Driver Board Manual

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Contents

1. Introduction

This manual is to help in integration of the driver board and use of the Xaar 128/Irix print heads. This product and kit has been designed and selected for ease of use and integration on multiple platforms and as such has a lot of flexibility.

1.1. Cautions

As other electrical products it is imperative that no hot swapping is done with the board and printheads. The board is designed in a way that through either removing USB power or sending the “power off” command the board and heads are safe to dis/connect.

2. Product Information

2.1. Driver Board

The driver board is a microcontroller based solution to driving four individual print heads whilst allowing for synchronisation through differential encoders, stepper motors, or strobing systems. As a microcontroller based solution some maximum timing considerations apply e.g. maximum encoder frequencies, serial communication while printing, minor jitter. However through testing it has been found that this board is capable at running all four print heads at maximum jetting speeds and without noticeable performance issues.

The benefit of taking a microcontroller based approach to the solution is that the system is highly flexible, and if a current function or feature is not supported please contact Added Scientific Ltd and we can investigate developing it.

2.2. A Research Platform

As a tool for R&D the board affords the user the most control possible with the lowest level integration possible. This means that the whole serial communication interface is described in this manual and users are free to use whatever programming language they choose to interface.

As an R&D tool the user has a number of controls to use when developing an ink:

- Print head temperature

    - The board allows the user to control the print head temperature, the suggested temperature range is between 20-70 degrees Celsius. However the board imposes a maximum limit of 150 degrees Celsius. When using printhead heating no warranty of guarantee can be offered and users will need to understand and investigate the limits.
- Waveform voltage
    - The amplitude of the of waveform is controllable between 0-35V, however in practice many fluids do not print under 15V.
- Waveform timing (Across all heads)
    - The Xaar 128/Irix heads do not allow for user waveform control and this function manipulates the timing of the head. This means that by changing the parameter not only is the waveform timing affected but also the maximum frequency and ABC staggering. This control can lead to printhead soft-locks that are only restored by fully powering down the board. This control typically has a 50 – 150% range. This control also applies to all heads connected to a single board and cannot be set individually.

2.3. Inkjet Print Heads

It should be noted that there are multiple print heads available that are compatible with this driver including: Xaar 128, Irix Core, Irix Pro series. These are available in wetting/non-wetting and 80/40pL variants. Across this whole range the printheads are 128 nozzles and have a native drop spacing of 185 NPI. As a shared wall type piezoelectric inkjet print head, a staggering of nozzles is required to print. This staggering results in a timing delay between ABC nozzle firing, this can be seen in Figure 1. This timing is fixed[1] and is around 60 microseconds between each phase, for a total of 120 microseconds between A and C nozzle firing. If your application is sensitive to this timing discrepancy then either only use nozzles on a single row or slow down substrate transfer to reduce placement accuracy reduction.

[1] The fixed nature is in relation to print frequency, when manipulating the printer clock this timing is affected.

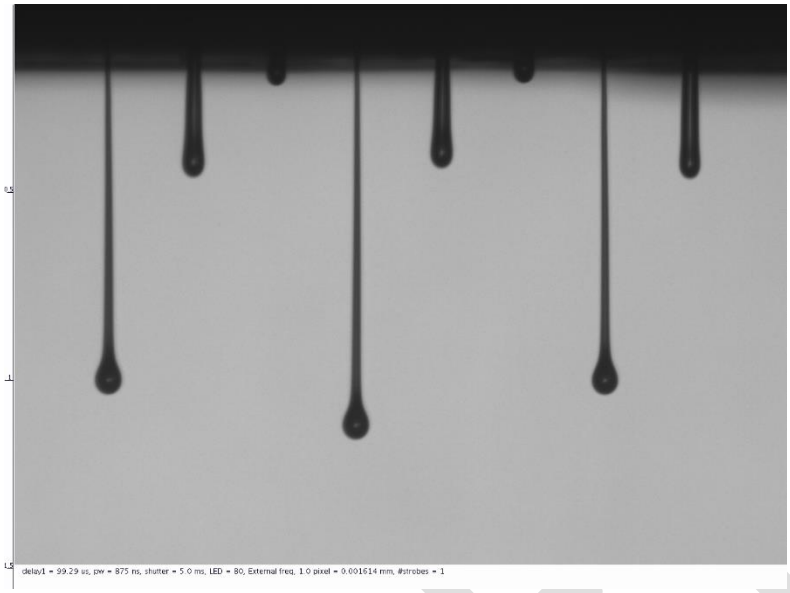


Figure 1 Drop watcher image of a Xaar 128 print head and the ABC cycle of nozzle firing.

