

**KOLLMORGEN**

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***PLATINUM DDL® and SERVOSTAR®***

**Setup Guide**  
**Part # M-LN-016-0702**  
**Rev D**



## Record of Manual Revisions

Revision	Date	Description of Revision
A	September, 1996	Initial Release
B	June, 2002	Corrected wiring information
C	September, 2004	Update corporate identity and contact information
D	May, 2007	Corrected airgap and shim information

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*Danaher Motion reserves the right to make engineering refinements on all its products. Such refinements may affect information in instructions. USE ONLY THE INSTRUCTIONS PACKED WITH THE PRODUCT.*

Safety-alert symbols used in this document are:



***Alerts users to potential physical danger or harm. Failure to follow warning notices could result in personal injury or death.***

**WARNING**



***Directs attention to general precautions, which if not followed, could result in personal injury and/or equipment damage.***

**CAUTION**



***Highlights information critical to your understanding or use of the product.***

**NOTE**

# SAFETY & WARNINGS:

Only qualified personnel are permitted to transport, assembly, commission, and maintenance this equipment. Properly qualified personnel are persons who are familiar with the transport, assembly, installation, commissioning and operation of motors, and who have the appropriate qualifications for their jobs. The qualified personnel must know and observe the following standards and regulations:

IEC 364 resp. CENELEC HD 384 or DIN VDE 0100

IEC report 664 or DIN VDE 0110

National regulations for safety and accident prevention or VBG 4



**CAUTION**

***Read all available documentation before assembly and commissioning. Incorrect handling of products in this manual can result in injury and damage to persons and machinery. Strictly adhere to the technical information on the installation requirements.***



**CAUTION**

***It is vital to ensure that all system components are connected to earth ground. Electrical safety is impossible without a low-resistance earth connection.***



**WARNING**

***The SERVOSTAR product contains electro-statically sensitive components that can be damaged by incorrect handling. Discharge yourself before touching the product. Avoid contact with high insulating materials (artificial fabrics, plastic film, etc.). Place the product on a conductive surface.***



**WARNING**

***During operation keep all covers and cabinet doors shut. Otherwise, there are deadly hazards that could possibly cause severe damage to health or the product.***



**WARNING**

***In operation, depending on the degree of enclosure protection, the product can have bare components that are live or have hot surfaces. Control and power cables can carry a high voltage even when the motor is not rotating.***



**WARNING**

***Never pull out or plug in the product while the system is live. There is a danger of electric arcing and danger to persons and contacts.***



**WARNING**

***After powering down the product, wait at least ten minutes before touching live sections of the equipment or undoing connections (e.g., contacts, screwed connections). Capacitors can store dangerous voltages for long periods of time after power has been switched off. To be safe, measure the contact points with a meter before touching.***

# DIRECTIVES & STANDARDS

The SERVOSTAR S and SERVOSTAR CD product series have been successfully tested and evaluated to meet UL/cUL 508C for both U.S. and Canadian markets. This standard describes the fulfillment by design of minimum requirements for electrically operated power conversion equipment, such as frequency converters and servo amplifiers, which is intended to eliminate the risk of fire, electric shock, or injury to persons, being caused by such equipment.

# CE MARK CONFORMANCE

Servo drives are components that are intended to be incorporated into electrical plant and machines for industrial use. When the servo drives are built into machines or plants, drives cannot be operated until the machine or plant fulfills the requirements of the EC Directive on Machines 89/392/EEC and the EC Directive on EMC (89/336/EEC). EN 60204 and EN 292 must also be observed.

In connection with the Low Voltage Directive 73/23/EEC, the harmonized standards of the EN 50178 series are applied to the amplifiers, together with EN 60439-1, EN 60146 and EN 60204.

The manufacturer of the machine or plant is responsible for ensuring that they meet the limits required by the EMC regulations. Advice on the correct installation for EMC - such as shielding, grounding, arrangement of filters, treatment of connectors and the laying out of cabling - can be found within this documentation.

Conformance with the EC Directive on EMC 89/336/EEC and the Low Voltage Directive 73/23/EEC is mandatory for the supply of servo drives within the European Community.

An authorized testing laboratory in a defined configuration with the system components has tested the servo drives. Any divergence from the configuration and installation described in this documentation means that you are responsible for the performance of new measurements to ensure that the regulatory requirements are met.

Danaher Motion's SERVOSTAR S-Series and C-Series drives and systems have been successfully tested and evaluated to the limits and requirements of the EC Directive on EMC (89/336/EEC) and the EC Directive on Low Voltage (72/73/EEC). The product lines have been evaluated to EN50178 and EN60204 as a component of a machine and other relevant standards.

The EMC of a system can be identified by emissions and immunity. Emissions refer to the generation of EMI (electromagnetic interference) and immunity refers to the susceptibility levels of the equipment. Limits were derived from generic standards EN55081-2 and EN55082-2 for heavy industrial environments. The SERVOSTAR S and SERVOSTAR CD series of drives and BUS Modules have been tested for radiated emissions, conducted emissions, EFT, ESD, surge, conducted immunity, and radiated immunity. These tests have been done in accordance with EN55011, EN61000-4-2, ENV50140, IEC 1000-4-4, EN61000-4-5, and ENV50141.



**CAUTION**

***Installation of the equipment is critical in designing for system and machine electromagnetic compatibility (EMC). You must apply the installation recommendations and the CE filtering Practices when mounting and installing the drive system for CE conformance.***

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# 1. GETTING STARTED

## 1.1 OVERVIEW

This manual provides a guideline and procedures for installing the Danaher Motion DDL Ironcore and Ironless Linear motors and integrating them with the SERVOSTAR® motor driver. This manual 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. Troubleshooting procedures are provided to assist with any problems that may occur during installation. These procedures assume that all other devices pertinent to system operation have been installed and are operating normally.

### 1.1.1. 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 in the coil assembly, this type of motor has 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.

