

# BIO X6

# User Manual

Welcome to the world of bioprinting!

Not too long ago, the idea of creating living human tissue was no more than a dream, but not anymore. The technology in front of you is the next step on the path to regenerative medicine and tissue engineering.

The BIO X6™ was designed with your research in mind. With an enhanced and extended printhead platform and a more intuitive bioprinting process, you can focus on your research and dream bigger than ever before.

Featuring unparalleled usability and versatility, the BIO X6 will take your research to the next level. With interchangeable Intelligent Printheads, Clean Chamber™ technology, print chamber sterilization, a temperature-controlled printbed, an improved, precise, and fast touchless autocalibration system and a user-friendly interface, the BIO X6 is ready to overcome the most complex bioprinting challenges.

This manual is your guide to getting started with the BIO X6. Read the manual in its entirety before using the BIO X6.

Because we regularly update our software and release updated bioprinting protocols for these added features, please refer to the digital manual included with your tablet for the latest protocols and printing instructions.

Create the future of medicine!

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# 01

## Safety

# 1 Safety information



Review the entire manual, as well as the manuals for any accessories, before using the BIO X6. Mishandling can lead to equipment damage and severe injury. The following symbols are used to indicate risk of equipment damage or personal injury:



This symbol indicates risk of injury or equipment damage.



This symbol indicates a heated surface. The BIO X6 has heated surfaces that may cause personal injury or equipment damage if not treated with care. A physical symbol labels these surfaces on the BIO X6, and the symbol appears on the BIO X6 touchscreen when the print chamber is heated.



This symbol indicates the presence of UV light. Keep the door closed and wear proper safety attire during UV sterilization and UV curing. This symbol appears on the screen when a UV light source is active.

## Manufacturer

Cellink Bioprinting AB  
Långfilsgatan 7  
412 77 Gothenburg Sweden

## 1.1 General safety information

If the BIO X6 acts in a way that is not described in this manual, turn it off and contact CELLINK. Use the BIO X6 for its intended purposes only. Do not modify its instruments, subcomponents, or accessories. Do not open or disassemble the BIO X6 or attempt any service other than those described in the manual.



Never place your fingers or any part of your body near BIO X6 until all parts have stopped moving. Moving parts can cause injury, (BIO X6 may start moving without warning).



Never clean or service the BIO X6 while it is on. Always turn off the power and disconnect any external sources of power and air pressure before cleaning or servicing the BIO X6 in all cases (including changing the filter).



The BIO X6 uses UV light for sterilization and curing. Never look directly at UV light. Never expose skin to UV light. Eye or skin exposure can result in serious personal injury. Always keep the BIO X6 door closed during the Clean Chamber mode and photocuring operation. (The UV modules might be hot right after use.)



The BIO X6 has heated surfaces that can reach temperatures of up to 250°C. Never touch heated surfaces when using the heating function. Always let printheads and printbed cool down after using the heating function.



Always ensure that the equipment is correctly mounted before use. Improperly mounted printheads, cartridges, cables, liquid spouts, and air spouts can be dangerous. If any equipment appears damaged, turn off the BIO X6, unplug all external connections, and contact CELLINK before further use.



Never tamper with any safety interlocks. Tampering risks equipment damage and personal injury.

## 1.2 Unpacking, lifting, and carrying

Read how to safely unpack and setup the BIO X6 in Section 3 of this manual.



The BIO X6 is heavy (approximately 50 kg/110 lbs.). Never attempt to lift alone. Always use a minimum of two people to unpack and move the machine.

## 1.3 Electrical information



Always connect the BIO X6 to a grounded socket and use the voltage described in the specifications. Improper electrical handling can cause equipment damage and personal injury.

## 1.4 Protective equipment



Always wear gloves and eye protection during bioprinting, UV curing and sterilization.



Always wear gloves and eye protection while handling hazardous materials, including materials that are toxic, corrosive, and carcinogenic.



Read the material safety data sheets, packing labels, and the manufacturers or distributor's catalogue before using the product.

## 1.5 Hazardous materials



Consult material safety data sheets, packaging labels, and the manufacturers or distributor's catalogue before handling hazardous dispensing materials, such as flammable and corrosive materials. Ensure all operators are informed of the characteristics of the material, as well as its compatibility with the dispensing unit. Always use appropriate safety equipment and attire. If you are unsure of the compatibility of a material, contact CELLINK.



After using ethanol to clean the BIO X6, wait at least 60 seconds before bioprinting to ensure that all flammable vapors have been ventilated.

## 1.6 Electrostatic discharge (ESD) protection

The BIO X6 print chamber is ESD sensitive. Follow the instructions below to ensure that you do not damage the BIO X6 or its accessories.

### 1.6.1 Discharging

Always discharge yourself before using the BIO X6 print chamber and handling printheads.

Always discharge yourself before touching any ESD sensitive parts.

To discharge yourself, touch a grounded metal surface. Examples of grounded metal surfaces include:

- Any metal surface in a laminar flow hood
- Any metal sinks
- The frame of the BIO X6 when connected to a grounded power outlet, as well as any exposed screws, including the screws on the left-side door hinges

### 1.6.2 Clothing

Avoid charging yourself to ensure ESD protection. Wear clothes made from cotton when appropriate.

## 1.7 Compliance

By using the BIO X6, you agree to the terms stated here and, in the warranty (see Warranty). Except for the express warranty set forth in the warranty information and in our software, license terms as applicable, all equipment and software provided hereunder are provided "as is", and CELLINK makes no warranty as to its use or performance.

Except for any warranty, condition, representation, or term the extent to which cannot be excluded or limited by applicable law, CELLINK and its suppliers make no warranty, condition, representation, or term (expressed or implied, whether by statute, common law, custom, usage or otherwise) as to any matter including, without limitation, noninfringement of third-party rights, merchantability, integration, or fitness for a particular purpose.

You assume responsibility for selecting the solution to achieve your intended results, and for the installation of, use of, and results obtained from the equipment and software. Without limiting the foregoing provisions, CELLINK makes no warranty that the equipment or software will be error-free or free from interruptions or other failures or that the software or equipment will meet your requirements.

Under no circumstances and under no legal theory, whether in tort, contract, or otherwise, shall CELLINK or its suppliers be liable to purchaser or to any other person for loss of profits, loss of goodwill, or any indirect, special, incidental, or consequential damages, or damages for gross negligence of any character.

Under no circumstances can CELLINK be responsible for consequences of misuse of the instrument or for use of the instrument outside the use specified in this user manual, be they material or personal.

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## Specifications

## 2 Specifications

### 2.1 Product overview

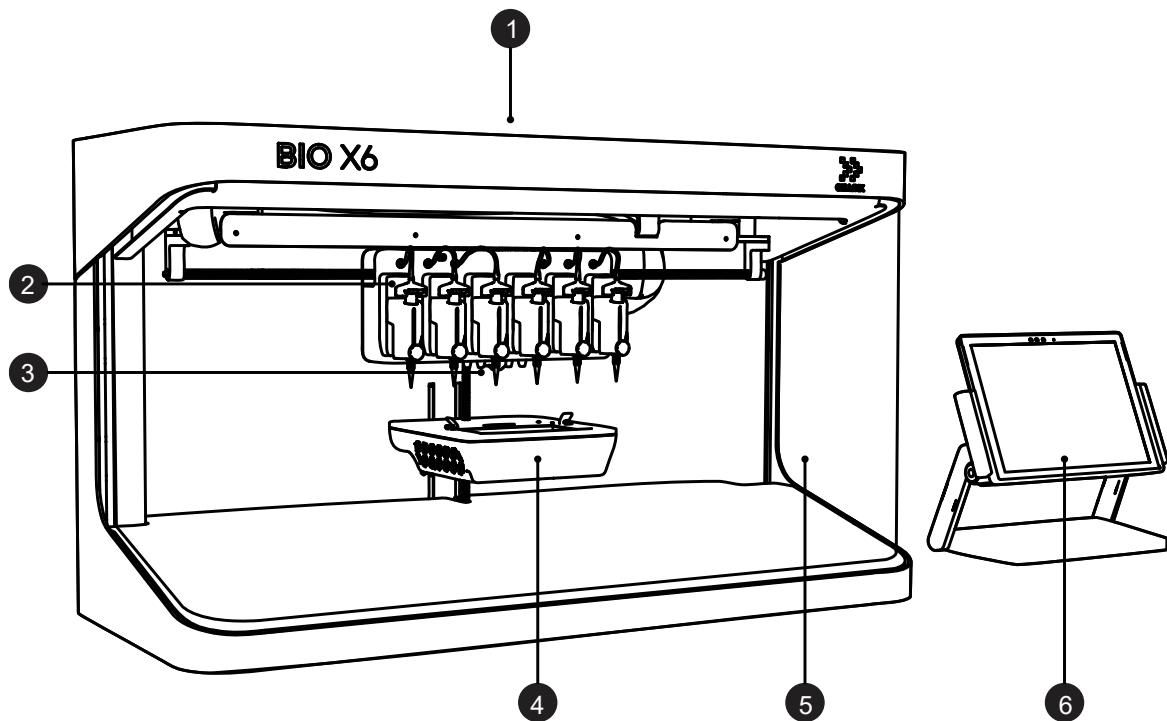


Figure 1 Front view of BIO X6

1. Clean Chamber unit
2. Printbox (printhead mount 1-6)
3. Photocuring LED 1-4
4. Printbed
5. UV protective door
6. Docking station

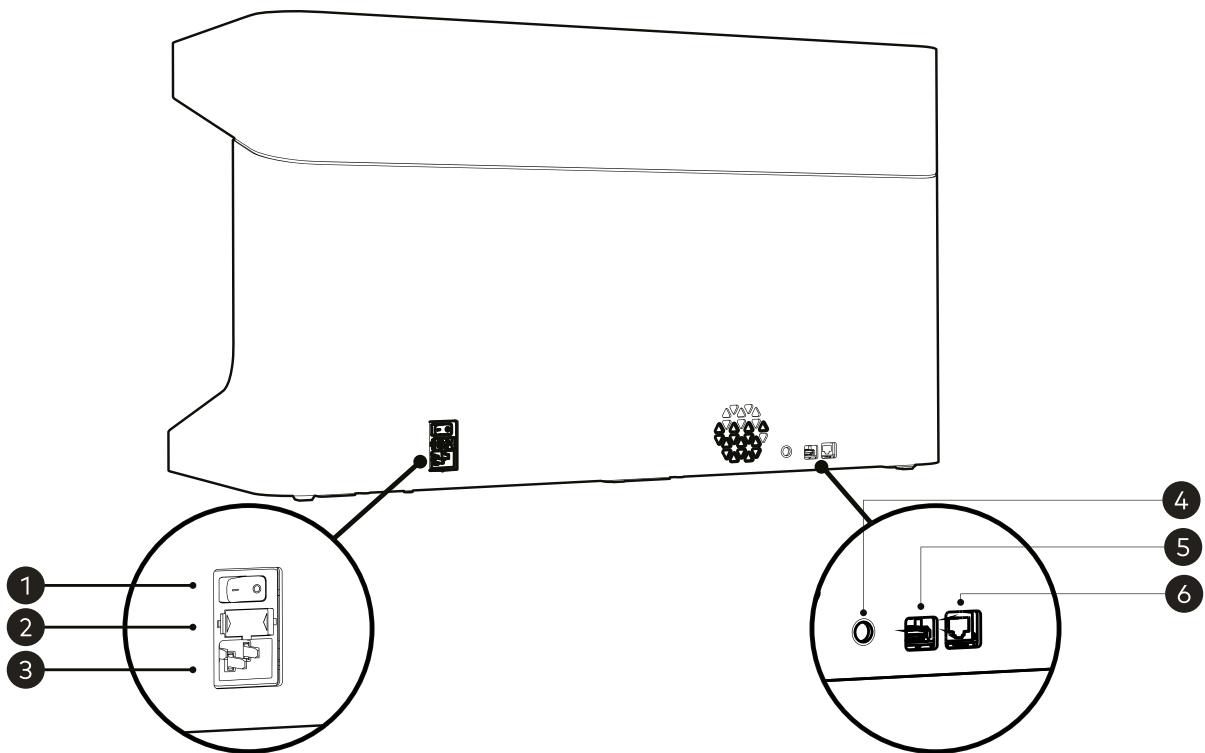


Figure 2 Back view of BIO X6

1. Power switch
2. Fuse
3. Power socket
4. Pneumatic port
5. USB port
6. Ethernet port

## 2.2 Technical specifications

### Electrical

Power input:	100–240 VAC, 50–60 Hz
Power (max):	600 W
Current (max):	6 A
Fuse:	250 VAC, F6.3A

### Outer dimensions

Length:	850 mm (33.46 in)
Width:	400 mm (15.75 in)
Height:	500 mm (19.69 in)
Net weight:	47.4 kg (104.5lb)
Build volume (L x W x H):	128 x 90 x 85 mm
Filter class:	HEPA 14
UV-sterilization:	UV-C (275 nm) 2W output
UV-curing modules:	365 nm, 405 nm, 475 nm, 520 nm

No. of printhead slots:	6
Calibration options:	X-Y-Z axis, Manual (mechanic based) X-Y-Z axis, Automatic (touchless based)
	Printbed, automatic bed levelling ABL (mechanic based)

### Resolution

Theoretical resolution XY:	1 $\mu\text{m}$
Theoretical layer resolution Z:	1 $\mu\text{m}$
Software Resolution XYZ:	10 $\mu\text{m}$

## **Pressure**

Pressure range (internal pump):	0–200 kPa
Pressure range (external air supply):	0–700 kPa
Output Pressure Offset:	+/- 5 kPa

## **Temperature**

Printbed temperature range:	4–65°C (lowest temperature 17°C below chamber temperature)
Printhead temperature range:	4–250°C (dependent on printhead type)
Pneumatic printhead:	30–65°C
Temperature-controlled Printhead:	4–65°C (lowest temperature 17°C below chamber temperature)
Thermoplastic Printhead:	50–250°C
Supported file formats:	G-code, stl, amf, 3mf, obj.
User interface:	Desktop application DNA Studio
Connectivity:	USB Storage, Ethernet connection

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## Getting started

## 3 Getting started

### 3.1 Unpacking the BIO X6



Do not attempt to unpack the BIO X6 without reviewing the procedures below.  
Doing so can lead to personal injury and equipment damage.



Always lift the BIO X6 from the underside.



The BIO X6 is heavy (approximately 50 kg/110 lbs). Never attempt to lift it alone.  
Always use a minimum of two people to unpack and move the BIO X6.

#### Follow these steps to unpack the BIO X6.

1. Clear a sturdy table and a floor space of at least 2 by 3 meters.
2. Place the box on the floor according to the printed arrows.

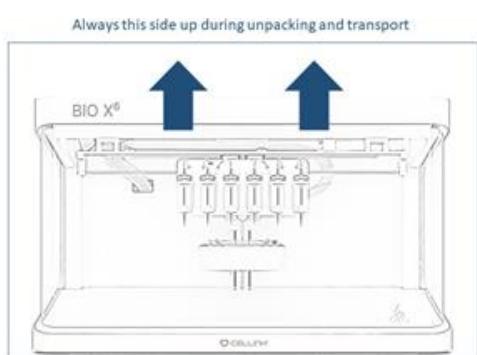
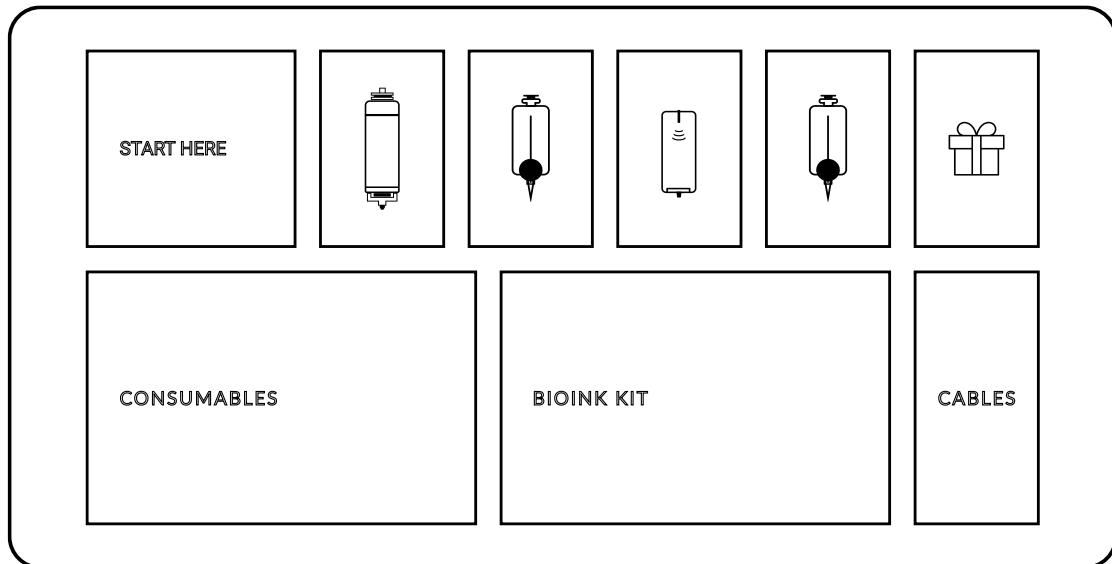


Figure 3 Direction for unpacking and transportation

3. Remove the pallet straps.
4. Carefully remove the top box.

5. Keep all original boxes and packaging material – you might need them for transportation.
6. Remove all the grey boxes from the foam inlay and check that you have received all the equipment listed under [Contents of the box](#).



*Figure 4 Overview of equipment included with the BIO X6*

7. Remove the docking station and the tablet from the compartment behind the BIO X6.
8. With the assistance of a second person, lift the BIO X6 from the underside and place it on the table.
9. Remove the thin foam covering the BIO X6.
10. Standing behind the BIO X6, gently grasp both sides of the door and raise the door slowly and evenly to access the printer chamber to access and remove the remaining packaging material.

## 3.2 Contents of the box

[1x] BIO X6 .....	<input type="checkbox"/>
[1x] Surface Pro 7 Tablet.....	<input type="checkbox"/>
[1x] Surface Pro, Docking station.....	<input type="checkbox"/>

### Box Start kit contains:

[6x] Cartridge adapters.....	<input type="checkbox"/>
[1x] Microscope springs.....	<input type="checkbox"/>
[1x] USB Flasdrive.....	<input type="checkbox"/>
[1x] Surface probe extender.....	<input type="checkbox"/>
[2x] USAC Periscope.....	<input type="checkbox"/>
[4x] Photocuring schnabel.....	<input type="checkbox"/>
[1x] BIO X6 User manual.....	<input type="checkbox"/>
[1x] Microsoft Stylus Pen.....	<input type="checkbox"/>
[1x] Sustainability note.....	<input type="checkbox"/>
[5x] F/F Luerlock adapter.....	<input type="checkbox"/>

### Box consumables contains:

[2x] 50 mL CELLINK Start.....	<input type="checkbox"/>
[2x] Glass Petri Dish.....	<input type="checkbox"/>
[20x] Cartridges with plunger and caps .....	<input type="checkbox"/>
[1x] non-sterile high precision conical nozzles, (Blue, 22G), 50 pcs .....	<input type="checkbox"/>
[1x] non-sterile high precision conical nozzles, (Red, GA 25), 50 pcs.....	<input type="checkbox"/>
[1x] non-sterile high precision conical nozzles, (Clear, GA 27), 50 pcs .....	<input type="checkbox"/>
[1x] non-sterile blunt needles (Pink 20G), 50 pcs .....	<input type="checkbox"/>
[1x] non-sterile blunt needles (Blue 22G), 50 pcs .....	<input type="checkbox"/>
[1x] non-sterile blunt needles (Red 25G), 50 pcs .....	<input type="checkbox"/>
[1x] non-sterile blunt needles (Clear 27G), 50 pcs .....	<input type="checkbox"/>

### Box cables contains:

[1x] Ethernet cable, 3m, Grey .....	<input type="checkbox"/>
[1x] Power cable (Based on Location) .....	<input type="checkbox"/>
[1x] Tablet stand adapter US if applicable .....	<input type="checkbox"/>

### Box Bioink kit contains:

[1x] Cell-mixer .....	<input type="checkbox"/>
[1x] CELLINK Bioink Sterile (3pcs) .....	<input type="checkbox"/>
[1x] Crosslinking solution.....	<input type="checkbox"/>
[1x] Sterile needle kit .....	<input type="checkbox"/>
[1x] SDS CELLINK Bioink safety data sheet.....	<input type="checkbox"/>

**Box Pneumatic Printhead contains:**

- |                                    |                          |
|------------------------------------|--------------------------|
| [3x] 3ml Pneumatic PH .....        | <input type="checkbox"/> |
| [3x] 3ml Pneumatic PH .....        | <input type="checkbox"/> |
| [1x] Pneumatic PH user manual..... | <input type="checkbox"/> |

**Box Thermoplastic contains:**

- |   |                          |
|---|--------------------------|
| [1x] Thermoplastic PH .....             | <input type="checkbox"/> |
| [1x] Heat resistant tubing .....        | <input type="checkbox"/> |
| [1x] Plunger removal with plunger ..... | <input type="checkbox"/> |
| [1x] Thermoplastic wrench .....         | <input type="checkbox"/> |
| [1x] Thermoplastic user manual .....    | <input type="checkbox"/> |

**Box Temperature controlled contains:**

- |  |                          |
|--|--------------------------|
| [1x] Temperature controlled PH .....         | <input type="checkbox"/> |
| [1x] Nozzle insulator .....                  | <input type="checkbox"/> |
| [1x] Steel tip insulator .....               | <input type="checkbox"/> |
| [1x] Temperature controlled user manual..... | <input type="checkbox"/> |
| [4x] M2x4 Hex 1.3 Screw .....                | <input type="checkbox"/> |
| [1x] Hex 1.3 L-key .....                     | <input type="checkbox"/> |

**Box gift contains:**

- |                          |                          |
|--------------------------|--------------------------|
| [1x] Kitchen timer ..... | <input type="checkbox"/> |
| [1x] Calculator .....    | <input type="checkbox"/> |
| [1x] Candy pack .....    | <input type="checkbox"/> |
| [1x] Sticky note .....   | <input type="checkbox"/> |
| [1x] Kitchen timer ..... | <input type="checkbox"/> |

### 3.3 Setting up the BIO X6

Before connecting the BIO X6 to a wall socket, ensure that the socket is grounded. Next, connect the BIO X6 to the power outlet (see 2.1 [Product overview](#)) and the grounded wall socket with the included power cable.

The BIO X6 has an internal air supply capable of providing up to 200 kPa to the printheads. To use higher pressure, connect an external air supply to the back of the BIO X6 (see 2.1 [Product overview](#)).

Turn on the BIO X6 by using the power switch on the back (see 2.1 [Product overview](#)).

Operate the BIO X6 in a room with a temperature between 18°C and 22°C. Under normal operating conditions, the chamber temperature will rise between 2°C and 3°C, and the temperature on the standard pneumatic printheads will rise between 4°C and 5°C.

For precise temperature control, use a Temperature-controlled Printhead and ensure that room temperature is between 18°C and 22°C.

Check the temperature of the print chamber with the integrated temperature sensor.



Always connect the BIO X6 to a grounded outlet. Connecting the bioprinter to an ungrounded outlet can cause equipment damage and personal injury.



Make sure that the external air supply does not exceed the specifications outlined in the [Technical specifications](#). Improper use can cause equipment damage and personal injury.

## 3.4 Starting the BIO X6 for the first time

When you start the BIO X6 for the first time, you are taken to the home screen.

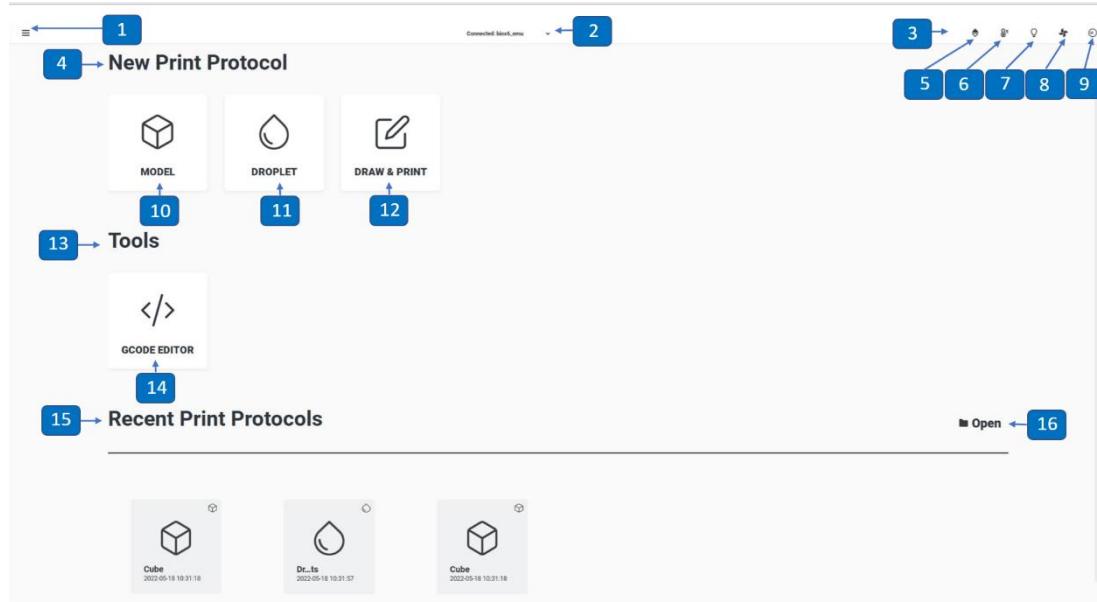


Figure 5 Home screen of BIO X6

1. **Printing Utilities menu** with advanced settings and troubleshooting functions
2. **Connection status**: Indicates whether the tablet/computer is connected to the BIO X6
3. **Tool bar**: Buttons to enable or disable functions as open and close door, temperature status, chamber lights, clean chamber fan and sterilize chamber
4. **New Print Protocol**: In this section you find the Model print, Droplet print and Draw & Print modes
5. **Open/close door**
6. **Temperature settings**
7. **Chamber Lights on/off**
8. **Clean Chamber fan**
9. **Chamber UV light**
10. **Model print**: Tap to start a bioprinting process
11. **Droplet print**: Tap to access the droplet process
12. **Draw & Print**: Tap to start a draw & print process
13. **Tools**: In this section you find tools such as Gcode Editor
14. **Gcode Editor**: Tap to open the Gcode Editor

**15. Recent print protocols:** This section shows shortcuts to the last 18 protocols. Protocols are saved with the file extension .biox.

**16. Open print protocols:** Tap to access all .biox protocols stored in your system.

## 3.5 Calibration trimming

The BIO X6 has a protocol for running an auto calibration trimming procedure. This procedure consists of an automatic calibration followed by a manual calibration of all six printheads. The whole process takes about 15 minutes.

Auto calibration trimming must be performed before using the system for the first time, to ensure that the automatic calibration is correctly aligned.

1. Tap > Printing utilities > Machine Calibration > Perform auto calibration trimming
2. Attach all 6 pneumatic printheads. Use the same kind of nozzle/needle for all printheads.
3. Attach the surface probe and the metal reflectors.



Objects left on the printbed may damage the printer. Ensure the printbed is empty without Petri dish, well plate, glass slice, or debris.

4. Tap **Start calibration** to start the automatic calibration.
5. Tap **Continue** to proceed to the manual calibration of each printhead.
6. Follow the step-by-step instructions shown on the screen.

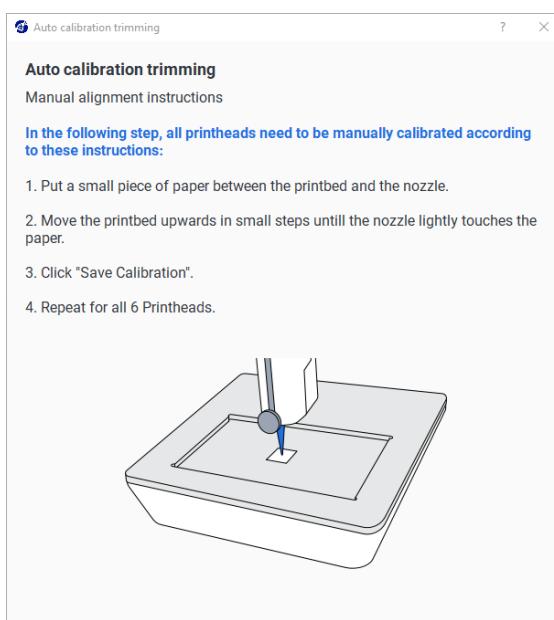


Figure 7 Auto calibration trimming

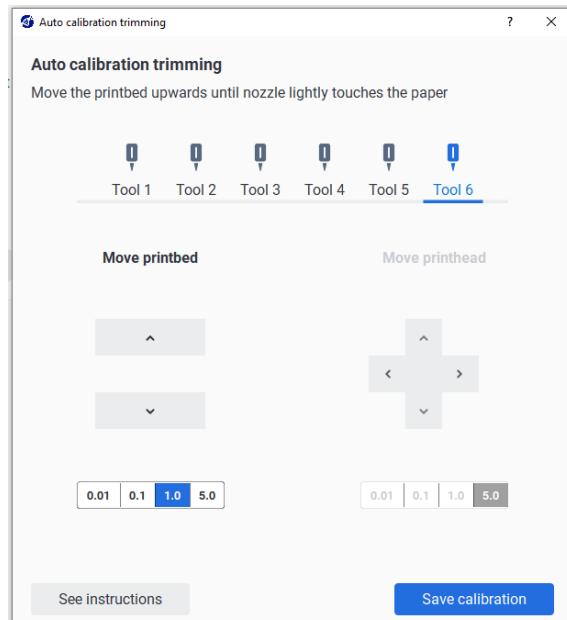


Figure 6 Auto calibration trimming, continued

7. When you have calibrated all 6 printheads, tap **Done**.

The calibration trimming is now complete. The only time you need to repeat it is when you upgrade or downgrade the firmware (HeartOS).

If you are working with a specific nozzle/needle gauge, and the autocalibration trimming has been performed using another nozzle/needle gauge, repeat the procedure with the new nozzle/needle to improve the accuracy of the autocalibration.

04

Bioprinting

# 4 Bioprinting with the BIO X6

## 4.1 Mounting of bioprinting equipment

### 4.1.1 Printheads

Ensure that you have mounted the printheads, print surfaces and bioink cartridges correctly before bioprinting.

Refer to the [Printhead manuals](#) at the end of this manual or to the specific printhead manuals for instructions on how to mount a cartridge.

#### Mounting a printhead in the BIO X6:

1. Move the printhead straight down toward the printhead holder.
2. Press it until you feel the magnet snap into place.

A white light turns on when the BIO X6 detects the presence of a printhead.

If the printhead is correctly mounted in the BIO X6, the light changes to blue.

**Note:** Remember to connect the pneumatic printheads to the compressed air outlet.

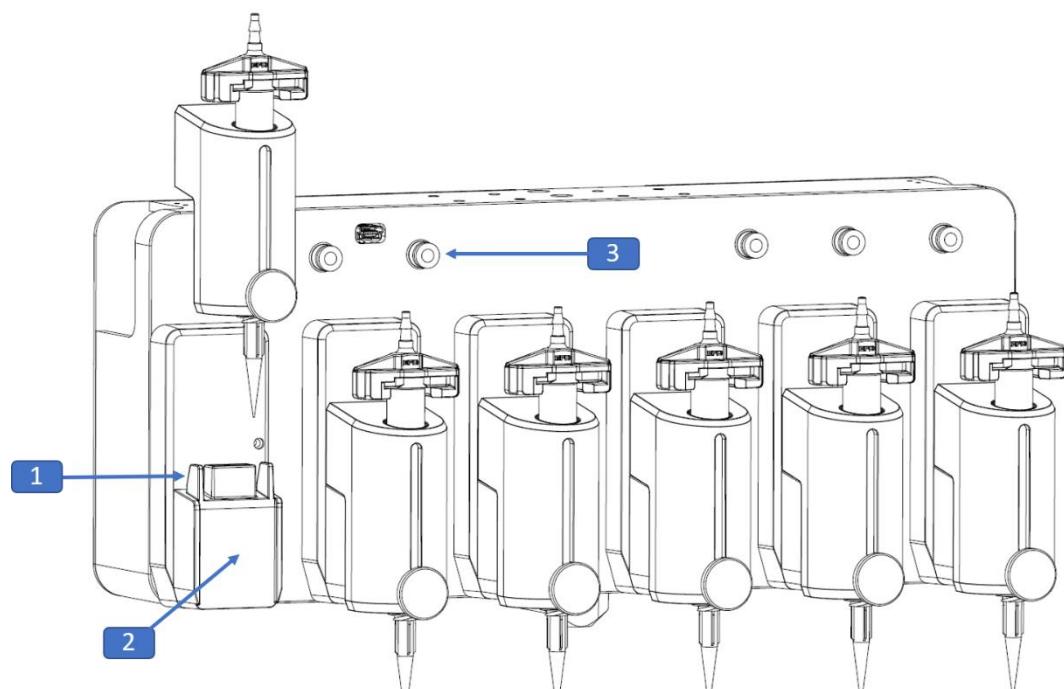


Figure 8 Printhead and pressure connectors

1. **Intelligent printhead connector:** This connector connects the intelligent printhead to the BIO X6.
2. **Magnet:** The magnets hold the printhead in place.
3. **Pressure connector:** The pressure connector delivers compressed air to the pneumatic printheads.

#### 4.1.2 Printbed

Use the spring-loaded arms to securely fasten the print surface on the printbed according to the illustration below.

Turn the arms to the sides when using a well plate. Ensure the outer dimensions of the well plate are 128 x 85 mm.

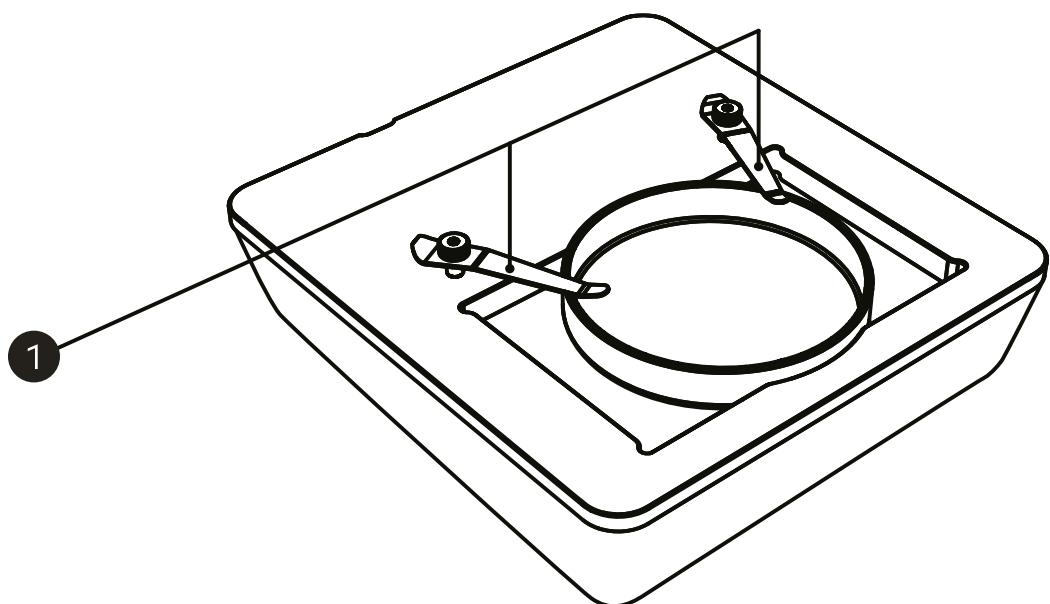


Figure 9 Printbed

1. Spring-loaded arms

## 4.2 Sterilizing the printing chamber

The BIO X6 has a UV sterilization system to ensure a sterile environment. The system sterilizes the print chamber, and the Clean Chamber™ Technology maintains the system's sterility.



Do not look directly at UV light and do not expose your skin to UV light. UV light can cause serious personal injury. Keep the door closed when running the clean chamber feature.



The UV sterilization procedure will kill or damage any living organisms inside the print chamber. Remove any cells and tissues from the print chamber before initializing the UV sterilization procedure.

Run the UV sterilization procedure before each bioprinting process to minimize the risk of contamination.

1. Close the door of the chamber. The UV sterilization process does not start if the door is open.
2. To begin the UV sterilization procedure, select **Printer** from the **Utilities menu** and tap **Initiate**.
3. In the **Sterilize chamber dialogue**, tap **Sterilize** to start or **Cancel** to abort.

The sterilization procedure takes about 6 minutes.

**Enable clean chamber fan:** Tap to turn the HEPA filter fan on or off. Keep the fan on during UV sterilization to clean the air and push it out of the chamber.

During bioprinting, you can turn the fan off if you want to reduce the noise level or if you are conducting an experiment that does not require sterility. Keep the fan on if you want to keep the chamber environment as clean as possible and ensure sterility.

## 4.3 Printing utilities menu

On the home screen, tap  to show the left side menu.

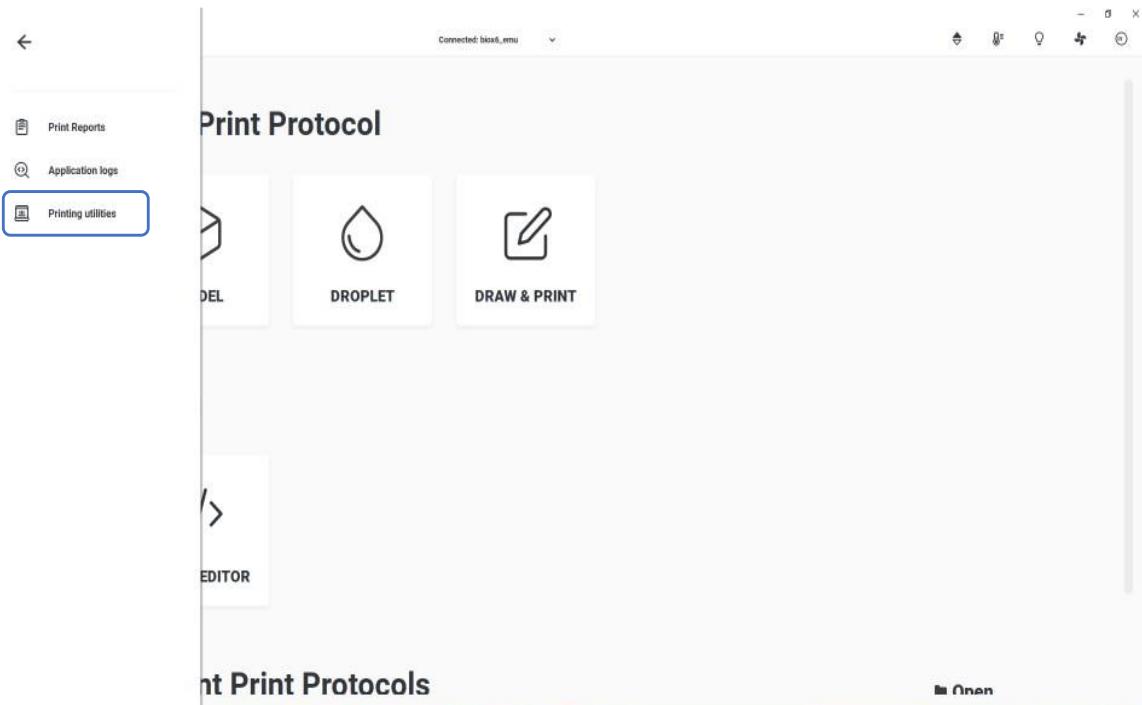


Figure 10 Printing utilities menu on the home screen

**Printing Utilities:** Tap to access the **Printing Utilities menu** with advanced settings and troubleshooting functions.

### 4.3.1 Connect tab

Use this tab to connect your tablet or computer wirelessly to the BIO X6. The **Utilities menu** will not be enabled unless you are connected to a bioprinter.

