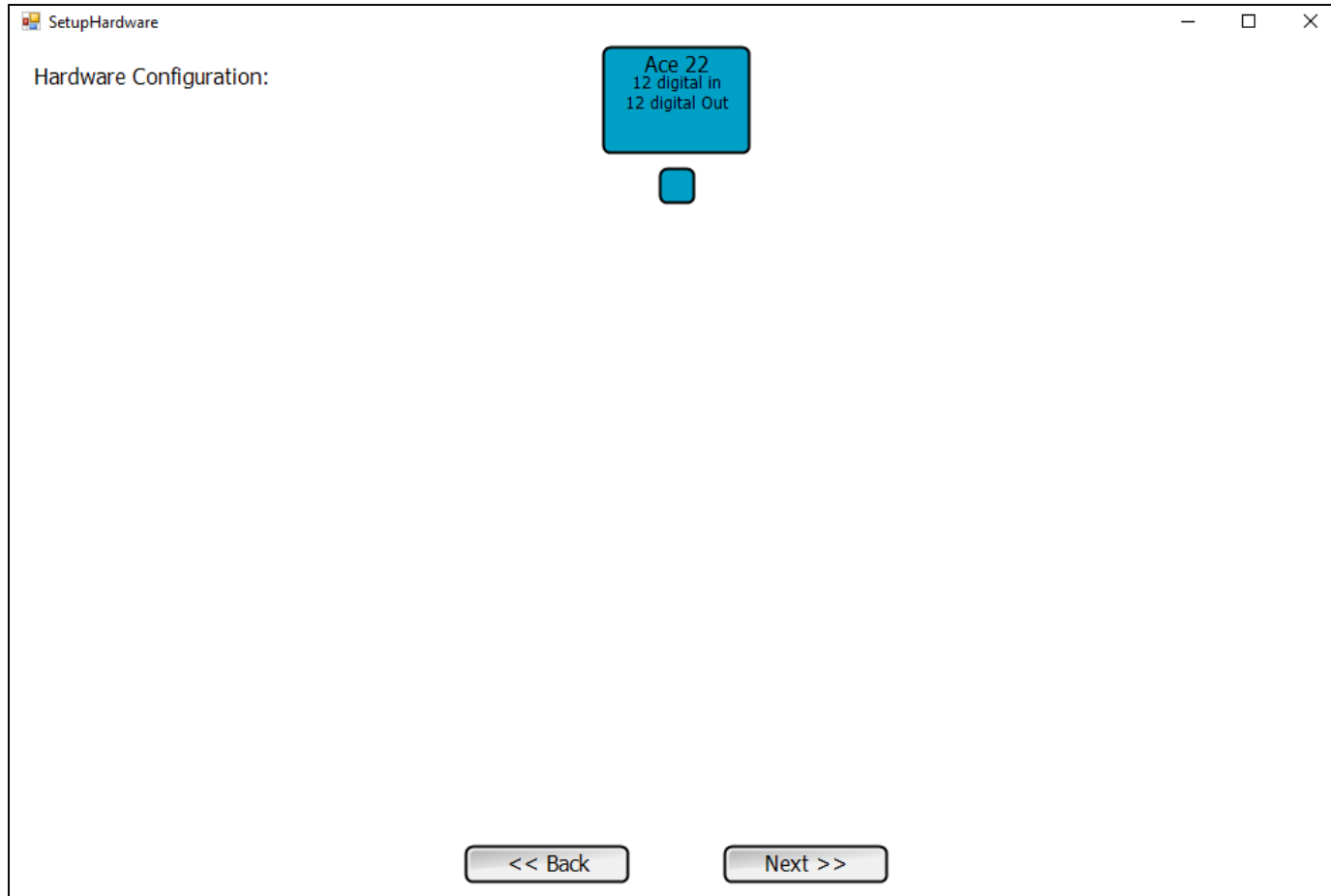
Setup Hardware Window for configuring the Ace 22 PLC.

Setting Up the Velocio "vBuilder" Software...



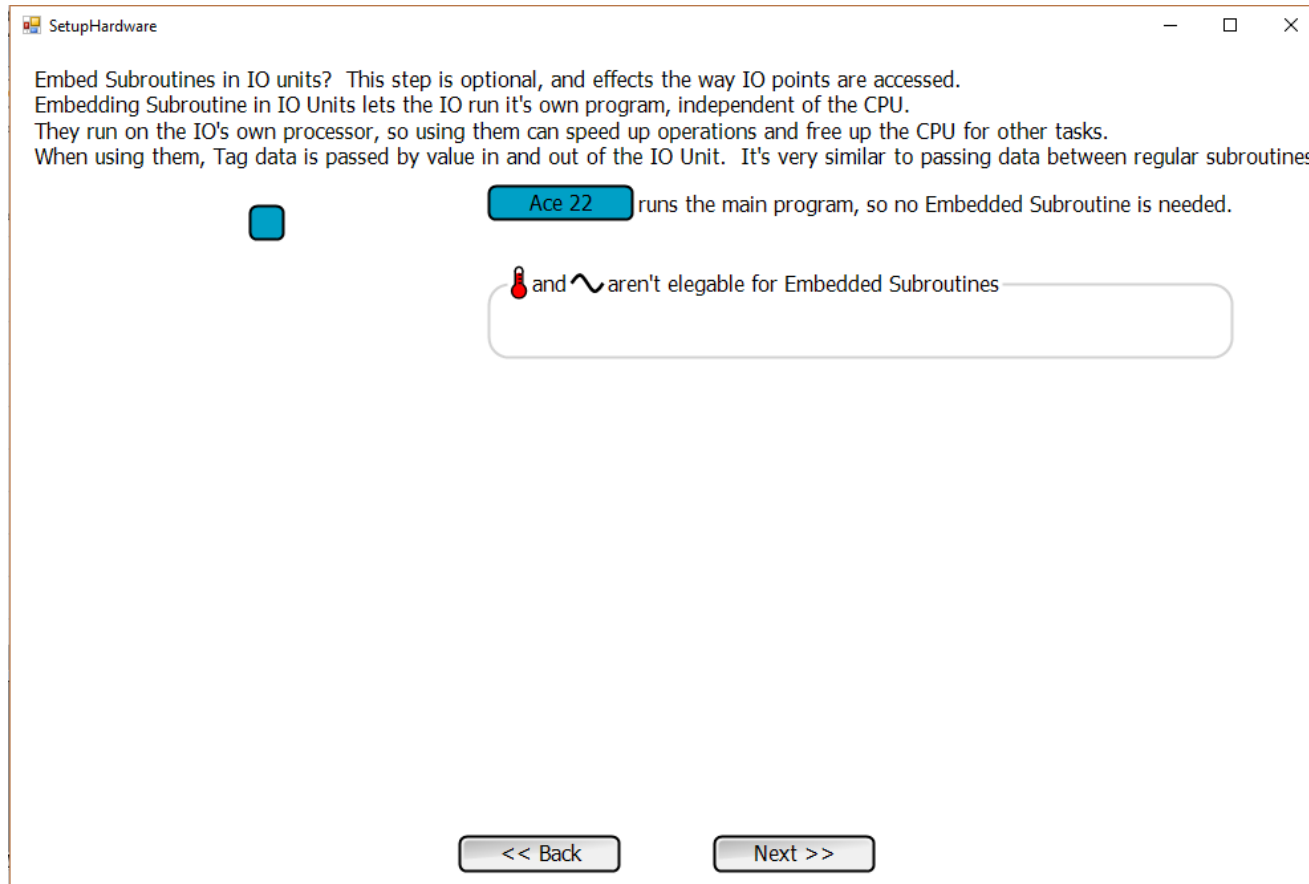
Setup Hardware Window for configuring the Ace 22 PLC.

Setting Up the Velocio "vBuilder" Software...



