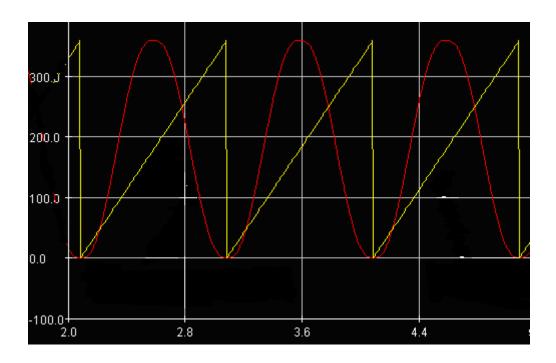


Application Note

Implementing Electronic Cams with MPiec Quick Start Guide



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Subject: Application Note	Product: MPiec	Doc#:	EM.MCD.09.043	
Title: Implementing Electronic Cams with MPiec: Quick Start Guide				

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.

VYASKAWA		2		
Subject: Application Note	Product: MPiec	Doc#:	EM.MCD.09.043	
Title: Implementing Electronic Cams with MPiec: Quick Start Guide				

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.

S	et Style					X
	- [Phase/Position Set	ting]				
	Unit(Phase) Unit(Position)	O Degree O Pulse O mm O Pulse	⊙ Nol ⊙ Nol			
Max. Phase Value from the Bottom Dead Center (Where the bottom dead center = 0.) Max. Position Value from the Bottom Dead Center (Where the bottom dead center = 0.)			er	00000360.		
	-[Machine/MotorInfo	ormation]				
	Ball Screw Lead	Not Provided Provided				
	Gear Ratio	O.0 rr Not Provided Provided Ball Screw Axis / Motor	m Axis 1	/	1	1
	Required Time for On	e Cycle(The shortest time)		60.0000	s	[MEMO]
	Motor Rated Speed [*]		3000	r/min	Input data to items with [*]. The following informations
	PG Pulse Number aft	er Multiplication	2048		p/r	are displayed when data is edited.
	Rated Torque [*]		0.0000000		kgf.m	1. Effective torgue as a
	Instantaneous Peak	Torque [*]	0.0000000		kgf.m	percent of motor rated
	Motor Inertia [*]		0.0000000		kg.m2	torque.
	Gear+Coupling Inertia	a [*]	0.0000000		kg.m2	 Peak torque as a percent of rated torque.
	Load Torque(Motor a	xis conversion) [*]	0.0000000		kgf.m	3. Max. speed
	Load Inertia(Motor ax	is conversion) [*]	0.0000000		kg.m2	·
	0K Cancel					

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

YASKAWA				
Subject: Application Note	Product: MPiec	Doc#: EM.MCD.09.043		
Title: Implementing Electronic Cams with MPiec: Quick Start Guide				

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.

Se	Set Parameter X						
	Num	Master Start	Master End	Follower Start Point	Follower End Point	Curve Shape	Master F
	1	00000000.0000		0000000.0000000	0000360.0000000	Modified sine	0000001.0
	2	00000180.0000	00000360.0000	0000360.0000000	0000000.0000000	Modified sine	0000001.0
	3					-	



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.

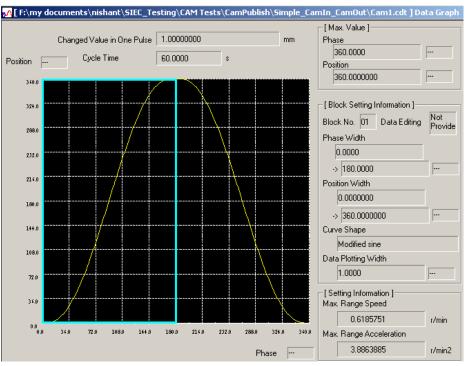


Figure 3: Two way cam profile

YASKAWA				
Subject: Application Note	Product: MPiec	Doc#: EM.MCD.09.043		
Title: Implementing Electronic Cams with MPiec: Quick Start Guide				

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.

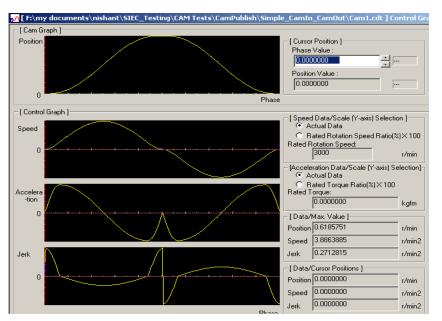


Figure 4: Control Graph – Cam analysis screen

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.

