LUMEN X

♥CELLINK | powered by **Volumetric** 〰

USER MANUAL

Contents

1. Safety information

Please review the entire manual before you start using the Lumen X.

The following symbols will be used to indicate if there is risk of personal injury or equipment damage:

⚠ This symbol indicates that there is a general risk of personal injury or equipment damage.

⚠ This symbol indicates that there are surfaces on the Lumen X that are heated and might cause personal injury or material damage if not handled with care. Beyond the manual, the physical surface with a heating function will be marked with this symbol in Lumen X. This symbol will also be visible on Lumen X's touchscreen at any time the vat surface is heated.

⚠ This symbol indicates that there is a risk of personal injury due to extended exposure to bright visible radiation. Always wear proper safety equipment and use the light shield of the Lumen X to cover the print area when printing. This symbol will also be visible on Lumen X's touchscreen at any time the projector is active.

⎓ This symbol indicates that the Lumen X is suitable for direct current (DC) only.

Manufacturer:

Volumetric Biotechnologies, Inc.
2450 Holcombe Blvd., Suite J
Houston, TX 77021
United States

1.1 General safety information

Use the instrument only for its intended purpose as described in the manual. Do not open, disassemble, modify the instrument or sub-components. Do not attempt any service beyond the maintenance instructions provided in the manual.

⚠ **Caution!** Never reach into the instrument when parts are moving.

⚠ **Caution!** Lumen X contains surfaces which can reach temperatures up to 50 degrees Celsius. If the heating function is used, do not touch the vat area. Let the vat area cool before handling if the heating function has been used.

⚠ **Caution!** Before cleaning or servicing the Lumen X, turn off the power and disconnect the instrument from the power source. Rather than spraying the Lumen X with 70% ethanol, it is suggested to wipe the Lumen X with a 70% ethanol pre-wetted sensitive-tasks wipe.

⚠ **Caution!** Always wear protective goggles, gloves, and lab coat while handling hazardous materials.

⚠ **Caution!** Always ensure that the light shield covers the print area when the printer is in operation. Wear protective safety goggles when using the printer. DO NOT LOOK DIRECTLY AT THE LIGHT DURING PROJECTION.

DO NOT DISASSEMBLE THE LUMEN X.

1.2 Electrical information

⚠ **Caution!** Always connect the Lumen X to a grounded socket and always use the voltage provided in the specifications. Not doing this can damage the Lumen X and cause personal injury.

1.3 Protective equipment

⚠ **Caution!** Always wear protective goggles and gloves, and secure the environment around the instrument from other personnel while operating the Lumen X. All safety equipment must be properly used when the printer is operating.

⚠ **Caution!** Always wear protective goggles and gloves while handling hazardous materials that can be absorbed by skin or which are toxic, flammable, corrosive, allergenic, carcinogenic, reproduction-endangering, or mutagenic to humans.

1.4 Hazardous materials

⚠ **Caution!** Before starting to work with hazardous materials, the operator must be informed about the characteristics of the material and its compatibility. The information can be found in the material safety data sheets, packaging labels, manufacturer or dealer catalogues. Always use adequate safety equipment.

⚠ **Caution!** When using 70% ethanol to clean the Lumen X, wait at least 60 seconds before starting a bioprinting procedure to ensure that all flammable vapors are ventilated out of the printer.

1.5 Compliance

By using the Lumen X and accepting the terms of use, you agree to the terms stated here and in the warranty information (see Chapter six: Warranty).

Except for the express warranty set forth in the warranty information, the printing formulation, equipment, and software provided hereunder are provided "as is" and Volumetric 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, Volumetric and its suppliers make no warranty, condition, representation, or term (express 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 printing formulation 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, Volumetric 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 Volumetric 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 Volumetric 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.

2 Specifications

Hardware
Build volume: 64 x 40 x 50 mm.
Display resolution: 1280 x 800.
Pixel resolution (XY): 50 μm.
Z Resolution (motor): 5 μm.

