

**Stepper Control Board
Manual
Version 5.00
Mar 2012**

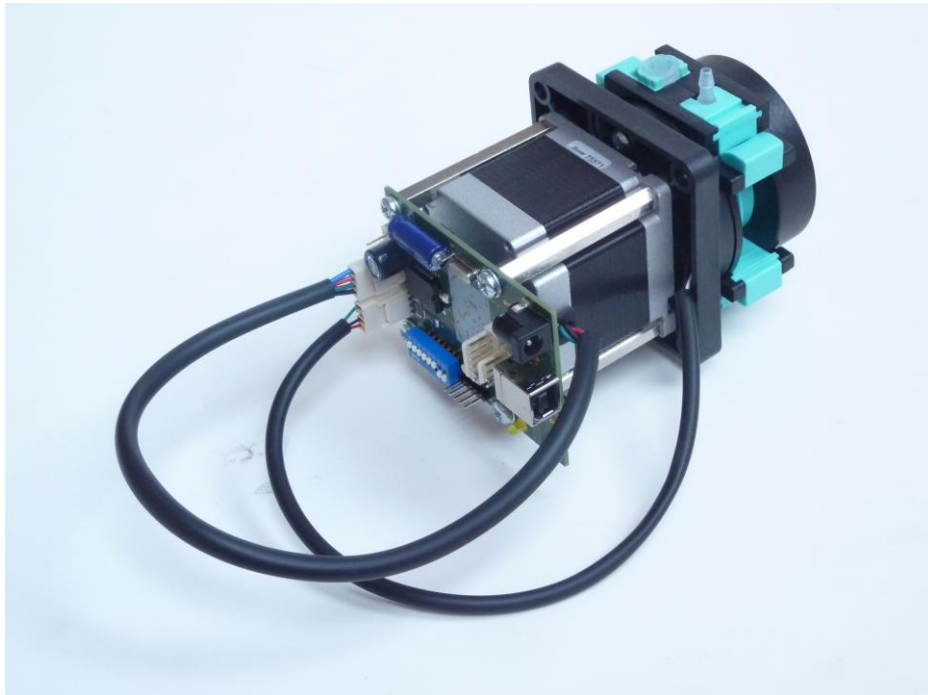


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1. General description

The Controlled Stepper Driver (CSD) a flexible and powerful controller for the accurate dispense. It is provided as means to drive one or more of the following pump models:

Boxer 3500/3600, Boxer 9600 or Unoverse 6100/6500.

Each pump controlled using the CSD has to have it's own CSD board and a power supply.

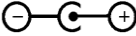
2. Required hardware

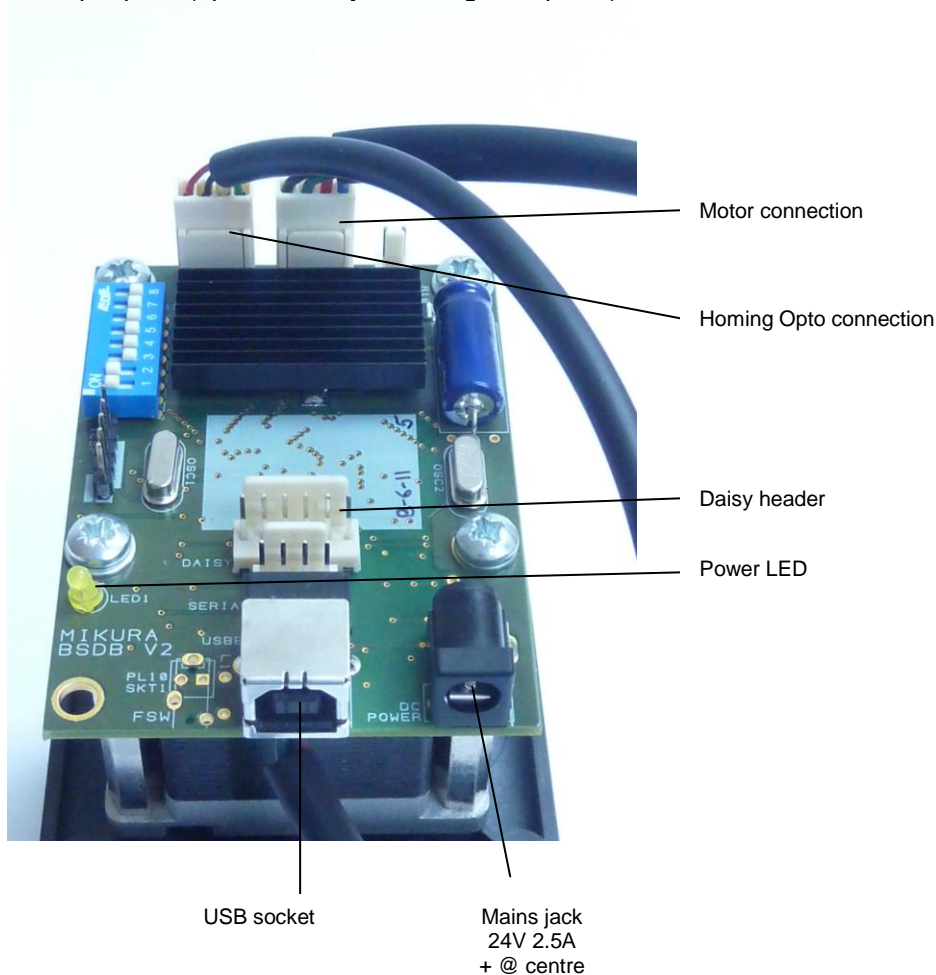
Apart of the CSD board you will require the following hardware:

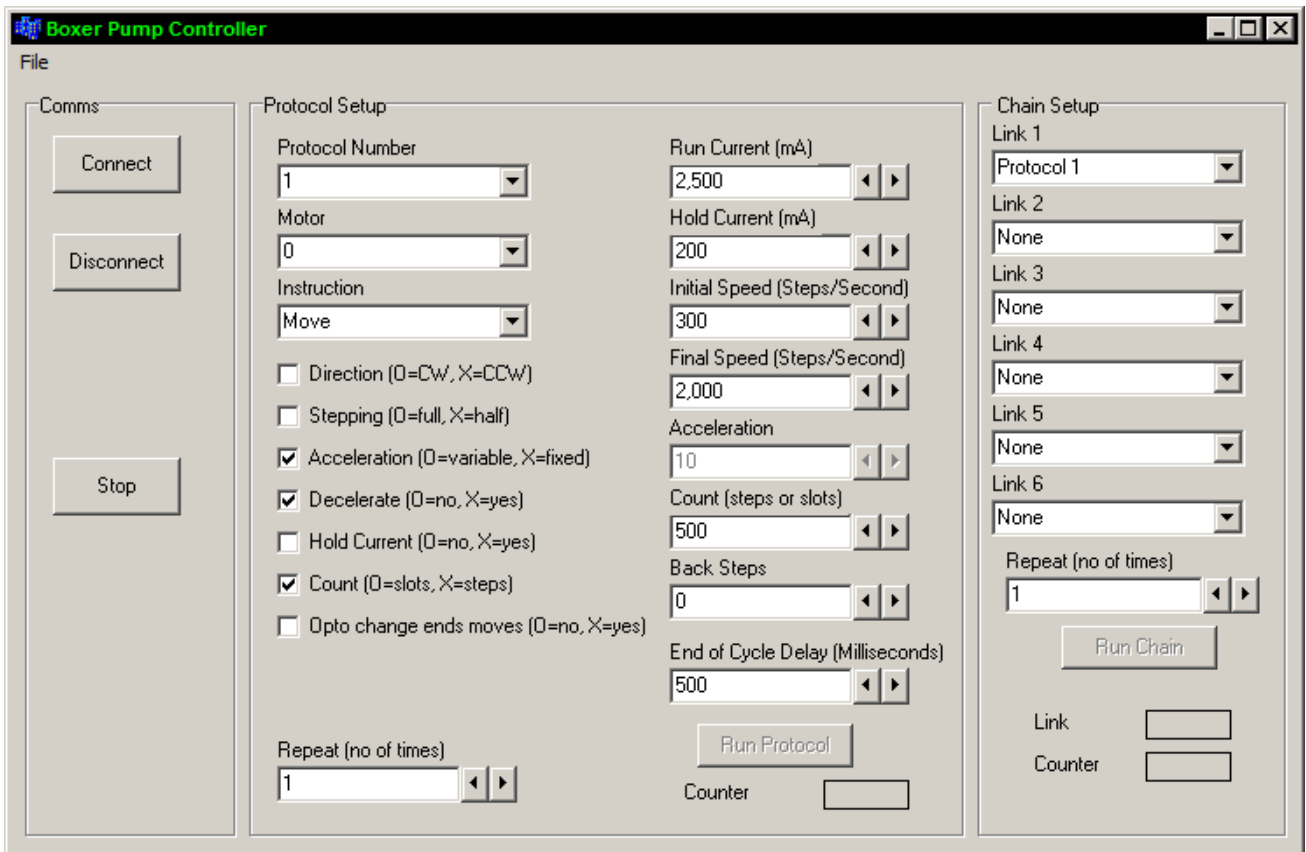
1. Power supply unit (PSU) 24V 2.5A+
2. USB cable A to B
3. PC with Windows XP, Vista or Windows 7 installed, .NET platform 2.0 minimum.

3. Connection between motor and CSD board

The CSD board requires three connections to run the pump:

1. Power in 24V 2.5A 2.1mm pin 
2. USB cable A to B
3. 4 motor poles via Molex 0.1" terminal connector
4. 3 Opto poles(optional - only if homing is required) via Molex 0.1" terminal connector





6. Software explanation

There are 3 groups of controls (from left to right):

1. **Comms** - communication to the CSD board
2. **Protocol Setup** - setup of the protocol which determines the sequence and characteristics of the pump action
3. **Chain Setup** - setup for a chain of protocols and motors

1. Comms

- **Connect:** Press the button to create the link between your PC and the CSD and enable the standby current to the motor. Connect will grey out as soon as connection has been established.
- **Disconnect** - break the communication between the PC and the CSD
- **Stop** - Panic button - will immediately stop any movement of the motor

2. Protocol Setup

- Protocol Number

The protocol characterizes the movement of your pump. You can edit up to 10 protocols which will be stored in the memory of your PC.

- Motor

You can chain up to 8 motors and control them from a single PC. This button determines which motor you address with the protocol you are writing. Your first motor is no. 0.

- Instruction

You can choose between Move and Home. Choose Home only if a homing Opto is installed.

- Direction

This button allows you to choose the direction the pump will operate - choose one direction for dispense and the other for suction.

CW - Blank
CCW - Tick

- Stepping

Most steppers have 200 steps per full 360° revolution. That makes 1.8° per step. You can run the pump at half steps and thus controlling 0.9° of a revolution. Running the motor at half step will at certain settings reduce the power of the motor but the motor will run much smoother. To make a full revolution you have got to set the motor to run 400 half steps.

