

13 Cam Applications

Introduction

The DSPL commands useful for cam applications are:

i) Commands used by all cam applications

CAM	;engages a cam function unconditionally
CAM_OFF	;disengages cam
CAM_OFF_ACC	;disengages cam and decelerates slaves to a stop
CAM_POINT	;inserts a cam point into the cam table
CAM_POS	;engages cam based on a programmed position
CAM_PROBE	;engages cam when an external signal is set

ii) Command used by applications requiring cyclic error corrections

REL_AXMOVE_SLAVE ;moves slaves relative to slave position(s)

iii) Command used by applications requiring several Mx4 cards (one master and up to 127 slaves)

SYNC ;synchronizes a slave Mx4 card to a master Mx4 card

The two steps involved in programming CAM on an Mx4 are:

Step 1:

Writing CAM points to the Mx4 CAM memories. This is done either in your DSPL program or by downloading the ASCII file that contains the CAM points to Mx4.

Step 2:

Issuing CAM instruction.

Cam Applications

Example:

Write a DSPL program to perform CAM function on motors 1 and 2. Use motor 1 as master and motor 2 as slave. The CAM positions for master and slave are:

MASTER POS	SLAVE POS
0	0
100	100
200	200
300	400
400	580
500	800
600	1000
700	1100
800	1000
900	950
1000	1200
1100	1400
1200	1500
1300	1500
1400	1200
1500	1000
1600	700
1700	500
1800	300
1900	150
2000	0

Generating CAM Points in DSPL

Write CAM points to the Mx4's CAM memory location inside your DSPL program:

```

PLC_PROGRAM:

run_m_program(CAMEXAMPLE)

END

CAMEXAMPLE:

    pos_preset(0x3,0,0)      ;preset positions
    maxacc(0xf,1,1,1,1)    ;set maximum accel
    ctrl(0x3,0,10,0,60,0,10,0,6);set gains
    cam_point(10,21,0,0,0)  ;enter all 21 points.
    cam_point(10,21,1,100,100) ;10 is offset into
    cam_point(10,21,2,200,200) ;cam table area
    cam_point(10,21,3,300,400) ;third argument in
    cam_point(10,21,4,400,580) ;cam_point inst.
    cam_point(10,21,5,500,800) ;point number
    cam_point(10,21,6,600,1000)
    cam_point(10,21,7,700,1100)
    cam_point(10,21,8,800,1000)
    cam_point(10,21,9,900,950)
    cam_point(10,21,10,1000,1200)
    cam_point(10,21,11,1100,1400)
    cam_point(10,21,12,1200,1500)
    cam_point(10,21,13,1300,1500)
    cam_point(10,21,14,1400,1200)
    cam_point(10,21,15,1500,1000)
    cam_point(10,21,16,1600,700)
    cam_point(10,21,17,1700,500)
    cam_point(10,21,18,1800,300)
    cam_point(10,21,19,1900,150)
    cam_point(10,21,20,2000,0)
    cam(0x1,0x2,10,21)      ;start master/slave
                                ;cam
END

```

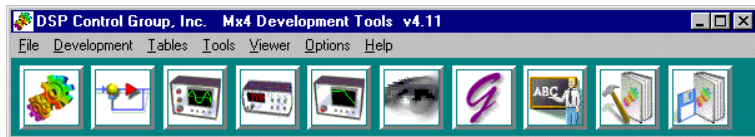
It is important to note that the DSPL instruction `cam_point` allows the use of variables for all of its arguments and through this mechanism users may change the CAM points on the fly.

It is equally important to note that master positions do not have to be uniformly spaced and that Mx4 linearly interpolates between the points.

