

Platinum DDL/SERVOSTAR Setup and Installation Guide

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Overview

Scope

The scope of this Application Note is to provide a guideline and procedures for installing the Kollmorgen DDL Ironcore and Ironless Linear motors, and integrating them with the SERVOSTAR motor driver. This Application Note also contains spaces to record pertinent information about the stage installation. This data should be maintained in a log about the machine for future reference as necessary. Additionally, troubleshooting procedures are provided to assist with any problems that may have occurred during installation. These procedures assume that all other devices pertinent to system operation have been installed and are operating properly.

Ironcore Linear Motor

The Ironcore Linear Motor is best suited for applications requiring high acceleration of large masses, or maintaining stiffness during machining or process forces. Due to the steel laminations incorporated into the coil assembly, this type of motor exhibits high magnetic attractive forces, ranging from over 300 pounds up to many tons. Special attention must be paid to this attractive force when designing stages for this type of motor.

Ironless Linear Motor

The ironless linear motor provides features for applications that require very high positional accuracy or precise constant velocity movement. The motor offers the advantages of light mass, zero cogging force, and absolutely no magnetic attraction.

ServoSTAR

The SERVOSTAR tuning section provides detailed procedures for tuning and setting up the SERVOSTAR Digital Amplifier. This Application Note also contains spaces to record pertinent information about the SERVOSTAR installation within a stage installation. This data should be maintained in a log about the machine for future reference as necessary.

Site Preparation

Unpacking & Handling the Equipment

- ! **CAUTION:** Electronic components in this amplifier are design hardened to reduce static sensitivity. However, proper procedures should be used when handling.
1. If the packaging was damaged upon delivery contact the shipping carrier prior to removing the components from the container.

2. Check the shipping invoice against the purchase order to make sure that all the ordered components have been sent by the factory. If a discrepancy exists contact the factory immediately.
3. Remove all packing material and equipment from the shipping container. Care must be exercised when unpacking the components to make sure that the smaller components are not accidentally discarded. Do not dispose of the packing material until all of the components in the packing list have been accounted for and verified.

ServoSTAR Power Requirements

Power/Current	Model PA08	Model PA28	Model PA50	Model PA75
Voltage (Vac) (line to line)	115 to 230	208 to 230	208 to 230	208 to 230
1 Phase / 3 Phase	1/3	1/3	3	3
Frequency +15 -5%	50/60			

Know Your Installation Site

Installation Questions

The installation procedures in this Application Note will ask specific questions about the installation. These questions will cover the various types of installations that can be accomplished for the SERVOSTAR and MotionLink Software. This section provides questions and hints that a technician will need to know about their installation prior to beginning.

Positioner Type Questions

Regardless of what positioner is used it must be configured to operate with the SERVOSTAR software. Therefore the following questions should be answered before installing the SERVOSTAR. It would be a good idea to write this information down as the questions are answered.

1. Is the positioner command output single ended? Is the enable line from the positioner to C3, pin 8 an active low to enable the drive?
2. Does the positioner's enable signal have an open collector output?

MotionLink Configuration Questions

As the technician is installing and configuring the SERVOSTAR a number of questions must be answered so that the installation can progress efficiently. These questions concern the configuration of the stage and types of devices that are installed to complete the system. It would be a good idea to write this information down as the questions are answered.

1. Linear motor type and model number?

2. Encoder type and resolution (lines per millimeter)? External or internal logic multipliers? _____
3. Is there a hall effect module? _____
4. Do we have 1 index pulse, or do we have multiple index pulses, or no index pulse on the scale? _____
5. Is there a thermistor in the motor? _____
6. Are there limit switches? _____
7. Is AC input power 110 or 220 volts? _____

Ironcore Linear Motor Installation

Before You Begin

Equipment Condition

1. All power to the stage and controlling device has been removed.
2. Additional personnel and suitable lifting device are available if needed.

Magnet Plate and Coil Assembly Mounting

Mounting and Design Considerations

The magnet way assembly(s) are bolted to the base plate portion of the stage. The coil assembly and the encoder reader head are mounted to the slide component of the stage. The stages' clearance, or cavity, for the linear motor components must be designed to provide adequate clearance for the motors' maximum outline dimensions. Shimming between the coil and the slide mounting surface should be a standard procedure to achieve the prescribed gap between the coil and magnet way.

- The mounting surface for the magnet way should be flat relative to the slide travel within 0.005 inch.
- To install the magnet way properly, it is recommended that the stage base includes precision 5mm dowel pins, see figures 1 and 2.
- If multiple magnet ways are designed into the stage, locating dowel pins should be installed to position and align each magnet way assembly, see figures 1 and 2.

CAUTION: Due to the high magnetic attractive forces of the magnet way, extreme care should be exercised during handling and installation.

HELPFUL HINT: The high magnetic attractive forces of the motor can cause the slide plate to deflect. These attractive forces must be considered in the stage design. This force must also be considered when selecting the linear rails and bearings for the stage. The bearings must be able to withstand the preload supplied by the motor and, for high speed applications, the maximum speed and acceleration must be factored into the bearing selection.

Installing the Motor

Overview

There are two preferred methods for installing the linear motor coil assembly and magnet plates into your system. Since PMI magnet plates are sold in standard, incremental sizes, in some instances it is possible to have a number of magnet plates installed together within one linear stage. The Multiple Magnet Plates Method describes the installation with multiple magnet plates. The Single Magnet Plate Method describes the installation procedure if you have a single magnet plate.

WARNING: Powerful magnetic fields and mechanical forces, developed by the magnet plates, can create hazards to personnel through chipping, shattering, or pinching upon impact. Whenever possible, leave the protective cardboard and steel plates on the magnets. Keep hand tools and equipment away from the magnet plate. Use extreme caution when installing the coil assembly over the magnet plate.

Multiple Magnet Plates Method (Figure 1)

1. Lightly stone and thoroughly clean the mounting surfaces on the stage for both the coil assembly and magnet plates.
2. Using M5 screws, securely mount the coil assembly to the slide. Push the slide to one end of travel to clear the 1st magnet way location.
3. Install the 1st magnet way assembly onto the 5mm locating dowel pins of the table's mounting surface. The locating pins will ensure that the magnet way is parallel to the table travel and that the critical magnet spacing between magnet way sections is met.

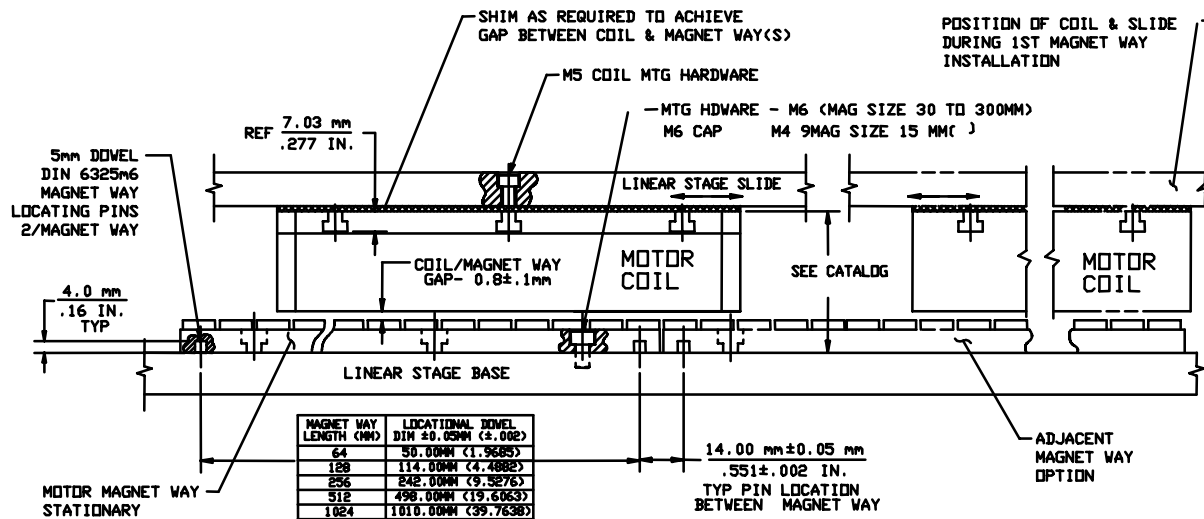
CAUTION: Due to the high magnetic attractive forces of the magnet way, extreme care should be exercised during handling and installation.

4. Carefully and slowly move the slide over the magnet plate, and using soft non-magnetic shim stock, check the airgap between the top of the magnets and the coil. Gap to be 0.031-inch $\pm$ 0.004-inch ($.8 \pm .1$ mm).

To correct the clearance gap, move the slide away from the magnet way. Remove the coil Assembly; place required shim stock (plastic material is not acceptable) between the coil mounting surface and the slide.

NOTE: If the minimum gap of .027-inch can not be achieved between the coil and magnet surface, the stage clearance for the linear motor must be increased. This can be achieved by placing shims between the bearing blocks at the base or slide contact surface.

5. Move the coil over the magnet way to recheck the airgap.
6. After the airgap is properly set, move the slide to the end of travel over the mounted magnet plate to install the remaining magnet ways.



RECOMMENDED IRON CORE INSTALLATION WITH PRECISION LOCATING PINS

Figure 1. Multiple Magnet Plate Method.

