

Polar3D Printer Guide

Kristin Hubner

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Chapter 1

Get connected to the Polar Cloud

When you open up your Polar3D printer shipping box, you will see contents such as shown in Figure 1.1: the printer frame (with [print head](#) mounted), a spool of (blue) [PLA](#) filament, a power adapter and cord, a can of Aqua Net hair spray, a [build plate](#), and a sample object test-printed on this printer at the factory (namely, a yellow boat).

There are two ways to setup your Polar3D printer to connect through a local network to the Polar Cloud:

1. Wireless (WiFi): see Section [1.1](#).
2. Ethernet cable: see Section [1.2](#)

Setting up your Polar3D printer as a network printer connected to the Polar Cloud is strongly recommended, as it permits full access to the power of the [Polar Cloud interface and features](#); see the *[Polar Cloud Guide](#)*. However, for times when you don't have an Internet connection (or even access to a local

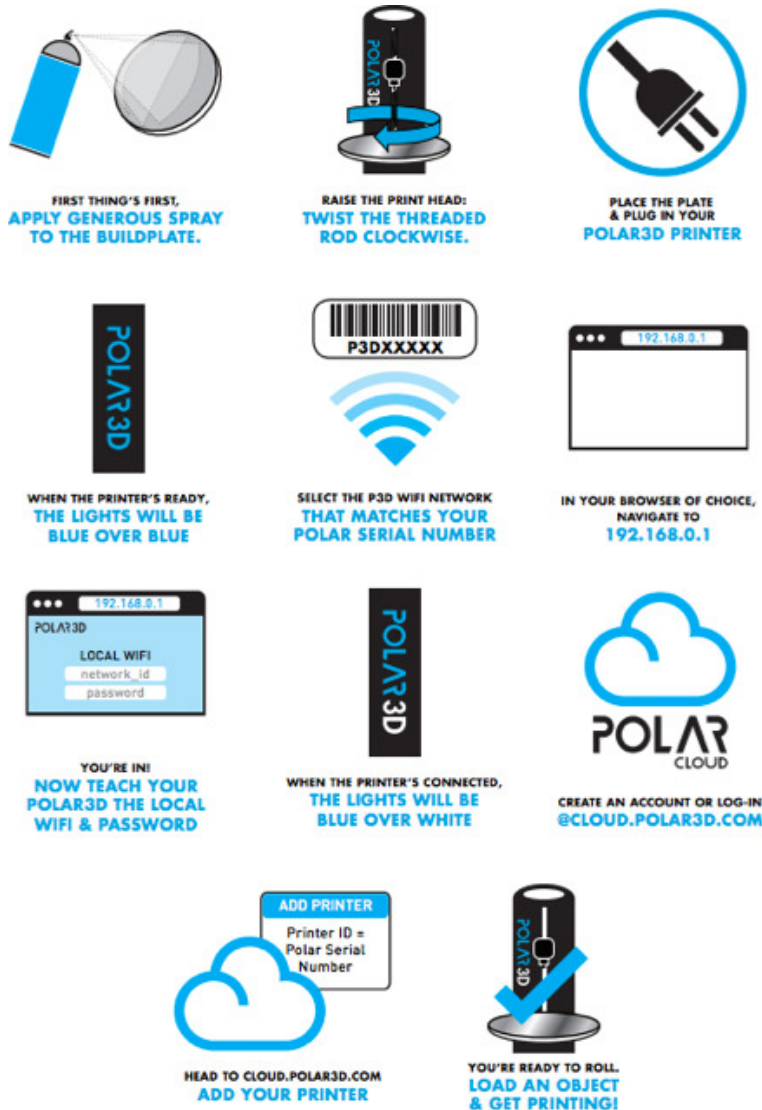
network), the Polar3D printer can instead be controlled directly from your device for printing: see Appendix C.

Figure 1.1: Printer in shipping box

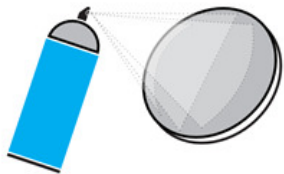


1.1 Connecting the Polar3D printer to the Polar Cloud via WiFi

Overview of getting your printer connected to the Polar Cloud via WiFi:



Details on getting your printer connected to the Polar Cloud via WiFi:



**FIRST THING'S FIRST,
APPLY GENEROUS SPRAY
TO THE BUILDPLATE.**

1. Unpack the **build plate**; it is a mirrored glass disk, that will arrive detached from the printer, shipped in its own slot in the foam padding material.

Apply a generous quantity of Aqua Net Extra Hold hair spray (included in the shipping box with your Polar3D printer) to the build plate of your new printer. You should apply a smooth and heavy coat, so that the surface looks milky; for a video demonstration, see:

<https://www.instagram.com/p/BJBaWwrjCwF/>

This will put a slightly sticky, but water soluble, layer on the build plate, giving better adhesion when objects are printing.



**RAISE THE PRINT HEAD:
TWIST THE THREADED
ROD CLOCKWISE.**

2. The printer arrives in its shipping box with the **print head** completely lowered, and the **build plate** (which is made of mirrored glass) not installed on the printer **build plate shuttle**. You will need to raise the print head in order to have room to place the build plate on the printer build plate shuttle.

Twist the threaded **Z rod** clockwise to raise the **print head**. Raising the print head one to two inches will give you room to install the build plate.

After you have unwrapped the **build plate** and prepared its surface by applying a coat of hair spray (see [step](#)

1 above), and raised the **print head** to make room for installing the build plate, you are ready to install the build plate on the printer **build plate shuttle**.

The bottom center of the build plate has a gear affixed. Place the build plate so that the center of the gear seats over the bearing on the build plate shuttle, and the gear teeth engage with the geared axle of the printer build plate shuttle.

Hint: pull the build plate shuttle out towards the front of the printer to give yourself more access. Tip the build plate slightly and engage the gear on its bottom with the drive gear on the shuttle; then push the build plate down onto the shuttle so that it seats onto the center bearing of the shuttle. For a video demonstration, see:

[Polar 3D youtube video: WWBD - Plate and Filament Installation](#)



PLACE THE PLATE
& PLUG IN YOUR
POLAR3D PRINTER



WHEN THE PRINTER'S READY,
THE LIGHTS WILL BE
BLUE OVER BLUE

3. Insert the power cord into the adapter, and the adapter plug into your Polar3D printer. Note: Do not force the adapter plug; it will *not* be flush with the printer.

Plug in to a power outlet.

4. When the printer has finished powering up, the **POLAR3D** LED lights along the side of the printer will be entirely blue.

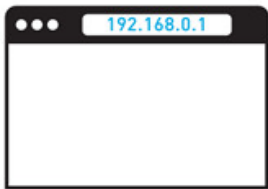


5. From your device (computer, tablet, or phone), select its WiFi network controls. From the list of WiFi networks your device displays, select the network named after your printer's serial number, as found on the back of the printer (see Figure 1.2); for example, "P3D02259-WIFI". You will be prompted for a password: that password is the 8-character serial number consisting of P3D and five digits, in this example "P3D02259"; (Figure 1.3 shows an example of entering this password on a Mac computer).

Figure 1.2: Back of printer: serial number and spool holder arm



Figure 1.3: Mac prompt for printer hotspot WiFi password

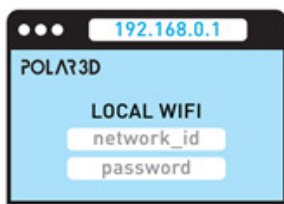
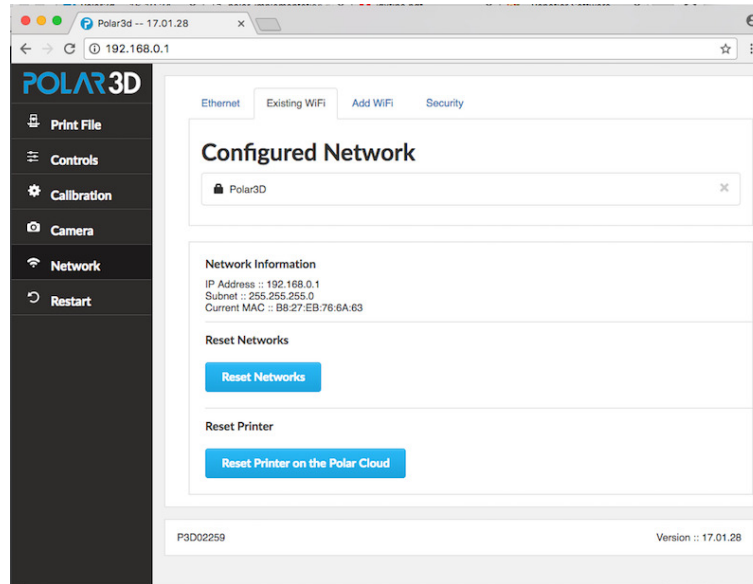


IN YOUR BROWSER OF CHOICE,
NAVIGATE TO
192.168.0.1

6. In your browser (Chrome, Internet Explorer, Safari, Firefox, *etc.*), enter 192.168.0.1 into the navigation bar. You are now connected to the printer and should see the printer's web interface, as in Figure 1.4.

At this stage, in the printer web interface, note that there is no blue highlighted network shown under **Configured Network**, meaning that the printer is *not* (yet) connected to any local WiFi and through that to the Internet, but rather is in HotSpot mode. (Aside: The Polar3D WiFi listed, which your printer is not on, is the Polar 3D corporate WiFi.) Once you connect to your site's local WiFi network, then instead under **Configured Network** you will see your local WiFi highlighted in blue (seen later in Figure 1.7).

Figure 1.4: Use the printer’s WiFi hotspot to connect to the printer’s web interface



**YOU'RE IN!
NOW TEACH YOUR
POLAR3D THE LOCAL
WIFI & PASSWORD**

7. Click the “Add WiFi” tab and choose the WiFi network to which you would like to connect the printer; see Figure 1.5. You will need to tell your printer the name of the local WiFi network you wish to use, and (likely also) its password; see Figure 1.6. (At some sites, local networking may require some additional configuration work here: if you know that your site uses static IP addresses or requires configuration assistance by the network administrator to allow your printer’s MAC address onto the local network or allow your printer access to outgoing HTTP ports, this is the time to perform such steps; see Section 1.4. Also, please note that *captive portal* network access is *not* supported.)

Once you have configured the printer to know about your

local WiFi network, go back to the “Existing WiFi” pane; as shown in Figure 1.7, your local network should now be listed, highlighted in blue, under Configured Network.

Figure 1.5: Select local WiFi network

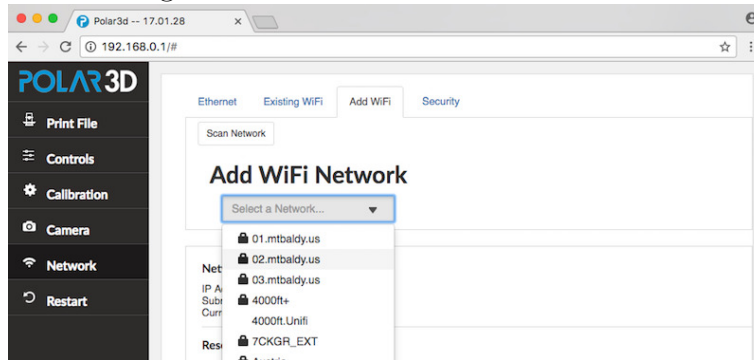


Figure 1.6: Enter local WiFi password

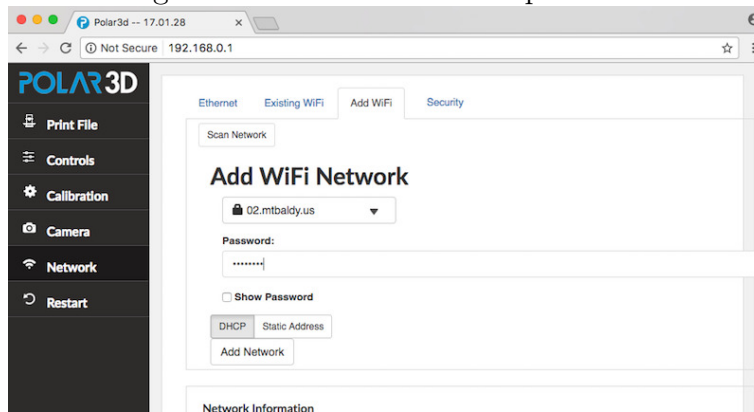


Figure 1.7: Local WiFi configured as network

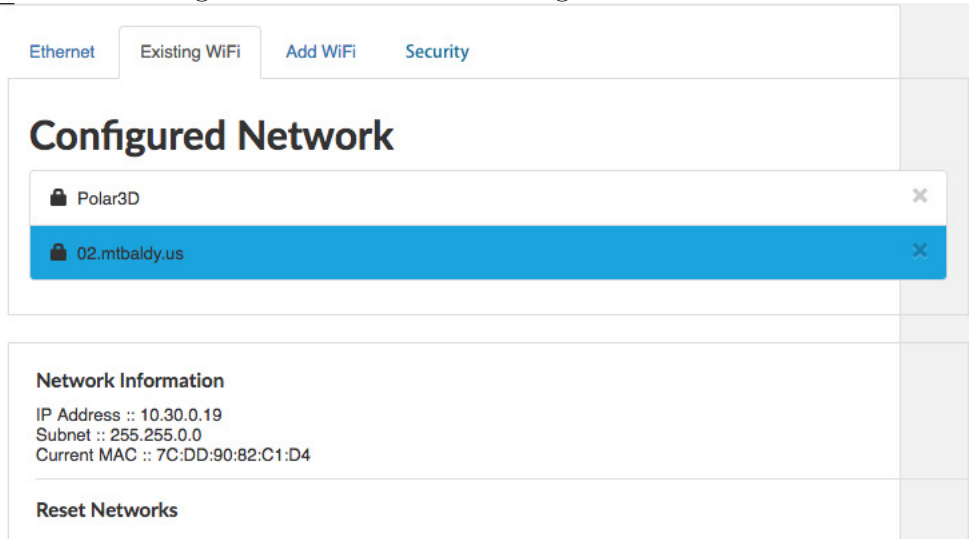
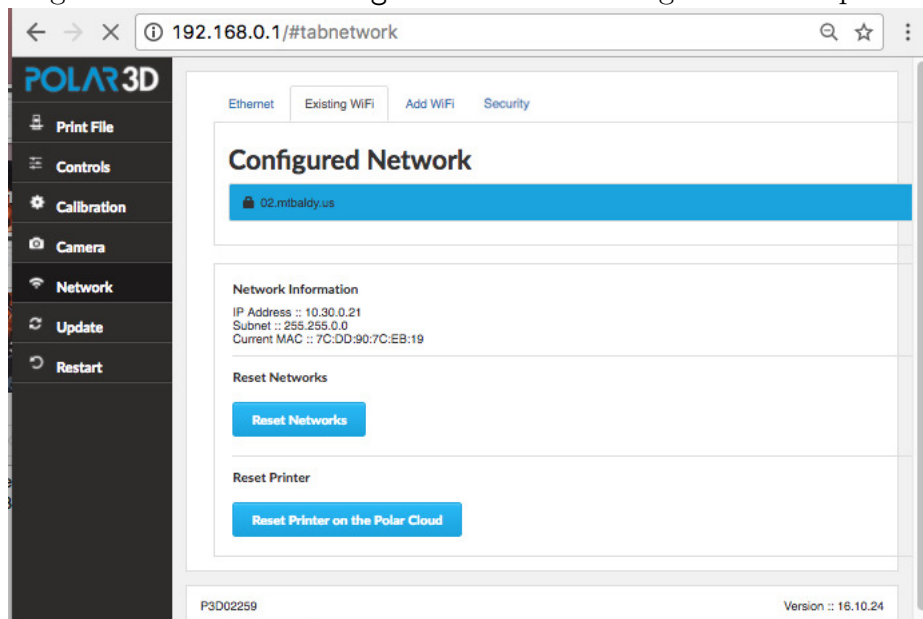


Figure 1.8: Printer Configured Network configuration completed

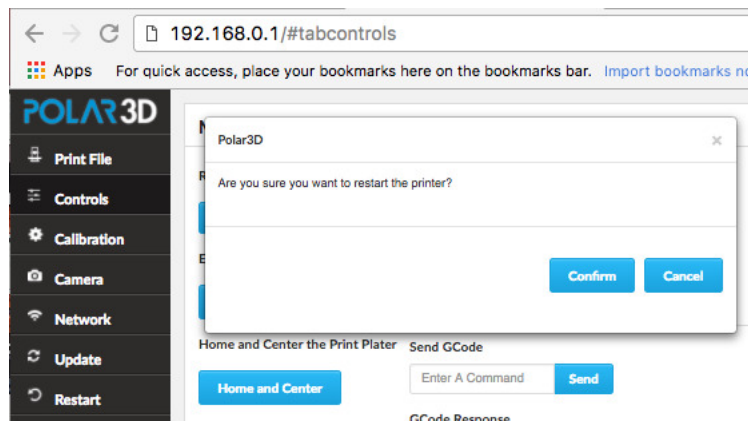


While not strictly necessary, we recommend that you *remove*

the “Polar3D” WiFi network from the **Configured Network** list by clicking on the X mark right of it; see Figure 1.7. (Removing the “Polar3D” network will prevent your printer from attempting to connect to that network after power cycles; you want your printer to attempt to connect first to *your* local network when it powers on.) After removing Polar3D WiFi network, your **Existing WiFi** screen should look similar to Figure 1.8.

You have now configured your 3D printer with a network profile for your local network. But incorrect values, such as for the local network password (see Figure 1.6), won’t be detected until your printer attempts to actually connect...

Figure 1.9: Printer **Restart** for local network connection attempt



Once your printer is configured to know how to connect to the local network (and if necessary, the local network has been configured by your network administrator to permit your printer to connect), click the “**Restart**” tab on the left navigation pane, and then click the “**Confirm**” button, see Figure 1.9, to have your printer attempt to connect to the local network, and through it to the Polar Cloud; upon success, the LED lights on

the side of the printer will go through a progression of colors ending as blue over white: **POLAR3D**.

If the connection attempt does not succeed, check that you properly entered the local WiFi password (see Figure 1.6), and attempt connection again. If the connection attempt still does not succeed, then at your site local networking may require some additional configuration work, such as configuring static IP address information rather than use of **DHCP**, and possibly assistance from your local IT administrator to permit your 3D printer onto the local network and permit it access to outgoing HTTP ports: see Section 1.4.

8. Once the printer is connected through your local network to the Polar Cloud, its **POLAR3D** LED lights will be blue over white.

You may now close the browser window that had been used to connect to the printer's local web interface (the browser window connected to 192.168.0.1, opened in [step 6](#)).

9. Creating a Polar Cloud account is a first step in establishing your Polar 3D environment, as the Polar Cloud is the central hub and command center of the environment.

For Polar Cloud, you will need a Google account, a Facebook account, a Microsoft Live account, or a Microsoft Office 365 account. If you do not already have any such account, you will need to make one.

(For instance, a Google account is very easy to create: go to



WHEN THE PRINTER'S CONNECTED,
THE LIGHTS WILL BE
BLUE OVER WHITE

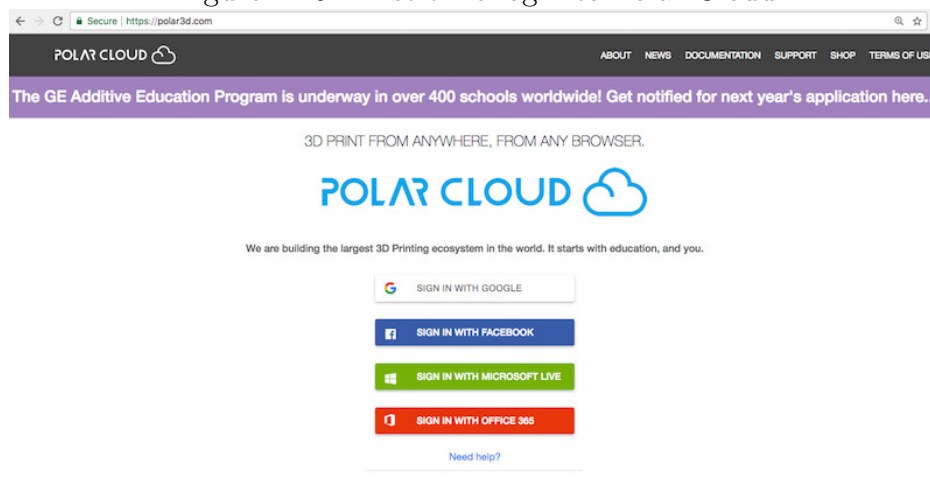


CREATE AN ACCOUNT OR LOG-IN
@CLOUD.POLAR3D.COM

www.gmail.com.) The Polar 3D support article [Linking Your Current Email Address to a Google, Microsoft, or Facebook Account](#) has additional details.

Go to polar3d.com on your device (computer, tablet, or phone); see Figure 1.10.

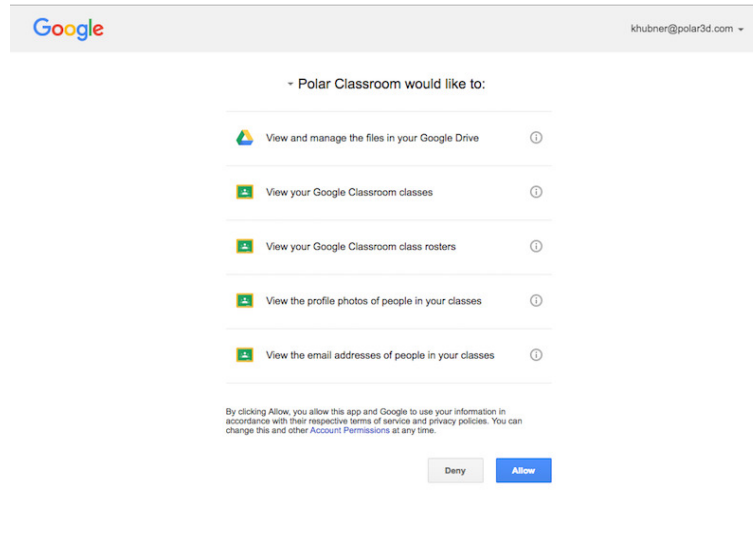
Figure 1.10: First time login to Polar Cloud



Click on the account that you're going to use for Polar Cloud access (Google, Facebook, Microsoft Live, or Microsoft Office 365). That will create your Polar Cloud account.

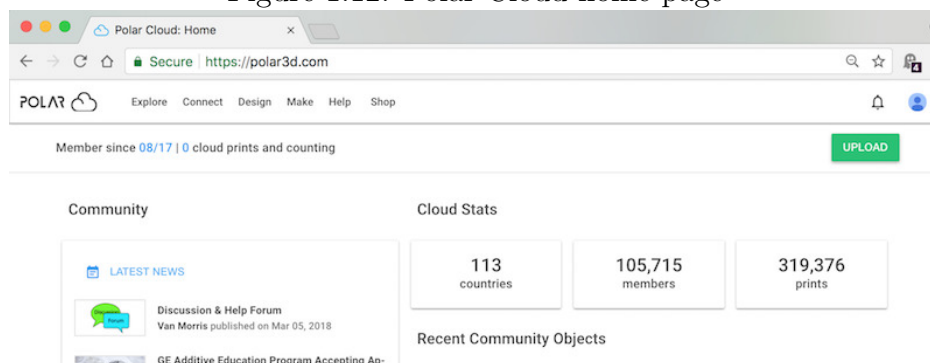
If this is your first time signing into the Polar Cloud, you may next see a screen asking for permission to access Polar Cloud sharing and classroom features. The exact screen and questions will depend upon what sort of account you used to create your Polar Cloud account; Figure 1.11 shows an example where log in was done with a Google account.

Figure 1.11: First time log in with Google credentials: classroom permissions screen



Once you're signed in, your home page should appear, looking similar to Figure 1.12.

Figure 1.12: Polar Cloud home page



10. Now, with the printer turned on and connected to the Polar Cloud, and with you logged in to your Polar Cloud account:



(i) From the Polar Cloud main menu, expand the menu lines at the upper left, click the “PRINTERS” tab, as shown in Figure 1.13, and then click the “ADD” (“+”) button (towards the upper right), shown in Figure 1.14.

Figure 1.13: Polar Cloud expand top menu and click PRINTERS

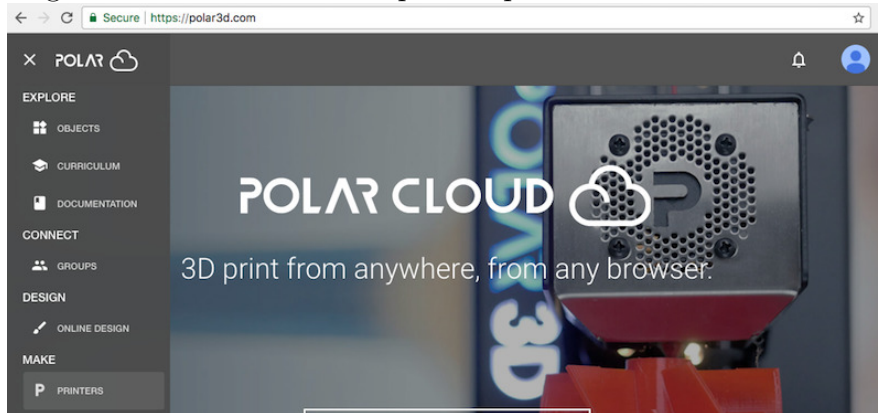
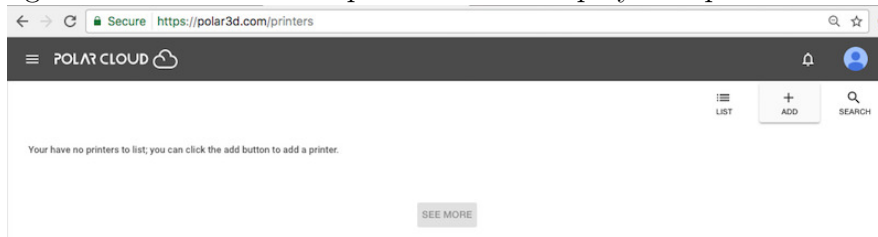
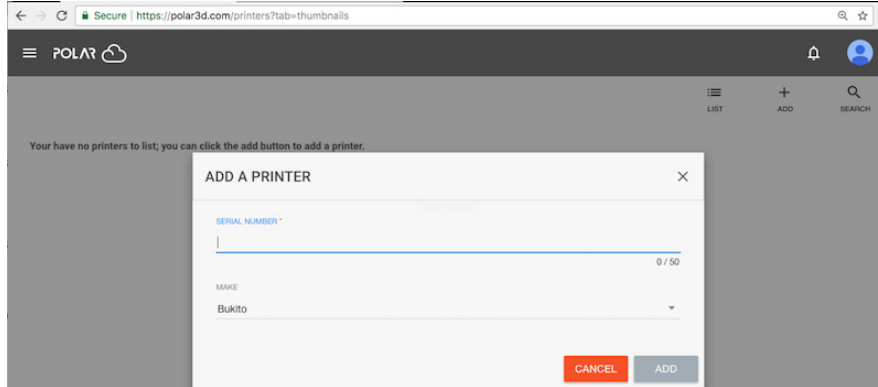


Figure 1.14: Polar Cloud printers TILE display ADD printer button



(ii) On the ADD A PRINTER screen shown in Figure 1.15, at “SERIAL NUMBER”, enter the printer’s serial number (the same “P3D” and five digits that you entered in step 5).

Figure 1.15: Polar Cloud ADD A PRINTER: enter serial number



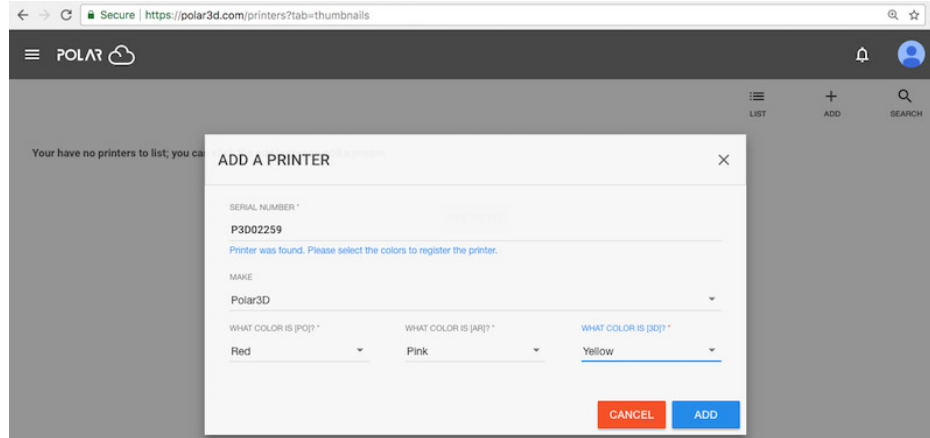
Once you have entered the printer’s P3D . . . serial number, the Polar Cloud will automatically presume that this is a Polar3D printer and automatically change the “MAKE” to “Polar3D”.

(iii) If the Polar Cloud located the printer with the serial number you entered, a message will appear, see Figure 1.16, saying

Printer was found. Please select the colors to register the printer.

(If you instead see an error message, see the trouble-shooting in Section 1.3.)

Figure 1.16: Polar Cloud ADD A PRINTER printer found: security color check

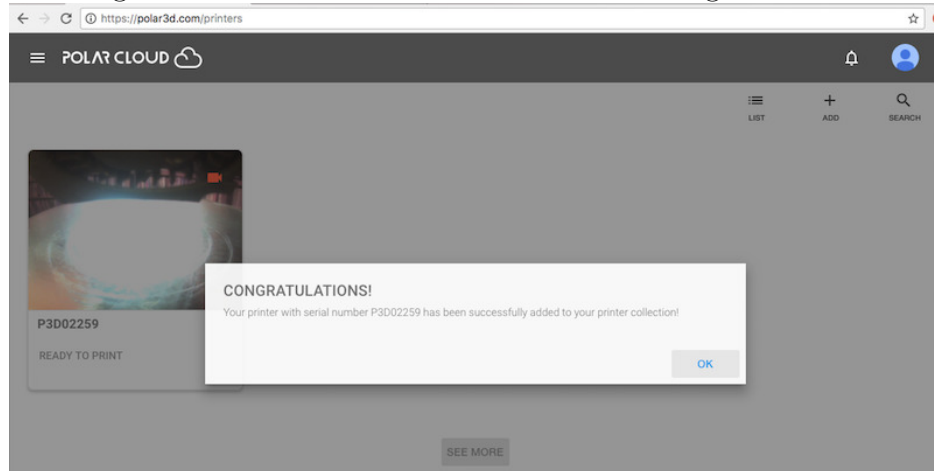


Once the Polar Cloud detects a connection to the printer with the specified serial number, the color of the LED lights spelling out “POLAR3D” along the side of the printer will form a security check. On the “ADD A PRINTER” screen, at each of the three drop down menus, enter the color that your printer’s lights are showing for the corresponding letters, for “PO”, “AR”, and for “3D”, as for instance shown in Figure 1.16 corresponding to printer LED lights **POLAR3D**; then click “ADD”.

Note that you have a limited amount of time (several minutes) to enter these colors; if you do not enter the colors properly, you will be “locked out” of adding the printer for a short time.

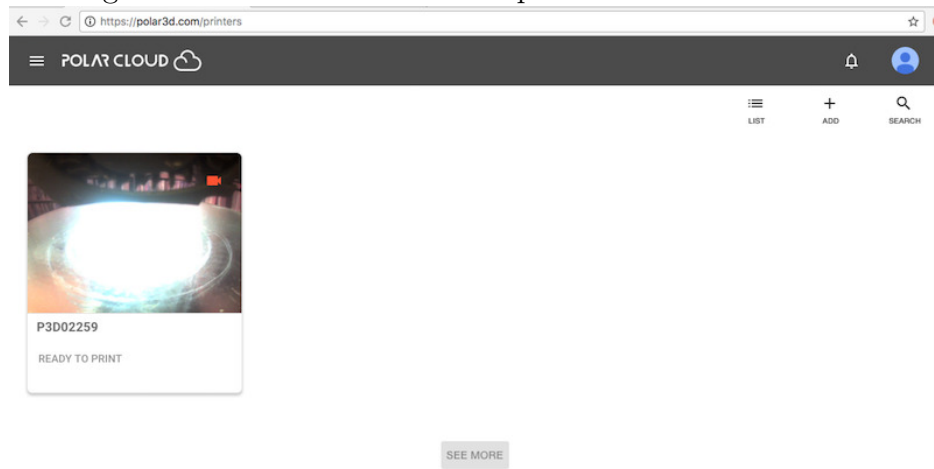
If you entered the colors successfully, you will get a confirmation that your printer was successfully added, as shown in Figure 1.17.

Figure 1.17: Polar Cloud ADD A PRINTER congratulations



Click “OK” to dismiss this confirmation and return to the printer “TILE” list-by-image screen, now updated with your newly added printer, as shown in Figure 1.18.¹

Figure 1.18: Polar Cloud added printer listed in TILE view



¹If you added the printer by clicking the “ADD” button on the printer “LIST” screen, instead of by clicking the “ADD” button on the “TILE” screen as shown in this example, than at this point you will return to an updated printer “LIST” screen instead of to an updated printer “TILE” screen such as shown in Figure 1.18.



11. The printer is now connected and ready to print! See Chapter 2 for an example of performing a first print through the Polar Cloud!

