

# Quick Guide to Copley Xenus Driver

2007.05.17

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Revision

| VER | Date        | Application         | Note  |
|-----|-------------|---------------------|---|
| 1.0 | 2005.05.25  | Xenus Firmware 4.40 | First Issue   |
| 1.1 | 2005.09.12  | Xenus Firmware 4.40 | 1. . Add system connection diagram<br>2.Add (2)Motor parameter file and (3)wiring diagram.<br>Add sec.14: auto phase procedure for digital Hall sensor.<br>Add sec 15: auto phase procedure for gantry  |
| 1.2 | 2005.09.30  | Xenus Firmware 4.40 | 1. Modify sec. 11(b): select Pull up +5V, and pointer location fix in Fig. 13(below Lo).  |
| 1.3 | 2005.11.21  | Xenus Firmware 4.40 | 1. sec. 2: add download motor parameter file name difference<br>2. sec. 14: add jump start caution  |
| 1.4 | 2005.12.19  | Xenus Firmware 4.66 | To cope with the addition of 800-15XX series driver, add Differential pulse explanation.<br>1. sec. 12.1 rename to pulse signal format.<br>2. Add sec. 12.2 pulse hardware format.<br>3. Delete Fig.2 in sec. 3. Add "Refer to LM Stage Configuration and Accessories Documentation"<br>4. Change AC Main power to 100~240Vac in Fig. 2 |
| 1.5 | 2006.07.04  | Xenus Firmware 4.66 | Section 3: Add use of tooth lockwashers and screws to fix driver onto electrical control box.   |
| 1.6 | 2006.10.19  | Xenus Firmware 4.66 | Add regen resistor specification appendix   |
| 1.7 | 2006.12.11  | Xenus Firmware 4.66 | Add driver surrounding temperature and attention notice on heat dissipation   |
| 1.8 | 2007.05.17. | Xenus Firmware 4.66 | Add appendix of configuring a custom Regen Resistor   |

This document illustrates how to connect linear motor to the driver and its basic parameter settings.

### 1. Specification Confirm

Please confirm the following items for the following setup procedure

- a. Motor forcer model
- b. Load mass (kg) on motor
- c. Encoder model
- d. Please pay special attention to surrounding temperature during driver installation. Please see Xenus User Guide VER2.0 Page159~162 for heat dissipation)

### 2. Download Motor Parameter

Motor parameter files can be found at

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

Please download the file according to your selection of HIWIN motor model (Categorized under iron-core linear motor LMS and coreless linear motor LMC) :

- a. LMS for Copley Xenus 051003.zip
- b. LMC for Copley Xenus 051003.zip
- c. LMT for Copley Xenus 051003.zip

The zip file contains drivers for many different motor types (.ccm ). The files contained in the CD or on the website will be updated to the newest version.

Therefore the file names might have slight discrepancy.

### 3. Connection (1)

To ensure driver is properly grounded, please use **tooth lockwashers** or screws to fix the driver securely on the electrical control box. The electrical control box should be properly grounded for safety precaution. Please refer to LM Stage Configuration and Accessories documentation and Fig. 1 for the following connection illustration :

1. Connect RS-232 cable between driver and PC(model: LMACR21D)
2. Confirm pin J7-3 IN1 (Enable) and pin J7-2 Signal Ground, on the driver connector J7, are properly connected to motion controller's servo on (or enable) output signal. Please note how the motion controller commands servo on signal. .
3. Confirm pin J8-14 IN5 (motor over-temp) and pin J8-15 Ground on driver connector J8 are properly connected to motor over-temperature signal cable. ( model: LMACS□□D or LMACS□□E)

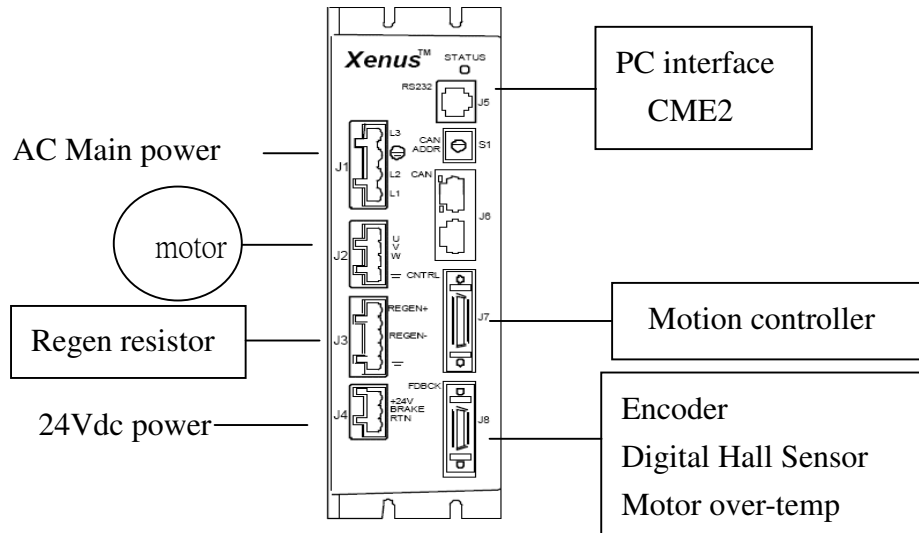


Fig. 1 Driver connection diagram

#### 4. Connection (2)

- Please refer to Fig. 2 for connection on driver power amplifier's AC power cord (J1), motor power cable (J2), 24V DC (J4) driver preamplifier's (DSP) power cord, ENCODER cable (J8) (Do not power on at this moment.)
- Connect driver amplifier AC power core properly to line filter, and install iron core to AC power core, encoder cable, and motor power cord.
- Confirm motor base plate is securely fixed, then turn on 24VDC power. Connection diagram shown in Fig. 3.

