BALDOR®
MOTORS AND DRIVES

LINEAR DRIVE

LinStep
Microstepping Driver

Installation & Operating Manual

3/01 **MN1852**

Table of Contents

Section 1
General Information

CE Compliance

A custom unit may be required, contact Baldor. Compliance to Directive 89/336/EEC is the responsibility of the system integrator. A control, motor and all system components must have proper shielding, grounding, and filtering as described in MN1383. Please refer to MN1383 for installation techniques for CE compliance. For additional information, refer to Sections 3 and 8 of this manual.

Limited Warranty

For a period of two (2) years from the date of original purchase, BALDOR will repair or replace without charge controls and accessories which our examination proves to be defective in material or workmanship. This warranty is valid if the unit has not been tampered with by unauthorized persons, misused, abused, or improperly installed and has been used in accordance with the instructions and/or ratings supplied. This warranty is in lieu of any other warranty or guarantee expressed or implied. BALDOR shall not be held responsible for any expense (including installation and removal), inconvenience, or consequential damage, including injury to any person or property caused by items of our manufacture or sale. (Some states do not allow exclusion or limitation of incidental or consequential damages, so the above exclusion may not apply.) In any event, BALDOR's total liability, under all circumstances, shall not exceed the full purchase price of the control. Claims for purchase price refunds, repairs, or replacements must be referred to BALDOR with all pertinent data as to the defect, the date purchased, the task performed by the control, and the problem encountered. No liability is assumed for expendable items such as fuses.

Goods may be returned only with written notification including a BALDOR Return Authorization Number and any return shipments must be prepaid.

Product Notice Intended use:

These drives are intended for use in stationary ground based applications in industrial power installations according to the standards EN60204 and VDE0160. They are designed for machine applications that require variable speed controlled three phase brushless AC motors.

These drives are not intended for use in applications such as:

- Home appliances
- Mobile vehicles
- Ships
- Airplanes

Unless otherwise specified, this drive is intended for installation in a suitable enclosure. The enclosure must protect the control from exposure to excessive or corrosive moisture, dust and dirt or abnormal ambient temperatures. The exact operating specifications are found in Section 7 of this manual.

The installation, connection and control of drives is a skilled operation, disassembly or repair must not be attempted.

In the event that a control fails to operate correctly, contact the place of purchase for return instructions.

Safety Notice: This equipment contains high voltages. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the start–up procedure or troubleshoot this equipment.

This equipment may be connected to other machines that have rotating parts or parts that are driven by this equipment. Improper use can cause serious or fatal injury. Only qualified personnel should attempt the start–up procedure or troubleshoot this equipment.

- System documentation must be available at all times.
- Keep non-qualified personnel at a safe distance from this equipment.
- Only qualified personnel familiar with the safe installation, operation and maintenance of this device should attempt start-up or operating procedures.
- Always remove power before making or removing any connections to this control.

PRECAUTIONS: Classifications of cautionary statements.

⚠ **WARNING:** **Indicates a potentially hazardous situation which, if not avoided, could result in injury or death.**

⚠ **Caution:** **Indicates a potentially hazardous situation which, if not avoided, could result in damage to property.**

Continued on next page.

PRECAUTIONS:

⚠ WARNING: **Do not touch any circuit board, power device or electrical connection before you first ensure that power has been disconnected and there is no high voltage present from this equipment or other equipment to which it is connected. Electrical shock can cause serious or fatal injury.**

⚠ WARNING: **Be sure that you are completely familiar with the safe operation of this equipment. This equipment may be connected to other machines that have rotating parts or parts that are controlled by this equipment. Improper use can cause serious or fatal injury.**

⚠ WARNING: **Be sure all wiring complies with the National Electrical Code and all regional and local codes or CE Compliance. Improper wiring may cause a hazardous condition.**

⚠ WARNING: **Be sure the system is properly grounded before applying power. Do not apply AC power before you ensure that grounds are connected. Electrical shock can cause serious or fatal injury.**

⚠ WARNING: **Do not remove cover for at least five (5) minutes after AC power is disconnected to allow capacitors to discharge. Electrical shock can cause serious or fatal injury.**

⚠ WARNING: **Improper operation may cause violent motion of the motor and driven equipment. Be certain that unexpected movement will not cause injury to personnel or damage to equipment.**

⚠ WARNING: **Motor circuit may have high voltage present whenever AC power is applied, even when motor is not moving. Electrical shock can cause serious or fatal injury.**

⚠ WARNING: **If a motor is driven mechanically, it may generate hazardous voltages that are conducted to its power input terminals. The enclosure must be grounded to prevent a possible shock hazard.**

⚠ WARNING: **A DB Resistor may generate enough heat to ignite combustible materials. To avoid fire hazard, keep all combustible materials and flammable vapors away from brake resistors.**

⚠ WARNING: **The user must provide an external hard-wired emergency stop circuit to disable the control in the event of an emergency.**

⚠ Caution: **To prevent equipment damage, be certain that the input power has correctly sized protective devices installed as well as a power disconnect.**

⚠ Caution: **Avoid locating the control immediately above or beside heat generating equipment, or directly below water or steam pipes.**

⚠ Caution: **Suitable for use on a circuit capable of delivering not more than the RMS symmetrical short circuit amperes listed here at rated voltage.**

Horsepower	rms Symmetrical Amperes
1–50	5,000

Continued on next page.

⚠ **Caution:**	**Avoid locating the control in the vicinity of corrosive substances or vapors, metal particles and dust.**
⚠ **Caution:**	**Baldor recommends not using "Grounded Leg Delta" transformer power leads that may create ground loops and degrade system performance. Instead, we recommend using a four wire Wye.**
⚠ **Caution:**	**Logic signals are interruptible signals; these signals are removed when power is removed from the drive.**
⚠ **Caution:**	**The safe integration of the driver into a machine system is the responsibility of the machine designer. Be sure to comply with the local safety requirements at the place where the machine is to be used. In Europe this is the Machinery Directive, the ElectroMagnetic Compatibility Directive and the Low Voltage Directive. In the United States this is the National Electrical code and local codes.**
⚠ **Caution:**	**Drivers must be installed inside an electrical cabinet that provides environmental control and protection. Installation information for the drive is provided in this manual. Motors and controlling devices that connect to the driver should have specifications compatible to the drive.**
⚠ **Caution:**	**Do not tin (solder) exposed wires. Solder contracts over time and may cause loose connections.**
⚠ **Caution:**	**Electrical components can be damaged by static electricity. Use ESD (electro-static discharge) procedures when handling this control.**

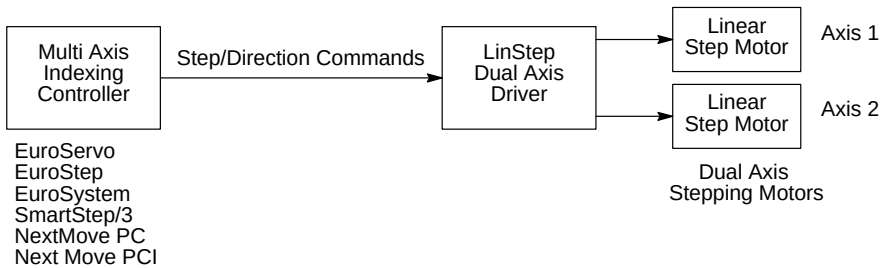
Section 2
Product Overview

Overview

The design of LinStep and LinStep+ microstepping motor drivers and the internal cooling tunnel are revolutionary. These drivers consumes less panel space than other controls and keep internal electronics cool and clean for years of reliable performance and operation. LinStep single and dual–axis drivers are used with Baldor motion controls and other popular stepper controllers that provide step and direction (or CW/CCW step pulses) . They are ideally suited to control Baldor single and dual–axis linear stepping motors. Figure 2-1 shows how the LinStep driver is placed in a linear stepper motor system.

The open loop linear stepper motor provides the most economical linear motor positioning solution. There are two types of linear stepper motors: a single–axis linear stepper motor and the compact dual–axis linear stepper motor. Linear stepper motors include the motor, positioning system and bearings in two components: a moving forcer and a stationary platen.

