LN3X Series Motor and Drives

Operator's Manual
PN 04-01920 C

PRECISION MOTION CONTROLS

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INTRODUCTION

Description

      The LN3X Drive is a microstepping drive with a linear amplifier output stage. It is intended for stepping motor applications where motor vibration must be minimized and EMI noise can't be tolerated. The LN3X drive eliminates EMI noise in the steady state condition and minimizes EMI noise while running. The drive's dual voltage supply design allows this unit to have speed vs torque curves superior to most pulsewidth modulated drives while minimizing the stress on the power amplifier. The drive provides extremely smooth movement with a microstepping resolution of 25600 steps/revolution; this makes this product suitable involving in applications with precision equipment where vibration must be minimized.

The LN3X drive can be purchased with a wide range of motors with torque ranges between 60 and 600 in-oz. The drive has two dip switches for easy access to current selection, auto-shutdown, 3rd harmonic correction, and a test mode. Each function is described in detail further on in the manual.

A standard 25 pin D connector with TX, RX Gnd, limit inputs, Home input and Fault output make this drive easy to interface with existing terminals on the market.

LN3X can be ordered in 2.5 amp or 3.5 amp peak current version. For 3.5 amp, the motor will go to standby mode automatically after the motor stops for 2 seconds. The voltage of the motor is limited to the low voltage supply. The high current version is intended for the applications that require high torque and low speed applications. Caution should be used when configuring current setting. The motor can be damaged if too much current beyond its specification is forced through the windings.

There is a 2k Internal EEPROM that can be used to store a move sequence after power up.

Features

      The LN3X is a high performance linear microstepping drive designed for low noise applications. The systems dual supply allows cool operation at idle and low speed operation while still enabling the drive to obtain high speeds.

* Wave shape correction of 3%, 5% third harmonic distortion

* 115/220 VAC line voltage operation

* Auto-standby reduces motor current to 50% after 2 seconds if no input is received.

* Short circuit current protection

* Low voltage sense

* Current configurable through dip switches

* External fault indicators

Warranty

PMC's linear drives have a one year warranty against manufacturing defects from the date of purchase. If your unit should ever fail, and you wish to send it back for repairs; you should do the following:

       1. Get the serial number from the defective unit.

       2. Check purchase date to see if the unit is under warranty. If not, obtain a purchase order number for repair costs.

       3. Call Precision Motion Controls or email to service@premotn.com for a return authorization

       4. Ship to:

           Precision Motion Controls
           5339 Prospect Rd. #209
           San Jose, CA. 95129

               Attention RMA #_____

INSTALLATION

Unpacking

When unpacking your unit verify that the unit was not damaged during shipping. Report any damage found to the shipper. Check the box contents against the packing slip. The box will contain the driver, an AC line cord and manual. If a complete system was bought a motor will also be included.
Connect the motor to the driver, check that the AC switch selection is set to the proper voltage and set the motor current, then plug in the AC line cord. Ensure the shaft of the motor is producing torque. If you are able to rotate the motor shaft, the motor is not producing torque. Check if the fault LED is on; and unplug the AC line cord. Check for any loose motor wires or a blown fuse. Contact the factory for a return authorization if the above checks prove negative. IF the above test works turn off the drive and put the unit into the test mode by placing dip-switch 2 position 7 to the on position. Plug the AC cord in; the motor will rotate 0.7 rev/second.

CAUTION, always disconnect the AC power prior to connecting or disconnecting the motor to the drive.

Mounting

The LN3X Drive comes with built in mounting brackets to facilitate mounting. The unit may be mounted in any direction. Our built-in fan eliminates the need for the user to be concerned about cooling. It is recommended that 3 inches be allowed around the box for air flow into the system. See appendix for a detailed drawing of the driver dimensions.

Cooling

The drive has a fan cooled enclosure; the surrounding temperature of the environment should not exceed 40 degrees centigrade. If the driver needs to be in a warmer environment, consult the factory for recommendations.

Wiring

Motor Connections

The drive has three connectors on the box; a standard AC inlet, a 25 pin "D" connector for the indexer, and a 5 pin Phoenix connector for the motor.