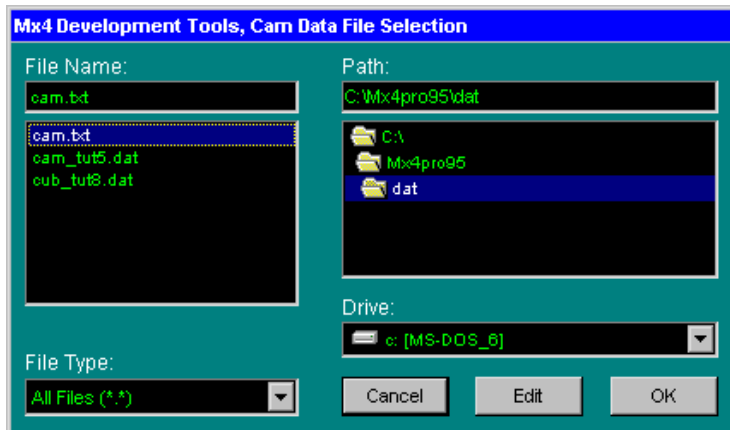
Using the Mx4Pro DownLoad Utility

Save your two column formatted master/slave positions in an ASCII file (e.g. cam.txt or cam.doc) and download this file to Mx4. In the next section we will talk about an alternative way of generating a cam file using MicroSoft Excel™.

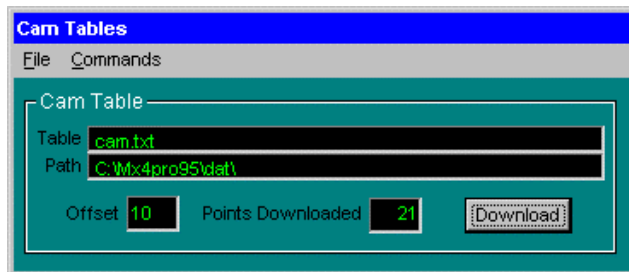
To download, use the CAM download utility in Mx4pro Deveopment Tools. This utility is available under Tables selection.



Select your already saved ASCII file (e.g. cam.txt).



And click OK.



Notice that cam.txt may be saved in any arbitrary area of the Mx4's CAM table memory. For example, in order to save cam.txt to CAM memory location 10 and on, enter 10 for offset value and click Download. Note that this offset and the offset value you will use in your DSPL program must be the same.

As a result of clicking on the Download key number 21 will appear in 'Points downloaded' field which indicates a successful transmission of all CAM points to the Mx4's CAM table memory.

Finally, the following DSPL program will run CAM function.

PLC_PROGRAM:

```
run_m_program(CAMEXAMPLE)
```

END

CAMEXAMPLE:

```
pos_preset(0x3,0,0)           ;preset positions
maxacc(0xf,1,1,1,1)          ;set maximum accel
ctrl(0x3,0,10000,0,6000,0,10000,0,6000)
                               ;set gains
cam(1,2,10,21)                ;start cam
```

END

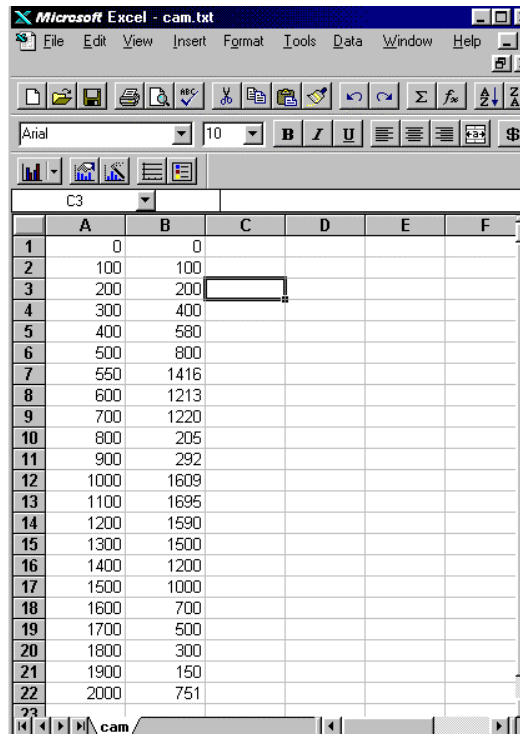
Generate CAM table Using MicroSoft Excel™

Using a spreadsheet program such as MicroSoft Excel™, users can create, and graphically view CAM Tables.

