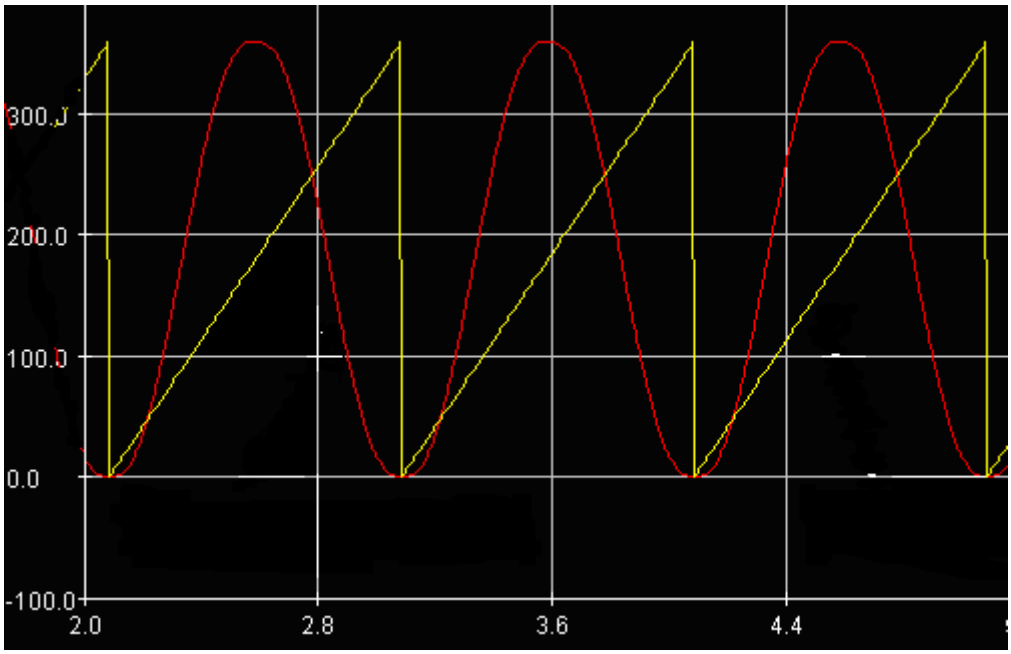
Application Note

Implementing Electronic Cams with MPiec
Quick Start Guide



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1. Application Overview

This document explains how to build a cam profile using Yaskawa's CamTool software and implement a cam application on an MPiec controller using MotionWorks IEC. This guide also explains how to download the cam profile file into the MPiec using MotionWorks IEC and designing a simple program that will demonstrate camming with two servo axes.

2. Application Highlights:

Industry: Any applications requiring electronic cam functionality
Major Features: Electronic cam
Results: Creation of cam profile. Procedure to create simple cam application

3. Products Used:

Component	Product and Model Number
Servopack	Two Sigma-5 servopacks
Motor	Two Sigma-5 motors
Controller	MPiec, Minimum FW ver 1.1.1.4
Software	MotionWorks IEC Express v 1.1.1, CamTool v 4.61

4. Steps to Implement Cam Application

A basic cam application can be implemented in just two steps. The first is the creation of a cam profile file (csv format) using Yaskawa's CamTool program or Microsoft Excel. The cam file is downloaded into the controller using MotionWorks IEC. The second step is the application program itself with Y_CamIn and Y_CamOut blocks to engage and disengage the cam function respectively.

4.1 Generating a cam data file using Cam Tool

Cam Tool is an editor for many of Yaskawa's products and has a number of features that do not apply when generating cams for use with an MPiec controller. Figure 1 shows Cam Tool's "**Set Style**" screen which allows the user to set the units for generating the cam profile. Master and Slave (a.k.a Phase and Position) units can be set on this page. Select "**No Unit**" to indicate that Cam Tool should not perform any position conversion when the file is saved. Proceed by simply entering all values in user units as defined by MotionWorks IEC's Configuration for the appropriate axes. The Machine/Motor Information section is not necessary.

