
BIO X HD Camera Toolhead

User Manual



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01

Package contents

01 Package contents

Item	Part number	Quantity
HD Camera Toolhead	D16110020853	1
Lens cap	D16110020652	1
Observation pad	D16110022041	1

02

Technical specifications

02 Technical specifications

- Resolution: 1600 x 1200 pixels for captured pictures.
- Maximum field of view: 37 x 28 mm.
- Minimum field of view: 7.4 x 5.5 mm.
- Dimensions (height x width x depth): 35.4 x 127.5 x 46.6 mm.
- Connection: BIO X toolhead mount and mini-USB.
- Weight: 235 g.
- Material composition:
 - External surfaces: Powder-coated steel on front, top, bottom and back.
 - Internal surfaces: PA plastic.
- Recommended operating temperature: 20-23 degrees Celsius.

02 Technical specifications

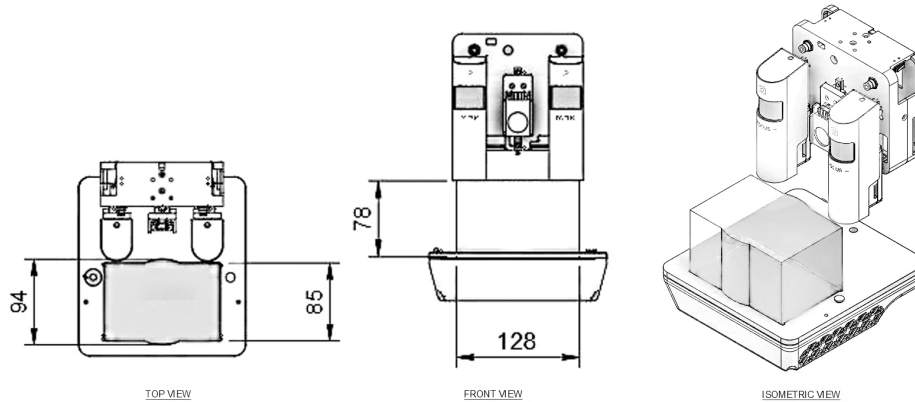


Figure 1: Theoretical maximum movement range shown from the top and side view when using HD Camera Toolhead. Movement range might be lower when combining the HD Camera Toolhead with a printhead that restricts printbox movement. Please consult manuals for the specific printheads used to determine potential restrictions.

03

Safety information

03 Safety information

3.1 BIO X system warnings

- Please consult the BIO X manual for BIO X-specific and general warnings and safety procedures

3.2 HD Camera Toolhead warnings

- Do not submerge the toolhead in liquid or use excessive spraying to clean it. Liquid inside the toolhead risks damaging the circuitry and motor.
- Do not manually move the mount. Moving the mount manually will damage the motor. If the mount needs to be moved, place the toolhead in the loading position described in the Getting Started section.
- Use the proper method to load and unload the HD Camera Toolhead onto the BIO X mounts. Instructions are outlined in the Getting Started section. While loaded on the BIO X, do not pull or push the toolhead with excessive force, especially when the BIO X system is turned on. This can damage the motor and its guides.
- Do not use a jerking motion to remove the toolhead. Using a jerking motion risks hitting and damaging the HEPA filter.

04

Getting started

04 Getting started

4.1 Unpacking and installation

1. Focusing knob

2. Body

3. Lens cap

- Open the package. Remove the HD Camera Toolhead.
- Remove the lens cap from the HD Camera Toolhead.
- To insert the toolhead, align the toolhead above a mount (Figure 3A, B) and push downward (Figure 3C, D). Secure the toolhead mount with your other hand to prevent the motors from moving during attachment.

