

If you were sent here from Creality, eBay, Aliexpress or any other site selling ABL kits be aware these are clones. They are NOT supported. Buying them will directly impact our ability to continue to provide for the 3D printing community and put food on our table. Please click here to get a [Genuine EZABL kit](#) from our website.

Before we start we just wanted to thank you for choosing the TH3D EZABL kit. We've been working on perfecting the easiest, well documented, and supported ABL kit on the market. The V3 kit is the result of over a year of research and testing done by TH3D and feedback given to us from our customers.

We pride ourselves by using the highest quality parts in the kits and hand assembling all of them in our offices here in the USA. Unlike other companies that use off the shelf hardware and/or low quality parts on their boards we only use the best and work directly with our sensor factory to bring you the best performing and reliable kits that we can.

We would not be where we are without YOU and your feedback. If you see something that needs changing/updating or you just want to suggest a new feature, we would love to hear from you. We can be easily reached by emailing Support@TH3DStudio.com. If something is not up to our rigorous QC standards, please let us know so we can make our assembly guys aware of it.

TH3D gives back to the community through many ways and you supporting us allows us to put out information for everyone as well as making donations every month to multiple open source projects (like the Marlin project that our firmware is built on).

Thank you again for choosing TH3D and Happy Printing!

Sincerely,



~Tim Hoogland



TH3D EZABL™ Installation Guide

V1.6.8 - 8/9/2018

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Getting Started

Welcome to the EZABL kit installation guide! This will walk through the steps to install the EZABL sensor on the printer.

There are 2 different versions of this kit so pay attention to which version you have. They both function the same but the wiring installation is slightly different.

We are always making things better so the case or sensor may look slightly different than the below pictures.

Direct Wire (EZABL on left, EZABL Mini on right) :



EZ-Connect (EZABL on left, EZABL Mini on right):



Preparation

If you are not comfortable flashing your printer's firmware, moving wires around, and/or taking your hotend mount apart you should NOT be attempting this upgrade as you could damage the printer. Contact us with any questions before hand if you are unsure of upgrading.

Before you begin you should have the following:

- **TH3D EZABL Kit**
 - 1x EZABL Sensor (Regular or Mini - this will be soldered to the EZABL Module)
 - 1x EZABL Module
 - Power Source – Varies on the module
 - Direct Wire has 3FT of 2 Conductor (red/black) wire included to go to the 2 pin terminal on the EZ ABL Module. Red is positive and black is negative.
 - EZ-Connect has an included 12V AC/DC Adapter (US Plug)
- **Printed Parts to Mount the Sensor to your printer**
 - You can find sensor mounts on www.Thingiverse.com or www.TH3DStudio.com if you want to print your own
 - OR we offer printed parts if you do not want to print your own. Prices are about \$10-15 shipped for an ABS printed mount. If you want one in your order please put a note on it and we can contact you.
- **Latest copy of the firmware for your printer**
 - This is usually the Marlin source code – Varies by printer model
 - If you have a custom printer and need firmware help this is available at a discounted rate for EZABL customers.
 - **We have firmware for the CR-10, CR-10S, Tornado, TAZ5, Anet (A2, A6, A8, E10 or E12), Ender 2, Ender 3, Wanhao (i3, i3 Mini, D6) on our website for customers – Check your order email for download info.**
- **USB Cable to connect your printer to your PC to update the firmware**
 - Your board MUST have the bootloader already flashed on it to perform this update. Check our video [HERE](#) for flashing the bootloader.
- **A #1 Regular Screwdriver to adjust the sensor sensitivity**

If you are missing anything from the TH3D EZABL kit then please email Support@TH3DStudio.com

Email support is included in the kit for setup, install, and firmware questions.

Pre-Installation Checks

Before installing the kit, there are a few things we recommend checking to make sure the printer is in optimal condition before installing the EZABL kit.

1. Make sure your bed is level if you are using springs still, use Loctite or superglue to lock the nuts in place on the screws to prevent shifting.
 - a. You can replace springs with aluminum or nylon spacers from a hardware store. We also sell solid mount kits that integrate bed wiring strain relief and optional camera mounts for select models on our website.
 - b. Check all the wheels and eccentric nuts if your machine uses these.
2. Run through the Z axis checks that are outlined on page 21 of this guide.
3. Make sure the power cord your printer uses has a grounding plug. If you are using an adapter and/or extension cord make sure they are also grounded. If it is not grounded there can be electrical interference that can cause the sensor to not work
 - a. If you are using an EZ-Connect model make sure the power is on the same power strip as the printer.
4. Depending on what mount you are using, printer model, etc you may need additional screws. Most mounts use M3 screws so it would be recommended to pick up a M3 screw assortment from Amazon or your local hardware store.
5. Some printers require a bootloader to load the firmware. You will need an Arduino Uno with some jumper wires. We sell a bootloader kit in the TH3D Shop that comes with the Uno and ALL the cables needed.

Any of the models with the 1284p chips require a bootloader.

The CR-10, Ender 2, Ender 3, and Wanhao i3 all use the same process for the bootloader. There is a guide on our knowledgebase on how to load the bootloader.

The Anet uses the same process as the CR-10 but with different pin connections (also on our Knowledgebase but select Anet V1.0 from the board menu in the IDE).

