Closed loop adapter for Stepper motor Drives

- Adds closed loop reliability to any Step / Direction stepper drive
- Supports Differential or Single ended encoders
- Fault output to stop controller is error limit is exceeded
- Opto isolated Step/Direction inputs
- 1 or 2 X Step input multiplier
- 2 or 4 X Encoder line multiplier
- Can also be used as a DRO (digital readout) for the axis.
- Settings are programmable by RS232 and ViperTune
DISCLAIMER
Larken Automation assumes no responsibility for any personal injury or damage caused by use of its products. Only electrically qualified personal should attempt to install the electrical modules.
High voltage can be lethal and proper safety procedures must be followed. Motors and drives should be properly grounded to prevent electrical shock.
Safety glasses should be worn, since electrical components can explode causing injury or blindness.

Copyright Notice
No part of this publication may be reproduced mechanically or electronically in any form without the prior written permission of Larken Automation Inc.
Firmware on the StepLok is property of Larken Automation and reverse engineering or disassembly of the code is strictly forbidden.
The information in this manual is for informational use only, is subject to change without notice and should not be construed as a commitment by Larken. Larken assumes no responsibility or liability for any errors or inaccuracies that may appear in this document.
StepLok, Viper, Starcam and Starcnc are registered trademarks of Larken Automation Inc.

© 2006, Larken Automation Inc.

Tech support
Contact
Larken Automation Inc.
5350 Canotek Unit 13
Ottawa, Ontario
Canada, K1J 9E1
Ph: (613) 746-5685
Fax: (613) 746-6451
E-Mail: Larken@storm.ca
Website: www.Viperservo.com
Website: www.LarkenCNC.com
Closed Loop Basics

A closed loop system has an optical encoder that provides feedback to the controller. This typically can have from 100-5000 counts per turn. The most popular type of encoder is the optical encoder, which consists of a rotating disk, a light source, and 2 photodetectors (light sensor).

The disk, which is mounted on the rotating shaft, has many slots in it. As the disk rotates, these slots interrupt the light emitted onto the photodetector, generating a digital or pulse train.

The encoder has 2 square wave outputs. They are staggered at 90 deg. This way one is leading the other when turning CW and then trailing the other when turning CCW. These are Channel A and B. The controller can tell which way the motor is turning by the A-B sequence
There may be an optional Index output also. (The index is not used by the StepLok)

A differential encoder has 2 outputs for A channel and 2 outputs for B channel. The second output is an inverted version of the original and is designed to drive a twisted pair cable to cancel noise. Differential encoders are recommended for motors with cables longer than 4-6 feet.
Encoder Line count is the number of lines per turn. Within the StepLok the line count is decoded 2 or 4 times finer (quadrature), so with a 1000 line encoder, the StepLok sees 4000 counts/turn. This is not to increase machine resolution, but to give the drive more counts to reduce error.

The Step Multiplier setting multiplies each incoming step pulse (from the CNC controller) by its value. So with a 1000 line encoder there are 4000 encoder counts per turn. With a step-multiplier of 1 you would have 4000 steps/turn. With a step multiplier of 2 you would have 2000 steps/turn. With a step multiplier of 10 you would have 400 steps/turn.

The StepLok can handle up to 625Khz encoder frequency (assuming good cableing).

A good source for encoders is US-Digital.com. We recommend the E5 and E6 series with the differential output option.
StepLok Operation and setup

The Steplok is an encoder interface for a stepper motor system. The internal Encoder count must equal the internal Step count.

There are software settings Decoding the encoder line count by 2x or 4x. Also you can set a Step multiplier of 1, 2 or 4 X as well

**Stepper Drive resolution X step-multiplier = Encoder Line cnt X Decode Mult**

Here are examples of useable encoders and Stepper drive resolutions

- 500 line encoder with 4X decoder and a 2000 step/rev Stepper drive
- 1000 line encoder with 2X decoder and a 2000 step/rev Stepper drive
- 400 count encoder with 2X decoder and a 800 step/rev Stepper drive
- 400 count encoder with 2X decoder and a 200 step/rev Stepper drive and 4x step multiplier
The StepLok requires a 9-16 DC powersupply with a current rating of 300ma. A 1 amp powersupply can power all 3 StepLok modules for a 3 axis system.

The Step/Dir inputs will operate on either a 3.3 or 5 volt input.

The RS232 programming cable is available from Larken Automation

J1 - 4 X encoder line decoder ( no jumper = 2 X encoder line decoder )
J2 - 2 X Step multiplier ( no jumper = 1 X Step multiplier )
# Encoder connections

**Differential Encoder Connections**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+5 volts output for encoder power</td>
</tr>
<tr>
<td>2</td>
<td>Channel B input (inverted)</td>
</tr>
<tr>
<td>3</td>
<td>Channel B input</td>
</tr>
<tr>
<td>4</td>
<td>Channel A input (inverted)</td>
</tr>
<tr>
<td>5</td>
<td>Channel A input</td>
</tr>
<tr>
<td>6</td>
<td>N/C</td>
</tr>
<tr>
<td>7</td>
<td>N/C</td>
</tr>
<tr>
<td>8</td>
<td>N/C</td>
</tr>
<tr>
<td>9</td>
<td>Gnd for encoder power (common)</td>
</tr>
</tbody>
</table>
**Single Ended encoders**  
When connecting a single ended encoder, the unused input should be pulled to ground with a 2K ohm resistor (2000 ohm 1/4 watt).

![Single Ended Connections](image1.png)

**Terminating long cables**  
A differential encoder is recommended for any cable longer than 6 feet (2 meters). For very long cables it is sometimes necessary to put a terminator resistor across the differential pairs. The resistor value is usually 150 ohms (1/4 watt), A 0.05uF capacitor may be put in series with the resistor to reduce power consumption.

![Terminator resistors](image2.png)
Step / Direction connections

Connecting the StepLok with a Gecko stepper drive
Error Indicator LED

When an error is flashed, the StepLok will hold down the Estop signal until the error is removed. You can add a Fault override switch (normally closed) in this estop line to allow the operator to jog the machine while holding the switch to recover from a warning error.
It will flash the RED led a count indicating the error number

LED error count

3  Encoder Range ( warning )
5  Encoder Trip ( Fault )
Programming the Step2Linear with Vipertune

The Step2lin board is programmed by connecting to a PC using the serial RS232 port. A cable can be made as described above or purchase from Larken Automation.

The RS232 settings are 38600 Baud, 8 1 N

Rs232 serial cable

For More info in Vipertune download the Vipertune manual.
and the viper command set is at the end of this document.

Settings can also be loaded with Hyperterm or Teraterm
Run the windows Hyper Terminal program from the Accessories group. Create a New session using Comm1, 9600 baud, 8,1,N. In the advanced tab, set Flowcontrol to ‘None’
If Hyper-term isn’t on your system then it can be installed from your windows cd rom or downloaded from the internet.
All commands are entered in lowercase and followed by a ‘carriage return’ <cr>.
Encoder Limit settings

There are 2 settings to signal that the following error is out of range.

The **Range** setting can be set to output a error warning to stop the cnc controller if the following error is to high. This will hold down the Estop signal, but **not disable** the Viper drive.

The **Trip** setting **will disable** the drive if exceeded, and hold down the Estop to the cnc controller.

Both Trip and Range are in quadrature counts (lines x 4) so to set the Trip command to 3/4 of a turn of a 500 line encoder, the setting would be 1500

This setting is designed to **protect** the drive and motor when an extreme out of range is detected. The max setting allowed for the Trip command is 4000.