# Yaskawa Camming Function

## Objective

The objective of this lab is to provide an introduction to Yaskawa's Camming Function and the process surrounding Camming in the Motionworks IEC 3 software. The contents of this lab will include:

- How to enter and edit cam data to Motionworks
- How to upload and view files on the controller
- How to execute camming movements via function blocks

## Background

Camming is a traditionally physical mechanism that is used to transmit motion or force in a controlled manner, often converting rotary motion into linear motion. There is typically an input motion and an output motion, referred to as master and slave respectively. The software and orientation videos that this lab is based off use that language and are clearly outdated, but recently there is a movement to change master-slave vocabulary to controller-peripheral. Do keep this in mind that the lab will try to refrain from master-slave usage, but the software's language cannot be changed. We will be making a program that the controller-peripheral relationship shown in Figure 1.

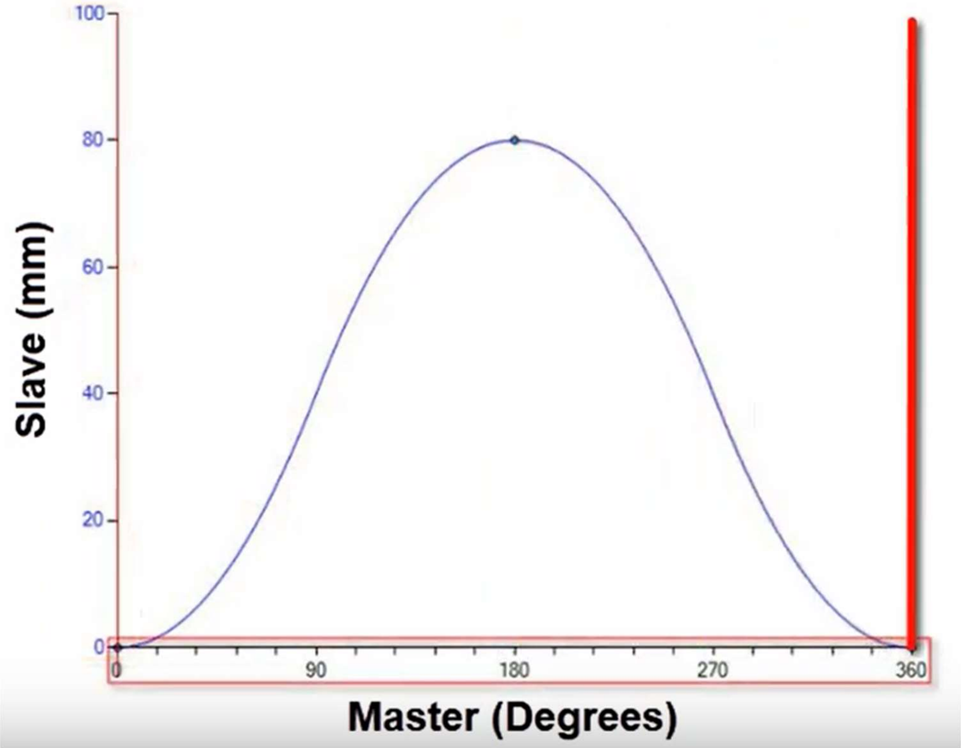


**Figure 1: Graph of Controller (Master) and Peripheral (Slave) Motion from** Yaskawa Cam Basics

## Step 1: Connect and Configure Controller in Motionworks

- Search for the MotionWorks IEC in the computer and launch the application. If your window looks like Figure 3 instead of Figure 2, then go to the top left and hit File>New Project and Figure 2 should open.

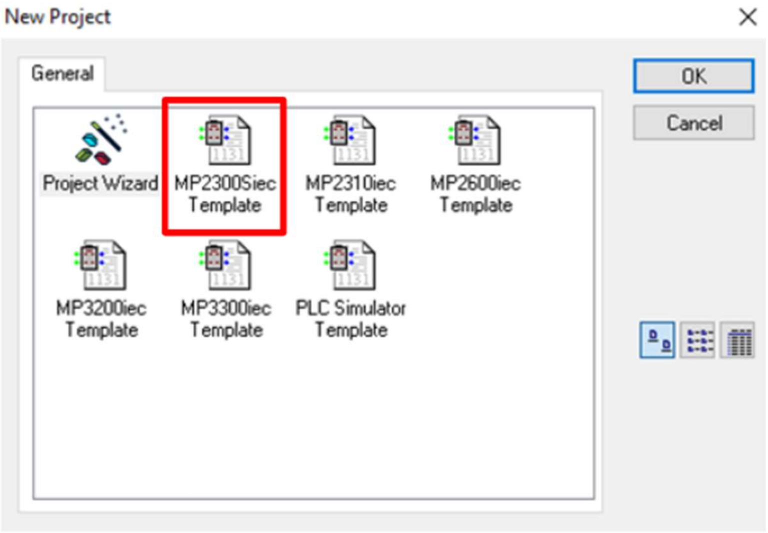


**Figure 2: New Project Prompt Window**

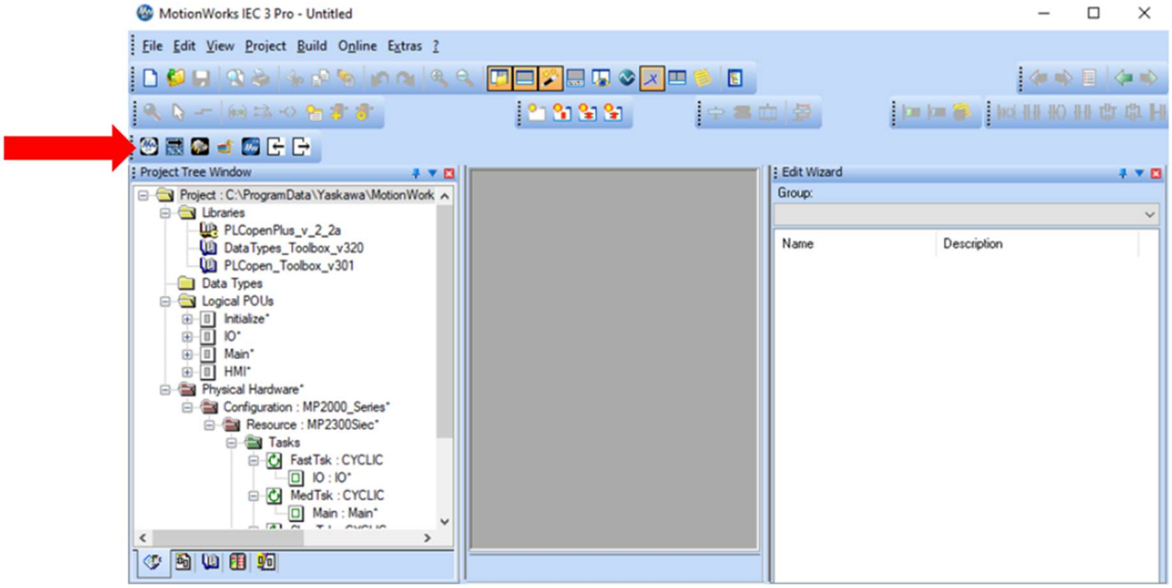
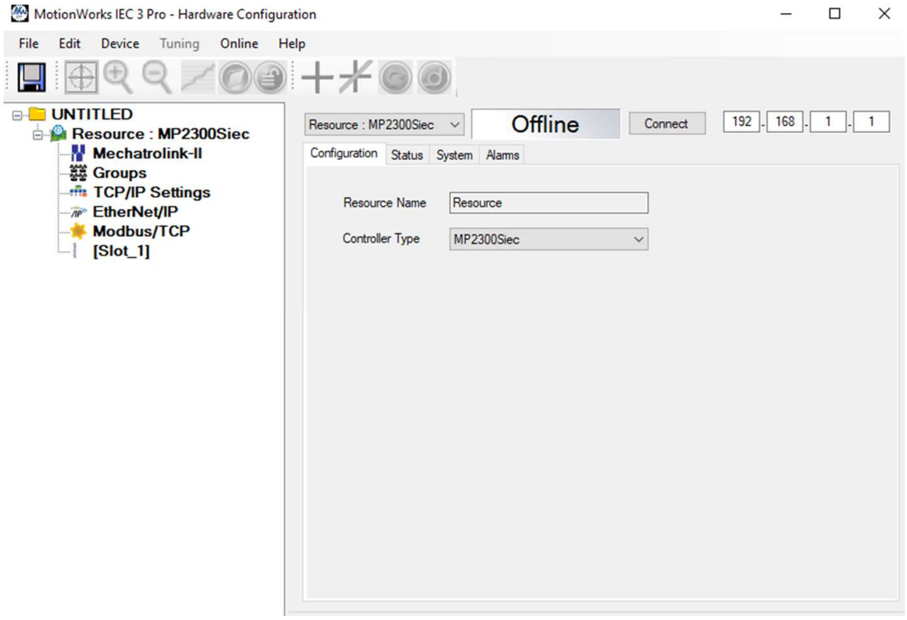


