

Copley Xenus with Hiwin TMS Quick Start

2006.10.04

CONTENTS

1. DOWNLOAD MOTOR PARAMETERS	4
2. HARDWARE WIRING AND SOFTWARE SETUP.....	4
2.1 HARDWARE WIRING.....	4
2.2 CME 2 INSTALLATION AND SERIAL PORT SETUP	7
2.2.1 Requirements	7
2.2.2 Serial Communication Setup	7
3. BASIC PARAMETERS SETUP	9
4. LOADING THE MOTOR PARAMETERS FILE	11
5. FEEDBACK PARAMETERS SETTING.....	11
6. CALCULATE LOOP GAINS AND LIMITS	12
7. DIGITAL INPUTS AND OUTPUTS SETTING	14
8. AUTO PHASE PROCEDURE	15
9. MOTION CONTROL.....	18
9.1 PULSE MODE	19
9.1.1 Pulse format	19
9.1.2 Hardware pulse format	20
9.2 CVM MODE	21
9.2.1 Wiring	22
9.2.2 Setting	22
9.2.3 Writing the sequence.....	23
10. CVM APPLICATION EXAMPLE	25

Revision History

Release	Date	Applies to	Comments
1.0	2006.10.04	Xenus firmware version 4.66 CME2 software version 4.1	Initial publication

This manual describes the operation and installation of Hiwin TMS series motor with Copley Xenus driver. It includes the wiring of TMS and Xenus, basic parameters setup and writes program Copley Virtual Machine (CVM) control programs to control the motor.

1. Download Motor Parameters

Hiwin TMS motor parameters can be found at:

<http://www.hiwinmikro.com.tw/chinese/csupport-1-2.htm>

Please download the file, TMS for Copley Xenus 060906.zip, which includes parameters file of TMS3 and TMS7 series motor.

NOTE: The file name will be modified according to the release version. Therefore, the file name you find may be different on the web site or Hiwin products CD.

2. Hardware Wiring and Software Setup

2.1 Hardware Wiring

Fig. 1 shows the amplifier wiring diagram.

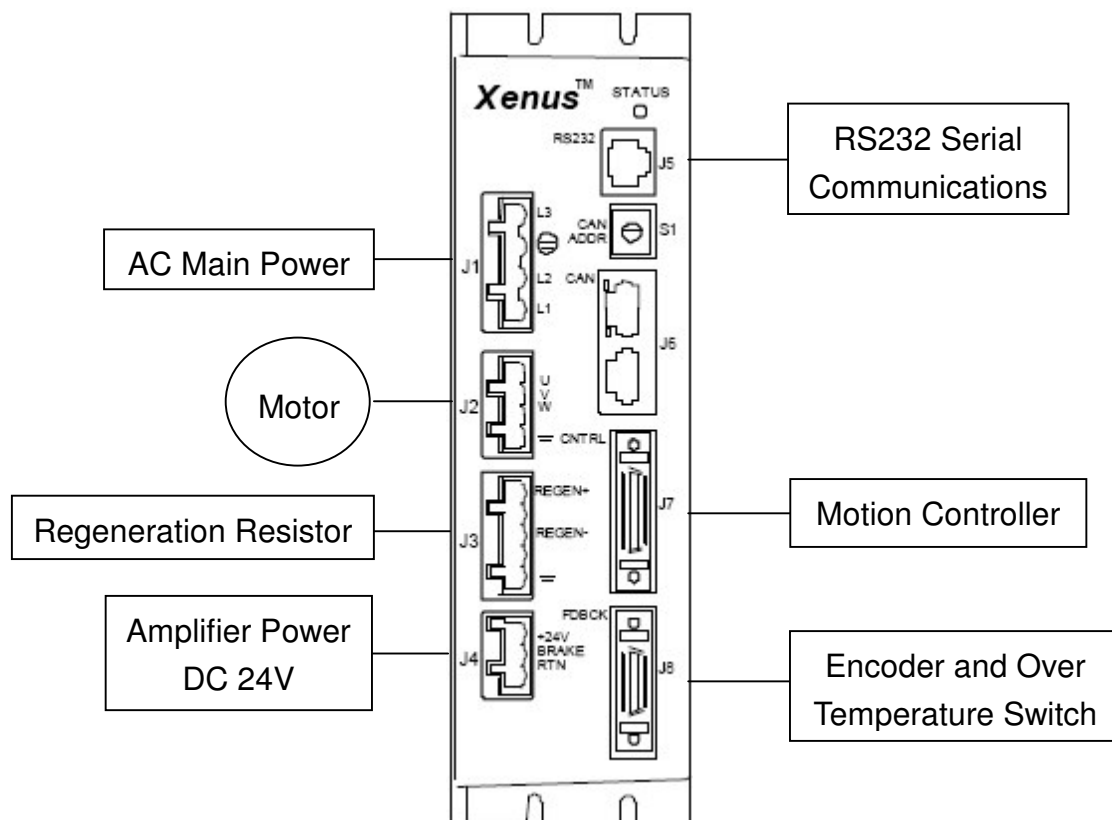


Fig. 1 Amplifier wiring diagram

The wiring of the driver and other components is shown as Fig. 2 and explain as follows,

- a. RS-232 cable for communication of the driver and PC (model number: LMACR21D).
- b. Confirm driver J7 connector pin J7-3(Enable) and J7-2 Signal Ground are properly connected to motion controller's servo on output signal. Ensure how to command motion controller to give servo on signal prior to operation.
- c. Confirm driver J8 connector pin J8-14 IN5 (motor over temperature) and pin J8-15 Signal Ground are properly connected to motor over temperature switch.
- d. Refer to Fig. 2 for connecting driver amplifier's AC power cord (J1), motor power cord (J2), 24V DC (J4) driver power, encoder cable (J8), but do not power up at this moment.
- e. Connect driver amplifier AC power cord properly to line Filter, and install iron core to AC power cord, Encoder cable, and motor power cord.
- f. Confirm motor frame is installed securely, turn on 24V DC power, connection is shown in Fig. 2 °

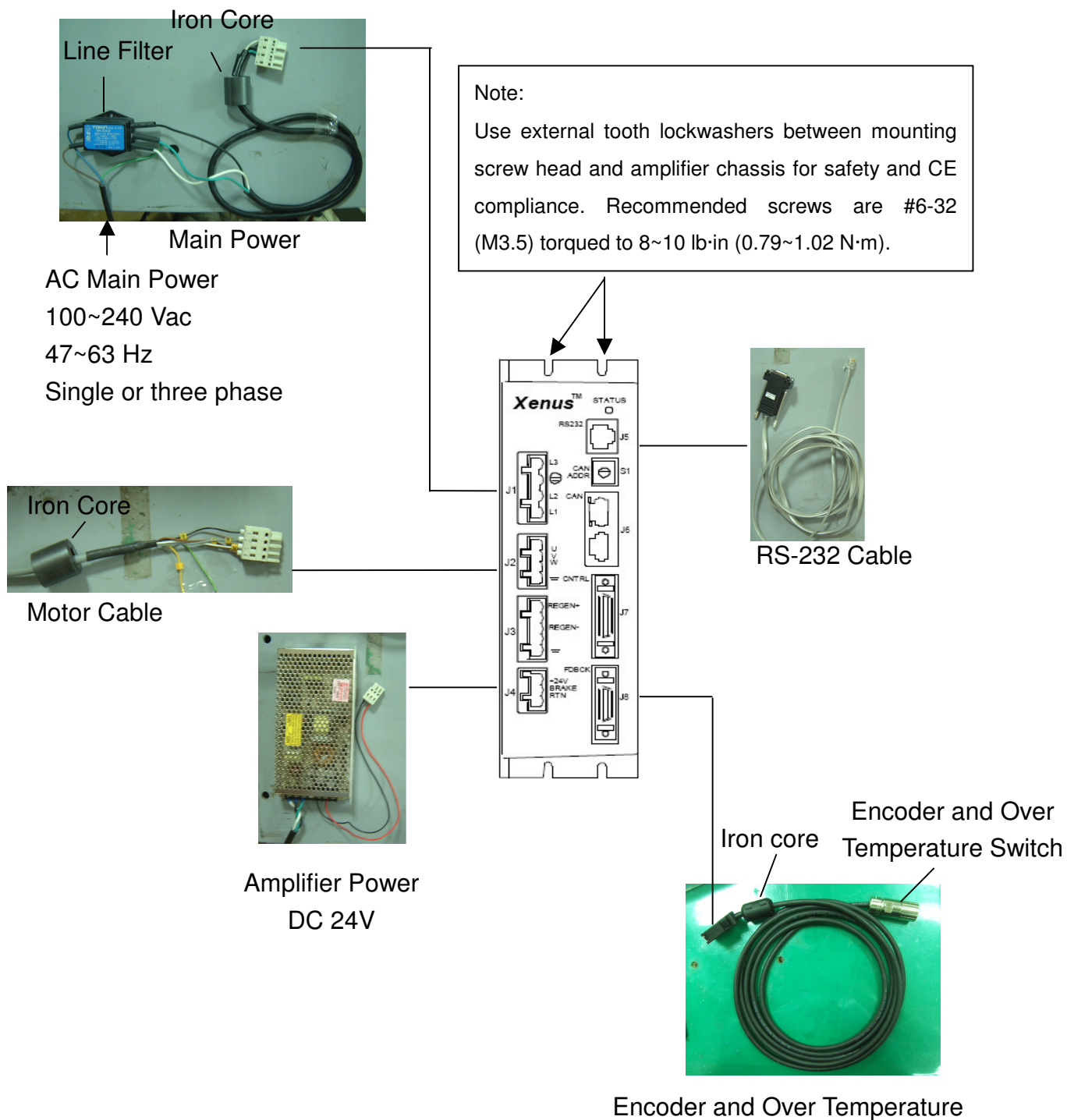


Fig. 2 Wiring between driver and other components

2.2 CME 2 Installation and Serial Port Setup

2.2.1 Requirements

Computer and Operating System

Minimum hardware requirements:

- ☐ CPU: Minimum: 166 MHZ. Recommended minimum: 266 MHZ.
- ☐ RAM : Minimum: 64MB. Recommended minimum: 128MB.
- ☐ Operating Systems Supported: Windows 95, 98, ME, NT, 2000, XP.
- ☐ At least one standard RS-232 serial port or a USB port with a USB to RS-232 adapter.

Software

- ☐ Copley Controls CME 2 software, Version 4.0 or higher.

2.2.2 Serial Communication Setup


Fig. 3 Communication Wizard appears when double click  on the Windows desktop. Choose Serial Ports, press Next and Fig. 4 appears. Choose available port and press Add and then the port you choose appears in Selected Ports. Press Next and Fig. 5 appears. Choose Baud Rate as 115200 and press Finish. If the communication is successful, Fig. 6 CME 2 Main Screen appears.



