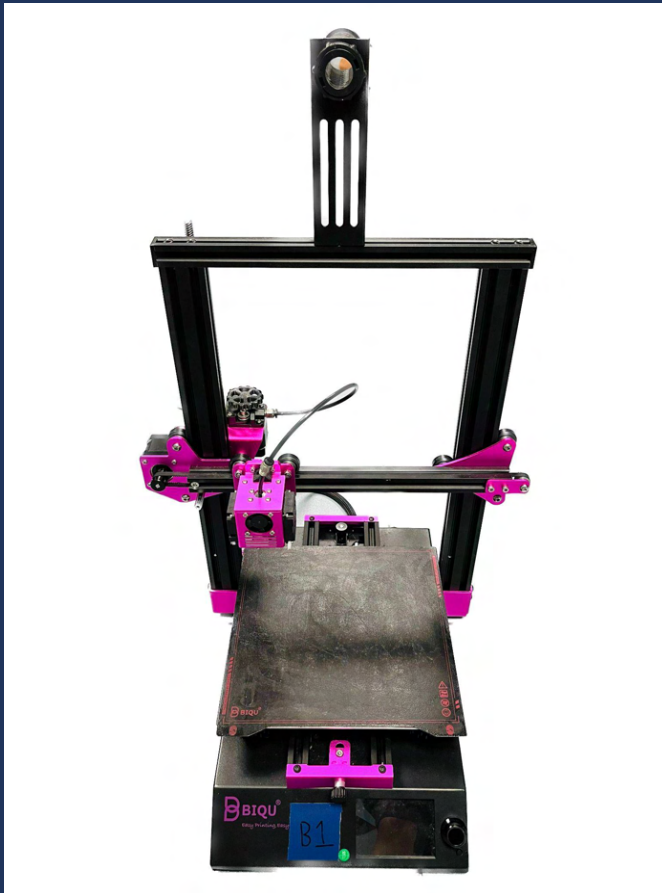


VRC High School

REVERSE ENGINEERING CHALLENGE 2023

BIQU B1 3D Printer Teardown



Team Members

Low Wern Jae Zach

Elston Law Jia Wei

Jeremy Tay Rui Sheng

Team

8059D

Location

Anglo Chinese School Independent, Singapore

Contents

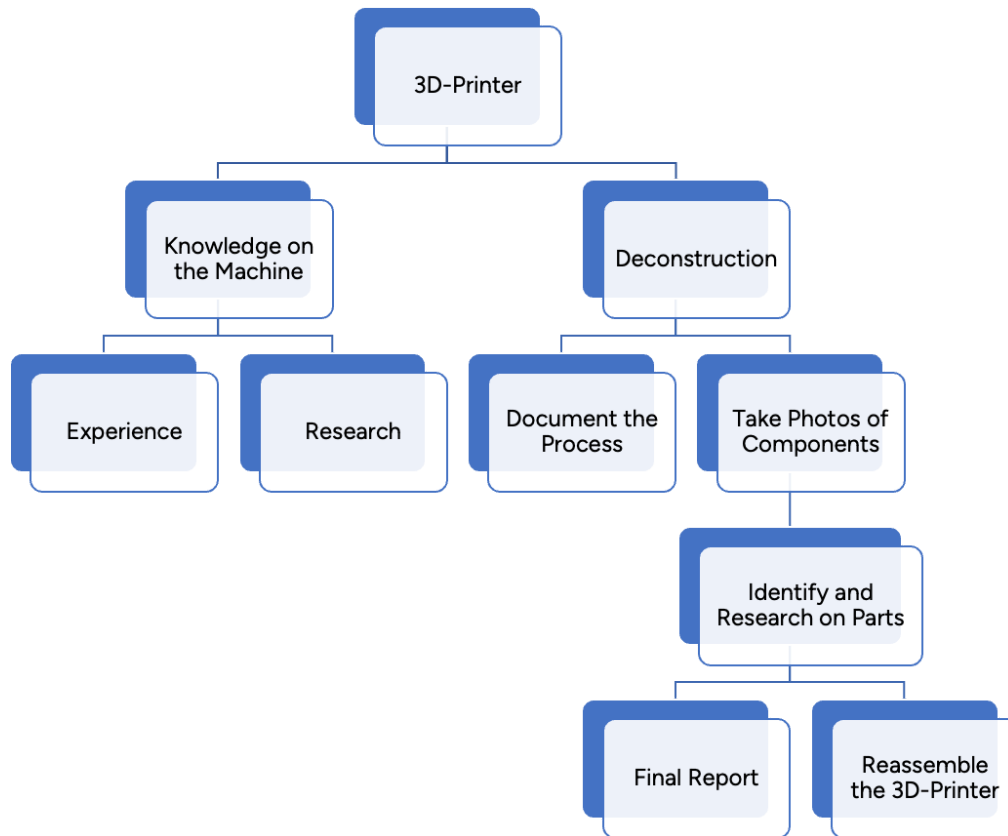
Content List	Page Number
Summary Report	3
Complete Deconstruction and Research Process <ul style="list-style-type: none">• Dismantling the Extruder• Removing the Frame• Removing the Print Bed• Opening the Base• Removing the Cooling Fan• Taking Pictures of the Components• Identifying and Researching the Various Components Online Using Datasheets, Forums, Blogs and Product Overviews	6
Interior of the 3D Printer	10
List of Components	12

Summary Report

Introduction

As members of the school's Robotics Technology Society, we have used 3D printers extensively in our projects and competitions and we have been continuously intrigued by the innovation behind the 3D printer. Through this challenge, we explored and documented the inner workings of the Biqu B1 3D Printer.

Approach (Flowchart)



Preparations

We started by taking all necessary precautions to ensure our safety before we got to work, including wearing safety glasses, having a fire extinguisher nearby, looking through the instruction manual, and seeking approval from our seniors. We exercised caution and responsibility throughout the teardown, especially while handling electronic components like capacitors, and ensured that nothing was damaged during the disassembly.