We now have an installation video here that goes along with this guide:

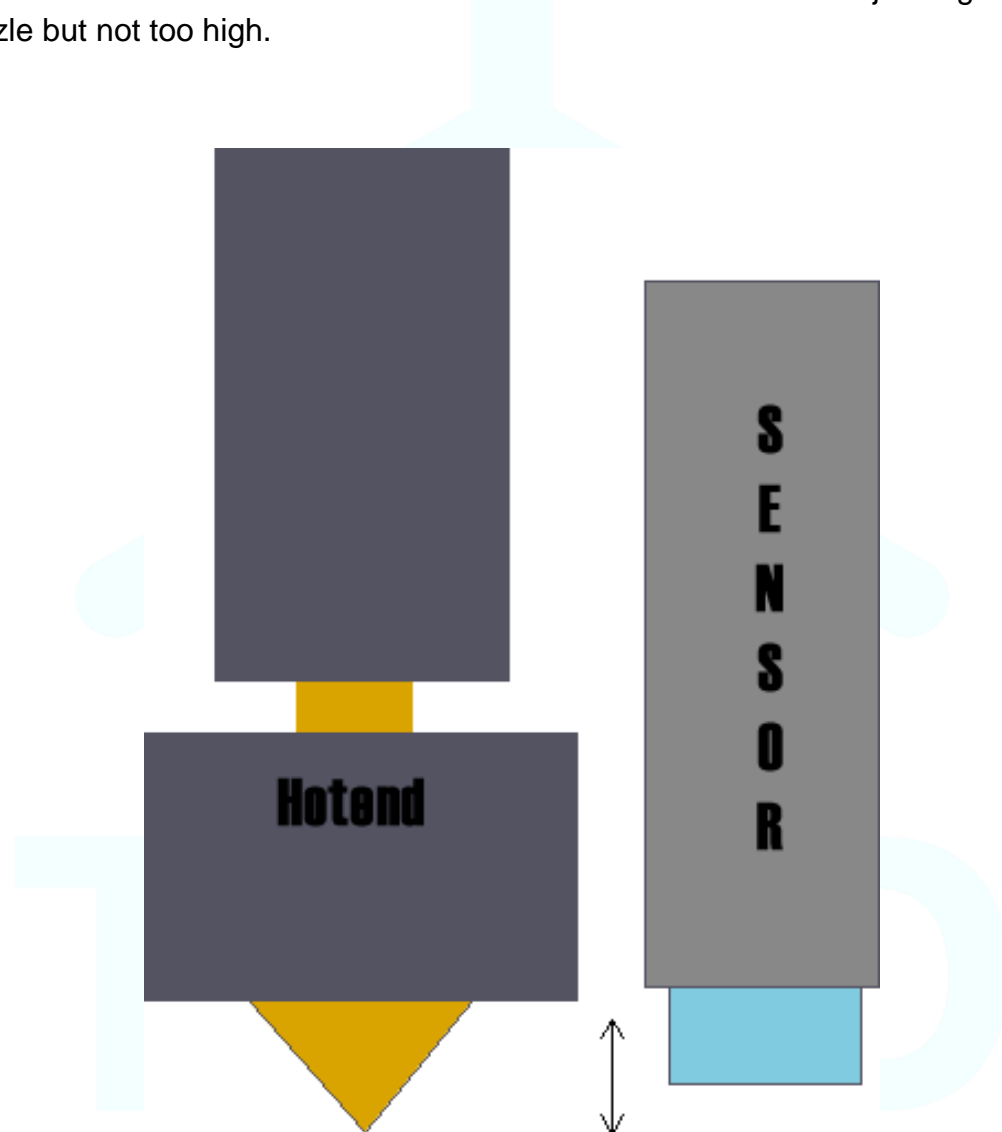
<http://EZABLVideo.TH3DStudio.com>

ALL TROUBLESHOOTING INFORMATION IS TOWARDS THE END OF THIS GUIDE

Installation

Mounting the sensor

Once you have the new mounts you will need to install them on your hotend and then mount the sensor to the new printed mount. **When you mount the sensor, it should be about 1mm ABOVE the tip of the nozzle for the EZABL Mini and 2mm ABOVE the tip of the nozzle for the EZABL.** This does not have to be exact just higher than the nozzle but not too high.

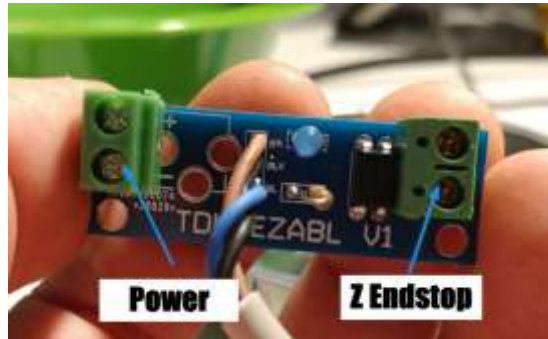


1MM higher than nozzle for EZABL Mini | 2MM higher than nozzle for EZABL

Wiring the sensor

Connect power to the EZABL Module

- If you are using the **direct wire** version then you will need to connect the module to the 12V OR 24V power that is on your printer. The **top pin is positive (+)** and bottom pin is negative (-). We recommend connecting direct to the power supply.



POLARITY MATTERS. BOARD WILL SHORT IF WIRED BACKWARDS ON V1 and V2 BOARDS. V3 BOARDS HAVE REVERSE VOLTAGE PROTECTION STANDARD.

- If you are using the **EZ-Connect** version then simply plug in the power adapter and the other end into the DC jack on the EZABL module

Connect your Z endstop to the EZABL Module

- If you are using the **direct wire** version then cut the leads going to your current Z endstop switch and connect them to the EZABL port labeled ZMIN
- If you have the **EZ-Connect** version then unplug the 3 pin connector from your Z endstop and plug it into the EZABL port labeled ZMIN

If your printer has 3 wires going to the Z endstop connection, please contact our support BEFORE connecting. You can contact us at Support@TH3DStudio.com.

Test the sensor for detection

Power on your printer and verify that the sensor is working by touching the sensor with your finger. The LED light on the Sensor AND the module should light up. If they do not light up adjust the screw on the sensor (top on EZABL, white on the side of the EZABL Mini) until it lights up when you touch it.