Figure 2-1 Motion Control with LinStep



Linear stepper motors move in discrete incremental moves called steps. The size of each step is determined by the spacing of the teeth in the platen and how the coils are energized. Baldor 2–phase motors travel 0.010 inches (0.254mm) in a single full step yielding 100 steps per inch. Baldor 4–phase motors travel 0.005 inches (0.127mm) in a step. When the coils are energized in a predetermined pattern, the forcer will move down the platen. Reversing the pattern will reverse the direction of travel. The microstep frequency determines the velocity of the forcer. Linear stepper motors produce their maximum force at zero speed. As speed increases the ability to switch winding current decreases due to motor inductance. This results in lower forces at higher speeds.

Contact your local Baldor distributor or sales representative for assistance with sizing and compatibility. Custom motors or motors not manufactured by Baldor may be used. Please contact your local Baldor distributor or sales representative for assistance.

Motors

Baldor LinStep Drivers are compatible with many Linear Stepper motors from Baldor and other manufacturers. Compatible Baldor motors include: (refer to BR1800 for additional motor information)

- LMSS Series Single Axis
- LMDS Series Dual Axis

Section 3
Receiving and Installation

Receiving & Inspection

Baldor Drivers are thoroughly tested at the factory and carefully packaged for shipment. When you receive your driver, there are several things you should do immediately.

1. Observe the condition of the shipping container and report any damage immediately to the commercial carrier that delivered your driver.
2. Remove the driver from the shipping container and remove all packing materials. The container and packing materials may be retained for future shipment.
3. Verify that the part number you received is the same as the part number listed on your purchase order.
4. Inspect for external physical damage that may have been sustained during shipment and report any damage immediately to the commercial carrier that delivered your driver.
5. If the driver is to be stored for several weeks before use, be sure that it is stored in a location that conforms to published storage humidity and temperature specifications stated in this manual.

Location Considerations

The location of the driver is important. Installation should be in an area that is protected from direct sunlight, corrosives, harmful gases or liquids, dust, metallic particles, and vibration. Exposure to these can reduce the operating life and degrade performance of the driver.

Several other factors should be carefully evaluated when selecting a location for installation:

1. For effective cooling and maintenance, the driver should be mounted on a smooth, non-flammable vertical surface.
2. At least 3 inches (75mm) top and bottom clearance must be provided for air flow. Between drivers (each side), allow at least 0.1 inch (2.5mm) for 1–axis or 2 inches (50mm) for 2–axis.
3. **Altitude derating**. Up to 3300 feet (1000 meters) no derating required. Derate the continuous and peak output current by 1.1% for each 330 (100) above 3300 feet. Maximum altitude is 8300 (2540m).
4. **Temperature derating**. From 0°C to 40°C ambient no derating required. Above 40°C, derate the continuous and peak output current by 2.5% per °C above 40°C. Maximum ambient is 50°C.

Power Dissipation

Cooling requirements can be determined if you know the maximum (or continuous) current output from the microstepping driver, I_D. Calculate heat dissipation, W_{Diss} as follows:

$W_{Diss} = 5 + 3.4I_D + 0.15I_D^2$

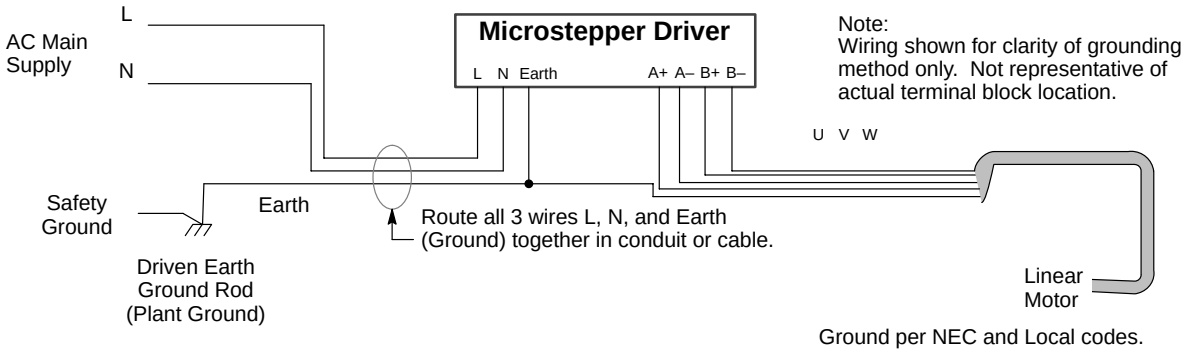
Mechanical Installation

Mount the driver to the mounting surface. The driver must be securely fastened to the mounting surface by the driver mounting holes. The location of the mounting holes is shown in Section 7 of this manual. Use #8 (M4) cap screws.

Electrical Installation All interconnection wires between the driver, AC power source, motor, host driver and any operator interface stations should be in metal conduits. Use listed closed loop connectors that are of appropriate size for wire gauge being used. Connectors are to be installed using crimp tool specified by the manufacturer of the connector. Only class 1 wiring should be used.

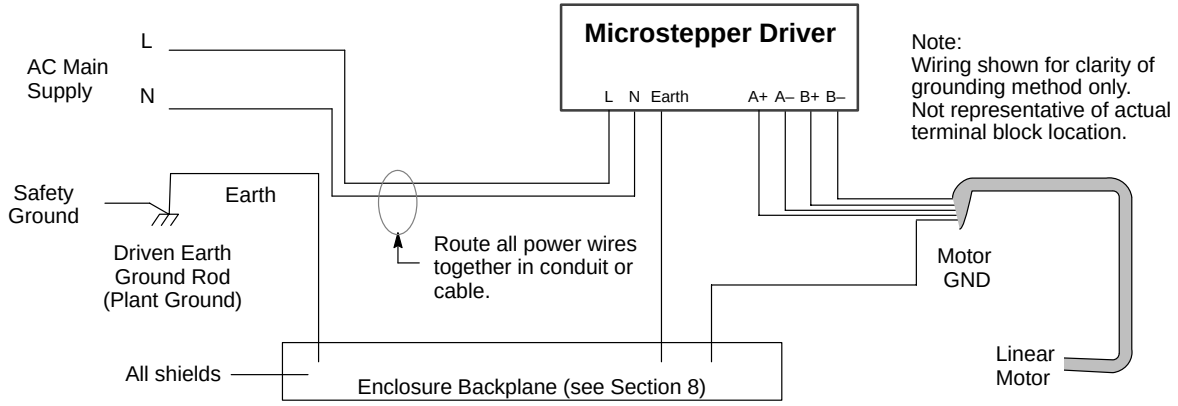
System Grounding Baldor drivers are designed to be powered from standard single phase lines that are electrically symmetrical with respect to ground. System grounding is an important step in the overall installation to prevent problems. The recommended grounding method is shown in Figure 3-1 for UL compliant systems (Figure 3-2 for CE compliant systems).

Figure 3-1 Recommended System Grounding for UL



Note: Use shielded cable for driver signal wires. Route driver signal wires in conduit. These wires must be kept separate from power and motor wires.

Figure 3-2 Recommended System Grounding (1 phase) for CE



Note: Use shielded cable for driver signal wires. Route driver signal wires in conduit. These wires must be kept separate from power and motor wires.

System Grounding Continued

Ungrounded Distribution System

With an ungrounded power distribution system it is possible to have a continuous current path to ground through the MOV devices. To avoid equipment damage, an isolation transformer with a grounded secondary is recommended. This provides three phase AC power that is symmetrical with respect to ground.

Input Power Conditioning

Certain power line conditions must be avoided. An AC line reactor or an isolation transformer may be required for some power conditions.

- If the feeder or branch circuit that provides power to the driver has permanently connected power factor correction capacitors, an input AC line reactor or an isolation transformer must be connected between the power factor correction capacitors and the driver.
- If the feeder or branch circuit that provides power to the driver has power factor correction capacitors that are switched on line and off line, the capacitors must not be switched while the driver is connected to the AC power line. If the capacitors are switched on line while the driver is still connected to the AC power line, additional protection is required. TVSS (Transient Voltage Surge Suppressor) of the proper rating must be installed between the AC line reactor or an isolation transformer and the AC input to the driver.