Fig. 3 Communications Wizard

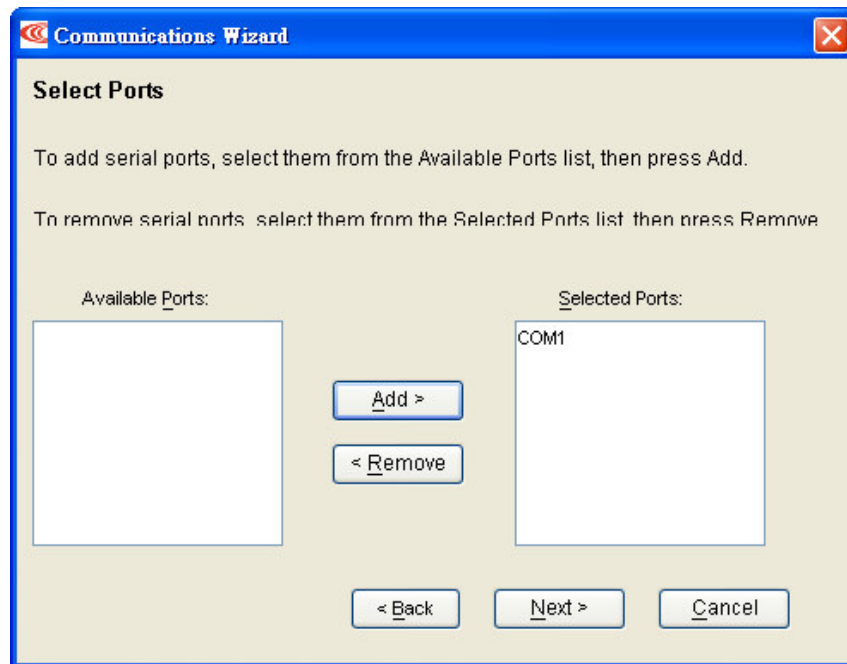


Fig. 4 Communications Wizard

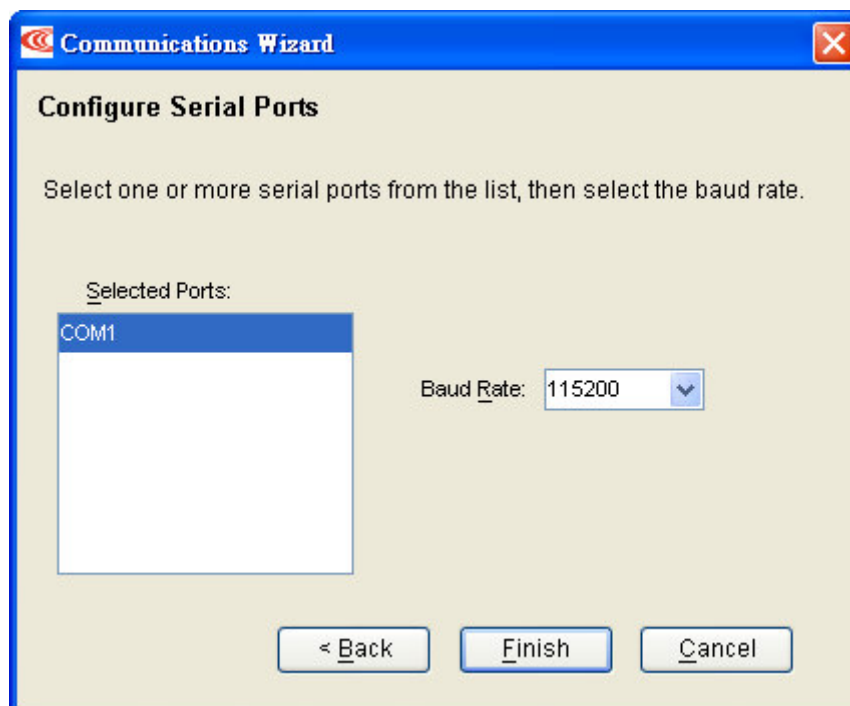


Fig. 5 Communications Wizard

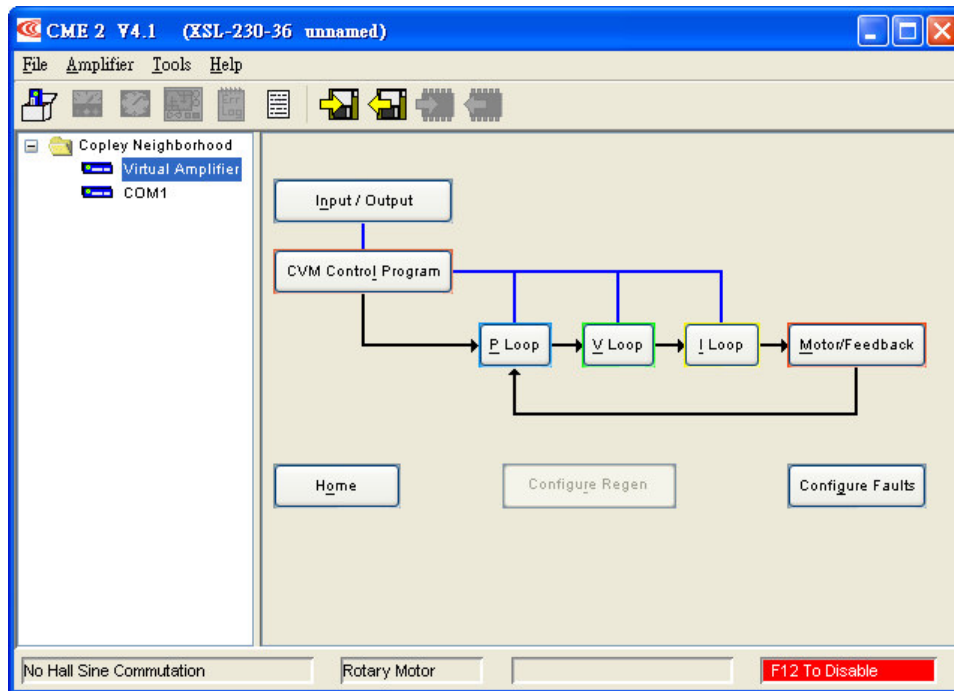


Fig. 6 CME 2 Main Screen

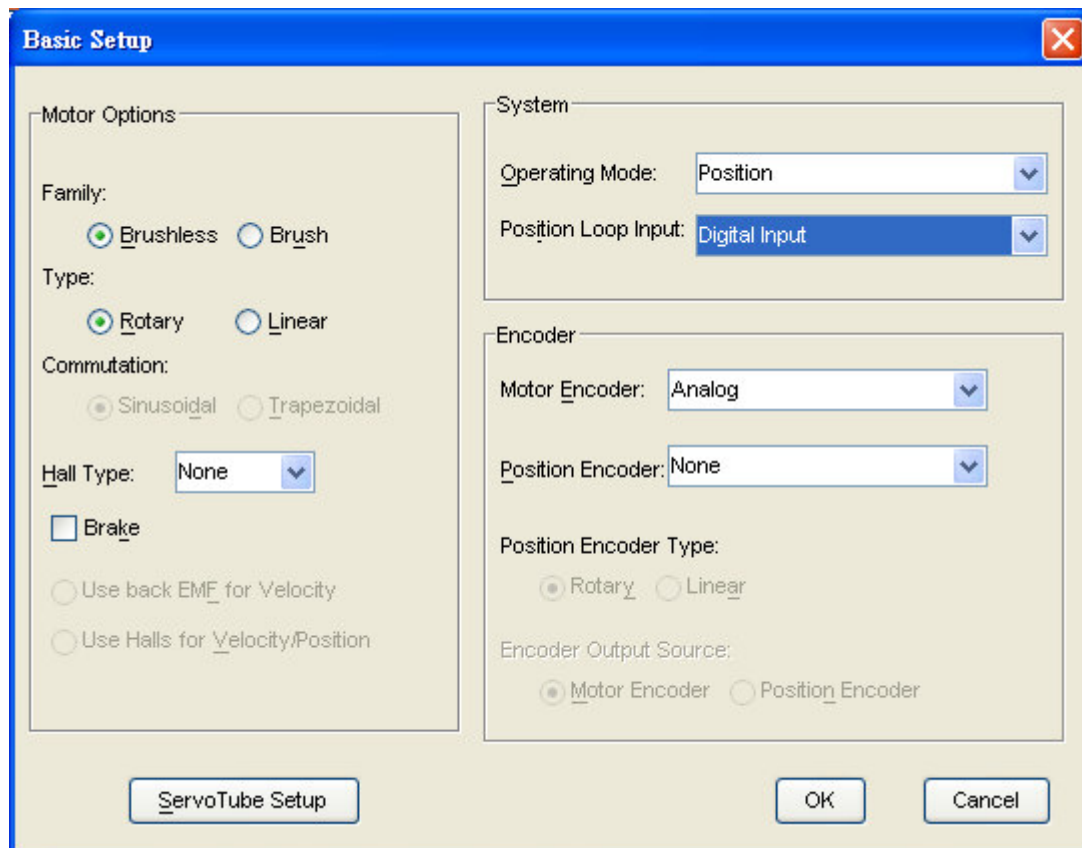
*NOTE: To immediately software disable the amplifier at any time while running CME 2, press function key **F12**.*

3. Basic parameters Setup

Click the **Basic Setup** button () to display the Basic Setup screen as Fig.7 and enter the following parameters.

- ☐ Motor Options
 - * Motor Family : Brushless
 - * Motor Type : Rotary
 - Hall Type : None
 - Break : Not checked
- ☐ System
 - Operating mode : Position
 - Position Loop Input : Digital input or CVM Control Program
- ☐ Encoder
 - Motor Encoder : Analog
 - Position Encoder : None

*NOTE: Above settings are the usual options. They can be modified according to the specification of motor except the * marked parameters.*



The image shows a 'Basic Setup' dialog box with a blue title bar and a red close button. It is divided into two main sections: 'Motor Options' on the left and 'System' on the right. The 'Motor Options' section includes radio buttons for 'Family' (Brushless selected, Brush unselected) and 'Type' (Rotary selected, Linear unselected). It also has radio buttons for 'Commutation' (Sinusoidal selected, Trapezoidal unselected), a 'Hall Type' dropdown menu set to 'None', a 'Brake' checkbox, and two unselected radio buttons for 'Use back EMF for Velocity' and 'Use Halls for Velocity/Position'. The 'System' section includes dropdown menus for 'Operating Mode' (Position) and 'Position Loop Input' (Digital Input). Below these are dropdown menus for 'Motor Encoder' (Analog) and 'Position Encoder' (None). Further down are radio buttons for 'Position Encoder Type' (Rotary selected, Linear unselected) and 'Encoder Output Source' (Motor Encoder selected, Position Encoder unselected). At the bottom of the dialog are three buttons: 'ServoTube Setup', 'OK', and 'Cancel'.

Basic Setup

Motor Options

Family:
☒ Brushless ☐ Brush

Type:
☒ Rotary ☐ Linear

Commutation:
☒ Sinusoidal ☐ Trapezoidal

Hall Type: None

☐ Brake

☐ Use back EMF for Velocity

☐ Use Halls for Velocity/Position

System

Operating Mode: Position

Position Loop Input: Digital Input

Encoder

Motor Encoder: Analog

Position Encoder: None

Position Encoder Type:
☒ Rotary ☐ Linear

Encoder Output Source:
☒ Motor Encoder ☐ Position Encoder

ServoTube Setup OK Cancel

Fig. 7 Basic Setup

4. Loading the Motor Parameters File

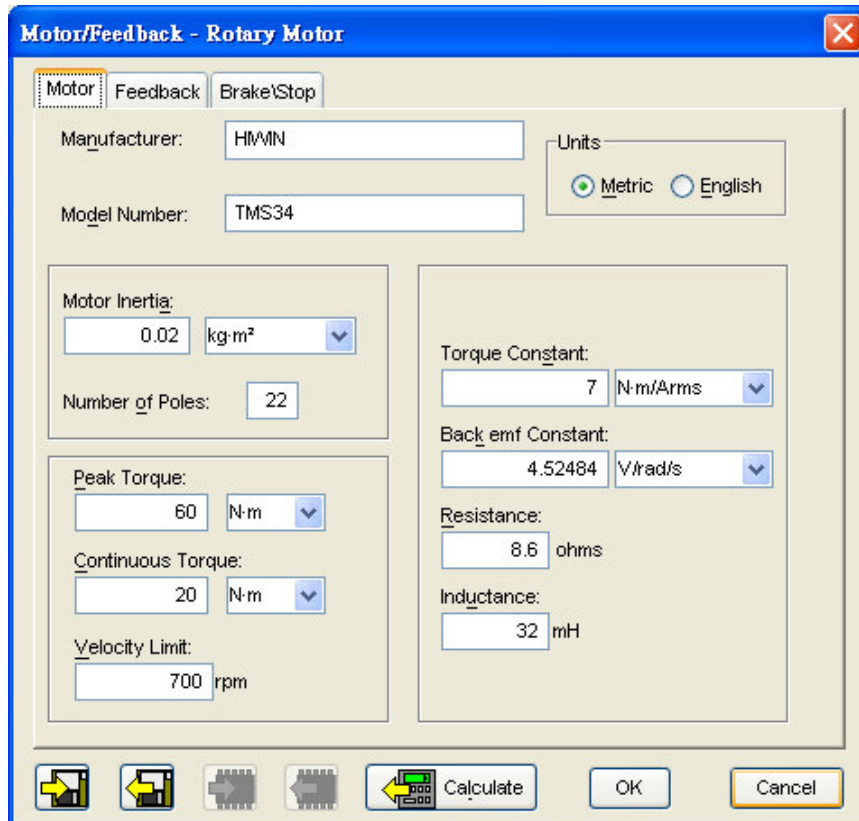
Use the ccm Motor parameters file that was loaded at step 1, click the



bottom, then it shows the Motor/Feedback as Figure 8. Click



the bottom which is for loading Motor parameters file, or input the parameters yourself by referring to Hiwin motor catalog. Finally, Click OK when complete all the setting.



