FCC Interference Statement

This equipment has been tested and found to comply with the limits for a Class A Digital Device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against interference if installed and operated properly in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy, and if not properly installed and used in accordance with the instructions in this manual, may cause harmful interference in which case the user will be required to correct the interference at his own expense.

Any changes or modifications to the equipment by the user not expressly approved by grantee or the manufacturer could void the users authority to operate such equipment.

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How To Use This User Guide

This user guide is designed to help you install, develop, and maintain your system. Each chapter begins with a list of specific objectives that should be met after you have read the chapter. This section is intended to help you find and use the information in this user guide.

Assumptions

This user guide assumes that you have the skills or fundamental understanding of the following information.

- ❑ Basic electronics concepts (voltage, switches, current, etc.)
- ❑ Basic motion control concepts (torque, velocity, distance, force, etc.)

With this basic level of understanding, you will be able to effectively use this user guide to install, develop, and maintain your system.

Contents of This Manual

This user guide contains the following information.

Chapter 1: Introduction

This chapter provides a description of the product and a brief account of its specific features.

Chapter 2: Getting Started

This chapter contains a detailed list of items you should have received with your LN Drive shipment. It will help you to become familiar with the system and ensure that each component functions properly.

Chapter 3: Installation

This chapter provides instructions for you to properly mount the system and make all electrical connections. Upon completion of this chapter, your system should be completely installed and ready to perform basic operations.

Chapter 4: Hardware Reference

This chapter contains information on system specifications (dimensions and performance). It may be used as a quick-reference tool for proper switch settings and connections.

Chapter 5: Troubleshooting

This chapter contains information on identifying and resolving system problems.

Installation Process Overview

To ensure trouble-free operation, pay special attention to the environment in which the LN Drive equipment will operate, the layout and mounting, and the wiring and grounding practices used. These recommendations are intended to help you easily and safely integrate LN Drive equipment into your manufacturing facility. Industrial environments often contain conditions that may adversely affect solid state equipment. Electrical noise or atmospheric contamination, may also affect the LN Drive System.

Developing Your Application

Before you attempt to develop and implement your application, there are several issues that you should consider and address.

① Recognize and clarify the requirements of your application. Clearly define what you expect the system to do.

② Assess your resources and limitations. This will help you find the most efficient and effective means of developing and implementing your application.

③ Follow the guidelines and instructions outlined in this user guide. Do not skip any steps or procedures. Proper installation and implementation can only be ensured if all procedures are completed in the proper sequence.

Installation Preparation

Before you attempt to install this product, you should complete the following steps:

① Review this entire user guide. Become familiar with the user guide's contents so that you can quickly find the information you need.

② Develop a basic understanding of all system components, their functions, and interrelationships.

③ Complete the basic system configuration and wiring instructions (in a simulated environment, not a permanent installation) provided in *Chapter 2, Getting Started*.

④ Perform as many basic functions as you can with the preliminary configuration. You can only perform this task if you have reviewed the entire user guide. You should try to simulate the task(s) that you expect to perform when you permanently install your application (however, do not attach a load at this time). This will give you a realistic preview of what to expect from the complete configuration.

⑤ After you have tested all of the system's functions and used or become familiar with all of the system's features, carefully read *Chapter 3, Installation*.

⑥ After you have read Chapter 3 and clearly understand what must be done to properly install the system, you should begin the installation process. Do not deviate from the sequence or installation methods provided.

⑦ Before you begin to customize your system, check all of the system functions and features to ensure that you have completed the installation process correctly.

The successful completion of these steps will prevent subsequent performance problems and allow you to isolate and resolve any potential system difficulties before they affect your system's operation.

Conventions

To help you understand and use this user guide effectively, the conventions used throughout this user guide are explained in this section.

Warnings & Cautions

Warning and caution notes alert you to possible dangers that may occur if you do not follow instructions correctly. Situations that may cause bodily injury are presented as warnings. Situations that may cause system damage are presented as cautions. These notes will appear in bold face and the word warning or caution will be centered and in all capital letters. Refer to the examples shown below.

WARNING

Do not touch the motor immediately after it has been in use for an extended period of time. The motor may be hot.

CAUTION

System damage will occur if you power up the system improperly.

Related Publications

Current Parker Compumotor Motion Control Catalog

Chapter 1. Introduction

Chapter Objective

The information in this chapter will enable you to:

- ❏ Understand the product's basic functions and features

Product Description

The LN Drive is a linear, microstepping amplifier. The FCC Class A approved LN Drive, was designed specifically for applications where EMI (Electromagnetic Interference) must be kept to an absolute minimum.

The LN Drive is capable of driving two phase permanent magnet hybrid rotary and linear motors. The LN Drive has sixteen motor resolutions that extend from 200 to 101,600 steps per revolution, as well as eight different waveforms. These features give the user excellent capabilities to control motor smoothness and accuracy.

The LN Drive has additional user features which allow the user to select between 115/230VAC, eliminating the need for a transformer. The Autostandby feature allows the drive to automatically switch to 50% of the preset current, allowing the motor and drive to cool when not in use. the unique Autotest feature allows the user to quickly determine that all connections and settings have been properly made.

Features

The LN Drive requires no external power supply, it uses 115/230VAC for its power inputs. Compumotor motors are two-phase hybrid motors (permanent magnet type). Four, six, or eight lead motors may be used, with the internal phases connected for either parallel or series operation, provided the motor's inductance does not drop below 5 mH. *For best performance, motor inductance should be above 5 mH, but motor with inductance ratings as low as 0.5 mH may be used.* The LN Drive also provides the following features:

- ❏ Microprocessor controlled microstepping provides smooth operation over a wide range of speeds
- ❏ FCC approved linear amplifier, produces virtually no conducted or radiated EMI
- ❏ Full short circuit protection for phase-to-phase and phase-to-ground short circuits
- ❏ Overtemperature and undervoltage protection
- ❏ Uses low-inductance motors for improved high-speed performance (17, 23, 34 frame size motors available with torques from 15-150 oz-in)
- ❏ LED status indicator: power, undervoltage, overtemperature (latched), motor fault (latched)
- ❏ Motor connector interlock to prevent connector damage
- ❏ Optically coupled step, direction, and shutdown are compatible with all Compumotor indexers (25-pin D connector)
- ❏ A fault output signals other equipment if a fault occurs
- ❏ 90-135VAC/185-275VAC, 50/60Hz power input, switch selectable
- ❏ 16 DIP switch selectable motor resolutions are available (200 - 101,600 steps/rev)
- ❏ Operates linear motor forcers
- ❏ 2 mHz step input

Chapter 2. Getting Started

Chapter Objectives

The information in this chapter will enable you to:

- ❏ Verify that each component of your system has been delivered safely
- ❏ Become familiar with the system components and their interrelationships
- ❏ Ensure that each component functions properly by bench testing

What You Should Have

Inspect the LN Drive upon receipt for obvious damage to its shipping container. Report any such damage to the shipping company. Parker Compumotor cannot be held responsible for damage incurred in shipment. The following items should be present and in good condition.

Part	Part Number
Power Cable	44-000054-01
LN Drive	LN-Drive
LN Drive User Guide	88-011931-01
Motor	Variety of sizes available*

*Refer to Table 2-2 for specific motor sizes

Table 2-1. Ship Kit List

Quick Test

This section will show you how to set the DIP switches and wire the unit quickly to ensure that your system is operating properly. Detailed installation instructions are provided in *Chapter 3, Installation*. You will need the following tools to complete these steps:

- ❏ A phillips head screw driver (to make the connections)
- ❏ A flat screw driver (to adjust the DIP switches)

WARNING

Do not apply power to the system until this entire chapter has been read.

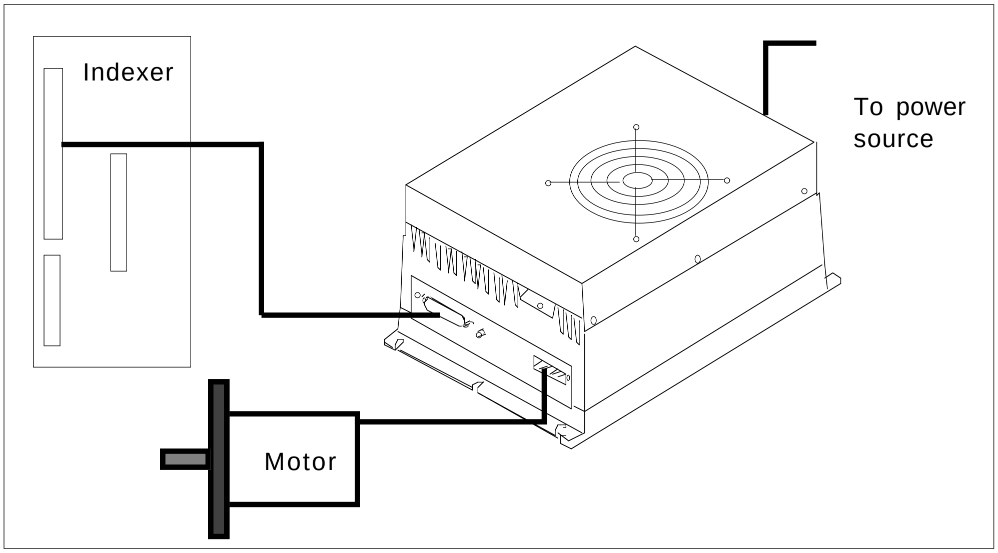

Figure 2-1. System Diagram

① *Set DIP Switches*

> **CAUTION**
>
> **Never adjust the DIP switches with a pencil. Lead from the pencil may damage the drive.**

The first thing that you must do is set the motor current on the LN Drive to match the motor that you are using. Use the directions below to set the DIP switches for your motor. (*To prevent damage to motors due to improper motor current settings, all LN Drives are shipped at the minimum motor current setting*).

The LN Drive has two sets of DIP switches. The first set of switches will be referred to as **SW1** and the second set as **SW2**. The individual switch will be preceded by the # symbol. Hence, the third switch on **SW1** will be referred to as **SW1-#3**, while the third switch on **SW2** will be referred to as **SW2-#3**. Figure 2-2 shows the location of the LN Drive's DIP switches.

The LN Drive recognizes changes to its switch settings during power-up only.

> **CAUTION**
>
> **The ergonomics of the DIP switches is physically reversed (upside down). The drive's installation label and all the tables in this user guide have been reversed, (8-1 instead of 1-8) to prevent installation errors.**

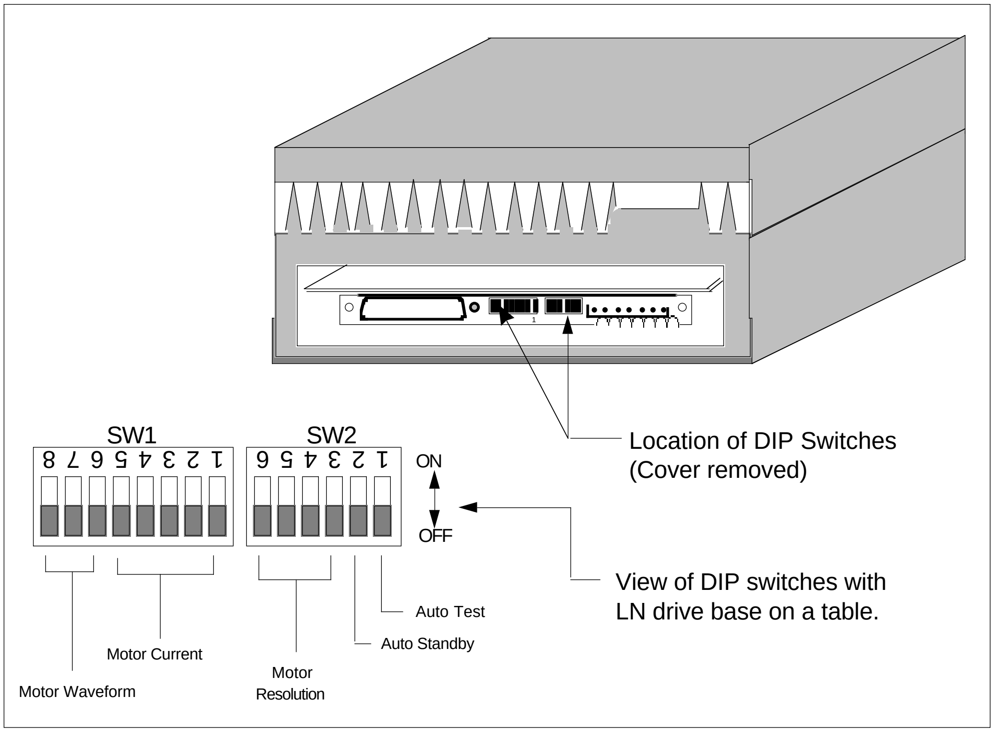

Figure 2-2. DIP Switch Locations

> **WARNING**
>
> **Be sure that power is not applied to the unit.**

① Remove the panel that covers the DIP switches (refer to Figure 2-2).

