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.
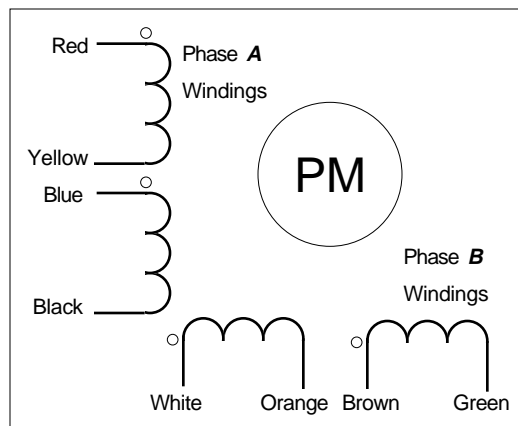

Figure 3-1. 8-Lead Motor Winding Color Code

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.

```
INLK
A-CT
A +
A -
EARTH    —  MOTOR
B +
B -
B-CT
INLK
```
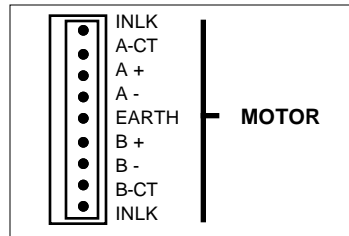
Figure 3-2. LN Drive Motor Connector

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)

Pin	9 Pin — 8 Lead (Series) Color	9 Pin — 8 Lead (Parallel) Color	9 Pin — 4 Lead 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.
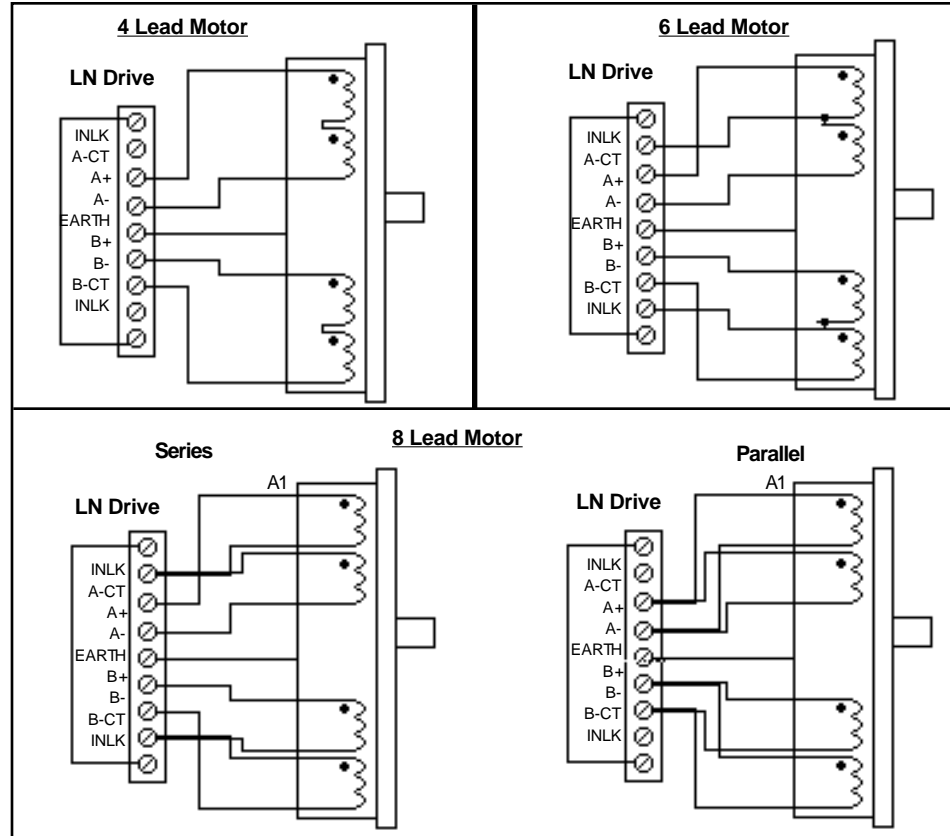
Figure 3-3. 9-Pin Motor Connector (Non-Compumotor Motors)