**Figure 3: MotionWorks IEC Workspace with Arrow to Hardware Configuration**

- Once in the Hardware Configuration Window, ensure that the IP in the top right corner matches what is shown in Figure 4. Then hit the ‘Connect’ button to proceed.



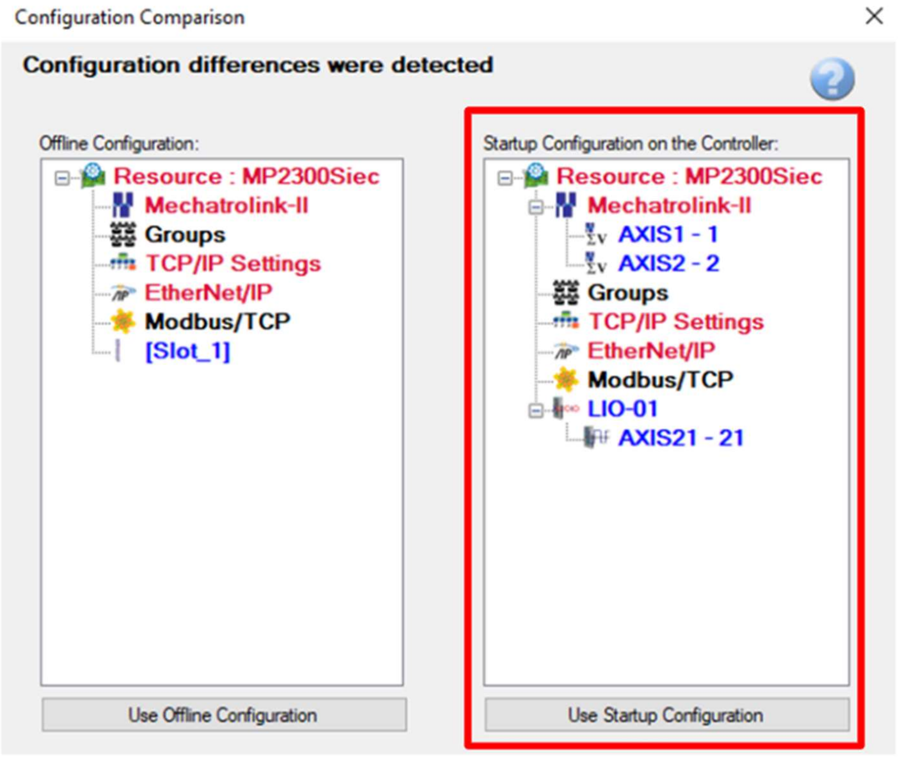
192.168.1.1

Resource Name: Resource

Controller Type: MP2300Siec

**Figure 4: Hardware Configuration Window**

- There should be a Startup Configuration already on the controller, so choose the Startup Configuration on the Controller as highlighted in Figure 5.



Configuration differences were detected

**Figure 5: Configuration Comparison Window**

## Step 2: Create Cam Table

- Once successfully connected to the motors, make your way to the Yaskawa CamEditor as shown in Figure 6 and click the 'Test Move Setup' Button.

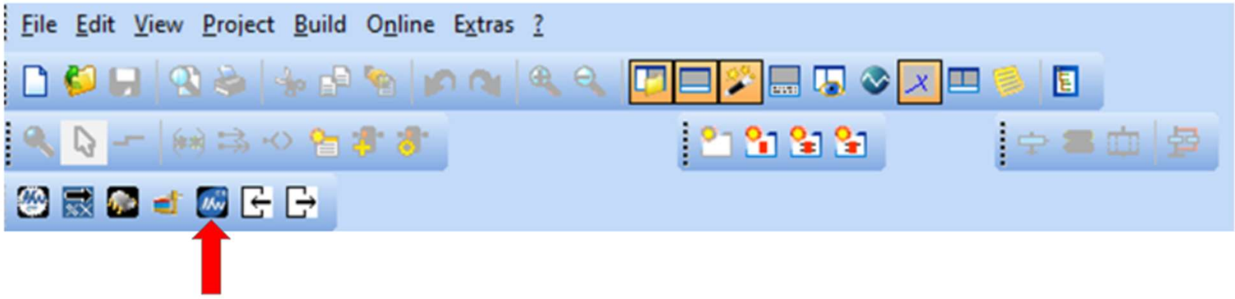
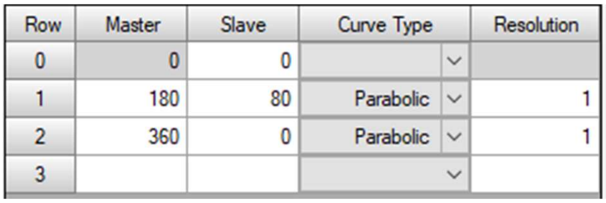


**Figure 6: Yaskawa Editor Button**

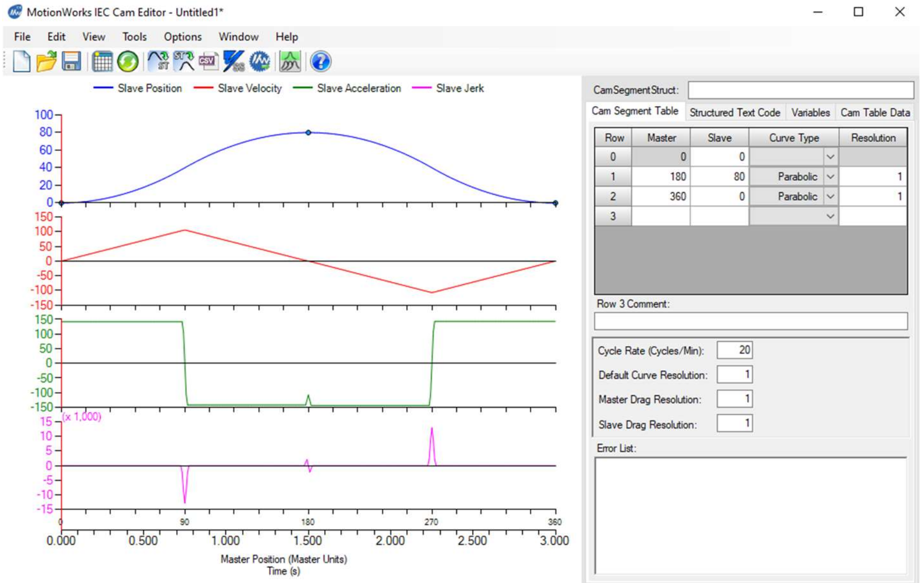
- Configure your CamEditor to look like Figure 7, resolution should autofill so you no need to fill it out.



| Row | Master | Slave | Curve Type | Resolution |
|---|---|---|---|---|
| 0 | 0 | 0 | | |
| 1 | 180 | 80 | Parabolic | 1 |
| 2 | 360 | 0 | Parabolic | 1 |
| 3 | | | | |

**Figure 7: CamEditor Table**

- After entering the values in Figure 7, the CamEditor window should look like Figure 8.