Deconstruction

To deconstruct the 3D-printer, we first unplugged the power socket. We detached the ribbon cables from the extruder unit and used screwdrivers to remove the entire extruder assembly

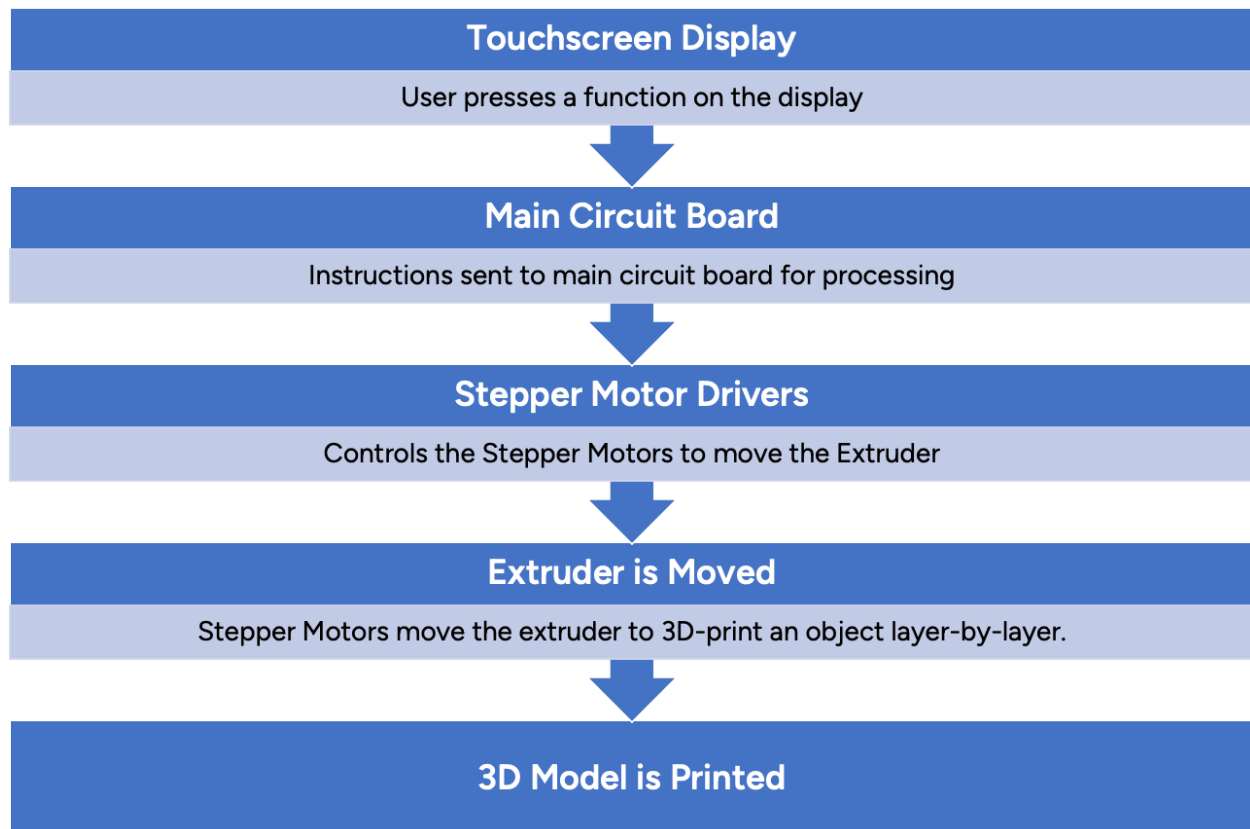
and its supporting frame. We then unfastened the print bed to reveal its internal wires and circuit boards. We then used a pair of insulated pliers to discharge the capacitors safely.

Post-Teardown

With the printer dismantled, we used a smartphone to capture high images of the components. We managed to identify most of the components, especially with the aid of serial numbers printed on the circuit board chips, which allowed us to search for information online.

From the teardown, we acquired vast knowledge about the 3D printer. We realised that the 3D printer was much more complex than it appeared to be. The base of the 3D-printer housed the main circuit board, the touchscreen display and the power supply unit. The touchscreen display circuit contained vital components such as the Touch Screen Controller, which detects applied pressure on the visual display surface, and then interfaces data between the processing system and the touchscreen element associated with the display, allowing the user's desired actions to be followed. The main circuit board, which is the 3D printer's "brain", also contained important elements which allowed it to function, such as the 32-Bit Arm Cortex-M3 Microcontroller, which has a plethora of instructions that may be used as a microcontroller to carry out multiple operations that consist of arithmetic, logic, and boolean. These components allow the 3D printer to function as a whole to ensure that each and every process goes through smoothly.

Processes in the 3D-Printer (Flowchart)



Conclusion and Lessons Learnt

Our team was able to gain valuable perspectives on 3D-printing and electronics from this experience. We discovered how the 3D-printer's sophisticated electronics played crucial roles in coordinating its operations and were fascinated by the numerous circuit board components. Learning more about the 3D-printer, which continues to be essential to us, has been a truly enriching experience.

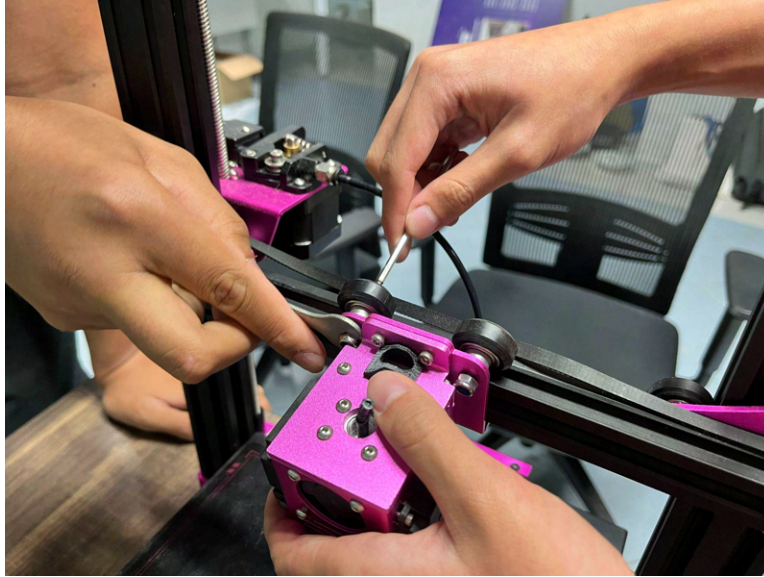
Lessons Learnt

1. We realised the paramount importance of safety when dealing with electronic components. We took extra precautions to eliminate any hazards when dismantling the 3D-printer.
2. This arduous process has taught us perseverance and we developed a growth mindset through the time spent working on the project.