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)
LN57	1.72	20 AWG	16 AWG
LN83	2.2	18 AWG	14 AWG

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 denotes the 50,000 row)*

* 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.
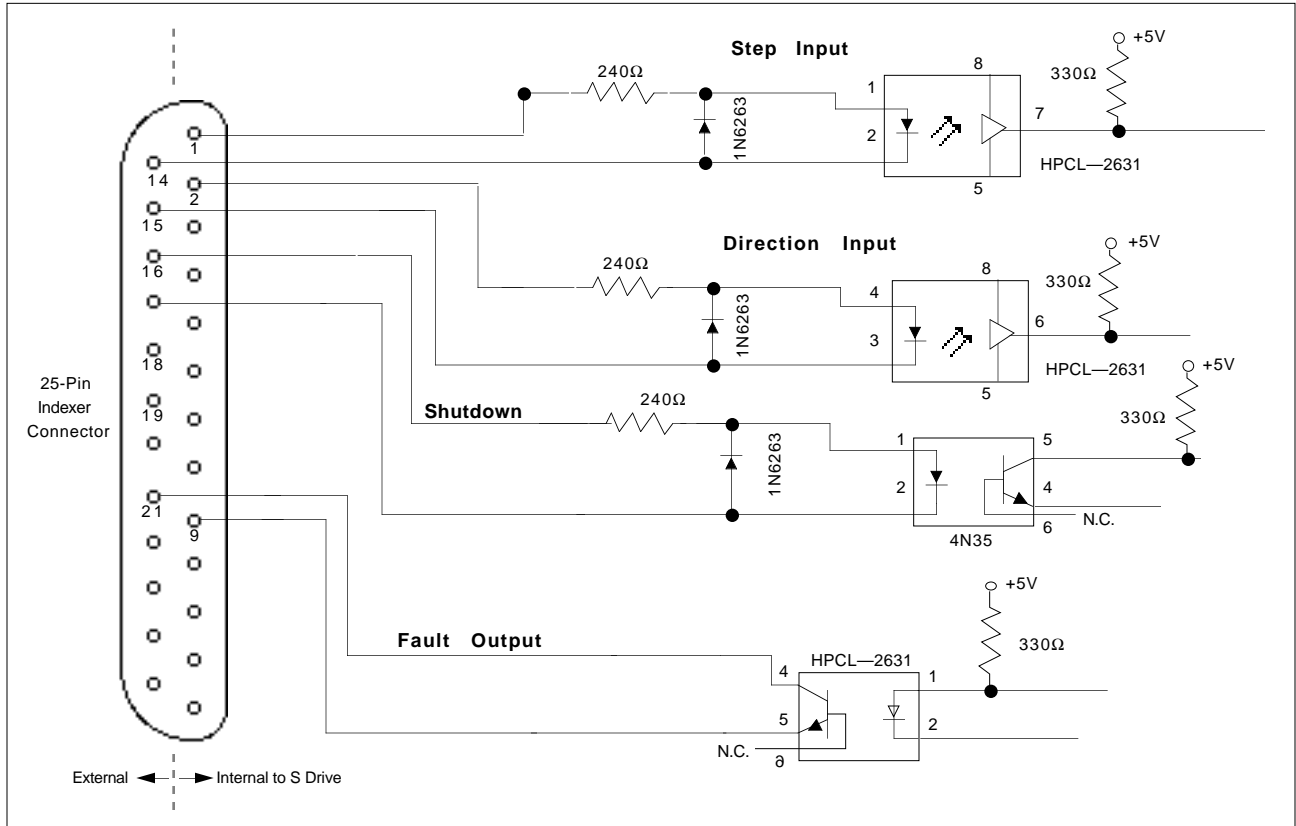
Figure 3-4. LN Drive I/O Schematic