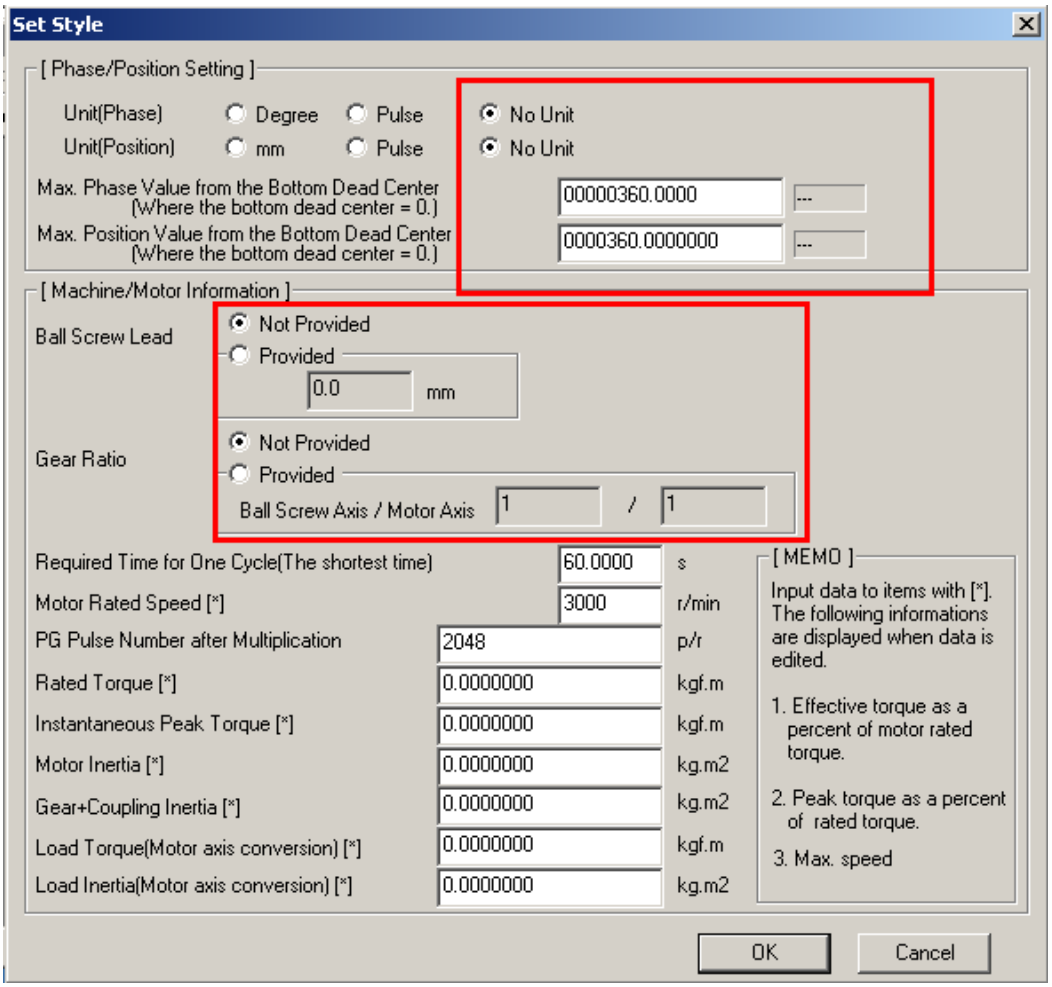


Figure 1: Cam Tool's Set Style screen for axis configuration

Figure 2 is a screenshot of the "**Set Parameter**" screen for inputting key points that build the cam profile. A variety of curves can be selected from the "**Curve Shape**" drop down menu.

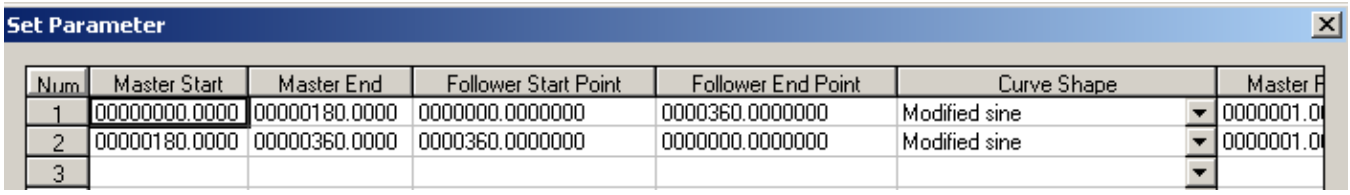


Figure 2: Cam profile generation page

Figure 3 is a screen shot of an "Out and Back" (Two way) cam profile. The X Axis is the master position and the Y axis is the slave position.

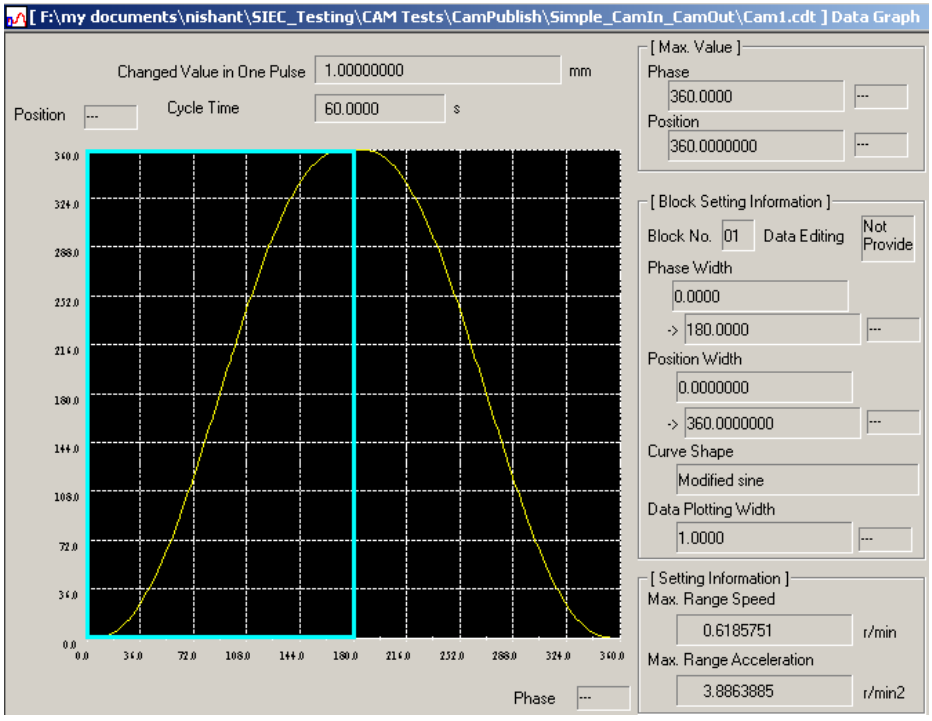


Figure 3: Two way cam profile

Figure 4 is a screen shot of the control graph that provides analysis the position, velocity, acceleration, and jerk profiles for the cam profile generated.