Word Count: 489 words

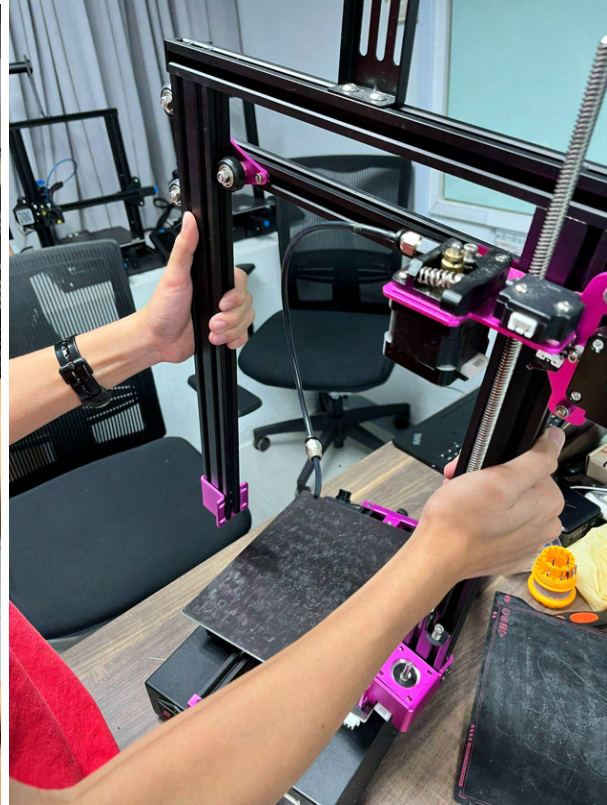
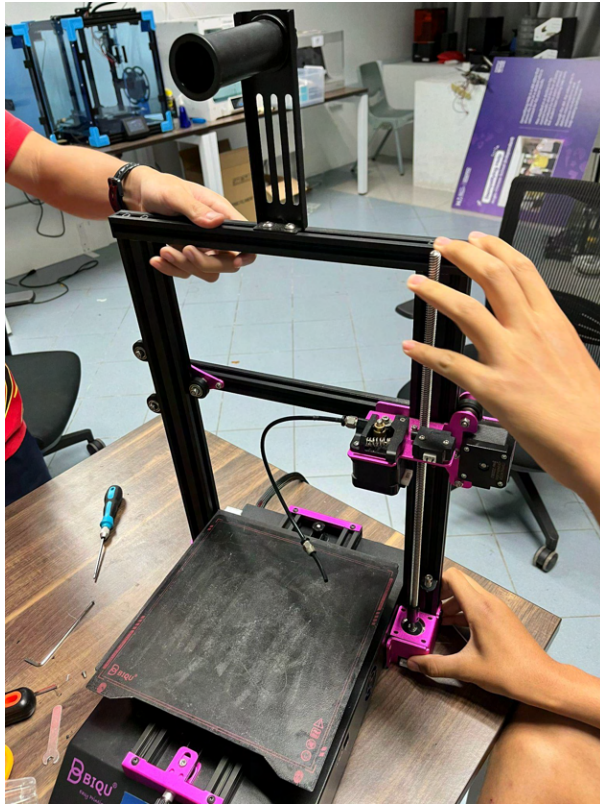
Complete Deconstruction and Research Process

