Quattrostep-2
4-axis stepper motor driver
and controller
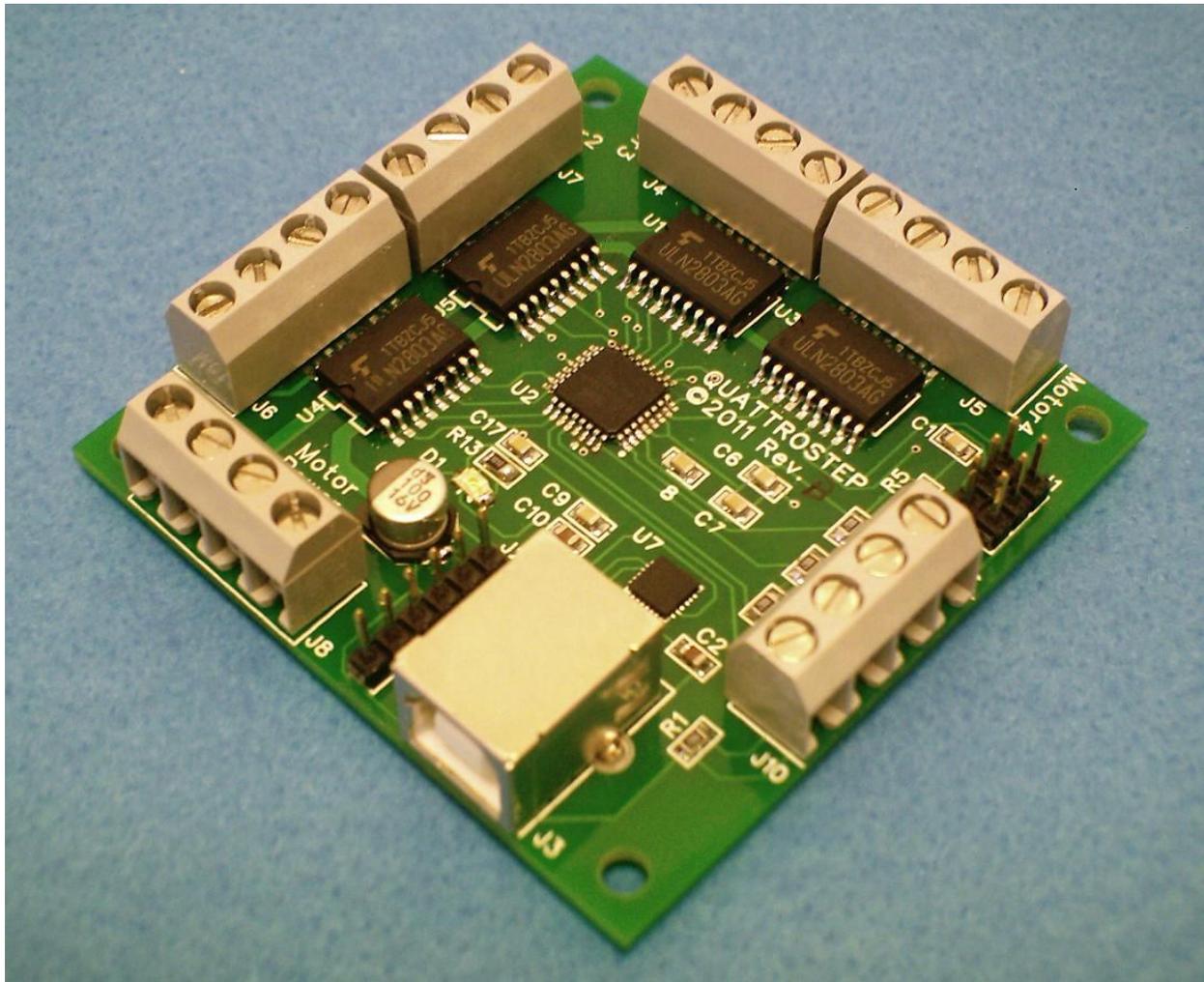
Quattrostep
Instruction Manual

TABLE OF CONTENTS

1 Introduction

Quattrostep-2 is a four axis, unipolar stepper motor driver/controller with USB/RS232 interface. New features have been added to support simple CNC and plotting operations. A simple open source PC application to support the new feature is included on CD. However, Quattrostep can still be controlled from a simple terminal program like Hyperterminal. Quattrostep enables independent or synchronized motion of up to four stepper motors. The choice of USB or 5V level RS232 interface make it a universal motor control solution for automation, robotics and education. The on-board ISP connector makes it possible to program the board with custom software. The original firmware as well as programming instructions and documentation is provided on the included CD.