Firmware Setup

If you have the CR-10 (all sizes), CR-10S (all sizes), Tornado, TAZ5, Anet (A2, A6, A8, E10 or E12), Ender 2, Ender 3, Wanhao (i3, i3 Mini, D6) we have already done all the firmware work for you. The pre-configured firmware is on our website here:

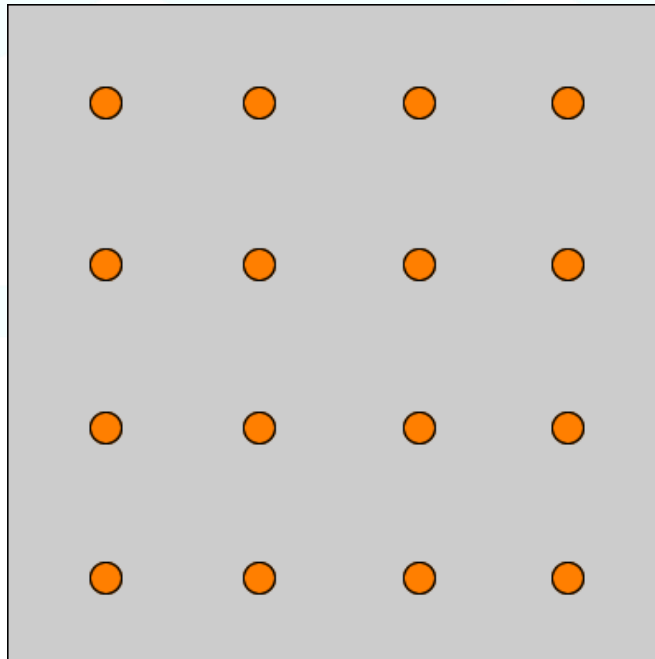
<https://www.th3dstudio.com/knowledge-base/th3d-unified-firmware/>

If you have a printer that needs a bootloader this must be flashed. See the Unified Firmware page for details on this. Select Arduino as ISP for the programmer.

In the Unified Firmware uncomment the printer model you have and the probe mount you are using. Probe mount STL files are included in the Unified Firmware package for every model we support.

Set the EZABL_PROBE_EDGE setting to 45-50mm for larger printer beds (300mm+ size beds) and 10-20mm for smaller printer beds. Check to make sure the probe is not probing over any binder clips and/or screw heads in the bed as this can affect the reading.

If you have a custom machine we can assist with setting up the firmware as long as you have the current firmware for the machine and it is working 100% without the EZABL installed already. We will need the full source code used to do these changes.



Example of probing points on a bed

Sensor/Endstop Test

The next step you want to do is to check if the endstop is properly being recognized by your board.

Make sure you have your Z endstop wire connected to our EZABL board.

DO NOT HOME YOUR Z UNTIL YOU VERIFY THAT THE FIRMWARE IS SEEING THE SENSOR CORRECTLY AND YOU HAVE CALIBRATED THE SENSOR (PAGE 9). YOU CAN DAMAGE YOUR HOTEND AND/OR PRINTER.

Start by moving the Z up until the light on the sensor and the EZABL module turn off.

Next, connect to your printer over your preferred slicer (or Octoprint) and issue an M119 and see if the Z_min is showing TRIGGERED or open.

If it shows open place your finger or an object under the sensor so the light comes ON and then issue M119 again. If it shows TRIGGERED then proceed to setting your sensor sensitivity.

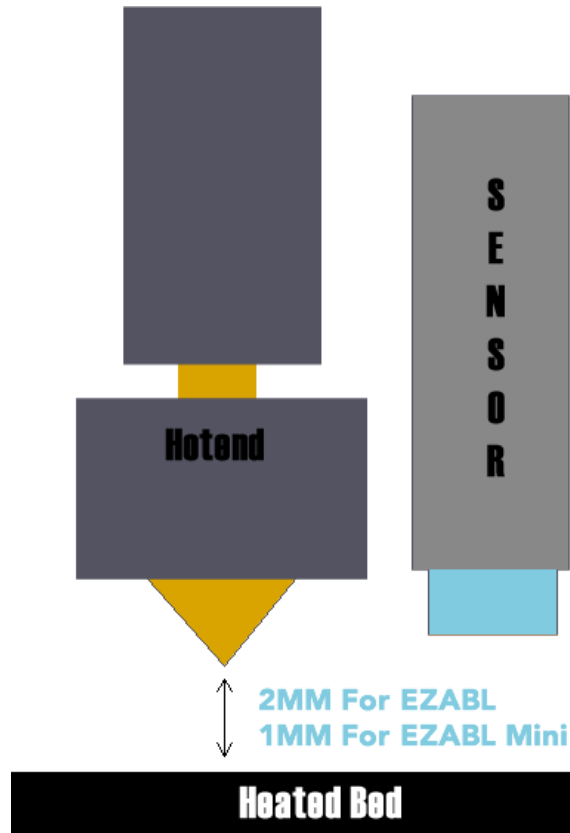
If it does not then reverse the 2 endstop wires. We have a guide (with video) for this here if you are using the EZ-Connect model on page 26.

If your slicer (namely Cura) does NOT support sending terminal commands then use the Gcode sender program in the “Extra Programs” folder of the Unified Firmware Package.

```
> M119
< Reporting endstop status
< x_min: open
< y_min: open
< z_min: open
> M119
< Reporting endstop status
< x_min: open
< y_min: open
< z_min: TRIGGERED
```

Setting the Sensor Sensitivity

The next step is setting the sensor sensitivity. To do this heat your bed to your normal print temperature. If you print at different temperatures depending on the material, you are printing then select one in the middle of the highest and lowest print temps you use.



WITH THE BED HEATED (i3 Mini does not have a heated bed) lower the Z until your NOZZLE is on the bed.

Manually move the Z with the printer LCD or your Computer/Pi until the nozzle is on the bed, then move up **2mm for EZABL** and **1mm for EZABL Mini**.

Adjust the screw on top (EZABL) or the white adjustment dial on the side (EZABL Mini) to set the sensitivity. Depending on your sensor and other factors the LED on the sensor may or may not be on.

If you have an AC bed turn the heat off during this step. If the sensor is already on turn the screw counter-clockwise until it turns off.

Now turn the screw clockwise slowly until the sensor LED turns on. Make sure the LED stays on when you remove your screw driver AND move your hand away from the sensor. If it shuts off or flickers when you do this turn it just a hair clockwise and move the screwdriver and your hand out of the way again. Repeat the clockwise adjustment until the LED stays on when you remove your screwdriver and hand from the sensor. If you are having issues getting the LED to stay on check the grounding on your machine.