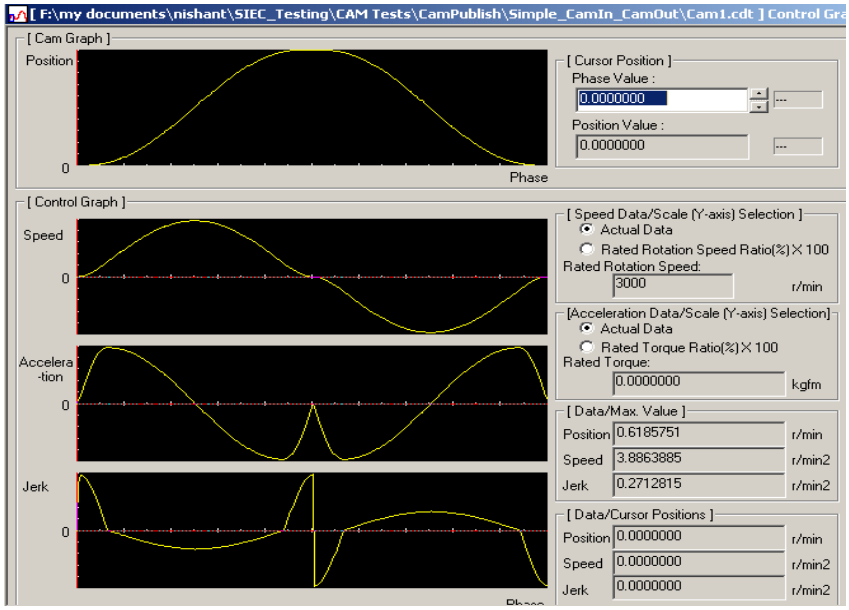


Figure 4: Control Graph – Cam analysis screen

Save the cam profile as a cdt or cdd file. Yaskawa recommends one of Cam Tool's native file types so that future edits are possible a later time using the Cam Tool application. The MPiec controller accepts csv files for cam projects. Cam Tool can open a CSV file, however all curve type information will not be restored.

Note: CamTool versions prior to 4.61 do not write a csv file that can be accepted by the MPiec controller. Yaskawa recommends opening and resaving the file in Microsoft Wordpad or Notepad to store the file as 8 bit ASCII, not Unicode ASCII.

An example of a one way cam profile been provided in Figure 5.

