

# 18 *Piecewise Linearization Lab*

## 18.1 Foreword

In many applications it is necessary to use one or more X,Y lookup tables. MOD 30ML provides multiple piecewise blocks with up to 60 x,y pairs which provide the lookup values for the Linearization blocks. Tuning displays can be created which allow the user to enter the X,Y coordinates from the front panel of the controller if desired.

The piecewise table block is a data only block. The table consists of two or more pairs of X, Y floating point coordinates (up to 60 pairs). A piecewise table can be constructed for supporting a linearization block or as a source of floating point recipe data. In addition, the X and Y coordinates are tunable parameters.

In this lab we will configure a piecewise block and a linearization block, and use them to linearize steam flow to a feedwater valve position, a typical requirement in a two or three-element boiler drum level controller. We will also construct a simple operating display and create tuning displays that will allow entry of new X,Y coordinates from the front panel.

## 18.2 Objectives

In this lab, we will create a very simple two-element drum level control strategy with a steam flow input, a drum level input, and a feedwater flow output. We will also place a piecewise table block and a linearization block in the strategy to adjust the output before it goes to the field. In Part II we will load a simple operating display from the Component Gallery and modify the Tune List to include the X,Y coordinates from the piecewise table so they will appear on the controller front face when the Tuning password is entered.

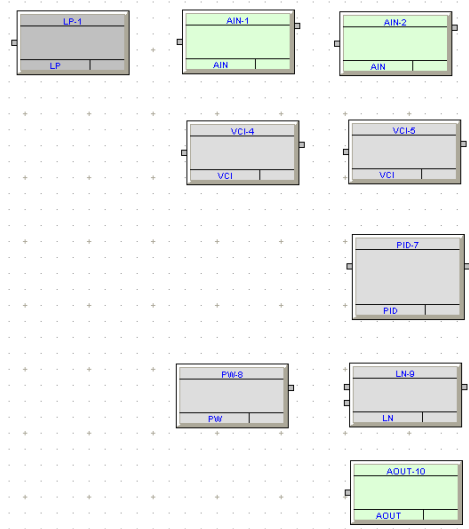
☞ NOTE: This lab assumes you have already completed all the standard ViZapp labs and you are familiar with the methods of placing and connecting blocks and configuring the OPC server for downloading to a controller.

## 18.3 PART I – Piecewise and Linearization Blocks Instructions

### A – SELECT AND PLACE THE REQUIRED BLOCKS

Step	Procedure	Comments
1.	Open a new Mod Function Block Diagram.	
2.	Place a new Loop Compound block in the workspace and call it DRUM LEVEL.	
3.	Open the compound. From the Algorithm library, select and place the following blocks: <ul style="list-style-type: none"> <li>Two AIN (built-in analog input) blocks</li> <li>Two VCI blocks</li> <li>One PID block</li> <li>One PW (piecewise) block</li> <li>One LN (linearization) block</li> <li>One AOUT (built-in analog output) block</li> </ul>	

Your workspace should look something like this:



**B - CONFIGURE THE INPUTS AND PID BLOCK**

**Step Procedure**

4. Open the AIN, VCI and PID blocks and make the following configuration entries:

AIN1  
 Name: FT-100  
 Input type: Current

AIN2  
 Name: LT-100  
 Input type: Current  
 Input number: 2

VCI1  
 Name: STM FLOW  
 Linearization type: Modified Square Root

VCI2  
 Name: LEVEL

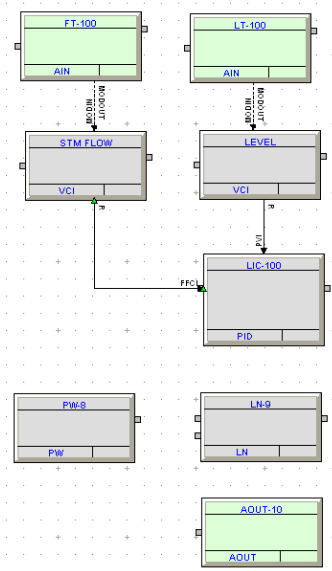
PID  
 Name: LIC-100  
 Feedforward Compensation Type: Add

**Comments**

We will leave all engineering units at 0 to 100 percent for the purposes of this lab.