### 1.1.2. IRONLESS LINEAR MOTOR

The Ironless Linear motor is best suited 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.

## 1.2 BEGIN



**CAUTION**

*Follow proper handling procedures of static-sensitive equipment when handling these products. Electrical shock may damage equipment.*

## 1.2.1. UNPACKING

1. Check the package and contents upon arrival. 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 the factory has sent all the ordered components. If a discrepancy exists, contact the factory immediately.
3. Remove all the packing material and equipment from the shipping container. Exercise caution when unpacking the components to be sure that smaller components are not accidentally discarded.



### NOTE

***Do not dispose of the packing material until all the components of the packing list have been accounted for and verified.***

## 1.2.2. POSITIONER QUESTIONS

Regardless of what positioner is used, it must be configured to operate with the **SERVOSTAR** software. The following questions need to be answered before installing the **SERVOSTAR**. Write this information down as the questions are answered.

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

## 1.2.3. MOTIONLINK QUESTIONS

These questions concern the configuration stage and type of devices installed to complete the system. Write this information down as the questions are answered.

1. Linear motortype and model number?
2. Encodertype and resolution (lines per millimeter)?
3. External or internal logic multipliers?
4. Is there a Hall effect module?
5. Is there one index pulse, multiple index pulses, or no index pulse on the scale?
6. Is there a thermistor in the motor?
7. Are there limit switches?
8. Is AC input power 110 or 220 volts?

## 1.3 BEFORE YOU BEGIN



**CAUTION**

*Remove all power to the stage and controlling device. Gather additional personnel and suitable lifting devices, if needed.*

### 1.3.1. MAGNET PLATE AND COIL ASSEMBLY MOUNTING

#### 1.3.1.1. 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 stage's clearance (or cavity) for the linear motor components must be designed to provide adequate clearance for the motor's maximum outline dimensions. Shim between the coil and the slide-mounting surface to achieve the prescribed gap between the coil and magnet way.

1. The mounting surface for the magnet way should be flat relative to the slide travel within 0.005 in.
2. To install the magnet way properly, it is recommended that the stage base include precision 5mm dowel pins. (See **Figure 1 Multiple Magnet Diagram** & **Figure 2 Single Magnet Diagram**).
3. If multiple magnet ways are designed into the stage, locating dowel pins should be installed to position and align each magnet way assembly. (See **Figure 1 Multiple Magnet Diagram** & **Figure 2 Single Magnet Diagram**).



**CAUTION**

*Due to the high magnetic attractive forces of the magnet way, exercise extreme caution during handling and installation to avoid damage to equipment or personnel injury*



**NOTE**

*The high magnetic attractive forces of the motor can cause the slide plate to deflect. These attractive forces must be considered in the design stage. 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.*

## 1.3.2. MAGNET WAY AND COIL ASSEMBLY MOUNTING

### 1.3.2.1. Mounting and Design Considerations



**CAUTION**

*The stage should be designed to center the coil in the magnet way with provisions for adjustment in order to maintain proper coil to magnet clearance. The relationship of the moving coil relative to the stationary magnet way is critical. The magnet way-mounting surface should be parallel within 0.005 in TIR with respect to the coil/slide travel. Regardless of the motor mounting configuration (bottom or side mount), the required setup gap is required between the coil surface and the magnet face surface. (See the Figure 3 Ironless Motor Installation Diagram, Figure 4 Typical Bottom Mounting Installation Diagram and Figure 5 Typical Side Mounting Installation Diagram.)*

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 a good practice to provide a means to independently align both the reader head and the coil assembly.*



**NOTE**

*The reader head needs to be critically adjusted for height, rotation, and perpendicularity.*

If the coil is installed from the top (opposite 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 airgap should be done on the reference side of the magnet way. The reference side is the side contacting the stage-mounting surface

## 2. INSTALLATION

There are two preferred methods for installing the linear motor coil assembly and magnet plates in your system. Since magnet plates are sold in standard incremental sizes, it is possible to have a number of magnet plates installed together within one linear stage. Review the information for the installation method appropriate for your application: 2. 1 Ironcore Multiple Magnet Plates Installation, 2. 2 Ironcore Single Magnet Plate Installation and 2. 3 Ironless Motors.



**WARNING**

***Power 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.***

### 2.1 **IRONCORE MULTIPLE MAGNET PLATES INSTALLATION**

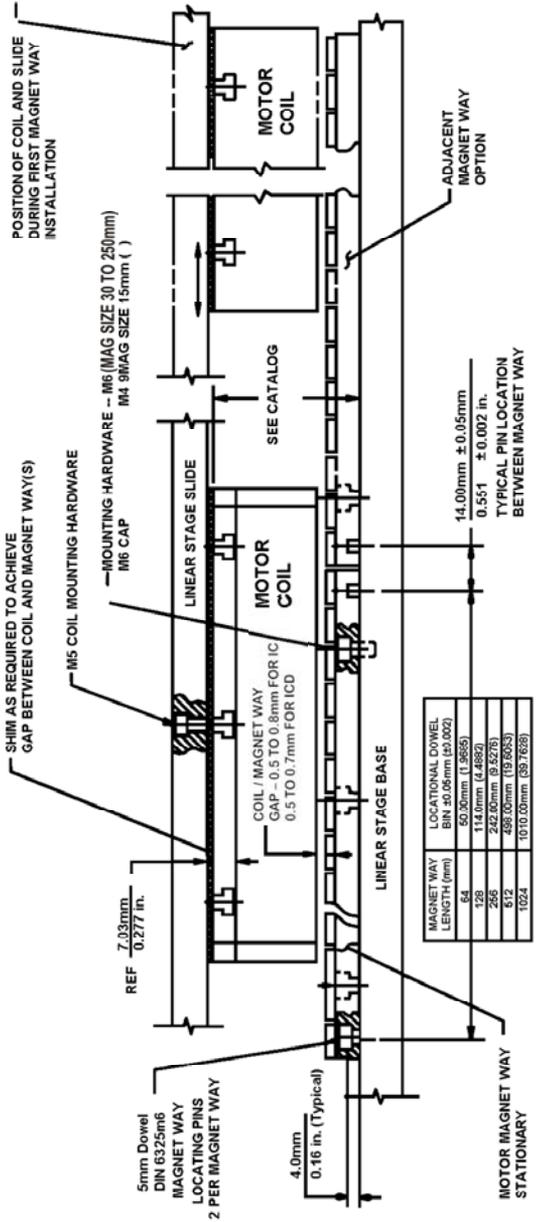
1. Lightly stone and thoroughly clean the mounting surfaces on the stage for both the coil assembly and magnet plates.
2. Using M5 screws, securely mount the coil assembly to the slide. Push the slide to one end of travel to clear the first magnet way location.
3. Install the first magnet way assembly on the 5 mm 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, exercise extreme caution during handling and installation to avoid damage to equipment or personnel injury.***