Do NOT change the sensitivity if you are getting different heights between prints due to temperature changes. This should be handled by the ZOffset and/or BabyStepping the Z height. Under normal conditions at most you should only have to occasionally Babystep about 0.1-0.2mm. If you are getting more than that please contact our support to go through more advanced troubleshooting steps.

Setting your Z Offset

I HIGHLY recommend you watch the video as it is much easier to see what to do. Here is a video on how to set the Z Offset: <http://EZABLVideo.TH3DStudio.com>

Now that we have the sensor installed and calibrated you need to set your Z Offset. This is the distance the printer needs to move the head down to place it on the bed after the sensor triggers.

To set your Z Offset heat the bed to your normal print temp and do a G28 to home the sensor. Your **EZABL sensor** should be in the middle of the bed. Let it sit there for 5 minutes after the bed has reached its target printer temperature. After homing the Z will be either 5MM off the bed. This is NOT included in the ZOffset. Move Z down 5mm before proceeding.

What you will do now is grab a sheet of standard paper and then move the nozzle down by 0.1mm until it just grabs the paper. Once you do that you can look at your printer LCD and note the number that the Z shows. This will be a negative number. That is what your Z Offset is.

Enter that number in the ZOffset section using your printer LCD. This is located under Menu>Control>Motion. Make sure you store your Z Offset by going to Menu>Control>Store Memory. If you do not store your memory the Z offset will be forgotten when you restart the printer.

Now do another G28 command. The Z should show 5+ the Z Offset. For example if your Z Offset was -1.72 then Z should show 6.72 after completing the G28 command. You can now move the nozzle down that exact amount and it should be grabbing the paper. If it is too high or too low you can further fine tune your Z Offset by increasing or decreasing that number. We recommend using the babystepping Z feature below to fine-tune.

When printing if you are getting it starting too high or too low press the printer menu button 2 times while printing and it will bring up the “BabyStepping Z” menu. You can then turn the knob left to bring the nozzle closer to the bed in real time or right to move it further away. It is NORMAL to have to babystep a little especially when changing bed temps. If the resulting 1st layer is level after adjusting the 1st layer height then the probe is working correctly.

If you notice that you ALWAYS have to babystep a certain amount every print then add that to the Z offset. Lets say you have to babystep -0.2mm and your offset is -2.0. You can change your offset to -2.2mm and store it.

1st Layer Recommended Settings

To get the best 1st layer and adhesion we recommend the following settings:

- 150% 1st layer width
- 0.3mm 1st layer height
- Print SLOW 25-30% speed or 20mm/s

Update your Starting Code in your Slicer

Here is the starting code that we use (we recommend you use this):

```

M75 ; Start Print Timer and Engage Fil Sensor
M84 E ; Disable E Motor for probe accuracy on direct drive systems
G28 ; home all axes
G28 Z ; home Z to get more accurate Z position
G29; EZABL mesh generation
G4 S10; wait for heaters to recover

M117 Purge extruder
G92 E0 ; reset extruder
G1 Z1.0 F3000 ; move z up little
G1 X0.1 Y20 Z0.3 F5000.0 ; move to start-line position
G1 X0.1 Y100.0 Z0.3 F1000.0 E15 ; draw 1st line
G1 X0.4 Y100.0 Z0.3 F5000.0 ; move to side a little
G1 X0.4 Y20 Z0.3 F1000.0 E30 ; draw 2nd line
G92 E0 ; reset extruder
G1 Z1.0 F3000 ; move z up little

M117 Printing.....

```

Make sure you replace your starting code with the one above. This will perform the auto bed leveling after Homing XYZ.

If 10 seconds is not enough to let your heaters recover change the S10 in the starting code above to however many seconds you want to wait for the heaters to recover.

Get into the habit of leaving your sensor homed BEFORE you start a print this will help keep the sensor temperature consistent with every print and make sure everything is at the correct temp before it runs through the EZABL routine. If you add G28 after G29 this will turn OFF ABL until G29 is run again.

Sensor Wire Routing

When you route the wire for your sensor so NOT create a pinch point with a zip tie where the wire will be bending back and forth while the print head is moving. This will internally break the wires on the cable and the sensor will no longer work.

We recommend using cloth or electrical tape (like Creality uses) to secure the wire to the existing hotend wiring. If you use Zip ties then leave about 1" of slack so the wire can freely move without being strained in the same place.

Damage to sensor cable due to zip ties:



Proper cable routing. Notice there is slack on the cable so it cannot be flexed by hotend movement.



Sensor Accuracy and Heat

It is important to note that these sensors can be affected slightly by large temperature changes from the bed heat. Therefore, it is important that you must do all the calibration **with the bed heated**. If you do not do the steps with the bed heated then your calibration and Z Offset will be incorrect. This will result in the print either being too low or too high when you go to print.

Converting the EZ Connect to Direct Wire

If you purchased the EZ connect version and want to do away with the wall wart to power the sensor you can simply cut the wire off the 12V AC/DC adapter and wire it to your 12V printer power supply. Doing this does void any support on the device but if you are comfortable with it you can do so. The center pin on the DC jack is the positive and the outer sleeve on the plug is negative. Verify this by testing the continuity on the wires to each of the parts of the plug.

All EZABL EZ-Connect kits shipped after June 2018 include an adapter plug to convert to direct wire for the power and are compatible with 12V and 24V input voltage.

If you wish to use another Z connection instead of the 3 pin plug you can simply pickup a JST-XH 3 pin connector and wire that to the ZMin port on the EZABL board.

OctoPrint Notes and Tips

For those of you using OctoPrint I highly recommend installing the Marlin EEPROM plugin. This allows you to set your offset from your web browser instead of the display. This is MUCH quicker and saves it to EEPROM automatically. This is the plugin we use on all our machines: <https://github.com/amsbr/OctoPrint-EEPROM-Marlin>

Firmware Setup and Support

Basic support for your firmware is included free with the purchase of the kit. TH3D supports covers features listed on the Unified Firmware page.

If you need more advanced configuration in a case where you have a custom machine or swapped a board on a standard machine this may or may not be included depending on how much time is required, this is handled on a case by case basis. If you need help please send an email to Support@TH3DStudio.com and check the Knowledgebase on <https://www.TH3DStudio.com>

Troubleshooting

If you need to submit a ticket, please email Support@TH3DStudio.com.

