Copley Camming User Guide

P/N 95-00501-000

Revision 2
June 2008

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ABOUT THIS MANUAL

Overview and Scope

This manual describes the use of the Copley Controls Camming feature, and its setup through Copley Controls CME 2 amplifier commissioning software. Thus, this book is intended to be used as an addendum to the CME 2 User Guide.

It is assumed that before the Camming feature is configured and operated, the amplifier will have been set up and tuned using CME 2 software.

Related Documentation

Documents of related interest include:

- *CME 2 User Guide* (describes the use of CME 2 amplifier commissioning software to set up and tune the amplifier)
- *Copley Indexer Program User Guide* (describes use of Indexer Program to create motion control sequences)
- *Copley ASCII Interface Programmer's Guide* (describes how to send ASCII format commands over an RS232 serial bus to set up and control one or more amplifiers).
- *Copley Amplifier Parameter Dictionary* (describes all Copley Controls amplifier parameters)

Links to these publications, along with hardware manuals and data sheets, can be found under the *Documents* heading of
http://www.copleycontrols.com/Motion/Downloads/index.html

Copley Controls software and related information can be found on:
http://www.copleycontrols.com/Motion/Products/Software/index.html

Comments

Copley Controls Corporation welcomes your comments on this manual. See http://www.copleycontrols.com for contact information.

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Document Validity

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1.1.1: Product Warnings

Observe all relevant state, regional, and local safety regulations when installing and using Copley Controls amplifiers. For safety and to assure compliance with documented system data, only Copley Controls Corporation should perform repairs to amplifiers.

DANGER

Hazardous voltages.

Exercise caution when installing and adjusting Copley Controls amplifiers.

Risk of electric shock.

High-voltage circuits are connected to mains power on certain Copley Controls amplifiers.

Risk of unexpected motion with non-latched faults.

After the cause of a non-latched fault is corrected, the amplifier re-enables the PWM output stage without operator intervention. In this case, motion may re-start unexpectedly. Configure faults as latched unless a specific situation calls for non-latched behavior. When using non-latched faults, be sure to safeguard against unexpected motion.

Latching an output does not eliminate the risk of unexpected motion with non-latched faults.

Associating a fault with a latched, custom-configured output does not latch the fault itself. After the cause of a non-latched fault is corrected, the amplifier re-enables without operator intervention. In this case, motion may re-start unexpectedly.

Using CME 2 or serial commands may affect or suspend CAN operations.

When operating the amplifier as a CAN node, the use of CME 2 or ASCII serial commands may affect CAN operations in progress. Using such commands to initiate motion may cause CAN operations to suspend.

CAN operations may restart unexpectedly when the commanded motion is stopped.

Use equipment as described.

Operate amplifiers within the specifications provided in the relevant hardware manual or data sheet.

Failure to heed these warnings can cause equipment damage, injury, or death.

1.1.2: Revision History

Revision	Date	DECO #	Comments
1	July 2006		Initial publication.
2	June 2008	16707	Various updates, including updated Web page references.

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CHAPTER 1: OPERATIONAL OVERVIEW

Topics include:

1.1: Host System Requirements

1.1.1: Computer and Operating System

Minimal hardware requirements:

- **CPU**: 400 MHZ.
- **RAM**: 128 MB.

Operating Systems Supported: Windows NT, 2000, XP, Vista.

1.1.2: Software

Copley Controls CME 2 software, Version 5.1 or higher.

1.1.3: Serial Communications

For each PC-to-amplifier connection via serial port: One serial communication cable. See amplifier data sheet for part numbers.

1.2: Camming Operation

Camming allows Copley amplifiers to synchronize the motion of an axis (the Cam Slave) to the motion or commands of an external device (the Cam Master).

A Cam Master can be an encoder, a PLC, or any device that generates electronic pulses to indicate the position of the Master axis. (In place of an external Master, the amplifier can generate Master position pulses with its own Internal Generator.)

A Cam Slave is an axis controlled by a Copley amplifier.

1.2.1: Cam Tables and Controls

A user defines camming moves by populating Cam Tables. Each Cam Table line contains a Cam Master Position and a corresponding Slave Position.

The user also configures the Cam Trigger and the source of the Master input.

Cam Table position values are entered in counts. (Note that because the value of a count is system dependent, a Master count and a Slave count may not have the same distance equivalent.)

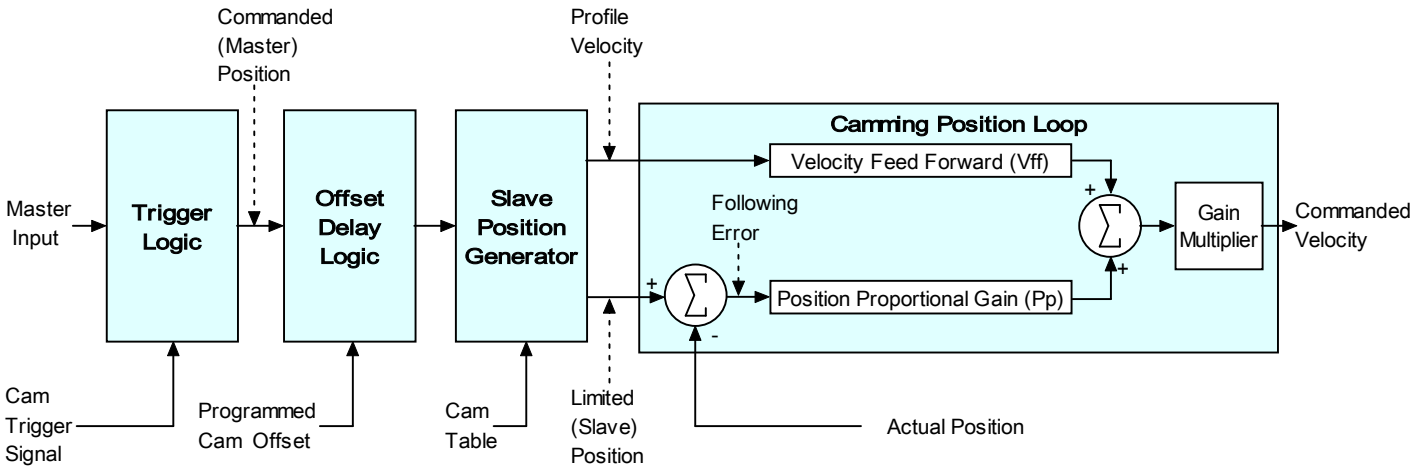
Master and Slave Position values are relative to the positions of the Master and Slave at trigger time.

NOTE: Normally, Cam Tables are stored in the amplifier's flash memory, allowing the Cam Tables to be uploaded once and persist between power cycles.

