



PowerTools Pro Application Note
PTAN #4, Rev. 1, 3/30/2009
Applicable Products: Epsilon EP-P, FM4E,
SM EZMotion, Digitax ST-Z

Chaining Cam Tables



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Introduction

PowerTools cam has the ability to chain or link cam tables, the chaining path can be set at the time the program file is downloaded to the drive or they can be dynamically modified by a user program. Chaining has some restrictions on how the data is arranged and this application note will detail the requirements.

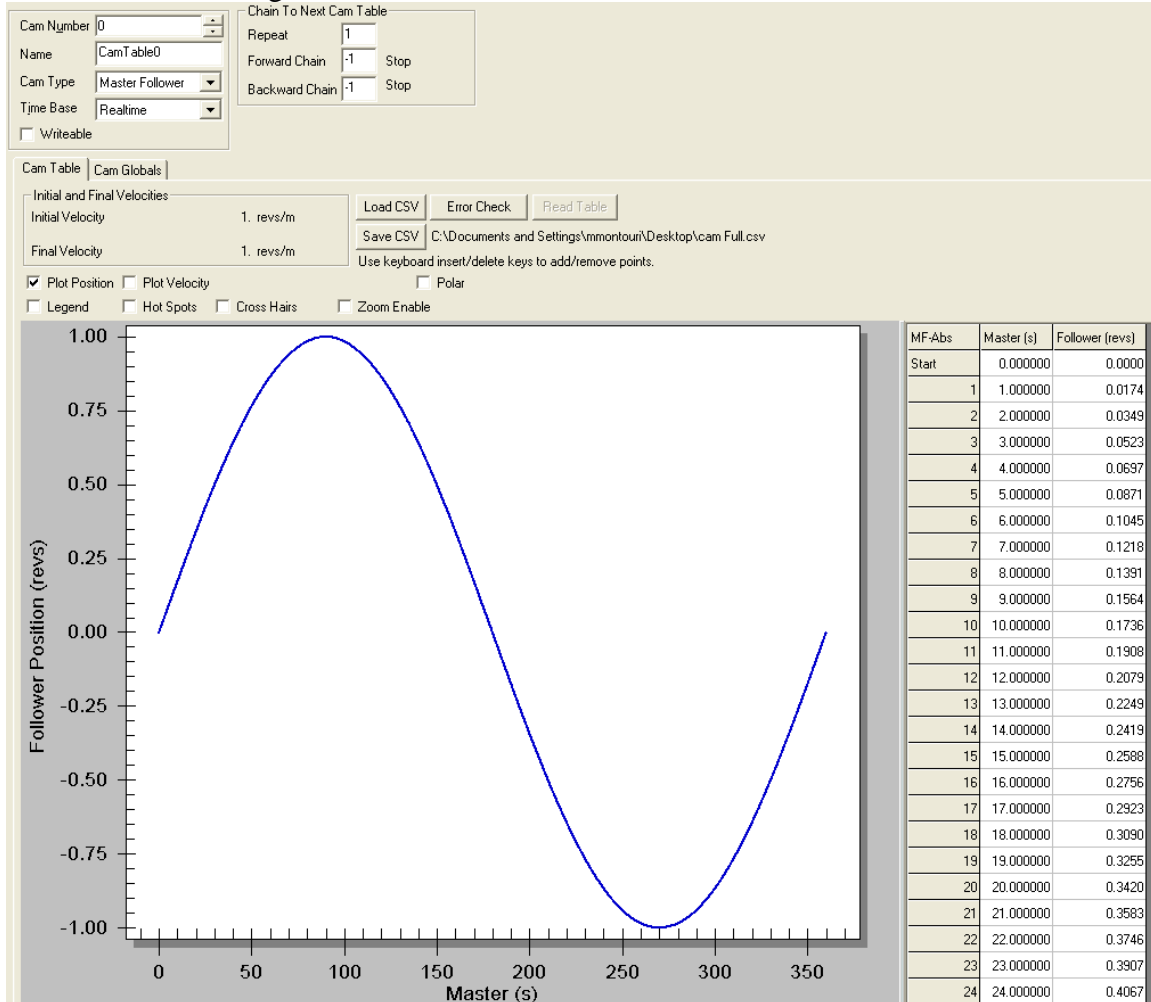
This application note shows how to take advantage of the forward and backward cam table chaining feature of cams within PowerTools to perform the following common functions:

1. Break up a single cam table into multiple cam tables
2. Dynamically chain cam tables

Chaining Cam Tables

Chaining is the procedure of allowing one cam table to blend into another. This allows for great flexibility in how the cam is implemented.