② Set the motor current for your Compumotor motor using Table 2-2. **SW1-#5** thru **SW1-#1** ***motor current*** (refer to Figure 2-2 for the location of the **SW1**). Make the required adjustments to match the drive and motor types that you are using.

Table 2-2 shows motor current settings for series and parallel motor configurations. ***Compumotor ships all LN Drive systems in series configurations***.

Motor Size	Drive Current	SW1-#5	SW1-#4	SW1-#3	SW1-#2	SW1-#1
LN43-34**S**	0.62	off	off	off	on	off
LN57-51**S**	1.17	off	off	off	off	on
LN57-83**S**	1.58	off	on	on	off	on
LN57-102**S**	1.78	on	off	off	on	on
LN83-62**S**	2.20	on	on	on	on	on

S: Series Configuration

Table 2-2. Setting Motor Current (Compumotor Motors)

If you are using a *non-Compumotor motor*, special precautions and instructions are required. Read the instructions in *Chapter 3, Installation* for non-Compumotor motors thoroughly before attempting to set the motor current or wire your motor.

③ To test the system, you will use the Automatic Test function. DIP switch **SW2-#1** controls this function (refer to Figure 2-2 for the location of the **SW2**). Turn **SW2-#1** on to enable the function. The Automatic Test function rotates the motor in an alternating move of slightly less than 6 revolutions at 1 rps.

④ After you have properly set motor current (**SW1-#5** thru **SW1-#1**) and the Automatic Test function (**SW2-#1**), screw the plate that covers the DIP switches back onto the drive. **Do not change any other DIP switch settings**.

⑤ Replace the cover.

② *Attaching the Motor*

> **WARNING**
>
> **POWER MUST BE OFF before cabling the drive. <u>Lethal voltages</u> are present inside the drive and on its screw terminals.**

The LN Drive motor is pre-wired in series. Plug the pre-wired motor cable into the motor connector on the drive (refer to Figure 2-4). If you use a non-Compumotor motor, refer to *Chapter 3, Installation* for instructions on wiring the motor to the drive. **Do not connect the motor to the load at this time.**

③ *Setting Voltage Select Switch*

The LN Drive is capable of using either 115VAC or 230VAC. You must select the voltage prior to applying power to the drive. The default is 115VAC.

① Remove the clip and panel that cover the voltage select switch (Figure 2-3).
② Determine what supply voltage will be applied to the unit, 115 or 230VAC.
③ Set the voltage select switch to the position required.
④ Replace the switch cover and clip.

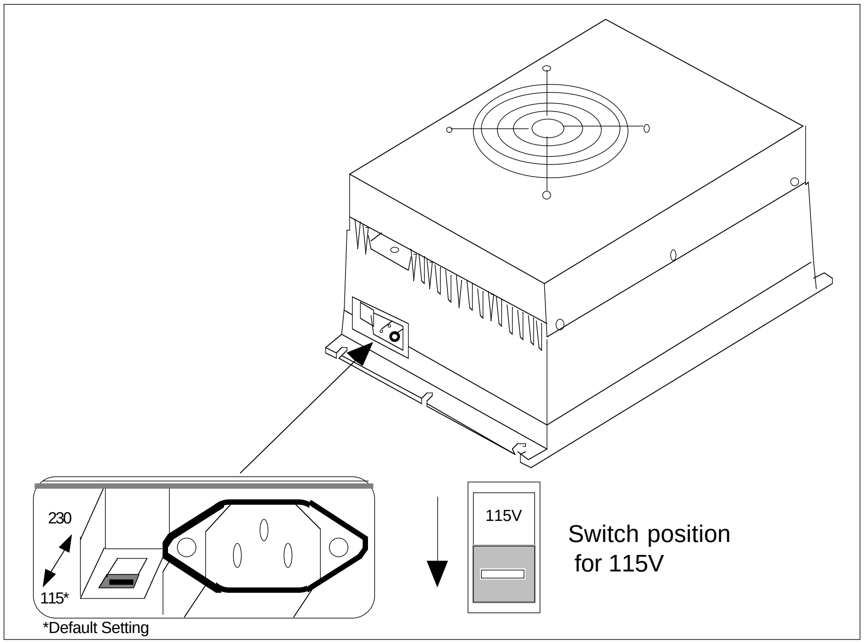

Figure 2-3. Voltage Select Switch Location

④ Applying Power

The power cable is provided. Complete the following steps to apply power.

① Plug the cable into the power connector on the drive (refer to Figure 2-4).

② Plug the other end of the cable into your voltage source. Observe that the fan is operating and the status LED is green. The motor should rotate CW and then CCW approximately 6 revolutions at 1 revolution per second (rps).

③ **To stop the motor, you must unplug the power cable from the power source.**

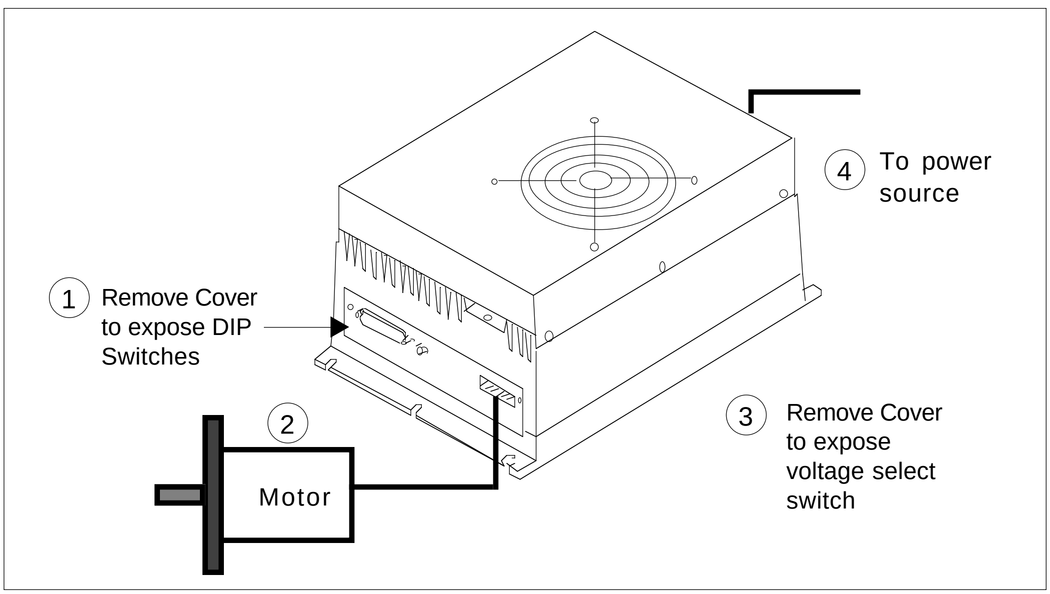

Figure 2-4. Test Configuration

The successful completion of this test indicates that the amplifier, motor, and microprocessor are operating properly. You can now test the indexer interface (Step, Direction, and Shutdown inputs). Be sure that power is not applied to the system when you begin. To perform this test, complete the following steps.

⑤ Quick Test with Indexer

With no power applied to the drive, perform the following steps to test the indexer interface. *This test assumes that your indexer's motor resolution is set to 50,000 steps/rev. This is the default motor resolution setting for the LN Drive.*

① Remove the panel that covers the DIP switches. Turn DIP switch **SW2-#1 off** to disable the Automatic Test function. Ensure that switches **SW2-#3** through **SW2-#6** are off. **Do not change any other DIP switch settings**. Screw the panel back onto the drive.

② Connect your Compumotor indexer to the drive's 25-pin D indexer connector (refer to Figure 2-1). The appropriate cable is provided with the indexer.

③ Ensure that the pre-wired motor cable is connected (refer to Figure 2-1). Apply power to the drive and indexer.

④ Using the indexer, send step pulses to the drive that will rotate the motor one CW revolution (50,000 step pulses) at an acceleration of 1 rps^2 and a velocity of 1 rps (50,000 steps per second).

⑤ Using the indexer, send step pulses to the drive that will rotate the motor one CCW revolution at an acceleration of 1 rps^2 and a velocity of 1 rps (50,000 steps per second).

⑥ Now you will test the Shutdown input. With no step pulses applied to the drive, activate the Shutdown input. Refer to your indexer's operations manual for instructions on activating the Shutdown input.

By activating the Shutdown input, all current will be removed from the motor, and the status indicator should be red. You should be able to turn the motor shaft manually. Try to turn the shaft slowly. If you can turn it easily, the Shutdown input is working properly. If the shaft still has torque, check your wiring and try the test again.

Chapter 3. Installation

Chapter Objectives

The information in this chapter will enable you to:

- ❏ Ensure that the complete system is installed correctly
- ❏ Mount all system components properly

Before proceeding with this chapter, you should have completed the steps and procedures in *Chapter 2, Getting Started*.

Installation Precautions

This section contains precautions that you must recognize and follow to configure and operate your LN Drive system properly.

Environmental Considerations

104°F (40°C) maximum allowable ambient temperature. An internal thermostat will shut down the drive if this ambient temperature is exceeded.

Wiring Considerations

There are hazardous voltages present on the LN Drive's connectors when power is applied. To prevent injuries to personnel and damage to equipment, note the following guidelines:

- ❏ Never connect/disconnect the motor from the drive when power is applied. Power should never be applied to the drive when the motor is not connected.
- ❏ Never increase the current setting (using the drive's DIP switches) to more than 10% greater than the current specified for the motor you are using. Excessive current may cause the motor to overheat and result in a motor failure.
- ❏ Never extend the **INLK** jumper beyond the connector. This jumper is intended to protect the motor connector and should **not** be used as a system interlock.
- ❏ **Never** probe the drive. **Never** connect anything other than the motor to the motor terminals. Probing or opening the drive in any other way will void the warranty. Hazardous voltages are present within the drive. **The thermal interface will be broken if you open the drive. The thermal interface is critical to the reliability of the drive.**

Grounding

Proper grounding of electrical equipment is essential to ensure safety. All Compumotor equipment should be properly grounded. Refer to the National Electrical Code published by the National Fire Protection Association of Boston, MA for more information on grounding requirements.

In general, all components and enclosures must be connected to earth ground through a grounding electrode conductor to provide a low-impedance path for ground fault or noise included currents. All earth ground connections must be continuous and permanent. Compumotor recommends a single-point grounding setup. Prepare components and mounting surfaces prior to installation so that good electrical contact is made between mounting surfaces of equipment and enclosure. Remove the paint from equipment surfaces where the ground contact will be bolted to a panel and use star washers to ensure solid, bare metal contact.

For temporary installation, or when you cannot implement the grounding method described above, connect the GND terminal on the AC power connector to earth ground. Whenever possible, route high-power signals (i.e., motor and power) away from logic signals (i.e., step and direction, RS-232C, RS-422/485, parallel output) to prevent electrical noise problems.

Installation Overview

The procedures in this chapter will enable you to configure and wire your system. Figure 3-2 shows the front panel of the LN Drive. The following installation steps will be discussed:

- ❏ Series vs. Parallel Motor Wiring
- ❏ Motor/LN Drive Configuration (Wiring & Motor Current)
  - Compumotor Motors
  - Non-Compumotor Motors
- ❏ Set Other DIP Switches
- ❏ Wire Indexer to LN Drive
- ❏ Apply Power to LN Drive
- ❏ Test the System
- ❏ Mount the LN Drive and the motor
- ❏ Attach the Load

Do not deviate from the steps in this chapter. Do not wire or apply power to the system until you are instructed to do so. If you do not follow these steps, you may damage your system.

Series vs. Parallel Motor Wiring

LN Series motors are shipped from the factory wired in series. You may re-wire the motor (shown later in this chapter—*Wiring Configurations*). Parallel configurations provide more torque than series configurations provide at high speeds (refer to the speed/torque curves in *Chapter 4, Hardware Reference*). (You must observe certain precautionary measures to prevent overheating when using motors wired in parallel configurations (refer to *Non-Compumotor—Drive/Motor Connection* in this chapter).

Motor Heating

LN Series motors that are wired in series can be run continuously at speeds that incur peak motor loss. LN Series motors that are wired in parallel, however, cannot be run at peak motor loss levels continuously without overheating (unless extensive cooling measures are employed). Most applications do not require continuous slewing at high speed. The average motor loss will be within safe limits.

Motor Configuration

The LN Drive can run Compumotor and Non-Compumotor motors. This section provides instructions for configuring Compumotor and Non-Compumotor motors. ***Follow only the directions that apply to the type of motor that you are using.***

Compumotor Motors—Drive/Motor Connection

Compumotor motors are pre-wired in series and require no setup other than being plugged into the drive. If you plan to run the motor is series, no further setup is required.

