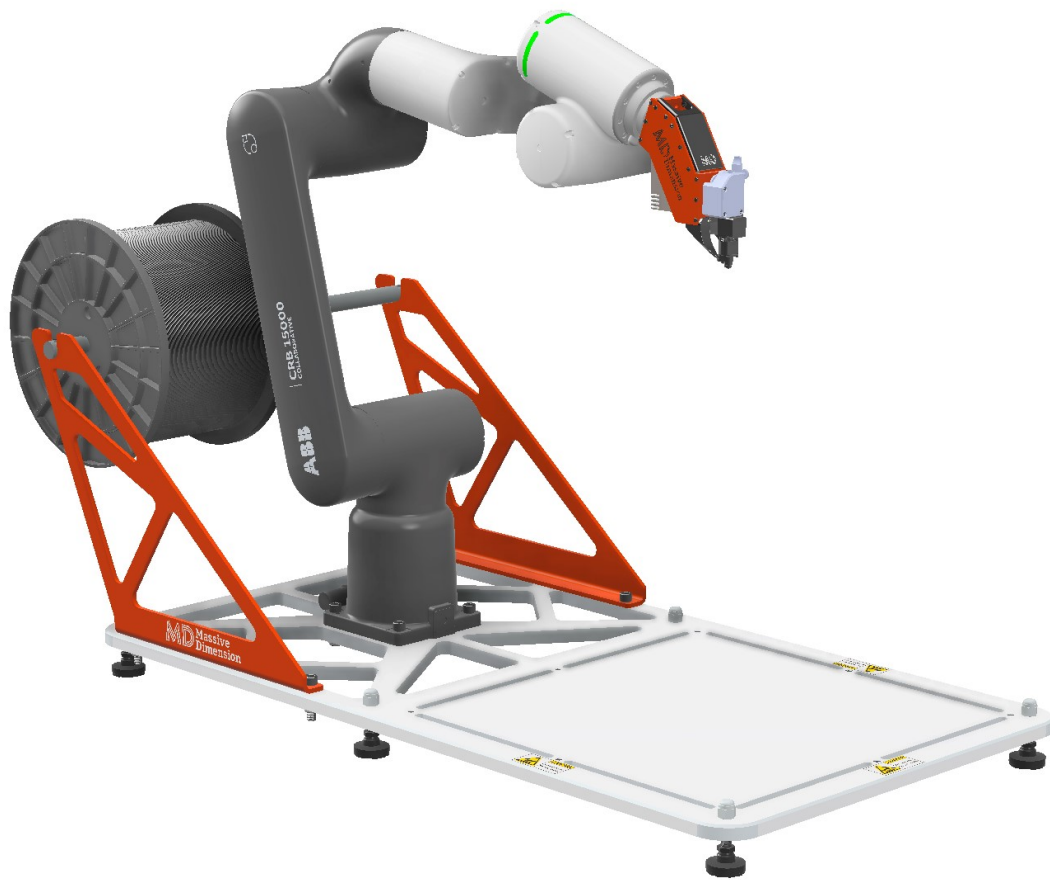# MD Massive Dimension

MDAC1 Unboxing & Quickstart Guide

Congratulations on receiving your MDAC1 and welcome to the world of six-axis 3D printing!

This guide is intended to get you started on your journey, by introducing you to the component parts that make up your printer, and describing the workflow necessary to go from CAD model, to toolpath, to printed part.

Table of Contents

Document Revision

11/05/2023 – Revision 1: Initial Release

Safety Guidelines and Warnings
Warning: Read All Safety Instructions Before Operating

General Safety
Intended Use: This printer is designed for trained users within the educational and professional use. It should only be operated by students, teachers, or engineering teams with proper training.

Indoor Use Only: Operate this printer in a dry, indoor environment. Avoid exposure to moisture or wet conditions.

Power Supply: Ensure that the printer is connected to a power supply that matches its specifications. Improper power supply can lead to electrical hazards. The system must use a grounded electrical source. Never use near or with liquids.

Burn and Electrical Shock Hazards
Hot Surfaces: The hotend filament extruder and heated build surface can reach high temperatures. Avoid direct contact to prevent burns.

Turn Off After Use: Always turn off the printer and unplug it from the power source when not in use. Never leave the printer unattended.

Inspection and Maintenance: Regularly inspect the printer for any damaged components, particularly the electrical wiring and heating elements. Do not operate if any damage is detected.

Pinch Points
Moving Parts: Keep hands and other body parts away from the printer's moving parts to avoid pinch injuries.

Protective Gear: Wear appropriate protective gear, such as gloves, when handling the printer's components such as gloves and safety glasses.

Fumes
Ventilation: Ensure adequate ventilation in the operating area to avoid inhaling fumes that may be emitted during printing with materials that require ventilation.

Material Safety: Use only recommended filament materials that are safe and suitable for this printer. Consult the material safety data sheets (MSDS) for each type of filament.

Modifications: Any modifications made to this printer may void its compliance with safety standards and regulations.

In Case of Emergency: Familiarize yourself with the emergency stop procedure and the location of the power-off switch.