1.1 Hardware Features

- Four axis unipolar stepper motor control
- Four Home/Limit inputs (1 per motor)
- USB Interface for PC communication
- Serial Interface for 5V level RS232 communication
- ISP connector for re-programming with custom software
- Motor Power up to 50V/1.0A

1.2 Software Features

- Independent or synchronized motion
- 20 selectable step speeds from 5Hz to 2.5kHz
- CNC operation with open source software
- Halfstep or Fullstep
- Acceleration enable/disable
- Hold current enable/disable
- Home/Limit polarity NO/NC
- 5 selectable communication baud rates
- Linear Interpolation for 2-axis moves

2 HyperTerminal Setup

Before you can connect Quattrostep, you need to run the QS_Installer.exe provided on the CD. The QS_Installer is located in the QS_INSTALL directory.
After installing the driver, connect Quattrostep to your computer and wait for Windows to install the new hardware. This should happen automatically and you should get the message below when done:

The below example applies to Windows XP but should be similar for other Windows versions. For Windows Vista and 7 you should download TeraTerm, a freeware program similar to Hyperterminal. Since Vista, Hyperterminal is no longer part of Windows.

To find Hyperterminal, follow the path below:

Start - All Programs – Accessories – Communication - Hyperterminal

1. Name the new connection and click OK.

2. Select the COM port to be used from the list (Connect using:) and click OK. Don't select COM1 since it is usually a serial port and not the USB port.

3. Select Bits per second: 9600 and Flow control: None and click OK.
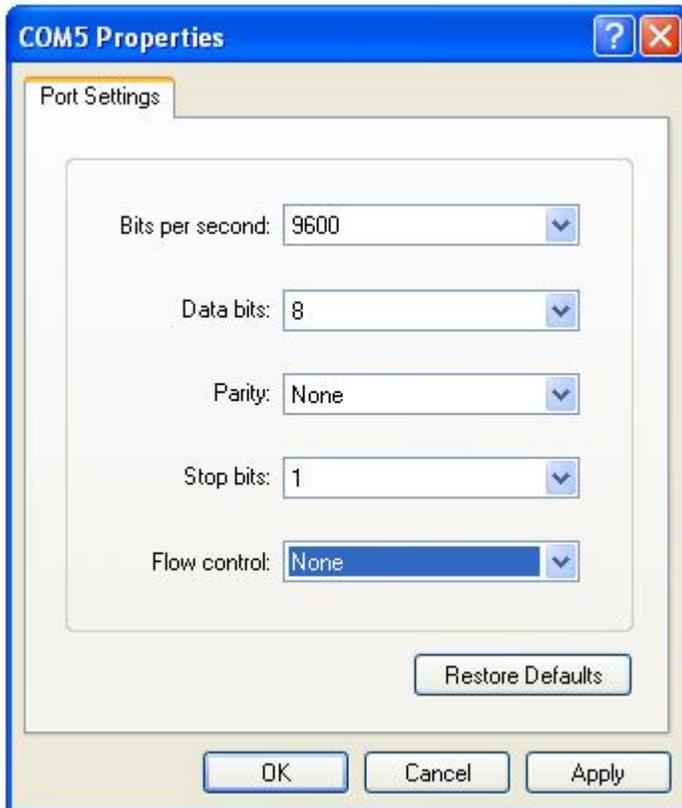
4. Select File – Save As... and select a location where you would like to save the new connection.

Now you can use Hyperterminal to communicate with Quattrostep. Keep in mind that you need to connect Quattrostep first before you can launch Hyperterminal. Once Hyperterminal is open, you can just press any key and Quattrostep should respond with the Quattrostep banner.

3 List of Commands

All commands are in upper case. Each command will be executed as soon as the last character is entered.