Power Disconnect A power disconnect should be installed between the input power service and the driver for a fail–safe method to disconnect power. The driver will remain in a powered-up condition until all input power is removed from the driver and the internal bus voltage is depleted.

Protection Devices The driver must have a suitable input power protection device installed. Input and output wire size is based on the use of copper conductor wire rated at 75 °C. Table 3-1 describes the wire size to be used for power connections and the ratings of the protection devices. Use the recommended circuit breaker or fuse types as follows:

Circuit Breaker: 1 phase, thermal magnetic.
Equal to GE type THQ or TEB for 115 or 230 VAC

Time Delay Fuses: Buss LPN on 115 VAC or
Buss FRN on 230 VAC or equivalent.

Recommended fuse sizes are based on the following:

UL 508C suggests a fuse size of four times the continuous output current of the driver.
Dual element, time delay fuses should be used to avoid nuisance trips due to inrush current when power is first applied.

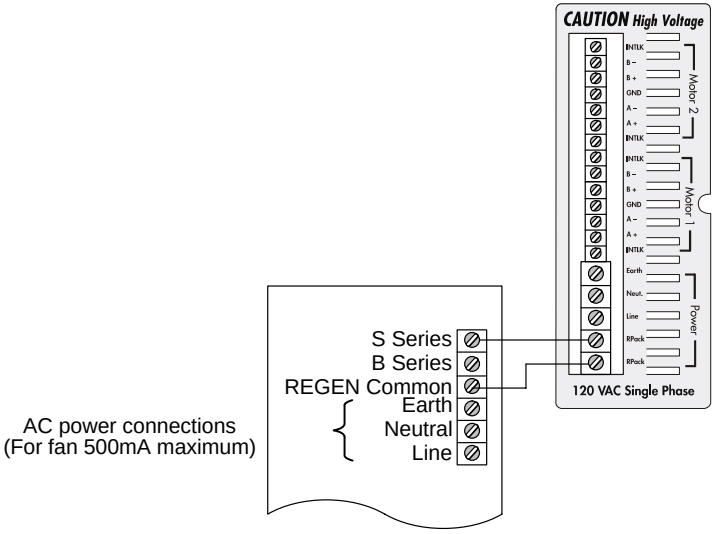
Table 3-1 Wire Size and Protection Devices (for units with Power Supply)

Catalog Number	Incoming Power					
	Nominal Input Voltage	Continuous Output Amps (RMS)	Input Breaker (A)	Input Fuse Time Delay (A)	Wire Gauge	
					AWG (USA)	mm² (Europe)
LX1D1A07F9	115V (1ϕ)	7.9A	30	30	14	2.5
LX2D1A06	115V (1ϕ)	6.0A	20	20	14	2.5
LX1D2A03F9	230V (1ϕ)	3.9A	20	20	14	2.5

Note: All wire sizes are based on 75°C copper wire. Higher temperature smaller gauge wire may be used per NEC and local codes. Recommended fuses/breakers are based on 25°C ambient, maximum continuous driver output current and no harmonic current.

Dynamic Brake Resistor 2–Axis Drivers Only. Requires optional dynamic brake assembly. An external DB (dynamic brake, regen or RPACK) resistor may be required to dissipate excess power from the DC bus during motor deceleration operations. DB hardware is connected at the RPACK terminals as shown in Figure 3-3.

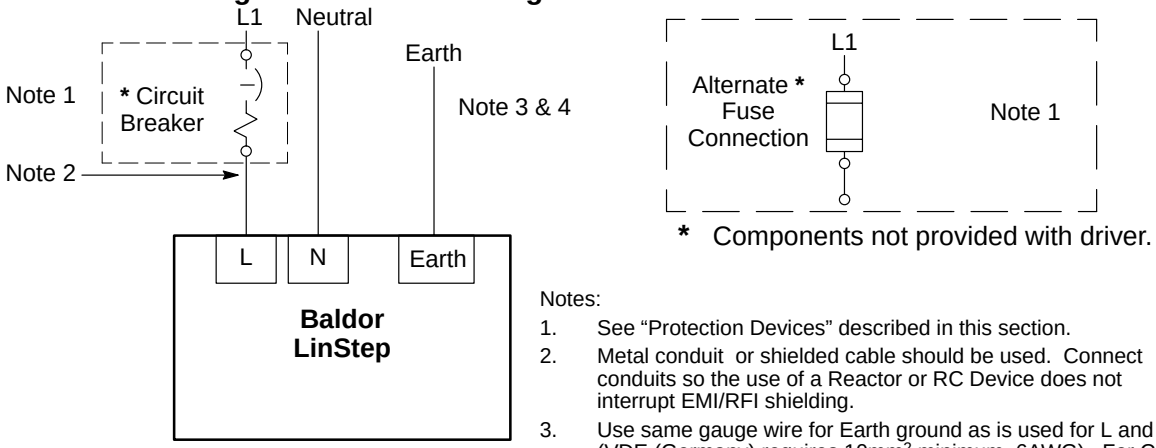
Figure 3-3 DB Connections



Power Connections

Power connections are shown in Figures 3-4 and 3-5.

Figure 3-4 115VAC Single Phase AC Power Connections

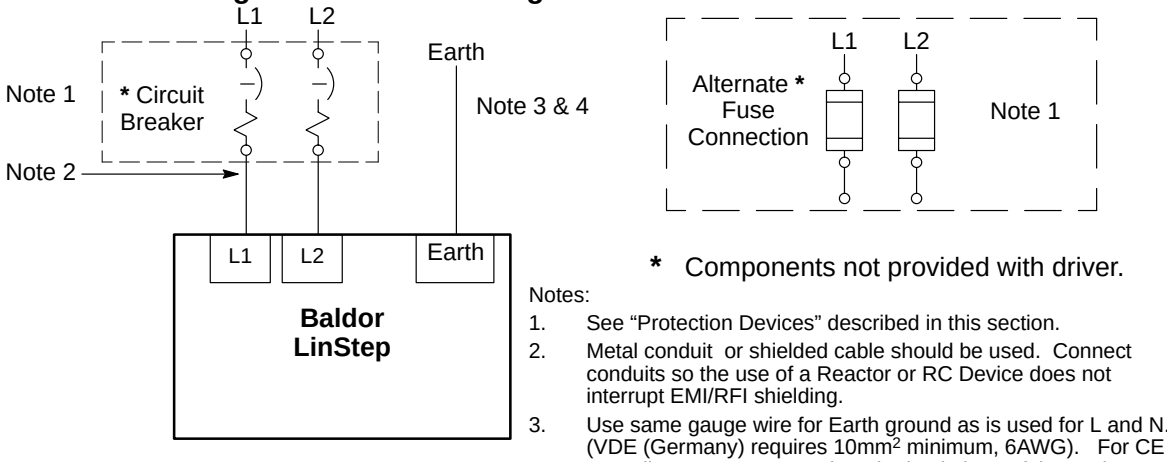


* Components not provided with driver.

Notes:

1. See “Protection Devices” described in this section.
2. Metal conduit or shielded cable should be used. Connect conduits so the use of a Reactor or RC Device does not interrupt EMI/RFI shielding.
3. Use same gauge wire for Earth ground as is used for L and N. (VDE (Germany) requires 10mm^2 minimum, 6AWG). For CE Compliance, connect Earth to the backplane of the enclosure.
4. Reference EMC wiring in Section 8.

Figure 3-5 230VAC Single Phase AC Power Connections



* Components not provided with driver.

Notes:

1. See “Protection Devices” described in this section.
2. Metal conduit or shielded cable should be used. Connect conduits so the use of a Reactor or RC Device does not interrupt EMI/RFI shielding.
3. Use same gauge wire for Earth ground as is used for L and N. (VDE (Germany) requires 10mm^2 minimum, 6AWG). For CE Compliance, connect Earth to the backplane of the enclosure.
4. Reference EMC wiring in Section 8.