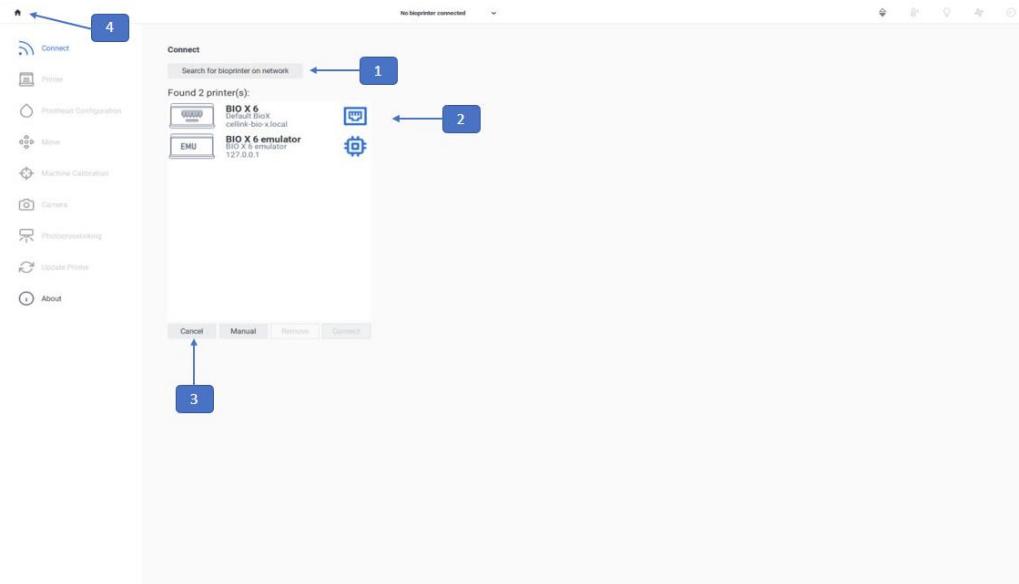


Figure 11 Overview of the Connect tab

1. **Search for bioprinter on network:** Tap to search for a bioprinter connected to the same Wi-Fi network as the tablet/computer you are using.
2. **Bioprinters found on network:** Select the bioprinter you wish to connect to. An illustration of the bioprinter and its serial number is displayed for each available option.
3. **Connect:** Tap to connect to the selected bioprinter.
4. **Home icon:** Tap to go to the home screen.

### 4.3.2 Printer tab

Use this tab to enable special features for experimental purposes.

All the changes to the printer settings done here are applied immediately to the BIO X6.

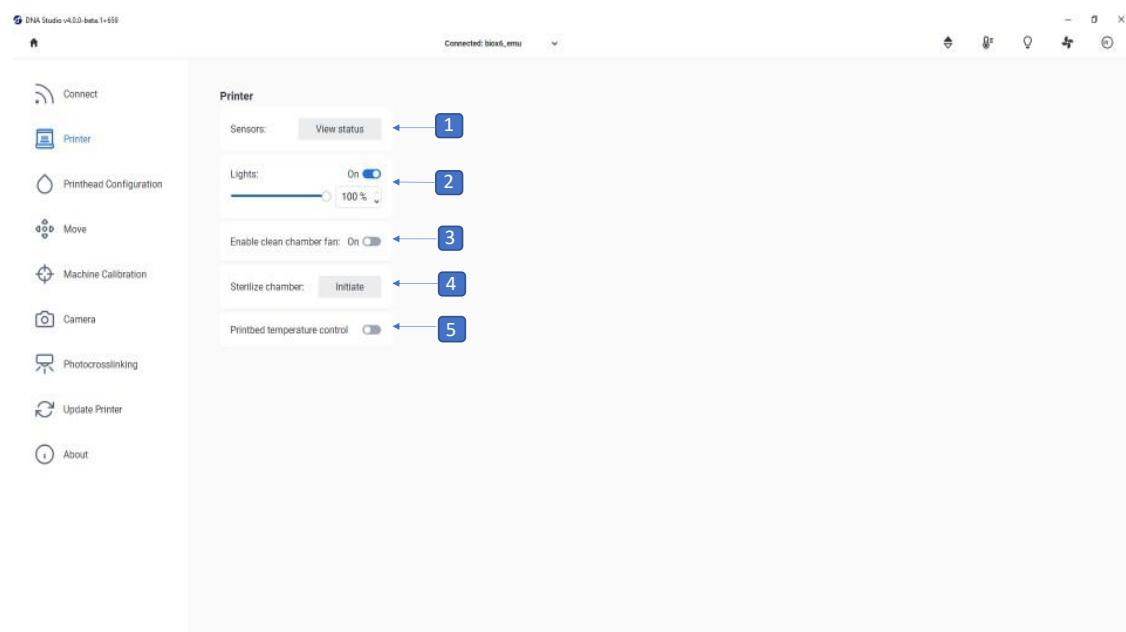


Figure 12 Overview of the Printer tab

1. **Sensors:** Display output data for customer support. CELLINK uses this tab to perform sensor testing.

Toolhead slots	Axes	Temperature
Slot 1 ▼	(down)	XAxis Ambient 21.1°C
Slot 2 ▲	(up)	YAxis (front) Printbed 25.0°C
Slot 3 ●		ZAxis (down) Slot 1
Slot 4 ▲	(up)	Slot 2
Slot 5 ▲	(up)	Slot 3
Slot 6 ▲	(up)	Door Slot 4 Surface probe Slot 5 Slot 6

Figure 13 Sensors: View status

2. **Lights:** Turn on/off and adjust intensity of chamber lights. Use this to work with photosensitive materials.
3. **Enable Clean Chamber fan:** Tap to turn the Clean Chamber fan on or off.
4. **Sterilize chamber:** Tap to initiate the Sterilize chamber protocol.
5. **Printbed temperature control:** Tap to enable temperature control on the printbed. If disabled, the printbed will be kept at room temperature.

### 4.3.3 Printhead Configuration tab

Use this tab to control general tool settings such as printhead temperature and pressure.

You have the option to pre-heat or pre-cool your equipment and to test the bioink flow (printhead configuration) by extruding the material.

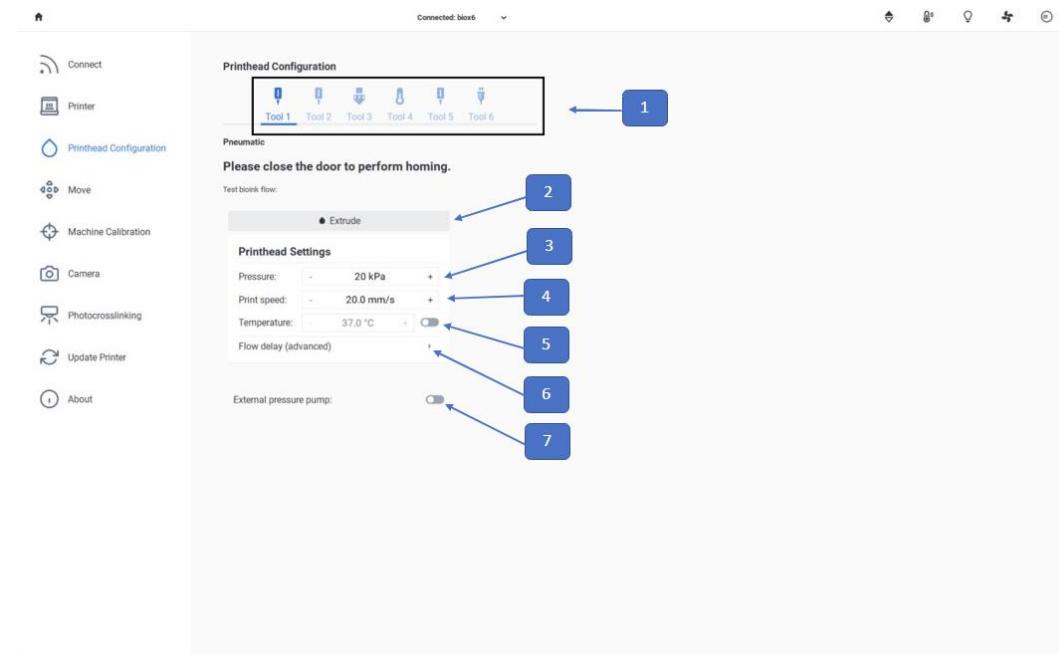


Figure 14 Overview of the Printhead Configuration tab

1. **Toolhead bar:** Use this bar to navigate through the settings for each one of the toolheads connected to the bioprinter. The selected toolhead is highlighted in blue, and its settings are displayed below. The displayed settings may vary depending on the printhead or tool connected.
2. **Extrude:** Tap and hold to test the bioink flow by extrusion with the Printhead settings displayed below.
3. **Pressure:** Set printhead pressure (see [Technical specifications](#)). Extrusion pressure depends mainly on the viscosity and rheological properties of the material to be printed.
4. **Print speed:** Tap to set the print speed.
5. **Temperature:** Tap to enable or disable temperature control on the printhead.

6. **Flow delay:** Tap to set the flow delay.
7. **External pressure pump:** Tap to indicate if an external pressure pump is connected to the BIO X 6.

#### 4.3.4 Move tab

Use this tab to move the toolheads and the printbed.

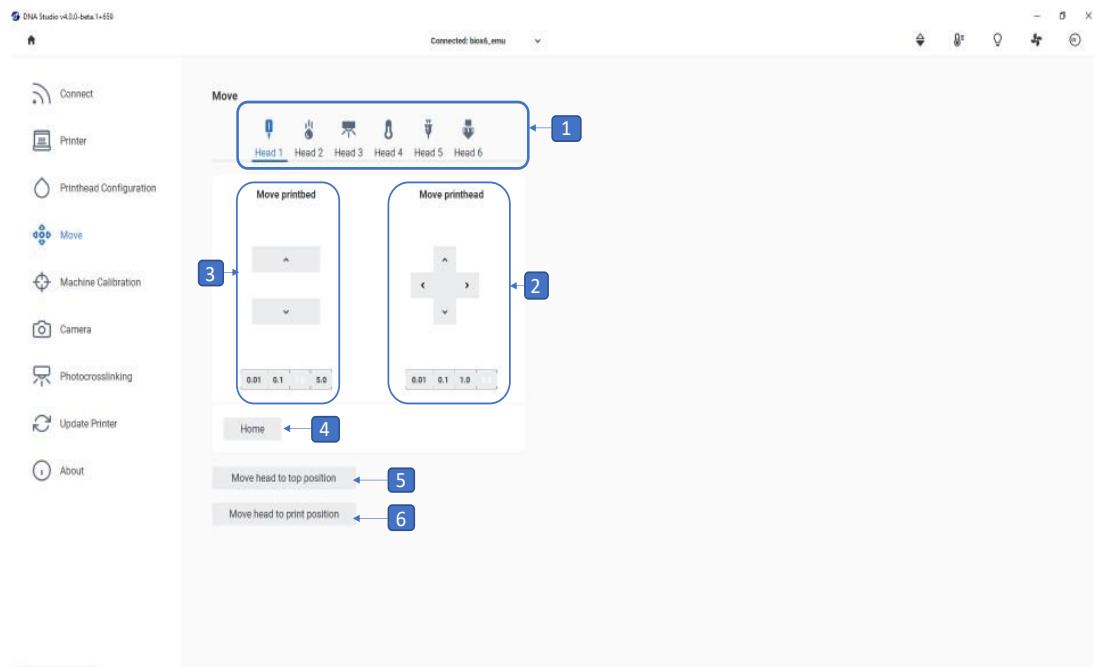


Figure 15 Overview of the Move tab

1. **Toolhead bar:** Use this bar to navigate through the settings for each one of the toolheads connected to the printer. The selected toolhead is highlighted in blue, and its settings are displayed below. The displayed settings may vary depending on the printhead or tool connected.
2. **Move printhead:** Use the arrows to move the toolhead on the x and y axes. Available step sizes are 5, 1, 0.1 and 0.01 mm.
3. **Move printbed:** Use the arrows to move the printbed on the z axis. Available step sizes are 5, 1, 0.1 and 0.01 mm.
4. **Home:** Tap to home the printer axes and return to absolute zero position.
5. Tap to move the toolhead to the top position.
6. Tap to move the toolhead to the print position.

#### 4.3.5 Machine calibration tab

Use this tab to perform a calibration trimming procedure when setting up your printer and after updating the software or performing a significant hardware change (see [Calibration trimming](#)).

The calibration is stored and remembered to perform automatic calibration in the **Bioprint menu**.

#### 4.3.6 Camera tab

Use this tab to adjust the Camera tool settings.

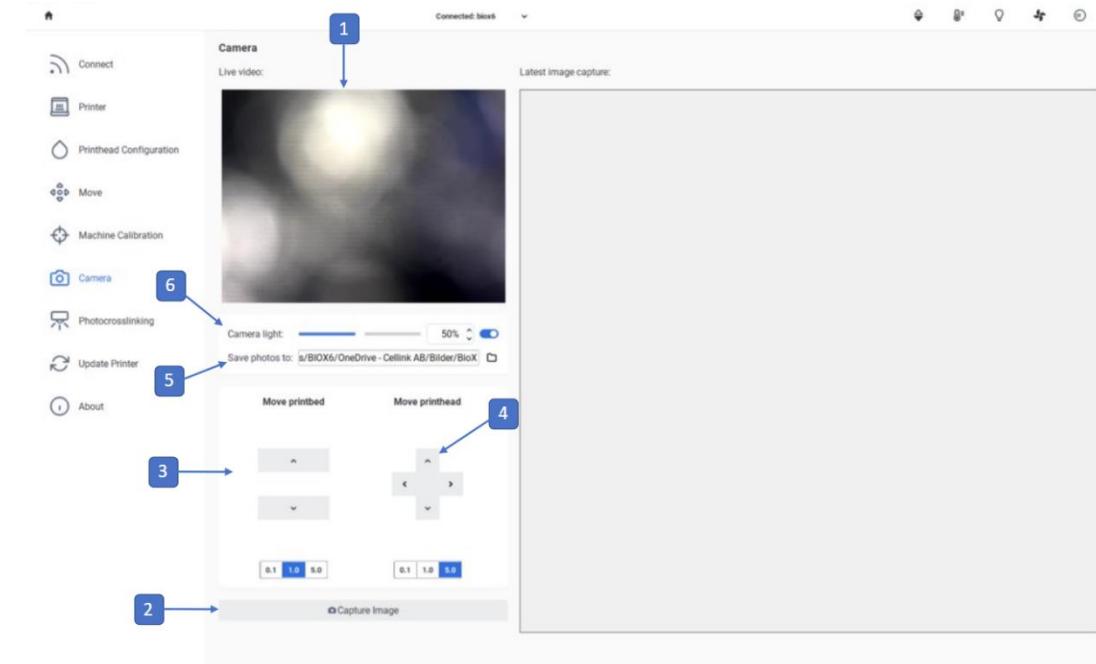


Figure 16 Overview of the Camera tab

1. **Live stream from the Camera tool.** This live stream is only available if the Camera tool is connected to the BIO X 6.
2. **Capture Image:** Tap to take a photo of the live stream from the Camera tool.
3. **Move printbed:** Use the arrows to move the printbed on the z axis. Available step sizes are 5, 1 and 0.1 mm.
4. **Move printhead:** Use the arrows to move the toolhead on the x and y axes. Available step sizes are 5, 1 and 0.1 mm.
5. **Save photos to:** Tap to select a folder to which the captured photos are to be saved.
6. **Camera light:** Tap to adjust the camera light.

### 4.3.7 Photocrosslinking tab

Use this tab to adjust the photocrosslinking settings.

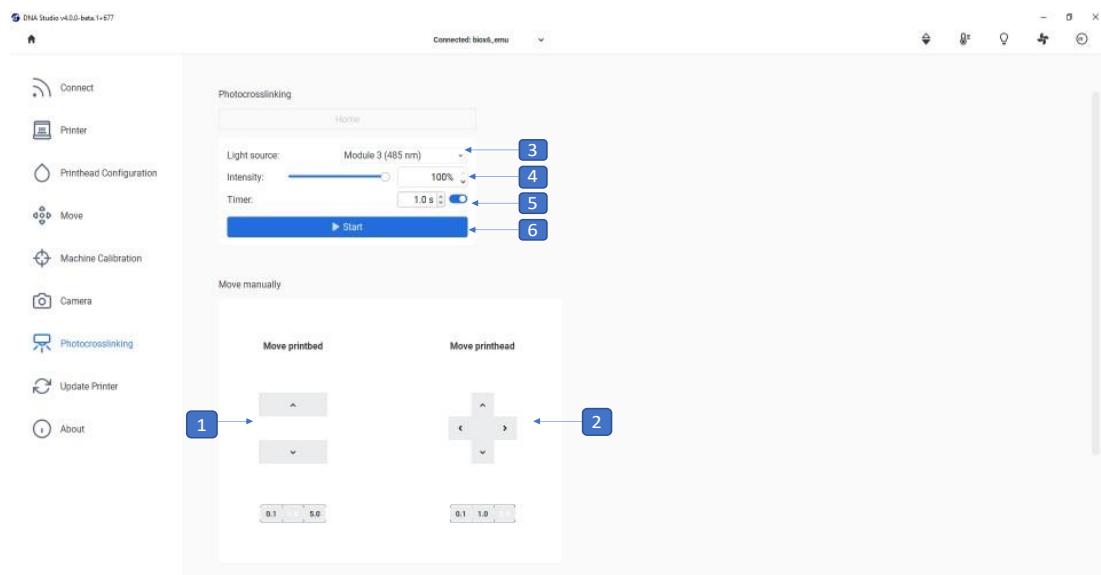


Figure 17 Overview of the Photocrosslinking tab

1. Tap the **up** and **down arrows** to adjust the distance between the printhead and the surface of the printbed in increments of 5, 1 or 0.1 mm.
2. Select the wells to be manually photocrosslinked and select the distance from the surface (**up**, **down**, **left**, **right**) in increments of 5, 1 or 0.1 mm.
3. **Light source:** Tap to select the light source for photocrosslinking. You can choose one of the UV curing LEDs or the Photocrosslinking tool.
4. **Intensity:** Use the slider to set the intensity to a value between 0 and 100%.
5. **Timer:** Tap to set the timer for photocrosslinking (0.1 s to 600 s).
6. **Start:** Tap to start the photocrosslinking.

#### 4.3.8 Update Printer tab

Download the latest software version from dna.cellink.com and save it to a USB flash drive. Insert the USB flash drive into the BIO X6.

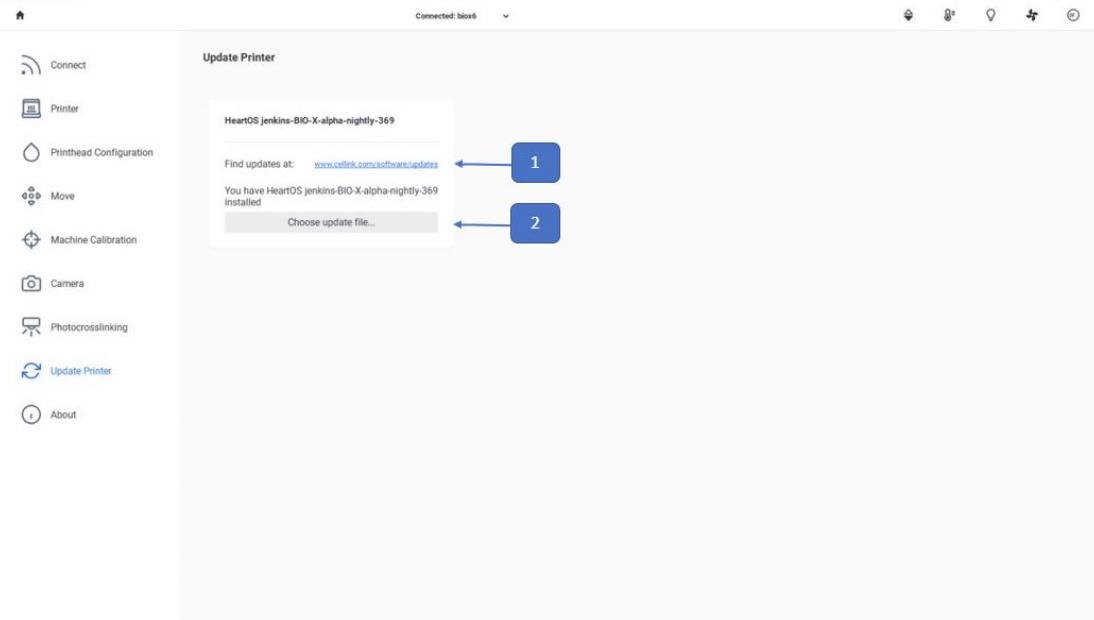


Figure 18 Overview of the Update Printer tab

In the **Utilities** menu, go to **Update Printer** to access the update.

1. **Find updates at:** Use this link to download the latest software version to your tablet or computer.
2. **Choose update file:** Select the software update file you have just downloaded. Make sure you select the latest version.

## 4.3.9 About tab

Use this tab to view contact information for customer support, the software version, and the printer and software licenses.

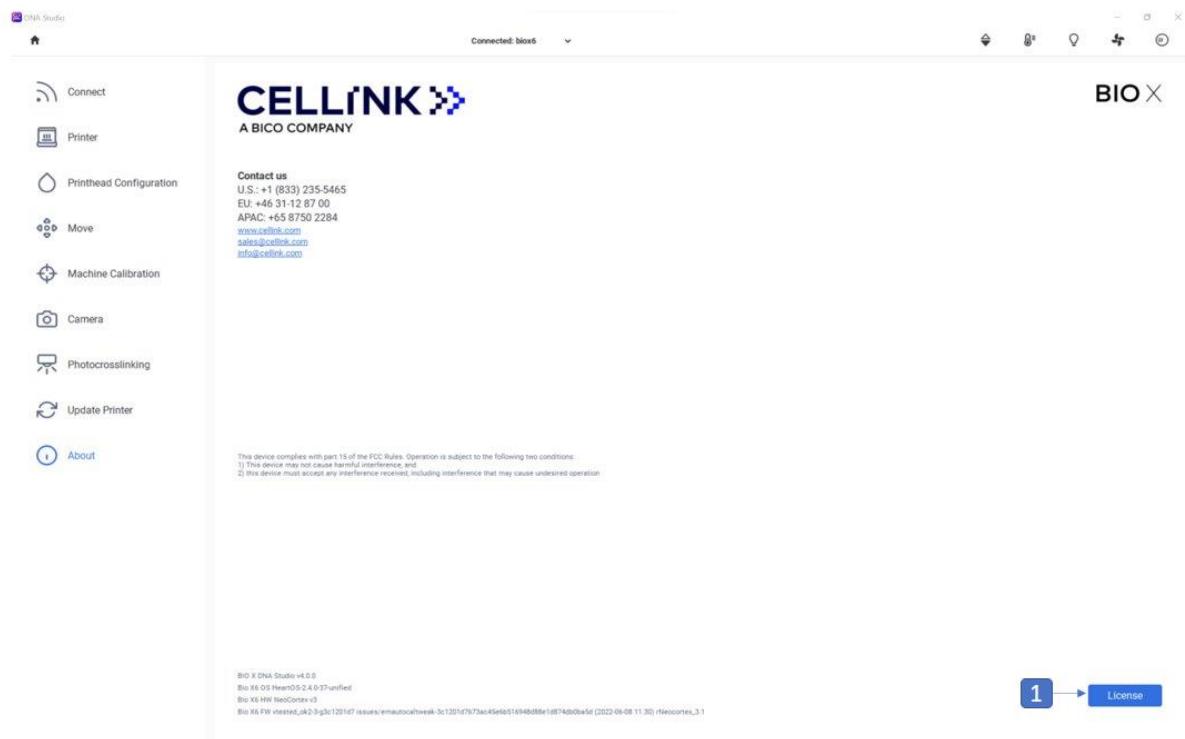


Figure 19 Overview of the About tab

1. **License:** Tap to show the printer and software license.

## 4.4 Bioprinting from a 3D model

On the home screen, tap **Model** to start a new bioprinting process using a 3D model. The BIO X6 guides you through the process of setting up your bioprint.

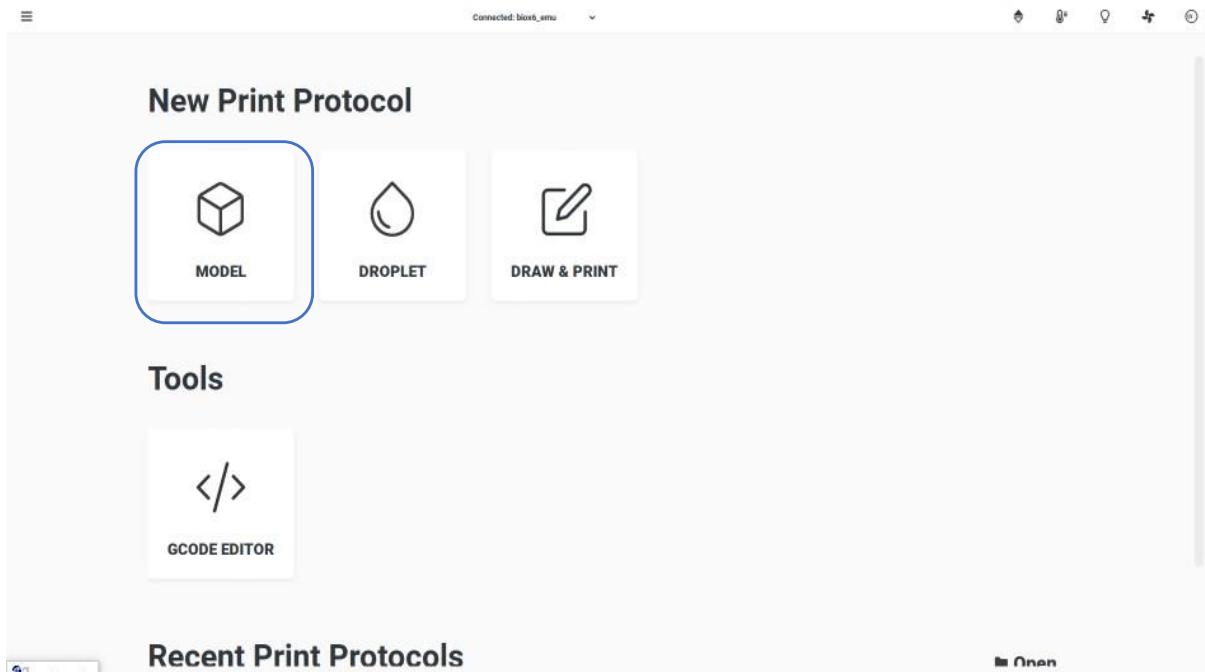


Figure 20 Model option on the home screen

#### 4.4.1 Print surface

The BIO X6 can bioprint on a variety of surfaces, including Petri dishes, well plates and glass slides. Select the surface you wish to bioprint on.



Figure 21 Overview of the Surface step

1. **Printing process bar:** This bar displays the steps of the overall printing process and indicates in blue the step you are currently in.
2. **Print surface:** Select the surface you wish to bioprint on (Petri dish, well plate or glass slide).
3. **Select a number** to choose a well plate to print in.
4. **Select a vendor** for the well plate you are using. This feature enables the BIO X6 to know the precise dimensions of the well plate, which may vary slightly depending on the vendor (1. Corning Costar, 2. Corning Falcon, 3. Thermo Fisher and 4. VWR).
5. **Preview:** The printing surface currently selected is displayed here.
6. **Isometric views:** Tap to choose between different options: perspective, top view, side view. This helps you visualize with more detail the models to print and check for issues on the model.
7. Tap **Custom well plate** to choose your own settings: well plate dimensions (number of rows and columns), well offset (offset X, offset Y), and well spacing (center to center rows X, center to center columns Y) (see separate screenshot below)

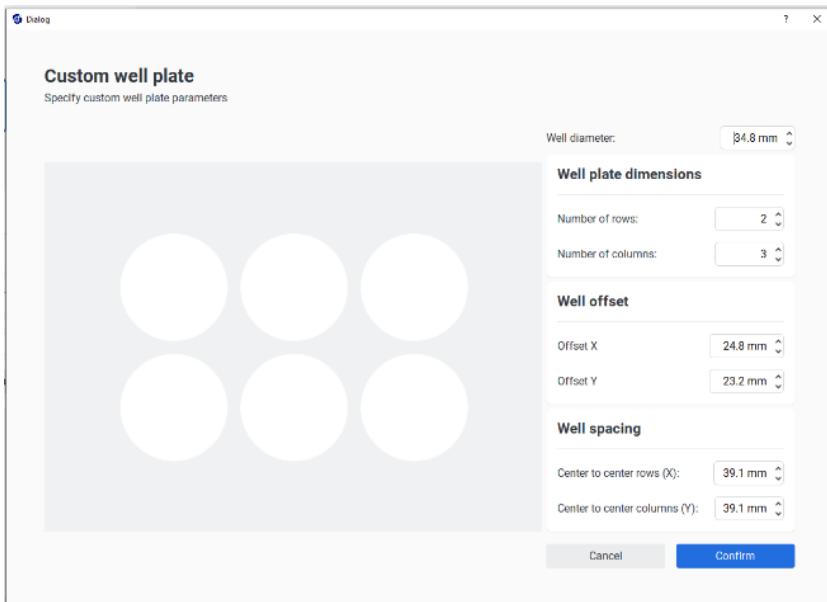


Figure 22 Custom well plate option

## 4.4.2 Model

**Note:** The USB flash drive needs to be readable and writeable.

**Note:** Keep the USB flash drive connected until the bioprinting process starts.

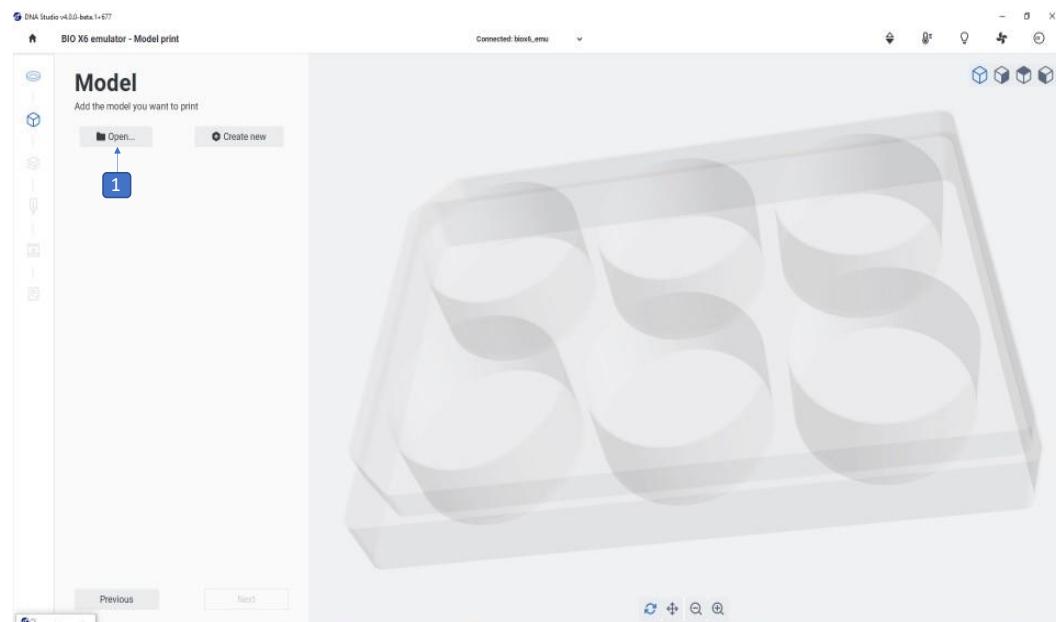


Figure 23 Open file option in the Model step

1. Insert a USB flash drive containing your 3D model and any custom profiles you would like to use into any of the USB ports on the back of the tablet docking station BIO X6  
Tap **Open...** to select the model you wish to bioprint from your files.

The BIO X6 accepts the following file formats: gcode, stl, .3mf, .amf, .obj and BIOX protocols.

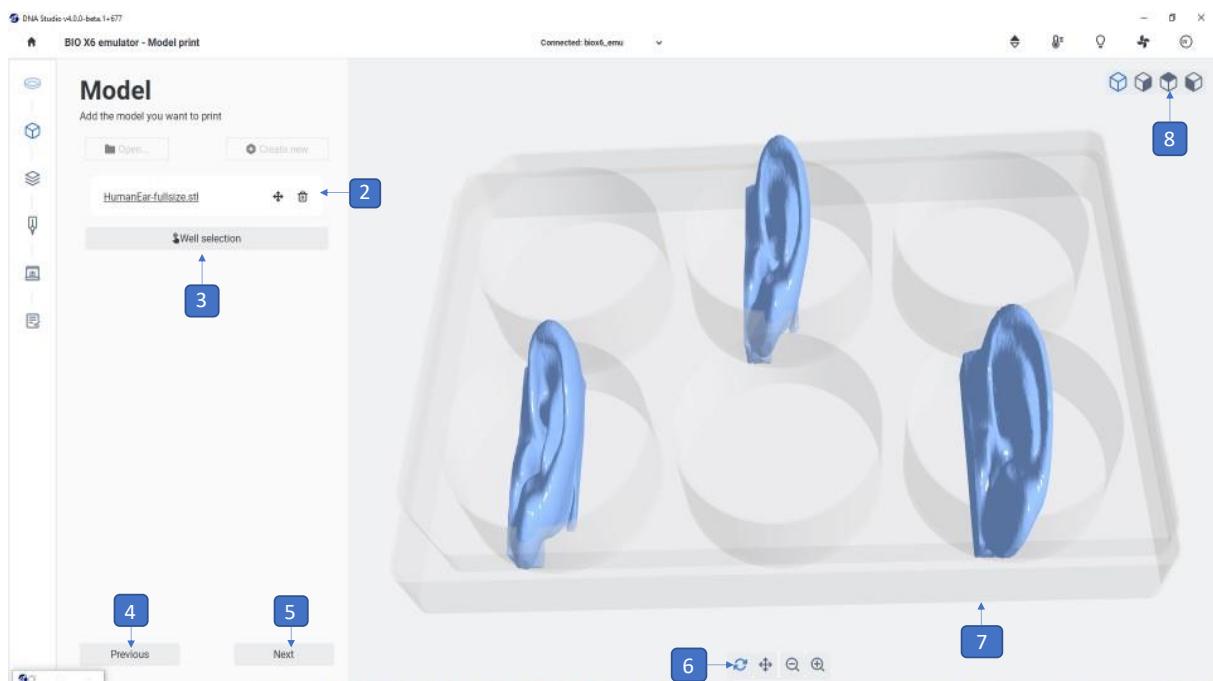


Figure 24 Overview of the Model step

2. **Selected model:** The file name of the 3D model you have selected is displayed here. Tap the **left button** to transform your 3D model by rotating, scaling, and moving it. Tap the **trash bin** to delete the selected file. Any modifications can be reset or previewed in the center of any print surface.

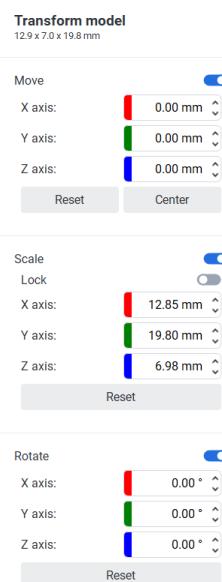


Figure 25 Transform model option

3. **Well selection:** Tap to select which wells to print in and in what order (see screenshot below).

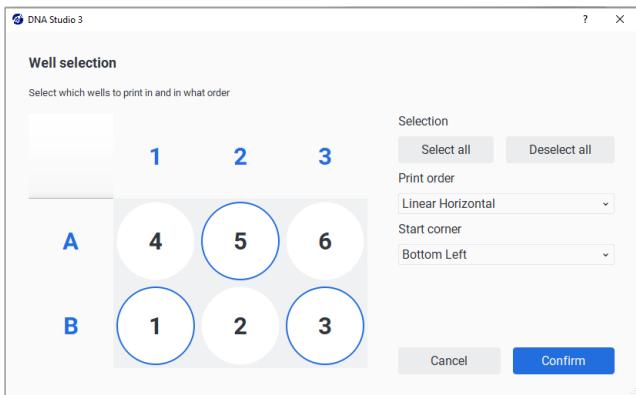


Figure 26 Well selection

4. **Previous:** Tap to go back to the previous step on the bioprinting process (**Surface**).
5. **Next:** Tap to go forward to the next step in the bioprinting process (**Layers**). This button is only available if a 3D model has been successfully opened or created.
6. **Visualization bar:** Tap to choose between different options: rotate, drag, zoom in and zoom out. This option helps you visualize with more detail the models to print and check for issues on the model or with the slice.
7. **Preview:** The model and its organization on the printing surface is displayed here.
8. **Isometric views:** Tap to choose between different options: perspective, top view, side view. This helps you visualize with more detail the models to print and check for issues on the model or with the slice.

### 4.4.3 Layer settings

Modify options to define the layers of the 3D model and how the BIO X6 should bioprint the selected model. Use the predefined settings or create custom settings.

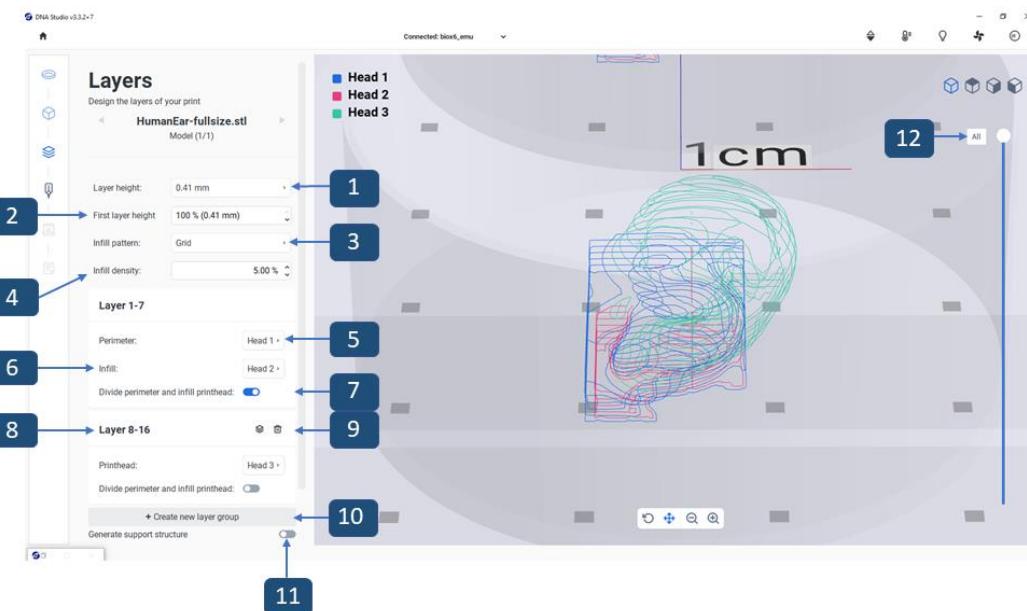


Figure 27 Overview of the Layers step

1. **Layer height:** Specify the thickness of each layer in mm. CELLINK advises to set the layer height to 80-100% of the nozzle diameter.
2. **First layer height:** 50-100% depending on the printability and viscosity of the bioprint material. Modify to ensure sufficient adhesion of the first layer to the print surface.
3. **Infill pattern:** Tap to select infill pattern (see Infill screenshot below).
4. **Infill density:** Indicate how dense the model should be from 0% for empty infill to 100% for high density.
5. **Layer group head perimeter selection** selects which printhead on one specific layer group is used to print the perimeter.
6. **Layer group head infill selection** selects which printhead on one specific layer group is used to print the infill.
7. Toggle button to divide **perimeter and infill for different prinheads**.

8. **Layer group:** This whole box specifies the layer parameters for printing a specific set of layers.
9. **Edit layer group:** Tap to select layers for a layer group or to erase a layer group.
10. **Create new layer group:** Tap to create a new layer group.
11. **Generate support structure:** Tap to automatically generate a support structure for your construct. You will need to designate a printhead for printing this structure support.
12. **Preview slider:** Drag this to select which layer to preview. The total number of layers may vary depending on the selected **layer height** (1).

