



ING. MECATRÓNICA

**Tesis previa a la obtención del título de
Ingeniero en Mecatrónica.**

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Diseño y Construcción de un Simulador de Sistema de
Sanitización de Botellas de Plástico
Design and Construction of a Simulator of Plastic Bottle
Sanitation System

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ACKNOWLEDGMENTS

I would like to express my sincere thanks to my dear mother, Norma Andrango, who has been a fundamental pillar in my life and education. Her constant support and encouragement have been my greatest inspiration, and without her unconditional love, this achievement would not be possible. I am also grateful to Professor Alexander Tirira for his dedication and guidance during the development of this project. His expertise and commitment were fundamental to this academic achievement.

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Design and Construction of a simulator of Plastic Bottle Sanitation System.

1 Mechanical design

The act of designing involves the development of a plan that meets a specific need or solves a particular problem. If this plan results in the creation of a physical product, it must be safe, reliable, competitive, useful, functional, manufacture and marketable. Design is an iterative and innovative process that also involves making decisions, sometimes with little information, sometimes with the right amount of information, and sometimes with conflicting information. Often these decisions are tentative, meaning that the right to make adjustments as more information is obtained must be reserved. In the mechanical design of a simulation of bottle sanitizing system, three stages must be considered, which are the dirt check, the cleaning and the emptying. On the other hand, it should be considered if the system is able to perform the cleaning process without any problem. At the time of design, it should be taken into account whether the process it performs is didactic and easy to maintain. Or if there is any failure, it should be easy to make the change without any problem, fulfilling efficiently.

According to the book "Industrial Design Manual" by Gerardo Rodriguez, design is a process that involves decision-making based on different levels of information and constant iteration to achieve a safe, reliable and functional product. In addition, in mechanical design, it is important to consider the efficiency and maintainability of the system, as is the case in the design of a simulated bottle sanitizing system.[1]

1.1 Technical specifications

The degree project consists of a didactic learning module with the following dimensions 350 mm x 750 mm x 750 mm, whose purpose is the cleaning of 600 ml plastic bottles. It power by a 110 V AC. The module make of A-36 steel and plastic polymers. Its programming consists in the union of a PLC with a HMI screen and an Esp32.

In addition, the bottles to be used in this process will be exclusively Dasani natural water bottles, of the transparent type.

In tab 1. In this part can see more detailed technical aspects of the machine.

Table 1: Technical specifications mechanical equipment

Power Supply	110V
General Dimension	350mmx750mmx750mm
Work space	350mmx750mm
Materials used for construction	Steel, PETG, Aluminium, Wood
Work object	600ml plastic bottle Dasani
Main controller	PLC LOGO8!
Display	LOGO! TDE

1.2 Alternatives analysis

1.2.1 Design approach

For the final selection of the module, several sets of ideas were evaluated for both the mechanical and the electronic part. Furthermore, the composition of the computer part depends on the combination of the mechanical and electronic part. In tab 2., In this part can see all the alternatives that were considered to reach a final goal with the same working principle.

Table 2: Selection of mechanical and electronic alternatives of the model to be built.

Mechanical alternatives	
Location of the colour sensor to identify colour spots on the bottle	The sensor is fixed and the base is rotatable. The sensor is fixed and the base is fixed.
Generate water pressure in order to clean the bottle.	Water reservoir system and water pump Water pump system and different sizes of nozzles at the water inlet Direct water intake system
The bottle's claw	Mechanical claw that allows the bottle to be picked up from the middle. Mechanical claw to fit the spout of the bottle.
Electrical alternatives	
Prototype control	PLC and extension modules PLC and Esp32

1.2.2 Final alternative

To understand the process of the project and where it is headed, a sketch is drawn up showing the composition, as shown in fig 1. This sketch consists of 3 stages through which the bottle must pass in order to simulate the cleaning process. As mentioned, the stages through which the cylinder must pass are: identification, cleaning and emptying.

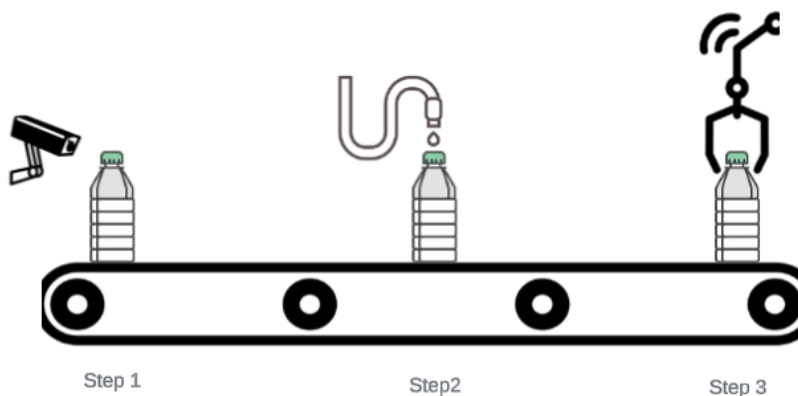


Figure 1: 2D drawing of the simplified process of bottle cleaning simulation

1.2.3 Identification

In the Identification stage, color sensors will be used to determine whether the bottle is dirty or not. It was decided to use blue and green color identification to signal whether the bottle is dirty or clean. Fig 2. shows a sketch of how the color sensors would be located.

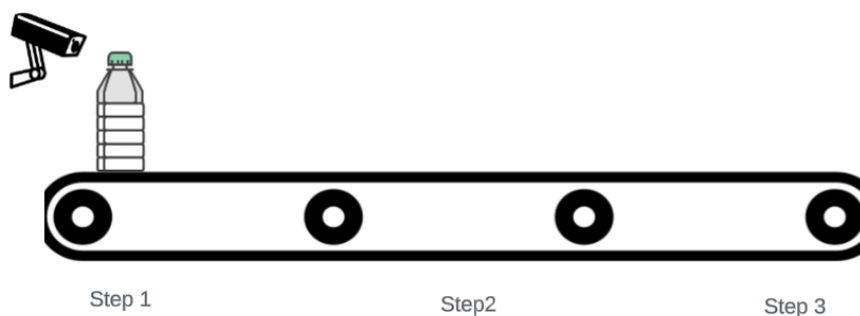


Figure 2: Positioning of the color sensor within the bottle cleaning simulation process.

1.2.4 Cleaning

In the cleaning stage, the cleaning process of the cylinder carry out. For this stage, it is considered to use the water pressure coming from the pipes. A hose connects to a servo valve that will control the flow of water, allowing it to exit. In this way, the water pressure will be used to clean the cylinder. A sketch representing the idea of this stage can be seen in fig 3.

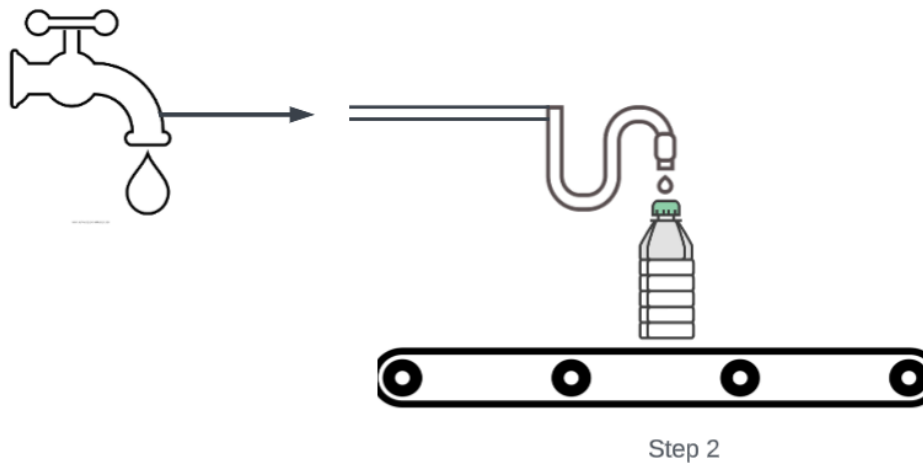


Figure 3: Positioning of the pressurized water system of the simulated bottle cleaning process

1.2.5 Emptying

In this emptying stage, it is planned to use a claw that attaches to the spout of the 600 ml Dasani bottle, picks it up, transports it and rotates it in order to extract the liquid used in the cleaning stage. A representation of how this stage will be carried out can be seen in fig 4.

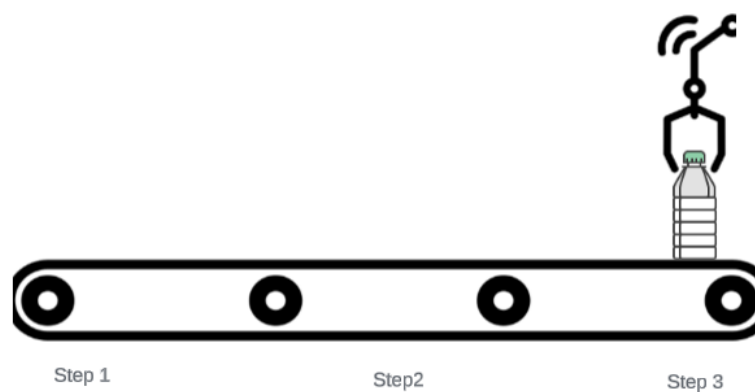


Figure 4: Position of the claw that performs the emptying of the bottle cleaning simulation process.

1.2.6 CAD sketch

Once the ideas of the project process were clear, we proceeded to modelling using the CAD software. As shown in fig 5, we can see the three stages mentioned above:

1. Identification
2. Cleaning
3. Emptying

Fig. 5 shows some circuits that indicate where each stage of the process is located.

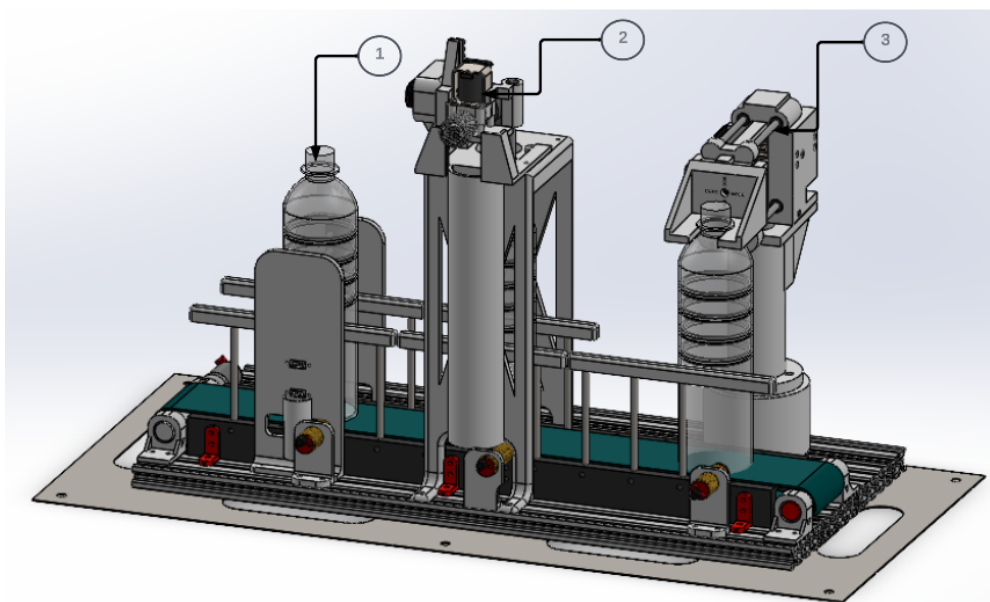


Figure 5: 3D drawing of the complete bottle cleaning simulation process assisted by CAD software.

In fig 5. of the CAD model, it have a more detailed view of how the process carry out.

- Identification: At this stage, the location of the sensors can be seen more clearly. Two brackets have been provided to place two sensors, one at the top and one at the bottom.
- Cleaning: During the cleaning stage, a mechanism can be observed that will facilitate this process. This mechanism is simple: by using a rack and pinion system, it lowers the servo valve that controls the water flow, allowing the cleaning to be carried out.
- Emptying: During the emptying stage, the claw used to pour the liquid used in the cleaning process can be seen. This claw consists of 4 movements: the first involves a horizontal displacement by means of the pinion-rack system, achieving the coupling to the bottle spout; the second is the return of the pinion-rack; the third, a 180° counterclockwise rotation from

the base of the claw; and finally, the fourth, a 180° rotation of the claw to remove the liquid. In addition, to complement the materialization of the analysis of alternatives, the design of a structure that allows us to support the electronic and mechanical parts was carried out, as shown in fig 6.

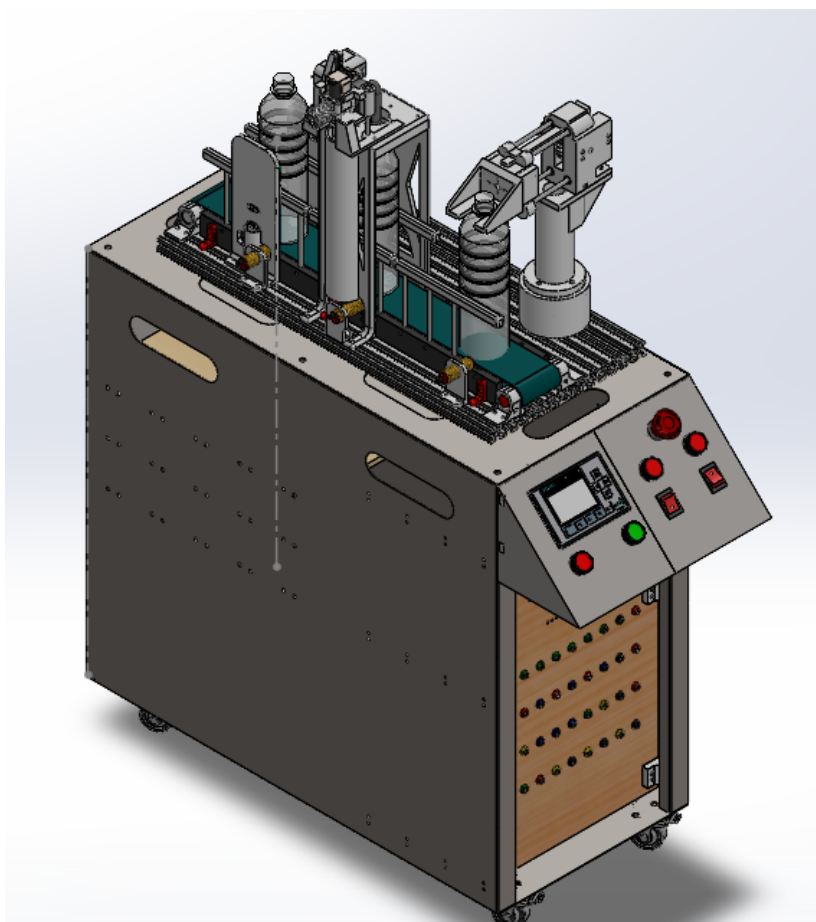


Figure 6: Complete view of the CAD model with all its components.

This equipment must take into account that the elements are not connected directly to the equipment, so a group of terminals were included in a connection board that allow us to make the connections interactively, as shown in the fig 7.

In addition, it has a control panel that includes push buttons and switches to operate the equipment, and a display to visualize the process through text messages, as shown in fig 8.

This whole process controls by a PLC that communicates with the different Esp32 via pulses on its outputs.



Figure 7: View of the connection board where the terminal blocks are located.

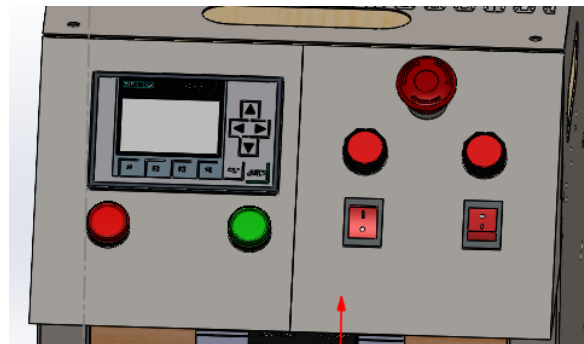


Figure 8: View of the control board with switches, push buttons and display

1.3 Dimension and selection of mechanical parts

1.3.1 Component supports

There are parts within the CAD design that play the role of supporting the elements and giving them a functional location, where they perform their work or action. Fig 9 shows the parts that fulfil this role.

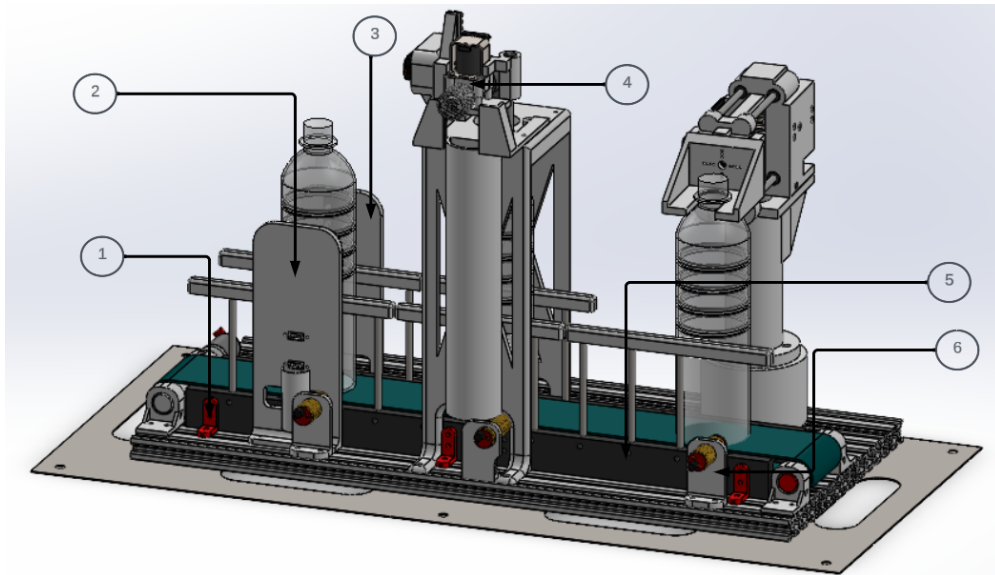


Figure 9: Location of the supports of the functional elements.