Please review the troubleshooting information below before submitting a ticket.

Changing your print surface

ANY time you change your surface type (example: going from glass to BuildTak) you will have a different Z offset. This is because the sensors detect different materials at different sensitivities. Just repeat the “**Setting your Z Offset**” section of this guide.

You can also automate this if you know what your offset is for each surface type by putting it in your slicer starting code. M851 Z-X.XX sets the Z offset. This must be placed BEFORE all the other starting code.

Sensor Inconsistent Readings

If you are getting inconsistent readings with the sensor do a G28 and then G29 before you start printing. This will make sure the sensor is up to the temperature that you used to calibrate the sensor. If you are still having issues check your printer for mechanical issues and run the M48 test outlined on page 17 to rule that out before contacting support.

My Z will not Home

You must home XY before you can home Z. Just use G28 to home all and your printer will home XYZ automatically.

Advanced EZABL and Printer Troubleshooting

- Please go through the Z guide on **page 21** of this guide
 - Let support know what issues you found on your machine.
- Also make sure you match the mount type you are using on the printer to the firmware. For example if you printed the "OEM" mount then you need to use the firmware from the "EZABL OEM Mount" folder. If they do not match then the kit will not work correctly.
- In addition to that be sure you followed ALL the steps of this installation guide (especially the sensor calibration, Z offset, and the slicer settings - try our starting code on page 11).
- Check your Z endstop trigger using the info on **page 26** of this guide
- **Whenever you update your firmware it is HIGHLY advised to send a M502 and then M500 to reset the EEPROM. If you do not do this you may have issues with the firmware working correctly. Please note that if you have an EZABL kit this will erase your Zoffset so make a note of what you had and put that in again.**
- Other things to check for
 - If your cold end fan (the always on one) is missing a fan blade or the bearing is failing (making a lot of noise) the high vibrations can affect the sensor.
 - If you are getting "slanting" on the 1st layer despite getting a good M48 result (anything UNDER 0.01mm) then check your X and Y belt tension. If it is over tensioned, then your X and/or Y carriage plate can be skewed while it moves and cause one side to be lower than the other.
 - For printers with wheels (CR-10, Ender 2/3, Tornado): Check your wheels on the bed and the X gantry. Make sure they are ALL rolling when you move the bed or X. If they are not you will need to adjust the eccentric nut that is on them. For example the CR-10 has 6 wheels and 3 on one side have the eccentric nuts. When you move any wheel it should make the bed move. The wheels should NOT be so tight that if you hold the bed and try to move them they do not move, they should be able to spin with some resistance.
 - If you have any LED or CCFL lamps near the printer, specifically desk lamps and LED strips NOT powered from the printer power supply, unplug them and see if the M48 is better and/or the 1st layer is better. Some IKEA LED lamps have very low quality power supplies in them that emit EMI that will affect the sensors
 - Make sure your Z movement is not bottoming out on the motor mounts. This happens on the CR-10 machines mainly when you do not have the stock glass on the bed. If it is bottoming out you can put the glass back on or use washers to equally shim up the bed to sit higher on all 4 corners.
 - Grounding issues can be a huge problem. Some people notice that their sensor calibration changes when they unplug the printer from the USB port and then try to print over SD. This happens because your printer is getting a ground through the USB shielding because it doesn't have one itself. Check the power cable going from the printer to the wall and make sure it actually has a ground plug on it. Also check the grounding wire going from the printer power socket to the power supply. Having a good ground is essential to any electronic equipment for function AND safety. If you are not sure if your outlet has a good ground then your local hardware store or Amazon sell inexpensive (under \$10) testers that you can plug into the outlet to check if it has a ground signal going to it.

To run the test send G28 (make sure your bed is clear) and then M48 P10 X150 Y150 V2. Then send that to our support team with the "standard deviation" that it spits back. See Page 17

Is the bed as flat and level as it can be?

EZABL can't work miracles. You need to make sure your bed is as level as you can get it by adjusting the corner screws. When you have EZABL working well you may like to consider swapping the springs and screws for fixed stands.

If you use printed parts for the bed mounts they **MUST** be in ABS and I recommend 3 outer walls with 75-90% infill. ABS will hold up to around 105C bed temps before it starts getting soft. We also offer hybrid aluminum/ABS mounts and ABS mounts for select models with extra features on the TH3DStudio.com store.

There's no magic number for how flat your bed needs to be, but you probably want any variations to be no more than 1mm across the entire bed. You can check it manually by laying a straight edge (such as a steel rule) across it or using your probe by increasing the number of probed points using the instructions under 'Measuring your bed flatness'.

You also want to make sure the X gantry is **level with the frame, not the bed**.

If you have a particularly warped bed try increasing the probe points in the firmware (located in the EZABL settings section towards the bottom of the Configuration.h file).

Which levelling method are you using?

The two main levelling methods are linear and bilinear. Linear creates a single tilted plane and is best suited to a perfectly flat surface which is tilted lower or higher on one side or corner. Bilinear is best suited to an uneven bed with dips/rises and is the recommended method.

It is unlikely that your bed is perfectly flat, so bilinear is usually a good option, especially if linear does not give good results.

http://marlinfw.org/docs/features/auto_bed_leveling.html

TH3D

Is your probe working well?

One of the first things you should do after installing your Z-probe is check how well it works using the M48 command to test it.

In our latest firmware (TH3D Unified Firmware) M48 is enabled by default for ALL machines that we support. Please update to this one before contacting support as it addresses issues present in older firmware releases.

Use commands like this to run 10 probes and get the measurements:

```
M48 P10 X150 Y150 V2
```

The output will look similar to this:

```
M48 Z-Probe Repeatability Test
Finished!
Mean: 3.450000 Min: 3.442 Max: 3.452 Range: 0.010
Standard Deviation: 0.004330
```

This shows the absolute maximum and minimum measurements the sensor took, the mean (average) of all the measurements, the range between the maximum and minimum, and the standard deviation.