Note that if you wish, you may use the Polar Cloud printer management interface to change the printer's name and enter a longer text description and location for the printer: perhaps describing the printer's location, its primary intended purpose, the class for whose use it is intended, *etc.*; see Section 9.2.2: [Printer settings: name, description, location, and make of printer](#) of the *Polar Cloud Guide*.

1.2 Connecting the Polar3D printer to the Polar Cloud via Ethernet cable

Connecting the printer to your network via an Ethernet cable is similar in functionality, from a Polar Cloud perspective, as a wireless connection. The only difference is in the portability of the printer, as with an Ethernet cable connection, the printer will be physically connected to the network.

Perform [steps 1 through 4](#) from Section 1.1.

But instead of [steps 5 through 8](#) from Section 1.1, simply plug in the Ethernet cable to both the printer, and to an Ethernet jack for your local network. If the **POLAR3D** LED lights on the printer become blue over white, it indicates that your printer has successfully connected to the Polar Cloud!

However, if the printer could not successfully connect to the Polar Cloud, see Section 1.4: you may need to enter a [static IP](#)

[address](#) for your printer, or ask your IT or network administrator to open up local network access to your printer.

Once the LED lights on the printer show as **POLAR3D** (blue over white), then perform [steps 9 and 10](#) from [Section 1.1](#); that is, log in to your Polar Cloud account, and add the printer to your Polar Cloud account.

1.3 Errors at ADD A PRINTER screen

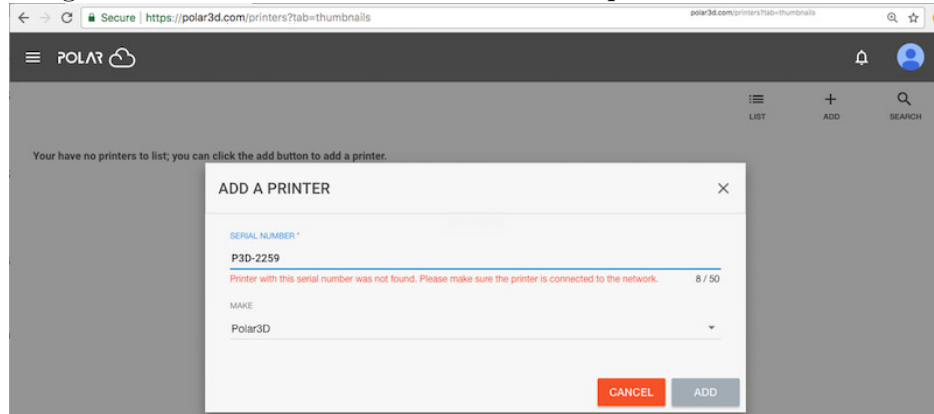
When you enter your printer's serial number at the Polar Cloud "ADD A PRINTER" screen shown in [Figure 1.15](#), you should then get presented with the LED light color security check, as shown in [Figure 1.16](#). However, if instead you get an error at the "ADD A PRINTER" screen, there are three general possibilities:

1. Network problems; check that the **POLAR3D** LED lights are blue over white, and if not, see [Section 1.4](#).
2. Incorrect/invalid printer serial number.
3. Your printer (its serial number) is already registered to someone in the Polar Cloud, and the printer is configured to disallow additional registrations.

If, as in [Figure 1.19](#), you see an error message saying

Printer with this serial number was not found. Please make sure the printer is connected to the network.

Figure 1.19: Polar Cloud ADD A PRINTER printer not found error

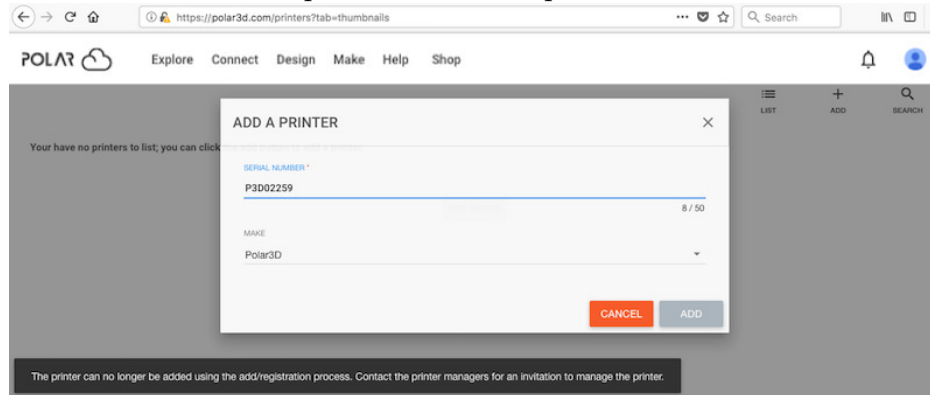


then return to [step \(ii\)](#) (of [step 10](#) of [Section 1.1](#)) and (after making sure that the printer is plugged in and connected to the Internet with [POLAR3D](#) LED lights blue over white) then double-check that you correctly input the printer's serial number. (For instance, if your printer's serial number includes any zeros, double-check that you typed zeroes rather than capital letter O's.)

If, as in [Figure 1.20](#), you see an error message saying

The printer can no longer be added using the add/registration process.
Contact the printer managers for an invitation to manage the printer.

Figure 1.20: Polar Cloud printer ADD attempt when Add Allowed is disabled



then this printer (its serial number) has already been registered in the Polar Cloud, and the printer’s “[SETTINGS](#)” switch “[Add Allowed](#)” has been disabled. This should not occur with a brand-new printer – but could occur if you have acquired your printer from a prior owner (who has not removed their registration of the printer in the Polar Cloud).

If you have the cooperation of the prior owner, you can ask the prior owner to transfer the Polar Cloud registration of the printer to you via the Polar Cloud printer “[MEMBERS](#)” screen’s “[CHANGE OWNER](#)” button, or simply “[DELETE PRINTER](#)” from their Polar Cloud account, or add you as a manager of the printer, or enable the “[Add Allowed](#)” switch under printer “[SETTINGS](#)”, (according to which effect you and the prior owner wish to achieve: respectively, preserve any existing printer queue of print jobs and transfer Polar Cloud registration to you, discard any existing printer queue of print jobs and allow you to register the printer yourself, add you as an additional printer manager, allow you to register yourself as an additional printer manager).

However, if you do not have the cooperation of the prior

printer owner, then see the [printer local web interface](#) and its “[Reset Printer on the Polar Cloud](#)” button.

1.4 Network issues and solutions

Note that [captive portal](#) network access is not supported.

If your site does not use [DHCP](#) and instead assigns static IP addresses to network devices (such as your 3D printer), you will need to configure your 3D printer to know its static IP information; see Section [1.4.1](#).

If your site uses advanced networking requiring authentication of a MAC address, then your IT or network administrator will need to add your 3D printer’s [MAC address](#) to the list of hardware on the network in order for your printer to successfully connect to the local network; see Section [1.4.2](#).

In order for your 3D printer to successfully connect to the Polar Cloud, outgoing HTTP ports 80 and 443 must be open to your printer. If your local network does not allow the printer to access those outgoing ports, then the printer’s attempts to connect to the Polar Cloud will not fully succeed. In this case, you will need your IT or network administrator to allow your printer to access those outgoing ports; see Section [1.4.3](#).

For a general overview of network connectivity diagnosis and solutions, see Section [1.4.4](#).

1.4.1 Static IP address for printer

Many networks automatically assign IP addresses (via **DHCP**) to network devices such as your 3D printer, but if your local network does not have a DHCP server, then you will need to manually configure your printer with a static IP address. If your local network requires a static IP address, then after connecting to 192.168.0.1 (and if necessary clicking the “**Network**” tab to get to a screen such as Figure 1.4), either click on “**Add WiFi**” and then select a WiFi network name from the drop down menu (if you are configuring a WiFi connection), or click on “**Ethernet**” (if you are configuring an Ethernet connection).

Instead of leaving the “**DHCP**” button highlighted, click the “**Static Address**” button. This will bring up a display such as shown in Figure 1.21 (WiFi) or Figure 1.22 (Ethernet).

Figure 1.21: WiFi static IP address

The screenshot shows a web browser window with the address bar displaying "10.30.0.10". The page is titled "POLAR3D" and has a dark sidebar with navigation options: "Print File", "Controls", "Calibration", "Camera", "Network", and "Restart". The "Network" option is selected. The main content area is titled "Add WiFi Network" and has tabs for "Ethernet", "Existing WiFi", "Add WiFi", and "Security". The "Add WiFi" tab is active. Below the tabs is a "Scan Network" button. The main form has a dropdown menu for "Network Name" showing "01.mtbaldy.us". Below that is a "Password:" field with a "Show Password" checkbox. There are two radio buttons: "DHCP" (selected) and "Static Address". Below these are fields for "IP Address:", "Network Mask:", "Gateway:", and "DNS (Space separated):". At the bottom of the form is an "Add Network" button. A "Network Information" section at the bottom right displays: "IP Address :: 10.30.0.10", "Subnet :: 255.255.0.0", and "Current MAC :: 7C:DD:90:82:C1:D5".

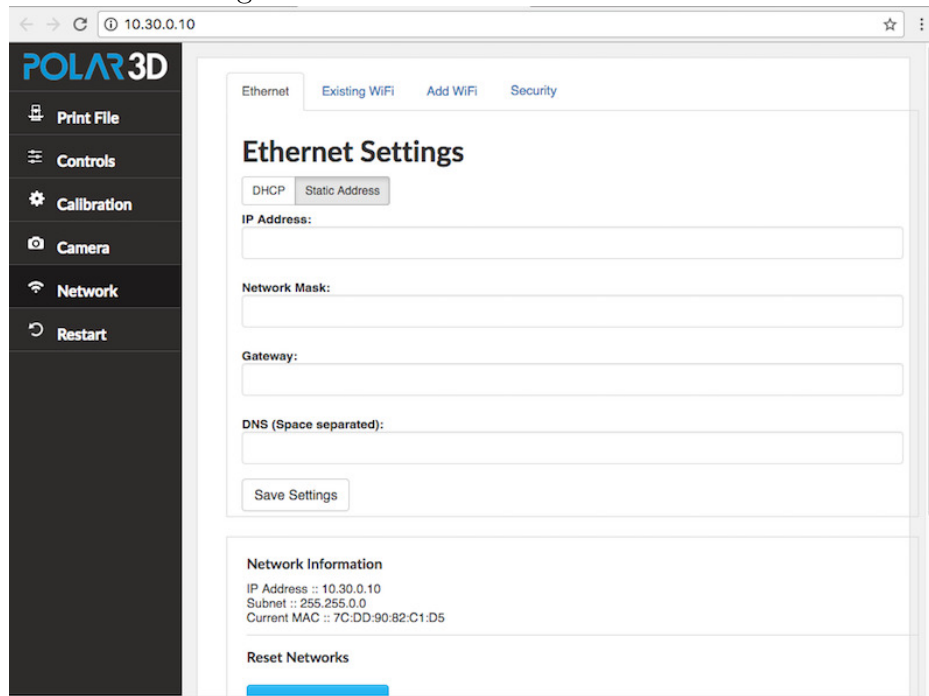
Enter specific values for:

1. IP Address
2. Network Mask
3. Gateway
4. DNS servers (space separated if your site has more than one)

If you are used to adding network devices to your network, you're probably familiar with the sorts of values to enter. Otherwise, ask your IT or network administrator for details on what

values to enter.

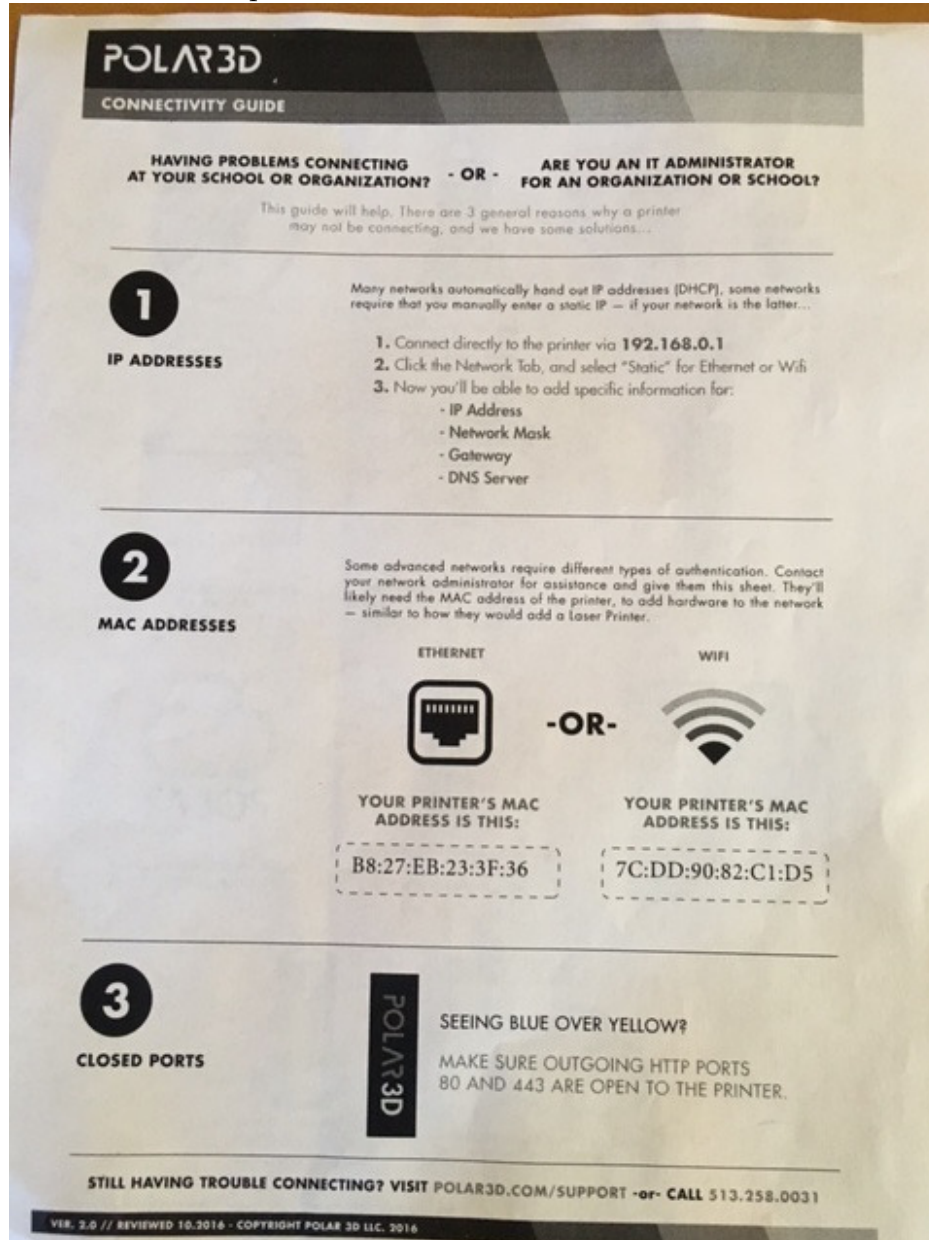
Figure 1.22: Ethernet static IP address



Once you have finished entering appropriate values for your site, click the “Add Network” button (WiFi – see Figure 1.21) or “Save Settings” button (Ethernet – see Figure 1.22).

Then click the “Restart” tab on the left navigation pane to have the printer attempt to use your newly configured local network information to connect to your local network, and then through it to the Polar Cloud.

Figure 1.23: Polar3D printer CONNECTIVITY GUIDE sheet: MAC address



1.4.2 MAC address for the printer

Some advanced networks require different types of authentication. In this case, your IT or network administrator will need to add your 3D printer’s **MAC address** to the list of hardware on the network – similarly to how they would add a laser printer.

Make a note of the MAC address of your printer, as your network administrator will likely need it! The MAC address is printed on the “CONNECTIVITY GUIDE” sheet (the back side of the “GETTING STARTED” sheet) shipped with your Polar3D printer; see Figure 1.23. The MAC address may also be found displayed by the printer local web interface: after connecting to 192.168.0.1, look under the header “Network Information” for the value in the “Current MAC” field; see for instance Figure 1.8. (Indeed, the printer local web interface shows the MAC address in multiple places; see also for example Figure 1.21 or Figure 1.22.)

Note that if you have left your Polar3D printer configured to potentially use multiple WiFi networks, then the MAC address displayed may differ in its final digit from the value printed on the “CONNECTIVITY GUIDE” sheet.

1.4.3 Open HTTP ports

Outgoing HTTP ports 80 and 443 must be open to the printer. If your local network does not allow the printer to access those outgoing ports, then the printer’s attempts to connect to the Polar Cloud will not fully succeed.

In terms of LED lights, the symptom you will see when the

rest of configuration was successful but now the printer can't access the outgoing HTTP ports is that the LED lights will be blue over yellow: [POLAR3D](#).

Make a note of your printer's IP address (if you are using a [static IP address](#)) and its [MAC address](#) and contact your IT or network administrator to ask them to open up access for your printer.

1.4.4 Solving network connectivity problems

If your printer's LED lights are not showing as [POLAR3D](#) (blue over white), then the printer is not connected to the Polar Cloud.

If the LED lights cycled:

1. [POLAR3D](#) → [POLAR3D](#) → [POLAR3D](#) (the LED lights cycled from entirely blue, to blue over red, before returning to entirely blue): the printer searched for the specified local network, but could not successfully connect.
 - (a) For WiFi connection, first go back to the network profile configuration ([step 7](#) in [Section 1.1](#); see in particular [Figure 1.6](#)), and check that you entered the local network password correctly!
 - (b) If using a static IP address, check that all those networking parameters were correctly entered; see [Section 1.4.1](#).
 - (c) On an advanced network, check with your network administrator that he or she has used your printer's [MAC address](#) to permit it access; see [Section 1.4.2](#).

2. POLAR3D → POLAR3D → POLAR3D (the LED lights cycled from entirely blue, to blue over red, before ending as blue over yellow): the printer successfully connected to your local network, but has not been able to connect over the Internet to the Polar Cloud.
 - (a) Confirm with your network administrator that the printer is being allowed access to [outgoing HTTP ports 80 and 443](#); if your local network normally blocks access to those ports, the network administrator will need to open up access for the printer.
 - (b) Check whether your site is having general Internet connectivity problems – the printer can't connect to the Polar Cloud unless your Internet connection is operating!

Chapter 2

Start printing

Once you have your printer connected to the Polar Cloud (see Chapter 1), you can start your first print through the Polar Cloud!¹

For your first print, you'll want to load filament (Section 2.1), get an object (Section 2.2), and then start a print job (Section 2.3); you can monitor the printing of your object through the Polar Cloud, including printer dashboard progress display and real-time video (Section 2.4) as the printer prints your object.

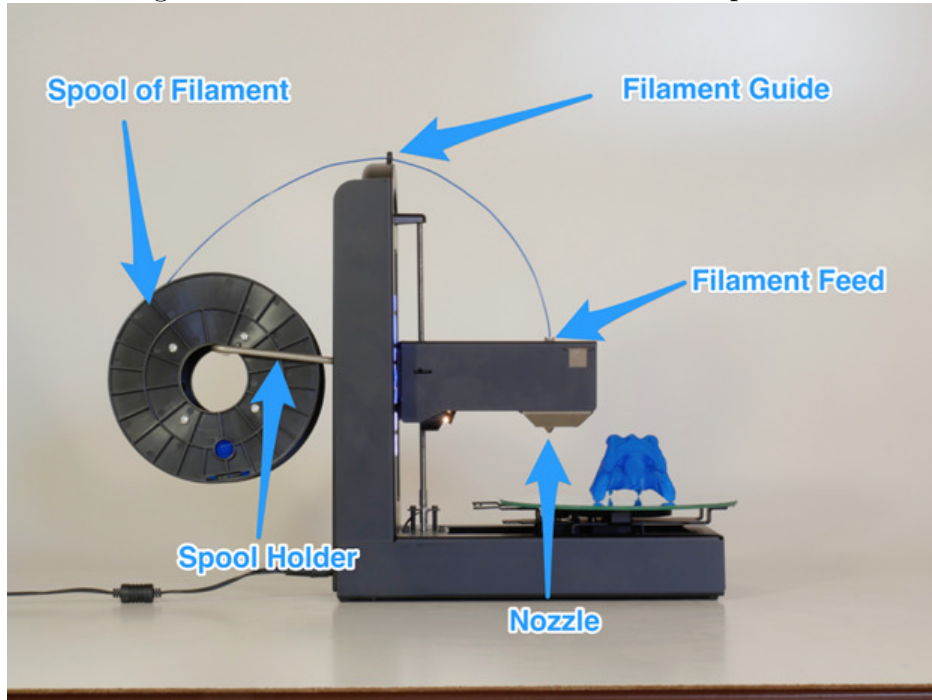
2.1 Load filament on the Polar3D printer

For a video demonstration, see:

[Polar 3D youtube video: WWBD - Plate and Filament Installation](#)

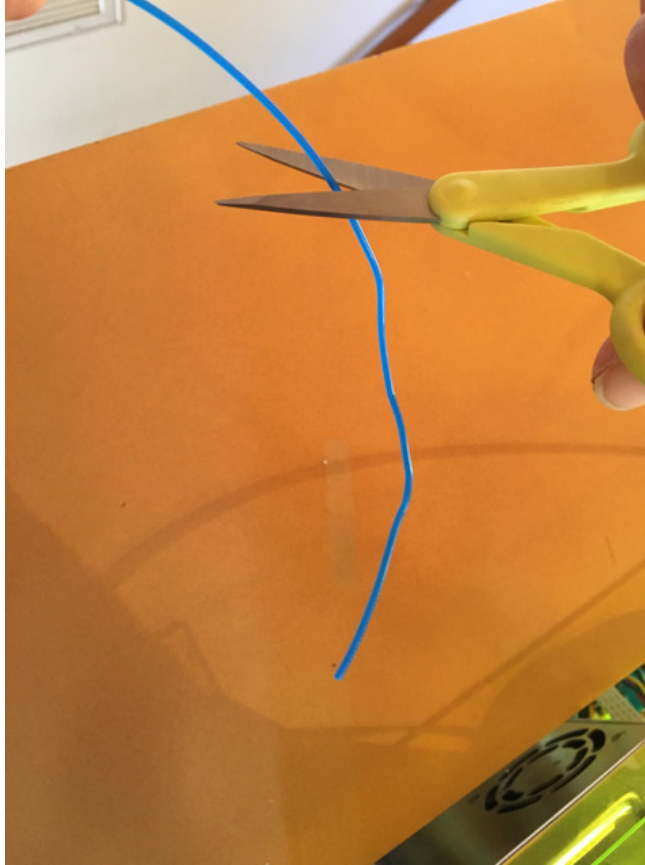
¹If you want to print without connecting through the Internet to the Polar Cloud, see Appendix C which explains how to get started printing when directly connected to the printer.

Figure 2.1: Load filament onto the Polar3D printer



1. Swing out the spool holder arm from the back (see Figure 1.2) of the Polar3D printer.
2. Unwrap the spool of filament and place it onto the spool holder; see Figure 2.1.
3. Find the end of the string of filament.
4. Snip off the end of the filament – perhaps an inch or two – with a pair of scissors or wire clippers to get a good, clean end to feed into the printer (*especially* if the end is kinked, or melted, or blobby); see Figure 2.2.

Figure 2.2: Snip end of filament



5. Feed the filament through the filament guide (the hole at the top of the Polar3D printer); see Figure 2.1.
6. Stick the end of the filament into the [filament feed hole](#) at the top of the [print head](#). The “feel” of this takes a bit of getting used to: when sticking the filament into the feed, you must push past some initial resistance: you must push the filament in far enough to engage with the filament drive gear inside the print head, and then down past that into the throat of the extruder. The Polar 3D support site has

a clip of this process:

[Polar 3D support document “Loading and Unloading Filament”](#)

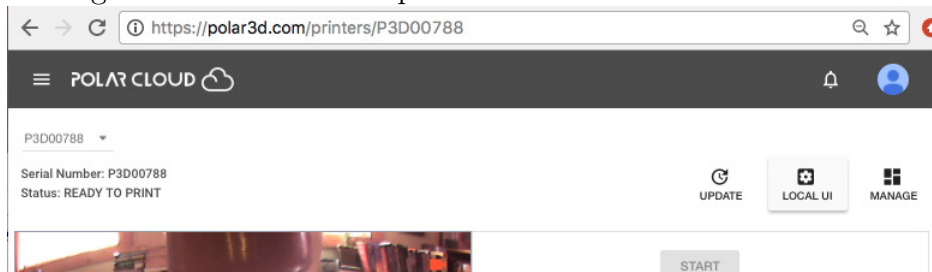
Note that if you cannot seem to get the filament past the resistance at the filament drive gear and properly engaged, it may be that a bit of old filament has stuck, hardened up, in the filament drive gear. (And since Polar3D printers get a sample print performed at the factory – see for instance the yellow “Benchy” boat object pictured in the shipping box in Figure 1.1 – your new printer *could* have a bit of filament hardened up in its filament drive gear.) In this case, heat up the extruder as discussed in step 7 and then again try inserting the filament, manually feeding it through the filament drive gear (and perhaps pushing out a now-melting blob of old filament).²

7. Check that the filament is properly inserted and engaged with the filament drive gear as follows:
 - (a) From your device (phone, tablet, computer), connect to the printer’s local IP address to access the [printer’s local web interface](#). (If your local network permits access from the Internet back to your printer’s local IP address, you may instead conveniently access the printer local web interface and perform such settings

²When the filament feeds into the extruder and engages with the filament drive gear cleanly in step 6, then step 7 describes how to use the printer’s normal controls to heat up and test extrude a bit of filament. But if you encounter difficulty getting your filament to engage properly with the filament drive gear (*not* a typical occurrence, but if this is your first time loading filament...), be aware that it is also fine (if more “hands on”) to heat up the extruder to filament melting temperature, and then manually push the filament gently through the extruder: you want to see a bit of your filament emerge, melted, from the extruder nozzle.

while within the Polar Cloud. From the Polar Cloud main menu, expand the left-hand menu and click on “PRINTERS”, then click on the image of the printer you are loading with filament; this will take you to the printer’s dashboard screen. At that printer dashboard screen, click on the “LOCAL UI” button (gear icon) at the upper right, to navigate to the printer’s local web interface; see Figure 2.3.)

Figure 2.3: Polar Cloud printer dashboard LOCAL UI button



At the printer local web interface, click on the “Controls” tab from the vertical menu on the right (Figure 2.4) to get to the “Manual Printer Controls” screen (Figure 2.5). At the “Manual Printer Controls” screen, enter a temperature of 185°C and click the “SET” button; see Figure 2.5.

Figure 2.4: Printer local web interface Controls tab

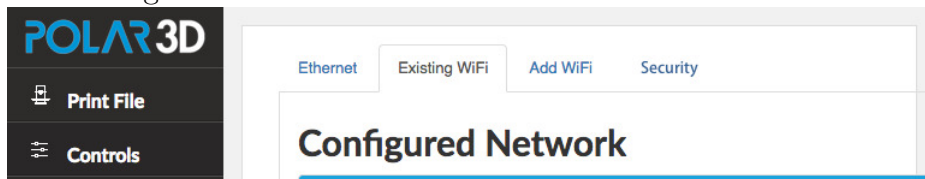
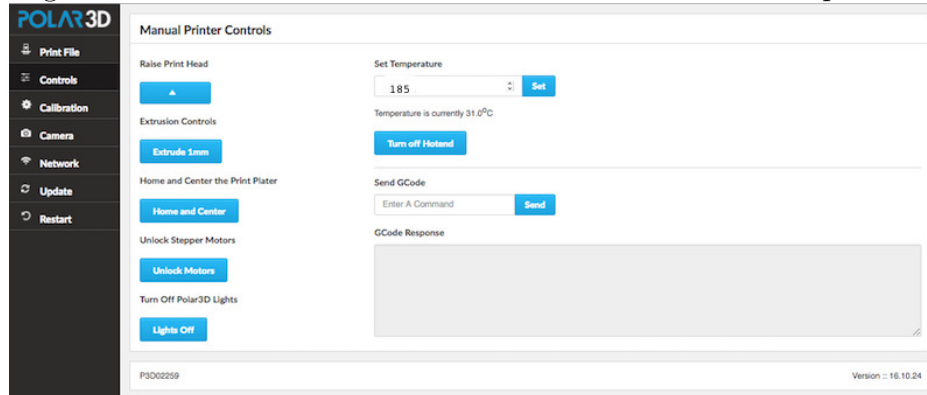


Figure 2.5: Manual Printer Controls screen: set the temperature



- (b) Once the extruder has warmed up, which you can see on the **Manual Printer Controls** screen just underneath where you set the desired temperature, on that same screen click the “**Extrude 1mm**” button several times, to extrude a few millimeters of filament.
- (c) Note that if the printer already had a bit of filament in the extruder – and the Polar3D printers get a test print performed at the factory so even a brand-new printer may have a bit of filament in the extruder – you may see molten plastic leaking out as the printer heats up, even before you tell it to extrude filament. But you want to see the printer feeding in and extruding *your* filament – the filament you just loaded. Seeing a string of your filament get extruded as now molten plastic confirms that your filament is properly loaded, and you’re ready to print!

2.2 An object to print

Figure 2.6: Polar Cloud top menu OBJECTS tab



To print using the Polar Cloud, you need an object (one or more [.stl files](#)) in the Polar Cloud; you may:

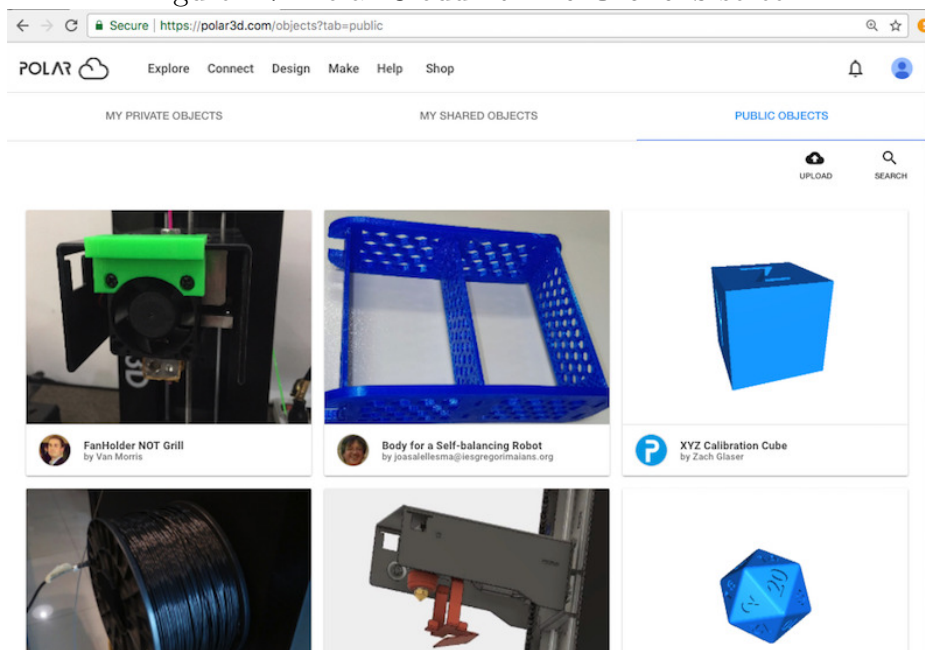
1. [Search for and find in the Polar Cloud an object shared by someone else](#),
2. [Upload an existing object](#) (from outside the Polar Cloud) into the Polar Cloud, (Section [5.3: Uploading objects](#) of the *Polar Cloud Guide*),
3. [Create a new object](#) yourself, using CAD software, (Chapter [6: Design or modify objects with design/CAD software](#) and Chapter [6.5: More design and CAD software – design your objects](#) of the *Polar Cloud Guide*),
4. Print any [object already in your Polar Cloud collection](#) (though if you're a new Polar Cloud member, you probably won't have any such objects yet). (Chapter [5: Objects in the Polar Cloud](#) of the *Polar Cloud Guide*.)

A quick way to get started is to find an object in the Polar Cloud, as will be demonstrated in Section 2.2.1.

2.2.1 Find an object in the Polar Cloud

From the Polar Cloud main screen, expand the top left menu and click on “OBJECTS”; see Figure 2.6. Then click on “PUBLIC OBJECTS”; this will bring up a screen such as shown in Figure 2.7. Scrolling to the bottom of the screen and clicking “SEE MORE” will load additional objects. You may click on an object to select it.