Wavelength: 405 nm.
Projection power output: 10 - 30 mW/cm².

Heated platform: 35 degrees Celsius.

Dimensions: 24 x 43 x 41 cm.
Weight: 9 kgs.
Shipping box: 59 x 39 x 51 cm.
Shipping weight: 11.3 kgs.

Software
Compatible file type: .stl.
Maximum model dimensions: 64 x 40 x 40 mm.

Electrical
Power input: 12V DC, 11.5 A, 138 W.

3 Getting started

The Lumen X is designed to study biology for improving the quality of life of human patients.

3.1 Unpacking

The Lumen X requires approximately 30 x 61 cm (12 x 24 in) of bench space. Place the Lumen X on a sturdy bench, with the rubber feet on the bench surface. Ensure that there is at least two inches of space on all sides of the Lumen X for adequate air flow into the printer. Ensure that the Lumen X has adequate room in the back for connecting/disconnecting the power cord.

⚠️ **Caution!** To avoid injury to personnel and to avoid damaging the Lumen X during the unpacking process, always follow the instructions provided below.

⚠️ **Caution!** The Lumen X is a heavy instrument. Always have a minimum of two people when unpacking or moving the Lumen X. Always lift and carry the instrument in the manner described in the manual.

1. Clear a sturdy bench of at least 30 x 61 cm and a floor space of at least 3 x 2 m.
2. Place the box containing the Lumen X so that the arrows on the box arrow are pointing up.
3. Carefully remove the tape on the top of the box.
4. Open the box and remove contents from the top, including the top foam part.
5. Grab the anti-static bag and lift the bag up until the Lumen X is raised above the bottom part of the foam.
6. While lifting the bag up, grab the bottom of the Lumen X and place the Lumen X onto the table.
7. Remove the Lumen X from the bag.
8. Ensure that you have received all equipment on the list below.

3.2 Contents

1x Lumen X printer
1x Glass print platform
1x Power cable
STARTER KIT (sold separately)
- 10x coated vats
- 10x plastic razor blades
- 5x 10 mL PEGDA PhotoInk (with Material Safety Data Sheet)

3.3 Overview
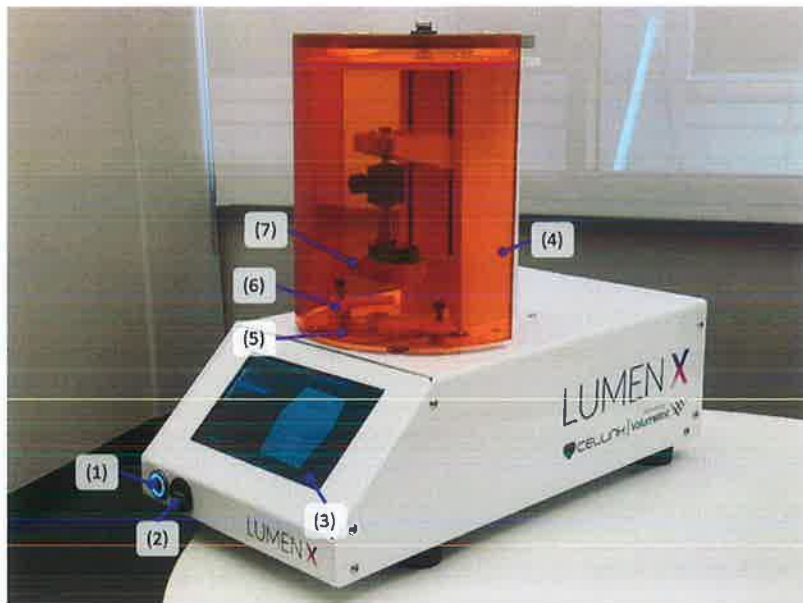
(1) Power button   (2) USB port
(3) Touchscreen   (4) Light shield
(5) Vat   (6) Vat clamps
(7) Build platform

Note: DO NOT DISASSEMBLE THE LUMEN X PRINTER.
Note: DO NOT LOOK DIRECTLY AT THE LIGHT DURING PROJECTION.