For example a pump speed of 1000 steps/sec at full steps is identical to 2000 steps/s at half step. You may find however that the motor runs much smoother when in ½ step division then in full steps.

Full stepping - Blank
Half stepping - Tick

- Acceleration

Using this button you can manually vary the motor's acceleration. This is useful when a high speed setting is required from the motor or whenever you want to control the dispense to start gradually. Leave this button ticked as long as you are a novice.

- Decelerate

You can choose between motor deceleration or abrupt stop. An abrupt stop to the motor without deceleration will normally result in rotor slippage and dispense inaccuracies. You should therefore avoid running the pumps without deceleration.

- Hold Current

When this button is ticked, a current is applied to the motor whenever the motor is idle. This feature is used whenever you want to make sure that the pump's rotor is firmly held after a rotation of the motor. This feature may add to the dispense accuracy of the pump. It will contribute to heating of the processor and make the addition of a cooling fan to limit the processor from overheating confined spaces, a requirement.

- Count

You can choose whether to count opto slots or motor steps. Opto slot counting works only when the opto is fitted and wired to the board. Optical slot counting is in any case coarser than step counting as there are only four slot per revolution compared with 200 motor steps per revolution.

- Opto change ends moves

This feature has only significance if the optical encoder is built and wired in. It changes from stopping the motor on an edge of covered to exposed to an edge of exposed to covered.

- Run Current

The current supplied to the motor for any movement. You can specify up to 3A but of course the limiting factor being the max current supplied by the PSU. The current should correspond to the speed you choose to run the dispense. For the slowest speed of 50 steps/sec choose 500mA.

- Hold Current

The current supplied to the motor between movements which holds the rotor in position. It is advised that the holding current should not exceed 250mA for continuous operation as the processor will require active cooling. The current is supplied to the motor during rest periods only if the Hold Current button is ticked.

- Initial Speed

This button will help to achieve the optimal acceleration rate. Setting the initial speed too high at a relative high load, and the motor will slip. The optimal acceleration rate is a function of the load and the chosen final speed for the motor.

- Final Speed

The speed in steps per second the motor will reach after acceleration. The max speed a motor can achieve is function of the load on the motor and the initial speed. You can set the speed at up to 3000 steps per second. As there are 200 full steps per revolution, the calculation of speed the motor in rpm is simple.

Speed in rpm = steps/seconds/200*60.

For example 2600steps/sec = 2600/200*60=780rpm

If you are in half stepping mode the speed will be accordingly only 390rpm.

And if the half step button is ticked, there will be 400 half steps per revolution and the calculation is:
Speed in rpm = steps/sec/400*60

- Acceleration

This button is of significance only if the Acceleration box is un-ticked meaning a variable acceleration. The value of 10 to 500 is a mathematical multiplication value used by the software to determine the acceleration rate - 10 being the slowest acceleration and 500 the highest.

Count

The extend of the motor revolution you request in this particular protocol. 200 means a whole revolution if the full steps are chosen or half a revolution if half steps are chosen.

- Back Steps

Peristaltic pumps which require accurate dispense of small volume benefit from a back step function. The back step will rotate the pump's rotor in the opposite direction of the dispense rotation. the number of steps requires for an efficient drop ejection is a function of the dispense nozzle aperture, liquid viscosity and hardness of tubing and must therefore be set empirically. The back movement is determined by the number of steps required and is executed at the same speed as chosen for the dispense function.

- End of Cycle Delay

The setting of this box has only significance if the protocol is repeated by the same or another protocol. It basically determines the period of rest before the action to follow. You can determine the period in Miliseconds - 1000 milliseconds per second - in increments of 100, up to a max of half a minute - 30 seconds (30,000 milliseconds).

- Repeat

The number of times you would like this particular protocol to repeat from 1 (a single action) to 1000. The protocols will follow each other without any delay if End of Cycle Delay is set to "0".

- Run Protocol

Once your required protocol is edited, press this button to run the protocol. the protocol will run the number of time as entered in the repeat box and the counter will tell you how many times the protocols have been run so that you are aware at which point you are in a repeat sequence. Press the "Stop" button at any time to terminate a protocol.

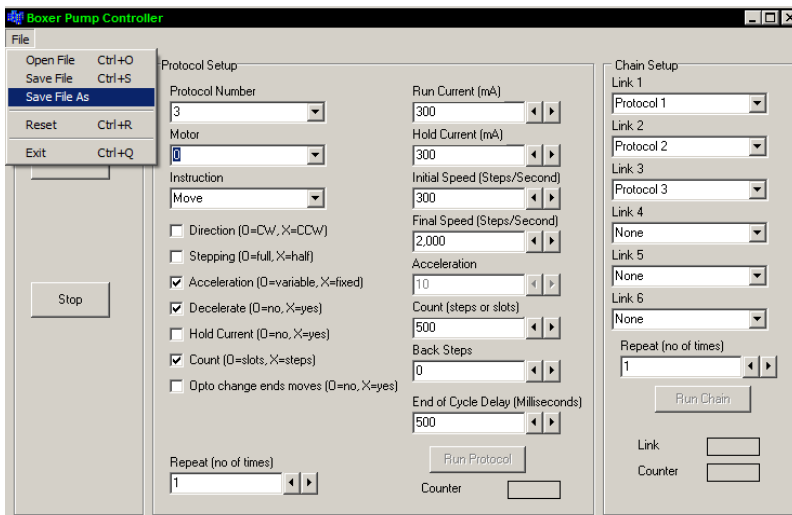
3. Chain Setup

You can chain any of the protocols and repeat the chain up to 1000 times.