Single Magnet Plate Method (Figure 2)

WARNING: For safety reasons, it is advised that jacking plates be constructed to prepare the magnet way and coil for installation into the stage.

1. Lightly stone and thoroughly clean the stages' mounting surfaces of both the coil and magnet way.
2. Install the magnet plate onto the base of the stage.
3. Attach the jacking plate(s) to the coil assembly as shown in figure 1, using M5 screws. Extend jacking screws (4 per plate) completely through the jacking plate(s), see figure 2.

NOTE: Multiple jacking plates will be required for size 22, 33, 44, 55 and 66 coils.

4. Place 0.031-inch (.8mm) thick, soft non magnetic shim material, slightly larger than the coil surface, onto the magnet plate. Carefully place the coil assembly on top of the shim so that the coil assembly is supported over the magnets by the jacking screws resting on the magnet plate surface.

5. Slowly lower the coil assembly onto the magnets by loosening the jacking screws sequentially to keep the coil assembly parallel to the magnet plate. Remove the jacking plate(s) when the coil is lowered fully.
6. Move the slide over the coil assembly. Use brass or stainless steel shims to establish the total shim thickness required between the coil mounting surface and the mating Slide (bottom) surface.
7. Mount the coil assembly, including the selected shim, to the Slide using M5 screws. Tighten screws sequentially to seat the coil assembly properly.
8. Remove the plastic shim from the magnet plate.

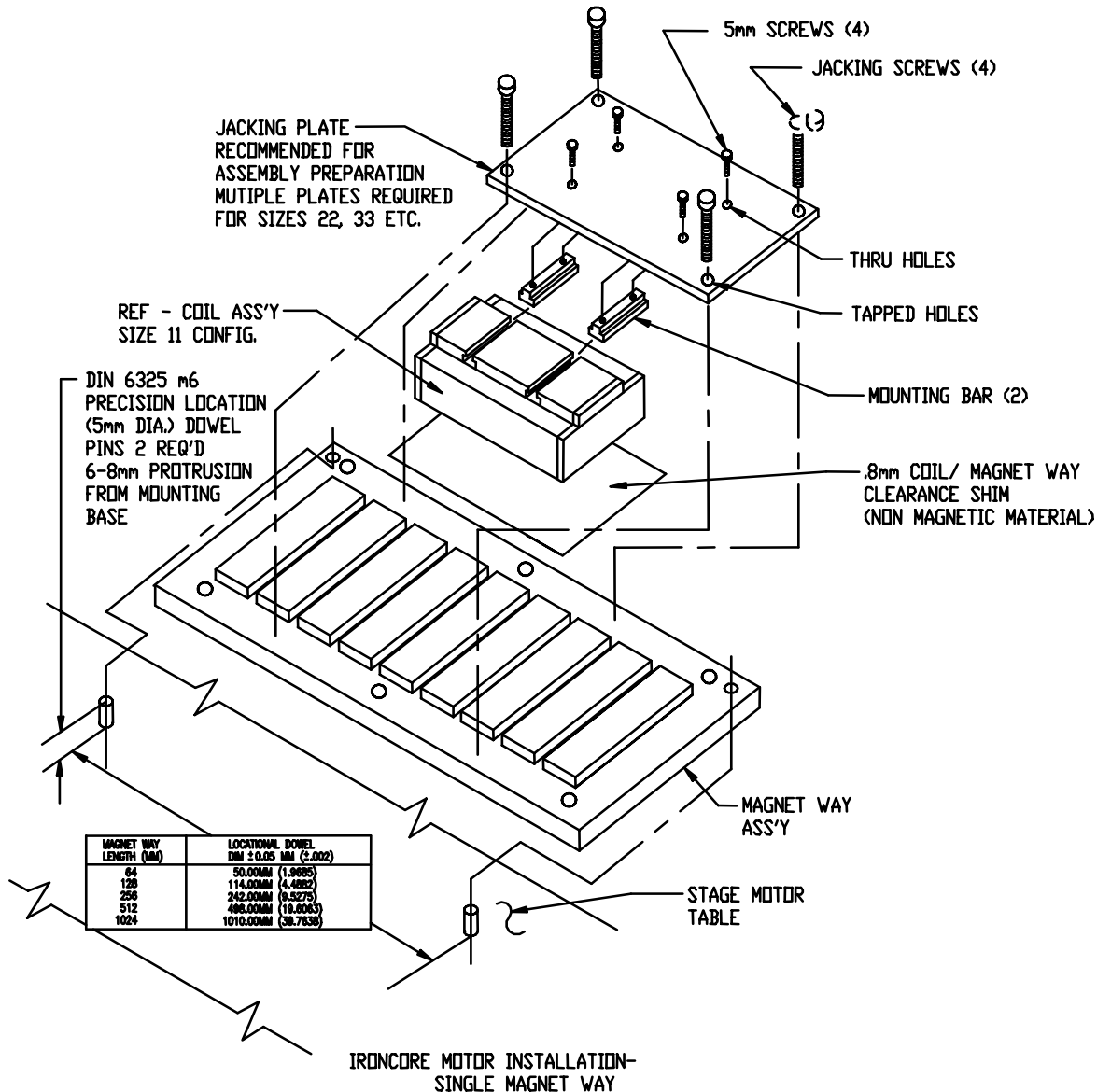


Figure 2. Single Magnet Plate Method.

Phase and EMF Definitions

All PMI Platinum DDL brushless motors are wired to the same convention. Phase AB leads phase BC by 120°, with the cable exit 'leading' as shown in the motor commutation diagram, see figure 3. The term AB is defined as the back emf voltage produced by the motor as it is moving, when connecting the probe of an oscilloscope to motor phase A, and the probe return to motor phase B. You can observe the back emf voltage of the motor with a two channel storage oscilloscope.

EMF Voltage

1. Connect the channel 1 probe to motor phase A (red wire), reference to phase B (white wire). Connect the channel 2 probe to motor phase C (black wire), reference to phase B (white wire).
2. Ground the inputs to both channels and adjust the offset so that both channels are separated by 1 division. Set both inputs to DC. Set both channels of the scope to 2 volts/division. Invert the channel 2 input, and select chop.
3. Push the stage back and forth and adjust the horizontal sweep time to obtain a suitable waveform (approximately 100 msec/div).
4. Push the stage so that the motor cable exit is leading, as shown in the motor commutation diagram, and store the image on the scope.

You will see two sinusoidal waveforms on the scope. These waveforms represent the back emf voltage of motor phases AB and BC. From this you can observe that phase AB (channel 1) leads phase BC (channel 2) by 120°. This agrees with the waveforms illustrated in the motor commutation diagram. By monitoring the hall effect signals, you can also find a pair of motor phases that is aligned with each individual hall effect.

Ironcore Motor Commutation

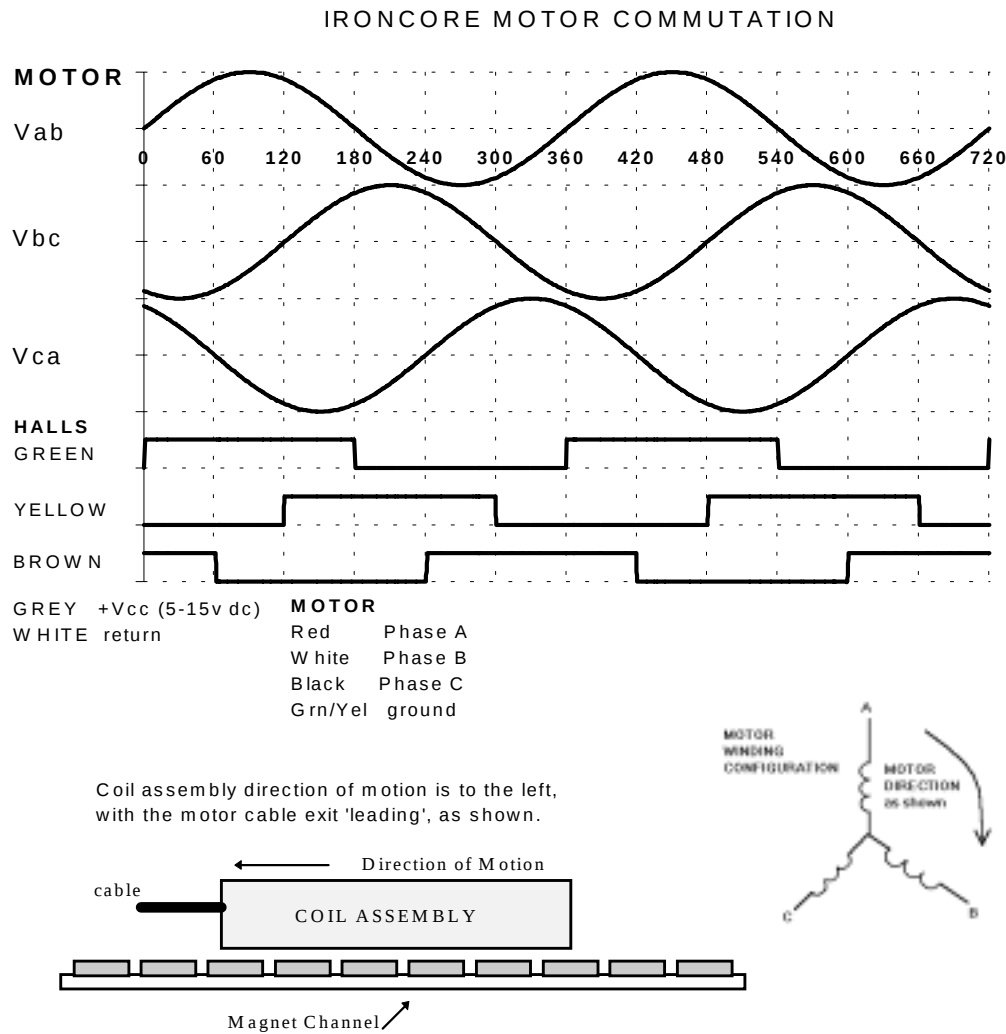


Figure 3. Ironcore Commutation Diagram

Ironless Motor Installation

Before You Begin

Equipment Condition

1. All power to the stage and controlling device has been removed.
2. Additional personnel and suitable lifting device are available if needed.