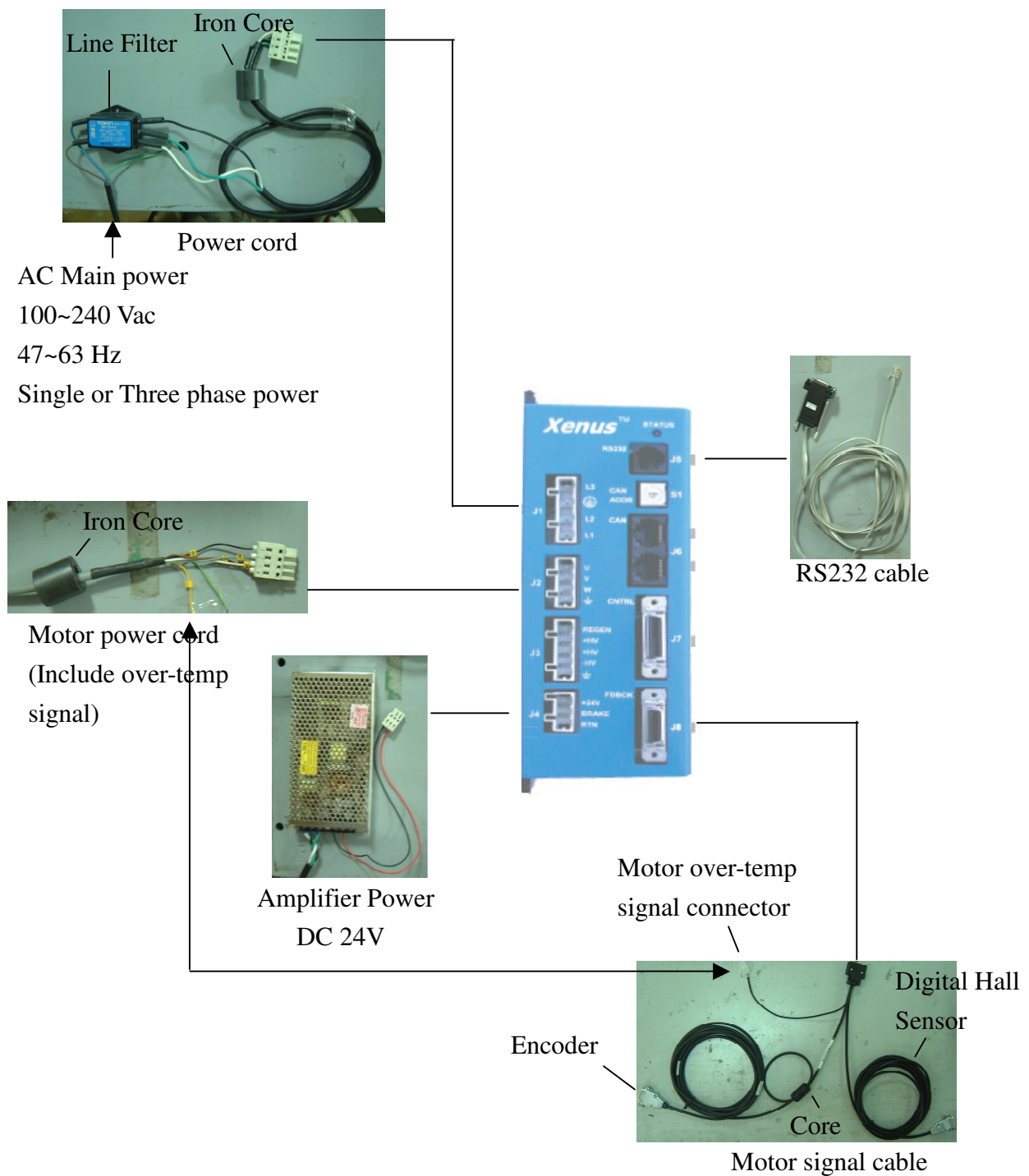


Fig. 2 driver actual connection

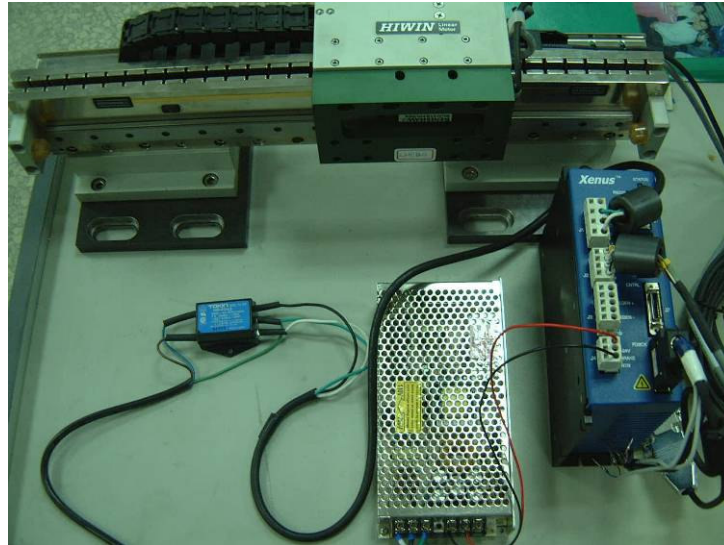


Fig. 3 Motor and driver actual connection

## 5. Starting User's Interface



Double click on ,Fig. 4 Main Interface will appear.

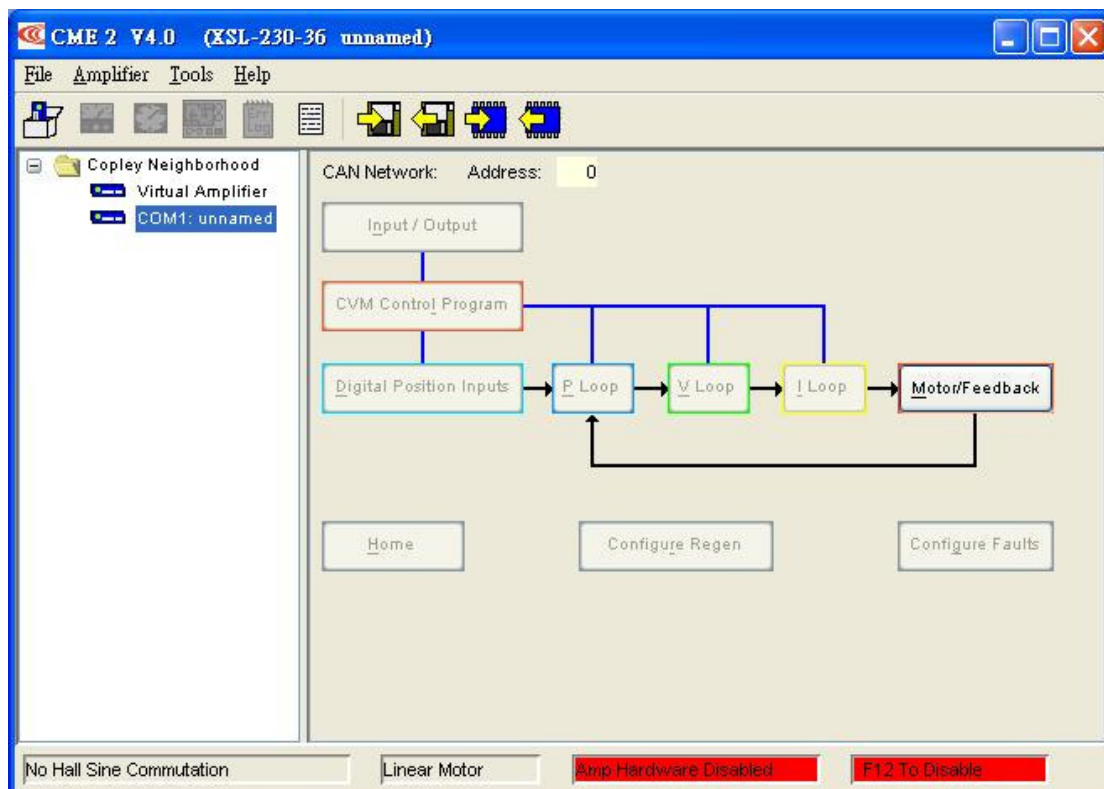



Fig. 4 Main Interface

## 6. Settings for Basic Parameter

Press on , and Fig. 5 Basic Setup page should appear for setting the following parameters

a. Motor options setting

Motor Family = Brushless motor

Motor Type = Linear motor

(Commutation = Sinusoidal)

Hall Type = None

b. System setting

Operating mode = Position

Position Loop Input = Digital input

c. Encoder setting

Motor Encoder = Primary Incremental

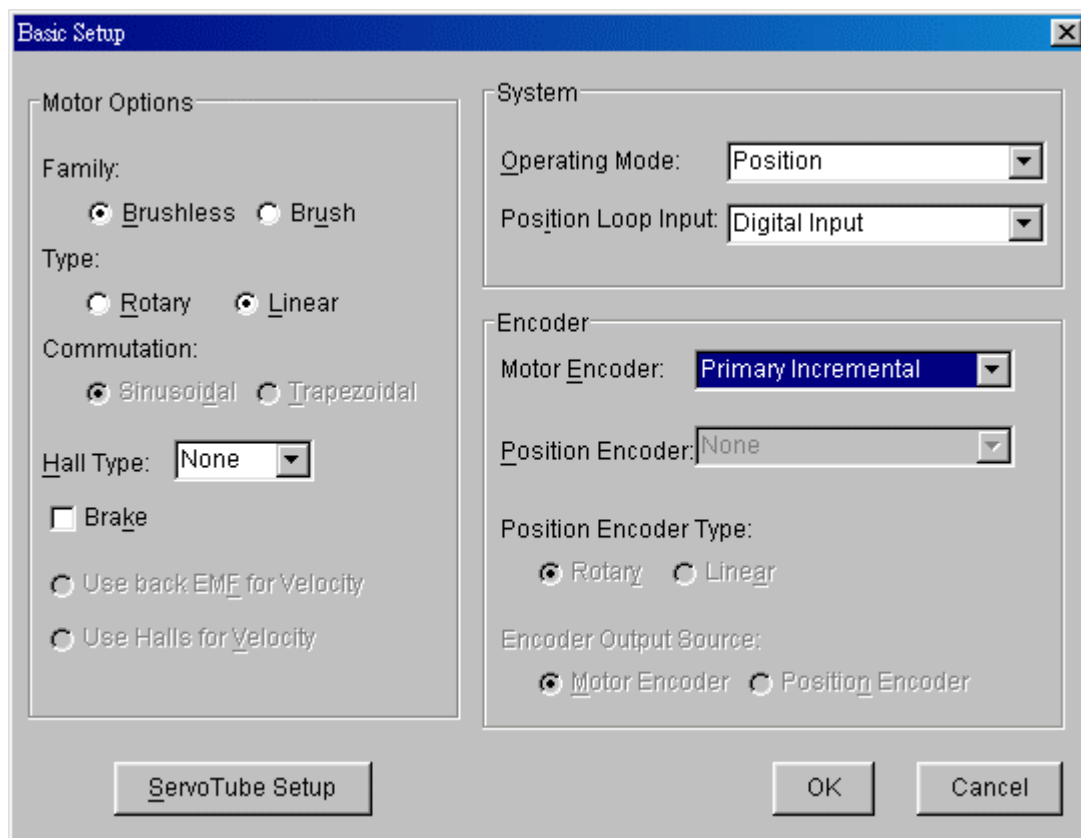
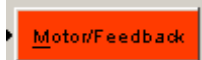