The counter at the bottom of the box will show you which link is running and how many of the chains have been processed already.

4. Saving your setting

DO NOT FORGET! Once you have completed to write a protocol go to "File" and "Save File As". Give the file a meaningful name and save it in a folder you will find on your hard drive. The file will be saved in the *.dat format.



7. Practical tips

Run any new tubing in. New tubing is very stiff and requires a lot of torque from the motor. Once the tubing has been "softened" you will be able to run at much higher speeds without problems. We suggest 100 revolutions to run a tube in.

Adjust the run current to the speed of rotor. If you want to run the pump very slowly, for example at the min speed of 50 steps/sec, reduce the Run Current to 500mA. Too much current causes the motor to shudder and the processor to overheat. In most applications you will not need a higher supply current than 1500mA. You can set a different Run Current for each protocol you run.

When a stepper motor slips, a high pitch noise can be heard and the motor stalls. Any of the variants can cause a motor to slip. The optimal settings of the acceleration, the initial speed and the final speed are all crucial for the best motor run.

Setting a high speed with too high initial speed will cause the motor to slip.

In very short rotations, for example 100 steps, the motor might not reach the requested speed.

8. Daisy chaining pumps

You can daisy chain up to eight pumps of various sorts and control them all from a single PC. Each pump must have a CSD board and a power supply. You can daisy chain the power supplies for all boards. You can run any number of different pump types sequentially. You can not run the pumps simultaneously.

8.1 Daisy chaining cable

In order to enable the software to talk to all pumps, you need a Daisy Chain Cable to run from each pump to the next.

A daisy chain cable for connecting two pumps consists of 2 female Molex connectors and a cable and can look like this:



uno.

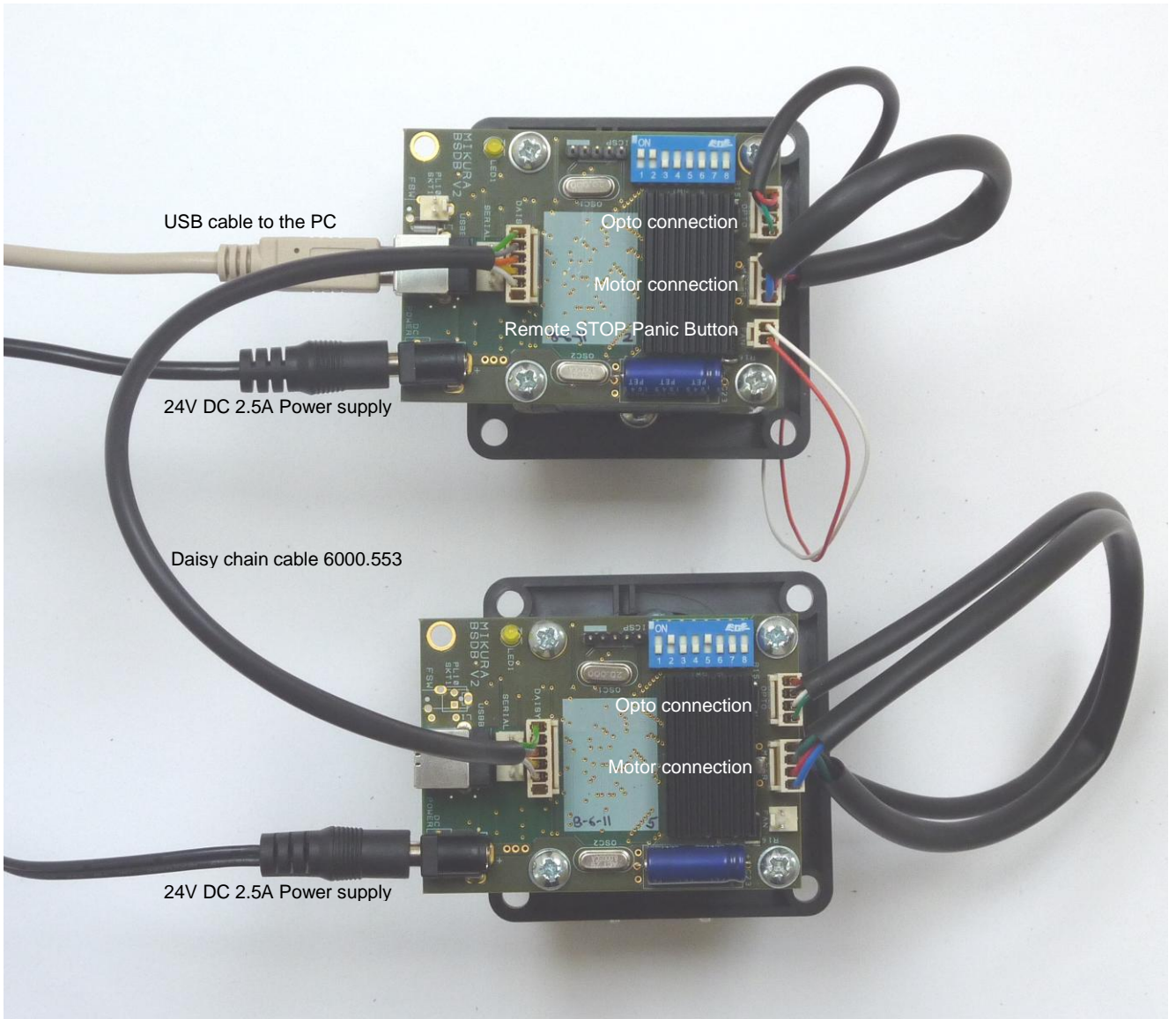
A daisy chain cable for connecting many motors could look like this:



These cables are available from Uno International Ltd.