The Lumen X should only be used with Volumetric PhotoInks (currently PEGDA, GelMA, or Microfluidic), vats, build platforms, power supply, and blades. Use of alternative materials is not supported.

Ensure that the USB flash drive used is FAT32 format.

Operating conditions
Indoors
Temperature: Use at room temperature (~15-30 degrees Celsius).
Humidity: 40-80%.

Transport and storage conditions
Indoors
Temperature: Use at room temperature (~10-40 degrees).
Humidity: 40-80%.

If the Lumen X was transported or stored outside of these recommended conditions, the Lumen X needs to reach the above conditions before use. It is recommended that the Lumen X not be used for a full day until the operating conditions have been met, otherwise Volumetric is not responsible for any damage that may result to the Lumen X.

3.4 Setting Up

Initial Preparation

(1) Connect power outlet to back of the Lumen X and to a grounded wall socket.

- Push the power connector into the back of the Lumen X until a click is heard.

(2) Switch on Lumen X by pressing the Power Button.

- The ring around the button will light up.

(3) Slide the build platform into the bottom of the bracket and secure clamp.

(4) Place a coated vat on the dish holder and secure the dish clamps by rotating them.

To sterilize the build platform

Ethanol sterilization:

(1) Place the build platform in a petri dish filled with 70% ethanol.
(2) Allow the build platform to sit in ethanol for >30 minutes.
(3) Remove the build platform from ethanol and let it sit for >30 minutes to dry.
   • Gently blowing with sterile gas can be used to accelerate the drying time.

Sterilization via autoclave is not recommended.

3.5 License and Acknowledgments

The Lumen X touchscreen program is open-source software, governed under the terms of the GNU General Public License (GPL) version 3.0. As such, this software and any modifications to this software must remain free and open-source.

We thank a number of people and their open-source communities that have facilitated the Lumen X software including Matt Keeter and fstl, Kliment Yanev and printrun, Alessandro Ranellucci and Slic3r, Erik van der Zalm and Marlin, and Johnny Russell and UltiMachine.

3.6 Software Overview
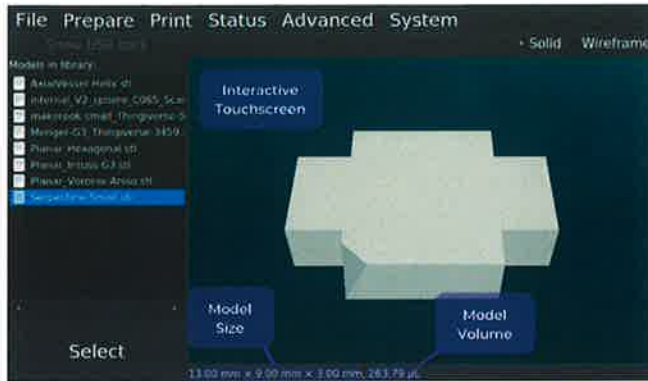
3.6.1 Select Tab
(1) Choose the desired 3D file and press "Select".
- To print a model from a USB drive, insert the USB drive into the front USB port and select "Show USB Stick". Ensure that the model is stored within the parent USB directory.

File Prepare Print Status Advanced System

Layer height: Current layer
• Standard res (100 µm)
  High res (50 µm)
Slicer: Idle
Image generator   Idle
Printer preparation

Tap the **Prepare** button to
prepare the printer.