Frame size 23 and 34 motors (LN57 or LN83) are 8 lead motors. Frame size 17 (LN43) are 4 lead motors. Figure 3-2 represents the motor winding color code for 8 lead, 23 and 34 frame size motors.

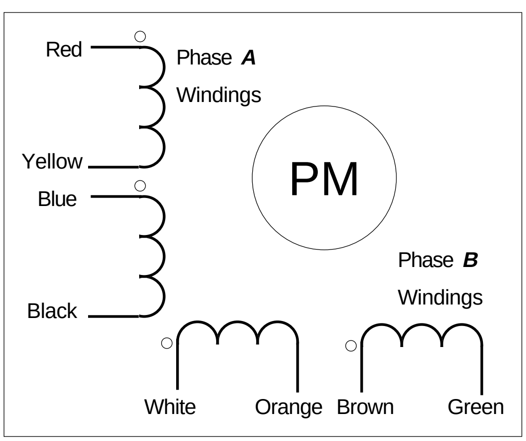

Figure 3-1. 8-Lead Motor Winding Color Code

LN Series motors in the 23 and 34 frame sizes (LN57 and LN83 series) are constructed with an 8 conductor motor cable to allow you to change the motor configuration on the connector at the drive.

9-Pin Motor Connector

Figure 3-2 shows the motor connector. Before connecting the motor, determine which motor wires correspond to Phase A and Phase B. The motor connector provides for easy installation when the motor is wired in series. **A-CT** and **B-CT** are not connections—they are terminal blocks used to terminate the center tap connections for series wired motors.

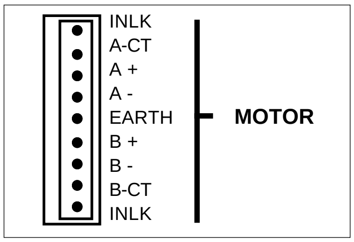

Figure 3-2. LN Drive Motor Connector

Table 3-1 show the color codes for the following types of motor to the LN Drive motor connector.

- ❑ 4 Lead Motors—(LN43)
- ❑ 8 Lead Motors—Series (LN57 and LN83)
- ❑ 8 Lead Motors—Parallel (LN57 and LN83)

	9 Pin — 8 Lead (Series)	9 Pin — 8 Lead (Parallel)	9 Pin — 4 Lead
Pin	**Color**	**Color**	**Color**
A-CT	Yellow & Blue	N.C.	N.C.
A+	Red	Red & Blue	Red
A-	Black	Black & Yellow	Black
EARTH	Shield	Shield	Shield
B+	White	White & Brown	White
B-	Green	Green & Orange	Green
B-CT	Orange & Brown	N.C.	N.C.
INLK	Jumper INLK to INLK	Jumper INLK to INLK	Jumper INLK to INLK

Table 3-1. Color Code—Motor Connector

Once you determine the wiring configuration, connect the motor to the drive's screw terminals according to the appropriate color code table. The following instructions should be also be completed.

① Connect shield to the motor connector's shield. **This is a very important safety precaution**. If your motor does not have a ground (shield) wire, attach a lug to the motor case and connect the motor to earth.

② Connect a short jumper wire from **INLK** (first pin of connector) to **INLK** (last pin of connector). This is a connector interlock designed to prevent connector damage in the event, it is removed while power is applied. The drive will not operate if this jumper is missing.

Extended Motor Cables

Table 3-2 contains the recommended motor cables for various motor types and the minimum recommended motor/driver wire size (AWG) and resistance.

Motor Series	Maximum Current Per Winding (Amps)	Less than 100 ft. (20.5M)	100 - 200 ft. (30.5M - 71M)
LN57	1.72	20 AWG	16 AWG
LN83	2.2	18 AWG	14 AWG

Table 3-2. Recommended Motor Cables

Cable runs of more than 200 feet (71M) are not recommended. Cable runs greater than 50 feet may degrade system performance.

Compumotor Motors—Setting Motor Current

Table 3-3 contains the proper motor current settings for Compumotor motors. **SW1-#5** thru **SW1-#1** control ***motor current***. Adjust the motor current to match the drive and motor that you are using. A Complete list of all current motor current settings is provided in *Chapter 4, Hardware Reference*.

	Motor Size	Drive Current	SW1-#5	SW1-#4	SW1-#3	SW1-#2	SW1-#1
	LN43-34**S**	0.62	off	off	off	on	off
	LN57-51**S**	1.17	off	off	off	off	on
	LN57-51**P**	2.2	on	on	on	on	on
	LN57-83**S**	1.58	off	on	on	off	on
*	LN57-83**P**	2.2	on	on	on	on	on
	LN57-102**S**	1.79	on	off	off	on	on
*	LN57-102**P**	2.20	on	on	on	on	on
	LN83-62**S**	2.20	on	on	on	on	on
*	LN83-62**P**	2.20	on	on	on	on	on

S: Series Configuration P: Parallel Configuration
*Not recommended

Table 3-3. Drive Motor Current (Compumotor Motors)

Wiring Configurations

You can determine the motor's wiring configuration by referencing the manufacturer's motor specification document supplied with the motor. You can also determine the wiring configuration with an ohmmeter using the procedures below (*4-Lead Motor, 6-Lead Motor, 8 Lead Motor*). Once you determine the correct motor wiring configuration, use the terminal connection diagram that applies to your configuration (Figure 3-5).

4-Lead Motor

① Label one motor lead **A+**.

② Connect one lead of an ohmmeter to the **A+** lead and touch the other lead of the ohmmeter to the three remaining motor leads until you find the lead that creates continuity. Label this lead **A-**.

③ Label the two remaining leads **B+** and **B-**. *Verify that there is continuity between the B+ and B- leads.*

④ Proceed to the *Terminal Connections* section below.

6-Lead Motor

① Determine, with an ohmmeter, which three of the six motor leads are common (one phase).

② Label each one of these three motor leads **A**.

③ Using the ohmmeter, verify that the remaining three leads are common.

④ Label the other three leads **B**.

⑤ Set the ohmmeter range to approximately the 100 ohm scale.

⑥ Connect the negative lead of the ohmmeter to one of the motor leads labeled **A**. Alternately measure the resistance to the two remaining motor leads also labeled **A**. The resistance measurements will reflect one of the following scenarios:

Scenario #1

The resistance measurements to the two remaining motor leads are virtually identical. Label the two remaining motor leads **A+** and **A-**. Label the motor lead connected to the negative lead of the ohmmeter **A-CT** (this is the center tap lead for Phase A of the motor).

Scenario #2

The resistance measurement to the second of the three motor leads measures 50% of the resistance measurement to the third of the three motor leads. Label the second motor lead **A-CT** (this is the center tap lead for Phase A of the motor). Label the third motor lead **A-**. Label the motor lead connected to the ohmmeter **A+**.

⑦ Repeat the procedure as outlined in step 6 for the three leads labeled **B** (**B-CT** is the center tap lead for Phase B of the motor).

⑧ Connect your 9-pin motor connector (**A-CT** motor lead) to the **A-CT** pin on the **motor** connector. Connect the **B-CT** motor lead to the **B-CT** pin on the **motor** connector.

⑨ Proceed to the *Terminal Connections* section below.

8-Lead Motor

Because of the complexity involved in phasing an 8-lead motor, you must refer to the manufacturer's motor specification document. You can configure the 8-lead motor in parallel or series. Using the manufacturer's specifications, label the motor leads as shown in Figure 3-3.

Parallel Configuration

Use the following procedures for parallel configurations.

① Connect motor leads labeled A1 and A3 together and relabel **A+**.
② Connect motor leads labeled A2 and A4 together and relabel **A-**.
③ Connect motor leads labeled B1 and B3 together and relabel **B+**.
④ Connect motor leads labeled B2 and B4 together and relabel **B-**.

Series Configuration

Use the following procedures for series configurations.

① Connect your LN Drive 9-pin motor connector (A2 and A3) to **A-CT**. You may also connect B2 and B3 to **B-CT**. Refer to Figure 3-5.

② Relabel the A1 lead to **A+**.

③ Relabel the A4 lead to **A-**.

④ Connect the motor leads labeled B2 and B3 together and cover this connection with electrical tape or shrink tubing. Make sure these leads are not connected to the LN Drive.

⑤ Relabel the B1 lead to **B+**.

⑥ Relabel the B4 lead to **B-**.

⑦ Proceed to the *Terminal Connections* section below.

Terminal Connections

After you determine the motor's wiring configuration, connect the motor leads to the 9-pin motor connector according to Figure 3-3.

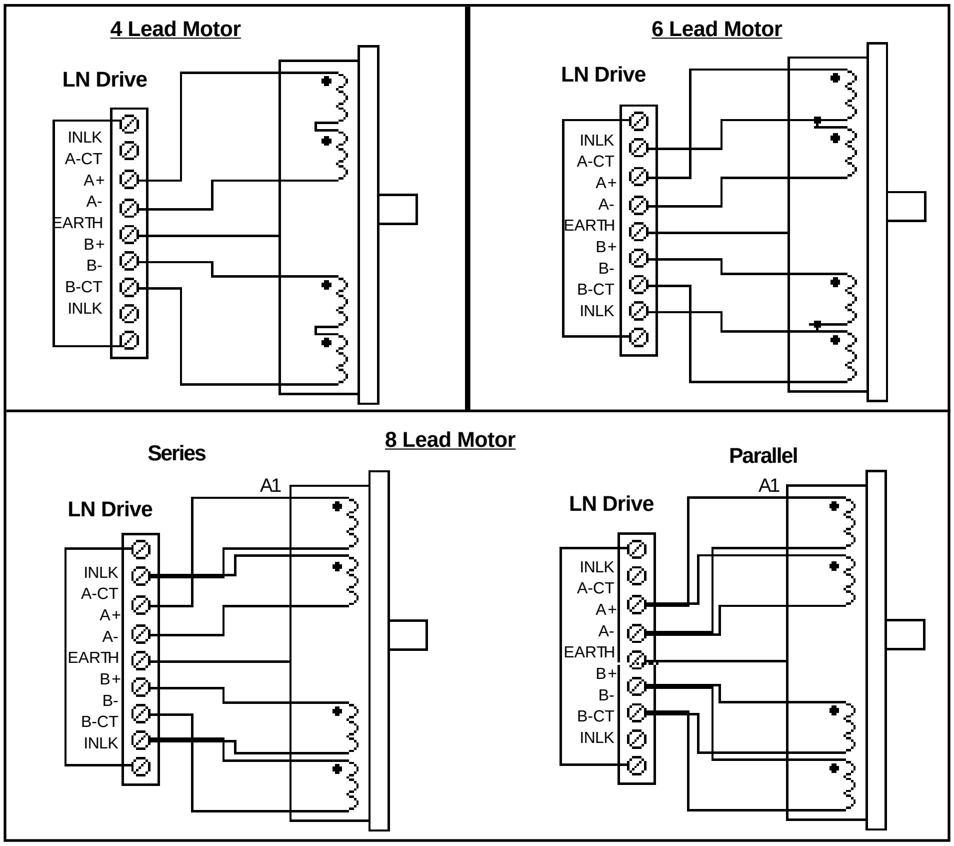

Figure 3-3. 9-Pin Motor Connector (Non-Compumotor Motors)

Extended Motor Cables

Table 3-4 contains the recommended motor cables for various motor types and the minimum recommended motor/driver wire size (AWG) and resistance.

Motor Series	Maximum Current Per Winding (Amps)	Less than 100 ft. (20.5M)	100 - 200 ft. (30.5M - 71M)
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Table 3-4. Recommended Motor Cables

Cable runs of more than 200 feet (71M) are not recommended. Cable runs greater than 50 feet may degrade system performance.

Non-Compumotor—Drive/Motor Connection

Compumotor does not recommend that you use non-Compumotor motors with the LN Drive. If you do use a non-Compumotor motor, it must meet the following requirements.

① A minimum inductance of 0.5 mH, series or parallel, may be used (Compumotor recommends a minimum inductance of 5 mH).

② A minimum of 500VDC high-pot insulation rating from phase-to-phase and phase-to-ground.

③ The motor must not have riveted rotors or stators.

④ Do not use solid rotor motors.

⑤ Test all motors carefully. Verify that the motor temperature in your application is within the system limitations. *The motor manufacturer's maximum allowable motor case temperature must not be exceeded*. You should test the motor over a 2- to 3-hour period. Motors tend to have a long thermal time constant, but can still overheat, which results in motor damage.

> **CAUTION**
>
> **Consult a Compumotor Applications Engineer if you intend to use a non-Compumotor motor.**

Non- Compumotor Motors—Setting Motor Current

Compumotor does not recommend that you use non-Compumotor motors with the LN Drive. If you do, refer to the formulas below that correspond to your motor (4-lead, 6-lead, or 8-lead) and use Table 3-11 to set the motor's current. **Never increase current more than 10% above the specified rating**.