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.)
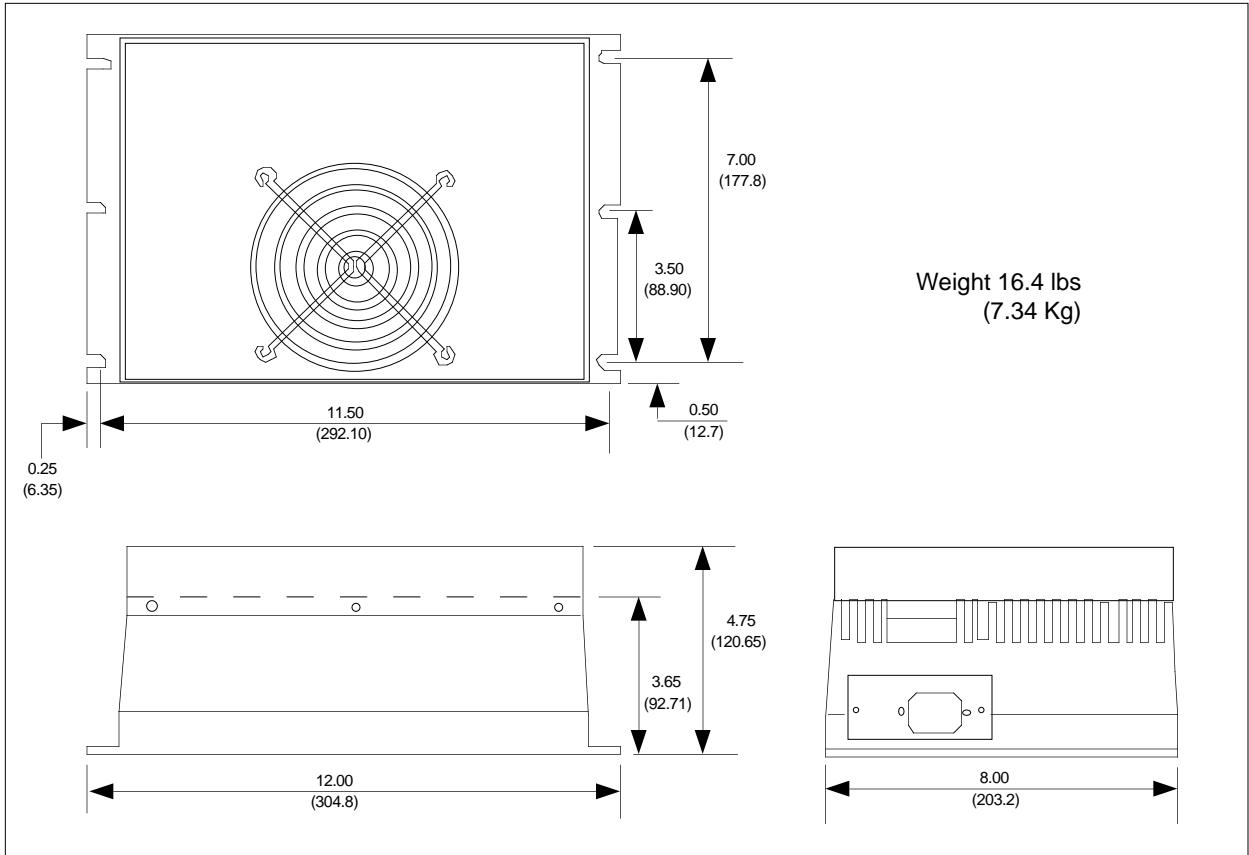
Figure 3-5. Mounting the Drive

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.)
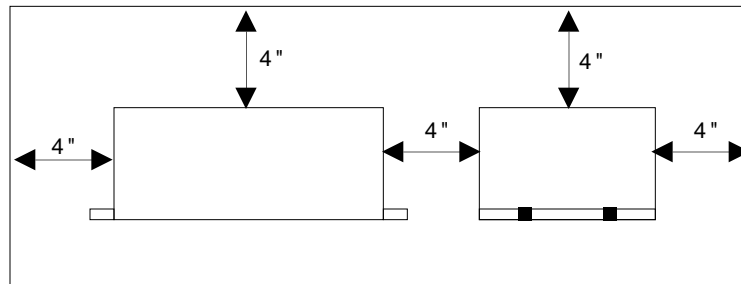

Figure 3-6. Enclosure Mounting Guidelines

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 <u>jeopardize personal safety</u>.

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.