3.1 Motor specific commands

The following commands apply to any of the 4 motors connected to Quattrostep.
The (n) needs to be replaced by the motor number (1 – 4). For example: M1TL.

MnTR

The command **'Turn Right'** will turn the selected motor continuously clockwise until a limit switch is activated or a stop command is issued.

MnTL

The command **'Turn Left'** will turn the selected motor continuously counter clockwise until a limit switch is activated or a stop command is issued.

MnST

The command **'Stop'** will stop the selected motor.

MnCLKxx

The command **'Clock'** will set the step speed for the selected motor. A total of 20 speed settings is available (xx = 01 – 20) ranging from 5Hz to 2.5kHz.

MnRxxxxx

This command will turn the selected motor clockwise for a specific number of steps or until a limit switch is activated or a stop command is issued. Any number between 00000 and 99999 can be entered.

MnLxxxxx

This command will turn the selected motor counter clockwise for a specific number of steps or until a limit switch is activated or a stop command is issued. Any number between 00000 and 99999 can be entered.

XndxxxxxYndxxxxx

This command will turn 2 motors simultaneously. It uses linear interpolation and is meant for CNC applications, where a straight move between two points is required. Any of the 4 motors can be used. The (d) needs to be replaced by 'L' or 'R' for the desired direction.

MnCxxxx

The command **'Control'** will set the 4 control bits for the selected motor. The 4 control bits can have a value of 0 or 1. The meaning of each bit is explained below.

XXXX

The first bit sets the acceleration option. This can be helpful if a motor is configured to run at high speed. Setting this bit to 1 will accelerate the motor from 1/3 of its selected speed to the maximum speed selected for this motor.

XXXX

The second control bit sets halfstep or fullstep mode. If higher resolution is desired, set this bit to 1 (Half Step). If higher torque is desired, set this bit to 0 (Full Step). In half step mode, the motor has about 70% of its maximum torque.

XXXX

The third bit will sets the hold current option. This can be helpful when the motor has to hold its position when not moving. However, enabling the hold current may also heat up the motor. Setting this bit to 1 will enable the hold current on this motor.

XXXX

The fourth bit sets the home/limit switch polarity. If home or limit switches are used, the software can be configured to use either NO (normally open) or NC (normally closed) switches. Setting this bit to 1 will enable NO switches.

LMnxxxx

The command **'Limit Move'** sets the number of steps that the selected motor will move in the opposite direction when a home/limit switch is activated. This is necessary when limit

switches are used otherwise the motor would be stuck. Any number between 0000 and 9999 can be entered.

3.2 Motor independent commands

The following commands are not motor specific.

?LIM

This command will display the state of the 4 home/limit switch inputs. A 1 means the switch is not activated (open) and a 0 means that the switch is activated (closed).

?CON

This command will display the control bits for all 4 motors.

DEMO

This command will run all 4 motors in a predetermined pattern.
REST

The command **'Restore'** will restore the factory defaults for all motors as listed below. Default parameters are not automatically saved and will be lost when power is cycled.

Motor Clock	160Hz
Limit Move	100 steps
Acceleration	disabled
Hold Current	disabled
Motor Steps	Halfstep
Switch Polarity	N/O

SAVE

This command will save the motor control bits, motor speeds, limit move steps and baud rate to permanent memory. This will allow you to run the motors with the same settings even when power is cycled.

LAST

This command will execute the last entered command.

STOP

This command will stop all motors.

WAIT

This command will delay the motor movement until the MOVE command is issued. This is useful for synchronous motor operation. All 4 motors can be setup to run with specific parameters and will not start moving until the MOVE command is issued.

MOVE

This command will start a synchronous move on all motors that have been setup with specific parameters.

SBRxxxx

The command **'Set Baud Rate'** will set the baud rate of the serial communication. Possible values for xxxx are 4800, 9600, 19.2, 38.4, 56.4.