4-Lead Motors If you use a 4-lead motor, the manufacturer's current setting will translate directly to the values shown in Table 3-5.

6-Lead Motors If you use a 6-lead motor, and the manufacturer specifies the motor current as a unipolar rating, you must use the following formula to convert the unipolar current rating to the correct bipolar rating.

Unipolar Current X .707 = Bipolar Current

After you make the conversion, use Table 3-12 to set the motor current. If the manufacturer specifies the motor current as a bipolar rating, you can use Table 3-7 directly (no conversion) to set motor current.

8-Lead Motors If you are using an 8-lead motor, manufacturers generally rate the motor current in one of two ways:

- ❑ If the motor current is listed as a unipolar rating, use the following formula to convert the unipolar current rating to the correct bipolar current rating.

  Unipolar Current X .707 = Bipolar Series Current

  If you are wiring the motor in ***series***, use Tables 3-11 and the converted value to set the motor current.

  If you wire the motor in ***parallel***, you must **double** the converted value and use Table 3-11 to set the motor current.

- ❑ If the motor current is listed as a bipolar series rating, you can wire the motor in ***series*** and use Table 3-11 directly (no conversion) to set motor current.

  If the motor current is listed as a bipolar series rating and you wire the motor in ***parallel***, you must **double** the manufacturer's rating and then use Table 3-11 to set the motor current.

If you have any questions with regard to the configurations, please call Compumotor's Applications Engineering Department at 800-358-9070.

LN Drive Current Settings

Current	SW5-#5	SW4-#4	SW3-#3	SW2-#2	SW1-#1
0.07	off	off	off	off	off
0.14	on	off	off	off	off
0.21	off	on	off	off	off
0.28	on	on	off	off	off
0.34	off	off	on	off	off
0.41	on	off	on	off	off
0.48	off	on	on	off	off
0.55	on	on	on	off	off
0.62	off	off	off	on	off
0.69	on	off	off	on	off
0.76	off	on	off	on	off
0.82	on	on	off	on	off
0.89	off	off	on	on	off
0.96	on	off	on	on	off
1.03	off	on	on	on	off
1.10	on	on	on	on	off
1.17	off	off	off	off	on
1.24	on	off	off	off	on
1.31	off	on	off	off	on
1.38	on	on	off	off	on
1.44	off	off	on	off	on
1.51	on	off	on	off	on
1.58	off	on	on	off	on
1.65	on	on	on	off	on
1.72	off	off	off	on	on
1.79	on	off	off	on	on
1.86	off	on	off	on	on
1.93	on	on	off	on	on
1.99	off	off	on	on	on
2.06	on	off	on	on	on
2.13	off	on	on	on	on
2.20	on	on	on	on	on

Table 3-5. Setting Drive Motor Current (Non-Compumotor Motors)

Configuration of the Drive

In this section, you will set the following DIP switch selectable functions:

- ❏ Motor Waveform setting
- ❏ Motor Resolution setting
- ❏ Auto Standby function
- ❏ Auto Run function

Setting Motor Waveforms

Motor Waveforms help you to overcome resonance problems and allow the motor to run smoothly. DIP switches **SW1-#8** thru **SW1-#6** control the waveform shape (refer to Table 3-6). *This function will not operate when the 200-step motor resolution is used, or when the Automatic Test function (SW2-#1) is enabled.*

Waveform Shape	SW1-#8	SW1-#7	SW1-#6
+2—3rd	on	on	on
+1—3rd	off	on	on
Pure Sine	on	off	on
-1—3rd	off	off	on
* **-2—3rd**	**off**	**off**	**off**
-3—3rd	off	on	off
-4—3rd	on	off	off
-6—3rd	on	on	off

* Default Setting

Table 3-6. Motor Waveform Settings

Setting Motor Resolutions

Switches **SW2-#6 - SW2-#3** control motor resolution (refer to Table 3-7). **Your indexer and drive must be set to the same resolution.** If the drive and indexer's motor resolution settings do not match, commanded accelerations and velocities will not be performed accurately.

	Resolution	SW2-#6	SW2-#5	SW2-#4	SW2-#3
	101,600	on	on	on	on
	100,000	off	on	on	on
	50,800	on	off	on	on
*	**50,000**	**off**	**off**	**off**	**off**
	36,000	on	on	off	on
	25,600	off	on	off	on
	25,400	on	off	off	on
	24,000	off	off	off	on
	21,600	on	on	on	off
	20,000	off	on	on	off
	18,000	on	off	on	off
	12,800	off	off	on	off
	10,000	on	on	off	off
	5,000	off	on	off	off
	2,000	on	off	off	off
	200	off	off	on	on

* Default Setting

Table 3-7. Motor Resolution Settings

Automatic Standby Function

The Automatic Standby function allows the motor to cool when it is not moving. This function reduces the current to the motor 50% when the drive does not receive a step pulse for one second. Switch **SW2-#2** controls Automatic Standby. Full power is restored upon the first step pulse that the drive receives. *Do not use this function in systems that use an indexer and an encoder for position maintenance.* ***If used in this environment, the system will go in and out of the Auto Standby mode.***

	Auto Standby	SW2-#2
	Enabled	ON
*	Disabled	OFF

* Default

Automatic Run Function

The Automatic Run (***DIP switch* SW2-#1**) function turns the motor shaft slightly less than six revolutions in Alternating mode at 1 rps. The Automatic Standby function and motor resolution settings are disabled when you use the Automatic Run function.

	Auto Run	SW2-#1
	Enabled	on
*	Disabled	off

* Default Setting

Drive/Indexer Connection

If you are using a Compumotor indexer, plug the indexer cable into the LN Drive's indexer connector. If you are using a non-Compumotor indexer, the indexer must meet the specifications listed below. Use Figure 3-2 to wire the indexer to the drive.

Step, Direction & Shutdown Signal Specifications

The inputs are optically isolated and may be driven (activated) by providing a positive pulse to the *plus* input with respect to the *minus* input. These inputs may also be differentially driven. The input driver must provide a minimum of 6.5 mA (15 mA maximum). Figure 3-4 is a schematic of the inputs.

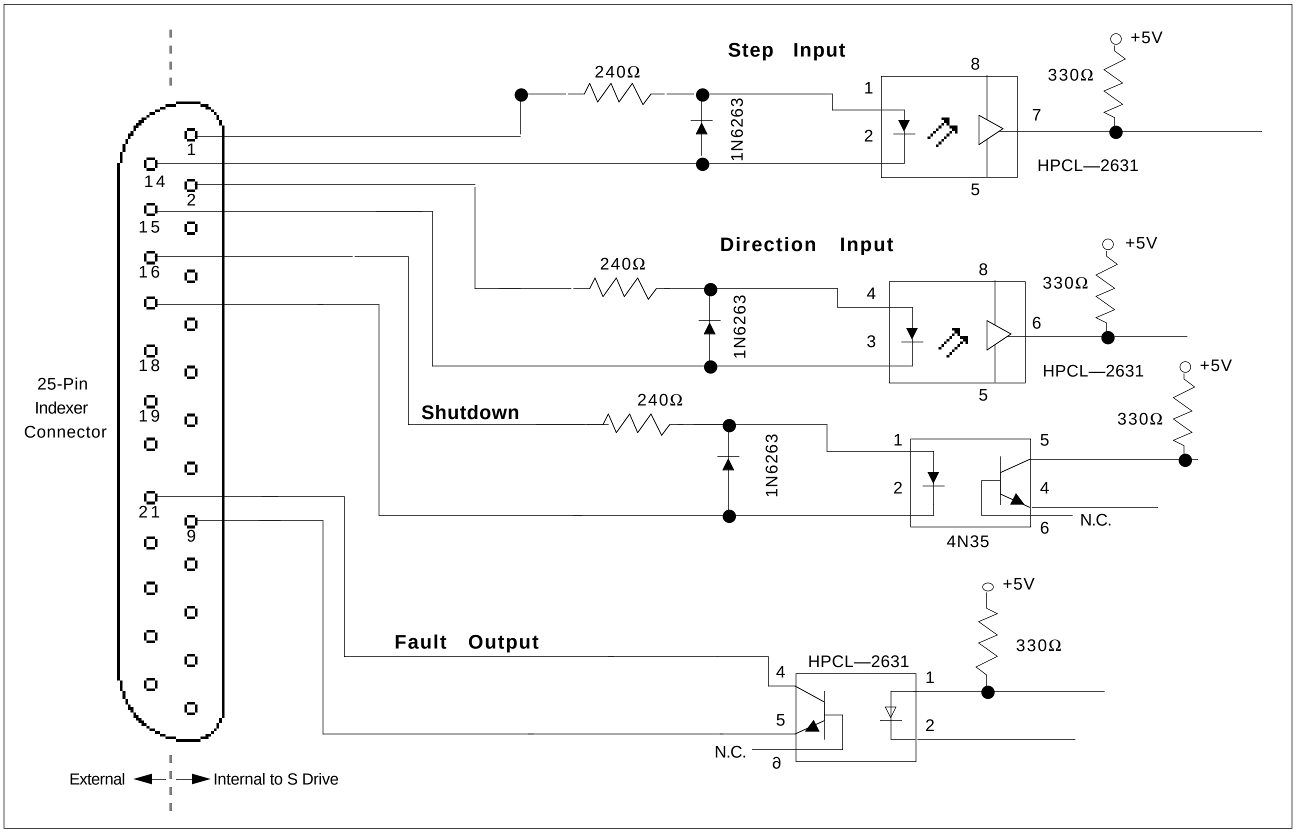


Figure 3-4. LN Drive I/O Schematic

Step Pulse Input

You must operate the step pulse input within the following guidelines.

- ❑ 200 nanosecond-pulse minimum
- ❑ 40% - 60% duty cycle (2 MHz max pulse rate)

Direction Input

The direction input may change polarity coincident with the last step pulse. The direction input must be stable for at least 0.3 ms before the drive receives the next pulse.

Shutdown Input (Amplifier Disable)

You can enable it when the motor is not moving. The input must be active for 100 ms to disable the amplifier. The shutdown input must be inactive for 100 ms before the first step pulse is received.

Fault Output

This output is an open-collector, open emitter output from a 4N35 OPTO isolator. The output transistor will conduct when the drive is functioning properly. The transistor will not conduct when any of the following conditions exist:

- ❑ No power is applied to the drive
- ❑ There is insufficient AC line voltage (90VAC)
- ❑ The drive temperature is too high
- ❑ The drive detects a motor fault
- ❑ The Shutdown input is enabled

Electric Parameters: Outputs

This output has the following characteristics:

- ❑ V_{CE}(max) = 30VDC
- ❑ V_{CESAT} = 0.3VDC maximum
- ❑ Collector Current toi saturate = 15 mA minimum
- ❑ Dissipation = 300 mW maximum
  Formula:
  Dissipation =I_c * V_{ce} @ 5V on pin 21, require 330Ω to GND on pin 9

AC Power Connection

CAUTION

AC power to the LN Drive is switchable between 115VAC and 230VAC. Be sure that proper voltage is applied to the drive. Low-voltage limit is 90VAC or 185VAC.

Testing the System

With no power applied to the drive, perform the following steps to test your installed LN Drive system.

① Ensure that all DIP switches are properly set for the motor and indexer that you are using.
- ❑ Motor Current
- ❑ Automatic Standby Function
- ❑ Motor Resolution (must match indexer)
- ❑ Motor Waveform
- ❑ Automatic Test Function (should be off)

② Check your connections. Ensure that the system is properly configured.

③ **Apply power to the system *(make sure the fan is operating properly)*.** The Status LED should be green

④ Using the indexer, send step pulses to the drive that will rotate the motor one CW revolution at an acceleration of 1 rps^2 and a velocity of 1 rps.

When the drive receives the step pulses, the motor should rotate one CW revolution.

⑤ Using the indexer, send step pulses to the drive that will rotate the motor one CCW revolution at an acceleration of 1 rps^2 and a velocity of 1 rps.

When the drive receives the step pulses, the motor should rotate one CCW revolution.

⑥ Now you will test the shutdown input. With no step pulses applied to the drive, activate the shutdown input. Refer to your indexer's operations manual for instructions on activating the shutdown input.

By activating the shutdown input, all current will be removed from the motor. You should be able to turn the motor shaft manually. Try to turn the shaft slowly now. If you can turn it easily, the shutdown input is working properly. If the shaft still has torque, check your wiring and try the test again.

Drive Mounting

Mounting of the LN Drive is done by fastening the unit to a flat surface. Be sure to secure the drive using all four of the mounting slots. The mounting slots are designed for number ten screws or bolts. (Refer to Figure 3-5.)