Correct fluid pressure is of utmost important for inkjet printing. The Xaar 128/Irix head works at around 10 mBar of meniscus pressure. This can be configured through gravity ink feed systems or off-the-shelf ink delivery systems.[2]

[2] ASL are developing a pressure controller system however this is currently not available.

3. Components

This section lists the components in a starter kit for easy reference.

3.1. Driver board

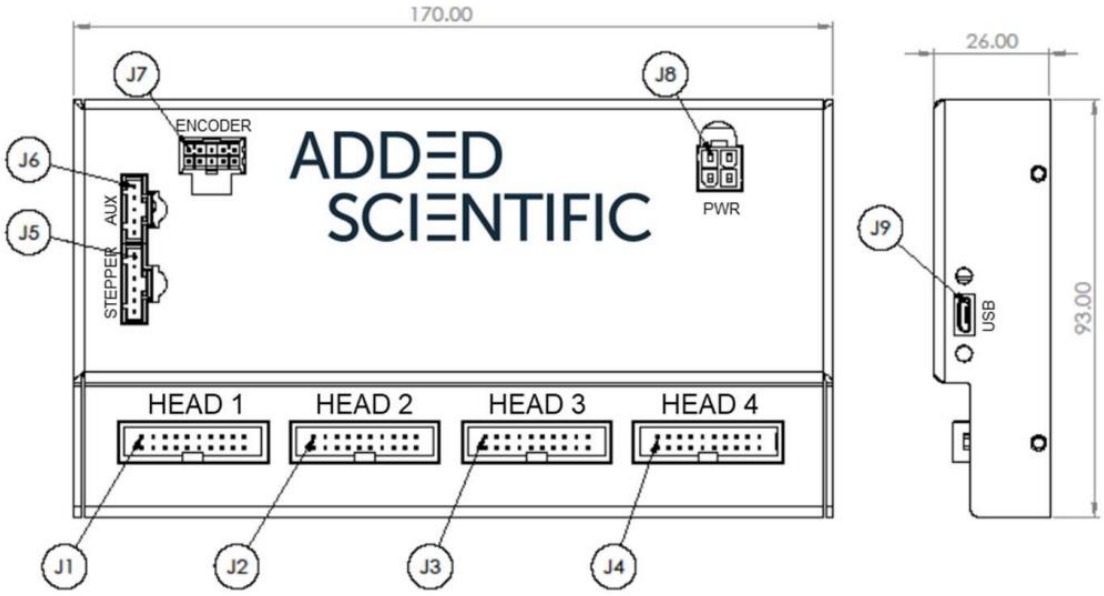


Figure 2 Bare PCB for driver board

3.1.1. J1-J4 ASL Connector

This connector is combined printhead and heating connector cables. Pin 1-4 are for the heater system. Pins 5-20 are for the printhead.

3.1.2. J5 Stepper Motor Interface

To write.

3.1.3. J6 Auxiliary Connector

To write.

3.1.4. J7 Encoder Interface

A RS-485/422 compatible interface for quadrature encoder signals. The J7 connector supports both single axis tracking, product detect, and strobe commanding.

A+B = Encoder C = Product Detect D = Print Trigger

2B	1B	GND	4B	3A
2A	1A	5V (50 mA)	4A	3B

Figure 3 J7 Pinouts

3.1.5. J8 Power Input

The pins are labelled on the PCB, there are two power rails required for printing operation with heating. If heating is not required the 24V rail is not used. Current on the 36V rail is require to be 1A or greater, 24V rail is 3A or greater.

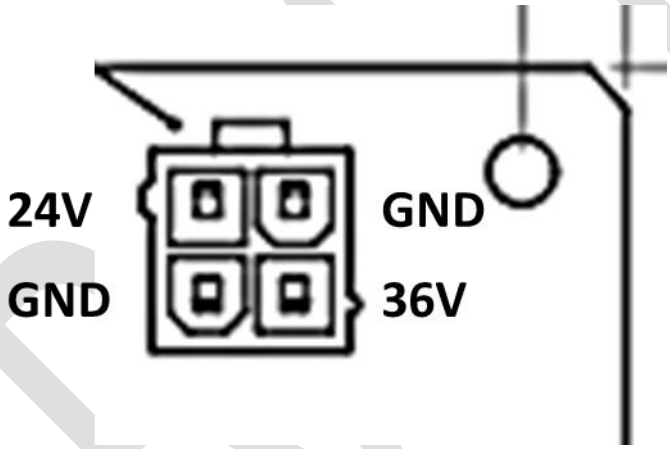


Figure 4 Pin numbers for the DC connector.