Fig. 5 Basic Setup page



## 7. Loading Motor Parameter File

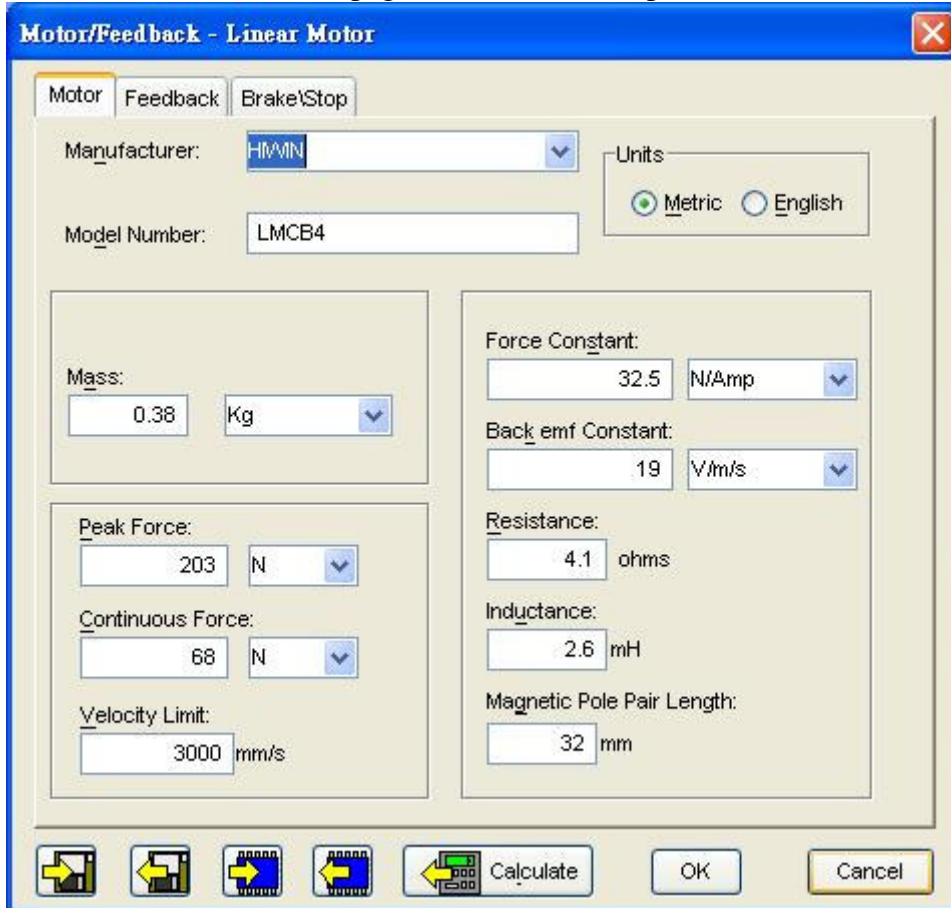
- a. In order to load the CCM motor parameters prepared in section 2, press on



, then Fig. 6 Motor/Feedback page will appear , and press



at the bottom of the page to load the motor parameters.



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

- Manufacturer:** HIWIN (dropdown)
- Model Number:** LMCB4 (text box)
- Units:** Metric (selected), English (radio buttons)
- Mass:** 0.38 (text box), Kg (dropdown)
- Force Constant:** 32.5 (text box), N/Amp (dropdown)
- Back emf Constant:** 19 (text box), V/m/s (dropdown)
- Peak Force:** 203 (text box), N (dropdown)
- Continuous Force:** 68 (text box), N (dropdown)
- Resistance:** 4.1 (text box), ohms (text)
- Inductance:** 2.6 (text box), mH (text)
- Velocity Limit:** 3000 (text box), mm/s (text)
- Magnetic Pole Pair Length:** 32 (text box), mm (text)

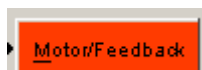
At the bottom, there are four directional arrow buttons, a "Calculate" button, and "OK" and "Cancel" buttons.

Fig. 6 Motor/Feedback

- b. If necessary, return to Basic Setup page (Fig. 5) and modify settings according to actual application parameters.

- Encoder type (i.e. Analog or Digital)
- Hall sensor type (i.e. Analog or Digital )
- Operation Mode (i.e. Velocity or Force Loop)

## 8. Entering Load Parameter



Press on , Fig. 6 Motor/Feedback page will appear. Enter actual load (kg) in Mass box. Other motor settings are automatically loaded with preset settings via CCM file, no modification is necessary.

## 9. Settings for Encoder Parameter

Press on Feedback tab in Fig. 6

- a. If encoder was set to Incremental digital encoder, Fig. 7 will appear. Please enter the correct encoder resolution value according to the feedback hardware. (i.e. Renishaw RGH41X resolution is 1 $\mu$ m, shown in Fig. 8.)

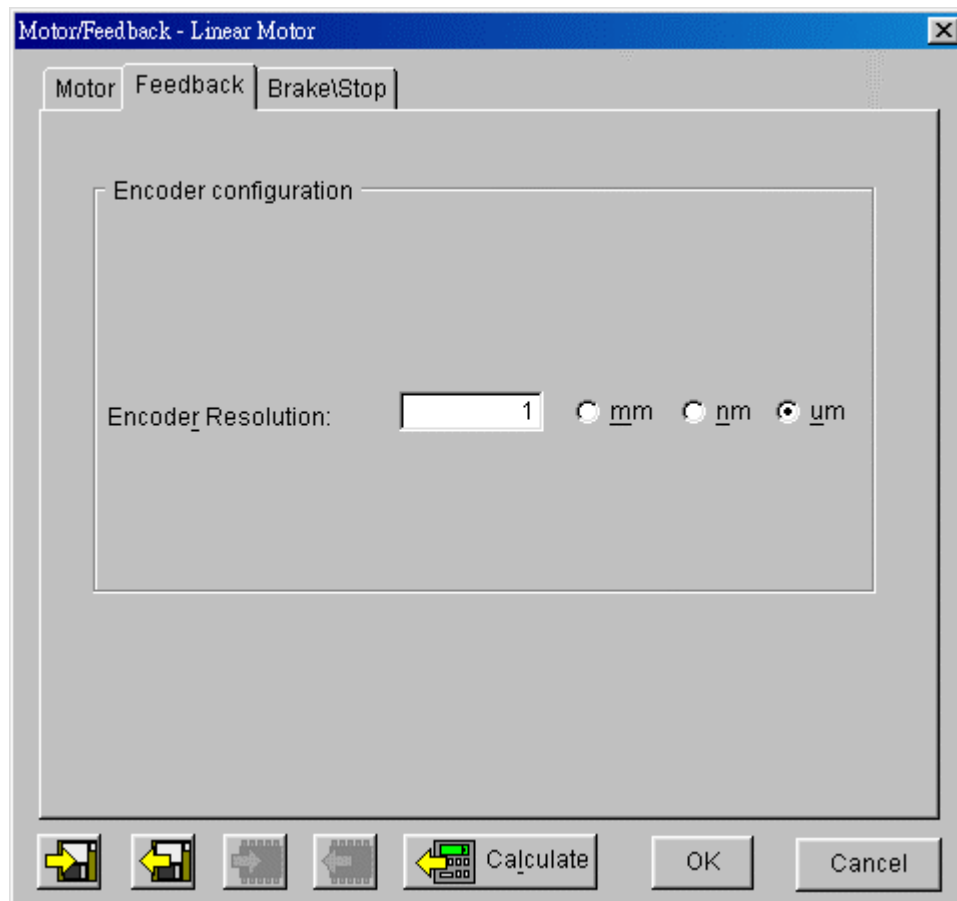


Fig. 7 Feedback



Fig. 8 Renishaw digital encoder RGH41X

- b. If encoder was set to analog encoder, Fig. 9 will appear. Please enter the correct fundamental resolution and interpolation value according to the feedback hardware. (i.e. Renishaw RGH41B resolution is 40  $\mu\text{m}$ , shown in Fig. 10. If Interpolation is set to 16, then resolution is 0.625 $\mu\text{m}$  (one encoder count = 0.625  $\mu\text{m}$ ).