Prepare

Reslice
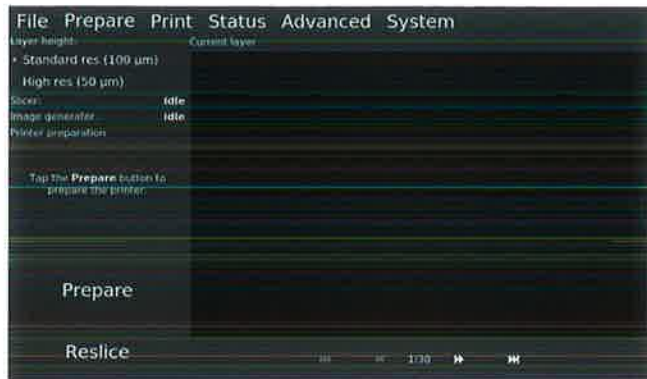
3.6.2 Prepare Tab

(1) Select the desired layer thickness and press "Slice".

(2) Loosen the top silver metal knob, move the platform assembly up, and secure the silver metal knob.

(3) Tap the "Prepare" button, the build platform will be lowered and stop.

(4) Grab the build platform with one hand and unscrew the platform knob #1 and knob #2 with the other hand.

(5) Lower the build platform until the platform touches the coated vat.
(6) Secure the platform knob #1 and knob #2.
(7) Press "Continue".
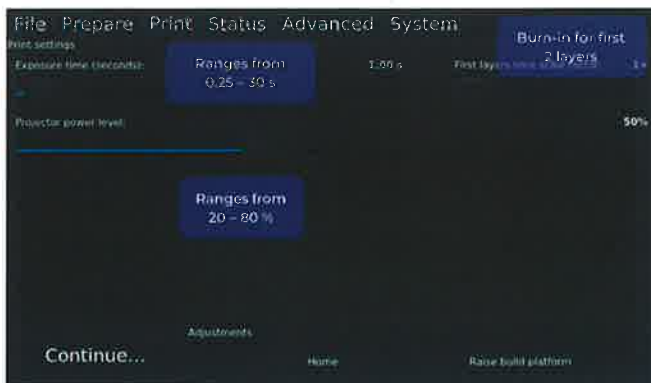
3.6.3 Print Tab

(1) Adjust the exposure time per layer and the burn-in time factor for the first layers.
   - For optimal adhesion of the first layer to the build platform, it is recommended that the burn-in time factor is set to 2x or 3x.
(2) Adjust the projector power level and print speed.

(3) Press "Print".
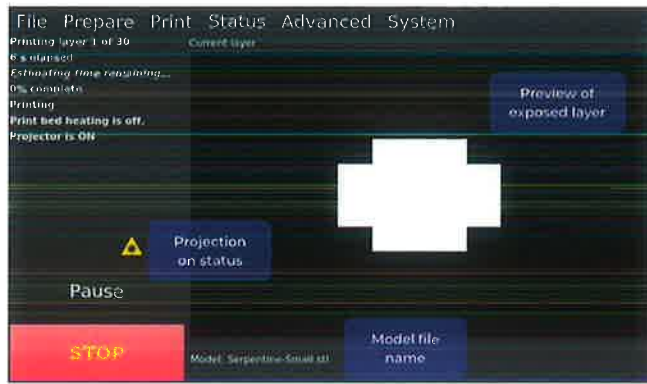
3.6.4 Status Tab

   (1) Press "Start".
   (2) Add the recommended volume of printing formulation, as shown in the middle of the screen.
- To avoid running out of print formulation, add 2-3x volume of the model volume.

   (3) Press "Print".

Stopping a Print

Status
   (1) If needed, press "Stop" to stop print.

After a print

Removing printed object from platform
   (1) Remove the platform from the bracket.
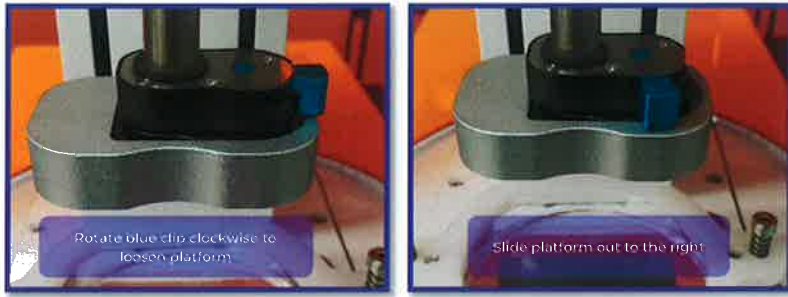
(2) Carefully remove the printed part from the platform using a plastic razor.