Figure 3-6 Connection Locations (115VAC, 1–Axis)

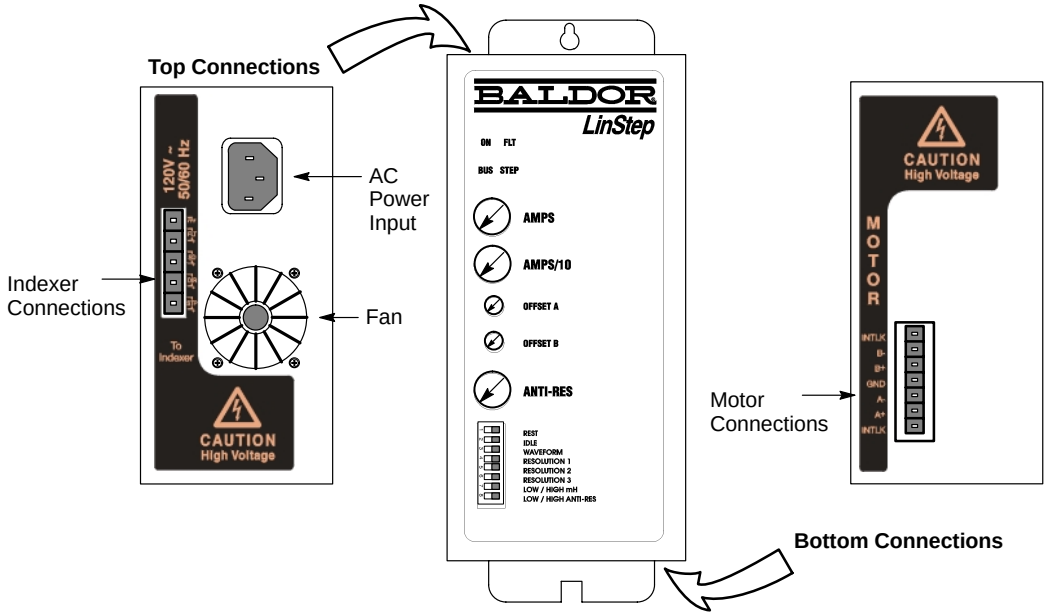


Figure 3-7 Connection Locations (230VAC, 1–Axis)

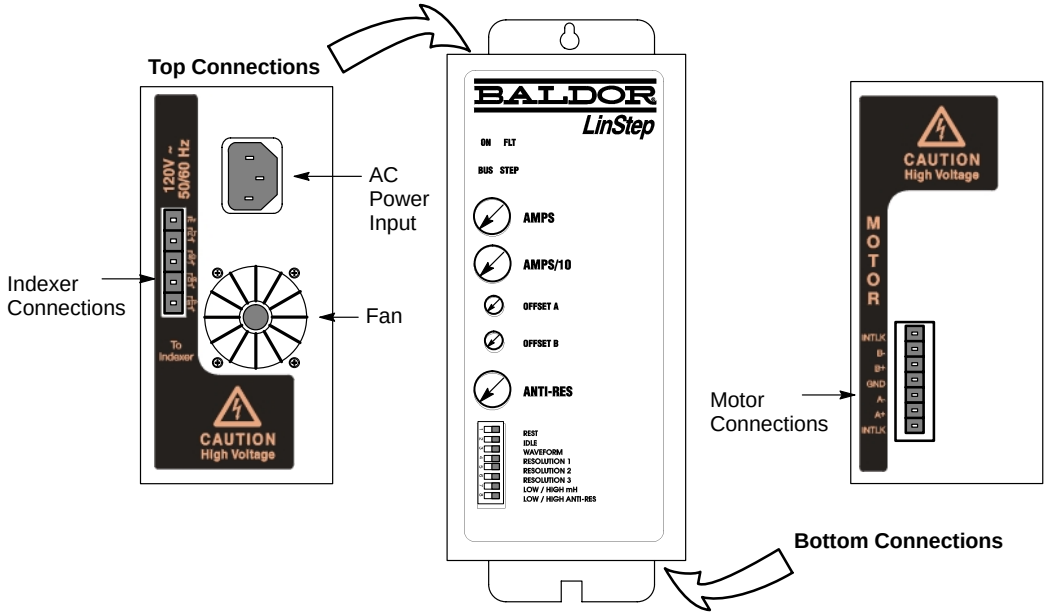
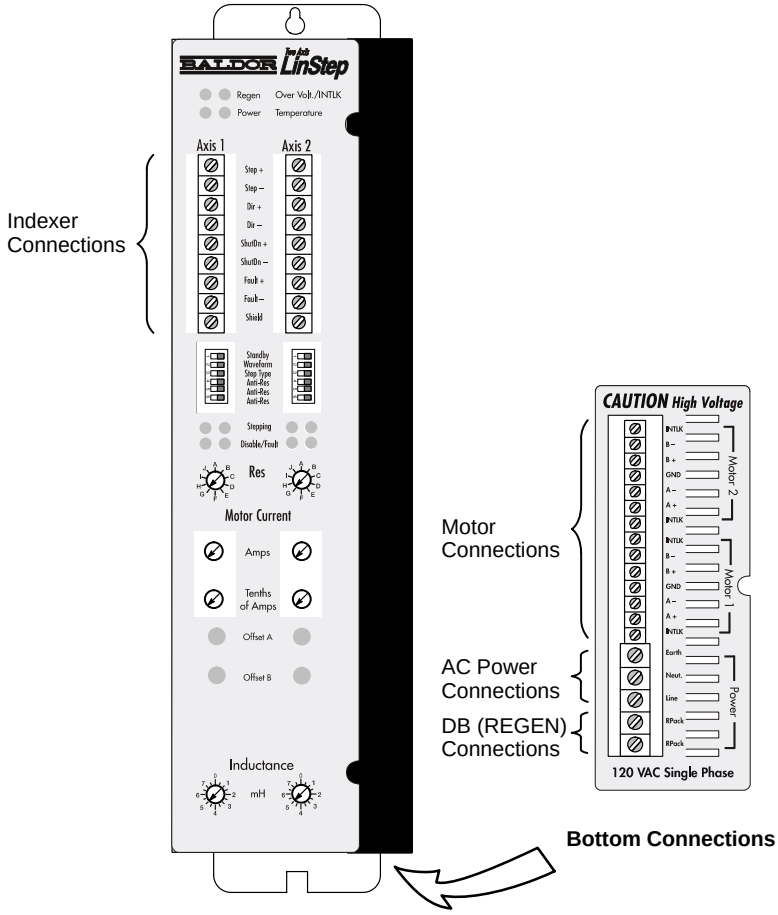


Figure 3-8 Connection Locations (115VAC, 2–Axis)



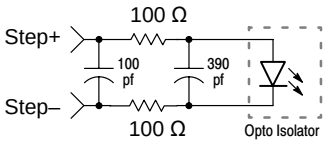
Indexer Connections The first pin of the Indexer connector is a ground for the shield wire of the indexer cable. To prevent noise, only connect one end of this shield. If the shield is connected at the indexer, do not connect the other end at the driver. Signal levels are described in Table 3-2.

Note: A 2–Axis driver has these same connections for each axis.

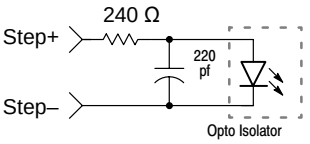
Step Input (STP or CW)
The motor will advance one step following each low–going transition of this input. The width of the step pulse should be at least 0.4 msec. When the drive is configured for CW/CCW Mode, this input causes the motor to step in the clockwise (CW) direction.

Figure 3-9 Step Input Connections

1–Axis



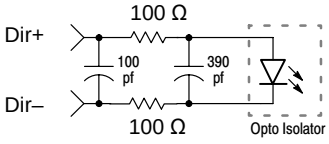
2–Axis



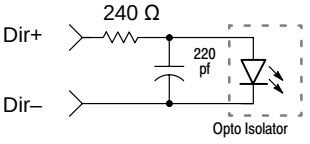
Direction Input (DIR or CCW)
Logic high = CW rotation. Logic low = CCW rotation. The direction line must be stable for at least 0.4 µsec after a direction change to insure that the next step pulse turns the motor in the correct direction. When in CW/CCW Mode, low–going transitions on this input cause the motor to step in the counterclockwise (CCW) direction.