Dismantling the Extruder

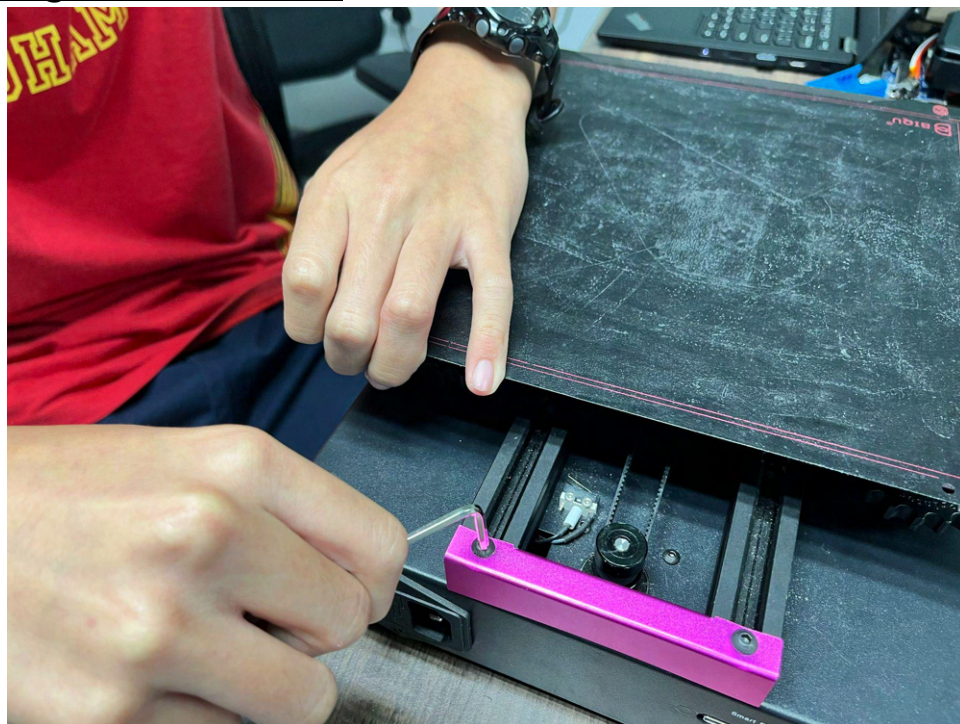


Removing the Frame

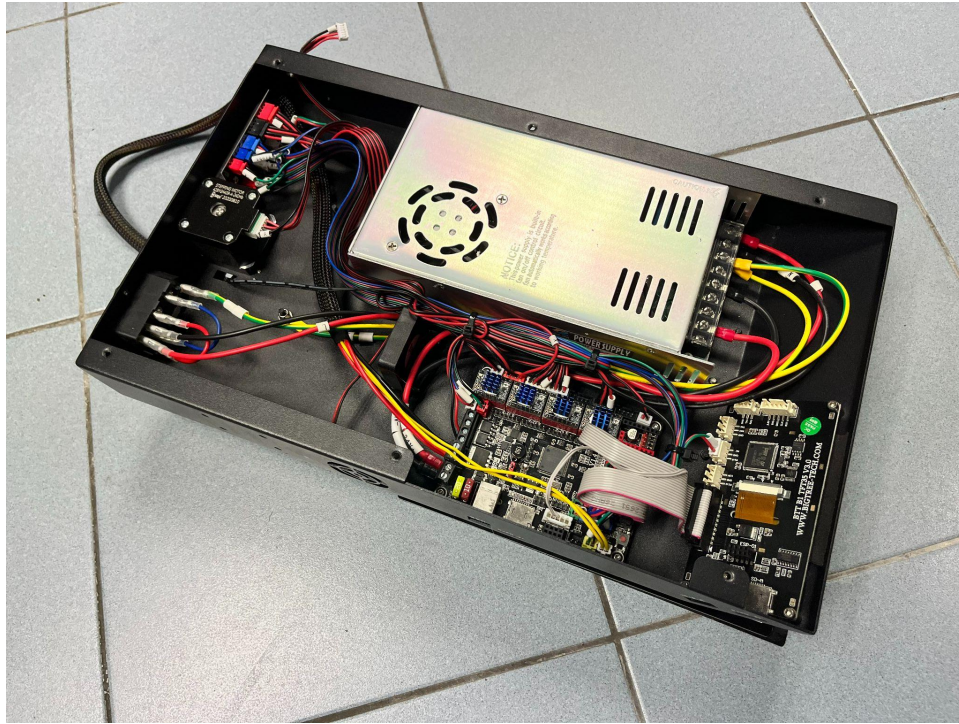




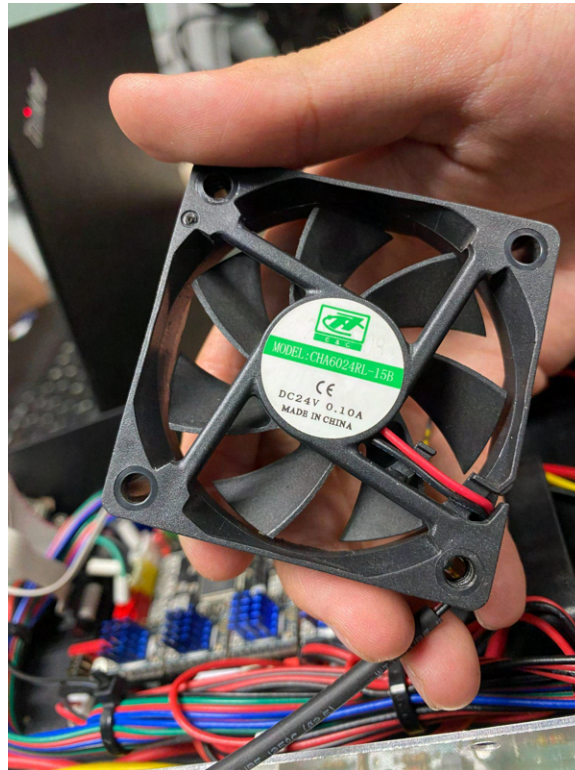
Removing the Print Bed



Opening the Base



Removing the Cooling Fan