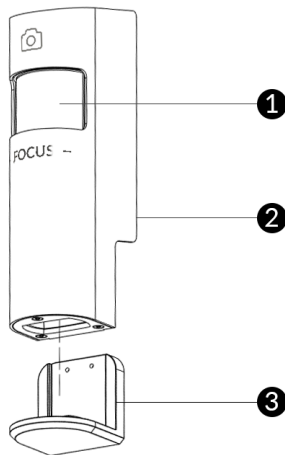


Figure 2: Components of the HD Camera Toolhead.

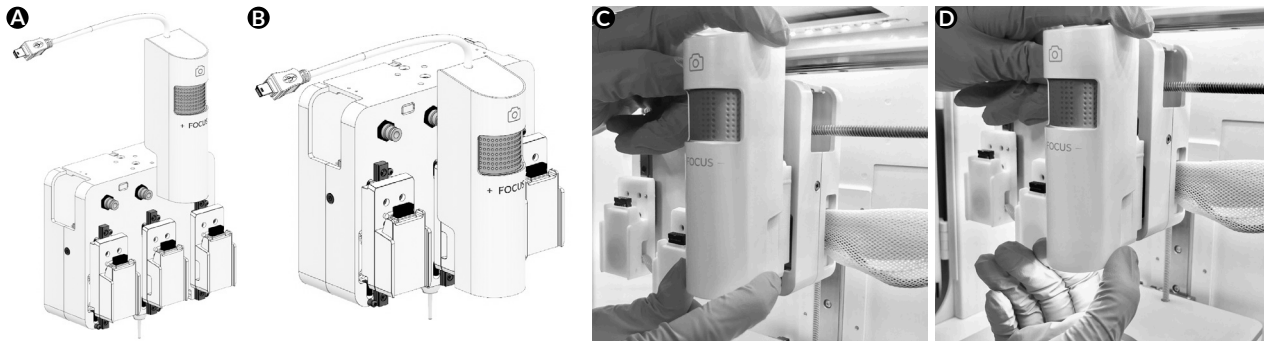


Figure 3: Inserting the HD Camera Toolhead into a BIO X mount.

04 Getting started

- Make sure the camera light turns on after the toolhead clicks onto the mount (Figure 3D).
- Connect the mini-USB cord to the mini-USB port on the printbox to enable the camera to save images (Figure 4).



Figure 4: Attaching the micro-USB to the BIO X printbox.

05

**Initial calibration, focusing and
manual image capture**

05 Initial calibration, focusing and manual image capture

5.1 Your first image

1. Ensure the HD Camera Toolhead is properly installed (Section 4).
2. Insert a USB flash drive in the BIO X.
3. Go to the Move and Calibrate tab on the right side of the screen and home the system (Figure 5).

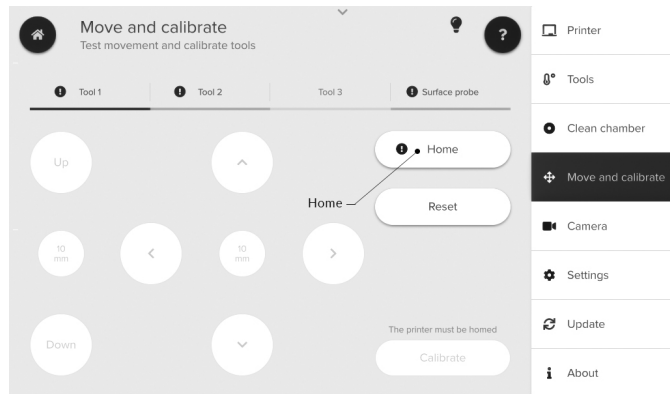


Figure 5: Homing the system.

05 Initial calibration, focusing and manual image capture

4. Wait until the system has homed. Ensure the HD Camera Toolhead is in the active position. You can place the toolhead in the active position using the Tools tab on the Utilities menu (Figure 6).

