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

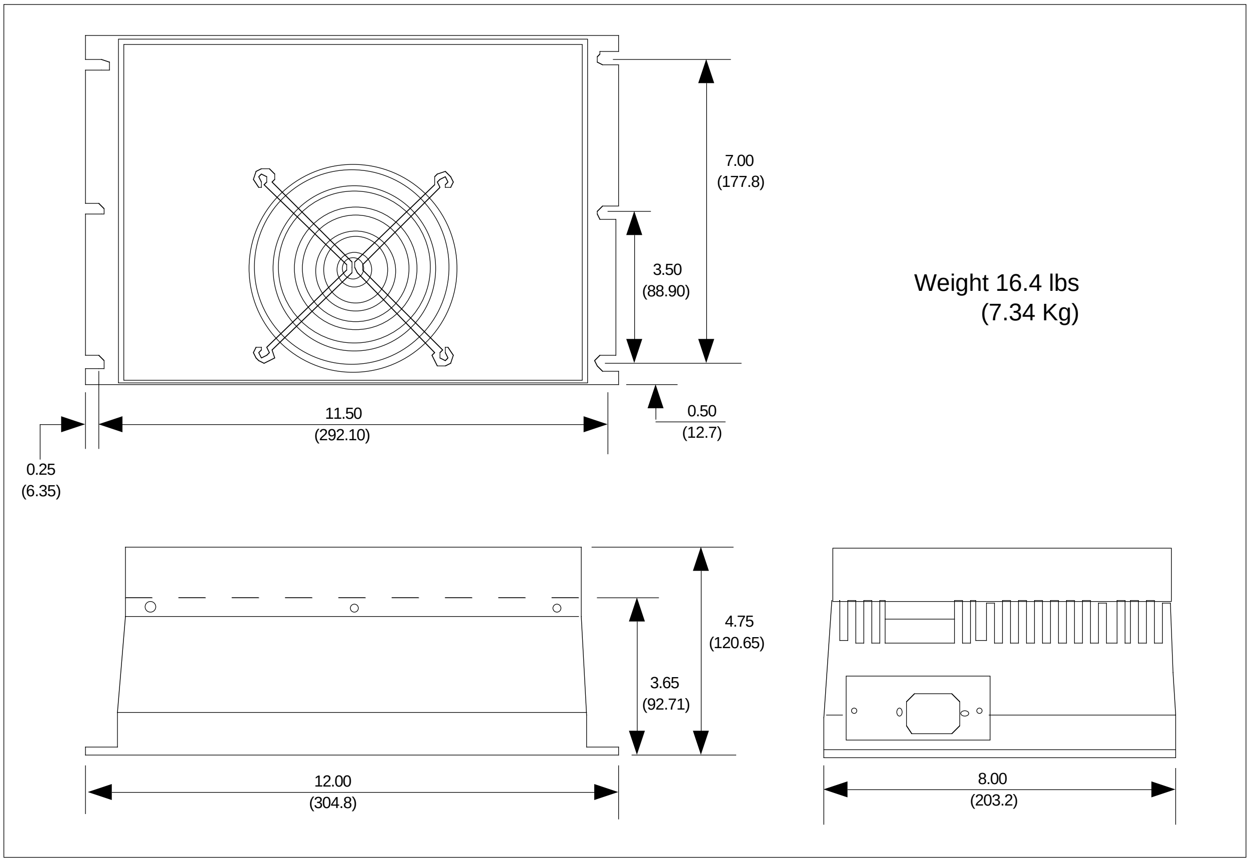