Taking Pictures of the Components

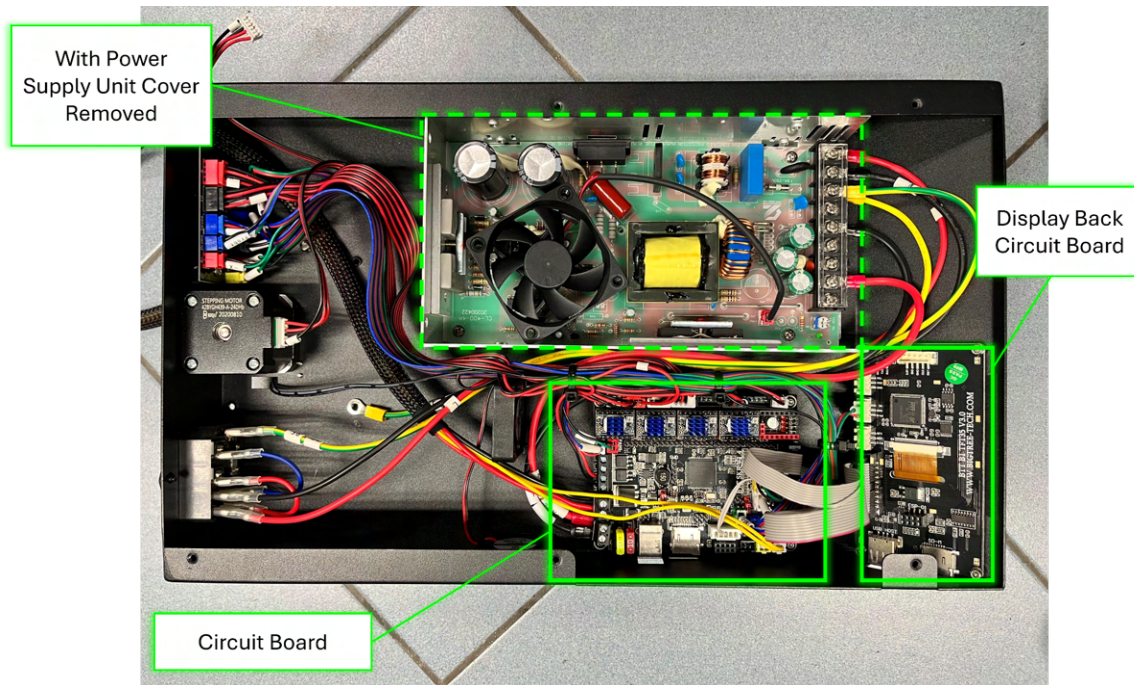
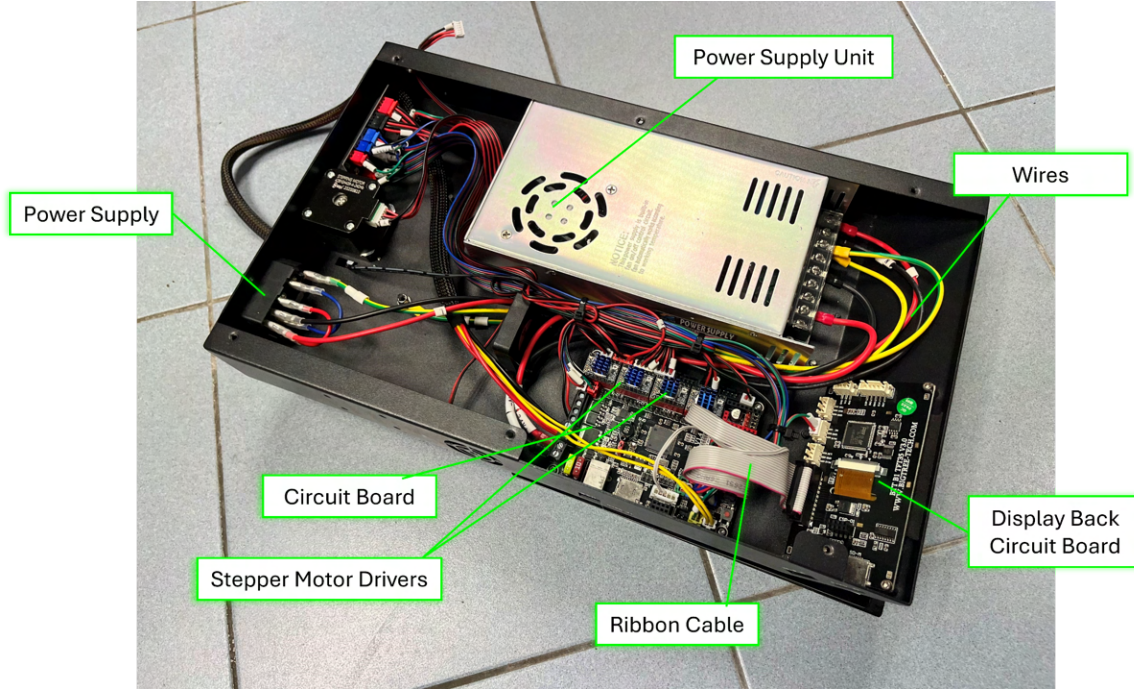


Identifying and Researching the Various Components Online Using Datasheets, Forums, Blogs and Product Overviews