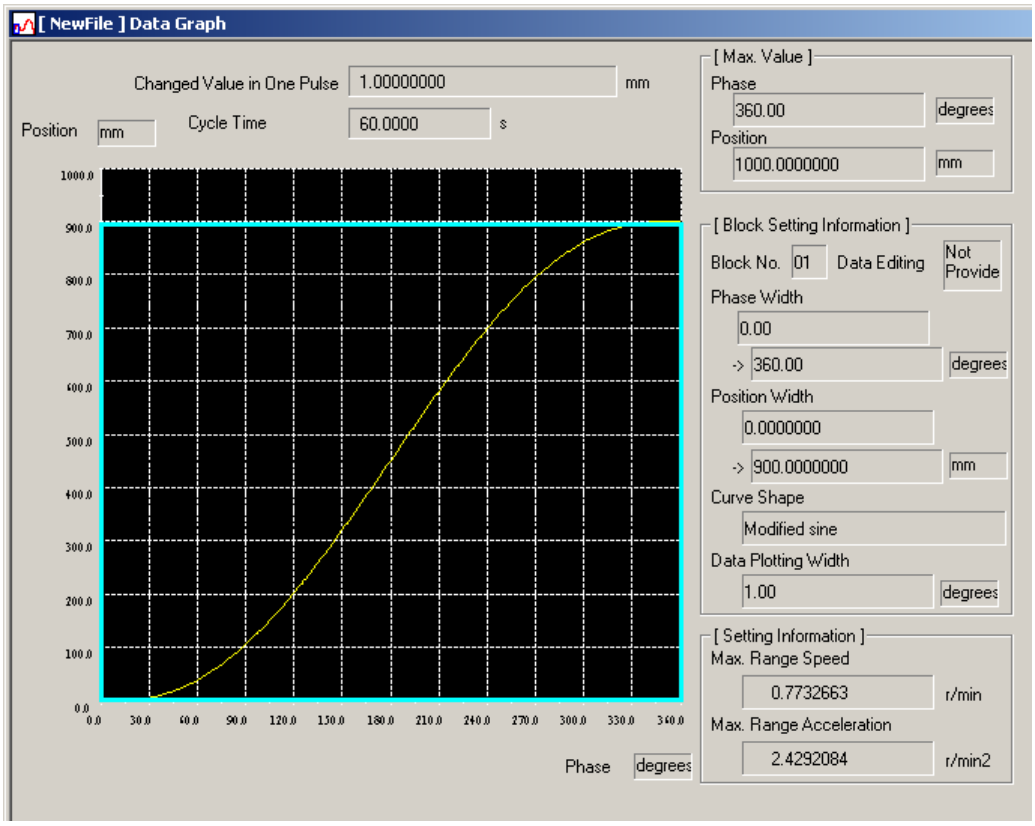
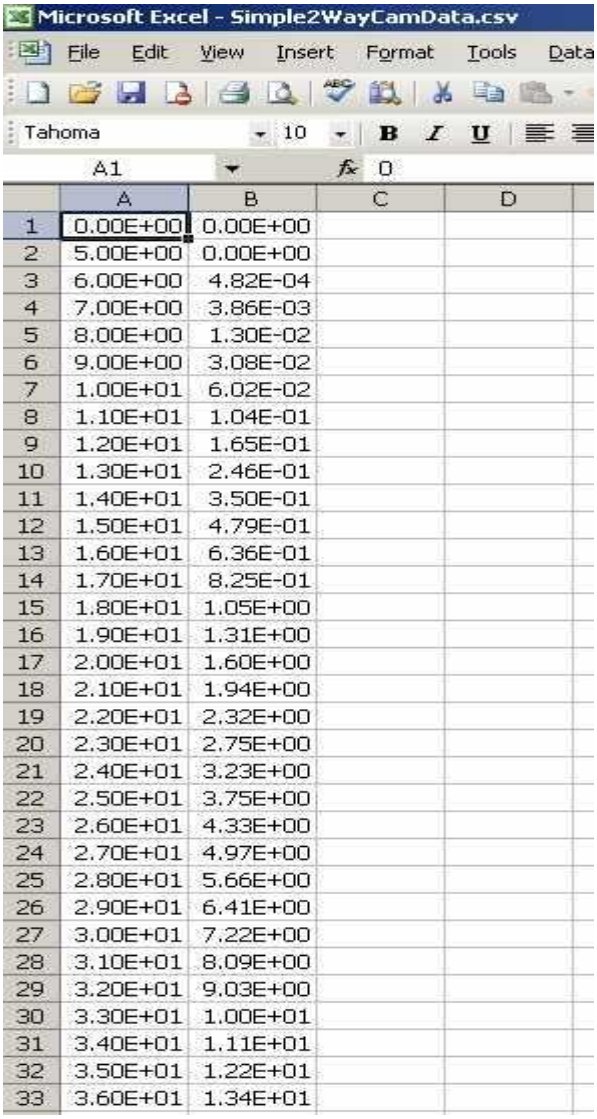


Figure 5: One way cam profile

4.2 Cam files using Microsoft Excel

The cam CSV file format consists of two columns. The first column is the master position and the second column contains slave position corresponding to the master. The data can be entered in scientific notation or integer. After generating the data in Excel, save as a csv file as shown in .



	A	B	C	D
1	0.00E+00	0.00E+00		
2	5.00E+00	0.00E+00		
3	6.00E+00	4.82E-04		
4	7.00E+00	3.86E-03		
5	8.00E+00	1.30E-02		
6	9.00E+00	3.08E-02		
7	1.00E+01	6.02E-02		
8	1.10E+01	1.04E-01		
9	1.20E+01	1.65E-01		
10	1.30E+01	2.46E-01		
11	1.40E+01	3.50E-01		
12	1.50E+01	4.79E-01		
13	1.60E+01	6.36E-01		
14	1.70E+01	8.25E-01		
15	1.80E+01	1.05E+00		
16	1.90E+01	1.31E+00		
17	2.00E+01	1.60E+00		
18	2.10E+01	1.94E+00		
19	2.20E+01	2.32E+00		
20	2.30E+01	2.75E+00		
21	2.40E+01	3.23E+00		
22	2.50E+01	3.75E+00		
23	2.60E+01	4.33E+00		
24	2.70E+01	4.97E+00		
25	2.80E+01	5.66E+00		
26	2.90E+01	6.41E+00		
27	3.00E+01	7.22E+00		
28	3.10E+01	8.09E+00		
29	3.20E+01	9.03E+00		
30	3.30E+01	1.00E+01		
31	3.40E+01	1.11E+01		
32	3.50E+01	1.22E+01		
33	3.60E+01	1.34E+01		