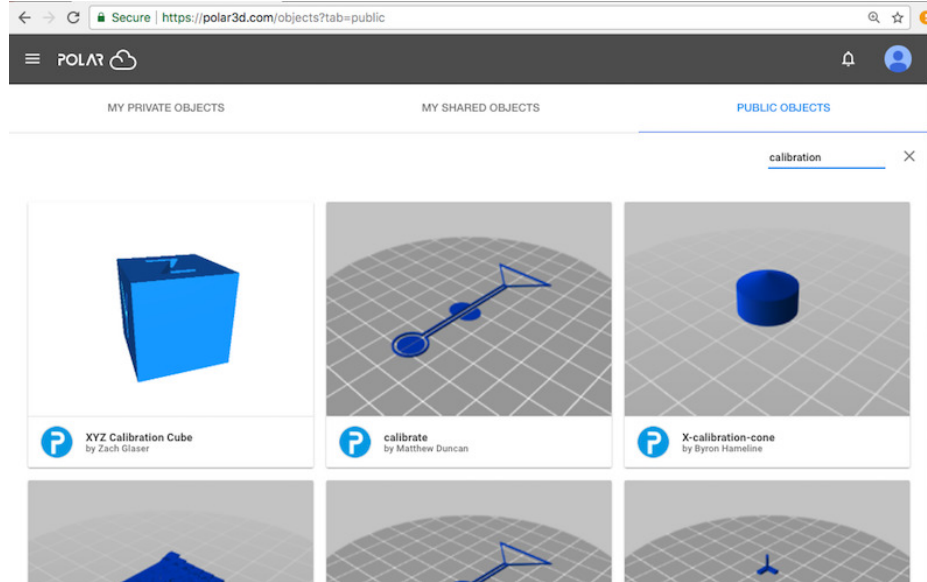
Figure 2.7: Polar Cloud PUBLIC OBJECTS screen



Note that you may also search these objects by clicking on “SEARCH”. For instance, if you don’t see any object that particularly appeals to you as your first print, you might try searching

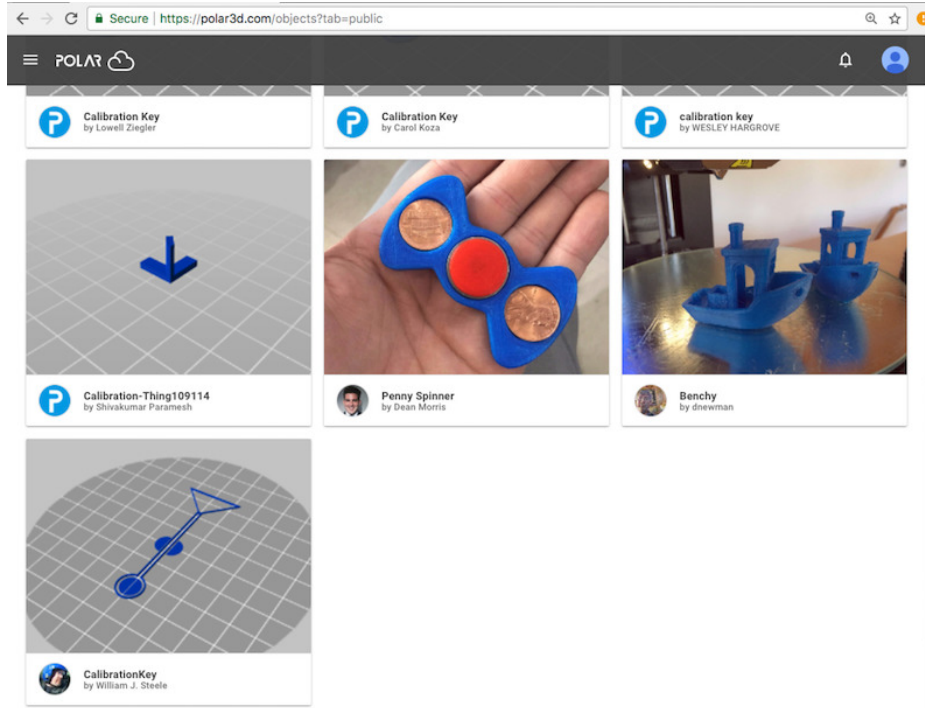
for “calibration” (to find objects intended for checking calibration) and try one of those objects as your first print; see Figure 2.8.

Figure 2.8: Searching for “calibration” on the PUBLIC OBJECTS screen



Let’s scroll down and find William Steel’s original calibration key, as shown in Figure 2.9.

Figure 2.9: PUBLIC OBJECTS listing of William Steele's CalibrationKey



Clicking on that object's tile image takes you to the object's detail screen, as shown in Figure 2.10.

Then clicking on the “3D PRINT” button will take you to the build plate screen, as shown in Figure 2.11. (Note that for especially complex objects, objects with multiple or large `.stl` files, the process of loading the object's image to the screen may take a minute or so; you will see a blue swirling loading icon towards the bottom right of the build plate screen as the object loads.)

Figure 2.10: CalibrationKey object detail screen

Secure | <https://polar3d.com/objects/20878>

CalibrationKey
by William J. Steele

3D PRINT DOWNLOAD SHARE

43 15 2

Description
How to read Calibration Key

Step #1.
Look at center.

Do you see blobs towards the middle? If so, then X axis offset is too great.
Do you see even blobs on the outside of the center? If so, then the X axis offset is too small.
Do you see off center blobs on the outside? If so, then the nozzle is off center.

Step #2.
Look at Circle

Do you see any flat spots?

Do you see a flat spots on the end? X axis gear is too loose.
Do you see flat spots on the sides? Y axis (rotation) gear is loose.

Step #3.
Look at the two small knobs on the tip of the triangle.
Do you see them touching? If so, the Z axis is too low.
Do you see them uneven with each other? If so, then the X axis gear is too loose.

Step #4.
Look at the triangle.

Does one side look wider then the other side (or are there gaps in either side walls?) If so, then the Y motor (rotation) gear is too loose.
Is the end not stuck to the built plate firmly? If not, then the shuttle arms are bent and need to be realigned with the center.

Step #5.
Look at the flat half disks.

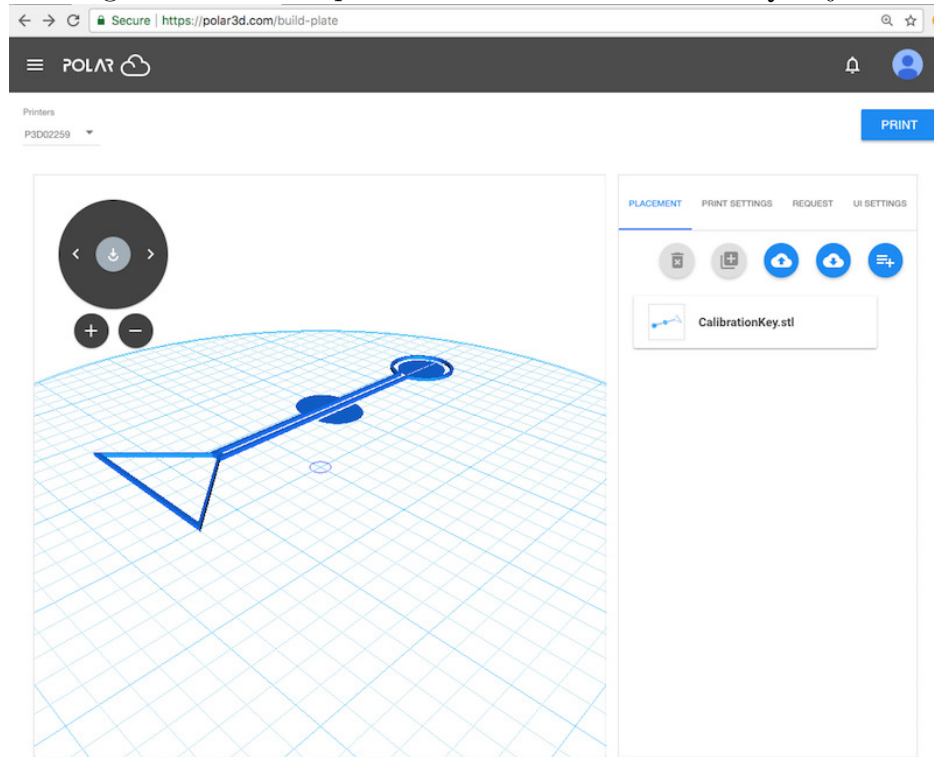
Are they touching anything else? If so, the Z height is too low.
Are there gaps in the filled areas? If so, then the Z height is too high?

Created: Jan 29, 2016
Last modified: Jan 29, 2016

FILES COMMENTS

DOWNLOAD 3D PRINT REPORT

Figure 2.11: Build plate screen for CalibrationKey object



At the build plate screen, you may optionally make *numerous* adjustments to the object; see Section 2.2.2.

Once you are content with the planned object, click the “PRINT” button (at the build plate screen’s upper right) to submit the print job to the printer; this will automatically take you (after possibly a minute or so with a blue swirling loading icon towards the lower right of the screen) to the printer dashboard screen; see Figure 2.16.

2.2.2 Experiment with adjusting object placement and print settings

Once you choose an object to print and click the “3D PRINT” button on the object’s display screen (see Figure 2.10), you will be at a screen such as shown in Figure 2.11, where you have the opportunity to adjust your object, and adjust printer settings, if you wish.

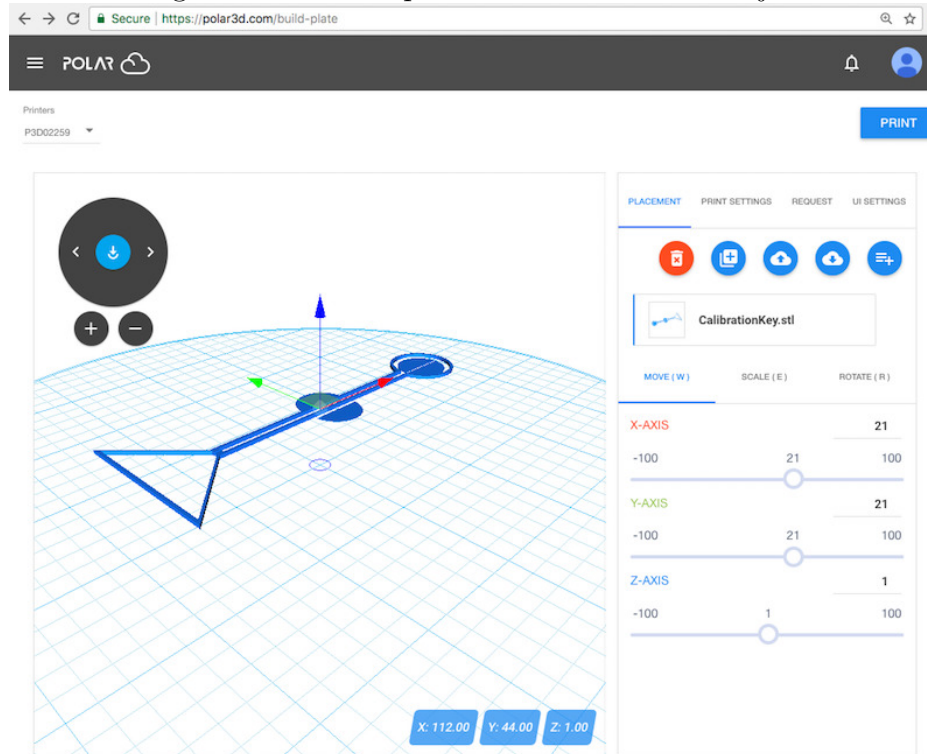
There are *many* ways to adjust your object, as well as adjust printer settings, before printing. (The variety of possible adjustments are discussed in detail in Section 10.2: [The build plate screen \(3D PRINT\), and adjusting your print](#) of the *Polar Cloud Guide*.) For now, you may merely want to experiment with, and check, the following:

1. [Move the position of the object](#) on the build plate.
2. [Change the size of the object](#), making it bigger or smaller.
3. [Rotate your view](#) of the object.
4. Check that your [extruder temperature is set](#) sensibly for the [filament](#) that you are using; for the PLA filament supplied by Polar 3D, the proper temperature is 185°C.

2.2.2.1 Experiment with moving the object on the build plate

At the object build plate screen, see Figure 2.11, check that “PLACEMENT” is highlighted (in blue), meaning that placement is the active mode; if necessary, click on “PLACEMENT” to select it.

Figure 2.12: Build plate PLACEMENT: MOVE object

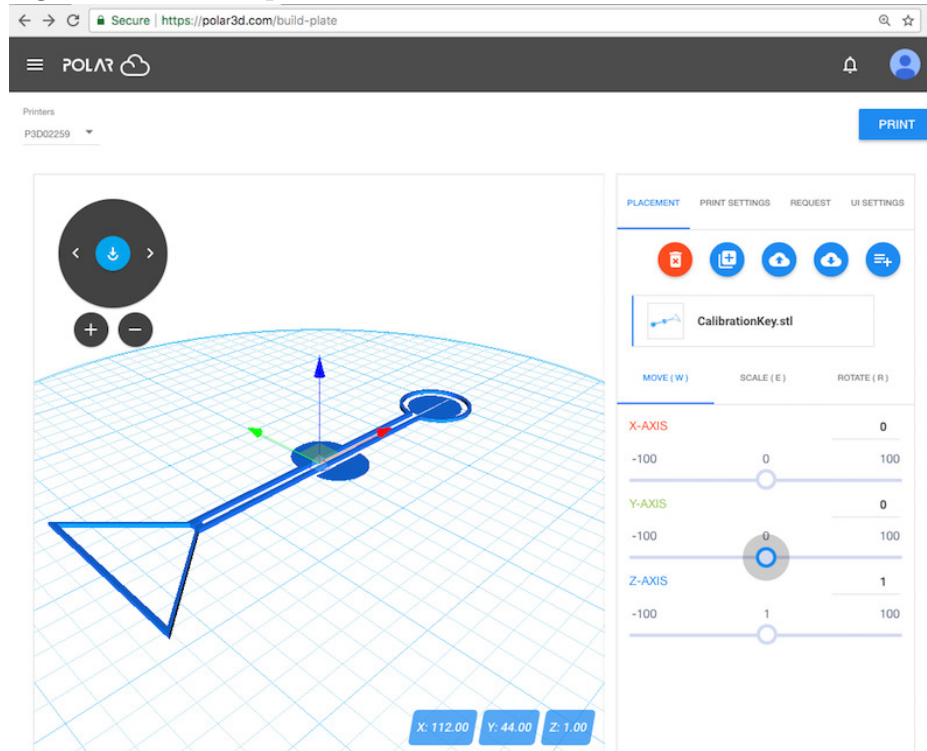


Click on the object image on the build plate screen, or click on the object name on the right underneath “PLACEMENT”. Clicking either place will bring up a set of colored axes (red x -axis, green y -axis, blue z -axis) superimposed on the object image, and three tabs will appear in the right pane (or lower pane on mobile or small displays) under “PLACEMENT”: “MOVE (W)”, “SCALE (E)”, and “ROTATE (R)”. Check that “MOVE” is highlighted (in blue), meaning that it is selected; clicking on “MOVE”, (or clicking the **W** key), will select it; see Figure 2.12.

To move the object’s desired placement on the build plate, you may do whichever is most convenient:

1. Click on the axis arrow in the left-hand, object view pane, (or the upper pane on mobile or other small displays) and then drag the object to a desired position.
2. Move the slider position on desired axes in the right-hand pane (or lower pane on small displays).
3. Enter a numeric value for how much to move along the desired axis in the right-hand pane (lower pane on small displays); such a numeric value can be entered at the far right of the right hand pane, level with the axis name.

Figure 2.13: Build plate PLACEMENT: MOVE to center CalibrationKey



While in general objects are best printed *offset* from the center of the Polar3D printer build plate (thereby avoiding blem-

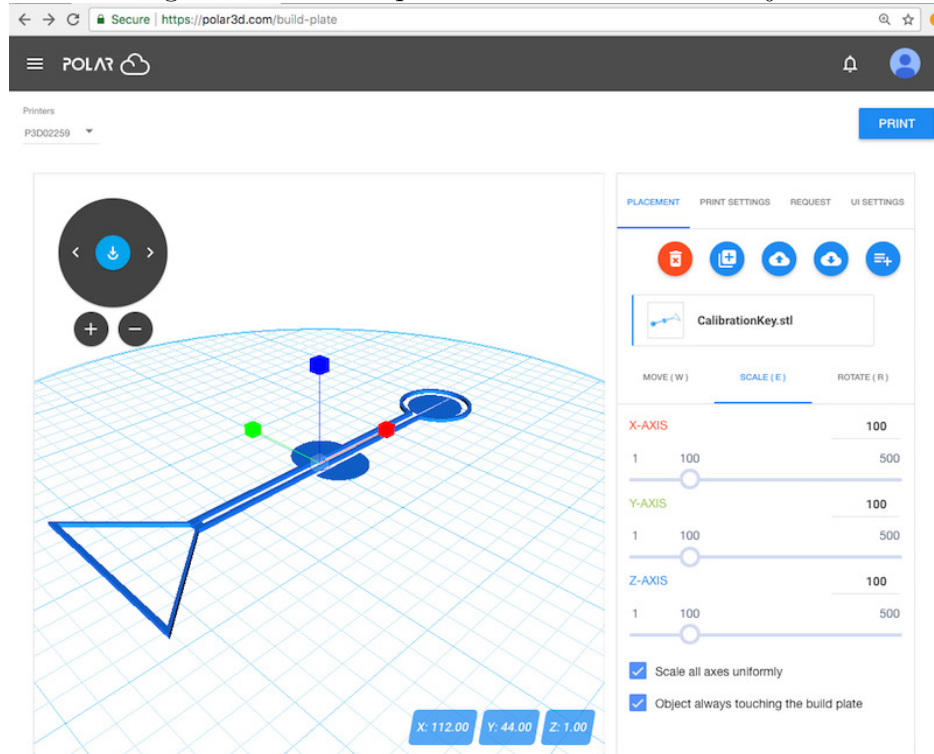
ishes from any suboptimal calibration at the build plate center, (see Section 14.1.1: [Position objects towards the edge of the Polar3D printer build plate](#) of the *Polar Cloud Guide*), the `CalibrationKey` object, as it intended to test and *display* any calibration issues, is best printed with its center at the center of the build plate. Figure 2.13 shows the `CalibrationKey` moved to be centered on the build plate.

2.2.2.2 Experiment with changing the size of the object

At the object build plate screen, see Figure 2.11, check that “PLACEMENT” is highlighted (in blue), meaning that placement is the active mode; if necessary, click on “PLACEMENT” to select it.

Click on the screen where the object image is shown on the build plate. This will bring up a set of colored axes (red x -axis, green y -axis, blue z -axis) superimposed on the object image, and three tabs will appear in the right window under “PLACEMENT”: “MOVE (W)”, “SCALE (E)”, and “ROTATE (R)”. Click on “SCALE” (or click the `E` key) to select it; (check that “SCALE” appears highlighted in blue indicating that it is selected); see Figure 2.14.

Figure 2.14: Build plate PLACEMENT: SCALE object



You may choose to scale the object's overall size uniformly along all axes, or scale the object differently along different axes: see the "Scale all axes uniformly" checkbox below the "SCALE" tab. To adjust the object's size, you may: move the slider position on an axis in the right-hand pane, enter a new numeric value at an axis in the right-hand pane, or you may click on an axis in the left-hand, object view pane, and then drag to change the size along that axis as desired.

2.2.2.3 Experiment with rotating your view of the object

At the object build plate screen, see Figure 2.11, the dial towards the upper left of the left-hand (object on build plate) screen in effect “rotates the build plate” – it rotates your view of the object. The two small buttons underneath the dial allow you to zoom in and zoom out on your view of the object and build plate.

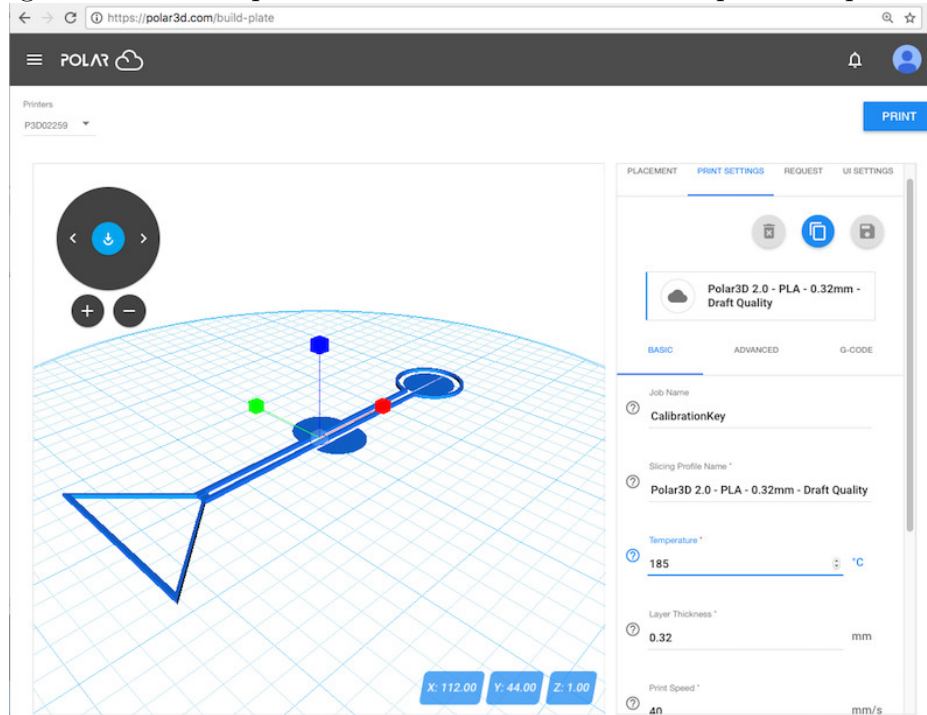
(Note that this rotation of your *view* of the build plate and the object on it is distinct from rotating the object’s *placement* on the build plate – that latter operation, rotating the placement of the object while keeping the build plate stationary, is instead controlled via the “ROTATE (R)” tab under “PLACEMENT”.)

Try clicking on the left arrow and right arrow on the dial to rotate the build plate (and the object on it), and try clicking on the ⊕ button below the dial (to zoom in) and the ⊖ button below the dial (to zoom out). You may also click-and-drag the build plate image itself (clicking on the build plate, rather than on the object on the build plate) and to rotate your view of the build plate, or use mouse or trackpad “scrolling” to zoom in or out on the build plate display.

2.2.2.4 Check temperature

At the object build plate screen, see Figure 2.11, clicking “PRINT SETTINGS” in the right-hand window will bring up three tabs: “BASIC”, “ADVANCED”, and “G-CODE”. The temperature which the printer is set to use for printing is displayed under the “BASIC” display, as shown in Figure 2.15.

Figure 2.15: Build plate PRINT SETTINGS: check the print temperature



The proper temperature for the **PLA** filament provided by Polar 3D on a Polar3D printer is 185°C. (If you are using a different type of filament, see the filament manufacturer's recommendation for what temperature to use for it.)

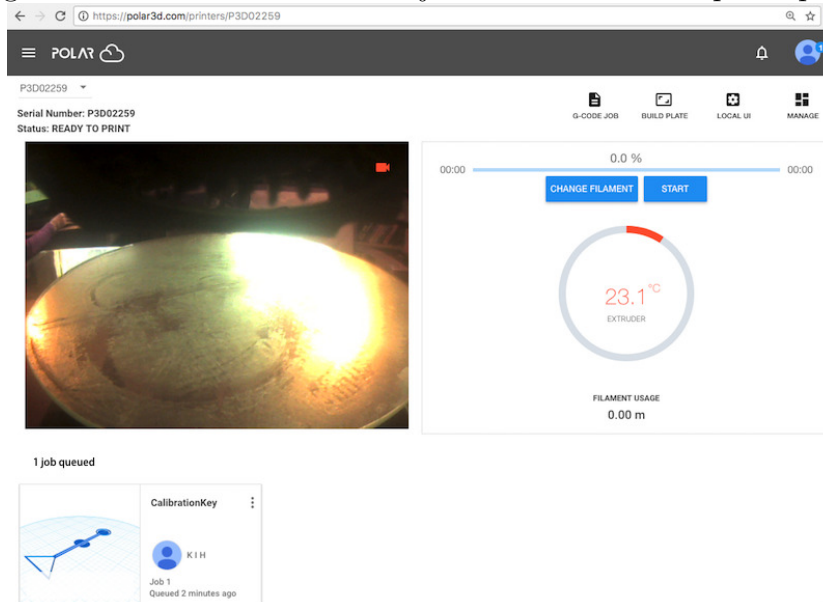
2.3 Start the print job

Are you ready to submit your object for printing? (Note that if you don't like any adjustments you tried making in Section 2.2.2, you may go back to the list of objects, and simply select the object again to have it back in its original location, size, *etc.*: that is, return to Section 2.2.1 and repeat the initial steps

of selecting an object.)

Once you are ready to submit a print job – that is, once you have completed any adjustments you wished to make at the build plate (“3D PRINT”) screen overviewed in Section 2.2.2 (and discussed in detail in Section 10.2: [The build plate screen \(3D PRINT\)](#), and [adjusting your print](#) of the *Polar Cloud Guide*), then clicking the “PRINT” button towards the upper right of the build plate screen will submit your job to your selected printer. (Note that, especially with complicated object models, the loading of the `.stl` file to the printer may take some time – it is normal for this stage to take a minute or two: a blue swirling loading icon will appear towards the lower right of the screen.) Once the submission has completed, you will be shown a printer dashboard screen such as in Figure 2.16.

Figure 2.16: Printer dashboard: job submitted to the print queue



Click the “START” button (towards the upper right of the printer dashboard screen) to begin the print.

2.4 Monitor the printing

Having submitted your job and clicked “START” (see Section 2.3), the Polar Cloud printer dashboard screen (see Figure 2.16) will begin updating, showing you a camera view of the printer (on the left) and status data on the progress of the printer (on the right). (On mobile devices or other small displays, the printer dashboard “screen” is actually two screens, a “CAMERA” screen and a “STATS” screen; see Section 10.4.1: [Printer dashboard screens on smartphones or other narrow display devices](#) of the *Polar Cloud Guide*.)

If the Polar Cloud detects that you are connected to the Polar Cloud via the same local network over which the printer is connected to the Polar Cloud, then the Polar Cloud will update the printer dashboard with a live video feed from the printer camera (indicated by a small red printer icon within the printer image – see Figures 2.17–2.21). If instead you appear to be connected to the Polar Cloud remotely from your printer, over a different network, then the Polar Cloud will instead update the printer dashboard every few seconds with successive snapshots from the printer camera (giving a “time-lapse” sort of effect).

Note that after you have clicked “START”, the status line underneath the printer name (towards the top left of the printer dashboard screen) will cycle (fairly rapidly) through: **WAITING FOR RESPONSE**, **PREPARING PRINT**, and then **PRINTING**. At **Status: PRINTING**, control buttons (“CHANGE FILAMENT”, “COLD PAUSE”,

“PAUSE”, and “STOP”) will show up as active on the printer dashboard.

At 175°C, the printer will home (*i.e.*, move the build plate and print head into proper position for the beginning of the print); see Figure 2.17. Then the printer will continue to heat up to 185°C (the proper temperature for extruding Polar 3D PLA filament). At 185°C, the printer will begin extruding melted filament and your print is in progress!

See Figure 2.18, Figure 2.19, and Figure 2.20 for examples of progress as a job prints.

Figure 2.17: Printer “homing” when the temperature reaches 175° C

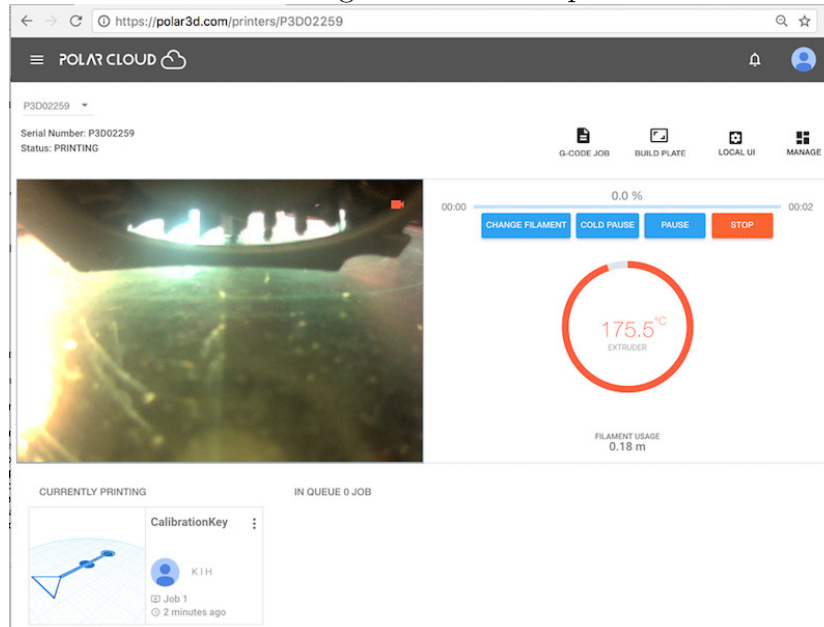


Figure 2.18: Printer dashboard: print job extrusion has begun

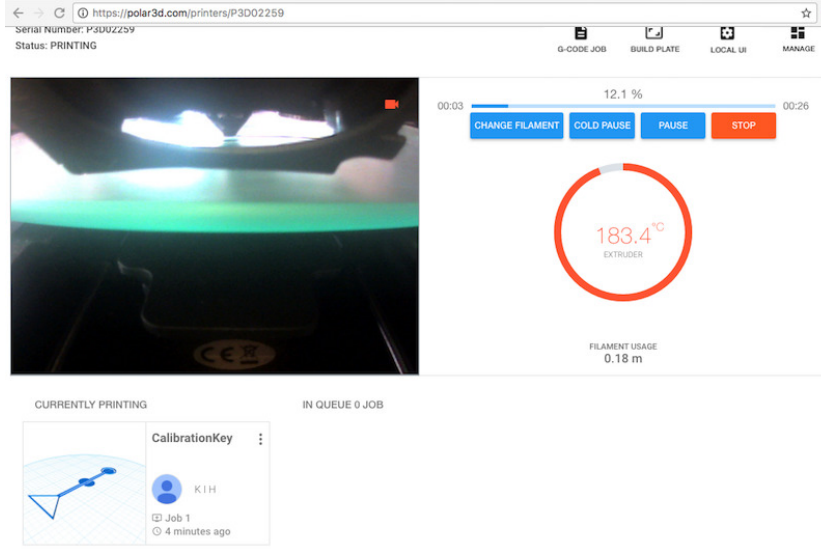


Figure 2.19: Printer dashboard: print job in progress

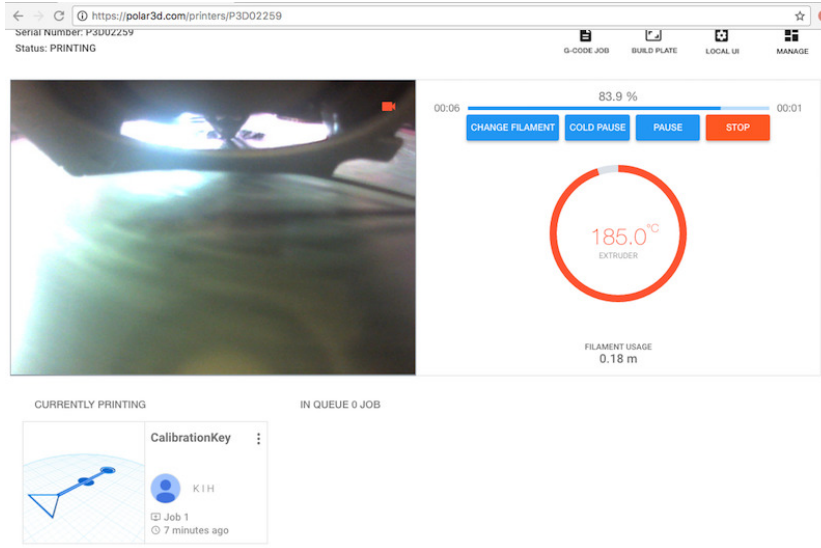


Figure 2.20: Printer dashboard: print job extrusion completed

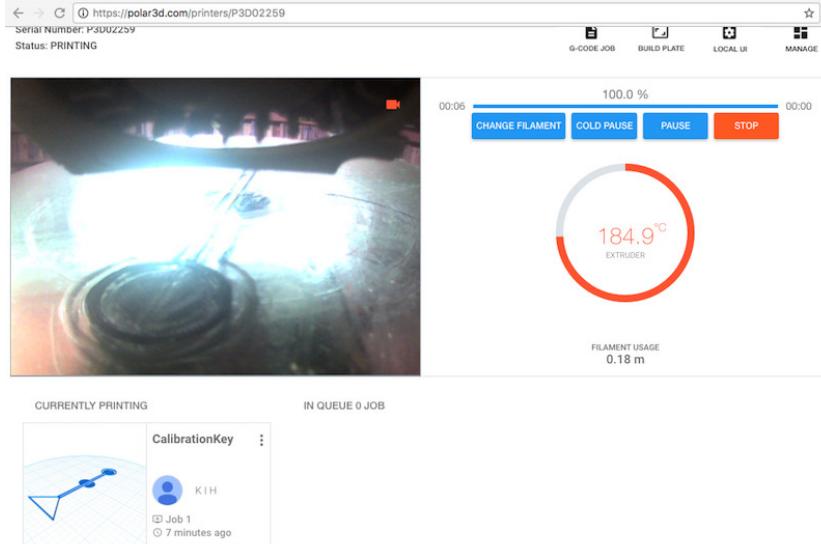
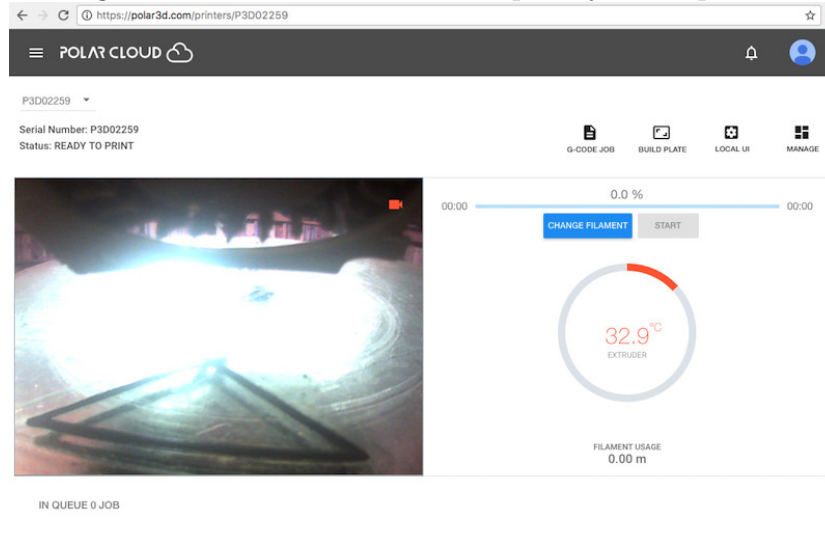


Figure 2.21: Printer dashboard: print job completed

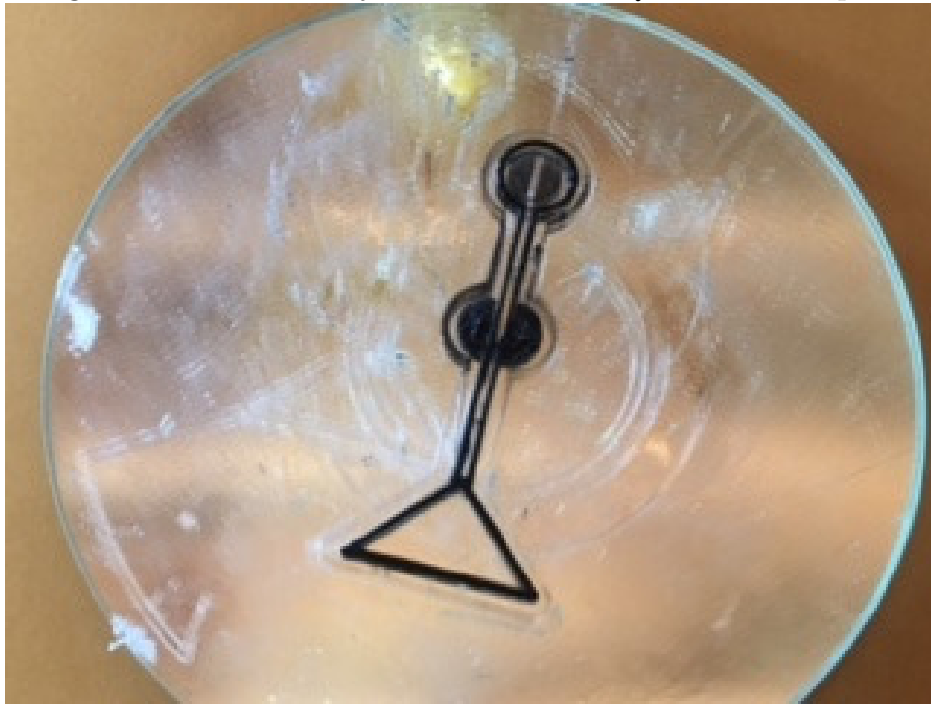


Once the object has finished printing, the status line under the printer name (towards the top left of the screen) will cy-

cle through: **COMPLETING PRINTING**, **FINISHING PRINTING**, and then **READY TO PRINT** (when it is ready for a new job); see Figure 2.21.