4 Using Quattrostep CNC

Quattrostep CNC is a simple console application that enables Quattrostep to plot or route 2-dimensional shapes. The file format used is HGL, a vector format that can be generated by converting bitmap images. Quattrostep CNC is open source. The source code and a sample HGL file is provided on the included CD.

```
Quattrostep X-Y CNC control with UP/DOWN for Z-axis

Software reads *.hgl files.
User can select motor speed, Z travel, scale factor, file name and COM port.

Select COM port:  (Input: 1 - 10)  1

Serial port configured at 9600 8N1 on COM1

Select X axis motor # (Input: 1,2,3 or 4)  1

Select Y axis motor # (Input: 1,2,3 or 4)  2

Select Z axis motor # (Input: 1,2,3 or 4)  3

Select Z axis travel distance (Input: 0 - 30000)  1000

Select motor speed (Input: 1 - 20)  8

Select scale factor (Input: 1 - 10)  5


Setup ok.

X axis will be controlled by motor #1
Y axis will be controlled by motor #2
Z axis will be controlled by motor #3
Z axis travel is: 1000 counts
Speed has been set to 5

Select hgl File    shape.hgl
```

The following selections can be made:

X and Y motor: Selects the motors used for the 2 plot dimensions.
Z motor: Selects the motor that moves the pen UP and DOWN.
Z travel: Selects how many steps the Z motor moves UP or DOWN.
Motor Speed: Selects the speed for all 3 motors.
Scale Factor: Selects a multiplication factor to enlarge the object.
HGL File: Selects the HGL file to be plotted.

If Quattrostep was used with Hyperterminal, it needs to be power cycled prior to launching the application !

5 Reprogramming Quattrostep

To change or update the firmware on Quattrostep, you will need a PC with USB port to power Quattrostep. You will also need a programmer like AVRISPmkII that features a 6-pin ISP connector to interface to J1 on Quattrostep. If you are using AVRISPmkII, the correct setup is shown below. To program Quattrostep with the original firmware, please use the

batch file provided on CD as it automatically calibrates the internal oscillator. In order to use this batch file, you need to download and install AVR Studio 4.
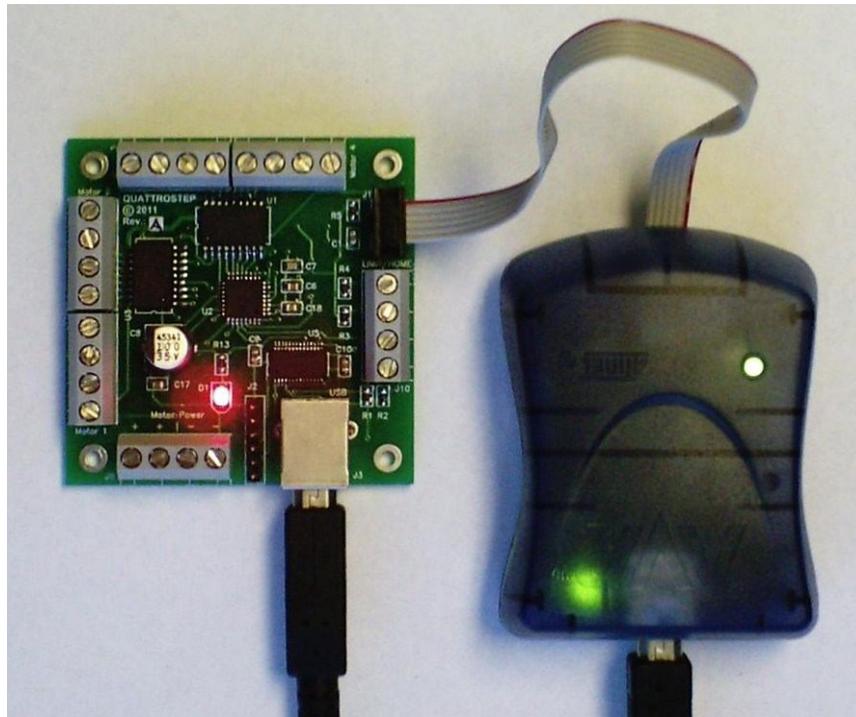
The table below shows the port pins used on the ATMEGA328 for each of the motors and the home/limit inputs. For communication Quattrostep is using the RX and TX pins of the ATMEGA328. Please refer to the ATMEGA328 datasheet for additional details.