The dialog box titled "Motor/Feedback - Rotary Motor" contains the following fields and controls:

- Tabs:** Motor (selected), Feedback, Brake/Stop
- Manufacturer:** HIWIN
- Model Number:** TMS34
- Units:** Metric (selected), English
- Motor Inertia:** 0.02 kg·m²
- Number of Poles:** 22
- Peak Torque:** 60 N·m
- Continuous Torque:** 20 N·m
- Velocity Limit:** 700 rpm
- Torque Constant:** 7 N·m/Arms
- Back emf Constant:** 4.52484 V/rad/s
- Resistance:** 8.6 ohms
- Inductance:** 32 mH
- Buttons:** Load Motor Parameters (icon), Calculate, OK, Cancel

Fig. 8 Motor/Feedback

5. Feedback Parameters Setting

Owing to the analog encoder is set at step 3, click the Feedback label shows on Fig. 8, it comes to show Fig. 9. Please set the actual resolution of encoder, and take Fig. 9 for example, the resolution of motor is:

$$\begin{aligned}
 \text{Interpolated Counts Per Rev.} &= \text{Fundamental Lines} \times 4 \times \text{Interpolation} \\
 &= 3600 \times 4 \times 64 \\
 &= 921600
 \end{aligned}$$

$$\begin{aligned}
 \text{Resolution of Motor} &= 360 \times 60 \times 60 / \text{Interpolated Counts Per Rev.} \\
 &= 129600 \text{ } ^{\circ} / 921600
 \end{aligned}$$

=1.4 Arc-sec

NOTE: Angle unit:

1 revolution = 360 degrees

1 degree = 60 Arc-mins

1 Arc-min = 60 Arc-secs

Fundamental Lines is according to which encoder, TMS3X series is 3600, TMS7X series is 5400, and Interpolation can be set by resolution you need. Recommend that to set 64.

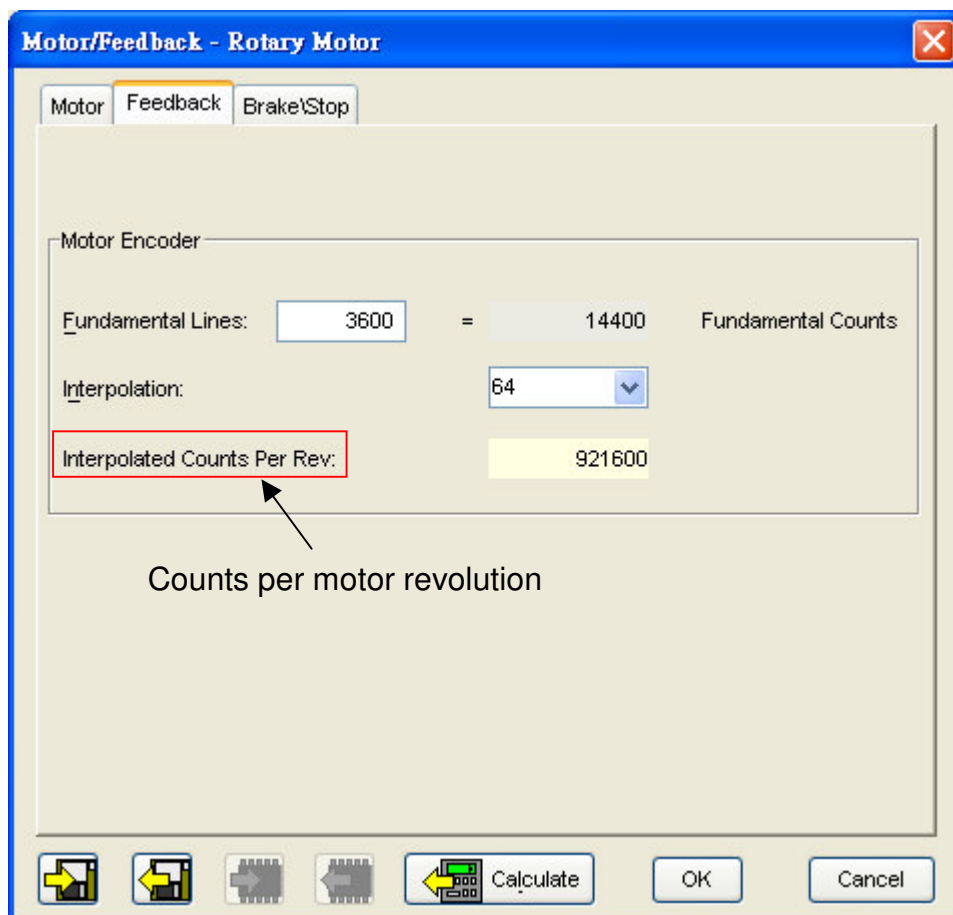
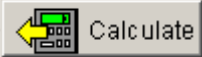


Fig. 9 Feedback

6. Calculate Loop Gains and Limits

Click  button then show Fig.10, the initial control loop gains and limits will be calculated by CME 2, and they can be modified follow-up if the values are not satisfied. If the calculated values are anomalous, click cancel button then back to label Motor/Feedback, re-check whether the parameters you input are right or not. Finally, click OK if there's no problem.

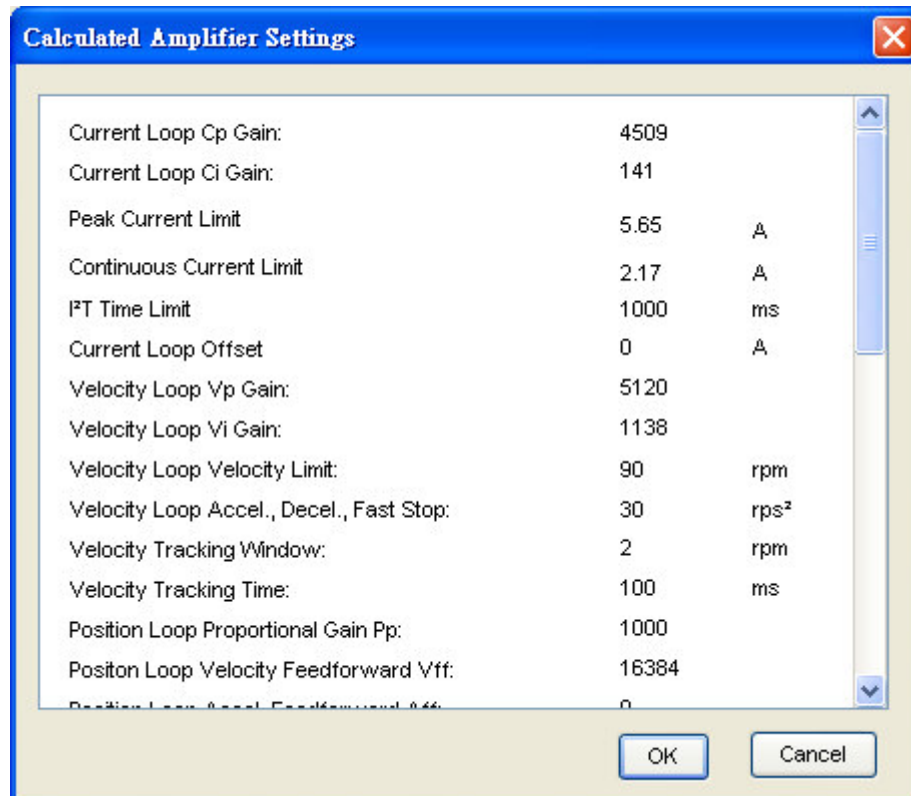


Fig. 10 Calculated Amplifier Settings

After setting up the parameters of driver, remember to save the parameters to driver flash memory, for fear of parameters disappear after turning off the power, or you can backup to PC so that use it one day. The operating description is shown as follows: (in CME2 Main Screen)



: Save driver parameters to PC



: Loading driver parameters from PC to CME 2




: Save driver parameters into driver flash memory



: Read driver parameters from flash memory to CME 2

7. Digital Inputs and Outputs Setting

Click  button to set up the digital inputs. The screen is like Fig. 11.

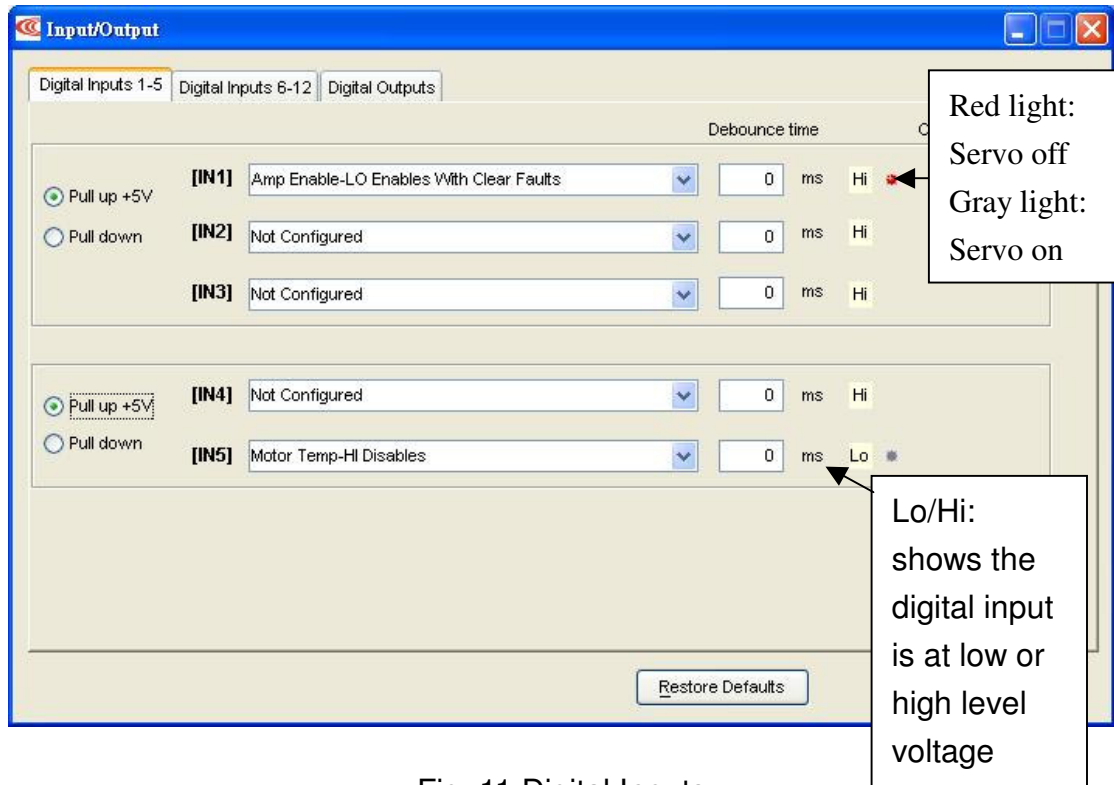


Fig. 11 Digital Inputs

- To modify initial value of IN2 and IN3 as “Not configured”.
- Set IN5 to “Motor Temp-HI Disable”. (motor over temperature signal)
- In needed, to set the logical definition of Digital input as you wish.
- Check J7-3 pin “IN1 (Enable)” and J7-2 pin “Signal Ground” of J7 connector on the driver properly connect to the “Servo On” output signal of motion controller and then output the “Servo On” signal. When the “Servo On” is output, please check whether the light, right screen of [IN1], shows gray light or not. Gray light represents servo on, and red light represents servo off. Please check when turn off the controller, the light need to be red.
- Check J8-14 pin “IN5 (Motor over temperature)” and J8-15 pin “Signal Ground” on J8 connector of the driver properly connect to the over temperature switch of the motor. When the motor is in over temperature status, the red light is represented and the motor can’t move any more until the temperature of motor reduce.