In applications where flash storage is not appropriate or optimal, up to 16 Cam Tables can be loaded into and run from amplifier RAM instead. For more information, see the *CANopen Programmer's Manual*.

1.2.2: Control Diagram

As shown below, when the Cam Trigger is activated, the amplifier receives position data (counts) from the Master Input and interprets the active Cam Table to command the Slave position loop. When the Master reaches a programmed Master position, the Slave axis reaches the corresponding Slave position. The position loop uses linear interpolation to drive the Slave axis smoothly from point to point.



Note that during camming, profile velocity, acceleration, deceleration, and Aff have no effect. The only limiting variables are the current limits and the velocity limit in the velocity loop.

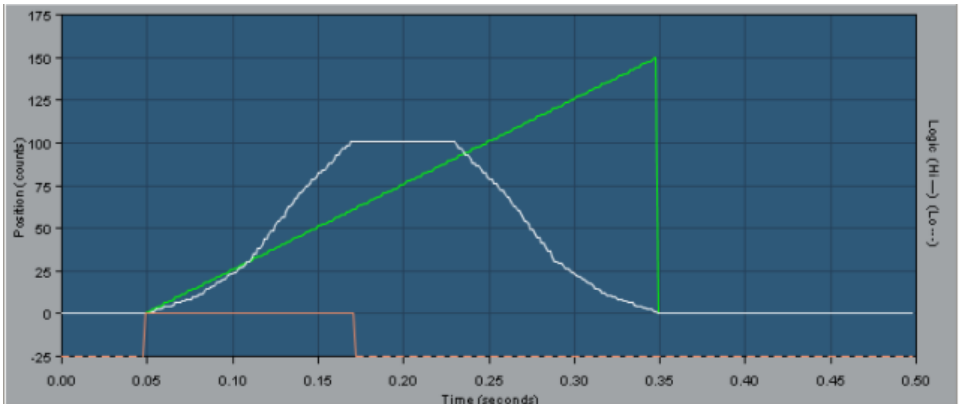
1.3: Monitoring Camming Moves

To monitor the Cam Master position in the CME 2 Scope tool or Control Panel, use the **Commanded position** variable. To monitor the Cam Slave position, use the **Limited position** variable. For an example, see Scope Trace of a Sample Camming Move below.

Another useful variable to monitor is the **Event Status Misc.: In Motion** flag.

1.3.1: Scope Trace of a Sample Camming Move

Following is a trace of a simple camming move shown in the CME 2 Trace Viewer tool. Scope Channel 1 (green) traces Commanded position, representing the Cam Master position. Channel 2 (white) traces Limited position, representing the Cam Slave position. Channel 6 (red) traces IN 2, which was used as the Cam Trigger.



The Cam Table that was interpreted to control this move is shown below:

	Master Position	Slave Position
0	0	0
1	15	10
2	30	30
3	45	70
4	60	100
5	75	100
6	90	100
7	105	70
8	120	30
9	135	10
10	150	0

CHAPTER 2: CAMMING SETUP

This chapter shows how to use CME 2 to prepare the amplifier to run camming profiles. Perform the steps outlined below. Details follow in the chapter.

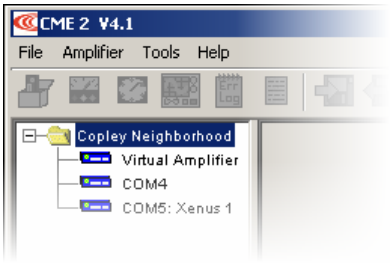
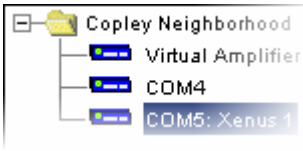
1. Start CME 2 (p. 12).
2. Configure CME 2 Basic Setup for Camming Mode (p. 13).
3. Configure Camming Parameters (p. 14).
4. Load the Cam Tables (p. 16).

2.1: Start CME 2

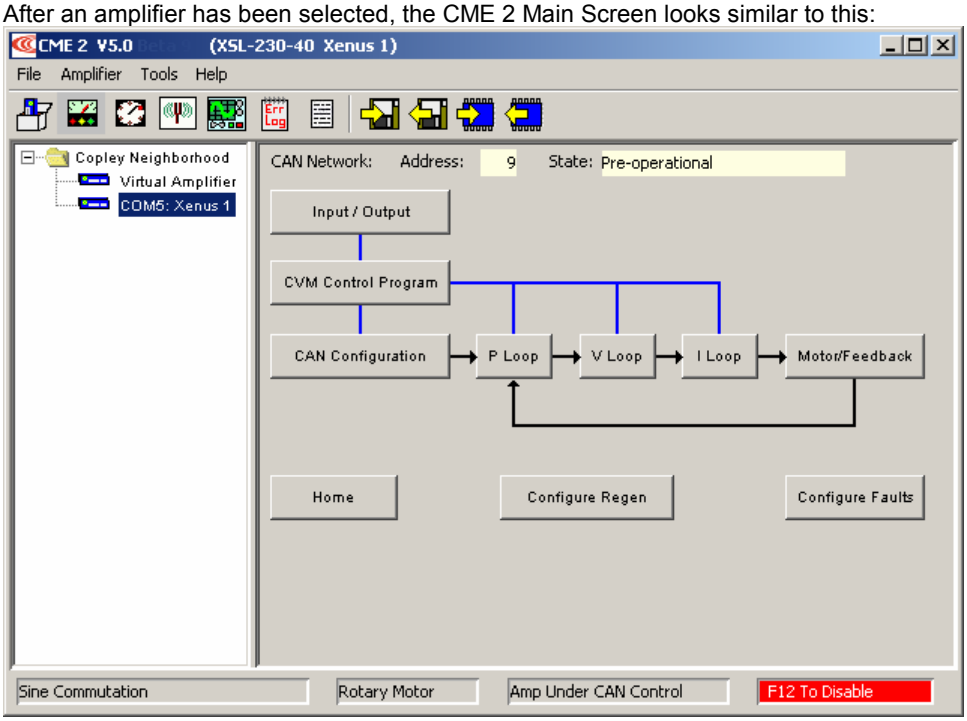
1 

Double-click the CME 2 shortcut icon on the Windows desktop to start CME 2.

2

If communications were set up already…	**If communications were not set up…**
…the CME 2 Main Screen opens. If there are multiple ports, the Copley Neighborhood root will be selected as shown below:  Select the desired amplifier. For instance:  	…see the screen below:  In this case, see the Copley Controls *CME 2 User Guide*.