(3) Clean model in appropriate solvent.
- If a resin part is printed, submerge in isopropyl alcohol for 10-15 minutes, then remove to air dry.
- If a hydrogel part is printed, submerge in appropriate media (DI water, PBS, cell media), until dye no longer elutes from the printed gel, and replace media every 2-4 hours.
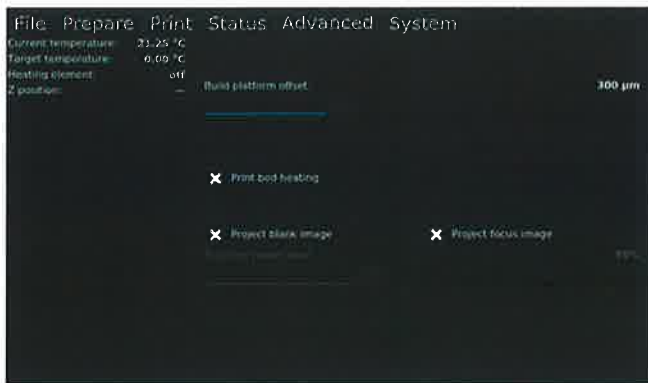
To Print After a Print is Completed

If using the same vat and printing the same model:

(1) Either add more printing solution to the vat or wipe the leftover printing solution from the vat.

(2) Replace the build platform.
(3) Go to "Status" tab and press "Reprint".
(4) Add additional printing solution, if needed.
(5) Press "Print".

If using a new vat and printing the same model:
(1) Secure new vat onto printer and place build platform back.
(2) Go to "Prepare" tab and follow the instructions to set up the build platform.
(3) In the "Print" tab, adjust the exposure time, burn-in time, and power level, if needed.
(4) Press "Print".

If printing a new model:
(1) Go to "Select" tab and select a new model.
(2) Follow instructions and follow 3.6.1-3.6.4.

3.6.5 Advanced Tab
Using the heating function
(1) Turn heating on by selecting the box next to "Print bed heating"
(2) Place vat onto printer, wait 5 minutes.
- Note: the vat can be incubated in a 37 °C oven to accelerate the heating of the vat.
(3) Continue printing procedure as above.
- Note: if the print solution is heat-sensitive, incubate the print solution in a 37 °C incubator or water bath to maintain the temperature.
(4) Turn off heater by selecting the box next to "Print bed heating".

Only aqueous media containing non-volatile and non-flammable content is suitable for use with heating.

3.6.6 System Tab

Updating Software
(1) Extract contents of update zip file (.kit and .kit.sig files) into parent directory of USB.
(2) After inserting USB into the Lumen X, the "Update Software" button will fade in.

(3) Tap "Update Software" and select the latest LightField version.
  - After the update is complete, the Lumen X will reboot.

Transfer Debug Files to USB
  (1) After inserting the USB into the Lumen X, the "Copy logs to USB" button will fade in.
  (2) Tap "Copy logs to USB" and allow the file transfer to finish.

Shut Down Procedure
  (1) To shut down the Lumen X, tap "Shut Down".
  (2) Confirm shut down by selecting "Yes".
  (3) After waiting 5 seconds, push the power button to turn off the Lumen X.

4 Troubleshooting

Lumen X is turned on with the power button (the power button ring becomes white) but the LightField software does not start up.