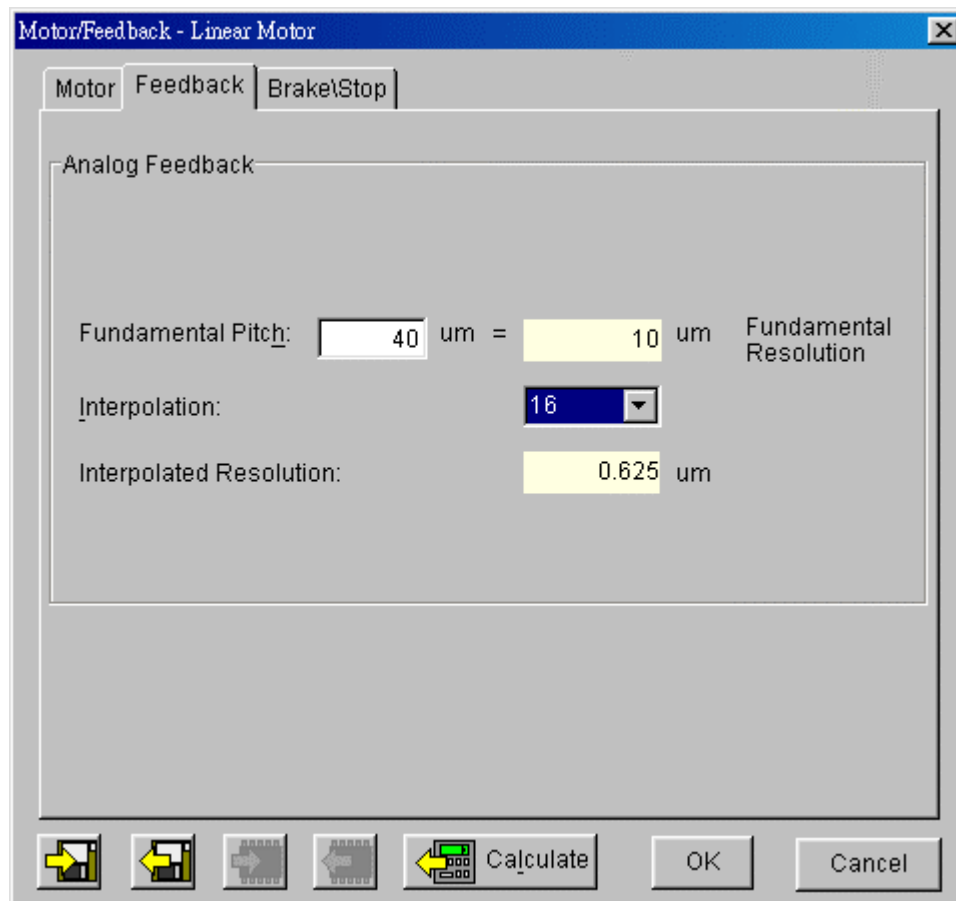


Fig. 9 Feedback

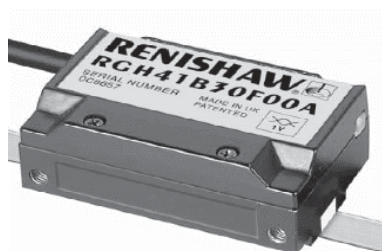
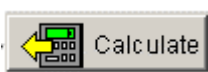



Fig. 10 Renishaw analog encoder RGH41B

## 10. Calculating Gain Parameter

Press on  Calculate, then Fig. 11 will appear. The interface will calculate estimated values for gains and limits, which can be modified later. If estimated values are incorrect, please press cancel and return to Motor/Feedback page to confirm all motor parameters are correctly entered. If estimated values are correct, click OK and  to store into flash memory.

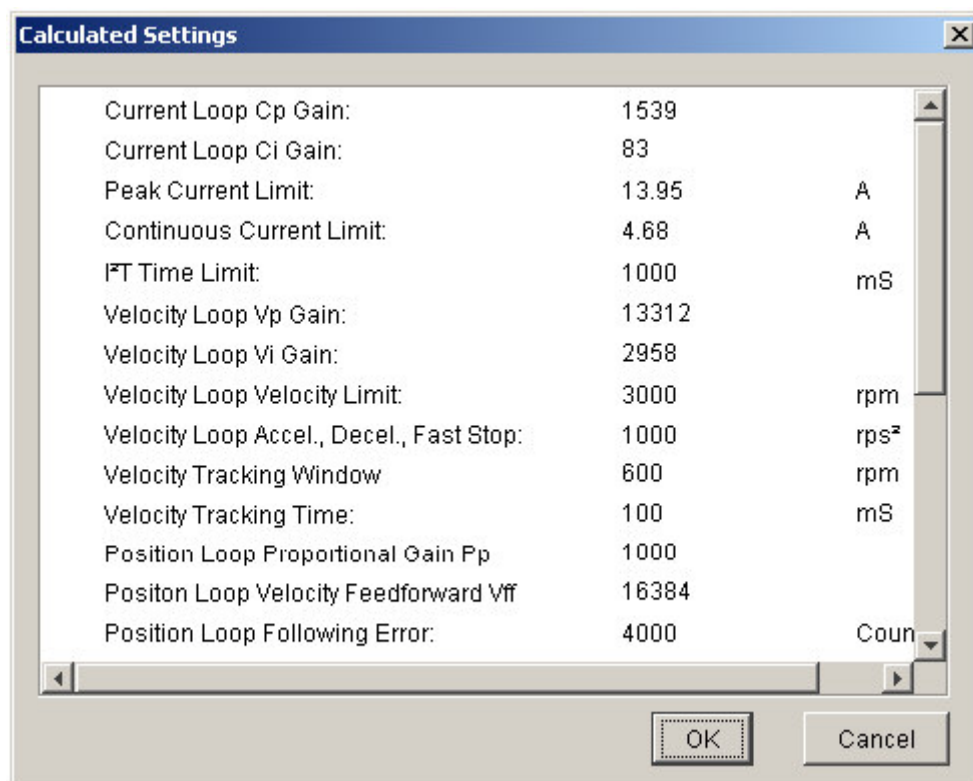


Fig. 11 Calculated Setting

## 11. Settings for I/O

To set digital input, press on , and Fig. 12. Input/Output page will appear.

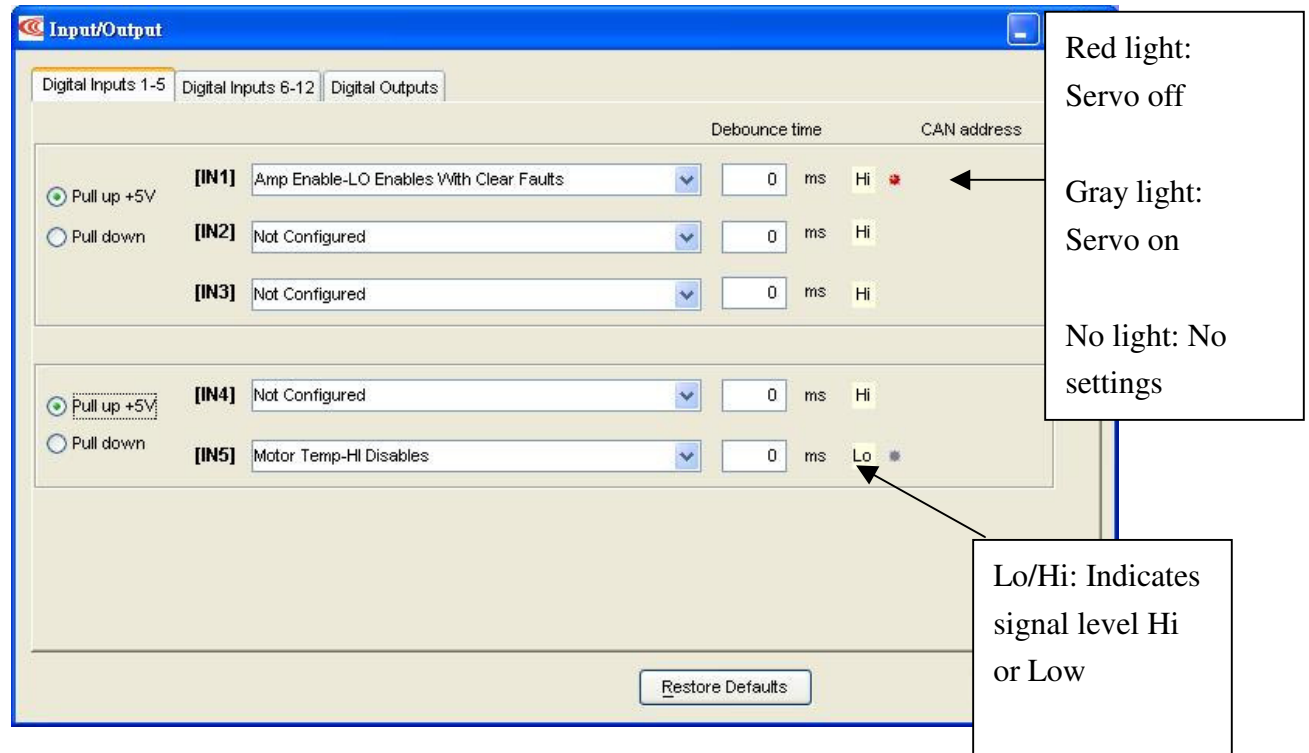



Fig. 12 Input/Output

- Change the preset selection to Not Configured for IN2 and IN3.
- Set IN5 to Motor Temp HI Disable. (for motor over-temp signal )
- If necessary, enter input signal's logic definitions.
- 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, to the right of [IN1], shows gray 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.
- Confirm pin J8-14 IN5 (motor over-temp) and J8-15 Ground on driver connector J8 are properly connected to motor over-temp signal cable ( model LMACS□□D or LMACS□□E). IN5 should show gray when the over-temp cable is correctly plugged, and red when unplugged, which means the motor is not operatable.