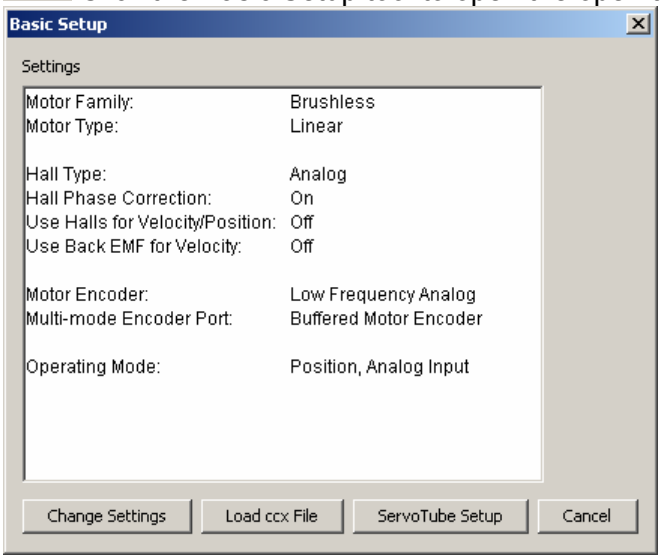
After an amplifier has been selected, the CME 2 Main Screen looks similar to this:



If the Basic Setup options have not been chosen, the *Basic Setup* screen opens.

2.2: Configure CME 2 Basic Setup for Camming Mode

1  Click the Basic Setup tool to open the open the *Basic Setup* screen:



2  Click **Change Settings** to start the Basic Setup wizard. Use the Back and Next buttons to navigate screens. Screen details vary depending on amplifier model and mode selection.

3 Verify the settings on the *Motor Options* and *Feedback Options* screens. See the Copley Controls *CME 2 User Guide* for more information.

4 Click the **Next** button to display the *Operating Mode Options* screen.

5 Set *Operating Mode* to **Position**.

6 Set *Command Source* to **Camming**.

7 Set *Digital Input Source:*
To control camming with an external master using two of the amplifier's digital input lines (typically IN 9 and IN 10), set *Digital Input Source* to **High Speed Inputs**.
To control camming with an external master using the amplifier's secondary encoder inputs, set *Digital Input Source* to **Multi-mode Port**.
To control camming with the amplifier's Internal Generator, set *Digital Input Source* to **High Speed Inputs**.

8 Verify settings on the *Miscellaneous Options* screen.
See the Copley Controls *CME 2 User Guide* for more information.

9 Click **Finish** to close the screen.

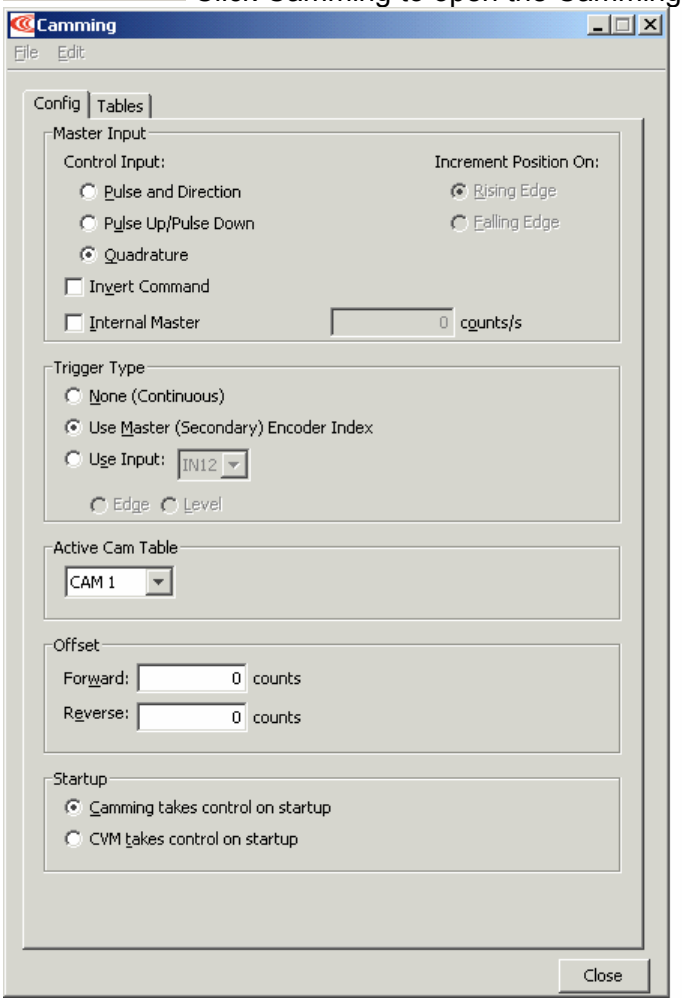
10 If you are following the setup procedure described at the beginning of this chapter, proceed to Configure Camming Parameters (p. 14).

2.3: Configure Camming Parameters

2.3.1: Configuration Procedure

1 

Click Camming to open the Camming screen:



2 Enter values for the Camming Parameters described on p. 15 (including the Active Cam Table parameter).

3 If you are following the setup procedure described at the beginning of this chapter, proceed to Load the Cam Tables (p. 16) and make sure that the Active Cam Table assigned in the previous step has been saved to flash.

2.3.2: Camming Parameters

Parameter	Description
Control Input	Specifies the type of digital control: **Pulse and Direction:** One input takes a series of pulses as motion step commands, and another input takes a high or low signal as a direction command. **Pulse Up / Pulse Down:** One input takes each pulse as a positive step command, and another takes each pulse as a negative step command. **Quadrature:** A/B quadrature commands from a master encoder (via two inputs) provide velocity and direction commands.
Increment position on	**Rising Edge:** Increment position on the rising edge of the input pulse. **Falling Edge:** Increment position on the falling edge of the input pulse. (For Pulse and Direction or Pulse Up / Pulse Down control only.)
Invert Command	When selected, inverts commanded direction.
Internal Master	When set, an internal pulse generator is used to generate the Camming master pulses at the rate specified in the **counts/s** field.
Trigger Type	Controls how execution of a Cam Table is triggered. **None (Continuous):** The active Cam Table is repeated continuously. **Use Master (Secondary) Encoder Index:** The active Cam Table is executed when the amplifier receives an index pulse from the camming master encoder. Index pulses received during execution are ignored. **Use Input, Edge:** The active Cam Table begins executing on the rising edge of the designated input pin. Trigger input transitions received during execution are ignored. **Use Input, Level:** The active Cam Table repeats continuously as long as the designated input is high.
Active Cam Table	Selects the Cam Table that the amplifier will execute when the camming trigger is activated.
Offset	**Forward:** A delay (in Master counts) applied before the Cam Table is executed when the Master is moving forward. **Reverse:** A delay (in Master counts) applied before the Cam Table is executed when the Master is moving in reverse.
Startup	**Camming takes Control on startup:** Camming takes control of the amplifier on amplifier startup. **CVM takes control on startup:** The Copley Virtual Motion (CVM) Indexer program takes control of the amplifier on amplifier startup. This makes it possible to use the Indexer program to home the amplifier before putting the amplifier under Camming control.