4. Carefully and slowly move the slide over the magnet plate. Using soft non-magnetic shim stock, check the airgap between the top of the magnets and the coil. The airgap should be 0.020 to 0.031 inch (0.5 to 0.8 mm) for the IC and 0.020 to 0.028 inch (0.5 to 0.7 mm) for the ICD. To correct the clearance gap, move the slide away from the magnet way. Remove the coil assembly. Place the required shim stock (plastic material is not acceptable) between the coil mounting surface and the slide. A minimum gap of 0.020 inch (0.5 mm) must be maintained for both the IC and ICD models.
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 Diagram

## 2.2 **IRONCORE SINGLE MAGNET PLATE** **INSTALLATION**



### **WARNING**

*For safety reasons, construct jacking plates to prepare the magnet way and coil for installation into the stage.*

1. Lightly stone and thoroughly clean the mounting surfaces on the stage for both 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 using M5 screws (shown in the **Figure 1 Multiple Magnet Diagram** Extend jacking screws (4 per plate) completely through the jacking plate(s) (see the **Figure 2 Single Magnet Diagram**).



*Multiple jacking plates are required for sizes 22, 33, 44, 55, and 66 coils.*

### **NOTE**

4. For IC, place 0.031 inch (0.8 mm) thick, soft non-magnetic shim material (slightly larger than the coil surface) on the magnet plate. For ICD, use a 0.028 inch (0.7 mm) shim. 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 fully lowered.
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) into the slide using M5 screws. Tighten screws sequentially to properly seat the coil assembly.
8. Remove the plastic shim from the magnet plate