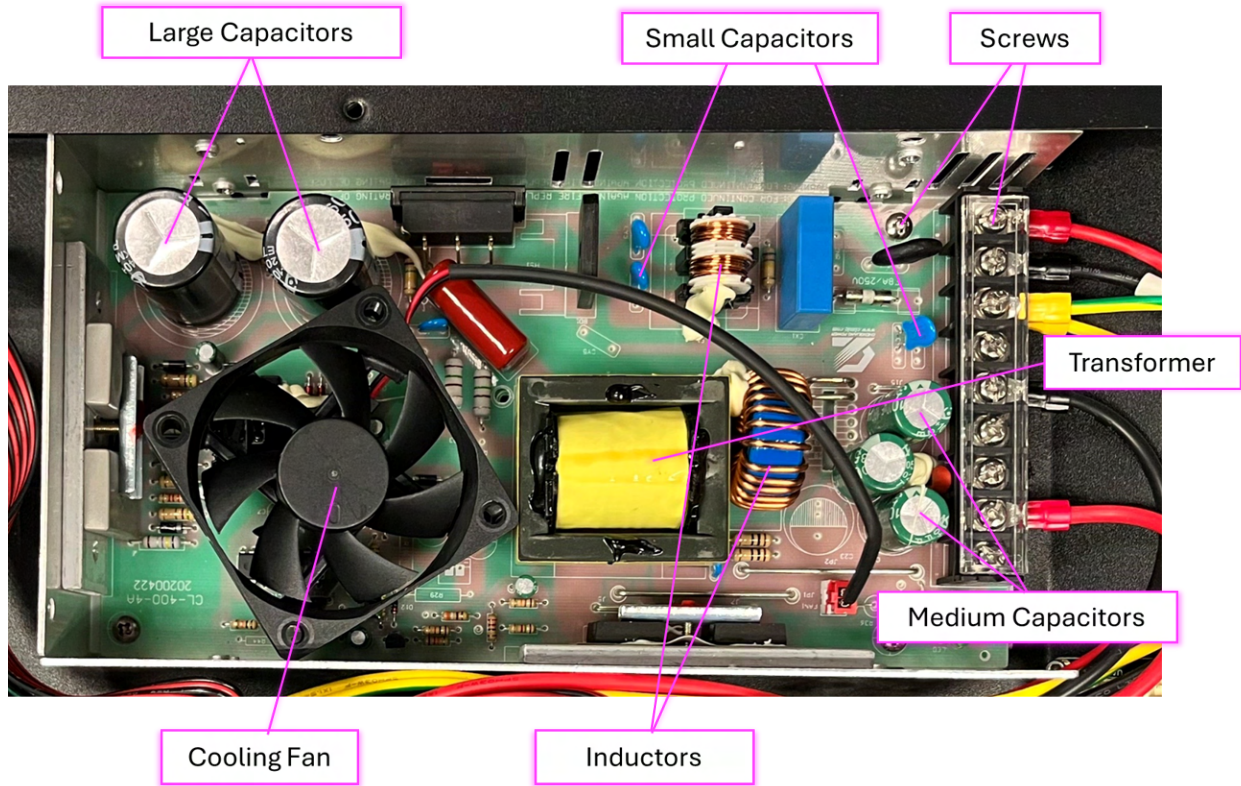


Interior of the 3D Printer

Base of 3D Printer

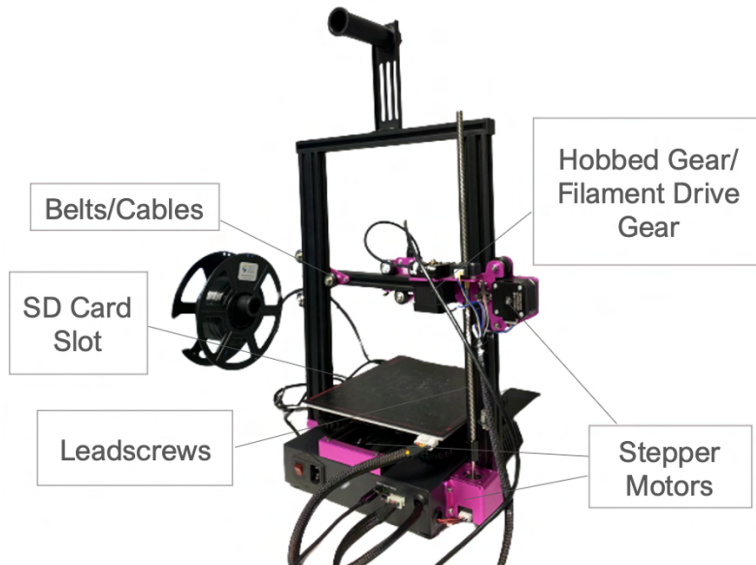
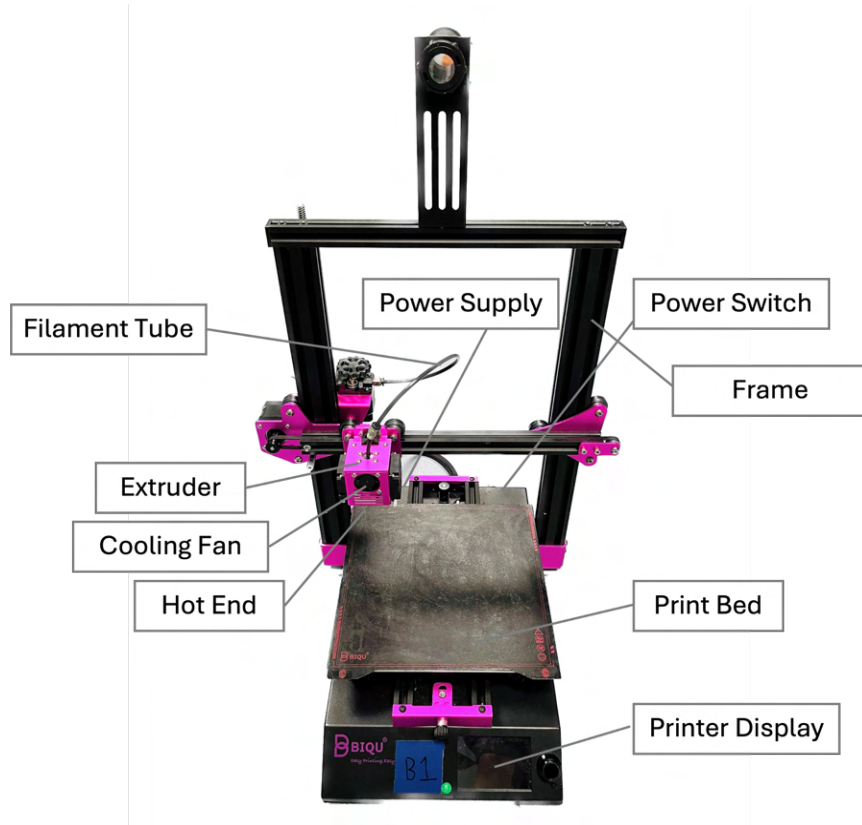