Magnet Way and Coil Assembly Mounting

Mounting Considerations

CAUTION: The relationship of the moving coil relative to the stationary magnet way is critical. The magnet way mounting surface should be parallel within .005-inch TIR with respect to the coil/slide travel. Regardless of the motor mounting configuration, bottom mount or side mount, the required set up gap of .020-inch is required, between the coil surface and the magnet face surface. See figures 4 and 5.

- Precision 5 mm dowel pins, in the stage base, are recommended to position the magnet way(s) accurately. Two dowels are required for each magnet way.

NOTE: Typically, the coil assembly and the encoder reader head are mounted to the same plate. It is good practice to provide a means to independently align both the reader head and the coil assembly.

HELPFUL HINT: The reader head needs to be critically adjusted for height, rotation, and perpendicularity. If the coil is installed from the top (opposite from the coils), the coil mounting holes should be slotted to allow for setting up the required airgap between the coil and inside the magnet way.

If the coil is side mounted, place metal shims between the coil and mounting surface to adjust the coil position and to set up the prescribed airgap between the coil and the magnet surface in the magnet way.

The setup gap should be done on the reference side of the magnet way. The reference side is the side that is contacting the stage mounting surface.

Installing the Motor

Procedure

1. Lightly stone and thoroughly clean the mounting surfaces on the stage for both the coil assembly and magnet channel.
2. Check the parallelism of the magnet way mounting surface to the coil/slide travel. The TIR of the surface must be within 0.005-inch to provide working clearance between the magnet way and the coil.

NOTE: It is not necessary to consider the magnetic polarity in the linear stage with multiple magnet ways. magnetic orientation is not required.

4. Install the magnet ways using two 5mm locational dowels (recommended), see figures 4 and 5. Two pins required per magnet way. For Pin location dimensions see the magnet way outline drawing. Pin location between magnet ways is $1.811 \pm .002$ -inch for all magnet way lengths.

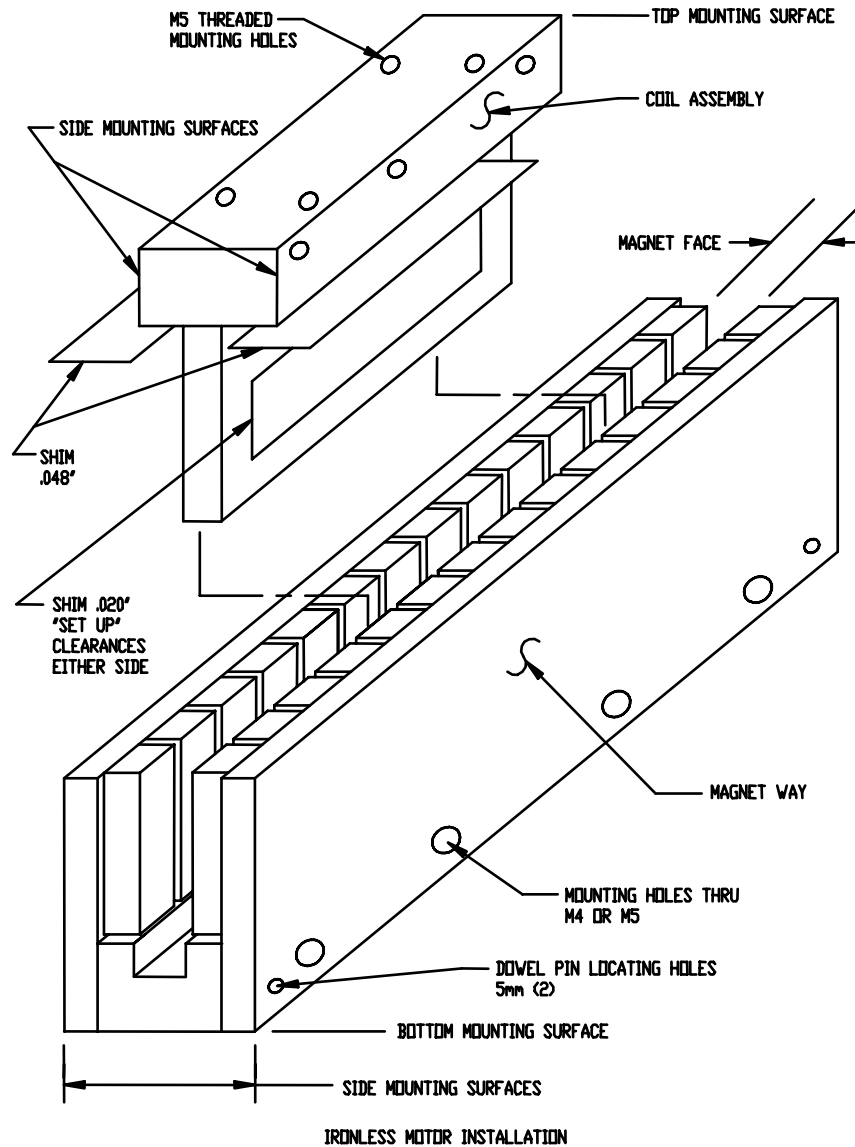


Figure 4. Ironless Motor Installation.

5. The airgap setup clearances between the side surface of the coil and either magnet surface of the magnet way is $.020 \pm .002$ -inch.

The setup clearance dimension between the top of the magnet way and the coil is $.048 \pm .002$ -inch, see figure 4.

6. After installation of the coil and the magnet way(s), slowly move the slide/coil through the magnet way(s) to examine the clearances. Re-shim or re-position the coil if necessary.

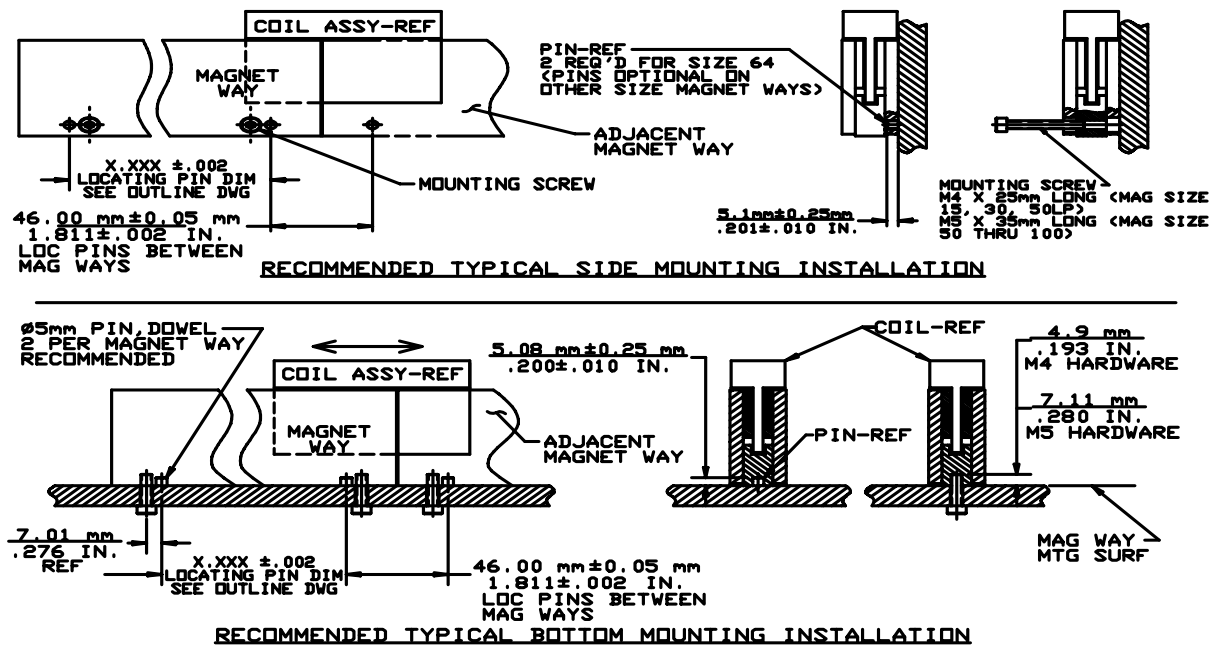


Figure 5. Recommended Installation.