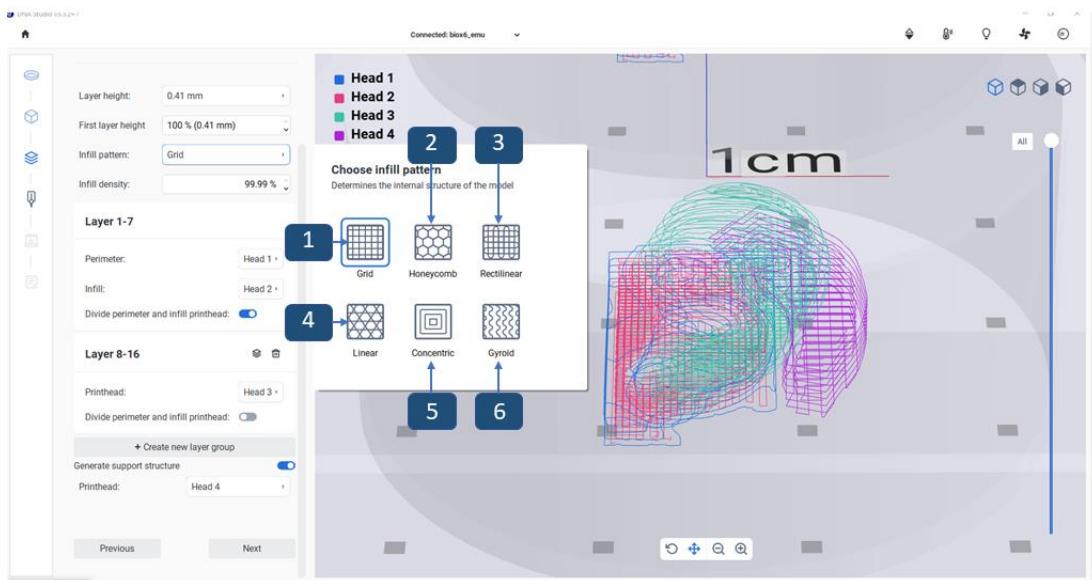


Figure 28 Infill patterns

This setup, is a general setup for all types of layers, but not for individual set of layers

1. **Grid:** The grid pattern is a suitable infill for tissue constructs with isotropic mechanical characteristics. This infill pattern is consistent across adjacent layers, resulting in solid walls between the pores and good compressive strength. This pattern is most applicable for tissues like bone and cartilage. It can also generate constructs with porosity to allow diffusion of nutrients or filling with other bioinks or materials.
2. **Honeycomb:** The honeycomb pattern is suitable for constructs with isotropic mechanical characteristics. This infill pattern is consistent across adjacent layers, resulting in solid walls between the neighbouring pores with good compressive strength. This pattern is most applicable for tissues like bone and cartilage. This pattern can also generate constructs that contain porosity to allow diffusion of nutrients or filling with other bioinks or materials.
3. **Rectilinear:** The rectilinear pattern is a suitable infill for tissue constructs with isotropic mechanical characteristics. This pattern is most applicable for tissues like skin, fascia, and cartilage. This infill pattern changes the fill angle by 90 degrees based on the layer.
4. **Linear:** The linear pattern is similar to the rectilinear except shifted by 45 degrees instead of 90 degrees from layer to layer. This pattern is suitable for fibers and striated tissues. It can also generate constructs that contain porosity to allow diffusion of nutrients or filling with other bioinks or materials.

5. **Concentric:** The concentric pattern is suitable for irregular shapes and circular objects. The infill mimics the shape of the outer walls, creating concentric ripples. It is ideal for high infills and complex geometries, and it ensures that the structure is filled in. Note that there is minimal crossing of filaments, which might be detrimental for the structural integrity of the construct.
6. **Gyroid:** The gyroid pattern consists of wave-like patterns which are suitable to use in applications that require elasticity. The pattern is similar in structure and orientation to the rectilinear pattern. This is most applicable for tissues such as skin, ligament, muscle, tendon, and others where elasticity is important.

#### 4.4.4 Printhead settings

The BIO X6 can use up to six different printheads in a single bioprinting process.

Depending on the printhead you are using, different settings are required for configuration. For general information about the printheads, see [Printhead manuals](#). Further details are outlined in the separate printhead manuals.

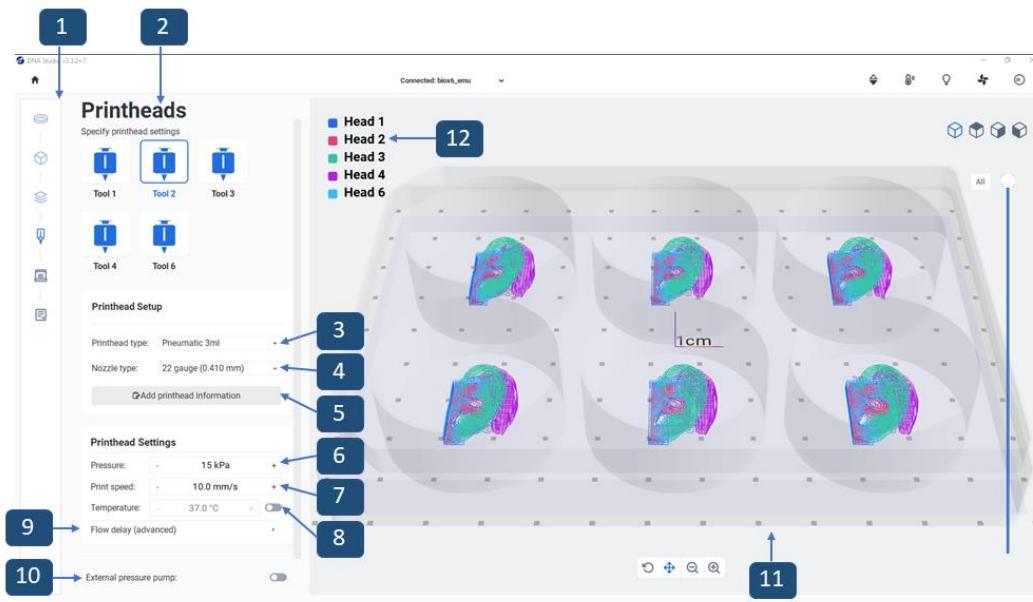


Figure 29 Overview of the Printheads step

1. **Printing process bar:** This bar displays the steps of the overall printing process and indicates in blue the step you are currently in.
2. **Tool bar:** Indicates the printheads previously selected for the printing process. Tap on each printhead to set it up with the information in the two boxes below (3–9).
3. **Printhead type:** Tap to select the type of printhead you are using. Different settings appear below, depending on what type of printhead you select. The BIO X6 comes preloaded with profiles for all CELLINK's intelligent printheads.
4. **Nozzle type:** Tap to select the nozzle or needle type you are using.
5. **Add printhead information:** Tap to add printhead information that will be saved in the print log. With this feature you can add information regarding the nozzle brand, shape, and length, as well as information about the bioink, such as the batch number and cell concentration. All information saved in the print log can be accessed later and can be useful for your lab records or for planning future experiments (see screenshot below).

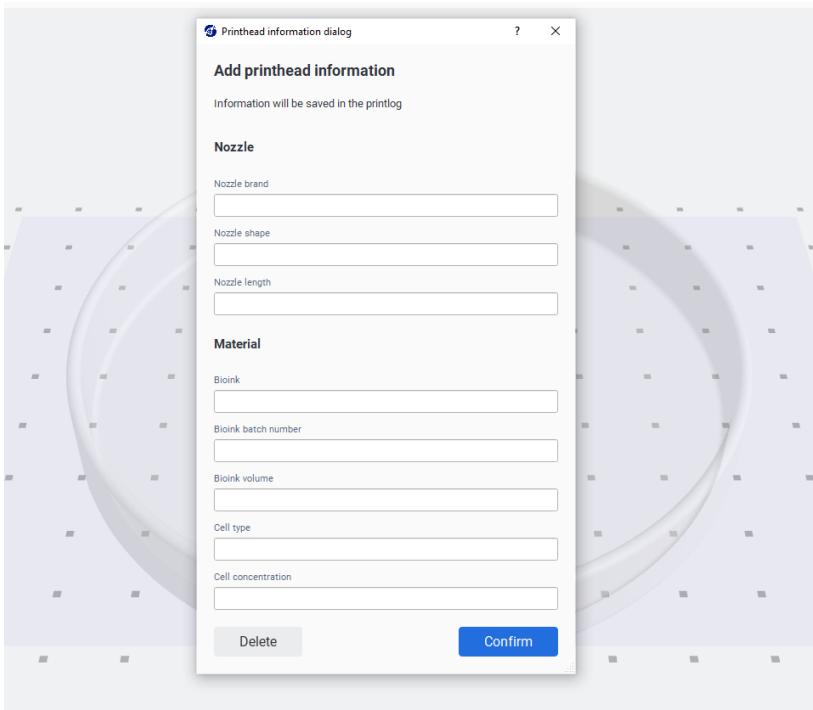


Figure 30 Add printhead information

6. **Pressure:** Tap to set pneumatic pressure flow, which determines material flow out of the nozzle. (Pressure should be between 0-200 kPa with the internal air compressor and between 0-700 kPa with an external air compressor). Extrusion pressure depends mainly on the viscosity and rheological properties of the material to be printed.
7. **Print speed:** Tap to select the speed of the printhead.
8. **Temperature:** Enable and set printhead temperature.
9. **Flow delay:** Set to compensate for delayed and excess extrusion.
10. **External pressure pump:** Tap to indicate if an external pressure pump is connected to the BIO X6.
11. **Preview:** A preview of the printing process including the selected surface, 3D models and layer parameters.
12. **Toolhead bar:** Displays the toolheads indicated to be involved in the bioprinting process. Each tool is given a color for identifying the layers it must print of the 3D model in the preview (11).

#### 4.4.5 Printer settings

In the Printer step you can adjust the printbed temperature, the photocrosslinking settings, the lights and fan of the chamber. Use temperature control to keep the printbed at a certain temperature, or turn temperature control off to print at room temperature.

You can check the current temperature of the print chamber at the user interface.

Note: the settings selected in this step will only be applied once the bioprinting process has started.

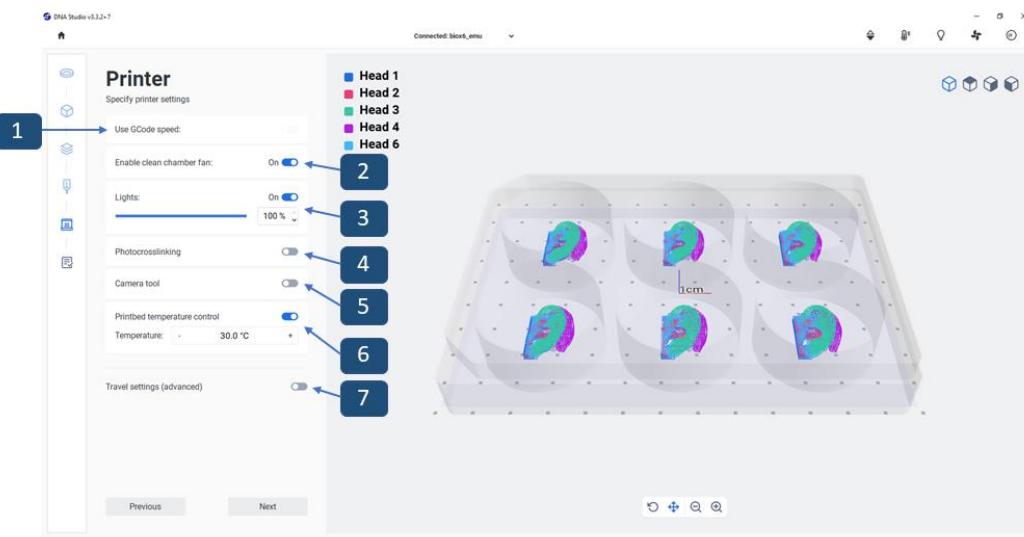


Figure 31 Overview of the Printer step

1. **Use Gcode speed:** When user use this option, it will overwrite the speed, which user select from UI during setup, the printer uses the print speed which is written already in Gcode.
2. **Enable Clean Chamber fan:** Tap to enable or disable the clean chamber fan. (The fan will be on right after you are done with the print setup and have clicked on Go to print. The fan will then be kept on or turned off, depending on your choice).
3. **Lights:** Tap to enable or disable the interior lights of the BIO X6. If enabled, you can drag to select the light intensity.
4. **Photocrosslinking:** Tap to enable or disable a Photocrosslinking scheme. If enabled, you can indicate the light source (one of the UV curing LEDs or the Photocrosslinking tool) and the light exposure parameters, such as height above the surface and time.

5. **Camera tool:** Tap to enable or disable the Camera tool. If enabled, the tool must be coupled to one of the intelligent connectors on the BIO X 6.
6. **Printbed temperature control:** Tap to enable or disable temperature control on the printbed. If disabled, the printbed will be kept at room temperature.
7. **Travel settings:** Tap to change the speed of the travelling movement. This feature is mainly for speeding up prints by performing the non-print movements faster, for example when the printhead moves from one well to another.

## 4.4.6 Summary

In this step, you review all your selected settings. If a setting or value is incorrect, use the boxes to the right or the navigation bar to the left to edit.

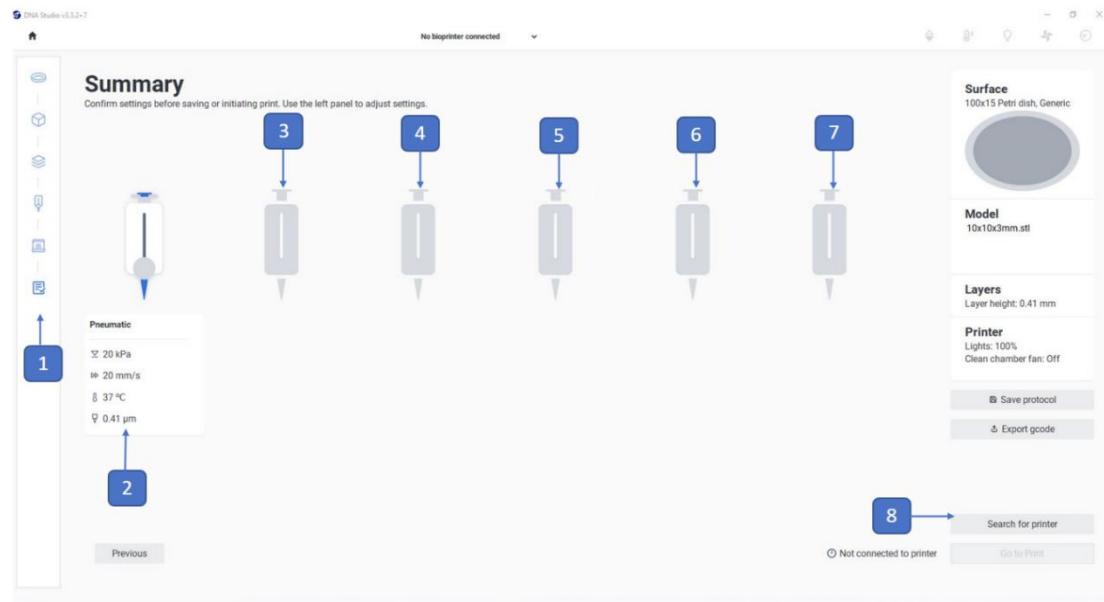


Figure 32 Settings summary, part 1

1. **Printing process navigation bar:** This bar displays the steps of the overall bioprinting process and highlights in blue the step you are currently in.
2. **Tool 1:** Displays an illustration of the tool 1 and shows its settings.
3. **Tool 2:** Displays an illustration of the tool 2 and shows its settings.
4. **Tool 3:** Displays an illustration of the tool 3 and shows its settings.
5. **Tool 4:** Displays an illustration of the tool 4 and shows its settings.
6. **Tool 5:** Displays an illustration of the tool 5 and shows its settings.
7. **Tool 6:** Displays an illustration of the tool 6 and shows its settings.
8. **Search for printer:** This button indicates that the BIO X6 is not connected with the tablet/computer on which the bioprinting process is being set up. If not connected, you cannot proceed with the bioprinting process.

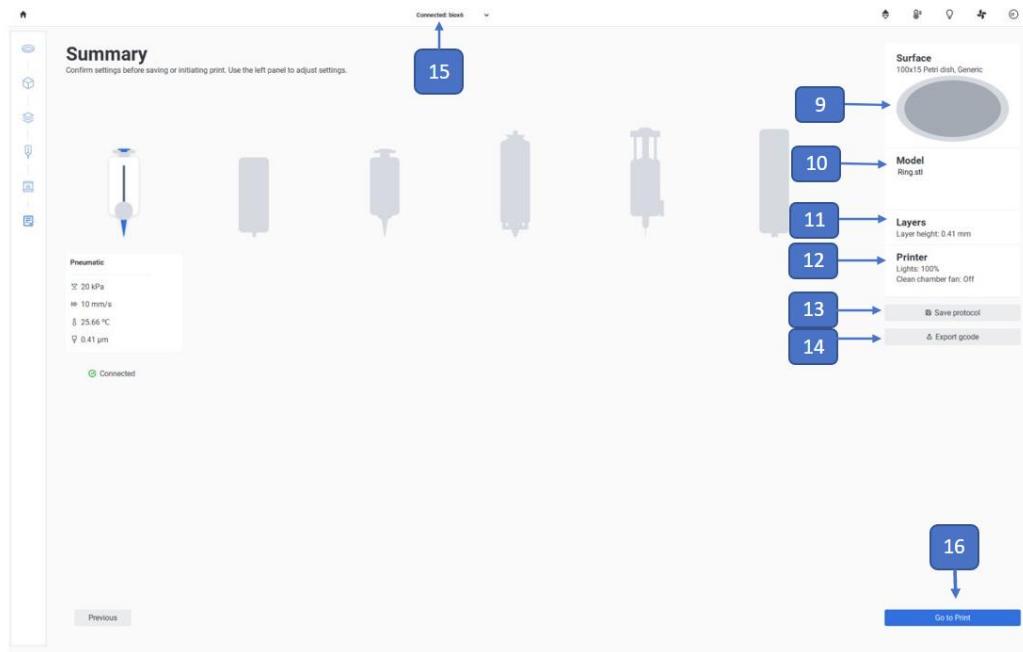


Figure 33 Settings summary, part 2

9. **Surface:** Displays a summary of the selected settings for the print surface.
10. **Model:** Displays the file name of the 3D model selected.
11. **Layers:** Displays a summary of the layer settings. Tap to edit settings.
12. **Printer:** Displays a summary of the printer settings. Tap to edit settings.
13. **Save protocol:** Tap to save the current printing protocol with the “. BIOX” file extension.
14. **Export gcode:** Tap to export the current printing protocol with the “. gcode” file extension.
15. **Connection status:** Indicates whether a bioprinter is connected to the tablet/computer or not. If not connected, you cannot proceed with the bioprinting process.
16. **Go to Print:** Tap to proceed with the bioprinting process.

After checking all the settings, proceed with the bioprinting process, tap **Go to Print** and continue with the calibration settings.

#### 4.4.7 Calibration and Automatic Bed Levelling (ABL)

Once the printing settings are fully reviewed, calibration of the printheads is required before starting the bioprinting process. Each printhead to be used must be calibrated individually.

On this screen you can also check the material flow with the printing settings already defined.

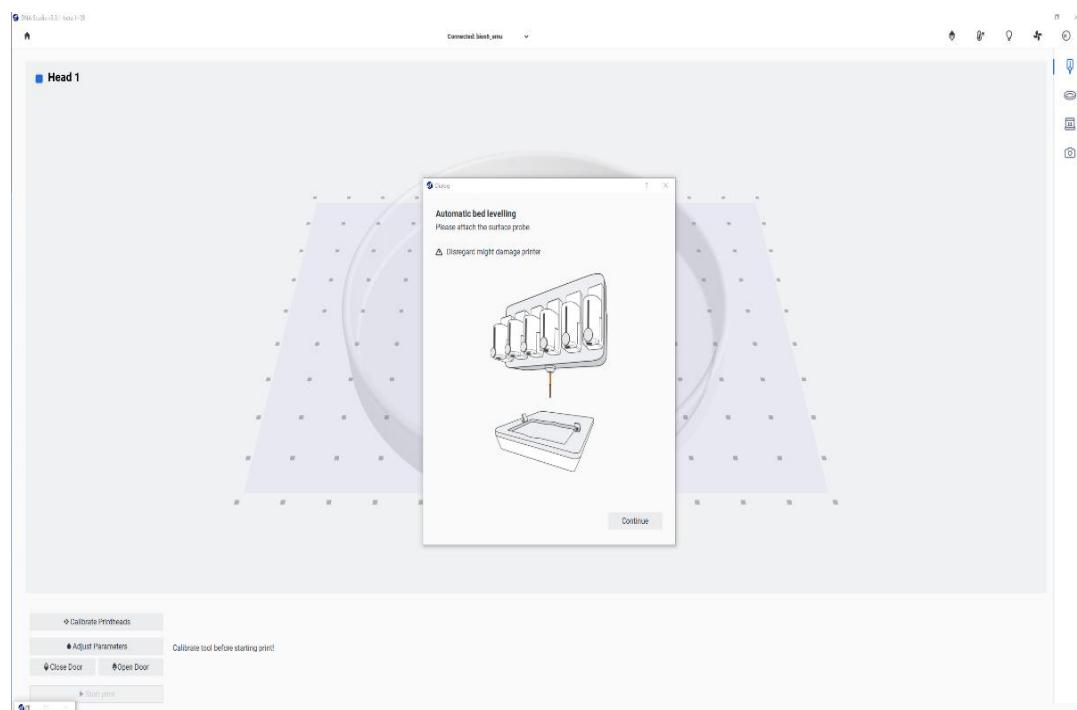


Figure 34 Automatic bed levelling

1. **Calibrate printhead:** Tap to calibrate the printheads and the print bed.
2. **Adjust Parameters:**
3. **Close Door:** Tap to close the door if the door is open.
4. **Open Door:** Tap to open the door if the door is closed.
5. **Start print:** Tap to start print. This button is only enabled once the calibration protocol is complete.

Tap **Calibrate** to calibrate the printheads and the printbed. There are three calibration options: **Automatic calibration**, **Manual calibration**, and **Automatic bed levelling** (see screenshot below).

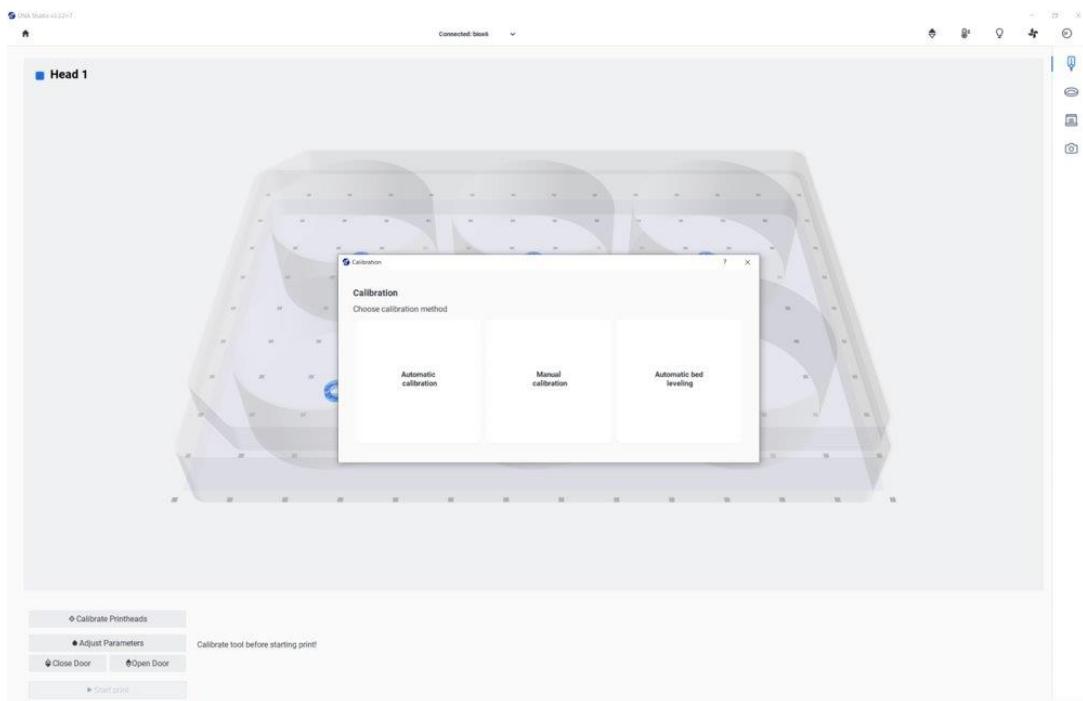


Figure 35 Calibration options

#### 4.4.8 Automatic calibration

The Automatic calibration protocol is not compatible with the HD Camera toolhead, Photocuring toolhead, Thermoplastic Printhead or EMD Printhead. If one of these toolheads is connected to the BIO X6 when performing Automatic calibration, you can choose to calibrate them manually.

The Automatic Bed Levelling (ABL) probes the bed at three points to enable bed-levelling compensation. It uses a matrix to compensate for tilt in the bed or print surface. It is recommended to perform ABL when printing large models or when using well plates as the printing surface.

The surface probe only needs to be calibrated once, the printer will then remember this calibration and apply it for each coming printing. However, the ABL should be enabled before each printing since it compensates not only the bed but also if the print surface is tilted.

To perform automatic calibration, you must first attach the surface probe to the printhead connector body and the metal reflectors to the printbed. Tap **Continue** to proceed.

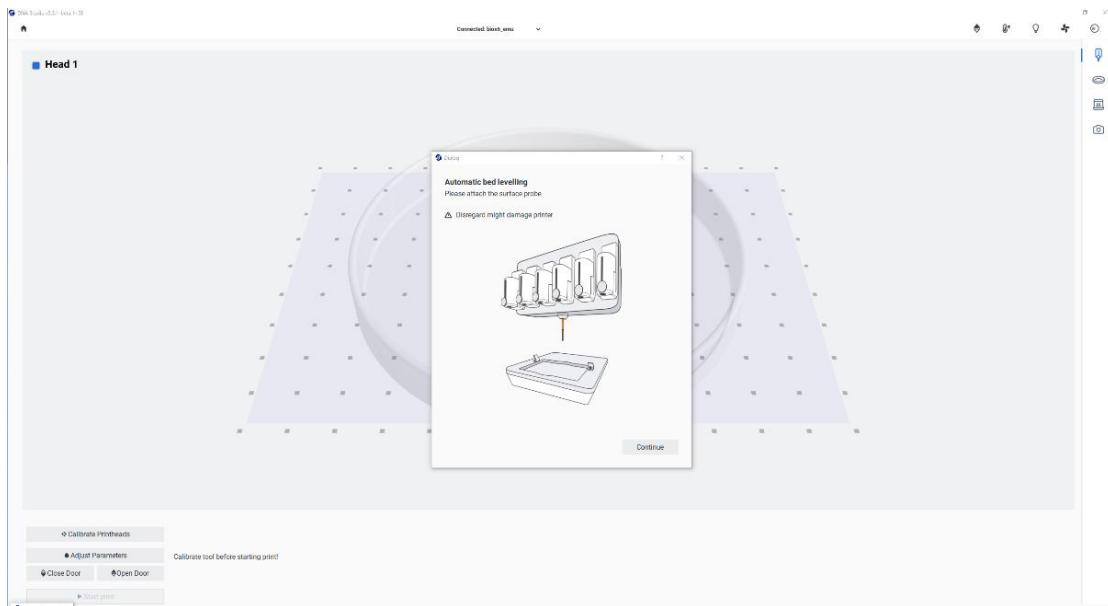


Figure 36 Automatic bed levelling dialog

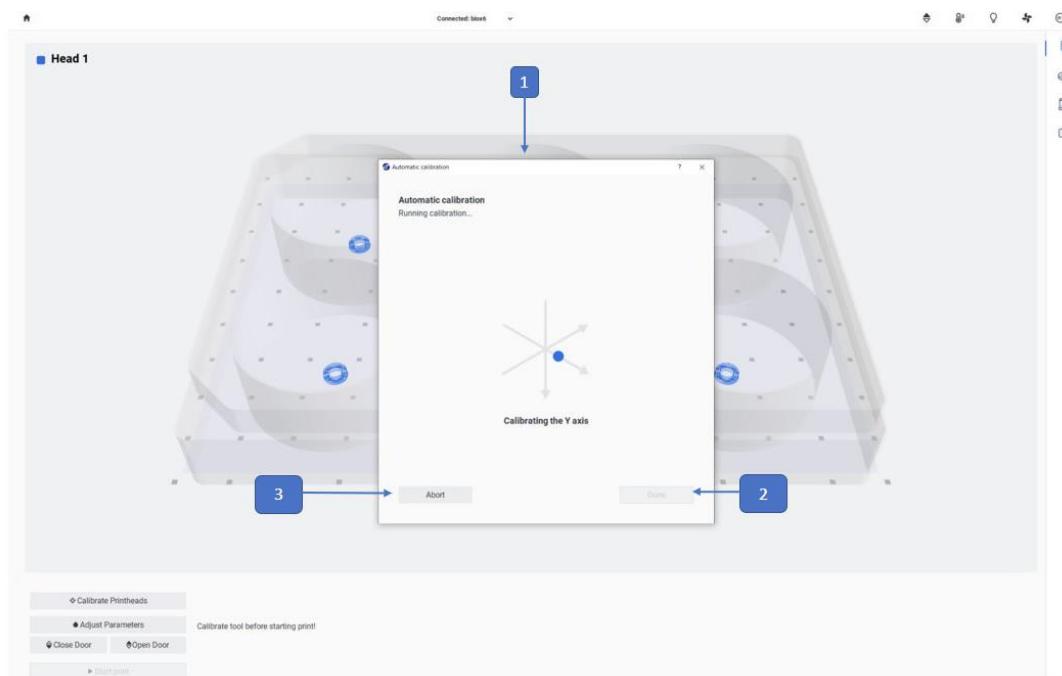


Figure 37 Automatic calibration dialog – Model

1. **Calibration for all printheads and surface probe:** Calibration tab for all printheads and (Surface: Home the printer axes and return to absolute zero position).
2. **Done:** Tap to proceed with the bioprinting process. This button will only be enabled once the calibration has been successfully completed.
3. **Abort:** Tap to abort the calibration.

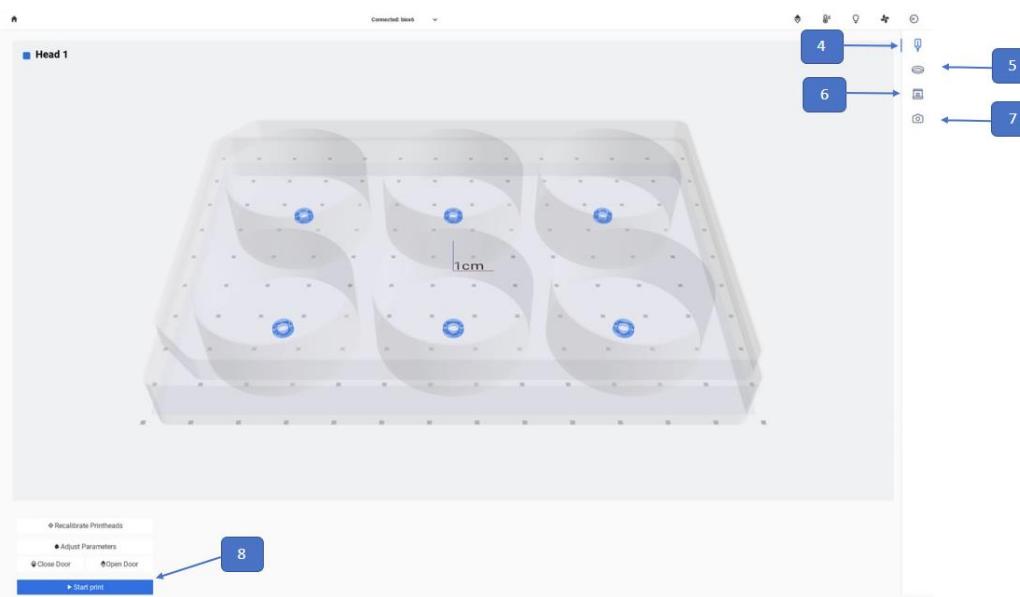


Figure 38 Review and edit settings

4. **Printhead icon:** Tap to review and edit the printhead setting.
5. **Printer icon:** Tap to review and edit the printer settings.
6. **Surface icon:** Tap to review and edit the surface settings.
7. **Camera icon:** Tap to review and edit the camera settings. This option is only available if the Camera tool is connected to the BIO X6.
8. **Start print:** Tap to start the bioprinting process. This button will only be enabled once the calibration protocol is complete.

#### 4.4.9 Manual calibration

With manual calibration you can adjust the start point of printing for each of the heads in each of the 6 slots, with this calibration mode you can adjust the value in X, Y & Z, initially, manual calibration does an automatic homing to calculate the zero initials of each of the coordinate axes values, the user must calibrate the heads to the surface with 0.0 distance. depending on the surface used.

The printer runs a homing cycle to get the 0 values in all the axes.

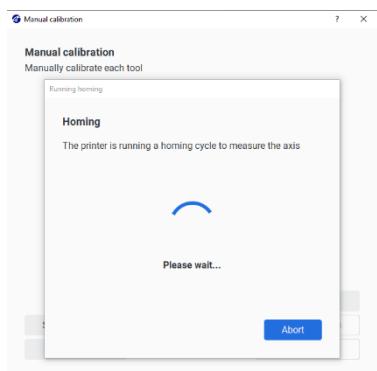


Figure 39 Homing cycle

**Tip:** Before calibration, unscrew the cartridge locking screw to avoid damaging the nozzle if accidentally moving the printbed too high. Re-tighten it before saving the calibration.

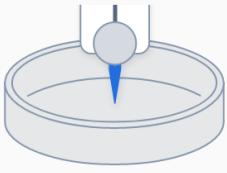
The first step of the instructions to follow vary depending on what surface you use:

## Petri dish

**Manual calibration**

Instructions

1. Move the nozzle to the center of the petri dish.
2. Move the printbed upwards carefully until the nozzle lightly touches the surface.
3. Click the "Save calibration" button.



Tip: Before calibration, unscrew the cartridge locking screw to avoid damaging the nozzle if accidentally moving the printbed too high.  
Re-tighten it before saving the calibration.

[Back to calibration](#)

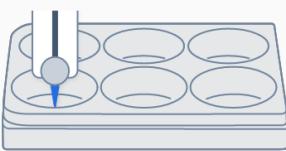
Figure 40 Manual calibration – Petri dish

## Well plate

**Manual calibration**

Instructions

1. Move the nozzle to the center of the front-left well.
2. Move the printbed upwards carefully until the nozzle lightly touches the surface.
3. Click the "Save calibration" button.



Tip: Before calibration, unscrew the cartridge locking screw to avoid damaging the nozzle if accidentally moving the printbed too high.  
Re-tighten it before saving the calibration.

[Back to calibration](#)

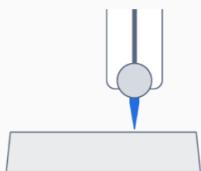
Figure 41 Manual calibration – well plate

## Glass slide

## Manual calibration

Instructions

1. Move the nozzle to the center of the glass slide.
2. Move the printbed upwards carefully until the nozzle lightly touches the surface.
3. Click the "Save calibration" button.



**Tip:** Before calibration, unscrew the cartridge locking screw to avoid damaging the nozzle if accidentally moving the printbed too high.  
**Re-tighten it before saving the calibration.**

[Back to calibration](#)

Figure 42 Manual calibration – glass slide

Calibrate each tool manually to the same point. You can calibrate all printheads that are using nozzles and needles.

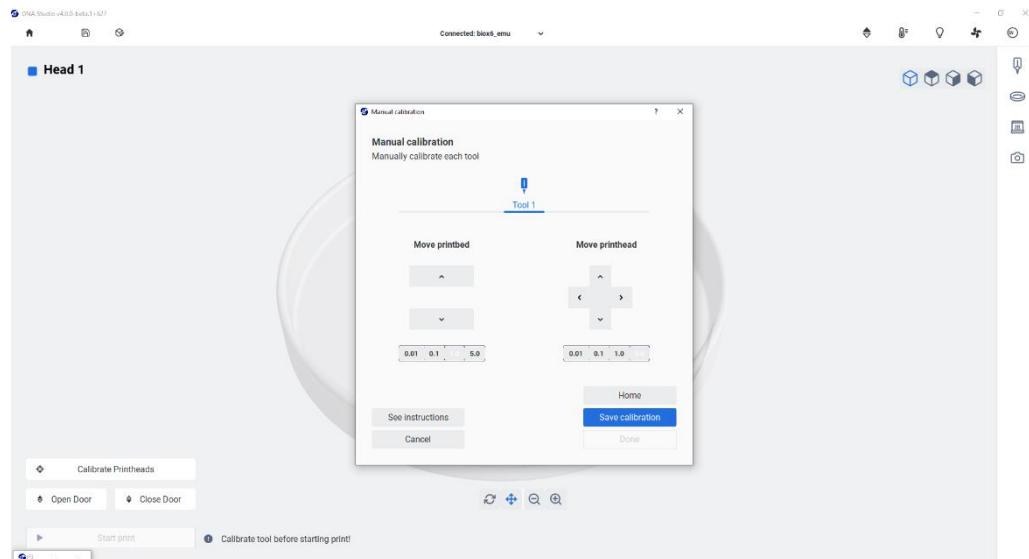


Figure 43 Manual calibration dialog

When you are done, tap **Save calibration**.

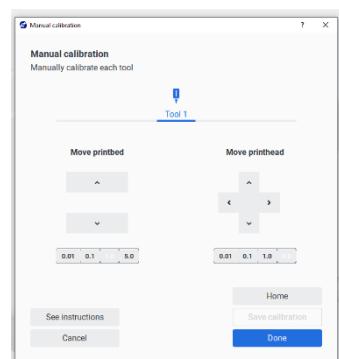


Figure 44 Manual calibration dialog, continued

You can repeat the same procedure to calibrate all the printheads in your system by using the same point on the selected surface as a reference.

**Note:** Manual calibration works with all printhead types and all needles and nozzles.

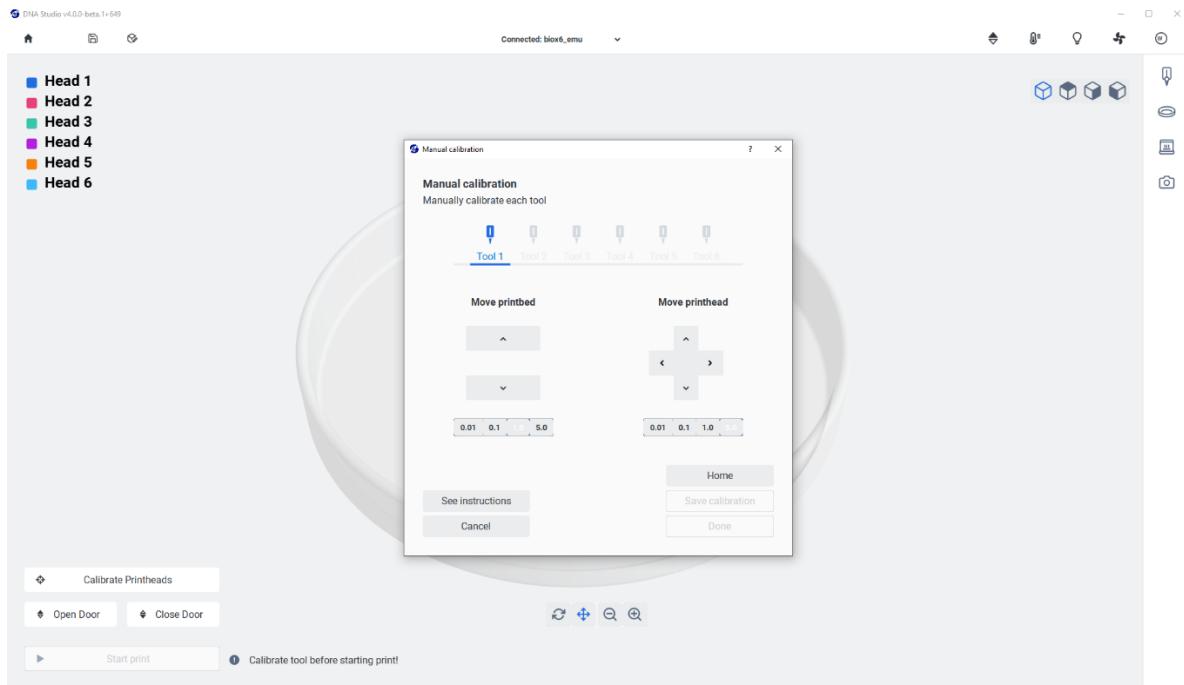


Figure 45 Overview of the manual calibration of each tool

When you have calibrated all the toolheads, tap **Done** and **Start print**.