The elements are:

1. Conveyor belt support bracket.
2. Support of the color sensor lower part.
3. Support of the color sensor upper part.
4. Servo valve support.
5. Conveyor belt support.
6. Presence sensor support

Conveyor belt support bracket

This piece allows us to fasten the conveyor belt track to the aluminum profiles, as shown in fig 10, preventing the track from slipping and maintaining its position to avoid any inconvenience to the conveyor belt.

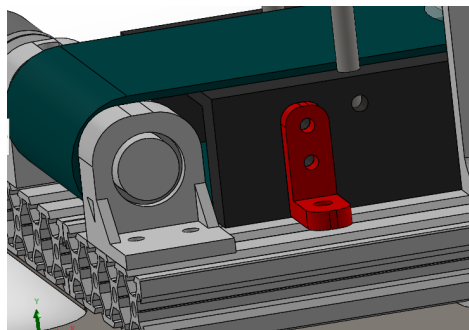


Figure 10: View of the conveyor belt support bracket and how it makes the connection between the aluminum profile and parts.

Support of the color sensor lower part

This part allows us to hold the color sensor to identify colored spots on the bottom of the bottle, as shown in fig 11. It can be seen that the part has a large surface area in relation to the size of the sensor and is white. This is because, during identification, the sensor is prevented from detecting colors other than the one indicated, as it has a white restriction in the programming. In addition, as the bottle is transparent, the sensor can read colors through it. Therefore, both sensor holders share this design to cover the entire bottle, preventing other colors from the outside from being identified.

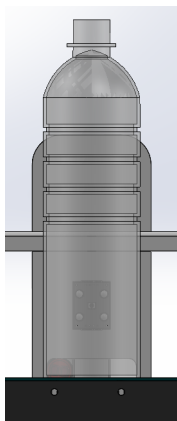


Figure 11: View of the color sensor at the bottom of the bottle

Support of the color sensor upper part

This part allows us to hold the color sensor to identify colored spots on the top of the bottle, as shown in fig 12. It can be seen that the part has a large surface area in relation to the size of the sensor and is white. This is because, during identification, the sensor is prevented from detecting colors other than the one indicated, as it has a white restriction in the programming. In addition, as the bottle is transparent, the sensor can read colors through it. Therefore, both sensor holders share this design to cover the entire bottle, preventing other colors from the outside from being identified.

Servo valve support

This piece allows us to hold the servo valve, which controls the water flow. In addition, this support has the rack that allows vertical displacement so that the servo valve fits into the spout of the bottle and can carry out the cleaning process. This can be seen in fig 13.

Conveyor belt support

This part prevents excessive displacement of the bottle on the conveyor belt and serves as a support for the conveyor belt. It can be seen in fig 14.

Presence sensor support

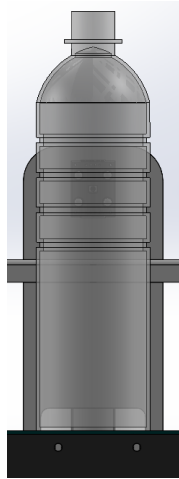


Figure 12: View of the color sensor on top of the bottle

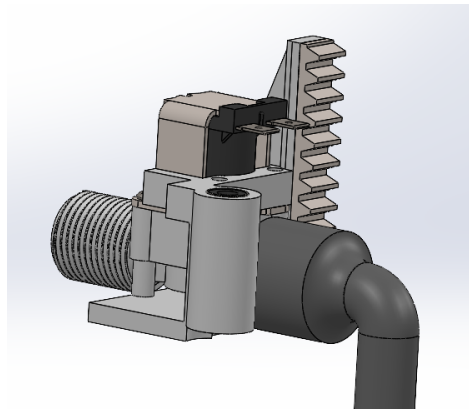


Figure 13: View of Servo valve support

This part holds the infrared color sensor and must be placed on the conveyor belt support so that it only detects bottles. If it were at the height of the conveyor belt, it would be constantly detecting objects due to the continuous presence. Fig 15 shows its design and position.

1.3.2 Conveyor belt system

Dimension

In order to transport the 600 ml plastic bottles, a conveyor belt was designed. This conveyor belt allows the bottle to be placed at the different stations where identification, cleaning and emptying will take place.

The following dimensions were considered in the design of the belt: a total length of 635 mm, given that the work table is 350 x 750 mm. By default, The equipment have a space

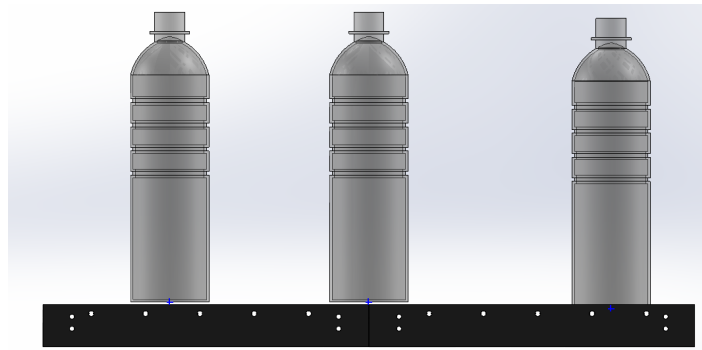


Figure 14: View of Conveyor belt support with plastic bottles

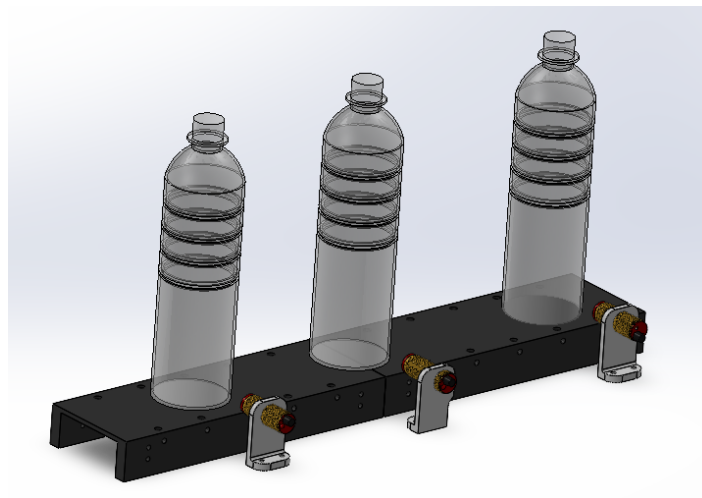


Figure 15: View of Presence sensor support in the three stages of the equipment

of 750 mm to install the belt, taking into account the other elements and the space needed to tension it. In addition, the width of the band will be 70 mm, a measurement selected on the basis of the diameter of the 600 ml Dasani plastic bottles. The main objective is that the bottle is positioned on the band and, by means of rails, any deviation is avoided, ensuring its correct position. Regarding the radius of curvature that the conveyor belt has, it was chosen according to the criteria of the PVC belt manufacturer, whose minimum diameter is 30 mm. Therefore, the aim was to keep this measure as compact as possible, opting for the minimum required.

Fig 16. shows more graphically where the aforementioned measures are located.

On the other hand, in order to move the conveyor belt, it is equipped with:

1. Roller support
2. Roller
3. Steel bar
4. Rail

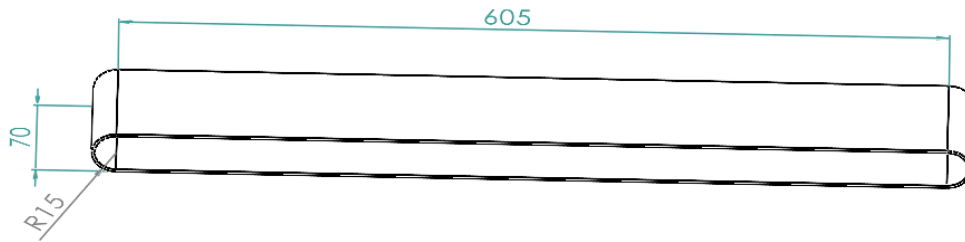


Figure 16: View of the overall dimensions of the conveyor belt

- 5. Conveyor belt support
- 6. Conveyor belt
- 7. Motor support
- 8. Motor roller
- 9. Conveyor belt support bracket

The list of elements can be seen in figure 17.

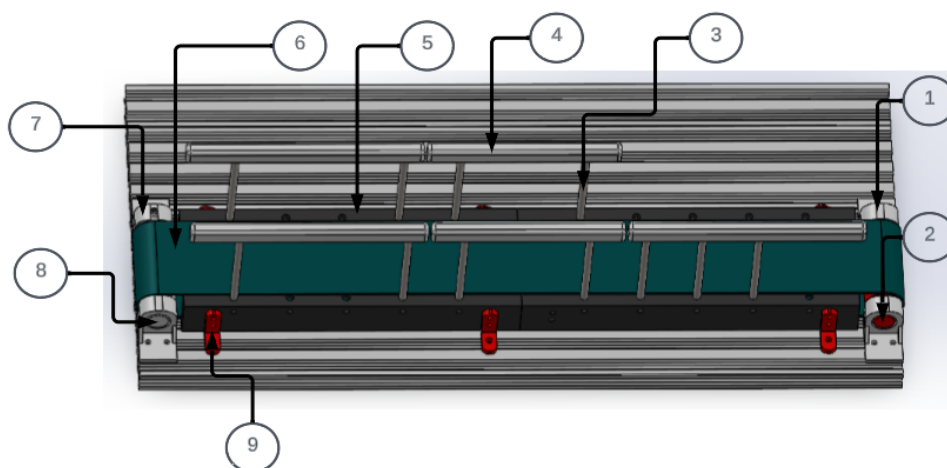


Figure 17: View of the parts that make up the conveyor belt.

All the aforementioned elements are mounted on aluminum profiles, which allows us to move them on their rails and position the elements in the best possible way.

In this way, in order to be able to tension the belt, the roller supports move horizontally to achieve the tension necessary to carry out the movement.

All elements shall be fastened with M4 bolts and M4 T-nuts.

Conveyor belt calculation

In this part, the calculations necessary to know the minimum power of the motor and to be able to select the most suitable and available motor in the place where the module manufac-

tured to discuss. A sketch of the conveyor belt system is shown in fig 18.

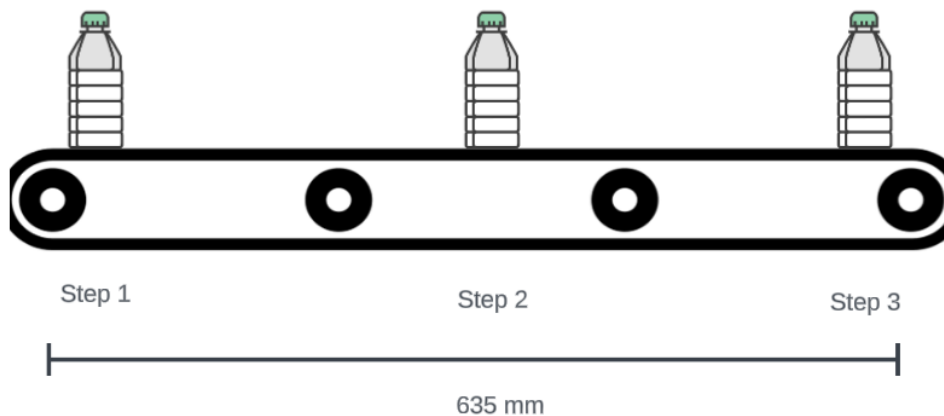


Figure 18: Outline of the conveyor belt

In fig 19 we can see in more detail where the data to be searched is entered.

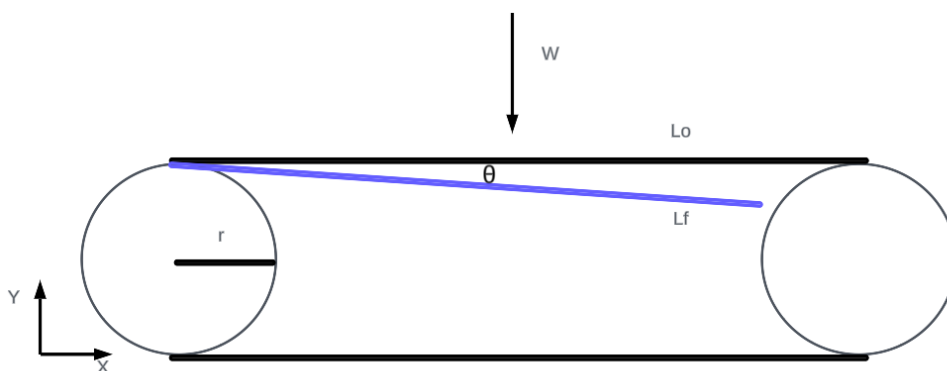


Figure 19: Free-body diagram of the conveyor belt

First, you need to know the final length of the belt with the applied weight. Therefore apply the formulas for the factor of safety and for the stress. With the equation of the factor of safety and the stress, can clear the stress, as shown in equation 1, to obtain the value of the final length. Tab 3 shows the data

$$\frac{S}{n} = E \cdot \frac{L_f - L_o}{L_o} \quad (1)$$

$$L_f = 636,01 \text{ mm}$$

Table 3: Parameters for the calculation of the final length

Denomination	Symbol	Value
Traction force [2]	S	51,7 MPa
Safety factor	n	10
Initial length	L_o	635 mm
Young modulus of PVC[2]	E	3,25 GPa
Final length	L_F	636,01 mm

Knowing the final length, it can determine how much the final length displaced. This is shown in equation 2

.Tab4 shows the data

$$L_o = L_f \cdot \cos(\theta) \quad (2)$$

$$\theta = 3,23^\circ$$

Table 4: Parameters to know the displacement of the belt

Denomination	Symbol	Value
Initial length	L_o	635 mm
Final length	L_F	636,01 mm
Displacement angle	θ	3,23°

Deriving the angular velocity that the band will have, used the equation 3. Tab 5 shows the data

$$\omega = \frac{V}{r} \quad (3)$$

$$\omega = 13,33 \frac{rad}{s}$$

Table 5: Parameters to know the angular velocity of the belt

Denomination	Symbol	Value
Angular velocity	w	13,33 $\frac{rad}{s}$
Radio	r	0,015 mm
Velocity	V	0,2 $\frac{m}{s}$

Calculate the force needed to move the belt. In equation 4, seeing the formula. Tab 6 shows the data

$$F = (m_B + m_C) \cdot g \cdot \sin(\theta) \cdot e^{\mu \cdot \pi} \quad (4)$$

$$F = 7,35 \text{ N}$$

Table 6: Parameters to know the force needed to move the belt

Denomination	Symbol	Value
Bottles weight	m_B	1,8 kg
Weight of the conveyor belt	m_C	0,22 kg
Gravity	g	9,8 $\frac{m}{s^2}$
Coefficient of friction[3]	μ	0,6
Force	F	7,35 N

Calculate the torque required using equation 5. Tab 7 shows the data

$$T = F \cdot r \quad (5)$$

$$T = 0,11 \text{ Nm}$$

Table 7: Parameters to know the torque of the belt

Denomination	Symbol	Value
Torque	T	0,11 Nm
Force	F	7,35 N
Radio	r	0,015 m

Convert torque to power, looking for a commercial engine available at the construction site. Using equation 6, Calculate the engine power. Tab 8 shows the data

$$P = T \cdot \omega \quad (6)$$

$$P = 1,47 \text{ W}$$

Table 8: Parameters to know the Power of the belt

Denomination	Symbol	Value
Torque	T	0,11 Nm
Angular velocity	w	13,33 $\frac{rad}{s}$
Power	P	1,47 W

In this case, needing a motor with a minimum power of 1,47W.

Knowing that the belt has a small stretch, it was decided to include a support for the conveyor belt. This will be limited by 11 steel rods with a diameter of 6 mm, connected to the rail, which will prevent the bottle from slipping out of its path, as well as the belt. The corresponding illustration is shown in fig 20.

