



Application Note #2444

Cam Tables with Linear Sections (EW command)

Galil’s ECAM mode replaces mechanical cams by establishing a nonlinear relationship between two axis positions (a master and a slave). Master positions must be evenly spaced according to the EP (ECAM master positions) command; however, EW (ECAM widen segment) allows one or two of these segments to be widened. This note describes how to use EW to generate a smooth cam table consisting of both curved sections as well as one or two linear sections. Cam tables composed of only linear sections or only curves would not benefit from EW.

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1 When to Use EW

Figure 1 shows an example of a cam table that benefits from the use of EW. It consists of three curved sections and two long linear sections. It is desirable to use as many points as possible in the curved sections for smooth motion. Since linear interpolation is used in between each point, only two points are needed to define each long linear section and EW is used for this purpose (figure 1 left). Without EW, all segments must be of equal length and thus points are “wasted” on the two linear sections (figure 1 right).

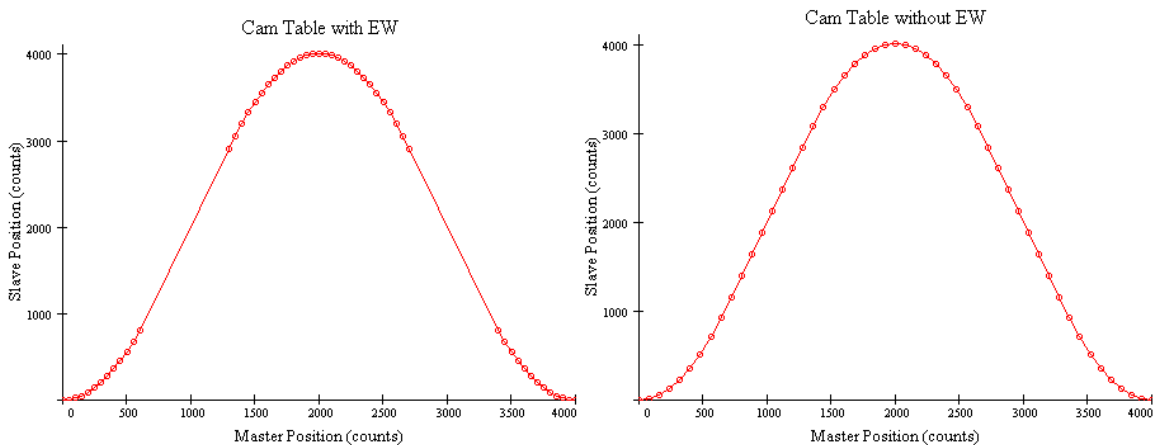


Figure 1. Left: with EW, the curved sections have more points. Right: without EW, all points are equally spaced, reducing the number of points on the curved sections. Both graphs have the same number of points.

2 Example

This section details a simple example that uses the EW command to implement the cam table in figure 2 below. Although this table could be implemented with only three points and without the EW command, its simplicity makes it easier to understand how to use EW to create a cam table such as that in figure 1 above.