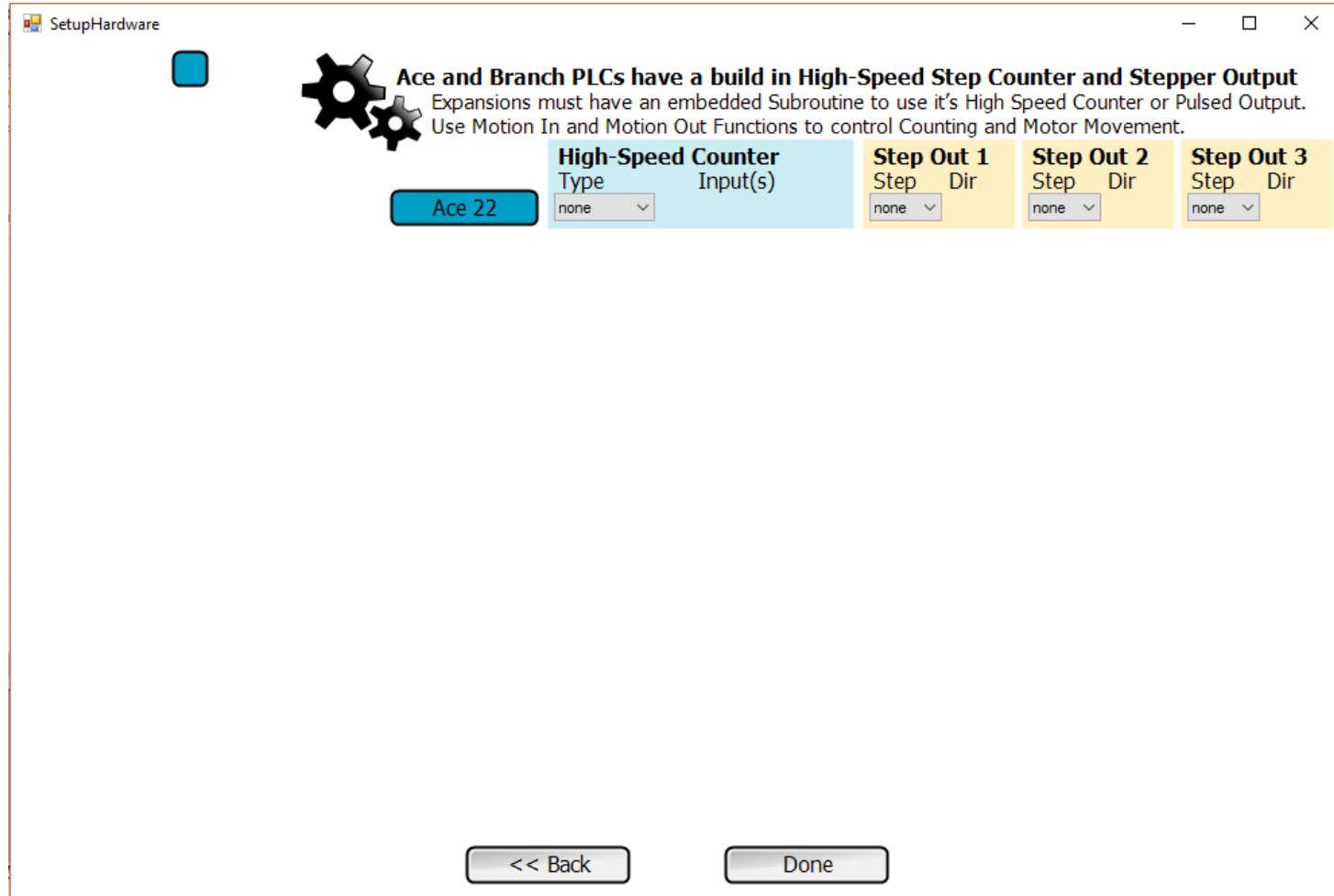
Ace 22 PLC detected by vBuilder software.

Setting Up the Velocio "vBuilder" Software...



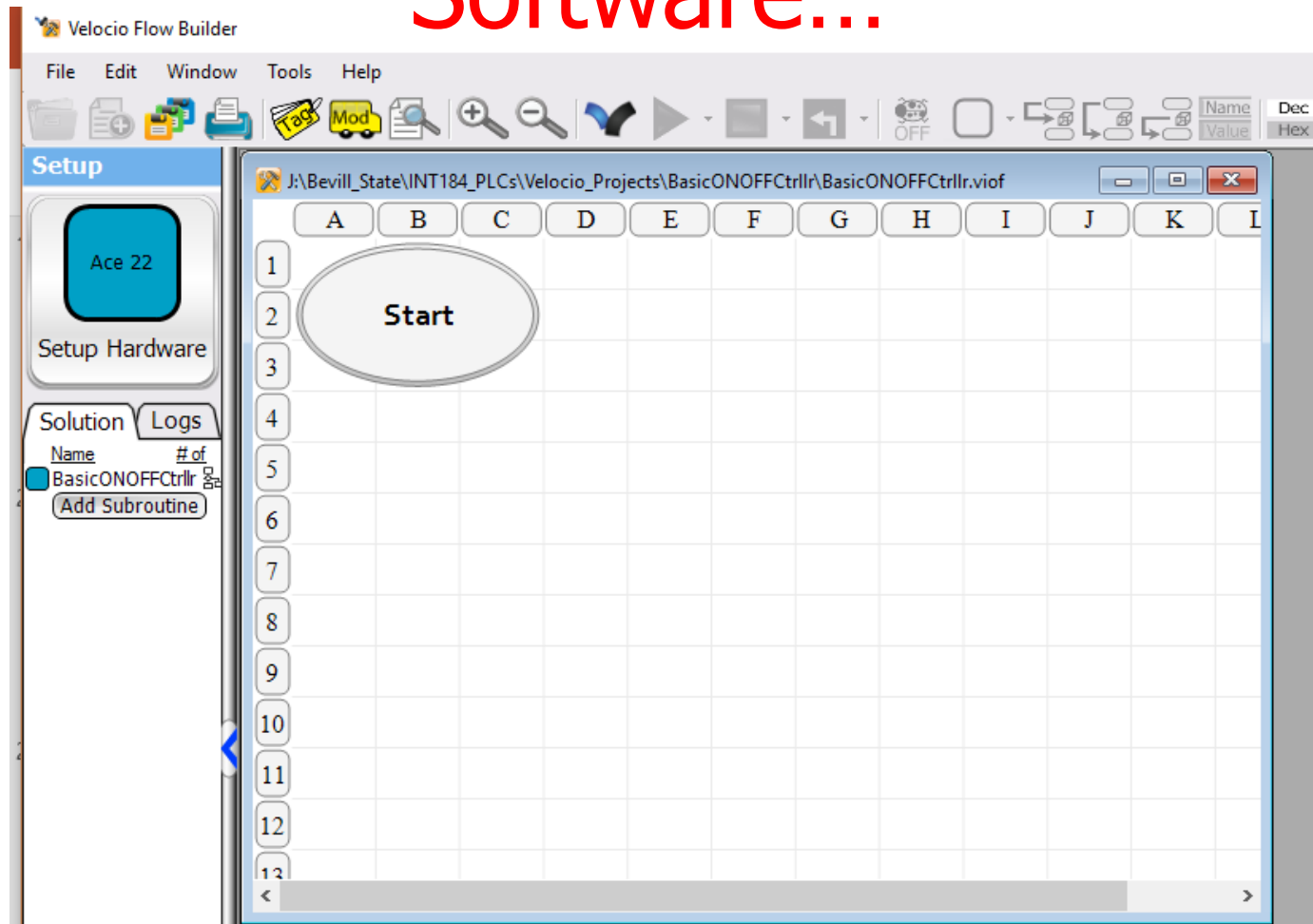
Continuation of the Ace 22 PLC Hardware setup step.

Setting Up the Velocio "vBuilder" Software...



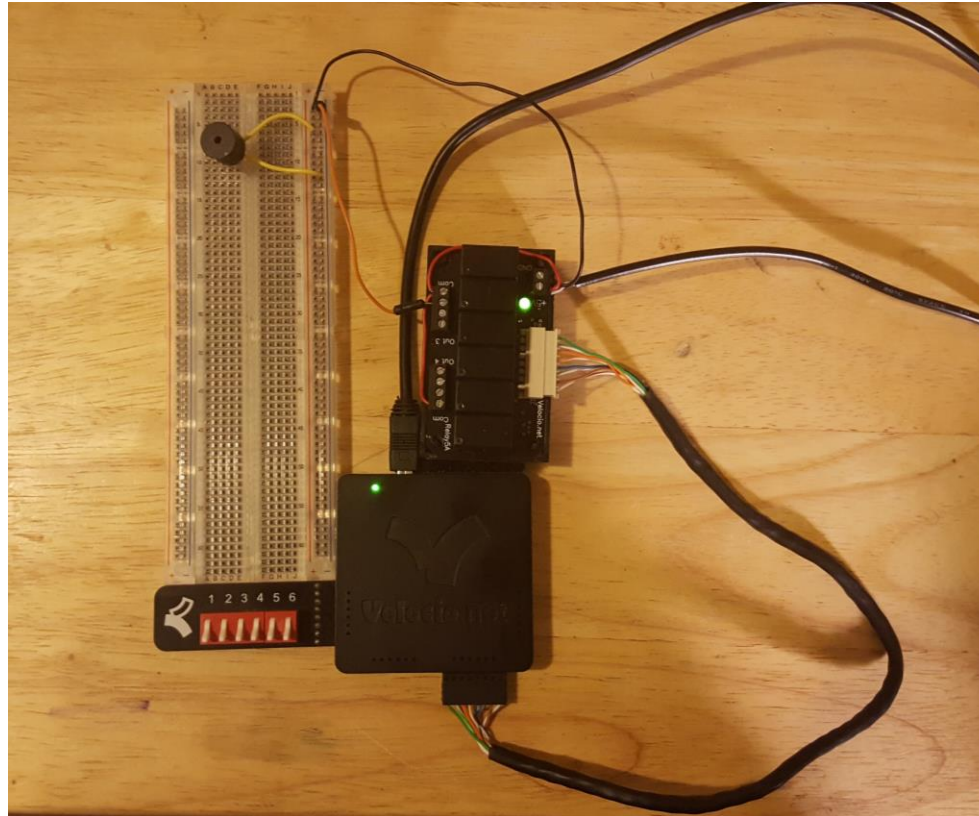
The Ace 22 PLC Hardware setup continuation.

Setting Up the Velocio "vBuilder" Software...