Phase and EMF Definitions

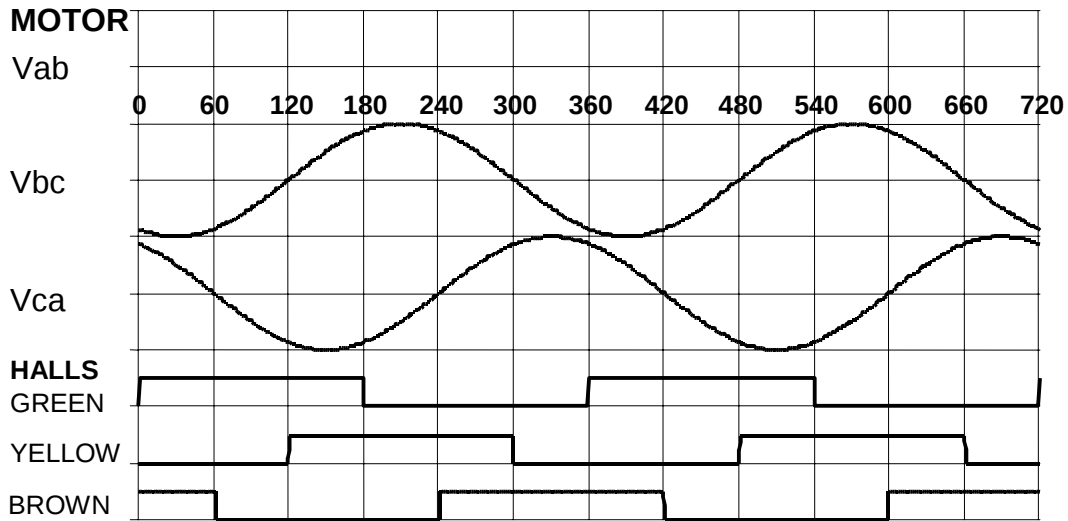
All PMI Platinum DDL brushless motors are wired to the same convention. Phase AB leads phase BC by 120°, with the cable exit leading as shown in the motor commutation diagram, see figure 6. The term AB is defined as the back emf voltage produced by the motor as it is moving, when connecting the probe of an oscilloscope to motor phase A, and the probe return to motor phase B. You can observe the back emf voltage of the motor with a two channel storage oscilloscope.

EMF Voltage

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You will see two sinusoidal waveforms on the scope. These waveforms represent the back emf voltage of motor phases AB and BC. From this you can observe that phase AB (channel 1) leads phase BC (channel 2) by 120°. This agrees with the waveforms illustrated in the motor commutation diagram. By monitoring the hall effect signals, you can also find a pair of motor phases that is aligned with each individual hall effect.

IRONLESS MOTOR COMMUTATION



GREY +Vcc (5-15vdc)
WHITE return

MOTOR

Red Phase A
White Phase B
Black Phase C
Grn/Yel ground

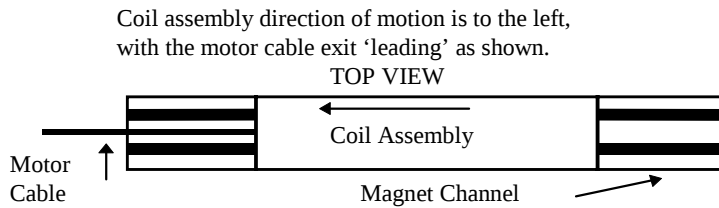
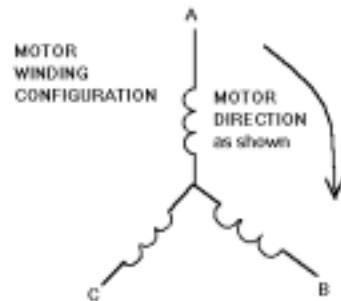


Figure 6. Commutation Diagram.

Driver Integration

Drive and Power Supply Wiring

Using the wiring diagrams and procedures contained in the SERVOSTAR Installation and Setup Manual, wire the AC input to the power supply. Wire the DC logic and bus voltage from the power supply to the drive.

Wiring the Drive

Using the wiring diagram provided in the rear of this Application Note, wire the drive to the linear motor. Using the data sheet supplied by the encoder manufacturer, wire the encoder to the drive. Additional information is provided on the connector pinout sections that follow.

Drive Enable Switch Installation

For the purpose of enabling and disabling the drive during setup and other tuning functions, it is recommended that a drive enable switch be installed in the system. This switch is a normally open single pole single throw switch. To install the switch perform the following:

1. Locate a suitable location to place the switch so that it easily accessible by the operator and will not interfere with any components associated with the stage. The switch does not have to be hard mounted to any platform and can remain free with a long wire lead as necessary.
2. Wire the switch to pins 4 (DC Common) and 8 (Remote Enable Input) of User I/O Connector C3, see figure 7.

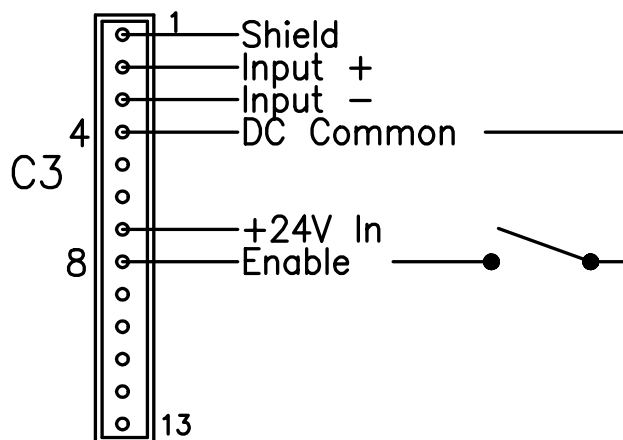


Figure 7. Enable Switch Wiring Diagram.

Load/Run MotionLink Software

Software Installation

To install the MotionLink software follow the basic steps below to get started. When the procedure is complete follow the instructions on the MotionLink screen to customize your installation for your computer.

1. Insert the SERVOSTAR MotionLink diskette into the 3.5 inch drive.
2. For Windows 3.1, go to Program Manager and select File, Run.
For Windows 95 users, click Start, Run.
3. Type the 3.5 drive letter: setup.exe and press Enter.
4. The SERVOSTAR Setup screen will be displayed. Click OK to begin the installation process.
5. Follow the instructions that appear on the screen to complete the installation.

Run Program

MotionLink can be run by clicking on the MotionLink icon or by accessing the icon within the ServoStar MotionLink program group. Software commands are located in the SERVOSTAR Installation and Setup Manual and the SERVOSTAR Quick Reference Guide.

Power Up & Tuning the Drive

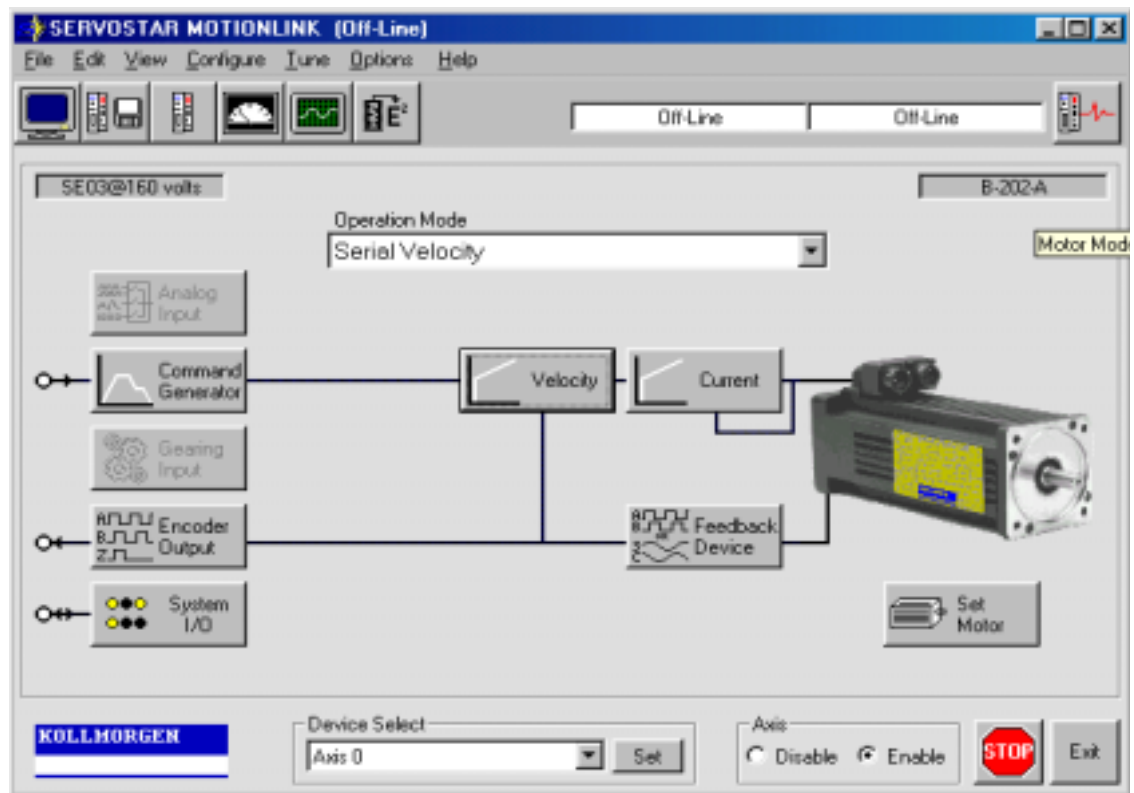
MotionLink Setup

Equipment Condition

1. The SERVOSTAR has been properly installed and set as per instructions in the SERVOSTAR Installation and Setup Manual.
2. Disconnect the motor leads from the drive.
3. Power up the SERVOSTAR drive.
4. Boot up the computer and start the MotionLink software. Click OK at the SERVOSTAR MotionLink main screen.