MOTOR # 1	MOTOR # 2	MOTOR # 3	MOTOR # 4	HOME/LIMIT
PORTC_0	PORTD_4	PORTB_0	PORTB_4	PORTC_4 (Limit 1)
PORTC_1	PORTD_5	PORTB_1	PORTB_5	PORTC_5 (Limit 2)
PORTC_2	PORTD_6	PORTB_2	PORTB_6	PORTD_2 (Limit 3)
PORTC_3	PORTD_7	PORTB_3	PORTB_7	PORTD_3 (Limit 4)

6 Troubleshooting

If Quattrostep is not communicating with your PC/Laptop check the following:

- Is the USB cable connected and the power LED on Quattrostep is on ? If the cable is connected but the power LED is off, try a different USB port.

- Check your terminal setup as described on page 4 and make sure you have the correct COM port selected and the baudrate and flow control are correct.
- Check your Device Manager for the COM port assigned to the USB port on Quattrostep.

If one of the motors is not moving, check the following:

- Is sufficient power supplied to the motor power input ? You will generally need more than 1A to run stepper motors.
- Is the motor wiring correct ? If the motor vibrates but it doesn't move, the motor leads may be connected in the wrong order. Try swapping 2 of the leads at the time until it starts working. If you have a datasheet for the motor, try to find out which color belongs to which coil. Then refer to the wiring diagram for correct connection.
- Is the motor speed to high ? If you have changed the motor speed, use the Restore command to reset to factory defaults. The defaults are designed to run almost any motor. If you need to run the motor at higher speeds, try to enable acceleration.

If one of the motors is getting hot, check the following:

- Is the motor power appropriate for the selected motor ? If you overdrive the motor with higher voltage or higher current it might get hot.
- Is hold current enabled ? Enabling the hold current will heat up the motor even under normal conditions. If the application doesn't require hold current, it is better to disable that feature.

Most motor related problems can be resolved by doing the following:

- Use the Restore command to reset factory defaults.
- Connect only one motor to Quattrostep.
- Disconnect all limit/home switches.

If you cannot get Quattrostep to work, contact the manufacturer with as much detail as possible: info.quattrostep@yahoo.com.

7 Embedded Application

Quattrostep can also be controlled by other microcontroller boards. To use that feature, you have to disconnect the USB cable and connect the microcontroller board to J2 on Quattrostep. In this configuration, 5V power, GND and 5V level serial communication is coming from the microcontroller. Please refer to the below connection diagram for details:

Note: Do not connect Quattrostep to a PC USB port while applying power to J2.
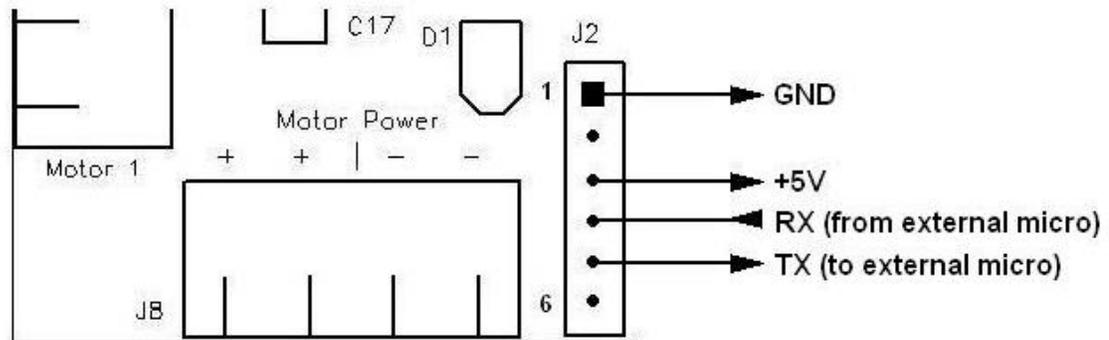
8 Wiring Diagram

Motor power is indicated in red and needs to be connected to an independent power source like a bench top power supply. The home/limit switches on the right are optional. Most unipolar stepper motors have 5 or 6 wires. 5 wire motors have internally connected center taps while 6 wire motors require external connection of the center taps.

Note: If the motor has only 4 wires, it requires a bipolar stepper driver and cannot be used with Quattrostep.