- This may be due to the mini-PC not booting properly. Remove the plug on the left side of the case to expose the PC power button. Insert a pen, press and hold the power button for 5 seconds, then release.
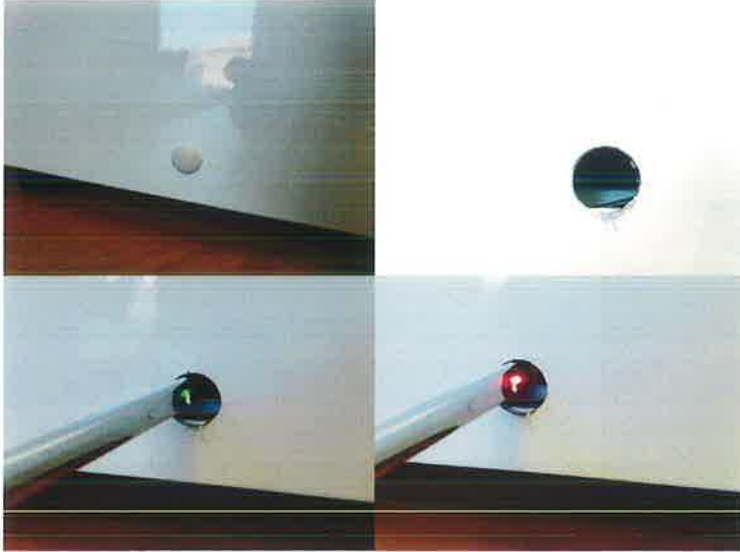
Build platform does not move when "Prepare" is selected.

- Reboot by going to "System" and select "Reboot".

Part does not attach to Build Platform.

- Ensure that the Build Platform is positioned properly and that the knobs are secure. Utilize a higher value for the "Burn-in Factor".

Part appears to be undercured or is delaminating.

- Increase exposure time and/or power output.

Features within print are not preserved.
- Decrease exposure time and/or power output.

After preparation step, the "Print" tab is inactive.
- Reslice the selected file at the desired layer thickness.

5 Maintenance

The Lumen X can be left powered on when not in use.

The maintenance activities below can be performed by the user, no special skillset is needed for general maintenance.

Shutting down the Lumen X
    (1) Navigate to the "System" tab.
    (2) Press "Shut Down", when a new window pops up select "Yes".
    (3) Wait 10 seconds, then press the power button at the front of the Lumen X.

To sterilize the Lumen X
    (1) Spray 70% ethanol onto a Kimwipe and gently wipe the surface of the printer.
    (2) Let the printer sit for 60 s to allow the ethanol vapor to evaporate.

Cleaning the build platform
    (1) Submerge the build platform in water for 5 minutes or until the platform appears clean.
    (2) Gently wipe with a Kimwipe or gently blow inert gas on build platform.

General cleaning
If PhotoInk is spilled on the printer, quickly wipe any spilled material with a dry Kimwipe. After the spilled material has been cleaned from the Lumen X, wipe the spilled area with a pre-wetted 70% ethanol Kimwipe and allow to dry.

Always wipe down the printer if printing solution spills/drips onto the printer. The printer can be wiped down with water or 70% ethanol. Avoid direct spraying of ethanol, isopropyl alcohol, or other cleaning reagents onto the Lumen X as this may result in damage to the Lumen X.

6 Warranty

Every bioprinter will be sent under Declared Value Insurance, also optioned by FedEx. If, in the case there is a problem with the Lumen X 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 Volumetric will work out the problem on an individual basis with the customer. In the rare case of a specifically diagnosed and proven DOA (dead on arrival) part (detailed description and documentation required), Volumetric will most likely send a replacement part to the customer. 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, Volumetric 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 and Volumetric are not in any way responsible for any consequential losses or downtime what-so-ever caused by a problem in the performance of our products. Volumetric is not responsible for additional customs fees and tariffs. CELLINK and Volumetric are not responsible for delivery delays or the inability to deliver from the carrier. CELLINK and Volumetric are 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 does 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 customers to modify the Lumen X outside of the recommended guidelines in the user manual unless personally instructed to do so by Volumetric. If the Lumen X is used in a manner not specified by Volumetric, the protection provided by the equipment may be impaired. Volumetric provides no guaranties on the safety or performance of modified Lumen X bioprinters. Volumetric is also not responsible for incorrect

voltage being used, environmental conditions (moisture, fire, water, flood, lightning, etc.), or any other form of neglect on the customer's part. If you are unsure about something, feel free to contact CELLINK prior to using the Lumen X.