Note: This product is continually improved for safety and efficiency. Stay updated with the latest safety guidelines and firmware updates.

Unboxing

Your MDAC1 will have arrived on a pallet. All the mechanical components are pre-assembled, though the process cabinet wires will need to be connected, which is easily achieved via twist-lock or clamp-lock connectors.

The different mechanical parts of the MDAC1 are as follows:

Mounting Frame & Build Plate

This ½" thick aluminum plate is mounted on six feet, which can be adjusted if necessary to maintain a stable position on a floor or table. The robot is bolted to this plate, and the front half of this plate has a heated pad underneath it, which creates the heated build surface. The cutouts help to create a heat break, but you should be aware that the metal of the build surface as well as surrounding areas will be hot to the touch once turned on and set via the PID control.
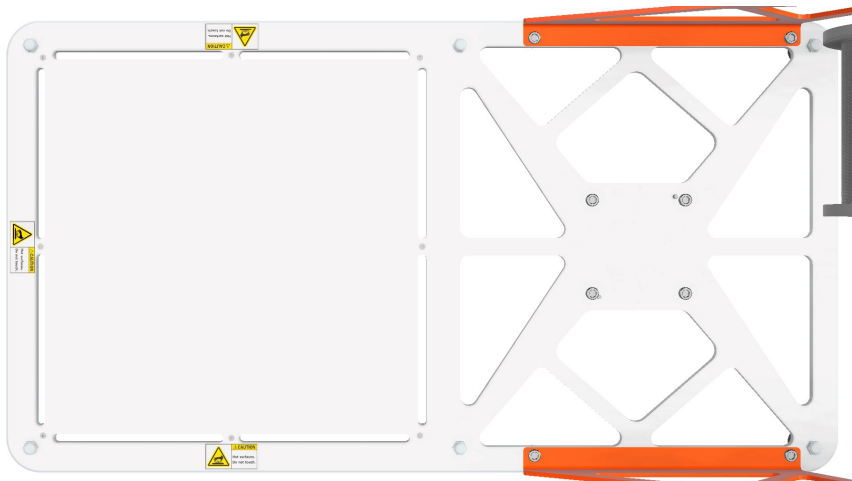
Filament Spool Holder

This sits behind the robot and is comprised of two wings and a rod. The wings are bolted through the aluminum plate. The rod can be lifted off the wings to add or remove filament spools.

GoFa Six-axis Robot

Bolted to the aluminum plate and also situated on locator pins in the plate. Controlled via the OmniCore controller and connected via a single cable.

Filament Hotend Assembly

Bolted to the end-of-arm flange (axis 6) of the GoFa, comprised of a number of metal plates, carrying a filament drive, stepper motor, and 1.75mm filament hotend. Connected to the MD process cabinet via a single cable.
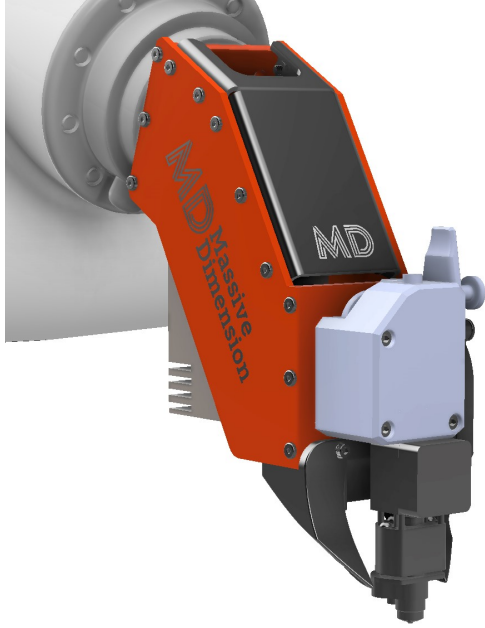
Electrical

The different electrical enclosures for the MDAC1 are as follows:

ABB OmniCore Controller

See the included quick start documents from ABB for initializing this controller. Can be plugged into single-phase 110V or 220V, ships with a standard three-prong 110V plug. Operated via the teach pendant as HMI, can be connected to a PC via the MGMT ethernet jack, connects to the MD process cabinet via an ethernet cable into any port on the ethernet switch.

MD Process Cabinet

Plugs into single phase 220V, ships standard with a male L25-30. Connects to the hotend via a sixteen-pin cam-lock connector. Connects to the OmniCore via an ethernet jack. Connects to the bed via a six-pin cam-lock terminate with an L6-20 twist-lock connector. Additionally, connects to the bed thermocouple via a thermocouple jack. Has two PIDs on the front swing door for controlling the hot end and bed temperatures.

Power In **Hotend** **Build Plate** **Ethernet**

Build Plate Thermocouple

ABB OmniCore Controller

See included printed documents from ABB for initializing this controller. If you already lost it, a PDF of the unboxing pamphlet can be found [here](). PDF of the full product manual is [here]() for further reference.