CamSegmentStruct:

| Row | Master | Slave | Curve Type | Resolution |
|---|---|---|---|---|
| 0 | 0 | 0 | | |
| 1 | 180 | 80 | Parabolic | 1 |
| 2 | 360 | 0 | Parabolic | 1 |
| 3 | | | | |

Row 3 Comment:

Cycle Rate (Cycles/Min): 20

Default Curve Resolution: 1

Master Drag Resolution: 1

Slave Drag Resolution: 1

Error List:

**Figure 8: Finished CamEditor Window**

- Once completed, save the data as seen in Figure 9 then Write to the controller using the button in Figure 10 and enter the information in Figure 11 and hit OK to send to the controller.

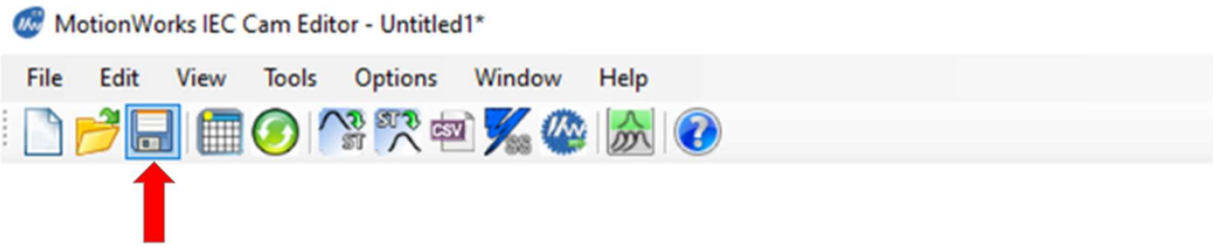


**Figure 9: Save Button**

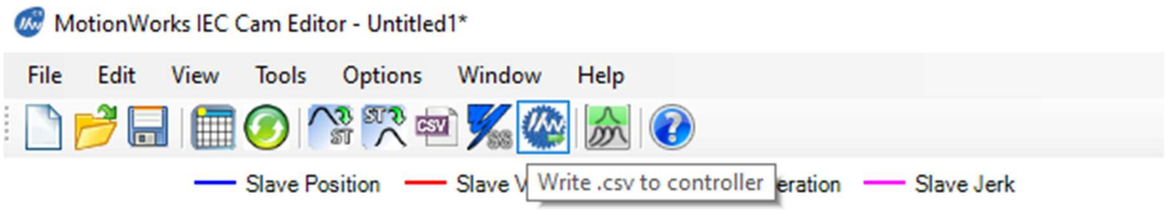
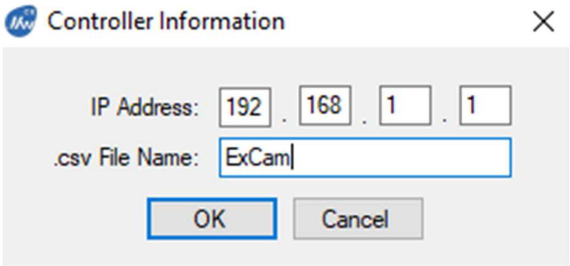


**Figure 10: Write .csv to Controller Button**



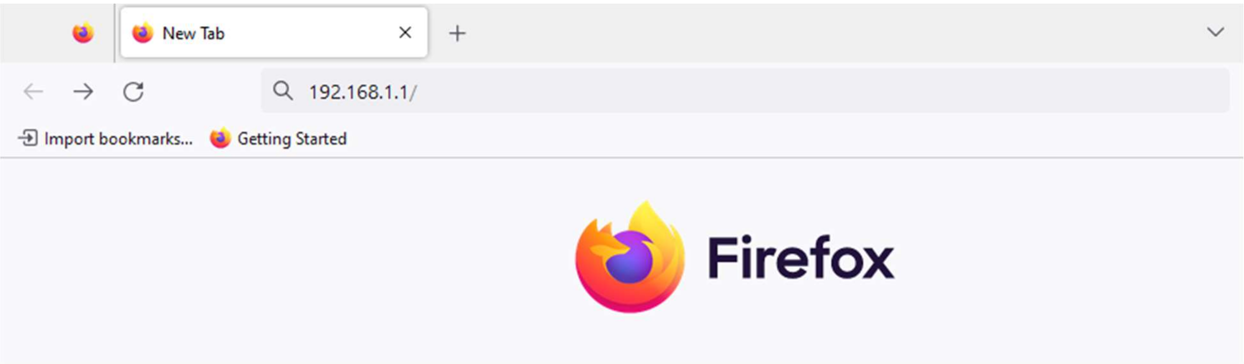
IP Address: 192 . 168 . 1 . 1

.csv File Name: ExCam

**Figure 11: Controller Information**

## Step 3: Check for Location of Cam Table

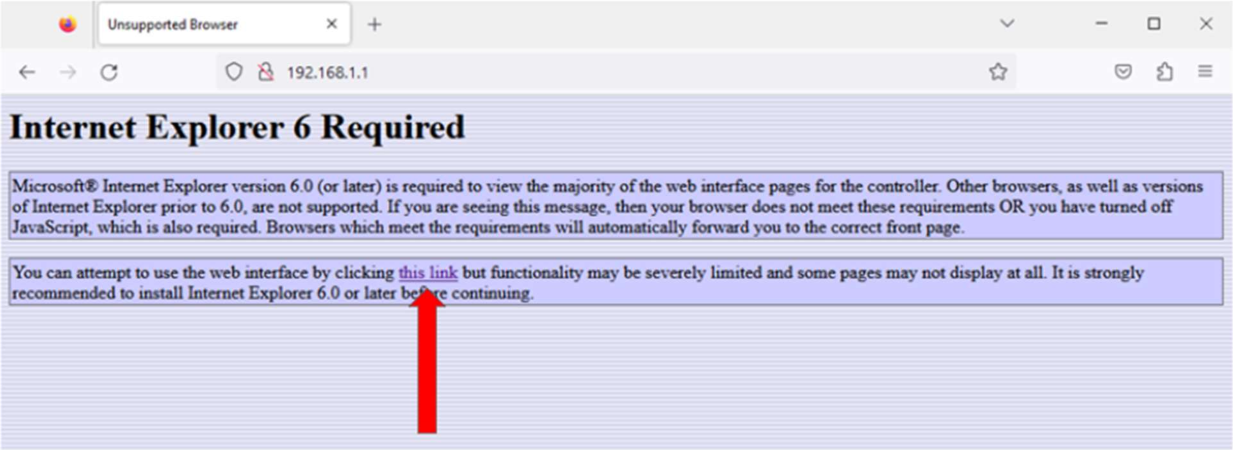
- Let's check where the file is on the controller, so we know how to reference it. Open any internet browser and enter just the controllers IP address in the search bar as seen in Figure 12.



192.168.1.1/

**Figure 12: Internet Browser with IP address in Search Bar**

- Once there you may receive and error message like Figure 13, but just click the link and it should work fine and take you to the window seen in Figure 14.