## 12. Setting Pulse Parameter

### 12.1 Pulse Signal Format

Press on , and Fig. 13, will appear. Select the Configuration tab to set the following parameters:

- setting pulse signal format: select Control input from three of the following
  - Pulse and Direction
  - Pulse Up / Pulse Down (CW/CCW)
  - Quadrature (A/ B phase digital signal )
- When paired with HIWIN PCI-4P motion control card, select Falling Edge when operating at high speed.
- Set the pulse weight under Stepping Resolution, e.g. analog encoder resolution set to  $0.625\ \mu\text{m}$  (one encoder count =  $0.625\ \mu\text{m}$ ). When the pulse weight is set to 10 Input Pulses and 16 Output Counts, every pulse received from the motion controller will be interpreted as 1.6 encoder counts by the driver, meaning one Input Pulses will move  $1\ \mu\text{m}$ . (Similar to electric gear-ratio function)

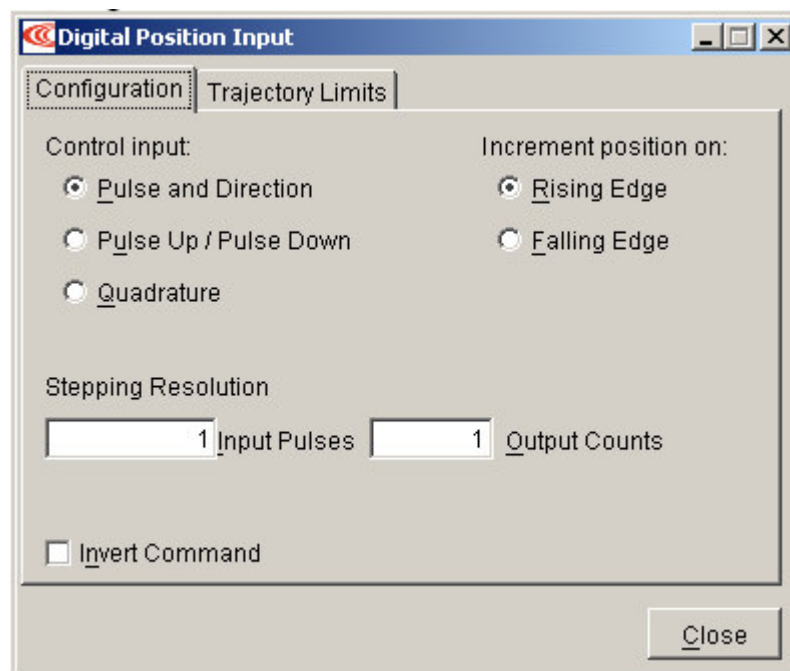


Fig. 13 Digital Position Input

## 12.2 Pulse Hardware Format

There are two hardware formats for interfacing the pulse. One is differential (every signal utilizes two channels) and single ended (every signal only utilizes one channel, but requires additional common reference.) HIWIN driver 800-15XX supports both differential and single ended interfaces, where XSL-230 series only supports single ended interface.

On Fig. 12, select Digital Inputs 6-12 tab, and Fig. 14 will appear. .

- a. When using differential interface for pulse output, such as HIWIN PCI-4P motion control card and 800-15XX series driver, select Differential Control Input on the lower left corner of the page. (IN9 indicates Pulse+ , IN7 indicates Pulse-, IN10 indicates Direction+ , and IN8 indicates Direction-.)
- b. When using single ended interface for pulse output, select Single Ended Control Input on the lower left corner of the page. (IN9 indicates Pulse, IN10 indicates Direction, IN7 and IN8 can not be used.) Then select Pull up +5V or Pull down, depending on control card's output interface utilizes sinking or sourcing.

The above naming example for IN7~IN10 is when pulse signal format is set to Pulse and Direction. If not using such signal format, please use Table 1 for reference.

When using XSL-230 series, then Control Input format selection will not appear on lower Fig. 14.

Please refer to LM Stage Configuration and Accessories documentations for cable routing.

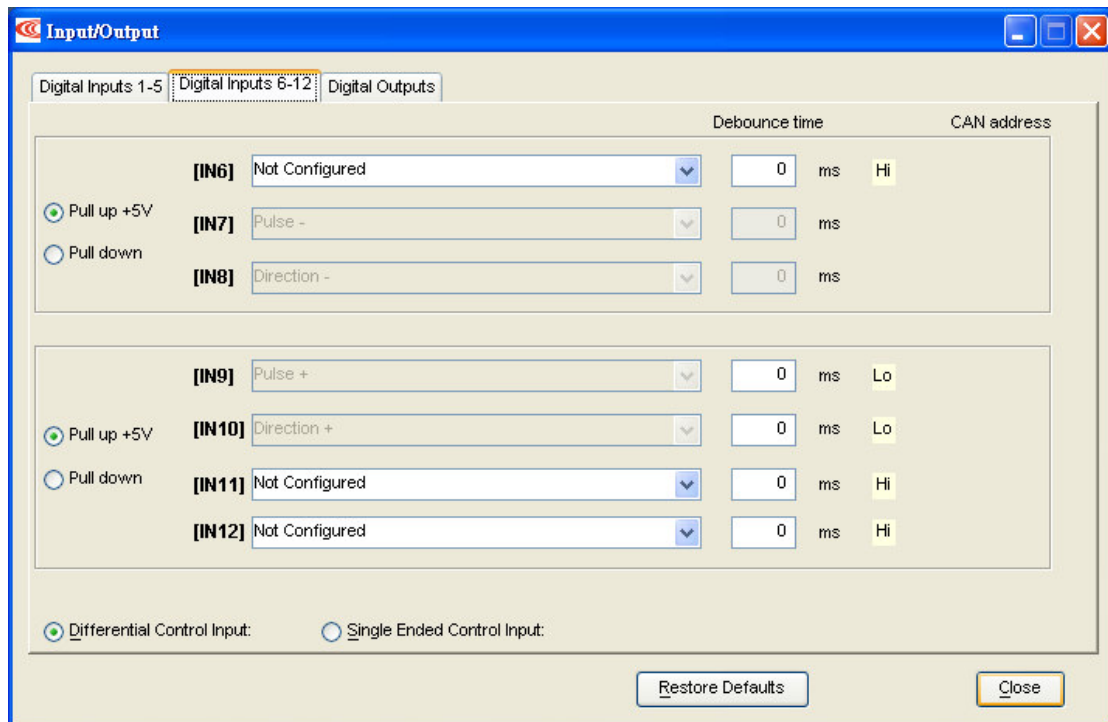


Fig. 14 Digital Input

| Pulse signal format   | Digital Input |             |           |             |              |            |
|-----------------------|---------------|-------------|-----------|-------------|--------------|------------|
|                       | 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    |

Table 1. 800-15XX Digital Input



### 13. Procedure for First Time Auto Phase (Without Hall Sensor)

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, please select Software Enable Amplifier to servo on. If successful, then you so not need to perform Auto Phase.

If digital hall sensors are not implemented, please follow the procedures listed in this section. If digital hall sensors are implemented, please follow steps listed in section 14.

- a. Confirm the servo on signal is turned off on the motion controller, then turn

on driver's AC power , and Press on , Fig. 15 will appear.

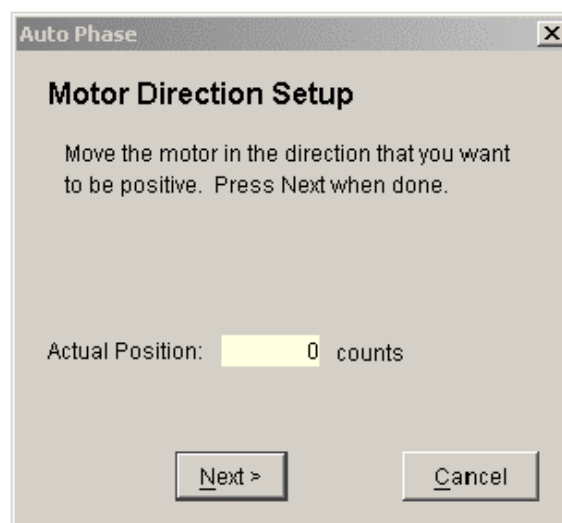


Fig. 15 Motor Direction Setup

- b. Manually push the motor to the positive direction defined by the user, and the actual position readout will change. (Possibly up or down)
- c. Please send servo on signal from the motion controller.
- d. Press on next and Fig. 16 Motor Wiring Setup page will appear. Press on Start to activate, and driver will start sending current to motor coil. (Motor will start to move back and forth slowly.) If successful, "Motor Wiring has been configured" will appear on the message box.

