Driver Board Manual

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NG7 2RH

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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.

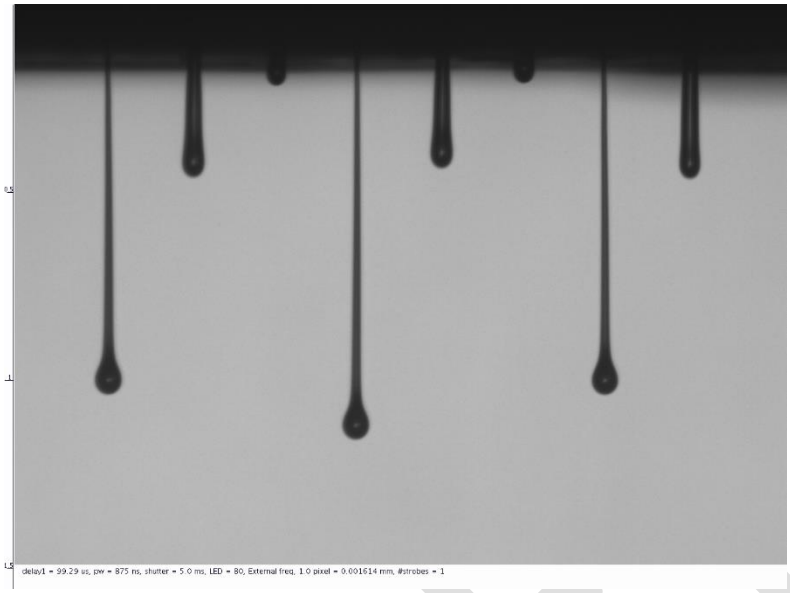


Figure 1 Drop watcher image of a Xaar 128 print head and the ABC cycle of nozzle firing.