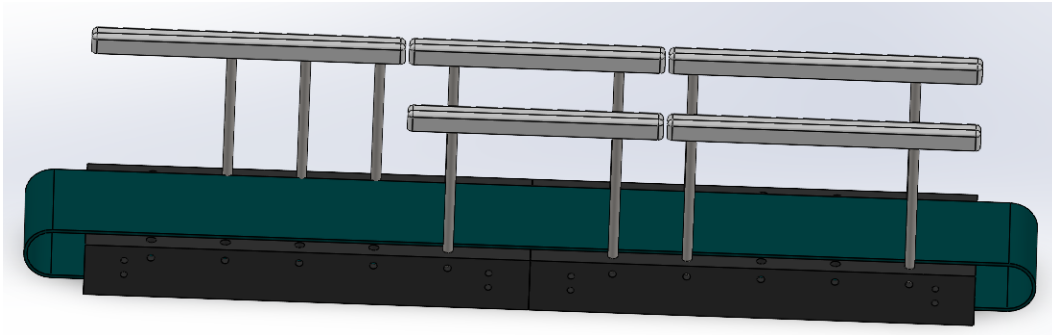


Figure 20: View of the conveyor belt with rail constraints

Rolleres

The conveyor belt is moved by rollers that are subjected to a force and supported by their respective bearings. The two rollers are different. The roller supported by the motor has a hole through which the motor shaft enters and is fitted with a locking device to prevent the motor shaft from slipping out. Fig 21 shows what the motor roller looks like. The roller is made of grilon, as mentioned above. This roller has a hole in the side. This material was chosen because of its hardness and compactness, thus preventing the hole from being deformed by the force of the motor.

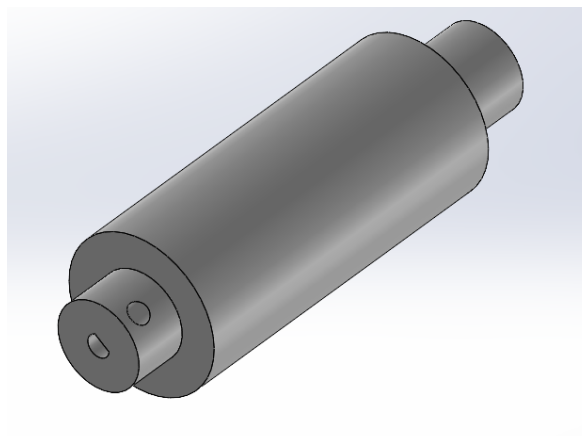


Figure 21: View of the roller that couples with the motor and moves the belt.

In addition, it has a second roller that simply holds the belt and allows the circular movement for the belt to rotate around it. In fig 22, they can see what this looks like. In this case, this roller is made of PETG and printed on a 3D printer. Unlike the motor roller, this one did not need to have a hole, so it was decided to use PETG for this roller.

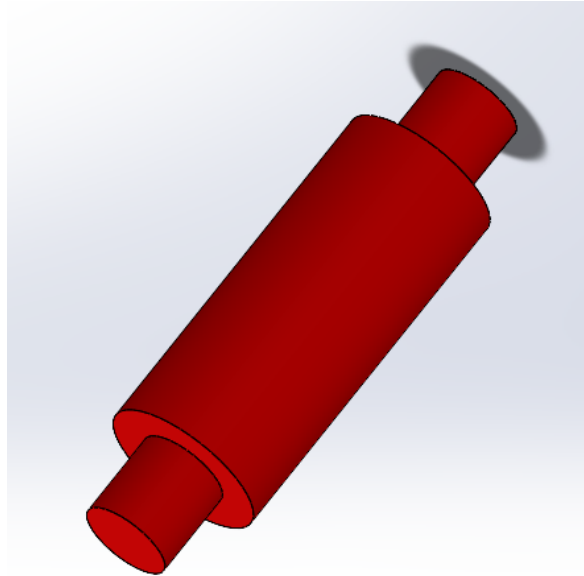


Figure 22: View of the roller that performs the circular movement following the main roller.

On the other hand, the two rollers have a diameter of 30 mm, as the belt manufacturer mentioned to us that the minimum diameter for the use of the belt is 30 mm. Therefore, choosing to make them as compact as possible, but functional, using the minimum size.

In the manufacturing or machining process, the elements are not always perfect and may have minor faults. Therefore, in order to guarantee the circular movement of the rollers, bearings incorporated at the ends. The bearings chosen for this purpose are 6803-2RS-SS, which are the largest bearings available at the module's manufacturing site. Their dimensions are 17 mm x 26 mm x 5 mm. This can be seen in fig 23.

As mentioned above, the bearings will be attached to the ends of the rollers. In fig 24 can see them more clearly. The use of the bearings is due to the fact that the circular motion is to be cleaner and without complications and impediments to turning, and so the circular motion is not only depend on the circular shape of the roller ends, but also on the smoothness and ease provided by the bearings.

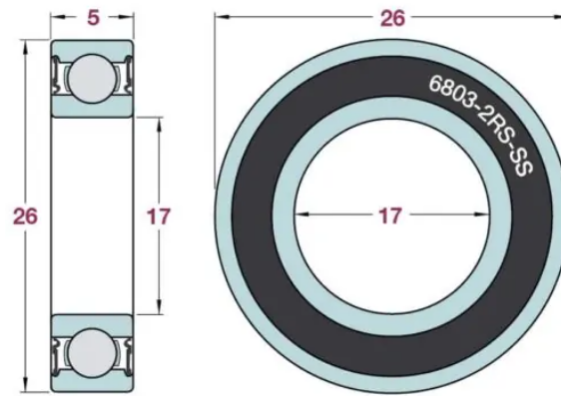


Figure 23: 6803-2RS-SS bearings used for conveyor belt rollers

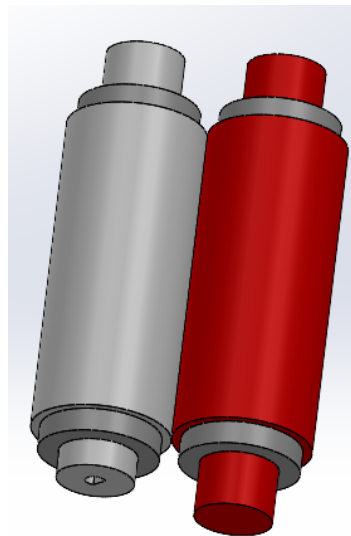


Figure 24: View of the conveyor belt rollers with the 6803-2RS-SS bearings in place.

As can be seen in fig 24, the white roller has a smaller end. This is because it is connected to the motor shaft. While the red roller is attached to the brackets and only performs the circular motion.

Roller force calculation

The force exerted by the roller to initiate the movement were calculated. With this calculation, the simulation of the roller supports carried out. The free body diagram is obtained as shown in fig. 25.

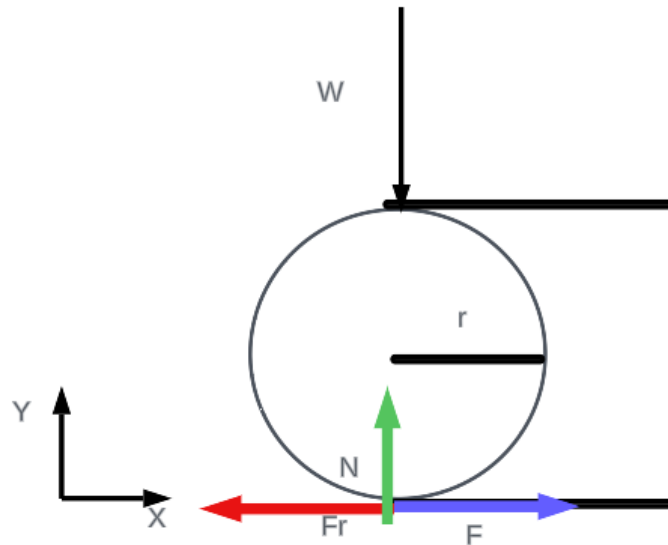


Figure 25: Free-body diagram of the roller relative to the belt

By looking at the diagram, equation 8 can be deduced. Where the frictional force is equal to the starting force. Tab 9 shows the data

$$F = F_r \quad (7)$$

Table 9: Parameters to know the force

Denomination	Symbol	Value
Force	F	N
Friction Force	F_r	N

In equation 8 can see the equality of the friction force. Tab 10 shows the data

$$F_r = m \cdot g \cdot \mu = 1,76N \quad (8)$$

Table 10: Parameters to know the friction force

Denomination	Symbol	Value
Friction Force	F_r	$1,76N$
Gravity	g	$9,8 \frac{m}{s^2}$
Mass	m	$0,6kg$
Coefficient of friction	μ	$0,3$

The equation for the frictional force is equal to the force required to perform the initial movement.

Roller support

In order to support the rollers with their bearings, specific parts have been created. Fig 26 shows the roller support, which uses 3 identical parts. These parts support the roller and its bearing. It can be seen that it has perforations at the back that facilitate the circular movement of the roller without problems. On the other hand, fig 27 shows the motor support, which is responsible for holding the motor and connecting it to the roller. For this reason, it has internal perforations to allow for bolting.

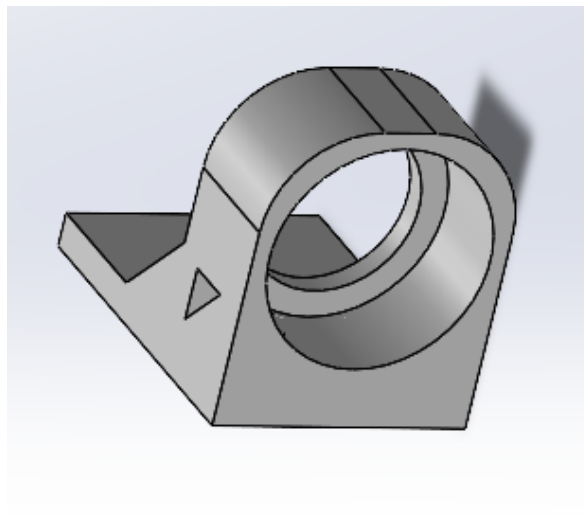


Figure 26: View of conveyor belt bearing bracket that only follows the belt rotation

Simulation of the supports

knowing that the force applied to the bearings is 1,76 N, this force is applied to the entire bearing. Therefore, choosing to do the simulation using this force. The following simulations carried out to study the deformation suffered due to the applied force, the useful life of the support and thus verify if it withstands various movements. The simulation of the safety factor, also be carried out to ensure that the support is designed correctly.

-Roller support

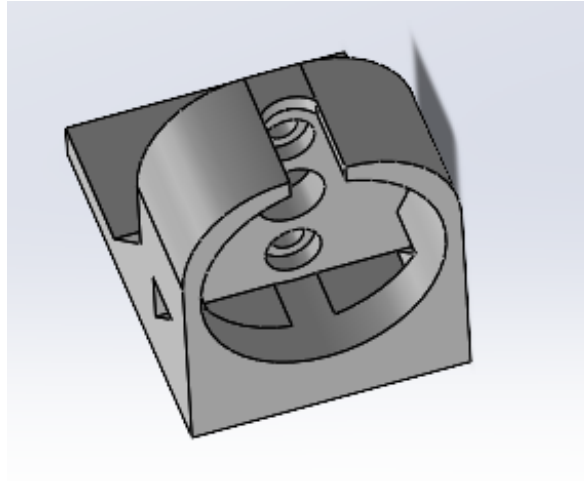


Figure 27: View of the motor support that drives the conveyor belt

Simulation of deformation: In fig 28 can see the roller support. At the top, the largest deformation is $6.3651e-5$ mm, which is almost negligible. Therefore, knowing that the part deforms but does not break.

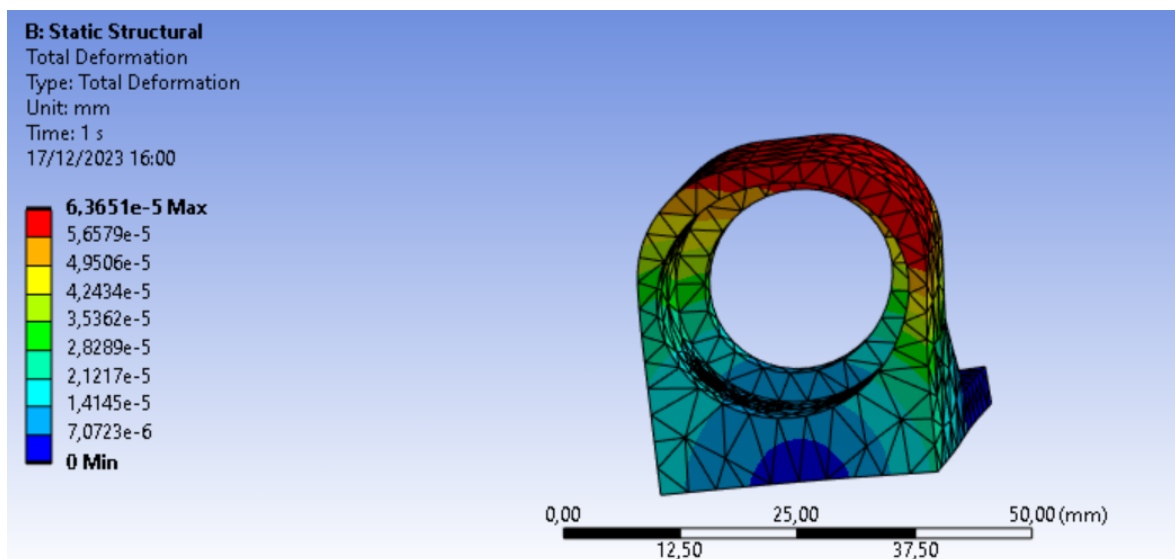


Figure 28: Simulation in ANSYS WORKBENCH of the roller support deformation

In the simulation of the life cycle, in the figure can observe that it supports $1e6$ movements before failing, so can conclude that the support has an infinite life. This is very helpful as the belt is in constant motion and the part is not fail. This information is shown in fig 29

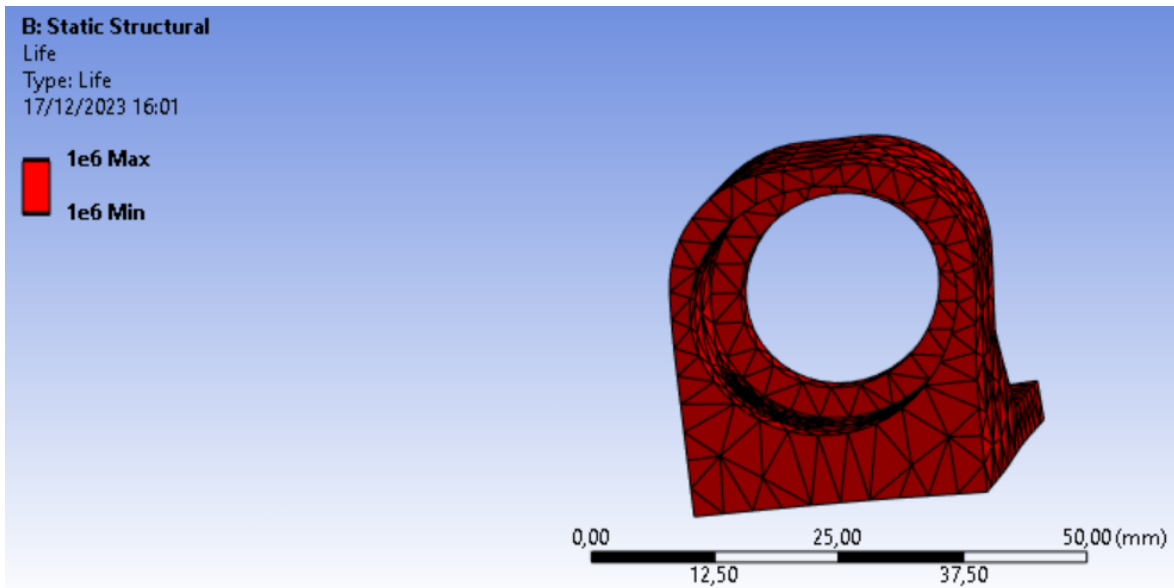


Figure 29: ANSYS WORKBENCH simulation of the roller support life cycle

This indicates that the part is not fail, as it has exceeded the minimum required value, which is greater than 1. This also indicates that the part is well-designed for the applied load. The safety factor simulation is shown in fig 30.

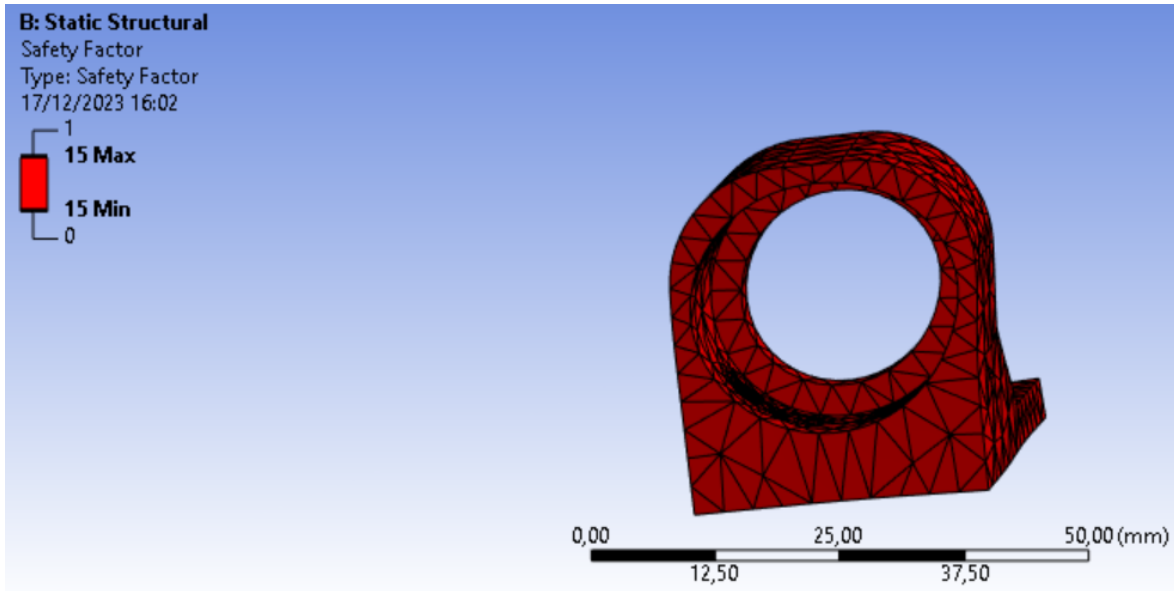


Figure 30: ANSYS WORKBENCH simulation of the roller support safety factor

-Motor support

Simulation of deformation: In fig 31 can see the roller support. At the top, the largest deformation is $6.78e-5$ mm, which is almost negligible. Therefore, knowing that the part deforms

but does not break.