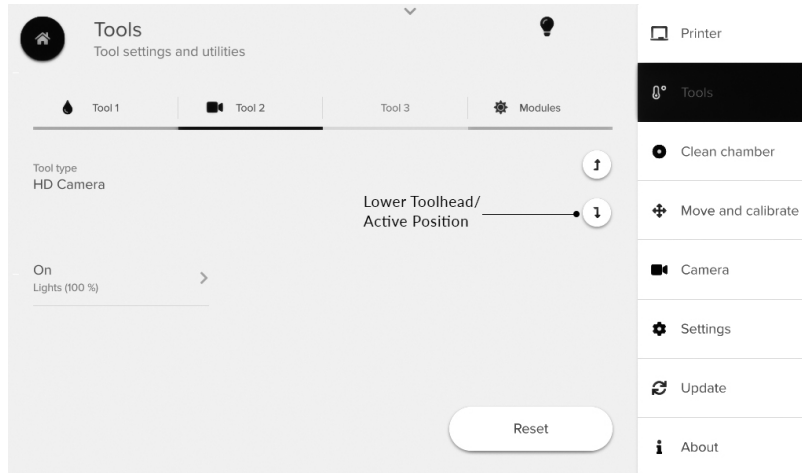
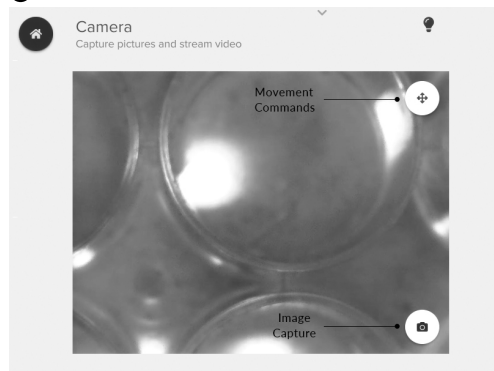


Figure 6: Putting the toolhead in the active position.

05 Initial calibration, focusing and manual image capture

5. Place a calibration target on the printed bed. You can use a piece of paper with printed text.
6. Go to the Camera tab on the right side of the screen.
7. Press the movement commands icon on the top-right side of the video feed to display the movement arrows (Figure 7).

A Camera View



B HD Camera Movement

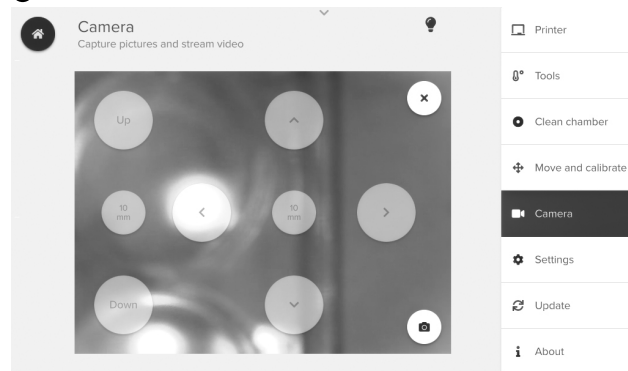


Figure 7: (A) Camera display overview on the Utilities menu. (B) Movement commands overlaid with the camera display.

05 Initial calibration, focusing and manual image capture

8. Position the toolhead above the target.

9. Manually adjust the focus knob until the target is in focus (Figure 8A and B). To focus objects closer to the camera, turn the focusing knob to the right (negative sign). To focus objects further from the camera, turn the focusing knob to the left (positive sign).

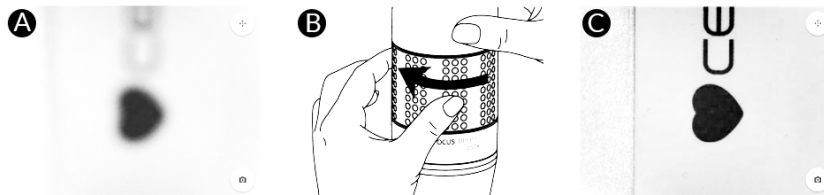


Figure 8: Focusing the HD Camera Toolhead on a test image.