Figure 4-1. LN Drive Dimensions

Motor Dimensions

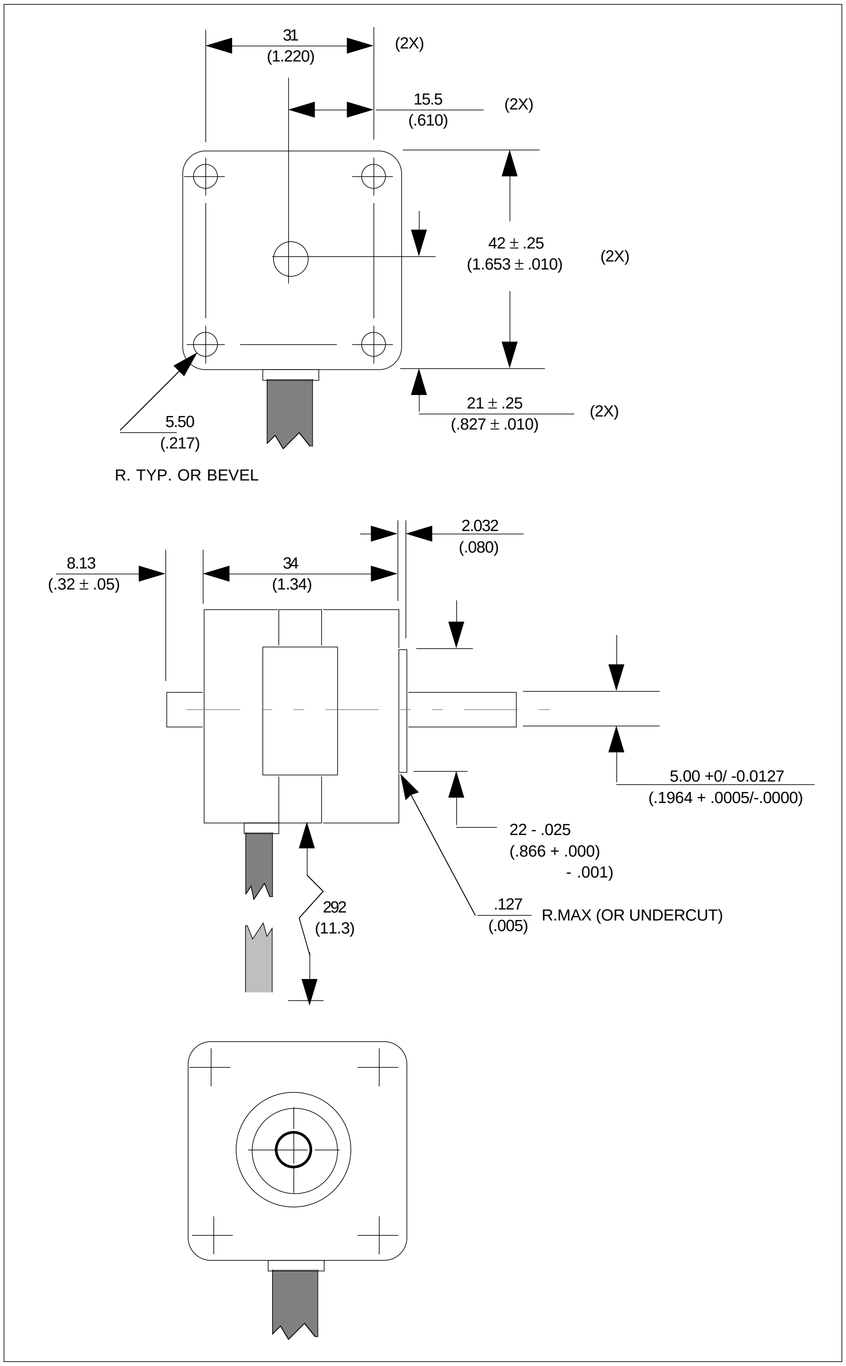