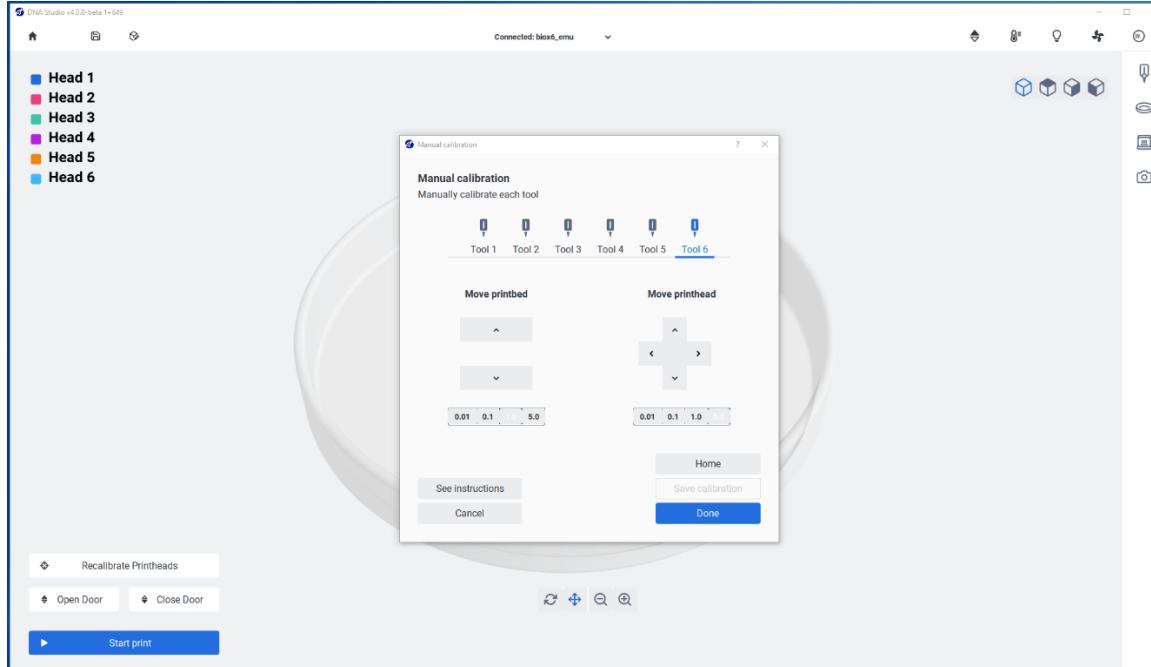


Figure 46 Completing the manual calibration

#### 4.4.10 Printing model

This screen allows you to track the bioprinting process in the BIO X6. You can monitor the activity of each printhead, of the printbed, of the photocrosslinking LEDs, and of the print chamber while printing. In addition, you can change the printing parameters of any of the printheads while the printing process is running. This includes pressure, speed, and temperature.



Always pause the bioprinting process before opening the door. Do not remove printheads before the bioprinting has stopped. Doing so risks aborting the process and compromising your cells.

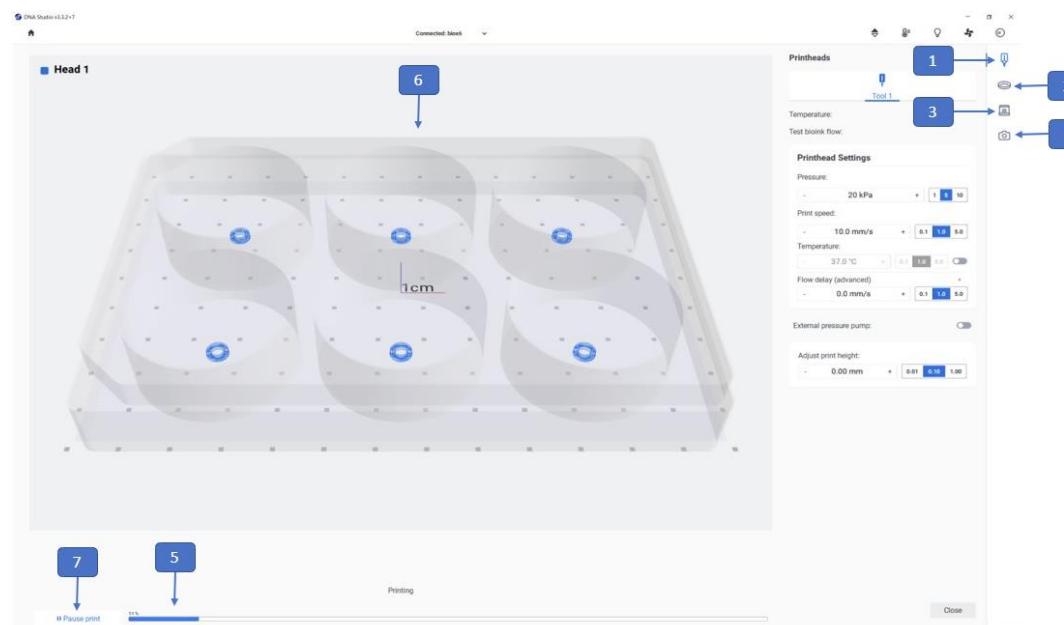


Figure 47 Overview of the Printing model screen

1. **Printhead icon:** Allows you to monitor and change the settings of the printheads used in the bioprinting process.
2. **Surface icon:** Allows you to monitor the settings of the print surface.
3. **Printer icon:** Allows you to monitor and change the settings of the printer.
4. **Camera icon:** Allows you to review and edit the camera settings. This option is only available when the Camera tool is connected to the BIO X6.
5. **Progress indicator:** Displays the progress of the bioprinting process as a percentage value (%). This value is calculated by considering the total number of layers to be printed and the layer currently being printed.

6. **Preview:** A preview of the printing progress is displayed here.
7. **Pause print:** Tap to pause the bioprinting process. When the process is paused, tap to resume the bioprinting process.

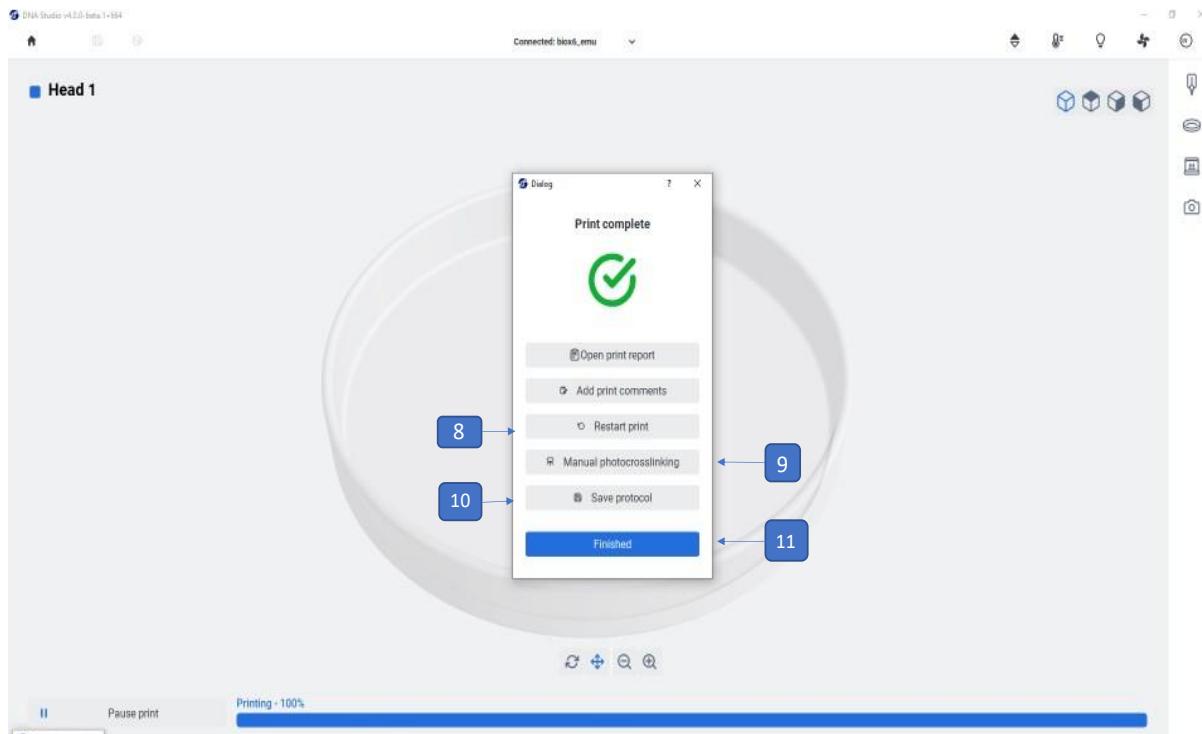


Figure 48 Print complete dialog

8. **Restart print:** Tap to restart the print. This feature can be used to print the same model by using the same parameters and print surface as the previous print.
9. **Manual photocrosslinking:** Tap to perform manual photocrosslinking on your final constructs. You can select wells, the wavelength, the distance from the printbed and the time.
10. **Save protocol:** Tap to save the current printing protocol with a ".BIOX" file extension.
11. **Finished:** Tap to finish the current print and go to the home screen.

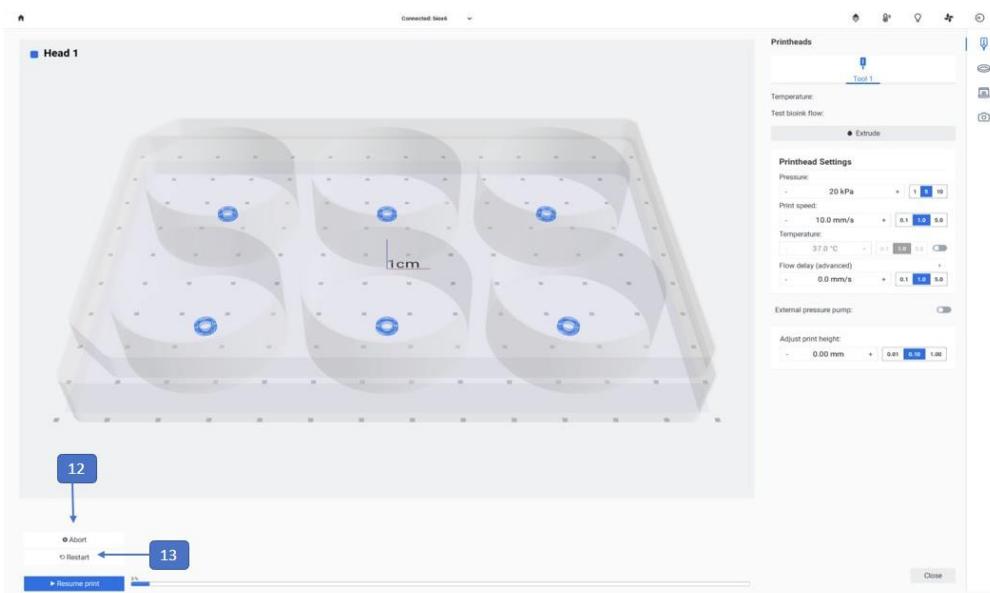


Figure 49 Printing model, continued

12. **Abort:** Tap to cancel the print.

13. **Restart:** Tap to restart the print.

#### 4.4.11 Manual photocrosslinking – Model

When you tap **Manual photocrosslinking** after the print is finished, you will be redirected to the Photocrosslinking tab in the Printing Utilities menu (see screenshot below).

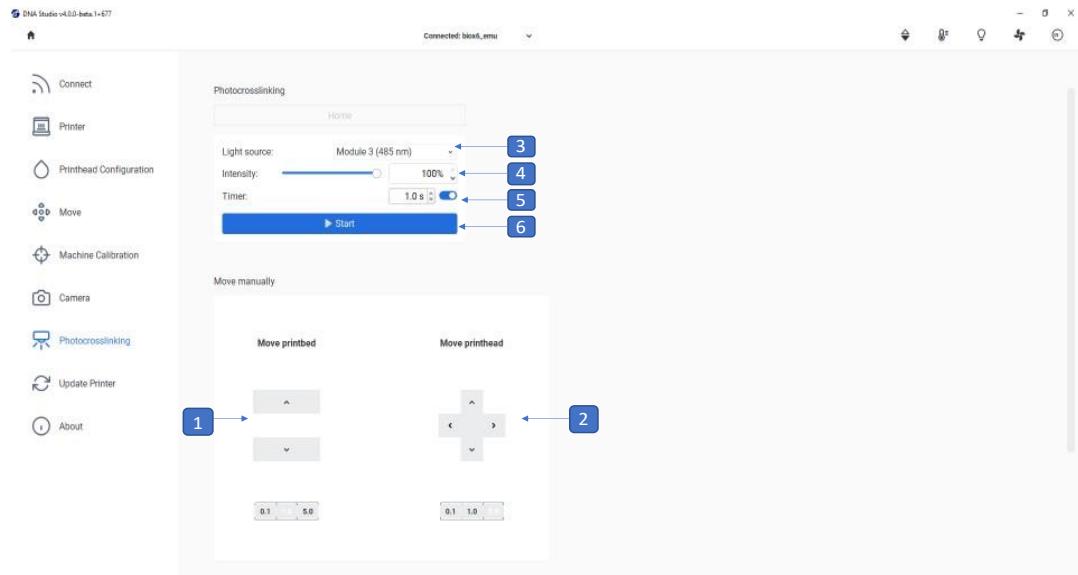


Figure 50 Manual photocrosslinking

1. Select the **distance from the surface bed** up and down and adjust it for precision by using 5-, 1- or 0.1-mm steps.
2. Select the **wells to be manually photocrosslinked** and select the distance from the surface (up, down, left, right) and adjust it for precision by using 5-, 1- or 0.1-mm steps.
3. **Light source:** Tap to select the light source for photocrosslinking. You can choose one of the UV curing LEDs or the Photocrosslinking tool.
4. **Intensity:** Tap to change the intensity from 0 to 100%.
5. **Timer:** Tap to set the timer for photocrosslinking (0.1 s to 600 s).
6. **Start:** Tap to start the photocrosslinking.

Note that the Photocuring Toolhead offers even more targeted and powerful photocrosslinking than the built-in photocuring modules.

## 4.5 Bioprinting droplets

On the home screen, tap **Droplet** to start to start bioprinting droplets without a Gcode. The BIO X6 guides you through the process of setting up your bioprint.

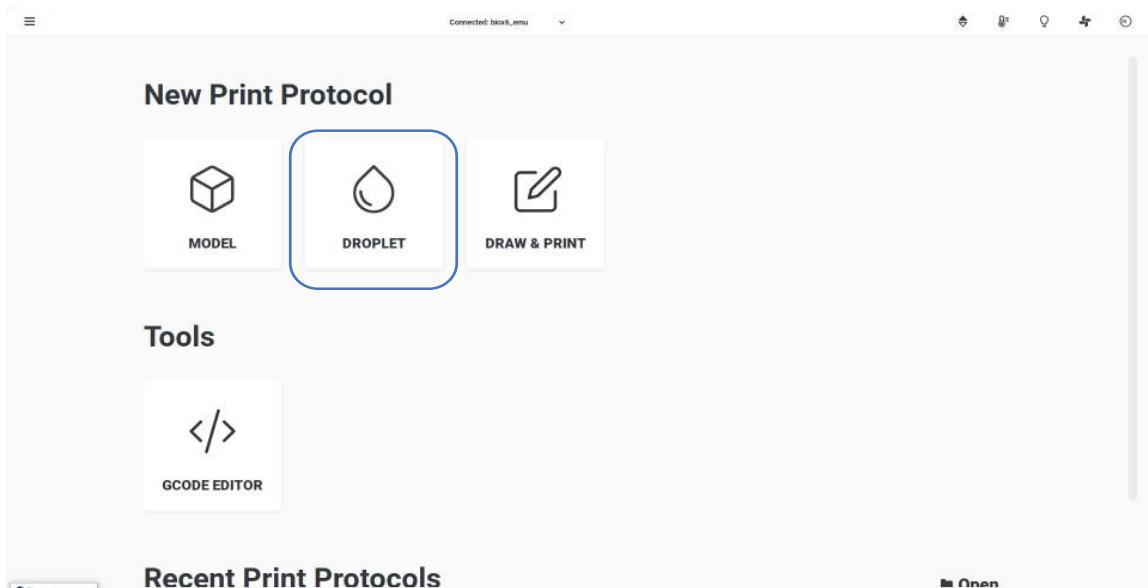


Figure 51 Droplet option on the home screen

#### 4.5.1 Print surface

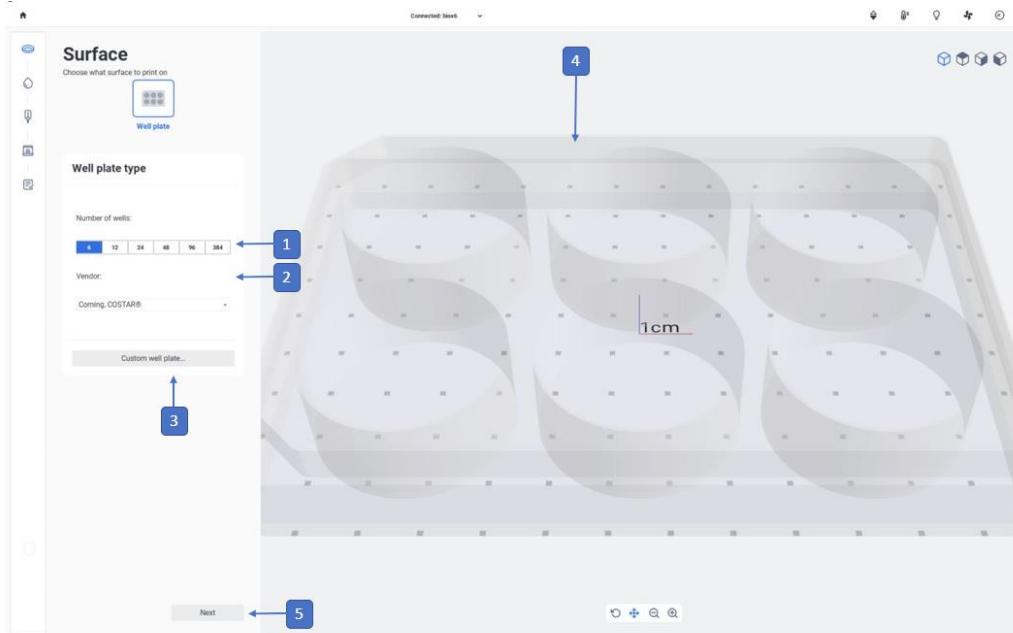


Figure 52 Overview of the Surface step – Droplet

1. Select a number to choose a well plate to print in.
2. Select a vendor for the well plate you are using. This feature enables the BIO X6 to know the precise dimensions of the well plate, which can slightly vary depending on the vendor. The current supported vendors are Corning Costar, Corning Falcon, Thermo Fisher and VWR.
3. **Custom well plate:** Tap to create a custom well plate.
4. **Preview:** A preview of the selected well plate is displayed here.
5. **Next:** Tap to proceed with the next step of the bioprinting process. This button will only be enabled once a print surface is selected.

## 4.5.2 Droplet

The Droplet step allows you to choose to print one droplet per well and to use several printheads in the same printing process.

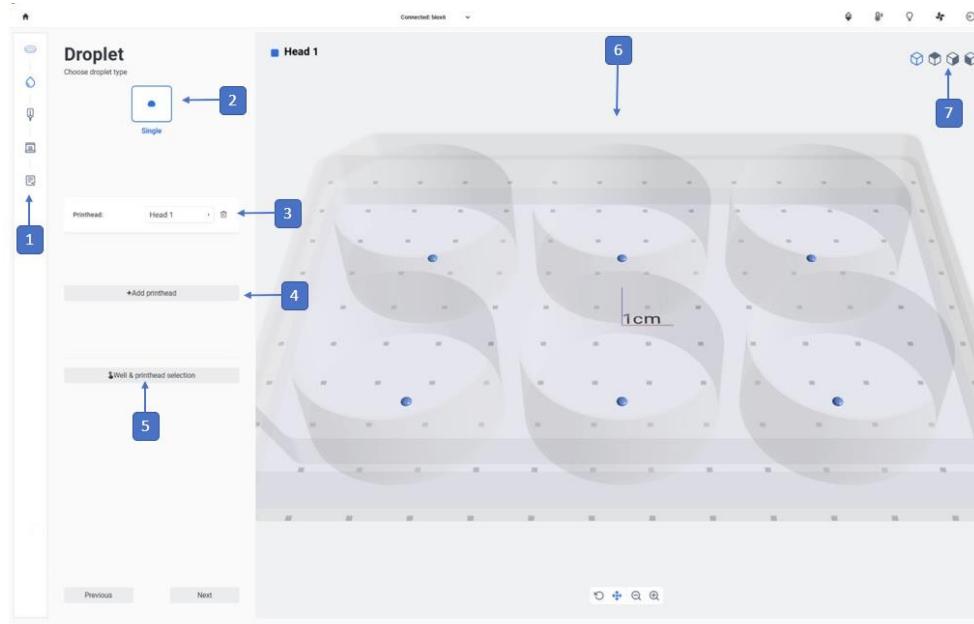


Figure 53 Overview of the Droplet step

1. **Printing process navigation bar:** This bar displays the steps of the overall bioprinting process and highlights in blue the step you are currently in.
2. **Select single droplet:** With this feature you can select to print single droplet with one printhead in each well.
3. **Printhead type:** Select the type of printhead you want to use. Different settings will appear below depending on what type of printhead you select. Droplet printing is compatible with Standard Pneumatic, Temperature-controlled, and Syringe Pump printheads.
4. **Add printhead:** Tap to add another printhead to the bioprinting process.
5. **Well selection:** Tap to select which wells to print in and in what order. In case you are using multiple printheads, you can also select which printhead is going to print on which wells.
6. **Preview:** A preview of the well plate with the droplet print mode selected will be displayed here. Different printheads will be displayed as different colors on the wells.
7. **Face preview:** Tap to rotate the preview and view it from different sides.

### 4.5.3 Printhead settings

Depending on the printhead you are using, different settings are required for configuration. General information about the printheads can be found on section 12 of this manual. Further details are outlined in the separate printhead manuals.

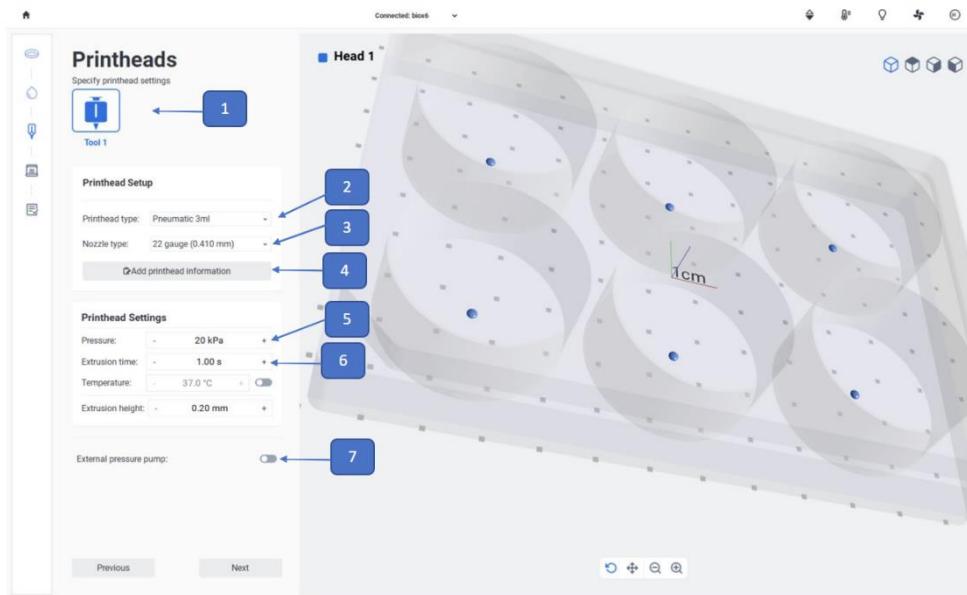


Figure 54 Overview of the Printheads step

1. **Tool bar:** Indicates the printheads previously indicated to be involved in the printing process. Tap on each printhead to set it up with the information in the two boxes below (2–6).
2. **Printhead type:** Tap to select the printhead type. Droplet printing is only compatible with Standard Pneumatic, Temperature-controlled, and Syringe Pump printheads.
3. **Nozzle type:** Tap to select the nozzle type (No matter if the user is using needles or nozzles, user is allowed to choose the nozzle size only (the nozzle type option can be used for both needles and nozzles)).
4. **Add printhead information:** Tap to add printhead information that will be saved in the print log. With this feature you can add information regarding the nozzle brand, shape, and length, as well as information of the material such as bioink, the batch number, bioink volume, cell type, and cell concentration. All information saved on the print log can be accessed later and can be useful for your lab records or for planning future experiments.

5. **Pressure:** Tap to set the extrusion pressure. (Pressure should be between 0-200 kPa with the internal air compressor and between 0-700 kPa with an external air compressor). Extrusion pressure depends mainly on the viscosity and rheological properties of the material to be printed.
6. **Extrusion time:** Tap to set the extrusion time.
7. **External pressure pump:** Tap to indicate if an external pressure pump is connected to the BIO X6.

#### 4.5.4 Printer settings

Adjust the printbed temperature, the photocrosslinking settings and the lights and fan of the chamber in the Printer step. Use temperature control to keep the printbed at a certain temperature, or turn temperature control off to print at room temperature. You can check the current temperature of the print chamber at the user interface.

**Note:** The settings selected in this step will only be applied once the bioprinting process has started.

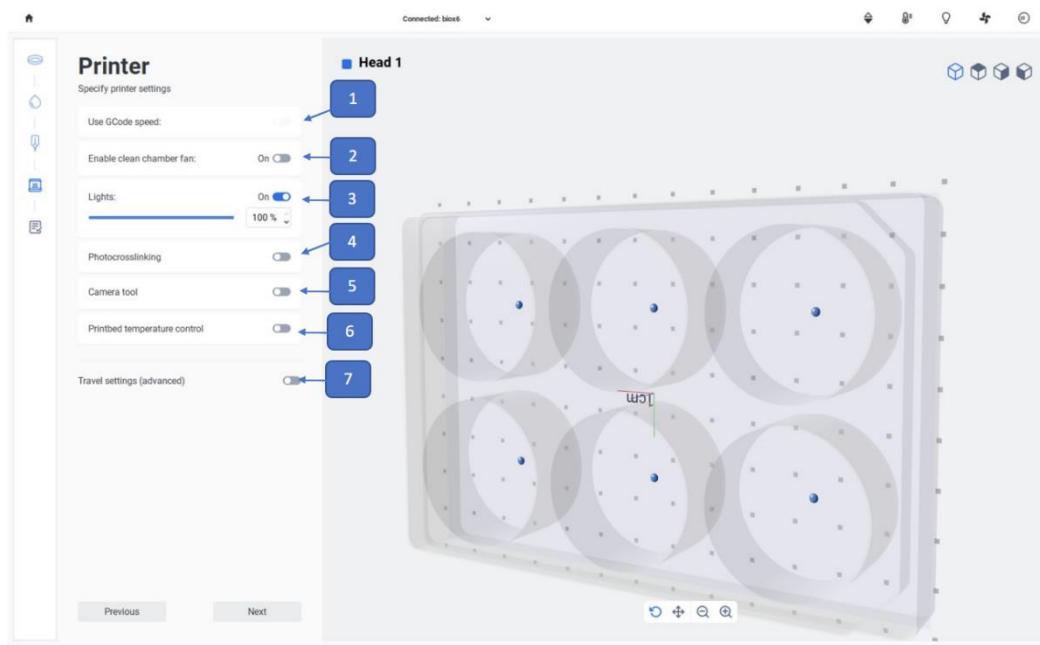


Figure 55 Overview of the Printer step

1. Tap to use GCode speed during print, it will override the speed which user select during setup.
2. **Enable Clean Chamber fan:** Tap to enable or disable the clean chamber fan.
3. **Lights:** Tap to enable or disable the print chamber lights of the BIO X6. If enabled, you can drag to select the light intensity.
4. **Photocrosslinking:** Tap to enable or disable a photocrosslinking scheme. If enabled, you can indicate the light source (one of the UV curing LEDs or the photocrosslinking tool) and the light exposure parameters, such as height above the surface and time.

5. **Camera tool:** Tap to enable or disable the camera tool. If enabled, the tool must be coupled to one of the intelligent connectors on the BIO X6.
6. **Printbed temperature control:** Tap to enable or disable temperature control on the printbed. If disabled, the printbed will be kept at room temperature.
7. **Travel settings:** Tap to change the speed of the traveling movement. This feature is mainly for speeding up prints by performing the non-print movements faster, such as those required for travelling from one well to another.

## 4.5.5 Summary

Review all your selected settings. If a setting or value is incorrect, use the boxes at the right side of the interface or the navigation bar at the left to edit any settings. To proceed with the bioprinting process, tap **Go to Print** and continue with the calibration settings.

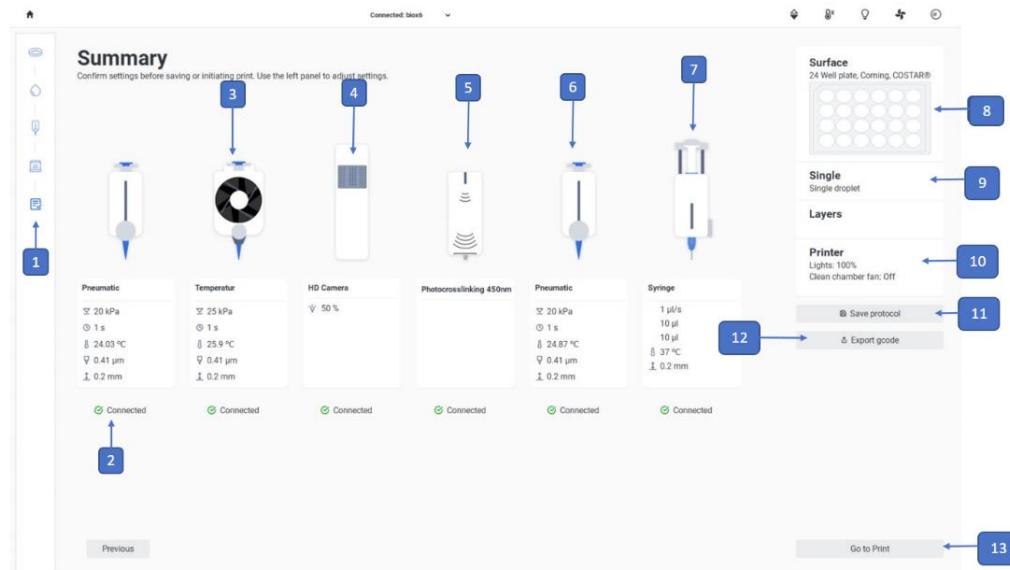


Figure 56 Settings summary – Droplet

1. **Printing process navigation bar:** This bar displays the steps of the overall bioprinting process and highlights in blue the step you are currently in.
2. **Tool 1:** Displays an illustration of the tool 1 and shows its settings.
3. **Tool 2:** Displays an illustration of the tool 2 and shows its settings.
4. **Tool 3:** Displays an illustration of the tool 3 and shows its settings.
5. **Tool 4:** Displays an illustration of the tool 4 and shows its settings.
6. **Tool 5:** Displays an illustration of the tool 5 and shows its settings.
7. **Tool 6:** Displays an illustration of the tool 6 and shows its settings.
8. **Surface:** Displays a summary of the selected settings for the print surface.
9. **Droplet:** Displays the selected droplet mode.

10. **Printer:** Displays a summary of the selected settings for the printer. Tap to edit settings.
11. **Save protocol:** Tap to save the current printing protocol as a file with the “.BIOX” extension.
12. **Export gcode:** Tap to save que current printing protocol as a file with the “.gcode” extension.
13. **Go to Print:** Tap to proceed with the bioprinting process.

#### 4.5.6 Calibration and Auto Bed Levelling (ABL)

Once the printing settings are fully reviewed, calibration of the printheads is required before starting the bioprinting process. Each printhead to be used must be calibrated individually.

On this screen you can also check the material flow with the printing settings already defined.

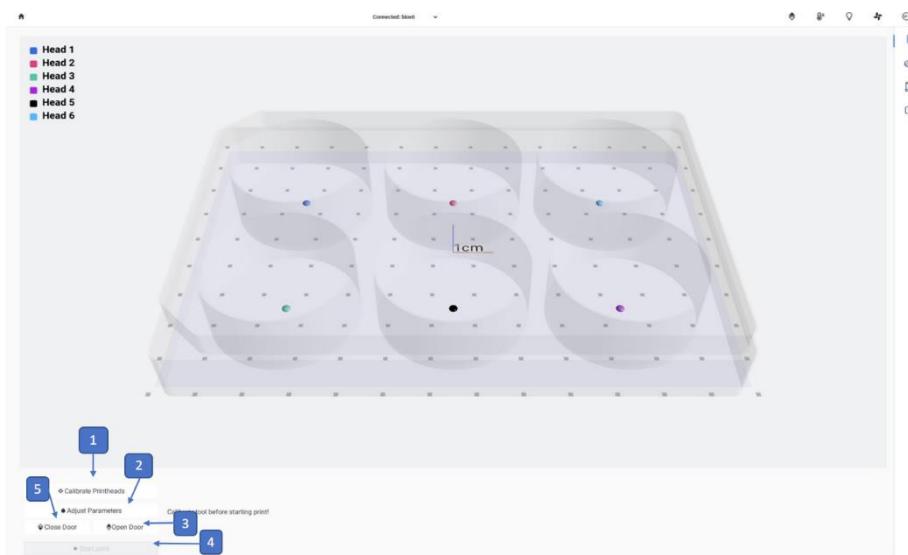


Figure 57 Calibration options – Droplet

1. **Calibrate Printheads:** Tap to calibrate the printheads and the print bed.
2. **Adjust Parameters:** Tap to open the right side of settings for the print.
3. **Open Door:** Tap to open the door if the door is closed
4. **Start print:** Tap to start print. This button is only enabled once the calibration protocol is complete.
5. **Close Door:** Tap to close the door if the door is open.

Tap **Calibrate** to calibrate the printheads and the printbed. There are three calibration options: **Automatic calibration**, **Manual calibration** and **Automatic bed levelling (ABL)**.

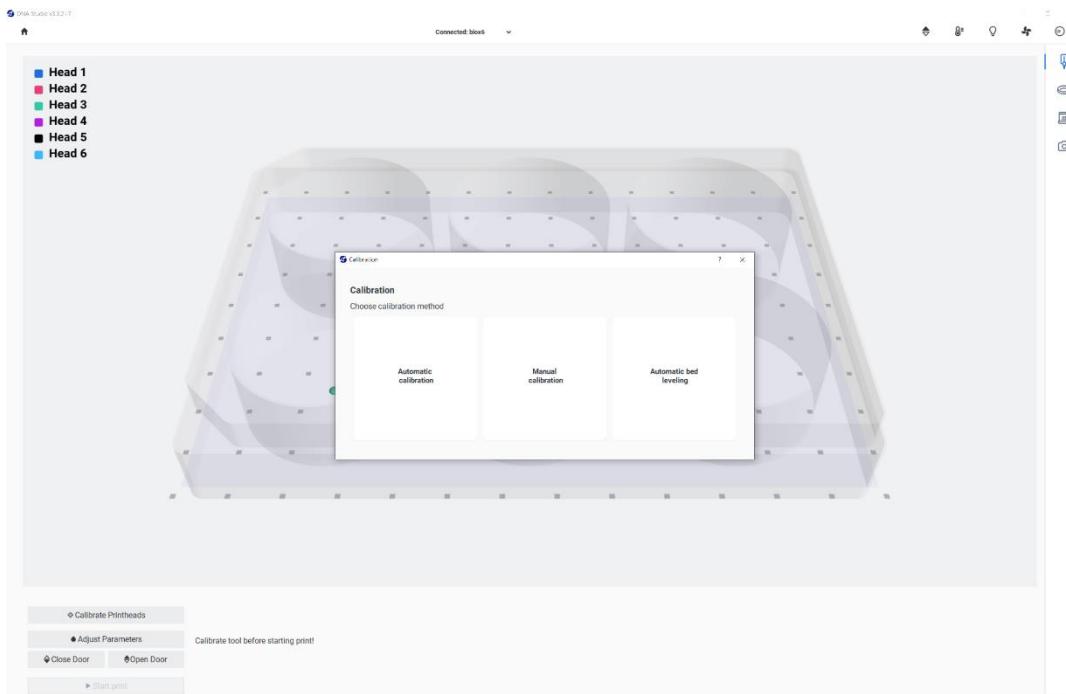


Figure 58 Calibration options – Droplet

**Note:** The Automatic calibration protocol is not compatible with the HD Camera toolhead or the Photocuring toolhead. If one of these toolheads is connected to the BIO X6 when performing Automatic calibration, you can choose either to calibrate them manually or to link their calibration to one of the other toolheads.

ABL probes the bed at three points to enable bed-levelling compensation. It uses a matrix to compensate for tilt in the bed or print surface. It is recommended to perform ABL when printing large models or when using well plates as the printing surface.

The surface probe only needs to be calibrated once, the printer will then remember this calibration and apply it for each printing. However, the ABL must be enabled before each printing since it compensates not only the bed but also the print surface tilt.

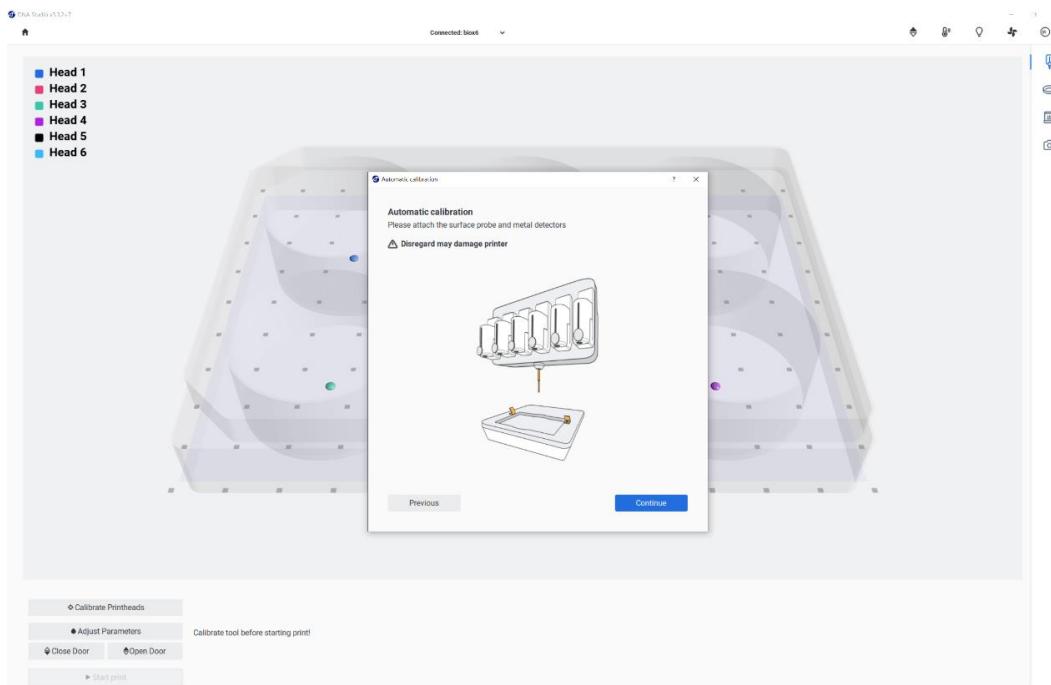


Figure 59 Automatic calibration dialog 1 – Droplet

To perform automatic calibration, you must first attach the surface probe to the printhead connector body and the metal reflectors to the printbed. Then tap **Continue** to proceed.