05 Initial calibration, focusing and manual image capture

10. Press the Camera icon in the bottom-right corner of the live camera feed to capture an image.
11. This image will be stored on the USB flash drive with the name bio-x-screen-capture.png.
12. Repeated captures will be saved with numbers at the end of the file name.

NOTE: To include a scale reference, you can capture a portion of the observation pad along with your sample. This enables calibration when using imaging analysis software.

05 Initial calibration, focusing and manual image capture

5.2 Automated imaging during print

1. Attach the HD Camera Toolhead as detailed in Section 4.
2. Proceed through the printing process until you reach the Printer tab.
3. Select HD Camera Toolhead under Tool type, and select image capture mode (Figure 8).
 - After Print: Takes a picture of the structure when the print is finished.
 - Layer-by-Layer: Takes a picture after each layer.
4. Proceed to the calibration page.
5. When the HD Camera Toolhead is selected, the Calibration tab will show the camera feed (Figure 9).
6. Position the toolhead in the desired print area and desired height above the construct. The position should align with the other calibrated printheads in the X and Y axes to ensure images of the print are captured. The Z position should be higher and based on the desired image area.
7. Use the focus knob to finely tune the camera's position and ensure the print area is in focus.
8. Press Calibrate to save the X-Y-Z position of the toolhead.
9. Perform the print.
10. The pictures will be saved on the USB flash drive. Pictures captured during well-plate printing will have an additional indication of the well number.

05 Initial calibration, focusing and manual image capture

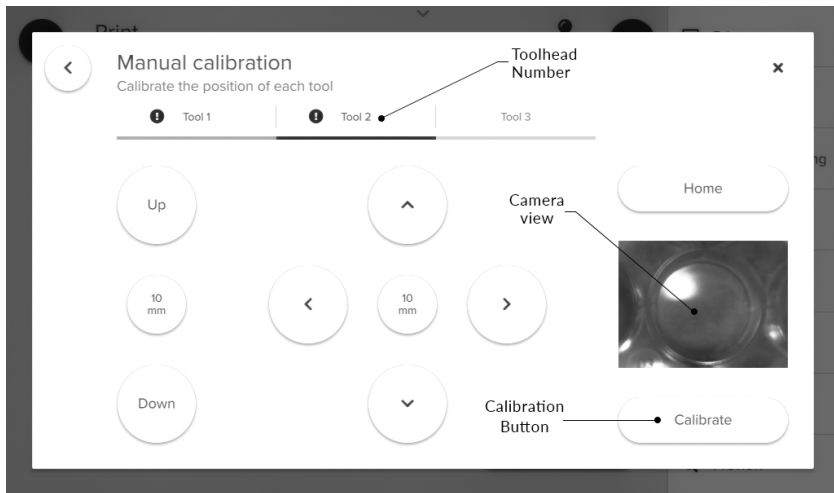


Figure 9: Calibration of the HD Camera Toolhead.

05 Initial calibration, focusing and manual image capture

5.3 Removing the HD Camera Toolhead

1. Disconnect the micro-USB cable from the printbox to remove the HD Camera Toolhead (Figure 10).
 2. Hold the mount in place with your hand and pull the toolhead up to remove it with the other hand.
- See Section 3.2 for warnings associated with removing the toolhead.



Figure 10: Detaching the micro-USB from the BIO X.