MD Process Cabinet

The process cabinet has the main on/off switch on the left-hand side, there is an additional miniature circuit breaker inside the enclosure that is rated for 20A. If there is no power to your process cabinet, check that this breaker is not flipped. In this case, green on the breaker represents the switch being off, and red represents it being off.

The cabinet contains a 240-watt 24VDC power supply which provides power to the hot end heater, the filament drive motor, and the I/O cards in the cabinet.

The I/O stack has an analog output card, and a digital output card, and communicates via Ethernet/IP.

There is a single-phase 220V solid state relay that is controlled by the build plate PID and switches power to the build plate heater.

There are three 24VDC SSRs, one that is controlled by the nozzle PID and switches power to the hot end, one that is controlled by the digital I/O card and interrupts the analog 0-5VDC process signal, and one that is left as an additional option for user customization.

There is a mechanical relay controlled by the digital I/O that cuts the power to the PIDs and is therefore the PID master control.

The wiring diagram for the process cabinet can be found here and is subject to change and revision.

Loading filament into the hotend:
This can be done with the hotend at operating temperature, or with the temperature zone off. Pick up the spool holder rod from the two wings behind the robot. Slide the filament spool onto the rod, then replace it on the wings. It does not particularly matter if the filament spools off on the bottom or the top, somewhat like toilet paper. Push the filament through the bowden tube, until it reaches the end of the tube. The bowden tube connects to the filament drive by a push-to-connect fitting, simply press the tube in to seat it, or if you would like to remove it, press in on the fitting and pull on the tube. You can release the gear that grabs the filament by operating the thumbscrew level on the drive, then push the filament fully into the hot end. If the hot end is cold, it will stop in the feed throat. If it is hot, you will be able to push it by hand until it extrudes. If the extruder is at operating temperature, you can manually enter a motor speed on the I/O page of the teach pendant to make the filament drive spin and ensure that it is pushing the filament.

Operating the PIDs
The PIDs are what will allow you to set the operating temperatures for the hotend and build plate. They are located on the swing door of the MD Process cabinet, and are labeled for their respective zones. The green number on the bottom is the set point, and the red number is the actual temperature. Just adjust the setpoint with the arrows based on manufacturer recommendations for your specific filament. It is as simple as that, though if you want more advanced operations, see the manufacturer user manual [here](#).

Teach Pendant Operation
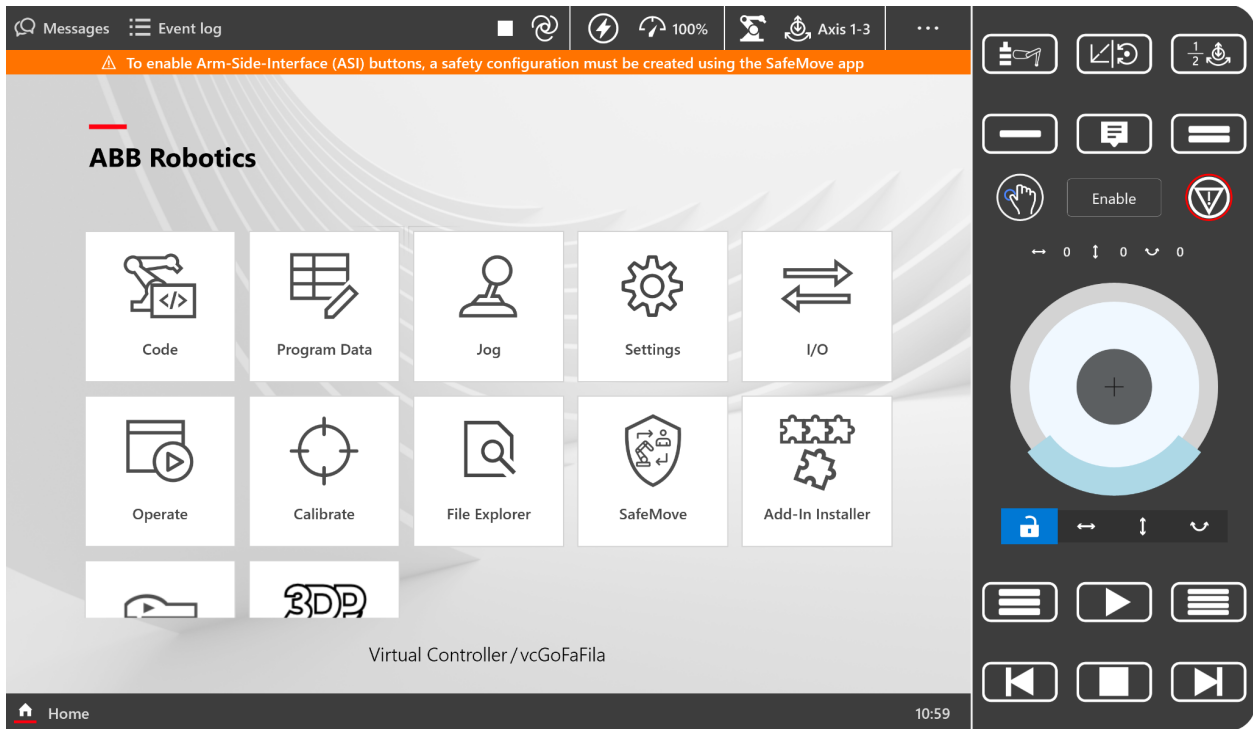
The teach pendant is your HMI for operating the MDAC1. There are many windows from the home screen, the main windows you will be interested in initially will be "Code", "Jog", "I/O", and "Settings".
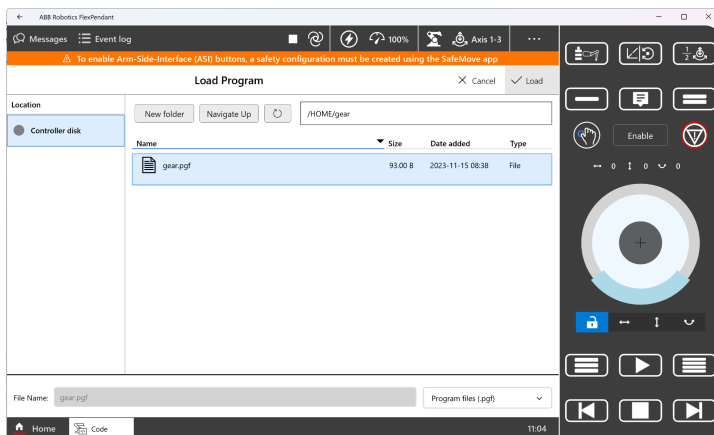
Code
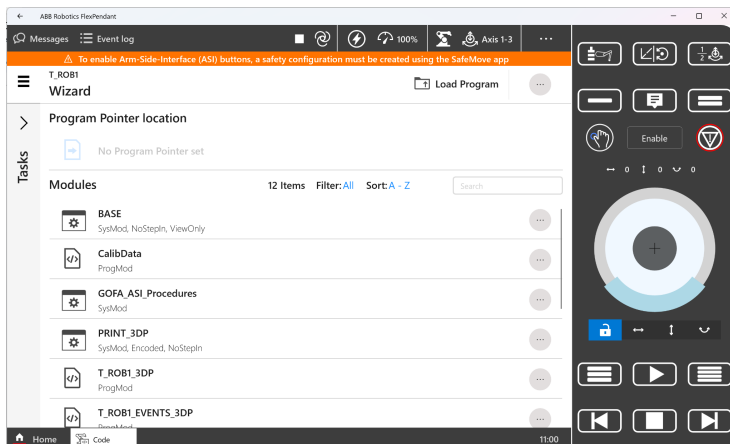
"Code" is where you can load the programs that you will create within Adaxis.