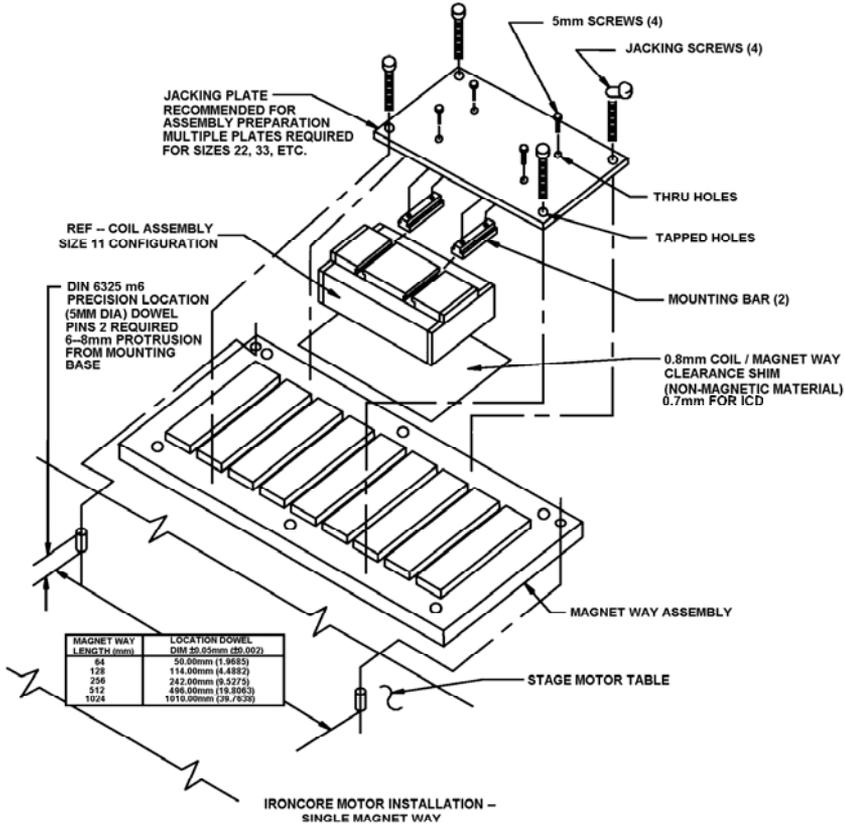


Figure 2 Single Magnet Diagram

## 2.3 IRONLESS MOTORS

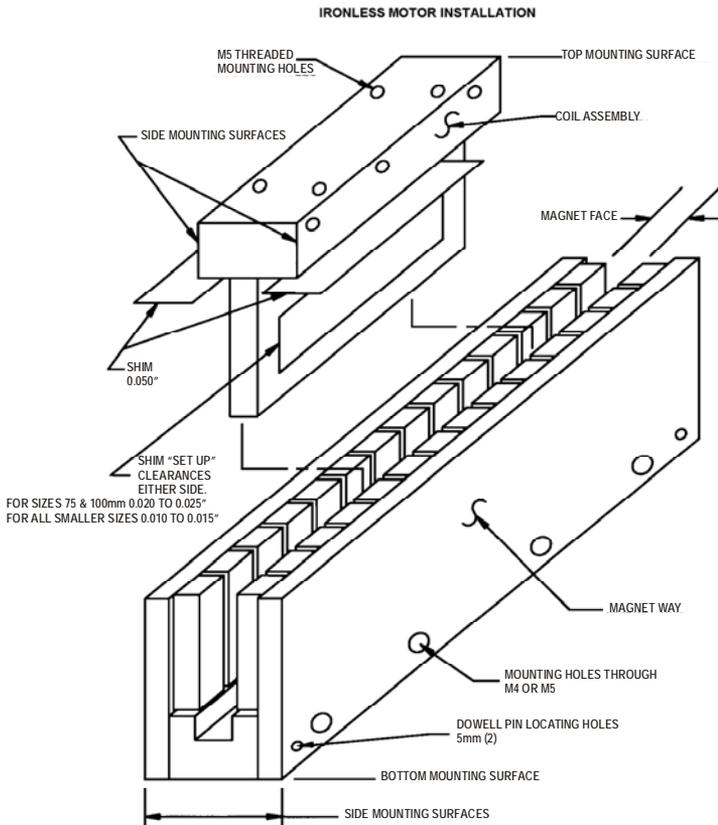
1. Lightly stone and thoroughly clean the mounting surfaces on the stage for both the coil assembly and magnet channel
2. Check the parallelism of the magnet way-mounting surface to the coil/slide travel. The TIR of the surface must be within 0.005 in to provide working clearance between the magnet way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

3. Install the magnet ways using two 5 mm locational dowels (recommended). (**See Figure 3 Ironless Motor Installation Diagram, Figure 4 Typical Bottom Mounting Installation Diagram and Figure 5 Typical Side Mounting Installation Diagram**). Two pins are required per magnet way. For pin location dimensions, see the magnet way outline drawing. Pin location between magnet ways is  $1.811 \pm 0.002$  in for all magnet way lengths.
4. The shims used for the airgap setup clearances between the side surface of the coil and either magnet surface of the magnet way should be  $0.020$  to  $0.025$  inch for 75 and 100 mm magnet ways and  $0.010$  to  $0.015$  inch for all smaller sizes.
5. The shims used for the setup clearance dimension between the top of the magnet way and the coil should be  $0.050$  inch. (**See the Figure 3 Ironless Motor Installation Diagram.**)
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.



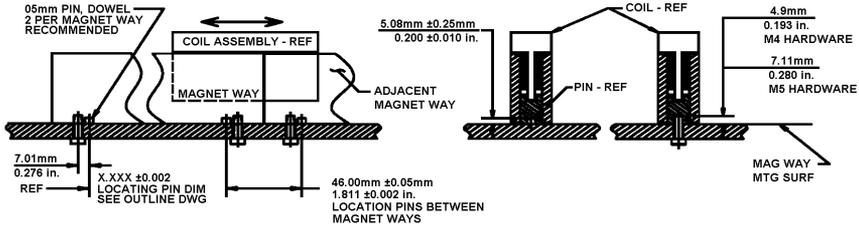


Figure 4 Typical Bottom Mounting Installation Diagram

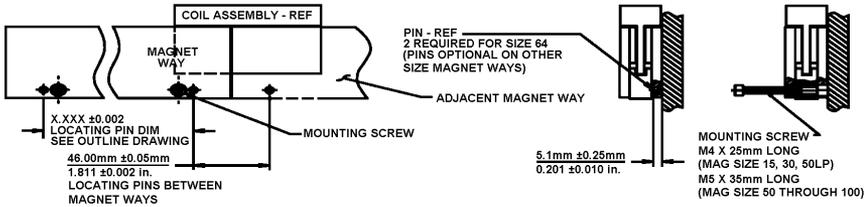
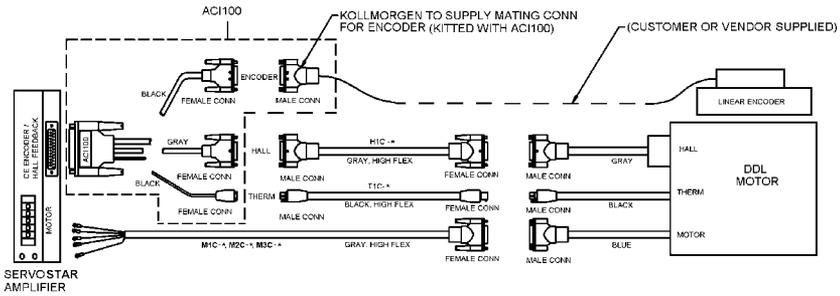


Figure 5 Typical Side Mounting Installation Diagram



NOTES:

1. BOTH INNER AND OUTER SHIELD (IF SUPPLIED) OF ENCODER CABLE ARE TO BE TERMINATED 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.

Figure 6 Cable Diagram

## 3. POWER AND CONNECTORS

### 3.1 **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			

### 3.2 **POWER SUPPLY CONNECTOR PINOUTS**

Input power range is 180 VAC to 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*)
C	External Regen Resistor C Terminal (PA28xx only*)

*\*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 connected across BUS+ and C*

#### 3.2.1. POWER SUPPLY TO DC BUS STATUS (C6)

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 open. Attempting to enable the **SERVOSTAR** before the DC Bus Status output is active may cause erratic operation.

Connector type: 2-pin

DC Bus Status Connector (C6)	
Pin Number	Functionality
1	DC Bus OK
2	DC Bus OK

### 3.2.2. POWER SUPPLY TO LOGIC POWER OUTPUT (C7)

Connector type: 4-pin

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

### 3.2.3. POWER SUPPLY TO LOGIC INPUT VOLTAGE (C8)

**PA28xx only!**

Connector type: 3-pin

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

## 3.3 **SERVOSTAR CONNECTOR PINOUTS**

### 3.3.1. SERVOSTAR TO SERIAL COMMUNICATION (C1)

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 open. Attempting to enable the **SERVOSTAR** before the DC Bus Status output is active may cause erratic operation.

Connector type: 2-pin

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

### 3.3.2. SERVOSTAR TO FEEDBACK (C2)

This connector is used for resolver and encoder feedback models. The pins have different function assignments for each product.