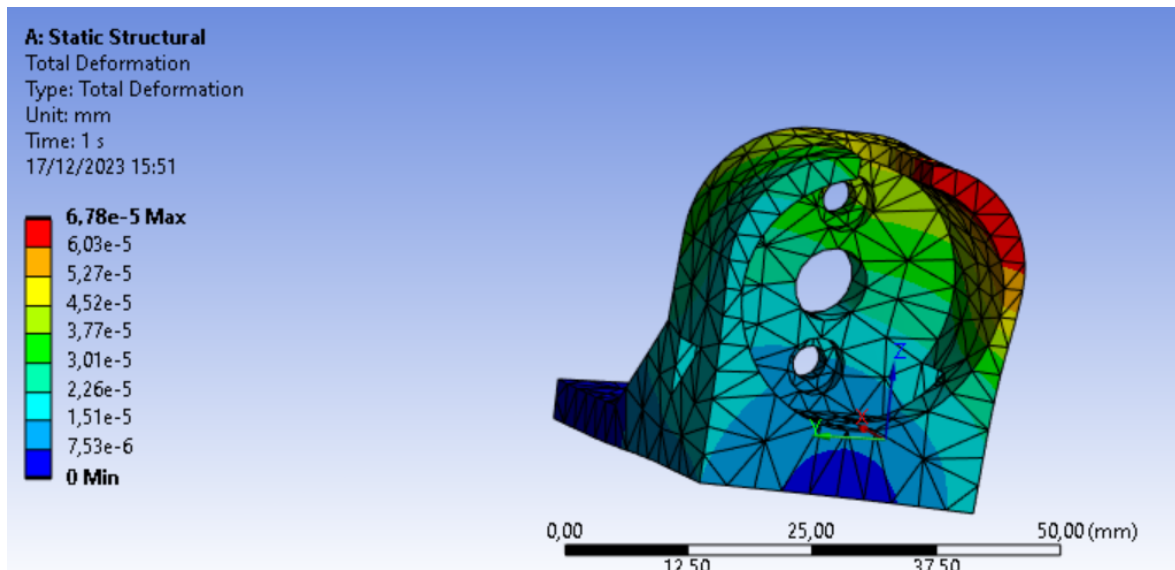


Figure 31: Simulation in ANSYS WORKBENCH of the roller support deformation

In the simulation of the life cycle, can observe that it supports $1e6$ movements before failing, so we can conclude that the support has an infinite life. This is very helpful as the belt is in constant motion and the part is not fail. This information is shown in fig 32

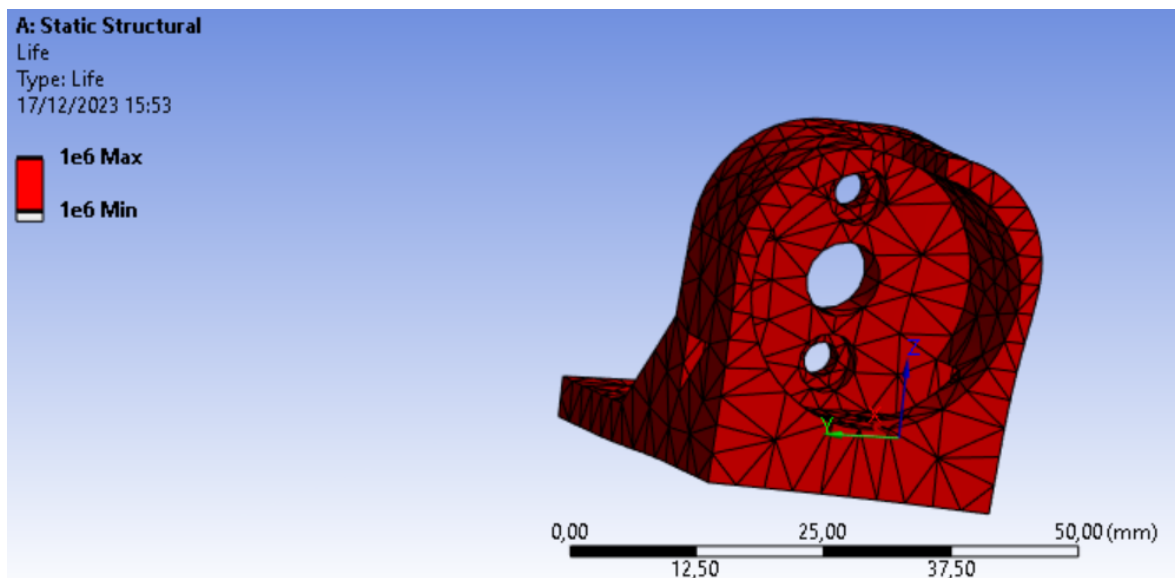


Figure 32: ANSYS WORKBENCH simulation of the roller support life cycle

This indicates that the part is not fail, as it has exceeded the minimum required value, which is greater than 1. This also indicates that the part is well-designed for the applied load. The safety factor simulation is shown in fig 33.

All simulations were done in the ANSYS Workbench software under the student license.

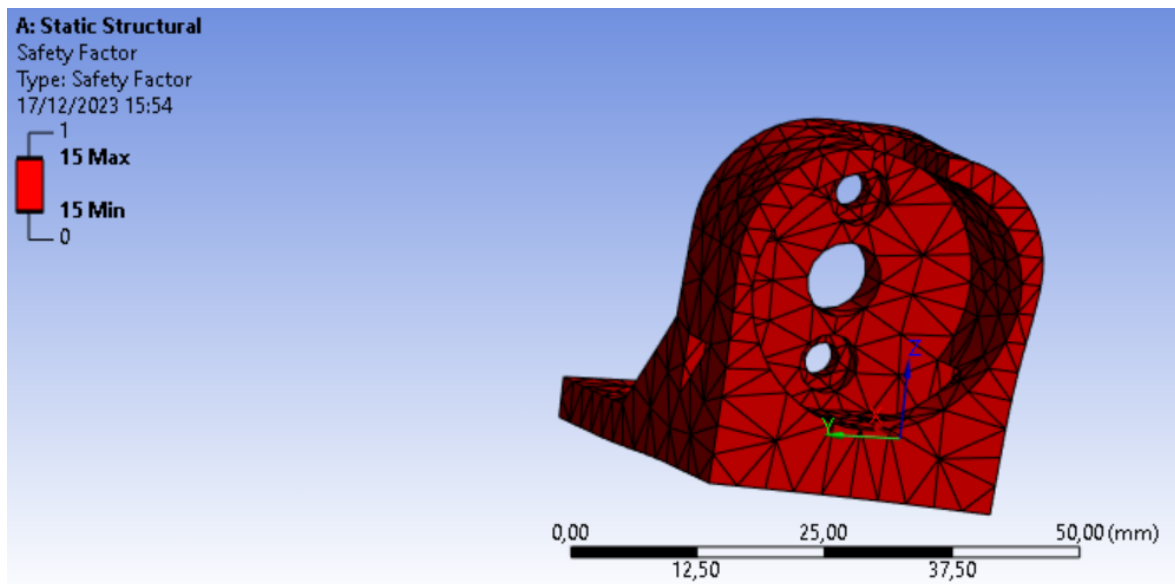


Figure 33: ANSYS WORKBENCH simulation of the roller support safety factor

The material used for the simulation was PET, which is used to create PETG, as this material is obtained from recycled bottles and was used to print the parts.

1.3.3 Water removal system

In order to carry out the water removal system, a clamp was designed that allows us to carry out the work, which can be seen in fig 34

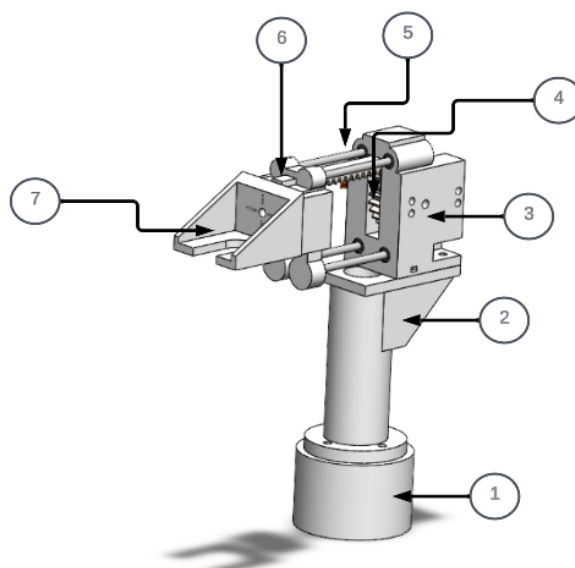


Figure 34: Drawing of a system that allows the removal of the liquid inside the bottle.

This system consists of several elements, which are as follows:

1. Rotating base
2. Pillar of the clamp
3. Clamp rail
4. Rack and pinion system
5. Steel bar
6. Support of bottle mouth coupling
7. Bottle mouth coupling

This clamp has 3 movements: a 180° displacement in coupling with the bottle, a horizontal displacement provided by a rack and pinion system, and a 180° displacement on the rotating base.

Dimensions: Bottle mouth coupling

Moreover, the 600 ml Dasani bottle has a protrusion on the top of its spout. Therefore, it was decided to use this protrusion to make a coupling that fits without any problem. It is much simpler and quicker to design a part that allows the bottle to be gripped rather than developing a complex mechanism to grasp it. In fig 35, the coupling would look like, which make it easier to hold the bottle during the emptying stage.

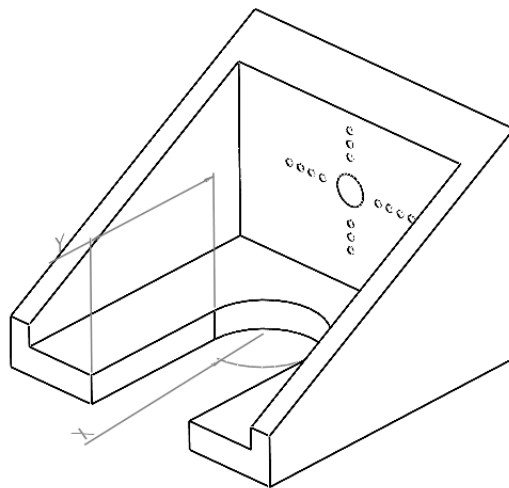


Figure 35: View of coupling for 600ml bottle spout

In fig 35., there are letters 'X' and 'Y'. The 'Y' represents the lane where the bottle pass through, while the 'X' indicates where the bottle placed at the end of the process. This whole process will be carried out by means of a horizontal displacement.

Calculation of the motor to bottle mouth coupling

In the emptying stage, the liquid shall be removed, for which the designed coupling shall perform a 180° rotation with the bottle at its 'X' point. It is assumed that by rotating the bottle 180° , the liquid is placed horizontally, and its weight is evenly distributed. In addition, to avoid any drop, the total weight of the bottle at its far end is considered. This is done to avoid problems when determining the required motor power.

Taking into account the degrees required for rotation, a servo motor used to control the degrees effectively. In fig 36, a sketch is shown to help us in the calculation and understanding of this process.

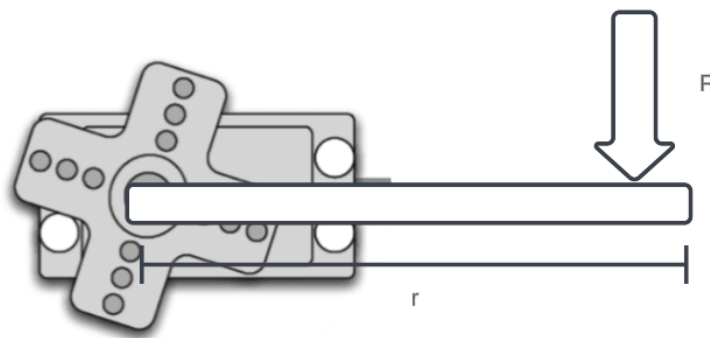


Figure 36: Sketch of the location of the servomotor and its applied forces.

In fig 37 can see a free body diagram that will allow us to analyze correctly and carry out the respective calculations.

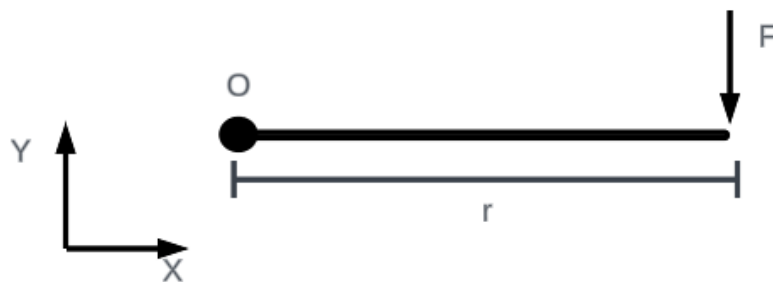


Figure 37: Free-body diagram of the force applied on the servo motor of the gripper

In order to know the force of the servomotor needed to perform the 180° turn, equation 9 is applied. Tab 11 shows the data

$$F = m \cdot g = 5,88N \quad (9)$$

Table 11: Parameters to know the Force

Denomination	Symbol	Value
Force	F	5,88 N
Gravity	g	9,8 $\frac{m}{s^2}$
Mass	m	0,6 kg
Coefficient of friction	μ	0,3

In order to select the servomotor and search the market, it is necessary to know the torque. For this, use equation 10 to calculate it. Tab 12 shows the data

$$T = F \cdot r = 2,24N \quad (10)$$

Therefore, a motor of at least 2,24 Nm is required to perform the action.

Table 12: Parameters to know the touch of the claw servomotor

Denomination	Symbol	Value
Torque	T	2,24 Nm
F	F	5,88 N
Ratio	r	0,040 m
Coefficient of friction	μ	0,3

Horizontal displacement of the rail

The clamp for emptying the bottle has a horizontal movement, as can be seen in fig 38. This movement is achieved by means of a rack and pinion mechanism. As can be seen in the figure, it consists of two positions. Position 1 is when it is fully retracted and Position 2 is when it is fully extended. For this movement, a servo motor is used which allows us to control its displacement with greater precision. As can be seen in fig38, it also has 6 mm diameter steel bars. These allow us to support the structure and prevent the rack and pinion from suffering excessive stresses.

On the other hand, they know that the steel bars do the job of supporting the structure in horizontal displacement. To avoid friction between the steel bar and the PETG, which forms the clamp rail, LM6UU linear bearings were used. These allow the bar to move horizontally without jamming or interference in the movement.

Calculation of horizontal displacement of the rail

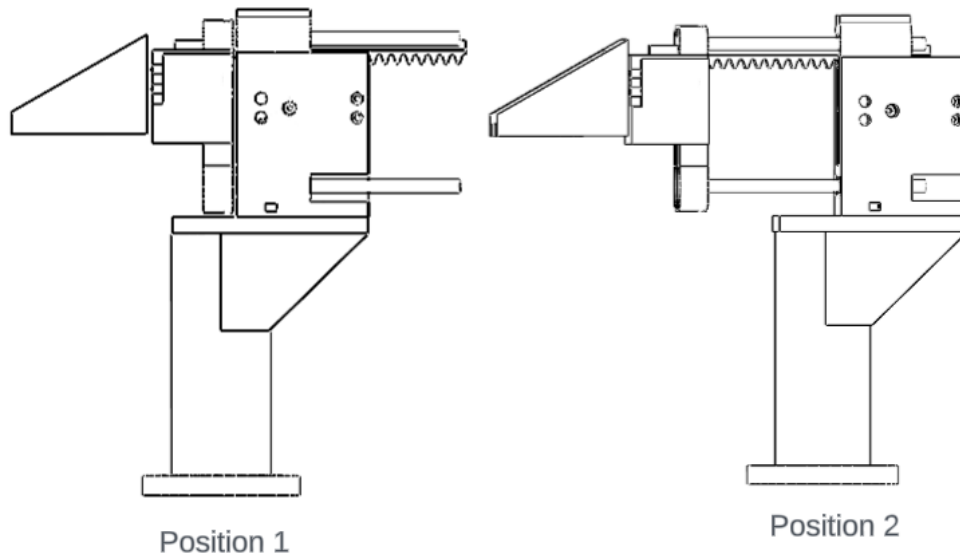


Figure 38: Clamp position

In order to carry out the horizontal displacement of the gripper, a rack and pinion mechanism is used, which allows us to carry out the movement. It is therefore necessary to determine the force required to execute this movement and to select the appropriate motor. Fig 39 shows a free-body diagram of the rack and pinion system.