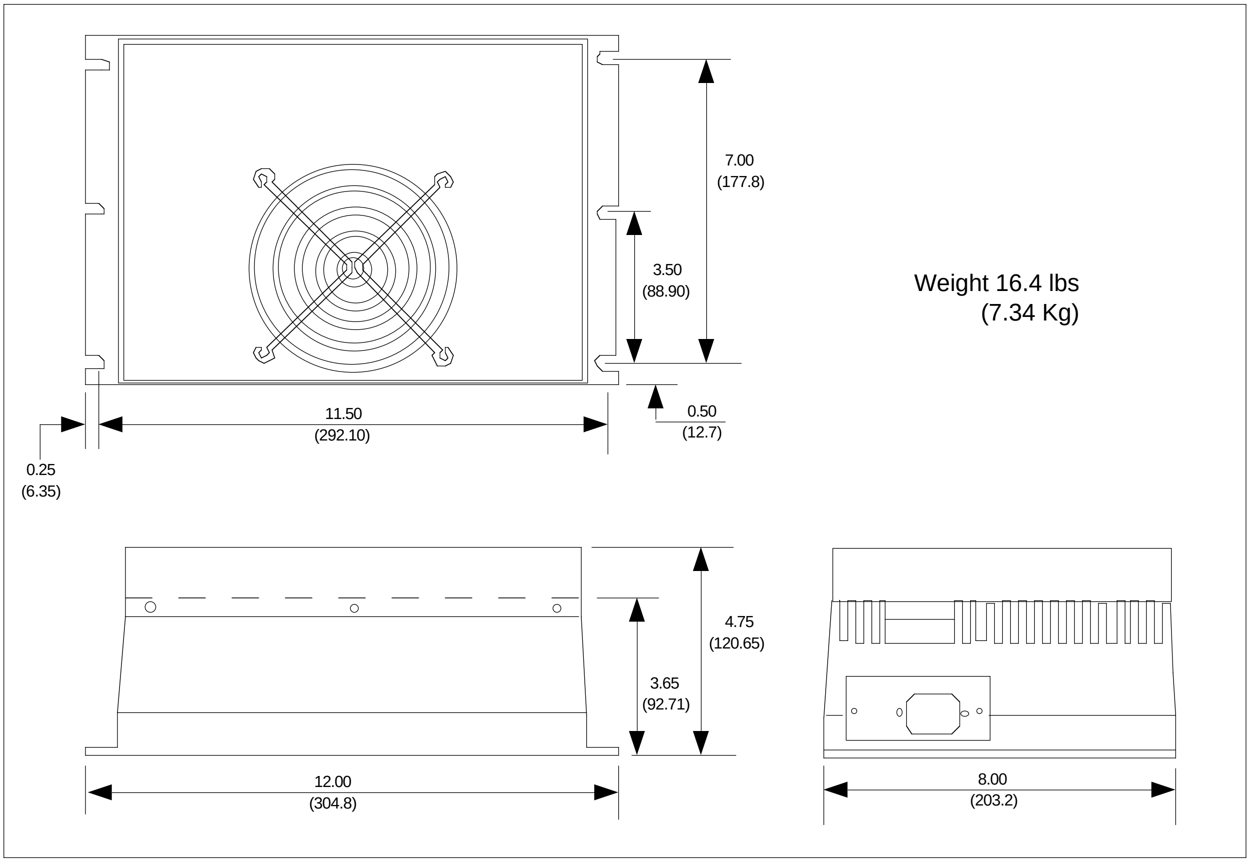


Figure 3-5. Mounting the Drive

Panel Layout If you mount the LN drive in an enclosure, observe the following guidelines:

① The vertical and horizontal clearance between the LN Drive and other equipment, or the top or bottom of the enclosure, should be no less than 4 inches. (Refer to Figure 3-6.)

② Do not mount large, heat producing equipment directly beneath the LN Drive.

③ Do not mount the LN Drive directly below an indexer (The LN Drive produces more heat than an indexer.)

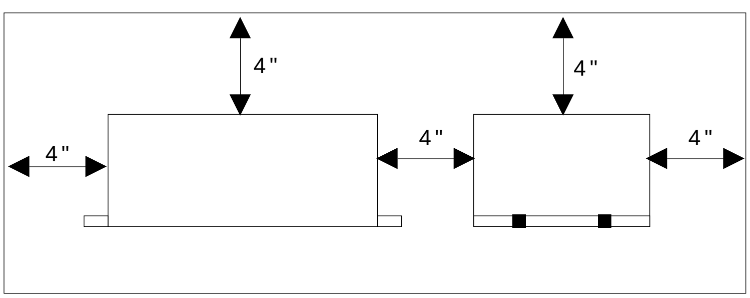


Figure 3-6. Enclosure Mounting Guidelines

Motor Mounting

Rotary stepper motors should be mounted using flange bolts and positioned with the centering flange on the front face. Foot-mount or cradle configurations are not recommended because the torque of the motor is not evenly distributed around the motor case and they offer poor registration. Any radial load on the motor shaft is multiplied by a much longer lever arm when a foot mount is used rather than a face flange.

> **WARNING**
>
> **Improper mounting can compromise system performance and jeopardize personal safety.**

The motors used with the LN Drive can produce very large torques. These motors can also produce high accelerations. This combination can shear shafts and mounting hardware if the mounting is not adequate. High accelerations can produce shocks and vibrations that require much heavier hardware than would be expected for static loads of the same magnitude. The motor, under certain profiles, can produce low-frequency vibrations in the mounting structure. These vibrations can also cause metal fatigue in structural members if harmonic resonances are induced by the move profiles you are using. A mechanical engineer should check the machine design to ensure that the mounting structure is adequate. **Do not attach the load to the motor yet. Coupling the load to the motor is discussed later in this chapter.**

> **CAUTION**
>
> **Consult a Compumotor Applications Engineer [800-358-9070] before you machine the motor shaft. Improper shaft machining can destroy the motor's bearings. *Never* disassemble the motor (it will cause a significant loss of torque).**

Attaching the Load

This section discusses the main factors involved when attaching the load to the motor. The following three types of misalignments can exist in any combination.

Parallel Misalignment

The offset of two mating shaft center lines, although the center lines remain parallel to each other.

Angular Misalignment

When two shaft center lines intersect at an angle other than zero degrees.

End Float

A change in the relative distance between the ends of two shafts.

Couplings

The motor and load should be aligned as accurately as possible. Any misalignment may degrade your system's performance.

There are three types of shaft couplings: single-flex, double-flex, and rigid. Like a hinge, a single-flex coupling accepts angular misalignment only. A double-flex coupling accepts both angular and parallel misalignments. Both single-flex and double-flex, depending on their design, may or may not accept end-play. A rigid coupling cannot compensate for any misalignment.

Single-Flex Coupling

When a single-flex coupling is used, one and only one of the shafts must be free to move in the radial direction without constraint. *Do not use a double-flex coupling in this situation because it will allow too much freedom and the shaft will rotate eccentrically; this will cause large vibrations and immediate failure.*

Double-flex Coupling

Use a double-flexed coupling whenever two shafts are joined that are fixed in the radial and angular direction (angular misalignment). *Do not use a single-flex coupling with a parallel misalignment; this will bend the shafts, causing excessive bearing loads and premature failure.*

Rigid Coupling

Rigid couplings are generally not recommended. They should be used only if the motor is on some form of floating mounts which allow for alignment compensation.

Coupling Manufacturers

HELI-CAL
901 McCoy Lane
P.O. Box 1460
Santa Maria, CA 93456
(805) 928-3851

ROCOM CORP
5957 Engineer Drive
Huntington Beach, CA 92649
(714) 891-9922

For unusual motor installations contact a Compumotor Applications Engineer for assistance.

Tuning

This section contains the issues and concerns that you should be aware of as you tune and develop your system.

- ❏ Resonance
- ❏ Mid-Range Instability

Resonance

Resonance exists in all stepper motors and is a function of the motor's mechanical construction. It can cause the motor to stall at low speeds. Most full step motor controllers *jump* the motor to a set minimum starting speed that is greater than the resonance region. The LN Drive's microstepping capability allows you to operate a motor smoothly at low speeds.

Motors that will not accelerate past 1 rps may be stalling due to resonance. You can add inertia to the motor shaft by putting a drill chuck on the shaft. The drill chuck may provide enough inertia to test the motor when it is ***not loaded.*** *In extreme cases, a viscous damper may also be needed. Refer to Chapter 4, Hardware Reference for the maximum inertia ratings for your motor.*

The LN Drive is set to a factory default to minimize resonance problems. If you are running the LN Drive at motor resolutions of 200 steps/rev, you may need an indexer that provides start/stop speed.

Mid-Range Instability

All step motors are subject to mid-range instability, also referred to as parametric oscillations. These oscillations may stall the motor at speeds from 6 to 16 rps.

Motor Waveforms

Step motor manufacturers make every effort to design step motors that work well with sinusoidal current waveforms. However, due to physical limitations, most motors operate best with a current waveform other than a pure sine wave.

The purpose of adjusting motor current waveforms is to set the step motor to move with a step size that is equal to the current waveforms that are sequenced through the motor. This *waveform matching* will also help the motor run more smoothly.

Adjusting the Motor Waveform

To adjust the LN Drive, follow the directions below:

① Connect an indexer and set the indexer controls so that the motor is running at maximum roughness, as shown in Table 3-8 for the 1st speed motor resonance.

② Adjust the waveforms for best smoothness (SW1-#6, SW1-#7, and SW1-#8). *The values in Table 3-8 are approximate resonant speed values.*

Motor Size	1st Speed Resonance	2nd Speed Resonance
LN43-34	0.9 rps	1.8 rps
LN57-51	0.9 rps	1.8 rps
LN57-83	.0.9 rps	1.8 rps
LN57-102	0.9 rps	1.8 rps
LN83-62	0.7 rps	1.4 rps

Table 3-8. Motor Resonance

③ Double the motor speed (2nd speed resonance) until the motor once again is running rough.

④ Repeat step 2 until no noticable difference is evident.

Chapter 4. Hardware Reference

Chapter Objectives

The information in this chapter will enable you to:

- ❑ Use this chapter as a quick-reference tool for most system specifications
- ❑ Use this chapter as a quick-reference tool for DIP switch settings

Environmental Specifications

Drive Temperature

104°F (40°C) maximum allowable ambient temperature. An internal thermostat will shut down the drive if this ambient temperature is exceeded.

Motor Temperature

212°F (100°C) maximum allowable motor case temperature. Actual temperature rise is duty cycle dependent.

Electrical Specifications

Input Power

90VAC to 135VAC/185VAC to 275VAC @ 50/60 Hz

Output Power

0.07 to 2.2A per phase @ ±24VDC

Winding Inductance

The minimum motor wiring inductance is 0.5 mH (Compumotor recommends 5 mH measured in series or parallel).

There is no maximum motor wiring inductance (Compumotor recommends 50 mH measured in series or parallel).

Minimum Motor Hipot

500VAC

Step Direction & Shutdown

The inputs are optically isolated and may be driven (activated) by providing a positive pulse to the *plus* input with respect to the *minus* input. These inputs may also be differentially driven. The input driver must provide a minimum of 6.5 mA (15 mA maximum). Figure 3-5 is a schematic of the inputs.

Step Pulse Input

You must operate the step pulse input within the following guidelines.

- ❑ 200 nanosecond-pulse minimum
- ❑ 40% - 60% duty cycle (2 MHz max pulse rate)

Direction Input

The direction input may change polarity coincident with the last step pulse. The direction input must be stable for at least .3 ms before the drive receives the first pulse.

Shutdown Input (Amplifier Disable)

You can enable it when the motor is not moving. The input must be active for 100 ms to disable the amplifier. The shutdown input must be inactive for 100 ms before the first step pulse is received.

Fault Output

This output is an open-collector, open emitter output from a 4N35 OPTO isolator. The output transistor will conduct when the drive is functioning properly. The transistor will not conduct when any of the following conditions exist:

- ❑ No power is applied to the drive
- ❑ There is insufficient AC line voltage (95VAC/185VAC)
- ❑ The drive temperature is too high
- ❑ The drive detects a motor fault
- ❑ The Shutdown input is enabled

Electric Parameters: Outputs

This output has the following characteristics:

- ❑ V_{CE} = 30VDC (maximum)
- ❑ V_{CESAT} = 0.3VDC
- ❑ Collector Current = 15 mA minimum to saturate
- ❑ Dissipation = 300 mW maximum
- ❑ Open Collector
- ❑ Open Emitter

Operational Specifications

Accuracy

±5 arc-minutes typical (unloaded, bidirectional) with Compumotor motors.

Repeatability

±5 arc-seconds typical (unloaded, unidirectional).