Let your object cool a bit on the build plate to firm up, and then remove it from the build plate! (Note that Section 4.2 has a few hints on removing objects from the build plate.)

Figure 2.22: Printed object CalibrationKey on the build plate



On your build plate, as in Figure 2.22, you may notice a faint “outline” or partial outline of printing around your actual object: a single layer of printing 3 mm from the object itself. That is a **skirt**; the default **slicing profiles** for the Polar3D printer include a skirt (to help establish a smooth flow of melted filament before extruding the object itself). You may

disable skirt generation, or modify skirt generation, via the Polar Cloud build plate “PRINT SETTINGS”, “BASIC”, “Support”, “Platform Adhesion Type: None (Skirt)”, “Skirt Settings”; see Section 10.2.2.2: [The build plate screen: PRINT SETTINGS BASIC](#) of the *Polar Cloud Guide*.

Chapter 3

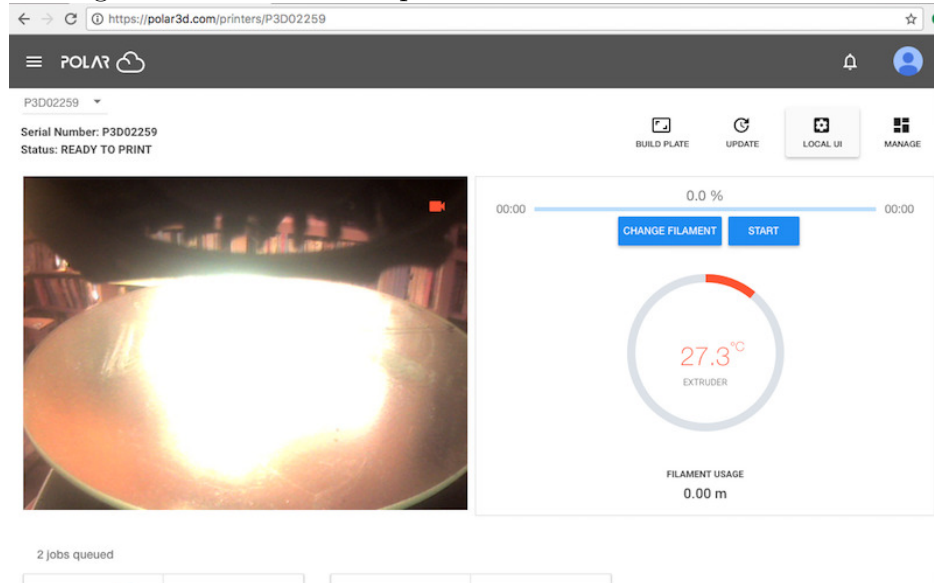
The Polar3D printer local web interface

If you are controlling your Polar3D printer directly through its local WiFi (see Section [C.1](#)) rather than going through the Polar Cloud, then the printer’s local web interface will be your main control interface. From a device on your local network (computer, tablet, or phone), simply open a browser window connecting to the printer’s local IP address¹ and you will be at the printer local web interface.

If you connect your printer to the Polar Cloud, then after performing its initial connection (see Chapter [1](#)), you likely will seldom have a need or interest in connecting directly to the printer’s local web interface. However, the printer’s local web interface is still accessible. If you are on the same local network as the printer, you may simply open up a browser window and connect to its local IP address without going through the Polar Cloud. Or from within the Polar Cloud, navigate from the main

¹For a discussion of the printer’s local IP address, see Section [14.6: Printer local IP address \(for connecting to local web interface\)](#) of the *Polar Cloud Guide*.

Figure 3.1: Polar Cloud printer dashboard LOCAL UI button

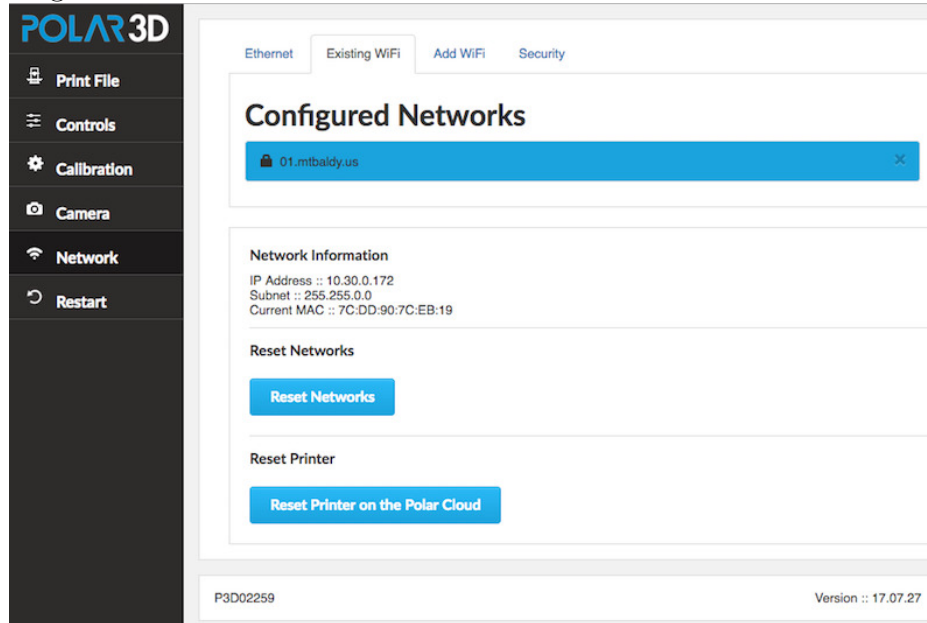


menu to your list of printers, then click on the printer itself, and then at the printer dashboard printer managers may click on the LOCAL UI button (towards the upper right), shown in Figure 3.1.

The Polar Cloud will then attempt itself to connect to what it knows as the printer's local IP address. If your local network permits access to the printer's local IP address from the Internet (which some local networks may not), this will open a new window onto the printer local web interface, as shown in Figure 3.2.

(If your local network does not permit such access from the Internet, then you may still connect to the printer's local web interface more manually, by simply connecting directly to its local IP address, as previously mentioned.)

Figure 3.2: Printer local web interface as viewed from Polar Cloud



3.1 Navigating through the Polar3D printer local web interface

Connecting to the printer’s local IP address will put you at the printer local web interface’s “**Network**” screen with its “**Existing WiFi**” pane; see, for instance, Figure 3.2. This is the same screen you would see if you selected the “**Network**” tab on the left menu; see Section 3.1.5 (and in particular Figure 3.8).

The tabs/icons at the left of the screen select additional screens:

1. The printer icon (“**Print File**”) selects the “**Project Details**” screen, where you may upload a file to print, or select an already available file to print (as the Polar3D printer’s user

interface ships with several test `.stl files`), and then initiate printing. This screen also displays, on the right hand side under “Printer Status”, various status information regarding the printer.

2. The lines-with-boxes icon (**Controls**). At this screen, you may manually direct the printer; *e.g.*, change the filament, raise the `print head`, set the temperature, extrude a millimeter of filament, turn on/off the printer’s LED lights, unlock the `stepper motors` (so that the `print head` and `build plate shuttle` may be moved manually), *etc.*
3. The dial/gear icon (**Calibration**) will take you to the “Calibration” screen, where you may perform *z*-axis (`Z rod`) and *x*-axis (`build plate shuttle`) calibration.
4. The camera icon (**Camera**) takes you to a screen showing live camera feed from the printer, and various printer status details.
5. The network icon (**Network**) tab will take you to the “Network” screen, with a pane of network details at the bottom and another pane at the top, initially the “Existing WiFi” pane. At the “Network” screen, you may see what network the printer is on currently and the printer’s own IP address on that network, and even switch to a different network. In addition to the “Existing WiFi” top pane, tabs along the top of the “Network” screen allow switching to the “Ethernet” pane, the “Add WiFi” pane, or the “Security” pane.
6. The update icon (**Update**), if clicked, will show you a summary of any current update, and ask if you wish to apply that update.

7. The restart icon (**Restart**) will ask if you wish to restart the printer.

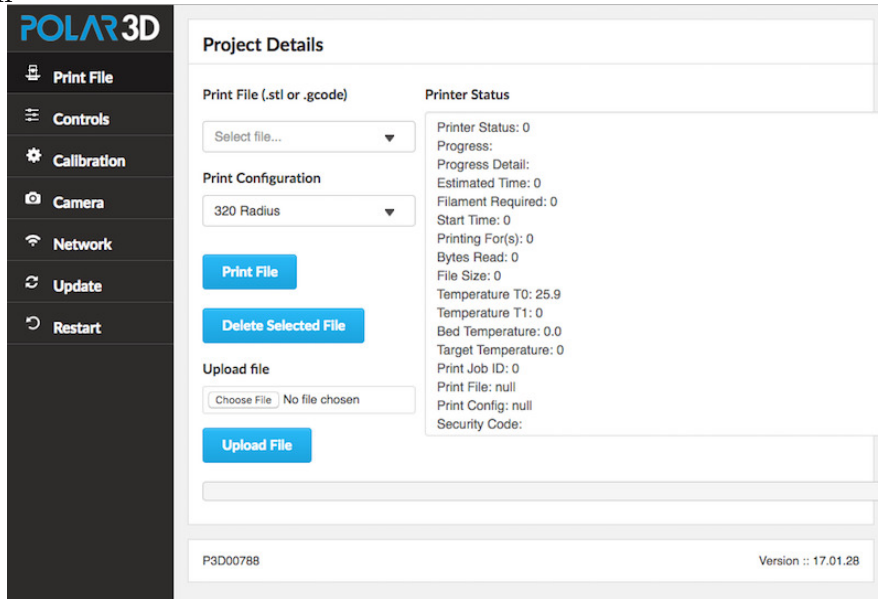
3.1.1 The Print File tab and the Project Details screen

Clicking the “Print File” tab (printer icon) of the printer local web interface main menu will take you to the “Project Details” screen. At this screen, you may upload a file to print, or select an already available file to print (as the Polar3D printer’s local web interface ships with several test **.stl files**), and then initiate printing.

Note that Polar3D printer local web interface supports printing **.stl files** and **G-code files**, but it does *not* directly support printing **OBJ files**. (However, you may use the Polar Cloud to convert an OBJ file to **.stl file** format: submit a print job of your desired OBJ file object, and then use the print job “**Download STL File**” option – see Section 5.5: **Downloading objects** of the *Polar Cloud Guide* – to download to your device an **.stl file** version of the object, including any virtual build plate modifications you may have made to the object.)

This screen also displays, on the right hand side under “**Printer Status**”, various status information regarding the printer; see Figure 3.3.

Figure 3.3: Printer local web interface Print File (Project Details) screen

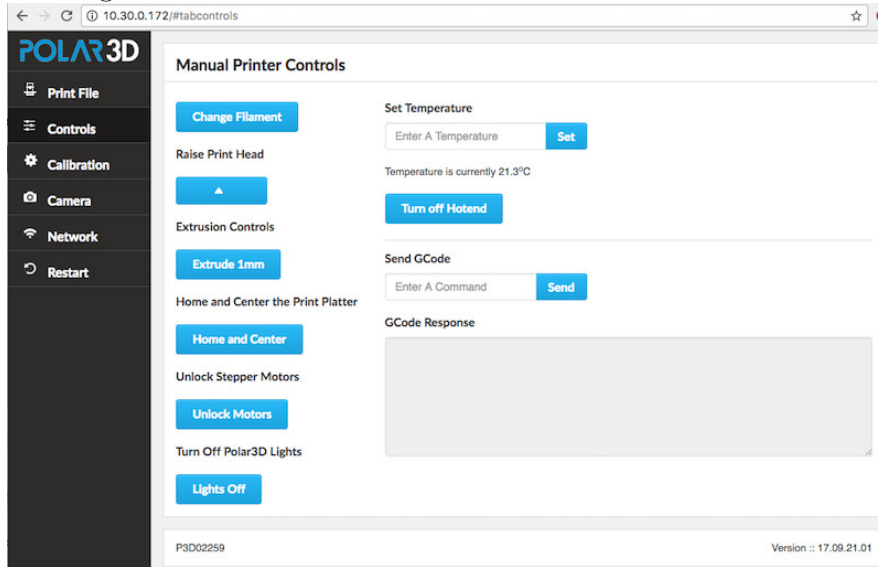


3.1.2 The Controls tab and the Manual Printer Controls screen

Clicking the “Controls” tab (lines-with-boxes icon) of the printer local web interface main menu will take you to the “Manual Printer Controls” screen. At this screen, you may manually direct the printer; *e.g.*, raise the **print head**, set the temperature, extrude a millimeter of filament, turn on/off the printer’s LED lights, unlock the **stepper motors** (so that the **print head** and **build plate shuttle** may be moved manually), *etc.*

As of version 17.09.21 (released early October, 2017) of the Polar3D printer firmware, this is also where you will find the “Change Filament” button, used for unloading or changing filament.

Figure 3.4: Printer local web interface Controls screen



3.1.3 The Calibration tab and Calibration screen

Clicking the “Calibration” tab (dial/gear icon) of the Polar3D printer local web interface main menu will take you to the “Calibration” screen, where you may perform z -axis (**Z rod**) and x -axis (**build plate shuttle**) calibration.

Polar3D v2.0 and v2.5 printers have some automatic leveling/calibration built in, so the screen and options are different for such printers; see Figure 3.6.

Figure 3.5: Polar3D printer v1.0 local web interface Calibration screen

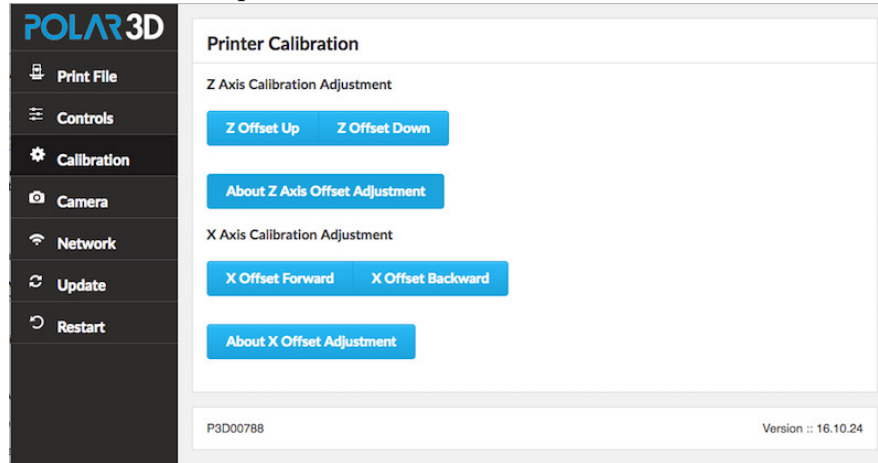
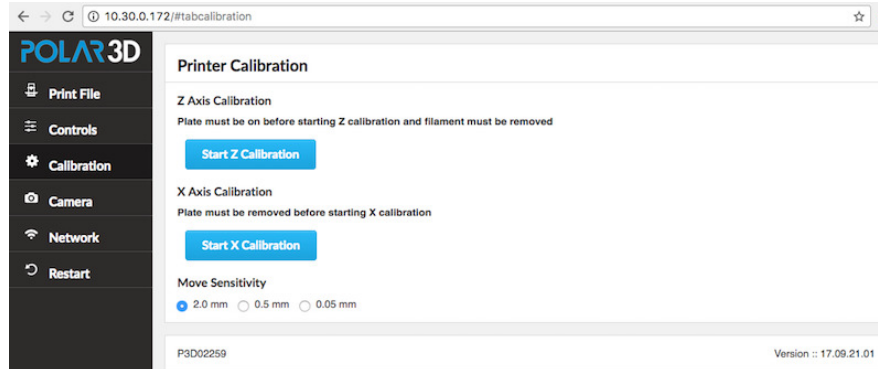


Figure 3.6: Polar3D printer v2.0 and v2.5 local web interface Calibration screen



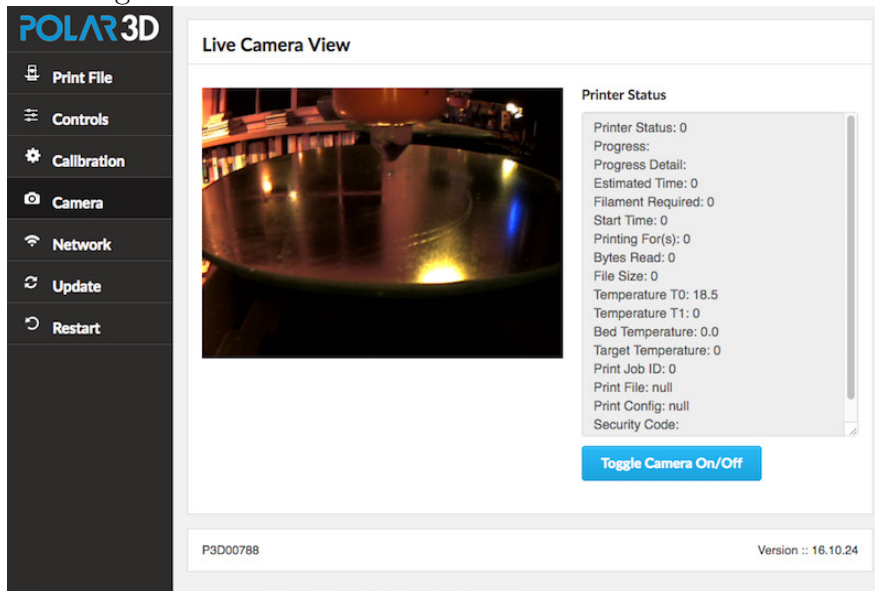
See Section 6.5 for further discussion of performing calibration.

3.1.4 The Camera tab and Camera screen

Clicking the “Camera” tab (camera icon) at the Polar3D printer local web interface main menu takes you to a screen showing live

camera feed from the printer, and various printer status details; see Figure 3.7.

Figure 3.7: Printer local web interface Camera screen



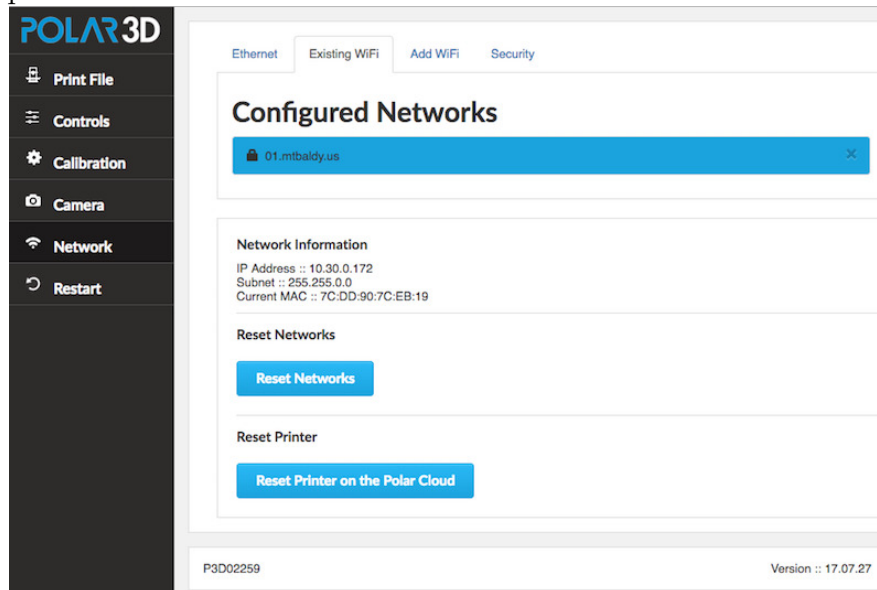
The “Toggle Camera On/Off” button on this screen may be used to turn the camera on or off.

3.1.5 The Network tab

Clicking the “Network” tab (network icon) of the Polar3D printer local web interface will take you to the “Network” screen, with a pane of network details at the bottom and another pane at the top, initially the “Existing WiFi” pane. At the “Network” screen, you may see what network the printer is on currently and the printer’s own IP address on that network, and even switch to a different network. In addition to the “Existing

WiFi” top pane, tabs along the top of the “Network” screen allow switching to the “Ethernet” pane, the “Add WiFi” pane, or the “Security” pane.

Figure 3.8: Printer local web interface Network screen showing Existing WiFi pane

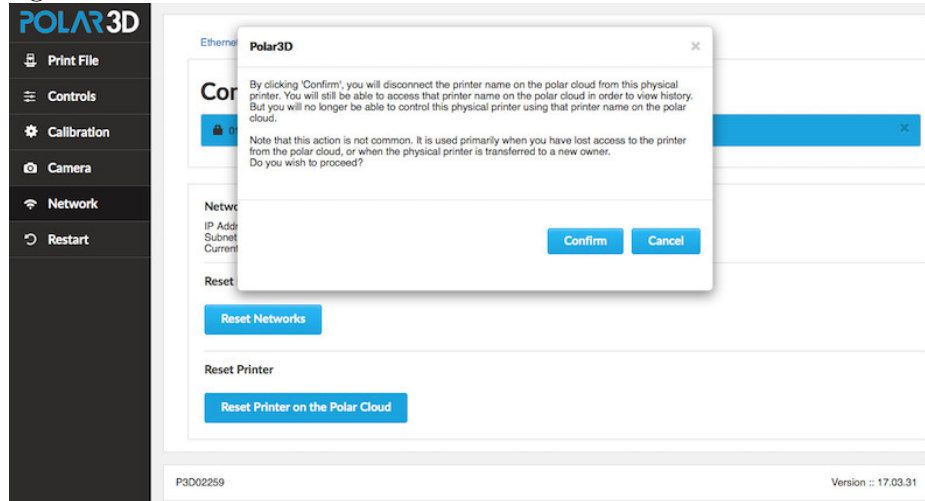


Note that the “Reset Networks” button will remove any configured network profiles, resetting the printer’s network knowledge back to factory defaults. Thus you would *not* normally want to click this button *except* when permanently transferring the printer to an entirely new location (entirely different network milieu) or owner! (If you are merely temporarily moving your own printer to another network, it is more convenient to instead *add* the new WiFi network or plug in the Ethernet cable, and then use the “Restart” tab on the main menu (to the left of the screen) to have the printer reconnect using the newly added network; see [step 7](#) in [Section 1.1](#). Then you can switch back to

the original network later, by selecting the original network and then again clicking “Restart”, without having to entirely redo the network profile.)

Note that the “Reset Printer on the Polar Cloud” button on the “Network” screen will obsolete any existing ownership of this printer in the Polar Cloud; see Figure 3.9. That is, any Polar Cloud members who had formerly been the owner of or been allowed access to this printer will now no longer see the *P3Dserial-number* printer, and instead will see a reference to *P3Dserial-number-DELETED-date*; see for instance Figure 10.64 in the *Polar Cloud Guide*. (Such members may wish to move any queued jobs that had been on that printer to some other printer; see Section 10.5.5 of the *Polar Cloud Guide*.) Thus you would *not* normally want to click this button except when transferring ownership of the printer to some other person (some other Polar Cloud member). After clicking this button, the printer will need to be re-registered to some Polar Cloud account in order to be used by any Polar Cloud members; see step 10 of Section 1.1.

Figure 3.9: Reset Printer on the Polar Cloud confirmation check



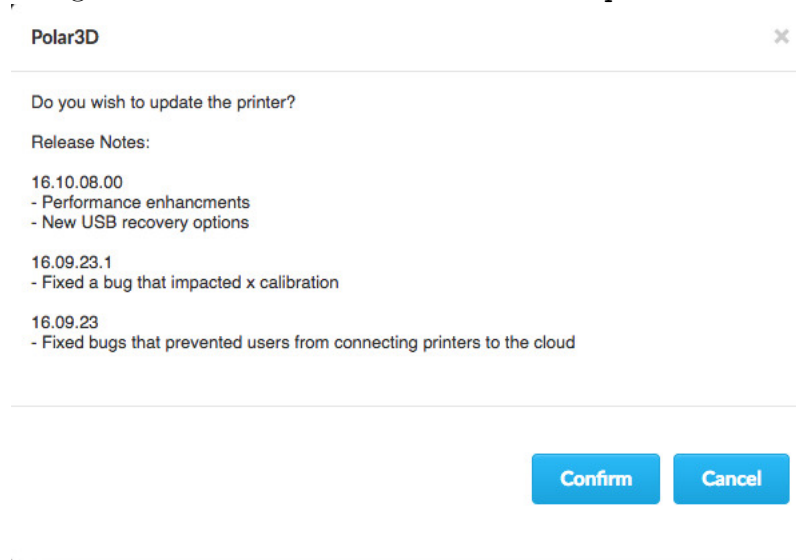
Thus both the buttons “Reset Networks” and even more so “Reset Printer on the Polar Cloud” are primarily of interest when *transferring the printer to another owner*.

3.1.6 The Update tab

An “Update” tab (update icon) will only be present on the Polar3D printer local web interface main menu at times when the printer is connected to the Internet and an update to printer firmware has been made available from Polar 3D.

At such a time, clicking the “Update” tab (update icon) at the Polar3D printer local web interface main menu will show you a summary of any current update, and ask if you wish to apply that update; see Figure 3.10.

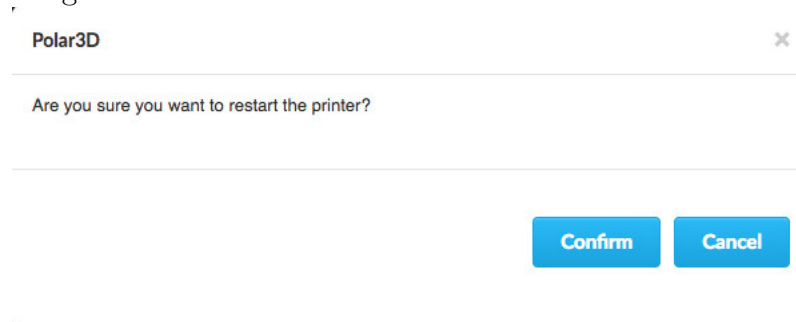
Figure 3.10: Printer local web interface **Update** screen



3.1.7 The Restart tab

Clicking the “Restart” tab (restart icon) of the Polar3D printer local web interface will ask if you wish to restart the printer; see Figure 3.11.

Figure 3.11: Printer local web interface **Restart** screen



Clicking “Confirm” causes a restart of the printer’s software.

If the printer is connected to a network, it will close down that connection and re-open a new network connection – so in particular, you should use the “Restart” tab after configuring to use a different local network at the “Network” screen.

3.2 Security of access to the local web interface

Three approaches (independent of any network security that may also be in place at a site) for Polar3D printer local web interface access security are as follows, in order from most convenient/least secure, to least convenient/most secure:

1. Default for a new Polar3D printer: Anyone who connects to the Polar3D printer’s local web interface can use the interface. The first person to go through the [security light check](#) becomes the printer owner; later persons going through the security light check can add themselves as additional managers of the printer. Anyone connecting can also use the “[Reset Printer on the Polar Cloud](#)” button, and thereby “obsolete” current ownership (registration) of the printer in the Polar Cloud; after which, such a person is then free to register him or herself (via the security light check) as the printer owner.

This is the default configuration of the Polar3D local web interface and the Polar Cloud, as it permits a newly purchased Polar3D printer to be easily connected to the Polar Cloud!

2. Polar Cloud printer “SETTINGS” switch “[Add Allowed](#)” set

to OFF position: Going through the [security light check](#) will *not* add later persons as additional printer managers. However, since anyone connecting to the Polar3D printer local web interface may still use the “[Reset Printer on the Polar Cloud](#)” button to “obsolete” the current ownership/registration of the printer, (after which the person may then re-register the printer to him or herself via the security light check), this configuration is intended to reduce cases of *accidentally* overriding existing printer registration, rather than to truly prevent printer re-registration.

While this configuration is not fundamentally more secure than the default configuration, it is often useful and suitable for teachers, or for other situations when others able to access the printer physically, or via the local network, are all essentially trusted. While reducing the chance that another person with physical or local network access to the Polar3D printer will *accidentally* override printer registration in the Polar Cloud, this configuration still allows others (such as new teachers or substitute teachers) to autonomously add themselves as additional printer managers. And if a Polar3D printer needs to be reassigned to another owner, again this remains possible (without explicit action by the current printer owner) via the “[Reset Printer on the Polar Cloud](#)” button.

3. Password control on use of the Polar3D printer’s local web interface, configured via the “[Security](#)” pane of the “[Network](#)” screen of the Polar3D printer local web interface: the local web interface cannot be used without supplying a password.

This configuration of course is more secure. However, ex-

PLICIT action by the current printer owner will then be required to add printer managers, or to change printer ownership/registration in the Polar Cloud. And don't lose the password!

Note also that site IT personnel may also choose to institute additional restrictions on accessing the Polar3D local web interface at the network level: for instance, permitting only certain local IP addresses to access the Polar3D printer local web interface over the local network. However, even if local network access is restricted, persons with physical access to the Polar3D printer would still be able to connect to the printer's local web interface via physical Ethernet cable direct to the printer.