2.4: Load the Cam Tables

1. Click on *Camming* screen *Tables* tab.

2. Import any externally generated Cam Tables as instructed in Import an Externally Created Table (p. 22).

   As needed, use CME 2 to create and edit tables as instructed in Create a New Table with CME 2 (p. 23) and Edit Table Values with CME (p. 24).

3.  Save all Cam Tables to amplifier flash memory.

4. Close the screen. If you have followed the setup procedure described at the beginning of this chapter, the amplifier is now ready to execute Cam Tables.

ALTERNATE:

A *.cct* file can be downloaded directly to amplifier flash by selecting **File->Restore Cam Tables** from the CME 2 Main Screen. All Cam Tables in amplifier flash will be replaced by the tables in the .cct file. This table loading method can be used even when CME 2 is locked by the **Tools->CME 2 Lock/Unlock** control.

CHAPTER 3: CAM TABLES

Contents include:

3.1: Cam Table Specifications and Guidelines

A Cam Table contains a progression of Master Position values paired with corresponding Slave Position values. Tables can be created, viewed, and edited directly within the *Tables* tab of the CME 2 *Camming* screen. They can also be created using external tools, saved as ASCII text files (such as .txt or .csv), and then imported into CME 2.

NOTE: Normally, Cam Tables are stored in the amplifier's flash memory, allowing the Cam Tables to be uploaded once and persist between power cycles. In applications where flash storage is not appropriate or optimal, up to 16 Cam Tables can be loaded into and run from amplifier RAM instead. For more information, see the *CANopen Programmer's Manual*.

3.1.1: Cam Table Storage Limits

The amplifier can hold up to 10 Cam Tables. The total number of Master/Slave position value pairs that can be distributed across all 10 tables is 3,000 for ACM ACJ, ACP, XSL, STP, and STM model amplifiers and 3,960 for AMP, AEP, XSJ, ADP, XTL, and STX model amplifiers. The maximum number of value pairs per table varies as described below, but the grand total of all tables can not exceed 3,000 or 3,960 respectively.

The number of Cam Table lines is limited by the amount of CVM memory space available in the amplifier. Management of each populated Cam Table requires a certain amount of that memory space. Also, Cam Tables share that space with Copley Virtual Machine (CVM) programs. Therefore, the maximum number of Cam Table lines will decrease if more than one Cam Table is populated or if CVM programs are stored in the amplifier.

The *Camming* screen *Tables* tab displays the percentage of amplifier memory used as described in CVM Memory Usage (p. 21).

3.1.2: Master/Slave Position Value Rules

- All position values must be whole numbers (no fractional values) in counts.
- All Master Position values must be positive and increasing, and thus, only the first line may contain a zero for the Master Position value.
- The difference between successive master values must be less than 16384.
- The difference between successive slave values must be less than 32768.

3.1.3: Externally Created Table Files

<table>
<tr><td>Data format:</td><td>ASCII. No header line allowed in file.</td></tr>
<tr><td>Line Syntax:</td><td><Master Position value><delimiter><Slave Position value><new line>
Where delimiter is a comma, a space, or a tab character, and all values conform to the Master/Slave Position Value Rules.</td></tr>
<tr><td>Syntax examples:</td><td>
<table>
<tr><th>Comma-separated</th><th>Space-separated</th></tr>
<tr><td>0,0</td><td>0 0</td></tr>
<tr><td>5,2</td><td>5 2</td></tr>
<tr><td>10,13</td><td>10 13</td></tr>
<tr><td>15,42</td><td>15 42</td></tr>
</table>
</td></tr>
<tr><td>File name:</td><td>An externally created table file must not have a .cct filename extension (which is reserved for table files saved by CME 2.) There are no other special restrictions on file names. File name extension (for instance, .csv for comma separated values) is optional.</td></tr>
<tr><td>File location:</td><td>May be stored anywhere. Default location is the CamTables folder in the CME 2 installation directory (typically c:\Program Files\Copley Motion\CME 2\CamTables).</td></tr>
</table>

3.1.4: Programming Note: Small Master Increments and Slow Master Input

The combination of very small Cam Table Master Position increments and a camming Master Input speed that is slower than the amplifier's servo loop cycle can generate undesired resonance. Here is an example of the problem, and how it was solved.

The original Cam Table specified a new Slave Position for every count of the Master Position, as shown below.

Original Cam Table		
Table Line #	Master	Slave
0	0	0
1	1	10
2	2	50
3	3	120
4	4	220

The amplifier was programmed to use its Internal Master. The Master speed was set to 1,000 counts/second. The amplifier's servo loop sampled the Master Position at the rate of 3,000 samples per second, or at 3 times the update speed of the Master.

Thus, as shown in A below, the Camming interpolator would read the same Master Position for three servo loop sample cycles in a row. With no change in the Master Position, no update was commanded for the Slave Position.

On the fourth cycle, the new Master Position was read. The amplifier would abruptly drive the Slave axis to the corresponding Slave Position as per the Cam Table.

As shown in B below, the problem was solved by increasing the Master speed and each programmed Master Position by a factor of 10.

Because the speed and Master Position changes were proportional, both configurations drove the Slave to the programmed positions at the same time, but the increased Master Speed in B allowed for 3 times as many Master Position increments, resulting in a smoother profile.

		A Master Input: 1,000 counts/sec		B Master Input: 10,000 counts/sec	
Servo Cycle	Cam Table Line #	Master	Slave	Master	Slave
0	0	**0**	**0**	**0**	**0**
1		0	0	3	3
2		0	0	7	7
3	1	**1**	**10**	**10**	**10**
4		1	10	13	23
5		1	10	17	37
6	2	**2**	**50**	**20**	**50**
7		2	50	23	73
8		2	50	27	97
9	3	**3**	**120**	**30**	**120**
10		3	120	33	153
11		3	120	37	187
12	4	**4**	**220**	**40**	**220**