Figure 3-10 Direction Input Connections

1–Axis



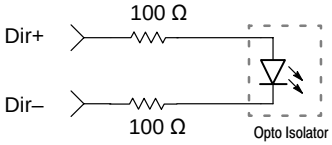
2–Axis



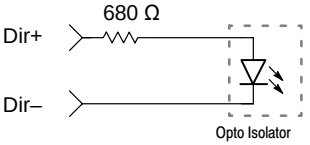
Shutdown Input (SD)
Activating the Shutdown Input (logic low) disables the drive amplifier and de–energizes the motor. When this input is off (logic high) the drive is enabled and the motor is energized.

Figure 3-11 Shutdown Input Connections

1–Axis



2–Axis

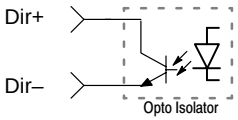


Fault Output (FLT)
The fault output turns ON (active) for any of the following conditions:

- Overvoltage
- Undervoltage
- OverTemperature/Shutdown
- Short Circuit Fault
- Interrupted Interlock

Figure 3-12 Fault Input Connections

1–Axis



2–Axis

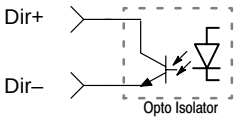


Table 3-2 Signal Requirements

Signal Name	Voltage	Current	Comments
Step or CW	* 5VDC	5–15mA	Maximum frequency: 2MHz
Direction or CCW	* 5VDC	5–15mA	Setup time: 250ns minimum On & Off time
Shutdown	* 5VDC	5–15mA	High = Enabled
Fault	30VDC (Maximum)	50mA (Maximum)	Normally conducts. Opens on fault.

Note: * External current limiting resistor is required for voltages greater than 5VDC. Use 560 ohm, 0.25W resistor for 12VDC signals. Use 1.3k ohm, 0.5W resistor for 24VDC signals.

Motor Connections The A+, A–, B+ and B– phase outputs provide power the motor windings. These connections are shown in Figures 3-6, 3-7 and 3-8. The motor windings can be connected in series or parallel as shown in Figure 3-13.

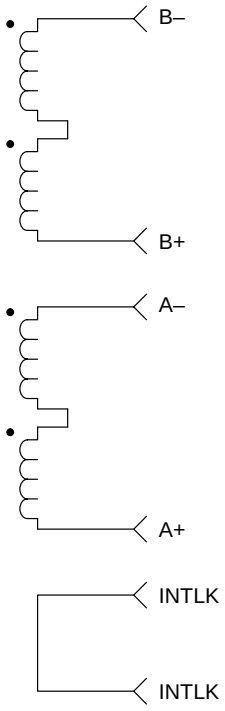
Note: A 2–Axis driver has these same connections for each axis.

Interlock (INTLK)
The two INTLK pins must be jumpered together at the motor connector for the drive to apply power to the motor. If the interlock wire breaks, or the connector is removed, the current to the motor is immediately stopped, the drive faults (latched) and flashes the dual function LED labeled Over Volt./INTLK. Extending the interlock wire beyond about 5 inches can lead to noise generated shutdowns.

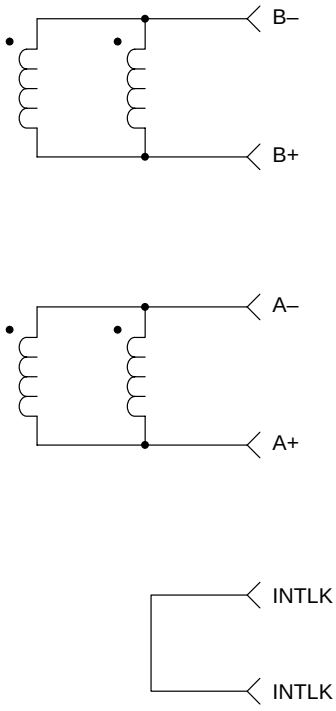
Ground (GND)
GND is internally connected to the Earth pin on the Power connector. This provides a convenient terminal for grounding the motor frame and a motor cable shield.

Figure 3-13 Stepper Motor Connections

Series Motor Connections



Parallel Motor Connections



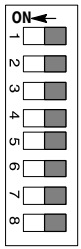
Section 4
Adjustments

Switch Settings The switch settings are summarized in Figure 4-1.

Note: If Resolution1, 2 or 3 switch is changed, the power must be cycled (Off then On) before the new resolution will take affect. All other switches and potentiometer settings may be changed at any time for immediate effect.

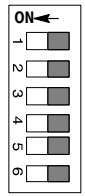
Figure 4-1 Switch Settings

1 Axis



Rest
Idle
Waveform
Resolution1
Resolution2
Resolution3
Low/High mH
Low/High Anti–Res

2–Axis



Standby
Waveform
Step Type
Anti–Res
Anti–Res
Anti–Res

Anti–Res 2 Axis Only see Table 4-1.
Anti–Resonance compensation improves motion performance in two ways. First, it prevents motor stalls due to mid–range step motor resonance and yields higher usable shaft power. Second, it reduces the amount of transient ringing that occurs at the end of a move. These phenomena combine to produce faster move times and therefore higher machine throughput. Three Anti–RES switches adjust the gain of the compensation circuit. The gain required is a function of the motor winding and load inertia (gain is inversely proportional to load inertia).

If you the load inertia, use the following formula to calculate the gain value (N) needed in your application.

$$N = \frac{0.45}{V\sqrt{T\,(J_L + J_M)}}$$

Where: J_M = Rotor moment of inertia (kg m^2)
J_L = Load moment of inertia (kg m^2)
T = Motor stall torque (N–m) less 10%
V = Motor speed (RPS) at which torque has decreased 10% from its stall value. This speed/torque point is located just beyond the “knee” of the motor’s speed torque curve.

The value of N is usually between 0 and 10. The proper Anti–Res setting is rounded to the nearest available value (0–7) and set the corresponding binary weighted DIP switches (On=1, Off=0). (Example, for N=6, set the switches as follows: 4=Off, 5=On and 6=On).

Table 4-1 Anti–Res Switch Values

N	Switch 6	Switch 5	Switch 4	N	Switch 6	Switch 5	Switch 4
7	On	On	On	3	Off	On	On
6	On	On	Off	2	Off	On	Off
5	On	Off	On	1	Off	Off	On
4	On	Off	Off	0	Off	Off	Off

Idle 1 Axis Only
The ON setting reduces motor current to 75% of the AMPS setting if no step pulses are received for 10ms. Full current will resume when the next step pulse is received.

Low/High mH 1 Axis Only

Low/High Anti–Res 1 Axis Only
To set the Low/High Anti–Res and rotary Anti–Res switches, the AR (anti–resonance) value must be calculated using the following formula. When AR is determined, the Anti–Resonance settings are found in Table 4-2.

$AR = S - K$

$$K = \log \frac{\left(\frac{J_{Rotor} + J_{Load}}{J_{Rotor}}\right)}{0.155}$$

Where: J_{ROTOR} = Rotor inertia (kg-m^2)
J_L = Load inertia (kg-m^2)

$$S = (12.987)\log\left[\frac{9.3}{V_b \sqrt{(T_M)\,(J_{Rotor})}}\right]$$

Where: J_{ROTOR} = Rotor inertia (kg-m^2)
T_M = Low speed motor torque (N-m)
V_b = Break velocity or “knee” of speed-torque curve (RPS)

Table 4-2 Anti–Res Dial and Switch Settings

AR	Anti–Res Dial	SW8	AR	Anti–Res Dial	SW8	AR	Anti–Res Dial	SW8	AR	Anti–Res Dial	SW8
30	0	Off	22	8	Off	15	0	On	7	8	On
29	1	Off	21	9	Off	14	1	On	6	9	On
28	2	Off	20	A	Off	13	2	On	5	A	On
27	3	Off	19	B	Off	12	3	On	4	B	On
26	4	Off	18	C	Off	11	4	On	3	C	On
25	5	Off	17	D	Off	10	5	On	2	D	On
24	6	Off	16	E	Off	9	6	On	1	E	On
23	7	Off				8	7	On	0	F	On

Resolution

Motor resolution is most often set to the maximum that your indexer can handle (i.e. such that the maximum step rate of the indexer provides the maximum motor speed you require). In other applications, you may want to choose your motor resolution to achieve a desired number of steps per engineering unit (per inch, degree, mm, etc.). Resolution also affects velocity smoothness. Above 10,000 steps per revolution however you will notice little improvement in smoothness, unless you are moving only a few steps per second.