5. Make the block connections as follows:  
 FT-100.MODOUT to STM FLOW.MODIN  
 LT-100.MODOUT to LEVEL.MODIN  
 LEVEL.R to LIC-100.PVI  
 STM FLOW.R to LIC-100.FFCI

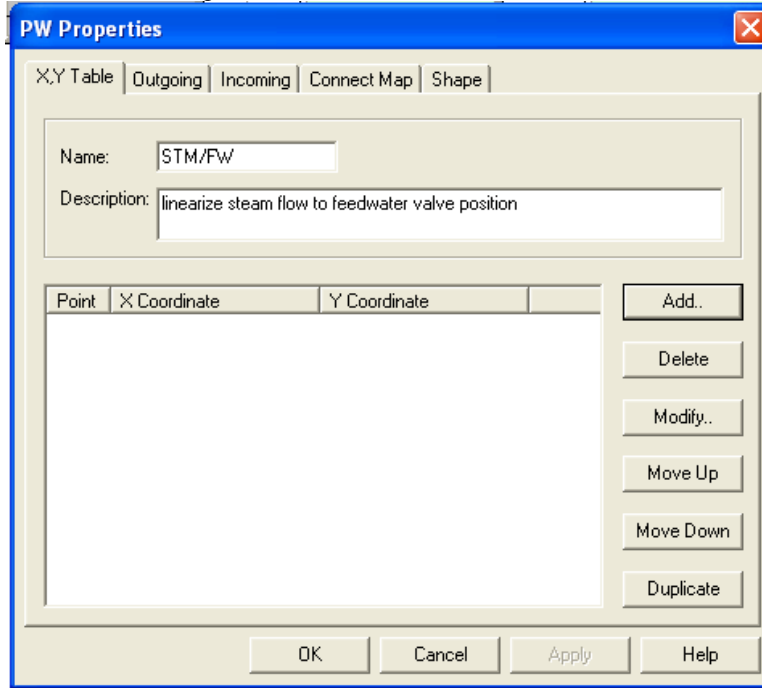
The strategy should now look something like this:



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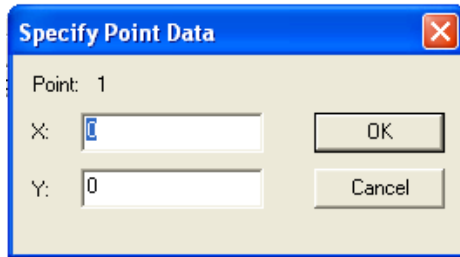
**C - CONFIGURE THE PIECEWISE TABLE BLOCK**

6. Double-click the PW block to open it.
7. Type STM/FW in the Name field and type a Description such as: linearize steam flow to feedwater valve position




8. Click the Add button in the right of the PW Properties menu

The Specify Point Data dialog box appears



9. Click OK. The X and Y coordinates for the first point are added to the block.
10. Create 8 more points using the Add button, with the following coordinates:

Since the actual values would almost always change when the controller is installed and commissioned, we will use linear values for initial configuration.

 The table can be used by the linearization block for either piecewise (X coordinates) or inverse piecewise (Y coordinates) linearization. The appropriate coordinates must ALWAYS be in ascending order with no duplicates.

Up to 60 pairs may be entered. Blocks can be cascaded if more pairs are required.

- Close the block by clicking OK.

## **D - CONFIGURE THE LINEARIZATION BLOCK**

- Double-click the LN block to open it.
- Type FW LN in the Name field and type a Description such as: Feedwater valve linearization
- Use the pull-down menu to set the Linearization Type to Piecewise

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15. Click OK to close the block.