If there is an existing program, you can press the "X" by its title to remove it from the window. You will be asked if you want to save the program. You can say no, the program will still be in the home directory if you wish to load it again later.
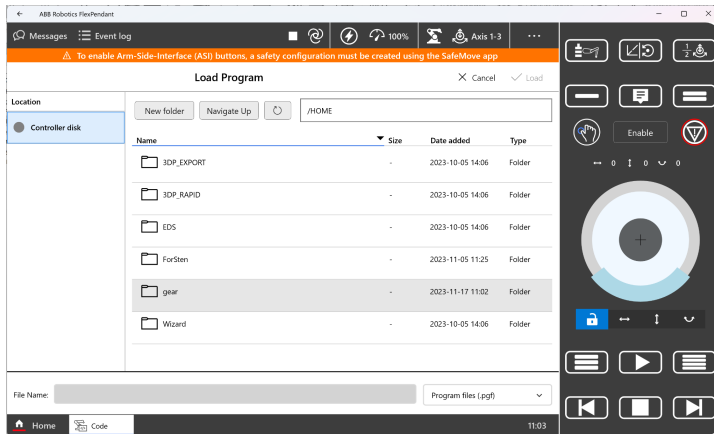

Tap "Load program" in the upper right-hand corner. You will then be in the file explorer and can navigate to the HOME directory. Print files from Adaxis should be transferred here as root folders. If you open the folder with the name you have assigned when you saved your program in Adaxis, it will contain a program file (.pgf). Select this, and it will load the master module for the print routine.
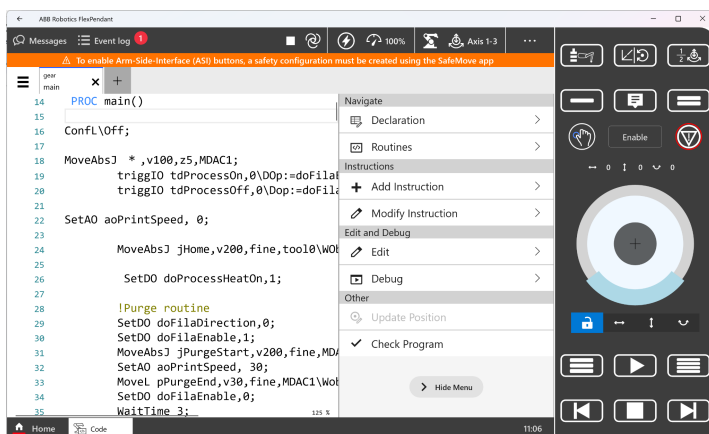