3.2.1 The Security pane and setting a password for the local web interface

Figure 3.12: Printer local web interface Security pane

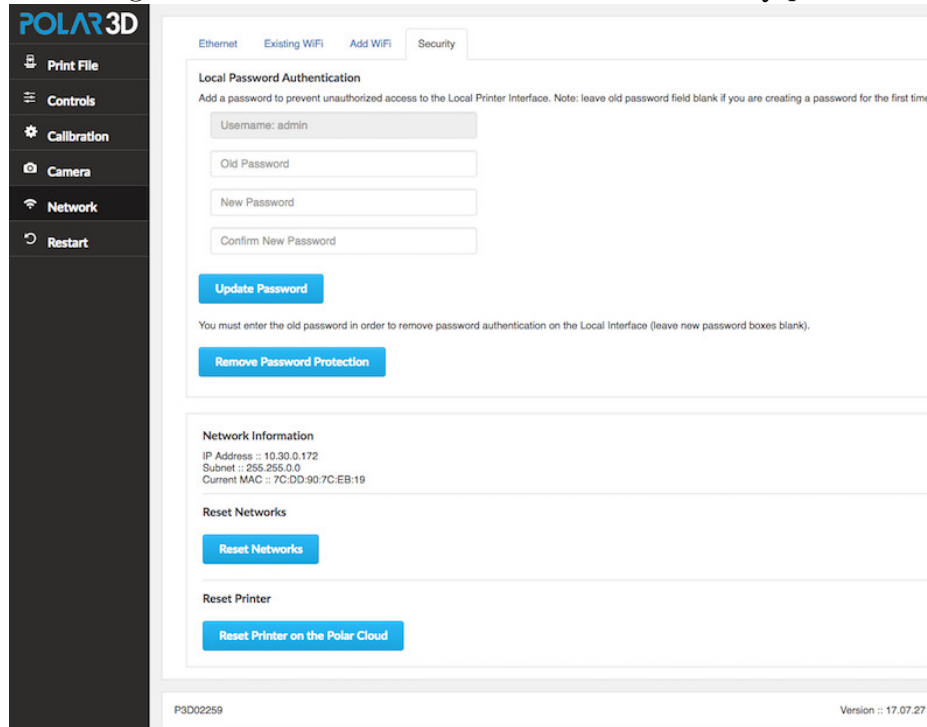
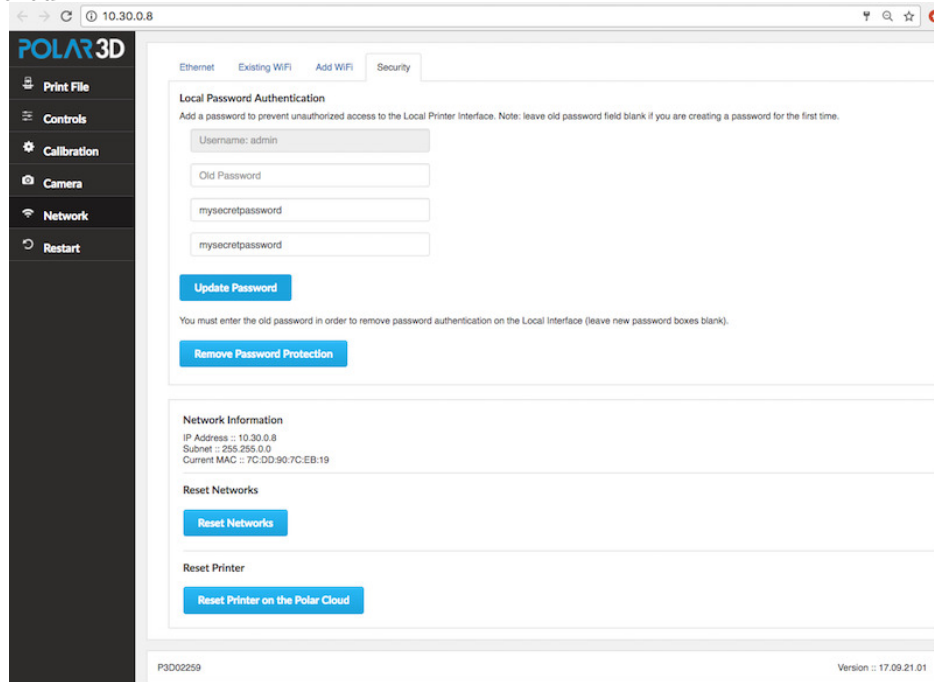


Figure 3.12 shows the “Security” pane of the “Network” screen. To add a password for the first time, enter the desired pass phrase in the “New Password” and “Confirm New Password” boxes and then click the “Update Password” button; see Figure 3.13.

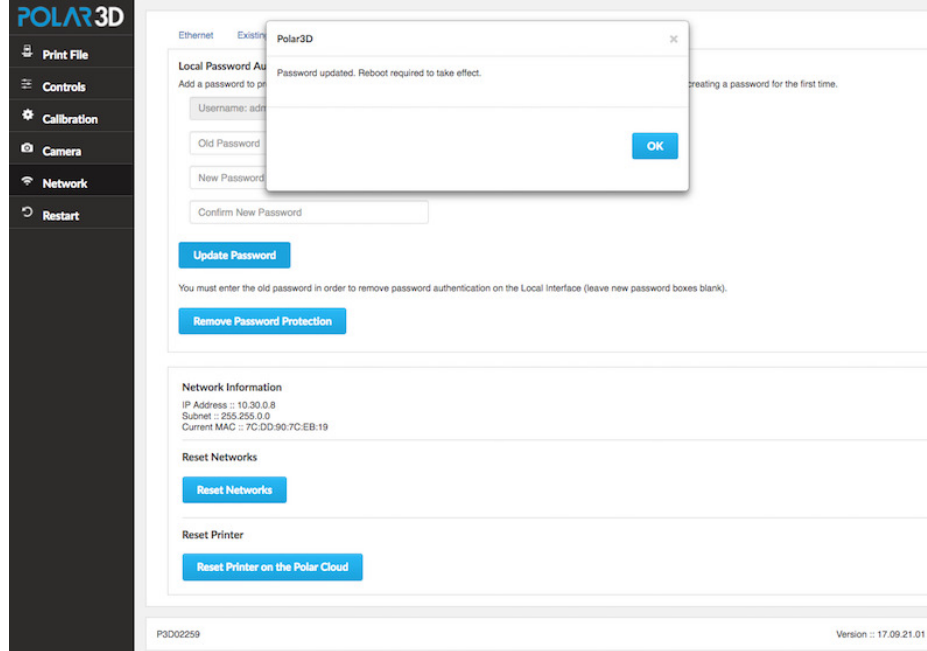
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Figure 3.13: Printer local web interface **Security** pane: initial password entered



Clicking the “Update Password” button at the “Security” pane will pop-up a notice that you must “Restart” the printer (click the “Restart” tab on the left main menu of the printer local web interface) in order to have your password change take effect; see Figure 3.14.

Figure 3.14: Printer local web interface: Password updated, restart required



Once you have restarted the printer to have the password addition take effect, then in future any time you attempt to connect to the printer’s local web interface (whether by connecting directly to the printer’s local IP address, or whether via the “LOCAL UI” button from the Polar Cloud), you will be prompted to enter “User Name” (always “admin” for the Polar3D printer local web interface) and its “Password”. The exact appearance of the username/password prompt screen is controlled by the browser; see Figure 3.15, Figure 3.16, Figure 3.17, and Figure 3.18 for examples.

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Figure 3.15: Chrome: user name and password prompt to reach printer local web interface

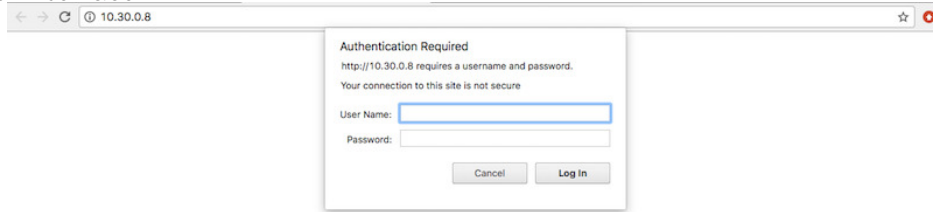


Figure 3.16: Firefox: user name and password prompt to reach printer local web interface

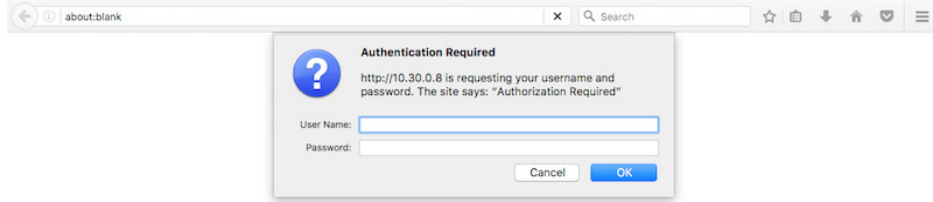


Figure 3.17: Opera: user name and password prompt to reach printer local web interface

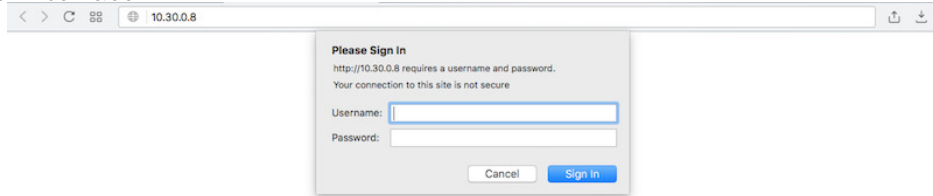
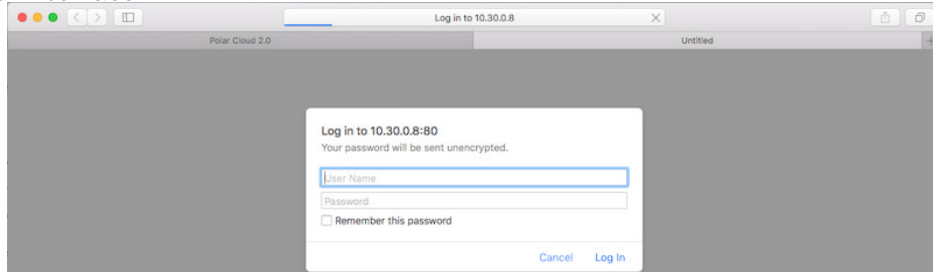


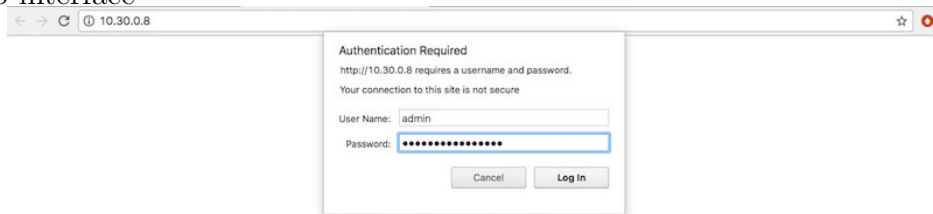
Figure 3.18: Safari: user name and password prompt to reach printer local web interface



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Enter “**admin**” as the username and enter your password; see Figure 3.19 for an example. Only after you successfully enter “**admin**” and the password will you proceed to the printer local web interface.

Figure 3.19: Chrome: entering user name and password to reach printer local web interface

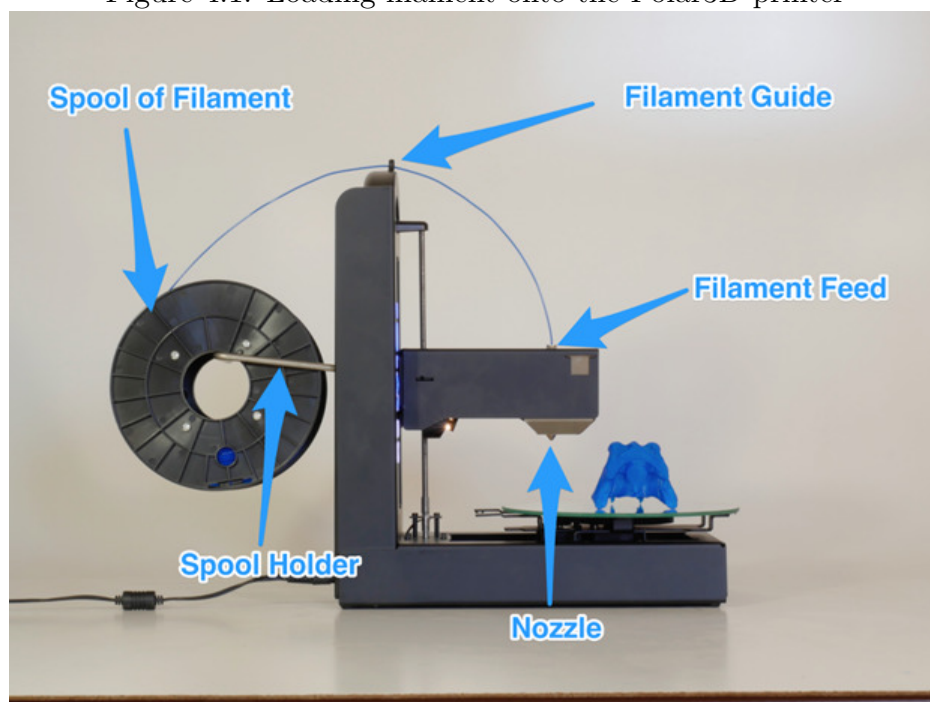


Chapter 4

Operational tips for Polar3D printers

4.1 Loading and unloading (and changing) filament on Polar3D printer

Figure 4.1: Loading filament onto the Polar3D printer



The Polar 3D support site has detailed discussions of loading and unloading filament on Polar3D printers.

For Polar3D printers with serial numbers P3D02150 and higher, see:

[Polar 3D support document “Loading and Unloading Filament”](#)

For Polar3D printers with serial numbers P3D02000 - P3D02150, see:

[Polar 3D support document “Loading and Unloading Filament”](#)

For Polar3D printers with serial numbers P3D00000 - P3D02000, see:

[Polar 3D support document “Loading and Unloading Filament”](#)

4.1.1 Loading filament on Polar3D printer

Refer to Figure [B.1](#) and especially to Figure [4.1](#).

1. Take the spool of filament and hook it onto the spool holder.
2. Find the end of the string of filament.
3. If the end of the string of filament is blobby or thin (something to check if this spool has been previously used, so that the filament end got a bit melted previously) or kinked (*e.g.*, from being pinched in the spool holder), consider snipping the end off – perhaps snip an inch or two off – so that you

have a “clean” end to feed into the printer. (See Figure 2.2.)

4. Feed the filament through the filament guide (the hole at the top of the Polar3D printer). (Having the filament properly guided keeps the filament from flopping wildly from the spool to the [print head](#).)
5. Stick the end of the filament into the feed hole at the top of the [print head](#). The “feel” of this takes a bit of getting used to: when sticking the filament into the feed, you must push past some initial resistance: you must push the filament in far enough to engage with the filament drive gear inside the print head. At about 1 inch in, the filament will have reached the filament drive gear and you will feel the resistance – push the filament *past* that. (Note that if this printer has previously had filament in it – and note that new Polar3D printers have a sample print performed at the factory! – and that filament was not completely removed but rather left a blob solidified in the filament drive gear, then you may find that you cannot get your new filament to engage with the filament drive gear until you heat up the extruder to re-melt the bit of filament still caught in the filament drive gear.)
6. If you want to check whether the filament is all the way in, raise the temperature of the printer to 185°C,¹ and slowly hand feed the filament through. Seeing a string of molten

¹To set the temperature of the printer, you may use the Polar Cloud [printer dashboard's temperature dial](#). Alternatively, you may use the “[Manual Printer Controls](#)” screen of the printer local web interface. If you are using a direct cable connection to the printer and Repetier-Host to control the printer, under Repetier-Host’s “[Your Printer](#)”, use the controls on the “[Manual Control](#)” screen to set the extruder temperature.

plastic get extruded tells you you're ready to print!

4.1.2 Unloading filament from Polar3D 2.0 or 2.5 printer

DO NOT attempt to simply pull loaded filament out of a cold Polar3D 2.0 or 2.5 printer! It *will* cause the filament to break off in the nozzle, jamming the extruder, and you *will* need to disassemble the print head to clear the nozzle!

With a Polar3D 2.0 or 2.5 printer,² you *must* ask the printer to back out the filament before you attempt to unload the filament. There are three ways to do this:

1. Use the “**CHANGE FILAMENT**” button on the Polar Cloud printer dashboard screen of an idle printer.³ (See Section 10.4.2: [Printer dashboard control buttons](#) of the *Polar Cloud Guide*.)
2. Use the “**CHANGE FILAMENT**” button on the Polar Cloud printer dashboard screen of a printer while a print job is running. (See Section 10.4.2: [Printer dashboard control buttons](#) of the *Polar Cloud Guide*.)

Note: If you don't currently have a print job running, feel free to submit and “**START**” a print job (that you have no intention of really starting, let alone completing) merely to get the printer heating up and the Polar Cloud printer dashboard showing its “**CHANGE FILAMENT**” button. If the printer started out with a cold extruder, then the printer

²Note that the Polar Cloud printer “**LIST**” view displays printer make number.

³The “**CHANGE FILAMENT**” button is *always* present on the printer dashboard, regardless of whether or not a print job is running, as of Polar3D printer firmware version 17.09.19 or later, released early October, 2017.

dashboard will make the “CHANGE FILAMENT” button available well *before* the printer has even finished heating up (to begin actually extruding), and you may click the “CHANGE FILAMENT” button as soon as it appears (before extrusion has actually begun).

3. Use the “[Change Filament](#)” button on the printer local web interface “[Manual Printer Controls](#)” screen.⁴

Wait by the printer after clicking “CHANGE FILAMENT”. Once the extruder heats up, you will hear the printer filament drive gear running as the printer backs out the filament. As soon as the printer has backed out the filament and the filament drive gear has stopped running (the printer is quiet again), you should then pull the filament the rest of the way, entirely out of the printer.

4.1.3 Unloading filament from Polar3D 1.0 printer

These instructions apply to Polar3D 1.0 printers only! **DO NOT** attempt to pull filament out of a Polar3D 2.0 or 2.5 printer – instead, see Section [4.1.2](#) for instructions on unloading!

After a print job completes, the Polar3D printer will slowly retract the filament back out of the melt zone of the extruder. This allows you to unload the filament even when the printer is cool. However, removing the filament while still warm (or else heating up the extruder again to somewhat melt the filament)

⁴This button is present on the “[Manual Printer Controls](#)” screen as of Polar3D printer firmware version 17.09.19 or later, released early October, 2017.

will likely be easier (and less likely to result in flakes of filament jamming up the filament drive gear).

Particularly if the filament is still warm, you should be able to simply pull the filament straight up and out of the **print head**.

If the filament is stuck, raise the **extruder** temperature to 200°C.⁵ Once the filament has softened, you should now be able to pull the filament straight up out of the **print head**.

If changing filament while a print job is printing, a printer manager (or members of a group configured with “Control Printers” access) may conveniently use the “CHANGE FILAMENT” control button on the printer dashboard to have the print pause and the printer “back out” the filament in-use.

4.2 Removing objects from the Polar3D build plate

Cooling a printed object, still on the **build plate**, briefly in the refrigerator or freezer may make it easier to remove from the build plate. Check that your object won’t bump the **print head** when you remove the build plate from the printer: slide the build plate forward, and if necessary raise the **print head** to leave plenty of room above your printed object; the “Raise Print Head” button on the printer local web interface “**Manual**

⁵Printer extruder temperature can be controlled at the Polar Cloud [printer dashboard’s temperature dial](#) or at the printer local web interface’s “[Manual Printer Controls](#)” screen. If using a direct cable connection with Repetier-Host to control the printer, under Repetier-Host’s “Your Printer”, use the controls on the “Manual Control” screen to set the extruder temperature.

Printer Controls” screen may be helpful. Then remove the **build plate**, with freshly printed object still attached, from the 3D printer and place it in the refrigerator or freezer: four or five minutes in the freezer may suffice; ten to fifteen minutes is usually plenty.

If you have used a layer of (water soluble) hair spray on the build plate to create an adhesive surface, soaking the build plate (with object still attached) in water should loosen up the hair spray enough to easily remove the object.

A spatula may be useful to aid in removing objects from the build plate. But use the spatula gently (so as not to break the build plate)! You should not have to “pry” or “force” the object.

Note that while an object may be less “stuck” to the build plate while still slightly warm, delicate or fragile details may benefit from thorough cooling before you attempt to remove an object.

For some objects, printing with a **raft** may better allow removal from the build plate without damage to the bottom of the object.

For a video discussion of removing objects from the build plate, see:

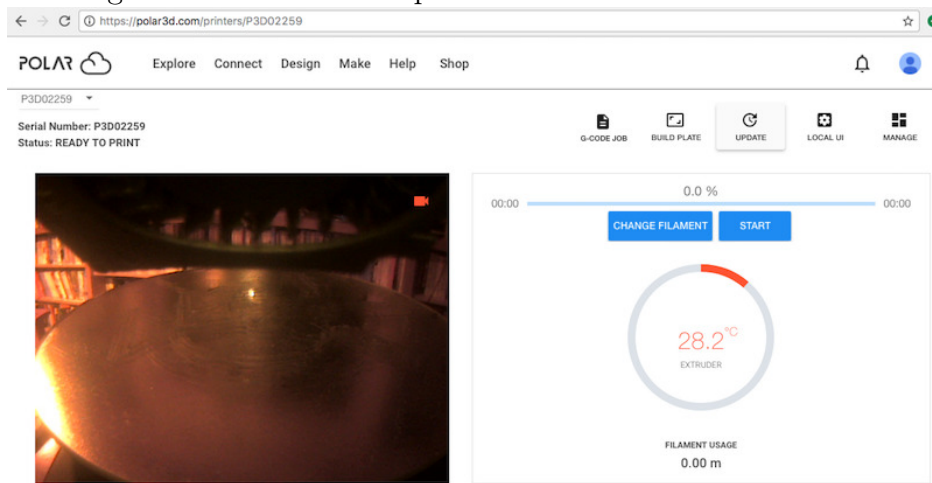
[Polar 3d youtube video “WWBD - Removing Print from Plate](#)

After removing an object, check whether it is time to **clean the build plate** and/or **apply more hair spray (or other adhesion aid)**.

Chapter 5

Updating the Polar3D printer

Figure 5.1: Polar Cloud printer dashboard UPDATE button

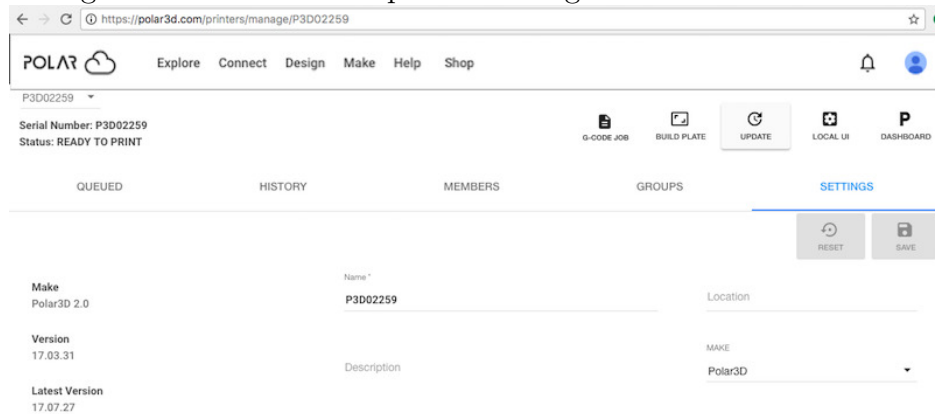


Occasionally, an update to the printer firmware will be available.¹ When an update is available for a Polar3D printer, you will see an update button visible in three locations:

¹This chapter focuses on firmware updates to Polar3D printers. However, some other printers also support through-the-Polar-Cloud firmware updates, in which case those print-

1. On the [printer dashboard screen](#) within the Polar Cloud; Figure 5.1.
2. On the [printer manage screen](#) within the Polar Cloud; Figure 5.2.

Figure 5.2: Polar Cloud printer manage screen UPDATE button



3. On the [printer's local web interface](#); Figure 5.3.

Clicking the UPDATE button or Update tab in any of these respective locations will cause the update to be performed.

Alternatively, you can force an update as follows. From a device (computer, tablet, phone) on your local network, open a browser window and go to the location:

```
http://localip/update
```

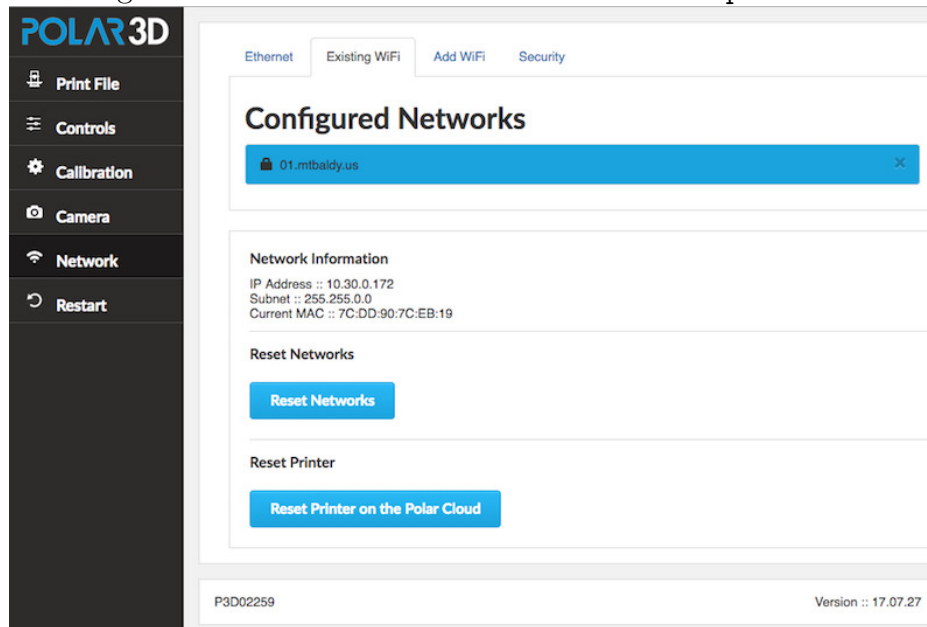
where *localip* is your printer's local IP address². The effect

ers too will have an "UPDATE" button available on the printer dashboard and printer manage screen; see Section 9.5: [Updating the printer](#) of the *Polar Cloud Guide*.

²If you need a reminder of just what your printer's local IP address is, note that from within the Polar Cloud, clicking the "LOCAL UI" button while viewing a printer dashboard screen will show you in the resulting browser window navigation bar what the Polar Cloud believes to be the printer's IP address.

is identical to clicking the “Update” tab of the printer’s local web interface.

Figure 5.3: Printer local web interface shows Update tab



Whichever of the four approaches above you use to request an update, you will be presented with a screen asking you to confirm that you truly wish to update the printer. The Polar Cloud version of the confirmation screen is shown in Figure 5.4; on that screen click “UPDATE PRINTER” to perform the update.

Note that when updating using the Polar3D printer’s local web interface, its confirmation screen also displays release notes regarding the update; an example is shown in Figure 5.5; on that screen click “Confirm” to perform the update.

Figure 5.4: Polar Cloud UPDATE PRINTER confirmation screen

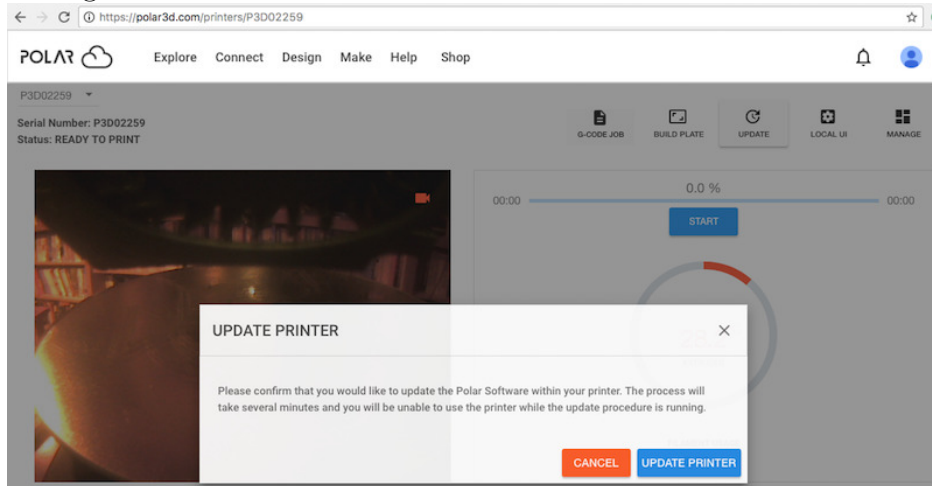
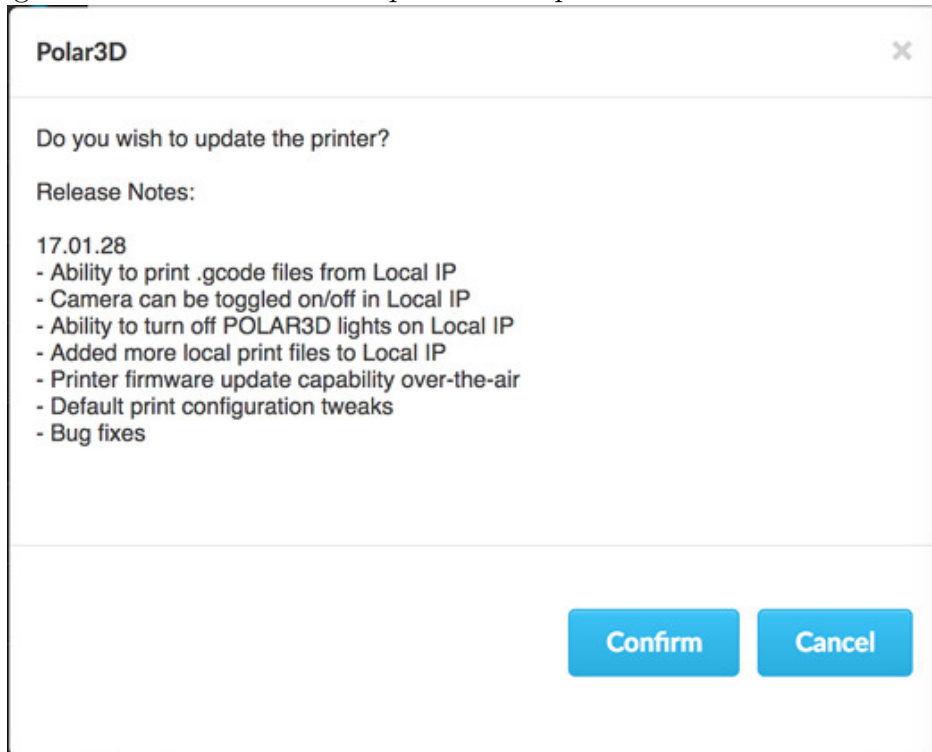


Figure 5.5: Printer local UI update description and confirmation screen



Note that when the printer is performing an update, the LED lights along the left-hand side of the printer will go through a color change: the LED lights towards the bottom (3D) will turn green, `POLAR3D`, and then the green color will gradually move up until all the lights are green, `POLAR3D`, indicating that the update is complete, before the lights return to their normal colors (blue over white, `POLAR3D`, for a printer connected to the Polar Cloud).

Note also that the update process may take several minutes; the printer `Status:` will go through `WAITING FOR RESPONSE` and `UPDATING PRINTER` (and then the printer `Status:` may go `OFFLINE` briefly if the update requires the printer to restart).

Chapter 6

Polar3D printer maintenance

The Polar3D printer's [polar coordinates](#)-based design means a simpler machine with fewer moving parts, so fewer maintenance issues. But as with any machine, there are a few parts that benefit from some occasional maintenance attention.

6.1 Cleaning your build plate

Something you will need to do fairly regularly is to clean your [build plate](#).

Remove the build plate from the printer, and wash it with warm water. If bits of filament are still a bit stuck, rub it lightly with a fingernail or green scrubber (but do not scrub hard). Then dry the build plate thoroughly, both top and bottom, before replacing it on the printer.

For a video demonstration, see:

[Polar 3D youtube video: WWBD – Cleaning your Build](#)

Plate

6.2 Lubrication

There are five spots which can benefit from occasional lubrication: the bottom of the threaded **Z rod**, and around the bushings on each of the four steel rods (two rods for the **build plate shuttle**, and two rods for the gantry); see Figure **B.1**. We recommend Tri-Flow lubricant (often used on bicycle chains), which is a “dry” lubricant. Put a drop of the lubricant at the bottom of the threaded Z rod, and a drop both in front of and behind each bushing on each rod.

In addition, if you are hearing any squeaking from the printer, you may wish to apply a drop of lubricant at the top of the threaded **Z rod**, and on the drive pinion.

For a video demonstration see:

[Polar 3D youtube video: WWBD – Care and Maintenance](#)

6.3 Clean filament drive gear

Over time, small particles of filament may start clogging up the filament drive gear in the **print head**. A filament jam in the nozzle, or low quality (flaky) filament, or frequent changes of filament (pushing filament in or pulling it out) may accelerate this. So occasionally you should remove the block from over the filament drive gear, clear out any accumulated filament dust or particles, and reinstall the block.

For a video demonstration, see:

[Polar 3D youtube video: WWBD – How to Unclog a Nozzle and Clear a Leaky Nozzle](#)

6.4 Replace a corrupted SD card

SD cards are fragile, and relatively easily corrupted by static discharges, or sudden power failures. So while it's rare, sometimes unfortunately an SD card will need replacing. Please contact [Polar 3D support](#) if you need a new SD card.

If you have had an SD card fail, and now have a new SD card from Polar 3D to install, for directions on replacing the SD card see:

[Polar 3D support solutions: Replacing the SD card](#)

6.5 Printer calibration

One of the advantages of the Polar3D printer's underlying **polar coordinates** architecture, and minimal number of moving parts, is that the Polar3D printer doesn't tend to require frequent calibration. However, occasionally you may want to check and adjust its calibration.

There are three general types of calibration of the Polar3D printer: (1) the z height of the **extruder**, (2) the alignment of the center of the build plate along the x -axis, and (3) the consistent levelness of the **build plate**. (Three dimensions implies three

calibration adjustments – but because the Polar3D printer operates in polar coordinates, with a spinning build plate achieving both x -axis and y -axis movements, rather than a separate and distinct y -axis calibration, calibration of the Polar3D printer’s movement in the xy -plane is achieved via x -axis calibration and build plate levelling.)