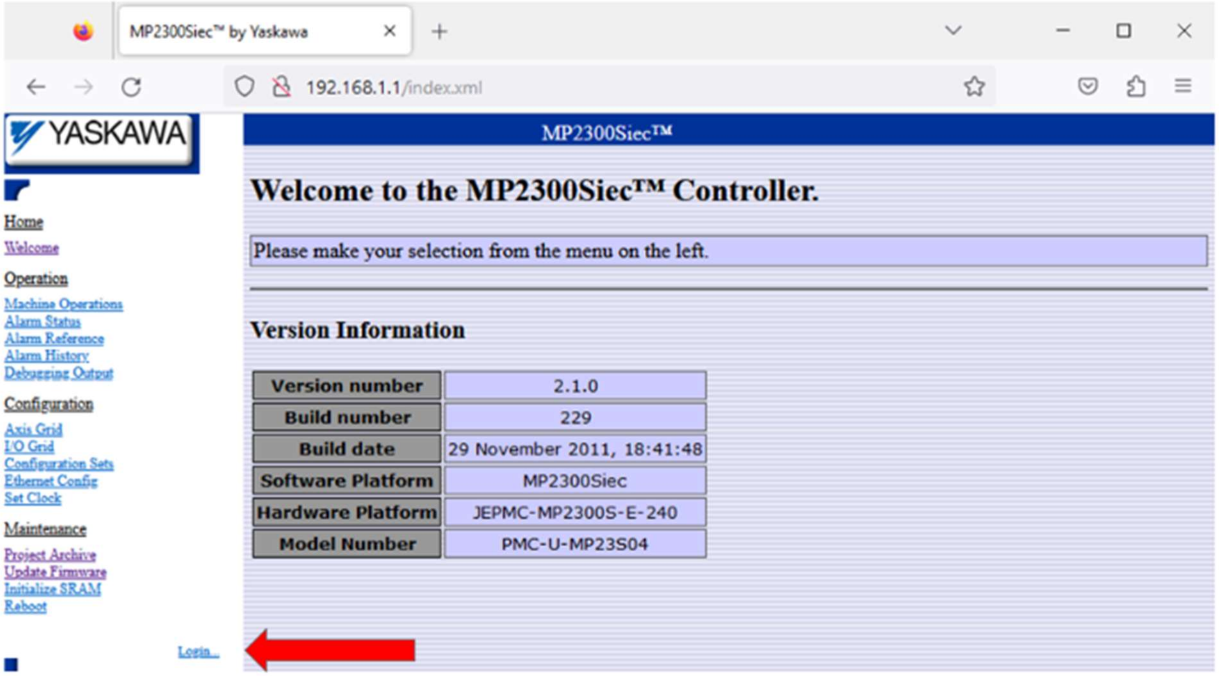
## Internet Explorer 6 Required

Microsoft® Internet Explorer version 6.0 (or later) is required to view the majority of the web interface pages for the controller. Other browsers, as well as versions of Internet Explorer prior to 6.0, are not supported. If you are seeing this message, then your browser does not meet these requirements OR you have turned off JavaScript, which is also required. Browsers which meet the requirements will automatically forward you to the correct front page.

You can attempt to use the web interface by clicking this link but functionality may be severely limited and some pages may not display at all. It is strongly recommended to install Internet Explorer 6.0 or later before continuing.

**Figure 13: Unsupported Browser Page with Arrow to Link**

- Once at the Home Page, click Login and log in with the following information to achieve access to admin level privileges (Case Sensitive):
  - Username: Admin
  - Password: MP2300S



MP2300Siec™

## Welcome to the MP2300Siec™ Controller.

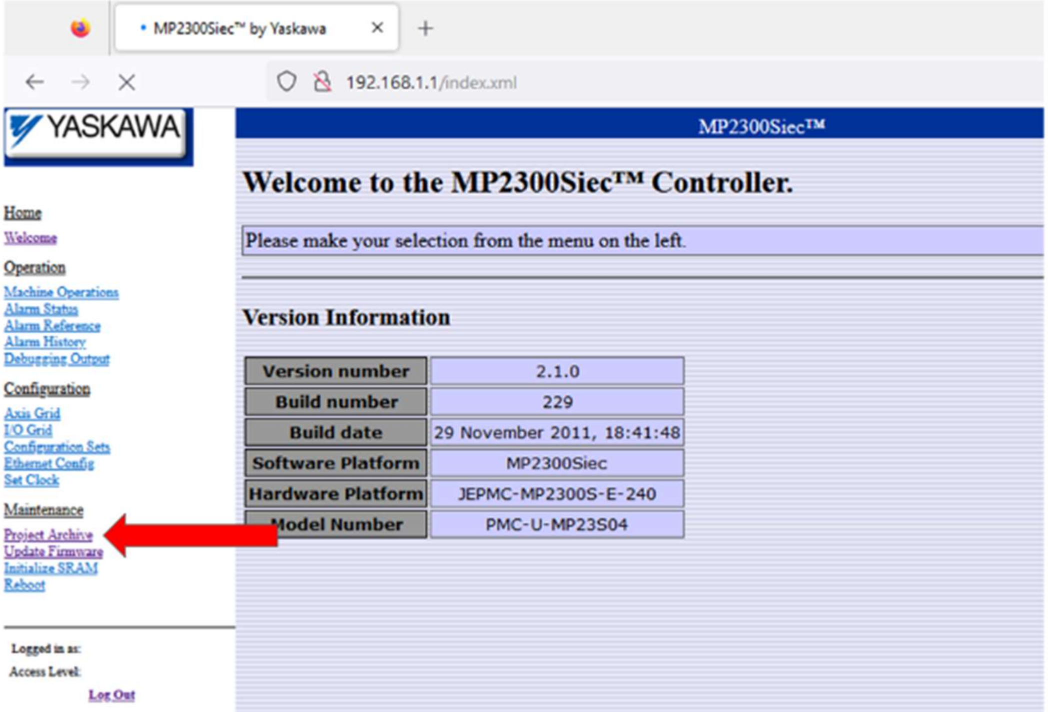
Please make your selection from the menu on the left.

### Version Information

| | |
|---|---|
| Version number | 2.1.0 |
| Build number | 229 |
| Build date | 29 November 2011, 18:41:48 |
| Software Platform | MP2300Siec |
| Hardware Platform | JEPMC-MP2300S-E-240 |
| Model Number | PMC-U-MP23S04 |

**Figure 14: Controller Home Page with Arrow to Login**

- Once logged in you can make your way to Project Archive as shown in Figure 15 and the window should look like Figure 16.



Welcome to the MP2300Siec™ Controller.

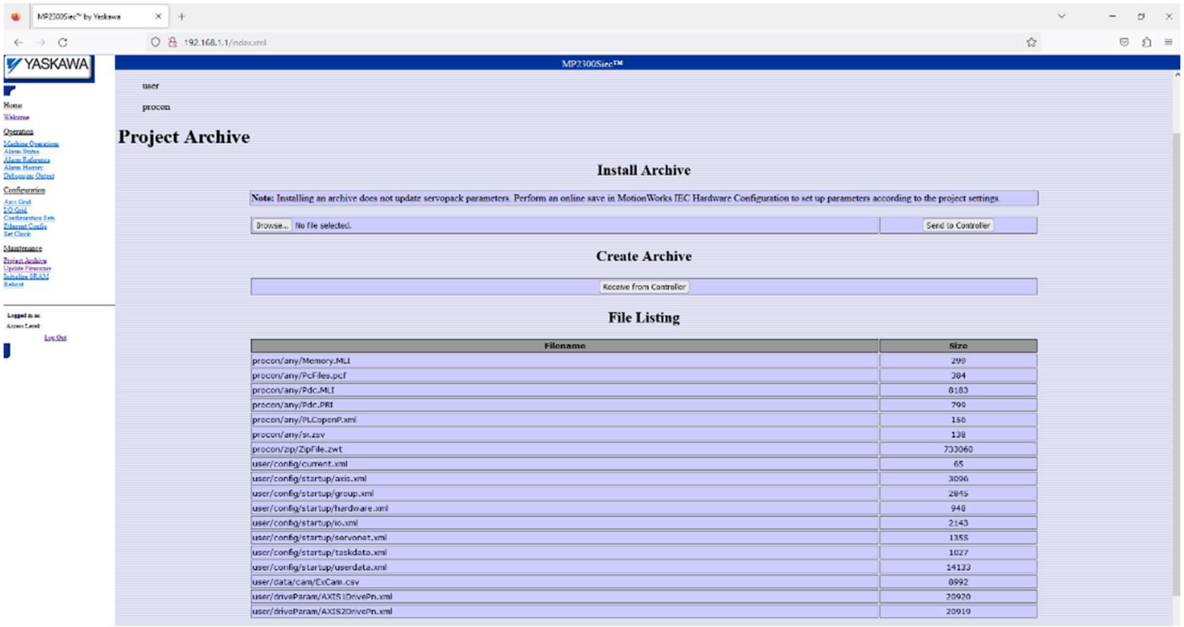
Please make your selection from the menu on the left.