Connector type: 25-pin D (female)

Feedback Connector (C2)		
Pin	Resolver	Encoder
1	Sine High	A
2	Sine Low	/A
3	Shield	Shield
4	Cosine High	B
5	Cosine Low	/B
6	Shield	Shield
7		E5V Return
8		E5V Return
9		Hall 1 B
10		Hall 2 B
11		Hall 3 B
12	Shield	Shield
13	Thermostat High	Thermostat High
14	Shield	Shield
15	Ref. High Out	Index
16	Ref. Low Out	/Index
17	Shield	Shield
18		E5V Supply
19		E5V Supply
20		E5V Supply
21	Shield	Shield
22		Hall 1 A
23		Hall 2 A
24		Hall 3 A
25	Thermostat Low	Thermostat Low

### 3.3.3. SERVOSTAR TO USER I/O (C3)

This connector is numbered from top to bottom.

Connector type: 13-pin (male)

User I/O Connector (C3)	
Pin Number	Functionality
1	Analog Signal Shield
2	Analog Differential Input + (High)
3	Analog Differential Input – (Low)
4	Analog 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

### 3.3.4. SERVOSTAR TO ENCODER EQUIVALENT OUTPUT (C4)

Connector type: 9-pin D (female)

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

### 3.3.5. SERVOSTAR TO LOGIC POWER (C5)

Connector type: 4-pin D (male)

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

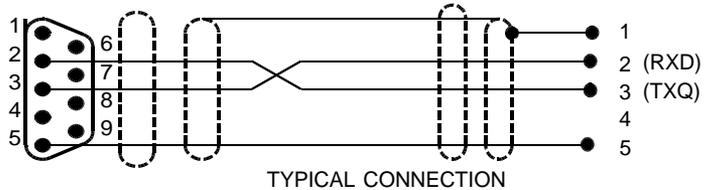
### 3.3.6. SERVOSTAR TO POWER CONNECTOR (C6)

Connector type: 5 screw terminals

Power Connector (C6)	
Terminal	Functionality
1	Bus Voltage Input +
2	Bus Voltage Input -
3	Motor Output Phase A
4	Motor Output Phase B
5	Motor Output Phase C

### 3.3.7. SERVOSTAR TO MULTI-DROP COMMUNICATION (C7)

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



## 3.4 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

## 3.5 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 are also connected to this net.



## 4. WIRING

All PMI **PLATINUM** DDL brushless motors are wired using the same convention. Phase AB leads phase BC by 120° with the cable exit leading as shown in the motor commutation diagram. 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.

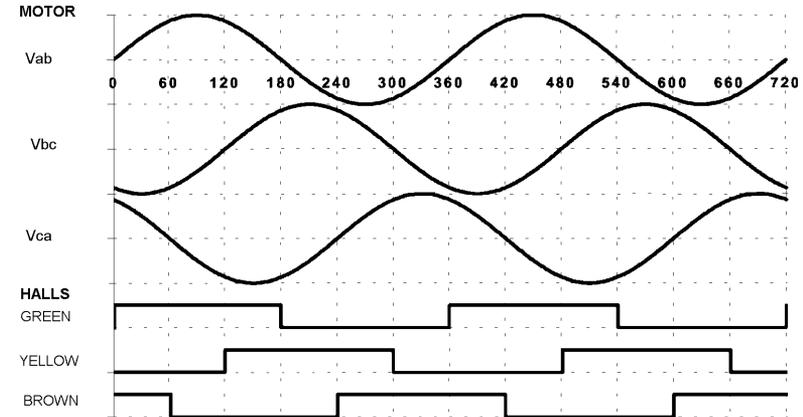
### 4.1 *EMF VOLTAGE*

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

# 4.1.1. IRONCORE COMMUNICATION DIAGRAM

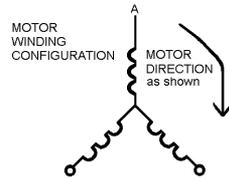
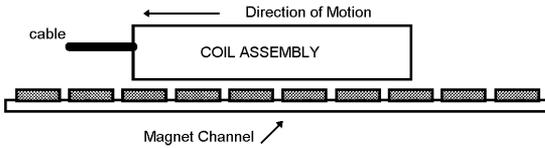
IRONCORE MOTOR COMMUTATION



GREY +Vcc (5 - 15 VDC)  
 WHITE Return

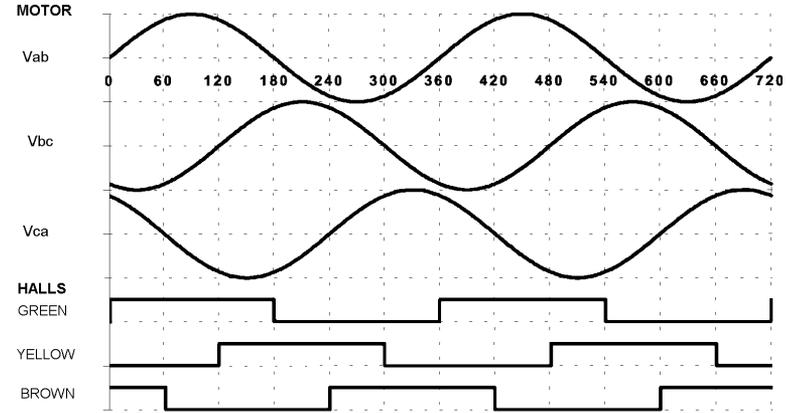
**MOTOR**  
 Red Phase A  
 White Phase B  
 Black Phase C  
 Grn/Yel Ground

Coil assembly direction of motion is to the left, with the motor cable exit 'leading,' as shown.