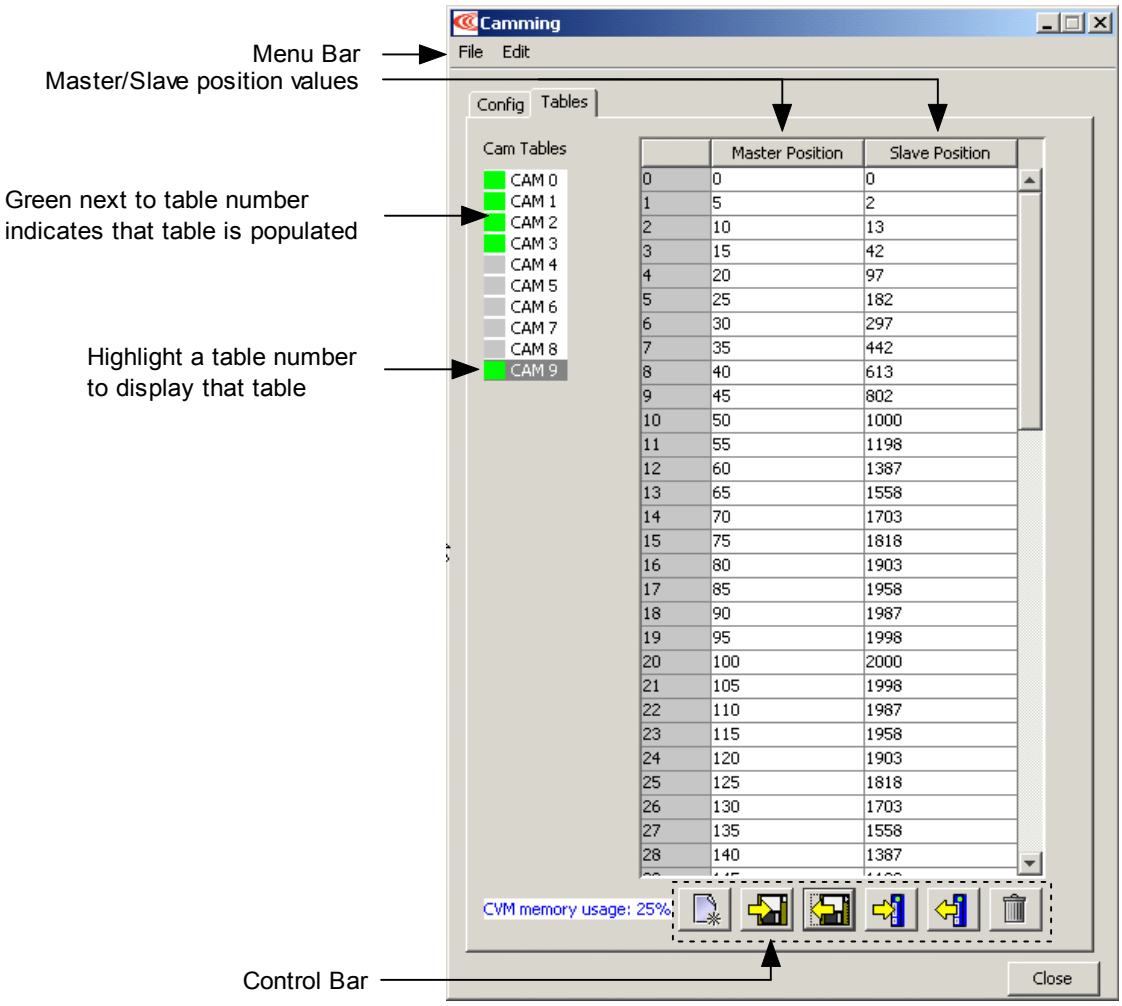
3.2: Overview of the Tables Tab

3.2.1: Viewing the Tables Tab

1 If necessary, Start CME 2 (p. 12).

2 

Click **Camming** to open the Camming screen. Click the **Tables** tab.



3 See Cam Tables Menu Bar, Cam Tables Tool Bar, and CVM Memory Usage (p. 21) for more details.

3.2.2: Cam Tables Menu Bar

Menu	Selection	Description
File	**New Table**	Creates a new table at position indicated by the highlighted table number. See Create a New Table with CME 2 (p. 23).
	Save Cam Table Data	Saves contents of all cam tables from PC ram to a disk file, with a filename extension of *.cct*.
	Restore Cam Table Data	Restores tables from disk file to PC ram. Results depend on format and content of the disk file. From a *.cct* file, all tables are restored. From an ASCII file created by an external application and containing a single table of data, that one table is restored. See Import an Externally Created Table (p. 22). NOTE: Tables restored from disk will not be accessible to the amplifier until saved to amplifier flash memory. See Cam Tables Tool Bar, below.
Edit	**Insert Line Before**	Insert a line in the table before the currently selected line.
	Insert Line After	Insert a line in the table after the currently selected line.
	Delete Current Line	Delete the currently selected line from the table.

3.2.3: Cam Tables Tool Bar

Click on any of the tools in the toolbar to access the tools described below.

Icon	Name	Description
	Create new table	Creates a new table at position indicated by the highlighted table number. See Create a New Table with CME 2 (p. 23).
	Save all cam tables to disk	Saves contents of all cam tables from PC ram to a disk file, with a filename extension of *.cct*.
	Restore cam tables from disk	Restores tables from disk file to PC ram. Results depend on format and content of the disk file. From a *.cct* file, all tables are restored. From an ASCII file created by an external application and containing a single table of data, that one table is restored. See Import an Externally Created Table (p. 22). NOTE: Tables restored from disk will not be accessible to the amplifier until saved to amplifier flash memory, as described below.
	Save all cam tables to amplifier flash memory	Saves all Cam Tables, as currently held in PC RAM and viewable in the Tables tab, to the amplifier's flash memory.
	Restore all cam tables from amplifier flash memory	Replaces the tables currently held in the PC's RAM with the tables last saved to amplifier flash memory.
	Deletes the highlighted cam table from amplifier flash and PC	Deletes the highlighted table form the amplifier's flash memory and the PC's RAM memory. The deleted table cannot be recovered.

3.2.4: CVM Memory Usage

The percentage shown in *CVM memory usage* 

is the sum of:

- The percentage of total amplifier flash memory currently occupied by CVM programs
- The percentage of total amplifier flash memory that would be occupied by the Cam Tables presently held in PC ram and represented on the CME 2 Camming Tables tab.

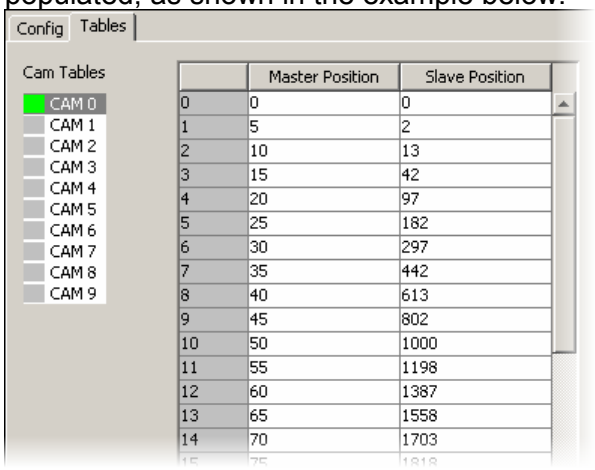
The percentage changes as Cam Tables are created, deleted, and edited.