Components of the Power Supply Unit



List of Components

External

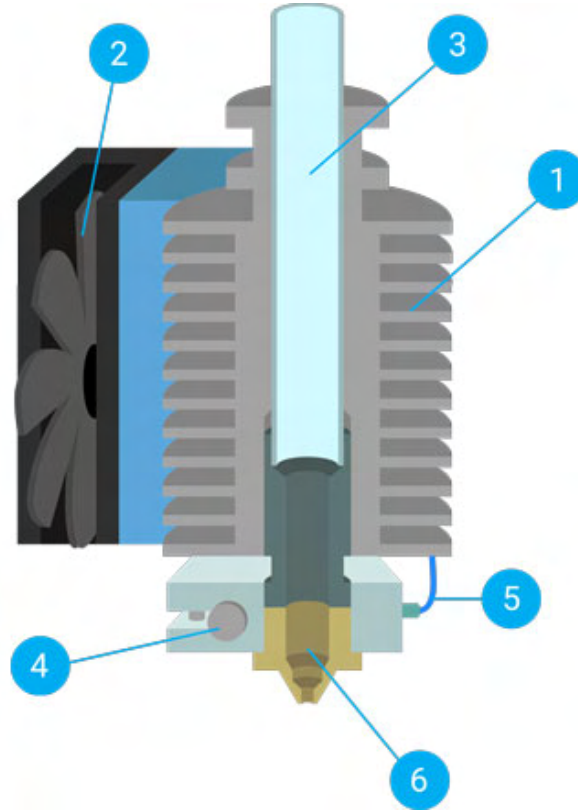


No.	Component	Part Type	Part Description
1	Printer Display	LCD display	<p>Presents users with printer temperature and other related data, in which the user can also adjust such data using the display</p> <p>Acts as the point of interaction between the user and the printer</p>
2	SD Card Slot	Information Component	Permits direct file loading into the printer from a connected micro SD card
3	Hobbed Gear /Filament Drive Gear	Movement Component	Moves the filament to the extruder
4	Print Bed	Printing System & Movement Component	<p>Heats up for the first layer of extruded plastic to settle down on and stick to to prevent movement of the print during printing and warping</p> <p>Has the ability to move in the y axis through the use of motors</p>
5	Leadscrews	Movement Component	Drives movement to the z axis by rotating back and forth, moving the extruder up and down
6	Belts/Cables	Movement Component	Connected to the printer's extruder and controlled by attached motors to provide the extruder with movement along the x and y axis
7	Stepper Motors	Movement Component	Gives the extruder and other sections of the printer movement by employing belts.
8	Extruder	Printing System	All of the internal operations of a 3D printer take place in the extruder.
9	Hot End	Printing System	The melting and depositing of filament takes place at the hot end of 3D printers.

10	Nozzle	Printing System	Filament is extruded from the 3D printer's nozzle, which is attached to the hot end, and travels to the print bed to create the model.
11	Power Supply Unit	Power Source	Supplies power to the printer

Hot End

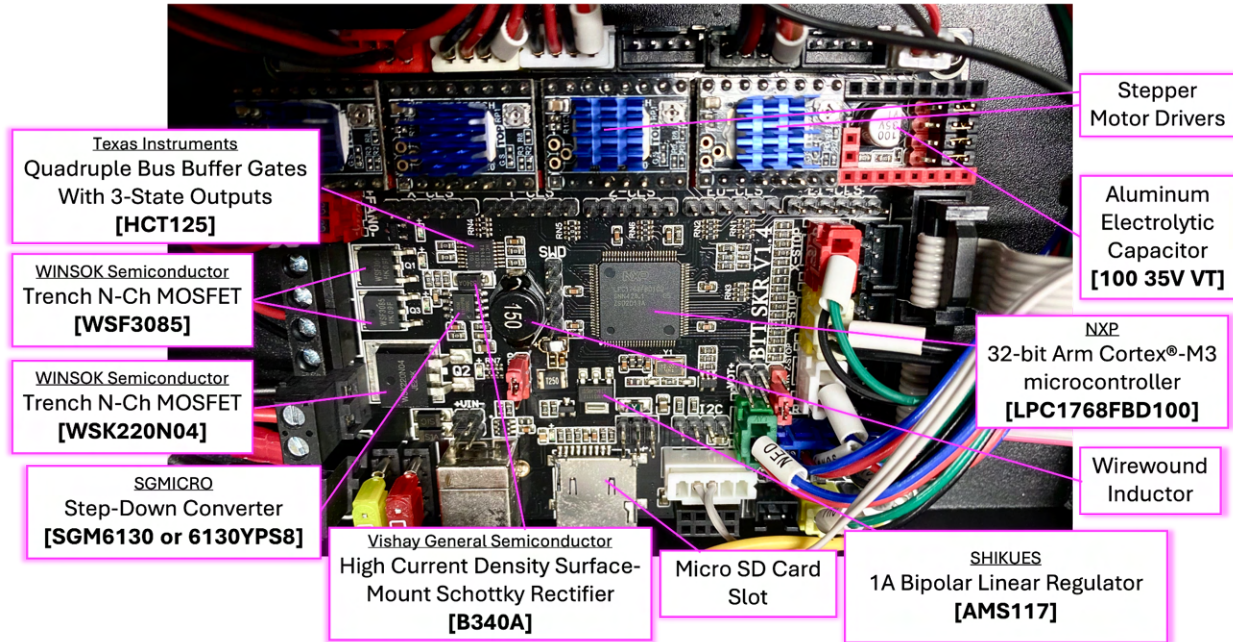
This subsection includes all components in the printer's hot end.



No.	Component	Part Type	Part Description
1	Heat Sink	Cooling Component	Keeps heat from travelling upward and melting the filament prematurely
2	Heat Sink Fan	Cooling Component	Cools down the heat sink to stop any heat moving up the extruder barrel, preventing filament from becoming wedged in the barrel Cools down the extruded plastic to quickly solidify it and help it retain its shape
3	PTFE Tube	Cooling Component	Stops heat moving up the extruder which would cause filament to melt prematurely

4	Heater Cartridge/ Heat Element	Resistor/ Heating Component	Heats up filament for extrusion
5	Thermistor/Thermocouple/ RTD	Temperature Sensor	Measures the temperature of the hot end
6	Nozzle	Extrusion Component	Hold for melted filament to be extruded in different diameters depending on its size Most commonly 0.4mm nozzles are used