### **E - CONNECT THE BLOCKS**

<b>Step</b>	<b>Procedure</b>	<b>Comments</b>
16.	Connect the output (OP) of LIC-100 PID block to the Input of the FW LN linearization block.	
17.	Select the connection icon again and double-click on the STM/FW piecewise block	A menu of possible connections appears
18.	Select TABLEOUT from the menu	
19.	Drag the cursor into the FW LN block and select the block	
20.	The only possible connection is TABLEIN; this is done automatically by ViZapp. Click on this connection.	
21.	Return to EDIT mode by selecting the arrow on the right toolbar	
22.	To check your connection, open the Linearization block and select the INCOMING tab.	

### **F – COMPILE THE DATABASE:**

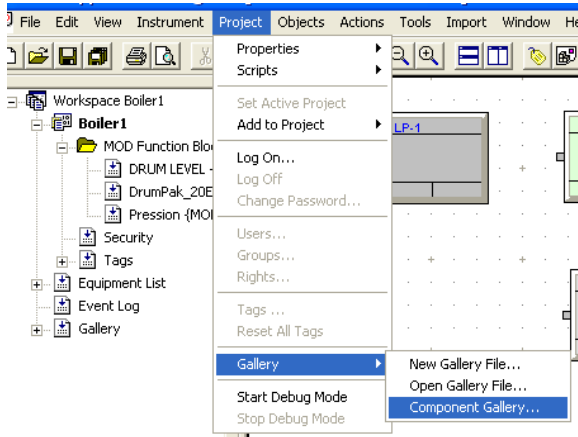
Save and compile your database. It is not necessary to download at this time since we have not yet constructed a display to view the coordinates.

# 18.4 PART II – Displaying Piecewise Coordinates Instructions

## A – LOAD AND CONFIGURE A PID DISPLAY

**Step Procedure**

1. Click on **Project** on the top toolbar of the workspace, then select **Gallery** and **Component Gallery**.



**Comments**

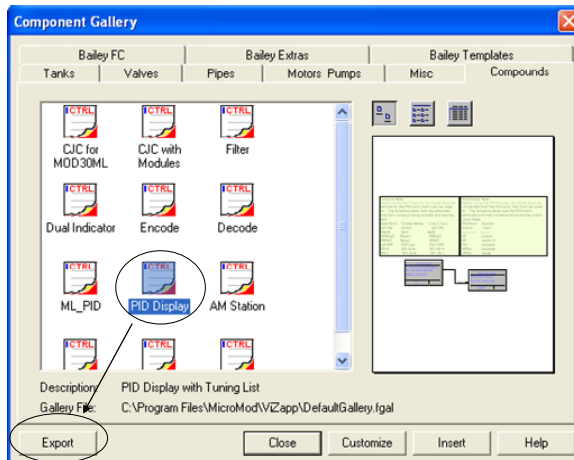
It is important to select Component Gallery rather than Open Component Gallery or New Component Gallery, both of which will try to install a new gallery file.

If your Component Gallery appears empty, close ViZapp. Launch **RestoreGallery** from the MicroMod Automation\ViZapp folder of the Windows Start Menu, then follow the directions.

Re-open ViZapp, load your strategy and open the Loop Compound, then access the Component Gallery as shown at right.

2. Click on the Compounds tab in the Gallery, and select PID DISPLAY.
3. Click the Export button to place the compound in your workspace.