Verify Port Configuration

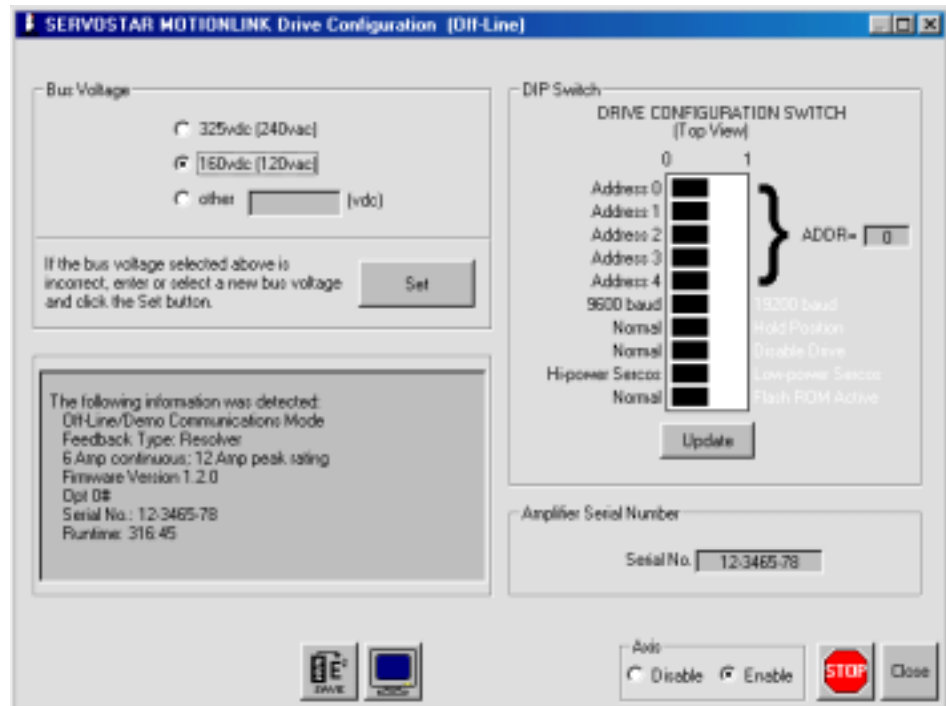
1. At the Start ServoStar MotionLink screen the default settings show that the Com Port is 1 and the Baud Rate is 9600. If these settings are correct then click on the Start button. If the settings are not correct go to step 2.
2. Click on the Com Setup button and the ServoStar MotionLink Communications Setup screen is displayed. Select the correct Com Port (Com1) and Baud Rate (9600) and click OK.
3. At the Start ServoStar MotionLink screen, click Start. At this point you will have two options from which to choose to set up MotionLink. When the Start button is clicked the New Amplifier Startup screen is displayed. You have the option of setting up the drive from this screen or click on the Exit button to the Main MotionLink screen. For the purpose of this Application Note we will be describing the MotionLink Screen.



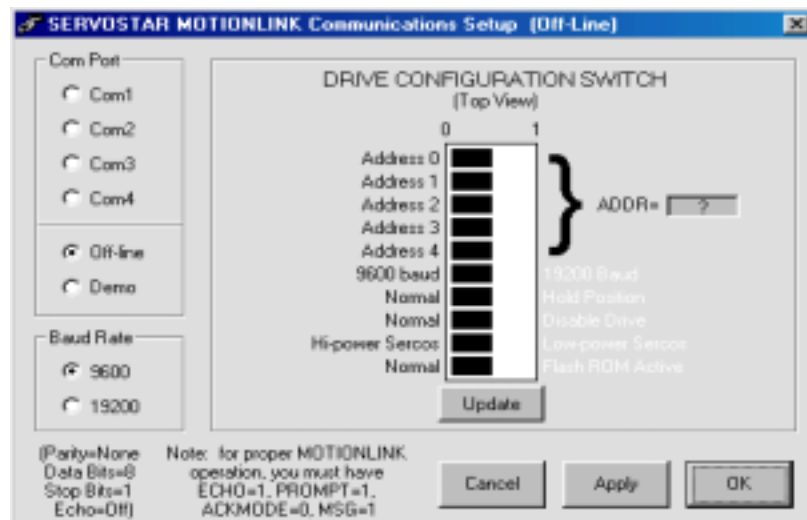
Main ServoStar MotionLink Screen

1. Click on Exit to access the main ServoStar MotionLink screen. On the bottom center of the main screen, click on the Set button in the Amplifier segment.

- At the ServoStar MotionLink Drive Configuration screen, you can set the Bus Voltage for the drive at 325vdc (240vac) or 160vdc (120vac) and click on the Set button. The screen also displays the drive information that was detected and the Serial No. Click on the Exit button and you will be returned to the ServoStar MotionLink screen.

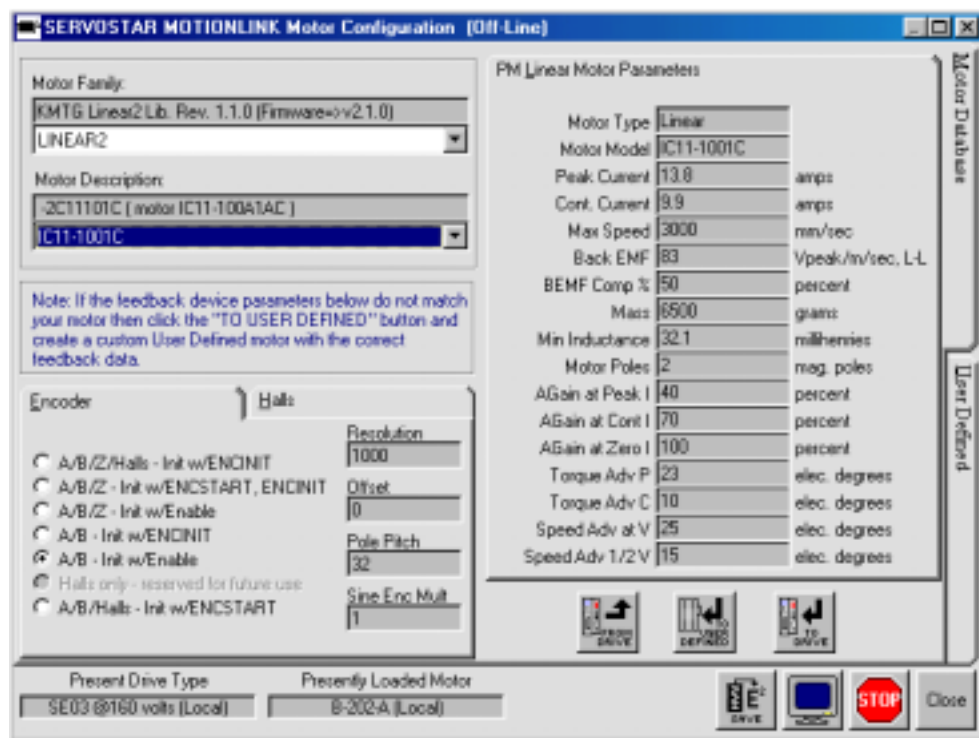


- On the Drive Select segment, along side the Amplifier segment, click Set and the ServoStar MotionLink Communications Setup window will display if the technician needs to make any changes to those parameters. If the settings are all right, click OK and you will be returned to the ServoStar MotionLink screen.



Select Motor

4. On the Motor segment, along side the Device Select segment, click Set and the ServoStar MotionLink Motor Configuration screen is displayed. In this screen you have two options. You may select a motor from one of the motors already stored in the database, or you may select the User Defined screen and enter any motor configuration you desire. For the purpose of this discussion we will use one of the motors from the list.



Set Encoder Resolution

The encoder resolution is based on the magnet pitch of the motor, times the encoder resolution, times the logic multiplier (if any). The units are Lines per Pitch. Kollmorgen DDL motors have a magnet pitch of 32mm. For example, if you have a 25 lines per millimeter scale (40 micron pitch), you would enter 800 ($25 * 32$) as your Encoder Resolution. If you have a 10X multiplier, you would enter 8000 ($25 \text{ lines/millimeter} * 10\text{X multiplier} * 32\text{mm pitch}$).