The standard deviation is interesting because it tells us that 68% of all the measurements were within 0.00433mm (one standard deviation) of either side of the mean, and 95% of the measurements were within 0.00866 (two standard deviations) of the mean.

A good probe should consistently give a range in the hundredths of mm, e.g. 0.05mm. A very good probe will have a range in the thousandths. EZABL probes typically test UNDER 0.02mm on well setup machines with no mechanical or electrical issues.

If you get a very large range or standard deviation you should look for sources of movement in your Z-axis or the VREF on Z is set too low.

The motor couplers can contribute to excess play and you can consider upgrading them to better ones (like Upgraded Couplers, TH3D sells them), ESPECIALLY if yours are stretched out. Failing that, contact our support for more troubleshooting. If the probe is bad we will replace it under warranty.

Some tips for probe accuracy

- The 'spring' type Z-motor couplers allow vertical play, which can affect the probe results. You can replace them with 'Plum' style couplers which have no vertical movement.
 - TH3D Shop link: <https://www.th3dstudio.com/product/upgraded-leadscrew-coupler-for-cr-10-cr-10s-tornado-ender-2-and-more/>
- Probe measurements will vary near the edge - ensure that your probe boundaries are far enough from the edge to avoid this, the entire probe cap needs to be ON the bed.

Are you probing enough points?

If your bed is curved or particularly warped you can increase the number of points the probe measures in order to create a more detailed correction matrix (at the expense of time - more probes means G29 takes longer).

Try a 5x5 or 7x7 grid by changing this line:

```
#define EZABL_POINTS 5
```

Are your X and Y offsets correct?

For EZABL to work correctly it is **essential** that the printer knows the exact offset from the nozzle to the probe, otherwise any correction is not going to be applied in the right place, and it may look like the printer isn't correcting at all.

If you downloaded the Unified Firmware and used one of the mounts we supply these are correct already as we have printed, mounted, and measured them all for you already.

It is absolutely vital that you check the sensor offsets once your probe is installed, and update the values in configuration.h accordingly, you will need to uncomment #define CUSTOM_PROBE and enter them in the configuration.h file.

These are the relevant lines:

```
#define X_PROBE_OFFSET_FROM_EXTRUDER 65 // X offset: -left +right [of the nozzle]
#define Y_PROBE_OFFSET_FROM_EXTRUDER -36 // Y offset: -front +behind [the nozzle]
```

Typically, sensors are most sensitive in the center, so we need to know the offset from the tip of the nozzle to the center of the probe. Here is an approach you can use to measure it:

Measuring X and Y offsets

1. Home X and Y then move your Z down until the nozzle is on the bed
2. Move the nozzle to roughly center on the bed and mark where the nozzle was
3. Cycle the power on the printer to reset the XY position, it should show 0 for each
4. Now move the head using the Prepare > Move Axis on the LCD (or you can also use your computer to move the axes) until the center of the probe is over where the nozzle was
5. Look at your X and Y position, these are your offsets.
 1. If the sensor is LEFT of the nozzle the offset is negative (Ex: -10). If it is to the right then the offset is positive (Ex: 10)
 2. If the sensor is in FRONT the nozzle on Y then the offset is negative (Ex: -5). If it is BEHIND the nozzle on Y then the offset is positive (Ex: 5).

The offset parameters are integers, so round your results to whole numbers before updating configuration.h

Did you let it warm up?

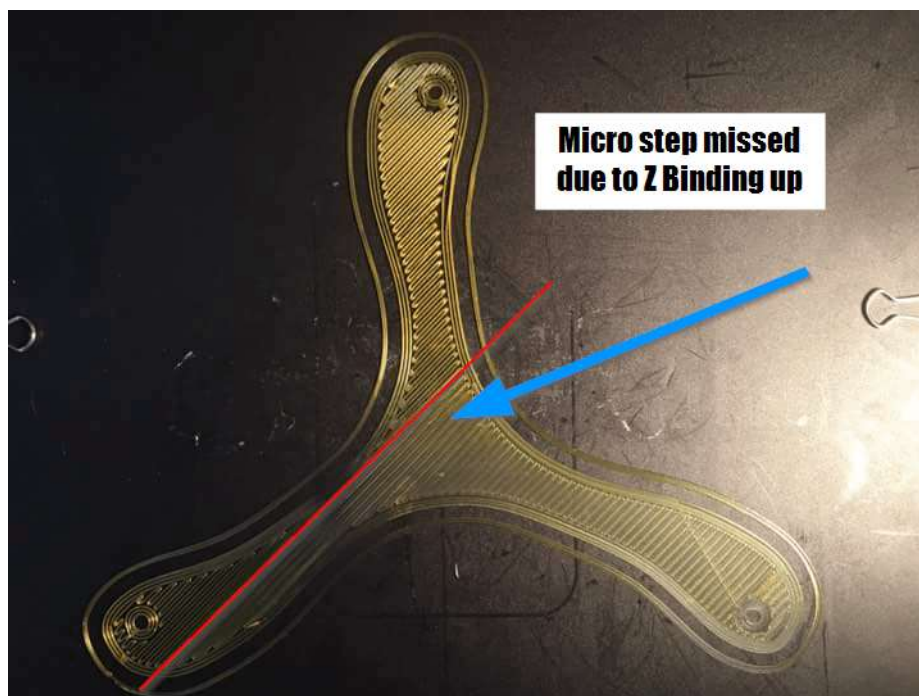
Before setting your Z-offset you need to make sure your printer is up to temperature and you've given it a few minutes for any thermal expansion to occur. Differences in nozzle height of around 0.2mm have been observed between a hot and a cold nozzle. If you set your Z-offset with the nozzle cold, you will most likely find it is too close to the bed when it is hot.

You should also ensure that the printer has had sufficient time at temperature before starting a print. Ideally give the printer 3-5 minutes after it reaches printing temperatures before you start to print. I typically issue a G28 so that the sensor is dead center on the bed while I am heating up the printer for calibration or a print. If you have a Pi setup you can add G28 to the starting scripts under the GCODE Scripts section in your OctoPrint settings.



Is your Z Binding up (CR-10 images but applies to ALL printers)?