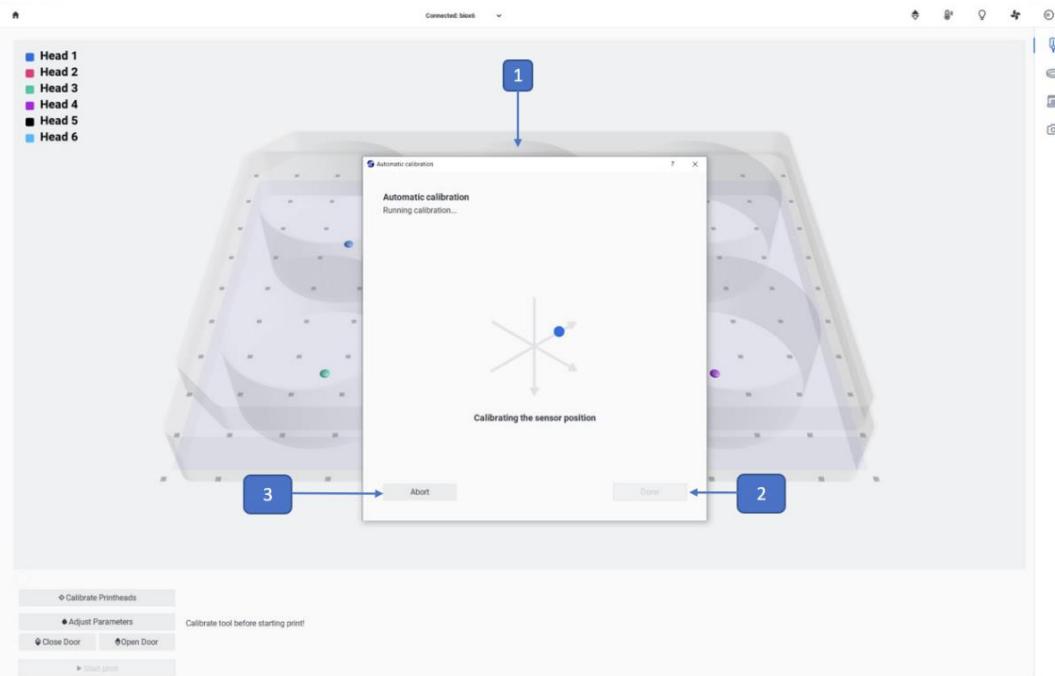


Figure 60 Automatic calibration dialog 2 – Droplet

- Head 1,2,3,4,5,6 and surface probe:** Calibration tab for all printheads and (surface probe: Home the printer axes and return to absolute zero position).
- Done:** Tap to proceed with the bioprinting process. This button will only be enabled once the calibration has been successfully completed.
- Abort:** Tap to cancel the calibration

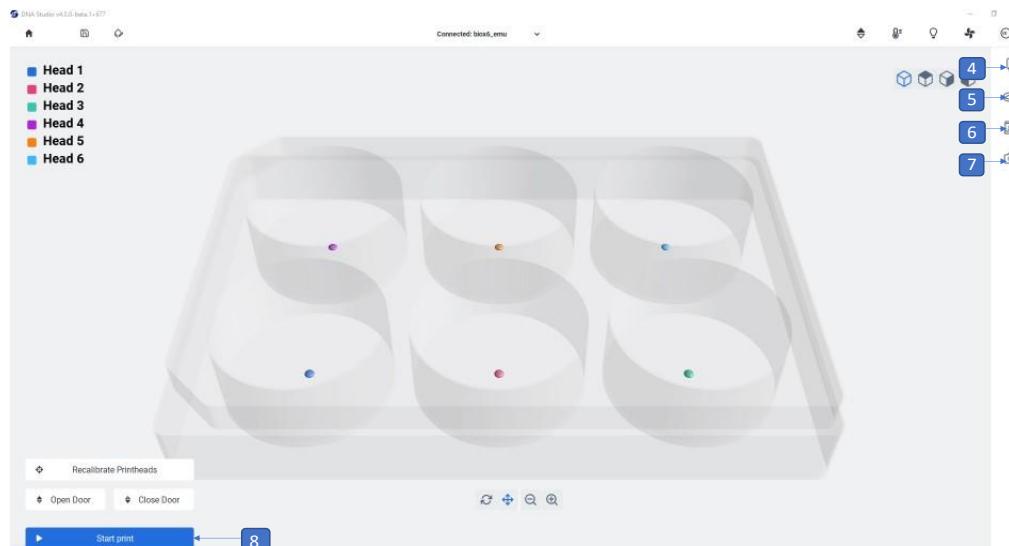


Figure 61

- Printhead icon:** Tap to review and edit the printhead setting.
- Printer icon:** Tap to review and edit the printer settings.
- Surface icon:** Tap to review and edit the surface settings.
- Camera icon:** Tap to review and edit the camera settings. This option is only available when the Camera tool is connected to the BIO X6.
- Start print:** Tap to start the bioprinting process. This button will only be enabled once the calibration protocol is complete.

#### 4.5.7 Printing droplets with multiple heads

This screen allows you to track the bioprinting process in the BIO X6. You can monitor the activity of each printhead, of the printbed, of the photocrosslinking LEDs and of the print chamber while printing. In addition, you can change the printing parameters of any of the

printheads while the printing process is ongoing. This includes pressure, speed, and temperature.



Always pause the bioprinting process before opening the door. Do not remove printheads before bioprinting has stopped. Doing so risks aborting the process and compromising your cells.

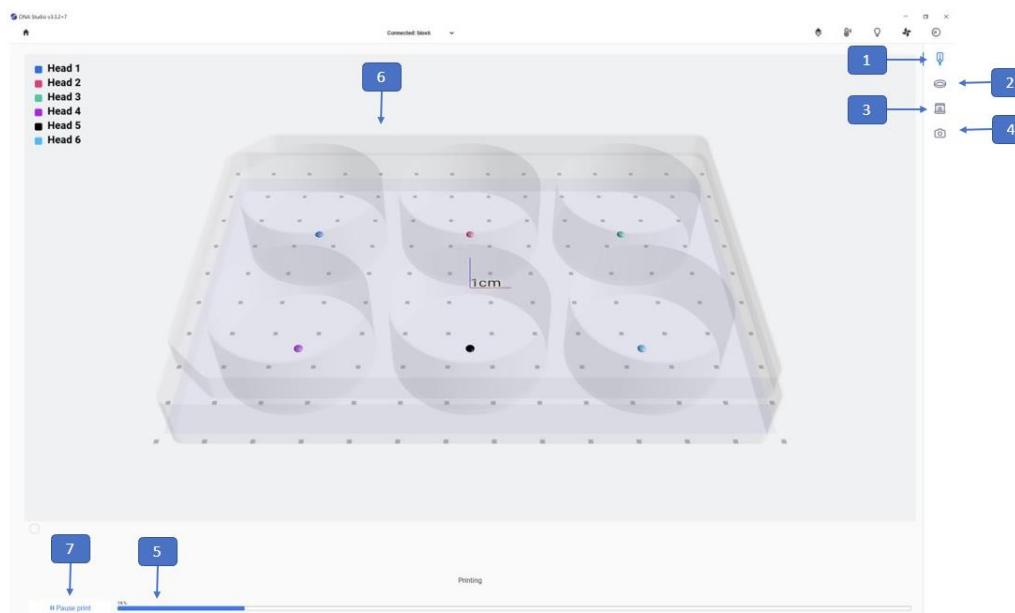


Figure 62 Printing droplets screen

1. **Printhead icon:** Allows you to monitor and change the settings of the printheads participating in the bioprinting process.
2. **Surface icon:** Allows you to monitor the settings of the print surface.
3. **Printer icon:** Allows you to monitor and change the settings of the printer.
4. **Camera icon:** Allows you review and edit the camera settings. This option will only apply when the Camera tool is connected to the BIO X6.
5. **Progress indicator:** Displays progress of the bioprinting process as a percentage (%). This is calculated by considering the total number of layers to be printed and the layer which is being currently printed.
6. **Preview:** A preview of the printing progress will be displayed here.

7. **Pause/restart print:** Tap to pause the bioprinting process. When the process is paused, tap to resume the bioprinting process.

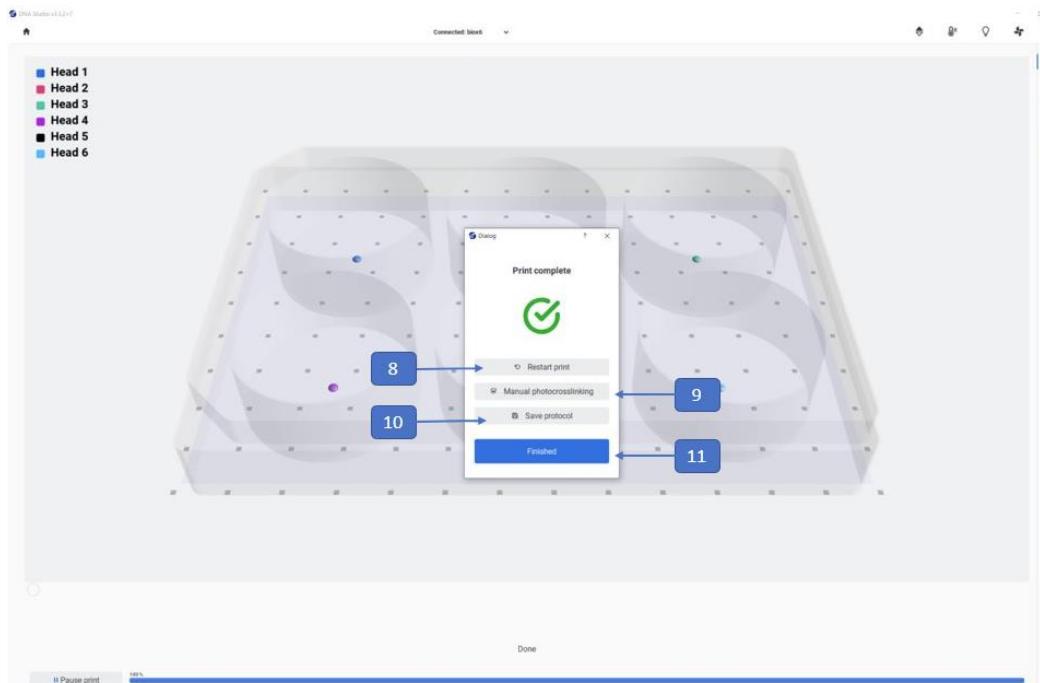


Figure 63 Printing droplets screen, continued

8. **Restart print:** Tap to restart the print. This feature can be used to print the same model by using the same parameters and print surface as the previous print.
9. **Manual Photocrosslinking:** Tap to perform manual photocrosslinking on your final constructs. You can select wells, the wavelength, the distance from the printbed and the time.
10. **Save protocol:** Tap to save the current printing protocol with a “. BIOX” file extension.
11. **Finished:** Tap to finish the current print and go to the home screen.
12. **Abort:** Tap to cancel the print.
13. **Restart:** Tap to restart the print.

#### 4.5.8 Manual photocrosslinking – Droplet

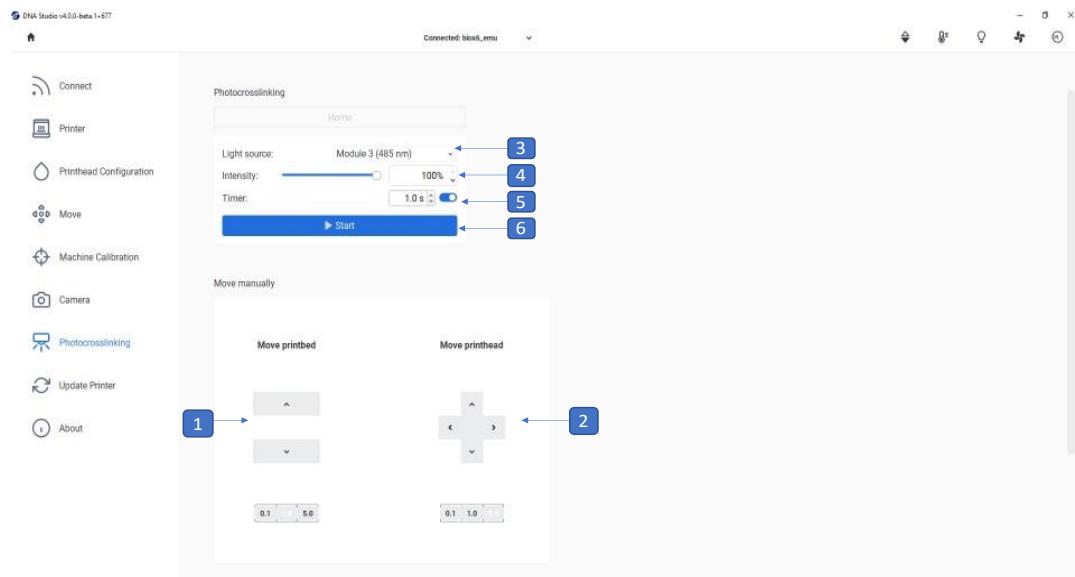


Figure 64 Manual photocrosslinking – Droplet

1. Select the **distance from the surface bed** up and down and adjust it for precision by using 5-, 1- or 0.1-mm steps.
2. Select the **wells to be manually photocrosslinked** and select the distance from the surface (up, down, left, right) and adjust it for precision by using 5-, 1- or 0.1-mm steps.
3. **Light source:** Tap to select the light source for photocrosslinking. You can choose one of the UV curing LEDs or the Photocrosslinking tool.
4. **Intensity:** Tap to change the intensity from 0 to 100%.
5. **Timer:** Tap to set the timer for photocrosslinking (0.1 s to 600 s).
6. **Start:** Tap to start the photocrosslinking.

Note that the Photocuring Toolhead offers even more targeted and powerful photocrosslinking than the built-in photocuring modules.

## **4.6 BIO X6 Protocol Parameter Guidelines**

### **4.6.1 BIO X6 Protocol Parameter Guidelines Protocol aim**

The aim of this protocol is to provide instructions on how to improve printed structures. Illustrations will provide clarity on how to adjust the print settings and how it will affect the print. At the beginning of the document is an explanation of what the different parameters in DNA Studio are.

### **4.6.2 Background**

The basic settings in the DNA Studio printhead tab are printhead, nozzle type, pressure, print speed, temperature, External pressure pump. By modifying these values, improvements to the print can be made. Below you can find common issues and how these parameters can influence your print.

### **4.6.3 Parameters in DNA Studio**

#### **Nozzle type:**

The nozzle type includes the size of the nozzle/needle inner diameter. Changing the nozzle type will result in thinner or thicker printed lines. It is recommended to use a nozzle type between 16–30 G.

#### **Pressure:**

Pressure flow determines material flow out of the nozzle type (16–30 G). (Pressure should be between 0–200 kPa with the internal air compressor and between 0–700 kPa with an external air compressor). Extrusion pressure depends mainly on the viscosity and rheological properties of the material to be printed.

#### **Speed:**

The speed of the printhead during printing moves. Increasing the printing speed will result in a shorter printing time while decreasing the speed can give higher resolution of the printed structures. It is not recommended to use a speed higher than 0–10 mm/s.

#### **Temperature:**

The temperature of the printhead. Changing the temperature of some materials can alter their viscosity. Check which temperature the material prints best at. Certain materials require a cooled printhead to keep from premature gelation, such as Matrigel and collagen.

#### **Pre-flow delay:**

The amount of bioink that is extruded before starting a new filament as well as infill on each layer. Increase the Pre-flow delay if the bioink is not extruding at the start point of each layer of the filament. Decrease pre-flow if there is an accumulation of bioink at the start point. It is recommended to set between 0–200 ms.

#### **Post-flow delay:**

The amount of bioink that stop extrusion before the end of the filament or before the last coordinate of the filament. Increase post-flow delay if extrusion need to stop far from the last coordinate of the filament. Decrease post-flow if extrusion needs to stop close to or on the last coordinate

### **4.6.4 Helpful hints and troubleshooting**

To improve the structures even further, open the Flow delay (Advanced) option, settings bar and adjust the extra pre-flow delay and post-flow delay. Some parameters are closely connected and can be adjusted in relation to one another. For example, if the filament thickness is as desired, but the speed is reduced by half, combine this change with doubling the pressure to retain the same filament thickness when printing at the lower speed.

### P1 – There is a gap at the end of the filament

Increase the post-flow delay if the end of the filament does not completely extrude before the start of the next move. Adjusting this value up or down has little impact on the printed structure, however, a long post-flow delay can extend the print time, which can be stressful for the cells.



Figure 65 A, B, C Adjusting the post-flow delay: A) short, B) enough, C) long delay

### P2 – There is a gap at the start of the filament

Increase the pre-flow delay if that start of the filament does not extrude in start of every layer, and infill in each layer. Decrease pre-flow if there is an accumulation of bioink at the start point of layer or infill of each layer.

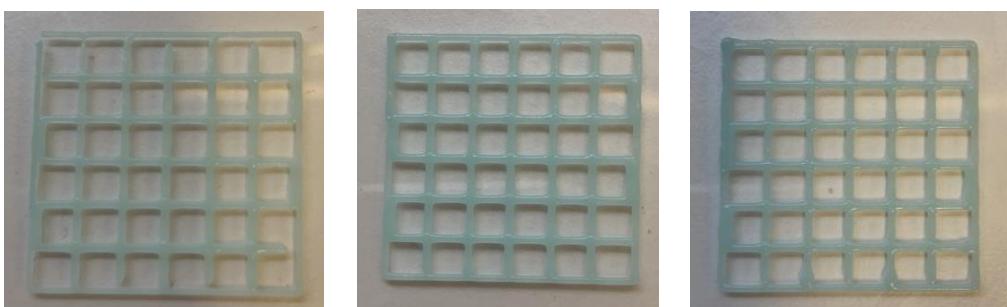


Figure 66 Adjusting the pre-flow delay: A) short, B) enough, C) long delay

**05**

**Gcode Editor**

# 5 Gcode Editor

The Gcode Editor allows you to create or alter Gcodes through line-by-line text editing.

Creating Gcodes from scratch is often time-consuming. With this tool you can import and edit existing Gcodes or create a new Gcode based on existing Gcodes.

The Gcode Editor also allows you to check the Gcode syntax, to find and replace Gcodes, and visualize step-by-step and layer-by-layer the structure you are going to print.

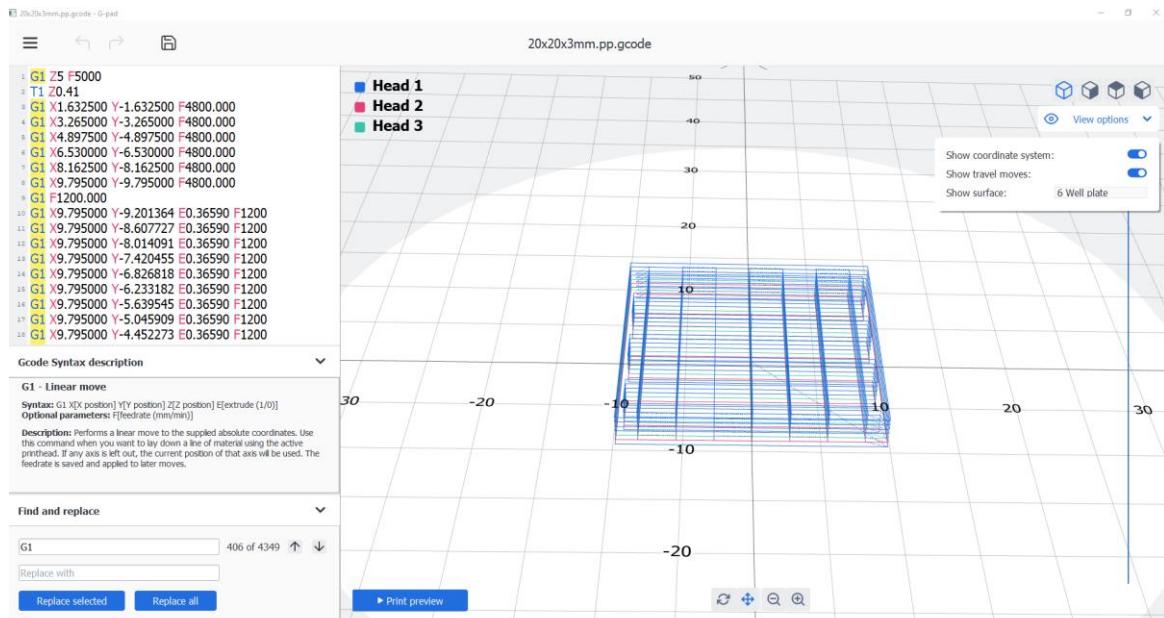


Figure 67 Overview of the Gcode Editor

## 5.1 Launching the Gcode Editor

Tap the Gcode Editor button on the home screen. A new Gpad window opens.

Alternatively, go to the Windows search bar, type “Gpad” and Enter.

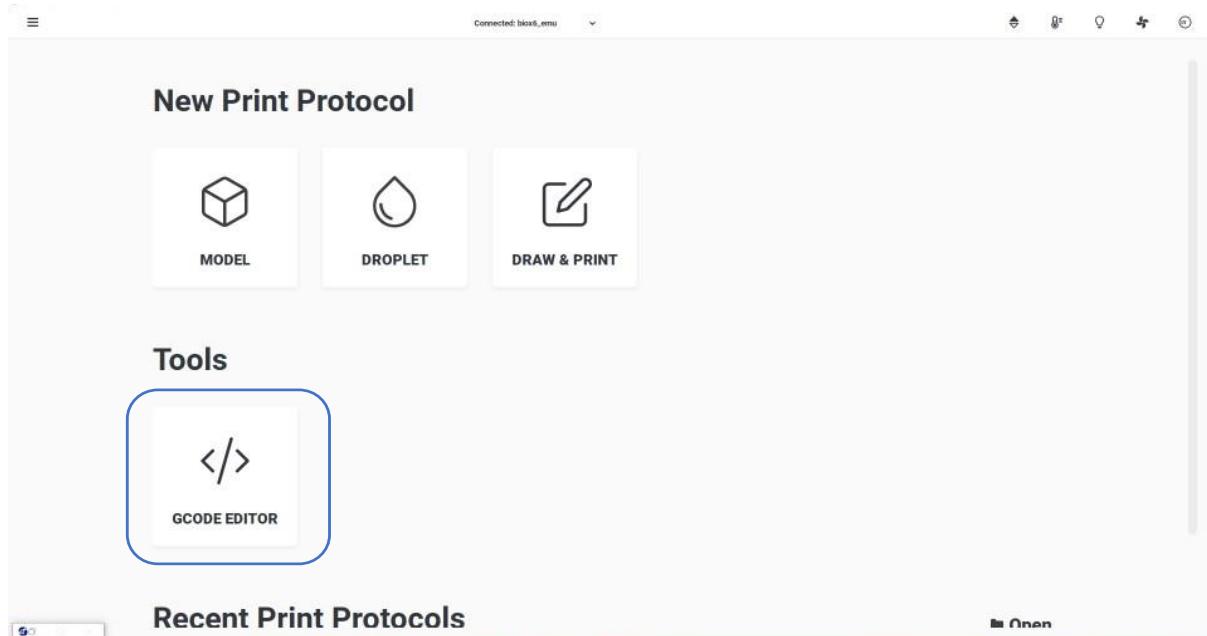


Figure 68 Gcode Editor tool on the home screen

## 5.2 Gcode Editor menu options

Tap  $\equiv$  in the G-pad window to access the menu options.

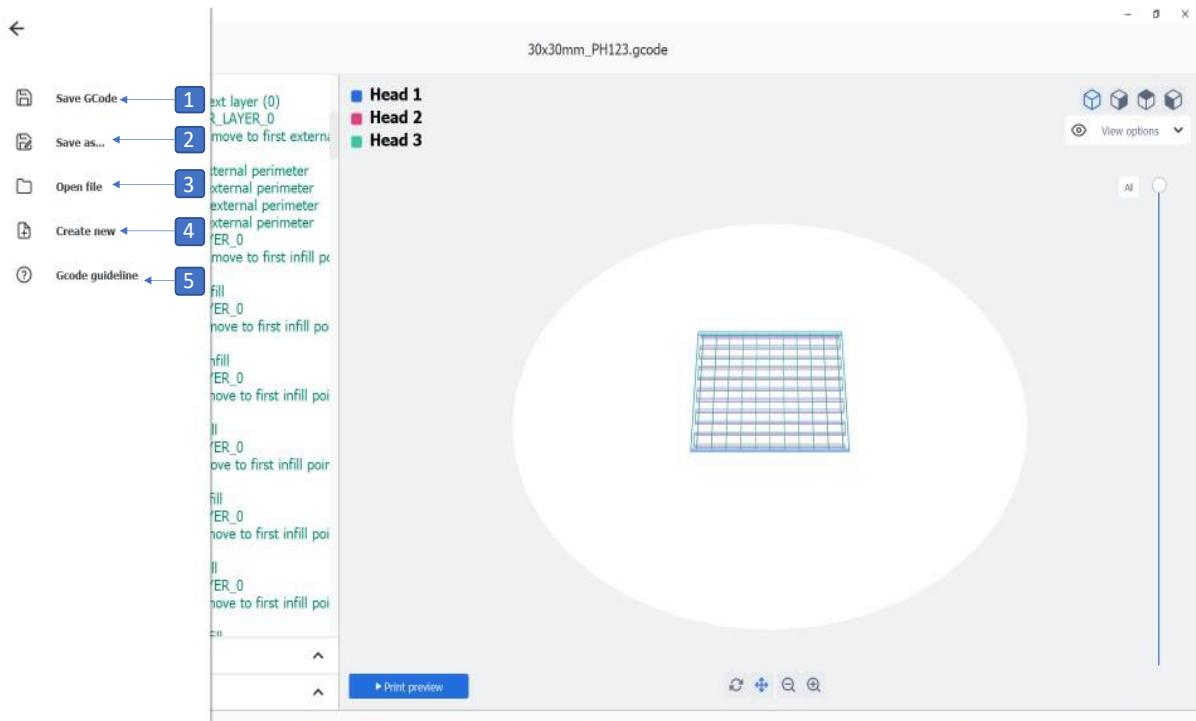


Figure 69 Menu options in the Gcode Editor

1. **Save GCode:** Tap to save the updates made in the existing Gcode file
2. **Save as:** Tap to save the new/existing file under a new file name
3. **Open file:** Tap to open an existing Gcode file
4. **Create new:** Tap to create a new Gcode file
5. **Gcode guideline:** Tap to go to the Gcode specification document with information about different G- and M-commands, the purpose of those commands and what parameters to use



Figure 70 Actions bar in the Gcode Editor

6. **Redo:** Tap to redo the changes or updates you have made.
7. **Undo:** Tap to undo the changes or updates you have made.
8. **Save icon:** Tap to save the changes. Alternative to the save shortcut on the left side menu.

## 5.3 View options

The **View options** menu in the upper right corner offers different options to facilitate the visualization and understanding of the Gcode. It allows you to visualize the coordinate system, the travel moves, and the chosen surface.

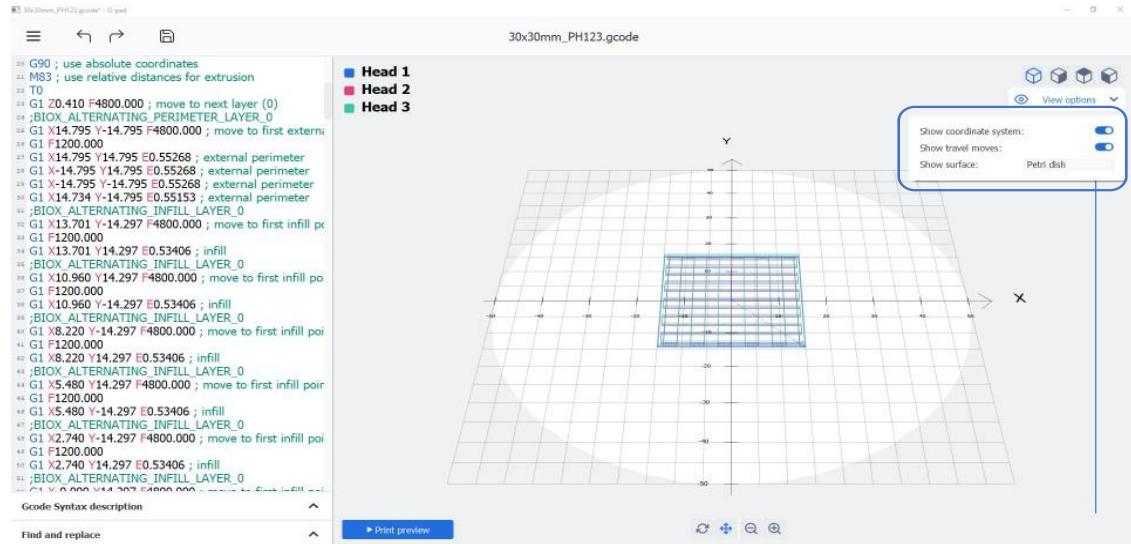


Figure 71 View options

**Show coordinate system:** Enable this toggle button to show the coordinate systems on the screen for the X, Y, and Z axes.

**Show travel moves:** Enable this toggle button to show the path described by the nozzle when not printing during the transfer between distant extrusion points.

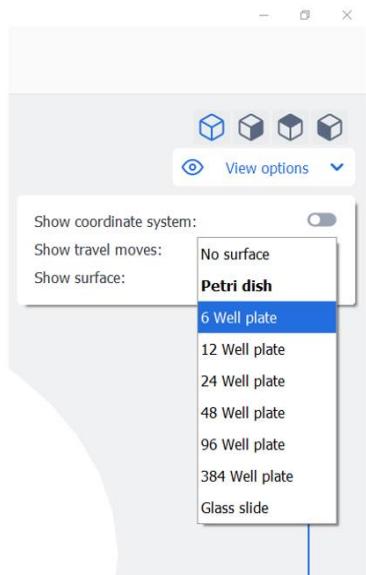


Figure 72 Show surface dropdown

**Show surface:** This option visualizes the surface where the construct described by the Gcode is going to be printed. The size and shape changes according to the selected surface (Petri dish, well plate or glass slide).

## 5.4 Find and replace

Use the **Find and replace** feature to quickly modify your Gcode.

Here you can see the number of Gcodes entries with the same description, and replace one, several, or all entries to see how this affects the code.

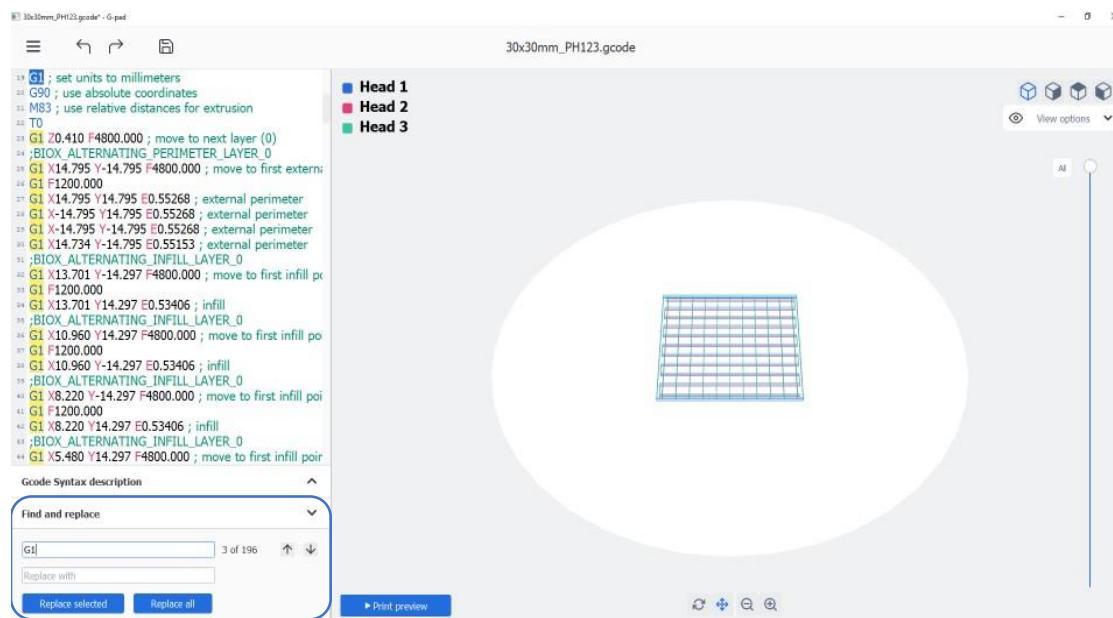


Figure 73 Find and replace

Use the **up and down arrows** to navigate through the list of codes. Tap **Replace selected** to replace one or several selected Gcodes. Tap **Replace all** to replace all the entries of a specific Gcode.

## 5.5 Gcode preview mode

The Gcode Print preview option allows you to preview the travel moves of each line of your code.

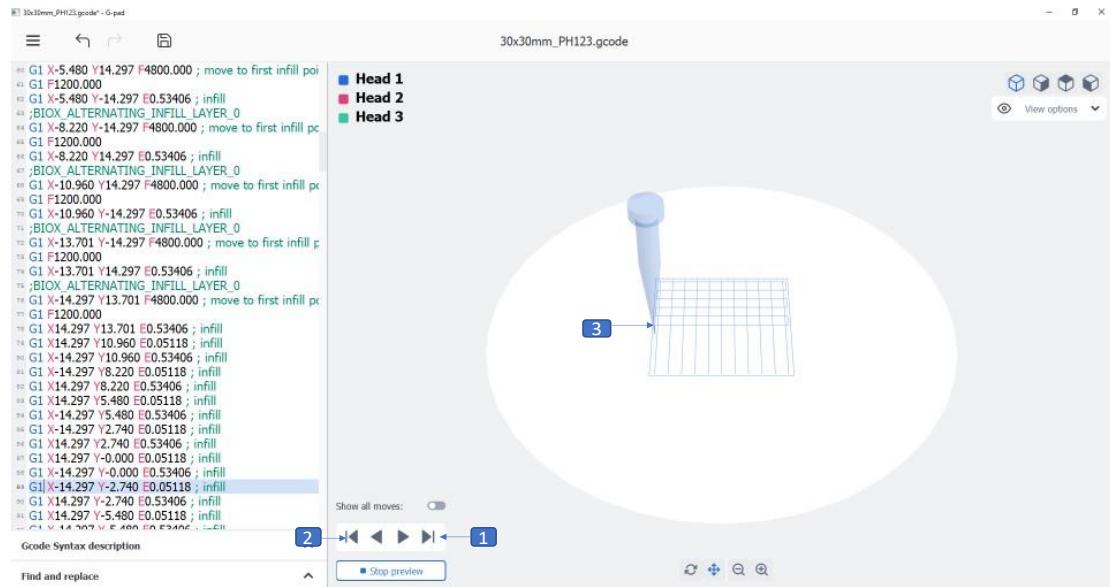


Figure 74 Overview of the preview mode, part 1

1. Tap the **Right end arrow** to manually move forward to the next line of code.
2. Tap the **Left end arrow** to manually move to previous line of code and undo the travel move.
3. A line-by-line preview of each travel move, showing the nozzle in the same color as the selected printhead.



Figure 75 Overview of the prieview mode, part 2

4. Tap the **Right arrow** to preview the travel moves automatically for each line of code in forward motion.
5. Tap the **Left arrow** to preview the travel moves automatically for each line of code in backward motion.
6. **Show all moves:** Enable this toggle button to view all the layers of code in the preview and show the travel moves in the selected direction. Disable the toggle button to show only the preview of the current layer.
7. **Preview:** Preview all the layers of code along with travel move when the Show all moves toggle button is enabled
8. **Stop Preview:** Tap to stop the preview of travel move
9. **Toolhead bar:** Display the tool heads to be used in the bioprinting process. Each tool is given a color for identifying the layers it is to print of the 3D model in the preview.
10. **Isometric views:** Tap to choose between different options: perspective, top view, side view. This helps you visualize with more detail the models to print and check for issues on the model or with the slice.
11. **Visualization bar:** Tap to choose between different options: rotate, drag, zoom in and zoom out. This option helps you visualize with more detail the models to print and check for issues on the model or with the slice.

## 5.6 Gcode Syntax description

The Gcode Syntax description feature displays the syntax of the selected Gcode, optional parameters to provide (if any), and a description of the purpose of the selected Gcode.

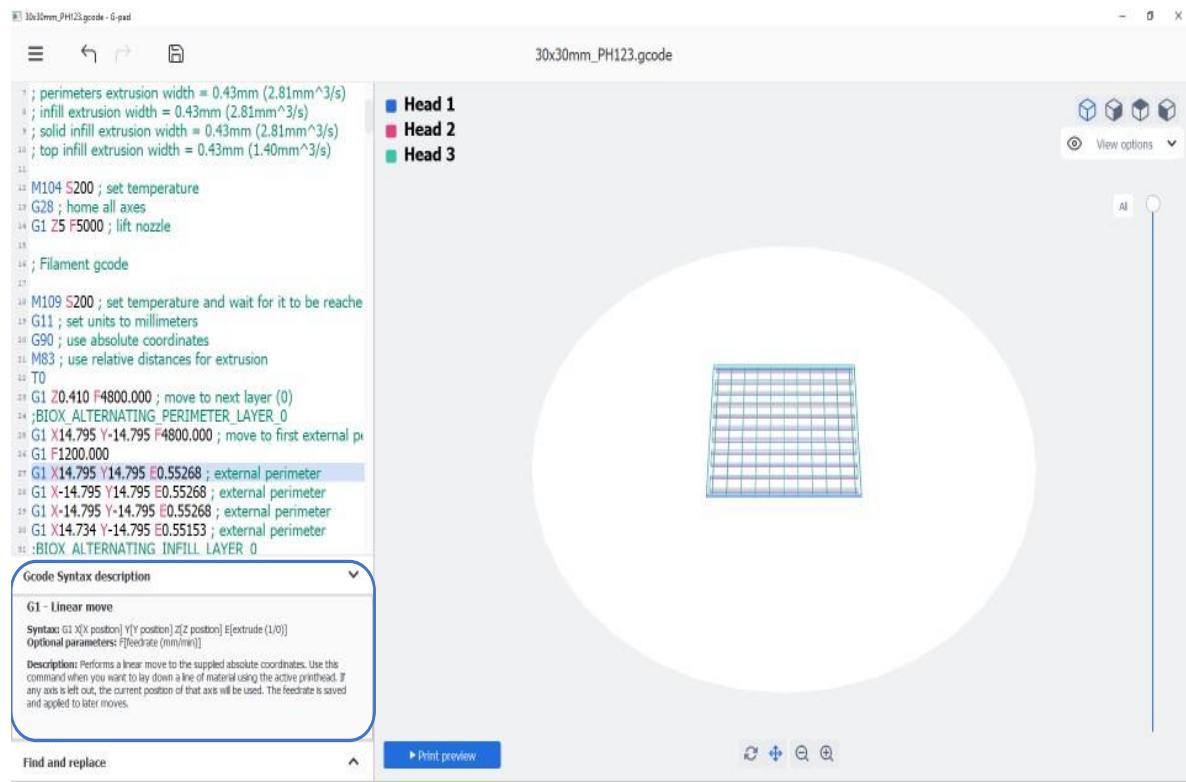


Figure 76 Gcode Syntax description

When using any G-, M-, or T-commands that are not allowed or that are not part of the Gcode specification, the error message **Command not supported** is shown, together with a reference link to the Gcode guidelines (see screenshot below).

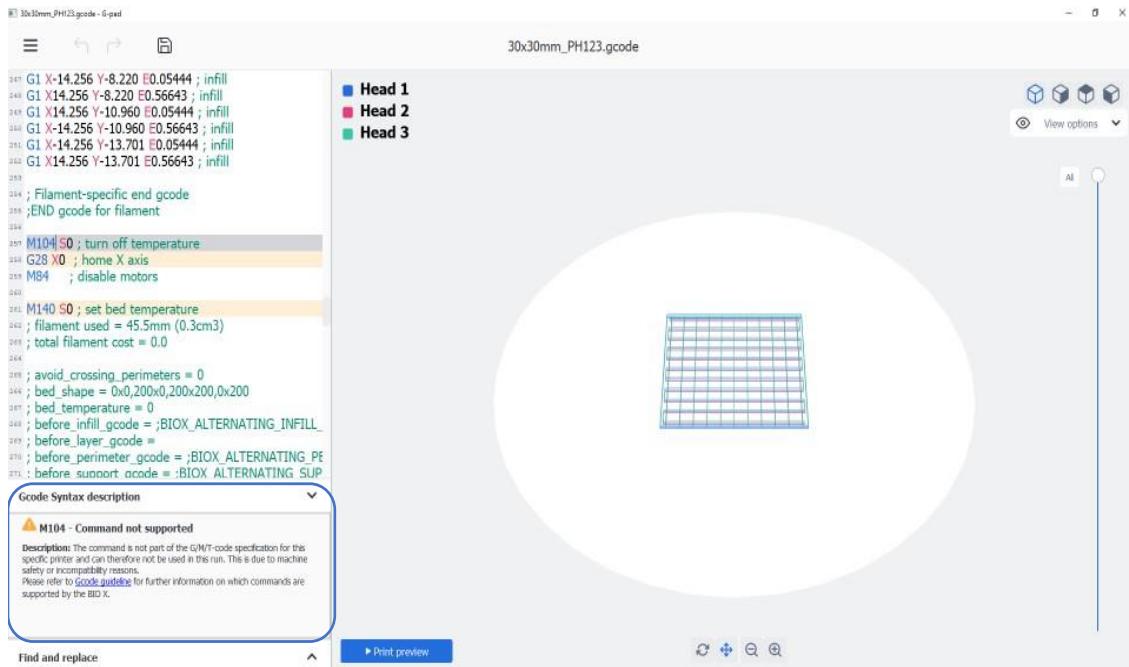


Figure 77 Error message: Command not supported

# 06

## Draw & Print

## 6 Draw & Print

The Draw & Print feature allows you to create structures, including layer properties and infill, without any CAD or Gcode input.

Free draw structures with lines and create squares, circles, and polygons shapes. Each line or shape is shown in the same color as the color code for the designated printhead.

Tap **Draw & Print** on the home screen to open.