8. Auto Phase Procedure

If Auto Phase procedure has been completed, you can skip this step. How to determine if Auto Phase has already been completed? In Control Panel (Fig. 12), please select Software Enable Amplifier to servo on. If successful, then you so not need to perform Auto Phase.

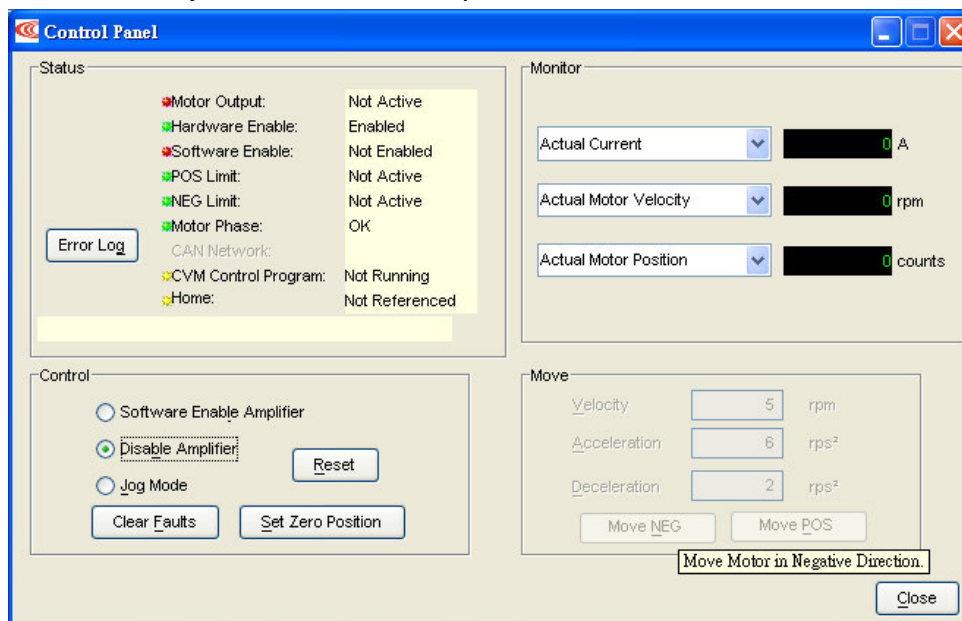



Fig. 12 Control Panel

Auto phase procedure as follows :

- First confirm the servo on signal from the motion controller is turned

off , then turn on the AC power and press  , Fig. 13 should appear.

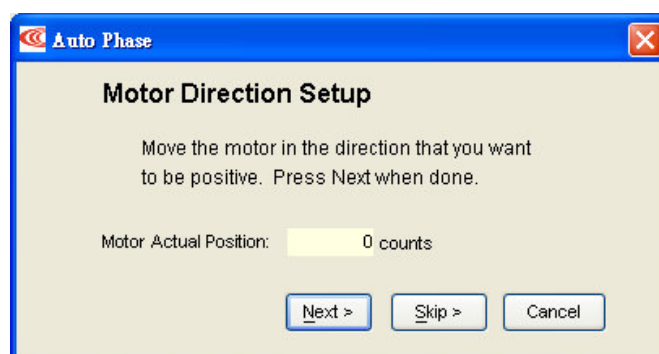


Fig. 13 Motor Direction Setup

- Mover the motor manually in direction to be defined as positive, Motor Actual Position on the screen should change. (It can increase or decrease).
- Turn on the servo on signal from the motion controller.
- Press Next and Fig. 14 should appear. In the Motor Wiring Setup menu,

press Start, and driver will drive the motor according to the Auto Phase current set by the user, motor will move back and forth slowly, which indicates the Auto Phase is completed successfully.

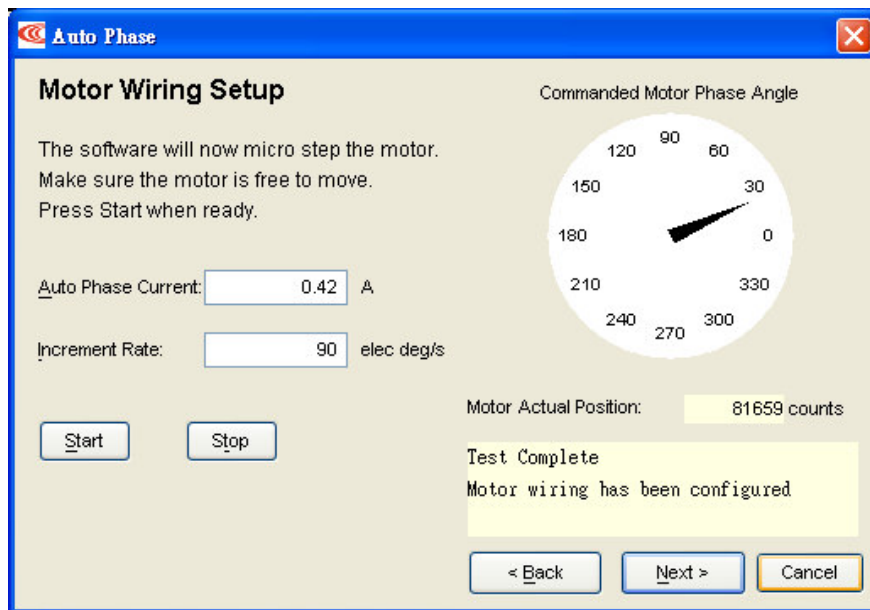


Fig. 14 Motor Wiring Setup

- e. After finishing Motor Wiring Setup, press next and Fig. 15 Phase Count Test appears. Press Start, and the amplifier would drive the motor according to Auto Phase Current which is set by user. Now the motor turns slowly one revolution, after finished, if Actual Motor Position is close to the setting of Interpolation counts per Rev. shown in Fig. 9, it shows Test Complete Phase Count OK.

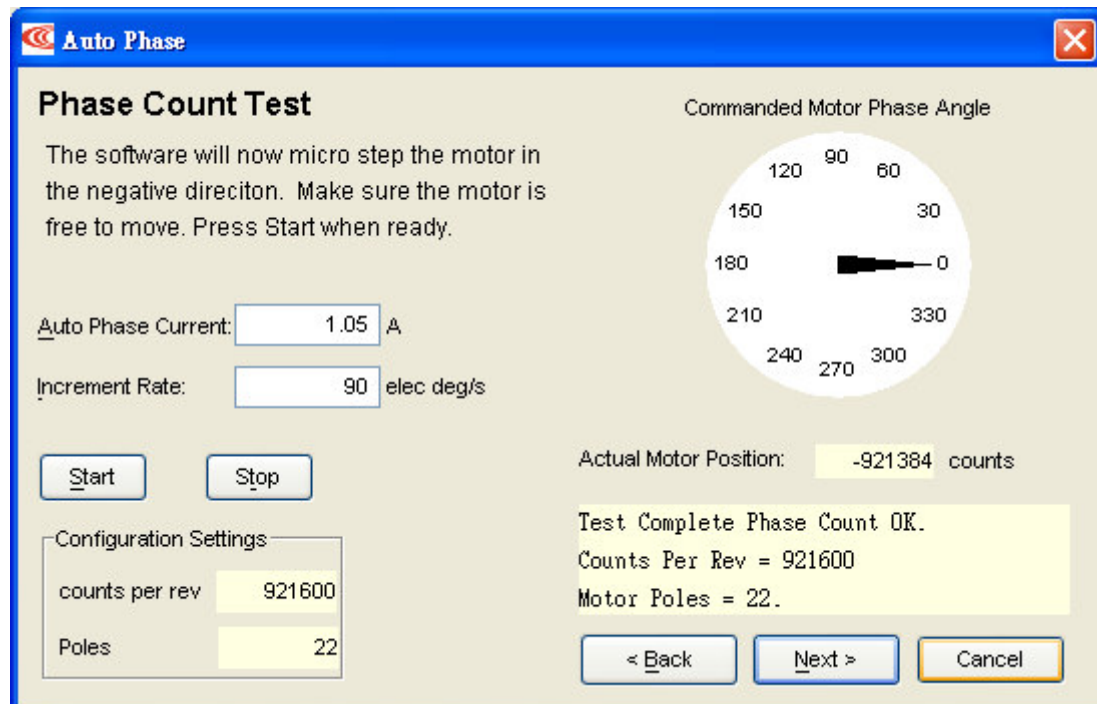


Fig. 15 Phase Count Test

- f. Press Next, and Fig. 16 Motor Phase Initialize appears.

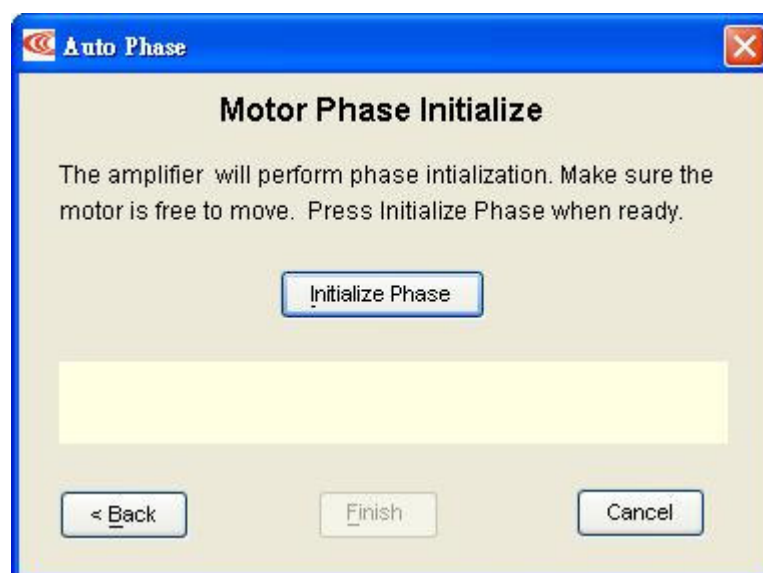


Fig. 16 Motor Phase Initialize

- g. Press Initialize Phase, and the motor will perform phase initialization. If it is successful, Fig. 17 Phase has been initialized appears.

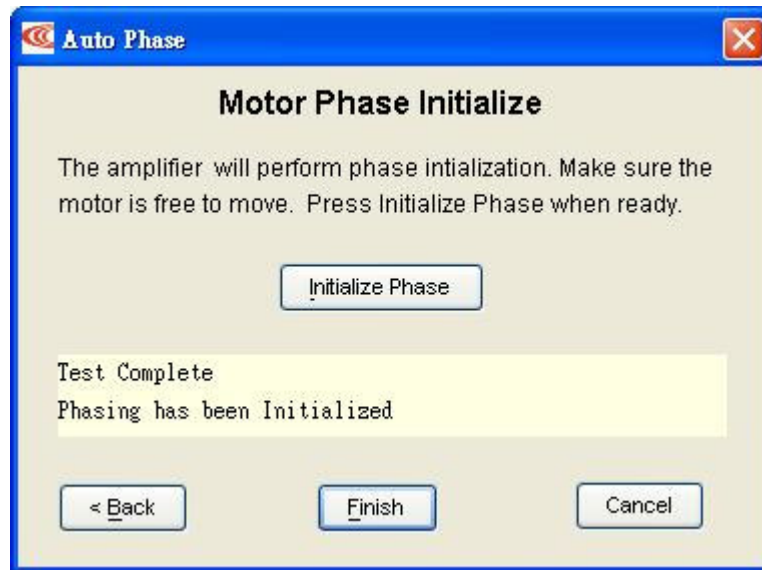


Fig. 17 Phase has been Initialized

h. Press Finish and parameters are saved to flash memory.