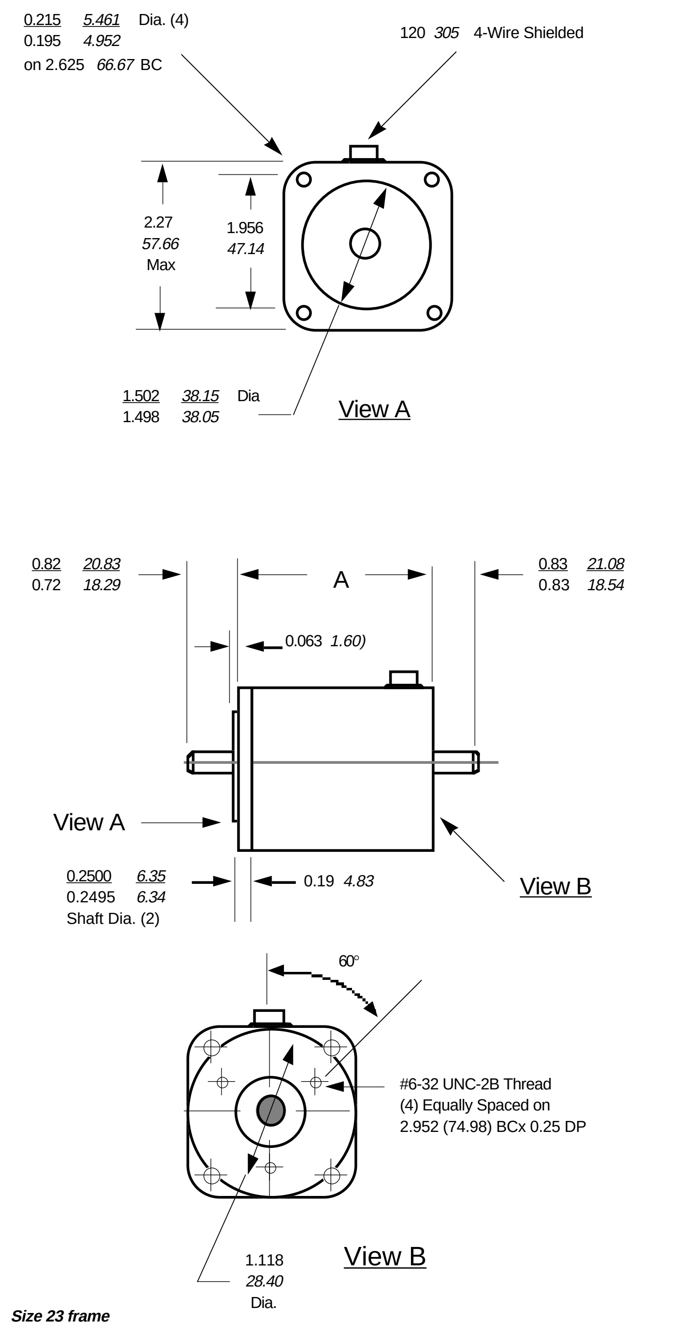
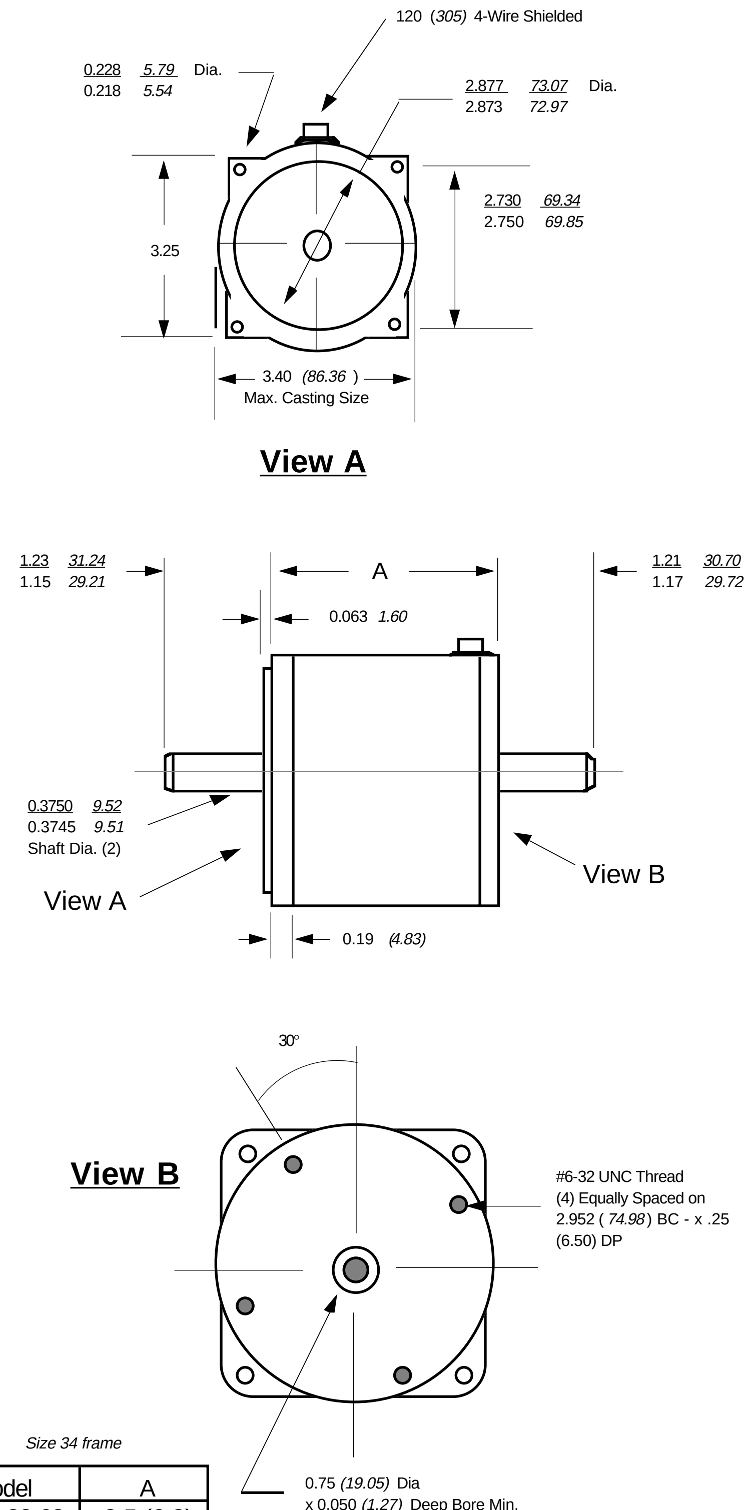