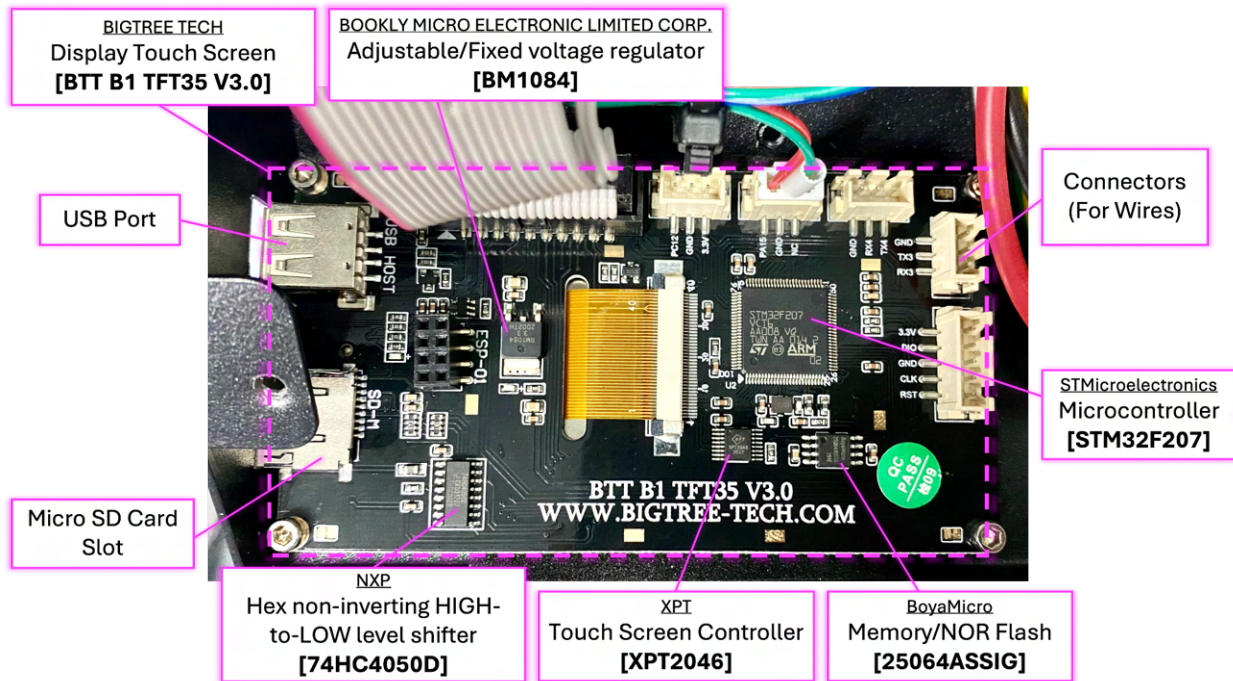
Internal Circuit Board Components



No.	Component	Part Type	Part Description
1	WSK220N04 WINSOK Semiconductor WSF3085 WINSOK Semiconductor https://datasheet.lcsc.com/sz/lcsc/WSK220N04_C148446.pdf	Trench N-Ch MOSFET	Enhances voltage and current control for many different power supply design requirements, some of which include high switching frequencies
2	HCT125 Texas Instruments https://www.ti.com/lit/ds/symlink/sn74hct125.pdf?ts=1671950975942&ref_url=https%253A%252F%252Fwww.google.com%252F	Quadruple Bus Buffer With 3-State Outputs	Increases the voltage of the source to the voltage required by the load and allows multiple logic devices to connect to the same wire or bus without causing any damage or loss of data

3	SGM6130 or 6130YPS8 SGMICRO https://file.remont-aud.net/baza/dc_dc/data/SGM6130.pdf	Step-Down Convertor	Converts high voltage to a lower form, commonly by converting AC current into DC current
4	B340A Vishay General Semiconductor https://www.vishay.com/docs/88896/b330la.pdf	High Current Density Surface-Mount Schottky Rectifier	Enables easy current flow only in a single direction, and is frequently used to enable or block current or to shape waves in AC circuits
5	Micro SD Card Slot	Information Component	Permits direct file loading into the printer from a connected micro SD card
6	AMS117 SHIKUES https://datasheet.lcsc.com/szlcsc/2001081204_Shikues-AMS117-1-2_C475600.pdf	1A Bipolar Linear Regulator	Regulates a constant output voltage in the pass device by checking it with an accurate reference voltage.
7	Wirewound Inductor	Power Inductor	Reduces core losses in an application that requires voltage conversion
8	LPC1768FBD100 NXP https://www.nxp.com/part/LPC1768FBD100#/	32-Bit Arm Cortex-M3 Microcontroller	Has a collection of instructions that may be used as a microcontroller to carry out arithmetic, logic, and boolean operations.
9	100 35V VT	Aluminium Electrolytic Capacitor	Smooths and buffers rectified DC voltages
10	Stepper Motor Drivers	Movement Component	Gives the extruder and other sections of the printer movement by employing belts.

Touchscreen Display Components



No.	Component	Part Type	Part Description
1	BM1084 BOOKLY MICRO ELECTRONIC LIMITED CORP http://www.bookly.com/images/BM1084.pdf	Adjustable/Fixed Voltage Regulator	Produces a DC output voltage value that can be adjusted to any other value of a certain voltage range, which can be either positive or negative
2	BTT B1 TFT35 V3.0 BIGTREE TECH https://biqu.equipment/products/btt-b1-tft35-v3-0-display-touch-screen-two-working-modes-for-biqu-b1	Display Touch Screen	An electronic display screen that displays printer relevant information
3	USB Port	Information Component	Allows files to directly load into the printer from a connected USB drives
4	Micro SD Card Slot	Information Component	Permits direct file loading into the printer from a connected micro SD card

5	74HC4050D NXP https://www.nxp.com/docs/en/data-sheet/74HC4050.pdf	Hex non-inverting HIGH-to-LOW level shifter	Allows for signal translation from one logic level or voltage domain to another, enabling interoperability between integrated circuits with different voltage requirements.
6	XPT2046 XPT https://www.datasheet-pdf.info/entry/XPT2046	Touch Screen Controller	Detects applied pressure on its visual display surface. The Controller then interface data between the processing system and the touchscreen element associated with the display
7	25064ASSIG BoyaMicro https://www.lcsc.com/product-detail/FLASH_BOYAMICRO-BY25Q16BSTIG_C382744.html	Memory/NOR Flash	Retains data without using a battery or any other voltage supply. It also writes and reads individual bytes of data. Furthermore, it is used where random access and execute-in-place access techniques are required
8	STM32F207 STMicroelectronics https://www.st.com/en/microcontrollers-microprocessors/stm32f2x7.html	Microcontroller	Controls a predefined function inside the printer by interpreting data it receives using its central processor. They run one specific program and are dedicated to a single task

References

Hot End Picture: <https://www.makeshaper.com/anatomy-of-a-3d-printer/>

Datasheet sources are included in the List of Components

Note: All images and diagrams not listed above were original from 8059D