

# **Rockwell Software**

# **Connected Components Workbench**

  

## **Micro800**

## **Programming**



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This document is a supplement to the “Lab 1.doc” lab exercise that introduces one to the basics of ladder logic programming. The following equipment is assumed:

A-B 2080-L50E-24QBB Micro850

24-volt power supply

This document is primarily for Rev 13 of the Connected Components Workbench (CCW) software. A USB cable connection from the PC to the processor is also assumed.

In order to become familiar with basic ladder logic programming and addressing techniques on the Allen-Bradley equipment, the steps to accomplish the first part of the first lab exercise are outlined in sections A, B, and C. The remainder of the sections outline the steps to document your ladder, to print the ladder logic program, and to save your ladder logic diagram. The last section explain the differences when programming offline, accessing the programming software outside of the laboratory.

In an industrial setting, the initial PLC programming is done offline and then later downloaded to the PLC when ready for the final test and debug.

Rockwell Software CCW version 13.0 is used to program the Allen-Bradley Micro800. Icons for these programs should already be on the desktop.

The PLC and the PC used to program it are connected directly through a USB link.

## A. STARTING A PROJECT WITH THE MICRO800

Make sure PLC is powered.

Start RSLinx Classic if not already running.

Start the Connected Components Workbench (CCW) programming software by clicking on the CCW icon on the desktop, or by selecting

Start | Rockwell Automation | Connected Components Workbench

**If your project is already in the PLC**, either select it from the list in the "Recent" section, or select "Open Existing.." and browse to your project, and then click on **OK**. Skip to the online programming functions.

**If starting a new project:**

Click on "New"

Type a name for your project and use the default location, or browse to the S:\ drive for the location.

Click on **Create**

A window will pop up to select the hardware

Expand "Controllers" and then "Micro 850"

Select 2080-LC50-24QBB

Make sure version is "12" and then click on **Select**

Click on **Add to Project**

The processor configuration information is displayed as a tree in the center of the screen.

Select the catalog number of the three plug-in modules.

Right-click on "<Empty>" in "Plug-in Modules". Select "Digital" and then "2080-IQ4OB4"

Repeat for the other two. All three plug modules are the same.

Now set the aliases for the discrete input and discrete output channels.

Double-click on "Global Variables" in the project tree on the left side of the screen.

You may want to adjust the column widths to show the "Alias" column, which is on the right side.

Type in the aliases for output channels 0 to 4, which are addressed as

\_IO\_EM\_DO\_00 to \_IO\_EM\_DO\_04

Type in the aliases for input channels 0 to 3, which are addressed as \_IO\_EM\_DI\_00 to \_IO\_EM\_DI\_03

The PLC hardware has now been configured.

The default PC display consists of one main window, a project tree window on the left, and a toolbox window on the right. The main window displays the ladder logic program, tags, or hardware. The particular window is selected with the tab on the upper part of the window.

Verify that the connection to the PLC has been set to use the USB port. Do the following:

On the top menu bar, click on **Device**

On the pull-down menu, select ***Setup connection path***

On the pop-up window, the "Selected Path" should end with "USB\xx"

If not, click on the ***Browse*** button to set up the communication path

On the pop-up window, click on "+" box next to "USB" since the processor is connected with a USB cable to the PC.

Select the line with "Micro850".

Click on **OK**.

Click on ***Close***

## **B. LADDER LOGIC PROGRAMMING**

The MicroLogix processors cannot be edited while on-line. One must edit the program while off-line and then the program downloaded to the processor.

The OFFLINE/ONLINE box should show "OFFLINE". If not, click on the arrow to the right of "REMOTE" box. The steps necessary to program the first part of the experiment, the series rung, will be explained in detail. For the other parts of the exercise, only the different steps required to do these parts are explained.

### **1. Two Contacts in Series (Logical AND)**

The first ladder program to be implemented will be a simple series control rung. Two switches, LS and WT\_SENSE, will be placed in series and will be used to control a single light, LA5.

To define a new program, in the project tree, right-click on "Programs", then "Add", then "New LD: Ladder Diagram". The new program is added to the project tree. Click on the name of the new program if you want to change it.

To show the ladder program in the Editor window, double-click on the program name in the project tree. The ladder logic appears, which consists of an empty rung. The edit icons (tools) can be shown in two ways:

1. Toolbar at top. Notice the two small "down arrows" above the first rung and on the right side. Click on the top arrow to open/close the toolbar.
2. Toolbox to the right of the ladder diagram. If the toolbox is not being shown on the right side, click on the "Toolbox" tab on the right side and then click on the horizontal "pin" icon to disable the auto-hide of the toolbox.

To put in the contacts and coil, do the following:

A normally open (NO) contact is needed at the input. Two ways of placing it:

1. Click on the blank rung. It should be surrounded by a light green box. Click on the contact (-| |-), called a "Direct Contact" in the toolbox window. It will appear in the rung. Double-click on the contact. A window will pop up to specify the address controlled by the contact. Click on the "I/O-Micro 850"

tab. You may need to scroll horizontally to see the aliases. Select the appropriate channel (\_IO\_EM\_DI\_02, LS). Click on “OK” to close the popup.