If a motor is purchased with the drive, the motor will have the connector attached to it; otherwise a connector with screw mountings will be supplied. The center pin of the connector is for the shield connection of the motor cable. The center pin (shield) is connected to the motor case on PMC supplied motors. The motor connections are listed below.

Phoenix 5 pin connector

A+   (Red)
A-   (Black)
Shield (Earth Ground)
B+   (White)

B-   (Green)

You can change motor rotation direction by swapping A+ with A- or B+ with B-.

Line Power

The drive has an AC line voltage (115 or 220 VAC) selection switch on the side of the unit. All units are shipped with the selection switch in the 115 VAC line voltage position. The correct line cord is supplied for connection of 115 VAC power. Make sure that the unit is plugged into a wall socket with earth ground.

It is very important to select the line voltage correctly before turning on the drive.

Indexer Connections

The drive has RS232 compatible signals for TX, RX and Communications ground. Inputs for limit CW, CCW and home are provided; these signals are photo-coupled to eliminate ground loops.

The RS232 serial communication uses 3 pin standard RS232C interface, the setup is listed in the following table.

| BAUD RATE	DATA BITS	PARITY	STOP BITS
9600	8	NONE	1

If an over-current, under-voltage or over-temperature condition is detected the photo-transistor across the Fault+ and Fault- output is turned on. If the Fault signal is active, the drive's AC power needs to be cycled to reactivate the drive.
The Error condition is satisfied if the drive current exceeds 7 Amps, line voltage drops below 90 VAC, or if the internal temperature exceeds 50 degree C.

25 pin "D" connector

1	Limit + Pwr
14	Limit + ret
2	Limit - Pwr
15	Limit - ret
16	Home Pwr
17	Home ret
9	Fault + (collector)
21	Fault - (emitter)
11	RXD
24	TXD
12	RS232 ret

Typical inputs, output connections
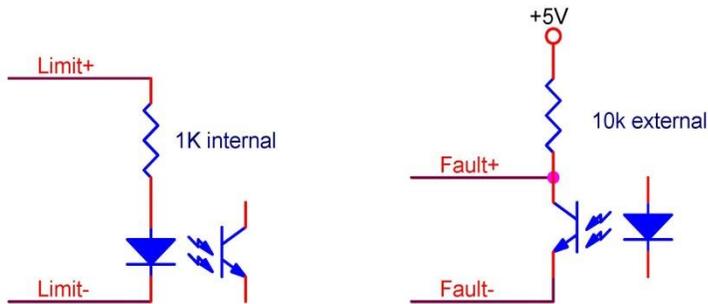
The limits and home typically are connected to 5V TTL signal, they are active when there is a 5V drop across + and – pins. A current limit resistor is required between the Fault+ and external 5V supply. Typically a 10K resistor is used for 5V supply. The maximum voltage between Fault+ and Fault- is 50V.

Switch Settings

Disconnect AC power from the unit prior to attempting to change any switch settings. The switch settings control the maximum winding current, 3rd harmonic correction, and test mode.

The two dip switches are accessible from the bottom of the box. The following graphic shows the location of 2 switches. Switch1 (SW1) is the on the left hand side in the graphic.
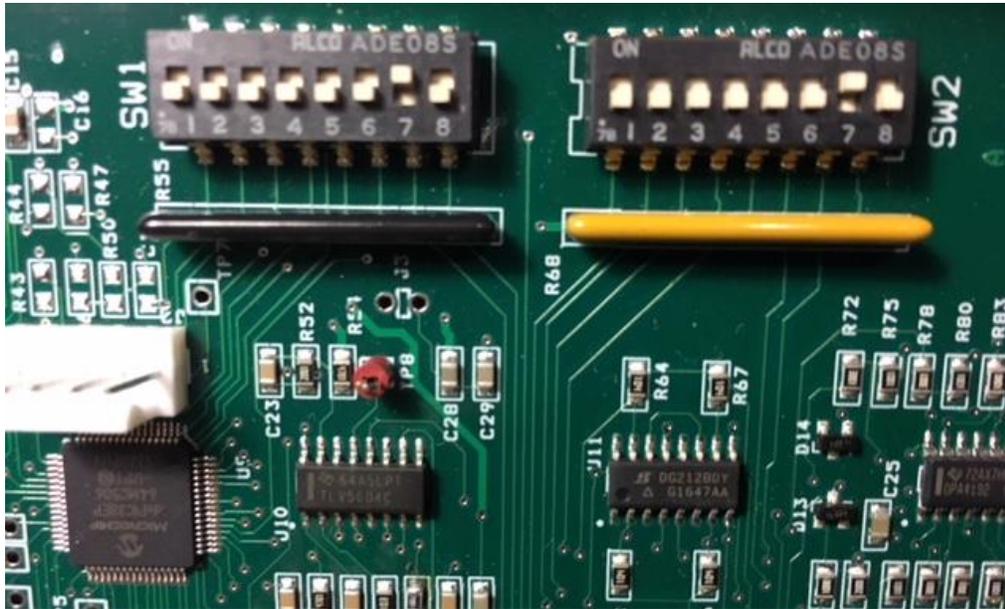