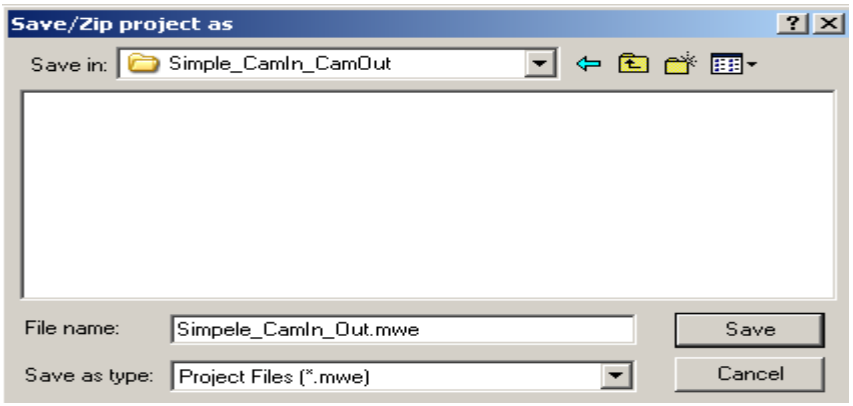
Figure 6: Creating a Cam file using Microsoft Excel

4.3 Cam Application in MotionWorks IEC

Controller Firmware : 1.1.1 build 4
Software IDE : MotionWorks IEC v 1.1.1.7
CamTool version : 4.61

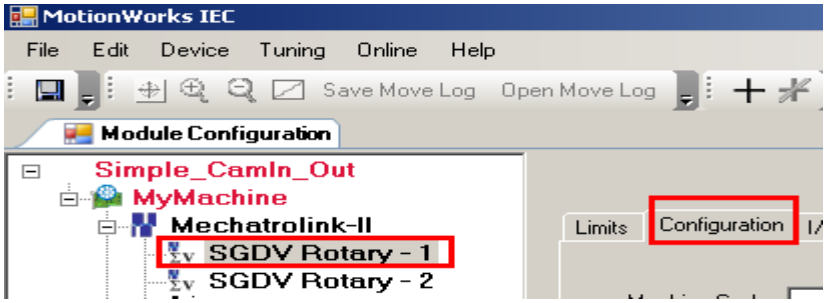
Note:
Before planning to use the camming functions, the user is expected to have basic familiarity with the MPiec controller and MotionWorks IEC. He/She is expected to understand the basic concepts of electronic camming and servo based motion controls.

1. Open a new project in MotionWorks IEC Express. Choose an MPiec Project Template.
2. Name and save the project.

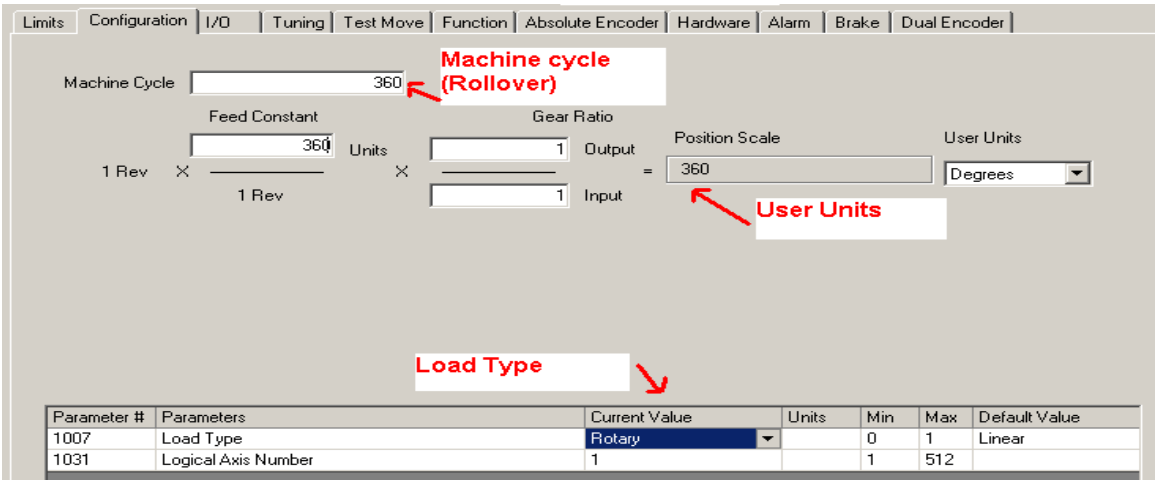


3. Go to the Hardware tab. Right click on resource and set the IP address.
4. Make (compile) the project.
5. Open the Configuration.
6. Connect to the controller. (Choose auto-discovered configuration for new project. CNFG switch should have been on when the controller was powered up.)

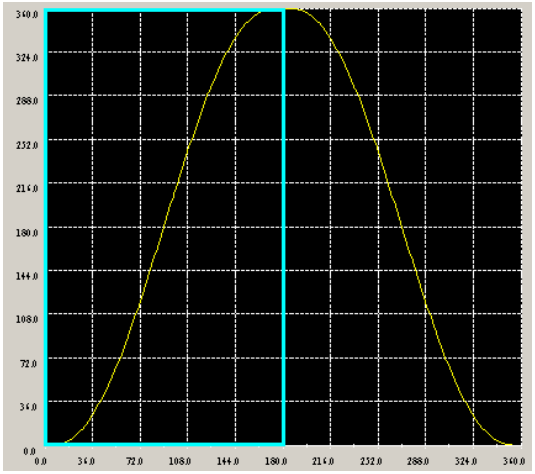
7. Click on the MLINK axes individually to configure each axis. Click on the configuration tab to set the axis type and configure user units.