In the next window, click the ProgMod with the same title, as highlighted in the picture below.
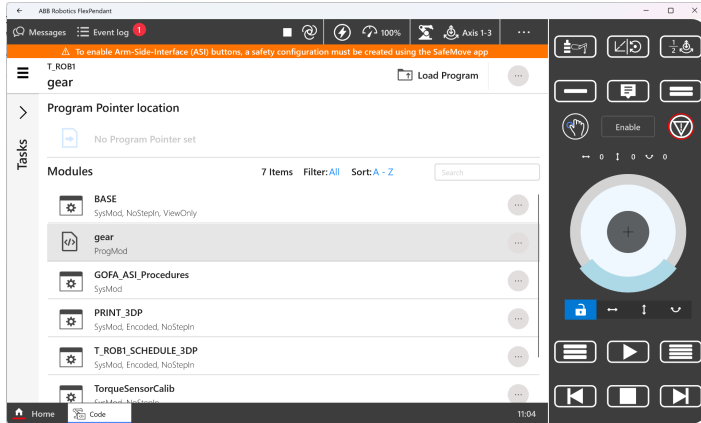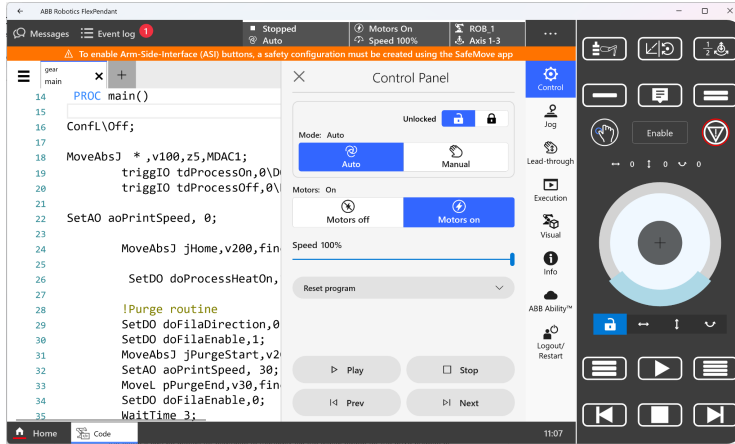
In the next window, click "main".
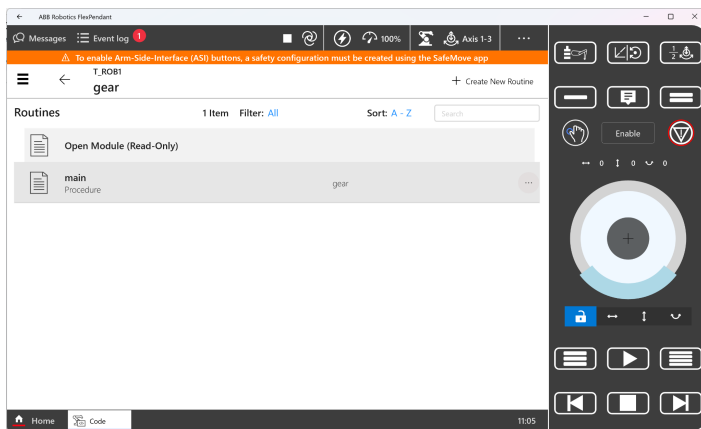
Your program is now loaded on the controller and ready to run. You will see the start code in the following window.


You can run the program either by pressing the play button or through the control mini-menu. If you click the three dots in the upper right it will bring up the control mini-menu.

Here you can reset the program, switch between auto and manual mode, and turn motors on and off. You can also start and stop programs, and adjust execution speed. If you are running a program for the first time, it is recommended that you run the first approach points in manual mode, at reduced speed (such as 20 percent) to check that you have the correct Z-height.

I/O

To manually access the I/O in the process cabinet, click I/O, then Ethernet I/P, then Print_IO.
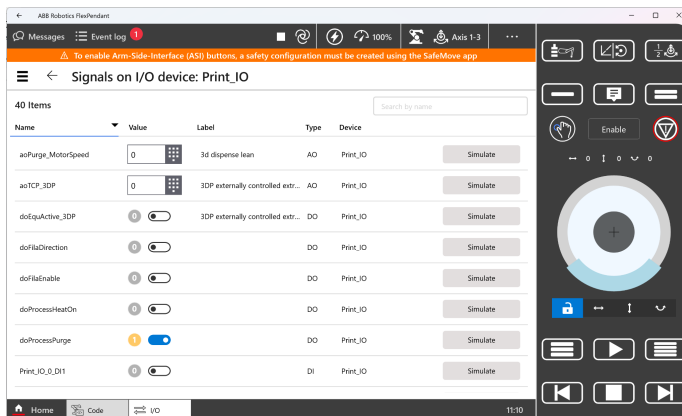
"I/O" is where you can manually control the digital and analog I/Os involved with the print process. Though once you start a print program everything is controlled automatically by the code, it can be useful, for example, to manually flip the digital output for the drive enable, or drive direction, when loading or unloading filament. Digital outputs can be switched from 0 to 1, which represent on and off states, by tapping them. Analog outputs can have values entered into them. The MDAC1 comes standard with just one analog output, to control the filament drive speed and a handful of digital outputs.