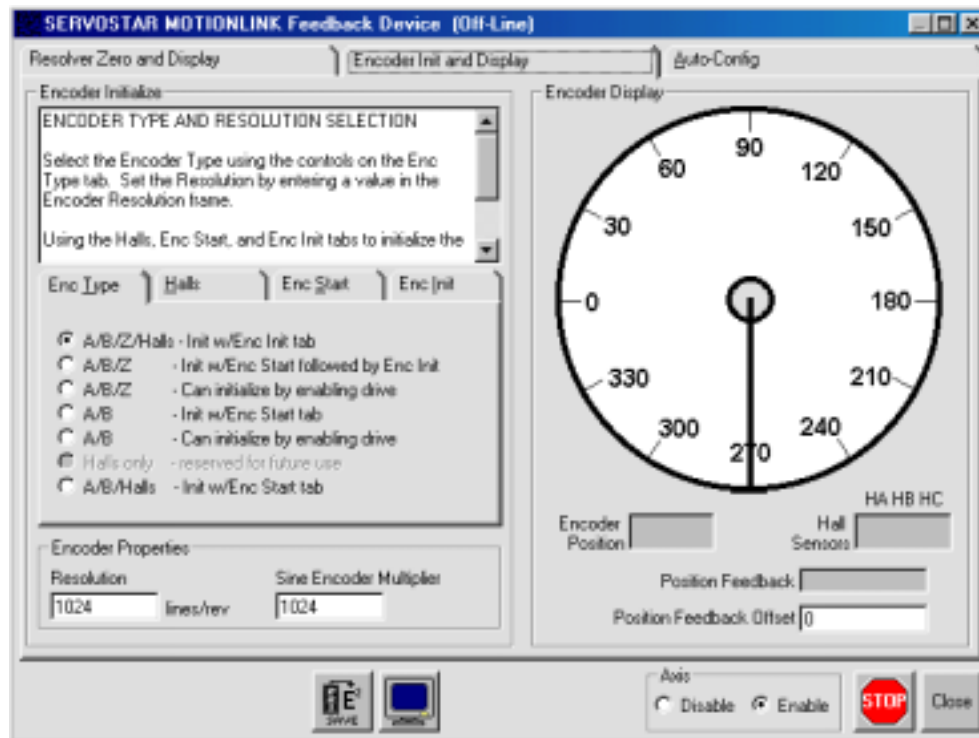
The following chart provides typical encoder resolution figures and their equivalent ServoSTAR value. These values are provided as MENCRES parameters.

Encoder Equivalent Resolution	ServoStar Resolution	Encoder Equivalent Resolution	ServoStar Resolution
μm	lines/pitch	μm	lines/pitch
(after quadrature)	MENCRES	(after quadrature)	MENCRES
50	160	0.25	32000
25	320	0.2	40000
10	800	0.1	80000
5	1600	0.08	100000
2.5	3200	0.05	160000
2	4000	0.04	200000
1	8000	0.02	400000
0.5	16000	0.01	800000
0.4	20000		

- When you have finished with the motor information, click on the “To Drive” button to upload the motor data to the amplifier.
- Click on the Save button to save parameters.
- Click Exit to return to the ServoStar MotionLink screen.

Check PRD Counter

5. At this point we have to check the PRD counter. Select the Feedback Device button and the ServoStar MotionLink Feedback Device screen is displayed. On the right side of the screen is an Encoder Display indicator. This indicator can be used to verify the PRD counter.



If you are using encoder type 0 (A/B/I/Halls), it is necessary to initialize the encoder. Click on the **Enc Init** tab and follow the initialization instructions. After completing the initialization, you can move the stage back and forth by hand to read the PRD counter.

If the stage does not have hall effects, you can initialize the drive using the drive enable switch. This switch will enable the drive and after a few seconds the drive will be initialized. Insure that the motor leads are disconnected from the drive so that no power will be applied to the motor.

With the PRD count stable, move the table back and forth and notice that the PRD Encoder Display indicator changes. Line the edge of the motor with the edge of a magnet and check the location of the indicator. Push the table with the cable lagging (following the motor) exactly two magnets. The PRD indicator should complete one revolution in the clockwise direction. If the indicator does not travel in the clockwise direction see WHAT IF condition that follows.

WHAT IF!: If the indicator travels in the counter-clockwise direction, swap pins 1 and 2 (A and A/) on the SERVOSTAR Feedback connector C2. Then repeat the procedure to verify that the counter goes in the clockwise direction.

HELPFUL HINT: If the table has a lot of travel. Line up the motor to the edge of the first magnet and count 20 magnets, or any even number. Move the stage to that magnet and stop. If there is an error on the menbres number, you will receive an accumulated error. If the number is off there will be a large offset on the PRD indicator.

Click on the Save button.

Connect Motor

CAUTION: In the next step two 2 x 4 pieces of wood need be cut and positioned between the stage and the end stops. This wood is a safety measure to insure that if the table runs away it will not gain sufficient speed to damage the end stops and the entire stage. The wood will stop the table before it gains speed.

6. Measure the distance between the table and the end stops. Allowing for 6-inches of travel on both sides, cut two 2 x 4 pieces of wood. Position the wood with one end against the end stops and the other facing the table.
7. Power down the drive and re-connect the motor, using the wiring diagram. Open the enable switch. Power up and the STATUS display on the SERVOSTAR will display a number representing the current Opmode.

NOTE: At this point, the LED display may show errors, a flashing number, or a series of error messages.

Set Stage Options

8. The following steps are conditional depending on certain information that has been determined when the MotionLink Configuration Questions have been answered. To incorporate this information, click on the Terminal Screen icon. This icon appears on all of the MotionLink screens.

- If there is a thermistor in the motor, type: `thermode 0` and press Enter.

If there is no thermistor in the motor, type: `thermode 3` and press Enter.

- If there are limit switches on the stage, type: `limdis 0` and press Enter.

If there are no limit switches on the stage, type: `limdis 1` and press Enter.

- Type `vbus` and press Enter, to verify the bus voltage setting for the system.

If there is 120 volt AC power, `vbus` should be set to 160.

If there is 220 volt AC power, `vbus` should be set to 325.

- Click on the Save button to save parameters.

Powering Up the Motor

9. Type `ilim` and press Enter. Record the number that is displayed on the screen. For testing purposes we will be entering 1/2 the value of this number into the system.

Type: `ilim <1/2 value>` and press Enter.

- Type: `opmode 0` and press Enter.

- Type: `config` and press Enter.

- Type: `en` and press Enter.

- Click on the Save button to store the parameters.

10. **For Menctype 4**, close the Drive Enable Switch and the table will move slightly and stop. The drive is now initialized, which means that the commutation parameters have been calculated. Type J10 and press Enter and allow the table to move more than 2 magnets. If the table moves smoothly, this confirms that the stage has gone through an electrical cycle. Type K and press Enter to disable the drive. Type save and press Enter.
11. **For Menctype 0**, at the terminal screen, type encinit and press Enter. Remove the 2 x 4s and push the table throughout its travel making sure that you go over the index pulse. Position the table in the center of the stage and put back the 2 x 4s. Turn the Drive Enable Switch on and table should hold its position, if it does not see the Troubleshooting section of this Application Note. If the table is OK, type J10 and press Enter and allow the table to move more than two magnets. If the table moves smoothly, type K and press Enter to disable the drive. Type save and press Enter.

HELPFUL HINT: You can use the parameter encinitst (encoder init status) to determine what is happening in the encoder.
12. **For both Menctype 0 and 4**, remove the 2 x 4s and jog the stage forward and backward at 50, 100 and 500 (J50, J-50, J100, J-100, J500, J-500). Type K and press Enter to disable the drive when completed and reset the ILIM parameter to its maximum recorded value, determined in step 8. Type save and press Enter.

Guide to Integrating the Positioner

HELPFUL HINT: The positioner must be set up to work with the SERVOSTAR in order for both devices to operate effectively.

1. Connect the encoder, control signal, command signal, and the enable line using the wiring diagrams. The encoder signals for the positioner are available on the SERVOSTAR's C4 connector.
2. If the command signal from the positioner is single ended, connect the return to C3, pin 3, and install a jumper from C3, pin 3, to C3, pin 4.
3. The enable from the positioner must go to pin 8 on connector C3 and must be active low (a low enables the drive).
4. It is preferred that the enable signal from the positioner be an open collector output.
5. Click on the Terminal Screen icon and type K to kill any existing motion command. Then type opmode 3 and press Enter. Save the parameter. This puts the amplifier in the current mode.
6. With the drive disabled, boot up the positioner software and establish communication with the positioner (see appropriate positioner documentation). Verify that the encoder is counting in the plus (+) or minus (-) direction. The encoder count direction is important because it has to be phased with the command signal to the drive. Limit the current on the positioner to 10% of maximum. Set the error limit to 1-inch and put the 2 x 4s back on the stage.
7. Enable the positioner and verify that the table holds position. Manually move the table and see if the stage holds position. If the positioner is phased properly it should hold position, go to step 8. If the slide runs away and strikes the 2 x 4s, it is not phased properly. Disable the drive and swap A and A/ (pins 1 and 2) on the C4 Encoder connector.
8. It is recommended that the 2 x 4s remain in place while fine tuning the positioner until you are confident that the tuning parameters created a stable condition for the stage. Set the current limit parameter to maximum, and use the positioner tuning parameters to fine tune the positioner to the stage. Remove the 2 x 4s.

9. Write a program that will run the slide back and forth between two points, at a slow speed and acceleration, with a one second dwell between moves.
10. Slowly increase the speed and acceleration parameters while fine tuning the positioner's parameters. When all of the positioner's parameters have been optimized, proceed to step 11.