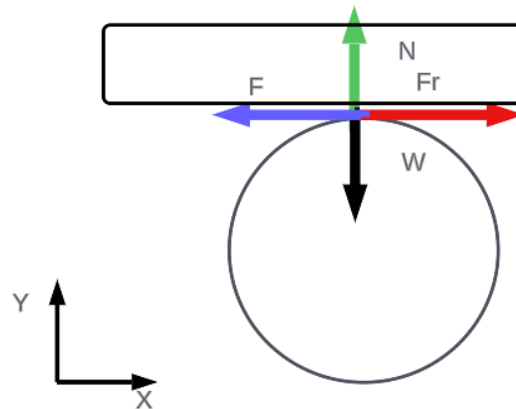


Figure 39: Free body diagram of the clamp rail rack and pinion rack system

Looking at the diagram, a summary of forces is made, equation number 11 and equation number 12 are obtained. Tab 13 shows the data

$$F = Fr \quad (11)$$

Table 13: Parameters to know the force

Denomination	Symbol	Value
Force	F	N
Friction Force	F_r	N

In equation 12 can see the equality of the friction force. Tab 14 shows the data

$$Fr = m \cdot g \cdot \mu = 4,88N \quad (12)$$

Table 14: Parameters to know the friction force

Denomination	Symbol	Value
Friction Force	F_r	$4,78 N$
Gravity	g	$9,8 \frac{m}{s^2}$
Mass	m	$0,98 kg$
Coefficient of friction	μ	$0,5$

Knowing the force, can calculate the torque required for the motor using equation 13.

$$T = F \cdot r = 0,11N \quad (13)$$

Table 15: Parameters to know torque of servomotor

Denomination	Symbol	Value
Torque	T	$0,11 Nm$
F	F	$4,78 N$
Ratio	r	$0,0225 m$

Therefore, a motor of at least 0,11 Nm is required to perform the action.

Rotating base

To perform the complete 180 degree rotation of the gripper, a system consisting of 4 pillars and the servo motor is implemented. This system supports the structure of the gripper, including the weight of the water bottle. To avoid the motor overload, bearings were placed in the 4 pillars, which facilitate the rotation and stabilize the base to prevent its deformation. Fig 41 shows the composition of this system.

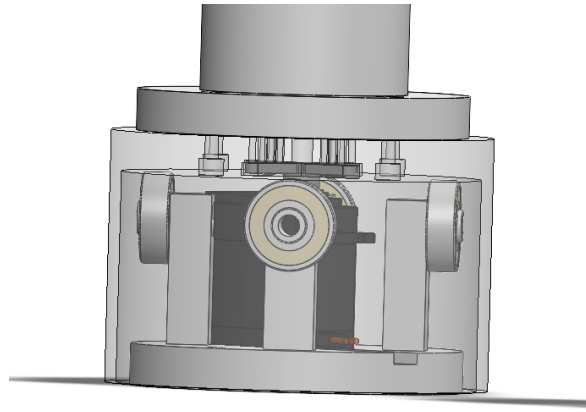


Figure 40: Swivel base system that allows the clamp to be rotated 180°.

In fig 41, the location of the bearings is shown, which are the 608zz. These are in contact with the caliper abutment, allowing frictionless rotation. In addition, it can be seen that the servo motor is located in the central part of the base.

1.3.4 Servo valve lowering system

In the cleaning stage, a mechanism is needed that allows us to clean the bottle. Therefore, opting for the use of a rack and pinion system, which allows the valve spout to travel a vertical distance that allows it to position itself on the bottle spout to carry out the cleaning process. This system has a number of elements, which are:

1. Servo valve mechanism bracket.
2. Servo valve servo motor bracket.
3. Rack and pinion system
4. Servo valve support
5. Left servo valve support.

Figure 6 shows the above.

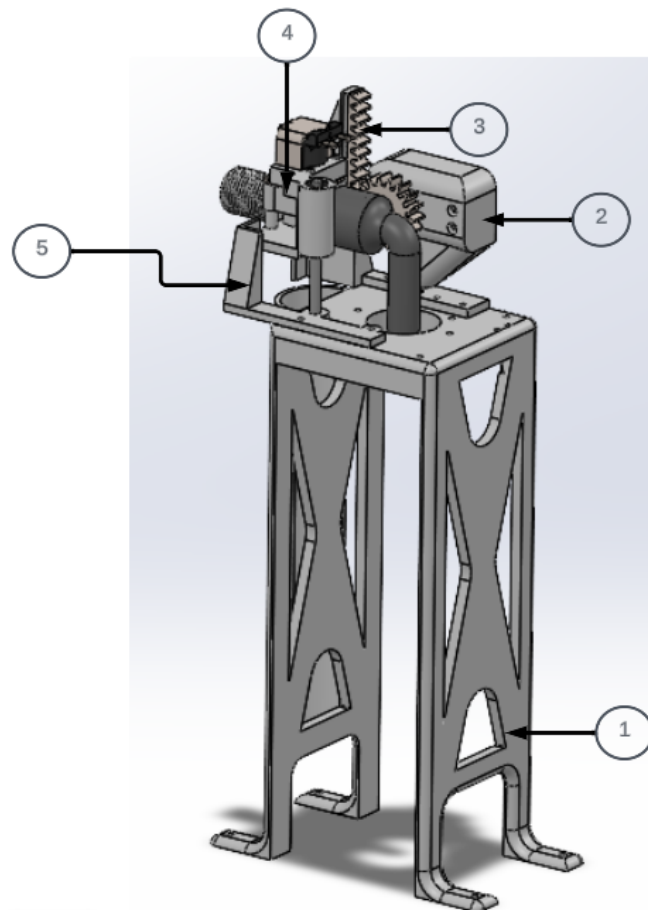


Figure 41: Servo valve lowering system and its parts

1.4 Prototype control box

To support all the elements mentioned above, a metal structure made of A-36 steel with a thickness of 1.1 mm was chosen. In addition, 9 mm thick MDF parts and parts printed with PETG were used. This allows us to support the elements of the project. This structure has several parts, of which 3 are the most important: the Connection Board, the Control Panel and the Frame Box.

1.4.1 Connection Board

The aim of the project is to create a module that allows us to make connections from the outside and provide a way to interact with the user. To achieve these connections, colored banana jacks were used, which allow us to connect the elements to the PLC and vice versa. This board is made of 9 mm thick MDF, on which are mounted the banana jacks and brackets that allow us to connect them to the metal structure. As shown in fig 42

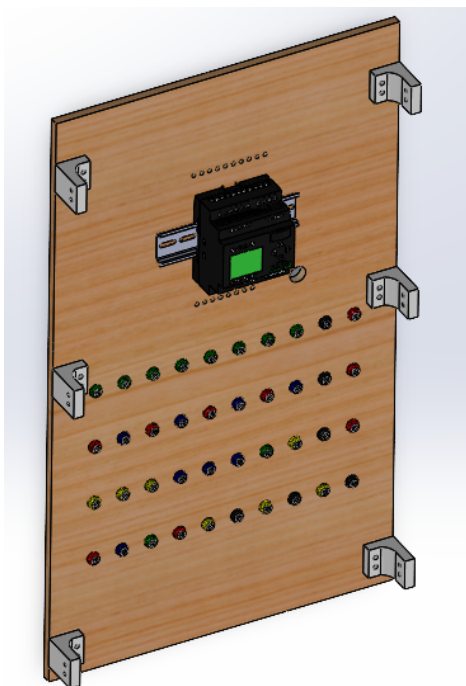


Figure 42: Board to make the connections to the PLC

1.4.2 Control panel

In this case, in order to hold the start, stop and restart buttons of the process, and to visualize the process it performs, a piece made of PETG was dimensioned. As shown in fig 43

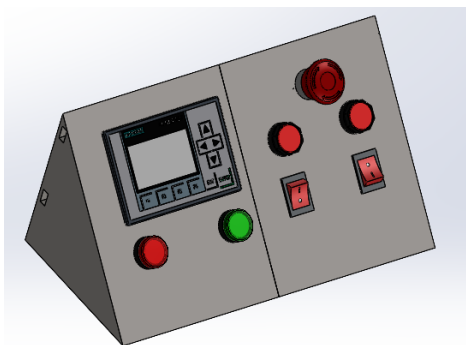


Figure 43: Control panel for supporting the drive elements

1.4.3 Frame box

In order to be able to support all the elements and structures designed, an A-36 steel structure was made to join all the elements together. This structure is made of A-36 steel and, in addition, its parts are spot welding to improve its rigidity. In addition, it also has wheels that allow the module to be moved without any problem to the different places where it is going to be used. As shown in fig 44

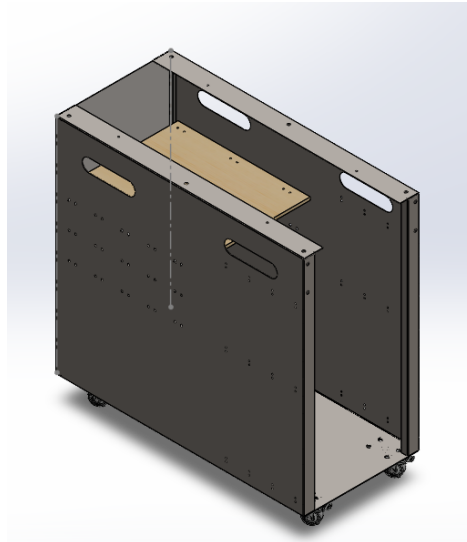


Figure 44: Board to make the connections to the PLC

1.5 Summary table of components

In this section, the elements that make up the bottle disinfection system will be mentioned. In tab 16, can see the components, where their names and overall dimensions are shown.

Table 16: Summary table of components

Part	Dimensions
Electronic base	800mm x 694mm x 9 mm
Control panel part 1	875mm x 750mm x 750mm
Control panel part 2	875mm x 750mm x 750mm
Rear of the control panel	345,8mm x 673,8mm x 1,1mm
Structure of the control desk	750mm x 350mm x 765,8mm
Electronic support	400mm x 100mm x 300mm
Board support	400mm x 100mm x 300mm
Rear door of the control desk	300mm x 250mm x 1,1mm
Baseband part 1	94mm x 270mm x 35mm
Baseband part 2	94mm x 300mm x 35mm
Color sensor base 1	200mm x 80mm x 21,7mm
Color sensor base 2	200mm x 80mm x 21,7mm
Structure of the control table	600mm x 347mm 9mm
Right tap base	44,5mm x 29mm x 15 mm
Left tap base	44,5mm x 29mm x 15 mm
Servo pivot base	80mm x 80mm x 40 mm
Upper pivot base for servo	92mm x 92mm x 60,6mm
Servo rail	107mm x 60mm x 68mm
Servo base column	143,45mm x 80mm x 80mm
Rack tap	12mm x 80mm x 7mm
Servo rail rack	12mm x 120mm x 7mm
Gear servo rail	270mm x 270mm x 60mm
Gear tap	20mm x 20mm x 10mm
Claim	70mm x 70mm x 51,5mm
Water frame	300mm x 100mm x 108mm
Nerve band rail	23mm x 30mm x 12mm
Motor roller	98mm x 30mm x 30mm
Roller	104mm x 30mm x 30 mm
Curb	190mm x 13mm x 10 mm
Motor bracket	34,1mm x 30mm x 41mm
Roller bracket	34,1mm x 30mm x 41mm
Sensor bracket 1	58 mm x 35mm x 19mm

Sensor bracket 2	58 mm x 35mm x 19mm
Sensor bracket 3	58 mm x 35mm x 19mm
Servo motor swivel bracket	159,2mm x 63,9mm x 98mm
Top tap support	79,9mm x 58mm x 48,2mm
Base of the profiles	350mm x 750mm x 1,1mm

2 Electronic design

2.1 Technical specifications

It is important to mention that adequate planning has been considered for the system's power supply. For those electronic elements that require DC voltage, a 24 V and 10 A CNC power supply has been carefully selected to ensure optimal and efficient operation of the components.

Likewise, the respective electrical projections will be taken into account to guarantee the proper power supply for the project. In this sense, it is planned to use the 110 V electrical network as an additional power source, which will be properly regulated and supervised to ensure the correct functioning of the system.

2.1.1 Energy consumption table

It is important to highlight that special attention has been paid to the selection of power sources and the planning of the distribution of electrical energy to ensure optimal performance and system safety at all times.

Therefore, it was decided to make a table of energy consumption, ensuring that all elements within the module do not exceed the value of the source, avoiding any future problems. This data is shown in tab 17.

Assuming that all elements are running at the same time and at their maximum power consumption, we have a power consumption of 6212 mA. They know that the 10 A supply will have no problem with the power consumption of the components.

Table 17: Table of power consumption of all electronic components

Electronic element	energy consumption
Esp32 1	20 mA
Esp32 2	20 mA
Esp32 3	20 mA
I293d	833 mA
Servomotor 1 MG996R	900 mA
Servomotor 2 MG996R	900 mA
Servomotor 3 MG996R	900 mA
ServomotorFT5330M	1300 mA
Motor DC 12V and 12 RMP	507mA
PLC LOGO8!	62 mA
LOGO! TDE	150 mA
Solenoid valve	300 mA
Infrared Sensor E18-D80NK	20mA
4-pin relay module	360 mA
Step-Down XL4015	160mA
Step- Down 1 XL4016E1	40mA
Step- Down 2 XL4016E1	40mA
Green pilot light	20 mA
Red pilot light	20 mA
Total energy consumption	6212 mA

2.2 Components selection

The module has different electronic elements which have to communicate with each other. In the following section, dealing with the most relevant elements in the electronics part.

2.2.1 PLC

The module can be reprogrammable and works with a direct current (DC) power supply, so it was decided to use a LOGO 8! PLC to control the project.

These are the following PLC characteristics:

- Model :12/24 RCE
- Power supply :12/24VDC
- Communication/Programming Interface :Ethernet RJ45
- External memory: Micro SD Card (standard)
- Internal Super Capacitor: 480 hours of program -backup
- Maximum expansion capacity (DI/DO/AI/AO):24/20/8/8
- Digital Inputs (DI): 8
- Analog Inputs (of the integrated DI): 4 (0-10VDC inputs): I1, I2, I7, I8 -
- Digital Outputs (DO) to relay: 4

2.2.2 Esp32

The PLC to be used only has digital inputs and outputs and it must communicate between motors, sensors, etc. Therefore, they chose to use Esp32, which will have established routines so that, when the PLC communicates with Esp32, it will be done without any problem.

These are the following Esp32 characteristics:

Inputs:

- GPIO (General Purpose Input/Output) Pins: The Esp32 has several GPIO pins that can be used as digital or analog inputs.
- Integrated Sensors: Some Esp32 boards include integrated sensors such as accelerometers, gyroscopes or temperature sensors.
- Communication Interfaces: Supports multiple communication interfaces such as UART,

SPI, I2C for connecting external devices.

-WiFi and Bluetooth: Wireless functionalities that can receive data as inputs.

Outputs:

-GPIO pins: GPIO pins can also be used as digital outputs. PWM (Pulse Width Modulation) outputs: Allows devices such as motors or LEDs to be controlled with PWM signals.

-Communication Interfaces: Can act as outputs to send data to peripheral devices via UART, SPI, I2C.

-WiFi and Bluetooth: Ability to send data over wireless connections.

Power:

-USB Port: Many Esp32 boards have a USB connector that can be used to power the device and program it.

Batteries: Some Esp32 boards are designed to run on batteries, allowing for portable power.

-External power: It can also be powered through specific pins, using an external power supply with appropriate voltage and current.

-Built-in voltage regulators: The Esp32 has integrated circuits that allow for a variety of input voltages, typically between 3.3V and 5V, depending on the particular model and board.

2.2.3 Power supply of electronic equipment

They know that not all the electronics inside the training module operate at the same voltage and it have a 24 V supply. Therefore, the right voltages must be distributed to avoid damage to the electronics. The solution to this issue was the use of voltage regulators.

Step-Down XL4015

The Step-Down XL4015 voltage regulator was used to supply power to the 5V electronics.

These are the following Step-Down XL4015 characteristics:

-Pins: 4 (IN-, IN+, OUT- and OUT+)

-Input voltage: 4 to 36 Volts DC (INPUT)

-Output voltage: 1.25 to 32 Volts DC (OUTPUT)

-Output current: 5 A max., recommended (use heatsink for currents greater than 3.5 A)

-Output power: 50W

Step-Down XL4016E1

The Step-Down XL4016E1 voltage regulator was used to supply power to the 7V and 12V to the electronics.

These are the following Step-Down XL4015 characteristics:

- Input voltage: 4 V - 40V
- Output voltage: 1.25 V - 36V
- Maximum power: 200W
- Output current: up to 8A (long term use recommended 5A)

2.2.4 PLC to Esp32 communication

To make the communication between the PLC and the Esp32, we know that the PLC has digital outputs with a voltage of 12V. Therefore, by using a PULL-UP, the Esp32 receive the signal from the PLC and execute the previously established routine. This circuit has a voltage input that uses a resistor and has an output between the push button and the wire that goes to ground. Each time the circuit receives power, it has output a logic signal of 1 which input to the Esp32.