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

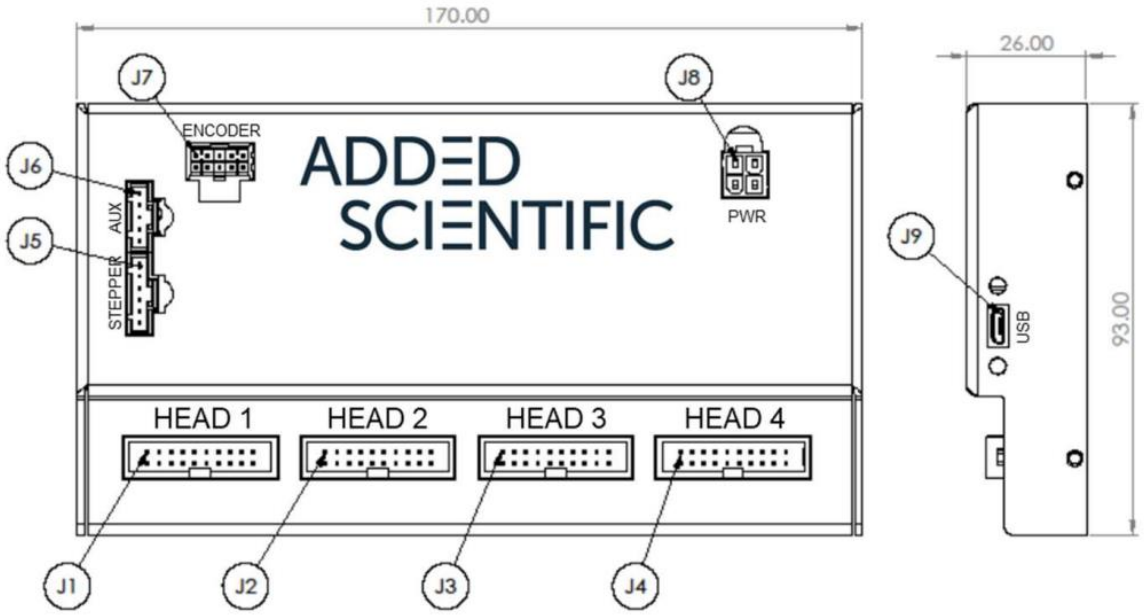


Figure 2 Bare PCB for driver board

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

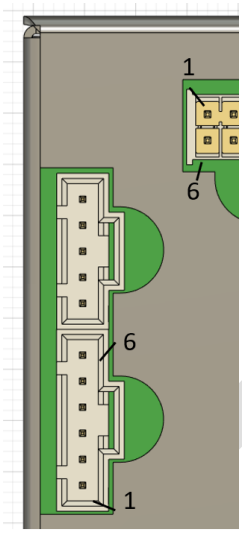


Figure 3 Top down view of J5 connector showing pin labelling

This connector is used for interface the board with a stepper motor or non-quadrature encoder. It expects a step and direction, as well as external power and ground, the maximum voltage is 5V.

Table 1 Stepper motor pinout

Pin Number	Function
1	External Power (5V Max)
2	Reserved
3	Step
4	Direction
5	Reserved
6	External Ground

3.1.3. J6 Auxiliary Connector

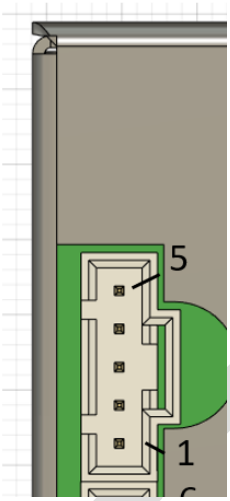


Figure 4 Top down view of J6 connector labelling pin identification

Currently the auxiliary connector is only used for a strobe output to synchronise to drop watching systems. To ensure precise timing this connector has unprotected pins so it is imperative that no voltage is applied to these pins and only minimal current loads are applied.

Table 2 Auxiliary connector

Pin Number	Function
1	3.3 V Power (50 mA max)
2	Reserved
3	Strobe Pin (5 mA max)
4	Reserved
5	Ground

3.1.4. J7 Encoder Interface

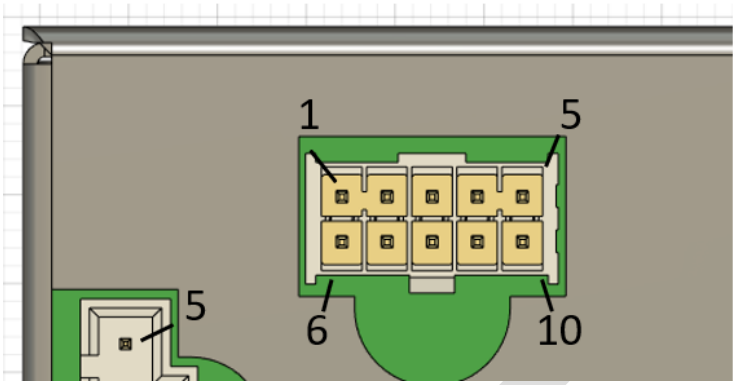


Figure 5 Top down view of J7 connector labelling pin identification.

A RS-485/422 compatible interface for quadrature encoder signals. The J7 connector supports both single axis tracking, product detect, and strobe commanding. Channel 2 is used for strobe commanding, when enabled in the firmware every pulse will cause an immediate nozzle firing, this is used for strobing systems that command firing. Channel 1 and 4 are used for the quadrature encoder tracking and print positioning. Channel 3 is used for a hardware product detect.

Table 3 Differential connector

Pin Number	Function
1	Channel 2 Negative
2	Channel 1 Negative
3	Ground
4	Channel 4 Negative
5	Channel 3 Positive
6	Channel 2 Positive
7	Channel 1 Positive
8	5V Power (50mA max)
9	Channel 4 Positive
10	Channel 3 Negative

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.