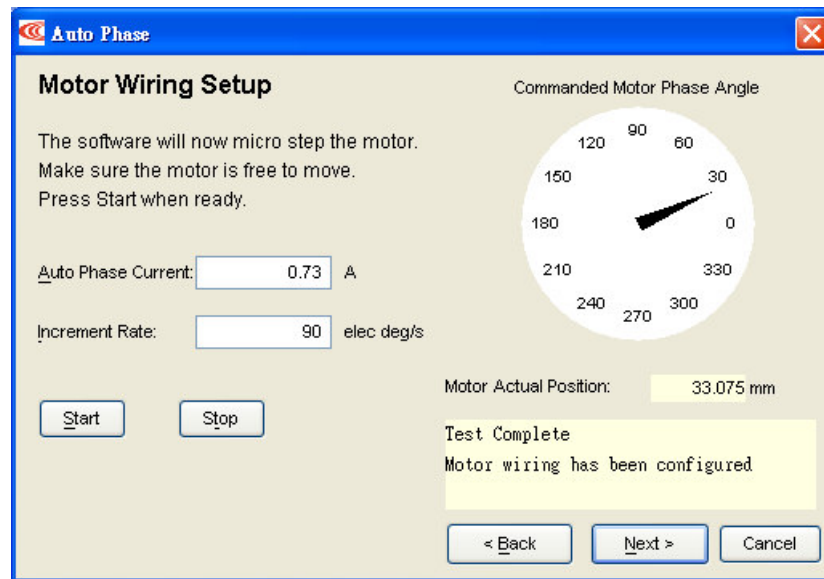


Fig. 16 Motor Wiring Setup

- e. Press next and Fig. 17 Motor Phase Initialize page will appear.

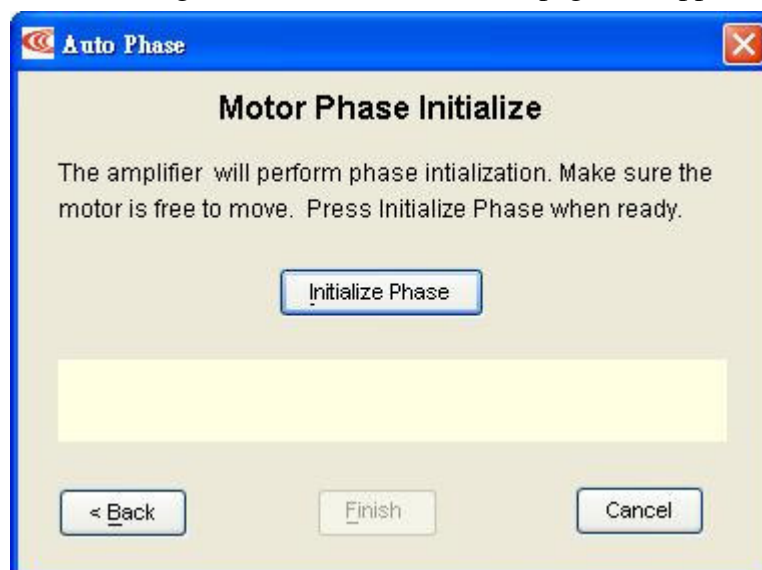


Fig. 17 Motor Phase Initialize

- f. Press on Initialize Phase, the motor will perform short servo on. If successful, Fig. 18 Phase has been Initialized message will appear.

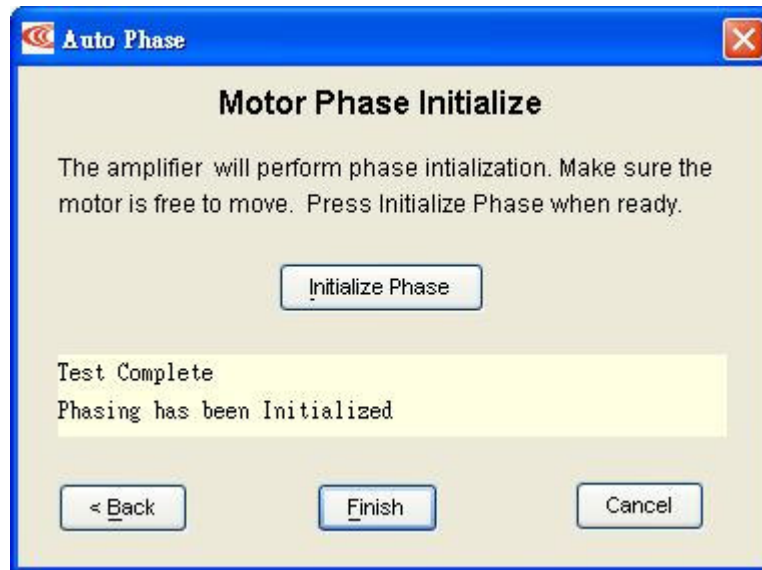


Fig. 18 Phase has been Initialized

- g. Press Finish to complete process, then save to flash memory.


This step has only to be performed for once every time after mechanical 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.

#### 14. Procedure for First Time Auto Phase (With Hall Sensor)

If auto phase procedure has been completed, please skip this section.

**Caution:** Enabling the control in the lower left corner of the Control Panel page without properly configuring through auto phase procedure will cause the motor to jump start.

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

Then turn on the driver's AC power , Press on , and Fig. 19 will appear.

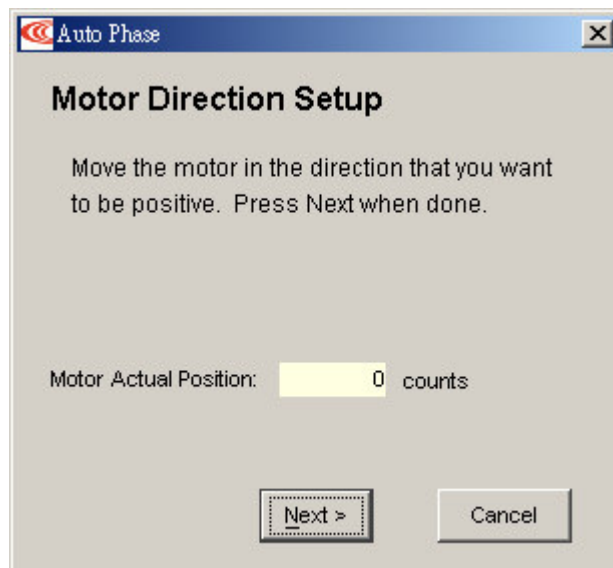


Fig. 19 Motor Direction Setup

- b. Manually push the motor to the positive direction defined by the user, and the actual position readout will change. (Possibly up or down)
- c. Please send servo on signal from the motion controller.
- d. Press on next and Fig. 16 Motor Wiring Setup page will appear. Press on Start to activate, and driver will start sending current to motor coil. (Motor will start to move back and forth slowly.) If successful, "Motor Wiring has been configured" will appear on the message box.

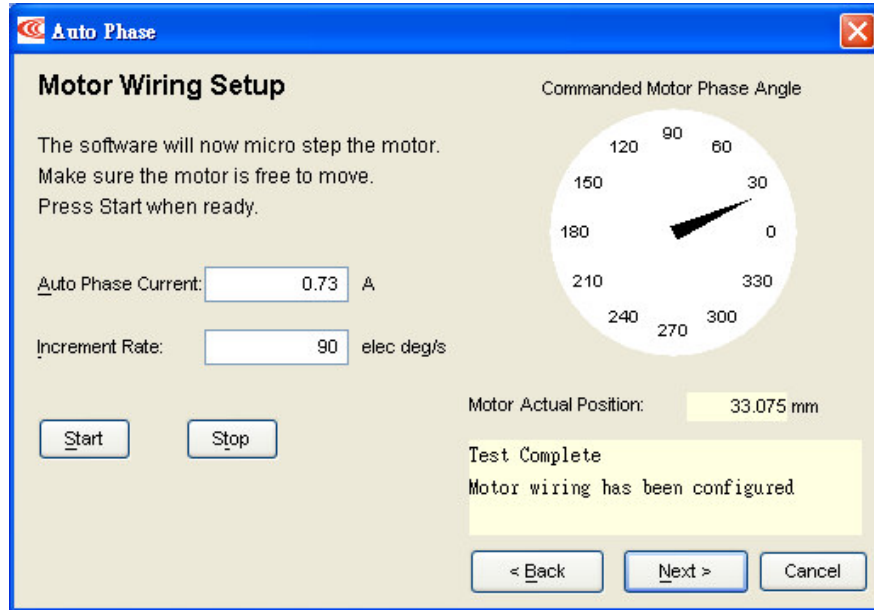


Fig. 20 Motor Wiring Setup

- e. Press on next and Fig. 21 will appear. Then press start to activate, the driver will start sending current to motor coils, and move one pole pair pitch in negative direction. Make sure the moved distance is 32mm. If successful, the lower right corner message box will display message shown in Fig. 22. (This procedure can be skipped by pressing on Skip button.)