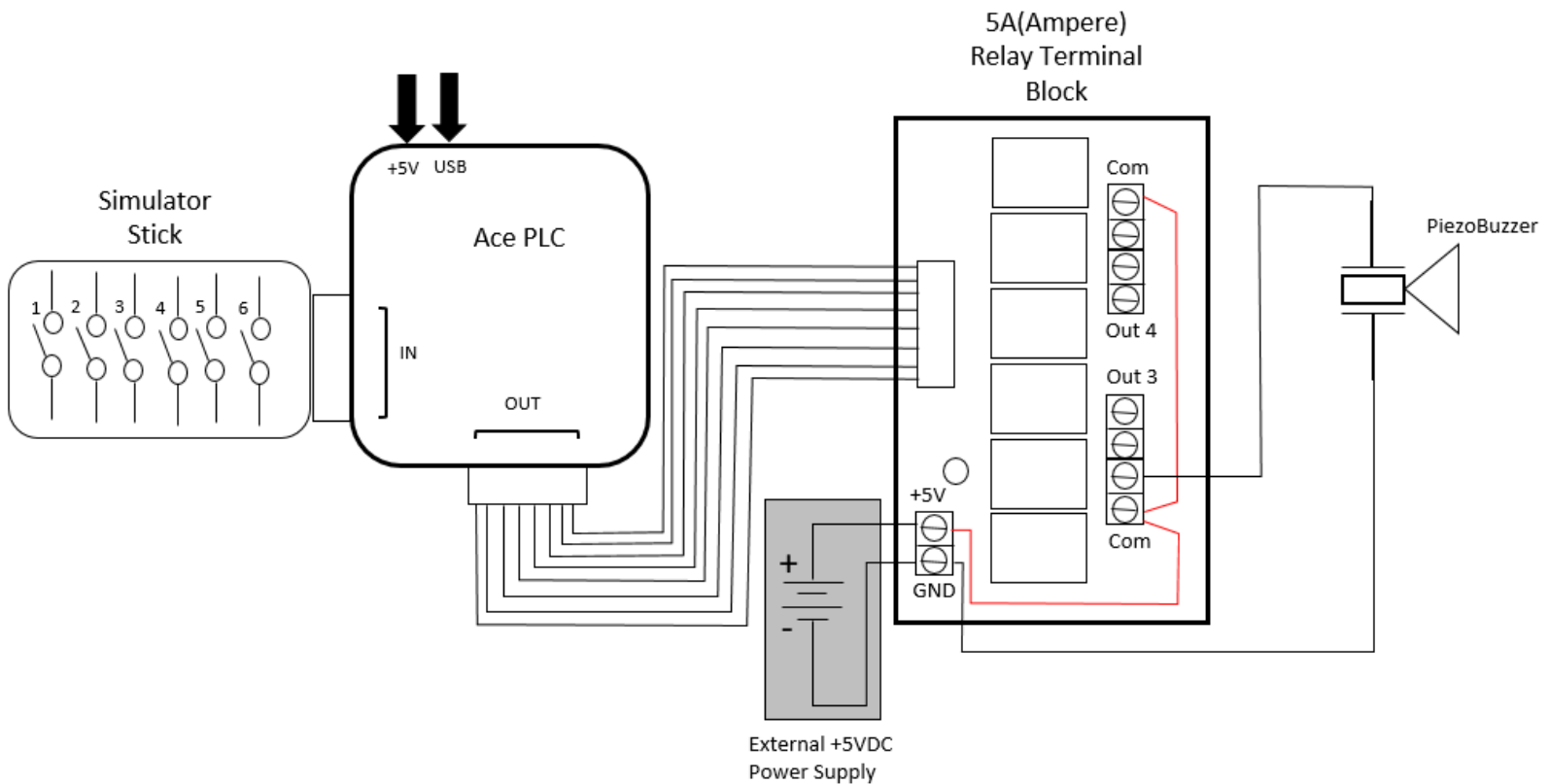


The Ace 22 PLC Hardware setup is completed.

Hands-On Project: Build a Basic ON/OFF Controller



Hands-On Project: Build a Basic ON/OFF Controller...



Electrical Wiring Diagram

Building the ON/OFF Controller Flowchart

The screenshot shows the Velocio Flow Builder interface. A 'Tags' dialog box is open, displaying a table of available tags for the Ace 22 PLC. The table has columns for Name, Signal, Debounce (ms.), Used, and Modbus. The 'Input / Output' section is expanded, showing various tag types and their corresponding signal names and addresses.

Input / Output	Name	Signal	Debounce (ms.)	Used	Modbus
Input bit	InBit1	B1	0	<input type="checkbox"/>	<input type="checkbox"/>
Input i16	InBit2	B2	0	<input type="checkbox"/>	<input type="checkbox"/>
Input Float	InBit3	B3	0	<input type="checkbox"/>	<input type="checkbox"/>
Output bit	InBit4	B4	0	<input type="checkbox"/>	<input type="checkbox"/>
Output ui16	InBit5	B5	0	<input type="checkbox"/>	<input type="checkbox"/>
Register	InBit6	B6	0	<input type="checkbox"/>	<input type="checkbox"/>
bit	InBitC1	C1	0	<input type="checkbox"/>	<input type="checkbox"/>
ui8	InBitC2	C2	0	<input type="checkbox"/>	<input type="checkbox"/>
i16	InBitC3	C3	0	<input type="checkbox"/>	<input type="checkbox"/>
ui16	InBitC4	C4	0	<input type="checkbox"/>	<input type="checkbox"/>
i32	InBitC5	C5	0	<input type="checkbox"/>	<input type="checkbox"/>
Float	InBitC6	C6	0	<input type="checkbox"/>	<input type="checkbox"/>

Creating Tags for Input and Output port pins of the Ace 22 PLC.

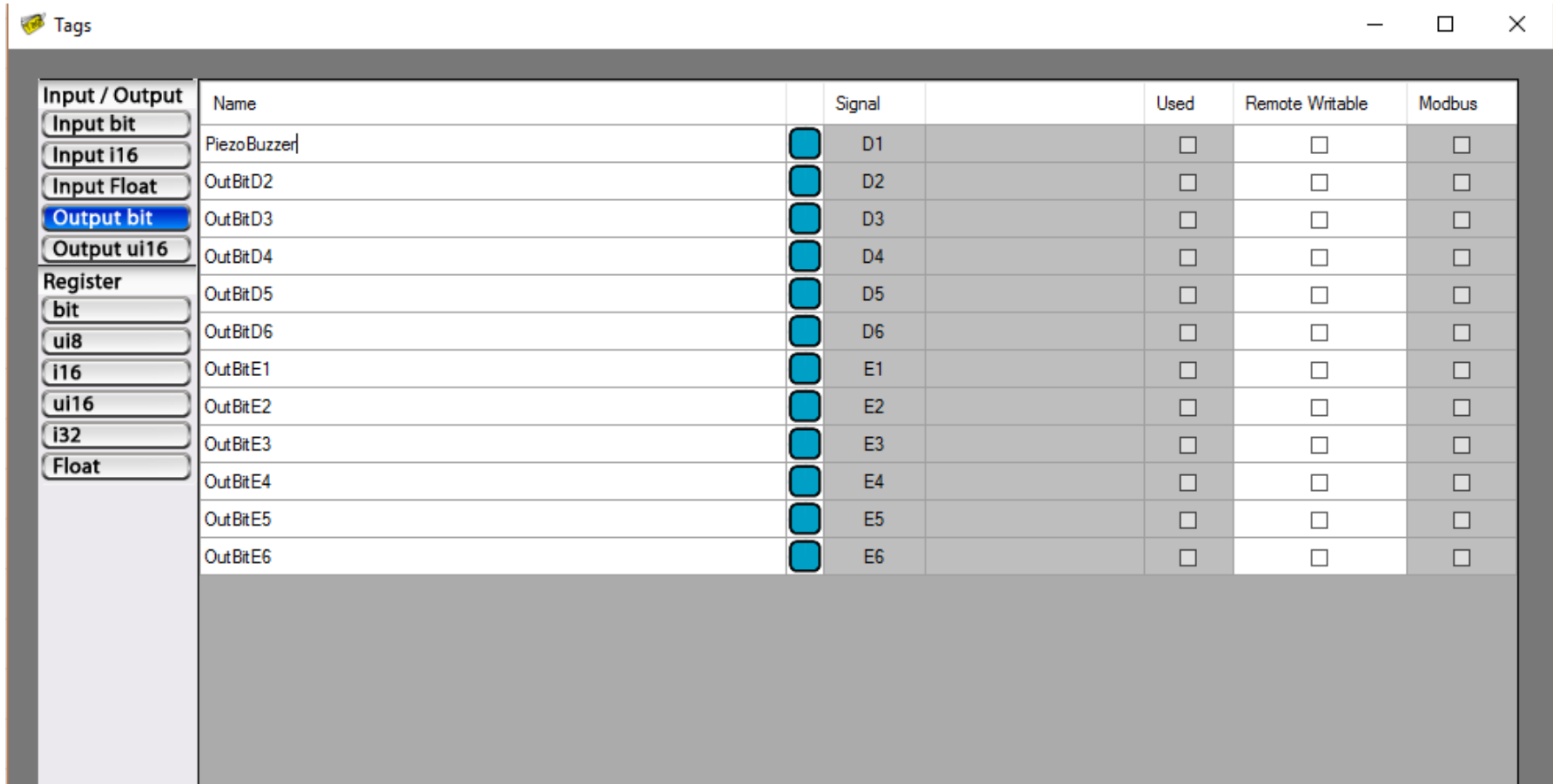
Presented by:

Building the ON/OFF Controller Flowchart...