Digital Outputs

doFilaEnable
Enables the filament drive motor. If this is 0, the motor will not spin even if an analog voltage is applied. If it is 1, it will spin when provided voltage. This digital output is turned on and off along with the process signals during a print. I.e. it will be 0 during travel moves, 1 during print moves.

doFilaDirection
Changes the direction of the filament motor. Useful for unloading filament.
Can be utilized for retraction moves for more advanced printing strategies. 0 is forward, 1 is backwards.

doProcessHeatOn
Cuts the power to the PIDs, turning the heat zones on or off. 0 is off, 1 is on. Is automatically turned on at the beginning of the print program with default post processor settings, and turned off at the completion of a print.

doPrintSignal
Controls a solid-state relay that the 0-5VDC analog signal passes through. Is by default set to 1- which allows the signal to pass through. Can be used as an alternative to the enable signal, or left alone by default.

Analog Output

aoPrintSpeed
Physically a 0-5VDC signal, converted logically to scale for 0-60RPM on the filament drive motor. This number would be adjusted to change your extrusion rate for different size nozzles, or can have multipliers applied to it via postprocessor for more advanced toolpath strategies. Use this to manually purge when filament loading, if desired.
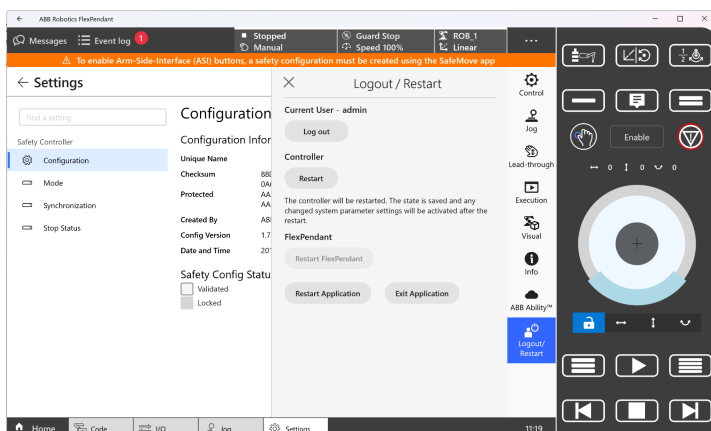
Jog
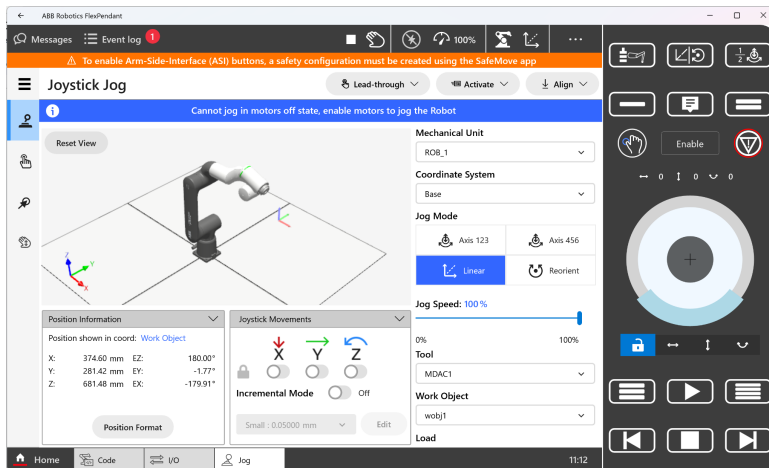
"Jog" is a great window if you are unfamiliar with the different modes for manually manipulating the robot, as it provides visual cues for the different axes, orientations, etc. You can also manipulate your coordinate system readouts from here in order to make measurements or check calibration.

Settings

"Settings" is where you will find the safety menu that you need to periodically revisit to do cyclical brake checks and safety synchronization requisite to keep the robot happily running. This might be necessary immediately after receiving your MDAC1, as the joints occasionally move during shipping while powered off and will ask to be synchronized.

Go to "Settings", then "Safety Controller". You will need to be logged in as an admin- username: admin, password: robotics. This can be done by clicking the three dots in the upper right, then clicking "Logout/Restart". Logout then log back in with the credentials.

Go to the Synchronization tab. Click Enable Move to Sync Position, then Press and Hold to Move.

Once the robot has moved and the positions match up, click Synchronize in the bottom right corner.

Next, click Cyclical Brake Check on the bottom of the list on the left. It will appear below "Stop Status". You can click execute on this window and follow the prompts, the robot will run a brief program and you will be all set.