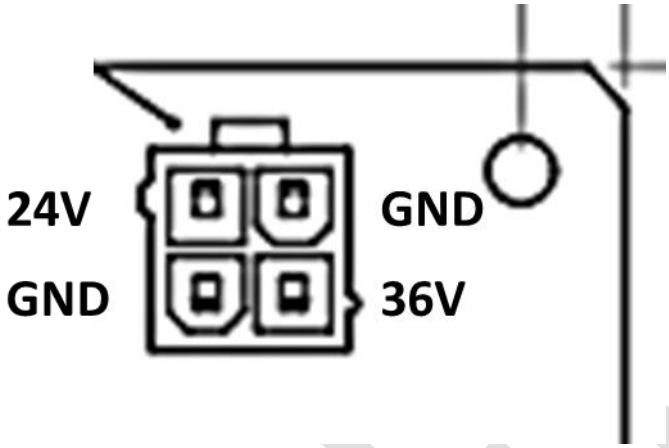


Figure 6 Pin numbers for the DC connector.

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 7 PCB and interface cable with connectors for heating

3.3. Printhead heater block

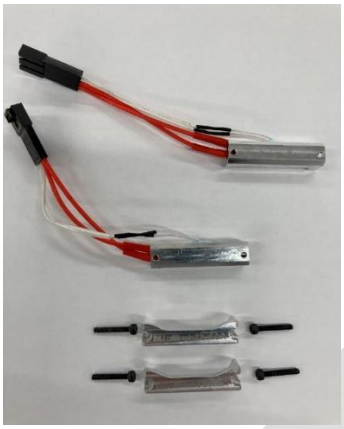


Figure 8 Heater block with bracket and mounting screws (M2.5)

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. Tool Quick Start Guide

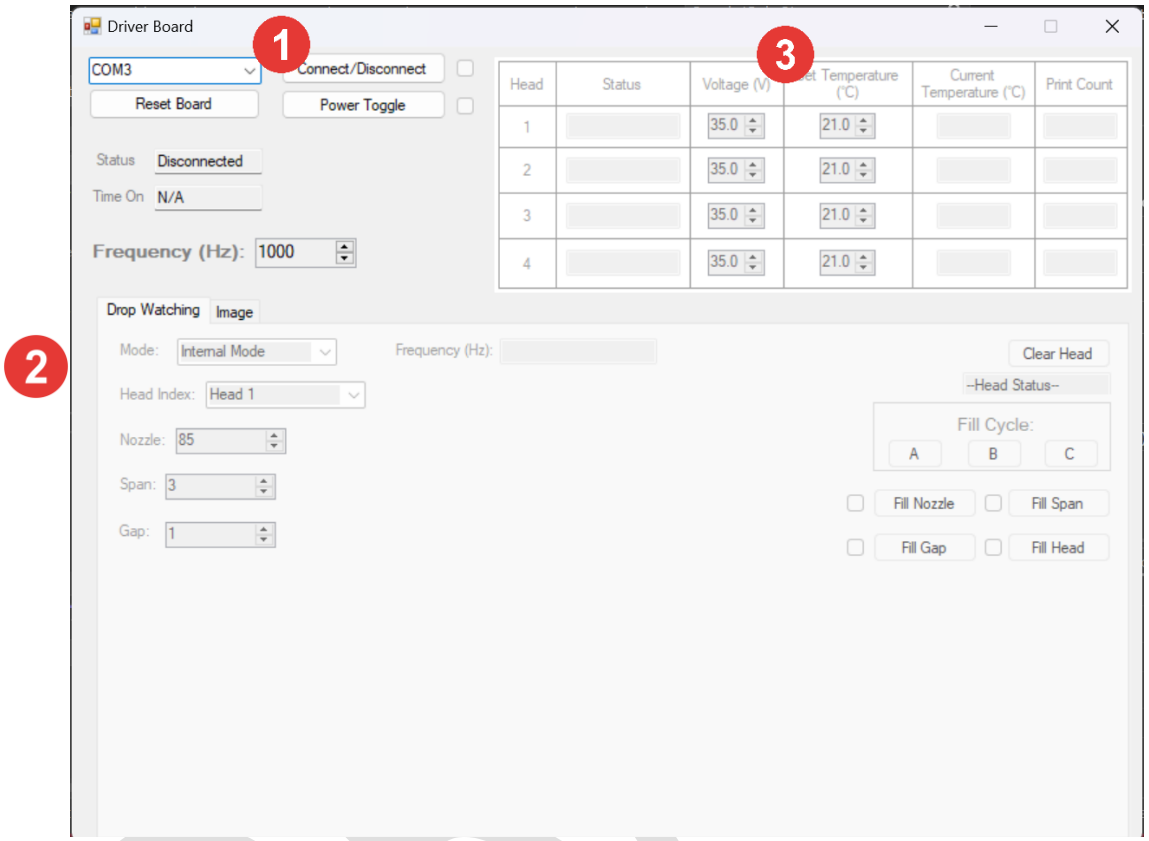
This guide uses the software tool provided named “Driver Board Dropwatcher” found in the “Products” GitHub repository (https://github.com/AddedScientific/Products)