8.2 Connecting the pumps

The first pump's PCB must be connected via the USB cable to the computer.
Each pump has to have a power supply.
A daisy cable must connect the pumps together.
Here is a typical installation of 2 daisy chained pumps:



uno.

8.3 Addressing the pumps

In order for the computer software to find which pump it is supposed to communicate with, each of the boards has to have a unique address.

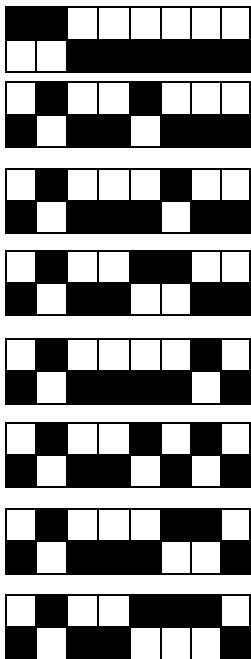
The first pump which is connected to the PC via the USB cable must be set on the controller software as no. 0. The DIP switch setting on this pump must be as per following picture.

Picture shows setting for Master:

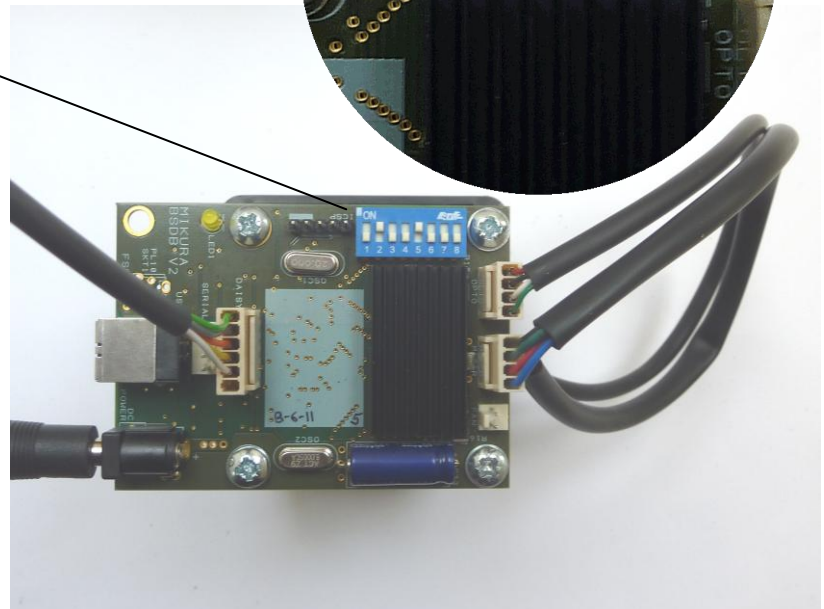
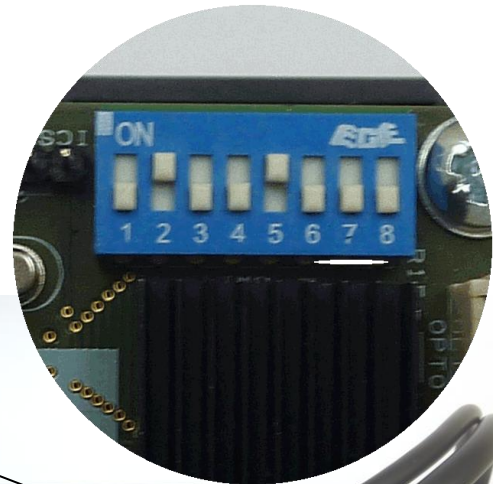


DIP switch address setting is as Binary code and is used to daisy chain boards:

- | | |
|---------------------|----------------------------------|
| 1 – Master or Slave | ON for Master, address must be 0 |
| 2 – USB or RS232 | ON for USB control |
| 3 – not used | Leave OFF |
| 4 – not used | Leave OFF |
| 5 – Address A | Binary 1 |
| 6 – Address B | Binary 2 |
| 7 – Address C | Binary 4 |
| 8 – Address D | Binary 8 |