Version Information

| | |
|---|---|
| Version number | 2.1.0 |
| Build number | 229 |
| Build date | 29 November 2011, 18:41:48 |
| Software Platform | MP2300Siec |
| Hardware Platform | JEPMC-MP2300S-E-240 |
| Model Number | PMC-U-MP23S04 |

**Figure 15: Logged in Home Page with Arrow to Project Archive**

- Once there, look through the File Listing to find a filename ending in the ‘ExCam.csv’ that we designated when we wrote to the Controller.



Project Archive

Install Archive

**Note:** Installing an archive does not update servopack parameters. Perform an online save in MotionWorks IEC Hardware Configuration to set up parameters according to the project settings.

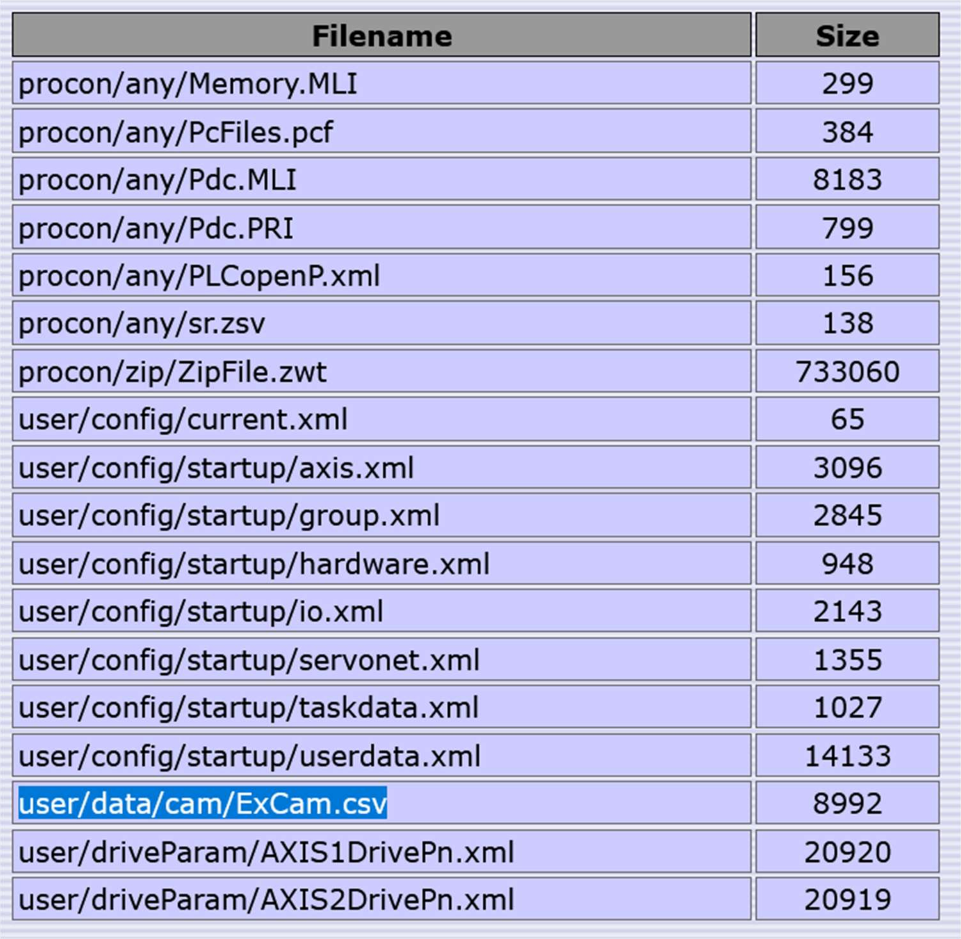
No file selected.

Create Archive

File Listing

| Filename | Size |
|---|---|
| procon/any/Memory.MLI | 299 |
| procon/any/PcFiles.pcf | 384 |
| procon/any/Pdc.MLI | 8183 |
| procon/any/Pdc.PRI | 799 |
| procon/any/PLCopenP.xml | 156 |
| procon/any/sr.zsv | 138 |
| procon/zip/ZipFile.zwt | 733060 |
| user/config/current.xml | 65 |
| user/config/startup/axis.xml | 3096 |
| user/config/startup/group.xml | 2845 |
| user/config/startup/hardware.xml | 948 |
| user/config/startup/io.xml | 2143 |
| user/config/startup/servonet.xml | 1355 |
| user/config/startup/taskdata.xml | 1027 |
| user/config/startup/userdata.xml | 14133 |
| user/data/cam/ExCam.csv | 8992 |
| user/driveParam/AXIS1DrivePn.xml | 20920 |
| user/driveParam/AXIS2DrivePn.xml | 20919 |

**Figure 16: Logged in Home Page with Arrow to Project Archive**



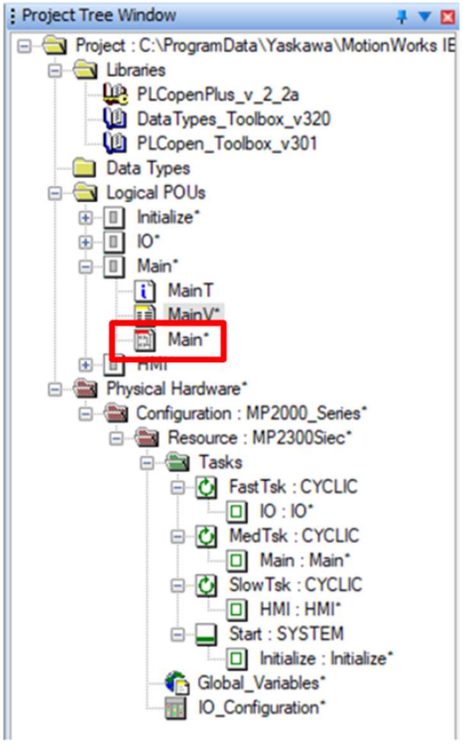
| Filename | Size |
|---|---|
| procon/any/Memory.MLI | 299 |
| procon/any/PcFiles.pcf | 384 |
| procon/any/Pdc.MLI | 8183 |
| procon/any/Pdc.PRI | 799 |
| procon/any/PLCopenP.xml | 156 |
| procon/any/sr.zsv | 138 |
| procon/zip/ZipFile.zwt | 733060 |
| user/config/current.xml | 65 |
| user/config/startup/axis.xml | 3096 |
| user/config/startup/group.xml | 2845 |
| user/config/startup/hardware.xml | 948 |
| user/config/startup/io.xml | 2143 |
| user/config/startup/servonet.xml | 1355 |
| user/config/startup/taskdata.xml | 1027 |
| user/config/startup/userdata.xml | 14133 |
| user/data/cam/ExCam.csv | 8992 |
| user/driveParam/AXIS1DrivePn.xml | 20920 |
| user/driveParam/AXIS2DrivePn.xml | 20919 |

**Figure 17: ExCam.csv File Address**

- The file name should be 'user/data/cam/ExCam.csv' as seen in Figure 17.