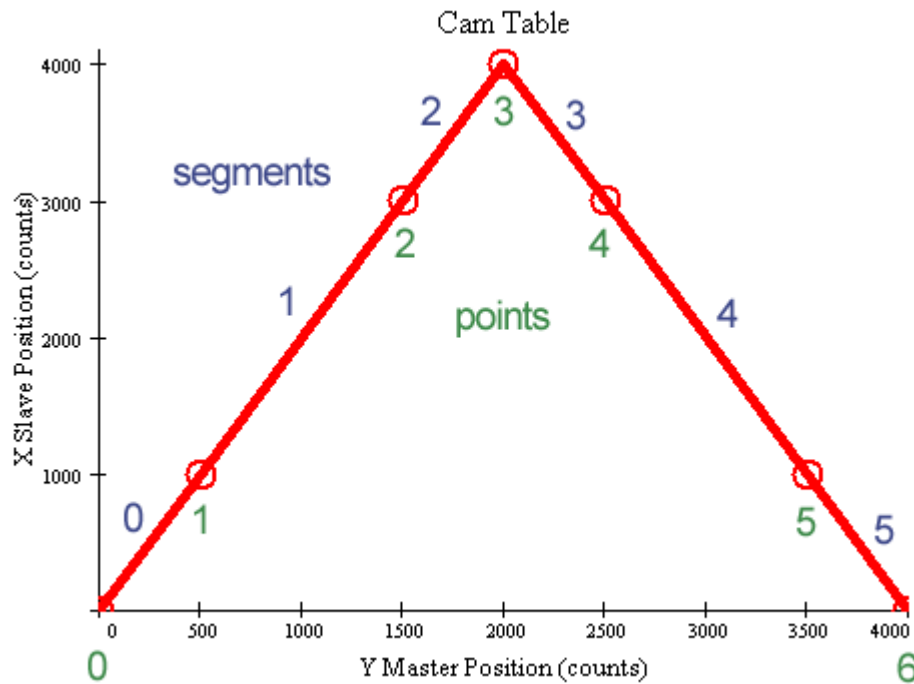


Figure 2. Cam table generated using EW to widen segments 1 and 4 (see code on next page)

The table in figure 2 is made up of seven points (labeled 0 to 6 in green) and six segments (labeled 0 to 5 in blue). The segment associated with each point is the segment just to the right of the point (with the exception of point 6, which has no associated segment). Use point numbers for ET (ECAM table) and segment numbers for EW. Segments 0, 2, 3, and 5 are of equal length (500 counts), specified with EP 500. We wish to widen segments 1 and 4 to 1000 counts with the command EW 1=1000, 4=1000.

The master modulus EM must be computed according to the following table:

Number of EW Segments	Master Modulus EM
0	$EM = S * EP$
1	$EM = (S - 1) * EP + EW1$
2	$EM = (S - 2) * EP + EW1 + EW3$

Where: EM is the master modules in master counts
 S is the total number of segments
 _EP is the master interval width
 _EW1 is the length in master counts of the first widened segment
 _EW3 is the length in master counts of the second widened segment

For our example, EW segments = 2, S = 6, _EP = 500, _EW1 = 1000, and _EW3 = 1000, so:

$$EM = (6 - 2) * 500 + 1000 + 1000 = 4000$$

The code to generate the cam table in figure 2 is below:

```

EB0           ;'turn cam off
EAY           ;'y axis is the master
EM 0,4000    ;'x slave change, y master change
EP 500,0     ;'interval width, starting position

ET[0]=0
ET[1]=1000

ET[2]=3000
ET[3]=4000
ET[4]=3000

ET[5]=1000
ET[6]=0

EW 1=1000, 4=1000 ;'widen segments 1 and 4 to 1000 master counts

EB1           ;'turn cam on
EG0           ;'engage slave immediately
JGY=1000     ;'jog the master
BGY           ;'begin motion
AMY           ;'wait for motion complete
EN           ;'end program

```

3 EW Command Page

FUNCTION: ECAM Widen Segment

DESCRIPTION:

Allows widening the length of one or two ECAM segments beyond the width specified by EP.
For ECAM tables with one or two long linear sections, this allows placing more points in the curved sections of the table.

There are only two widened segments, and if used they are common for all ECAM axes.
Remember that the widened segment lengths must be taken into account when determining the modulus (EM) for the master. The segments chosen should not be the first or last segment, or consecutive segments.

ARGUMENTS: EP m1=n1, m2=n2 where
m1 is the index of the first widened segment. m1 is a positive integer between 1 and 255
n1 is the length of the first widened segment in master counts. n1 is an integer between 1 and 2,147,483,647.

m2 is the index of the second widened segment. m2 is a positive integer between 3 and 255
n2 is the length of the second widened segment in master counts. n2 is an integer between 1 and 2,147,483,647.

If m1 or m2 is set to -1, there is no widened segment. The segment number m2 must be greater than m1 and m2 may not be used unless m1 is used.

USAGE:

While Moving No
In a Program Yes
Command Line Yes
Controller Usage **ALL CONTROLLERS**

DEFAULTS:

Default Value -1, 0, -1, 0
Default Format

OPERAND USAGE:

_EW0 contains m1, the index of the first widened segment.
_EW1 contains n1, the length of the first widened segment.

_EW2 contains m2, the index of the second widened segment.
_EW3 contains n2, the length of the second widened segment.

RELATED COMMANDS:

EP ECAM master positions
EA Choose ECAM master
EB Enable ECAM
EC Set ECAM table index
EG Engage ECAM Slave
EM Specify ECAM cycle
EQ Disengage ECAM Slave
ET ECAM table

EXAMPLES:

EW 41=688 ;*Widen segment 41 to 688 master counts
EW 41=688, 124=688 ;*Widen segments 41 and 124 to 688 master counts