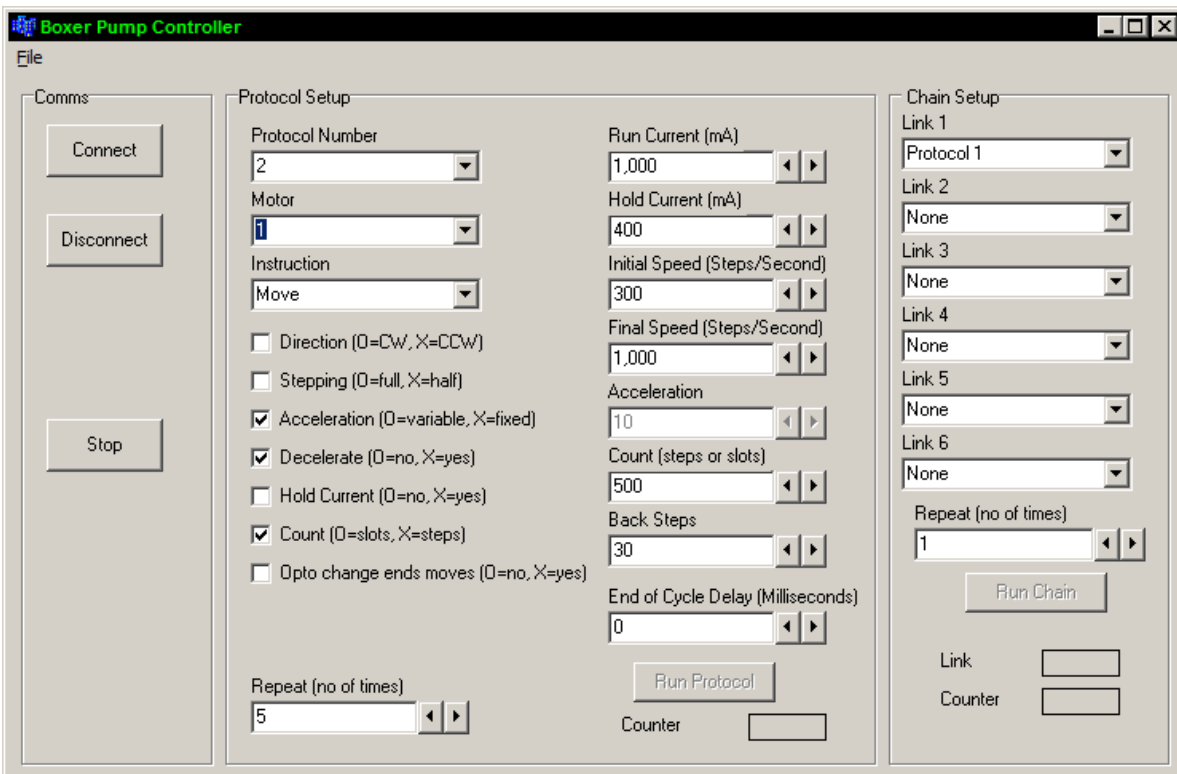
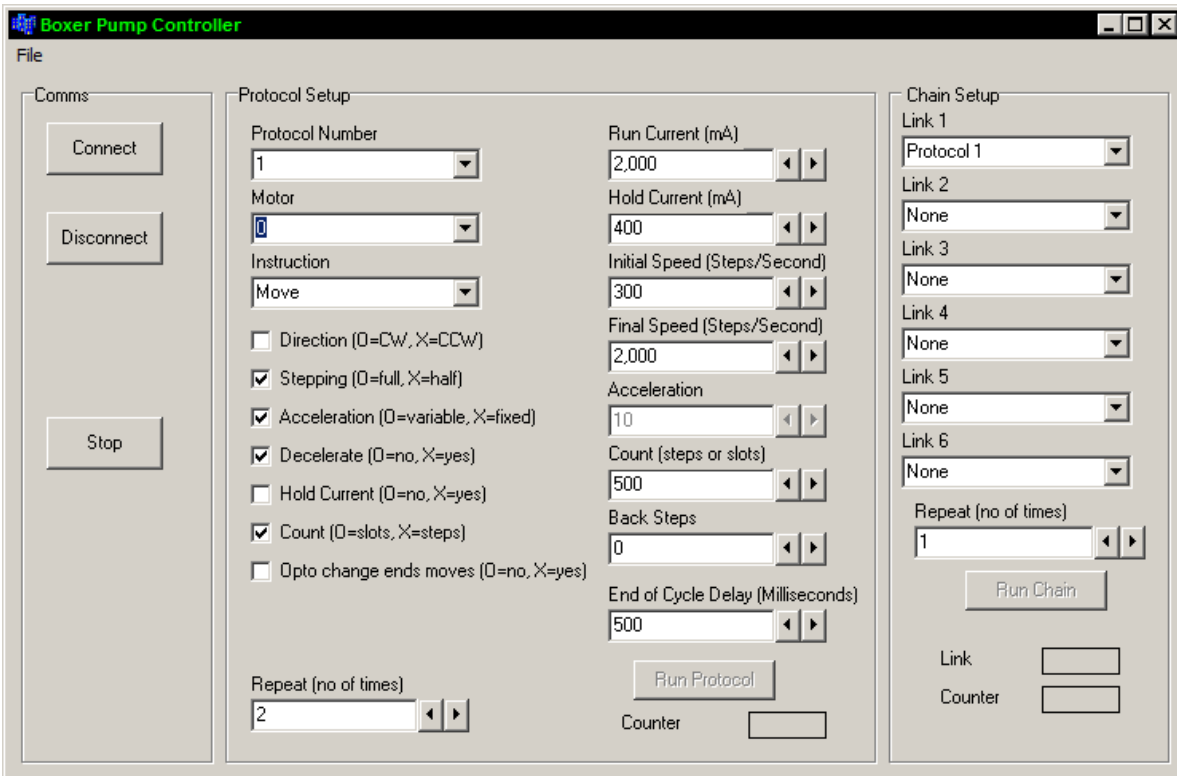
Master
Slave 1
Slave 2
Slave 3
Slave 4
Slave 5
Slave 6
Slave 7