This step has only to be performed for once every time after mechanically assembly. It is not necessary to do it for multiple times. Except that the wiring of motor and encoder are remade or it is desired that the coordinate direction (positive or negative) be changed, it is necessary to perform this step.

9. Motion control

In this section, two modes for motion control are explained. They are pulse mode (digital input mode) and CVM mode.


Pulse mode: Commands are sent by controller e.g. motion board or PLC to driver, then motor would move according to pulses from the controller.

CVM mode: User can write their motion sequences (programs) in the driver (max. 32 sequences). Then it is possible to control which sequence to be executed through external I/O signals.

IN1 is for enabling motor. No matter in pulse mode or CVM mode, it is necessary to enable through IN1. Also when there is fault, IN1 can be used to disable and then enable so that fault is cleared.

9.1 Pulse mode

9.1.1 Pulse format

Click  and Fig. 18 appears. Choose the configuration tab, and set the following parameters.

- Set pulse format under Control Input, choose between the following three options

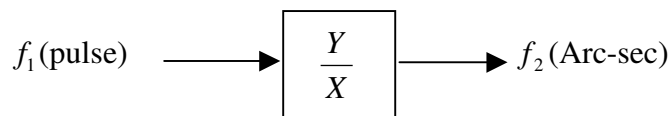
- ☐ Pulse and Direction
- ☐ Pulse Up / Pulse Down (namely CW/CCW)
- ☐ Quadrature (namely A, B phase digital signal)

- If you are using HIWIN PCI-4P motion board, choose Falling Edge for higher speed motion.

- Set the pulse weight under Stepping Resolution

Assuming that one input pulse makes the motor turn one arc second, set the Input Pulses and Output Counts as described below:

When motor turns 360 degrees, it is exactly 1296000 arc-sec. For TMS3 series torque motor, if you set Interpolation as 64, a turn would be 921600 counts, so when Input Pulses=1296000 and Output Counts=921600, if motion controller sends 1296000 pulses, motor will turn a revolution. (namely 921600counts). So 1 pulse corresponds to 1 arc-sec. Since the maximum value for Input Pulses and Output Counts is 32767, so it is necessary to reduce the fraction, so that both the nominator and denominator becomes smaller than 32767. The setting here is like electronic gear.



$$\frac{f_2(\text{Arc} - \text{sec})}{f_1(\text{pulse})} = \frac{Y(\text{counts})}{X(\text{pulse})} \cdot \frac{1296000(\text{Arc} - \text{sec})}{921600(\text{counts})}$$

$$\text{if } \frac{f_1}{f_2} = 1 \left(\frac{\text{Arc} - \text{sec}}{\text{pulse}} \right), \text{ then } 1 \text{ pulse} = 1 \text{ Arc} - \text{sec}$$

$$\text{so } \frac{Y}{X} = \frac{32}{45}$$

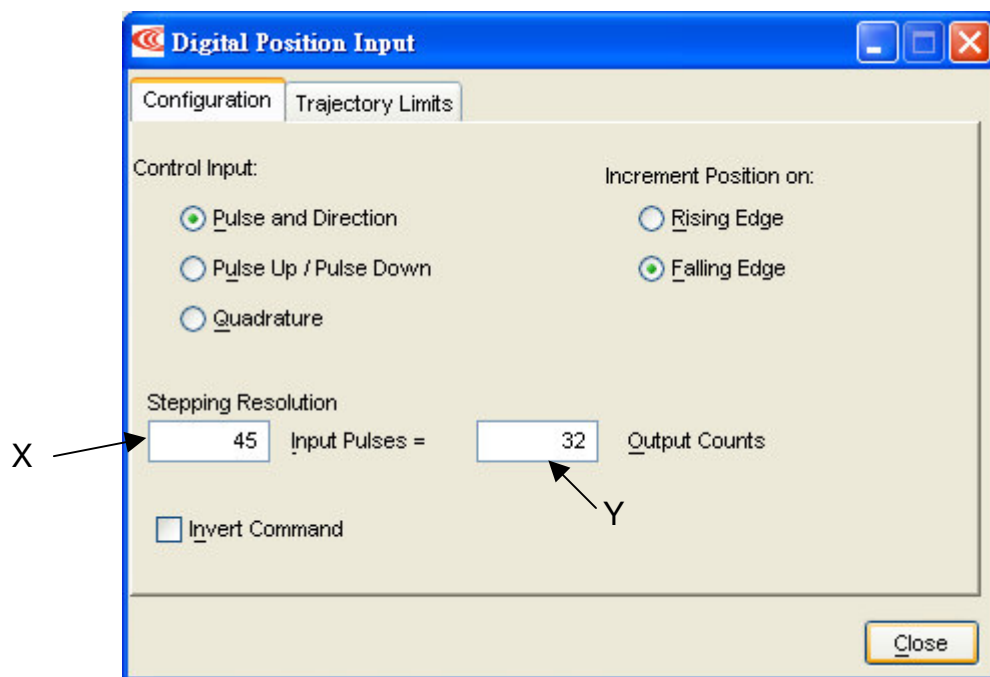


Fig. 18 Digital Position Input

9.1.2 Hardware pulse format

Generally, there are two different formats. One is differential, in which each channel of signal is realized with 2 lines. And the other is single ended, in which each channel is realized with only 1 line, but an additional common signal is necessary. HIWIN driver 800-15XX supports both differential and single ended formats. However XSL-230 supports only single ended pulse.

In Fig. 11 choose Digital Inputs 6-12 tab, and Fig. 19 appears.

- If the motion controller sends differential pulses like HIWIN PCI-4P motion controller and the driver is 800-15XX, please click on Differential Control Input at the bottom side of the window. Now IN9 corresponds to Pulse+, and IN7 corresponds to Pulse-. IN10 corresponds to Direction+, and IN8 corresponds to Direction-.
- If the motion controller sends single ended pulses, please click on Single Ended Control Input at the bottom side of the window. Now IN9 corresponds to Pulse, and IN10 corresponds to Direction. IN7 and IN8 are of no use. Regarding the selection of Pull up +5V or Pull down, it depends on the motion controller: sinking or sourcing.

In the above explanation, the shown names of IN7~IN10 are for the case of Pulse and Direction, if it is a different format, please refer to Table 1 for

actual name displayed.

If the driver model is XSL-230, there is no similar display like Control Input in the bottom side of Fig. 19.

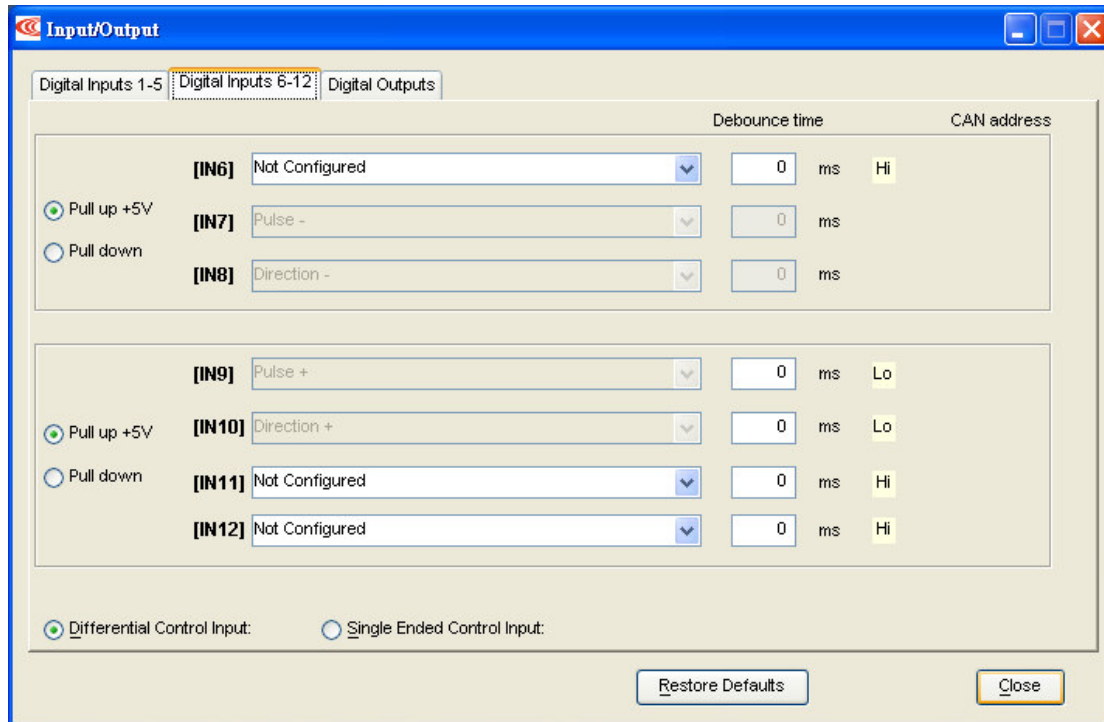


Fig. 19 Digital Input

Table 1 Digital Input display name for 800-15XX

Pulse format	Digital Input display name					
	Differential				Single ended	
	IN7	IN8	IN9	IN10	IN9	IN10
Pulse and Direction	Pulse-	Direction-	Pulse+	Direction+	Pulse	Direction
Pulse Up / Pulse Down	Pulse Up-	Pulse Down-	Pulse Up+	Pulse Down+	Pulse Up	Pulse Down
Quadrature	Input B-	Input A-	Input B+	Input A+	Input B	Input A

9.2 CVM mode

CVM (Copley Virtual Machine) makes it possible, to write motion sequences in the driver. User can use I/O from motion controller to choose which sequence to execute. With help of another I/O to trigger the driver, motor runs the desired motion sequences.

9.2.1 Wiring

Through CVM, you can write a preprogrammed motion sequences and save it into flash memory of the driver. Then use controller to activate the driver, and the wiring is shown in Fig. 20.

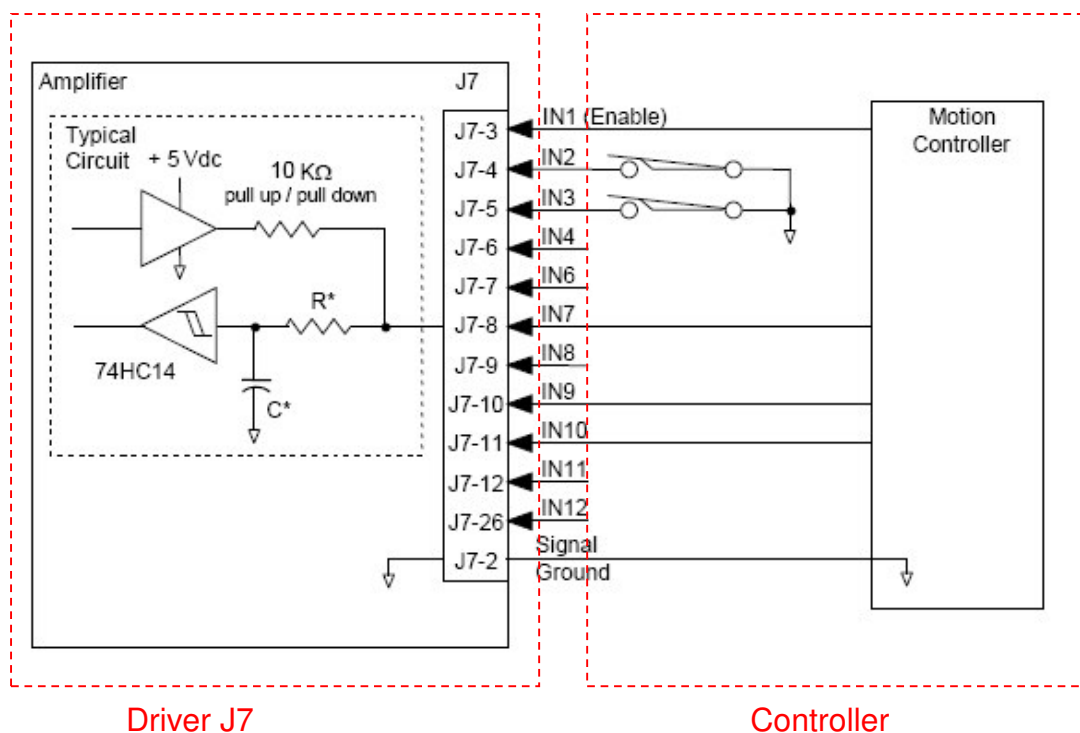



Fig. 20 Wiring between driver and controller

NOTE: From Fig. 20, if set pull up, when controller sends ON via switch, INx would be grounded, so amplifier detects low voltage level. ∴ how the driver outputs high or low level voltage to command the driver is defined by controller programmer.