## Step 4: MotionWorks Program

- Now we will develop and execute a simple MotionWorks Program to use the Cam file and excute a cam motion between the 2 axes.
- On the left side of the screen in the Project Tree Window, navigate to Project > Logical POUs > Main > Main and double click it as highlighted in Figure 12 to get to the correct workspace.

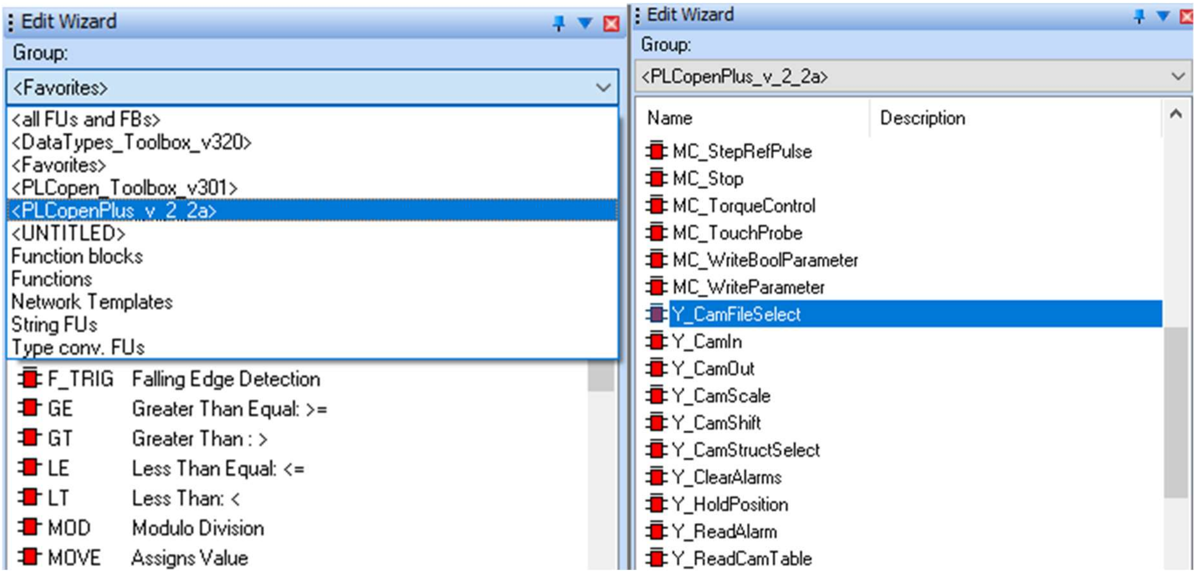


Project Tree Window

- Project : C:\ProgramData\Yaskawa\MotionWorks IE
  - Libraries
    - PLCopenPlus_v_2_2a
    - DataTypes_Toolbox_v320
    - PLCopen_Toolbox_v301
  - Data Types
  - Logical POUs
    - Initialize*
    - IO*
    - Main*
      - MainT
      - MainV*
      - Main*
    - HMI
  - Physical Hardware*
    - Configuration : MP2000_Series*
      - Resource : MP2300Siec*
        - Tasks
          - FastTsk : CYCLIC
            - IO : IO*
          - MedTsk : CYCLIC
            - Main : Main*
          - SlowTsk : CYCLIC
            - HMI : HMI*
          - Start : SYSTEM
            - Initialize : Initialize*
        - Global_Variables*
        - IO_Configuration*

**Figure 18: Navigation to Main Program Workspace**

- On the right side of the screen in the Edit Wizard, choose PLCopenPlus from the drop-down menu and click and drag Y_CamFileSelect out onto the blank workspace in the middle of the window.



Edit Wizard

Group:

<Favorites>

<all FUs and FBs>
<DataTypes_Toolbox_v320>
<Favorites>
<PLCopen_Toolbox_v301>
<PLCopenPlus_v_2_2a>
<UNTITLED>
Function blocks
Functions
Network Templates
String FUs
Type conv. FUs

| | |
|---|---|
| F_TRIG | Falling Edge Detection |
| GE | Greater Than Equal: >= |
| GT | Greater Than : > |
| LE | Less Than Equal: <= |
| LT | Less Than: < |
| MOD | Modulo Division |
| MOVE | Assigns Value |

Edit Wizard

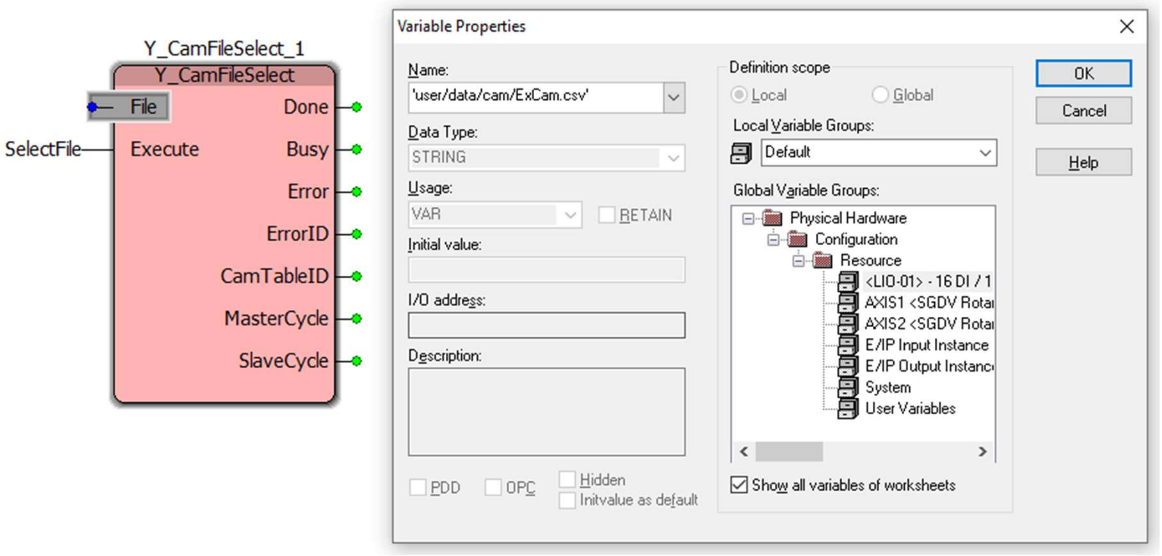
Group:

<PLCopenPlus_v_2_2a>

| Name | Description |
|---|---|
| MC_StepRefPulse | |
| MC_Stop | |
| MC_TorqueControl | |
| MC_TouchProbe | |
| MC_WriteBoolParameter | |
| MC_WriteParameter | |
| Y_CamFileSelect | |
| Y_CamIn | |
| Y_CamOut | |
| Y_CamScale | |
| Y_CamShift | |
| Y_CamStructSelect | |
| Y_ClearAlarms | |
| Y_HoldPosition | |
| Y_ReadAlarm | |
| Y_ReadCamTable | |

**Figure 19: PLCopenPlus in Edit Wizard**

- Click on the File Input and enter the address from the last step as a name, shown in Figure 20



Variable Properties

Name: 'user/data/cam/ExCam.csv'

Data Type: STRING

Usage: VAR □ RETAIN

Initial value:

I/O address:

Description:

□ PDD □ OPC □ Hidden □ Initvalue as default

Definition scope: ● Local ○ Global

Local Variable Groups: Default

Global Variable Groups:

```
Physical Hardware
  Configuration
    Resource
      <LIO-01> - 16 DI / 1
      AXIS1 <SGDV Rota
      AXIS2 <SGDV Rota
      E/IP Input Instance
      E/IP Output Instanc
      System
      User Variables
```

☑ Show all variables of worksheets

OK Cancel Help

**Figure 20: File Variable Properties**

- Make the Execute Input a Boolean Variable with name ‘SelectFile’ and the CamTableID Ouput an INT variable with name ‘CamTable’.
- The complete block should look like Figure 21.