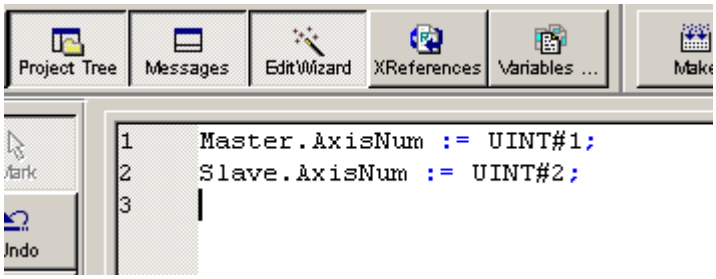
8. Set the axis type, machine cycle (if axis is rotary), and feed constant (for user units) for the master axis.



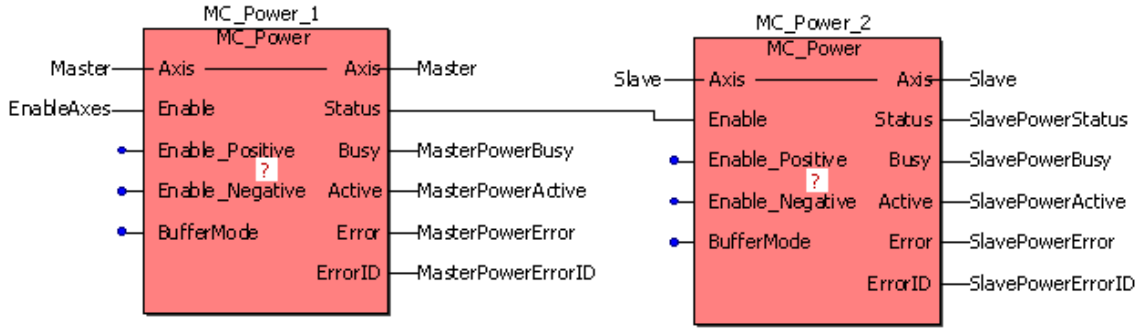
9. Configure user units and machine cycle for the slave axis in the same way. User units and machine cycle is application dependent. The numbers shown in this example are for a master and slave system where 360 degrees of the master corresponds to the out and back slave profile shown below.



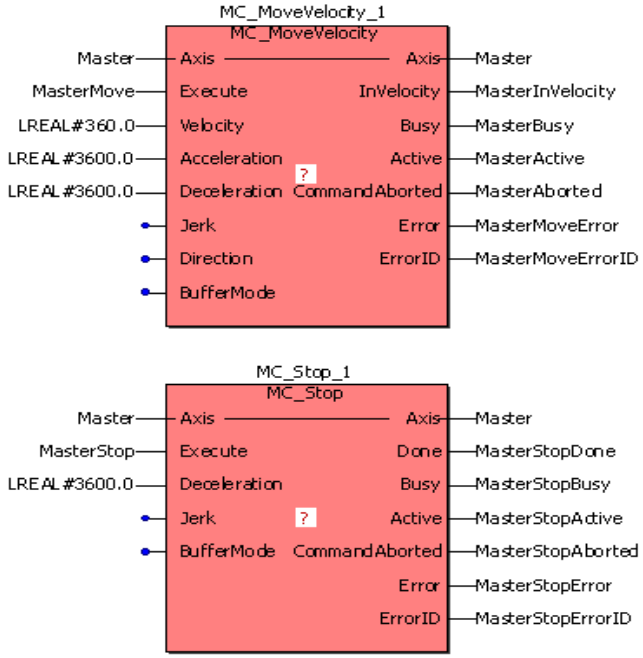
10. Save the configuration.
11. Initialize the master and slave axes.