9.2.2 Setting


In Basic Setup (in Fig. 7), choose CVM Control Program as Position

Loop Input, it looks like Fig. 21. In Fig. 21, click on  and Fig. 22 Index Program appears, open Setup tab like Fig. 23:

- Use digital input.
- Set Number of BCD inputs and Starting BCD input (LSB).
- Number of BCD inputs determines the number of Sequence, and Starting BCD input (LSB) determines the starting input.

- d. At Go Command, choose Use Digital Input. And choose the input for go command.
- e. Set Trigger condition. Edge or Level is available for selection.

9.2.3 Writing the sequence


After Setup is done, click  in Fig. 22 to edit the actions in each Sequence. Like shown in Fig. 24:


- ☐ Motion
 - Move: Set motor motions.
 - Home: Set homing motions.
- ☐ Settings
 - Set Gains: This is for setting current, velocity and position loop gains.
- ☐ Wait
 - Wait For Delay Time: This is to set delay time.
 - Wait For Input: This is for waiting an input.
- ☐ Input/Output
 - Set Output: This is to activate an output.

NOTE: After finishing the sequences, remember to write them to the flash memory in driver, or they are gone after power off. After writing sequences, please do not forget to save them into the flash memory in driver, or sequences will be gone after turning off the power. Furthermore, it is possible to save the sequences onto files on a PC, so that later they could be used. Icons are explained as below. Regarding CVM descriptions please refer to [index_user_guide.pdf](#),

which is available after clicking  on the PC desktop.

: save to PC.

: load from PC.

: save to flash memory in driver.

: read from flash memory in driver.

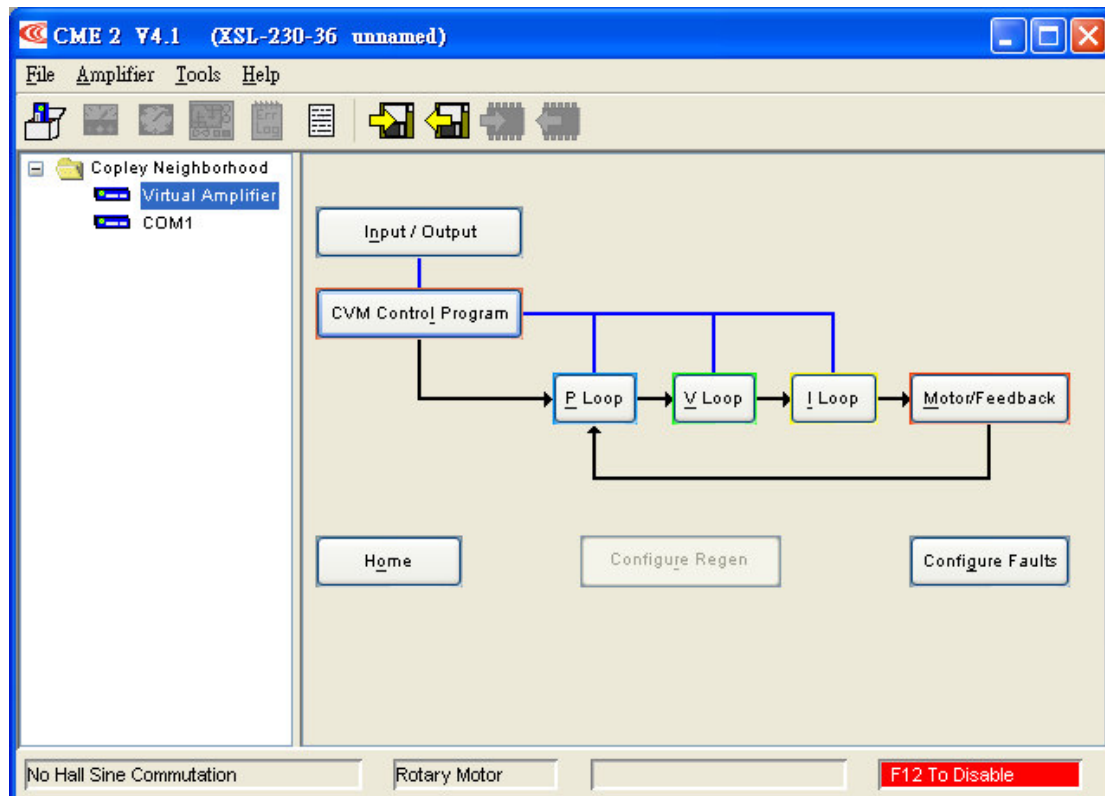


Fig. 21 CVM Control Program

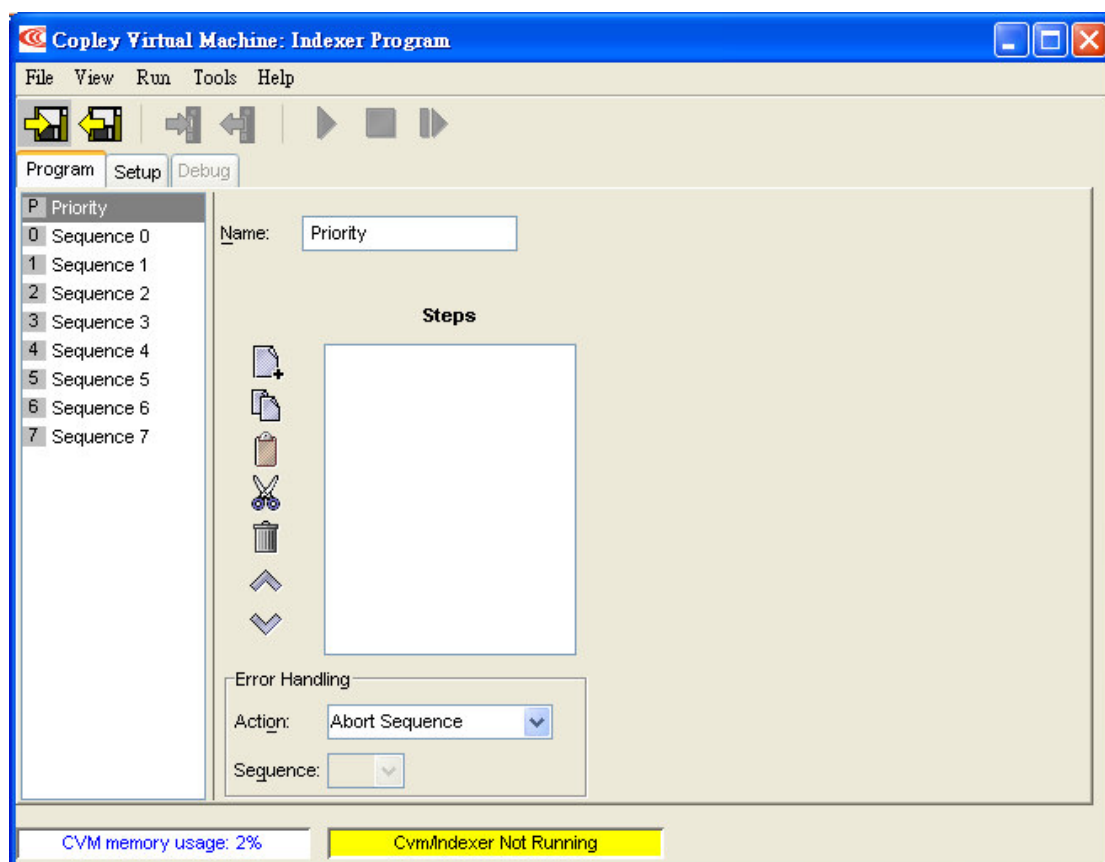


Fig. 22 Index Program

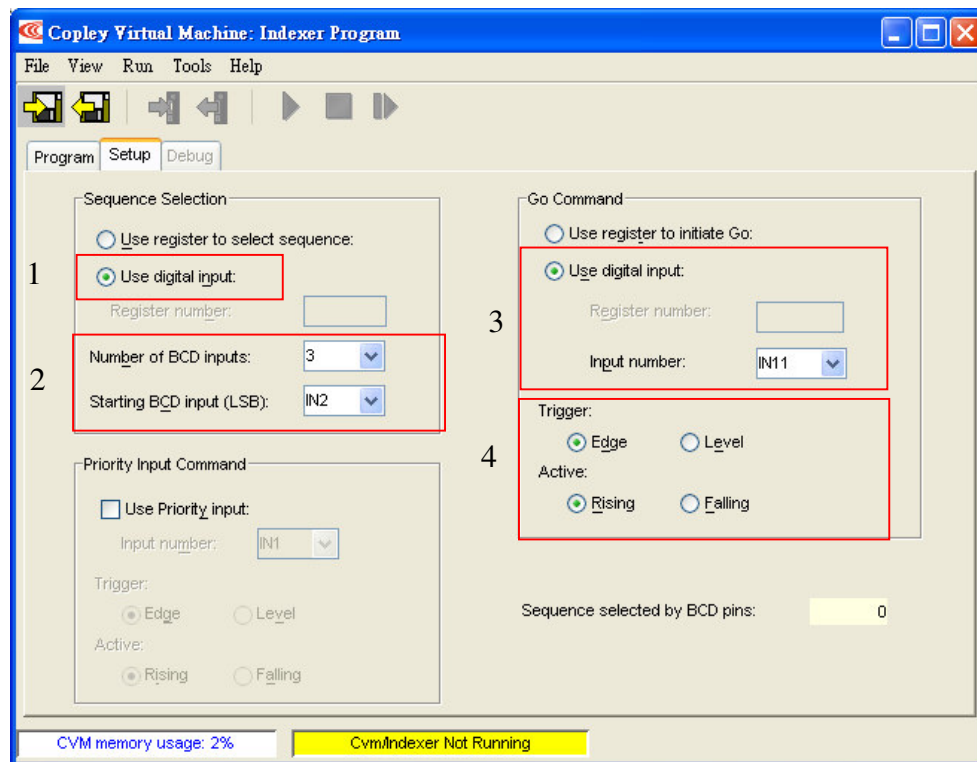


Fig. 23 Index Program

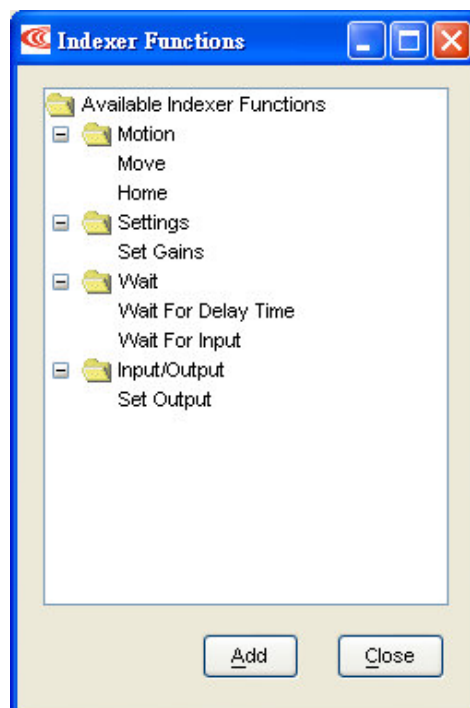


Fig. 24 Indexer Functions

10. CVM application example

This example is using CVM together with PLC to control the motor. The

wiring between driver and PLC is shown in Fig. 25. There are mainly 3 sequences, each of which performs turning to 0 degree, turning to 90 degree and homing. Settings are listed in Table 2:

Table 2 Sequence setting

IN3	IN2	Sequence	Action
0	0	0	Homing
0	1	1	Turn to 0°
1	0	2	Turn to 90°

0: ON

1: OFF

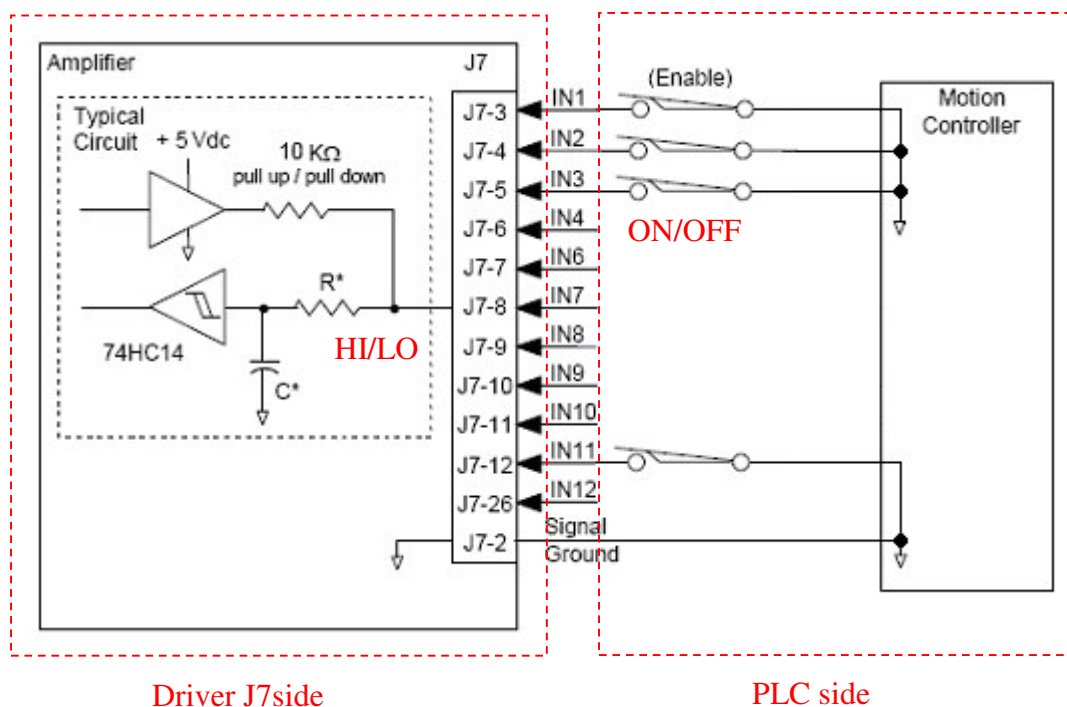


Fig. 25 Wiring between driver and PLC

Step1: Input/Output setting

Click Input/Output in Fig. 6, it shows like Fig. 26. For inputs, Pull up +5V is used. So, when IN1 is floating, it is HI; when IN1 is grounded, it is LO. For IN1, choose the setting of Amp Enable-LO Enable With Clear Faults, so when IN1 is LO, driver is enabled and faults are cleared. For the rest of the inputs, please choose Not Configured.

Step2: CVM Setup (Fig. 27)

- Because there are only 3 actions: homing, turn to 90 degree and turn to 0 degree, the Number of BCD inputs is set to 2. 2^2 provides maximal 4 sequences.
- Start BCD input (LSB) is set to IN2, so IN2 (LSB) and IN3(MSB) are used for selecting sequence.
- Input Number under Go Command is set to IN11 for triggering sequences.
- Use Falling Edge trigger.

In this example IN3 and IN2 are used for selecting Sequence.

NOTE: In this example, IN11 is used for execution of Sequence. And trigger mode could be selected between Level and Edge trigger. When IN11 does not satisfy the trigger condition, Sequence is not started. It is until the trigger condition is satisfied, the sequence is executed. For example, Trigger=Edge and Active=Falling, IN11 has to go through HI→LO(switch OFF→ON) transition, so that Sequence be executed. Therefore PLC has to control IN2, IN3 and IN11 to switch and execute sequences.

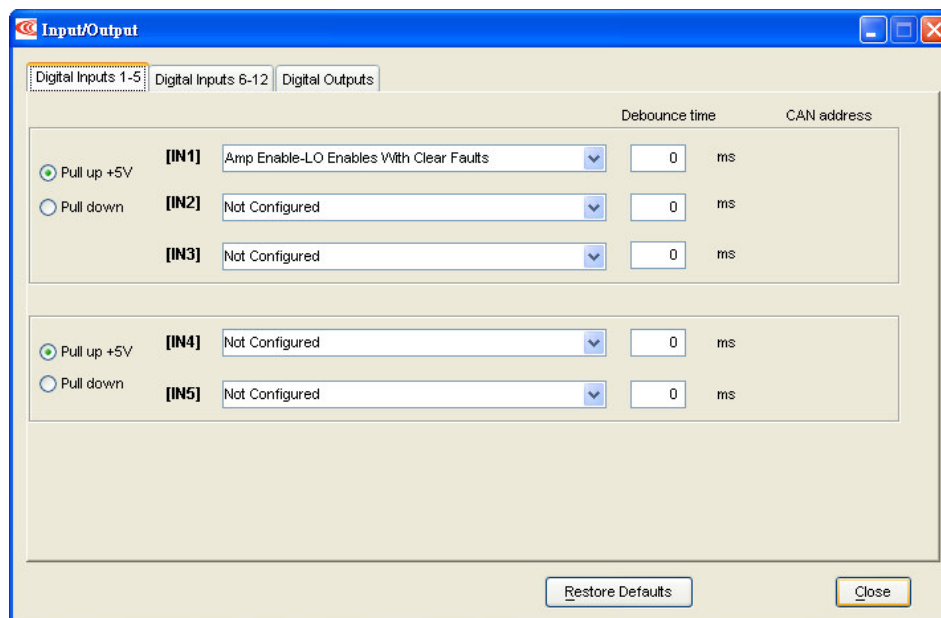


Fig. 26 I/O setting

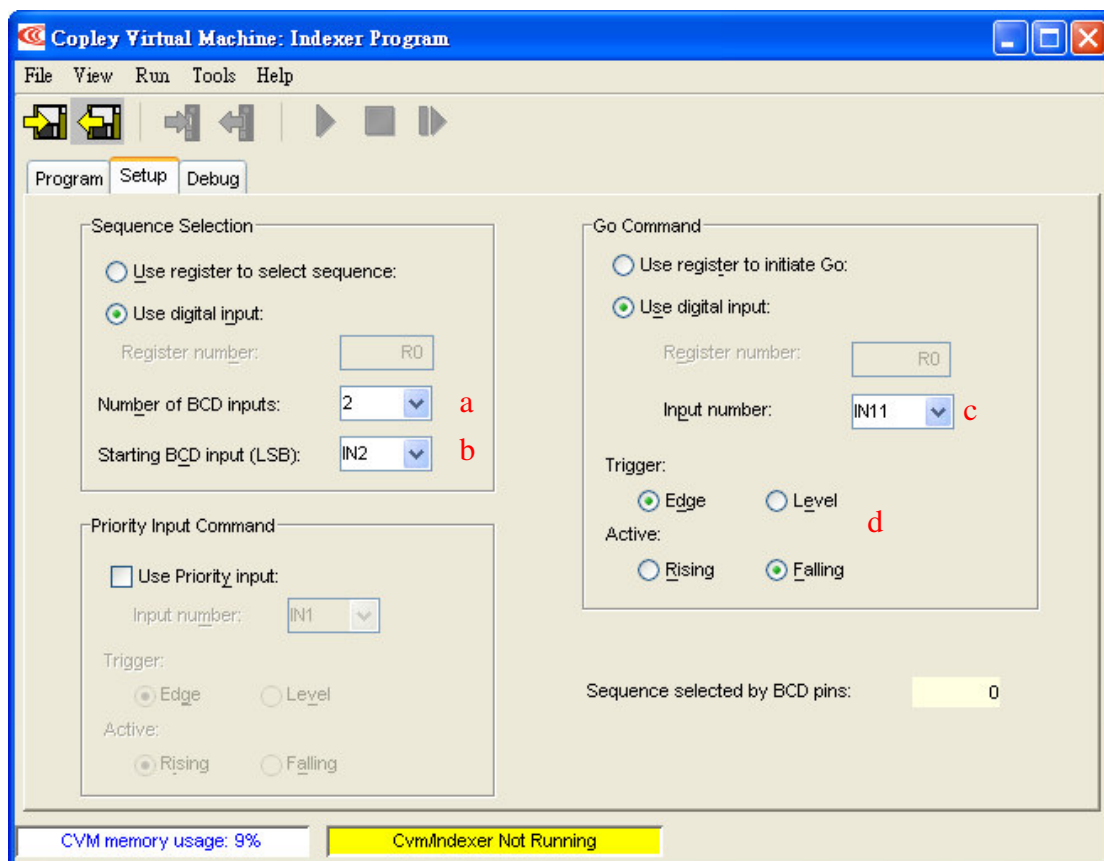


Fig. 27 CVM Setup

Step3: Homing

In Sequence0, add Home action, like Fig. 28. Settings like below:

a. Homing Method

Choose Next Index, so that Z signal of encoder is searched for homing.


※The encoder in TMS series motors has only one Z signal in a revolution.

b. Direction of Motion

This determines counterclockwise or clockwise for searching home. (It depends on user's need.)

c. Set homing speed, acceleration and deceleration. Offset distance after home is found could also be set.

Offset is used for the case, in which the index is not the home position.

Use Offset to define the position of origin point. Use  in Fig. 6 to home the motor and then turn the motor to the angle which is going to be defined as new home position. Use Control Panel (Fig. 29) and check Actual Position counts. That value is the required Offset (notice the sign of the number). See also Fig. 30. Slow Velocity is the velocity for searching Index. Fast Velocity is the velocity for moving to Offset distance.

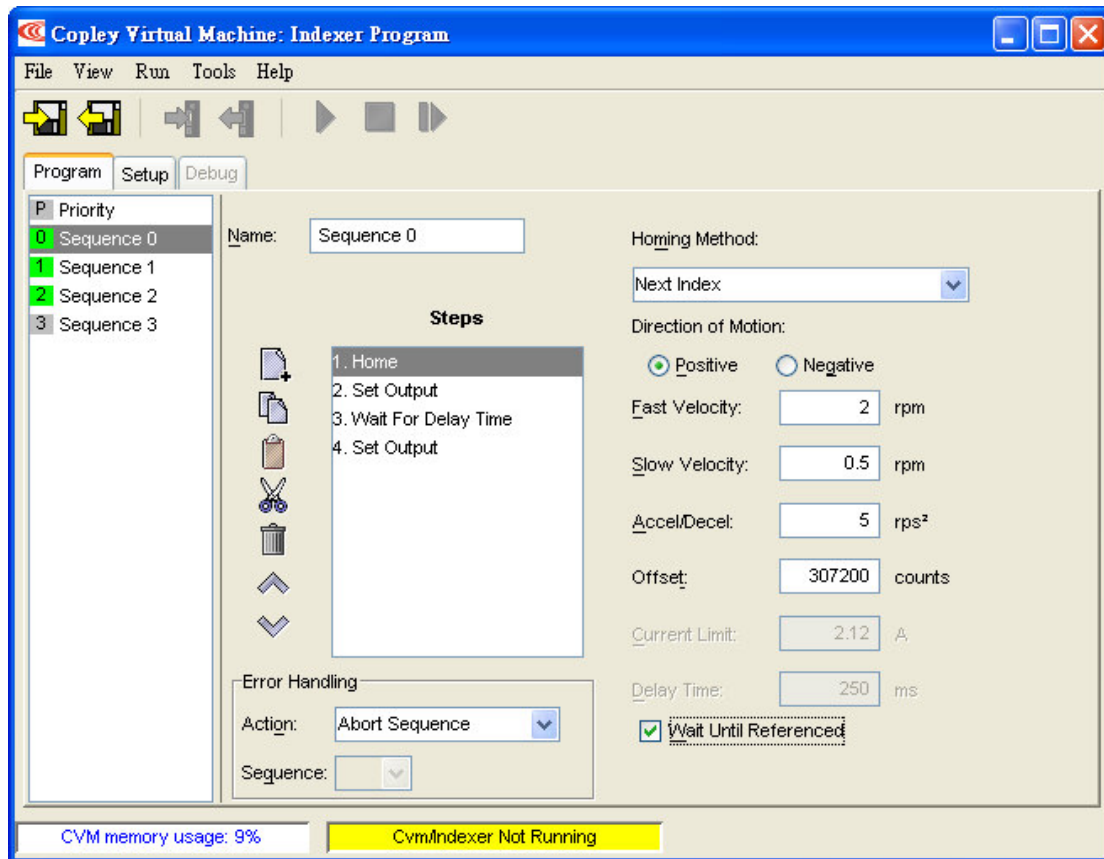


Fig. 28 Setting for homing

NOTE: Like shown in Fig. 28, it is possible to insert delay time (Wait For Delay Time) after a motion is done. In Step1 you can set a Digital Output as Program Control, then you can use Set Output here for signaling PLC. PLC can wait for this signal and does further control.