Figure 1: Dip Switch location SW1 on the left**, SW2 on the right**.

The tables below list the dip switch settings for various motor currents, motor waveform and various RS232 communication options.

TABLE 1

Switch 2	1	2	3	4	5	6	7	8
PMC - 60 MTR	on	on	off	off	off	off	X	X
PMC - 90 MTR	on	on	off	off	off	off	X	X
PMC - 130 MTR	off	off	off	off	off	off	X	X
PMC - 160 MTR	on	off	off	off	off	off	X	X
PMC - 260 MTR	on	off	off	off	off	off	X	X
PMC - 320 MTR	on	off	off	off	off	off	X	X
PMC - 420 MTR	on	off	off	off	off	off	X	X
PMC - 600 MTR	on	on	on	off	off	off	X	X
Test Mode	X	X	X	X	X	X	on	X
Standby	X	X	X	X	X	X	X	off

The first 6 switches of dip switch 2 are the current settings and are approximately 40 ma per bit for 2.5 amp drivers and 56ma per bits for a 3.5amp driver. The off position of the switch selects the current; switch 6 is the most significant bit. The PMC supplied motors run at approximately 2.5 amp/phase peak current. The motor current table above is for 2.5 amp version. In the 2.5amp version the user can activate the standby mode by selecting switch 2-8 to off position. Standby mode is automatically entered in the 3.5 amp model regardless of the switch setting

Test

This is a mode that is entered upon power up if switch 2-7 is in the on position. The motor will rotate at 0.7 rev/sec after power up. Power must be turned off and switch 2-7 put in the off position to leave test mode.
The commands are ignored in test mode. Set Test mode to the off position before entering command mode**.**

Auto-Standby

The motor current is reduced to 50% after 2 seconds of no movement in the 2.5 amp version when switch 2-8 is selected OFF position. The motor current goes to standby mode regardless of the switch setting in the 3.5 amp version.

	Switch 1							
	1	2	3	4	5	6	7	8
wave shape								
0%	X	X	X	on	on	on	X	X
+3%	X	X	X	off	on	on	X	X
-3%	X	X	X	on	off	on	X	X
5%	X	X	X	off	off	on	X	X
-5%	X	X	X	on	on	off	X	X
enable DN	on	X	X	X	X	X	X	X

enable echo		X	on	X	X	X	X	X	X
enable CR		X	X	off	X	X	X	X	X

The user has the ability to select the motor current wave shape. This will help provide even steps and minimize motor vibrations for various motors. If you use motors that have a large detent torque compared to the motor torque you may need to select a wave form other than 0% wave shape. The wave shape corrections are based on a percentage of third harmonic distortion.

Switch 1-1 enables and disables the characters from being echoed from the drive. It is best to have the echo enabled while debugging.

Switch 1-2 enables or disables the drive from sending a DN response when a move stops. This can be used as an indication that the drive has reached the desired position without polling the position status.

Switch 1-3 can be set to output a "CR" carriage return after status

Switches 7 and 8 set the system ID so that the units can be daisy chained.

Fault indicators

There are two LED indicators adjacent to the motor terminal.