12. Add MC_Power blocks to enable the master and slave axes

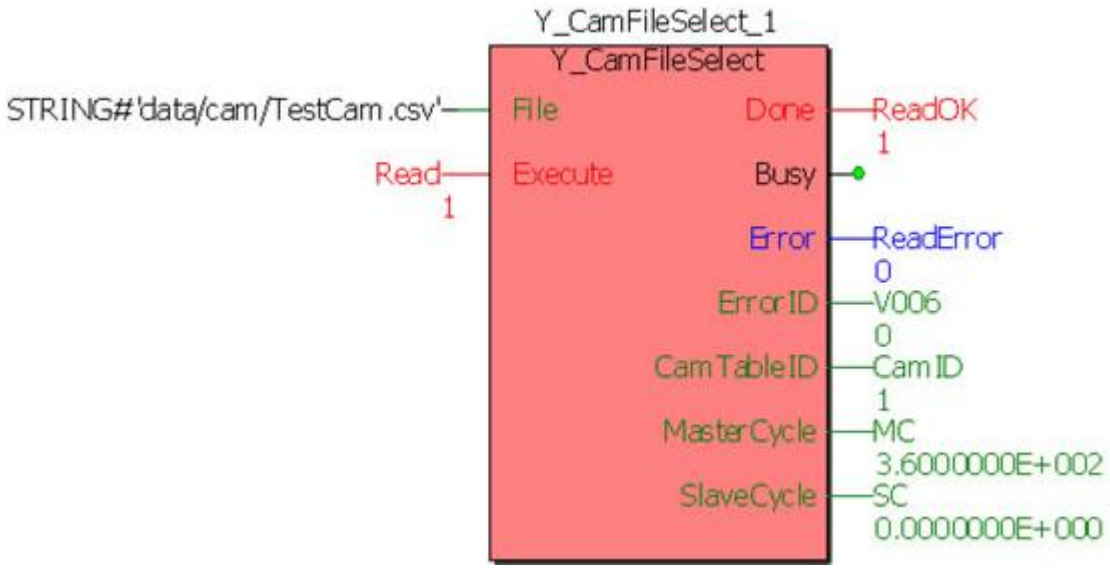


13. Add MC_MoveVelocity and MC_Stop blocks for the continuous motion from the master axis.



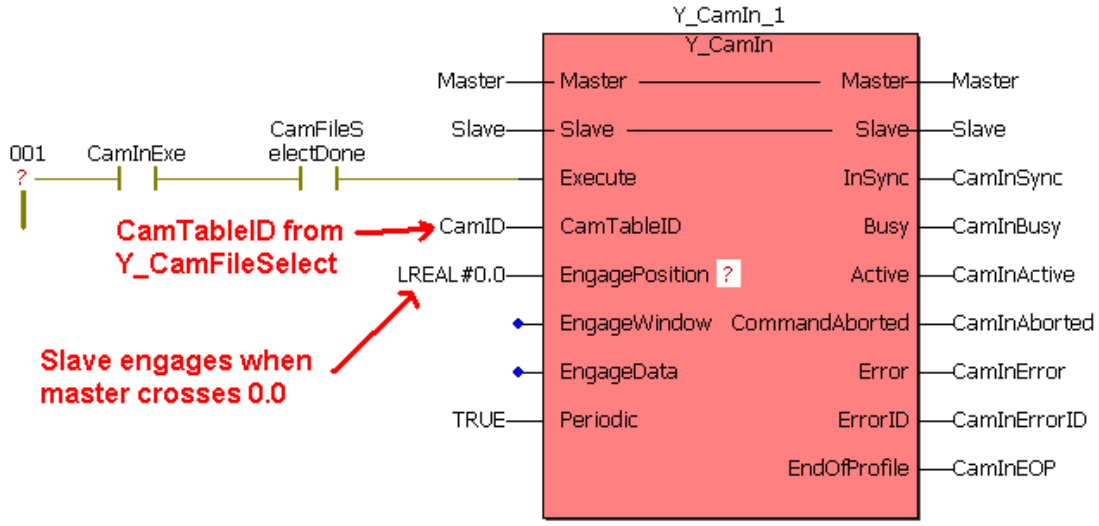
14. Add a Y_CamFileSelect function block.

The filename is case sensitive and the name of the csv file cannot be more than 8 characters long (8.3 file name format).

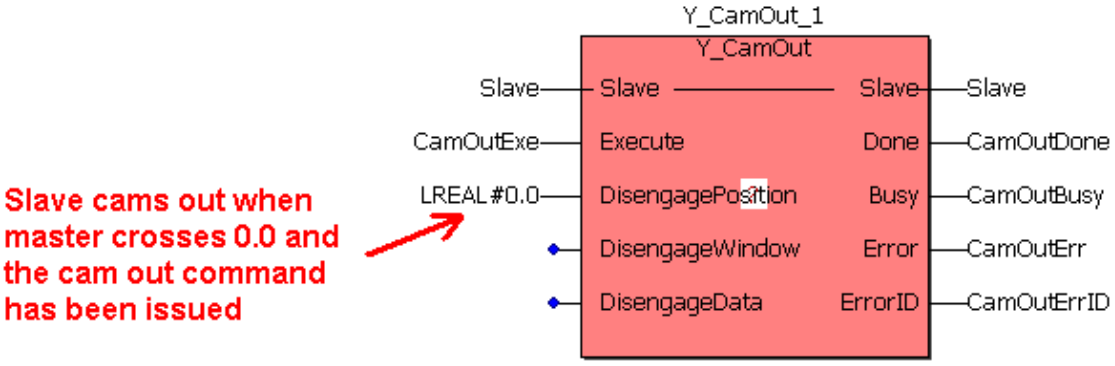


The CamTableID set by the Y_CamFileSelect block is input into the Y_CamIn block to engage the cam.