Hysteresis

Less than 2 arc-minutes (0.0334°) unloaded, bidirectional.

Rotor Inertia

Size 17	Rotor Inertia oz-in^2	Rotor Inertia Kg-cm^2
LN43-34	0.11	0.020
Size 23		
LN57-51	0.48	0.088
LN57-83	1.28	0.234
LN57-102	1.75	0.320
Size 34		
LN83-62	3.50	0.64

Table 4-1. Rotor Inertia (Compumotor Motors)

Motor Current & Torque

Speed/torque curves for the LN Drive are provided later in this chapter.

Motor Size	Current	Static Torque (in-oz)
LN43-34	.62	18
LN57-51 **S**	1.18	65
LN57-51 **P**	2.20	65
LN57-83 **S**	1.52	100
LN57-83 **P**	2.20	100
LN57-102 **S**	1.72	130
LN57-102 **P**	2.20	100
LN83-62 **S**	2.20	150
LN83-62 **P**	2.20	80

S: Series Configuration P: Parallel Configuration

Table 4-2. Motor Specifications

Drive Dimensions

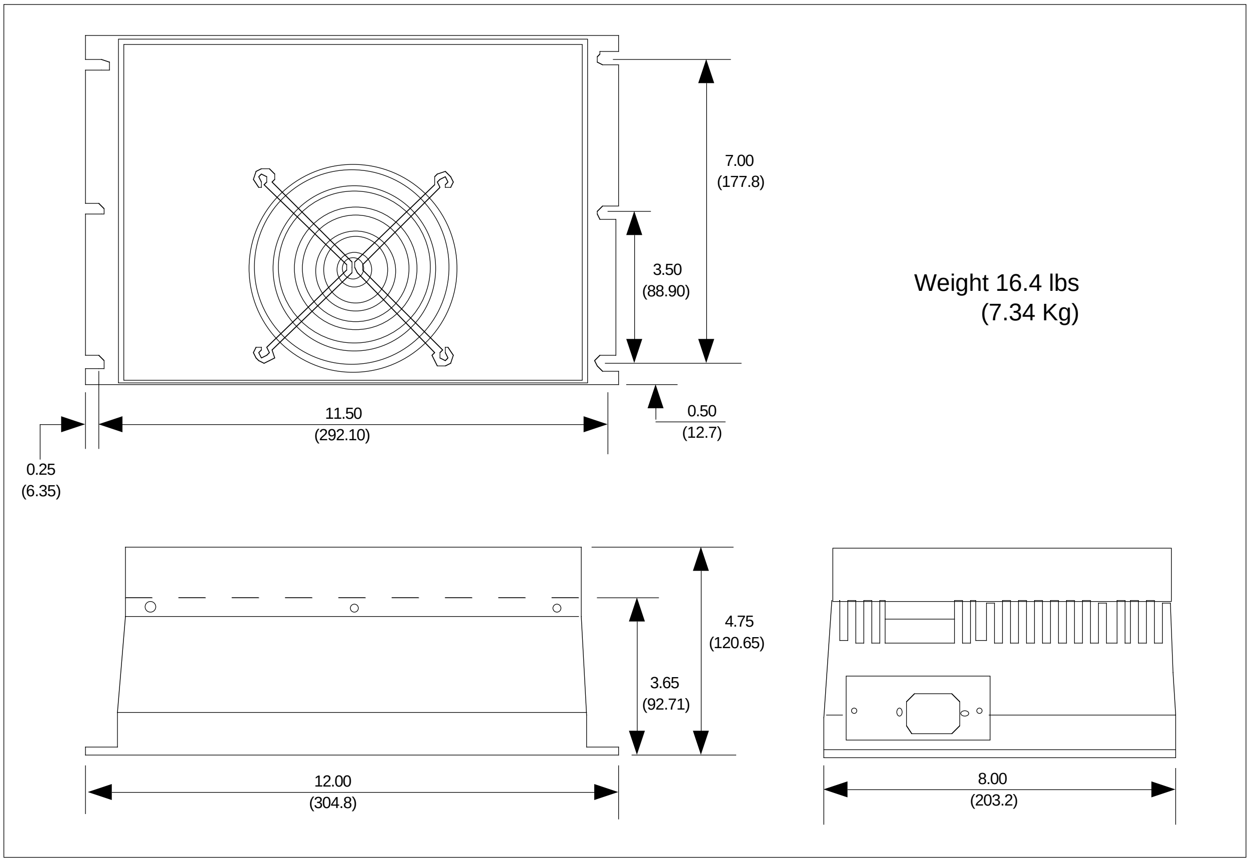


Figure 4-1. LN Drive Dimensions

Motor Dimensions

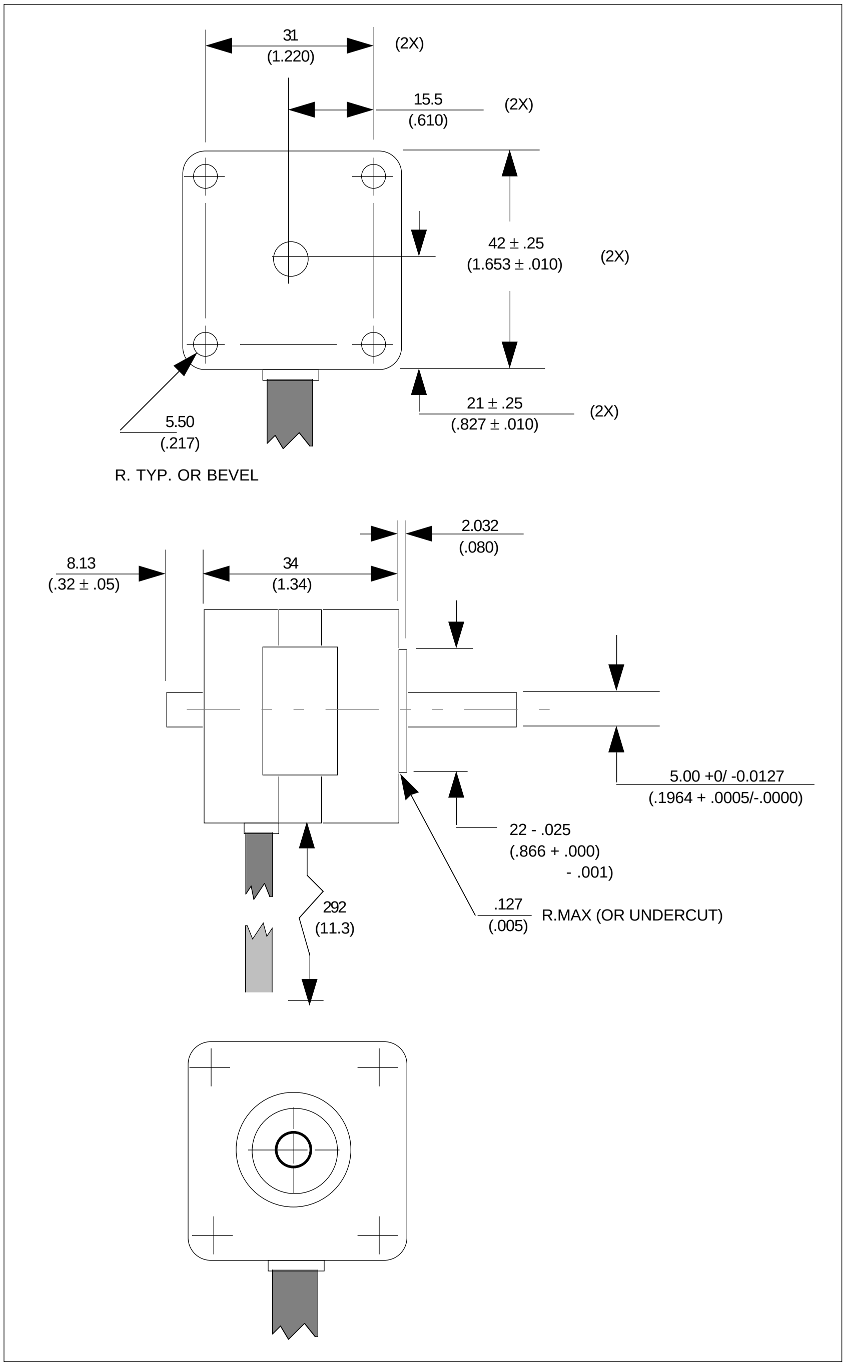
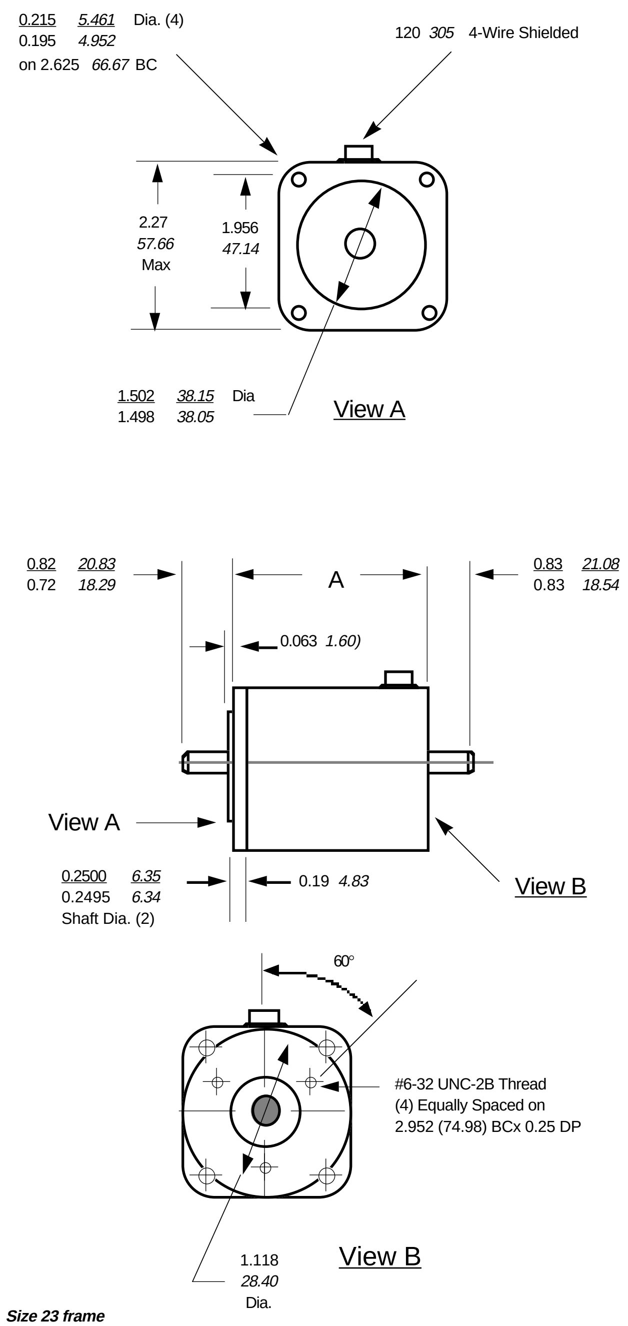
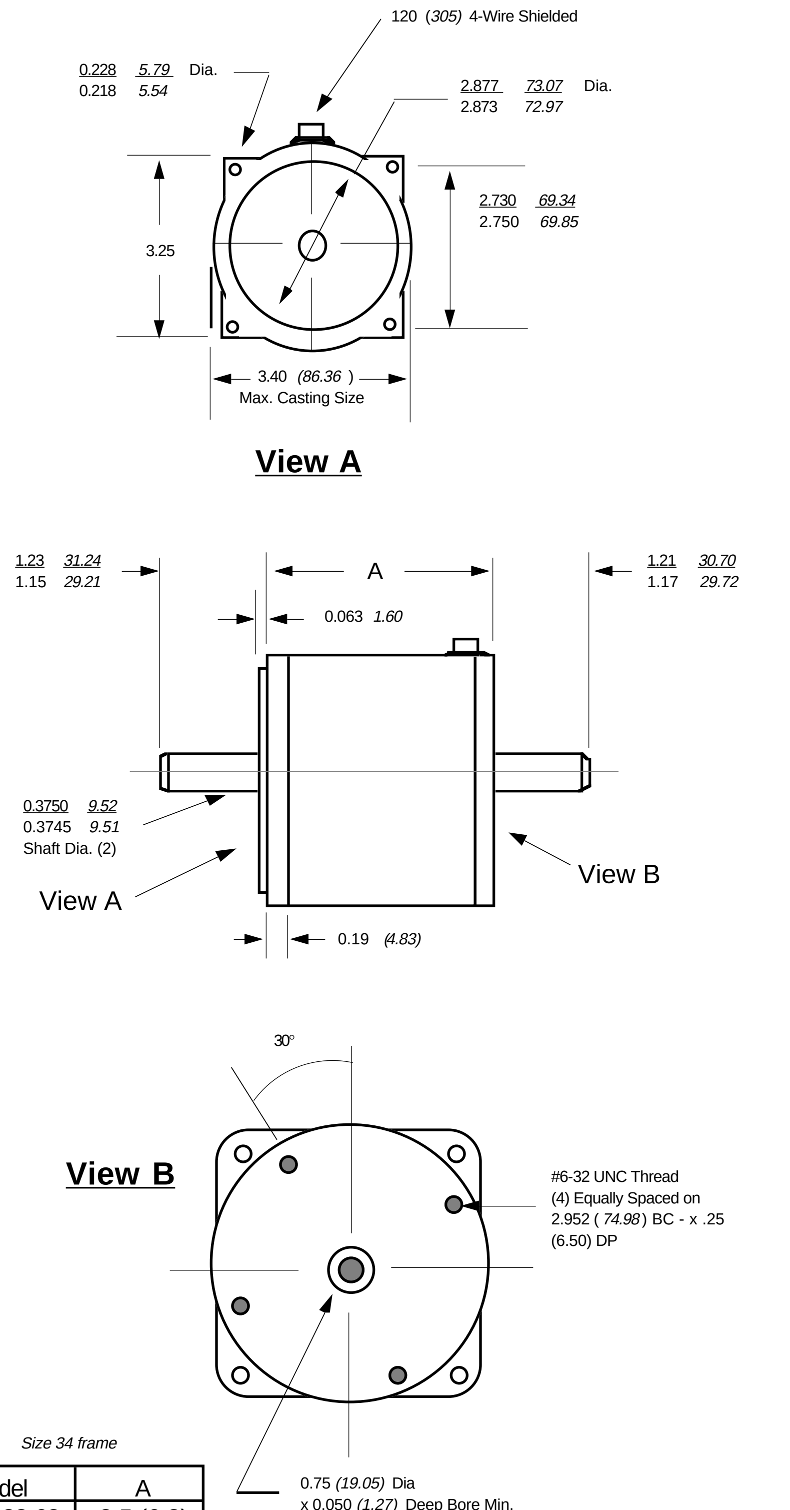