Input / Output	Name	Signal	Debounce (ms.)	Used	Modbus
Input bit	ON_Switch	B1	0	<input type="checkbox"/>	<input type="checkbox"/>
Input i16	InBitB2	B2	0	<input type="checkbox"/>	<input type="checkbox"/>
Input Float	InBitB3	B3	0	<input type="checkbox"/>	<input type="checkbox"/>
Output bit	InBitB4	B4	0	<input type="checkbox"/>	<input type="checkbox"/>
Output ui16	InBitB5	B5	0	<input type="checkbox"/>	<input type="checkbox"/>
Register bit	InBitB6	B6	0	<input type="checkbox"/>	<input type="checkbox"/>
ui8	InBitC1	C1	0	<input type="checkbox"/>	<input type="checkbox"/>
i16	InBitC2	C2	0	<input type="checkbox"/>	<input type="checkbox"/>
ui16	InBitC3	C3	0	<input type="checkbox"/>	<input type="checkbox"/>
i32	InBitC4	C4	0	<input type="checkbox"/>	<input type="checkbox"/>
Float	InBitC5	C5	0	<input type="checkbox"/>	<input type="checkbox"/>
	InBitC6	C6	0	<input type="checkbox"/>	<input type="checkbox"/>

InBitB1 address renamed to ON_Switch tag

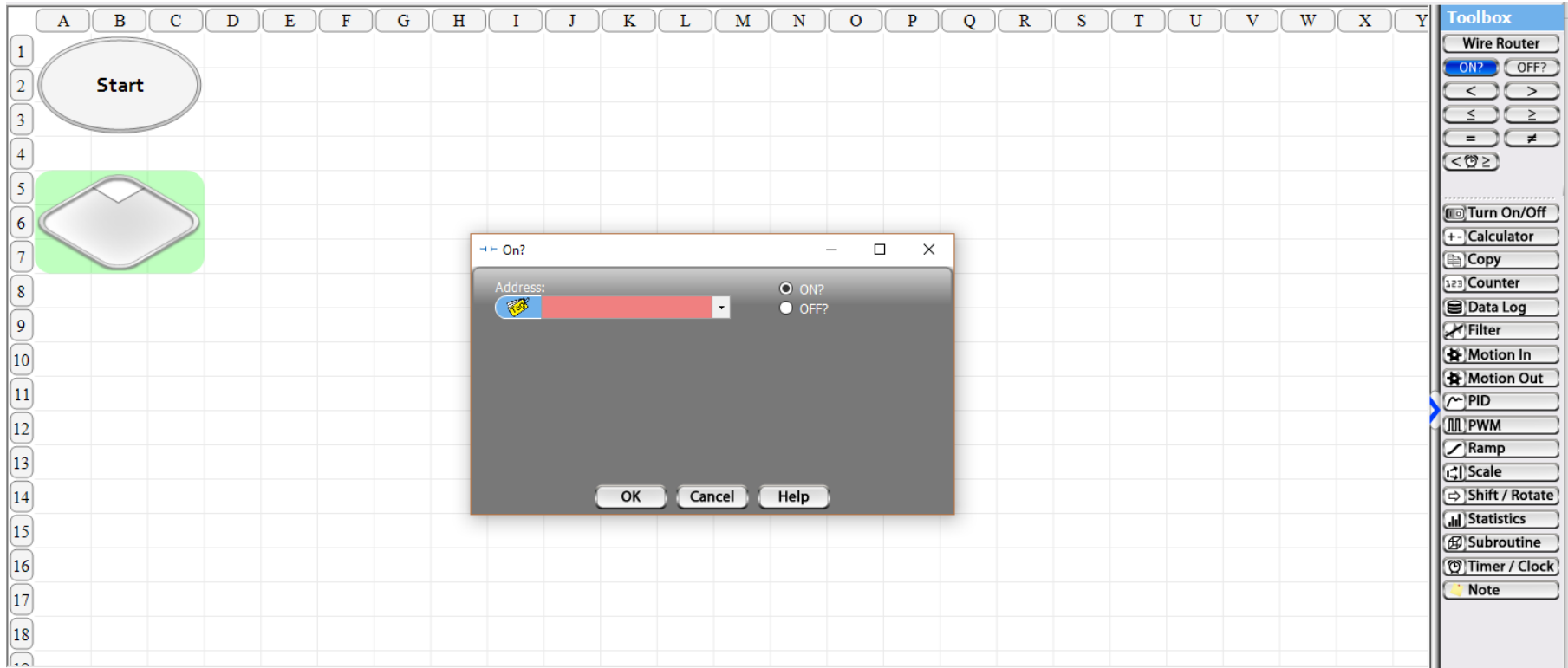
Building the ON/OFF Controller Flowchart...



Input / Output	Name	Signal	Used	Remote Writable	Modbus
Input bit	PiezoBuzzer	D1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Input i16	OutBitD2	D2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Input Float	OutBitD3	D3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Output bit	OutBitD4	D4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Output ui16	OutBitD5	D5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Register	OutBitD6	D6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
bit	OutBitE1	E1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ui8	OutBitE2	E2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i16	OutBitE3	E3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ui16	OutBitE4	E4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i32	OutBitE5	E5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Float	OutBitE6	E6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

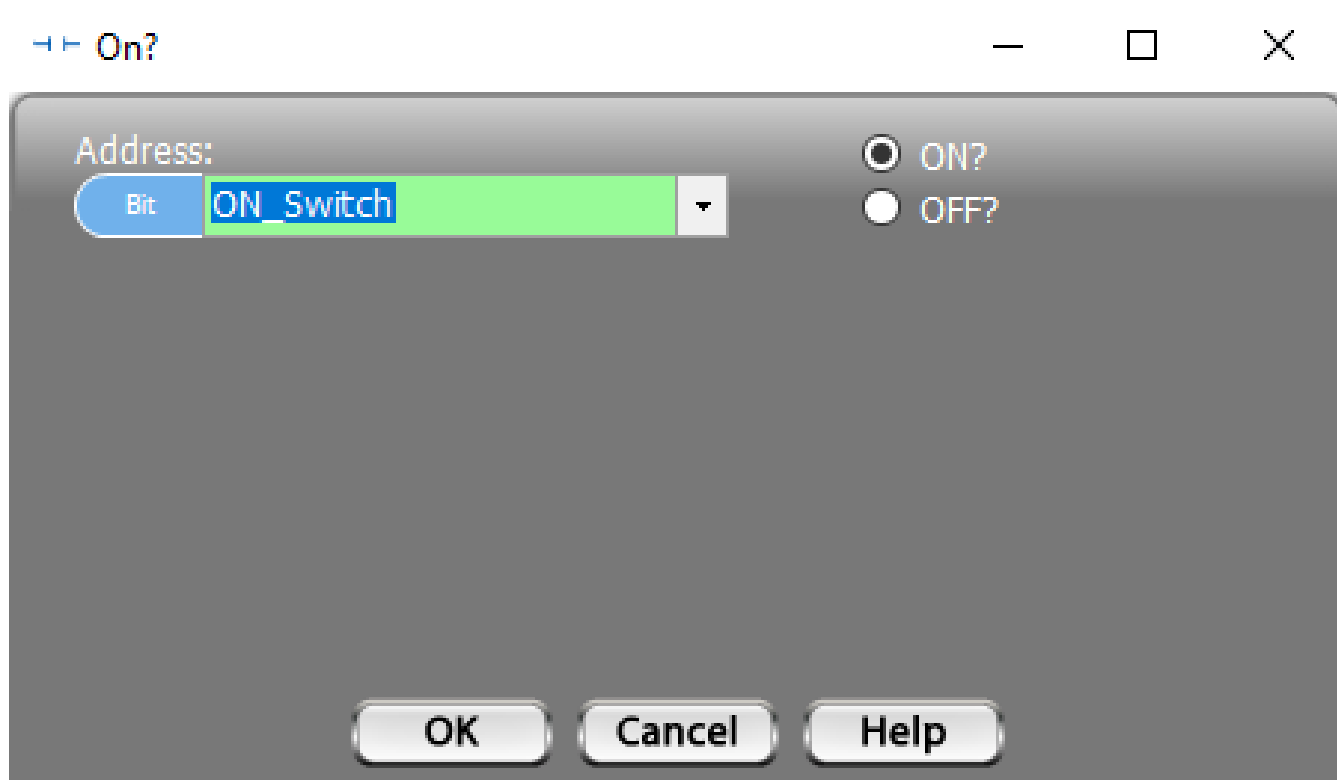
OutBitD1 address renamed to PiezoBuzzer tag.

Building the ON/OFF Controller Flowchart...



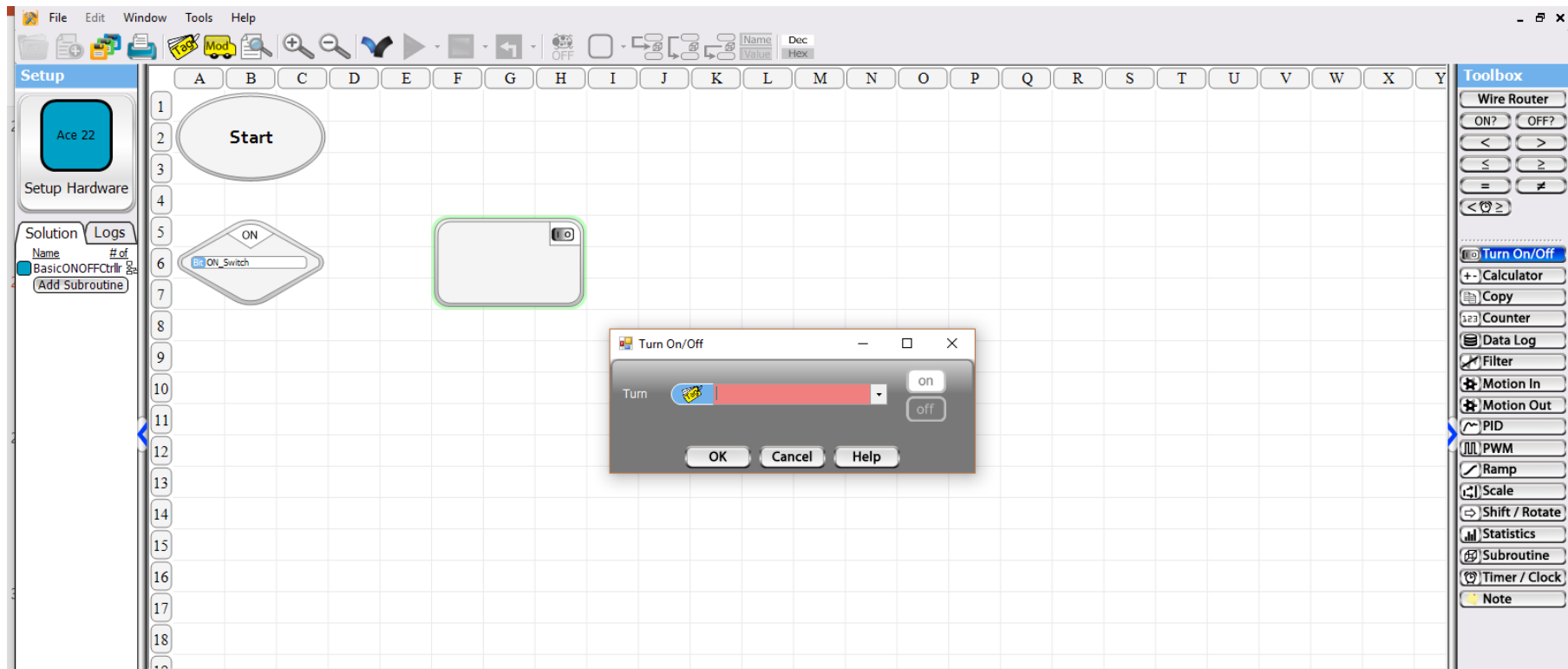
Select the ON Decision Block from the right side of Toolbox under Wire Router button.