Slicing

You will get the best results and the widest array of slicing options in AdaOne if your CAD models are in .step format. The Adaxis portal can be logged into here. We recommend reading through each topic for a thorough understanding of the features, then dive right in and start experimenting! You will have received a pack-and-go file with the MDAC1 digital twin, as well as a postprocessor. Once you unpack the cell and import the postprocessor, you will be ready to create a toolpath and test it out.

File Transfer

After saving a toolpath from AdaOne, you can use RobotStudio File Transfer to load it onto the OmniCore controller. Connect your computer to the MGMT port on the back of the controller, then open RobotStudio. Go to the controller tab, then click "Add Controller". You can click "One-click connect" and log in as a default user.
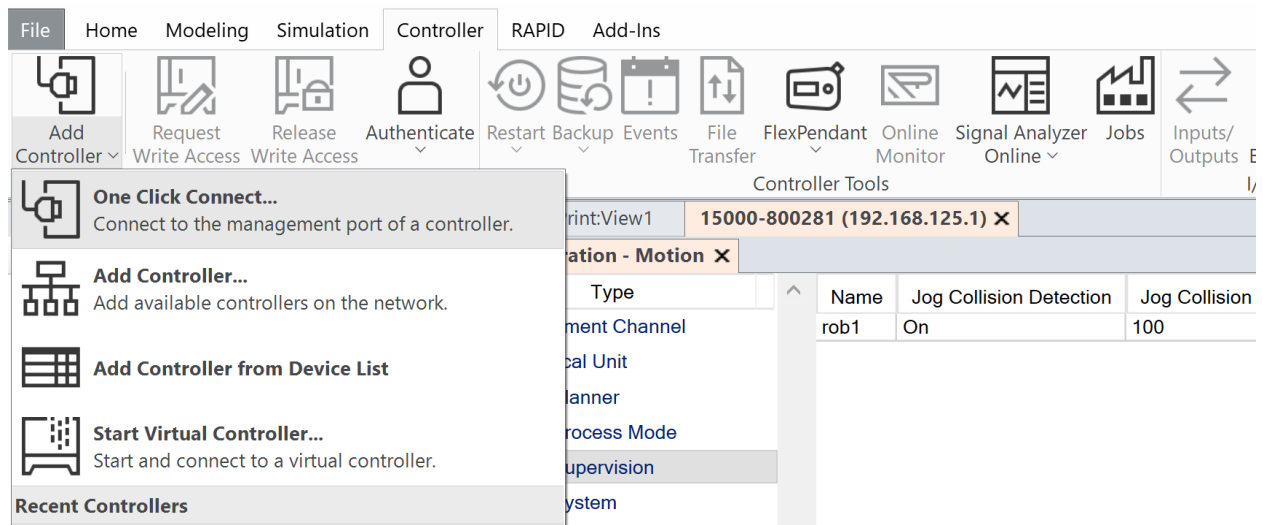
Once you are connected, click File Transfer along the top menu bar.
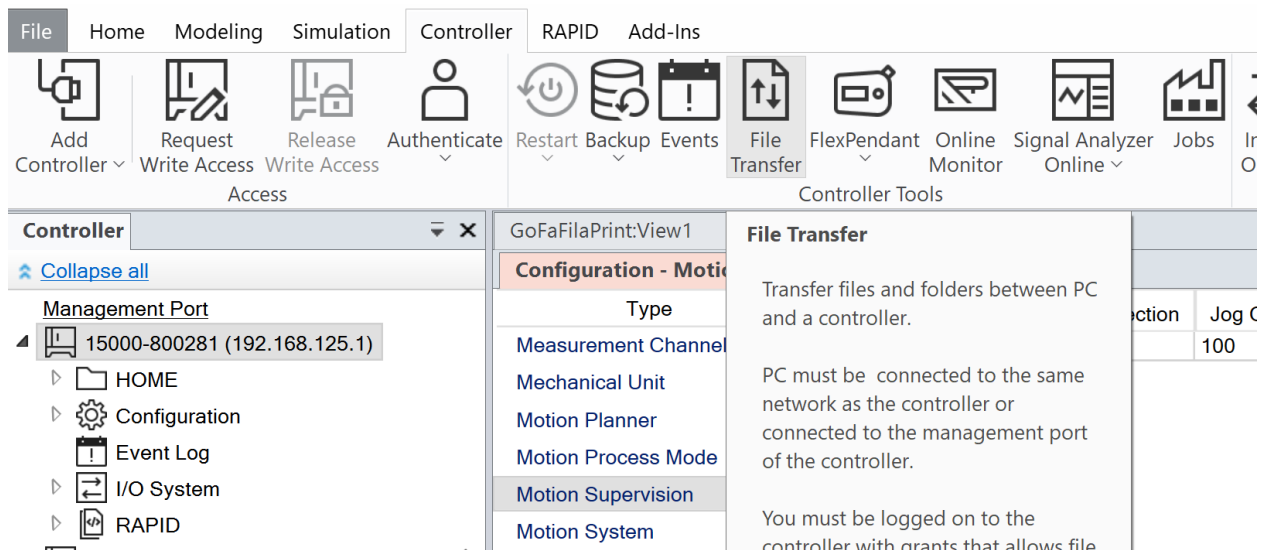
The file transfer window will show you files on the left that are on your computer, and files on the right that are on the controller.
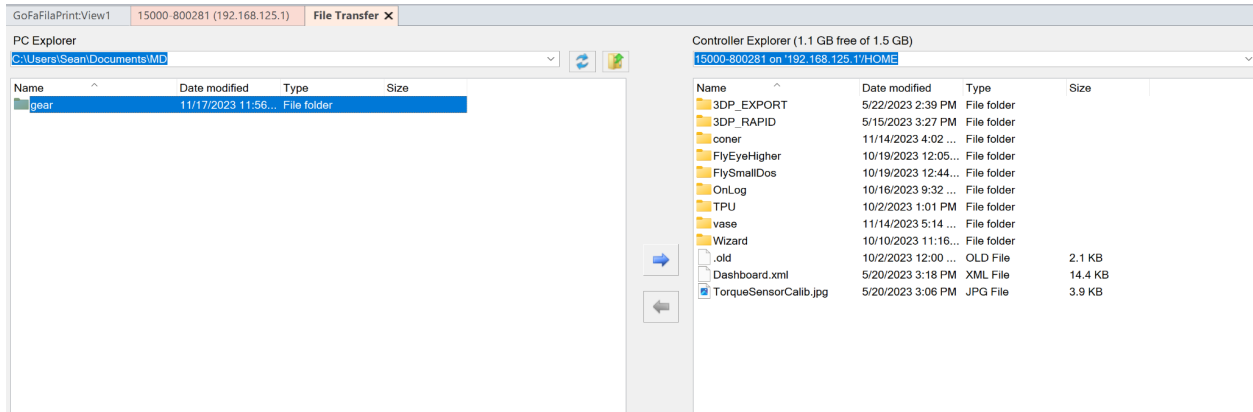
Simply navigate on the left to the folder containing your print files, and navigate to the HOME directory on the right. Highlight the folder you want to transfer on the left and then click the arrow pointing to the right. Files will be copied over.