1 Axis drivers use switches 4, 5 and 6 to select the motor resolution, Table 4-3. Based on 2 phase, 1.8 degree motor step angle.

Table 4-3 Motor Resolutions, 1 Axis

Standard & –CW	Motor Resolution		LRES & LRES–CW	Res1	Res2	Res3
	in	mm				
5,000	4.00×10^{-4}	1.02×10^{-2}	200 CW/CCW	OFF	OFF	ON
10,000	2.00×10^{-4}	5.08×10^{-3}	400 CW/CCW	ON	OFF	ON
18,000	1.10×10^{-4}	2.79×10^{-3}	1000 CW/CCW	OFF	ON	ON
20,000	1.00×10^{-4}	2.54×10^{-3}	2000 CW/CCW	ON	ON	ON
25,000	8.00×10^{-5}	2.03×10^{-3}	200 Step & Direction	OFF	OFF	OFF
25,400	7.80×10^{-5}	1.98×10^{-3}	400 Step & Direction	ON	OFF	OFF
36,000	5.50×10^{-5}	1.39×10^{-3}	1000 Step & Direction	OFF	ON	OFF
50,000	4.00×10^{-5}	1.02×10^{-3}	2000 Step & Direction	ON	ON	OFF

Note: If Resolution1, Resolution2 or Resolution3 switch is changed, the power must be cycled (Off then On) before the new resolution will take affect.

Two axis Drivers have rotary switches to select eight selectable motor resolutions (200, 400, 1,000, 5,000, 10,000, 18,000, 25,000 and 25,400 steps per motor revolution.) The motor resolution setting determines the number of incoming step pulses per revolution. This resolution setting assumes you are using a step motor with 1.8° step angle.

Rest 1 Axis Only

The ON setting reduces motor current to 1 ampere after no motion has occurred for 12 minutes. Full current will resume when the next step pulse is received.

Standby 2 Axis Only

Automatic current standby allows the motor and driver to operate cooler by reducing motor current during idle periods. Standby switch = ON reduces motor current by 30% when the driver has not received a step pulse for 250 msec. Full current is restored when the next step pulse is received. A 30% reduction in motor current during standby correlates to approximately 30% reduction in motor holding torque. Do not use standby mode when more than 70% of the motor's torque is needed to hold a load stationary (e.g. holding a vertical load against gravity with a ball screw). Do not use this feature in applications that use an encoder to perform end–of–move position maintenance.

Step Type 2 Axis Only

Two choices for the command input; Step/Direction (Step Type DIP witch OFF), and Clockwise/Counterclockwise (Step Type DIP switch ON). In Step & Direction mode, the motor will advance one step with each low going transition on the Step input. The level of the Direction input determines the direction that the motor steps. In Clockwise/Counterclockwise mode, the motor will advance one step clockwise for each low going transition on the Step input, and advance on step counter–clockwise for each low going transition on the Direction input.

Waveform

Changes the shape of the current waveform to optimize smoothness and step–to–step accuracy at low speeds. OFF is sinusoidal. ON changes waveform to 4% 3rd harmonic. Depending on motor design and the current required, it may be better to distort the sinusoidal waveform to achieve better low speed smoothness and step–to–step accuracy. Most applications run best with the Waveform switch OFF. Determine proper setting as follows:

1. Operate the motor at less than 1 RPS.
2. Move the Waveform switch from Off to On and back to Off. Determine which setting produced the smoothest operation and set the switch to that position.

Motor Inductance 1 Axis

Low/High mH switch =ON, is used for less than 10mH for 115VAC units (less than 40mH for 220VAC units). Low/High mH switch = Off for greater motor inductance values.

Motor Inductance 2 Axis

Motor Inductance is adjustable in the range of 2–60 mH per phase, with 16 settings over that range. The 16 position rotary inductance setting switch has inductance settings from 0 to 60 mH, in multiples of 4 mH. For proper inductance setting, determine the motor inductance specification and round to the nearest multiple of 4 mH. (When using motors with an inductance less than 4 mH, always set the Motor Inductance switch to 4mH.)

If the exact inductance of the motor is not known, initially set the inductance to 32 mH. Because manufactures specify motor inductance in different ways, it can be difficult to relate a specification to an actual setting. Therefore, some adjustment may be needed. If the inductance is set too low, the motor will not run at its rated torque and speed. You will experience premature stalling. Setting the Inductance switch too high will produce an audible hum from the motor, and increase motor heating. Between these two extremes, there are generally 2 or 3 inductance settings that are “right”.

With 4–lead motors, the manufacturer’s inductance rating usually translates directly to the LinStep inductance setting. To determine the 6–lead unipolar motor inductance setting, use 4X the manufacturer’s rating. For 8–lead (bi–filar wound) motors in series, set the inductance to 4X the manufacturer’s rating. In parallel, use the manufacturer’s rating. Again, please check with the motor manufacturer to be sure.

Offset Adjustments

Offset adjustments are provided to optimize smooth operation and step–to–step accuracy. To adjust offsets:

1. Disconnect the load from the motor.
2. Operate the motor and observe smoothness of operation.
3. Adjust Offset A and Offset B potentiometers.
4. Repeat steps 2 and 3 for best operation.
5. Connect the load to the motor.

Note: For 2 Axis drivers, perform this procedure for each axis.

Motor Amps Adjustments

The Motor Current range is 0.0–6.0 Amps (peak) per motor phase. Each axis has two, 10 position rotary switches for setting the current independently in each motor. The “AMP” switch sets the integer current value, and the “Tenths of AMP” switch sets the tenths of amps value.

If you need to use another manufacturer’s motors, they should meet the following guidelines:

1. 2 phase, hybrid, permanent magnet step motor
2. 4, 6, or 8 lead motor
3. Series or parallel inductance rating between 2–60 mH. Motors with greater inductance will not damage the driver, but they will have limited dynamic performance.
4. A minimum high–pot test rating of 500 VDC

If possible, use the manufacturer’s 160 VDC, bipolar current rating. With 4–lead motors, the manufacturer’s (bipolar) current rating translates directly to the current setting. For the proper current setting for 6–lead (unipolar) motors, use 70% of the manufacturer’s rating. For 8–lead motors, you have the choice of wiring the motor in series or parallel. In Series, set the current to the manufacturer’s bipolar rating. In Parallel, double the bipolar current rating. Care should be taken when running a step motor in parallel to avoid overheating the motor windings. A step motor in parallel may be duty cycle and speed limited. Check with the motor manufacturer for temperature guidelines.

Section 5
Troubleshooting

Overview

The system troubleshooting procedures involve observing the status of the LED's. The tables in this section provide information related to the indications provided by these devices.

Table 5-1 Operating Mode Indications, 1 Axis

LED	Color	Status	Comments
ON	Green	Power is applied.	Not a failure.
	Yellow	Power is applied and "Shutdown" was issued.	Not a failure if Indexer issued a valid shutdown command.
	Red	Power is applied and "Overtemperature" condition exists.	Allow driver to cool down. Determine reason for overtemperature, high ambient temperature, lack of air flow, motor current too high, adjust standby current.
Step	Green	Incoming Steps, Direction CW	Not a failure.
	Yellow	Incoming Steps, Direction CCW	Not a failure.
	Red		
Bus	Green		
	Yellow	Continuous on=overvoltage condition Flashing = Regen condition	Verify input voltage is proper. Not a failure. Regen operation is not a failure.
	Red	Undervoltage condition	Verify input voltage is proper
FLT	Green		
	Yellow	Interlock condition.	Verify motor connections.
	Red	Motor short.	Replace motor.