Building the ON/OFF Controller Flowchart...



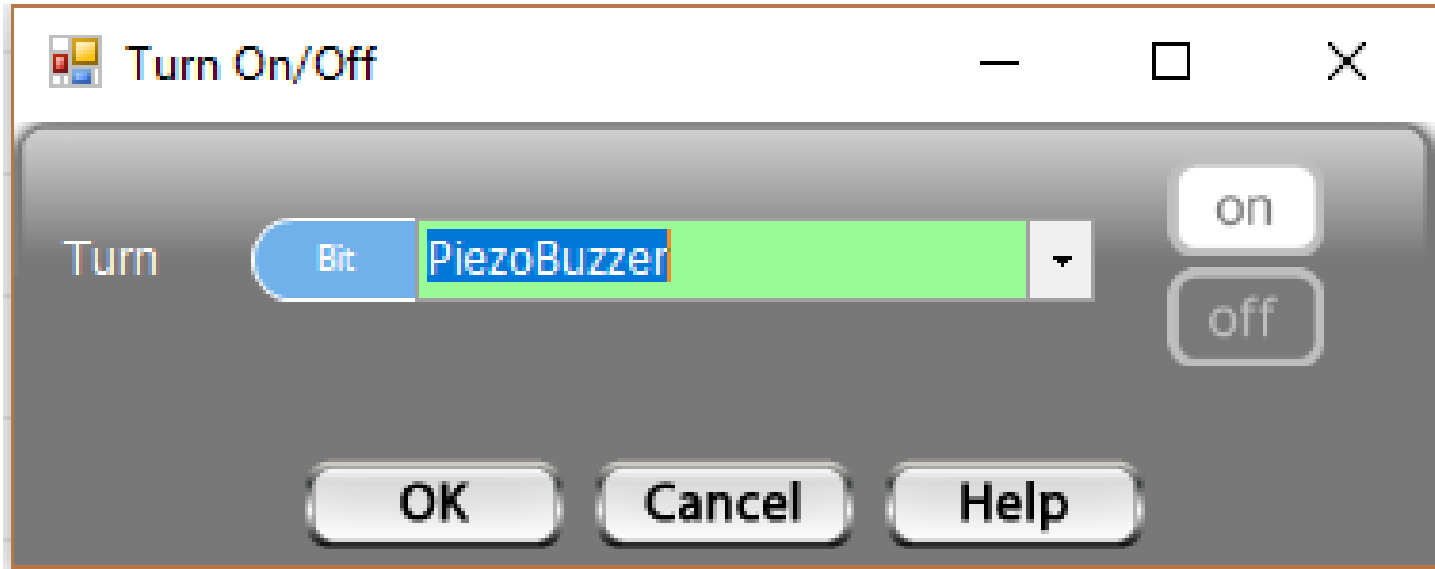
Selecting the ON_Switch Tag for the Turn ON/OFF Decision Block.

Building the ON/OFF Controller Flowchart...



Selecting the Turn ON/OFF Process Block.

Building the ON/OFF Controller Flowchart...



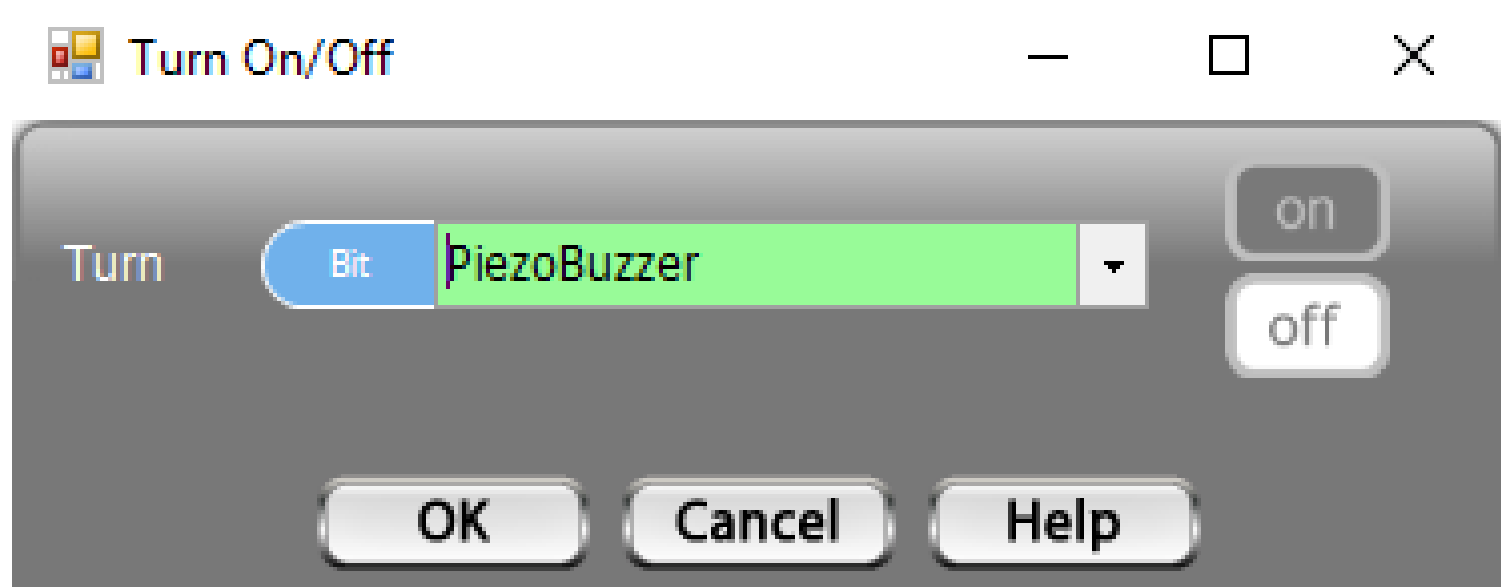
Selecting the PiezoBuzzer Tag for the Turn ON/OFF Decision Block.

Building the ON/OFF Controller Flowchart...

The screenshot displays a flowchart editor interface. On the left, a 'Setup' panel includes 'Ace 22' and 'Setup Hardware'. Below it, a 'Solution' panel shows a table with columns 'Name' and '# of', containing 'BasicONOFFCtrlr' and an '(Add Subroutine)' button. The main workspace is a grid with columns A-Y and rows 1-18. A flowchart is partially visible, starting with an oval 'Start' block at row 2, column B. A diamond-shaped decision block labeled 'ON' is at row 6, column B, with a 'Bit ON_Switch' input. To its right is a rectangular process block labeled 'turn' with a 'PiezoBuzzer' input and an 'on' output. A 'Turn On/Off' dialog box is open in the center, featuring a 'Turn' dropdown menu with a red bar, 'on' and 'off' buttons, and 'OK', 'Cancel', and 'Help' buttons at the bottom. On the right, a 'Toolbox' panel lists various components like 'Wire Router', 'ON?', 'OFF?', 'Calculator', 'Copy', 'Counter', 'Data Log', 'Filter', 'Motion In', 'Motion Out', 'PID', 'PWM', 'Ramp', 'Scale', 'Shift / Rotate', 'Statistics', 'Subroutine', 'Timer / Clock', and 'Note'. The 'Turn On/Off' block is highlighted in blue in the toolbox.