3.3: Cam Table Procedures

3.3.1: Import an Externally Created Table

1. Create a table that meets the Cam Table Specifications and Guidelines (p. 18).
2. If necessary, Start CME 2 (p. 12).
3. 

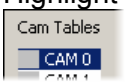
Click **Camming** to open the Camming screen. Click the **Tables** tab.
4. Highlight the number of the Cam Table into which you will import the data. For instance, Cam 0:

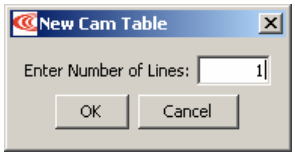

5. 
Click the **Restore cam tables from disk** tool to open the *Restore Cam Table from Disk* screen. Highlight the name of the file containing the data you wish to import, and click **Open**. The box next to the name turns green, and the table is populated, as shown in the example below:


6. 
Click **Save all camming tables to amplifier flash memory** before attempting to run the new table. Note that this will save all tables to flash memory.
7. **Close** the screen.

3.3.2: Create a New Table with CME 2

1. If necessary, Start CME 2 (p. 12).
2. 

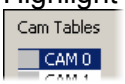
Click **Camming** to open the Camming screen. Click the **Tables** tab.
3. Highlight the number of the Cam Table you wish to create. For instance, Cam 0:


4.  Click the **Create new cam table** tool. See the prompt:


5. Enter the number of lines (equal to the number of Master/Slave position pairs). Click **OK**.
6. Enter the Master/Slave position values, observing Cam Table Specifications and Guidelines (p. 18). Click in a field to enter or modify a value. Standard mouse and keyboard editing techniques are available.
7.  Click **Save all camming tables to amplifier flash memory** before attempting to run the new table. Note that this will save all tables to flash memory.
8. **Close** the screen.

3.3.3: Edit Table Values with CME 2

1. If necessary, Start CME 2 (p. 12).
2. 

Click **Camming** to open the Camming screen. Click the **Tables** tab.
3. Highlight the number of the Cam Table you wish to edit. For instance, Cam 0:


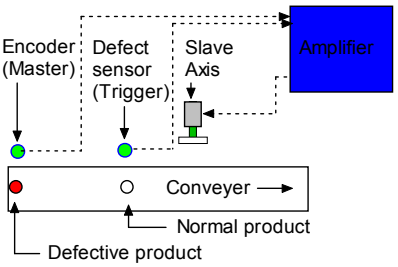
4. Edit using standard keyboard and mouse techniques. Note that if you begin typing immediately, the numbers you enter will be inserted in front of any existing numbers.
5. 
Click **Save all camming tables to amplifier flash memory** before attempting to run the modified table. Note that this will save all tables to flash memory.
6. **Close** the screen.

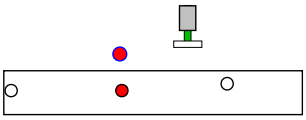
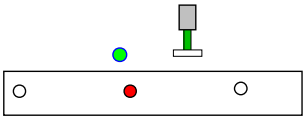
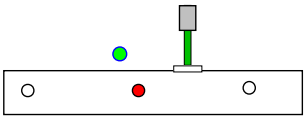
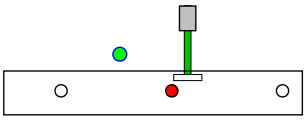
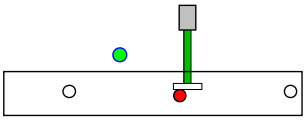
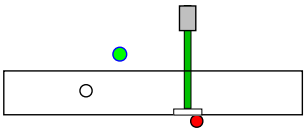
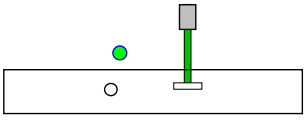
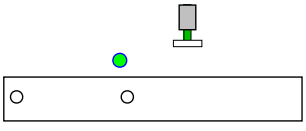
CHAPTER 4: APPLICATION AND CONNECTION EXAMPLES

Contents include:

4.1: Conveyer Camming Application Example

Here, Camming helps synchronize a Slave axis to the variable speed of a conveyer. The Cam Master is an encoder that monitors the conveyer speed. The Cam Slave is a ServoTube motor used to push defective products off the conveyer.

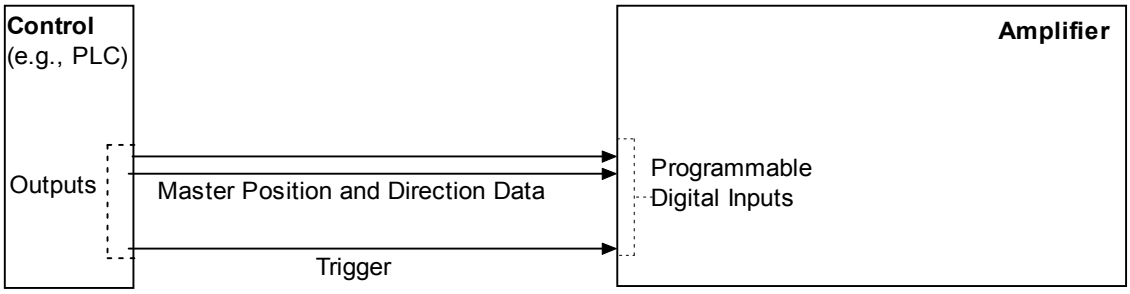
Legend	Picture (Top View)
Cam Slave: A ServoTube motor driven by a Copley Controls amplifier. **Cam Master:** An encoder on the conveyer belt. Connected through the Slave amplifier's secondary encoder interface or digital inputs. **Cam Trigger:** Defect sensor. Connected to a digital input on the amplifier. See Differential Master, Digital Input Trigger (p. 28) for a connection example.	

Event/Status	Master	Slave	
Defective product activates Cam trigger via sensor. Cam Table execution begins. The Master and Slave positions, relative to trigger positions, are both zero.	0	0	
Master has moved 10 counts from trigger position. As programmed in Cam Table, Slave has moved 10 counts from where it was when the trigger activated.	10	10	
Slave continues to move in response to Master movement as programmed in the Cam Table, knocking the defective product off the conveyer.	20	40	
	60	50	
	70	60	
	90	90	
Slave moves back to zero position, as programmed. Cam Table will remain inactive until another defective product is sensed. .	120	60	
	150	0	

4.2: Connection Examples

4.2.1: PLC Master

Here, two of the amplifier's programmable inputs are used to receive Master position and direction information (pulse and direction, pulse up/pulse down, or quadrature). Another digital input is used for the Camming trigger.