1. Navigate to the “Products” GitHub repository and download/clone the folder.

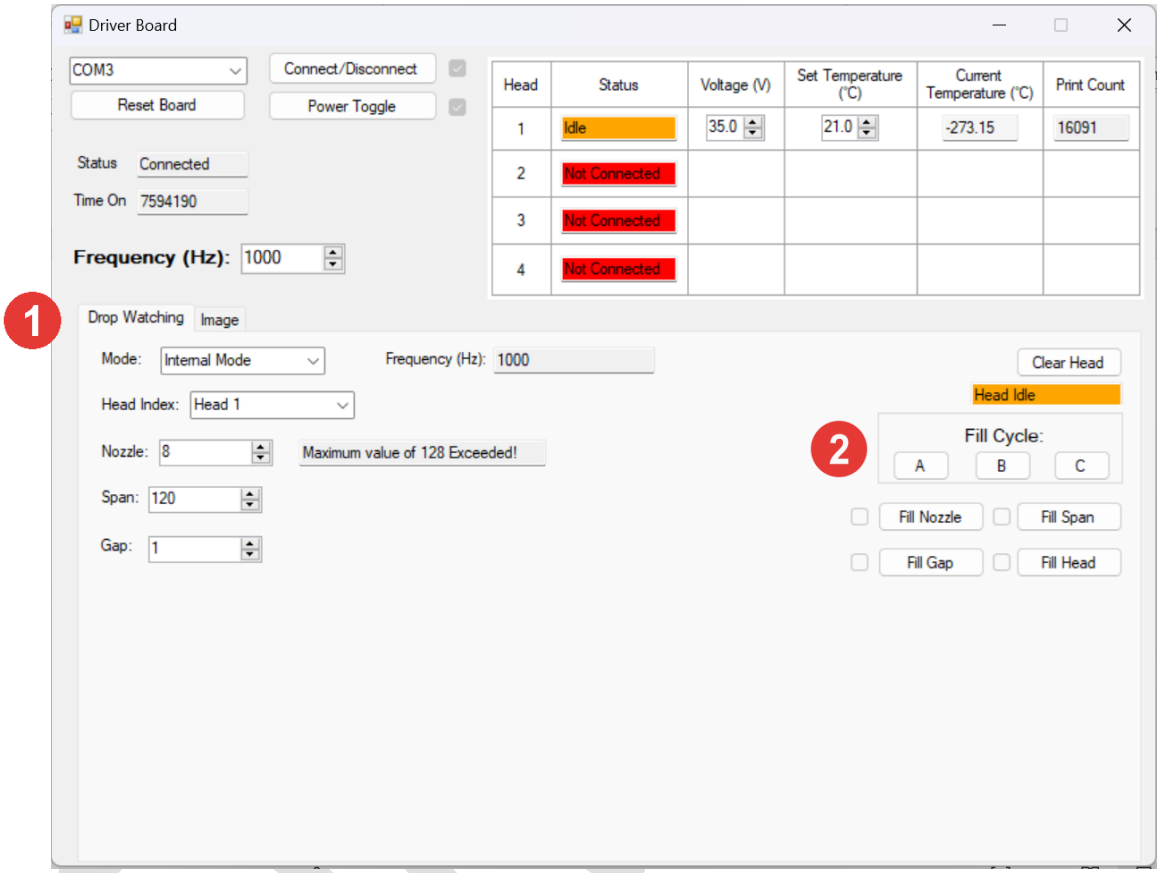
2. Navigate to the “DriverBoardDropwatcher.exe” file in the “Products” GitHub repository. This can be found in the path of: “MJ Driver Board/Software/DriverBoardDropwatcher/bin/Debug/DriverBoardDropwatcher.exe”