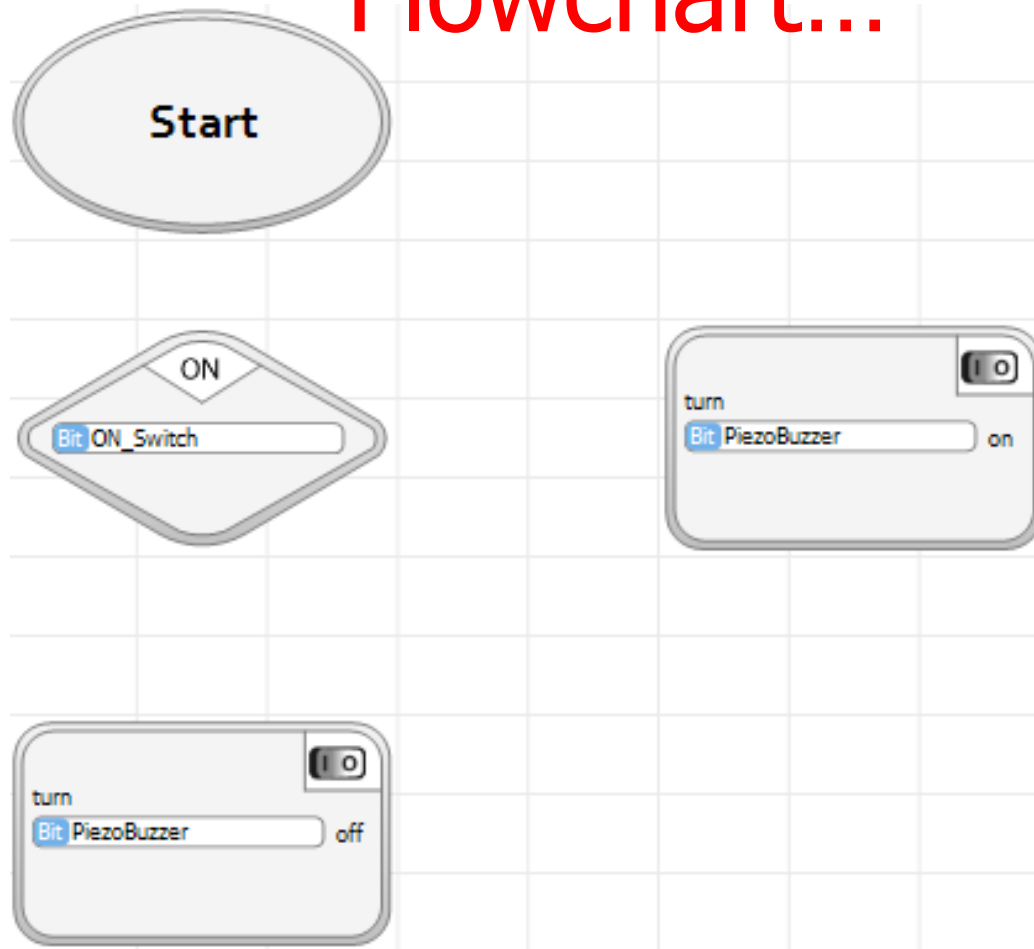
Selecting another Turn ON/OFF Process Block.

Building the ON/OFF Controller Flowchart...



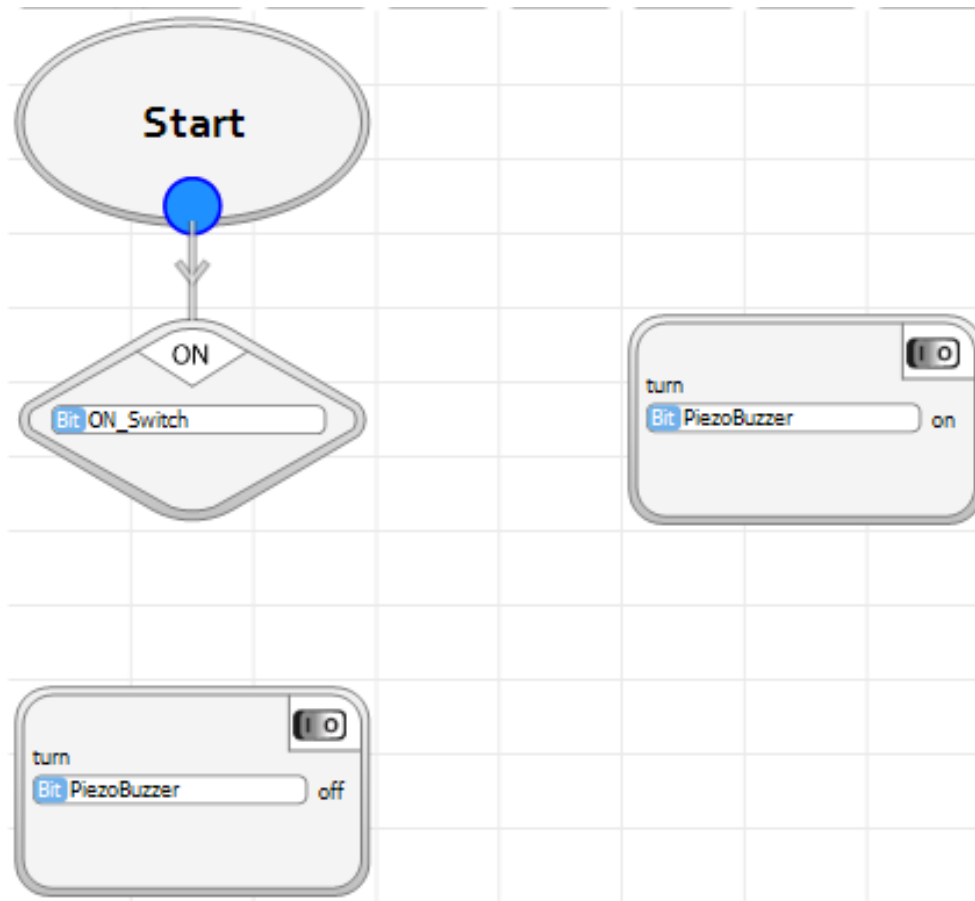
**Selecting PiezoBuzzer Tag for the Turn ON/OFF Process Block.
Select the OFF button for this Process Block.**

Building the ON/OFF Controller Flowchart...



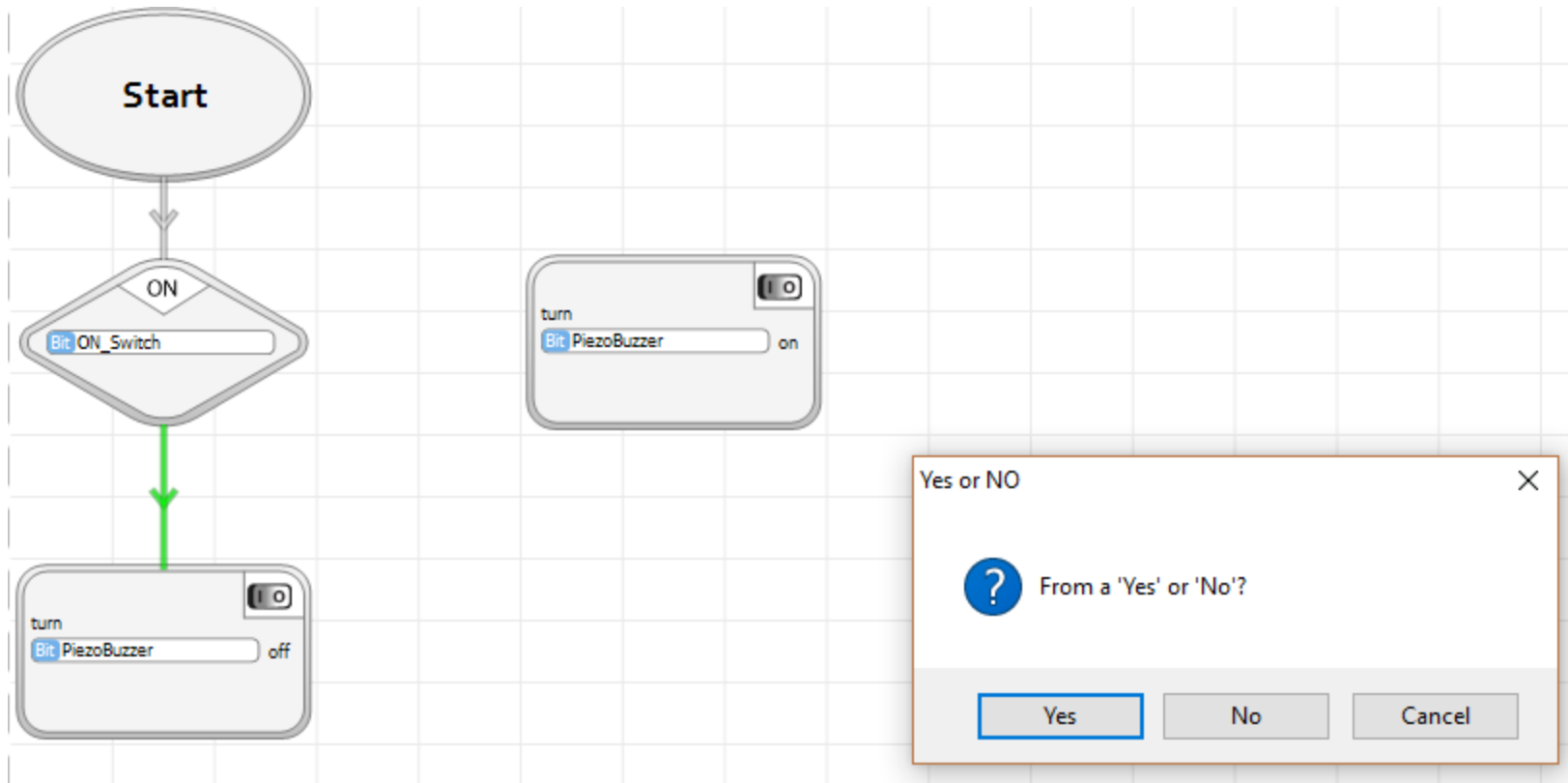
The Piezo Buzzer Turn ON/OFF Process and ON Decision Blocks for the ON/OFF Controller Flowchart have been configured.

Building ON/OFF Controller Flowchart...