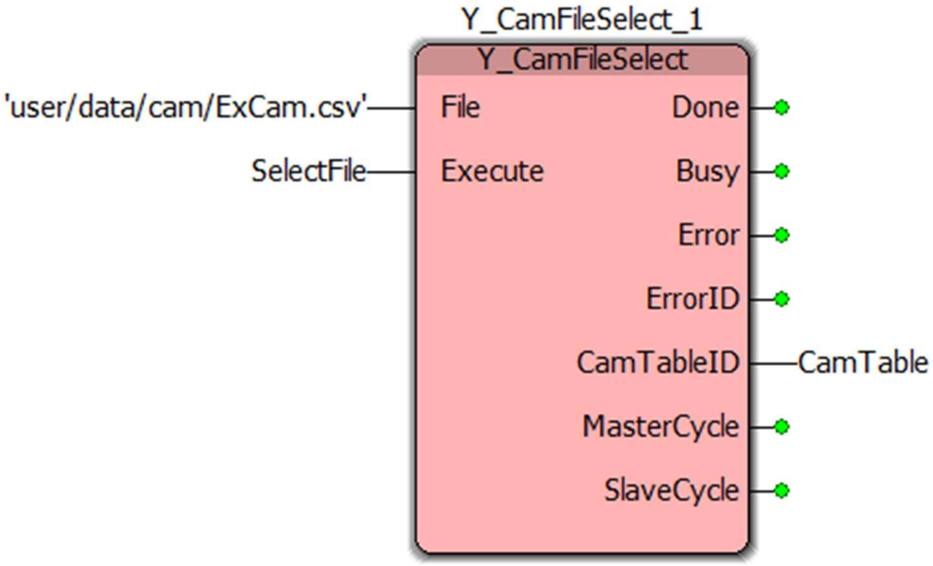
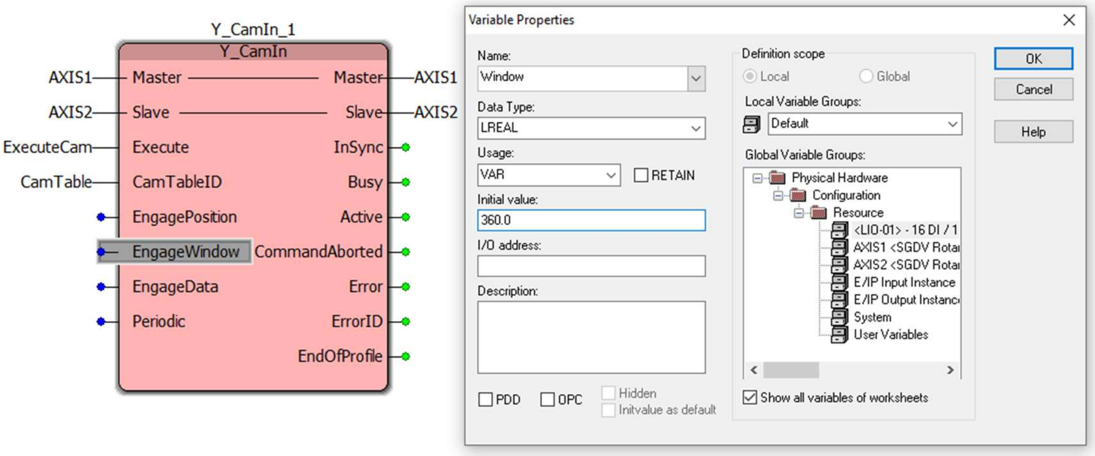


**Figure 21: Completed CamFileSelect Block**

- Now back in the Edit Wizard, add a block called Y_CamIn and add AXIS1 as Controller (Master and AXIS2 as Peripheral (Slavve), Execute as a Boolean variable, and CamTableID as the same variable from the output of the CamFileSelect Block.

- Engage Window details are shown in Figure 22.



Variable Properties

Name: Window

Data Type: LREAL

Usage: VAR ☐ RETAIN

Initial value: 360.0

I/O address:

Description:

☐ PDD ☐ OPC ☐ Hidden ☐ Initvalue as default

Definition scope: ● Local ○ Global

Local Variable Groups: Default

Global Variable Groups:

☑ Show all variables of worksheets

**Figure 22: EngageWindow Variable Properties**

- Remember that since we want AXIS2 to move on its own, we need to power it on with an MC_Power block. The end product (not including the FileSelect block) is shown in Figure 23.

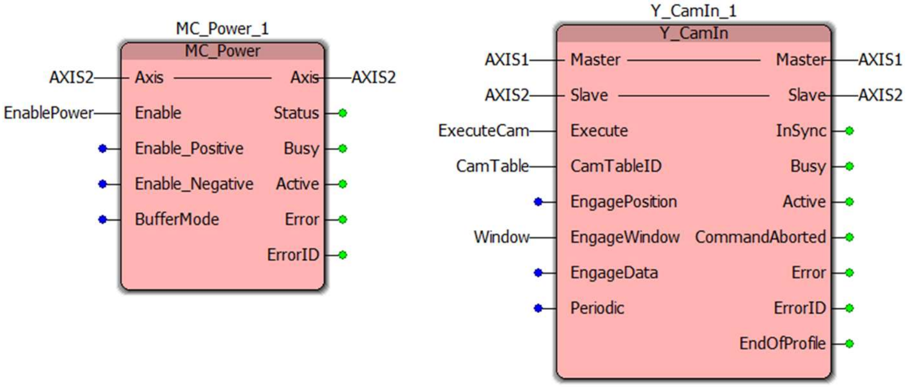


**Figure 23: Complete MC_Power and Y_CamIn Blocks**

- Finally, Download Changes and Switch to Debug Mode and the program should look like Figure 24.
- Execute the CamFileSelect by overwriting the SelectFile Variable and it should output a CamTableID of 1 as seen in Figure 25.
- Now with a CamTableID, you can sequentially execute the MC_Power block and then the Y_CamIn block and the motors should cam.
- It’s important to note that you may have to fiddle around with AXIS1 (Controller Axis) so that it reaches the correct ‘EngagePosition’ to start the cam and if you go further than the ‘EngageWindow’, the block will stop camming.