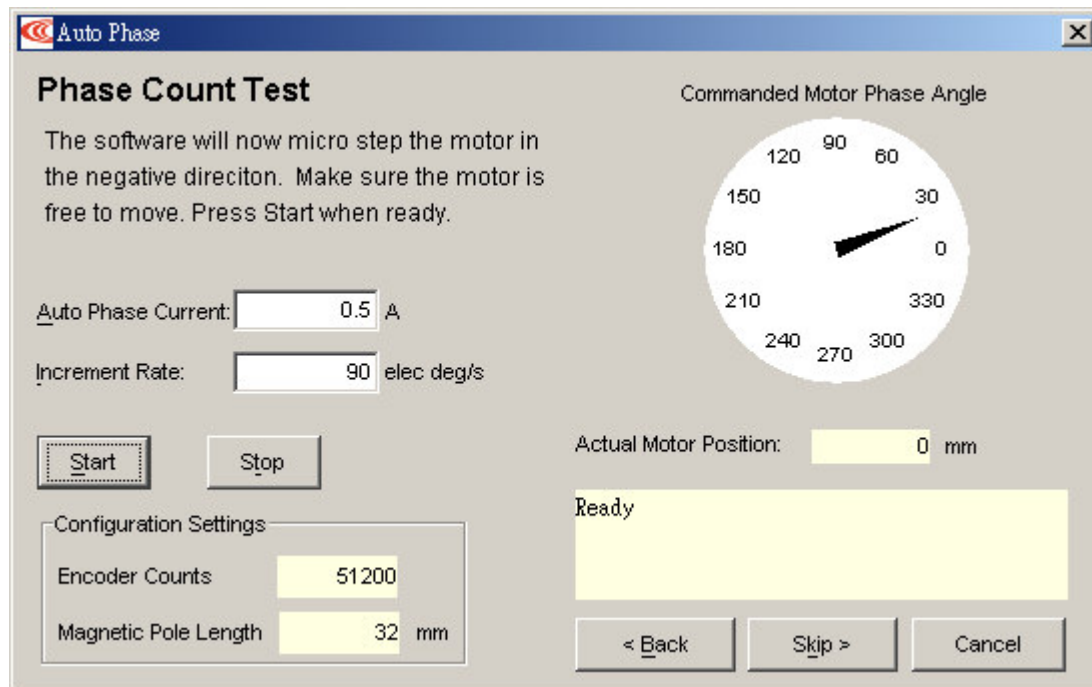


Fig. 21 Phase Count Test

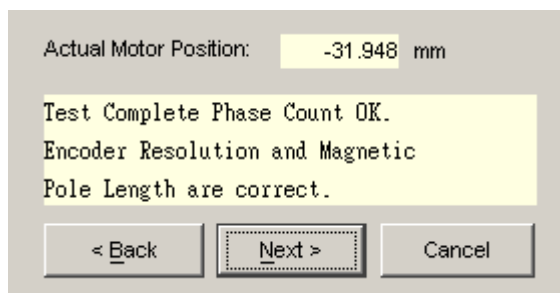


Fig. 22 Phase Count Test Successful Page

- f. Press on Skip or Next and Fig. 23 will appear. Then press on start to activate, and the driver will start collecting information from digital hall sensor for servo on procedure.

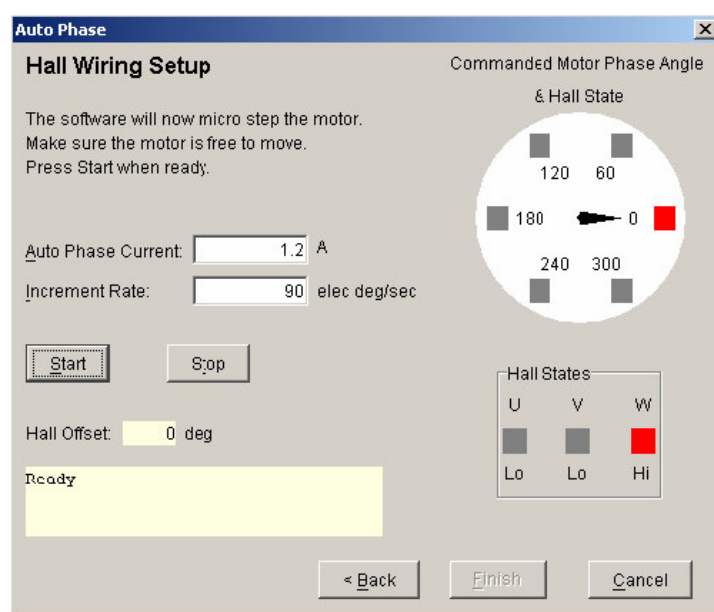


Fig. 23 Hall Wiring Setup

- g. If successful, press on Finish and save settings to flash memory.
- h. Depending on user usage, proceed with the following Manual Phase and configure accordingly. In Fig. 4 Main Interface page, select Tools→Manual Phase, and Fig. 24 will appear.

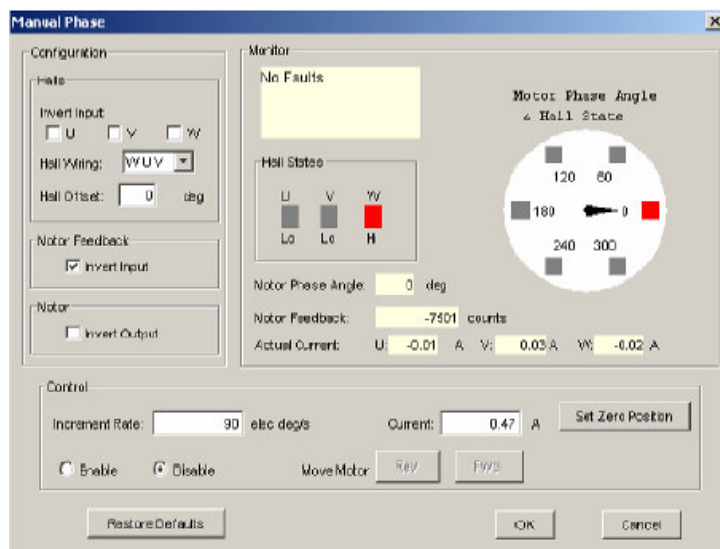


Fig. 24 Manual Phase

- i. Press on Enable to servo on the motor via open-circuit control, shown in Fig. 25. Please note that under open-circuit control, fixed current will continuously run through the motor, which causes the motor to heat up.

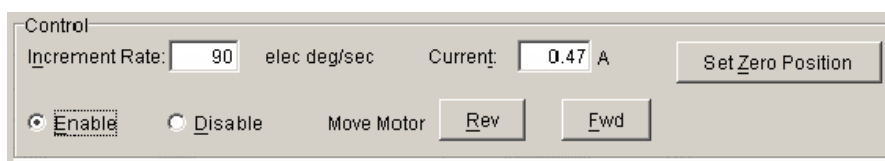


Fig. 25 servo on driver setting

- j. Press on Rev or Fwd to operate the motor under open-circuit control. If the motor does not move as set by increment rate, please try to decrease the Increment Rate or increase Current value. If motor load is light, please refer to the following settings:

| Motor Type | Increment Rate (deg/sec) | Current (A) |
|------------|--------------------------|-------------|
| LMS        | 15                       | 2           |
| LMC        | 15                       | 1.5         |

But when load is relatively higher, please try to increase the current to achieve desired motion. (Do not exceed maximum continuous current value for the motor.)

- k. By using the Rev, Fwd button, verify that the red indicator rotates in same direction as the motor phase angle, and that the transition occurs when the needle is between indicators ( $\pm 30$  degrees)
- (1) The transition of the red indicator rotates occurs when the needle is between indicators ( $\pm 30$  degrees, show in fig 26 ),
  - (2) If none of the six hall sensors indicates red, then the hall sensor signal is

abnormal.