06

Relevant G-code commands

06 Relevant G-code commands

Commands	Description
G1 Xnnn Ynnn Fnnn	When used in combination with the G90 command, which defines absolute coordinates, G1 is the absolute move command. The values for the X and Y parameters are the coordinates (in mm) directing where to move. The F parameter is the speed of the toolhead in mm/min.
G1 Znnn Fnnn	When used in combination with the G90 command, which defines absolute coordinates, G1 is the absolute move command. The value for the Z parameter is the coordinate (in mm) directing where to move. The F parameter is the speed of the toolhead in mm/min.
G4 Snnn Pnnn	The G4 command tells the system to dwell. S is the wait time in seconds and P is the wait time in milliseconds.
G7 Xnnn Ynnn Znnn Fnnn	When used in combination with the G90 command, which defines absolute coordinates, G7 is the relative move command. The values for the X and Y parameters are the coordinates (in mm) directing where to move relative to the current position. The F parameter is the speed of the toolhead in mm/min.
G7 Znnn Ennn Fnnn	When used in combination with the G90 command, which defines absolute coordinates, G7 is the relative move command. The value for the Z parameter is the coordinate (in mm) directing where to move relative to the current position. The F parameter is the speed of the toolhead in mm/min.
G92 Xnnn Ynnn Znnn	G92 sets the current position of the toolhead to the specified X, Y and Z coordinates. If no parameters are given, the position is assumed to be 0, 0, 0 (this will also change the Z position).

06 Relevant G-code commands

Tx	Switch to toolhead (x). 0, 1 and 2 designate toolheads 1, 2 and 3.
M400	M400 keeps the next command from execution until the printer finishes all movements.
C0 filename.png	C0 takes an image using the HD Camera Toolhead. Follow with the string "filename.png" to save the image with a specific file name.

You can use the template below for writing a G-code to take an image. Please note that this is not a complete G-code.

Tn; sets HD Camera Toolhead in active position (n is 0, 1, or 2).

G1 Xnnn Ynnn Fnnn; moves Tn to Xnnn and Ynnn at speed nnn.*

M400; finish all movements.

C0; capture image. Use default naming convention.

NOTE: Z is not used in order for the HD Camera Toolhead to default to calibration height. To take pictures of higher layers, use Znnn (nnn is the layer height).

07

Frequently asked questions

07 Frequently asked questions

- **What is the resolution and field of view?**

The HD Camera Toolhead has a resolution of 1600 by 1200 pixels. The maximum field of view of the toolhead is 37 by 28 mm and the minimum is 7.4 by 5.5 mm.

- **How does the HD Camera Toolhead focus?**

Users focus the HD Camera Toolhead manually during the calibration process.

- **Does the HD Camera Toolhead take up a printhead mount?**

Yes. You can print with a maximum of two materials at a time when using the HD Camera Toolhead on the BIO X.

- **Can it take real-time images?**

The HD Camera Toolhead can capture images at points defined by G-code. The functionality is more limited when using the user interface; it can only take images after the print's completion or after the completion of each layer.

- **Can I turn off or dim the light?**

Yes, you can control the light on the Utilities menu. Make sure to confirm your changes by pressing the check mark on the Lights submenu.

- **Does the light expose my material to UV?**

No, but it may interact with photoinitiators in the blue/visible range.

- **Can I use any printhead mount?**

Yes.

07 Frequently asked questions

- **Can it take videos?**

No.

- **How can I make sure tall objects are still in focus?**

We recommend calibrating the HD Camera Toolhead on a previously printed construct to ensure it's in focus when capturing an image at the completion of a print.

- **Does it work independently or do I need to combine it with a printhead? What if I want to image a previously printed construct?**

The HD Camera Toolhead can be combined with another printhead to take images during the printing process. To image previously printed constructs, we recommend positioning the toolhead and capturing the images through the Utilities menu.

08

Maintenance

08 Maintenance

- Keep the device dry during storage.
- Do not use harsh chemicals, cleaning solvents or strong detergents to clean the toolhead.
Wipe it with a soft cloth slightly dampened in a mild soap-and-water solution.
- Regularly clean the printhead to remove any dust or debris.
- Keep the cap on the HD Camera Toolhead during storage and transport to prevent damage to the lens.

Support information

- Official site: www.cellink.com
- Contact: support@cellink.com
- Contact: sales@cellink.com
- Web store: www.cellink.com/store



Store



Sales



Official site



Support