3.1.6. J9 USB Interface

Communication of data and printing parameters is conducted through the J9 micro USB connector. This connector also provides 5V power to the board and printheads. The interface is through a virtual COM port at 1000000 baud.

3.2. Printhead interface cable and pcb

Figure 5 PCB and interface cable with connectors for heating

3.3. Printhead heater block

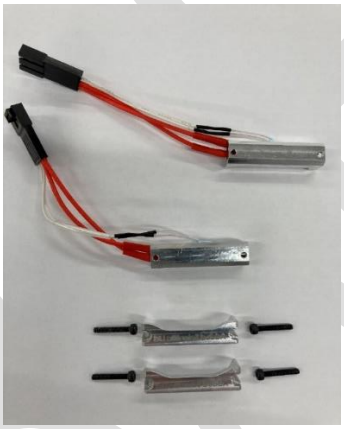


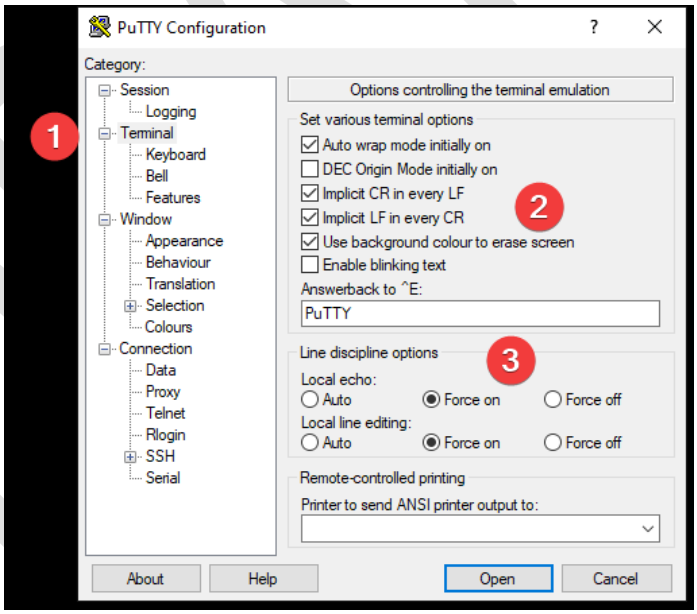
Figure 6 Heater block with bracket and mounting screws (M2.5)

4. Programming and Integration

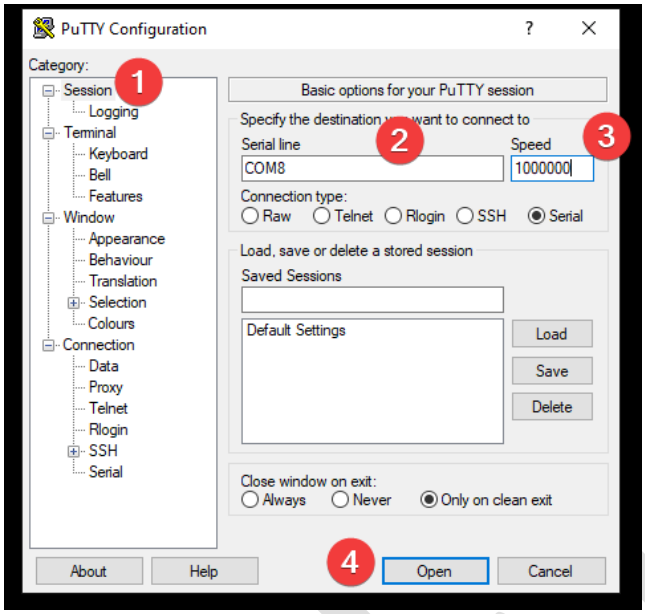
There are both python and C# scripts available for reference in how to use the driver board for material jetting. If you do not have these please contact Added Scientific Ltd to request them.