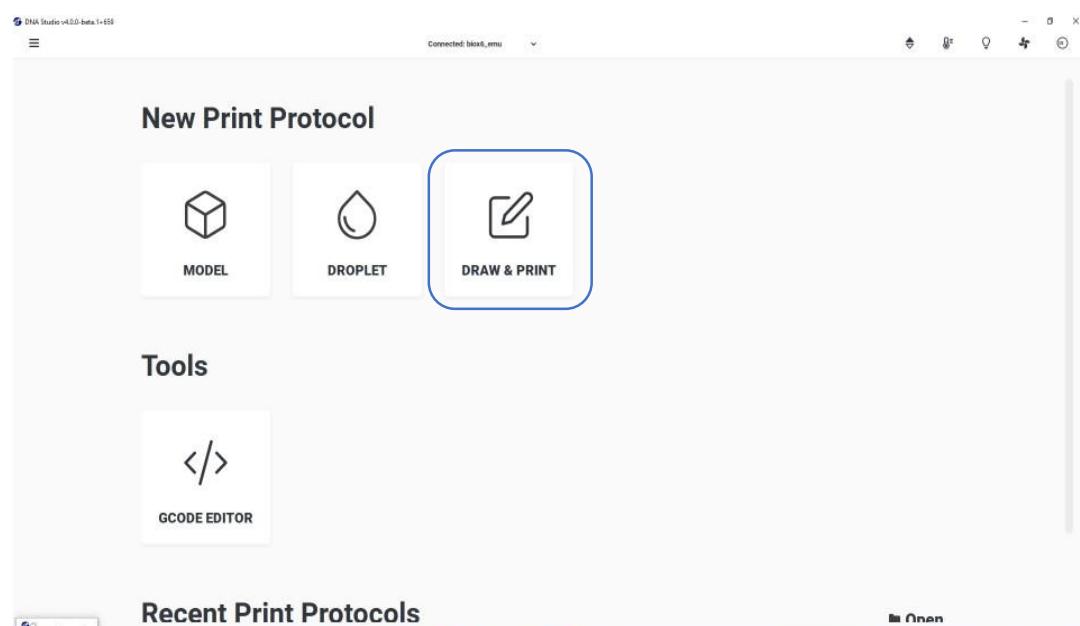


Figure 78 Draw & Print option on the home screen

## 6.1 Surface

The BIO X6 can draw and bioprint on a variety of surfaces, including Petri dishes, well plates and glass slides. Select the surface you wish to draw a shape and bioprint on.

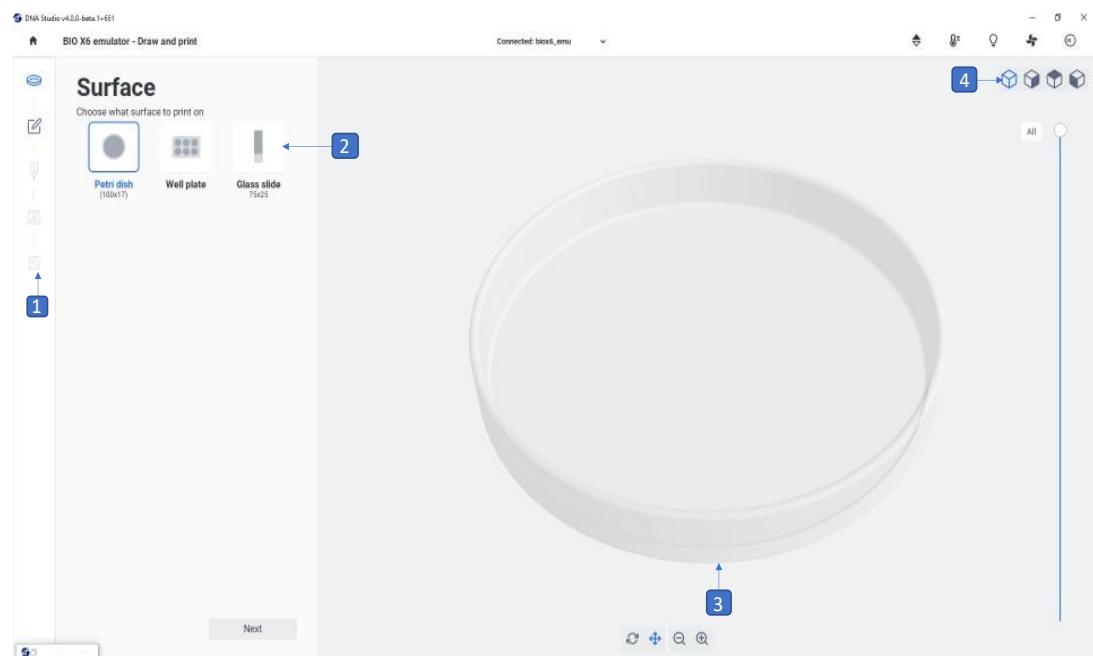


Figure 79 Overview of the Surface step – Draw & Print

1. **Printing process bar:** This bar displays the steps of the overall printing process and indicates in blue the step you are currently in.
2. **Print surface:** Select the surface you wish to draw and print on (Petri dish, well plate or glass slide).
3. **Preview:** The printing surface currently selected is shown in this preview.
4. **Isometric views:** Tap to choose between different options: perspective, top view, side view. This helps you visualize with more detail the models to print and check for issues on the model or with the slice.

**Note:** The screenshot above shows the settings for Petri dish. See [Print surface](#) for the well plate settings.

## 6.2 Draw

In this step you can draw any shape (circles, squares, polygons, lines, and free-hand curves) on the surface of your choice, adding any number of layers.

### 6.2.1 Layers panel

The layers panel offers different options to add and edit layers, including adding new layers, duplicating layers, and assigning thickness for each layer.

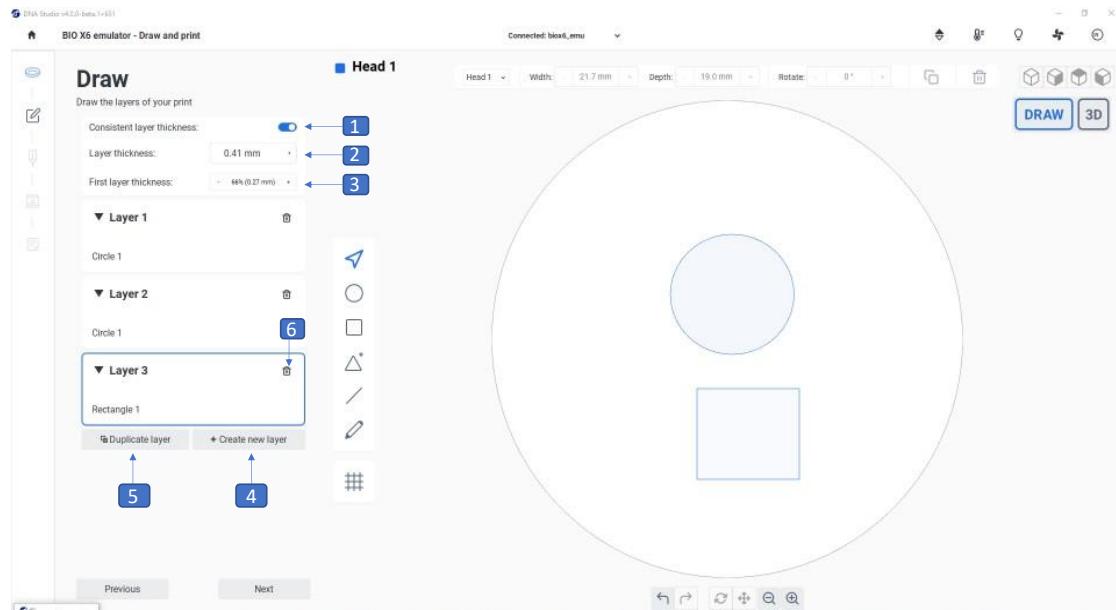


Figure 80 Layers panel

1. **Consistent layer thickness:** Enable this toggle button to apply consistent layer thickness to all layers.
2. **Layer thickness:** Tap to specify the thickness of each layer in mm. The default value for layer thickness is 0.41mm. CELLINK advises to set the layer height to 80-100% of the nozzle diameter.
3. **First layer thickness:** Default first layer thickness is 66%. It can be set to 50-100% depending on the printability and viscosity of the bioprint material. Modify to ensure sufficient adhesion of the first layer to the print surface.
4. **Create new layer:** Tap to create a new layer of any shape anywhere on the chosen surface.

When the **Consistent layer thickness** toggle button is enabled, it will apply same layer thickness and first layer thickness for the new layer.

When it is disabled, new layer thickness of any nozzle size can be chosen for the new layer (see screenshot below).

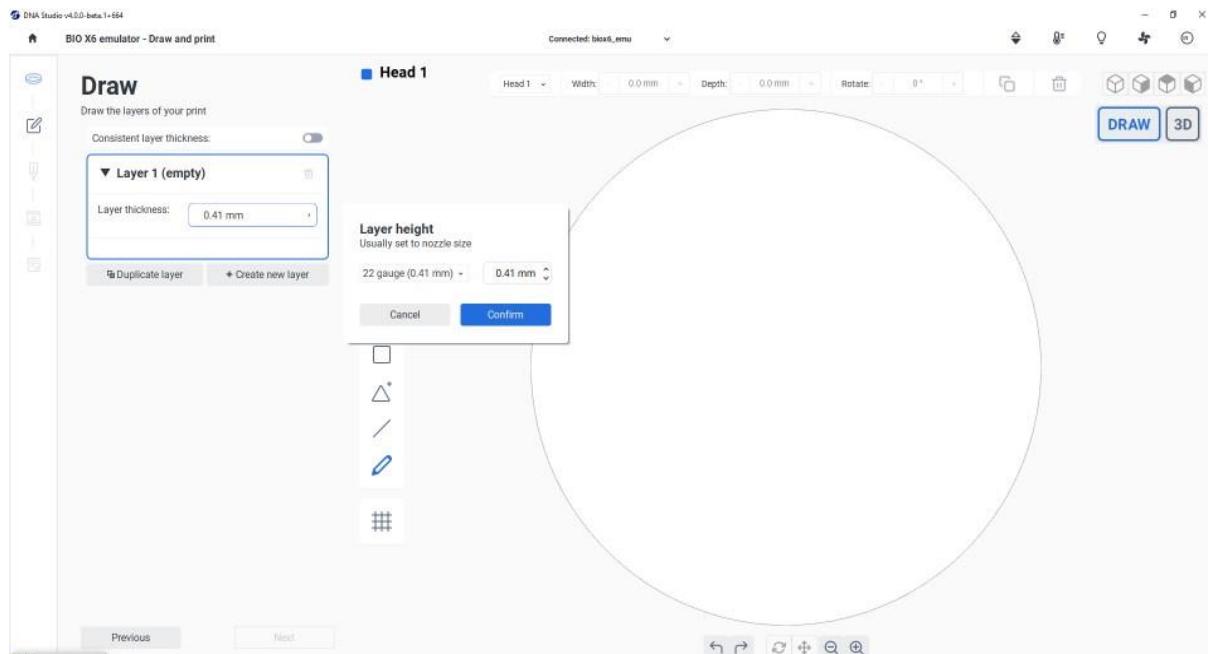


Figure 81 Consistent layer thickness disabled

5. **Duplicate layer:** Tap to create a duplicate layer. This will add a layer on top of previous layer.

When the **Consistent layer thickness** toggle button is enabled, it will apply the same layer thickness and first layer thickness for the new duplicate layer.

When it is disabled, new layer thickness of any nozzle size can be chosen for the new duplicate layer.

6. **Trash bin:** Tap to delete the selected layer.

## 6.2.2 Tool bar

The tool bar offers different options to draw shapes and to display and adjust the grid. Select predefined shapes such as lines, squares, circles, and polygons or use the pencil tool to draw freehand.

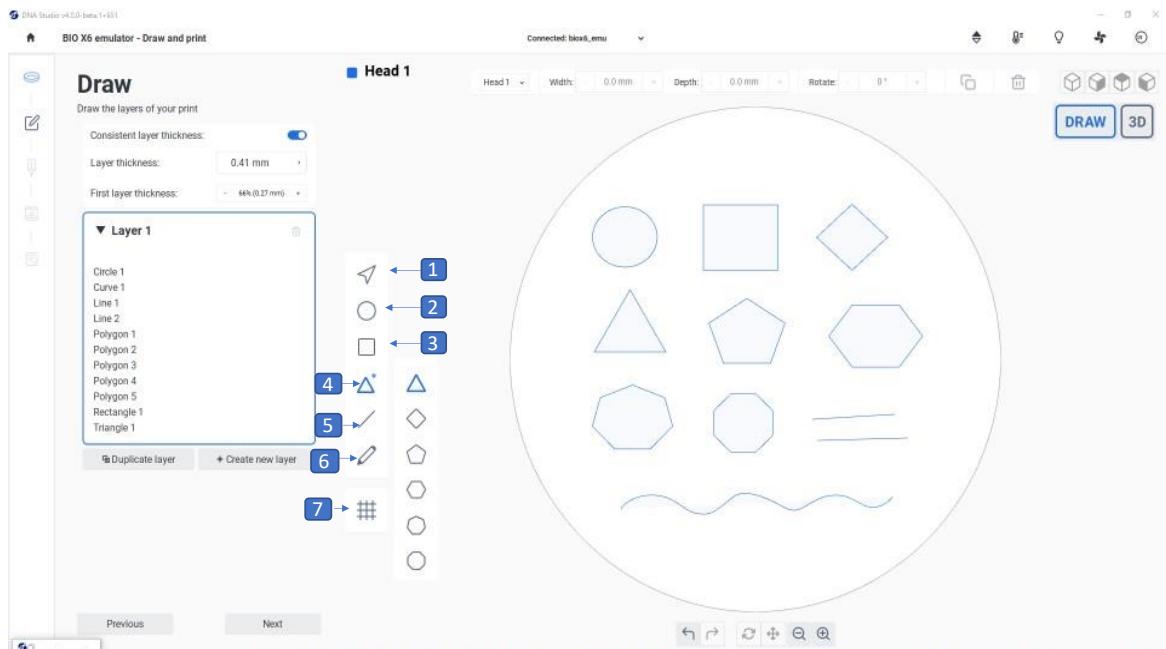


Figure 82 Draw tool bar

1. **Selector:** Tap this icon to select any shape which is already drawn on the surface.
2. **Circle:** Tap and drag the pointer on the surface to draw a circle.
3. **Square:** Tap and drag the pointer on the surface to draw a square.
4. **Polygons:** Tap, chose the required shape and drag the pointer on the surface to draw a polygon.
5. **Line:** Tap and drag the pointer on the surface to draw a line
6. **Pencil:** Allows you to draw any freeform shape. Tap and draw any shape or curves on the surface.
7. **Grid:** Tap to display the grid and to adjust the grid settings (see screenshot below).

## Grid settings

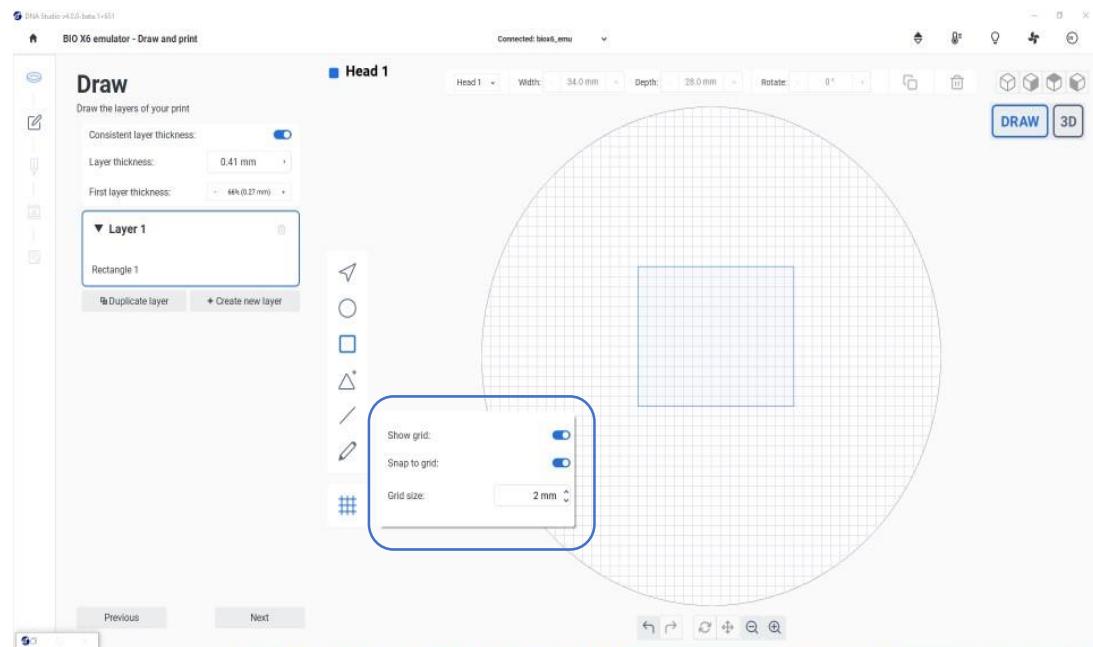


Figure 83 Grid option in the Draw tool bar

**Show grid:** Enable the toggle button to display the grid on the preview surface.

**Snap to grid:** Enable the toggle button to place your structure in the grid. This helps you improve accuracy when free drawing a shape. Note: Enable the button before you draw to make your structure snap to the grid. Structures already drawn will not be affected.

**Grid size:** Available settings for grid size are 1–20 mm. Use the arrows to change the grid size.

### 6.2.3 Shape Parameters bar

The shape parameter bar on the top of the screen offers different settings for existing shapes. Use this bar to assign a printhead to the current layer and to adjust the width and depth of the selected shape. You can also add infill and rotate, copy, or delete a shape.

**Note:** Except for the **Head** option, these tool bar options are only available when a shape has been selected using the **Selector tool**.

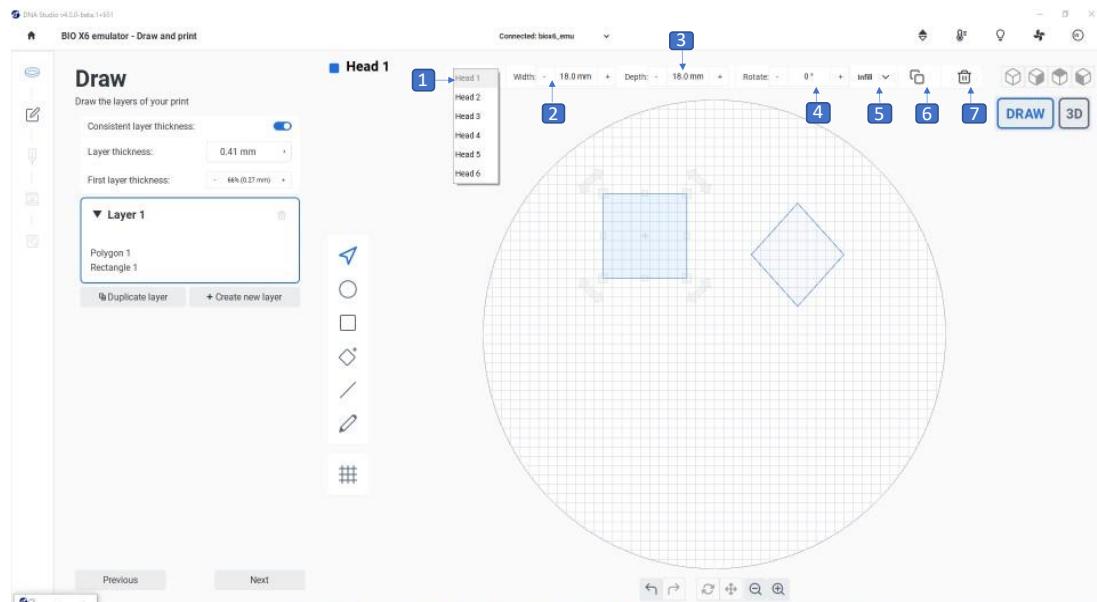


Figure 84 Shape Parameters bar

1. **Head:** Tap to select the printhead you want to use to print the shape.
2. **Width:** Select the required shape with the selector tool. Tap + - to change the width of the shape. Alternatively: Select the shape, hold the mouse pointer on the corner square and drag the shape to update the value.
3. **Depth:** Select the required shape with the selector tool. Tap + - to change the depth of the shape. Alternatively: Select the shape, hold the mouse pointer on the corner square and drag the shape to update the value.
4. **Rotate:** Select the required shape with the selector tool. Tap + - to rotate the shape in ±180 direction. Alternatively: Select the shape, hold the mouse pointer on the corner arrows and drag the shape.
5. **Infill:** Tap to apply patterns and density to the shape (see screenshot below).

## 6. Copy and Duplicate:

**Copy:** On a tablet: select **Copy**, tap and hold on the spot where you want to place your copy, and select **Paste** to insert. On a laptop: select **Copy**, right click the spot where you want to place your copy and select **Paste** to insert.

**Duplicate:** Select **Duplicate** to make a quick copy of the selected shape. The copy is automatically inserted with a small offset to the original shape.

## 7. Trash bin: Tap to delete the selected shape.

### Infill settings

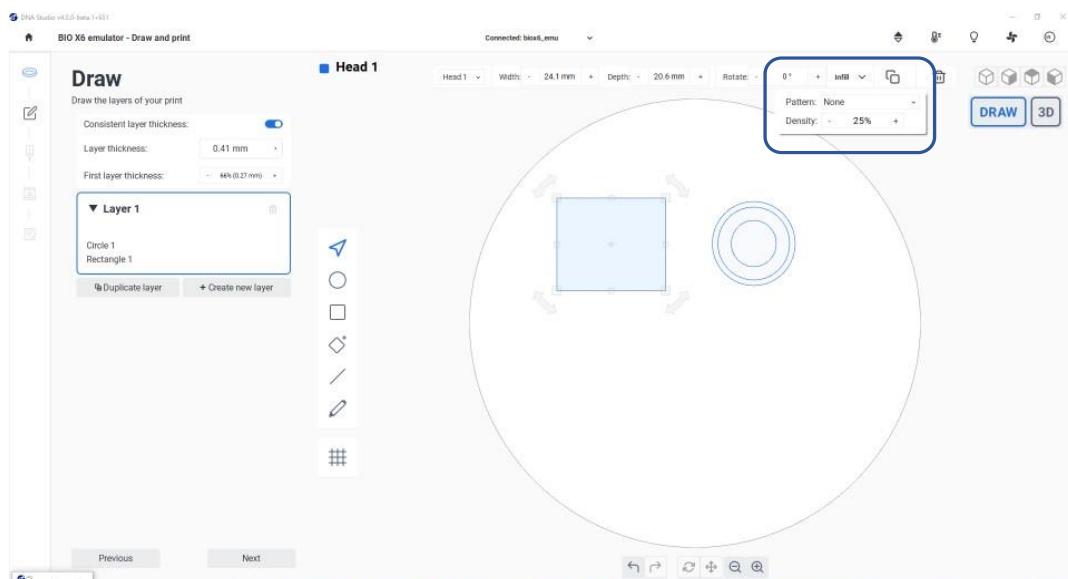


Figure 85 Infill settings in Draw & Print

**Pattern:** Tap to apply a pattern to the selected shape from the list of patterns. When no pattern is applied **None** is selected in the dropdown.

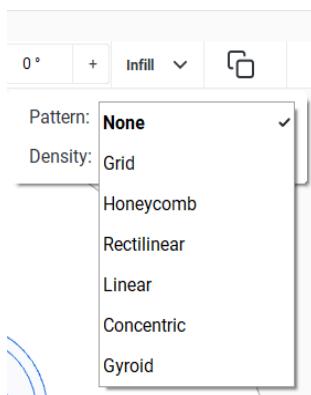


Figure 86 Infill pattern dropdown

**Density:** Tap to apply a density to the selected model. This indicates how dense the model should be, from 0% for no infill to 99% for high density.

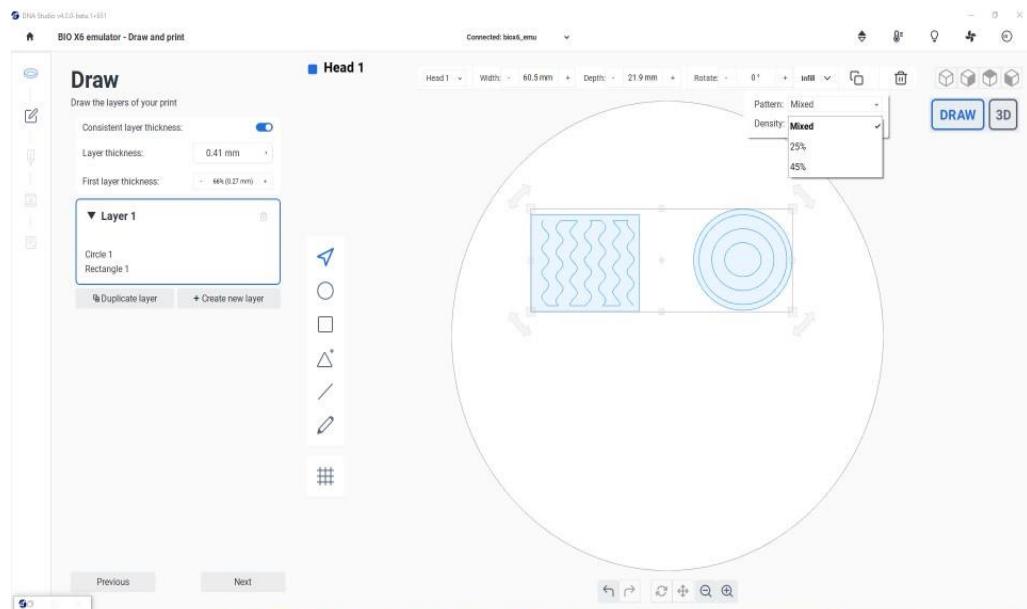


Figure 87 Mixed infill patterns in Draw & Print

When you select multiple shapes with different patterns, **Mixed** is selected in the dropdown. If a new pattern is selected, this is applied to all selected shapes.

When you select multiple shapes with different density, the density value box turns into a dropdown and displays **Mixed**. The dropdown shows a list of all densities of the selected shapes. The selected value is applied to all selected shapes.

When selecting multiple shapes with the same density, the value is shown in the density value box together with + - sign to modify the value.

## 6.2.4 Viewport options

The Viewport options bar in the upper right corner offers different ways to visualize the structure you have drawn.

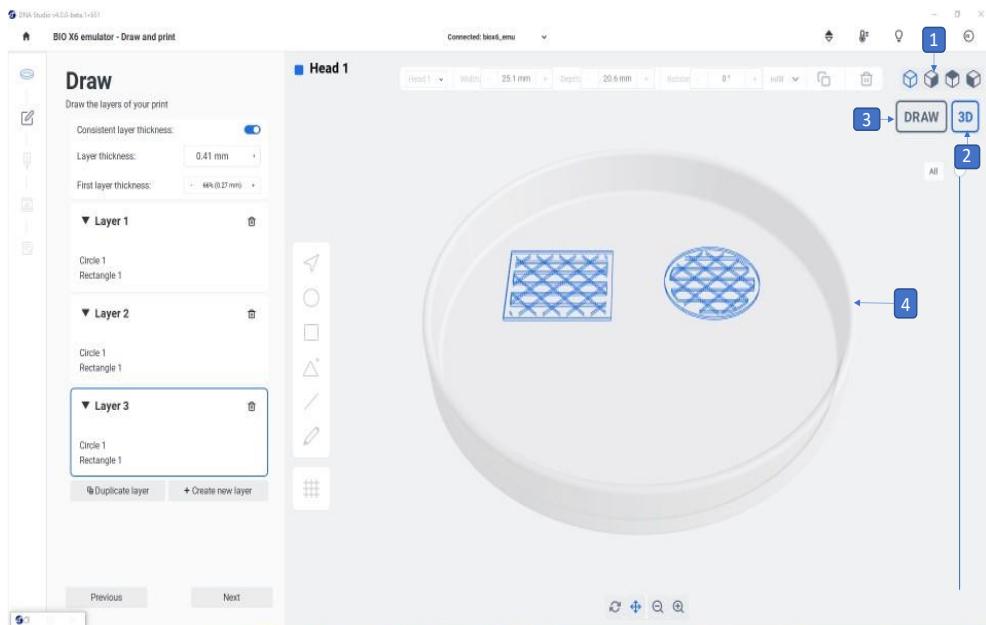


Figure 88 Views and draw modes in Draw & Print

1. **Isometric views:** These view options are only available in 3D mode. Tap to choose between different options: perspective, top view, side view. This helps you visualize with more detail the models to print and check for issues on the model or with the slice.
- View mode selector: The model can be viewed in two different dimensions
2. **3D:** The 3D view is the standard view for printing 3D models (see [Bioprinting from a 3D model](#)). Use the slider and isometric views to show all the layers in 3D.
3. **Draw:** Draw is an orthogonal (two dimensional) view from the top. It is the default selection when using **Draw** mode.
4. **Preview:** The shapes and how they are organized on the printing surface are displayed here.

## 6.2.5 Actions bar

The actions bar at the bottom center of the screen provides different options to undo and redo changes, zoom in and out, view the surface by dragging or rotating in all directions.

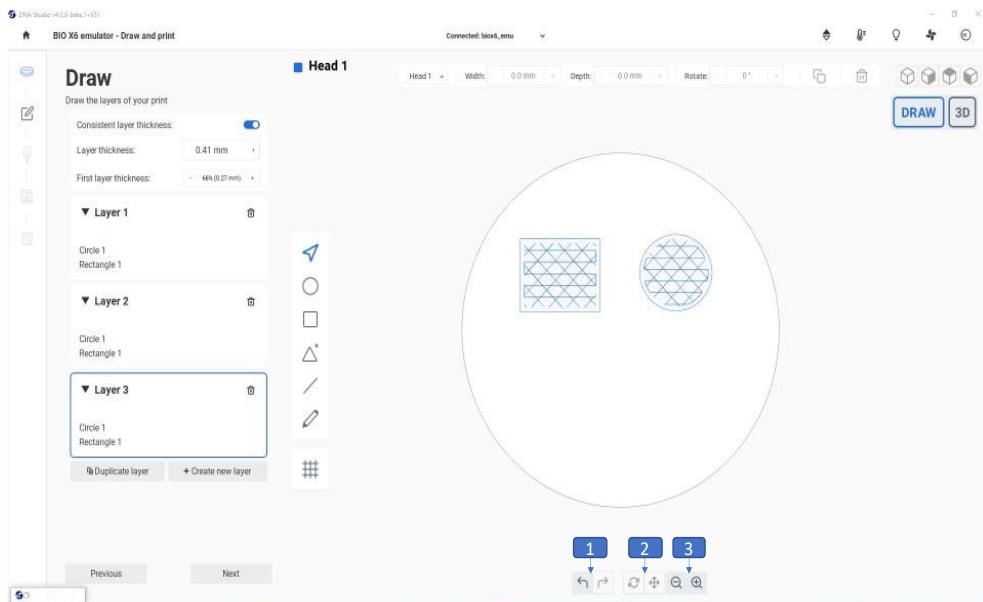


Figure 89 Actions bar in Draw & Print

1. **Undo and Redo:** Tap the left or right arrows to undo or redo your changes. These options are only available in the **Draw view mode**.
2. **Rotate and Pan:** Tap the **Rotate icon** and move the pointer on the surface in any direction to rotate the surface view. Tap the **Pan icon** to drag the surface to left, right, up, and down. These options are only available in the **3D view mode**.
3. **Zoom in and Zoom out:** Tap these icons zoom in or out. These options are available in both **3D** and **Draw view mode**.

## 6.2.6 Gcode generation

The application will generate the Gcode for the shape that you draw when you tap **Next** in the **Draw** screen and continue.

Follow the steps from [Printhead settings](#) to continue with bioprinting process

Tap the **Export gcode** button in the summary page to export Gcode that is generated for your shape and load the exported Gcode file for your next print.

07

Shape Generator

# 7 Shape generator

The Shape generator is a new feature in the **Model** protocol. It allows you to choose one of three predefined shapes: box, cylinder, and hemisphere to place on the print surface.

## 7.1 Create new model

This feature allows you to create constructs smaller than 1mm. 0.10mm is the smallest possible value. When any of the dimension chosen is less than 1.19mm size, an information of which gauge should be used will be shown.

In the example below are the settings available for the predefined shape box

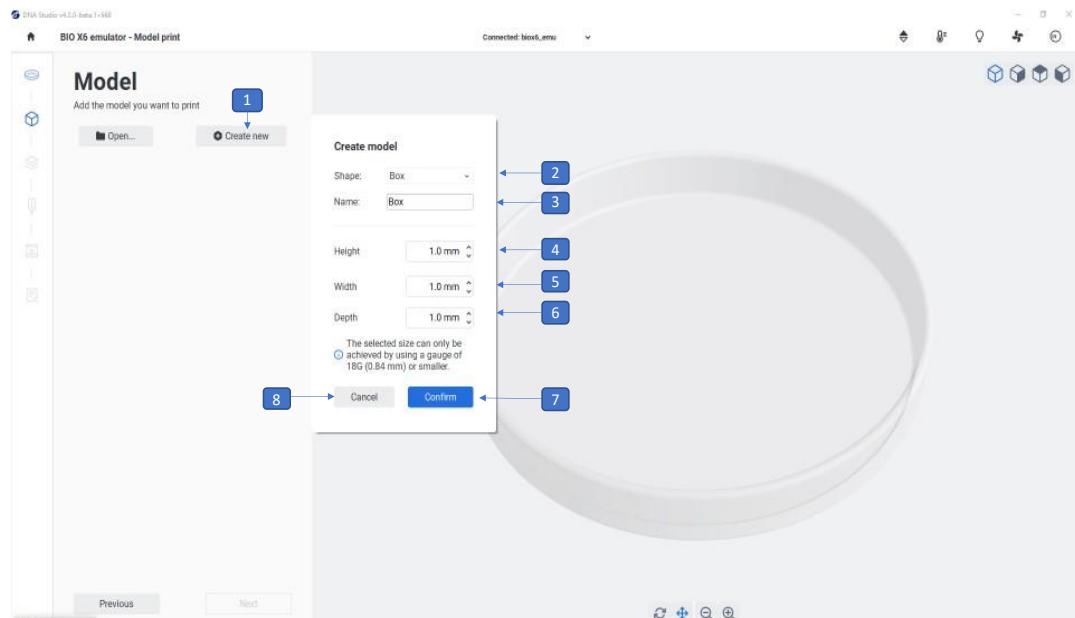


Figure 90 Create new shape

1. **Create new:** Tap to create a new model of a predefined shape (box, cylinder, or hemisphere)
2. **Shape:** Tap to show a list of predefined shapes to choose from
3. **Name:** Tap to specify a name for the model
4. **Height:** Tap to specify height dimension of the shape
5. **Width:** Tap to specify width dimension of the shape

6. **Depth:** Tap to specify depth dimension of the shape
7. **Confirm:** Tap to confirm the chosen shape and dimensions
8. **Cancel:** Tap to discard the settings made
9. **Diameter:** Specify the diameter for the cylinder and hemisphere shapes (see screenshots below)

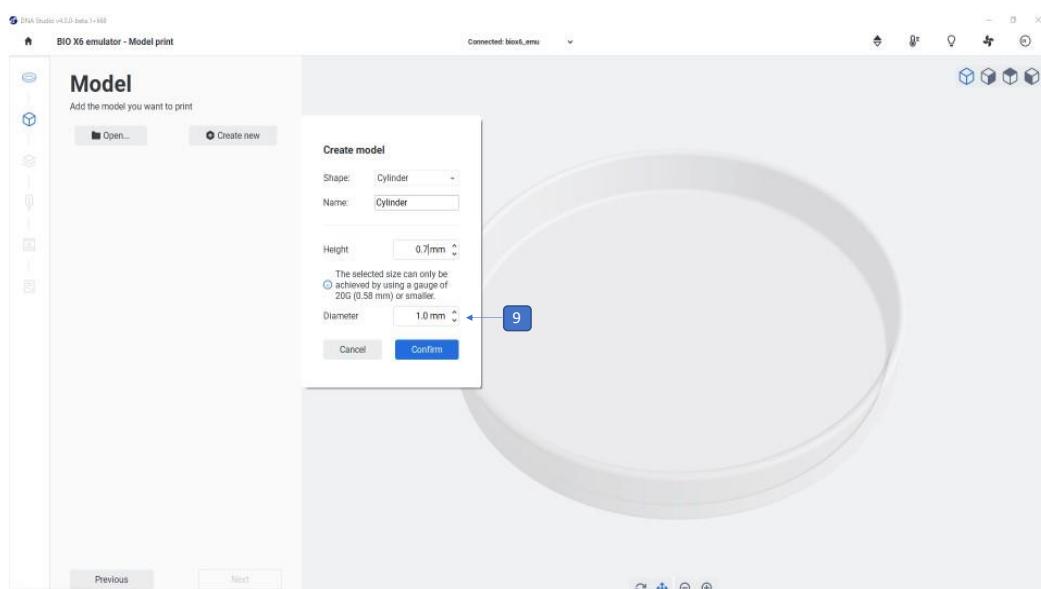


Figure 91 Cylinder dimensions

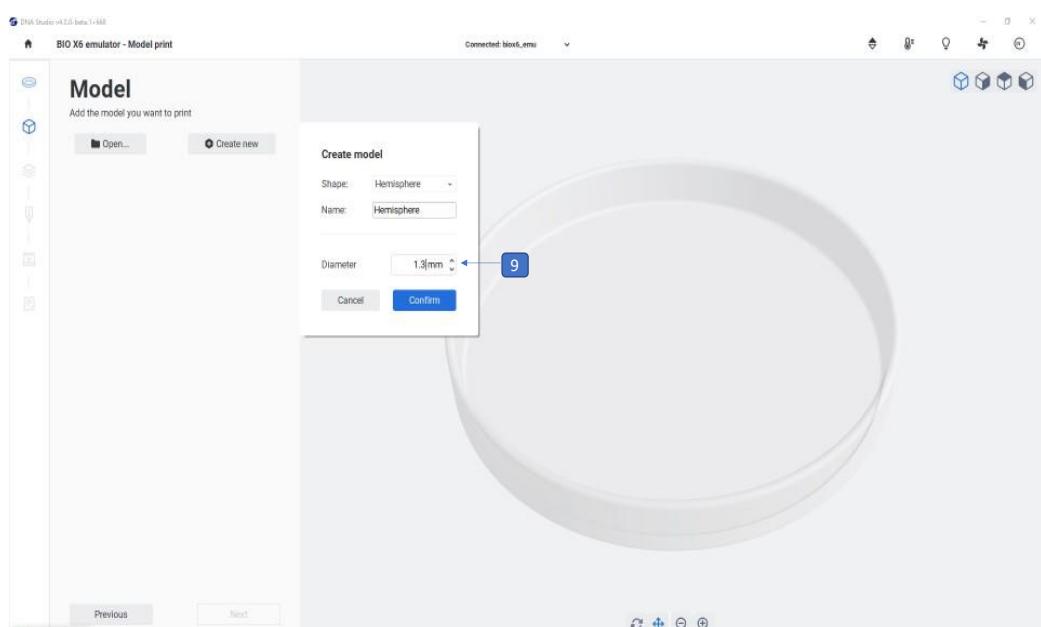


Figure 92 Hemisphere dimensions

## 7.2 Generate stl file and transform model

The Shape Generator also generates an stl file for the model or shape that you have created.