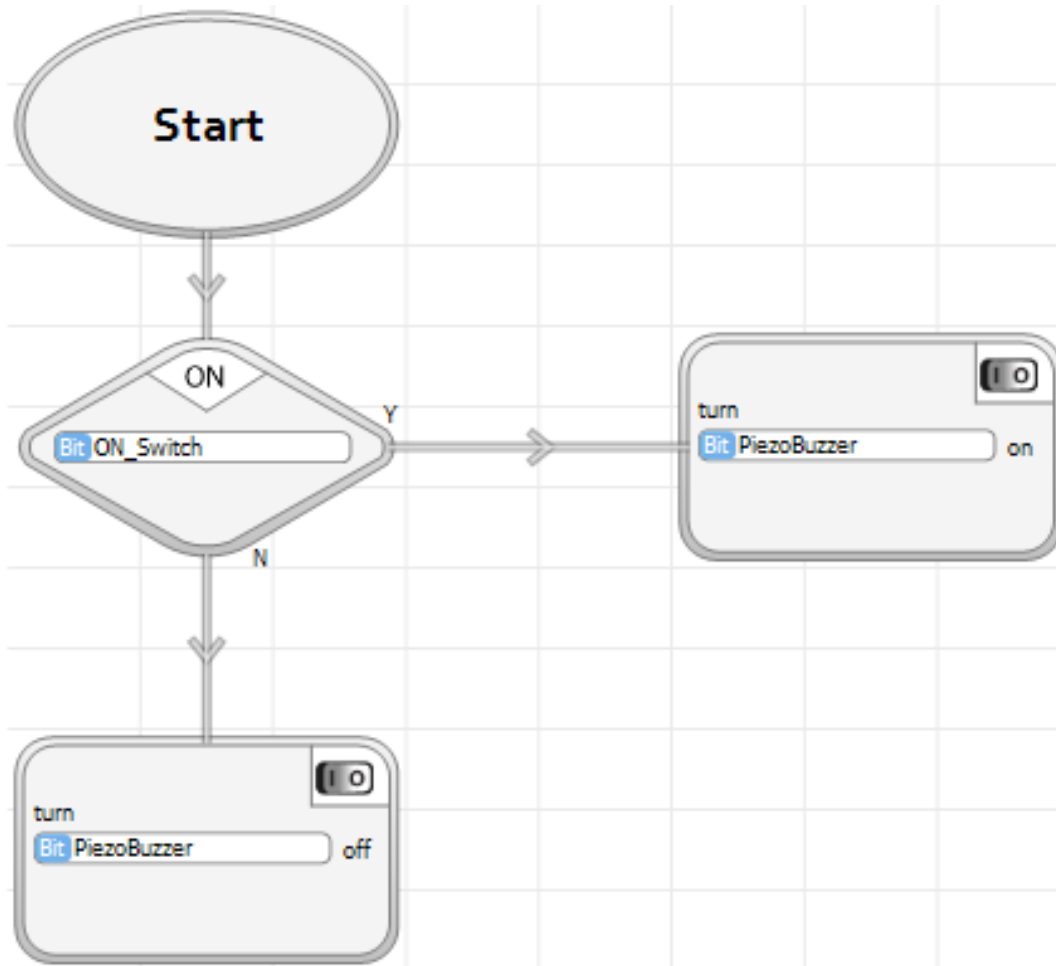
Select the flowchart symbol you want to attach with a click and drag motion of the mouse.

Building ON/OFF Controller Flowchart...



Select NO to finalize this connection to the Turn ON/OFF Process Block .

Building ON/OFF Controller Flowchart...

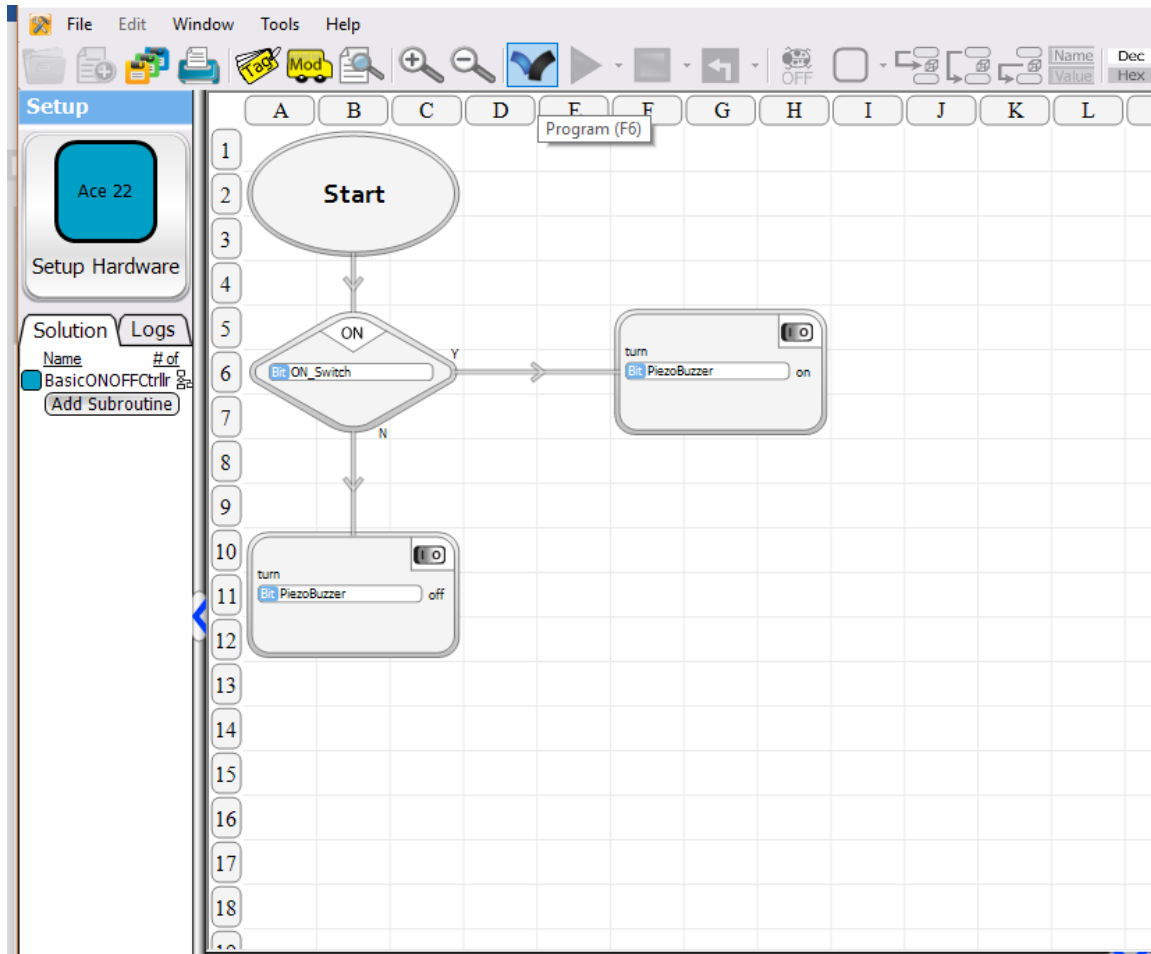


Dragging the arrow to the Turn ON/OFF (ON) Process Block will define this decision action as a Yes (Y).

Question 5

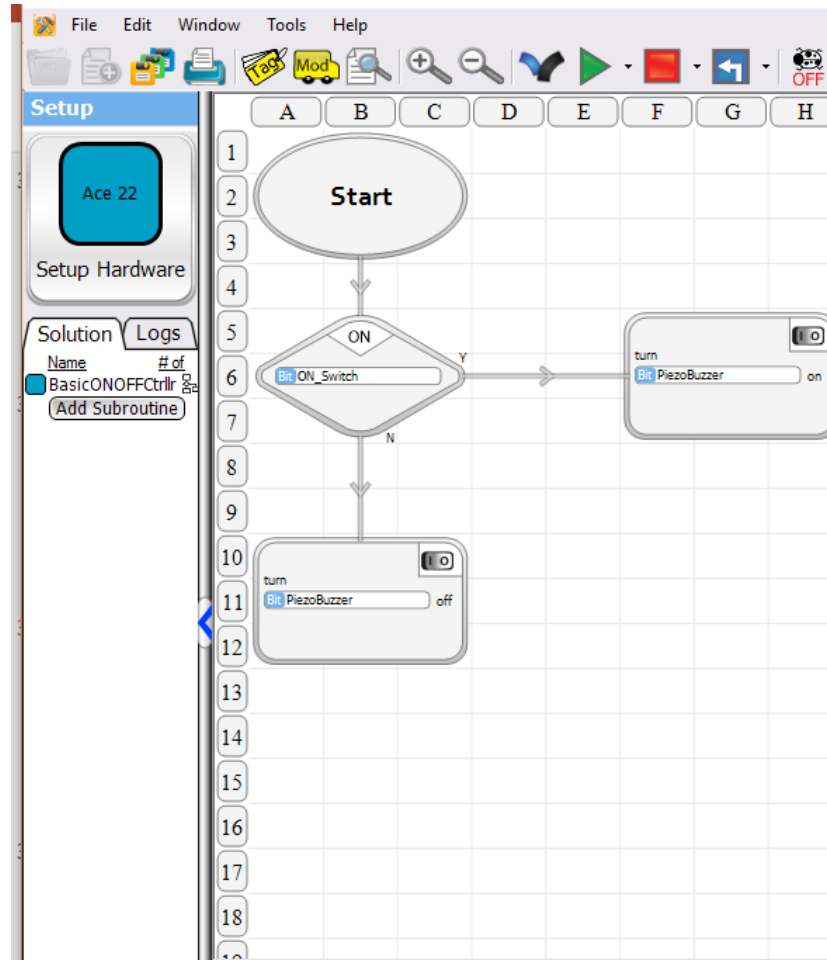
Describe how to create an inverting switch using the ON/OFF Controller Flowchart.

Building ON/OFF Controller Flowchart...