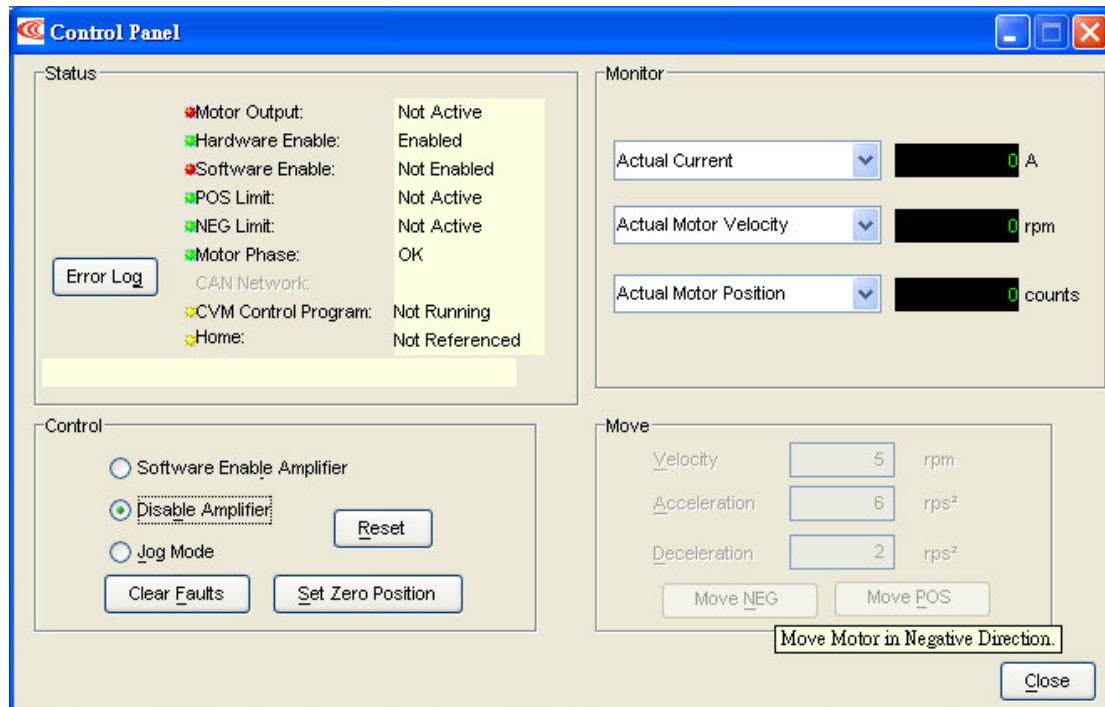


Fig. 29 Control Panel

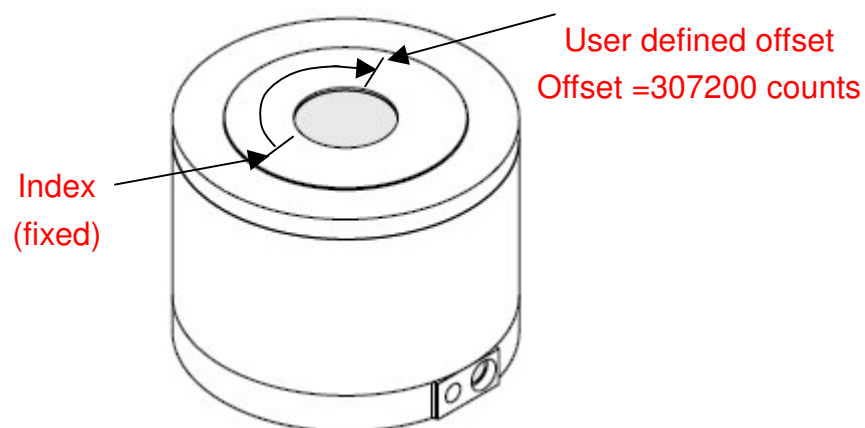


Fig. 30 User defined home offset

NOTE: If 24V is turned off, it is necessary to perform homing again. So if fault happens, use disable→enable to clear faults, instead of turning off 24V.

Step4 : Turn to 0 degree

In Sequence1, add a Move, like shown in Fig. 31. Setting is like below.

a. Move

Choose Absolute mode.

b. Type

Choose S Curve to get smoother motion and quicker in-position.

c. Set Position, Velocity, Accel and Jerk.

Position=0 counts means also home position.

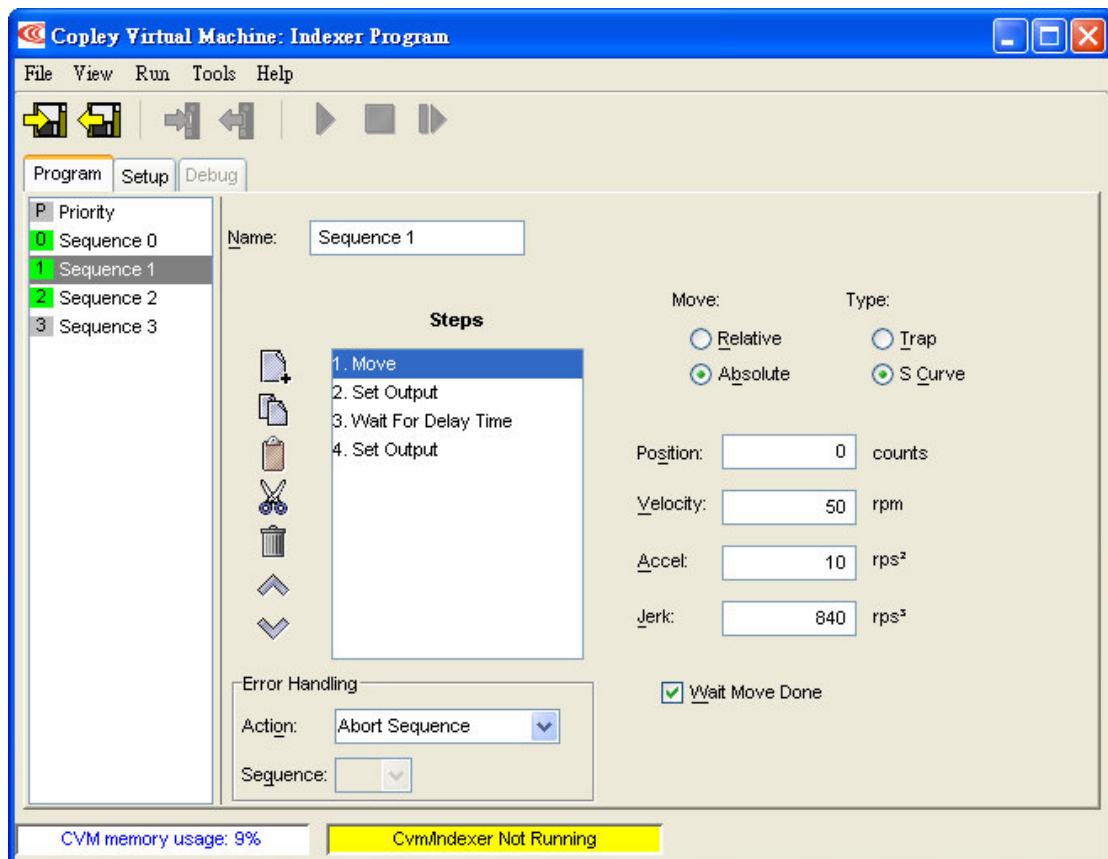


Fig. 31 Setting for turning to 0 degree

Step5 : Turn to 90 degree

Like setting in Sequence1, add Move in Sequence2. Like shown in Fig. 32. Take the example described in section 5, if there are 921600 counts per revolution, if you want to turn 90 degree, set $921600/4=230400$ counts is OK. Other angle can be calculated similarly.

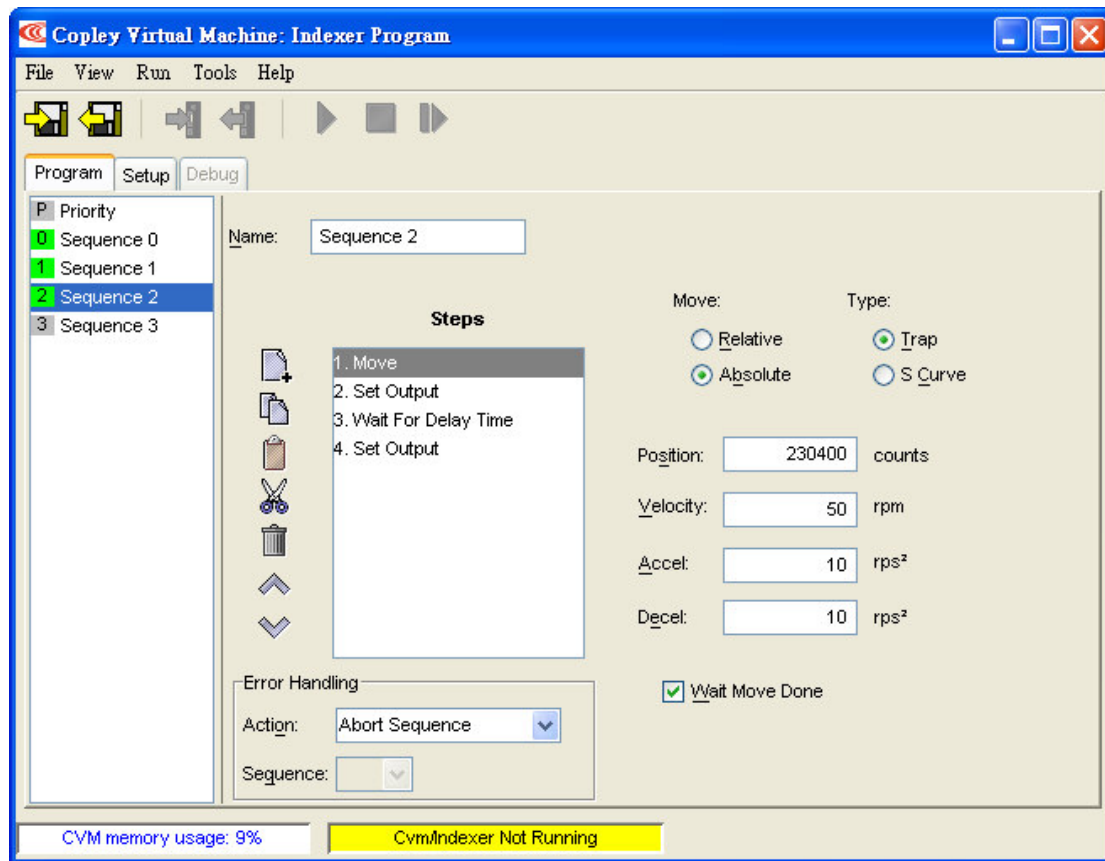




Fig. 32 Turning to 90 degree

After finishing the sequence, press  to save it into driver. Press  to start executing CVM, then you can use PLC to control the driver for motion sequences.