Figure 4-2. NEMA 17 Motor



Model	A
LN 57-51	2.0 (5.1)
LN 57-83	3.1 (7.8)
LN 57-102	4.0 (10.2)

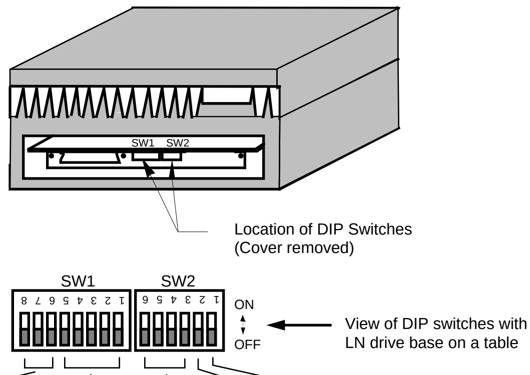
Figure 4-3. NEMA 23 Motor



Model	A
LN 83-62	2.5 (6.3)

Figure 4-4. NEMA 34 Motor

DIP Switch Summary



Motor Waveform

Waveform	#8	#7	#6
+2 — 3rd	on	on	on
+1 — 3rd	off	on	on
Pure Sine	on	off	on
-1 — 3rd	off	off	on
*-2 — 3rd	off	off	off
-3 — 3rd	off	on	off
-4 — 3rd	on	off	off
-6 — 3rd	on	on	off

Motor Current

Motor Size	#5	#4	#3	#2	#1
LN 43-34S	off	off	off	on	off
LN 57-51S	off	off	off	off	on
LN57-51P	on	on	on	on	on
LN57-83S	on	off	on	off	on
LN57-83P	on	on	on	on	on
LN57-102S	on	on	on	on	on
LN57-102P	on	on	on	on	on
LN83-62S	on	on	on	on	on
LN83-62P	on	on	on	on	on

S: Series Configuration
P: Parallel Configuration

Motor Resolutions

Resolution	#6	#5	#4	#3
101,600	on	on	on	on
100,000	off	on	on	on
50,800	on	off	on	on
*50,000	off	off	off	off
36,000	on	on	off	on
25,600	off	on	off	on
25,400	on	off	off	on
25,000	off	off	off	on
21,600	on	on	on	off
20,000	off	on	on	off
18,000	on	off	on	off
12,800	off	off	on	off
10,000	on	on	off	off
5,000	off	on	off	off
2,000	on	off	off	off
200	off	off	on	on

Auto Standby

Standby	#2
Enabled	on
*Disabled	off

Auto Run

Run	#1
Enabled	on
*Disabled	off

SW1 (Motor Waveform, Motor Current) — **SW 2** (Motor Resolutions, Auto Standby, Auto Run)

* Default Settings

Figure 4-5. DIP Switch Summary

Drive Current Settings

Current	SW1-#1	SW1-#2	SW1-#3	SW1-#4	SW1-#5
0.07	off	off	off	off	off
0.14	off	off	off	off	on
0.21	off	off	off	on	off
0.28	off	off	off	on	on
0.34	off	off	on	off	off
0.41	off	off	on	off	on
0.48	off	off	on	on	off
0.55	off	off	on	on	on
0.62	off	on	off	off	off
0.69	off	on	off	off	on
0.76	off	on	off	on	off
0.82	off	on	off	on	on
0.89	off	on	on	off	off
0.96	off	on	on	off	on
1.03	off	on	on	on	off
1.10	off	on	on	on	on
1.17	on	off	off	off	off
1.24	on	off	off	off	on
1.31	on	off	off	on	off
1.38	on	off	off	on	on
1.44	on	off	on	off	off
1.51	on	off	on	off	on
1.58	on	off	on	on	off
1.65	on	off	on	on	on
1.72	on	on	off	off	off
1.79	on	on	off	off	on
1.86	on	on	off	on	off
1.93	on	on	off	on	on
1.99	on	on	on	off	off
2.06	on	on	on	off	on
2.13	on	on	on	on	off
2.20	on	on	on	on	on

Table 4-3. Setting Drive Motor Current (Non-Compumotor Motors)

Indexer Connections

Pin #	Function	Color Codes
1	Step +	Red
2	Dir+	Green
9	Fault-	Yellow
14	Step-	Black
15	Dir-	White
16	Shutdown+	Blue
17	Shutdown-	Purple
21	Fault+	Orange

Table 4-4. Indexer Connections—Compumotor Supplied Cables

Motor Performance Specifications

The performance curves shown below indicate that different levels of performance can be obtained by connecting the step motor windings in series or in parallel.

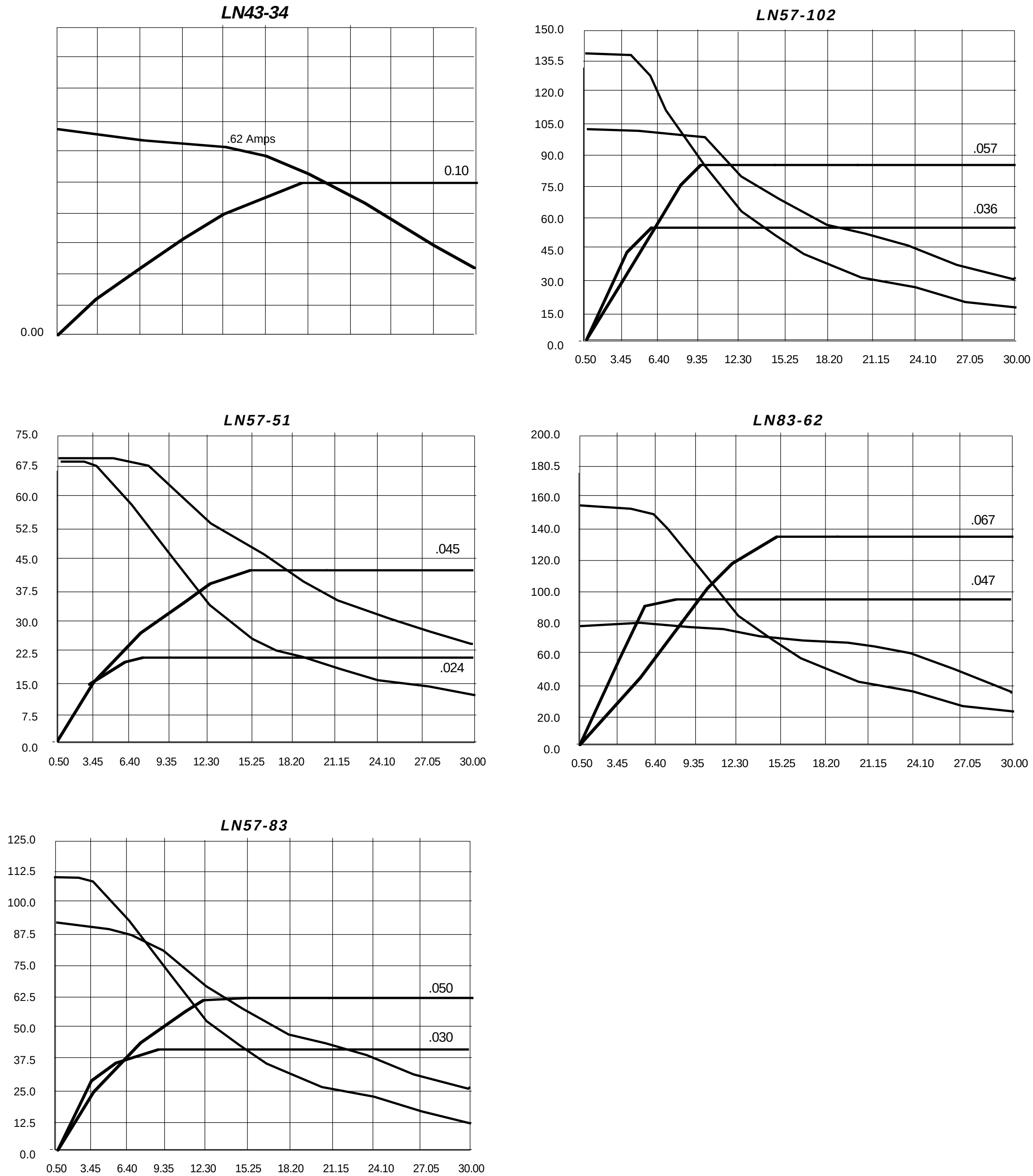


Figure 4-6. LN43-34 Speed Torque Curve

Chapter 5. Troubleshooting

Chapter Objectives

The information in this chapter will enable you to:

- ❑ Maintain the system's components to ensure smooth, efficient operation
- ❑ Isolate and resolve system hardware problems

Maintenance

The following items, which are included with the LN Drive, can be reordered from Compumotor.

Part	Part Number
9-Pin Phoenix Connector	43-008755-01
AC Power Cord	44-000054-01
25-Pin D Connector	43-004875-01*
Connector Cover	53-011638-01
Back Cover	53-011642-01

* Not included in original ship kit

Table 5-1. Spare Parts List

Drive Maintenance

Ensure that the drive heatsink is free of particles and has a free flow of air over its entire surface. Enclosures must be connected to earth ground through a grounding electrode conductor to provide a low-impedance path for ground-fault or noise-induced currents. All earth ground connections must be continuous and permanent.

Motor Maintenance

You should inspect all mechanical parts of the motor regularly to ensure that no bolts or couplings have become loose during normal operation. This will prevent some minor problems from developing into more serious problems.

You should inspect the motor cable periodically for signs of wear. This inspection interval is duty-cycle, environment, and travel-length dependent. The cable should not have excessive tensile force applied to it and should not be bent beyond a one-inch radius of curvature during normal operation. Tighten all cable connectors.

Problem Isolation

When your system does not function properly (or as you expect it to operate), the first thing that you must do is identify and isolate the problem. When you accomplish this, you can effectively begin to resolve and eradicate the problem.

The first step is to isolate each system component and ensure that each component functions properly when it is run independently. You may have to dismantle your system and put it back together piece by piece to detect the problem. If you have additional units available, you may want to use them to replace existing components in your system to help identify the source of the problem.

Determine if the problem is mechanical, electrical, or software-related. Can you repeat or re-create the problem? Do not make quick rationalizations about the problems. Random events may appear to be related, but they may not be contributing factors to your problem. Carefully investigate and decipher the events that occur before the subsequent system problem.

You may be experiencing more than one problem. You must solve one problem at a time. Document all testing and problem isolation procedures. You may need to review and consult these notes later. This will also prevent you from duplicating your testing efforts.

Once you have isolated the problem, take the necessary steps to resolve it. Refer to the problem solutions contained in this chapter. If your system's problem persists, contact Parker Compumotor at 800-358-9070.

LED

There is a Status indicator on the end of the LN Drive (refer to Figure 5-1).