Setting ServoSTAR Velocity and Torque Angle Advance

11. The torque and velocity advance parameters in the SERVOSTAR must be optimized in order to complete the fine tuning of the stage. When the advance is optimized the efficiency of the motor's use of the current is increased. Using the MotionLink terminal screen, set the following parameters to 0: **mtanglp**, **mtanglc**, **mvanglh**, and **mvanglf**. Details of the software commands are located in the SERVOSTAR Quick Reference Guide.

To optimize the torque angle advance (**mtanglp**) perform the following:

- a) With the loop program still running, raise the **mtanglp** parameter and monitor the command signal coming from the positioner to the SERVOSTAR either with an oscilloscope or through the positioner software package.
 - b) Keep increasing the **mtanglp** parameter until the level of the command signal is at it's *lowest* value (typical values range from 0 to 30).
 - c) When the command signal is at the minimum voltage that can be achieved, then set **mtanglc** for ½ of the value of **mtanglp**.
12. Repeat step 11 for **mvanglf**. This will optimize the value for the velocity angle advance. Keep increasing the **mvanglf** parameter until the level of the command signal is at it's *lowest* value (typical values range from 0 to 30). When the command signal is at the minimum voltage that can be achieved, then set **mvanglh** for ½ of the value of **mvanglf**.
 13. Type SAVE and enter to save the parameters in the drive.

Troubleshooting

Troubleshooting Table

Symptom	Probable Cause	Corrective Action
Drive does not enable	- Thermistor parameter incorrect. - Limit parameter incorrect.	Reenter the correct parameters for the system.
Table runs away (hall effect)	Check motor wiring using wiring diagram at the rear of this Application Note.	- Rewire motor correctly - Power down and restart the drive
With Encoder type 4, the table runs away, erratic (dead spots in movement)	If table was working properly, an errant problem has occurred	Power down and restart the drive. If this problem is persistent, change the value of the IENCSTART parameter.
With Encoder type 0, the table runs away, erratic (dead spots in movement)	Verify that there is one index pulse. Using an oscilloscope, check pulse polarity on connector C2. Pin 15 should be normally low and go high when it crosses over the index pulse. Pin 16 should be normally high and go low when it crosses over the index pulse. Check commutation by using the Motor and Hall Effect Connection Verification Test	Rewire pins 15 and 16 to reverse the polarity of the pulse. Follow corrective actions listed in the verification test procedure.

Motor and Hall Effect Connection Verification Test

Purpose

The following procedure can be used to verify the connections between the motor and hall effect. This procedure requires that an adapter be fabricated prior to performing the verification test.

Adapter and Wiring

The purpose of the adapter is to provide a useful tool which will allow you to monitor the hall effect signals during the test. The adapter will consist of one 25 pin male D connector and one 25 pin female D connector. The wiring for this connector is shown figure 8.

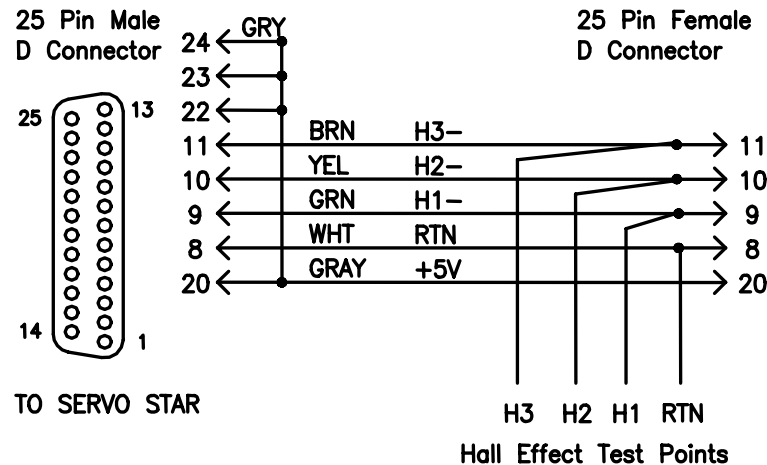


Figure 8. Adaptor Wiring Diagram.

Verification Test

1. Disconnect the motor leads from the drive. Insert this adapter between the stage wiring and the C2 connector on the SERVOSTAR.
2. Power up the motor driver.
3. Using a storage oscilloscope, connect channel 1 to pin 9 of the adapter, reference to rtn (pin 8). Connect channel 2 to pin 10, and set both channels to 2volts/div.
4. Push the stage manually at a moderate speed, and adjust the sweep time and vertical position to obtain a good image of both hall effect signals (there will be two square waves displayed on the screen).
5. Push the slide with the cable lagging (this is the positive direction), and store the waveform. Compare the phase shift between the two waveforms. The waveform on channel 2 should lag the waveform on channel 1 by 240° (see figure 7). If the lag is only 120°, swap the wires on pins 10 and 11, and check the phasing again.
6. Connect channel 2 of the scope to pin 11. Push the slide with the cable lagging, and store the waveform. Compare the phase shift between the two waveforms. The waveform on channel 2 should lag the waveform on channel 1 by 120°.
7. Connect channel 2 of the scope to any motor lead, referenced to any other motor lead. Set Channel 2 to 5v/div and leave channel 1 connected to pin 9, reference to rtn, and set to 2v/div. Push the stage in the positive direction, and compare the two waveforms.
8. Exchange the motor leads connected to channel 2 until you find that the motor back emf is 180° out of phase with the hall signal in the positive direction only (see figure 9). Label the motor lead connected to the probe as A, and the lead connected to the reference as B. Label the remaining lead C.
9. Connect channel 1 to pin 10, reference to rtn, and connect channel 2 to motor lead B, reference to lead C. Push the stage in the positive direction and observe the waveform. Verify that the back emf is 180° out of phase with the hall effect signal.

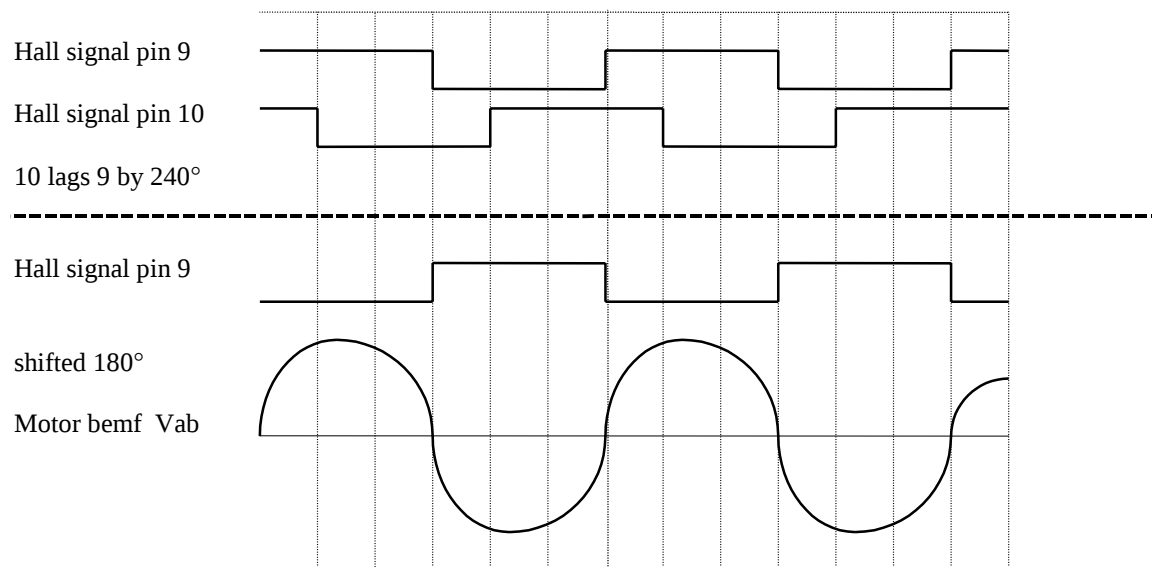
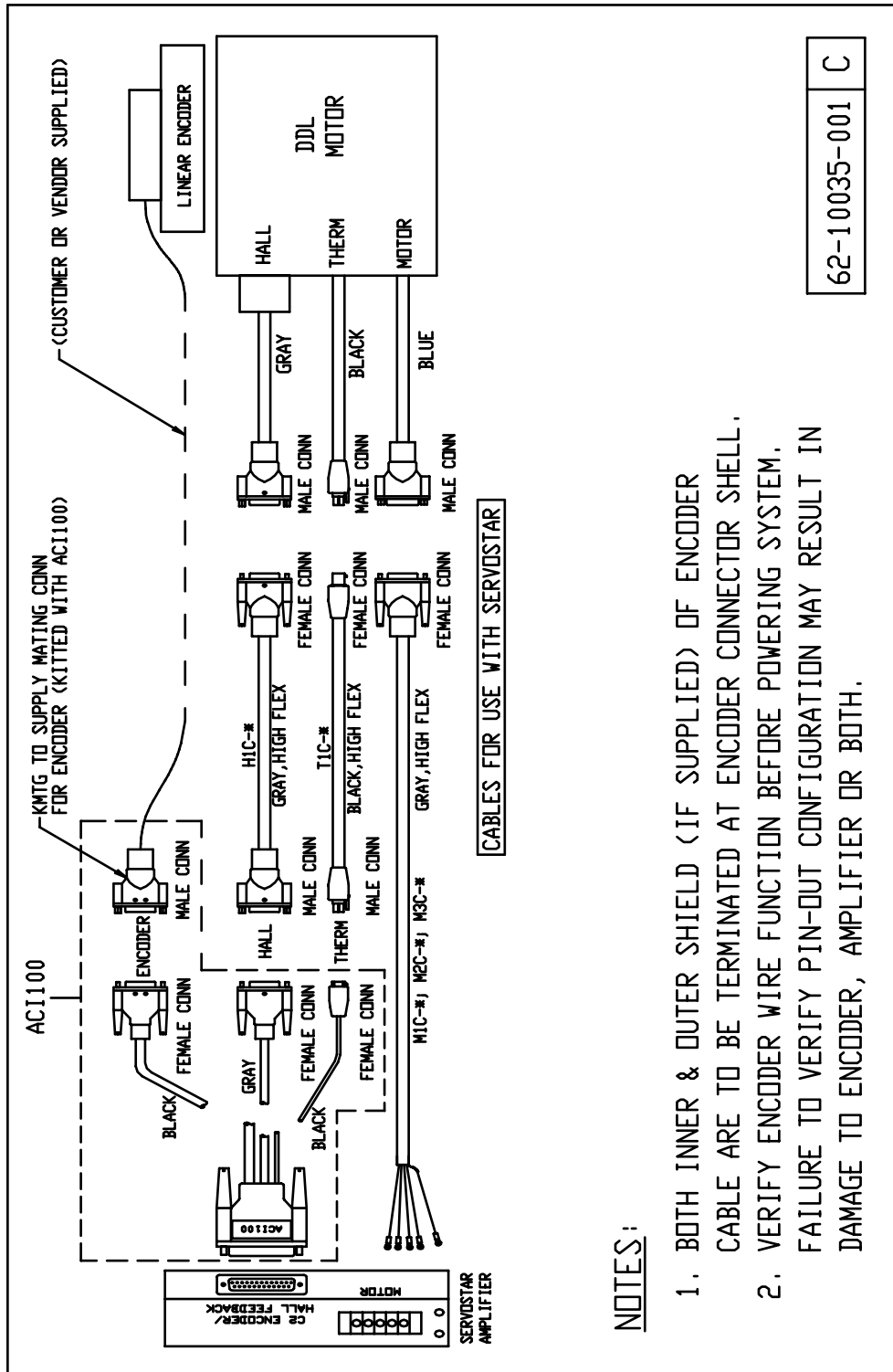