YASKAWA				
Subject: Application Note	Product: MPiec	Doc#: EM.MCD.09.043		
Title: Implementing Electronic Cams with MPiec: Quick Start Guide				

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

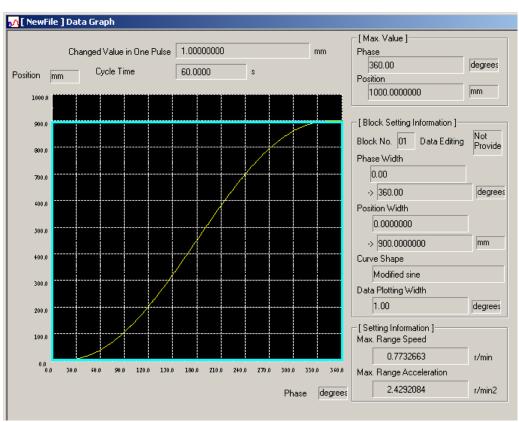


Figure 5: One way cam profile

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Subject: Application Note	Product: MPiec	Doc#: EM.MCD.09.043		
Title: Implementing Electronic Cams with MPiec: Quick Start Guide				

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 .

M	icrosoft Exc	el - Simple2	WayCamDa	ata.csv
:1	<u>Eile E</u> dit	⊻iew Inse	rt F <u>o</u> rmat	<u>T</u> ools <u>D</u> ata
1	🚰 🖬 🖪	BL	🎔 🛍 👌	6 8 8 -
Tah	oma	+ 10	- B I	<u>n</u> 📰 🗐
	A1	+	<i>∱</i> 0	
	A	В	С	D
1	0.00E+00	0.00E+00		
2	5.00E+00	0.00E+00		
З	6.00E+00	4.82E-04		
4	7.00E+00	3.86E-03		
5	8.00E+00	1.30E-02		<u>_</u>
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		1
13	1.60E+01	6.36E-01	. 1	1
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	1	
29	3.20E+01	9.03E+00	1	
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

YASKAWA		2		
Subject: Application Note	Product: MPiec	Doc#:	EM.MCD.09.043	
Title: Implementing Electronic Cams with MPiec: Quick Start Guide				

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.

Save/Zip proj	ject as						? ×
Save in: 🗀	Simple_CamIn_CamOut	-	¢	£	d *	<u></u> -	
1							
File name:	Simpele_CamIn_Out.mwe					Save	•
Save as type:	Project Files (*.mwe)		•	•		Canc	el

- 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.)

YASKAWA					
Subject: Application Note	Product: MPiec	Doc#: EM.MCD.09.043			
Title: Implementing Electronic Cams with MPiec: Quick Start Guide					

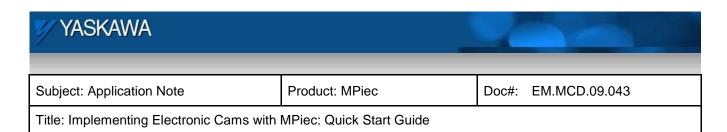
7. Click on the MLINK axes individually to configure each axis. Click on the configuration tab to set the axis type and configure user units.

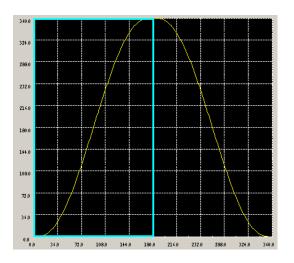
🔲 Mo	tionW	orks IEC							
File	Edit		Tuning	Online	Help				
i 💷)	. •	∌⊕€	} ⊠ s	ave Move	Log	Open N	love Lo	• 📜 i 🕂	- #)
	d Mod	lule Confi	guration						
Ξ	Sim	ple_Ca	mIn_Ou	it					
	<u>1</u>	<mark>/yMac</mark> h	ine					_	_
	÷		atrolink				Limits	Configurati	ion 1/
		Σv SG	iDV Ro	tary - 1					_
		Šv SG							_

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

nits Configura	ition 1/0 Tuning Test Mo	ve 🛛 Function 🗍 Absolute Encoder	Hardware Alarm E	Brake Dual End	oder
Machine Cyc	sle 360	Machine cycle (Rollover)			
	Feed Constant	Gear Ratio			
	360 Units	1 Output	Position Scale	Us	er Units
1 Rev	× >	-	360	De	egrees 💌
	1 Rev	1 Input	K		
			User Ui	nits	
		Load Type	1		
Parameter #	Parameters	Current V	alue Units	Min Max	Default Value
1007	Load Type	Rotary	•	0 1	Linear
1031	Logical Axis Number	1		1 512	

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.