4.1. Serial quick start

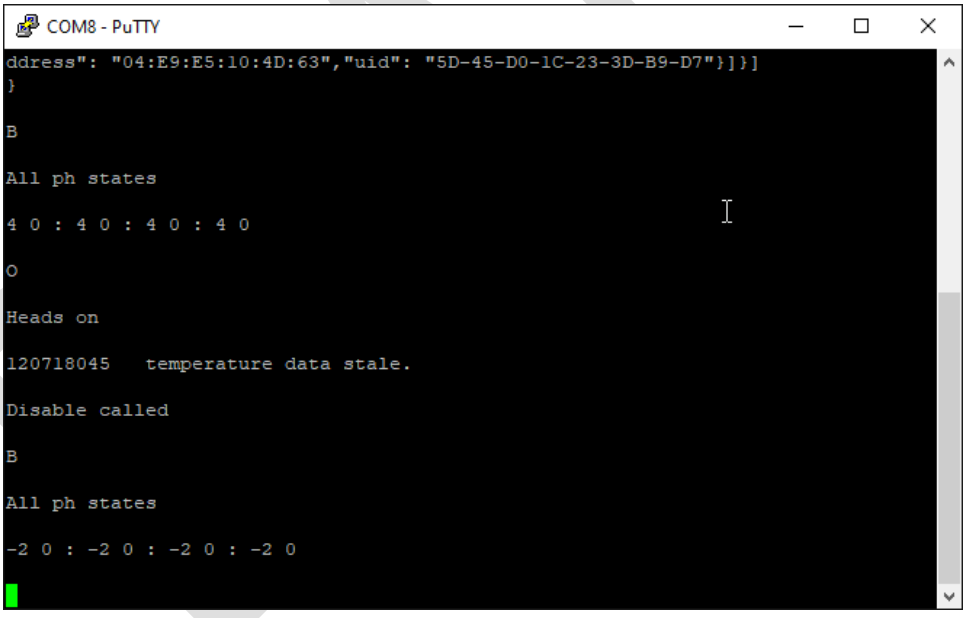
When using the board or checking performance the best method to determine if everything is correctly connected is to use a serial sender and print with each head. To do this any serial program can be used, this following guide uses PuTTY (https://www.putty.org/).

1. Once installed start Putty, go to the terminal section and enable
   - “Implicit CR in every LF”
   - “Implicit LR in ever CR”
   - “Force on”
   - “Force on”
   - 

2. Navigate to session
   - Enter the correct COMPort, Baud rate and open



3. Type “B” and hit enter/return



The reply from the board is an array of the current head statuses. Receiving all “4 0 : 4 0 : 4 0: 4 0” indicates the board is not currently powered on. In the above image the board is then powered on using “O” and the statuses requested again. The second reply is all -2, which indicates that the heads are not connected. A positive status would be normal operation, and lastly a -3 would mean there was a ready error and the board needs power cycling.

Once this check has been performed the printheads can be printed and checked again. This is best done when the heads are primed with a known printing ink, IPA works well for this test.

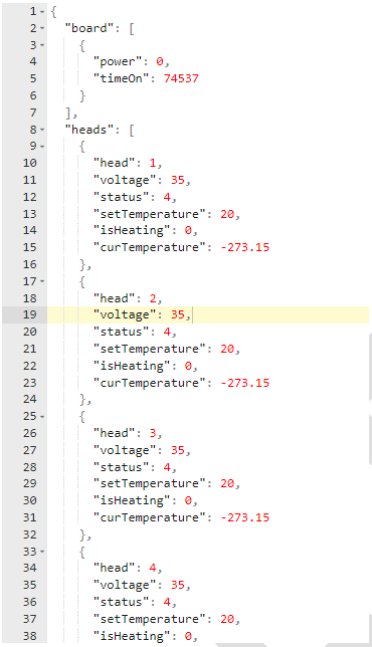
1. “O”
    - Turns on the board
2. “p 2000”
    - Sets print frequency to 2 kHz
3. “I 1”
    - Sets head 1 to print all nozzles
4. “C”
    - Clears all heads of printing
5. “I 2” etc

These series of commands turn the board on, set the print frequency to 2000 Hz and then fill the selected head with print data. The effect of this should be ink printing from the nozzle.

4.2. Full command list

To see the full command list refer to the CSV file, commands are designed around enabling human communication with the board wherever possible. This means that all commands are typeable on a normal keyboard. This does not apply to sending data which cannot be accomplished using typeable commands and must use a coded interface.

For monitoring and polling the “b” command requests and receives a JSON formatted report on the board.




```
{
  "board": [
    {
      "power": 0,
      "timeOn": 74537
    }
  ],
  "heads": [
    {
      "head": 1,
      "voltage": 35,
      "status": 4,
      "setTemperature": 20,
      "isHeating": 0,
      "curTemperature": -273.15
    },
    {
      "head": 2,
      "voltage": 35,
      "status": 4,
      "setTemperature": 20,
      "isHeating": 0,
      "curTemperature": -273.15
    },
    {
      "head": 3,
      "voltage": 35,
      "status": 4,
      "setTemperature": 20,
      "isHeating": 0,
      "curTemperature": -273.15
    },
    {
      "head": 4,
      "voltage": 35,
      "status": 4,
      "setTemperature": 20,
      "isHeating": 0,
```


Figure 7 An excerpt from the JSON report showing power status, time on, printhead 1/2/3/4 parameters.