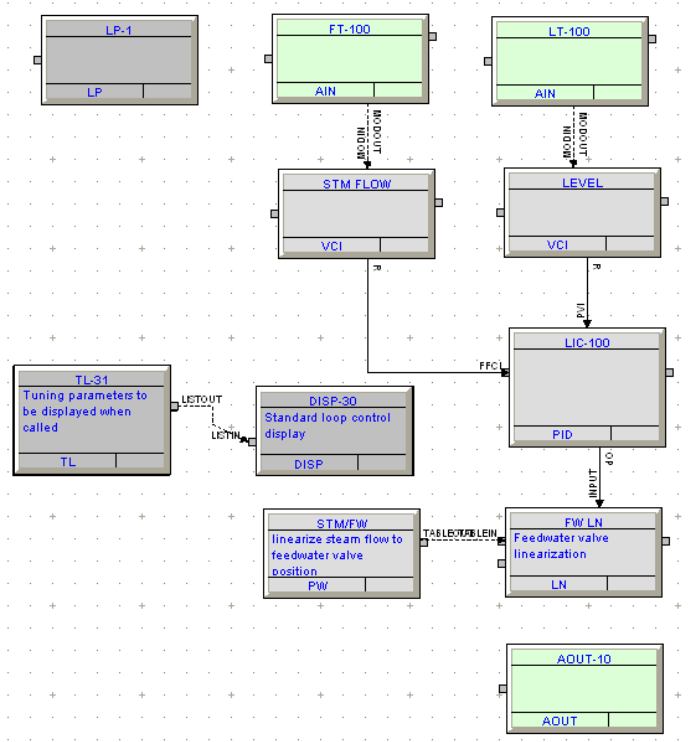
The resulting blocks overlay your original strategy. This will be fixed in the next steps!



4. Select and delete the Notes blocks.
5. Hold down the SHIFT key and select the TL and DISP blocks. Move them to the right of your work area, away from the other blocks.  
Your workspace should resemble this:

Note that the connection line moves with the blocks.

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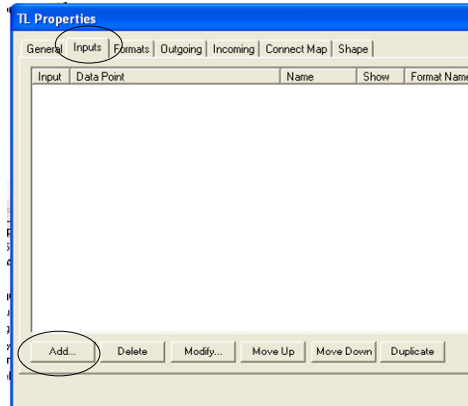
6. Double-click on the DISP block to open it, and make the following entries:  
 Name: LVL DISP  
 Description: Drum Level operating display  
 Display Tag: LIC-100
7. Click OK to close the block.
8. Select the Multi-Segment connection icon from the Algorithms window.
9. Click on the PID block and select OP from the list.
10. Drag the cursor over the DISP block and select it.
11. Select the attribute “output” from the list.
12. Make the following additional connections from the PID block to the DISP block:  
 PID.PVI to DISP.process  
 PID.SP to DISP.setpoint



**B – CONFIGURE THE TUNE LIST BLOCK**

13. Double-click on the TL (Tune List) block to open it.

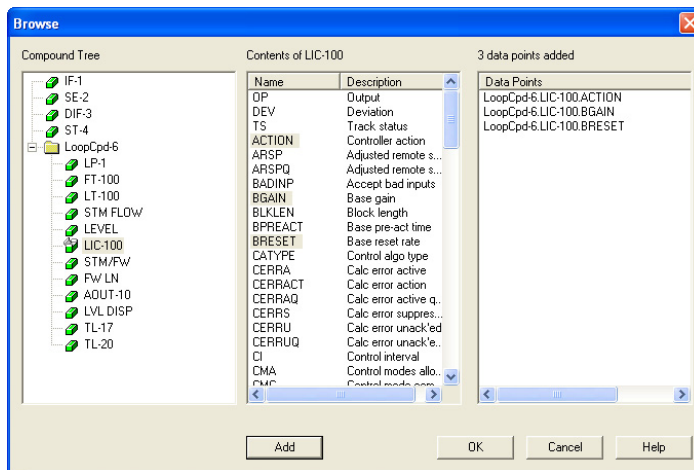
14. Click on the Inputs tab, then click the Add button at the bottom of the TL Properties menu. The tag browser dialog box appears.



15. In the right column of the Browser, double-click LIC-100 All the attributes in the PID block appear in the middle column.