In more detail, the three calibration areas are as follows:

1. z height (*the most important/most commonly in need of adjustment calibration item*): If the z height of the **extruder** is slightly high, the first print layer (first layer of material extruded) may only be lightly touching the build plate, instead of being “smooshed” so that it adheres to the build plate. If the z height is too low, filament either may not be able to come out at all, or may come out too “smooshed” and actually flattened. You will want to check that the tip of the extruder nozzle is *just* above (a thin sheet of paper higher than) the build plate surface.
2. x -axis (*more rarely an issue*): The center of the **build plate**¹ should be located directly under the **extruder** nozzle of the print head when the build plate is homed: neither too far forward, nor too far backward. This is more conveniently checked when the build plate itself is removed from the **build plate shuttle**: compare the alignment of the extruder nozzle *vs.* the center of the drive gear bearing on the build plate shuttle.
3. Consistent levelness of the build plate (*very rarely an is-*

¹The center about which the build plate spins, which corresponds to the center of the drive gear bearing on the build plate shuttle, rather than necessarily the *exact* center of the build plate itself.

sue): The **build plate** should remain at a consistent height relative to the **extruder** tip, even when sliding forward or back. Check the z height with the extruder at the middle of the build plate; then slide the build plate forward² so that the extruder is at the edge of the build plate and confirm that the z height hasn't changed. If the z height *is* changing from middle to edge of build plate, then:

- (a) The **build plate shuttle** arms in the back of the printer (near the **Z rod**) may be bent downwards. Push these arms up gently until the extruder nozzle stays at the same height across the entire radius of the build plate.
- (b) The pads that the build plate mirror rests upon may be slightly off. This is normally checked at the Polar 3D factory when the printer is assembled, but something *might* have happened to throw off this alignment after leaving the factory, so it is worth checking to confirm that the mirror is still properly aligned.

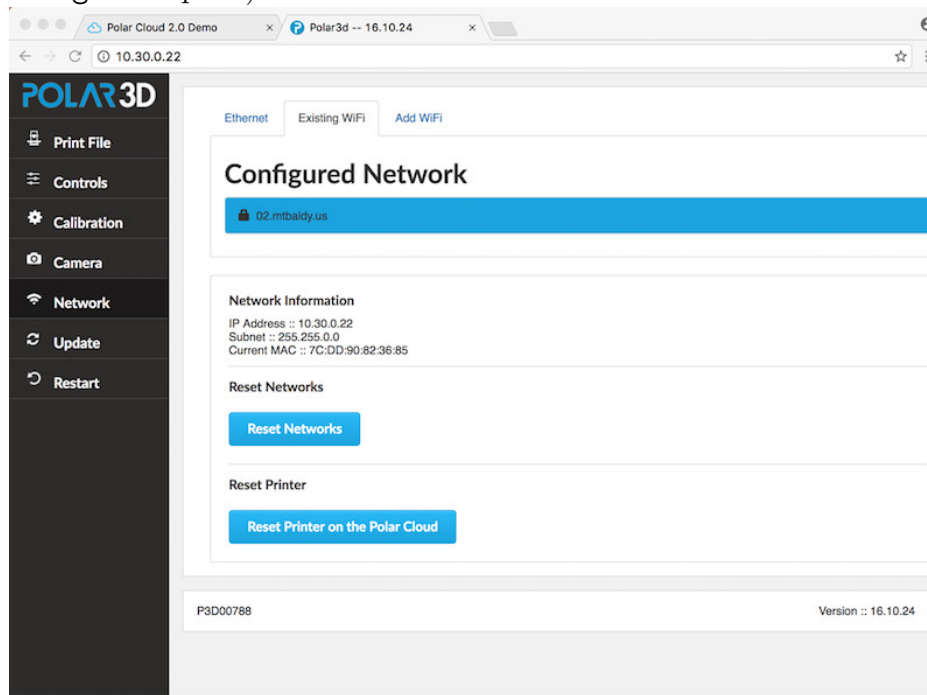
Calibrating a Polar3D printer's z height and x -axis (items 1 and 2) is performed using the printer **local web interface's** “**Calibration**” screen. But the “**Calibration**” screen, and the process overall, differs between **Polar3D 1.0 printers** (where the process is more manual), *vs.* **Polar3D 2.0 and 2.5 printers** (which have a more automated calibration feature).

²The build plate shuttle typically slides freely on its support rods. But if you happen to have interrupted a print in the middle of a job, so that the stepper motors are still engaged and the build plate is locked in place, use the “**Manual Printer Controls**” screen's “**Unlock Motors**” button, see Figure 6.3, to unlock the stepper motors and free the build plate to slide.

6.5.1 Polar3D 1.0 printer z and x calibration

1. To calibrate the z height of the **extruder**, from within the Polar Cloud, click on the printer, and then click on the “LOCAL UI” button (dial icon); or when communicating directly with the printer, from a browser on your device (computer/tablet/phone), connect to the printer’s local IP address. At this point you should be seeing the **printer’s local web interface**, as illustrated in Figure 6.1.

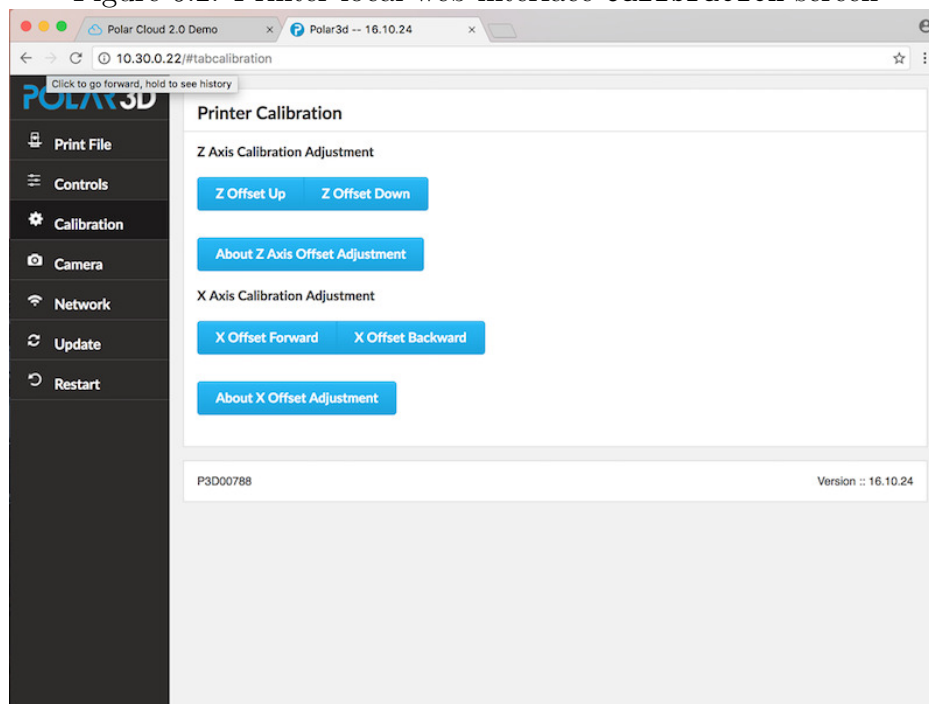
Figure 6.1: Printer local web interface landing screen (Network screen with Existing WiFi pane)



Select “Calibration” from the stacked tabs on the left to go to the calibration screen, see Figure 6.2; then click “Z Offset Down” or “Z Offset Up”, as desired.

Each click will lower (or raise) the z home of the **print head** (and hence the **extruder**) by 0.05 millimeters (about 1/2 the thickness of a sheet of paper). Adjust the z height until the tip of the extruder is just touching the build plate. When you are at the correct height, select the “**Just Right**” button.

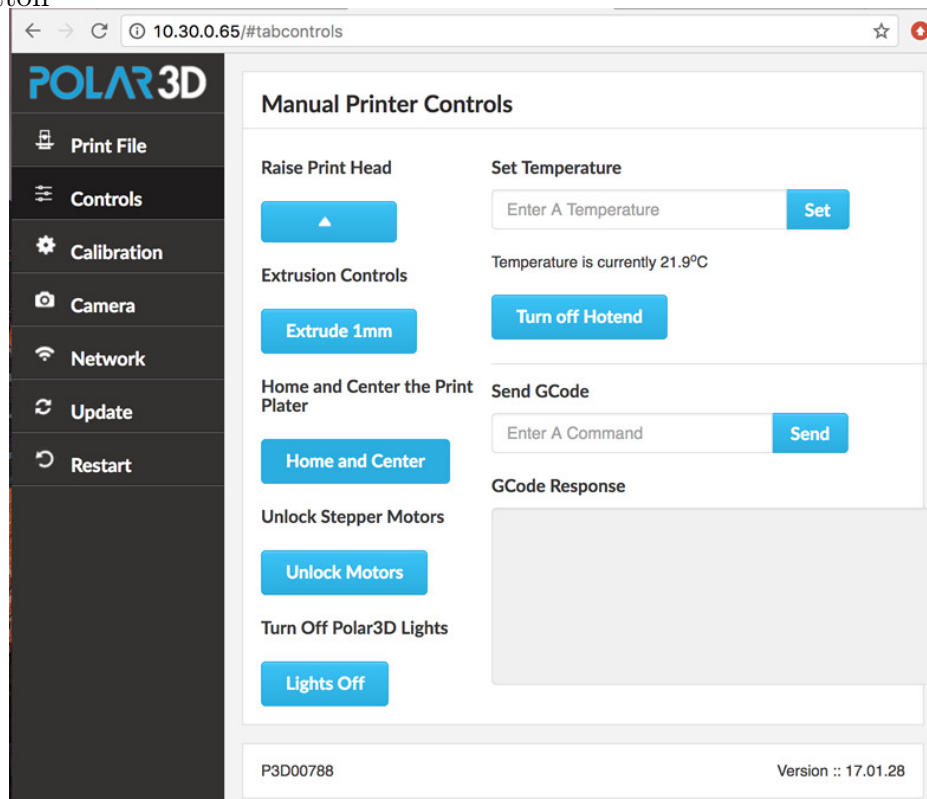
Figure 6.2: Printer local web interface Calibration screen



2. The center of the **build plate** should be located directly under the **extruder** nozzle of the print head when the build plate is homed. This is easier to check with the build plate *removed* from the **build plate shuttle**, so that you can compare the location of the center of the extruder nozzle with the location of the center of the build plate shuttle's drive gear bearing.

To home the build plate, click the “Controls” tab on the printer local web interface left-hand menu; then click the “Home and Center” button; see Figure 6.3.

Figure 6.3: Printer local web interface Controls screen’s Home and Center button



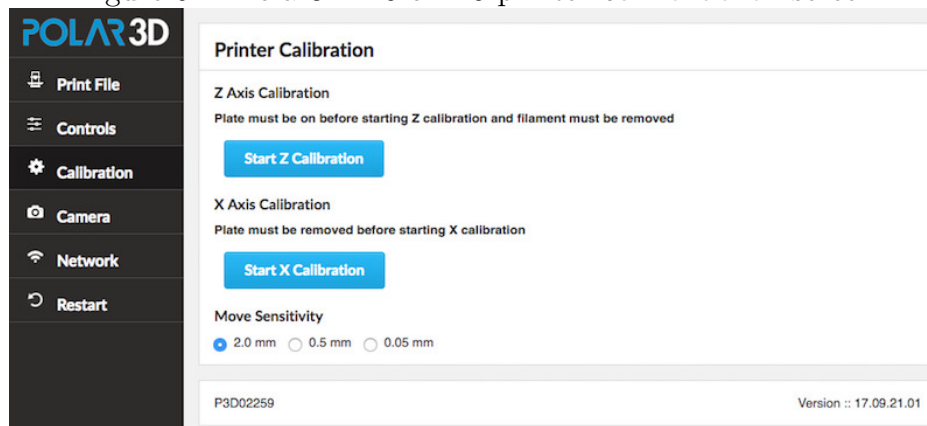
If the x offset (forward vs. backward) of the build plate seems a bit “off” from the location of the extruder nozzle when the build plate is putatively homed, then click the printer local web interface “Calibration” tab to go back to the calibration screen, Figure 6.2, and use the “Calibration” screen’s “X Offset Forward” or “X Offset Backward” buttons to adjust the build plate location.

You're done with z and x calibration! See the discussion of [consistent levelness of the build plate](#) (item 3 in Section 6.5) if you still seem to have a bit of miscalibration.

6.5.2 Polar3D 2.0 or 2.5 printer z and x calibration

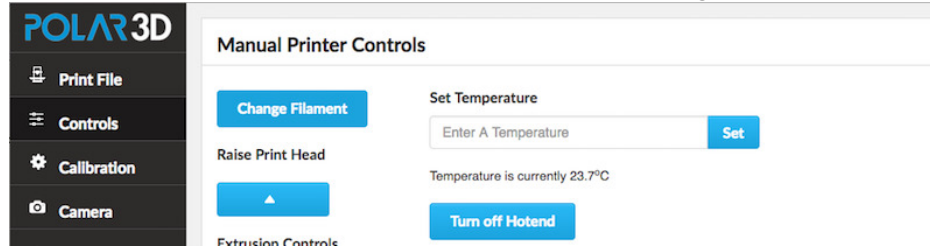
Go to the printer's local web interface and click the "Calibration" tab to get to the "Calibration" screen; see Figure 6.4.

Figure 6.4: Polar3D 2.0 or 2.5 printer Calibration screen



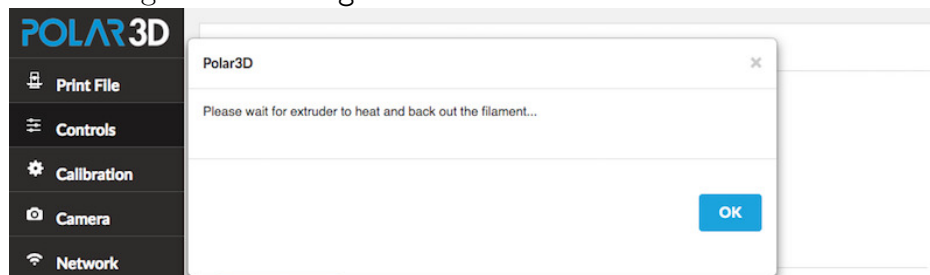
If filament is currently loaded onto the printer, you will need to unload the filament: click the "Controls" tab on the left menu to get to the "Manual Printer Controls" screen, and there click the "Change Filament" button; see Figure 6.5.

Figure 6.5: Manual Printer Controls screen: Change Filament button



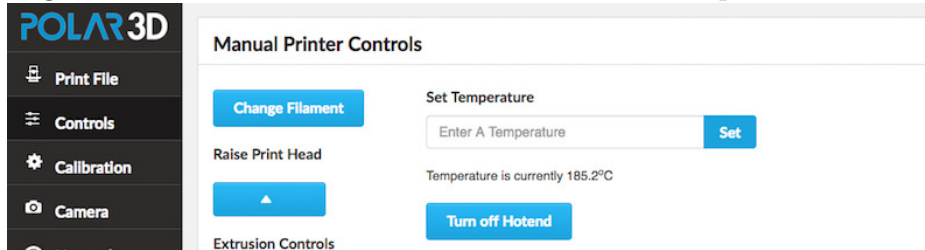
A screen will pop-up explaining that the printer needs to heat up the extruder in order to change the filament; click “OK” at this confirmation screen, (Figure 6.6).

Figure 6.6: Change Filament button: confirm screen



Once the temperature reaches 185° C, see Figure 6.7, (and if you are listening carefully, you should also hear the noise of the printer filament drive gear running to back out the filament from the extruder), pull the filament the rest of the way out of the extruder. (Note that the extruder temperature will not stay at 185° C: as soon as the printer has backed out the filament, it will turn the extruder heater off.)

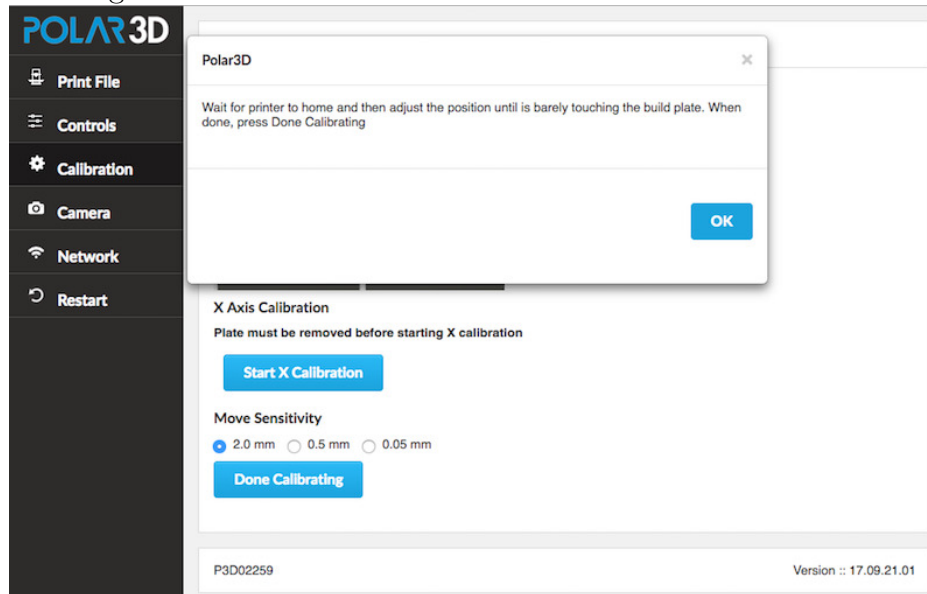
Figure 6.7: Manual Printer Controls screen: temperature 185° C



Having unloaded any filament, you are now ready to proceed with calibration, so click the “Calibration” tab on the left-hand menu to return to the “Calibration” screen.

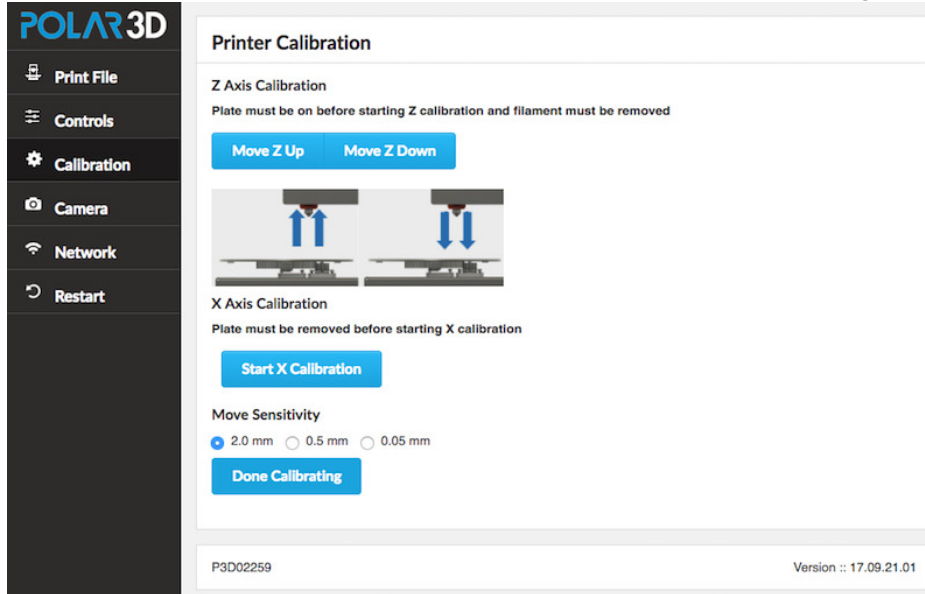
If you wish to perform z calibration, check that the build plate is installed on the printer. Then on the “Calibration” screen (refer to Figure 6.4), click the “Start Z Calibration” button.

Clicking the “Start Z Calibration” button will bring up the screen shown in Figure 6.8; click the “Ok” button to dismiss the screen.

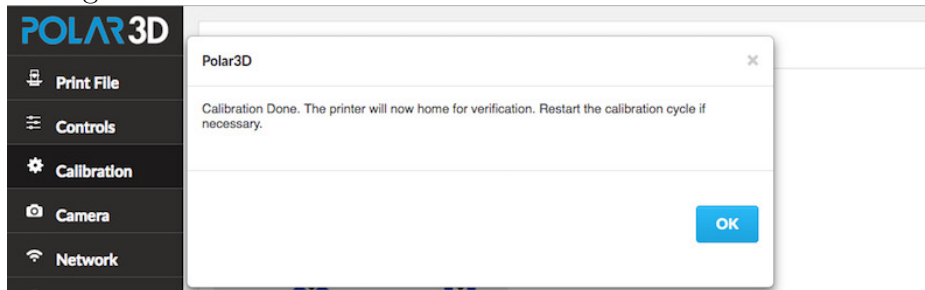
Figure 6.8: Calibration screen: z calibration wait screen

Now check the position of the extruder nozzle end relative to the build plate. You want to be able to *just* slide a sheet of paper between the two, feeling resistance. If the paper slides easily, not touching the extruder nozzle end at all, you need to lower the extruder nozzle: click the “Move Z Down” button. If a sheet of paper cannot slide underneath the nozzle end, if the nozzle end is touching the build plate, you need to raise the extruder nozzle: click the “Move Z Up” button.

Once you are finished with any moves of the nozzle up or down, click the “Done Calibrating” button; see Figure 6.9.

Figure 6.9: Calibration screen: z calibration Done Calibrating button

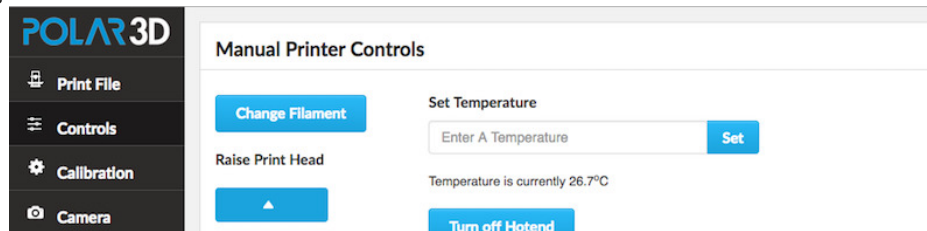
Clicking “Done Calibrating” will bring up the screen shown in Figure 6.10; click the “Ok” button to dismiss the screen.

Figure 6.10: Calibration screen: z done confirmation screen

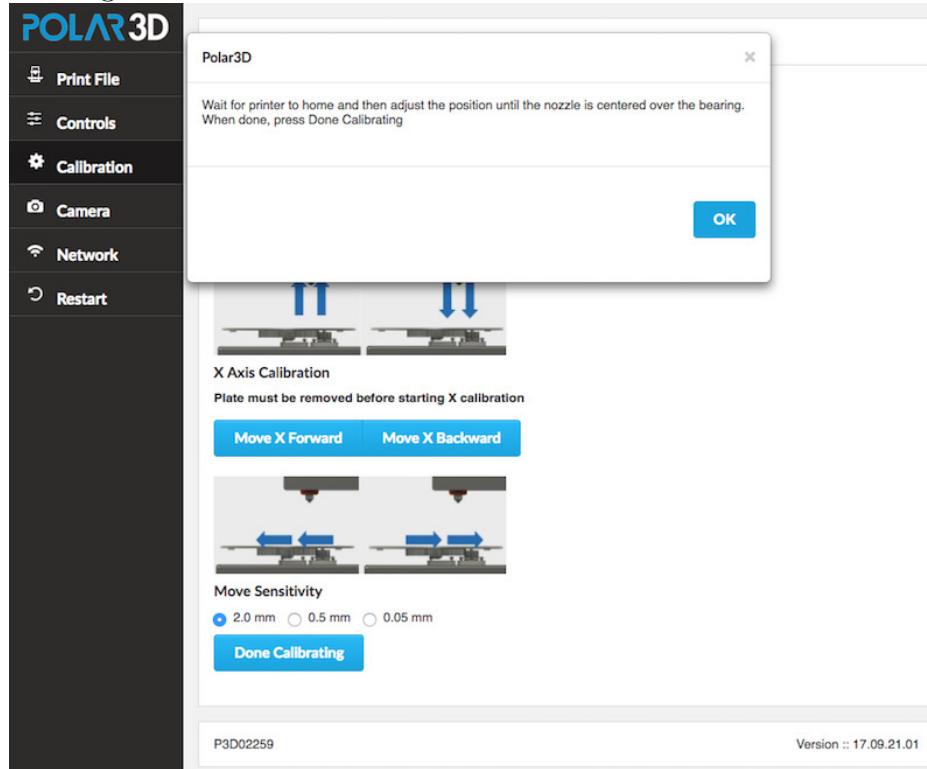
If you now wish to perform x calibration, you must remove the build plate from the printer (in order to be able to visually compare the locations of the extruder nozzle and the build plate shuttle’s drive gear bearing). If you just finished completing z

calibration, the print head will be lowered to the build plate and you will not have free room to remove the build plate; in this case, click the “Controls” tab on the left-hand menu to go to the “Manual Printer Controls” screen and at that screen click the “Raise Print Head” (up arrow) button a few times; see Figure 6.11. Once you have room to do so, remove the build plate from the printer.

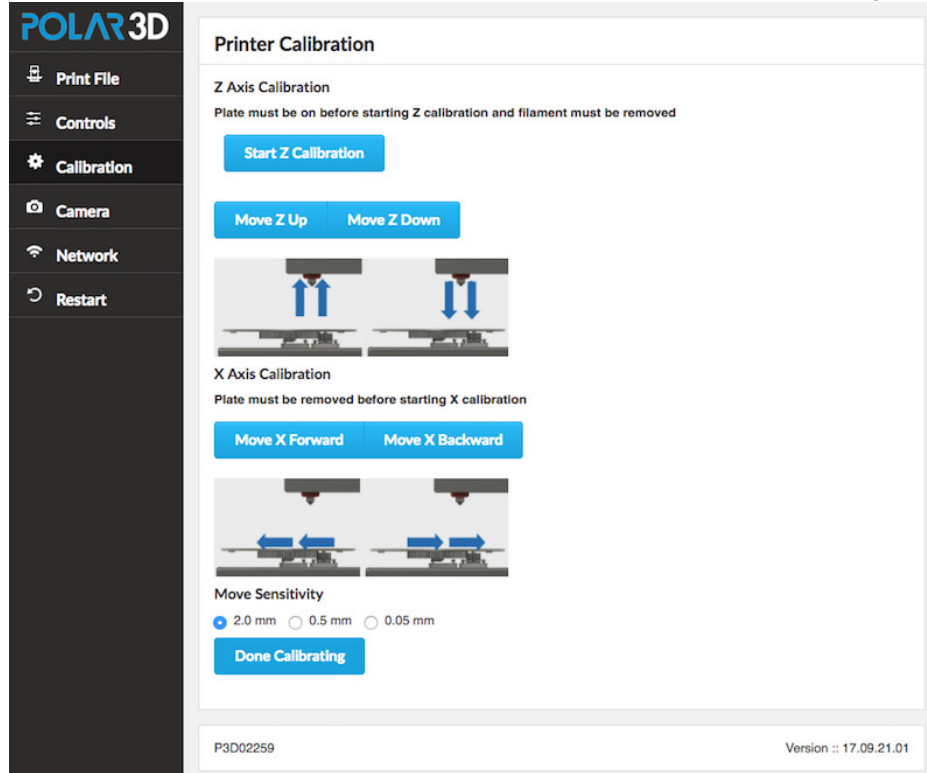
Figure 6.11: Manual Printer Controls screen: Raise Print Head button



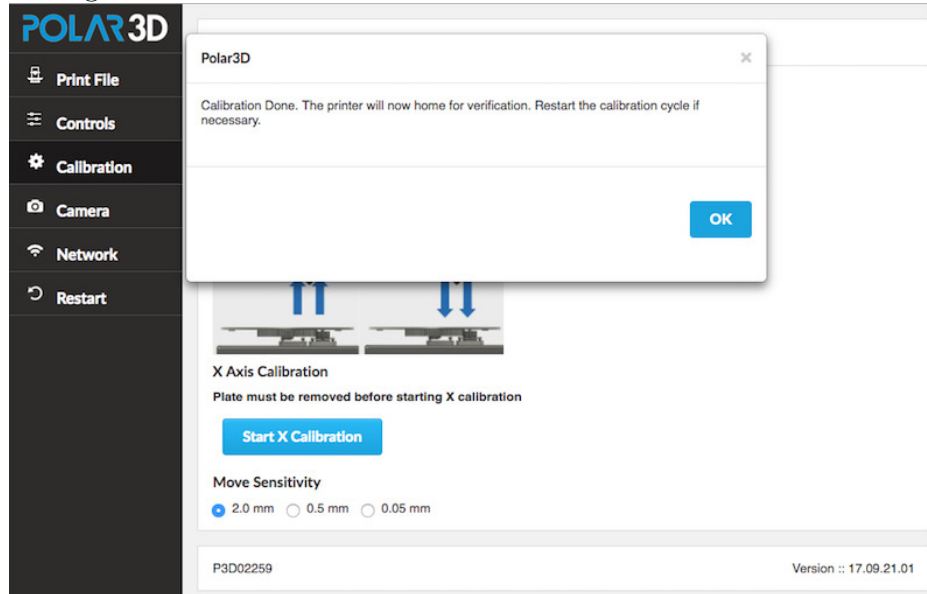
With the build plate removed from the printer, you are now ready to begin x calibration, click the “Calibration” tab on the left-hand menu to return to the “Calibration” screen. On the “Calibration” screen (refer to Figure 6.4), click the “Start X Calibration” button. This will bring up the screen shown in Figure 6.12; click the “Ok” button to dismiss the screen.

Figure 6.12: Calibration screen: x calibration wait screen

Compare the position of the center of the extruder nozzle to the center of the **build plate shuttle**'s drive gear bearing. If necessary, click the “Move X Forward” or “Move X Backward” button to adjust the location of the build plate shuttle to line up its drive gear bearing directly underneath the extruder nozzle. When done, click the “Done Calibrating” button; see Figure 6.13.

Figure 6.13: Calibration screen: *x* calibration Done Calibrating button

Clicking “Done Calibrating” will bring up the screen shown in Figure 6.14; click the “Ok” button to dismiss the screen.

Figure 6.14: Calibration screen: x done confirmation screen

You're done with z and x calibration! See the discussion of [consistent levelness of the build plate](#) (item 3 in Section 6.5) if you still seem to have a bit of miscalibration.

Chapter 7

Troubleshooting for Polar3D printers

The [Polar3D support](#) website has a number of [articles](#) and [videos](#) discussing commonly encountered issues. You can also open a support ticket at that site.

7.1 Polar3D printer LED lights

In addition to the small, white lights around the camera underneath the [print head](#) which are the very first lights to turn on when the printer is plugged in, the Polar3D printer has LED lights running vertically on the left hand side, with “POLAR” generally showing in blue when the printer is turned on (plugged in), and with the color of “3D” being an indication of the state of the printer. (Printer firmware updates or restarts are indicated with special coloring of the entire “POLAR3D” display: green for firmware updates, or white for firmware restarts.)

A summary of the meaning of the LED lights on these Polar3D printer is:

1. **POLAR3D** (BLUE over BLUE): The printer has finished turning on, but is *not* connected to a network, and has stood up its own wireless network.
2. **POLAR3D** (BLUE over RED): The printer has been configured to connect to a network, but that network has not yet, or could not, be found. (The LED lights will only remain BLUE over RED for a short time: then the lights will either return to BLUE over BLUE if the network could not be found, or progress to BLUE over YELLOW if the network is found.)
3. **POLAR3D** (BLUE over YELLOW): The printer found a network to which it could connect, but the printer has not connected.
4. **POLAR3D** (BLUE over WHITE): The printer is connected through the local network and the Internet to the Polar Cloud.
5. **POLAR3D** (BLUE over GREEN): The printer has begun an update.¹
6. **POLAR3D** (BLUE over GREEN): The printer is partway through an update.
7. **POLAR3D** (GREEN): The printer has just completed an update. (The LED lights will only remain solid GREEN for a short time; then the LED lights will return to their

¹The green color will move gradually upwards in the letters, until all the LED lights are green as the update completes, after which the LED lights will return to their normal color from before the update.

prior color(s), *e.g.*, BLUE over WHITE if the printer is connected to the Polar Cloud.)

8. **POLAR3D** (WHITE): The printer is about to restart (or is in process of restarting); that is, its firmware is rebooting. This is seen after clicking the “Restart” tab on the local web interface, and may also be seen after some printer firmware updates, if a restart is required to complete the update.

See also the Polar3D support discussion: [Polar3D Support: What do the different LED lights mean?](#)

And the Polar3D video:

[Youtube Polar3D channel: WWBD - LED Light Explained](#)

7.2 Polar3D printer clogged or leaky nozzle

See:

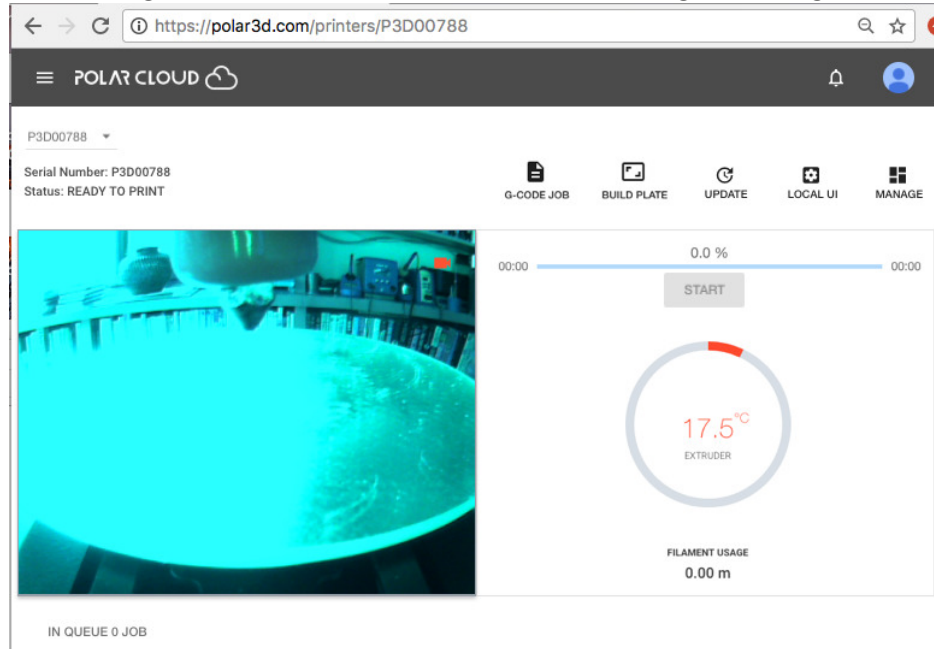
[Polar 3D youtube video: WWBD – How to Unclog a Nozzle and Clear a Leaky Nozzle](#)

7.3 Polar3D printer camera color balance

The camera in the Polar3D printer attempts to perform automatic color balancing. However, occasionally its color balancing algorithm may yield strange results, where the camera picture appears to have a strange overall tinge. (In particular, this may happen if the printer is left on in dark surroundings, such as

overnight; when the lights get brighter, as in the morning, the color balancing may not readjust properly.) See for instance Figure 7.1, where the image has a blue cast.