2.2.5 Esp32 to PLC communication

The PLC is going to use only has digital inputs, so the communication between the Esp32 and the sensors must be through a Relay. They use a 4-pin Relay module, which, by means of a simple activation signal, will allow us to send the signal to the PLC.

These are the following 4-Channel 5V Relay module characteristics:

- Operating Voltage: 5V DC
- Control Signal: TTL (3.3V or 5V)
- Number of Relays (channels): 4 CH
- Max Capacity: 10A/250VAC, 10A/30VDC
- Max current: 10A (NO), 5A (NC)
- Action time: 10 ms / 5 ms

2.2.6 Servo Motor

Regarding the selection of components with respect to the calculations previously performed, for the water removal system, a torque of 2,24 Nm was obtained. Therefore, for the required movement and force necessary to perform the work, a FT5330M Servo Motor was selected.

The FT5330M Servo Motor has the following characteristics:

- Operating voltage: 6V to 7,4V
- Operating speed: 0.238 sec/60° (6V), 0.192 sec/60° (7,4V)
- Stall torque: 28,8 kgcm = 2,82 Nm (6V), 35,5 kgcm = 3,48 Nm (7.4V)
- Rotation angle: approx. 180°

Observing the characteristics of the MG995 Servo Motor, it meets the necessary requirements to perform the work.

2.2.7 DC motor

On the other hand, for the belt motor, a 12V motor was selected which has 12RPM This speed was selected to have a better control in the transfer of the bottle, avoiding that when it is empty it falls down.

The DC motor with encoder has the following characteristics:

- Nominal voltage: 6V
- Maximum voltage: 12V
- Motor speed: 12 RPM

2.2.8 Color sensor

To simulate the dirt in the bottles, we opted for the use of colors, in this case, the colors blue and green will be used. These colors will allow us to identify whether the bottle is dirty, which is why we chose to use the TCS230 color sensors.

The DC motor with encoder has the following characteristics:

- Operating voltage: 5V DC
- Function shutdown pin
- Non-linear error: 0.2% at 50 kHz
- High resolution of light intensity to frequency conversion
- It can filter the RGB data from the light source and convert it to a square wave (50% duty cycle) with a frequency directly proportional to the intensity of the radiating light.

2.2.9 Position sensor

In order to be able to detect the water bottle and locate it in the corresponding stations of the process, the E18-D80NK Infrared Sensor was chosen, which sends a signal when it detects presence. This sensor was selected for its compatibility with the 4-channel relay module.

The DC motor with encoder has the following characteristics:

- Operating Voltage: 5V DC
- Dimensions: 45mm/70mm
- Operating Current: 20mA max.
- Output current (load): 100mA max.
- Sensing range: 3cm to 80cm
- Detection range adjustment by potentiometer
- Light emitter: Infrared Led

2.3 Electronic block diagram

The project involves electrical connections that allow the process to be carried out. These connections are both for receiving power and for communicating one element with another. In this section, looking at electronic block diagrams that give us an idea of how these elements are connected.

2.3.1 Main block diagram

In the following diagram, they can see the composition of the main diagram and how it connects to the PLC. This PLC, in turn, gives instructions to the Esp32s, which have subroutines

that allow the work to be carried out.

It also includes connections to the position sensors, LED lights and a display that lets you know the status of the process. In the fig 45, the block diagram that provides information on how the project work.

The block diagram in fig 45 shows the main element, the PLC, which has inputs and out-

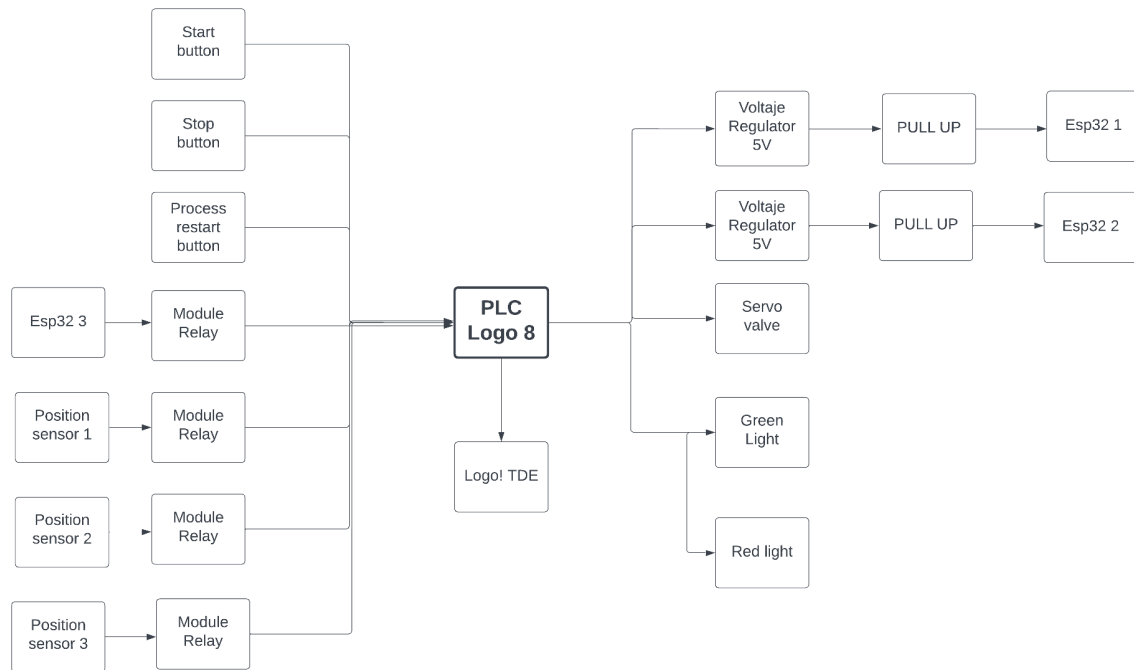


Figure 45: Block diagram of how the connections between the electronic elements are made.

puts. In the case of the inputs, there are 7 in total; of these, 3 are directly connected to the PLC, while the other 4 need intermediate devices for communication. This is where the Relay modules come into play: the ESP32 and the position sensors are connected to these modules, which send digital values to the PLC for communication.

In the center of the diagram, there is a connection between the PLC and the LOGO TDE. This communication does not take place via its digital inputs or outputs, but via its Ethernet input.

On the other hand, they have 4 outputs. In the first two outputs, at the beginning, we find a voltage regulator followed by a pull-up. This is because when the PLC activates one of its outputs, it does not emit 12V, and the microcontrollers work with only support 5V on their inputs. The pull-up is in charge of regulating the pulse from the voltage regulators.

In addition, output 3 allows activating and deactivating the servo valve, and the last output is connected to the pilot lights, which are witnesses that indicate the action of the motor and the activation of the sensors.

2.3.2 Block diagram of the power supply of the elements

For the power supply of the project, a 24V power supply was used, which distributing its voltage in two main levels: 12V and 5V. This allows us to power the different elements within the project.

In fig 46 can see how the voltages are distributed to the different electronic components.

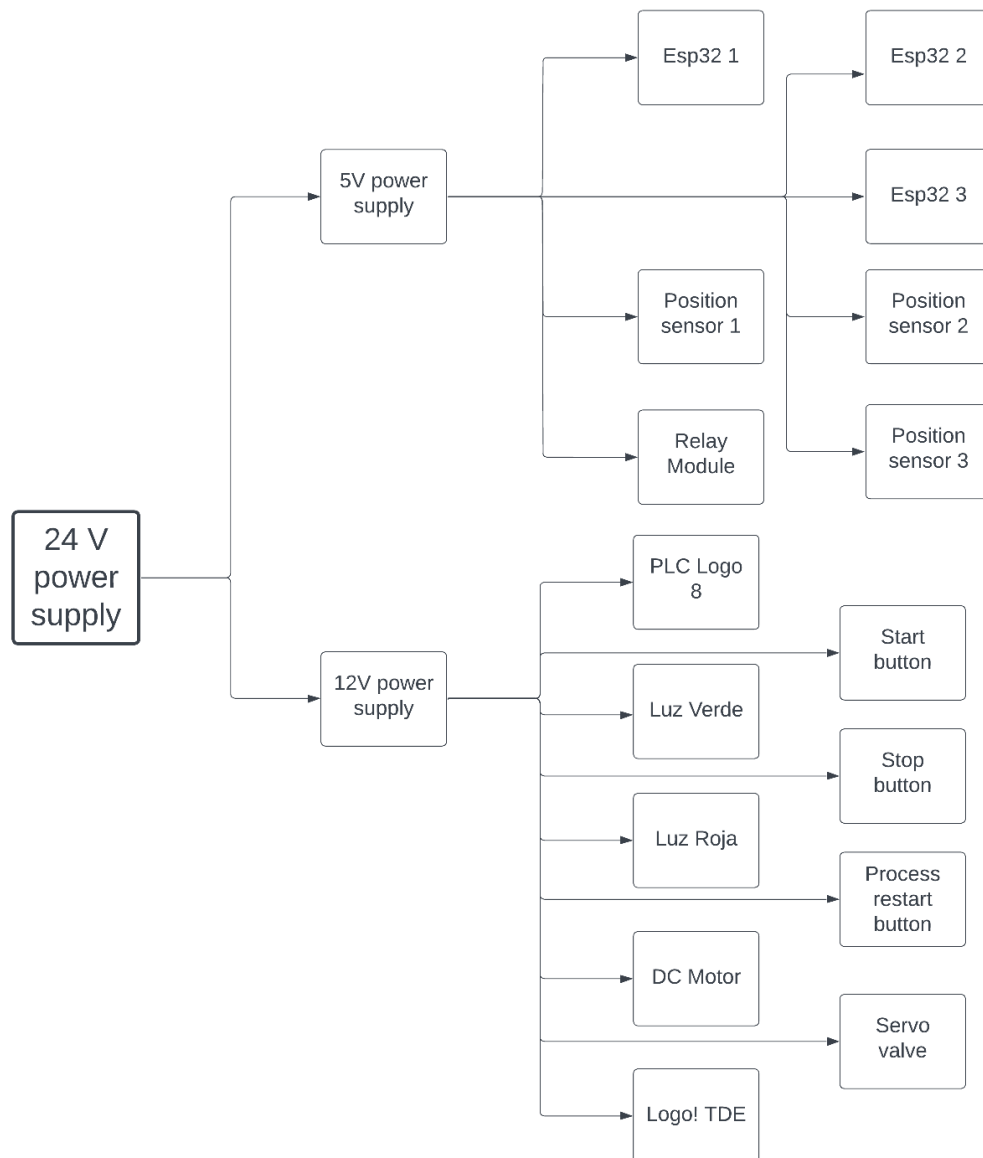


Figure 46: Block diagram of how the voltage connections of the elements are made.

As mentioned before, the main power supply voltage is distributed in two levels: 12V and 5V. On the one hand, on the 5V supply, they have the microcontrollers, the position sensors and the Relay module. On the other hand, in the 12V supply, we have the PLC, the display, the

pilot lights, the DC motor and the pushbuttons that generate the activation of the process.

2.3.3 Block diagram of the Esp32

DC motor

In order to control the DC motor that drives the belt and facilitate future improvements, an H-bridge was chosen. This device allows the DC motor to be controlled through instructions provided by Esp32.

In addition, fig 47 shows how the Esp32 1 diagram is connected.

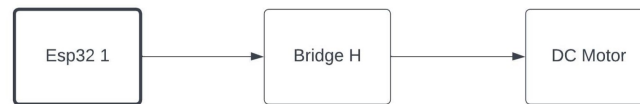


Figure 47: Block diagram of how the Esp32 connection that controls the DC motor is made.

Servo Motors

To control the servo motors, an Esp32 was used to send the necessary pulses to the servo motors, allowing a specific routine to be generated. In addition, fig 48 shows how the Esp32 2 diagram is connected.

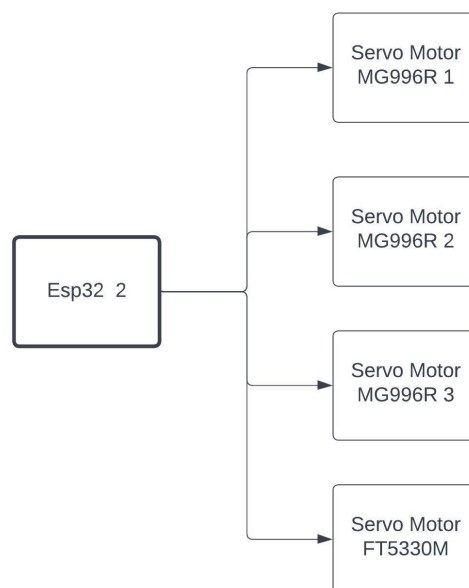


Figure 48: Block diagram of how the Esp32 connection that controls servomotors is made.

Color sensors

For color identification, specific sensors connected to the Esp32 3 were used. This device receives information from the sensors and communicates with the PLC to execute the established routine. In addition, fig 49 shows how the Esp3 diagram is connected.

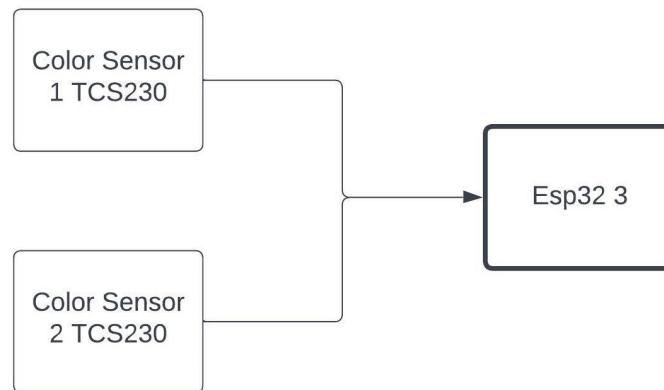


Figure 49: Block diagram of how the Esp32 connection that controls the color sensors is made.

2.4 PCBs

In order to make connections between elements that do not have direct solder terminals or some kind of input to interconnect the elements, electronic boards are made.

2.4.1 Voltage

5V voltage PCB

The XL4015 step-down has no terminal pins, so it was decided to design a board to allow us to make the connections. In fig 50 we can see the board made. This board has a double terminal type input and its output has 8 terminals, divided in two: 4 positive and 4 negative. In addition, this board is used to power all the elements that need 5V.

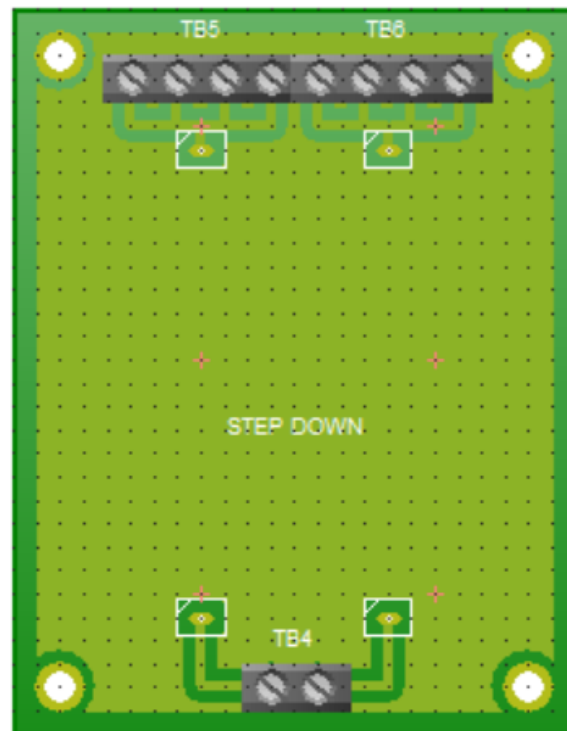


Figure 50: 5V voltage PCB

2.4.2 PLC to Esp32 PCB

The output of our PLC is 12V, so they know that if the Esp32 receives this voltage, it can burn out. Therefore, it was decided to create a board that would allow us to reduce the voltage. They opted for the use of voltage regulators, the LM7805, to obtain a 5V output to be connected to the pull-up. In fig 51, it can see the PCB.

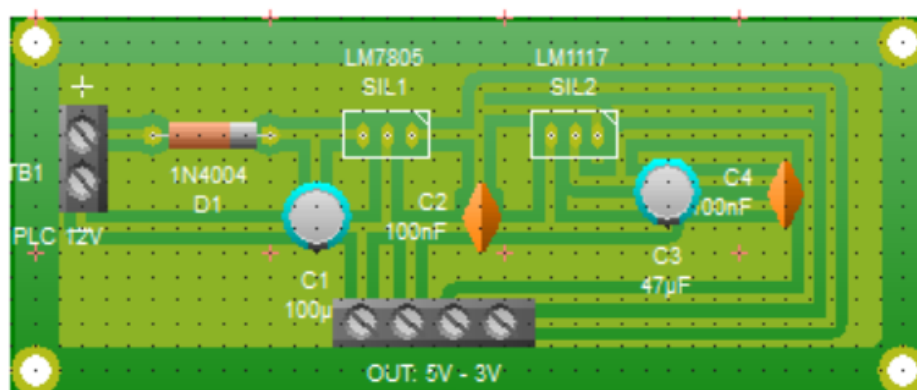


Figure 51: PLC to Esp32 PCB

2.5 Servomotors PCB

In order to be able to control the movement of the servos, a board was added to the Esp32 that allows us to connect all the servos in one place. A PCB has been created to facilitate this process. On this board, the dual power supply is highlighted, as 3 of the 4 servos operate at 5V due to their torque value. In the case of the servo operating at 7V, this is due to the need for a higher voltage to obtain a higher torque. On the other hand, in fig 52, an element called a bridge can be seen, which allows the Esp32 to be reprogrammed using the same board, avoiding the need to remove the Esp32 to load or update the code.