15. Add Y_CamIn block



16. Add a Y_CamOut block



17. Make (compile) the project

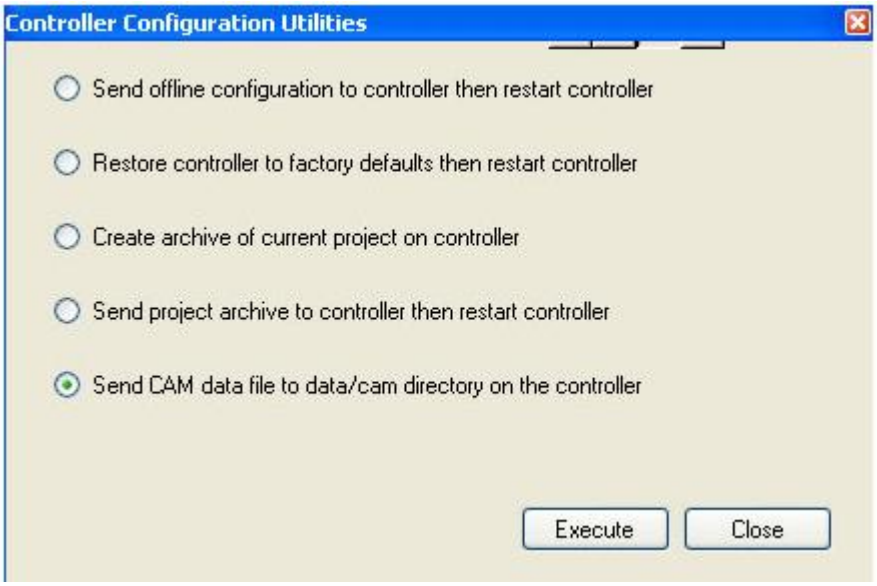
18. To add a CSV file to any MP2000iec controller, follow these steps:

    Open the Hardware Configuration

    Click the “Online” menu

    Click the “Controller Configuration Utilities” menu

    Select the radio button called “Send Cam Data to Controller”



    Select a CSV file.

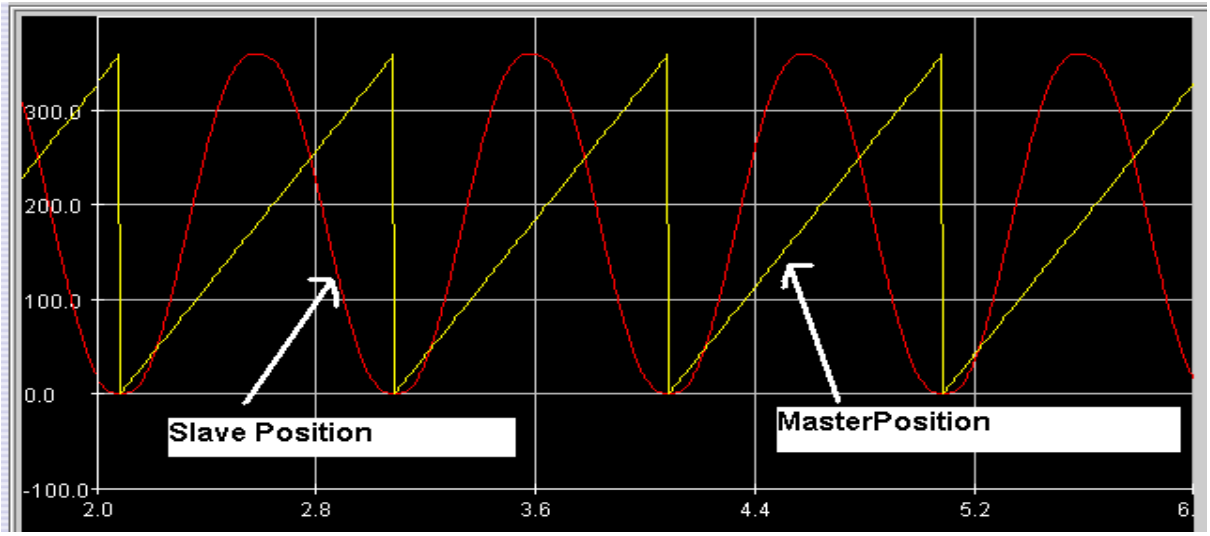
    Press Execute.

    The file will be visible from the web server Project Archive list, and it is possible to select the CSV file using Y_CamFileSelect. Use the directory path in the filename input as shown below:

File Listing

Filename	Size
procon/any/PcFiles.pcf	320
procon/any/Pdc.MLI	14078
procon/any/Pdc.PRI	716
procon/any/PLCopenP.xml	154
procon/any/sr.zsv	1391
procon/boot/BootFile.pro	79475
user/config/current.xml	65
user/config/disco/axis.xml	5788
user/config/disco/hardware.xml	912
user/config/disco/io.xml	2041
user/config/disco/servonet.xml	1449
user/config/startup/axis.xml	5204
user/config/startup/hardware.xml	944
user/config/startup/io.xml	1496
user/config/startup/servonet.xml	1309
user/config/startup/taskdata.xml	775
user/config/startup/userdata.xml	2906
user/data/cam/dawg4.csv	11550
user/data/cam/TestCam.csv	11550
user/driveParam/AXIS1DrivePn.xml	17211
user/driveParam/AXIS2DrivePn.xml	8781

19. Download the project to the controller
20. Start the PLC and select debug mode.
21. Execute the Y_CamFileSelect block and verify that the Done bit is on and a CamTableID is generated. If not, the ErrorID output will indicate the type of error. Right click on the function block when Debug mode is off to access the help file and review the error codes.
22. Enable the axes. Execute Y_CamIn.
23. Execute the master's MC_MoveVelocity.
24. The slave will follow the master once the master crosses the EngagePosition.
25. To disengage the cam, execute the Camout bit on the Y_CamOut block.
26. To stop the master, execute the MC_Stop block.
27. The master slave profile will be as described below.


300.0
200.0
100.0
0.0
-100.0
2.0
2.8
3.6
4.4
5.2
Slave Position
MasterPosition