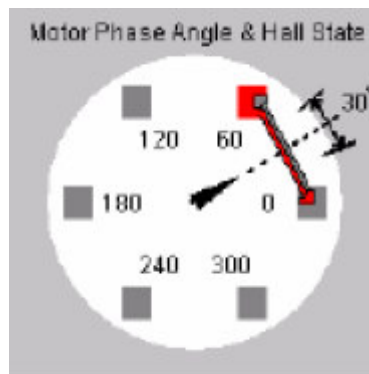


Fig. 26 motor phase angle and Hall state

1. If the red indicator change leads or lags the mid point more than  $30^\circ$ , then adjust the Hall offset value in Fig. 24 Configuration page (Detail shown in Fig. 27). Adjust until the red indicator change occurs at the mid point. (Please note, for LMS and LMT, the offset value is different in positive and negative direction. Please enter the average offset of the two directions.) Do not enter Hall offset more over  $\pm 30^\circ$ .



Fig. 27 Hall Offset

- m. Press OK to complete the initialization and store settings to flash memory.

This step has only to be performed for once every time after mechanical 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.



**15. Procedure for First Time Auto Phase for Gantry**

This procedure is for parallel drive motors on a gantry with two axes coupled together mechanically. For other types of gantry structures (i.e. Single drive motor or Non-Coupling machine), please follow procedures listed in section 13 or 14 to perform auto phase procedure at first time.

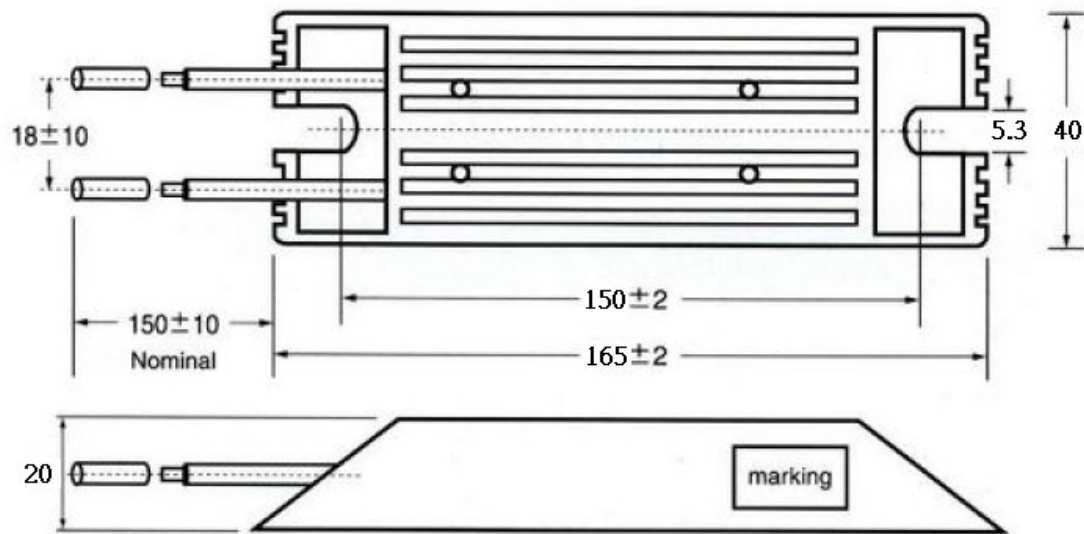
- a. This particular application of gantry utilizes digital Hall sensor. Please perform auto phase procedure for the 1<sup>st</sup> axis according to section 14 without connecting the power for the 2<sup>nd</sup> axis's driver.
- b. Perform auto phase procedure according to section 14 for the 2<sup>nd</sup> axis, while unplugging the power for the 1<sup>st</sup> axis' driver.

This step has only to be performed for once every time after mechanical 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.

After these, you can send enable signals to both axes, so that they become servo on.

**Appendix A. Regen Resistor Specification****A.1 Specification**

| model        | Resistance | Cont. Power | Inst. Power (5sec max) | Driver Model           |
|--------------|------------|-------------|------------------------|------------------------|
| 050100700001 | 68 ohms    | 100W        | 500W                   | XSL-230-xx<br>800-15xx |

**A.2 Dimension**

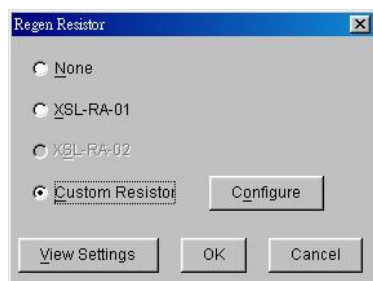
unit:mm

## Appendix B. Configuring a Custom Regen Resistor

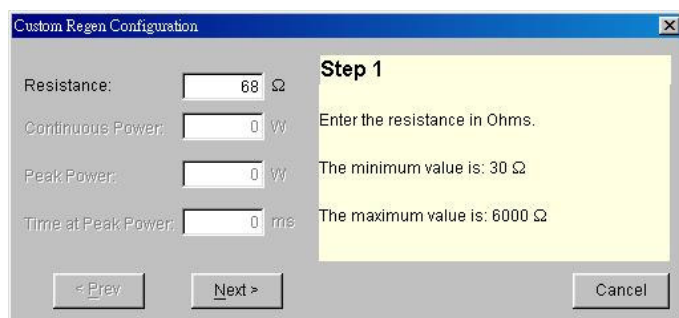
### Regen Configuration Instruction

1. On the *Main* screen, click **Configure Regen** () to open the *Regen*

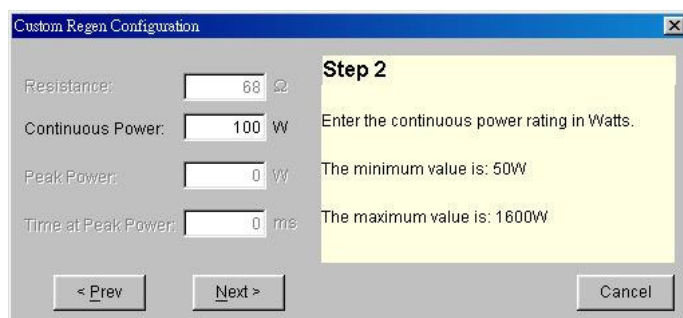
*Resistor* screen



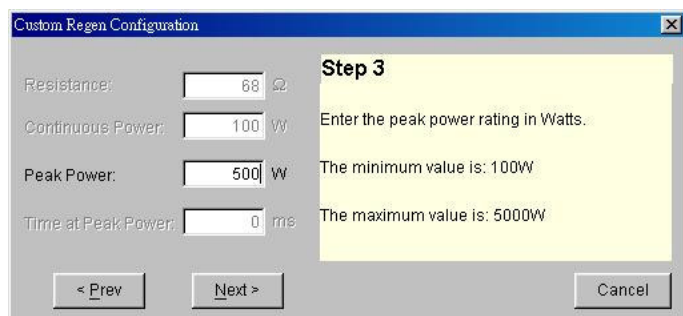
2. Select *Custom Resistor* and then click **Configure** to open the *Custom Regen Configuration* screen



3. Enter the **Resistance**, one like that in appendix A is 68 ohm, if three resistors connected in series, the value is 204 ohm. Click **Next** for Step 2



4. Enter the **Continuous Power**, one like that in appendix A is 100 W, if three resistors connected in series, the value is 300 W. Click **Next** for Step 3



5. Enter the **Peak Power**, one like that in appendix A is 500 W, if three resistors connected in series, the value is 1500 W. Click **Next** for Step 4

The screenshot shows the 'Custom Regen Configuration' dialog box at Step 4. On the left, there are four input fields: 'Resistance:' with a value of 68  $\Omega$ , 'Continuous Power:' with a value of 100 W, 'Peak Power:' with a value of 500 W, and 'Time at Peak Power:' with a value of 5000 ms. On the right, a yellow box contains the text 'Step 4' and instructions: 'Enter the peak power duration in milliseconds. The minimum value is: 50 mS. The maximum value is: 5000 mS'. At the bottom, there are three buttons: '< Prev', 'Next >', and 'Cancel'.

6. Enter the **Time at Continuous Power**, the value like that in appendix A is 5000 ms

The screenshot shows the 'Custom Regen Configuration' dialog box at Step 5. The input fields on the left remain the same: 'Resistance:' (68  $\Omega$ ), 'Continuous Power:' (100 W), 'Peak Power:' (500 W), and 'Time at Peak Power:' (5000 ms). The yellow box on the right now contains the text 'Step 5' and instructions: 'Custom regen configuration is complete! Press Finish to accept the values entered and save them to the amplifier's RAM and flash. To change any of the values press Prev'. At the bottom, the buttons are '< Prev', 'Finish', and 'Cancel'.

7. Click **Finish**, then it is completed