3. Once started, go to the COM selection option, and select the correct COM Port from the available ports, then toggle the “Connect/Disconnect” Button and the “Power Toggle” button.

4. Once successfully, connected and powered on, select required Frequency, Voltage and Temperature settings for each print head.

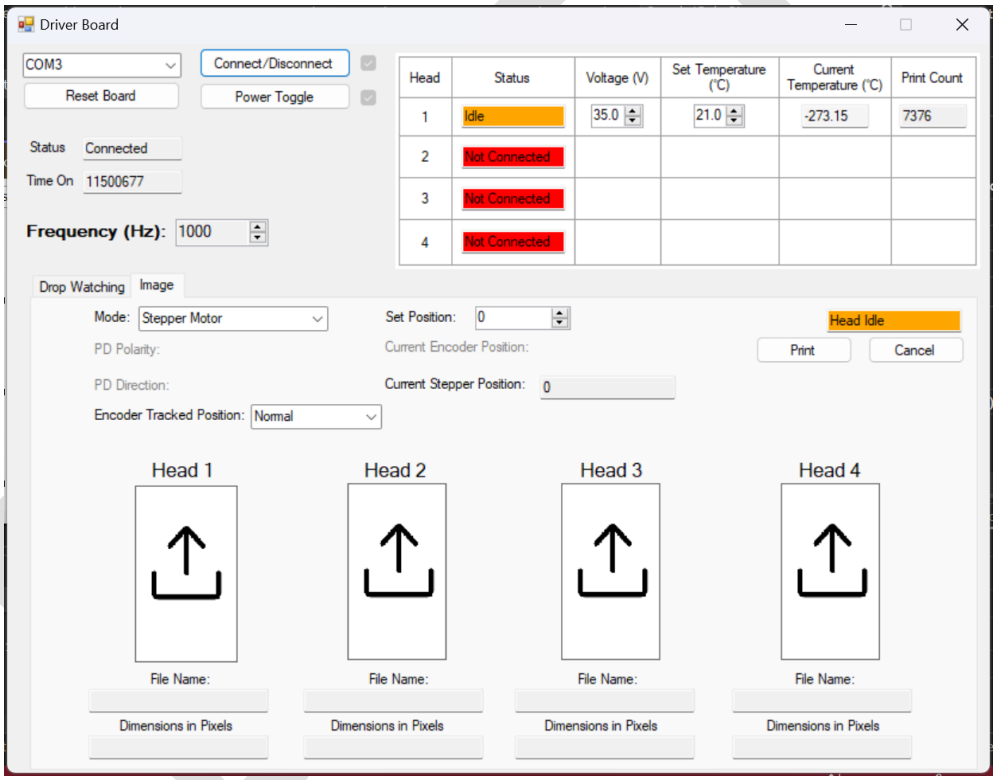


5. In the Drop Watching Tab, select the preferred mode, head index, nozzle, span, and gap value. Then hit the preferred fill setting. If you want to clear all the heads, then press the “Clear Head” button. If printing successfully, head status will change to green



and will state “Printing”.

6. If Image Mode is required, then switch to the Image Tab and select the preferred mode and other relevant settings. Click on the relevant image boxes where a



maximum of 4 images can be uploaded (1 for each head). Once ready, press the “Print” button.

3.4. Full command list

To see the full command list refer to the CSV file, commands are designed around enabling human 2 3 communication with the board 4 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 9 An excerpt from the JSON report showing power status, time on, printhead 1/2/3/4 parameters.