The user shall not attempt any maintenance other than what is mentioned in the previous section (Section 5). Volumetric will be responsible for repair and replacement of parts, as needed. To inquire if the Lumen X is still within warranty, contact CELLINK at support@cellink.com. Once warranty is confirmed and the service process is initiated, the Lumen X will be shipped to CELLINK, then Volumetric will lead the repair and/or replacement of components. Warranty will be void if user attempts to disassemble and repair the Lumen X themselves.

Volumetric is not responsible for damages caused by the use of old information, as we are a forward-looking company and information/manuals/users guides and suggestions are continually being updated, as we plan to manufacture and to evolve our products into many future generations as the technology develops. The latest documentation is always available on our website.

The guarantee and warranty cover critical components only. E.g., CELLINK and Volumetric will not replace a bioprinter because of a perceived blemish in the paint. You can order replacement parts through our online store or by contacting us by telephone or email. There is no warranty issued when exotic printing material is used with the Lumen X and doing so is not recommended by us at Volumetric. Foreign materials can damage the system. The warranty does not cover operating the bioprinter at speeds and settings that we have not recommended.

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

Concerning unauthorized returns:
Returns not pre-authorized will not be eligible for repair, replacement, or refund. Do not send it back to Volumetric unless you have contacted us first and we have preauthorized you to do so.

Concerning Refunds:

A refund is possible only for the Lumen X itself and will not be offered for any bioinks or consumables. If within two weeks (14 days) after receiving your Lumen X you are not completely satisfied, the customer will be offered a refund option. The customer will ship it back at their own expense and after Volumetric receives it, we will deduct a 10% restocking fee from the total refund of the price of the Lumen X (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 Lumen X, Volumetric 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. Volumetric waives all liability for any incidental, exemplary, punitive, collateral, indirect, consequential, or special damages. Volumetric will determine on sole discretion whether an issue is covered under the warranty or not.

For end of use disposal, please contact CELLINK at support@cellink.com. Once the process is formally initiated, hardware will be sent to Volumetric to dispose of the hardware properly.

Concerning any problems or inquiries, please contact us at: support@cellink.com

Returned parts/products can be sent to:

CELLINK LLC
100 Franklin St., Suite 702
Boston, MA 02135
United States

Lumen X is turned on with the power button (the power button ring becomes white) but the LightField software does not start up.

Created by: Chris slater
Modified on: Fri, 3 Apr, 2020 at 11:42 AM

This issue could be caused by the Mini-PC not properly booting when powering on the printer.
Step1) Remove plastic wire plug from the left side of the base to expose the internal PC drive

Step 2) Using a small pen or tool, press and hold down the power button for 5 seconds then release. If this does not resolve your issue please reach out to our support team at support@cellink.com for more assistance.

C   Chris is the author of this solution article.

LUMEN X BIOS Settings Procedure

Created by: Gerald De Vera
Modified on: Thu, 18 Mar, 2021 at 12:01 AM

Kindly feel free to follow the steps below:

1. Turn off the power of LUMEN X.

2. Insert the USB of a keyboard (wireless/wired) into LUMEN X main unit as shown in the image below.

3. The next step will need to be done by two individuals. If you turned on LUMEN X and there is no display showing on the LUMEN display screen for about 30 seconds to 1 minute as shown below,

then, the first person can kindly proceed with clicking the switch on the side panel of the LUMEN X as shown below using tweezers.

Once the clicking of switch is done and as soon the system reboots, the other person needs to simultaneously press the "Delete" button from your keyboard as shown in the image below for 10 seconds or more right after the other person clicked the switch from the side panel as shown.