Click on the Velocio Icon to program the Ace 22 PLC.

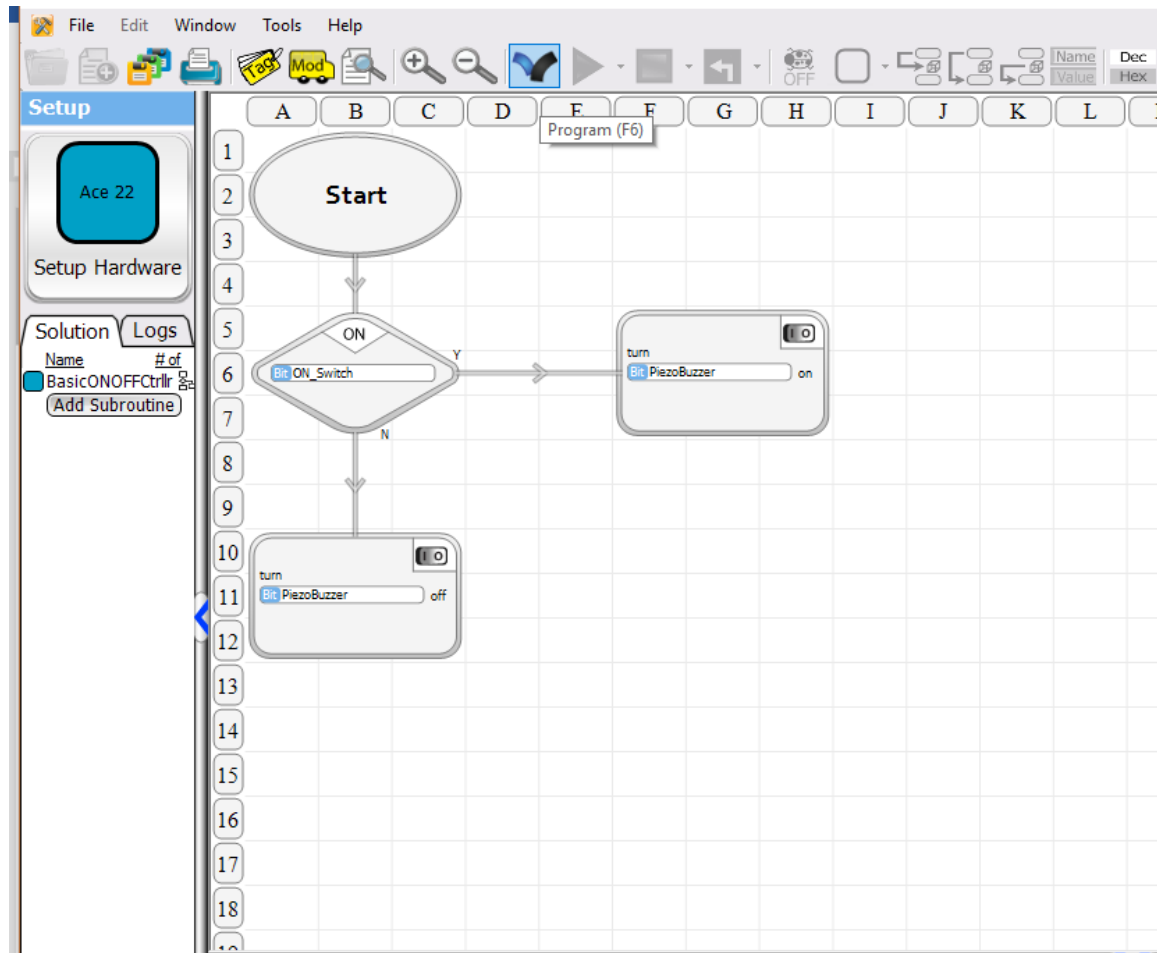
Building the ON/OFF Controller Flowchart...



The tool taskbar will become active once the PLC is programmed.

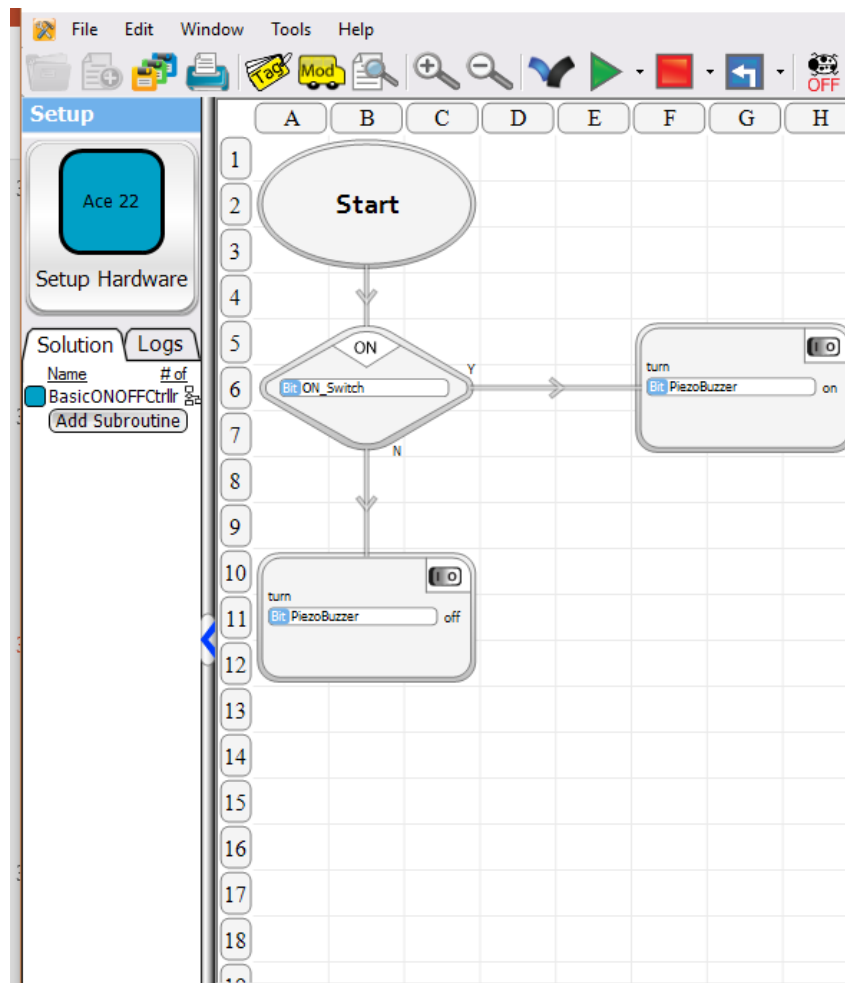
Presented by:

Programming the Ace 22 PLC



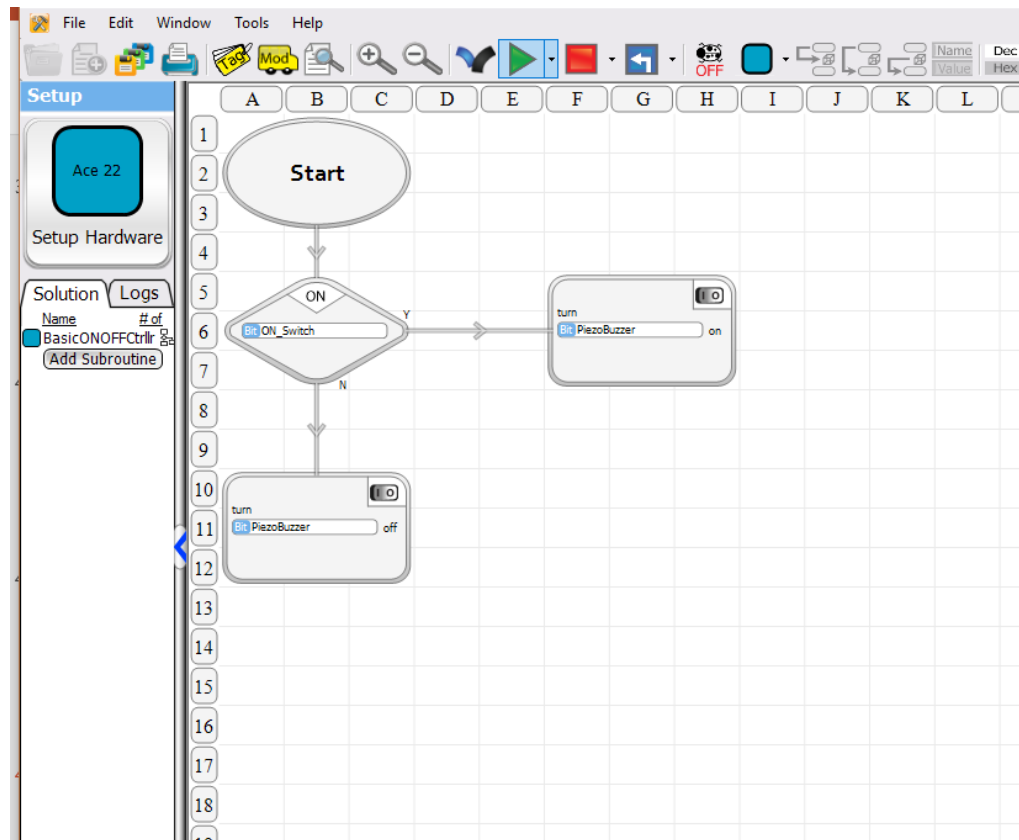
Click on the Velocio Icon to program the Ace 22 PLC.

Programming the Ace 22 PLC...



The tool taskbar will become active after once the PLC is programmed.

Running the Basic ON/OFF Controller Flowchart



Click the “Green” run button to operate the Piezo Buzzer with the Simulator switch.