Let's start with a single cam table as shown here:



The table is comprised of 360 rows; the Master column contains values 0-360, representing an angle in degrees of the master motion or can be real time. The Follower column contains the value of function $\text{Sin}(\text{master angle})$. Creating this table is very simple procedure when using a spreadsheet program and importing the CSV file with the Load CSV button.



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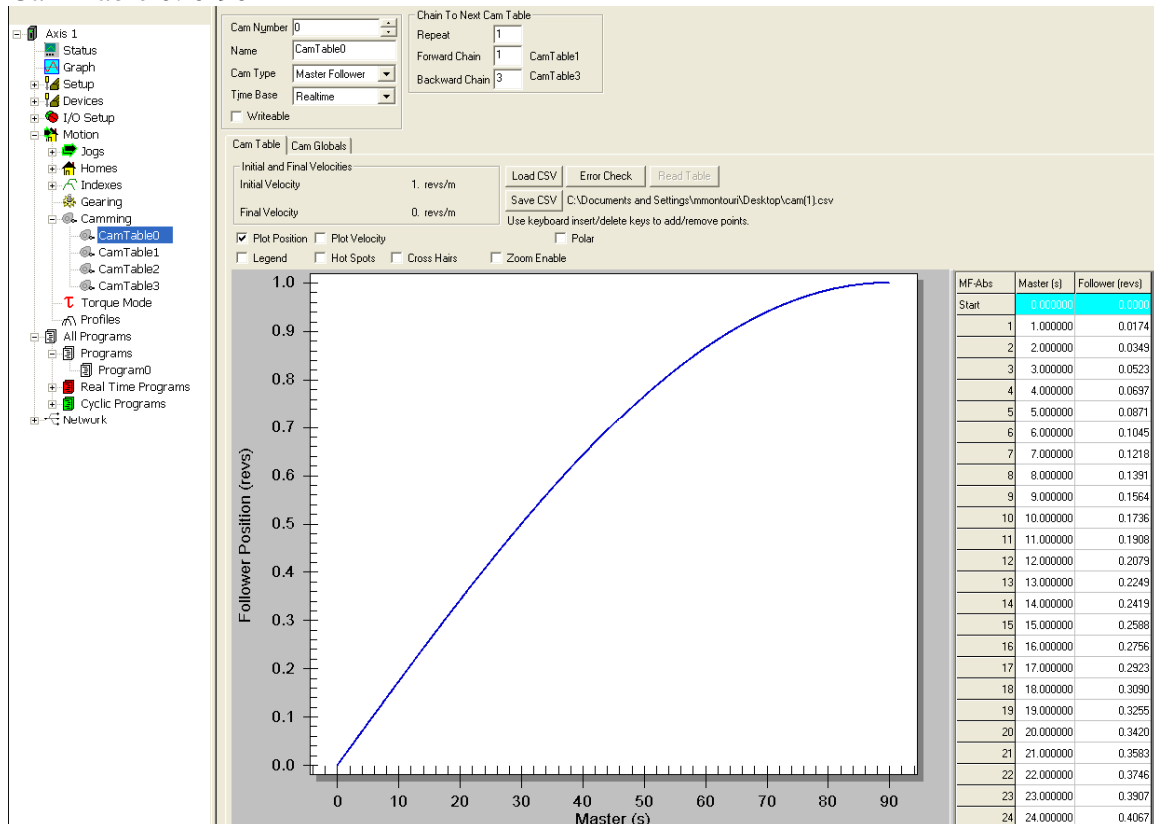
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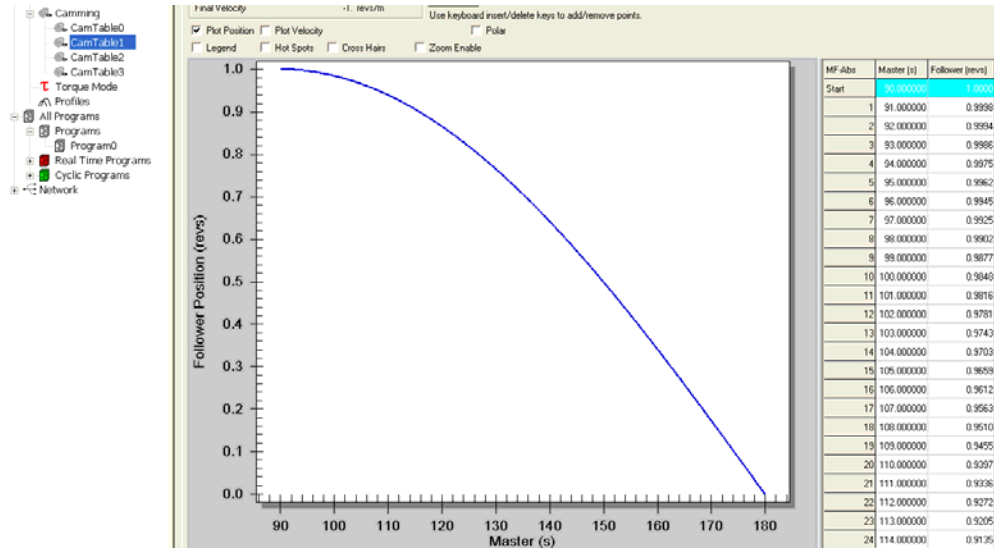
For our chaining example, we will take this single cam table and split the table up into four tables chained together. The easiest way to create these tables is to open a PowerTool EP-P file and click the Save CSV button; this will save a template file onto disk. The CSV file can then be opened in Excel or other spreadsheet software, the desired data can be manipulated and saved in a modified CSV file. Then click the Load CSV file to import the data into PowerTools. Be aware that the header information in the CSV file contains comment lines that start with a semicolon (;) and a file type delimiter contained within square brackets (e.g. [MF]). The file type delimiter must be the last line before the data values start.