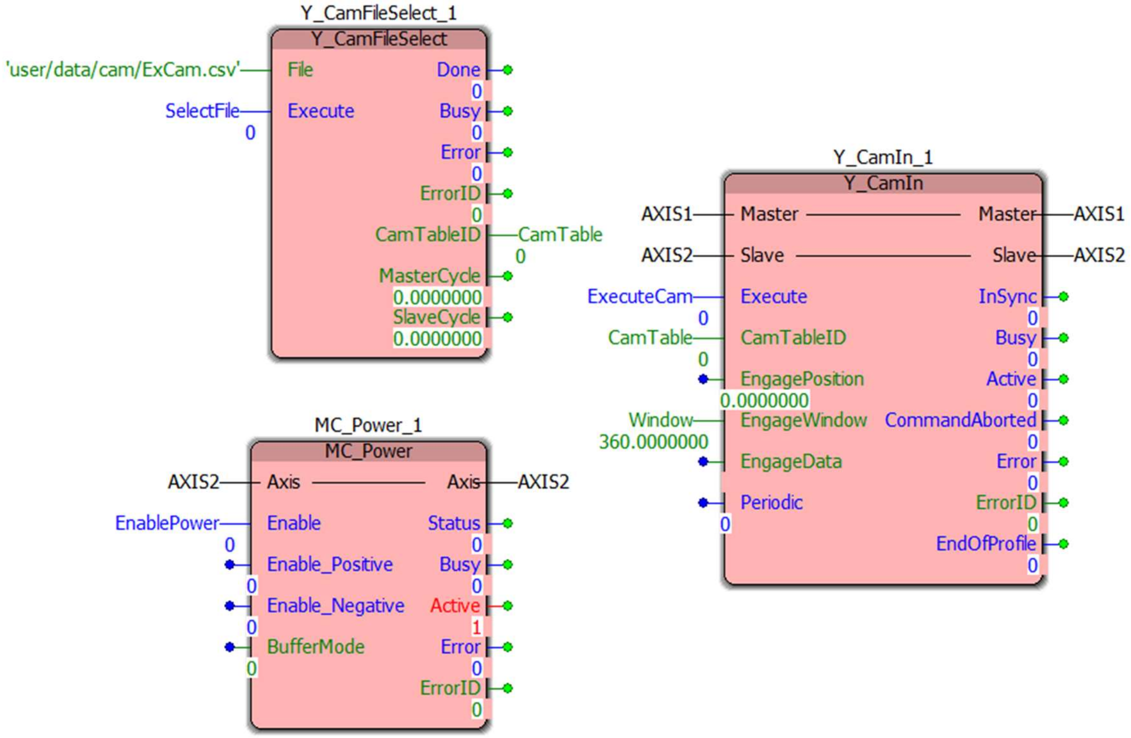


**Figure 24: Program in Debug Mode**

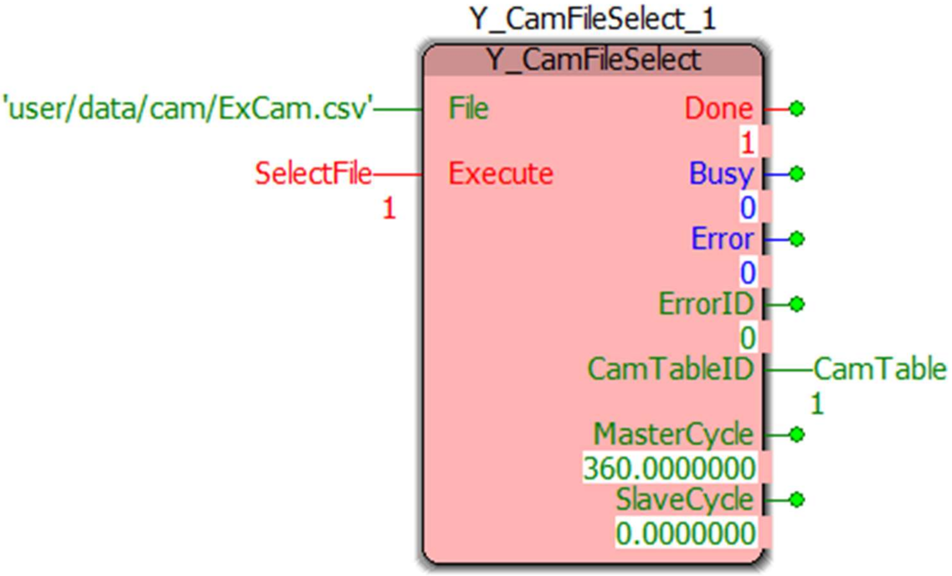


**Figure 25: CamFileSelect Button Executed**

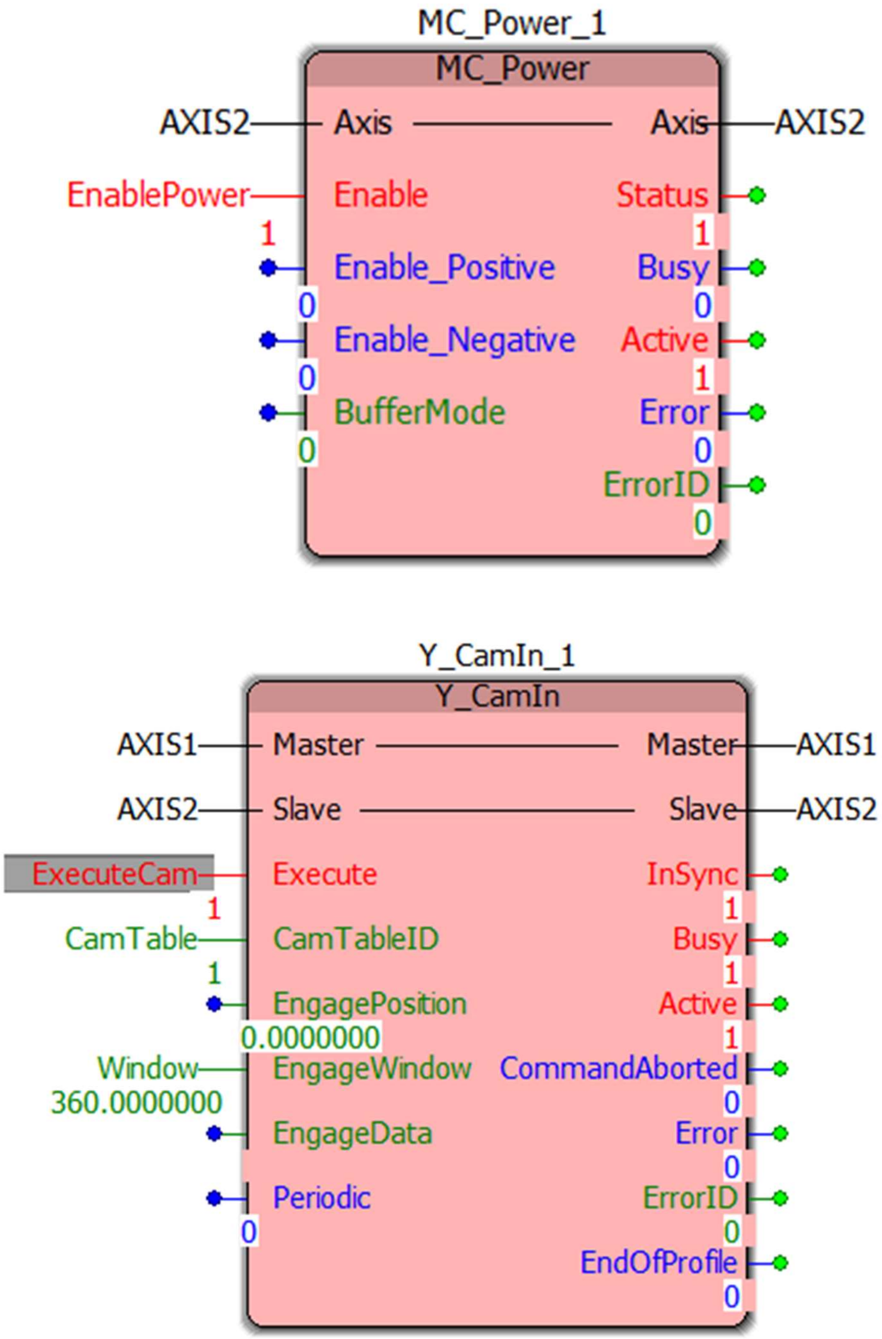


**Figure 23: Executed MC_Power and Y_CamIn Blocks**

## Deliverables

Demonstrate the camming of AXIS1 and AXIS2 (Step 4) to the lab instructor.