16. While holding down the Ctrl key, select ACTION, BGAIN and BRESET from the list in the middle column, then click the Add button at the bottom of the dialog box. This will allow adjustment of the controller Gain, Reset, and output Action (direct or reverse) from the front panel.

DO NOT click “OK” yet!



As you select the attributes they will be highlighted.

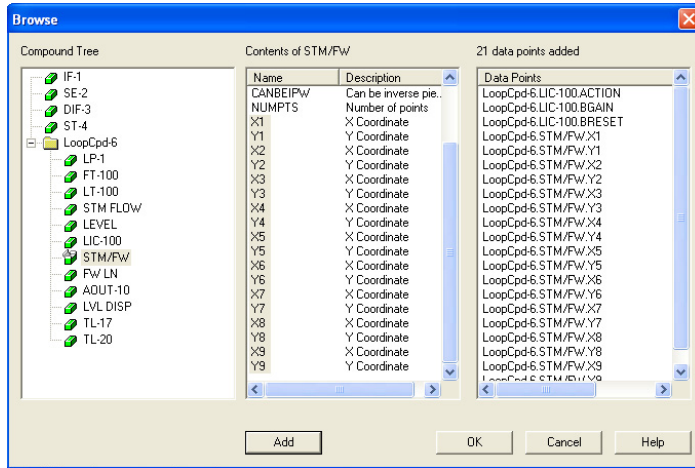
When you click the Add button they appear in the left window of the menu.

17. In the right window, double-click STM/FW

18. Hold down the SHIFT key and click on X1, then Y9. All the X,Y attributes from 1 to 9 should be highlighted

19. Click the Add button All the X,Y attributes are added to the right window

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20. Click OK to close the Browse dialog

All the added attributes now appear in the TL Properties Inputs tab.

21. Select the number 1 under Inputs and click on the Modify... button at the bottom of the window

You can also double-click the number 1

22. Make the following entries in the Specify Input Data window:  
 Display Format Name: Action  
 Line 2 Text: ACTION

The Display Format "Action" was predefined in the compound.  
 The first line of text will be the Display Tag name (LIC-100)

Click OK to close the dialog box.

23. Enter the Input Data for Inputs 1 and 2 (Gain, Reset) as follows:

Input 2  
 Display Format Name: Gain  
 Line 2 Text: GAIN

Input 3  
 Display Format Name: Reset  
 Line 2 Text: RESET

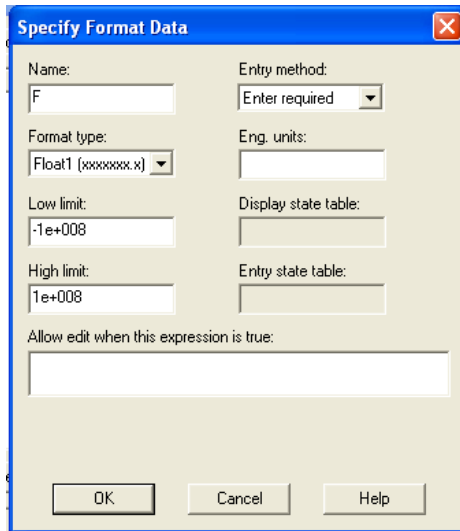
24. Click on the Formats tab at the top of the TL Properties window

25. Click the Add button at the bottom of the window

The Specify Format Data window appears

26. Enter the following:  
 Name: F (an arbitrarily chosen name)  
 Format type: Float 1 (floating point, one decimal place)  
 Low limit: -1e+008  
 High limit: 1e+008  
 Entry method: Entry required

The new format is now added to the Format list, and ready to be used by inputs.



Click OK to close the window

27. Click on the Inputs tab at the top of the TL Properties window
28. Double-click on Input 4 (LoopCpd.STM/FW.X1)
29. Make the following entries:  
 Display Format Name: F  
 Line 1 Text: click Use This Text and type FW OP X1  
 Line 2 Text: FW CV
30. Continue configuring the remaining X,Y attributes as shown in the table below.