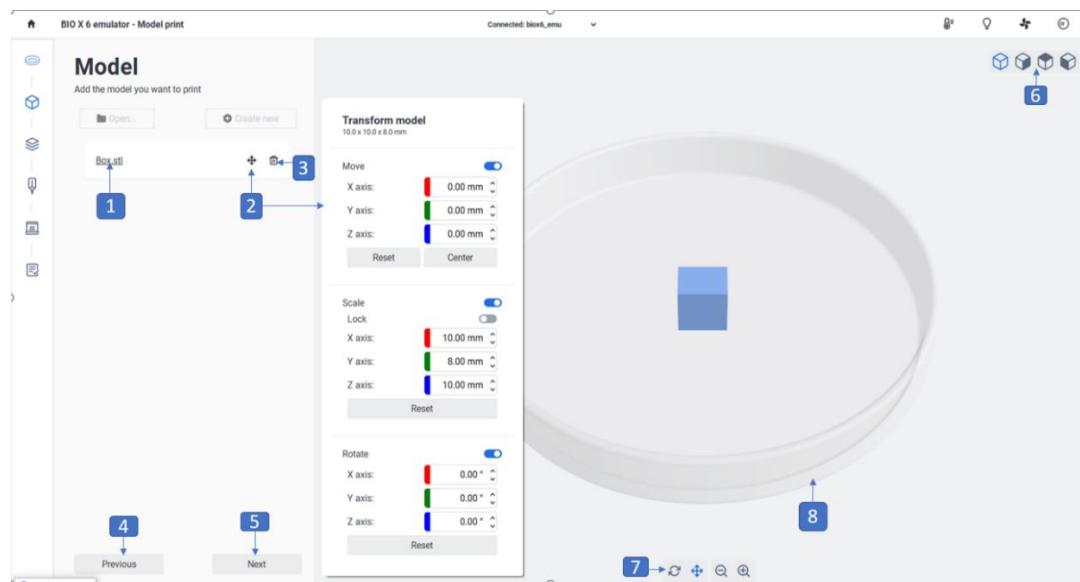


Figure 93 Overview over Shape Generator options

1. **Generated stl:** The name of the stl file that is generated for the chosen predefined shape is displayed here.
2. Tap this button to transform your 3D model by rotating, scaling, and moving it.
3. Tap the **trash bin** to delete the selected file.  
Any modifications can be reset or previewed in the center of any print surface.
4. **Previous:** Tap to go back to the previous step in the bioprinting process (Surface).
5. **Next:** Tap to go forward to the next step in the bioprinting process (Layers). This button is only available if a 3D model has been successfully opened or created.
6. **Isometric views:** Tap to choose between different options: perspective, top view, side view. This helps you visualize with more detail the models to print and check for issues on the model or with the slice.

7. **Visualization bar:** Tap to choose between different options: rotate, drag, zoom in and zoom out. This option helps you visualize with more detail the models to print and check for issues on the model or with the slice.
8. **Preview:** The model and its organization on the printing surface is displayed here.

To continue your 3D model, tap **Next** and follow the steps under [Layer settings](#).

08

Print report

# 8 Print report

The Print Report feature generates a PDF and HTML report by capturing every parameter from your print.

## 8.1 Prerequisites

**Note:** The printer must be connected to DNA Studio during the entire print to successfully autogenerate and store a print report.

Disconnection during the printing process will require manual print report generation from a print log.

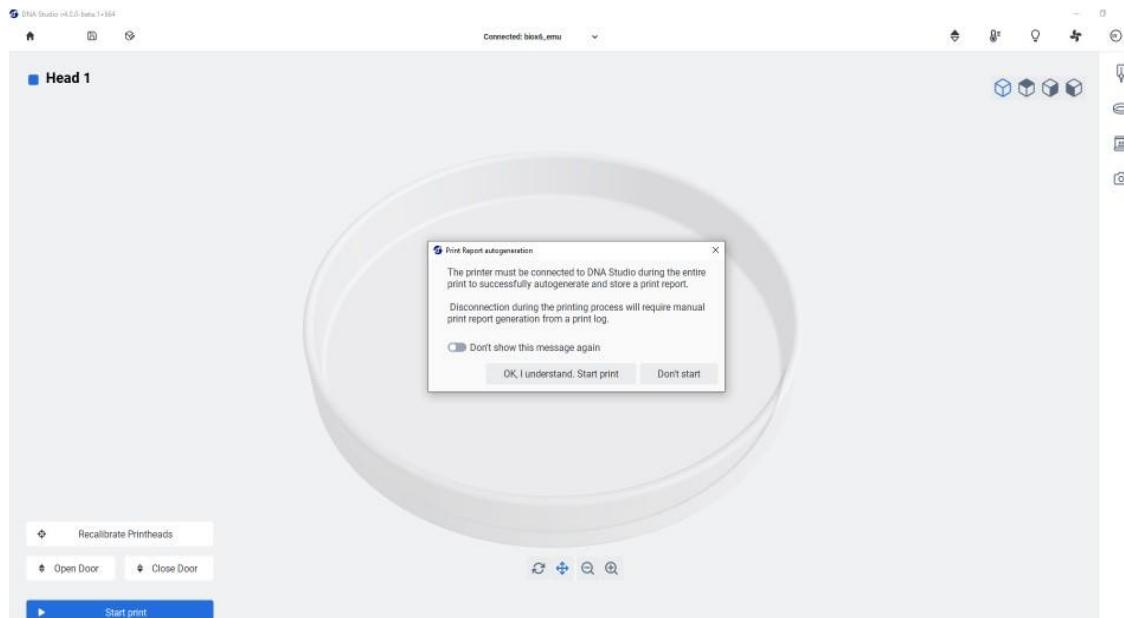


Figure 94 Automatically generated print report

Provided the BIO X6 is connected to DNA Studio, a print report is automatically generated at the end of the printing process

## 8.2 Opening and adding comments to print report

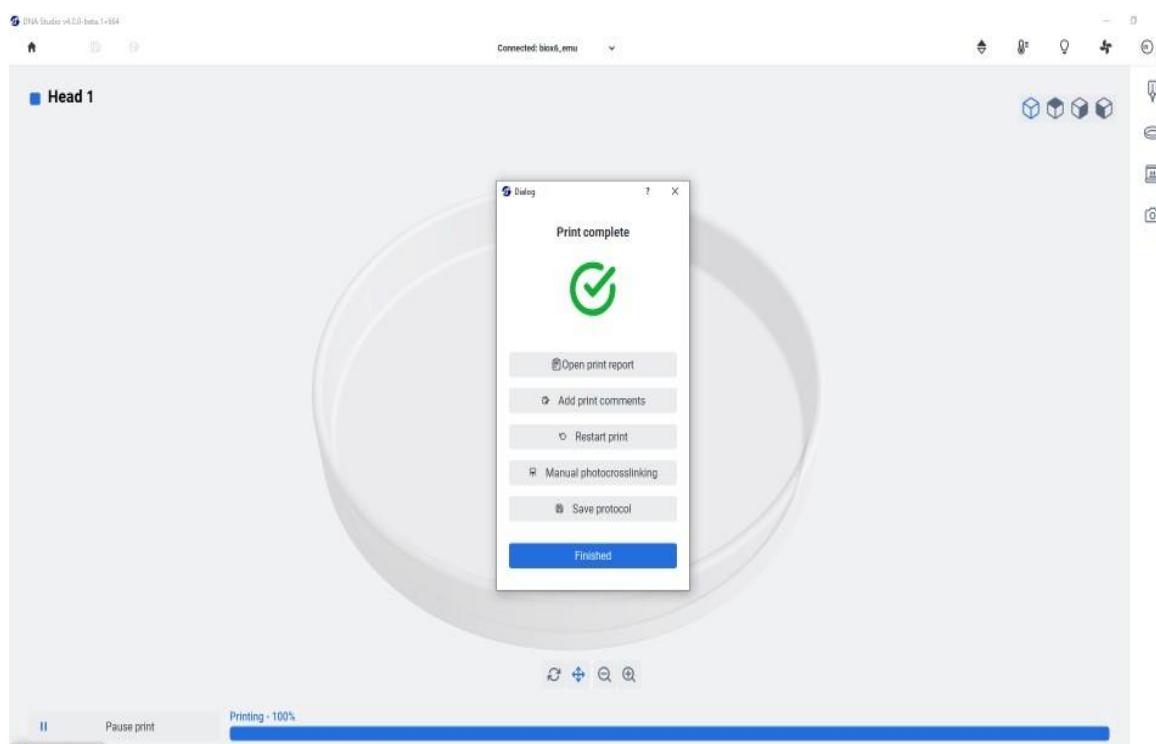


Figure 95 Print complete dialog

In the Print complete dialog:

Tap **Add print comments** to add any comments to your print report.

Tap **Open print report** to view the details of the protocol setup

## 8.3 Information included in the print report

Below you find some examples of what information is included in the print report and how it is presented (lists, tables, and charts).

Protocol name : model

Bio X6 - Model print

### Protocol setup

Surface	
Surface	petri_dish

Model	
Model:	20x20x1mm.stl
Well selection:	-

Layers	
Layer height:	0.84 mm
First layer height:	66% (.2 mm)
Infill pattern:	Grid
Infill density:	25
Support structure:	-
Layer 1, 2:	
Printhead:	Head 2

Printheads	
Head 2	
Printhead type:	Pneumatic
Pressure:	20 kPa
Print speed:	10 mm/s
Temperature:	Off
Preflow delay:	0 ms
Postflow delay:	0 ms

Figure 96 Protocol setup

<b>Photocrosslinking</b>	
Lightsource:	None
Pattern:	CenterOfSurface
Intensity:	100
Height:	4
Time:	15
Layers:	1,2

<b>Printer</b>	
Chamber fan:	Off
Lights:	Off
Printbed temp:	On
<b>Camera tool</b>	
Toolhead:	Head 5
When to capture:	AfterEachLayer
Camera light:	50
Save to:	C:/Users/BIOX6/OneDrive - Cellink AB/Bilder/BioX
<b>Travel Settings</b>	
Travel height:	1
Travel speed:	50

## Print time

<b>Print time</b>	
Time elapsed:	00:00:27
Start time:	1970-01-01T00:41:56.640
Finished time:	1970-01-01T00:42:24.472

Figure 97 Protocol setup, continued

## Printhead 2 - Pneumatic

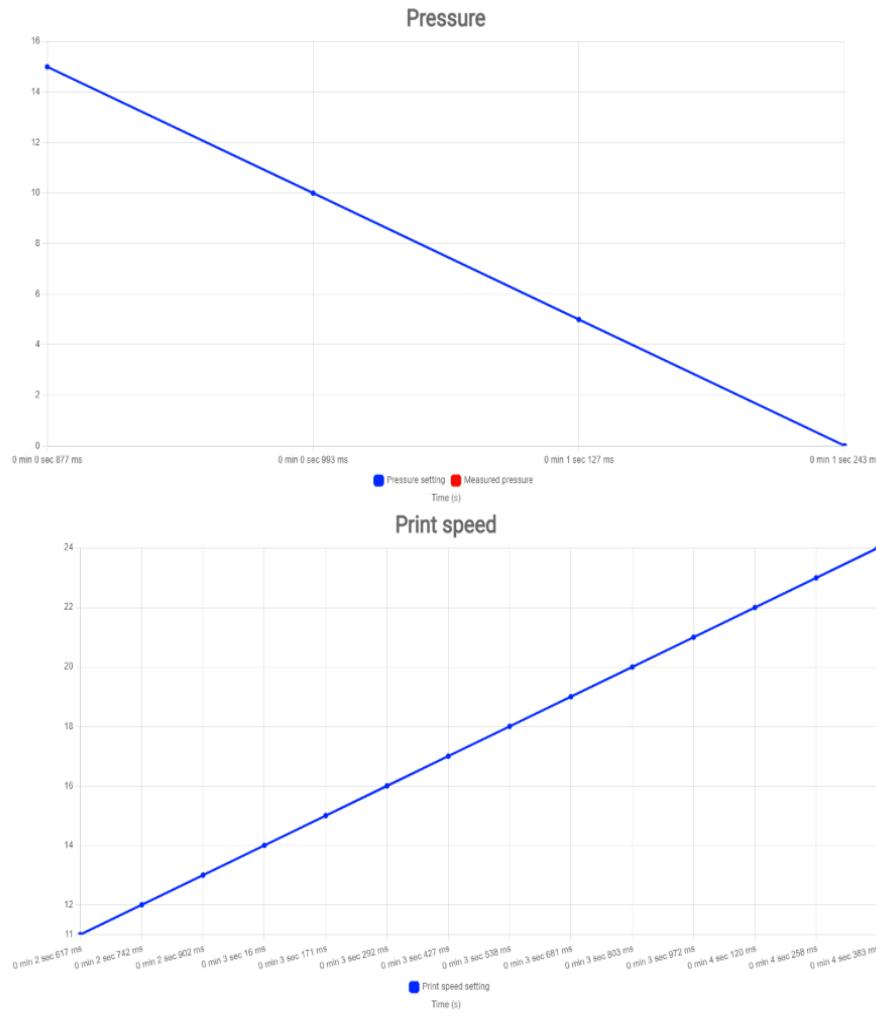
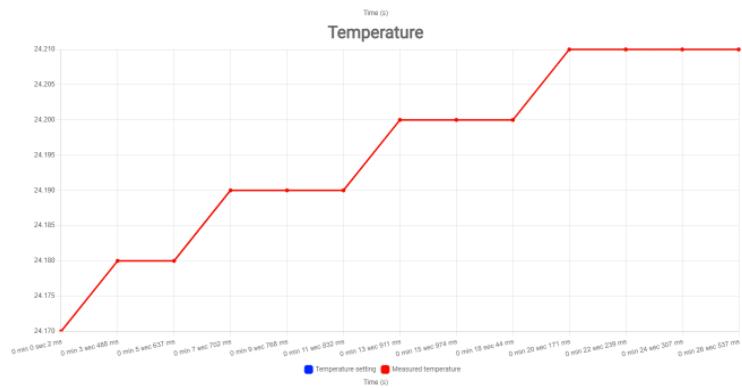


Figure 98 Example of data included in print report – printhead pressure and print speed



### Printbed

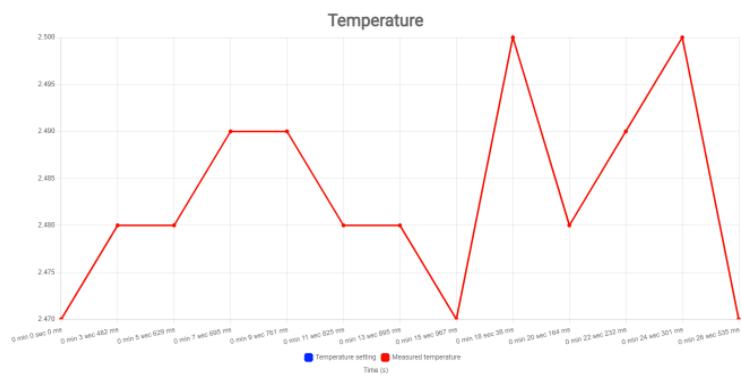


Figure 99 Example of data included in print report – printbed temperature

### Chamber

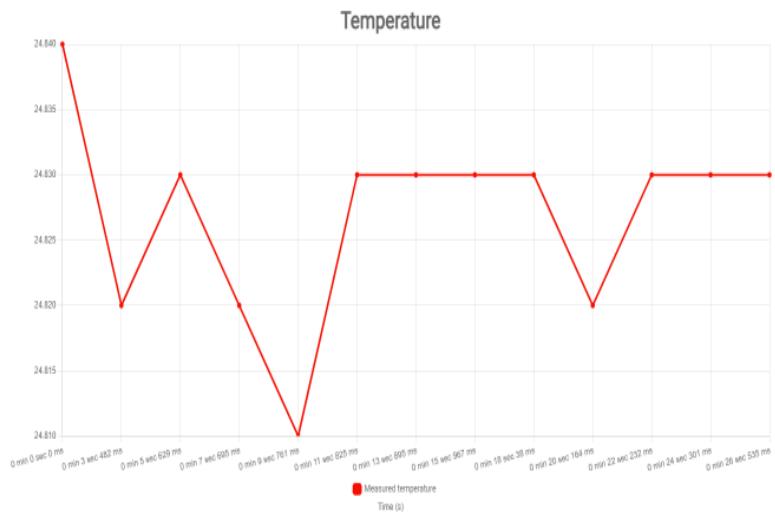


Figure 100 Example of data included in print report – chamber temperature

## 8.4 Opening previous print reports

Tap  $\equiv$  in the home screen and tap **Print Reports** to open stored PDF or HTML print reports

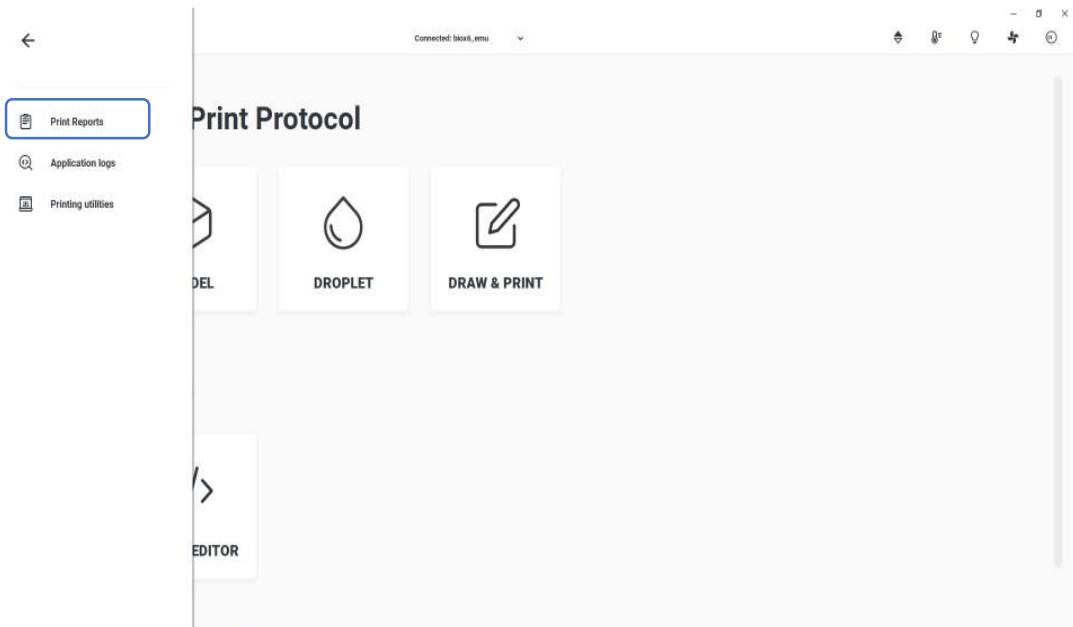


Figure 101 Print Reports option in the left menu on the home screen

09

Coaxial printing

# 9 Coaxial printing

Use this feature to simultaneously print two biomaterials from separate cartridges. This gives you better control when printing bioinks that require crosslinking or catalysing agents to maintain structure. Coaxial printing also supports printing vessel-like structures by enabling the combination of a primary material with a sacrificial material.

**Note:** The coaxial feature is only available for BIO X6.

## 9.1 Coaxial set-up

The coaxial printing set-up is made in the **Printheads** step in the **Model** protocol.

On the home screen, tap **Model** , choose surface to print on, open or create a new model, make the layer settings, and in the Printheads step enable the toggle button **Coaxial Printing**.

Tap  to open the **Coaxial printing dialog** to show an overview of the coaxial printing process.

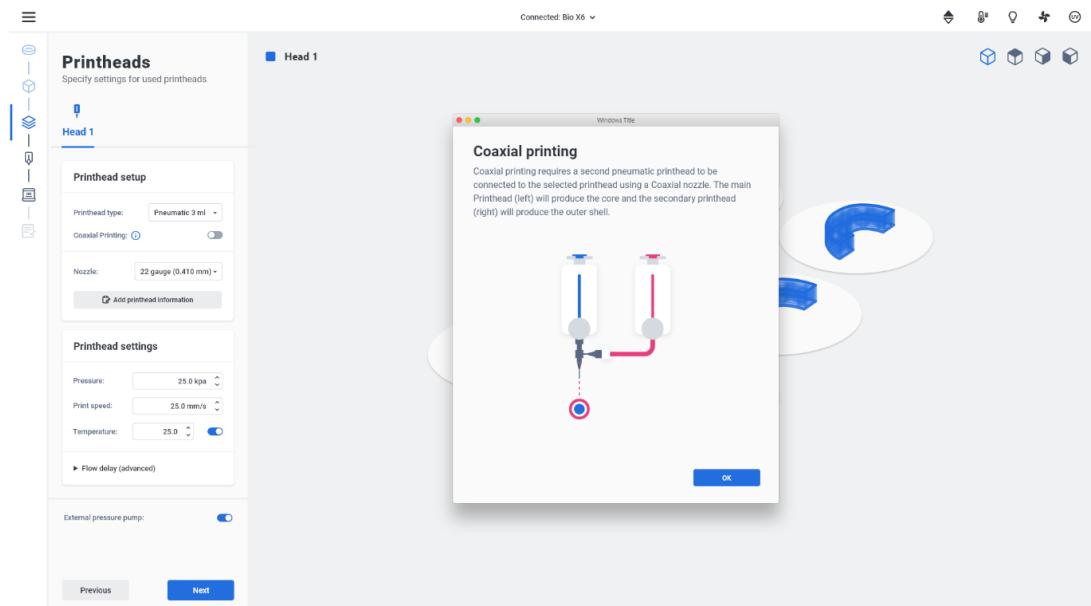


Figure 102 Coaxial printing dialog in the Printheads step

Learn more about coaxial printing and watch our video walkthrough:

[Creating More Complex Constructs with Coaxial Bioprinting - CELLINK](#)

## 9.2 Equipment for coaxial printing

The two printheads used when printing are connected through a special coaxial nozzle (see illustration below). This nozzle consists of one inner and one outer nozzle.

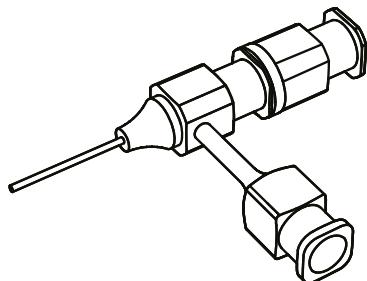


Figure 103 Coaxial nozzle

**Note:** Before printing, make sure the coaxial nozzle is well centralized between the inner nozzle and the outer nozzle. Use the spanner included in the coaxial kit to adjust it.

CELLINK offers different coaxial kits that contain everything you need to get started with coaxial bioprinting, including one 0.5-inch coaxial nozzle (suitable for cell printing), flexible connector tubes, Luer locks, cleaning wires, cleaning alcohol, a spanner and a 25 mL syringe.

Use this link to view all available coaxial kits: [Coaxial Kit - CELLINK](#)



Do not soak the printheads with too much fluid, for example surface disinfection, since the electronics of the backside fan is exposed on the temperature controlled printhead and the pneumatic printhead.

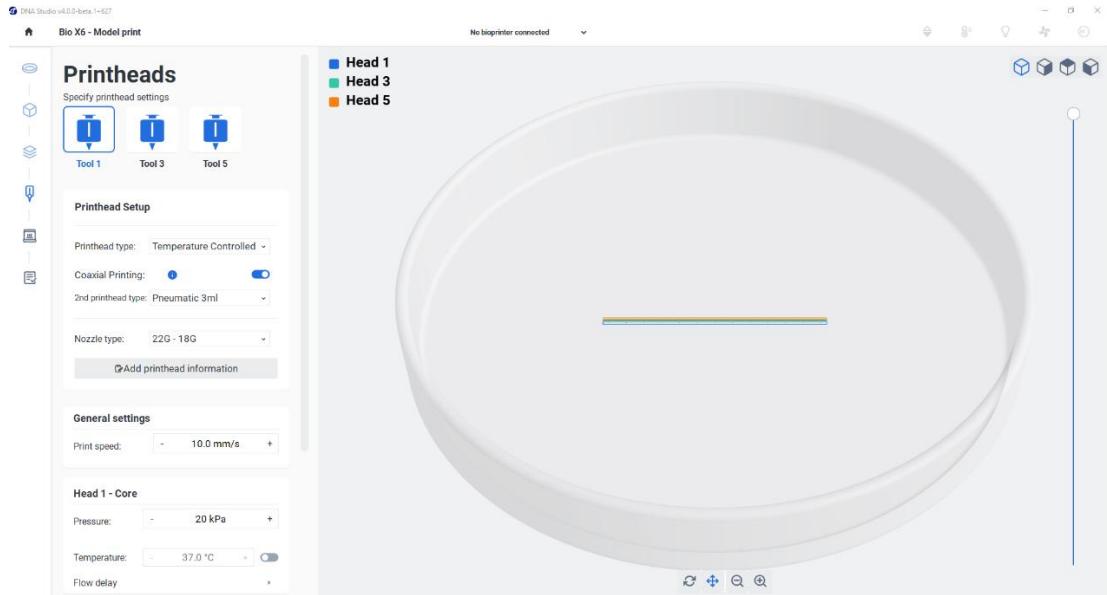


Figure 104 Printhead settings for coaxial printing

The coaxial printing feature can now handle up to 3 coaxial setups:

- First pair (first and second printhead)
- Second pair: (third and fourth printhead)
- Third pair: (fifth and sixth printhead)

Coaxial printing can be done with pneumatic printheads and temperature controlled printheads in any combination (see screenshot below).

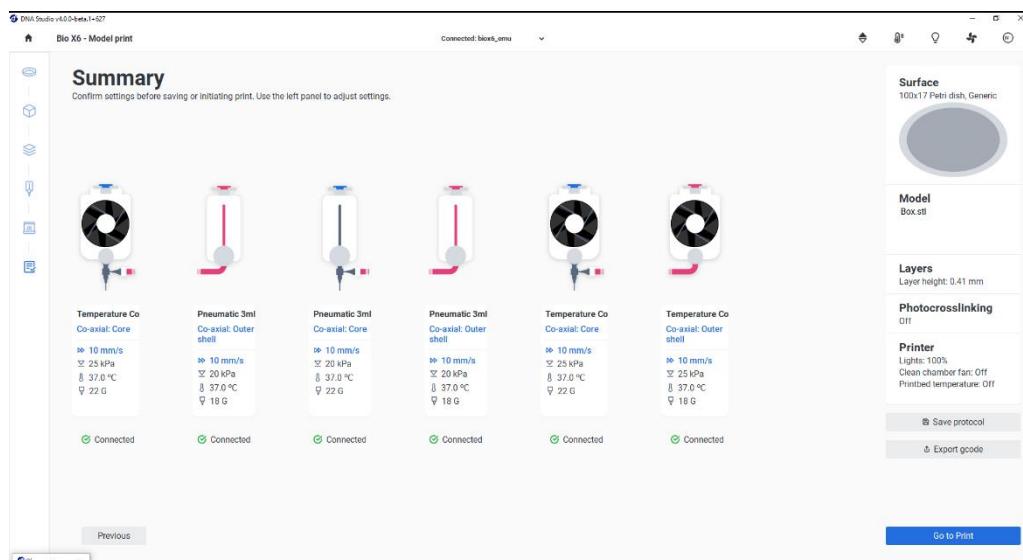


Figure 105 Printhead combinations for coaxial printing

After setting up your coaxial printing, follow the standard procedure to perform a manual or automatic calibration of the printheads.

# 10

## Maintenance

## 10 Maintenance

### 10.1 Maintenance plan



Read all general guidelines, warnings, and cautions before performing any maintenance on the BIO X6.



Always turn the power switch OFF and disconnect the power cord before you clean or perform maintenance on the product.

Task	Action	Regularity	Check Dates
Visual inspection and cleaning	Clean the bioprinter according to the instructions in Section 10.3 of this manual.	Every day before and after use	
Sensors and stop statuses	Check the sensors by triggering each sensor manually and checking the status in the printer sensor and <b>Utilities menu</b> (sensors and end stop statuses).	Every 3 months	
Software update	Update the software to the latest version for the BIO X6. The latest software can always be found on My CELLINK at <a href="http://my.cellink.com">my.cellink.com</a> .	Every 3 months or after a new software release	
HEPA filter	Replace the pre-filters and HEPA H14 filters.	Every 12 months or 2,000 h of use	

Preventive maintenance	Contact Customer Support to schedule a preventive maintenance check on your equipment to ensure that it continues to function as it did when it was first installed. Including recalibration, if needed.	Every 12 months	
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## 10.2 Troubleshooting

### 10.2.1 Software update

Make sure the main user has a MyCELLINK account. If you have not registered your BIO X6 yet, go to [my.cellink.com](http://my.cellink.com) and register to enable software updates.

Keeping your BIO X6 updated with the latest software version is highly recommended. This allows you to take advantage of the latest features and avoid any malfunctions while printing.

Follow the steps below to update your printer with the latest software version.

1. Log into your MyCELLINK account at [my.cellink.com](http://my.cellink.com). If you do not have an account, follow the steps online to register.  
**Note:** You need to provide the serial number of your BIO X6. This number is located on the back of the bioprinter.
2. Once you are logged in, go to **Downloads** and click on the **View** button in the BIO X6 image.
3. In the **Software Versions** list, click on the link to the latest version of HeartOS – BIO X6 and click **Download software**.
4. Locate the downloaded file on your computer and move it to the main folder on a USB flash drive.
5. Insert the USB flash drive into one of the USB ports on the BIO X6.
6. Locate the **Gear icon** in the upper right corner of the BIO X6 home screen.
7. Click **Update**.
8. Select the software file from your USB flash drive and follow the instructions shown on the screen. Do not turn off the bioprinter while it is updating.

9. Reboot the BIO X6 after the software update is complete.

If you run into any issues, please contact support@cellink.com.



Read all general guidelines, warnings, and cautions before performing any maintenance on the BIO X6.



Always turn the power switch OFF and disconnect the power cord before you clean or perform maintenance on the product

### 10.2.2 Troubleshooting quick guide

Problem	Cause	Remedy
The system doesnot power up properly.	The electricity supply has been cut off at the main.	Test another outlet and ensure nothing else is connected to the outlet.
		Check the voltage input on the outlet to ensure it matches the required voltage onthe back of the BIO X6.
The printbox is not moving or freezes during print.	Bioprinter is not homed.	Home the bioprinter in the Move and Calibrate menu.
	Dust and debris on shaft guide and screw.	Make sure the X- and Y-rails are clean; follow the maintenance guide to clean therails.
The output pressure onthe printheads is failing.	Tube inserted incorrectly into the pneumatic port.	Make sure the tubes are correctly fitted to the printhead and firmly connected to the desired pneumatic port.
	Tubing is bent or pinched.	Ensure tubing is straight and not bent.
	Clogged nozzle.	Replace or clean the nozzle.

Start Print (touch button) is not available to print.	Door is open.	Close the door.
Printer does not connect with the tablet.	Ethernet cable is damaged or broken.	Test another cable, make sure the cable is connected properly and the function of the computer outlet is OK.
	Computer software is blocking the connection.	Make sure no firewall blocks the printer from connecting with the computer.
	Wi-Fi connection fails.	Make sure Wi-Fi is enabled on the device you are trying to connect the BIO X6 to and that the BIO X6 hot spot is found and connected.
	Unable to connect to the printer's Wi-Fi	Ensure the Wi-Fi configuration is correct:  The hot spot name is the serial number of the BIO X6.  Password: cellinkbiox6
	Wi-Fi connection fails.	Be sure that you are using a 2.4 GHz Wi-Fi band to connect with the BIO X6. 5 GHz is not supported.
Printhead not recognized or connection is lost.	Printhead is not properly attached to the printhead mount.	Make sure the printhead is attached properly and the printhead LED turns on with a blue light.
HEPA-filter leakage or reduced airflow.	Leakage around the HEPA filter.	Make sure the HEPA filter is properly assembled.
	HEPA filter is damaged.	Replace the HEPA filter according to the manual.
	HEPA filter is clogged.	Replace the HEPA filter according to the manual.

Auto calibration is not available.	<p>Auto calibration is not supported with the following printheads:</p> <p>EMD Printhead</p> <p>Thermoplastic Printhead</p> <p>Auto calibration is not supported with the following toolheads:</p> <p>Photocuring</p> <p>HD Camera</p>	<p>Reach customer support if auto calibration is not available with the following printheads:</p> <p>Pneumatic Printhead</p> <p>Temperature-controlled Printhead</p> <p>Syringe Pump Printhead</p> <p>Check the sensor settings; make sure it is not being triggered.</p>
Print stops when connected to external air supply.	The air supply is interrupted.	<p>Check the connection and make sure it is connected correctly without leakage.</p> <p>If compressor is being used, ensure the compressor works as intended and supplies sufficient pressure.</p>
Printbed does not reach set temperature.	The ambient air is too hot.	<p>Turn off the BIO X6 and let it rest for 20 minutes.</p> <p>Open the door.</p> <p>Decrease the room temperature or increase the airflow to reduce the temperature of the ambient.</p> <p>Turn on the chamber fan to faster reduce the temperature of the BIO X6.</p> <p>Place the BIO X6 in a cool room.</p>
Temperature-controlled Printhead	The ambient air is too hot.	Decrease the room temperature or increase the airflow to reduce the temperature of the ambient air. Turn

does not reach set temperature.		on the chamber fan to faster reduce the temperature of the BIO X6. Place the BIO X6 in a cool room.
Thermoplastic Printhead is clogged.	Material is blocking the tip.	Clean the printhead by following the instructions in the Thermoplastic Printhead Manual.
Printer cannot read USB flash drive.	USB malfunction.	Try a different USB.  Ensure you have selected Safely Remove Hardware on your computer before removing the USB flash drive.
USB file does not appear.	USB file error.	Try a different USB.  Format the USB flash drive.  Redownload files to the USB flash drive.
UV lights not triggered.	Door is open.	Close the door.
Pump noise does not stop	Pump not reaching the pressure  Low air tank pressure detected while extruding  The pump is disabled after 15 seconds of continuous work	Check the air connections to printhead  Restarting the printer will re-enable the pump  Re-enable the pump, if error persist, contact support
ABL Automatic bed levelling fails.	The surface where the print is going to	

	<p>be is too tilted (more than 2 degrees)</p>	<p>Check the correct position and fixing of the surface, petri dish, well plates with the printbed.</p> <p>Add the Petri dish holder kit to avoid any movement on the surface while running ABL</p>
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## 10.3 Manually cleaning or sterilizing the BIO X6



Always turn off and unplug the BIO X6 before cleaning it with ethanol. Wear gloves to avoid direct contact with the bioprinter.

The BIO X6 has a chemical-resistant coating. Clean or sterilize it with >70% (v/v) ethanol. Spray the surface and wipe it with a soft cloth.



After using ethanol, wait at least 60 seconds before starting the BIO X6. Ethanol is flammable, and this ensures that all remaining ethanol vapor has been ventilated. Failure to wait can cause equipment damage and personal injury.

Task	Action	Regularity	Check Dates
Clean door (in/out)	Clean with a smooth cloth. Do not use harsh solvents. The glass is sensitive to acetone and other chemicals.	Every week	
Clean top plate	Clean carefully, avoid pushing dust/particles down to the pre-filter.	Every week	
Clean inside chamber	Remove any dirt on the rail or the lead screw with a clean, lint-free cloth or with your finger (with gloves on). After 6 months, it can be relubricated with clear fluoropolymer grease.	Every week	
Clean printbox	Clean with a smooth cloth, avoid using harsh solvents.	Every time it is used	
Clean printbed (top plate)	Clean the surface with a cloth and ethanol >70% (v/v).	Every time it is used	
Clean printbed (lower white part)	Clean with a smooth cloth, avoid using harsh solvents.	Every week	

Clean exterior (sides, back, front)	Clean the surface with a cloth and ethanol >70% (v/v).	Every week	
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Task	Action	Regularity	Check Dates
Clean touchscreen	Clean carefully with a smooth cloth, avoid using harsh solvents.	Every week	
Clean USB slots	No chemical solution or other liquid should be used when cleaning. Use a dust blower to carefully remove dirt and dust.	Every 3 months	
Clean ethernet slot	No chemical solution or other liquid should be used when cleaning. Use a dust blower to carefully remove dirt and dust.	Every 3 months	
Clean Pneumatic Printhead	Clean the printhead with a smooth cloth to remove any dust and debris. When not being used, store the printhead inside a sealed plastic bag in a cool and dry place to avoid dirt accumulation or deterioration of the instrument.	Every time it is used	
Clean Temperature-controlled Printhead	Clean the printhead body with a smooth cloth to remove any dust and debris.  Check the fan of the printhead for residues or accumulated dirt. Remove the printhead from the BIO X6 and use a dust blower  to carefully eliminate unwanted dust particles accumulated on the fan. When not being used, store the printhead inside a sealed plastic bag in a cool and dry place to	Every time it is used	

	avoid dirt accumulation or deterioration of the instrument.		
Clean Thermoplastic Printhead	<p>Remove residue of thermoplastic granules by heating the printhead with the cartridge mounted but not the nozzle and supply compressed air with the BIO X6.</p> <p>Clean the printhead body with a smooth cloth to remove any dust and debris. When not being used, store the printhead inside a sealed plastic bag in a cool and dry place to avoid dirt accumulation or deterioration of the instrument.</p>	Every time it is used	
Clean mirrors (metal reflectors)	<p>The ultrasound sensors are very sensitive elements that help the BIO X6 self-calibration process. Any type of residue, speck, dust, or dirt can considerably affect its performance. Cover the sensors before you clean the area around them. Make sure dirt is not deposited inside the tubes that inside the metal reflectors and that reflectors are held firmly place. If there is visible dirt and the autocalibration function of the BIO X6 does not work properly, contact the support team for instruction on how to clean the system and to check for proper operation.</p>	Every 3 months	

# 11

## Terms and conditions

# **11 Terms and conditions**

## **11.1 General terms and conditions**

These General Terms of Sale (the “General Terms”) apply to all products sold by CELLINK AB and CELLINK LLC (the “Products”), CELLINK Bioprinting AB for European sales at Långfilsgatan 7, 412 77 Gothenburg, Sweden, and CELLINK LLC for U.S. sales at 451 D Street, Ste 900, Boston, MA 02210 (“CELLINK”).

The General Terms shall constitute an appendix to a purchase agreement, supply agreement, order confirmation or other agreements of a similar nature, which together constitutes the Parties agreement (the “Agreement”).

The purchaser of products from CELLINK is hereinafter referred to as the “Buyer”, and “Party” means CELLINK, or the Buyer and “Parties” means CELLINK and the Buyer together.

If the General Terms contradict the Buyer’s general terms and conditions of purchase, CELLINK’s General Terms shall prevail.

Email shall be considered sufficient wherever “written” is used in these General Terms.

### **11.1.1 Orders and supplies etc.**

The Buyer shall order the Products in writing from CELLINK. No order is binding until CELLINK has confirmed an order. CELLINK will state the price and estimated delivery time in such confirmation. Notwithstanding the provisions in the Buyer’s order, each contract of sale shall be subject to these General Terms.

The Buyer is aware and acknowledges that the Buyer’s delivery capacity varies depending on, inter alia, the general market conditions. As soon as CELLINK has reason to assume that a delay in the agreed delivery could occur, CELLINK shall notify the Buyer thereof and shall in such case be entitled to reasonable prolongation of the delivery date of up to twenty (20) business days. Notwithstanding the foregoing, CELLINK shall always endeavour to maintain a delivery capacity that enables CELLINK to deliver the Products in accordance with accepted orders.

## **11.1.2 Payment**

The Buyer shall purchase the Products at the prices set out in CELLINK's price list applicable at the time when CELLINK has received each respective order. CELLINK has the right to change the price list at any time.

Unless otherwise agreed in writing, the Buyer shall pay for all Products no later than thirty (30) days from the date of CELLINK's invoice. When purchasing the Products marked with "advance payment" the Buyer shall pay 50% of the purchase price in advance, in accordance with CELLINK's invoice.

The Buyer has no right to offset. The Buyer shall not have the right to withhold payments to CELLINK or reduce the amount of payments owed to CELLINK under this Agreement for fees, claims, damages, expenses, or other amounts owed, or alleged to be owed, to Buyer from CELLINK under this Agreement or any other agreement.

In the event that the Buyer at any time should fail to make payment in full on the due date, CELLINK shall be entitled to claim interest on the sum overdue until payment is made at the rate equivalent to the reference rate of interest (as determined by the Central Bank of Sweden) plus eight percentage points per annum. Title to the Products shall remain with CELLINK until fully paid by the Buyer in accordance with this section.

## **11.1.3 Service**

Unless otherwise agreed in writing, CELLINK shall be solely responsible for, and entitled to, carry out after sales service and repairs on all Products.

## **11.1.4 General conditions of delivery**

The Products shall be delivered from CELLINK to the Buyer under the following delivery terms:

- (i) regarding new Products or Products returned after upgrading or repair - CPT - Carriage Paid To (Incoterms 2010).
- (ii) regarding Products returned after warranty actions - DAP - Delivered at Place (Incoterms 2010).

Any delivery from Buyer to CELLINK, e.g., of Products returned for repair or calibration (whether under warranty terms or not), shall be delivered DAP - Delivered at Place (Incoterms 2010).

CELLINK reserves the right to make partial deliveries. Unless otherwise agreed, invoices will be adjusted pro rata. For the purpose of these terms any partial delivery will be regarded as filling a specific order.

### **11.1.5 Product liability**

CELLINK is not liable for any damage caused by the Product to any movable or immovable property or the consequences of such damage, which occurs after the Product is delivered to the Buyer. The Buyer shall indemnify and hold CELLINK harmless to the extent that CELLINK incurs liability towards any third party in respect of loss or damage for which CELLINK is not liable in relation to the Buyer following Section 5.1.9 For the avoidance of doubt, the Buyer shall have a liability to recourse all costs inflicted on CELLINK, due to any such claims.