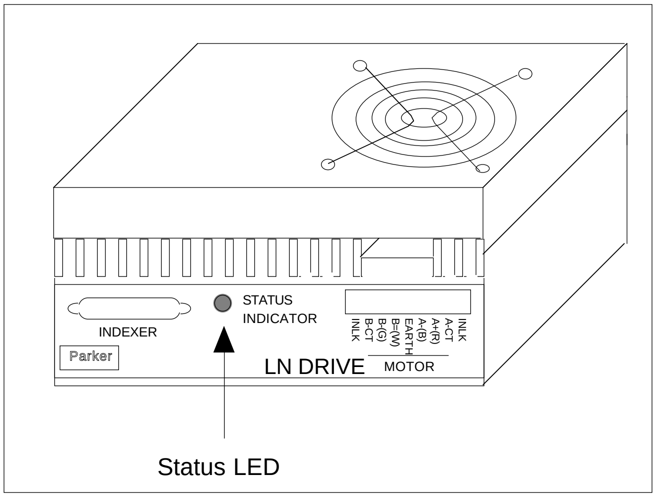


Figure 5-1. LED

The Status LED is **red** when any of the following conditions occur:

- ❑ Motor short-circuit
- ❑ The interlock is broken (opened)
- ❑ Shutdown enabled
- ❑ Overtemperature
- ❑ Undervoltage

Common Problems and Solutions

Table 5-2 contains common problems, probable causes, and solutions to the problems. It should help you eradicate most of the problems you might have with the LN Drive.

Symptoms	Probable Causes	Solutions
The status LED is not on (illuminated).	A. The drive is not receiving AC voltage.	A1. Verify that the connector on the drive is fully seated.
		A2. Verify that there is AC voltage at the AC outlet that the drive is plugged into.
		A3. Verify that there is AC voltage at the drive at the AC power connector.
There is little or no holding torque. The status LED is green.	A. The motor current is set too low.	A1. Check the current select switches and verify that the current is set correctly.
	B. The motor winding or cable is open.	B1. Check the motor and cable with an ohmmeter.
	C. The Auto Standby function is enabled.	C1. Disable the Auto Standby function if this function does not allow enough holding torque for your application.
The status LED is red.	A. The motor cable is disconnected or not fully seated at the drive.	A1. Check the motor cable
	B. The motor connector interlock jumper is missing or is disconnected.	B1. Check the interlock jumper.
	C. The drive has detected a motor/wiring short circuit.	C1. Check the motor and cable wiring.
	D. The internal drive temperature is greater than 70°C.	D1. Remove fan cooling obstructions to the drive.

Table 5-2. Problems & Solutions Table

The status LED is red.	E. The AC line voltage is less than 90VAC/180VAC.	E1. Provide a minimum of 95VAC or 185VAC under load to the drive.
	F. Remote shutdown is enabled.	F1. Disconnect the INDEXER connector to check if the shutdown input is enabled.
	G. AC line voltage is too low	G1. Voltage select switch may be switched to 230VAC, with input of 115VAC (looks like a brown-out)
	H. There is insufficient load regulation on the AC line.	H1. Increase the AC line wire size. Increase the isolation transformer size (if used).
The motor moves erratically at low speeds.	A. Motor current is set incorrectly.	A1. Check the current select switches and verify that the current is set correctly.
	B. Indexer pulses are being sent to the drive erratically or bad connection.	B1. Verify, with an oscilloscope, that the indexer pulses are being sent at a constant rate and are not being frequency modulated.
	C. Motor resolution is set for 200 or 400 steps per revolution	C1. Full and half step modes will cause the motor to run roughly at low speeds.
The drive loses pulses at high speed.	A. The indexer is overdriving the step input.	A1. Verify that the step input current is not greater than 15 mA.
	B. The indexer is underdriving the step input.	B1. Verify that the step input current is greater than 6.25 mA.
	C. The indexer is sending pulses too fast.	C1. Verify that the indexer is not exceeding the 2 MHz maximum pulse rate.
	D. The motor is out of torque.	D1. Verify that the motor is sized correctly for your application.
The motor stalls at high speeds.	A. The velocity is too high.	A1. The drive can handle a maximum pulse rate of 2 MHz or 50 rps, whichever comes first. Decrease the velocity.
	B. Motor current is not set correctly.	B1. Check the current DIP switches and verify that the current is set correctly.
	C. The motor is undersized for your application.	C1. Verify that the motor is sized correctly for your application and current is set properly.
The motor stalls during acceleration.	A. Motor current is not set correctly.	A1. Check the current select switches and verify that the current is set correctly.
	B. The acceleration is set too high.	B1. Decrease the acceleration.
	C. There is insufficient rotor inertia.	C1. Add inertia to the motor shaft.
	D. The motor is undersized for the application.	D1. Verify that the motor is sized correctly for your application
The motor (unloaded) stalls at nominal speed.	A. There is insufficient rotor inertia.	A1. Add inertia to the motor shaft.
The motor does not move the commanded distance.	A. The motor resolution is set incorrectly.	A1. Determine the resolution on your indexer and verify that the drive resolution setting is the same.
The motor will not change direction when commanded to do so.	A. The direction input is not being enabled.	A1. Verify that the direction input is being enabled (6.4 mA to 15 mA)
The indexer moves the motor in the wrong direction.	A. There is a direction conflict within the indexer.	A1. Change the direction sense within your indexer.
		A2. Change the motor direction by swapping motor leads A+ and A- at the drive connector.

Table 5-2. Problems & Solutions Table (continued)

Testing the Motor

If the motor fails to move, you should test the motor with an ***ohmmeter*** to examine the resistance between the motor connections. If the motor is not malfunctioning, the source of the problem is probably within the drive. If you operate a faulty drive with a reliable motor, you may damage the motor. If you find that the motor is not faulty, remove power, and remove the motor from the drive. Use the following steps to test the motor.

① Remove power from the system. Detach the motor from the drive.

② With the motor detached from the system, use an ohmmeter to check the resistance across Phase A. **It should be approximately 2 ohms**.

③ Now use the ohmmeter to check the resistance across Phase B. **It should be approximately 2 ohms too (*the resistance across Phase A and Phase B should be nearly identical*).**

④ Use the ohmmeter to check the resistance between Phase A and Phase B. **It should be infinite (∞).**

⑤ Use the ohmmeter to check the resistance between Phase A and Earth (the motor case shaft). **It should be infinite (∞).**

⑥ Use the ohmmeter to check the resistance between Phase B and Earth (the motor case shaft). **It should be infinite (∞).**

⑦ Turn the shaft manually. **There should not be any torque**.

If the motor responds as described to each of these steps, it is functioning properly. The source of the problem is probably within the drive.

Returning the System

If your LN Drive system is faulty, you must return the drive and motor for replacement or repair. A failed drive can damage motors. If you must return your LN Drive to effect repairs or upgrades, use the following steps:

Step ① Get the serial number and the model number of the defective unit(s), and a purchase order number to cover repair costs in the event the unit is determined by Parker Compumotor to be out of warranty.

Step ② Before you ship the drive to Parker Compumotor, have someone from your organization with a technical understanding of the LN Drive and its application include answers to the following questions:

- ❑ What is the extent of the failure/reason for return?
- ❑ How long did it operate?
- ❑ How many units are still working?
- ❑ How many units failed?
- ❑ What was happening when the unit failed (i.e., installing the unit, cycling power, starting other equipment, etc)?
- ❑ How was the product configured (in detail)?
- ❑ What, if any, cables were modified and how?
- ❑ With what equipment is the unit interfaced?
- ❑ What was the application?
- ❑ What was the system sizing (speed, acceleration, duty cycle, inertia, torque, friction, etc.)?
- ❑ What was the system environment (temperature, enclosure, spacing, unit orientation, contaminants, etc.)?
- ❑ What upgrades, if any, are required (hardware, software, user guide)?

Step ③ In the USA, call Parker Compumotor's Applications Engineering Department [(800) 358-9070] for a Return Material Authorization (RMA) number. Returned products cannot be accepted without an RMA number. The phone number for Parker Compumotor Application Department is (800) 358-9070.

Ship the unit to:

Parker Compumotor Corporation
5500 Business Park Drive
Rohnert Park, CA 94928
Attn: RMA # xxxxxxx

Step ④ In the UK, call Parker Digiplan for a GRA (Goods Returned Authorization) number. Returned products cannot be accepted without a GRA number. The phone number for Parker Digiplan Repair Department is 202-690911. The phone number for Parker Digiplan Service/Applications Department is 202-699000.

Ship the unit to:

Parker Digiplan Ltd.
21 Balena Close
Poole, Dorset
England
BH17 7DX

Step ⑤ Elsewhere: Contact the distributor who supplied the equipment.

Appendices

Glossary

Acceleration
The change in velocity as a function of time. Acceleration usually refers to increasing velocity and deceleration describes decreasing velocity.

Accuracy
A measure of the difference between expected position and actual position of a motor or mechanical system. Motor accuracy is usually specified as an angle representing the maximum deviation from expected position.

Ambient Temperature
The temperature of the cooling medium, usually air, immediately surrounding the motor or another device.

Block Diagram
A simplified schematic representing components and signal flow through a system.

Closed Loop
A broadly applied term relating to any system where the output is measured and compared to the input. The output is then adjusted to reach the desired condition. In motion control, the term is used to describe a system wherein a velocity or position (or both) transducer is used to generate correction signals by comparison to desired parameters.

Detent Torque
The minimal torque present in an un-energized motor. The detent torque of a Compumotor or step motor is typically about one percent of its static energized torque.

Efficiency
The ratio of power output to power input.

Encoder
A device that translates mechanical motion into electronic signals used for monitoring position or velocity.

Holding Torque
Sometimes called static torque, it specifies the maximum external force or torque that can be applied to a stopped, energized motor without causing the rotor to rotate continuously.

Home
A reference position in a motion control system, usually derived from a mechanical datum. Often designated as the *zero* position.

Hysteresis
The difference in response of a system to an increasing or a decreasing input signal.

Inertia
A measure of an object's resistance to a change in velocity. The larger an object's inertia, the larger the torque that is required to accelerate or decelerate it. Inertia is a function of an object's mass and its shape.

Inertial Match
For most efficient operation, the system coupling ratio should be selected so that the reflected inertia of the load is equal to the rotor inertia of the motor.

Microstepping
An electronic control technique that proportions the current in a step motor's windings to provide additional intermediate positions between poles. Produces smooth rotation over a wide speed range and high positional resolution.

Open Loop
Refers to a motion control system where no external sensors are used to provide position or velocity correction signals.

Opto-isolated
A method of sending a signal from one piece of equipment to another without the usual requirement of common ground potentials. The signal is transmitted optically with a light source (usually a Light Emitting Diode) and a light sensor (usually a photosensitive transistor). These optical components provide electrical isolation.

Pulse Rate
The frequency of the step pulses applied to a motor driver. The pulse rate multiplied by the resolution of the motor/drive combination (in steps per revolution) yields the rotational speed in rps.

Ramping
The acceleration and deceleration of a motor. May also refer to the change in frequency of the applied step pulse train.

Rated Torque
The torque producing capacity of a motor at a given speed. This is the maximum torque the motor can deliver to a load and is usually specified with a torque/speed curve.

Relative Accuracy
Also referred to as *Step-to-Step Accuracy*, this specification tells how microsteps can change in size. In a perfect system, microsteps would all be exactly the same size, but drive characteristics and the absolute accuracy of the motor cause the steps to expand and contract by an amount up to the relative accuracy figure. The error in not cumulative.

Repeatability
The degree to which the positioning accuracy for a given move performed repetitively can be duplicated.

Resolution
The smallest positioning increment that can be achieved. Frequently defined as the number of steps required for a motor's shaft to rotate one complete revolution.

Ringing
Oscillation of a system following a sudden change in state.

Slew
In motion control, the portion of a move made at a constant non-zero velocity.

Speed
Used to describe the linear or rotational velocity of a motor or other object in motion.

Static Torque
The maximum torque available at zero speed.

Step Angle
The angle the shaft rotates upon receipt of a single step command.

Stiffness
The ability to resist movement induced by an applied torque. Is often specified as a torque displacement curve, indicating the amount a motor shaft will rotate upon application of a known external force when stopped.

Stop Bits
When using RS-232C, one or two bits are added to every character to signal the end of a character.

Synchronism
A motor rotating at a speed correctly corresponding to the applied step pulse frequency is said to be in synchronism. Load torques in excess of the motor's capacity (rated torque) will cause a loss of synchronism. This condition is not damaging to a step motor.

Torque
Force tending to produce rotation.

Torque-to-Inertia Ratio
Defined as a motor's holding torque divided by the inertia of its rotor. The higher the ratio, the higher a motor's maximum acceleration capability will be.

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