ABL has sides that are lower and/or higher than the rest of the bed.

**Details**

After sending out multiple kits and getting feedback from customers that has issues there are many that had Z axes that were not working correctly and this throws off the probe. Before you move forward check that you can easily move your Z axis leadscrews. If there is a lot of resistance then you need to adjust and/or lube your Z axis (both sides if you have dual Z).

If you are getting inconsistent or odd behavior with the ABL then the likely culprit is a Z axis that is binding up in certain spots.

The Z leadscrews should be able to be turned by hand with minimal effort.

Checks

With the motors DISABLED try moving the Z by grabbing the coupler (the silver piece that connects the leadscrew to the motor) and turning it. Your couplers should look like below and NOT be stretched out.



There should be little to no resistance when you do this. If you have resistance then proceed with the checks below. **You must check this by HAND. Just because it moves with the motors does NOT mean you do not have an issue.**

Leadscrew Alignment

Your leadscrew should be the same distance from the extrusion from TOP to BOTTOM. Measure this. If yours is tilted try the “Z Motor is too close to the extrusion” solution below.

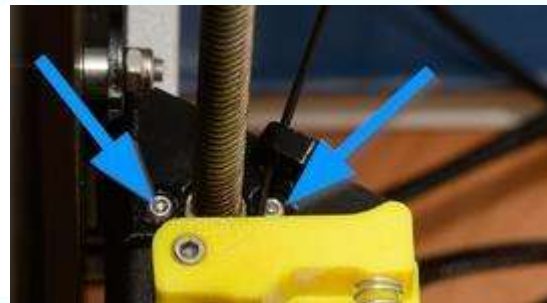


Resolution/Possible Causes

- **Z Motor is too close to the extrusion**
 - Print a new Z mount: <https://www.thingiverse.com/thing:2158680>
 - Add a washer to space it out from the extrusion

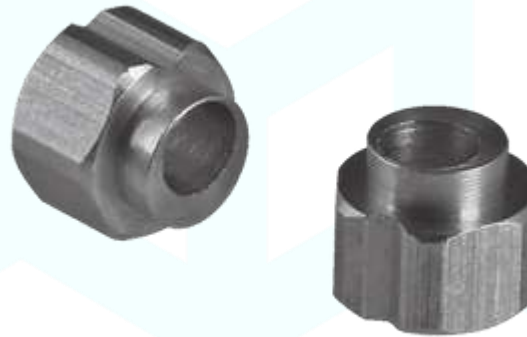


- **Z Leadscrew Brass Nut is Binding**
 - Loosen the screws on the brass nut about 3/4 turn so it is slightly loose in the bracket. This applies to BOTH if you have Dual Z



- **Z Tension Bearings are too tight**

- On each of your Z axis/X Gantry brackets there is a single wheel. This wheel has an eccentric nut that is use to adjust tension. Use the included wrench and turn this nut until you are just able to move that wheel smoothly with your hand. It should NOT spin freely but it should just touch the extrusion enough to keep the gantry straight.