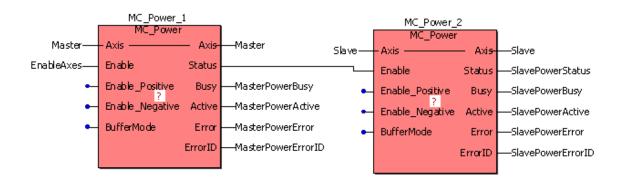


- 10. Save the configuration.
- 11. Initialize the master and slave axes.

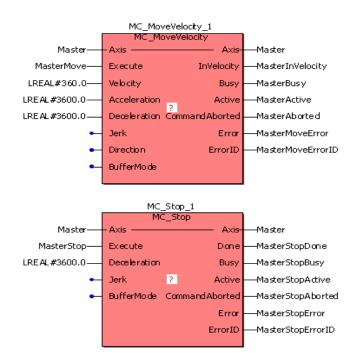
Project Tree	E Messages	Edit Wizard	References	Variables	Make
Aarik 2 Jindo			sNum := Num := U		

YASKAWA		2			
Subject: Application Note	Product: MPiec	Doc#:	EM.MCD.09.043		
Title: Implementing Electronic Cams with MPiec: Quick Start Guide					

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



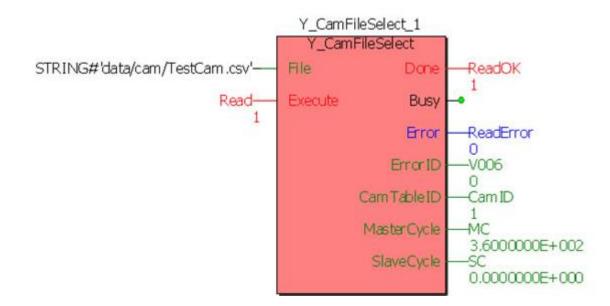
13. Add MC_MoveVelocity and MC_Stop blocks for the continuous motion from the master axis.



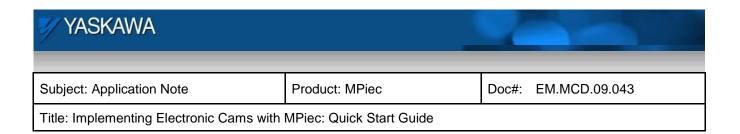
YASKAWA						
Subject: Application Note	Product: MPiec	Doc#: EM.MCD.09.043				
Title: Implementing Electronic Cams with	Title: Implementing Electronic Cams with MPiec: Quick Start Guide					

14. Add a Y_CamFileSelect function block.

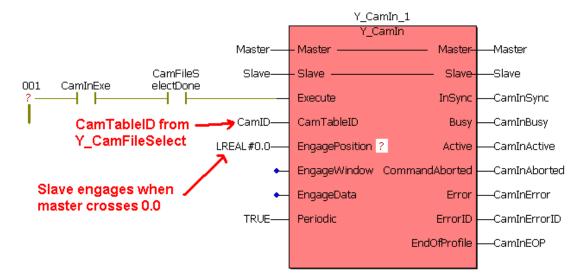
The filename is case sensitive and the name of the csv file cannot be more than 8 characters long (8.3 file name format).



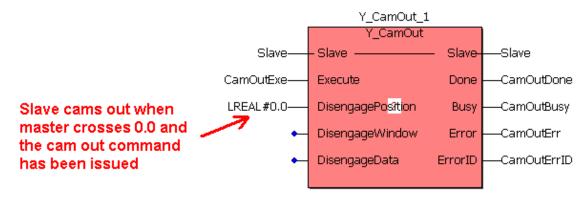
The CamTableID set by the Y_CamFileSelect block is input into the Y_CamIn block to engage the cam.

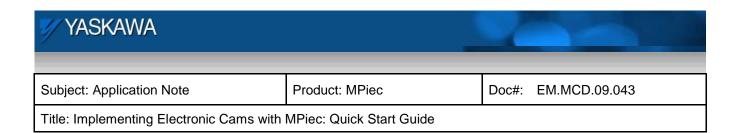


15. Add Y_CamIn block



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"

) Send offline configuration to controlle	er then restart controller
Restore controller to factory defaults	then restart controller
) Create archive of current project on	controller
) Send project archive to controller the	en restart controller
) Send CAM data file to data/cam dire	ectory on the 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:

YASKAWA Subject: Application Note Product: MPiec Doc#: EM.MCD.09.043 Title: Implementing Electronic Cams with MPiec: Quick Start Guide

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.

YASKAWA		2	
Subject: Application Note	Product: MPiec	Doc#:	EM.MCD.09.043
Title: Implementing Electronic Cams with	MPiec: Quick Start Guide		