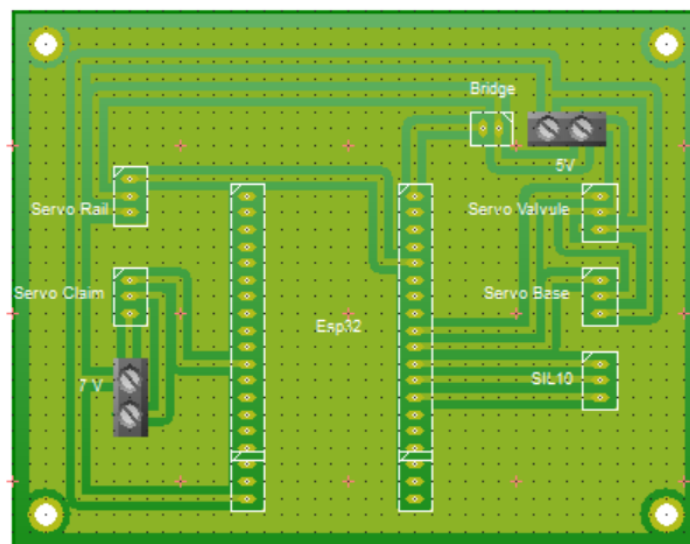


Figure 52: Servomotors PCB

2.5.1 Color sensors PCB

To acquire the signals emitted by the color sensors and allow them to reach the Esp32 for interpretation and action, it was decided to create a PCB that would connect both color sensors to the Esp32. In this case, in fig 53, we can see a component called a bridge, which in addition to allowing the reprogramming and updating of the Esp32 program, is also used to determine whether the activated colors have been identified.

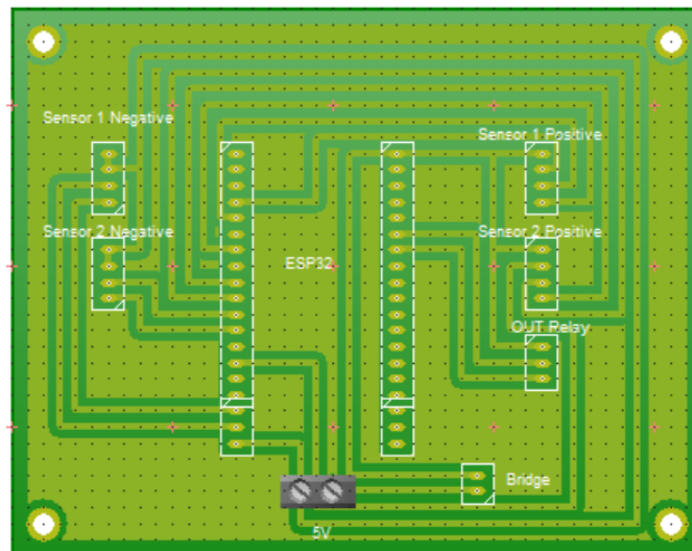


Figure 53: Color sensors PCB

2.5.2 DC motor PCB

A PCB was designed to facilitate communication between the H-bridge and the Esp32, visible in fig 54. This board makes it possible to have output pins from the Esp32 to the H-bridge, avoiding a direct connection between the Esp32 pins and the H-bridge.

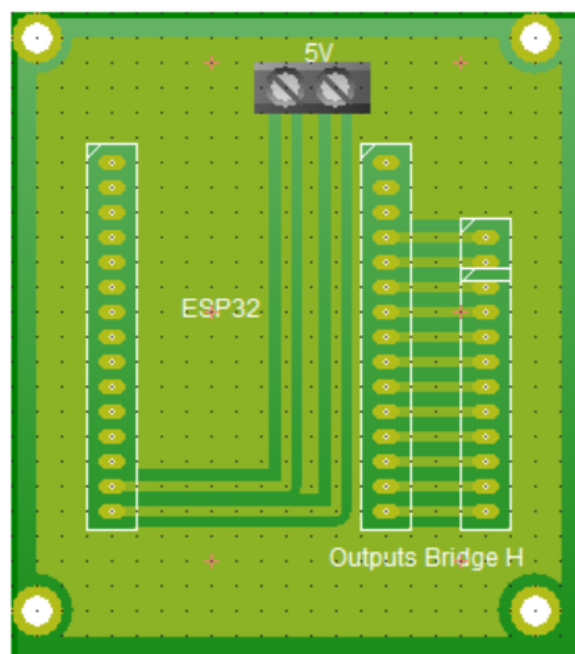


Figure 54: DC motor PCB

3 Programming design

3.1 Technical specifications

The equipment has 2 programming languages. The first is LADDER, which it use for programming the Logo 8 PLC, and the second is the C/C++ language for programming the Esp32 to carry out the programming of the PLC Logo! 8 PLC, it use the Logo Soft Comfort v8.3 software, which is compatible with our PLC. On the other hand, to program the Esp32, it use the Arduino development environment together with the Esp32 Dev library. In addition, Logo Soft Comfort v8.3 is used to program the LOGO TDE screen.

As previously mentioned, our project is controlling by the PLC, which will send the drive indications. Given that they use two different programming languages, to achieve communication between them, digital inputs and outputs will be used which, by means of relays, is facilitate communication.

3.2 Flow chart

3.2.1 Main flow chart

The main flow chart, one condition that covers the whole process, and that is whether the bottle is dirty or clean. This carry out the process or not.

In fig 55 can see a flow chart showing how the process that the machine would carry out would be carried out.

As shown in fig 55, this diagram represents the process. It starts with the start button, which activates the motor to move the empty bottle to Station 1, where identification takes place. In this phase, any stain on the bottle is identified; the sensors detect blue and green color as signs of dirt on the bottle. If this condition is detected, the bottle moves to step 2, which is cleaning. During cleaning, a servo control positions a valve at the mouth of the bottle and performs cleaning. It then moves to an emptying stage, where a robotic gripper removes the liquid from the bottle, ending the process.

Each station is reached by activating the motor that moves the belt. Each time the belt is

activated, a green light indicates that it is in motion. When the bottle reaches the different stages, a red light comes on, indicating its position in the station. In addition, a display shows the activity of the project and which stage the bottle is in.

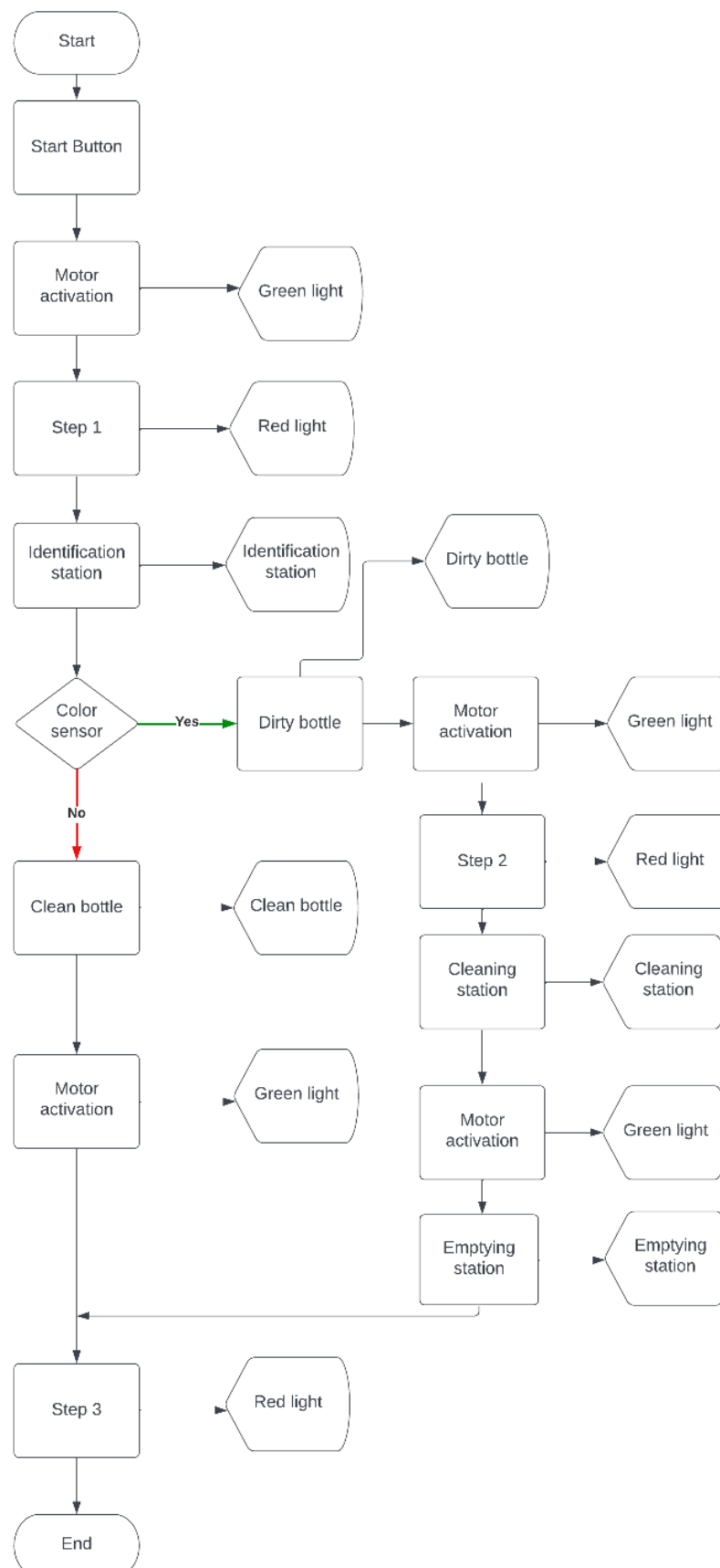


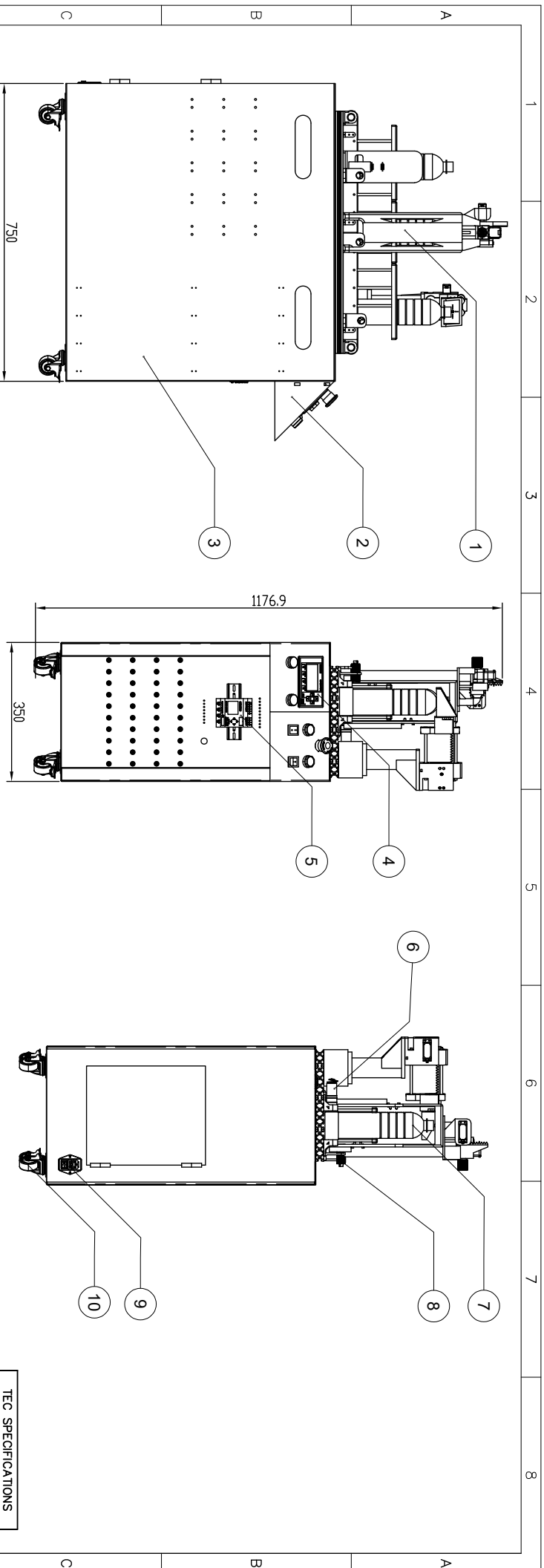
Figure 55: General equipment control flowchart

References

- [1] M. Gerardo-Rodriguez, *Manual Diseño Industrial*. 1983, p. 96, ISBN: 9688870277. [Online]. Available: <http://www.cua.uam.mx/pdfs/conoce/libroselec/16ManualDI.pdf>.
- [2] Z. Lafayette, "Bandas transportadoras termosoldables", p. 36, 2009.
- [3] W. Callister, *Ciencia e ingeniería de materiales*, novena edi. Mexico: Reverte, S.A, 2016, ISBN: 9788429172515.
- [4] G. Richard, *Diseño en ingeniería mecánica de Shigley*. MC GRAW HILL, 2011, p. 1068, ISBN: 9786071507716. [Online]. Available: <https://www.ptonline.com/articles/how-to-get-better-mfi-results>.

Appendix A


Mechanical Engineering Drawings



TEC SPECIFICATIONS	
MASS APPRO.	26 kg
HEIGHT	1176.9
WIDTH	350
DEPTH	750
POWER SUPPLY	110V AC

11	3D	CONVEYOR BELT	1	POLYMER	----	PVC
10	7C	WHEELSS	4	STEEL	----	ASTM A-36
9	7C	ROCKER SWITCH	1	PLASTIC	----	OTHERS
8	7A	ADJUSTABLE INFRARED PROXIMITY SENSOR E18-DB0NK	3	PLASTIC	----	OTHERS
7	7A	PLASTIC BOTTLE	3	PLASTIC	----	PET
6	5A	DC MOTOR 12RMP	1	STEEL	----	OTHERS
5	5B	LOGO 8I	1	PLASTIC	----	OTHERS
4	5A	LOGO! TDE	1	PLASTIC	----	OTHERS
3	3B	CONTROL DESK	1	OTHERS	D01-004	SUBCONJUNTO
2	3A	CONTROL PANEL	1	OTHERS	D01-003	SUBCONJUNTO
1	2A	PROFILES TABLE	1	OTHERS	D01-002	SUBCONJUNTO
POS	ZONA	DENOMINATION	CANT.	MATERIALS	PLANO/NORMA	OBSERVATION

MACHINE SPECIFICATIONS	
NO. OF WHEELS:	4
CLEANING TIME PER BOTTLE:	125s-145s
COLOR SENSORS:	TCS3200
DISTANCE SENSOR:	E18-DB0NK
MAIN CONTROL:	PLC LOGO! 8
DISPLAY:	LOGO! TDE