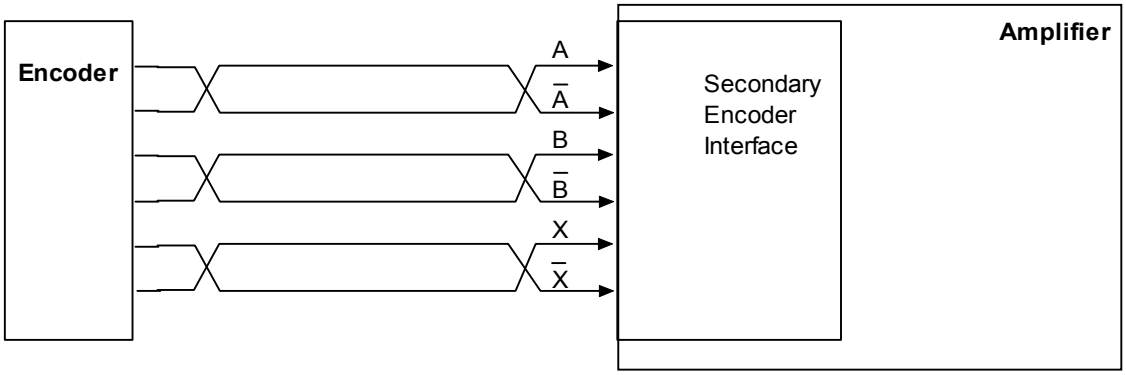


To operate correctly with this combination of connections, be sure the amplifier and camming configuration includes the following settings:

Amplifier Basic Setup Screen	
Parameter	**Value**
Position Loop Input	Camming Single Ended
Camming Config Screen	
Parameter	**Value**
Control Input	Choose one of the following as appropriate: Pulse and Direction, Pulse Up / Pulse Down, or Quadrature.
Trigger Type	Use Input <input number>, Edge or Level.

4.2.2: Differential Master, Index Trigger

Here, the secondary encoder interface is used to receive position and direction data from an encoder. The encoder index pulse (X) is used for the Camming trigger.

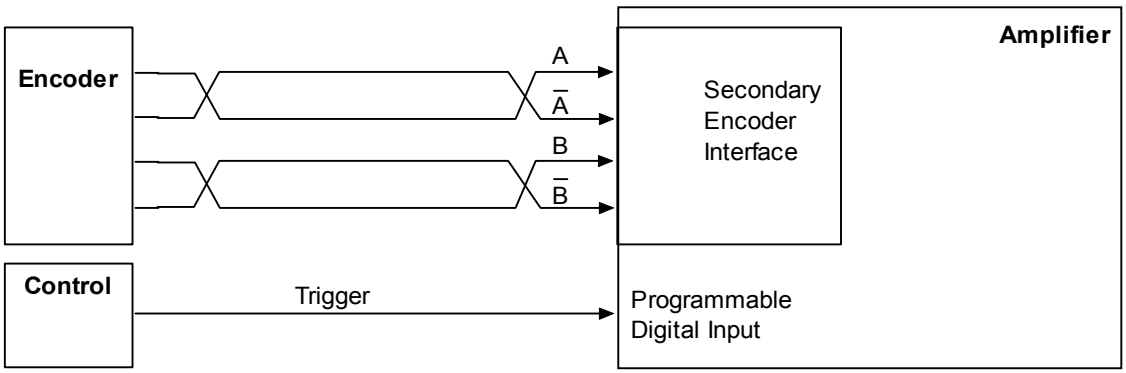


To operate correctly with this combination of connections, be sure the amplifier and camming configuration includes the following settings:

Amplifier Basic Setup Screen	
Parameter	**Value**
Position Loop Input	Camming Differential
Camming Config Screen	
Parameter	**Value**
Control Input	Quadrature.
Trigger Type	Use Master (Secondary) Encoder Index

4.2.3: Differential Master, Digital Input Trigger

Here, the amplifier's secondary encoder interface is used to receive position and direction data from an encoder. A programmable digital input receives an external trigger.

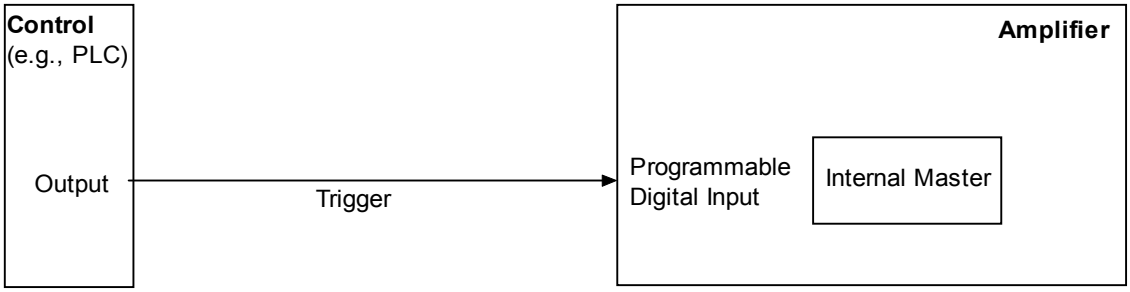


To operate correctly with this combination of connections, be sure the amplifier and camming configuration includes the following settings:

Amplifier Basic Setup Screen	
Parameter	**Value**
Position Loop Input	Camming Differential
Camming Config Screen	
Parameter	**Value**
Control Input	Quadrature.
Trigger Type	Use Input <input number>, Edge or Level.

4.2.4: Internal Master with External Trigger

Here, the amplifier's Internal Master is used as the Cam Master. A programmable digital input receives the trigger.



To operate correctly with this combination of connections, be sure the amplifier and camming configuration includes the following settings:

Amplifier Basic Setup Screen	
Parameter	**Value**
Position Loop Input	Camming Single Ended
Camming Config Screen	
Parameter	**Value**
Control Input	Internal Master
Trigger Type	Use Input <input number>, Edge or Level.

CHAPTER 5: CAMMING CONFIGURATION VIA ASCII

The Copley ASCII Interface is a set of ASCII format commands and variables that can be used to operate and monitor Copley Controls amplifiers over an RS-232 serial connection. This chapter describes the ASCII Interface variables that can be used to configure camming operation.

NOTES:

- These descriptions are intended to be used as an addendum to the *Copley ASCII Interface Programmer's Guide*. Consult that book before attempting to use the variables described below.
- The ASCII interface does not support the downloading of Cam Tables to the amplifier. Thus, even when using the ASCII Interface to configure camming, it is necessary to use CME 2, as described in this book, to save Cam Tables into the amplifier.