Table 5-2 Operating Mode Indications, 2 Axis

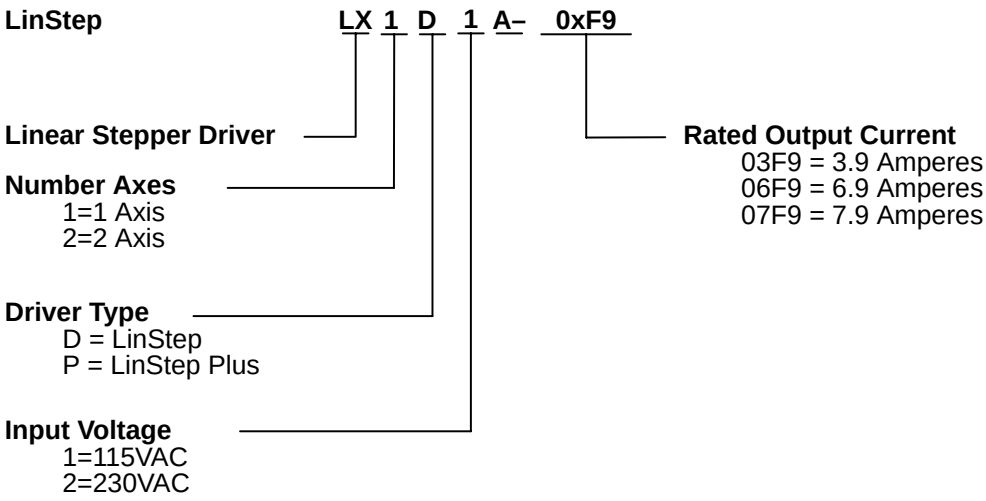
LED	Color	Status	Comments
Power	Green	Power is applied.	Not a failure.
	Off	Power is not applied.	If not "On" within two seconds after power up, replace the driver.
Regen	Yellow	"On" when dynamic brake (REGEN) circuit is active and maintaining Bus voltage.	Not a failure.
	Off	No dynamic brake activity.	Not a failure.
Over Volt/ INTLK	Red	Dynamic brake (REGEN) circuit is not maintaining bus voltage level. Must cycle power to reset fault.	Regen activity is more than the circuit can handle. Reduce load or increase Dynamic Brake capacity.
		Lost continuity in the Interlock circuit. Must cycle power to reset fault.	Verify motor connections and interlock jumpers.
	Off	Normal operation.	Not a failure.
Tempera-ture	Red	Temperature within driver exceeded 140° F (60° C). Must cycle power to reset fault.	Allow driver to cool down. Determine reason for overtemperature, high ambient temperature, lack of air flow, motor current too high, adjust standby current. Increase air circulation, install fan kit, use Standby mode, or reduce duty cycle.
	Off	Normal operation.	Not a failure.
Stepp-ing	Green	Receiving CW Step pulses (right LED) Receiving CCW Step pulses (left LED)	Not a failure.
	Off	Not receiving step pulses.	Indicates a failure if Indexer is sending pulses.
Disable	Yellow	Shutdown input received from Indexer.	
	Off	Normal operation.	Not a failure.
Fault	Red	Indicates a short circuit or undervoltage condition. Must cycle power to reset fault.	Verify a short circuit in the driver or motor . Problem within the driver, replace driver.
	Off	Normal operation.	Not a failure.

Additional Information (General)

LED	Possible Cause	Possible Remedies
Fault	Miswired or shorted motor.	Isolate problem by disconnecting motor leads from the motor connector, but leave interlock installed. Apply power and step pulses. If fault does not occur, the motor or its wiring is defective.
	Low AC Input voltage (less than 85 volts)	Verify AC input is within specification.
	Defective driver.	If fault still occurs, the drive is defective. Return to Baldor for repair.
REGEN	LED ON for long periods means dynamic braking is active. Deceleration too fast or load too heavy.	Install optional external Dynamic Brake resistor assembly. Verify driver/motor is correctly sized for load. Reduce load.
Over Volt/INTLK	Over Volt./Interlock LED is on, and Regen LED was fully illuminated before fault occurred. Overvoltage due to excessive regen energy from the motor.	Install optional external Dynamic Brake resistor assembly for additional regen dissipation capacity.
	Over Volt./Interlock LED is flashing. Broken Interlock connection.	Check continuity between interlock on one or both axes
Motor has little or no holding torque, the power LED is on and the Fault LED is off.	Drive is disabled by Shutdown input. Disable LED should be on. Motor wiring is disconnected. Motor current setting is too low.	Enable drive by removing Shutdown signal. Verify motor wiring. Verify current AMPS and Tenths of AMPS settings.
Motor stalls between 12–18 RPS	Wrong Anti–Res setting. Too fast an acceleration rate.	Verify Anti–resonance settings are correct. Reduce load or acceleration rate.
Motor runs rough at low speeds (1–5 RPS)	A setting of 200 or 400 steps per revolution is considered normal. Incorrect phase offsets or Waveform. Motor current setting too high. Step pulses are erratic or noisy.	Increase resolution setting. Verify adjustments are fine tuned. Verify (decrease) motor current setting. Verify step pulse integrity using an oscilloscope.
Motor seems to be “losing steps”.	Control is overdriving or underdriving the step input. The step pulses are coming too fast or are too narrow. The motor is stalling. The mechanical system is slipping.	Verify that the input current is at least 6.5 mA but less than 15 mA. Pulses must not exceed 1.25 MHz, or be less than 0.2 msec in width. See motor stall symptoms. Verify couplings, belts, pulleys, etc. are not slipping. Test the motor unloaded.
Motor moves the wrong distance.	Resolution settings are not matched.	Verify drive resolution setting corresponds to the indexer.
Motor stalls at high speeds.	Commanded velocity is too high for system capability.	Check motor current setting. Verify (reduce) velocity setting. Also see “Anti–resonance settings”.
Motor stalls during acceleration.	Motor current is incorrect. Acceleration rate is too high for the system capability.	Verify motor current setting. Verify (reduce) acceleration setting, or use a motor with higher torque.
Motor moves in the wrong direction.	Control and Drive directions conflict with each other.	Change the direction at the indexer (polarity of direction bit). Or, with AC power off, change motor direction by swapping A+ with A–. on the motor connector.
Motor direction will not change.	CW/CCW mode is selected instead of Step/Direction mode, or vice versa. Control is overdriving or underdriving the step input.	Check the Step Type dip switch. Verify that the input current is at least 6.5 mA but less than 15 mA.
The motor runs very hot	Step motors can run at up to 100°C, may not be a problem.	Use Standby mode if the application allows it. Reduce cycle rate.
Motor has torque, steps are being received (Stepping LED is on) but motor doesn’t turn.	Motor is stalled, or load is jammed mechanically.	Reduce the load or the speed of the move.

Section 6
Specifications & Product Data

Identification



General Specifications

Description	Unit	LX1D1A07F9	LX1D2A03F9	LX2D1A06F9
Input Voltage Range Nominal Minimum Maximum	VAC	115 92 132		230 184 265
Input Frequency	Hz	50/60 ±5%		
Nominal Output Bus (@ 115 / 230 input) Nominal Minimum Maximum	VDC	160 88 180		320 176 360
Adjustable in 0.1A increments	A_{RMS}	0.1 – 7.9	0.1 – 3.9	2.0
Resolution	Steps/ Rev	5000, 10000, 18000, 20000, 25000, 25400, 36000, 50000		
Efficiency	%	85		
Motor Inductance	mH	Low / High (Low is < 10mH)		Low / High (Low is < 40mH)
Switching Frequency	kHz	20		
Operating Temperature	°F (°C)	32 to 100 (0 to 40); 122 (50) Maximum		
Operating Altitude	ft (m)	8300 (2540) Maximum		
Storage Temperature	°F (°C)	–13 to 158 (–25 to 70)		
Humidity (non–condensing)	%	10–85		
Shock		10G (according to DIN IEC 68–2–6/29)		
Vibration		1G @ 10 – 150 Hz (according to DIN IEC 68–2–6/29)		