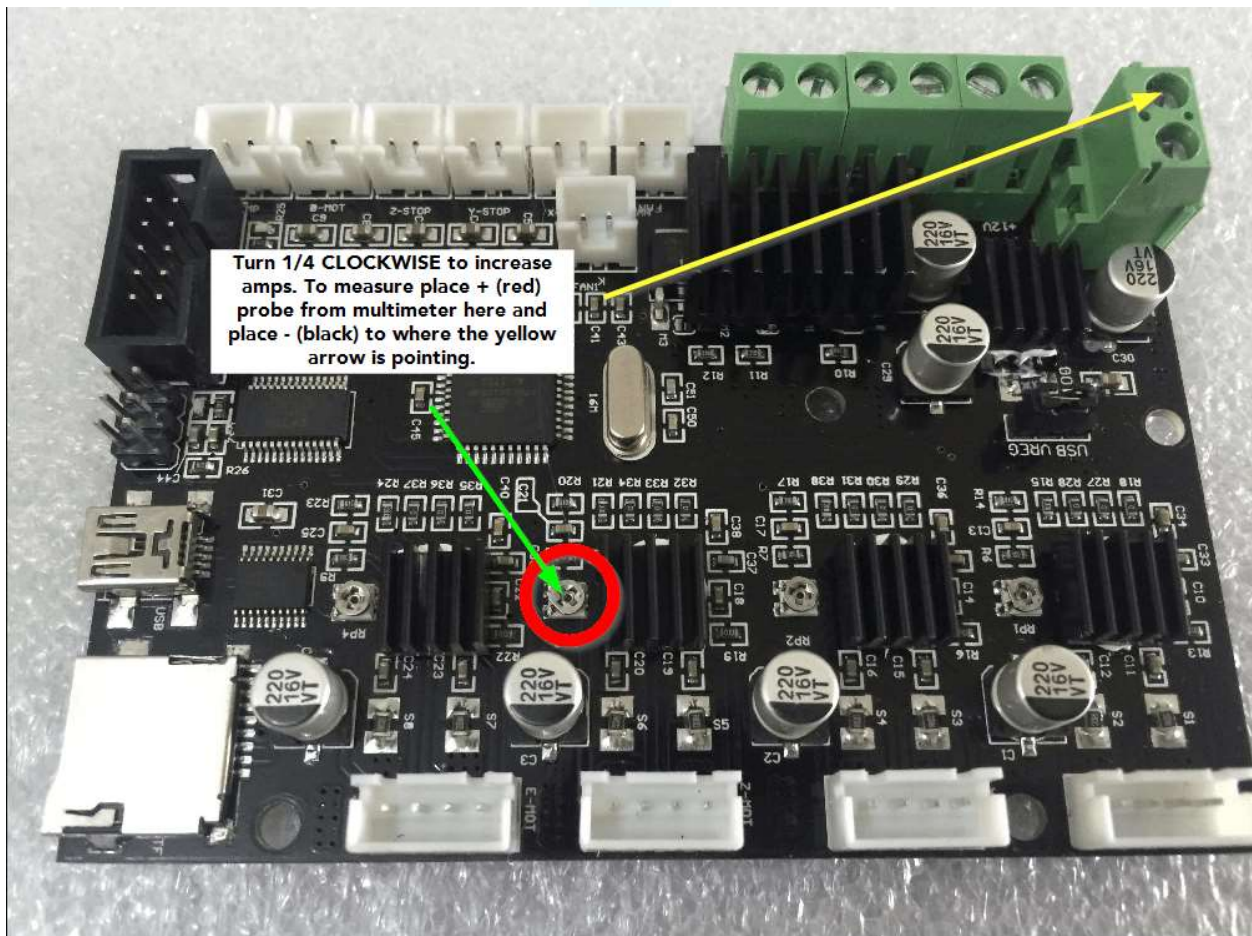
- **Z Leadscrew needs Lubrication**

- If the above fixes do not work try adding lubrication to the leadscrew from top to bottom. You just need a small amount and then move the z up and down completely a few times to spread the lube evenly. I recommend you do this anyways as it will help ensure smooth operation of the printer.
- Large Tube: <http://amzn.to/2uO244O>
- Small Tube: <http://amzn.to/2uO3Kvb>

Z Axis Stepper Amperage is too Low

If your Z steppers are getting too little power you can verify by moving the Z up 100mm from your control box and then grabbing the Z leadscrews. The motors will be engaged and if you have proper amperage then they will be VERY hard to turn. If you can turn them easily and make the motor skip (you will feel it skipping a step) then you need to check the connections to the Z motor(s).

If your connections are good then you need to adjust the VREF on your Z axis by turning the small potentiometer about 1/4 turn CLOCKWISE to increase the amperage going to the Z motor. If you have a multi-meter (HIGHLY recommended) you can check the VREF voltage by placing the positive probe on TOP of the potentiometer and the negative to any negative coming from the power supply. The ideal VREF for dual Z is about 0.9-1.0V, single is 0.7-0.8V.



TH3D sells a low cost multimeter AND ceramic screwdriver kit for \$10 in the TH3D Shop

All Amazon links ARE affiliate links meaning if you purchase the product from the links we receive a referral fee for you purchasing them. This does NOT cost you anything and helps support us.

Z Endstop Not Triggering

THIS ALSO APPLIES TO THE DIRECT WIRE. JUST SWAP THE 2 WIRES AND RUN THE M119 TEST AGAIN.

Issue

If your Z Endstop is not triggering this could be due to a manufacturer wiring configuration on your Z endstop connector. The EZ-Connect has been setup based on testing of multiple CR-10 machines that we have in house. But after sending out many kits it appears that the wiring that Creality uses is not consistent and they reversed the wires in some Z Endstop connectors.

Resolution

To fix this you need to use a small pin to carefully push out the wires from the Z Endstop pin and swap them around. This will make the Z Endstop trigger.

Here is a video showing how to do this. The connector in the video is slightly different than the CR-10 Z Endstop but this method works the same. <https://www.youtube.com/watch?v=TzF14MPu46I>

But why do I need to do this when the stock Z switch works?

The EZABL module uses an IC chip that is what is similar to a diode. Diodes only allow electricity to flow one direction. Whereas a switch just connects 2 wires together no matter what way they are connected. If the wires are reversed from the baseline printers that we used for testing then the signal will not flow and reversing the wires will fix this.

Will my stock Z Endstop still work if I want to go back to it?

Yes, this will not change how the stock switch works and you will not need to swap the wires back before installing the stock Z endstop switch.

Legal

By purchasing and install this kit you agree to the below terms and the terms of service on: <https://www.TH3DStudio.com/terms/>

There are many things you can do to your printer installing this upgrade kit or any other modification.

You are assuming all risk associated with this modification.

You understand that this and/or any modifications to your printer can and/or may void your manufacturer warranty (if any).

TH3D Studio LLC is not to be held liable for any damage to your printer, home, person, or anything else due to issues that may arise from improper installation or failure of this kit.

Warranty

This kit comes with a full 90 day warranty against any failed component of the kit (board, AC/USB adapter, sensor, enclosure).

If you have a problem with the unit you can contact us at Support@TH3DStudio.com and I will setup an RMA.

****International customers – Depending on the shipping cost you may be required to pay all or some of the shipping for RMA issues*****

STL files are on the website for download if you want to print your own for any reason (color, style, etc). **Removing the module from the factory case may void your warranty** as it is secured in with high strength hot glue. Do at your own risk or with guidance of our support team.

Change Log

- V1.0.NO.PROTO – Initial Draft
- V1.1.NO.PROTO – Changed Setting Z Offset & Sensor Sensitivity Procedure
- V1.2.DR – Added in-depth troubleshooting and ABL information
- V1.0 – Retail Final Release
- V1.1 – Usability changes based on feedback from Prototype customers and retail kit customers.
- V1.2 – Added in Z Axis Step, Updated Images for Sensor calibration and mounting, Added new Direct Wire Diagram for 2 pin power version (current as of 6/1/17), updated M48 directions for CR-10 Use.
- V1.3 – Minor changes to text and changed branding to TH3DStudio
- V1.4 – Overhaul for new firmware and grammatical corrections
- V1.4.1 – Added note about sensor wire routing
- V1.5 – Added notes for Tornado endstop plug wire with EZ-Connect version.
- V1.5.1 – Grammar corrections and updates for the Unified Firmware
- V1.5.2 – Notes about 12/24V since Direct Supports both now
- V1.5.3 – Update for new firmware changes and notes about Anet printers.
- V1.6 – Major updates to installation process, rewrites to make things easier to understand. Changes to links to fix outdated ones.
- V1.6.1 - Added all troubleshooting to the guide for centralized information.
- V1.6.2 – Updated sensor distances for each version, updated video link for Z offset
- V1.6.3 – Page number corrections in guide
- V1.6.4 – 1st Layer setting recommendations
- V1.6.5 – Z Offset Updates
- V1.6.6 – Updated for notes about Wanhao D6 and other small notes. Updated starting scrip to slow purge speed and turn off E motor for direct drive systems
- V1.6.7 – Grammatical issue corrections
- V1.6.8 – Added Notes about new EZABL Installation Video, added welcome letter <3