5.1: Camming Mode Variables

Variable ID	Bank	Description
0x24	R F	Desired state: 0 = Disabled 25 = Camming Mode, Servo 35 = Camming Mode, Stepper
0xa8	R F	Digital Command Configuration. See Digital Command Configuration Variable, 0xa8 (p. 32).
0x105	R F	Camming Configuration. See Camming Configuration Variable, 0x105 (p. 33).
0x106	R F	Camming Offset, Forward. Units: Master command counts
0x107	R F	Camming Offset, Reverse. Units: Master command counts
0x109	R F	Camming Internal Generator Velocity. Units: 0.1 counts / second

5.1.1: Digital Command Configuration Variable, 0xa8

Bits	Description	
0-7	Not used for camming, set to zero	
8,9	Command type	
	Code	**Type**
	0	Step & Direction mode.
	1	Separate up & down counters.
	2	Quadrature encoder input.
10,11	Reserved.	
12	If set, command pulses are counted on rising edge. If clear, command pulses are counted on falling edge. No effect if quadrature command type is used.	
13	If set, invert commanded direction.	
14-15	Selects source of digital position input command.	
	Value	Description
	0	Single ended high speed inputs.
	1	Multi-mode encoder port.
	2	Differential high speed inputs.
	3	Motor encoder port.

5.1.2: Camming Configuration Variable, 0x105

Bits	Description	
0-3	Number of the Cam Table to use (0-9).	
4	Reserved	
5	If set, exit table in forward direction.	
6	If set, use the internal generator. If clear, use digital command input as configured 0xa8. The internal generator runs at constant velocity programmed in variable 0x109.	
7	If set, run tables stored in RAM. If clear, use tables stored in the flash file system..	
8-11	Input number to use as trigger. Note: a value of 0 selects input 1, value of 1 selects input 2, etc.	
12-13	Camming trigger type:	
	Code	**Type**
	0	None (Continuous): The active Cam Table is repeated continuously.
	1	Use Input, Edge: The active Cam Table begins executing on the rising edge of the input pin selected by bits 8-11.
	2	Use Input, Level: The active Cam Table will run as long as the input selected by bits 8-11 is high.
	3	Use Master (Secondary) Encoder Index: The active Cam Table is executed when the amplifier receives an index pulse from the Master encoder. Index pulses received during execution are ignored.

CHAPTER 6: CAMMING CONTROL VIA INDEXER PROGRAM

The Copley Indexer program is an amplifier control program that runs on the Copley Virtual Machine (CVM) program. The Indexer Program includes functions that can be used to set camming configuration parameters.

The Indexer Program function descriptions that follow are intended to be used as an addendum to the *Copley Controls Indexer Program User Guide.* Consult that book before attempting to use the Indexer Program functions.

6.1: Indexer Camming Function

6.1.1: Indexer Camming Function Overview

This function is used to change the operating mode of the amplifier to camming and to configure the camming mode.

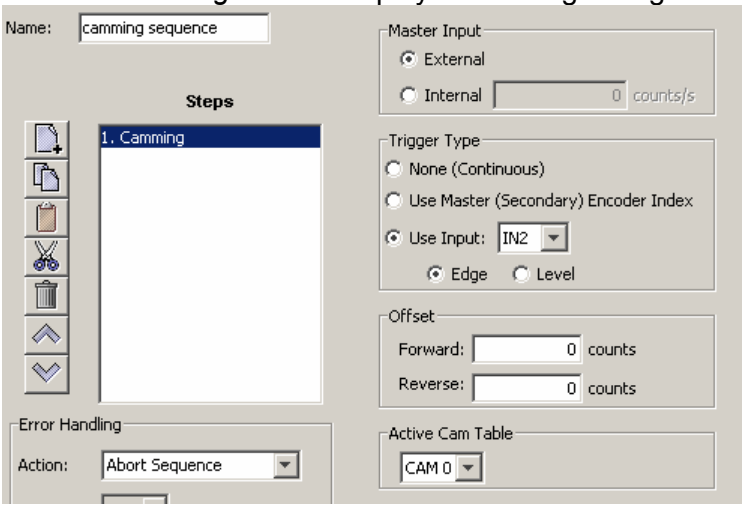
6.1.2: Add a Camming Configuration Step to a Sequence

1 

On the CME 2 Main screen, click **CVM Control Program** to open the Indexer Program screen.

2  Click **Add New Step** on the *Program* tab to open *Indexer Functions*.

3 Click **Mode: Camming** to select the function. Click **Add** to add it to the sequence. The *Indexer Program tab* displays Camming configuration settings.



4 Choose appropriate values for the parameters, as described in Camming Parameters (p. 15). Enter number values directly or enter the number (R0-R31) of an Indexer Program register. See *Using Registers to Pass Values to Functions* in the *Copley Indexer Program User Guide*.

6.1.3: Camming Function Notes

- The velocity of internal master pulse can be reset using the Camming Internal Master function.
- The amplifier will stay in the camming mode of operation until another indexer function changes it or the amplifier is reset or power cycled.

Errors

A sequence error will occur if this function is executed when:

- The amplifier is hardware disabled.
- The amplifier is faulted.
- Motor phasing is not initialized.
- A register is used for the Internal Master Velocity and it contains an illegal value.

6.2: Camming Internal Master Function

6.2.1: Camming Internal Master Function Overview

This function is used to change the velocity of the Camming Internal Master.

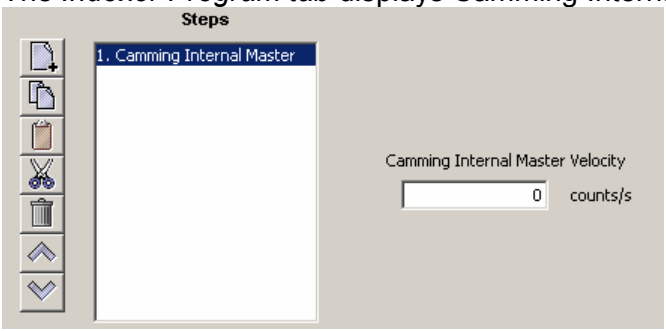
6.2.2: Add a Camming Internal Master Step to a Sequence

1 

On the CME 2 Main screen, click **CVM Control Program** to open the Indexer Program screen.

2  Click **Add New Step** on the *Program* tab to open *Indexer Functions*.

3 Click **Mode: Camming Internal Master** to select the function. Click **Add** to add it to the sequence.
The *Indexer Program tab* displays Camming Internal Master settings.



4 Enter a velocity. Enter the velocity directly or enter the number (R0-R31) of an Indexer Program register. See *Using Registers to Pass Values to Functions* in the *Copley Indexer Program User Guide*.

6.2.3: Camming Internal Master Function Notes

Errors

A sequence error will occur if this function is executed when:

- A register is used for the Internal Master Velocity and it contains an illegal value.

Copley Camming User Guide

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