The following outlines the steps involved in table creation and graphical display of master/slave positions.

Step 1 - Create a table

To create a CAM table, open Excel and fill columns A and B with master and slave positions respectively (See Figure 13-1). Notice that the first row must start with zeros for both master and slave positions and the last master position indicates the full move cycle (e.g. 2000 encoder counts). Also, bear in mind that the number of rows in a CAM table must be between 3 and 1600.



The screenshot shows a Microsoft Excel window titled "Microsoft Excel - cam.txt". The spreadsheet has columns A through F and rows 1 through 23. Column A contains master positions and column B contains slave positions. The data is as follows:

	A	B	C	D	E	F
1	0	0				
2	100	100				
3	200	200				
4	300	400				
5	400	580				
6	500	800				
7	550	1416				
8	600	1213				
9	700	1220				
10	800	205				
11	900	292				
12	1000	1609				
13	1100	1695				
14	1200	1590				
15	1300	1500				
16	1400	1200				
17	1500	1000				
18	1600	700				
19	1700	500				
20	1800	300				
21	1900	150				
22	2000	751				
23						

Figure 13-1: Master Slave positions entered in MicroSoft Excel

Step 2 - Graphical Illustration

Using the left mouse button, highlight the two columns created in the first step.

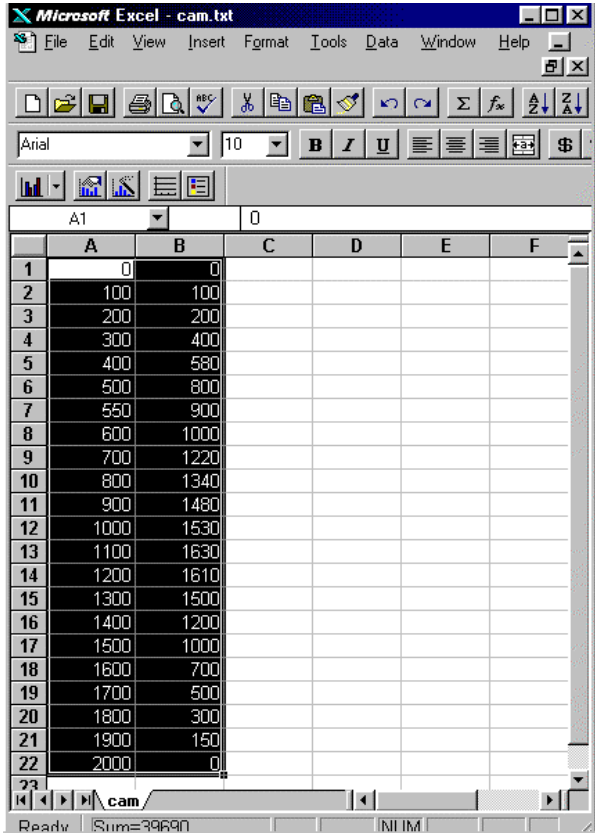


Figure 13-2: Use the left mouse button to select the entire table

Use Insert Chart or ChartWizard button to select an area of the spreadsheet in which you wish to place the graphical representation of the CAM function. This is done by dragging a window with the left mouse button depressed.

The Chart Wizard initiates the next window.

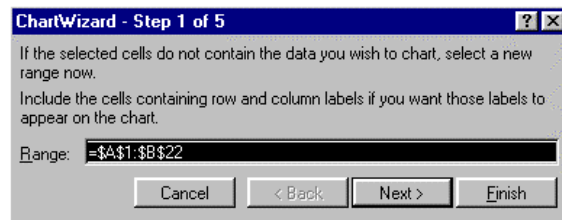


Figure 13-3: Select the cells containing master/slave information

Click Next> to proceed.