If you do not have RobotStudio, you can place files on a USB drive and insert it into the port on the bottom right of the teach pendant to access them. Use the File Explorer window to copy them from D: to the HOME directory.

Troubleshooting

If there is no extrusion
Check that the PIDs are on and at their proper operating temperature for your polymer.

Check that the filament is still feeding through the drive. If for some reason it jams, the gears can grind the plastic and make it no longer push through the drive, in which case you need to pull it back out, snip off the damaged section, and reload the filament.

Check that doFilaEnable is flipped to 1, doPrintSignal is flipped to 1, and there is an analog value on aoPrintSpeed.

PID reads "no cont"
This means there is a break somewhere in the thermocouple wire circuit. If it is on the PID for the bed, check that you have the thermocouple connector plugged into the jack correctly. If it is on the PID for the nozzle, reach out to MD for technical assistance.

Z-height for first layer is incorrect
You may find that when switching between different slicing strategies such as horizontal vs. 45-degree angular vs. conical fields nonplanar, you need to make micro-adjustments to your first layer z-height.

The easiest way to micro-adjust your z-height is by manually manipulating the work object data. This can be done in AdaOne in the data for the work frame, pictured below.
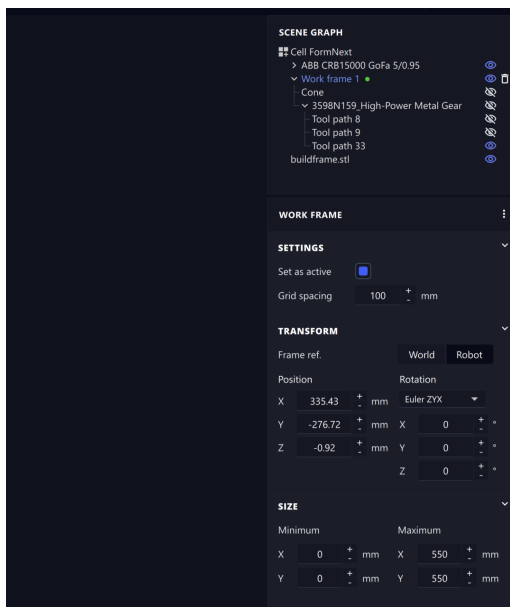
Changing the position data for "Z" will change your first layer height. If you are too close to the bed, adjust the number in the positive direction. If you are too far away, adjust in the negative direction. I.e. If I had these settings and found I was about 0.2mm too high for my first layer and it wasn't sticking - I would shift it to -1.12.

Alternatively, you can leave the number unchanged in AdaOne and adjust the value within the program in the RAPID modules. In RobotStudio, navigate to the first .modx file in the directory for your print program, then change the value in the z position for wobj1, as highlighted below. Save the changes and reload the program on the controller. If you do not have RobotStudio, you can open the same module with any text editor and make these changes.

Can't connect computer to OmniCore
Make sure the OmniCore controller is on and your laptop is connected via ethernet cable. Set your DHCP and IP settings to automatic. The default IP address for the GoFa is 192.168.125.1.