Figure 7.1: Printer camera color balance gets strange



Power-cycling the printer (unplugging it and then plugging it back in) may reset the camera so that a correct color balance is restored.

7.4 Polar3D printer stepper motors locked in place

While the printer is printing, its stepper motors are controlling the movement of the **build plate shuttle** and **print head**.

Normally, when the printer is not printing, the **build plate shuttle** and **print head** move freely on their respective support rods, should you wish to move them. However, if you have interrupted the printer in the middle of a print job, resulting in the stepper motors still being engaged (hence holding the build plate shuttle and print head locked in place), note that you may use the printer local web interface’s “**Manual Printer Controls**” screen’s “**Unlock Motors**” button to cause the stepper motors to disengage.

Appendix A

Polar3D printer specification sheet

See <https://shop.polar3d.com/products/polar-3d-printer>

Appendix B

Polar3D printer diagram

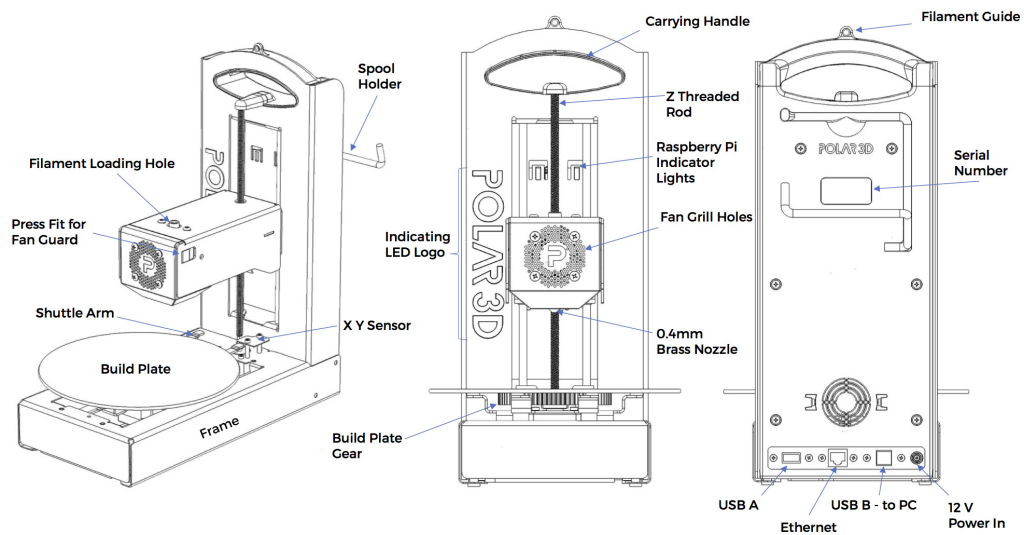


Figure B.1: Polar3D printer diagram

Appendix C

Connecting the Polar3D printer directly to your device

The Polar3D printer supports direct, non-Internet-enabled, printing; in such modes, the features of the Polar Cloud are not available, but direct printing may be useful when Internet access is not available yet you need to print an object. (When Internet access is available, see instead Chapter 1 for a discussion of connecting the printer to the Polar Cloud.)

If this is a brand new Polar3D printer, which you are just unpacking from its shipping box, begin by performing [steps 1 through 4](#) of Section 1.1; namely:

1. Spray the [build plate](#) generously with AquaNet hairspray; for a video demonstration, see:

<https://www.instagram.com/p/BJBaWwrjCwF/>

2. Twist the threaded [Z rod](#) clockwise to raise the [print head](#) enough (1" to 2") to install the [build plate](#).

After you have unpacked the [build plate](#) and prepared its

surface by applying a coat of hair spray (see above), and raised the **print head** to make room for installing the build plate, you are ready to install the build plate on the printer **build plate shuttle**.

The bottom center of the build plate has a gear affixed. Place the build plate so that the center of the gear seats over the bearing on the build plate shuttle, and the gear teeth engage with the geared axle of the printer build plate shuttle.

3. Insert the power cord into the adapter, and insert the adapter plug into your Polar3D printer. Do not force the adapter plug; it will *not* be flush with the printer.
4. Plug in to a power outlet; the Polar3D printer's LED lights should turn blue over blue: **POLAR3D**.

Then there are two ways to connect the printer directly to your device: wireless (WiFi) – see Section [C.1](#), or via direct USB cable – see Section [C.2](#).

C.1 Wireless direct connection and printing

For wireless (WiFi) direct **connection** and **printing**, you will use the printer's own hotspot and the printer's local web interface to communicate directly with the printer from your device (computer, tablet, phone), and will be able to print object files stored on your device.

C.1.1 Wireless direct connection

For this type of connection, you will connect to the printer's hotspot directly. (Thus this process starts out rather similarly to configuring the printer to connect via WiFi to a local network, as discussed in Section 1.1, but instead of merely using the printer's own hotspot to configure the printer's connection to a local network, you will instead stay connected to the printer's hotspot and communicate directly with the printer, rather than using the Polar Cloud interface.)

1. Connect to the printer's hot spot.

The printer should already be plugged in and all its LED lights blue: **POLAR3D**. From your device (computer, tablet, or phone), select WiFi network. From the list of networks, select the P3D network named after your printer's serial number, as found on the back of the printer; for example, "P3D00526-WIFI". You will be prompted for a password, which will be the 8-character serial number consisting of P3D and five digits: in this example, "P3D00526".

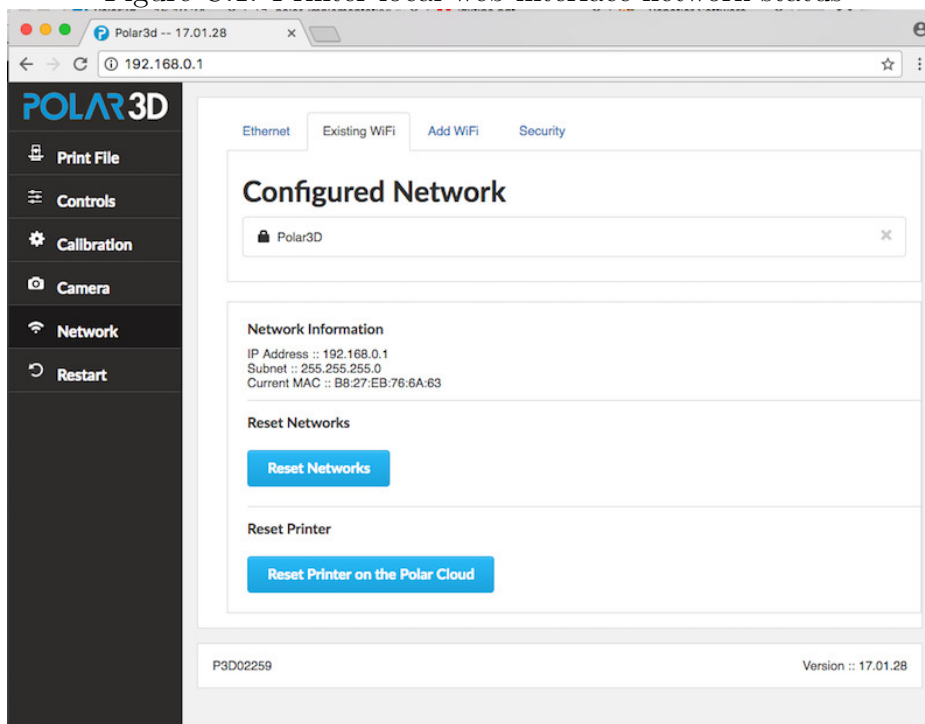
Note: Your device will not allow itself to be connected to two WiFi networks simultaneously. If your device is already connected to a WiFi network, you will need to (temporarily) disconnect from that network and then connect to the printer hotspot.

2. Connect to the printer.

In your browser (Chrome, Internet Explorer, Safari, *etc.*) enter 192.168.0.1 into the navigation bar. (On the printer's hotspot, that is, on the private P3D network which is named

after your printer's serial number and which the printer stood up itself, 192.168.0.1 will be the address of the printer.) You are now connected to the printer and should see the printer's local web interface, as shown in Figure C.1; (the printer local web interface is discussed in detail in Chapter 3).

Figure C.1: Printer local web interface network status



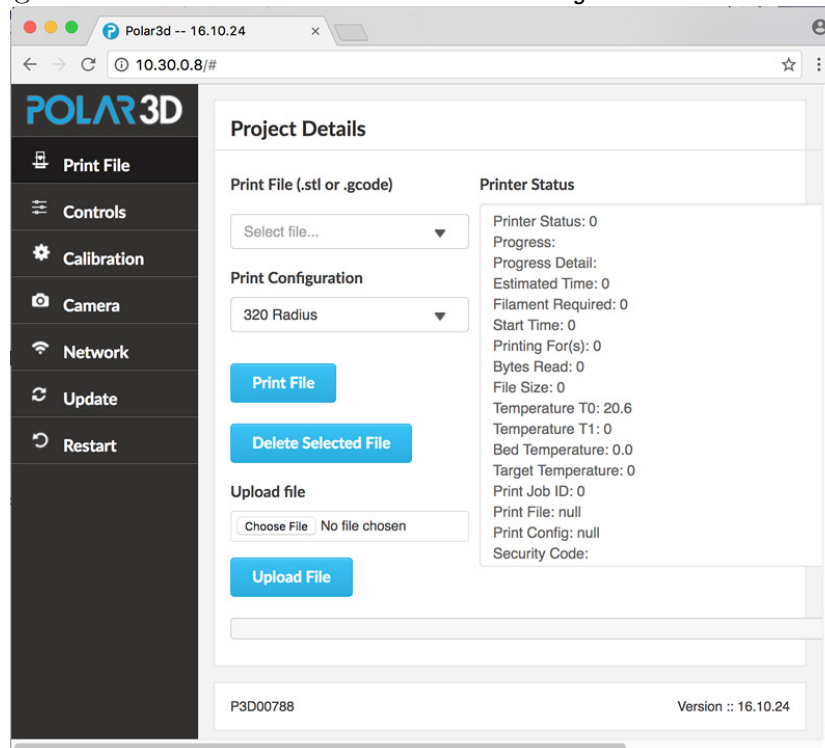
At this stage, in the printer local web interface, note that there is *no* blue highlighted network shown under **Configured Network**, meaning that the printer is *not* connected to any local WiFi, but rather is in HotSpot mode.

C.1.2 Wireless direct printing

The steps below describe the full process for uploading and printing an arbitrary `.stl` file. (However, note that the Polar3D printer ships with several `.stl` files, suitable for an initial test of the printer, already onboard the printer user interface; for your very first print, you may wish to print one of them rather than uploading your own file.)

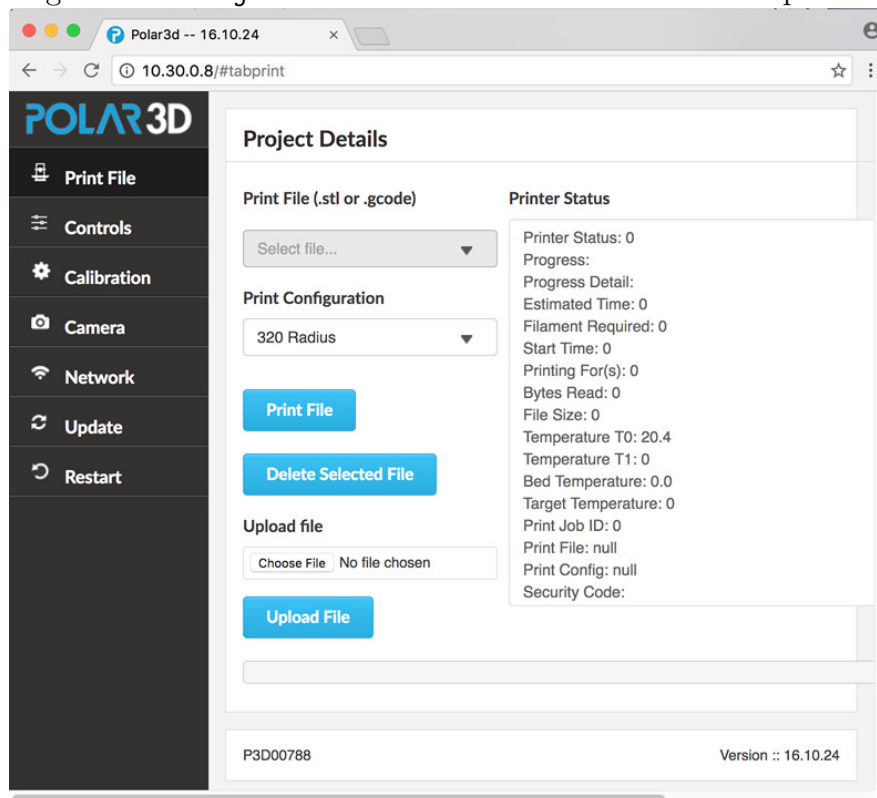
1. On the printer's user interface, click the **Print File** tab (top choice in the column on the lefthand side of the window). This will take you to the **Project Details** screen, as shown in Figure C.2.

Figure C.2: Printer local web interface **Project Details** screen



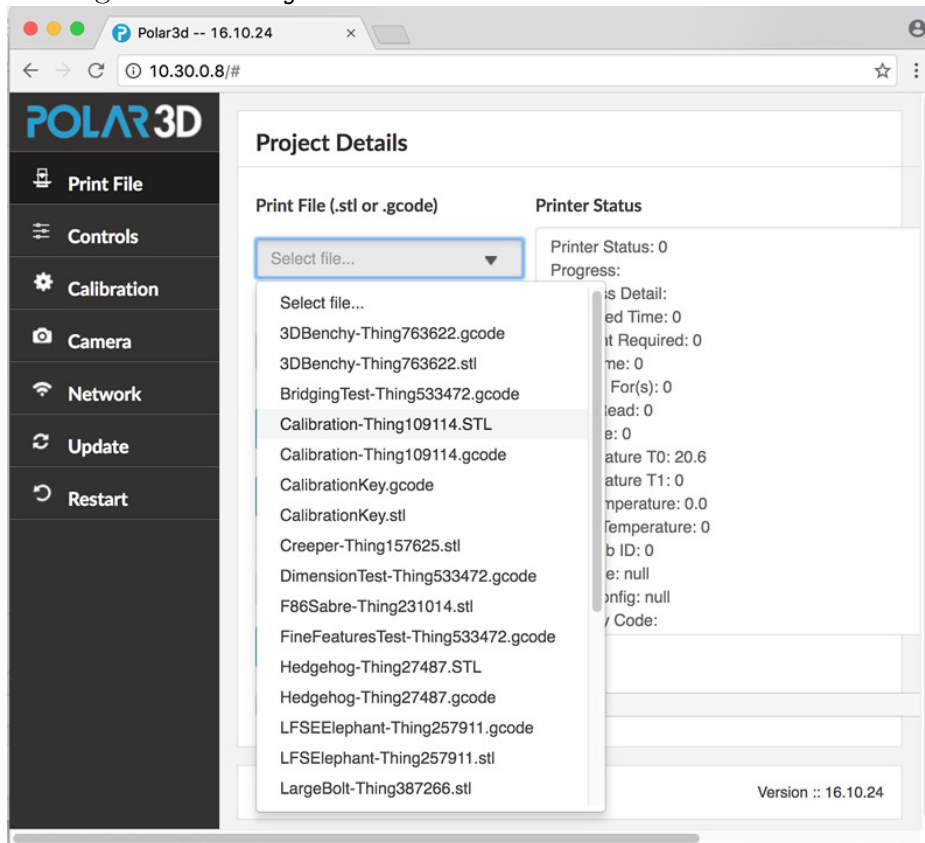
2. Upload a file to print. (If this is your very first print on this printer, you may prefer to skip this step, of finding and uploading an arbitrary `.stl` file, and instead go to step 3 to print one of the files shipped as test print files.)
 - (a) Under **Upload File**, select **Choose File**.
 - (b) Find the file, select the file, and click **Open**.
 - (c) Click the **Upload File** button.
3. Select and print the file.
 - (a) Click the **Select file...** drop down menu under **Print File (.stl or .gcode)**; see Figure C.3.

Figure C.3: Project Details screen: Select file drop-down



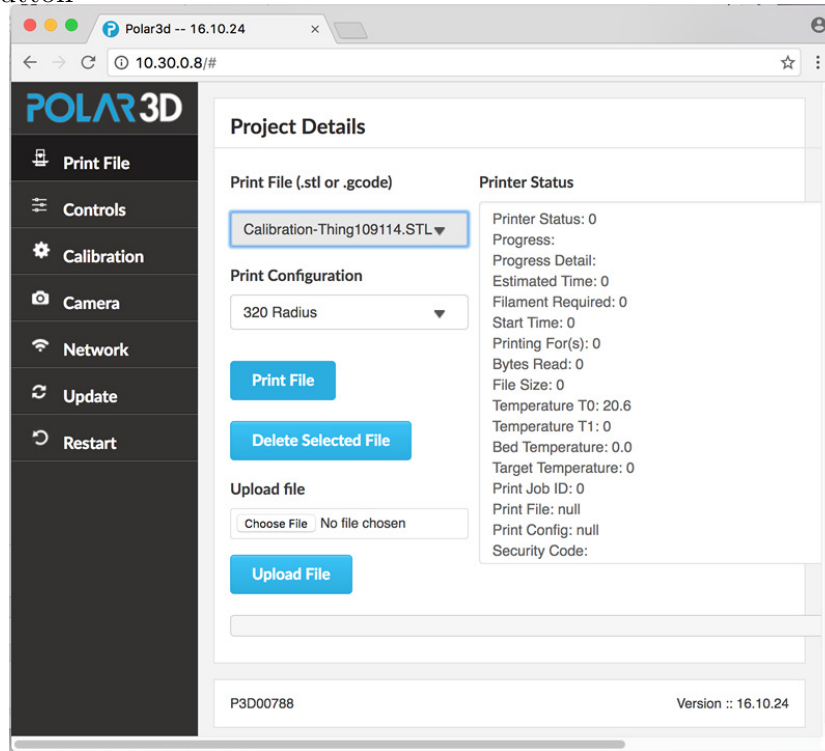
- (b) Select the desired file. (Note that several sample **.stl files** ship with the Polar3D printer, accessible from the [printer local web interface](#), for your convenience in using them as a first print, or for calibration prints; see Figure C.4.)

Figure C.4: Project Details screen: Select file choices



4. Click the Print File button; see Figure C.5.

Figure C.5: Printer local web interface Project Details screen: Print File button



Your object will begin printing! You may click the “[Camera](#)” tab (on the vertical menu at the left of the screen) if you would like to watch the camera view of the printer operating.

C.2 Cable direct connection and printing

With the cable direct method of [connection](#) and [printing](#), since you won’t be able to access either the Polar Cloud user interface, or the Polar3D printer’s own onboard web user interface, you will

need to run third-party printer control software on your device (typically your computer) that can control the printer. In particular, Repetier-Host is free software which can be downloaded and installed on your computer for this purpose.

You will also need an appropriate cable to connect your printer with your computer, such as a type-A-male-to-type-B-male USB cable to connect to your printer.

The proper type of USB cable looks like:



If you do not already have such a USB cable, you may purchase one from Amazon:

<https://www.amazon.com/AmazonBasics-USB-2-0-Cable-Male/dp/B00NH11KIK>

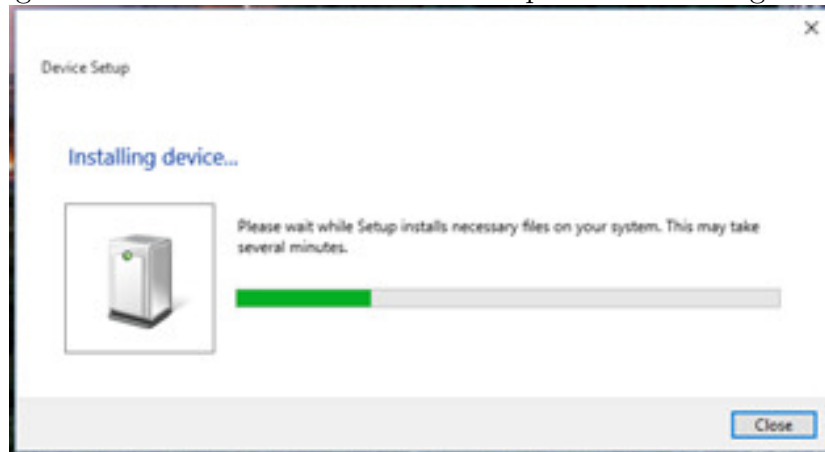
C.2.1 Cable direct connection

1. Obtain an appropriate cable, either a type-A-male-to-type-B-male USB cable of the type described above in Section [C.2](#), or an Ethernet cable.
2. Plug the cable into the printer and into your computer. A window should pop up that says it is installing drivers; see

APPENDIX C. CONNECTING THE POLAR3D PRINTER DIRECTLY TO YOUR DEVICE¹²⁴

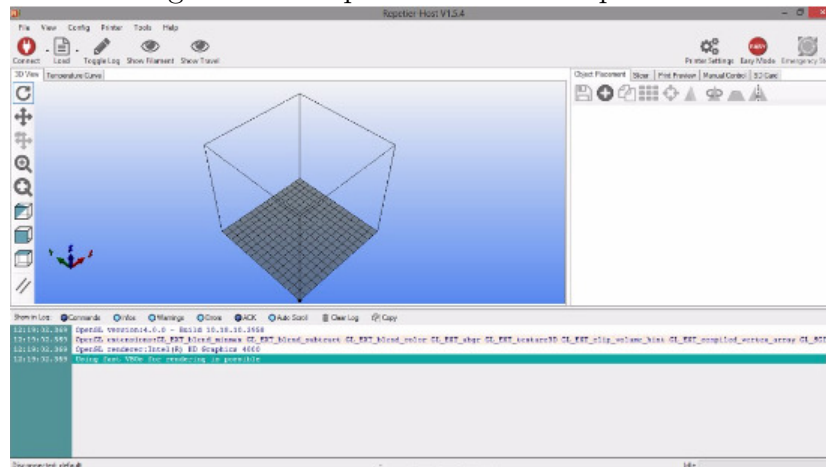
Figure C.6. Do not close that window!

Figure C.6: Cable direct connection to printer: installing device



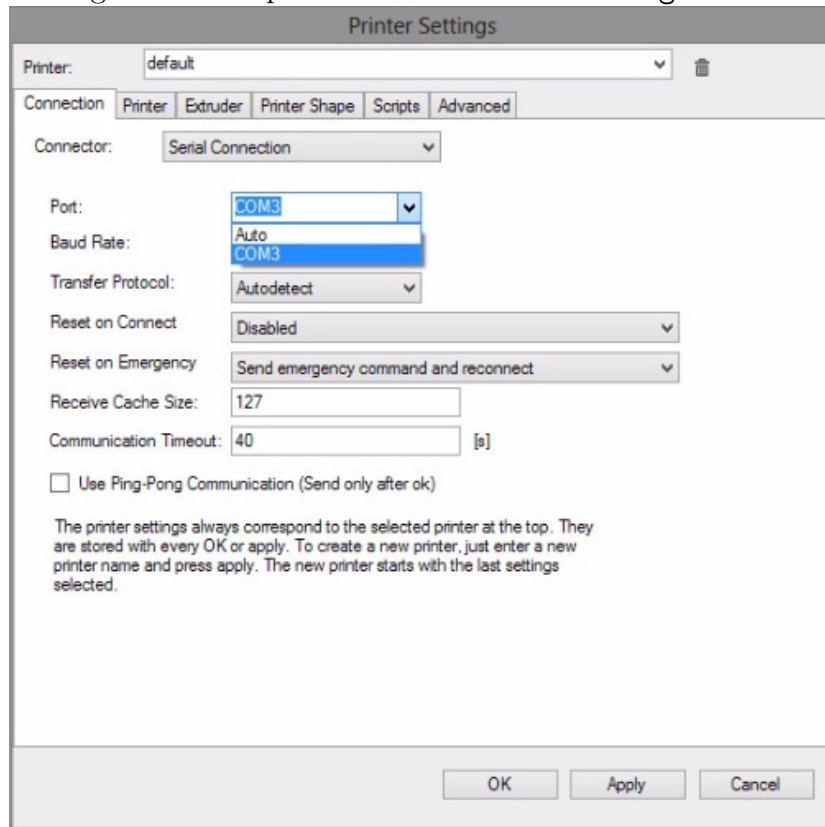
3. Now, download and install [Repetier-Host](#).
4. Start up Repetier-Host. You should see a screen such as shown in Figure C.7.

Figure C.7: Repetier-Host start-up screen



- Once the drivers from step 2 have finished downloading, unplug your printer. Then click **Printer Settings** on the top right of the Repetier-Host start-up screen. You should now be looking at a window such as shown in Figure C.8:

Figure C.8: Repetier-Host Printer Settings screen



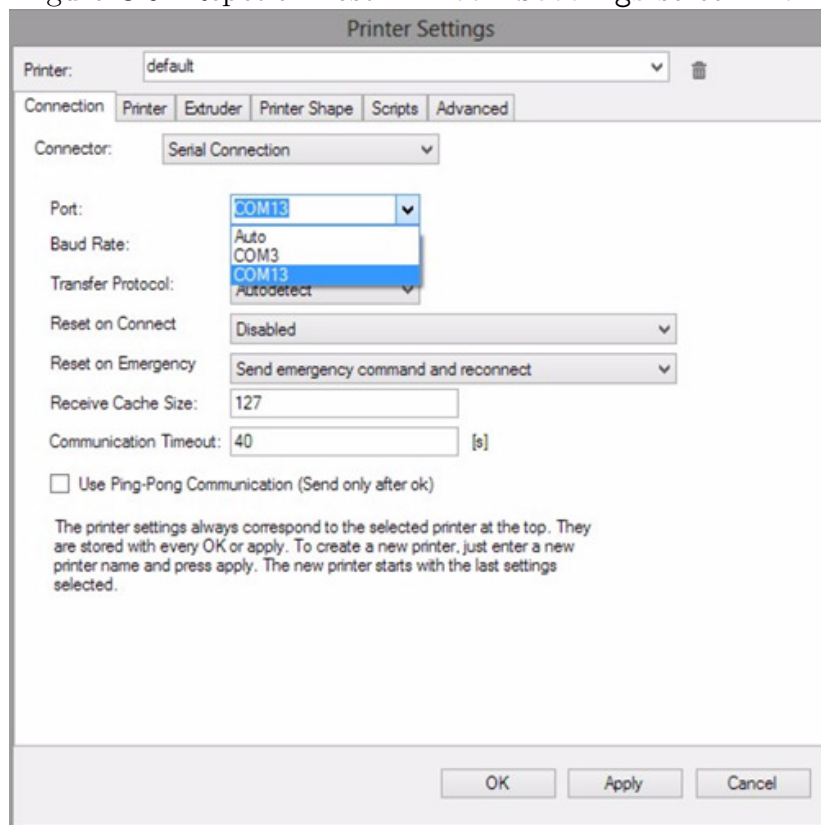
First, set the **Baud Rate** to 115200.

Next, click on the down arrow in the box labelled “**Port**” and make a note of the values shown in the drop-down menu. This will show you what ports you currently have on the device and will help you determine the port used by the Polar3D printer. Click “**Cancel**” to close the **Printer**

Settings window.

6. Plug your printer back in. Open **Printer Settings** again. Select the new value in the drop down menu. In the example shown below in Figure C.9, that new value is COM13, but the actual new value may vary.

Figure C.9: Repetier-Host Printer Settings screen: Port

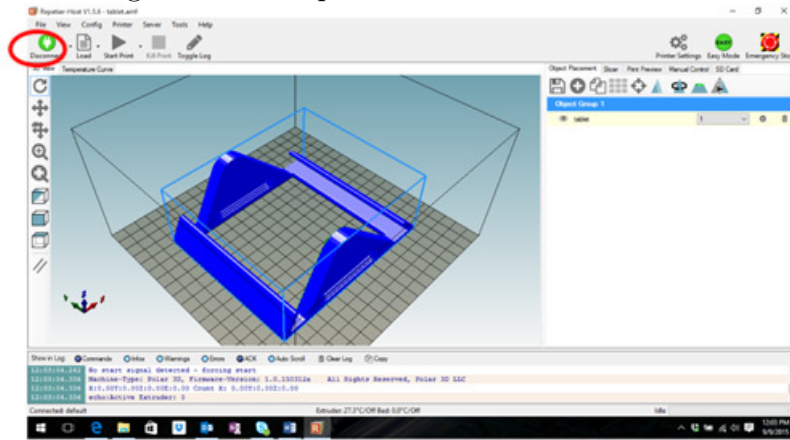


Click the “OK” button to save the changes.

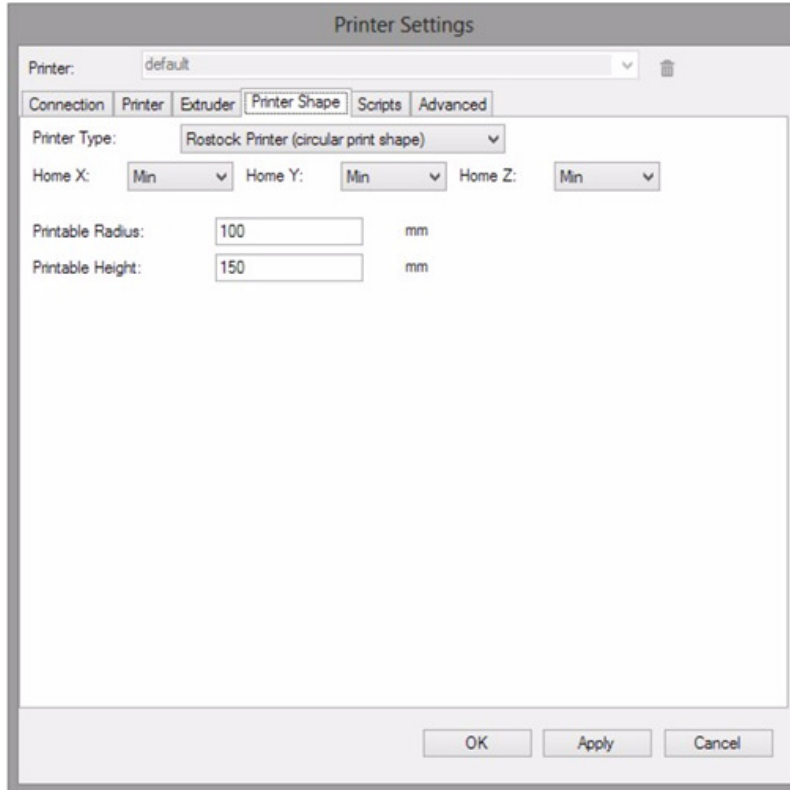
7. Click the red “Connect” button (towards the top left of the Repetier-Host window). If it turns green, that means you are connected; see Figure C.10.

APPENDIX C. CONNECTING THE POLAR3D PRINTER DIRECTLY TO YOUR DEVICE¹²⁷

Figure C.10: Repetier-Host Connect button



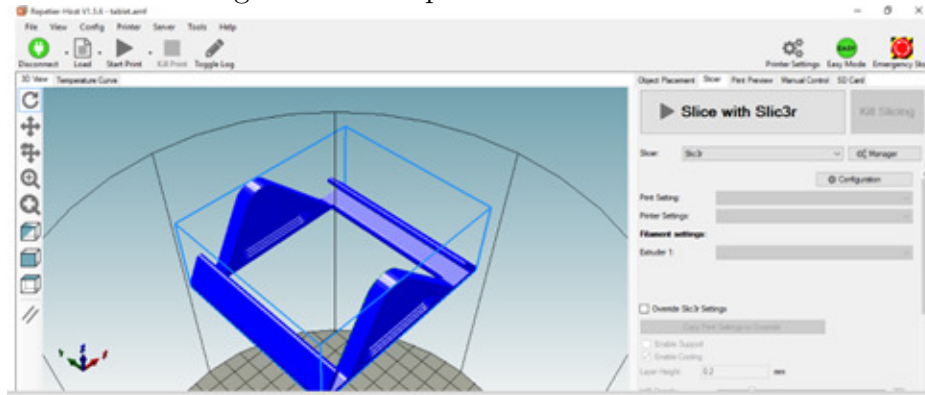
8. Now, configure Repetier-Host to work with your Polar3D printer. Under “Printer Settings”, enter the values shown in Figure C.11 below:

Figure C.11: Repetier-Host Printer Settings: Printer Shape, *etc.*

Click the “OK” button to save these settings.