5. If the "password prompt" appears, type "lumen".

6. During the booting process, while still keeping the "Delete" pressed 10 seconds or more, please also make sure that the "Press <DEL> to enter setup" statement changes to "Entering Setup" as shown in the image below. Once the statement changes to "Entering Setup".
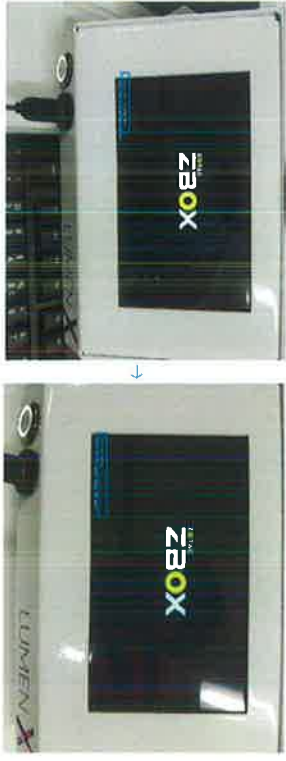
kindly wait for few more seconds (while still pressing the "Delete" button) until the display screen shows something like the image below:

7. Kindly navigate to other tabs by pressing the right/left button of your keyboard as shown below:

8. Kindly navigate to "Power" tab and press up/down buttons to navigate to subcategories. Kindly ensure that "USB Wake Up Power" is "Enabled" and "AC power loss" is "Power On". This can be done by pressing "Enter" to each subcategory and selecting the recommended options. After selecting the options, kindly press "Esc" to go back to the previous menu.

3/23/2021
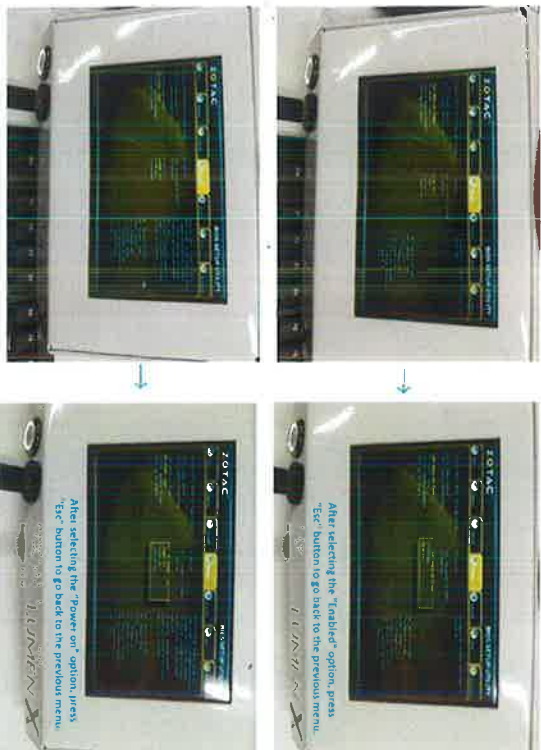
8. After selecting the recommended options, kindly navigate to the "Save&Exit" tab, and choose the "Save Changes and Exit" subcategory. Press Enter button from your keyboard and once the popup box shows "Save configuration and exit?", press the Enter button again to click the "Yes". After this step, the system will reboot.

After selecting the "Enabled" option, press "Esc" button to go back to the previous menu.

After selecting the "Power on" option, press "Esc" button to go back to the previous menu.

9. After the rebooting process, when you see the screen display, tap your finger to check if the screen behavior is normal and shut down the LUMEN X system.

10. When the screen goes dark, press the power button to turn off the power.

11. Turn on the power again. Make sure the screen lights up at this point.

Note: When turning off the power, it is necessary to take the steps of "system" → "shutdown" to minimize the possibility of losing the settings of LUMEN X.

For further assistance and queries, please feel free to reach us out at support@cellink.com or via phone:

US +1-833-235-5465

EU +46-31-128-700

G   Gerald is the author of this solution article.