To split the table, use the spreadsheet program to take only the portion of the total table needed. For our example we took the 0-360 degree array and split it into four tables every 90 degrees. The first table is 0-90, the second table is 90-180 and so on.

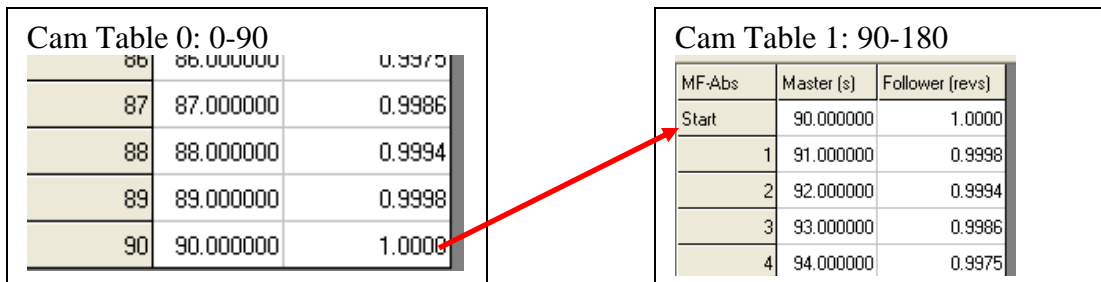
Cam Table 0: 0-90



Cam Table 1: 90-180

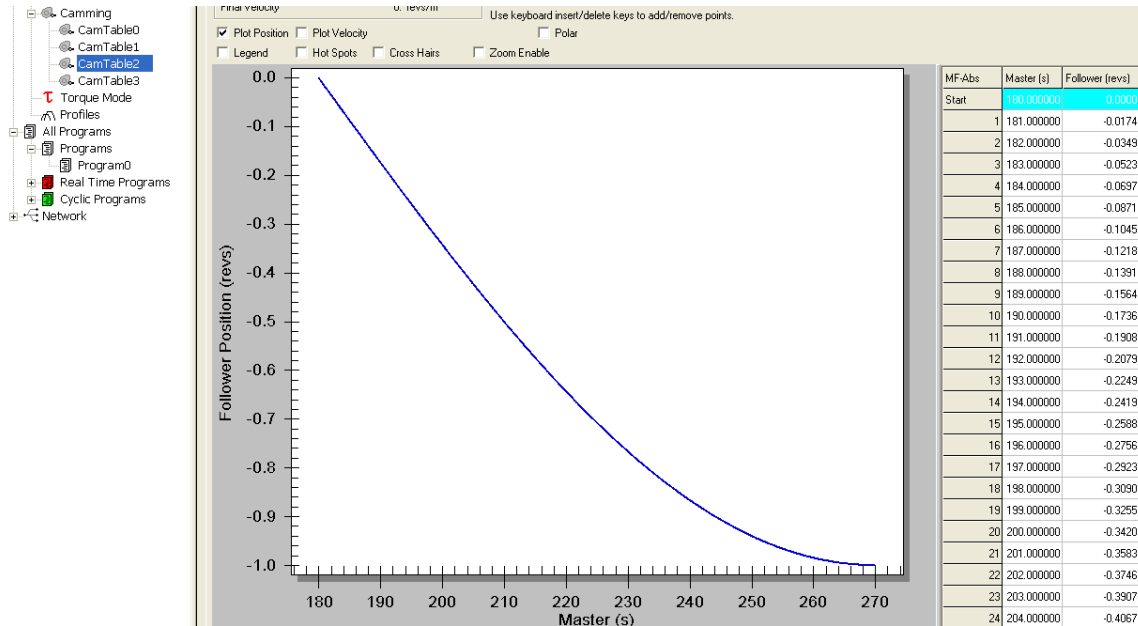


In order to make the chaining work perfectly, the following table's starting row must match the preceding table's ending row. As shown here:

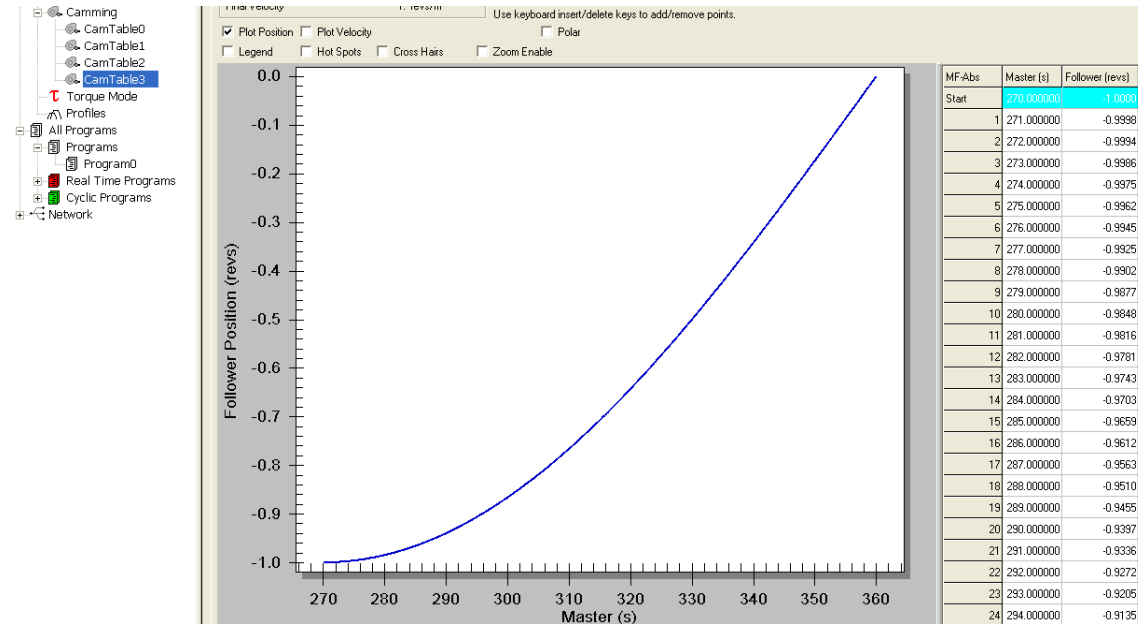


Continuing on with the last two tables:

Cam Table 2: 180-270



Cam Table 0: 270-360



Notice on the Cam Table 0 screen the 'Chain to Next Cam Table' frame:

| Chain To Next Cam Table | | |
|-------------------------|--------------------------------|-----------|
| Repeat | <input type="text" value="1"/> | |
| Forward Chain | <input type="text" value="1"/> | CamTable1 |
| Backward Chain | <input type="text" value="3"/> | CamTable3 |

In order to chain cam tables simply enter the table number of the Forward or Reverse chain. PowerTools will fill in the name of the Cam Table represented by the table number.

In the example below, Cam Table 2 was renamed to Table2_Name. In order to stop the chaining simply enter negative one (-1) as the chain value:

| Chain To Next Cam Table | | |
|-------------------------|---------------------------------|-------------|
| Repeat | <input type="text" value="1"/> | |
| Forward Chain | <input type="text" value="-1"/> | Stop |
| Backward Chain | <input type="text" value="2"/> | Table2_Name |

Chain values can be changed dynamically within a user program with the following program command example:

```
Cam.0.BackwardChain =1
Cam.0.ForwardChain = 2
```

As cam table 0 runs in the forward direction, it will chain into cam table 2, running in the backward direction it will chain into cam table 1.

By setting these commands to the appropriate cam table, the cam profile can be dynamically changed on-the-fly.

Once the chain values are set, the four 90 degree cam tables will operate exactly as the single 360 degree table.



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Finally, we can click on the top level Camming view and see the summary of the cam table structure:

The screenshot shows the PowerTools Pro software interface. The title bar reads "Emerson Control Techniques - PowerTools Pro - [EP-P Configuration [master resume 4 tables]". The menu bar includes File, Edit, Device, Options, Tools, View, Window, and Help. The toolbar contains various icons for file operations and navigation. On the left, a tree view shows the configuration structure under "Axis 1", including Status, Graph, Setup, Devices, I/O Setup, Motion, Jogs, Homes, Indexes, Gearing, and Camming. The "Camming" folder is expanded, showing a table with the following data:

| Name | Number | Key Data |
|-------------|--------|---|
| CamTable0 | 0 | Forward:1, Backward:3, Repeat:1, Master Follower, Realtime |
| CamTable1 | 1 | Forward:2, Backward:0, Repeat:1, Master Follower, Realtime |
| Table2_Name | 2 | Forward:3, Backward:1, Repeat:1, Master Follower, Realtime |
| CamTable3 | 3 | Forward:-1, Backward:2, Repeat:1, Master Follower, Realtime |



Dynamic Chaining of Cam Tables

Once downloaded, the cam table chain values can be changed by a user program very easily.

Simply use the cam parameter of Cam.x.ForwardChain or Cam.x.BackwardChain, where x is the cam number. Set the parameter equal to the cam table number to chain to. If you chain into a non-existent cam table, the drive will produce a program fault when it encounters that particular line of code.

To stop a cam from any further motion use the chain value of -1.

In this example, when cam.0 is moving in a backward direction (master moving backward and the top of the table is then encountered, the cam motion will stop.

```
If ( var.recipe = 3) then  
    Cam.0.ForwardChain = 2  
    Cam.0.BackwardChain = -1  
EndIf
```

For deterministic operation, a real time program can be used to alter the chain value.