Fault1 LED is on when Over-current or Over-temperature conditions occur.

Fault1 LED is flashing when under voltage condition occurs. Check AC voltage is selected correctly

Fault2 LED is on when the motor power is removed.

Commands

Set RS232 communication protocol correctly and de-select the test mode in the dip switch to enter command mode.

The following are a list of commands that are accepted over the RS232 input. The small x's after a command stand for numbers that can be entered. **The alpha characters must be capital**. **The command is entered by following a Space key**. See examples.

MC_A100_V100_G_

The above program will set motor to move in continuous mode, 10 rev/sec² acceleration, 1 rev/sec velocity. Each command is followed by a space represented by _ (underscore).

Axxxx

Acceleration
        This is in rev/sec/sec the least significant digit is in 0.1 rev. The drive does not accept a period to locate the decimal point. Thus accelerations from 999.9 to 0.1 rev/sec² are represented by the 4 integers. The least significant bit represents 0.1 multiples of acceleration.

Example A255 sets the acceleration to 25.5 rev/sec²; A3 sets the acceleration to 0.3 rev/sec². The acceleration should be set after each move is completed. In the distance mode the acceleration should not be changed while the motor is moving.

CF
COMMAND CURRENT OFF

Removes power from the motor and turns FAULT LED 2 on. This removes motor torque so the load can be moved by hand.

CN
COMMAND CURRENT ON
Puts power back on the motor. If the CF command is issued this command should be issued prior to doing a move.

Dxxxxxxxx

Distance
        The distance is in motor steps (25600 per revolution. Valid numbers are ±2.000.000.000). The distance is a 32 bit number internally. Putting in larger numbers will cause incorrect moves. The distance command is only applicable in the position mode (MI or MA). The distance is in reference to the current position.

Example

MI A100 V100 D256000 G

D256000 will set the move to 10 revolution CW, acceleration at 10rev/sec², incremental move; a D-256000 is 10 rev CCW. The distance must be entered before each move. There is not a default distance and it is reset after each move. Do not enter a distance while the motor is moving.

G

GO
This tells the unit to start the move. It calculates the ramp distances at this time for incremental moves and enables the limit in the direction of travel.

Example   see MA, MI and MC commands

GH
GO HOME

Seeks the CW edge of the home limit at the previously specified velocity, acceleration, and direction. Always specify the CW direction to ensure full travel search. If H- (CCW) direction specified the sequence is terminated if the CCW limit is found. The motor will continuously move after HOME sensor is reached until the home sensor is cleared.
Example
H+ A50 V200 GH
The unit uses an acceleration of 5rev/sec² and a velocity of 2rev/sec and moves in the CW direction looking for the HOME sensor. If the sensor is reached it stops and then continues in the CW direction at 0.1 rev /sec until the limit sensor is cleared. If the unit senses the limit before the home sensor on the initial move the drive stops and then drives CCW until the home sensor is reached. It then stops and moves CW at 0.1rev/sec until the home sensor is cleared. If the drive finds the CW limit and then the CCW limit without finding the home sensor the sequence is terminated.

Hx

Set direction
        H is followed by a "+" or "-" to indicated CW and CCW motor rotation respectively. This is used mainly in the MC mode to set the motor rotation direction. The H must be followed by a + or - to be valid.

MA
MODE ABSOLUTE

This puts the drive in the absolute position mode. The drive performs a trapezoidal move based on the acceleration, velocity and distance parameters entered. All distances entered are respect to the systems absolute position counter. Thus if a PZ command is issued, the internal counter is zero. Entering a distance off D2000 would cause the drive to move CW 2000 counts. Then entering a distance of D4000 would cause the drive to move 2000 steps again or move from the 2000 to 4000 absolute counter position. A distance of D-2000 would now cause a move of 6000 counts in the CCW direction. So the absolute counter reads -2000.
PZ MA A50 V200 D2000 G
D4000 G
D-2000 G

MC
Mode continuous

This puts the unit in velocity mode. The unit will accelerate to the velocity entered. New velocity values may be entered while the motor is running. As soon as the new velocity is entered it becomes the target velocity whether the previous velocity had been reached. The acceleration may also be changed while the motor is running.