Figure 9 Hall Effect and Motor Phasing

Wiring Diagrams (Sheet 1 of 2)

Wiring Diagrams (Sheet 2 of 2)



NOTES:

1. BOTH INNER & OUTER SHIELD (IF SUPPLIED) OF ENCODER CABLE ARE TO BE TERMINATED AT ENCODER CONNECTOR SHELL.
 2. VERIFY ENCODER WIRE FUNCTION BEFORE POWERING SYSTEM.
- FAILURE TO VERIFY PIN-OUT CONFIGURATION MAY RESULT IN DAMAGE TO ENCODER, AMPLIFIER OR BOTH.

Customer Support

Kollmorgen enjoys a reputation of excellence based on constant endeavors to update products. Information in this note is subject to change. Please feel free to contact us at the following:

Kollmorgen Customer Support Network
201A Rock Road, Radford, VA 24141
1-888-774-KCSN
540-633-3100 FAX
kmtg@kollmorgen.com
<http://www.kollmorgen.com>

Appendix A – Connector Pinouts

Overview

This Appendix provides information excerpted from the SERVOSTAR Installation and Setup Manual. It is the intent to provide a copy of this information to help streamline the installation process.

Power Supply Connector Pinouts

Power Connector

Input power range is 180 - 260 VAC.

Connector type: 5 screw terminals (7 screw terminals PA28xx only)

Power Connector	
Terminal	Functionality
BUS +	Bus Voltage Output +
BUS -	Bus Voltage Output -
LA	Main Bus Input Phase A
LB	Main Bus Input Phase B
LC	Main Bus Input Phase C
R	External Regen Resistor R Terminal (PA28xx only, see below)
C	External Regen Resistor C Terminal (PA28xx only, see below)

On the PA28xx, if an external regen resistor is not used, the R and C terminals must be jumpered together. If an external regen resistor is used, the jumper between the R and C terminals must be removed, and the resistor is connected across BUS+ and C.

Connector C6 (Power Supply to DC Bus Status)

This connector provides fault contact output that indicates the status of the DC Bus output, (BUS+ and BUS-) The contacts close when the DC Bus outputs are ready and available for use. Under faulted conditions, or when the DC Bus outputs are not available, these contacts will open. Attempting to enable the SERVOSTAR drive before the DC Bus Status output becomes active may cause erratic operation.

Connector type: 2 pin.

C6: DC Bus Status Connector	
Pin Number	Functionality
1	DC Bus OK
2	DC Bus OK

Connector C7 (Power Supply to Logic Power Output)

Connector type: 4 pin

C7: Logic Power Output Connector	
Pin Number	Functionality
1	+15 Vdc Unregulated Supply Output
2	-15 Vdc Unregulated Supply Output
3	DC Common
4	+8 Vdc Unregulated Supply Output

Connector C8 (Power Supply to Logic Input Voltage - PA28/55/70 only)

Connector type: 3 pin

C8: Logic Input Voltage Connector	
Pin Number	Functionality
1	AC Logic Power In
2	Not Used
3	AC Logic Power In

SERVOSTAR Connector Pinouts

Connector C1 (SERVOSTAR to Serial Communications)

Connector type: 9 pin D (male)

C1: Serial Communications Connector	
Pin Number	Functionality
1	shield
2	RECV (RXD)
3	XMIT (TXD)
4	Reserved
5	Common
6	Reserved
7	Reserved
8	Reserved
9	Reserved

Connector C2 (SERVOSTAR to Feedback)

This connector is used for Resolver and Encoder feedback models. The pins have different function assignments in each product.

Connector type: 25 pin D (female)

C2: Feedback Connector	
Pin Number	Encoder Based Board Assignment
1	A
2	A/
3	Shield
4	B
5	B/
6	Shield

C2: Feedback Connector	
Pin Number	Encoder Based Board Assignment
7	E5V Return
8	E5V Return
9	Hall 1 B
10	Hall 2 B
11	Hall 3 B
12	Shield
13	Thermostat High
14	Shield
15	Index
16	/Index
17	Shield
18	E5V Supply
19	E5V Supply
20	E5V Supply
21	Shield
22	Hall 1 A
23	Hall 2 A
24	Hall 3 A
25	Thermostat Low

Connector C3 (SERVOSTAR to User I/O)

Connector is numbered from top-to-bottom.

Connector type: 10 pin 3.5 mm Weidmuller (male)

C3: User I/O Connector	
Pin Number	Functionality
1	Analog Signal Shield
2	Analog Differential Input + (High)
3	Analog Differential Input - (Low)
4	DC Common
5	Fault Output Relay Contact
6	Fault Output Relay Contact
7	+24V Input Common Rail for Enable, CW and CCW inputs
8	Remote Enable Input
9	CW End Travel Limit Input/IN1
10	CCW End Travel Limit Input/IN2
11	IN3
12	O1
13	ANOUT

Connector C4 (SERVOSTAR to Encoder Equivalent Output)

Connector type: 9 pin D (female)

C4: Encoder Equivalent Output Connector	
Pin Number	Functionality
1	Encoder Channel A Output + (High)
2	Encoder Channel A Output - (Low)

C4: Encoder Equivalent Output Connector	
Pin Number	Functionality
3	DC Common
4	Encoder Channel B Output + (High)
5	Encoder Channel B Output - (Low)
6	Shield Connection
7	Encoder Marker (or Index) Channel Output + (High)
8	Encoder Marker (or Index) Channel Output - (Low)
9	Shield Connection

Connector C5 (SERVOSTAR to Logic Power)

Connector type: 4 pin D (male)

C5: Logic Power Connector	
Pin Number	Functionality
1	+15 Vdc Unregulated Supply Input
2	-15 Vdc Unregulated Supply Input
3	DC Common
4	+8 Vdc Unregulated Supply Input

Connector C6 (SERVOSTAR to Power Connector)

Connector type: 5 screw terminals

C6: Power Connector	
Terminal	Functionality
1 = BUS +	Bus Voltage Input +
2 = BUS -	Bus Voltage Input -
3 = Ma	Motor Output Phase A
4 = Mb	Motor Output Phase B
5 = Mc	Motor Output Phase C

Connector C7 (SERVOSTAR to Multidrop Communications)

Connector C7 is a 10 pin 0.1" x 0.1" Female Ribbon Cable Connector.

The pinout data on this connector is proprietary.

Common RS-232 Serial Device Pinouts

Common RS-232 Serial Device Pinouts							
IBM PC		IBM AT		TERMINAL		DEP01	
DB-25 male		DB-9 male		DB-25 female		DB-25 female	
1	SHIELD	1	SHIELD	1	SHIELD	1	SHIELD
2	TXD	2	RXD	2	TXD	2	TXD
3	RXD	3	TXD	3	RXD	3	RXD
7	COMMON	5	COMMON	7	COMMON	7	COMMON

Earth Ground (E1)

A solid low impedance connection to this product must be established. All shields must tie to this net. One or more screw holes for mounting the board is also connected to this net.