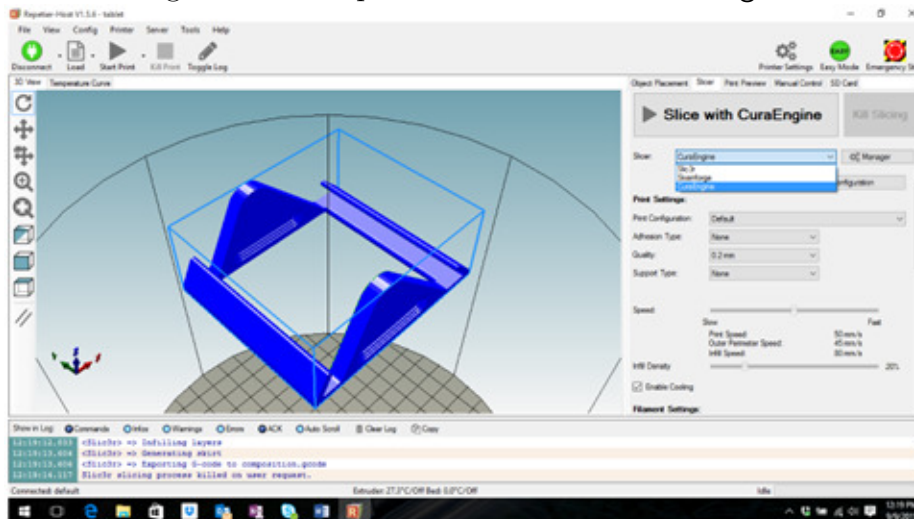
9. Now, configure the CuraEngine slicer settings. (CuraEngine is the *slicer* program that converts the 3D model – the *.stl file* – to *G-code* that the printer can read.) Click on the tab that says “Slicer”, towards the right of the window; see Figure C.12.

Figure C.12: Repetier-Host Slicer tab



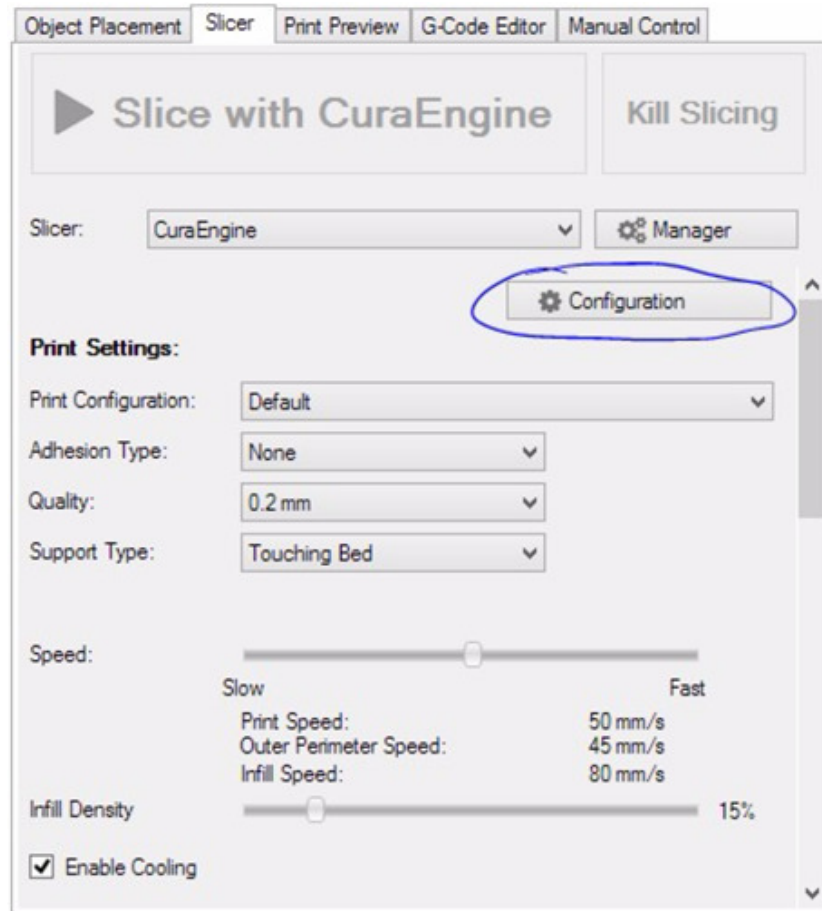
10. Make sure that the Slicer choice is set to CuraEngine:

Figure C.13: Repetier-Host Slicer: CuraEngine



Then, with the slicer set to “CuraEngine”, click the “Configuration” button; see Figure C.14.

Figure C.14: Zoomed in view of Slice with CuraEngine: Configuration button



11. You will need to download two files from the Polar 3D support page. The files to download are named “Polar Cura Settings.rcp” and “Polar PLA Settings.rcf”. They are available at the Polar 3D support website:

[Polar 3D support: Repetier-Host/USB printing](#)

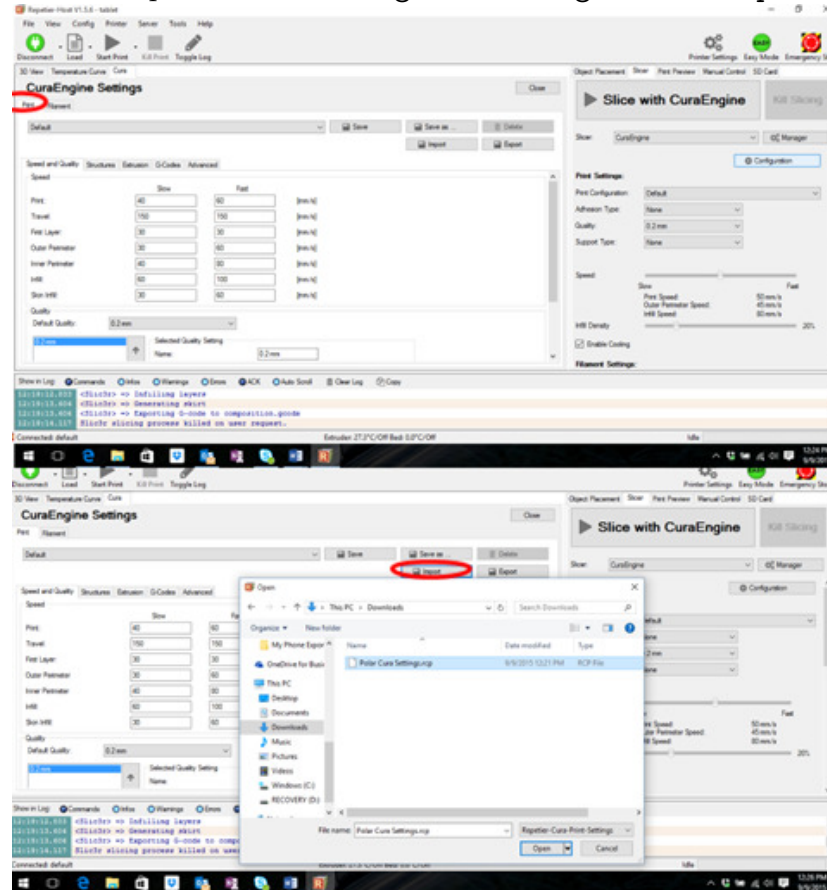
Save the two files to your desktop.

12. Still under the CuraEngine “Configuration” window from

APPENDIX C. CONNECTING THE POLAR3D PRINTER DIRECTLY TO YOUR DEVICE¹³¹

step 10, navigate to the “Print” tab, click “Import”, and then load “Polar Cura Settings.rcp”:

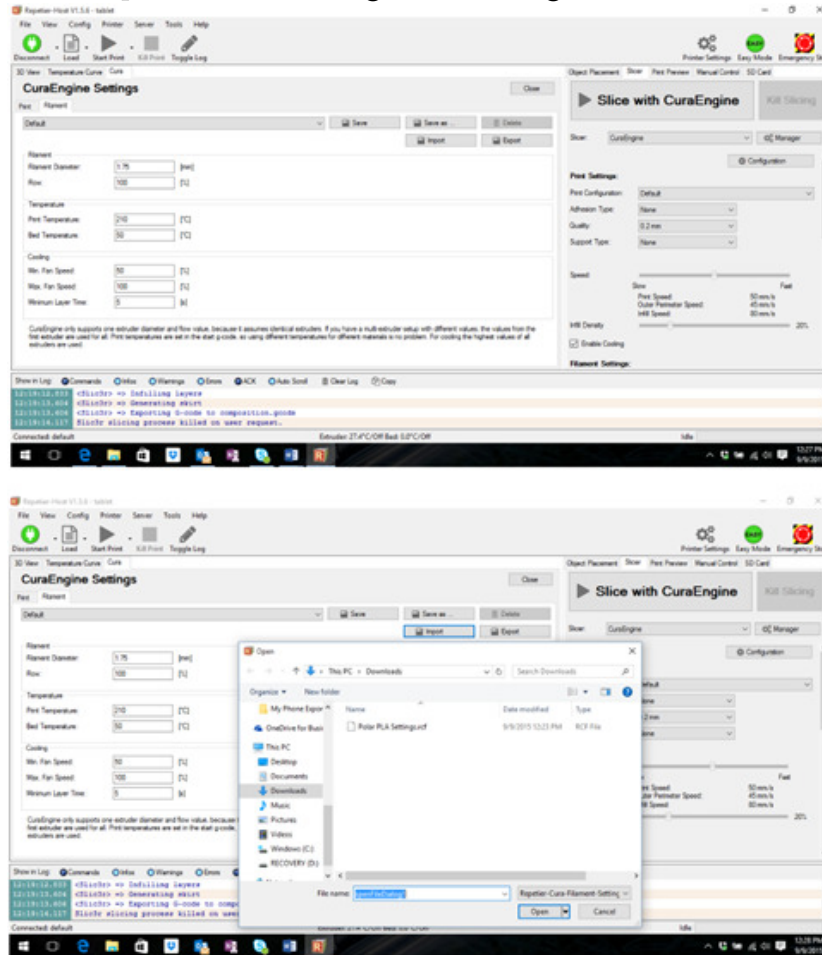
Figure C.15: Repetier-Host Configure Settings screen: Import button



13. Next, navigate to the “Filament” tab, click “Import”, and load “Polar PLA Settings.rcf”:

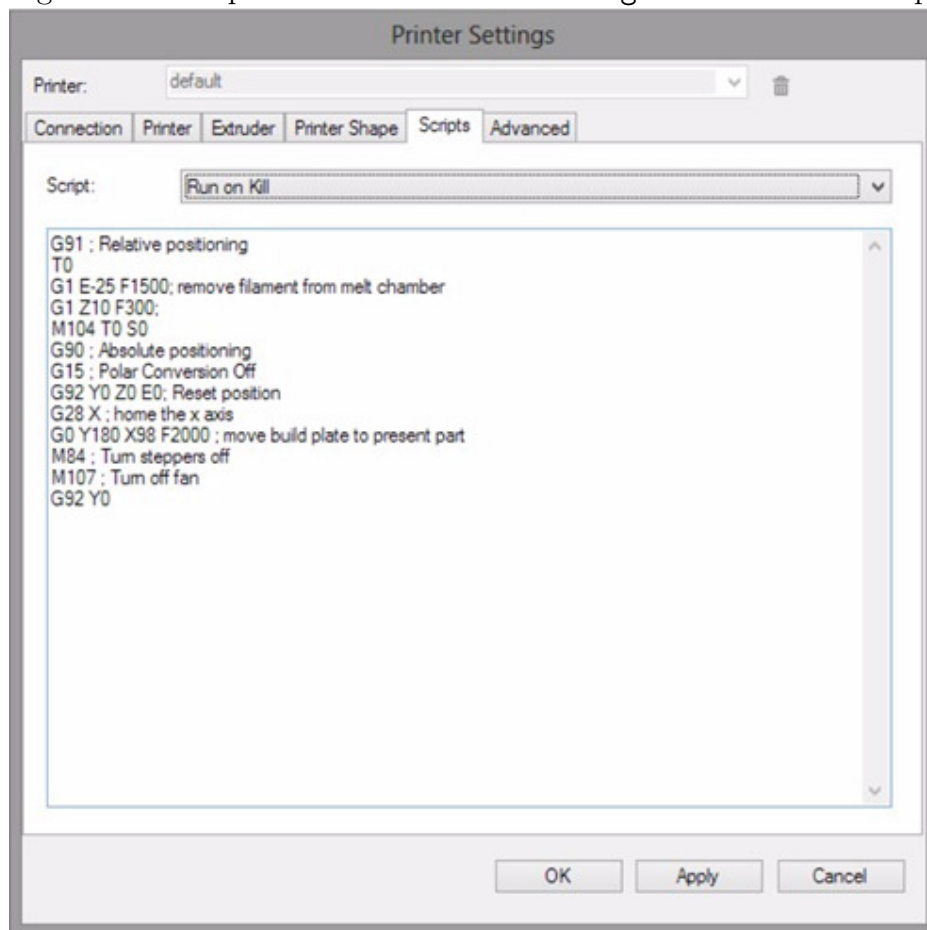
APPENDIX C. CONNECTING THE POLAR3D PRINTER DIRECTLY TO YOUR DEVICE¹³²

Figure C.16: Repetier-Host Configure Settings screen: Filament, Import



14. Navigate back to “Printer Settings” (see for instance steps 4 and 5), click on “Scripts”, then select “Run on Kill”; see Figure C.17.

Figure C.17: Repetier-Host Printer Settings: Run on Kill script



Copy the text as shown into the box as in Figure C.17 – or you may copy the text from [this link](#) and paste it into the box. Click “OK” to save.

Everything is set up and configured properly, and now it's time to print! See Section C.2.2!

C.2.2 Cable direct printing

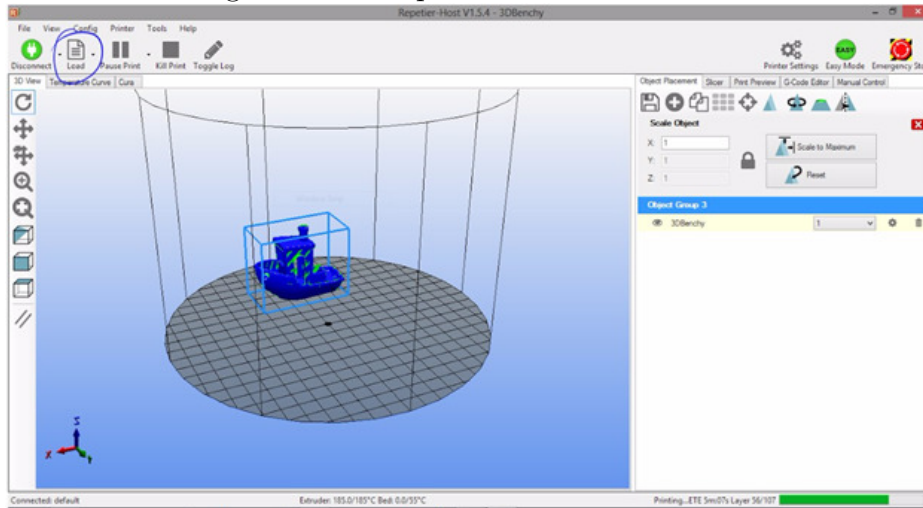
Once you have connected your printer via USB cable directly to your computer, and configured the printer controller software on your computer (*e.g.*, Repetier-Host), as described in Section C.2.1, you are ready to print an object!

1. Obtain an `.stl` file to print. (From your computer, you may want to [look for](#) an interesting file on the Polar Cloud, [download](#) it to your computer, and then you will be able to upload it from your computer to the printer.) But if this is your first print and you don't have something else you want to print, then for your convenience the Polar 3D support website has a sample `.stl` file along with the `.rcp` and `.rcf` files you already downloaded during the configuration in Section C.2.1. Go back to the Polar 3D support website and download the `3DBenchy.stl` file to your computer:

Polar 3D support: Repetier-Host/USB printing

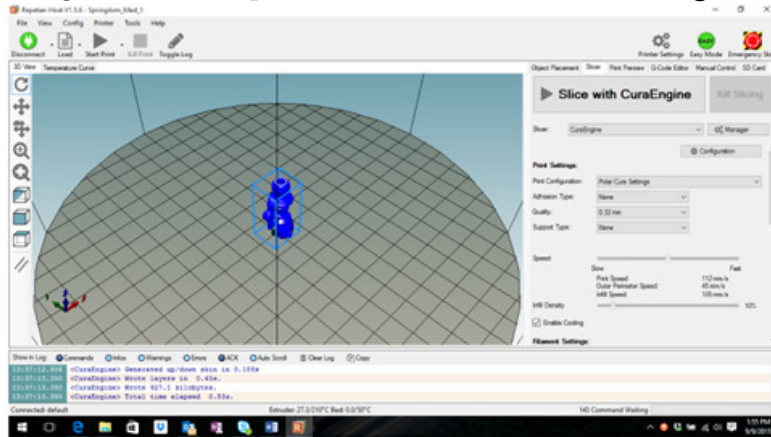
2. Use the Repetier-Host “Load” button (towards the upper left of the Repetier-Host main screen) to load an `.stl` file:

Figure C.18: Repetier-Host Load button



3. You may want to change the position of the object on the build plate. You will generally want to position the object so that it is *not* at the center of the build plate, and instead is near the edge of the build plate – this will tend to increase the speed of the print. (See Section 14.1: [Positioning objects](#) of the *Polar Cloud Guide* for additional discussion of operational tips regarding positioning objects.) To move the object, right click on the object and drag it – for instance, towards the edge of the build plate. You can also scale and rotate the object by utilizing the **Object Placement** tab on the right of the Repetier-Host screen.
4. Once you are satisfied with the placement of your object, click the “Slicer” tab, and then click “Slice with CuraEngine”:

Figure C.19: Repetier-Host Slice with CuraEngine



5. When the slicing completes, click “Start Print”.

That’s it!

Glossary

ABS

ABS (Acrylonitrile-Butadiene Styrene) is an oil-based plastic. If not quite as environmentally friendly as PLA, it is a bit tougher material, and besides its use as 3D printer filament, it is also used in making plastic objects for everyday use, including LEGO bricks. *See also* [filament](#) & [PLA](#)

build plate

For 3D printers in general, the build plate is the platform on which objects are printed. For the Polar3D printer, the build plate is a round mirror with a toothed gear on the underside, that meshes with a gear on the build plate shuttle. [1](#), [4](#), [84](#), [85](#), [91](#), [93–95](#), [97](#), [115](#), *See also* [build plate shuttle](#)

build plate shuttle

For the Polar3D printer, the build plate shuttle consists of the carriage underneath the build plate: the shuttle arms and pads, and the gear, on which the build plate rests. The build plate shuttle slides along two support rods (in the x axis of movement) and rotates (the θ polar coordinate) the

build plate via its gear. See Figure B.1. [4](#), [5](#), [60](#), [62](#), [63](#), [92](#), [94](#), [95](#), [97](#), [105](#), [111](#), [112](#), [116](#), *See also* [build plate & polar coordinates](#)

CAD

Computer Aided Design is the use of computer systems to aid in design. CAD output is often in the form of electronic files; for 3D printing, the industry de-facto standard is `.stl` files. *See also* [.stl file](#)

captive portal

A captive portal is a “landing” web page that a user must view, and at which a user typically must accept prescribed conditions for access, before access is permitted. Free WiFi hotspots at business centers, airports, coffee shops, *etc.*, typically permit access by means of a captive portal, where after a user accepts the conditions, the MAC address of the user’s device is permitted access for some period of time. In the context of Polar3D printers, note that a Polar3D printer cannot navigate itself through a captive portal; so for a Polar3D printer to get on a local network, the local network must allow access to the Polar3D printer (perhaps involving [local network configuration to recognize the printer’s MAC address](#)) *without* requiring the Polar3D printer to do an extra step of “viewing” or “agreeing to” some access agreement. This is the same sort of situation for any hardware device that needs to get on a local network. [8](#), [23](#), *See also* [MAC address](#)

Cartesian coordinates

Cartesian coordinates are rectilinear coordinates, describing the position of a point in two-dimensional space via x and y coordinates, or in three-dimensional space via x , y , and z coordinates. Cartesian coordinates are named after the 17th century mathematician René Descartes who developed them; compare with polar coordinates. *See also* [polar coordinates](#)

combing

In the context of 3D printing, combing contrasts to performing retraction and a Z hop: combing is when a non-extrusion move is performed *without* retracting the filament and *without* raising the print head, but ensuring that the extruder only moves over extrusion areas of the prior layer. With combing enabled, non-extrusion moves don't bother to lift up the filament but rather try to keep any resulting "ooze" or smearing only over infill areas by constraining movement paths so as to avoid crossing over edges (and hence unextruded areas) of the prior layer; movement (without extrusion) takes the "long way round", if necessary, in order to stay inside the currently printed island of extruded material. If printing via the Polar Cloud, see the "PRINT SETTINGS", "ADVANCED", "[Enable Combing](#)" option. *See also* [filament](#), [infill](#), [print head](#), [retraction & Z hop](#)

cylindrical coordinates

Cylindrical coordinates are one way of extending polar coordinates to three-dimensional space: cylindrical coordi-

nates use the r and θ of polar coordinates, plus a z height.
See [polar coordinates](#)

DHCP

DHCP (Dynamic Host Configuration Protocol) is a client/server protocol that automatically provides an IP host (such as your 3D printer) with its IP address and other related networking parameters such as the IP subnet mask and default gateway IP address. In the absence of a DHCP server on a local network, each network device (such as your 3D printer) will need to have a statically (*i.e.*, manually) assigned IP address.

DWG file

DWG is a proprietary, binary file format for storing 2D and 3D design data, used by a number of CAD packages, including for instance by Autodesk. There are a number of variants of DWG format. The Polar Cloud does not act on such files itself – but in case you have an object originally designed in a CAD package that generated such a file, and you would like to store an object's DWG design file in the Polar Cloud along with its `.stl` or `OBJ` model file, the Polar Cloud does support uploading and storing DWG files as object subsidiary files. *See also* [DXF file](#)

DXF file

DXF (Drawing eXchange Format) is a CAD file format developed by Autodesk, intended to enable interoperability between Autodesk's DWG files and other CAD programs. Although the Polar Cloud does not act on such files itself, in

case you have a DXF file that you would like to store along with an object, the Polar Cloud does support uploading and storing DXF files as object subsidiary files. *See also* [DWG file](#)

extruder

The extruder, or extruder nozzle, of a 3D printer is the nozzle at the bottom of the print head; it extrudes the melted filament. [84](#), [93–97](#), *See* [filament](#) & [print head](#)

filament

In the 3D printing context, filament generally refers to the plastic filament that the printer melts and prints; PLA and ABS are two of the most common materials for 3D printer filament. [43](#), *See also* [ABS](#) & [PLA](#)

Gcode

Gcode, sometimes written as “Gcode”, is a numerical control programming language used to control the operation of machine tools such as 3D printers. While there is an international standard for G-code, the 3D printing community loosely adheres to it. For example, different 3D printers accept different variations of G-code. The specific G-codes produced by different slicers and accepted by different printers are often not well specified. [61](#), [128](#), *See also* [slicer](#)

MAC address

A MAC address (Media Access Control address) of a network device is a unique identifier assigned for network data

layer communications purposes. MAC address are typically assigned by the manufacturer of a network device, encoding the manufacturer's registered identification number, and are stored in the device's read-only memory or other firmware. Among other uses, a device's MAC address is a way of identifying the device for network access purposes.

Mcode

Gcode can contain “miscellaneous” function codes known as “Mcodes” and which begin with the letter “M”. *See* [G-code](#)

MSDS sheet

Material Safety Data Sheets are a widely used system for cataloging information on chemicals, chemical compounds, and chemical mixtures – so for instance, the plastic of 3D printing filament. Note that 3D printing filament, especially PLA filament, is about as safe as plastic can get; but for those who need an MSDS document in their environment, Polar 3D has MSDS sheets available for the printing filament available from Polar 3D; see the Polar 3D support document [Polar Filament MSDS Sheet](#). *See also* [filament & PLA](#)

MTL file

MTL (Material Library file) format is a companion format to OBJ file format. MTL files can store surface properties such as color and texture. *See* [CAD & OBJ file](#)

OBJ file

The OBJ file format is an open format for representing 3D geometry of objects. It does not include features such as color or texture, nor does it specify a fixed size; it solely represents the shape. However, OBJ files can have a companion MTL file, where the MTL file stores properties such as color and texture. OBJ file format is an open format, first developed by Wavefront Technologies, and now used by other 3D graphics applications, including 3D printing. OBJ files are very commonly used for 3D art, design, and graphics in general, but `.stl` files are more commonly used in the specific arena of 3D printing, as `.stl` files are somewhat simpler, and more easily correctable. Note that as OBJ files often were not created with 3D printing in mind, models in OBJ format frequently are less “ready to print” than a typical `.stl` file might be. Some lovely OBJ format models may not be suitable for 3D printing; others, though printable, may require some adjustment of orientation ([ROTATE](#)), size ([SCALE](#)), and position ([MOVE](#)) prior to printing. [61](#), *See also* [CAD](#), [MTL file](#) & [.stl file](#)

over-extrusion

When the extruder outputs a surplus of plastic, over-extrusion results. Over and under-extrusion are caused by a mismatch between the slicer’s expectations and reality: the slicer expects that when a millimeter of raw filament is fed into the extruder, a specific volume V_e of plastic will then be extruded — output by the extruder. When the actual volume of plastic output, V_a , exceeds V_e , over-extrusion results; when V_a is less than V_e , under-extrusion results.

There are a number of causes of such a mismatch of plastic extruded, but it generally is the result of the input filament diameter not matching what the slicer expected, or the steps per mm for the extruder being incorrect. By carefully measuring your filament diameter, and then checking that that value is properly entered in the slicer – for a Polar3D printer, this means properly entered under the object’s “[PRINT SETTINGS](#)”, “[BASIC](#)”, “[Filament Diameter](#)” – you can generally prevent over- and under-extrusion from occurring. (But note that poor quality filament whose diameter varies can cause intermittent over-extrusion and under-extrusion.) *See also* [filament](#), [slicer](#) & [under-extrusion](#)

PLA

PLA (PolyLactic Acid) is a biodegradable plastic, typically made from renewable raw materials such as cornstarch or sugarcane. Besides 3D printing filament, other common uses are for plastic cups and plastic water bottles. [1](#), [49](#), *See also* [filament](#)

polar coordinates

Polar coordinates describe two-dimensional location via radius, r , and angle, θ . Compare with Cartesian coordinates, which instead describe two-dimensional location via x and y coordinates. The Polar3D printer uses polar coordinates at the hardware level, which has several advantages; see the [Polar 3D video “WWBD - Polar is Better”](#).

Does this mean that you or your students need to use or understand polar coordinates? No! The Polar3D printer expects industry-standard `.stl` files, which describe loca-

tion in the more familiar Cartesian x , y , and z coordinates; the Polar3D printer's firmware automatically converts from the Cartesian coordinates describing an object to the polar coordinates (technically, cylindrical coordinates) that the printer's hardware uses.

However, if you have students who are learning about polar coordinates in their math class – see Common Core standard <http://www.corestandards.org/Math/Content/HSN/CN/B/4/> – you may wish to draw such students' attention to the underlying polar operation of the Polar3D printer, both to help motivate them as to why one might want to learn about polar coordinates, and to help them visualize the relationship between polar coordinates and Cartesian coordinates.

Also, a couple of operational tips regarding optimal positioning of objects on the build plate (see Section 14.1: [Positioning objects](#) of the *Polar Cloud Guide*) will be more intuitive if you are conscious that the printer is operating, at the hardware level, in polar coordinates. 91, 93, *see also* [Cartesian coordinates](#) & [cylindrical coordinates](#)

print head

The print head is the assembly including the heating element and the filament extruder. It moves up and down the Z rod. See Figure B.1. 1, 4, 5, 33, 60, 62, 81, 84, 92, 97, 108, 111, 112, 115, 116, *See also* [extruder](#) & [Z rod](#)

raft

To promote better build plate adhesion or to accommodate an uneven build surface, most slicers can add to your print

a thick series of layers which can later be removed once the print is finished. These layers — referred to as a raft — are printed slowly so as to promote better adhesion to the build plate as well as to level out the printing surface. A raft usually has support material at its base, and a platform (smooth surface) at its top, to support the object's base. When printing via the Polar Cloud, see the “PRINT SETTINGS” under “[Raft Settings](#)”. 85, *See also slicer*

retraction

In the context of 3D printing, retraction typically refers to the amount by which the filament is retracted back into the extruder nozzle to keep it from oozing out during non-extrusion moves between sections of the print. That is, during printing there are normally extrusion moves, during which filament is being extruded, and non-extrusion moves, during which the filament is retracted slightly back up into the extruder nozzle while the extruder is moved *without extruding melted filament* to some other portion of the build plate where extrusion will be resumed. Retracting the filament slightly up into the extruder nozzle for non-extrusion moves helps keep filament from oozing out while the extruder moves to a new position. When printing via the Polar Cloud, see the “PRINT SETTINGS” under “[Retraction](#)”. *See extruder, filament & Z hop*

SD card

An SD card is specific type of memory flash card and is used to convey print files to your printer without using a USB or network connection. SD cards come in a variety of

sizes, ranging from a fraction of a gigabyte to upwards of 256 gigabytes or more. The term “SD” is an acronym for “Secure Digital”.

shell

When a model is prepared for printing by a slicer, the slicer generates commands to print a solid exterior. The exterior is typically printed by following the model’s perimeter. The perimeter may be printed multiple times per layer, each time inset from the prior pass. The final result can be thought of as a series of nested shells, one inside the other, from which arises the term “shell”. With some slicers, you control the thickness of the solid exterior by specifying the number of shells to generate. When printing via the Polar Cloud, see in particular the build plate “PRINT SETTINGS”, “ADVANCED”, “[Quality](#)” settings, especially “[Wall Thickness](#)”. *See also* [slicer](#)

skirt

A skirt is an extra outline of material surrounding, but not touching, the perimeter of a print object. A skirt is sometimes used to shield the main object from thermal drafts, especially when printing using ABS filament, or to establish a smooth flow of filament. [55](#), *See also* [ABS](#)

slicer

The process of turning a 3D model into printing instructions — Gcode — is referred to as “slicing”. That name derives from the fact that the process takes slices of the model and determines the necessary “tool paths” (extruder paths) to print that slice. The slice is a “layer” of the print.

As the process is referred to as slicing, the software which implements the process is often called a “slicer”. For a Polar3D printer, slicer settings are set in the Polar Cloud under “[PRINT SETTINGS](#)”. (If using a direct connection to the Polar3D printer via a cable, and hence third-party software to control the printer, then the slicer is controlled by that other software; for instance, Repetier-Host uses the CuraEngine slicer.) [128](#), *See also* [extruder](#), [G-code](#) & [tool](#)

slicing profile

Most slicers have a mechanism whereby you collect together a number of configuration settings used by that slicer when preparing a model for printing. Such a collection of settings is here referred to as a “slicing profile”. A given slicer may use a different name (e.g., a “factory” in Simplify3D). Each print of an object – each print job – has an associated slicing configuration. In particular, the Polar Cloud provides two pre-defined slicing profiles suitable for the Polar3D printer, a “[Draft Quality](#)” profile and a “[Medium Quality](#)” profile. Or alternatively, a customized slicing configuration may be specified; see [Section 10.2.2: The build plate screen: slicing profiles](#) of the *Polar Cloud Guide*. [55](#), *See* [slicer](#)

stepper motor

A stepper motor is a brushless DC (direct current) electric motor that divides a full rotation into a number of equal steps. In a 3D printer, stepper motors are typically used to move the extruder and build plate. In particular, in a Polar3D printer, there are three stepper motors: one controls the movement of the print head up and down the Z rod (z axis), one controls the movement of the build plate

shuttle (x axis), and one controls the rotation of the build plate (θ rotation). [60](#), [62](#), *See also* [build plate shuttle](#), [polar coordinates](#), [print head](#) & [Z rod](#)

.stl file

STL originally stood for the STereo Lithography file format native to CAD software created by 3D Systems, describing the surface geometry of a three-dimensional object. It does not include features such as color or texture, nor does it specify a fixed size; it solely represents the shape. It has become the de-facto standard format used in 3D printing. [37](#), [40](#), [50](#), [60](#), [61](#), [119–121](#), [128](#), [134](#), *See also* [CAD](#)

telegraphing

A print defect caused by too thin of an exterior shell through which interior printing penetrates leaving visible surface blemishes. *See also* [shell](#)

tool

In Gcode parlance, an extruder is a “tool” which is controlled by the printer. That is, a “tool” is another name for an extruder. If your printer has a single extruder, than that extruder may be referred to as “tool 0”. If your printer has two extruders, then the right extruder is “tool 0” and the left extruder is “tool 1”. To further confuse matters, in Gcode, motion commands for the right extruder may use the prefix “A” while commands for the left extruder use the prefix “B”. *See also* [extruder](#) & [G-code](#)

under-extrusion

When the extruder outputs a deficit of plastic, under-extrusion results. *See also* [over-extrusion](#)

Z hop

In the context of 3D printing, a Z hop typically refers to the amount by which the extruder nozzle is raised when performing non-extrusion moves between sections of the print. That is, during printing there are normally extrusion moves, during which filament is being extruded, and non-extrusion moves, during which the filament is retracted (retraction) and the extruder nozzle may optionally be raised by a Z hop amount so that the extruder may be moved *without extruding melted filament* to some other portion of the build plate where extrusion will be resumed. Performing a Z hop, raising the extruder nozzle (in fact the entire print head) for non-extrusion moves, helps keep the extruder nozzle from dragging or smearing extruded material while it is being moved to its new position. *See* [extruder](#), [filament](#), [print head](#) & [retraction](#)

Z rod

On a Polar3D printer, the Z rod or Z threaded rod is the tall, threaded rod towards the back of the printer on which the print head (the printer extruder assembly) moves up and down; see Figure B.1. [4](#), [60](#), [63](#), [92](#), [95](#), [115](#), *See also* [extruder](#) & [print head](#)

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