Subject to the limitations stated above, CELLINK is liable for claims made by a consumer, in accordance with mandatory law for personal injury or damage to property caused by the Product.

If a claim for damage as described in this section is lodged by a third party against one of the Parties, the latter Party shall forthwith inform the other Party thereof in writing.

A precondition for CELLINK's liability set forth above is that CELLINK has been notified in writing of such claim in accordance with above and given authority to settle the claim or control the defense of any suit and proceeding.

If in the event that a Product or parts thereof becomes subject to a recall decided by CELLINK, the Buyer shall participate and assist in such a process in accordance with CELLINK's instructions. The Buyer is entitled to compensation for its reasonable direct and documented costs occurred in relation to the provision of such assistance.

The limitation of CELLINK's liability set forth in this section shall not apply where CELLINK has been guilty of negligence.

Both Parties shall keep and maintain product liability insurance in accordance with customary conditions.

## **11.1.6 Acceptance**

The Buyer shall, immediately following each delivery of any Product, inspect the Product to identify any external damage and to ensure that the delivery is in accordance with the order. Any defects or deficiencies which are detected in conjunction with delivery shall immediately be reported in writing to CELLINK.

When a Product is unpacked, and in any event before the Product has been used by the Buyer, the Buyer shall perform a full inspection of the Product where such was not possible on receipt of the Product in question. The obligation to report any defects to CELLINK as set out in the section below shall apply in such context.

At the request of CELLINK, the Buyer shall make defective goods available to CELLINK for inspection and control.

If the Buyer does not report defects or deficiencies in Products delivered within the time limits set out above, the Buyer shall have no right to make any claims against CELLINK regarding the default or defect.

## **11.1.7 Liability for defects**

CELLINK shall remedy any defect in Products delivered, resulting from faulty design, specification, materials, or workmanship attributable to CELLINK in accordance with the provisions of Section 5.3

CELLINK is only liable for defects that appear under the intended and proper use of the Products, included printing using CELLINK's bioink only. Thus, the liability does not cover defects caused by faulty maintenance, handling or incorrect storage by the Buyer, alterations of the Products carried out without CELLINK's prior written consent, or normal wear and tear and deterioration.

In order to enable the Buyer to bioprint, the Buyer may insert a USB to upload an .stl file to the BIO X6. CELLINK shall not be liable for any damage or loss caused by the BIO X6 on any other software contained on the USB. CELLINK shall neither be liable to remedy any defects to the BIO X6 caused by faulty or corrupt software provided by the Buyer.

CELLINK's liability is limited to defects which appear within 12 months from the date when the Products were delivered.

The Buyer shall notify CELLINK in writing of a defect without undue delay after the defect has appeared, and in no case later than two (2) weeks after the expiry of the liability periods as set out above. The notice shall contain a description of how the defect manifests itself. If the Buyer fails to notify CELLINK in writing within the above time limits, the Buyer forfeits its right to make any claim in respect of the defect. If there is reason to believe that the defect

may cause damage, notice shall be given forthwith. If notice is not given forthwith, the Buyer forfeits the right to make any claim based on damage which occurs, and which could have been avoided, if such notice had been given. After receipt of a written notice, CELLINK shall, at CELLINK's option, repair or replace the Product or make a reasonable reduction of the purchase price for the Products without undue delay. If CELLINK fails to fulfil its obligations under this section within a reasonable time, the Buyer may by written notice require CELLINK to do so within a final time. If CELLINK fails to fulfil its obligations within that time limit, the Buyer may terminate the purchase of the defective Products in question by written notice.

If the Buyer gives such notice as referred to above, and no defect is found for which CELLINK is liable, CELLINK shall be entitled to compensation for the work and costs which it has incurred as a result of the notice.

All transports in connection with replacement shall be at the Buyer's risk and at CELLINK's expense. The Buyer shall follow CELLINK's instructions regarding how such transport shall be carried out. CELLINK shall have no liability for defects save as stipulated above. This applies to any loss the defect may cause, such as loss of production, loss of profit and other consequential economic loss.

The limitation of CELLINK's liability under this section shall, however, not apply where CELLINK has been guilty of negligence.

### **11.1.8 Software**

The software (proprietary software and third-party software), documentation, interfaces, content, and any data that came with the Products, which may be updated or replaced by feature enhancements or software updates provided by CELLINK (the "Product Software"), is licensed, not sold, to the Buyer for use in accordance with these General Terms. CELLINK [and its licensors] retain ownership of the Product Software itself and reserve all rights not expressly granted to you.

### **11.1.9 Granted rights**

CELLINK grants the Buyer a non-exclusive, non-transferable, non-sublicensable, perpetual right to use the Product Software in the Products within the Buyer's own business. The Buyer shall not have any right to the Product Software apart from the right to use Product Software in line with these General Terms. Except for the Buyer's right to make back-up copies if this is necessary for the intended use of the Product Software, and to decompile the Product Software to achieve interoperability with other programs, the Buyer is not allowed to modify, copy, disassemble, reassemble, distribute, publish, reverse engineer, build a derivate or

duplicate the Product Software, its components, services, or features. The Buyer is only allowed to use the Product Software for your own benefit, and you are not allowed to make the application available to third parties.

### **11.1.10 Trademarks and other intellectual property rights**

All intellectual property rights and other rights, including without limitation patents, design rights, trademarks, copyright and know how, relating to the Products and any and all documentation related thereto shall be the exclusive property of CELLINK.

Nothing in connection with purchase of Products or in the Agreement shall constitute or be construed as a transfer of ownership of any of CELLINK's intellectual property rights or other rights or to otherwise give the Buyer any proprietary rights to CELLINK's intellectual property rights. The Buyer shall not remove or change any trademark, trade name, sign or other mark on any Products or its packing or make any alterations in the construction or design of any Product.

### **11.1.11 Permitted use of the products**

You agree to and warrant that you only will use the Products in:

- accordance with these General Terms and the user manual provided for the Products.
- a way that does not promote or encourage illegal activity.
- a way that is not harmful, abusive, or offensive, does not infringe the rights of any third party or in any other way can harm CELLINK; and
- compliance with all applicable laws, including local laws of the country or region in which you reside, or in which use the Product.

### **11.1.12 Limitation of liability**

Save for what follows from Section 5.1.11, CELLINK's aggregate liability in relation to any claim of any kind for any loss or damage arising out of, connected with, or resulting from the Agreement or from the design, manufacture, sale, delivery, resale or use of the Products or

any part thereof, as the case may be, shall be limited to the refund of the purchase price of the Products with respect to which the loss, damage or breach occurred.

In no event shall CELLINK be liable towards the Buyer for any loss of production or profit, loss of use, loss of data, loss of contracts or for any other consequential, economic, or indirect loss whatsoever in respect of the sale, purchase, use or disposition of the Product.

The limitation of CELLINK's liability in this section shall not apply where CELLINK has been guilty of negligence.

### **11.1.13 Force majeure**

The Parties shall be relieved from liability for a failure to perform any obligation under the Agreement during such period, and to the extent that the due performance thereof by either of the Parties is prevented by reason of any circumstance beyond the control of the Parties ("Discharging Circumstance"). If not otherwise shown, war, warlike hostilities, mobilization, or general military call-up, civil war, fire, flood, or other circumstances of similar importance, shall be considered as Discharging Circumstances.

If a Party wishes to invoke a Discharging Circumstance, it shall give immediate notice to the other Party of the commencement and the cessation of such Discharging Circumstance, failing which, the Party shall not be discharged from liability for any non-performance caused by such Discharging Circumstance.

The time for performance of the relevant obligations of a Party shall be appropriately extended by the period during which a Discharging Circumstance continues, provided, however, that if performance of a contractual obligation is prevented by a Discharging Circumstance for a period of six (6) months or more, each Party shall be entitled to terminate the Agreement.

### **11.1.14 Confidentiality**

The Parties hereby undertake, during the term of this Agreement and thereafter, to hold in confidence and absolute secrecy any and all Confidential Information (as defined below), disclosed by the other Party pursuant to this Agreement and not to disclose to third parties any Confidential Information received. Furthermore, the Parties shall take reasonable steps to prevent an unauthorized disclosure or use of such Confidential Information by employees, subagents, or other intermediaries.

For the purpose of this Agreement, “Confidential Information” means any and all information (whether in written or oral form), including but not limited to technical, practical, commercial information and the contents of this Agreement, save as provided under (a) – (d) below:

- (a) information, which is known, or which becomes known in full detail to the public otherwise than by breach of the obligations herein contained.
- (b) information which the disclosing Party can show was in its possession before receiving it from the other Party.
- (c) information which a Party has received or receives from a third party without restraints as to the disclosure thereof.
- (d) information which a Party is legally obliged to disclose by compulsory law, court order or by order of another authority of competent jurisdiction.

Concerning unauthorized returns:

Returns not pre-authorized will not be eligible for repair, replacement, or refund. Do not send it back to CELLINK unless you have contacted us first and we have authorized you to send it.

### **11.1.15   Miscellaneous**

The Agreement, including all appendices hereto including the General Terms, contains the final, complete, and exclusive agreement of the Parties relative to the subject matter hereof and supersedes all prior and contemporaneous understandings and agreements relating to its subject matter.

These General Terms shall be interpreted and construed in accordance with the laws of Virginia. The United Nations Convention on Contracts for the International Sale of Goods shall not apply.

Any dispute, controversy or claim arising out of or in connection with this Agreement, or the breach, termination, or invalidity thereof, shall be finally settled by arbitration administered by the Arbitration Institute in Virginia. The place of arbitration shall be Blacksburg, United States. The language to be used in the arbitral proceedings shall be English.

## **11.2 End-user license agreement BIO X6**

CELLINK BIO X6 3D bioprinter software end user license agreement by clicking on “I accept” or by installing, downloading, or accessing the CELLINK 3D bioprinter software (“licensed software”), licensee acknowledges that it has read, understands, and agrees to be bound by the following terms and conditions, and licensee represents that it has the authority to enter into this user license personally, or if on behalf of a company to bind that company to the terms of this user license. If licensee does not agree to all terms and conditions of this user license, or if licensee does not have such authority, licensee must not click on “I accept” and must not use the licensed software. CELLINK may at any time and at its sole discretion modify these terms by posting revised or additional terms and conditions on its website (<https://cellink.com>) or within licensed software, including with- in or accompanying software updates or revisions. Such modifications shall be effective immediately upon posting, and licensee’s continued use of licensed software and any revisions or updates after the modifications have become effective shall be deemed licensee’s conclusive acceptance of the modified terms.

CELLINK holds all right, title, and interest in and to the CELLINK 3D Bioprinter Software (“Licensed Software”) and all associated websites, platforms, and applications, and is the sole and exclusive owner of <https://cellink.com> (the “Website”).

This CELLINK 3D Bioprinter Software End User License Agreement (“User License”) is entered into by and between CELLINK and users of the CELLINK 3D Bioprinter Software, including their employers and personnel of such employers (collectively “Licensee”).

CELLINK may offer certain Licensed Software in the form of software provided with or embedded on a CELLINK 3D Bioprinter product and/or on and through the Website, and Licensee wishes to access and to use the Licensed Software and the Website in accordance with the terms and conditions set forth in this User License.

### **11.2.1 License**

Subject to these terms and conditions and Licensee’s compliance therewith, CELLINK grants Licensee (each a “Party” and collectively the “Parties”) a non-exclusive, non-transferable, no sublicensable, limited and revocable license to install, use, and/or access the Licensed Software for commercial or non-commercial use by Licensee only on CELLINK 3D Bioprinter(s) owned or controlled by Licensee in accordance with this User License.

## **11.2.2 Authorized users**

Licensed Software may be installed, used, or accessed only by Licensee, who is responsible for compliance with this User License by its authorized users.

## **11.2.3 Reservation of rights**

Licensee acknowledges and agrees that the Licensed Software is not sold to Licensee but is only licensed. All rights not expressly granted in this User License are reserved by CELLINK. Licensee acknowledges and agrees that no ownership interest in the Licensed Software is acquired by downloading or using the Licensed Software and that Licensee has only the limited license granted in this User License and no other rights, implied or otherwise. The source code of the Licensed Software and any other materials identified as confidential or proprietary constitute the confidential and proprietary information of CELLINK and shall only be used in conjunction with Licensee's authorized use of the Licensed Software and may not be disclosed to third parties.

## **11.2.4 Updates or revisions**

CELLINK is not obligated to provide any services, updates, or revisions to the Licensed Software, however, such updates may be introduced by CELLINK from time to time. The Licensed Software may communicate with CELLINK or its third-party provider servers to check for available updates (e.g., enhanced functionality and new versions). Licensee may receive notice of (e.g., be prompted to download and install) or the Licensed Software may automatically download and install available updates. Licensee agrees to download and install any, and all updates when available and acknowledges that if not updated as recommended the Licensed Software may not operate as expected. Licensee acknowledges and agrees that updates, supplements, and replacements are part of the Licensed Software and are subject to all terms and conditions of this User License, unless separate terms are said to apply.

## **11.2.5 Trademarks**

CELLINK is the owner of various trademarks, including U.S. registered trademarks for CELLINK and BIO X6 and including logos relating to the CELLINK business. Licensee agrees not to use CELLINK's trademarks in any way, including but not limited to promoting Licensee's products produced with a CELLINK 3D Bioprinter or Licensed Software and shall make no claims that CELLINK endorses Licensee's products or services. Licensee

recognizes and acknowledges that its breach of this User License may cause irreparable damage to CELLINK, which cannot be readily remedied by monetary damages in an action at law and may constitute an infringement of CELLINK's intellectual property rights and rights under unfair competition laws. In the event of a breach by Licensee of this User License, including any action by Licensee which could cause some loss or dilution of the goodwill, reputation, or rights in any of CELLINK's trademarks, CELLINK shall be entitled to an immediate injunction in addition to any other remedies available, to stop or prevent such irreparable harm, loss, or dilution.

### **11.2.6 Third-party materials**

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## 11.3 Warranty

We guarantee that you will receive our product tested, working, fully assembled and ready to use. Every bioprinter is covered under the Conditions of Carriage by FedEx, DHL and UPS (see links below).

<https://www.fedex.com/en-hu/conditions-of-carriage.html>



[http://www.dhl.com/en/express/shipping/shipping\\_advice/terms\\_conditions.html](http://www.dhl.com/en/express/shipping/shipping_advice/terms_conditions.html)



<https://www.ups.com/us/en/help-center/legal-terms-conditions/service.page>



We will also personally insure every bioprinter sent under Declared Value Insurance, also optioned by FedEx. If, in the case there is a problem with the product outside of the FedEx terms, it is not the result of neglect of the purchaser and the incident occurs and is reported within 3 months (90 days) of the purchase date, conforms to all the rules of the warranty hereby included and the customer provides the original proof of purchase/ serial number, then CELLINK will work out the problem on an individual basis as each problem must be addressed this way.

In the rare case of a specifically diagnosed and proven DOA (dead on arrival) part (detailed description and documentation required), CELLINK will most likely send a replacement part to you. In the case that a customer has already been through all these previous options stated and is still not satisfied with the results, the customer must have the bioprinter sent back at their own expense. Once a return is received (for example a returned bioprinter), CELLINK will then send back a new unit at our own expense. Proper packaging is required in the rare case of a returned product or part, and the product itself must arrive back in the condition in which it was originally received.

CELLINK is not in any way responsible for any consequential losses or downtime whatsoever caused by a problem in the performance of our products. CELLINK is not responsible for additional customs fees and tariffs. CELLINK is not responsible for delivery delays or the inability to deliver from the carrier. CELLINK is not responsible for damages

resulting from improper handling during delivery. The warranty also does not cover any damages brought about because of an accident. All warranties are voided if the product has been moved from the original country of purchase.

The guarantee and warranty do not cover any alterations or repairs made by a second or third party. We are always eager to work with you personally to fix any problem that may arise in the most efficient fashion meeting its specific case, but we do not suggest you to "rig" up something outside of the recommended guidelines in your user manual unless personally instructed by us to do so. CELLINK provides no guarantees on the safety or performance of modified products. We are also not responsible for incorrect voltage being used, environmental conditions (moisture, fire, water, flood, lightning, ext.), or any other form of neglect on the customer's part. If you are unsure about something, feel free to contact us prior to using the product.

CELLINK is not responsible for damages caused by the use of old information. The latest documentation is always available on our website.

The guarantee and warranty cover critical components only. For example, CELLINK will not replace a bioprinter because of a perceived blemish in the paintjob. The critical components/replacement parts do not carry a warranty themselves and are only covered in the initial 3 months warranty starting on the purchase date. Components not included in the warranty include timing belts, linear ball bearings, rods, and the build platform.

Moving parts, although of the highest manufactured quality, must be properly maintained, serviced and/or oiled, and the failure to do so will result in progressed wearing and tearing. The heated build platform itself will be subjected to unavoidable scratching and wear upon use. If you wish to order replacement parts, they are available in our online store, or by contacting us personally by telephone or email. There is no warranty issued when exotic printing material is used with the product and doing so is not recommended by us at CELLINK. Foreign materials can damage the system. The warranty does not cover operating the bioprinter at non recommended speeds and settings.

In the case that a repair is determined to be outside of the warranty and the buyer decides to send back the product for repairs, the buyer will ship the product at their own expense. The costs to repair the product will also be at the buyer's expense.

**Concerning refunds:**

A refund is possible only with the BIO X6 3D Bioprinter itself and will not be offered for any filaments, or spare parts. If within two weeks (14 days) after receiving your BIO X6 3D Bioprinter you are not completely satisfied; we offer you a refund option.

You ship it back at your own expense and after we receive it, we will deduct a 10% restocking fee from the total refund of the price of the BIO X6 3D Bioprinter (excluding the tax and other fees). There will also be a thorough inspection of the bioprinter, and upon finding any damages deemed on the part of the buyer, other deductions from the refund would be made accordingly.

Deductions will be made for any wear perceived to the bioprinter, including scratches. The 14- day period after receiving the bioprinter will be concretely determined in calculation with the FedEx tracking information.

**Limitations:**

This guarantee and limited warranty are sole and final as they stand in reference to BIO X6, CELLINK and its products where permitted by law. Any implied warranty or fitness is limited to this 3-month (90 day) warranty starting from the date of purchase. CELLINK waives all liability for any incidental, exemplary, punitive, collateral, indirect, consequential, or special damages. CELLINK will determine on sole discretion whether an issue is covered under the warranty or not.

Concerning any problems or inquiries, please contact us at [info@cellink.com](mailto:info@cellink.com)

Returned parts/products can be sent to:

Cellink Bioprinting AB

Långfilsgatan 7

412 77 Gothenburg Sweden

**12**

**Printhead  
manuals**

## 12 Printhead manuals

### 12.1 CELLINK Standard Pneumatic Printhead

#### 12.1.1 Getting started

Go to the **Printing Utilities** menu.

Go to the **Move & Calibrate** menu. Home the BIO X6 system.

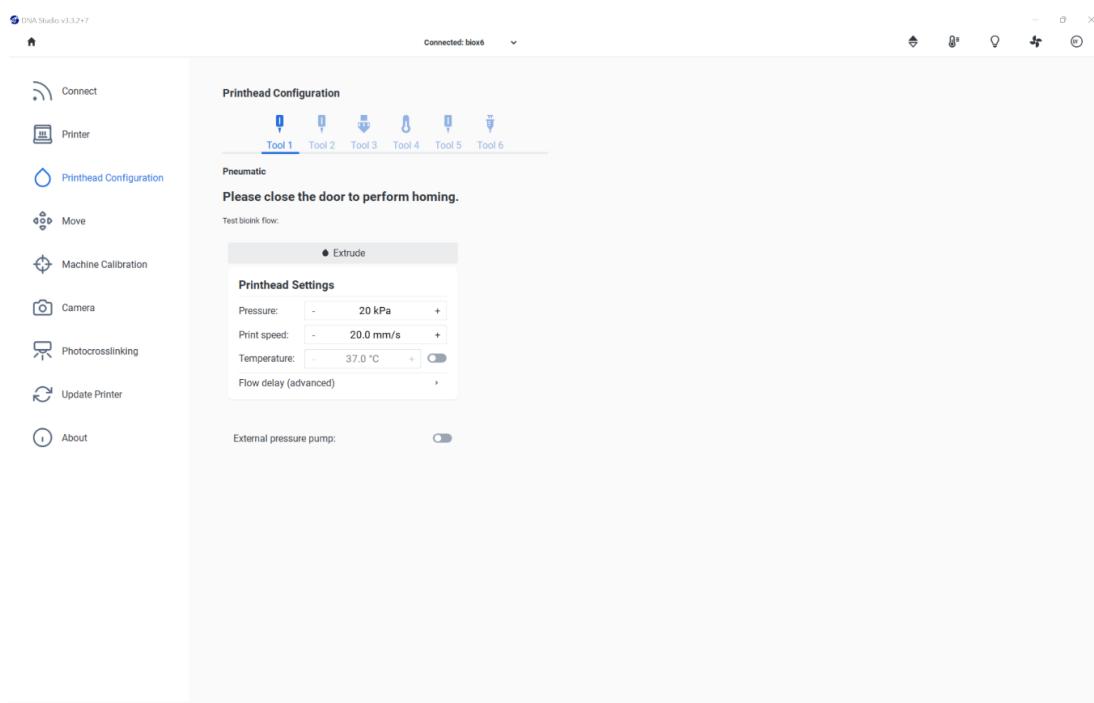


Figure 106 Example of printhead configuration

The Standard Pneumatic Printhead is an extrusion-based printhead. It is equipped with heating up to 60°C. It employs compressed air to extrude bioinks. The Standard Pneumatic Printhead is designed to fit 3 mL cartridges only.



The current temperature of the printhead is indicated in several ways, including a color indication on the printhead (red is hot, yellow is warm, and blue is cold) and an indication of the temperature on the printer display.

## 12.1.2 Printhead overview

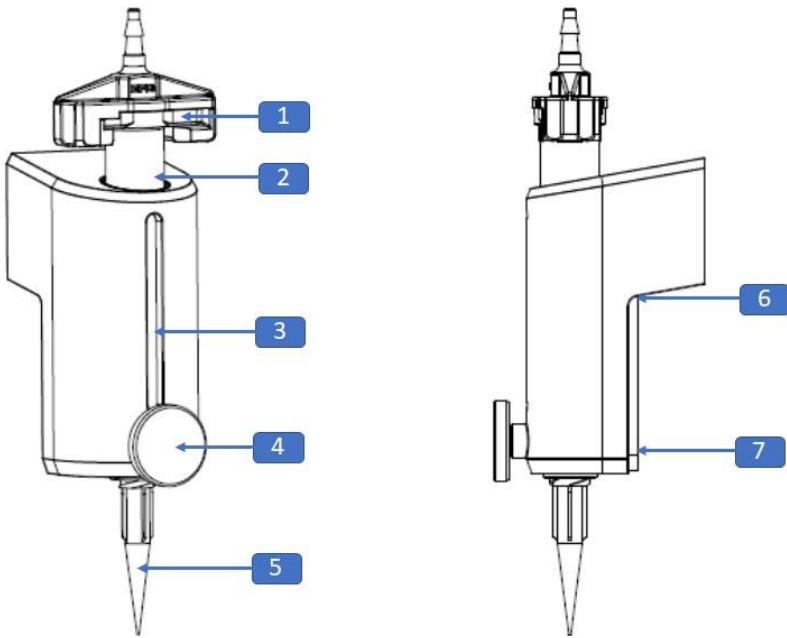


Figure 107 Overview of the Standard Pneumatic Printhead

1. Cartridge
2. Heat indicator: The LED changes color depending on the printhead temperature: red is hot, yellow is normal, and blue is cool
3. Opening for cartridge overview: View the volume of bioink left in the cartridge
4. Cartridge fastening screw: Securely fastens the cartridge to the printhead
5. Nozzle or needle
6. Printhead contact: The connector between the BIO X6 and the intelligent printhead
7. Magnet: The magnet securely fastens the printhead on the printhead holder

### 12.1.3 Mounting a cartridge in the printhead

Follow these steps to mount a cartridge in the Standard Pneumatic Printhead.

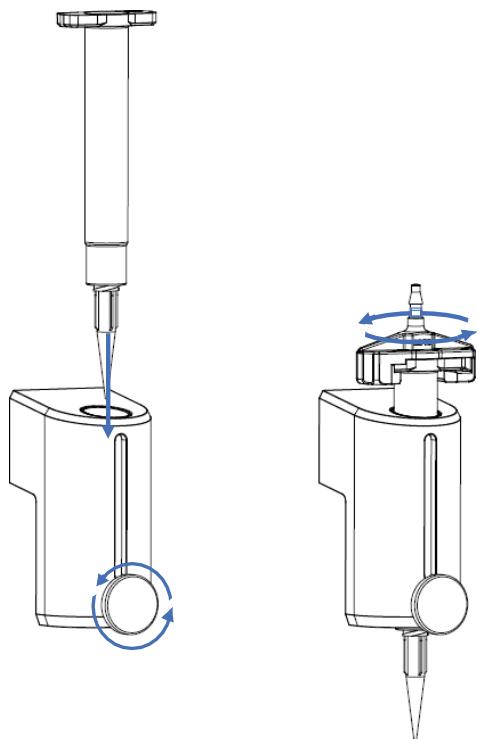


Figure 108 Mounting of cartridge in printhead

1. Twist the pressure connector to attach the pressure hose to the cartridge.
2. Insert the cartridge in the printhead. Push it down until the cartridge wings touch the top of the printhead.
4. Turn the cartridge-fastening screw to secure the cartridge in the printhead.

**Note:** The Standard Pneumatic Printhead needs to be connected to an air supply to function. When inserting the printhead, remember to connect the pressure hose to the pressure connector on the printhead holder.

## 12.2 CELLINK Temperature-controlled Printhead

### 12.2.1 Getting started

Go to the **Printing Utilities** menu.

Go to the **Move & Calibrate** menu. Home the BIO X6 system

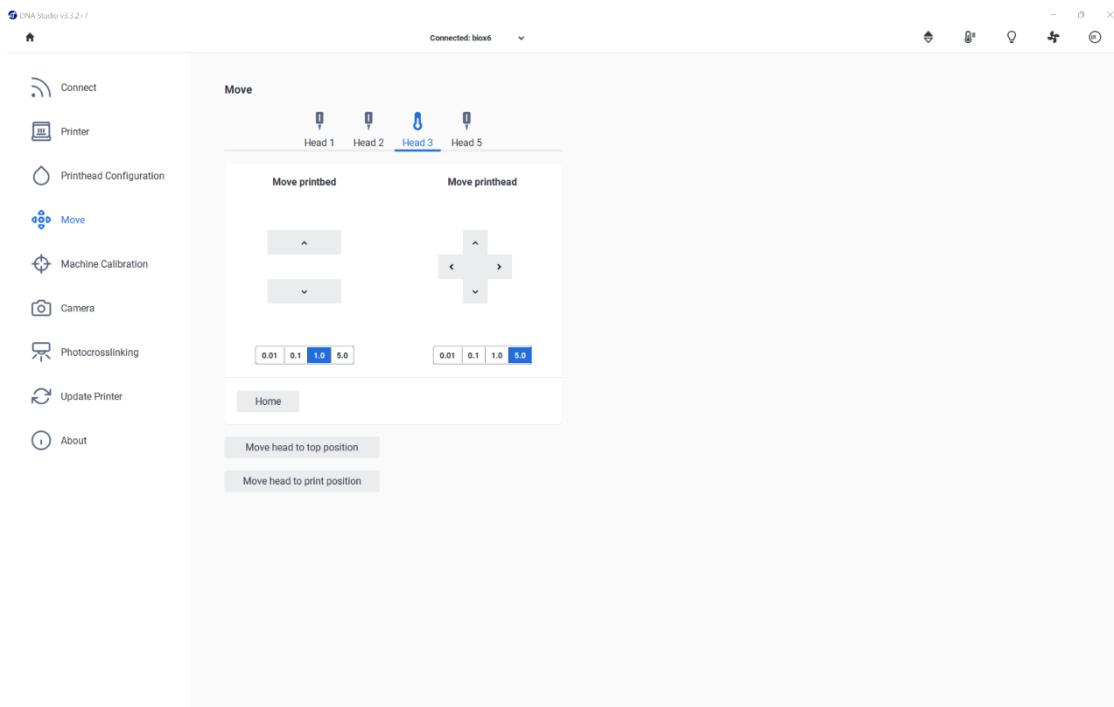


Figure 109 Move tab in Utilities menu

The CELLINK Temperature-controlled Printhead is an extrusion-based printhead. With the aid of a cooling fan, this printhead can keep your bioink at a temperature up to 17°C below the chamber temperature. It employs compressed air to extrude bioinks. The Temperature-controlled Printhead is designed to fit 3 mL cartridges only and is recommended for bioprinting thermo-sensitive bioinks such as those based on collagen or gelatin, for example.



The current temperature of the printhead is indicated in several ways, including a color indication on the printhead (red is hot, yellow is warm, and blue is cold) and an indication of the temperature on the printer display.



The cooling fan of the Temperature-controlled Printhead is exposed to allow for heat dissipation. DO NOT put fingers or other objects into the fan while the printhead is in operation. Doing so risks injury and damage to the printhead.

### 12.2.2 Printhead overview

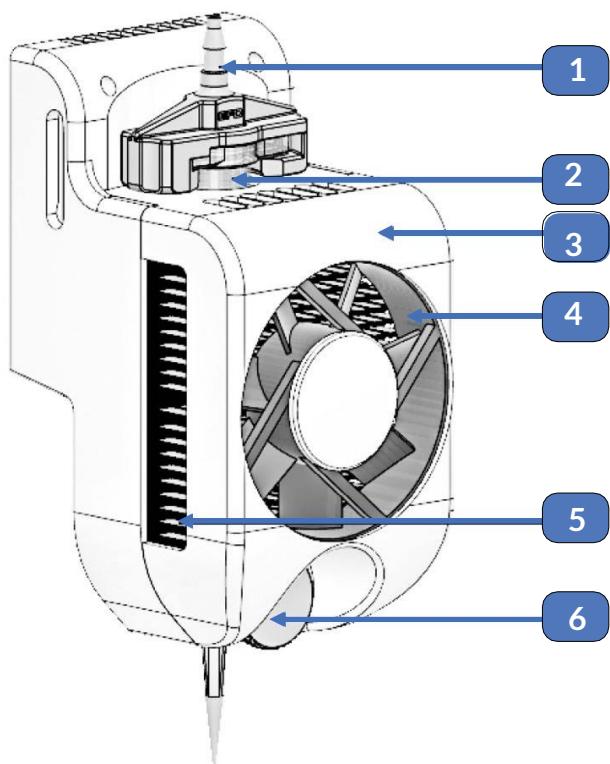


Figure 110 Overview of the Temperature-controlled Printhead

1. Cartridge adapter
2. Cartridge
3. Printhead body
4. Fan
5. Heat sink
6. Locking screw

## 12.3 CELLINK Thermoplastic Printhead

### 12.3.1 Getting started

Go to the **Printing Utilities** menu.

Go to the **Move & Calibrate** menu. Home the BIO X6 system.

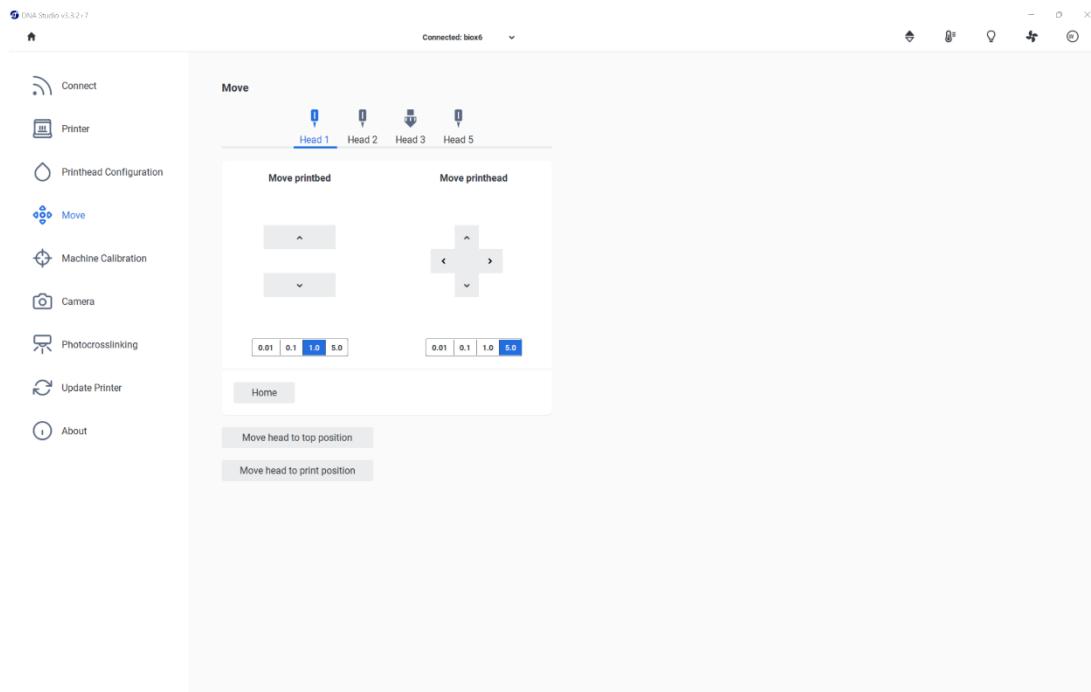


Figure 111 Move tab in the Utilities menu

The Thermoplastic Printhead is an extrusion-based printhead. It is specially designed to print thermoplastic materials, since it can reach a temperature of up to 250°C. It employs compressed air to extrude thermoplastics. Since most of these materials have a high viscosity when melted, it is recommended to print them with the Thermoplastic Printhead by using an external air compressor connected to the BIO X6.



The current temperature of the printhead is indicated in several ways, including a color indication on the printhead (red is hot, yellow is warm, and blue is cold) and an indication of the temperature on the printer display.

### 12.3.2 Printhead overview

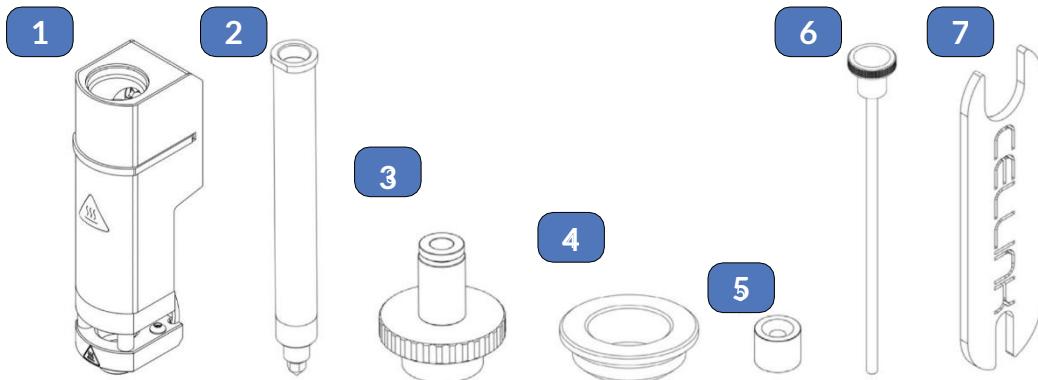


Figure 112 Overview of the Thermoplastic Printhead

1. Printhead body
2. Stainless steel cartridge
3. Top cap
4. Insulated locking ring
5. Stainless steel plunger
6. Plunger removal tool
7. Wrench for tightening the cartridge and the nozzle

### 12.3.3 Assembling the Thermoplastic Printhead

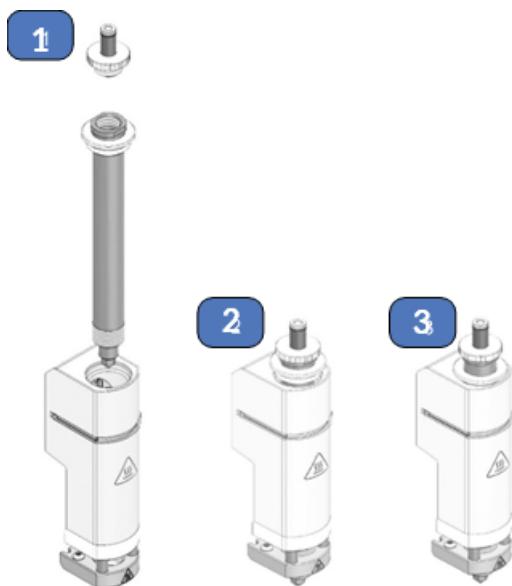
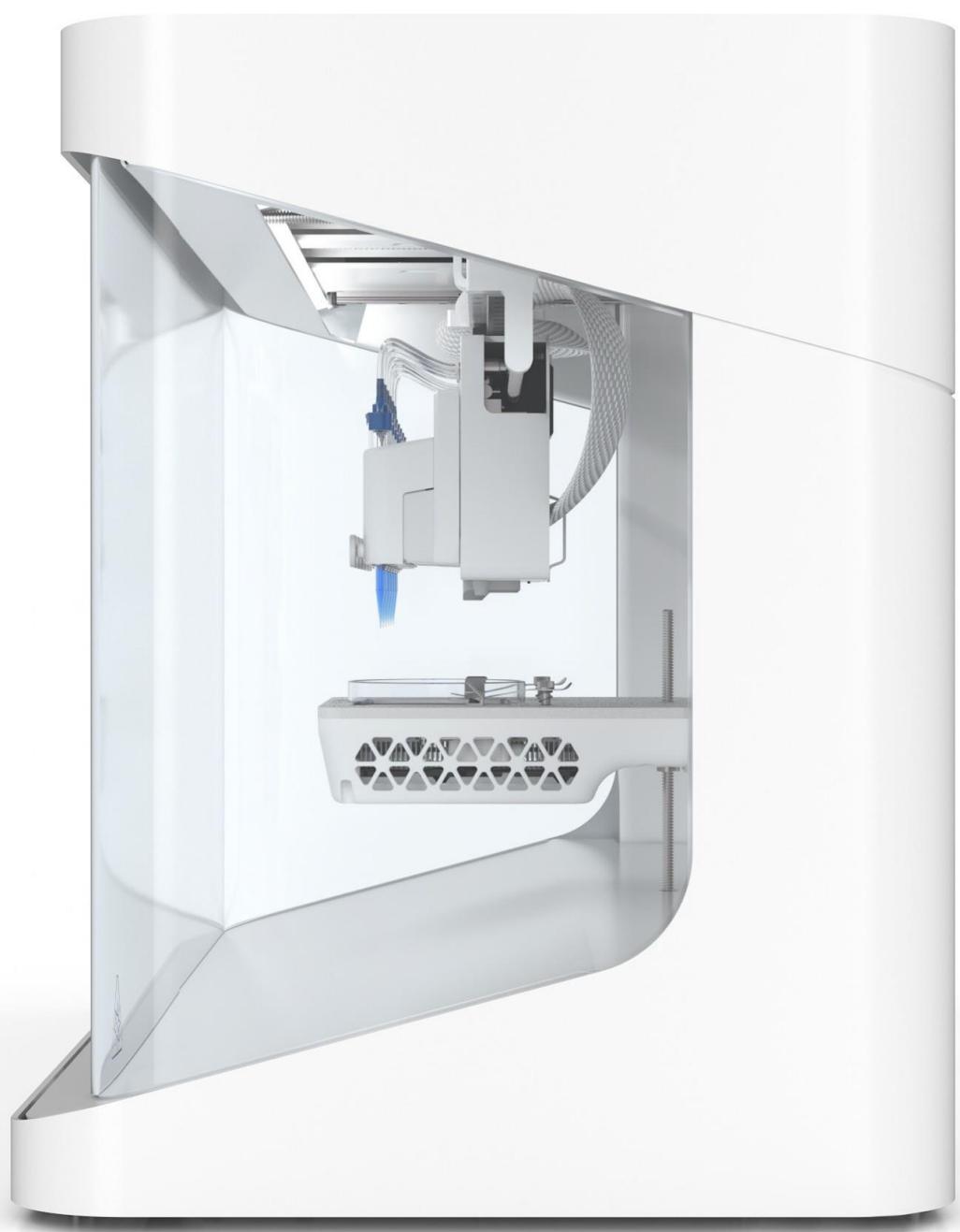


Figure 113 Assembling of Thermoplastic Printhead

1. Place the stainless-steel plunger inside the metal cartridge and attach the top cap.
2. Insert the assembled cartridge into the printhead. Twist until the cartridge is screwed in place and use the wrench to tighten.
3. Position the insulated locking ring downward to secure the assembled cartridge to the printhead





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