2. Click on the contact (-| -), called a "Direct Contact" in the toolbox window and drag it to the left side of the rung. When a box with a "+" appears below the contact, that is where it will be placed. A window will pop up to specify the address controlled by the contact. Click on the "I/O-Micro 850" tab. Select the appropriate channel (\_IO\_EM\_DI\_02, LS). Click on “OK” to close the popup.

Place another NO contact to the right of the other contact and specify “\_IO\_EM\_DI\_03” as the control.

Place an output coil (-( )-) to the right of the two contacts and specify “\_IO\_EM\_DO\_04” or “LA5”. (Note: you may need to horizontally scroll to see the coil on the right side of the rung.

In order to run this program, the changes must be downloaded into the PLC, as the changes you just made were not actually entered into the PLC memory. Steps:

Save program (disk icon on top of screen)

Build program (top menu Device | Build). If the “Output” window does not appear at the bottom, click on the “Output” tab on the bottom. Correct any errors.

Connect to controller. Click on “Disconnected” on the top tool bar.

A pop-up should appear, informing you that the current program does not match the program in the PLC. Select **Download current project**.

Select **Download** again.

When prompted about changing to Run mode, select **Yes**.

Try the input switches in various combinations and observe the output. Also observe the changing status of ladder components on the screen. Energized or true conditions cause the elements to be highlighted (red) on the ladder diagram.

## 2. Entering Branches (Logical OR)

Click on the “Connected” button to disconnect and return to offline editing.

A branch is added and the WT\_SENSE contact is moved to be parallel and below the LS contact,

Click and drag the branch icon in the toolbox to the left side of the LS contact.

Click and drag the WT\_SENSE **contact** into the branch.

Connect to the processor and download the program.

Test your program.

## 3. Timers

To put a timer block on a rung:

Place the cursor on the rung and double-click on the "Instruction Block" icon in the toolbox, or drag the "Instruction Block" icon to where you want to place the timer in the rung.

Double-click on box in the rung and specify the timer type as one of the following:

TON – On-delay

TOF – Off-delay  
RTO – Retentive on-delay

and the press <Enter>. The timer block appears in the rung. Note that it appears very similar to an S7 timer.

The PT input is the preset time. One can specify a tag name or time constant in the form T# format.

The output of the controller is the Q output.

The timer accumulator value is shown online after the ET output.

#### **4. Counters**

Counter blocks are placed in the ladder rung in much the same way as timers. To put a timer block on a rung:

Place the cursor on the rung and double-click on the "Instruction Block" icon in the toolbox, or drag the "Instruction Block" icon to where you want to place the timer in the rung.

Double-click on box in the rung and specify the timer type as one of the following:

CTU – Up counter  
CTD – Down counter  
CTUD – Up/down counter

and the press <Enter>. The counter block appears in the rung.

The PV input is the preset value. One can specify a tag name or integer constant.

The output of the timer is the Q output.

The counter accumulator value is shown online after the CV output.

Note that the Reset input can only be a variable, so one will generally define a internal coil that any reset logic (for example two contacts in series) drives and the Reset input to the counter is the name of the internal coil.

#### **5. Editing the Ladder**

Internal coils can be easily added to the program variables. Double-click on the “Local Variables” line beneath your ladder program and add them as names in the first column. Make sure the data type is correct.

### **C. ADDING COMMENTS TO LADDER PROGRAM**

To add comments to the ladder logic, if there is no “green space” above the rung, enable the comment display (for the rung) by right-clicking on the left side of the rung and select “Display Comment”. To enter a comment, double-click on the green space above the rung ladder logic. A cursor will appear. When finished, click outside the comment box.



## D. INPUT/OUTPUT FORCING

For inputs, the force function allows one to override the actual status of external inputs by forcing individual discrete inputs to be ON or OFF. Input forces are written to the input image table and have no effect on the actual input. The value in the force table overrides the actual input. For example, if `_IO_EM_DI_02` is forced to 1 (ON), it will appear in the input image and ladder logic as 1, regardless of the actual status of the device.

For outputs, the force function allows one to override the processor logic and force individual discrete outputs to be ON or OFF. Output forces are written directly to the output device and do not appear in the output image table. The value in the force table overrides the value in the output image. For example, if `_IO_EM_DO_02` is forced to 1 (ON), the actual output will be ON, regardless of how it appears in the ladder and output image table.

Note: Enabling or disabling forces can result in sudden machine movement, possibly injuring personnel. Applying of removing forces while forces are enabled takes place immediately, with no prompt for confirmation. **USE EXTREME CAUTION WHEN USING FORCES!**

Physical inputs are forced while on-line test mode.

Make sure you are not in the “Run Mode Change” state (indicated by “Run Mode Change” dark).

Double-click on “Global Variables” in the project tree.

The variable list will appear with a couple of additional columns.

Click on the checkbox in the “Lock” column for a variable to change the forcing function. The variable is being forced if the box has a checkmark.

Click on the checkbox in the “Logical Value” column for a variable to change the value function. The variable is being forced to “True” or “On” if the box has a checkmark.

## E. PRINTING A LADDER LOGIC PROGRAM

Prints the program as a .docx or pdf file. In project tree, right-click on the program to be printed and select Document Generator. In the print screen, select the following:

Select the type of file ("Microsoft Word" or :PDF Document")

Change the paper size to "Letter"

Click **Generate**

Specify the name of file and the folder to place it in.

Click **Save**

Generates document and then if .docx is generated, asks to open it for display