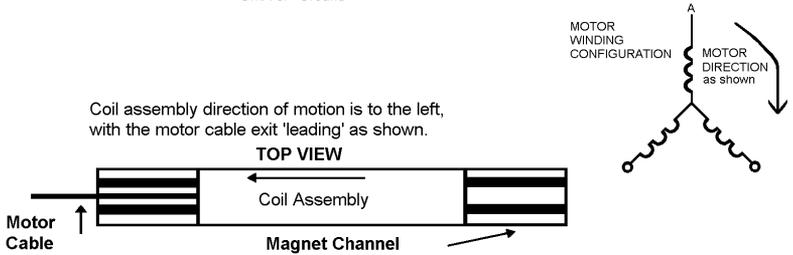


# 4.1.2. IRONLESS COMMUNICATION DIAGRAM

IRONLESS MOTOR COMMUTATION



- |       |                   |                |
|-------|-------------------|----------------|
| GREY  | +Vcc (5 - 15 VDC) | <b>MOTOR</b>   |
| WHITE | Return            | Red Phase A    |
|       |                   | White Phase B  |
|       |                   | Black Phase C  |
|       |                   | Grn/Yel Ground |



## 5. DRIVER INTEGRATION

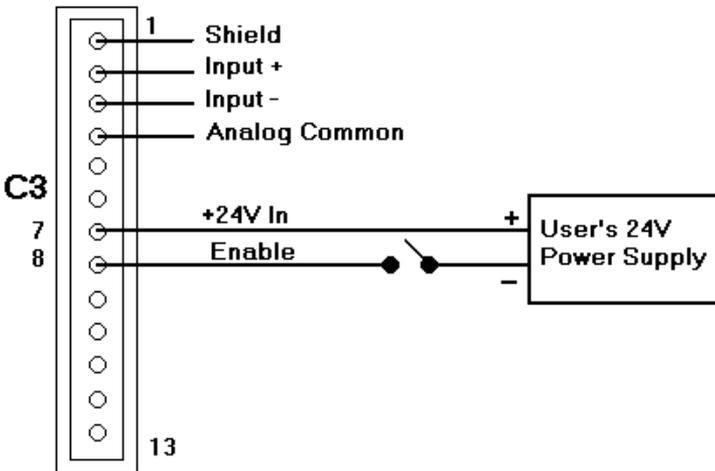
### 5.1 WIRING THE DRIVE

Wire the SERVOSTAR according to the Installation manual. Be sure you have wired the AC input to the power supply and the DC logic and bus voltage from the power supply to the drive. 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.

In order to enable and disable 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 throw switch. To install the switch:

1. Locate a suitable location to place the switch so it is easily accessible and will not interfere with any component 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, if necessary.
2. Wire the switch to pins 7 (24V Input) and 8 (Remote Enable Input) of User I/O Connector C3 (see 5.1.1 Enable Switch Wiring Diagram).

#### 5.1.1. ENABLE SWITCH WIRING DIAGRAM



## 5.2 MOTIONLINK

Install **MOTIONLINK**. Both software programs can be found on the website ([www.danahermotion.com](http://www.danahermotion.com)) and the Product Support Package (PSP) CD-ROM packaged with the drive. Follow the installation instructions.

**MOTIONLINK** gives you three methods to configure the **SERVOSTAR SC**. The first uses a Startup Wizard that is the easiest and most highly recommended approach. Its main purpose is for initial startups. The second approach allows you to more indirectly perform the same configuration as the first using the main **MOTIONLINK** screen. This method is most convenient when corrections to an existing configuration are needed. The third method uses the Terminal Mode screen to directly set (or monitor) values for the same variables and commands the other two methods configure through a friendlier user interface.

### 5.2.1. STARTUP WIZARD

The **MOTIONLINK** Startup Wizard is accessed either directly through **MOTIONLINK** or through **MotionSuite** once communication with the controller is established following the steps outlined above. For more details (including graphics), refer to the Installation manual.



***If you deactivate this screen, you can reactivate it by going to the Main MOTIONLINK screen, pulling down the Configuration menu, and selecting the New Drive (123) option.***

#### **NOTE**

1. Click Start. A dialog box is displayed describing the Drive Configuration settings required.
2. Read the entire text. When finished, click OK.
3. Set the Bus Voltage.
4. Verify the DIP switch settings and update if changes are made.
5. Verify the serial number.
6. Enable the axis.
7. Save.
8. Click Close to return to the main Wizard screen.
9. Click Next.
10. A dialog box displays describing the next screen. When you have finished reading the contents, click OK.
11. Configure the motor. Verify all settings. Save any changes. Click Close to return to the main Wizard screen.



***If the motor cannot be found in the database, click on the User Define tab. Contact Danaher Customer Support for detailed instructions.***

#### **NOTE**

12. Click Next.

13. Select Encoder type. 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/pitch. Kollmorgen DDL motors have a magnet pitch of 32 mm. For example, if you have a 25 lines/mm scale (40 micron pitch), enter 800 (25 \* 32) as your encoder resolution. If you have a 10X multiplier, enter 8000 (25 lines/mm \* 10X multiplier \* 32 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 µm (after quadrature)	SERVOSTAR Resolution lines/pitch MENCRES	Encoder Equivalent Resolution µm (after quadrature)	SERVOSTAR Resolution lines/pitch 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
0.04	20000		

14. When finished, click the To Drive button to upload the motor data to the amplifier.
15. Make any changes that are required. Save your changes. Click Close to return to the main Wizard screen.
16. Check the PRD counter (found under Feedback). On the right side of the screen is an Encoder Display indicator. This indicator is used to verify the PRD counter.
17. If you are using encoder type 0 (A/B//Halls), you must initialize the encoder. After completing the initialization, you can move the stage back and forth by hand to read the PRD counter.
18. If the stage does not have Hall effects, initialize the drive using the drive enable switch. This switch enables the drive and after a few seconds, the drive is initialized. Ensure that the motor leads are disconnected from the drive so that no power is applied to the motor.
19. With the PRD count stable, move the table back and forth. Notice the changes in the PRD Encoder Display
20. Line the edge of the motor with the edge of a magnet and check the location of the indicator.
21. Push the table with the cable lagging (following the motor) exactly two magnets. The PRD indicator should complete one revolution in the clockwise direction.
22. Click Next.
23. Read the Operation Mode Configuration dialog box. When finished, click OK.