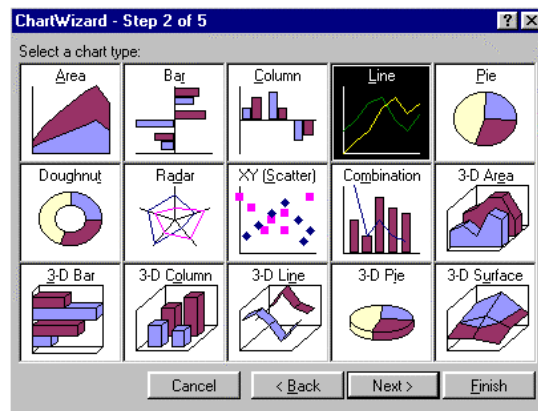


Figure 13-4: Select your desired chart type

Click Next> to proceed .

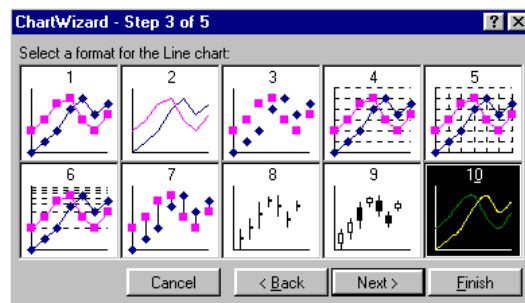


Figure 13-5: Select an appropriate format for the Line chart

Figure 13-5 shows a window with 10 selections for line format. Here we have selected format 10.

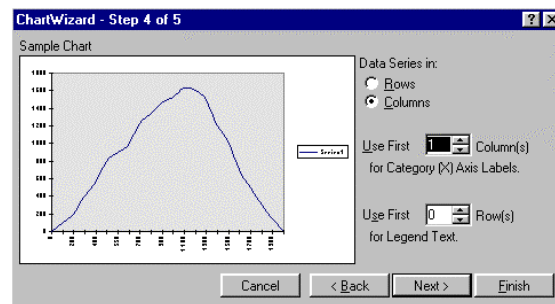


Figure 13-6: Assigning columns to x and y coordinates

Figure 13-6 illustrates the chart for our CAM table. Notice that we have assigned the master position to the x axis and the slave position the y axis.

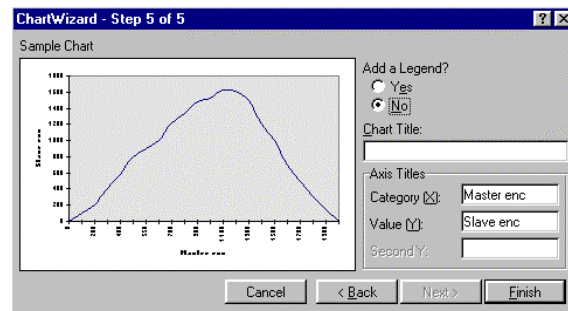


Figure 13-7: You can assign titles for x and y axes

Finally, if desired, the X and Y axes can be labeled. In this example, x axis is labeled as the Master enc. and Y is labeled as the Slave enc.

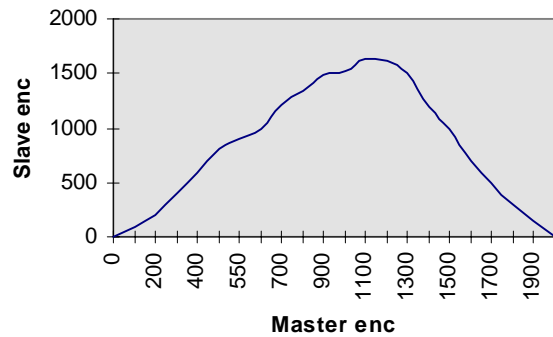


Figure 13-8: The final chart

Figure 13-8 illustrates the final chart that may be printed or imported to the other Windows applications such as MicroSoft Word.