Example
MC A100 V500 G; after the G is entered the motor accelerates to 5 rev/sec at 10 rev/sec/sec. A new acceleration and velocity or just velocity may now be entered and it will accelerate to the new value. Entering A20 V100 would cause the motor to decelerate from 5 to 1 rev/sec at 2 rev/sec/sec.

MI

MODE INCREMENTAL
This puts the drive in the incremental distance mode. The drive performs a trapezoidal move based on the acceleration, velocity and distance parameters entered. If the distance entered is not great enough to allow the motor to reach velocity with the acceleration given the velocity profile will be triangular and accelerate for 1/2 the distance and decelerate for the other half.

Example
MI A100 V1000 D1000000 G
The motor will accelerate for 128000 steps (5 rev); run at 10 rev/sec until the motor has traveled 872000 steps and then start decelerating. If the distance in the above move is changed to 200000. A100 V1000 D200000 the motor will accelerate until the motor reaches 100000 steps and then decelerate.

PZ

Zero absolute position counter
Set the position counter to 0 (800000 hex). This allows the user to establish the zero position. This should be done after a home command. On power up this counter is set to zero.

RD

REPORT POSITION
The contents of the 32 bit position counter are sent back in decimal format. A +0 is the power up zero position, +1 is one step positive and -1 is 1 step negative. This counter will roll over at max count. The counter can be read while the motor is moving but no guarantees are made on data integrity since the count could change during the reading and conversion to ASCII.
RD response +25600

RL

Report Limits

The contents of the limit status registers are sent in two hex values. These are located in bits, 0, 1, and 2. If the bit is 0 then it is active.
bit 0 = limit -
bit 1 = home sensor
bit 2 = limit+
RL response L03.
Limit- and Home sensor are 1

RS

Report Motor status
        Sends out the motor status in hex. It tells whether the last movement was acceleration or deceleration, whether the motor is running and the mode (velocity or incremental).

        b0   motor direction 1 = positive
        b1
        b2   continuous mode = 1
        b3   incremental mode = 1
        b4   absolute mode = 1
        b5   accelerate = 1
        b6   running = 1
        b7

 RS response S03

S
STOP

This causes the motor to decelerate to a stop in either the velocity or position mode.

Txxx
Use this command followed by a space key to set test speed after power up. T100 sets the test speed to 1rev/sec. T000 will return to default speed. Three digits must be entered otherwise the command will be ignored. . Remember to always enter commands when test mode is not selected by dip switch.

Vxxxx

Velocity

The velocity is in rev/sec. The acceptable range is from 50 to 0.01 rev/sec. Since decimals are not accepted this equates to a range of 5000 to 1.

Example V1002 represents a velocity of 10.02 rev/sec. The velocity "must" be set before each move. In the velocity mode (MC) entering a new velocity while the unit is running will cause the drive to accelerate to that velocity at the last acceleration rate entered. A velocity of 0 will cause the motor to come to a stop.
MC A50 V500 H+ G
The motor accelerates at 5 rev/sec2 to 5.00 rev/sec in the clockwise direction. Entering V1000 after the drive has reached speed will cause it to accelerate from the present speed to 10 rev/sec.

DN

Movement Done. This is sent by the drive when the motor stops. This can be used by the host as a notice of move completed.

XDx

Define stored program x . X can be 1-4. A stored program can be up to 120 characters including the command and all spaces. The program will be stored and kept in memory after power off. It can be executed

without re-entering after power up. Error checking is not done at this time. The motor should not be running when a stored program is created.
Example

XD1 MI A50 V200 D500000 G D-100000 V300 A10 G XE
The program defines stored program #1. This program contains 49 characters including the space at the end. The XE signifies end of the stored program

XE
End of stored program
XE followed by a space will terminate the program and store it into EEPROM.

XRx
Execution of the stored program x.

RXx
Send out stored program x via RS232

Electrical

Input Power: 95 to 130 VAC 50/60 Hz, 190 to 270 VAC 50/60, switch selectable.

Fuse: 3.5 Amp (located on PC board by voltage select switch).