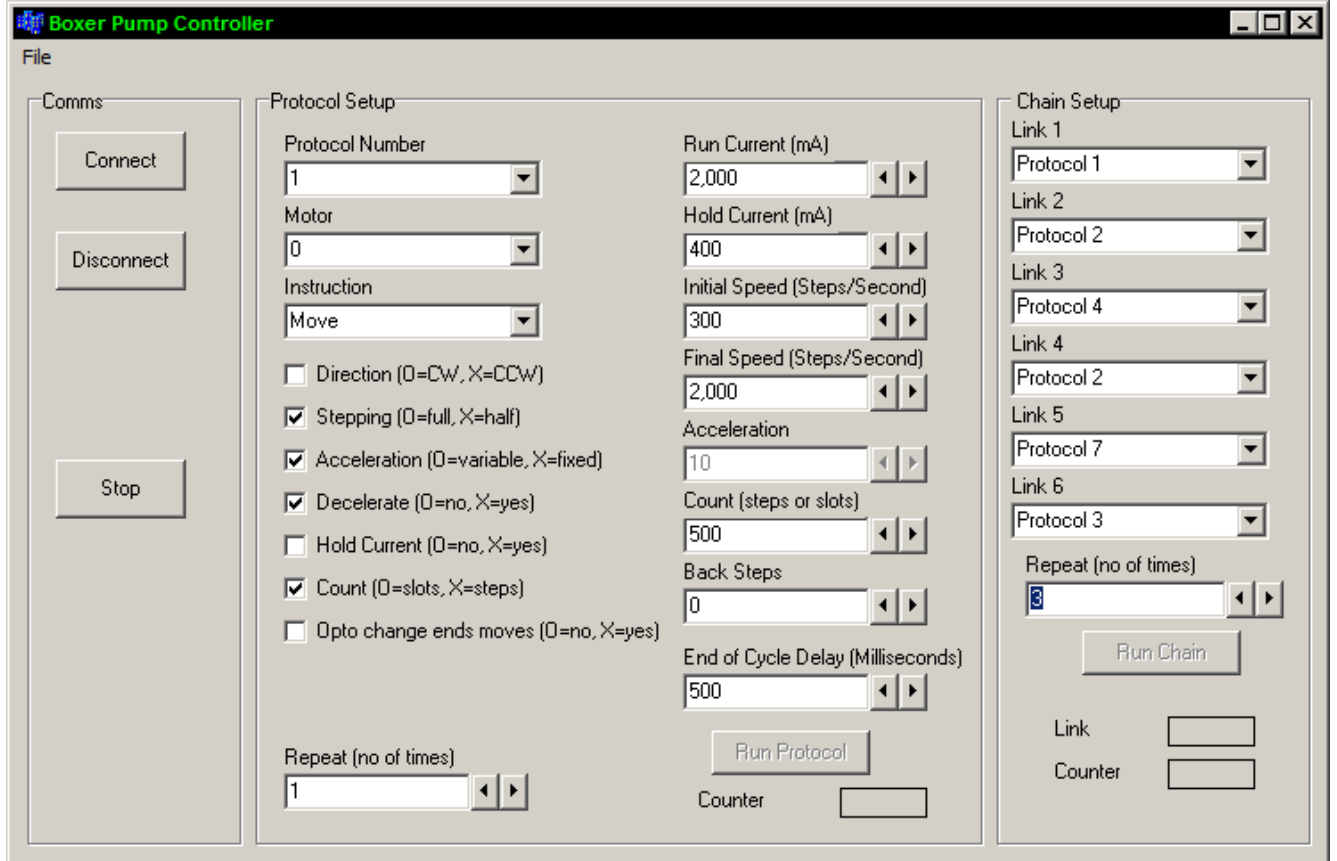
8.4 Writing protocols for multiple pumps

The procedure of writing the protocols for multiple pumps is identical to writing the protocol for a single pump. The only difference is that now as part of each protocol you have to specify which of the motors should carry out the task.

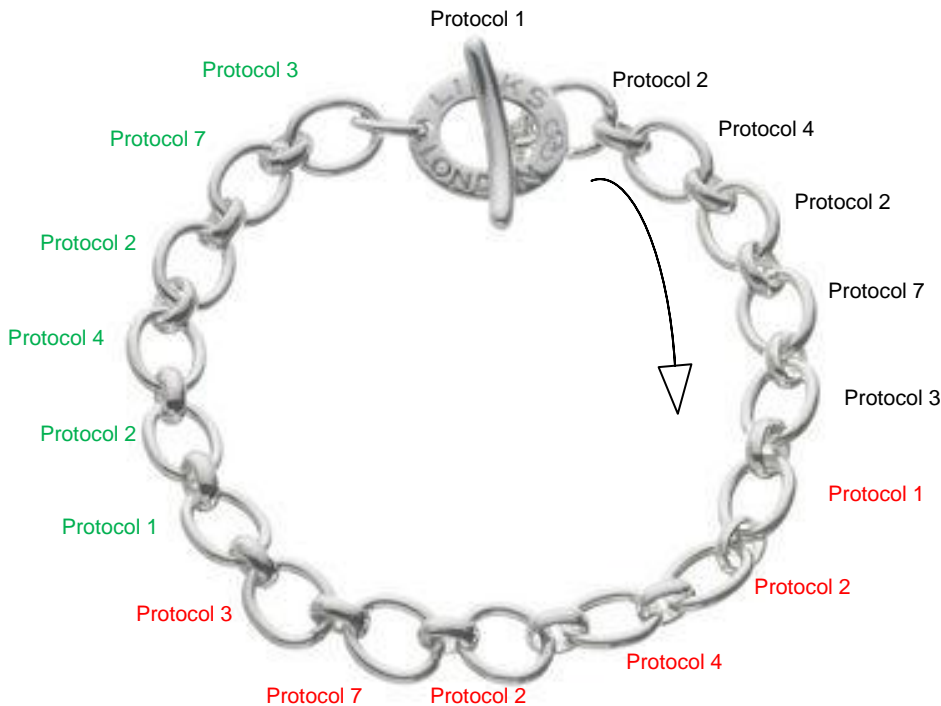
- Motor 0 = Master
- Motor 1 = Slave 1
- Motor 2 = Slave 2
- and so on....