Figure 4-2. NEMA 17 Motor



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

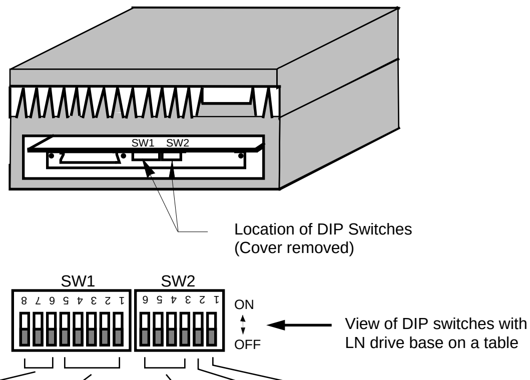
Figure 4-3. NEMA 23 Motor



Model	A
LN 83-62	2.5 (6.3)

Figure 4-4. NEMA 34 Motor

DIP Switch Summary



SW1

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

SW 2

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

* 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.

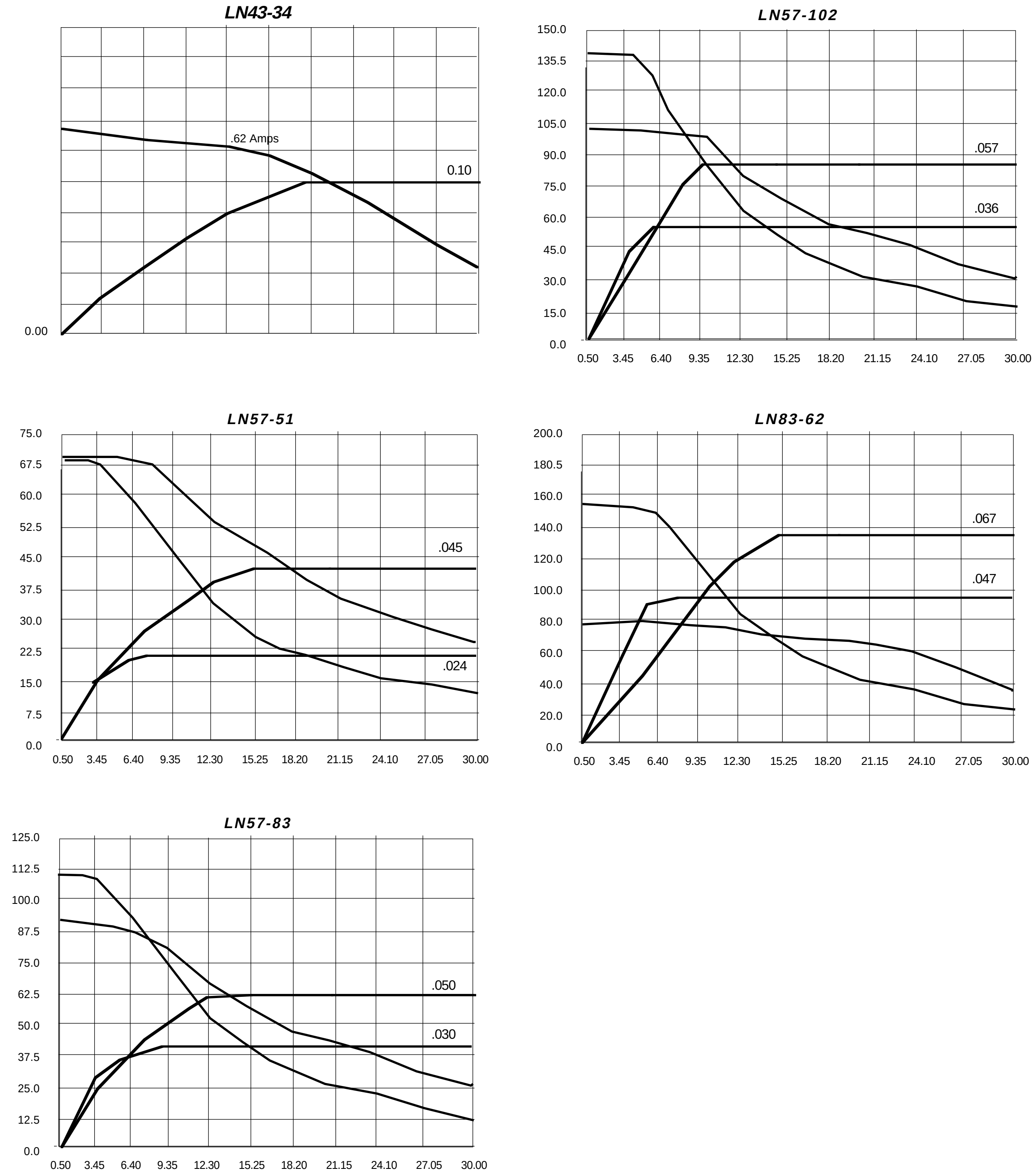


Figure 4-6. LN43-34 Speed Torque Curve

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).

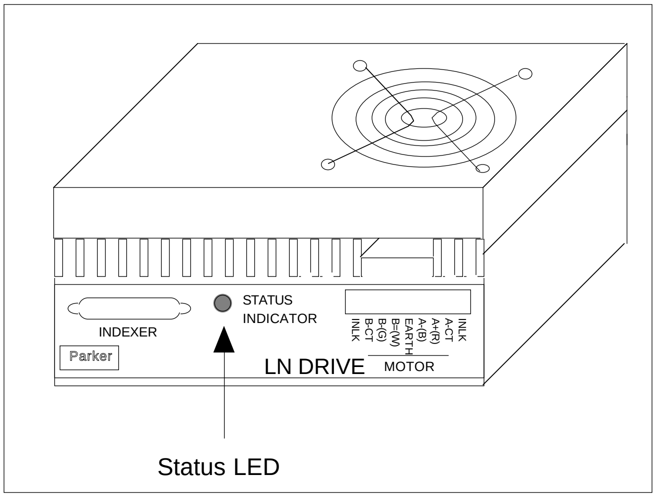


Figure 5-1. LED

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.

Index