Step 3 - Saving the CAM Table

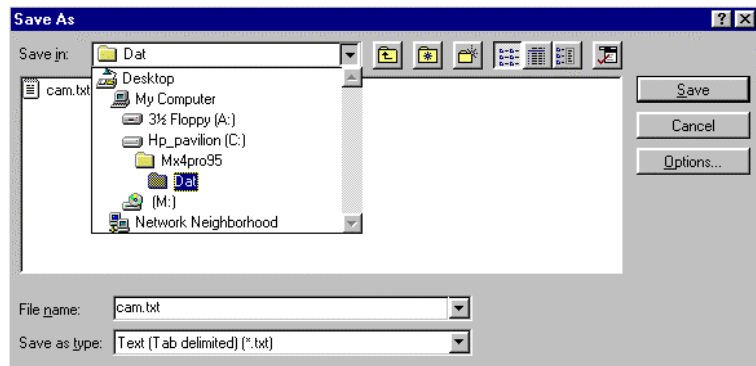


Figure 13-9: The path to CAM table data files

Finally, the Cam Table must be placed in the DAT sub-directory of the Mx4pro95 as illustrated in Figure 13-9. When saving CAM Table, you *must* use Text (Tab Delimited) for the file type.

Use of Multiple Mx4 Cards in Cam Master/Slaving

Applications requiring more than three slaves need multiple Mx4 cards. The figure below illustrates the hardware diagram of a multi-card operation.

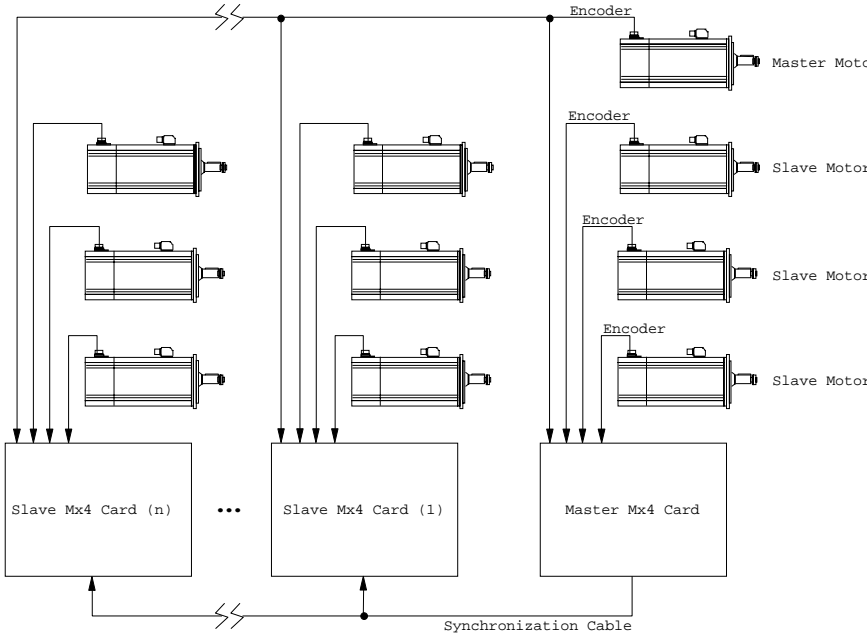


Figure 1: Multiple Mx4 Cards in Cam Master/Slaving

The position of the master position is used by the first axis of each Mx4 card. Therefore each card can only accept three slaves.

Hardware Settings for Multi-Card Cam Operation

Daisy-chaining several Mx4 boards and proper jumper settings for their synchronization is described in the *Mx4 User's Guide, Installing Your Mx4 Hardware*.

Software Commands for Multi-Card Cam Operation

The only difference between multiple- and single-card cam operations is that in multi-card operation, you must let a slave Mx4 card know that it has been selected as a slave. The master Mx4 card does not need to be notified!

On a slave card, the DSPL command that needs to precede those listed for a single card cam application (see Example 1) is:

```
sync( 1 )           ; Mx4 card is a slave
```

The “1” argument in the SYNC instruction configures the Mx4 board as a slave. If Mx4 powers-up and resets to a default Master status. To explicitly set the card as a master use a “0” argument in the SYNC command:

```
sync( 0 )           ; Mx4 card is a master
```



Note 1: The DSPL command `sync` *must* precede those listed in the first example.



Note 2: The above DSPL command `sync` is only *required to run on a slave* Mx4 card.

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