Output Power: 0 to 2.5 Amps at 40 VDC through an H bridge liner driver. 0-3.5 amps for 3.5 amp version at 20V DC

Motor Compatibility

Motor inductance - approximately 4 mH for a PMC supplied motor. The drive has a minimum inductance of 1mH. However a motor inductance greater than 20 mH will reduce the top motor speed and may cause stability problems.

Indexer Inputs/output

All input signal are optically isolated and have a current limiting resistor in series. A driving source of 5 volts will meet this requirement. If a higher voltage source is used a corresponding external resistor must be added

Fault (error+, error-) is an npn transistor photo-coupled rated at 50V maximum output. The typical current when on is 1ma. The transistor is on when an over-current, over-temperature or under-voltage- condition is detected.

The inputs and fault output can be programmed for a different function for OEM customers. Consult the factory if you have a need for this option.

PMC drives come pre tested and adjusted for the motor that is supplied with the unit. No further adjustments are necessary.

"DO Not" connect or disconnect the motor with power applied to the box.

Resonances

All stepper motor drives are subject to two oscillation regions; low speed (approximately 1 rev/sec) and mid-range (approximately 10 to 15 rev/sec).

Microstepping minimizes low speed oscillation. If your load has a high Q and resonates around 200 Hz, adding extra inertia to the motor shaft may eliminate the problem. Changing the current wave shape may help tune the motor driver to your motor load combination.

PMC motors and drives have been matched to eliminate most mid-range instability problems.

Drive Specification

Performance (unloaded motor)

Repeatability: ±5 arc-seconds (unidirectional)

Accuracy: ±5 arc-minutes (bidirectional)

Step-to-Step Accuracy: ±20 arc-seconds (unidirectional)

Inputs (optically isolated): 5 VDC, TTL typical

Home: Active low level

Limits: Active low level

Output (optically isolated): 30VDC, 5ma max.

Communication: RS232

Environmental – Operating

Driver: 0 to 60 °C measured at the heatsink

Motor: 80 °C measured at motor case

Ambient: 10 to 40 °C, 0 to 95% humidity, non-conducting

Environmental- Storage

Motor + Driver: 0 to 60 °C, 0 to 95% humidity, non-conducting

Power: 95-130/190-260 VAC 50/60 Hz, 1.2A

Weight: 15 Lbs.

Commands

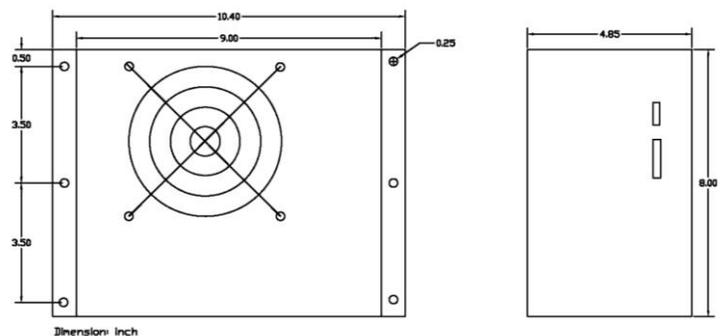|					
Vxxxx	velocity 0.01 to 50 rev/s	RD	report position	XDx	define program x
Axxxx	acceleration 0.1 to 999 rev/sec²	RS	report status	XE	end program
Dxxxxx	distance 0 to ±2000,000,000 steps	S	Stop	XRx	run program x
G	go start motion	RC	report software version	RXx	report program x
GH	go home	CF	turn off motor current		
Hx	set direction	CN	turn on motor current		
MC	motion velocity mode	RL	report limits, home status		
MI	motion incremental position	RS	report motor status		
PZ	zero position counter	Txxx	store power up test speed		

Indexer connector: 25 pin D

1. Limit CW+
2. Limit CCW+
9. Fault+
11 RxD
12 RS232 Ret
14 Limit CW-
15 Limit CCW-
16 Home+
17 Home-
21 Fault-
24 TxD

Motor connector: 5 pin terminal block

1. A+
2. A-
3. Gnd
4. B+
5. B-

LN3 dimension: inch

Dimension: inch

Precision Motion Controls