24. Here, you can change to Digital Velocity, Digital Position, or Analog Velocity. Save your changes. Click Close to return to the main screen.

**NOTE**

***If the indicator travels in the counter-clockwise direction, swap pins 1 and 2 (A and A/) on the SERVOSTAR feedback connector C2. Repeat the procedure to verify that the counter goes in the clockwise direction.***

**NOTE**

***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 MENCRES number, you will receive an accumulated error. If the number is off, there will be a large offset on the PRD indicator.***

25. Click Next.
26. Read the dialog box for tuning the drive. When finished, click OK.
27. In the Setup Record tab, verify the settings. Enter the Sample Rate and the number of Samples.
28. Select the Trigger Mode.
29. Select the Pre-Trigger Position.
30. Select the Channels.
31. Click the Setup Motion tab.
32. Select if you wish, the command to Jog, Step, or Move.
33. Set the Smooth factor.
34. Click the Vel. Gains tab.
35. Select the Active Control Loop.
36. Set the PDFF Loop Gain.
37. Set the PDFF Loop Integral.
38. Select the Feedforward Ratio.
39. Determine if Velocity Feedback Low Pass Filter is Off or On.
40. Click the Posn. Gains tab.
41. Set the Derivative Gain.
42. Set the Proportional Gain
43. Set the Acceleration Feedforward #1.
44. Set the Integral Gain.
45. Set the Velocity Feedforward Ratio.
46. Set the Acceleration Feedforward #2.
47. Click the Filters tab.
48. Select the Filter Mode.
49. Set the First Low Pass Filter (Hz).
50. Set the Second Low Pass Filter (Hz).
51. Set the Notch Filter Center Freq. (Hz).
52. Set the Notch Filter Bandwidth (Hz).
53. Click the Auto Tune tab.
54. Set the Tune Bandwidth.

55. Set the Tune Direction.
56. Set the Tune Speed (RPM).
57. Click the Save/Print tab.
58. Load the Plot.
59. Save the Plot.
60. Save the Variables.
61. Print.
62. Click Close to return to the main Wizard screen.
63. You are prompted to save the configuration settings. If you click OK, these settings will be available on the next powerup. If you click Cancel, these settings are not saved.
64. Click Next.
65. You are prompted to backup your drive's configuration to disk. Click OK to proceed. Click Cancel if you do NOT want to backup.
66. You are finished configuring the drive. Click Exit or GO to go to the Main MOTIONLINK screen.

### 5.3 CONNECT MOTOR



#### CAUTION

*In the next step, two 2 x 4 pieces of wood need to be cut and positioned between the stage and the end stops. This wood is a safety measure to ensure 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.*

67. 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.
68. 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 displays a number showing the current Opmode.



#### NOTE

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

### 5.4 SET STAGE OPTIONS

The following steps are conditional, depending on the information entered during **MOTIONLINK** configuration. To proceed with these steps, go to the Terminal screen in **MOTIONLINK**.

1. If there is a thermistor in the motor, type: `thermode 0` and press Enter
2. If there is no thermistor in the motor, type: `thermode 3` and press Enter.
3. If there are limit switches on the stage, type: `limdis 0` and press Enter.

4. If there are no limit switches on the stage, type: `limdis 1` and press Enter.
5. Type `vbus` and press Enter to verify the bus voltage setting for the system.
6. If there is 120V AC power, VBUS should be set to 160.
7. If there is 220V AC power, VBUS should be set to 325.
8. Click Save to save the parameters.

## 5.4.1. POWER MOTOR

1. Type `ilim` and press Enter. Record the number displayed on the screen. For testing purposes, enter half the value of this number into the system.
2. Type `ilim <1/2 value>` and press Enter.
3. Type `opmode 0` and press Enter.
4. Type `config` and press Enter.
5. Type `en` and press Enter.
6. Click Save to store the parameters.
7. For MENCTYPE 4, close the Drive Enable Switch. The table will move slightly and stop. The drive is now initialized. The commutation parameters have been calculated. At the terminal screen, type `J10` and press Enter. 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.
8. 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 do over the index pulse. Position the table in the center of the stage and replace the 2 x 4s. Turn the Drive Enable Switch on and the table should hold its position. If it does not, refer to Section 6 Troubleshooting. If the table is OK, type `J10` and press Enter. 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.



**You can use `ENCINITST` (encoder init status) to determine what is happening in the encoder.**

### **NOTE**

9. For both MENCTYPE 0 and MENCTYPE 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 in step 1. Type `save` and press Enter

## 5.4.2. INTEGRATING THE POSITIONER



### NOTE

*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, pin4.
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. Go to a Terminal screen and type  $\kappa$  to kill any existing motion command.
6. Type `opmode 3` and press Enter. Save the parameter. This puts the amplifier in the current mode.
7. With the drive disabled, boot up the positioner software and establish communication with the positioner (see the 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.
8. Enable the positioner and verify that the table holds position.
9. Manually move the table and see if the stage holds position. If the positioner is properly phased, it should hold position. Go to step 10. If the slide runs away and strikes the 2 x 4s, it is not properly phased. Disable the drive and swap A and A/ (pins 1 and 2) on the C4 Encoder connector.
10. 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 the maximum and use the positioner tuning parameters to fine-tune the positioner to the stage. Remove the 2 x 4s.
11. 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.
12. 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 5.4.3 Setting SERVOSTAR Velocity & Torque Angle

---

Advance.