Input	Data Point	Display Format Name	Line 1 Text	Line 2 Text
5	LoopCpd.STM/FW.Y1	F	FW OP	FW CV Y1
6	LoopCpd.STM/FW.X2	F	FW OP X2	FW CV
7	LoopCpd.STM/FW.Y2	F	FW OP	FW CV Y2
8	LoopCpd.STM/FW.X3	F	FW OP X3	FW CV
9	LoopCpd.STM/FW.Y3	F	FW OP	FW CV Y3
10	LoopCpd.STM/FW.X4	F	FW OP X4	FW CV
11	LoopCpd.STM/FW.Y4	F	FW OP	FW CV 4
12	LoopCpd.STM/FW.X5	F	FW OP X5	FW CV
13	LoopCpd.STM/FW.Y5	F	FW OP	FW CV Y5
14	LoopCpd.STM/FW.X6	F	FW OP X6	FW CV
15	LoopCpd.STM/FW.Y6	F	FW OP	FW CV Y6
16	LoopCpd.STM/FW.X7	F	FW OP X7	FW CV
17	LoopCpd.STM/FW.Y7	F	FW OP	FW CV Y7
18	LoopCpd.STM/FW.X8	F	FW OP X8	FW CV
19	LoopCpd.STM/FW.Y8	F	FW OP	FW CV Y8
20	LoopCpd.STM/FW.X9	F	FW OP X9	FW CV
21	LoopCpd.STM/FW.Y9	F	FW OP	FW CV Y9

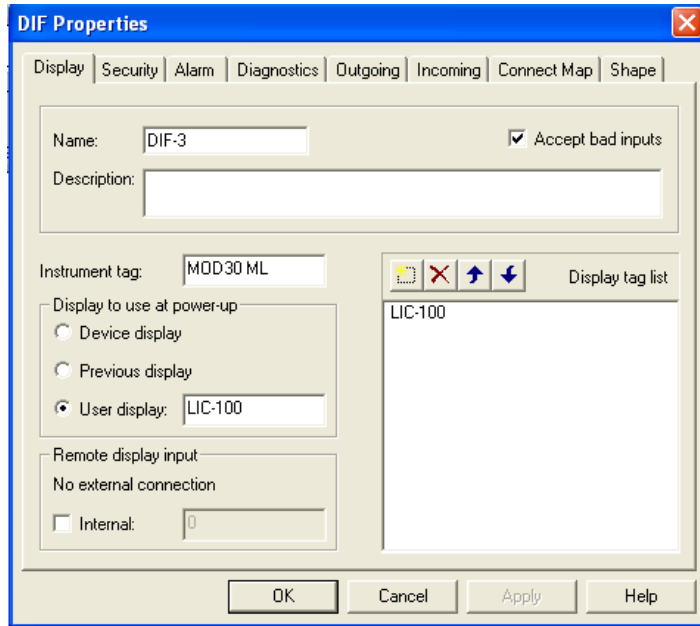
31. Click OK to close the TL Properties window.

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**B – COMPLETE THE DATABASE, COMPILE AND SAVE**

32. Connect the Result (R) of the FW LN block to the INPUT of the Analog Output block.
33. Close the Loop Compound
34. Open the Display Interface Block (DIF) and add the tag LIC-100 to the Display Tag list.

Specify User Display to be used at power up and enter LIC-100.



35. Add an MSC block to the database and make sure it is set for RS-232 Built In communications.
36. Compile the database and create a MIF file using a filename of your choice, such as DRUM or LEVEL.
37. SAVE YOUR DATABASE!

**D – DOWNLOAD AND VIEW THE TUNING PAGES**

38.	Open the OPC server and add the device	
39.	Return to ViZapp and download the database	
40.	From the front panel of the controller, press and hold the Scroll key. Enter the Tuning password, then scroll through the displays to view the X,Y coordinate entry pages.	