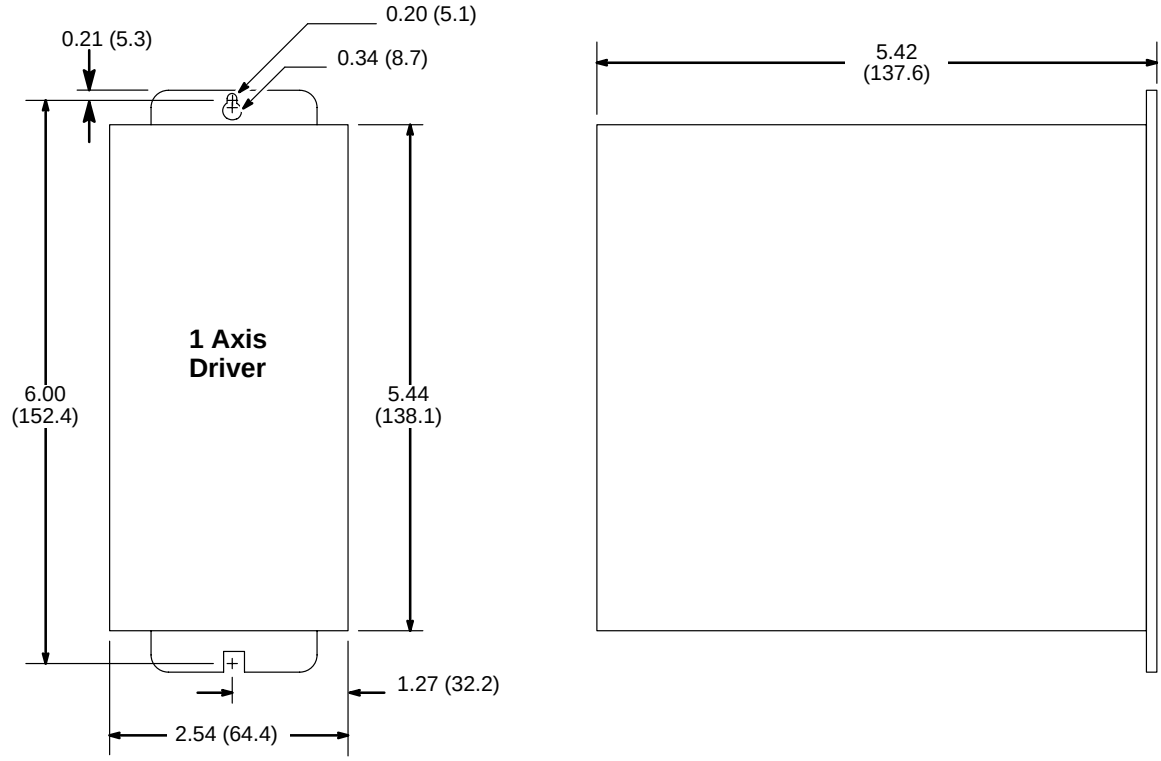
Indexer Input Connections Optically Isolated (Step, Direction, Shutdown)

Description	Unit	All
Voltage	VDC	5
Current	mA	5–15
Step (CW) maximum frequency	MHz	2
Direction (CCW) setup time	nsec	250 (minimum On to Off time)

Indexer Output Connection Optically Isolated (Fault)

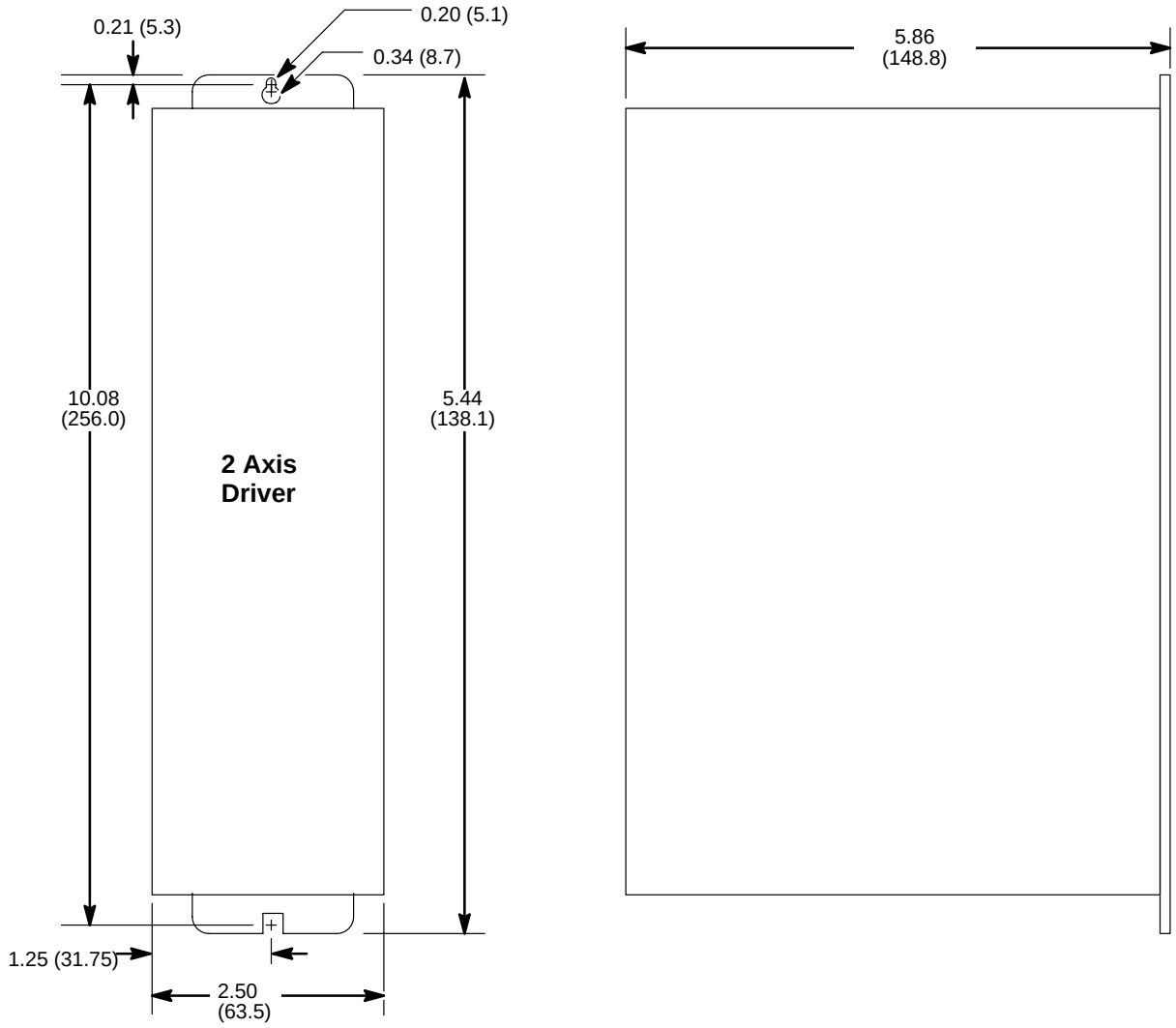
Description	Unit	All
Voltage	VDC	30
Current	mA	50 maximum
Polarity		Normally conducting (Open on fault)

Dimensions



For safe operation, allow a clearance distance between each control and on all sides of each control.

Dimensions Continued



BALDOR ELECTRIC COMPANY
P.O. Box 2400
Ft. Smith, AR 72902–2400
(501) 646–4711
Fax (501) 648–5792
www.baldor.com

CH TEL: +41 52 647 4700 FAX: +41 52 659 2394	**D** TEL: +49 89 90 50 80 FAX: +49 89 90 50 8491	**UK** TEL: +44 1454 850000 FAX: +44 1454 859001	**F** TEL: +33 145 10 7902 FAX: +33 145 09 0864
I TEL: +39 11 562 4440 FAX: +39 11 562 5660	**AU** TEL: +61 29674 5455 FAX: +61 29674 2495	**CC** TEL: +65 744 2572 FAX: +65 747 1708	**MX** TEL: +52 47 61 2030 FAX: +52 47 61 2010

MN1852

Printed in USA
3/01 PS10