### 5.4.3. SETTING SERVOSTAR VELOCITY & TORQUE ANGLE ADVANCE

The torque and velocity advance parameters in the **SERVOSTAR** must be optimized in order to complete the fine-tuning 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

MVANGLF

MVANGLH

Details of the software commands are located in the *SERVOSTAR S and SERVOSTAR CD VarCom Reference* manual. To optimize the torque angle advance (MTANGLP):

1. With the loop program still running, raise the MTANGLP value and monitor the command signal coming from the positioner to the **SERVOSTAR** either with an oscilloscope or through the positioner software.
2. Keep increasing the MTANGLP value until the level of the command signal is at its *lowest* value (typical values range from 0 to 30).
3. When the command signal is at the minimum voltage that can be achieved, set MTANGLC to half the value of MTANGLP.
4. With the loop program still running, raise the MVANGLF value and monitor the command signal coming from the positioner to the **SERVOSTAR** either with an oscilloscope or through the positioner software.
5. Keep increasing the MVANGLF value until the level of the command signal is at its *lowest* value (typical values range from 0 to 30).
6. When the command signal is at the minimum voltage that can be achieved, set MVANGLH to half the value of MVANGLF.
7. Type **SAVE** and Enter to save the parameters in the drive.

## 6. TROUBLESHOOTING

### 6.1 TROUBLESHOOTING TABLE

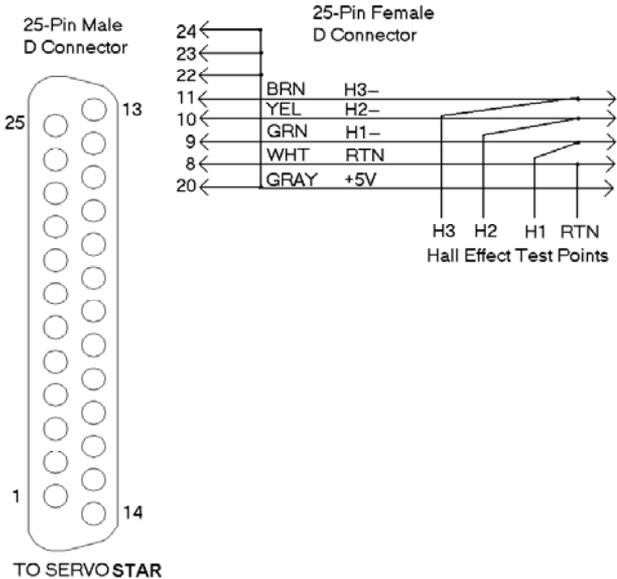
Symptom	Probable Cause	Corrective Action
Drive does not enable	Thermistor parameter incorrect. Limit parameter incorrect.	Re-enter the correct parameters for the system.
Table runs away (hall effect)	Check motor wiring using wiring diagram.	Rewire motor correctly. Power down and restart the drive.
With 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 IENCSTART
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 normally be low and go high when it crosses over the index pulse. Pin 16 should normally be high and go low when it crosses over the index pulse.  Check commutation by using the 6.2 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.

### 6.2 MOTOR AND HALL EFFECT CONNECTION VERIFICATION TEST

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.

#### 6.2.1. ADAPTER AND WIRING

The purpose of the adapter is to provide a useful tool to allow you to monitor the Hall effect signals during the test. The adapter consists of one 25-pin male D connector and one 25-pin female D connector. The wiring for this connector is shown in the next figure.

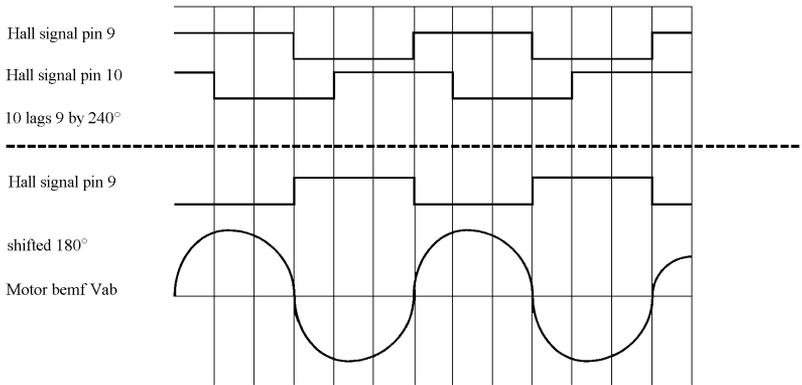


## 6.2.2. VERIFICATION TEST

1. Disconnect the motor leads from the drive. Insert the 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).
4. Connect channel 2 to pin 10.
5. Set both channels to 2 volts/div.
6. 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).
7. 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° (6.2 Motor and Hall Effect Connection Verification Test). If the lag is only 120°, swap the wires on pins 10 and 11. Recheck the phasing.
8. 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°.
9. Connect channel 2 of the scope to any motor lead, referenced to any other motor lead. Set channel 2 to 5 volts/div and leave channel 1 connected to pin 9, reference to RTN and set to 2 volts/div. Push the stage in the positive direction and compare the two waveforms.

10. Exchange the motor leads connected to channel 2 until you find that the motor back EMF is  $180^\circ$  out of phase with the hall signal in the positive direction only (6.2.3 Hall Effect and Motor Phasing Diagram). Label the motor lead connected to the probe as A and the lead connected to the reference as B. Label the remaining lead C.
11. 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  $180^\circ$  out of phase with the Hall effect signal.

### 6.2.3. HALL EFFECT AND MOTOR PHASING DIAGRAM



## CUSTOMER SUPPORT

Danaher Motion products are available worldwide through an extensive authorized distributor network. These distributors offer literature, technical assistance, and a wide range of models off the shelf for the fastest possible delivery.

Danaher Motion sales engineers are conveniently located to provide prompt attention to customer needs. Call the nearest office for ordering and application information and assistance or for the address of the closest authorized distributor. If you do not know who your sales representative is, contact us at:

Danaher Motion  
 203A West Rock Road  
 Radford, VA 24141 USA  
**Phone:** 1-540-633-3400  
**Fax:** 1-540-639-4162  
**Email:** [customer.support@danahermotion.com](mailto:customer.support@danahermotion.com)  
**Website:** [www.DanaherMotion.com](http://www.DanaherMotion.com)

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