Once you have written the protocols for each of the motors you can chain them together in the chain Setup box and tell the software how many time to run the chain.



Once this is done press "Run Protocol" if you want to run just one protocol on one of the motors or "Run Chain" if you want the protocol to run at the order you specified. If you told a protocol to repeat itself, it will do so the number of times you asked it to do it before progressing to the next link.



Any protocol is specific to one pump only. Using this software you can write the most complex procedures.

| | | | | |
|--------|--------------|---------|---------------|------------|
| Link 1 | Protocol 1 | Motor 1 | Direction CW | 1200 steps |
| | Delay 500ms | | | |
| Link 2 | Protocol 2 | Motor 2 | Direction CW | 500 steps |
| | Delay 0ms | | | |
| Link 3 | Protocol 3 | Motor 2 | Direction CCW | 200 steps |
| | Delay 1000ms | | | |
| Link 4 | Protocol 2 | Motor 2 | Direction CW | 500 steps |
| | Delay 0ms | | | |
| Link 5 | Protocol 1 | Motor 1 | Direction CW | 1200 steps |
| | Delay 500ms | | | |
| | Protocol 1 | Motor 1 | Direction CW | 1200 steps |
| Link 6 | Delay 500ms | | | |
| | Protocol 4 | Motor 1 | Direction CCW | 400 steps |
| | Delay 0ms | | | |
| | Protocol 4 | Motor 1 | Direction CCW | 400 steps |
| | Delay 0ms | | | |
| Link 6 | Protocol 4 | Motor 1 | Direction CCW | 400 steps |
| | Delay 0ms | | | |
| | Protocol 4 | Motor 1 | Direction CCW | 400 steps |
| | Delay 0ms | | | |
| | Protocol 4 | Motor 1 | Direction CCW | 400 steps |
| Link 1 | Protocol 1 | Motor 1 | Direction CW | 1200 steps |
| | Delay 500ms | | | |
| | Protocol 1 | Motor 1 | Direction CW | 1200 steps |
| Link 2 | Delay 500ms | | | |
| | Protocol 2 | Motor 2 | Direction CW | 500 steps |
| Link 3 | Delay 0ms | | | |
| | Protocol 3 | Motor 2 | Direction CCW | 200 steps |
| Link 4 | Delay 1000ms | | | |
| | Protocol 2 | Motor 2 | Direction CW | 500 steps |
| Link 5 | Delay 0ms | | | |
| | Protocol 1 | Motor 1 | Direction CW | 1200 steps |
| | Delay 500ms | | | |
| Link 6 | Protocol 1 | Motor 1 | Direction CW | 1200 steps |
| | Delay 500ms | | | |
| | Protocol 1 | Motor 1 | Direction CW | 1200 steps |
| | Delay 500ms | | | |
| | Protocol 4 | Motor 1 | Direction CCW | 400 steps |
| Link 6 | Delay 0ms | | | |
| | Protocol 4 | Motor 1 | Direction CCW | 400 steps |
| | Delay 0ms | | | |
| | Protocol 4 | Motor 1 | Direction CCW | 400 steps |
| | Delay 0ms | | | |
| Link 1 | Protocol 1 | Motor 1 | Direction CW | 1200 steps |
| | Delay 500ms | | | |
| | Protocol 1 | Motor 1 | Direction CW | 1200 steps |
| Link 2 | Delay 500ms | | | |
| | Protocol 2 | Motor 2 | Direction CW | 500 steps |
| Link 3 | Delay 0ms | | | |
| | Protocol 3 | Motor 2 | Direction CCW | 200 steps |
| Link 4 | Delay 1000ms | | | |
| | Protocol 2 | Motor 2 | Direction CW | 500 steps |
| Link 5 | Delay 0ms | | | |
| | Protocol 1 | Motor 1 | Direction CW | 1200 steps |
| | Delay 500ms | | | |
| Link 6 | Protocol 1 | Motor 1 | Direction CW | 1200 steps |
| | Delay 500ms | | | |
| | Protocol 1 | Motor 1 | Direction CW | 1200 steps |
| | Delay 500ms | | | |
| | Protocol 4 | Motor 1 | Direction CCW | 400 steps |
| Link 6 | Delay 0ms | | | |
| | Protocol 4 | Motor 1 | Direction CCW | 400 steps |
| | Delay 0ms | | | |

9. Warranty

Uno International Ltd. warrants that each product described herein will be free from defects in materials and workmanship for a period of one year from the date of delivery.

The limited warranty is not applicable to: (1) abnormal wear and tear (2) abuse, unreasonable use, improper installation, mistreatment, or neglect (3) damage caused by equipment or system with which the product is used (4) damage caused by modification or repair not made or authorized by Uno International Ltd., or (5) theft, vandalism, fire, water or other peril. Product may not be returned without proper authorisation from Uno International Ltd.. Cost of transportation, removal, or reinstallation of the equipment will be paid by the purchaser. This warranty and the remedies set forth herein are exclusive and in lieu of all other express or implied (including any implied warranties or merchantability or fitness for a general purpose), and no other representations or claims shall be binding on or obligate Uno International Ltd. in any way. In no event will Uno International Ltd. be liable for any special, incidental, or consequential damages resulting from use or malfunction of this product or the equipment or system with which it is used, loss of revenue, or cost of replacement of goods.