UIDE  MECHATRONICS ENGINEERING

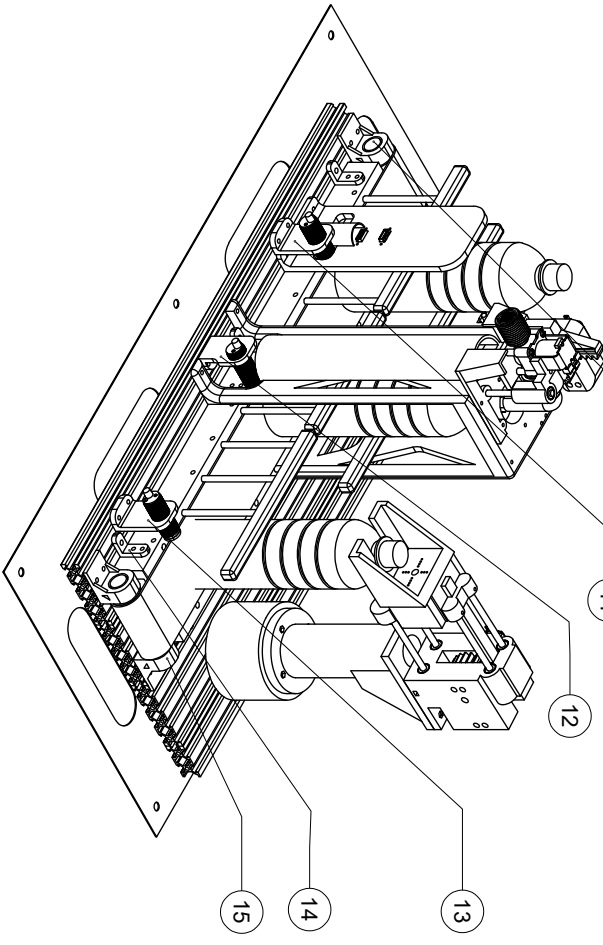
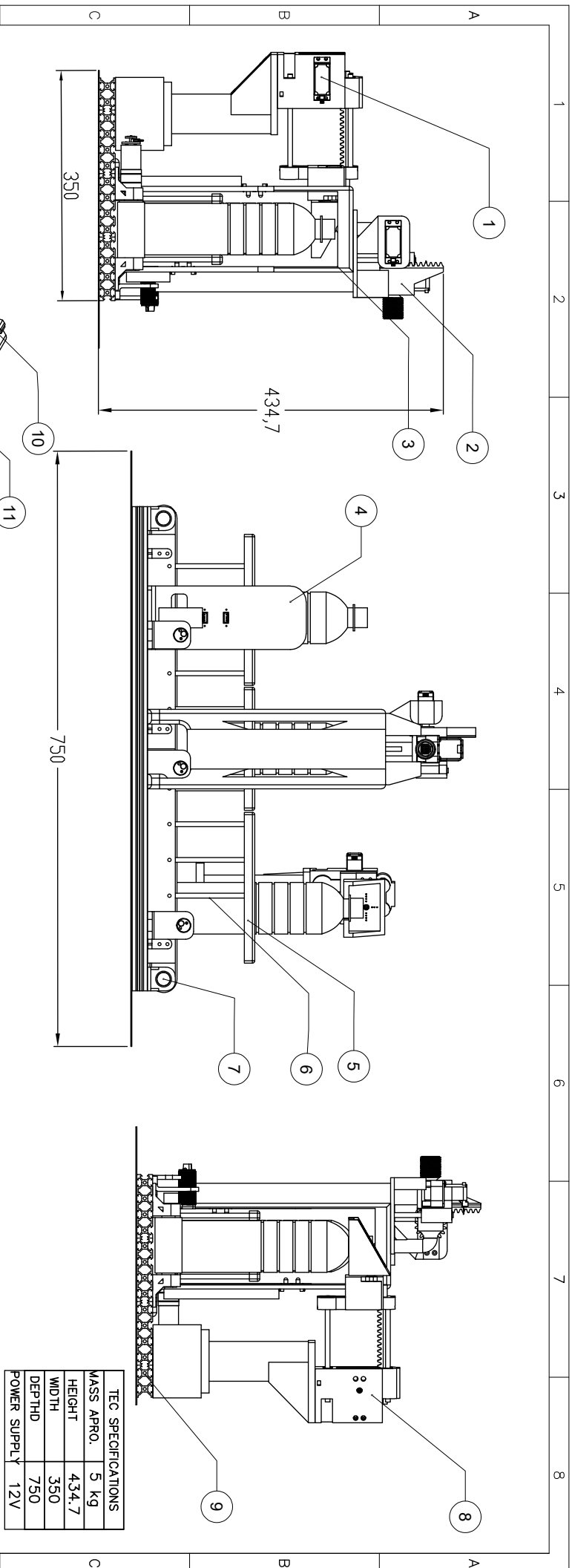
BOTTLE CLEANING

D01-001

DIBI RIVERA A. 03/02/24
DISI RIVERA A. 03/02/24
REVI TIRIRA A. 03/02/24

SCALE:
1:10





15	SE	ROLLER HOLDER	3	PLASTIC	D01-130	PETG
14	7C	RAIL RIB OF THE CONVEYOR BELT	6	PLASTIC	D01-126	PETG
13	4D	SENSOR SUPPORT 3	1	PLASTIC	D01-133	PETG
12	4D	SENSOR SUPPORT 2	1	PLASTIC	D01-132	PETG
11	3C	SENSOR SUPPORT 1	1	PLASTIC	D01-131	PETG
10	3C	ROLLER MOTOR	1	PLASTIC	D01-126	GRILON
9	8B	ALUMINIUM PROFILES	1	ALUMINIO	----	200X280X350mm
8	8A	CLAMP	1	OTHERS	D01-008	SUBCONJUNTO
7	6C	ROLLER	1	PLASTIC	D01-127	PETG
6	6B	STEEL ROD	1	STEEL	----	6mmx90mm
5	6B	BORDER	1	PLASTIC	D01-128	PETG
4	3B	BASE SENSOR COLOR 1	1	PLASTIC	D01-112	PETG
3	3A	FRAME OF WATER	1	PLASTIC	D01-124	PETG
2	3A	BASE AGUA	1	OTHERS	D01-007	SUBCONJUNTO
1	2A	SERVO MOTOR	4	OTHERS	----	OTHERS
POS	ZONA	DENOMINATION	CANT.	MATERIALS	PLANO/NORMA	OBSERVATION

UIDE  MECATRONICS ENGINEERING

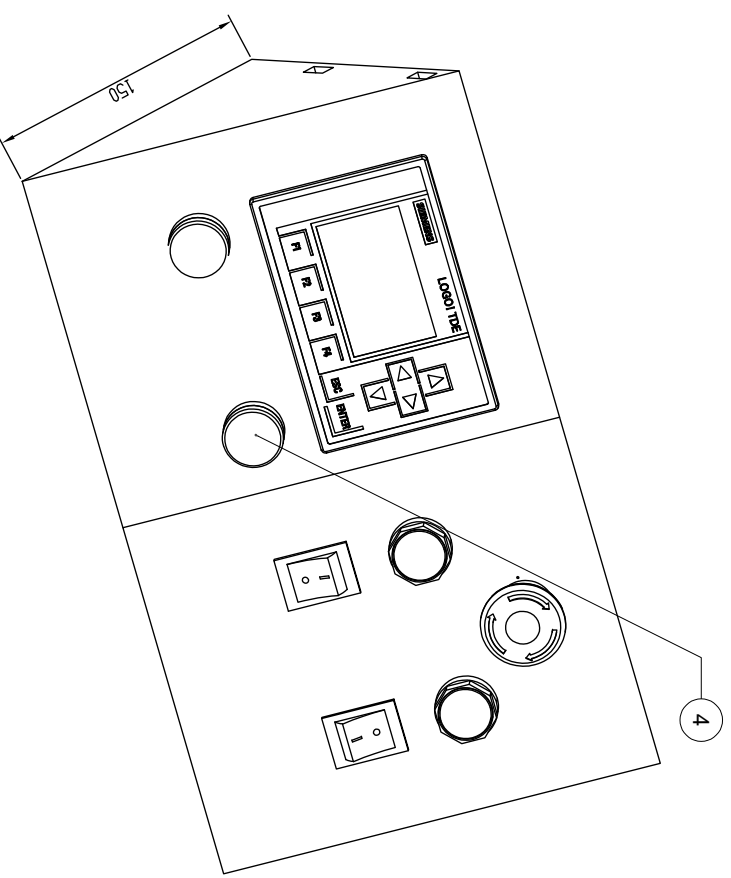
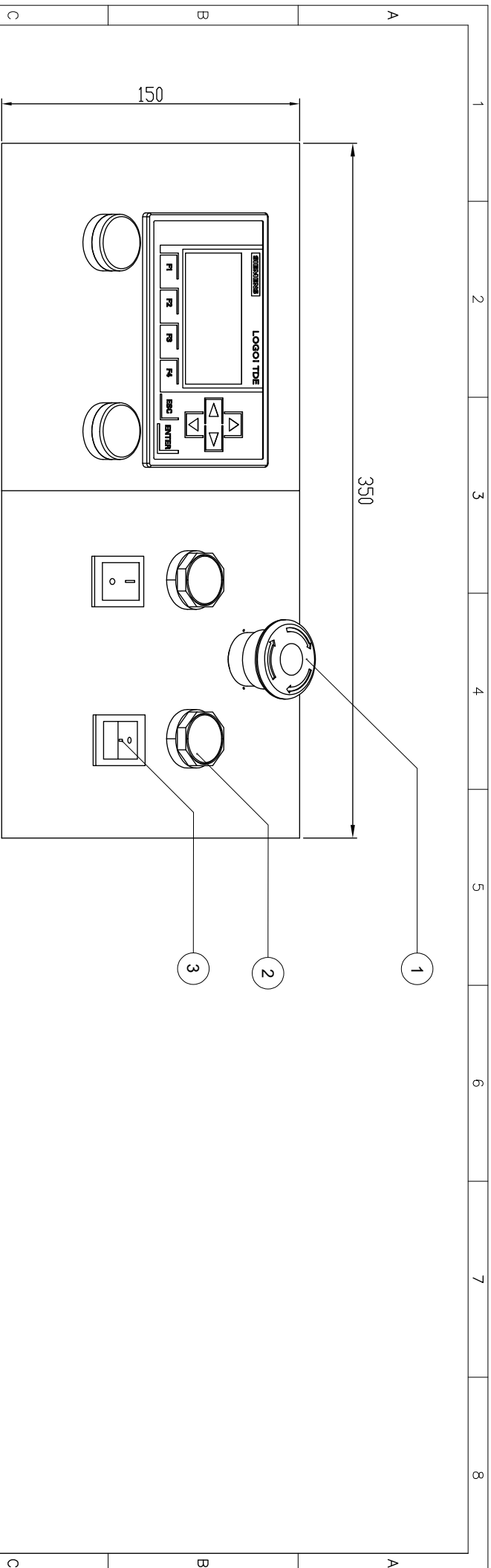
DIB. RIVERA A. 03/02/24
 DIS. RIVERA A. 03/02/24
 REV. TIRIRA A. 03/02/24

PROFILES TABLE

D01-002

SCALE:
1:10





TEC SPECIFICATIONS			
MASS APPRO.	900	gr	
HEIGHT	150		
WIDTH	350		
DEPTH	150		
POWER SUPPLY	12V		

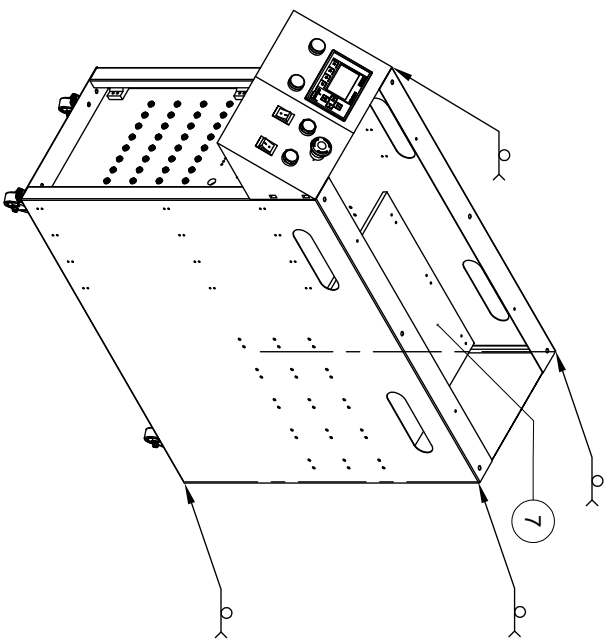
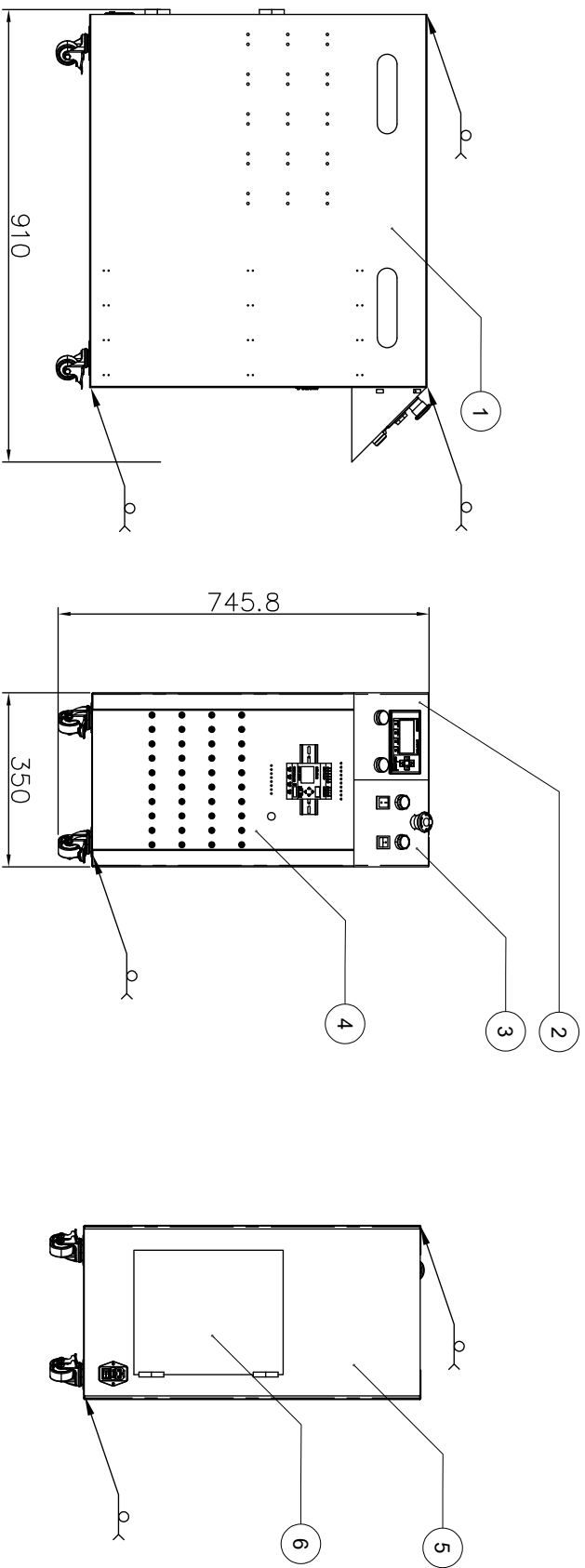
POS	ZONA	DENOMINATION	CANT.	MATERIALS	PLANO/NORMA	OBSERVATION
4	4D	LEDS	2	OTHERS		
3	5B	SWITCH	2	OTHERS		
2	5B	PULSADOR	2	OTHERS		
1	5A	PULSADOR TIPO HONGO	1	OTHERS		

UIIDE		MECHATRONICS ENGINEERING
	DIB. RIVERA A.	03/02/24
	DIS. RIVERA A.	03/02/24
	REV. TIRIRA A.	03/02/24

CONTROL PANEL D01-003


SCALE:
1:10





TEC SPECIFICATIONS			
MASS APPRO.	17	kg	
HEIGHT	745.8		
WIDTH	350		
DEPTH	910		
POWER SUPPLY 110V AC			

7	3D	ELECTRONIC WOODEN BASE	1	OTHERS	D01-006	SUBCONJUNTO
6	7B	BACK DOOR OF THE TABLE	1	STEEL	D01-109	ASTM-A36
5	7A	BACK OF THE CONTROL DESK	1	STEEL	D01-104	ASTM-A36
4	5B	CONTROL PANEL TOTAL	1	OTHERS	D01-005	SUBCONJUNTO
3	5A	CONTROL PANEL PART2	1	PLASTIC	D01-103	PETG
2	5A	CONTROL PANEL PART1	1	PLASTIC	D01-102	PETG
1	3A	STRUCTURE OF THE CONTROL DESK	1	STEEL	D01-105	ASTM-A36
POS	ZONA	DENOMINATION	CANT.	MATERIALS	PLANO/NORMA	OBSERVATION

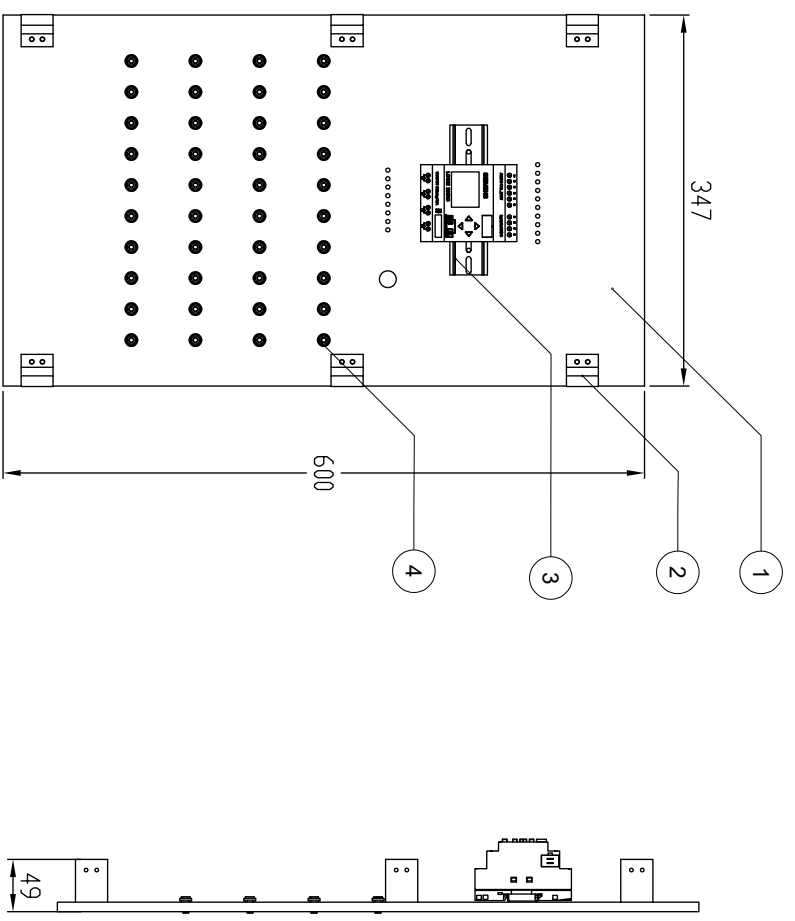
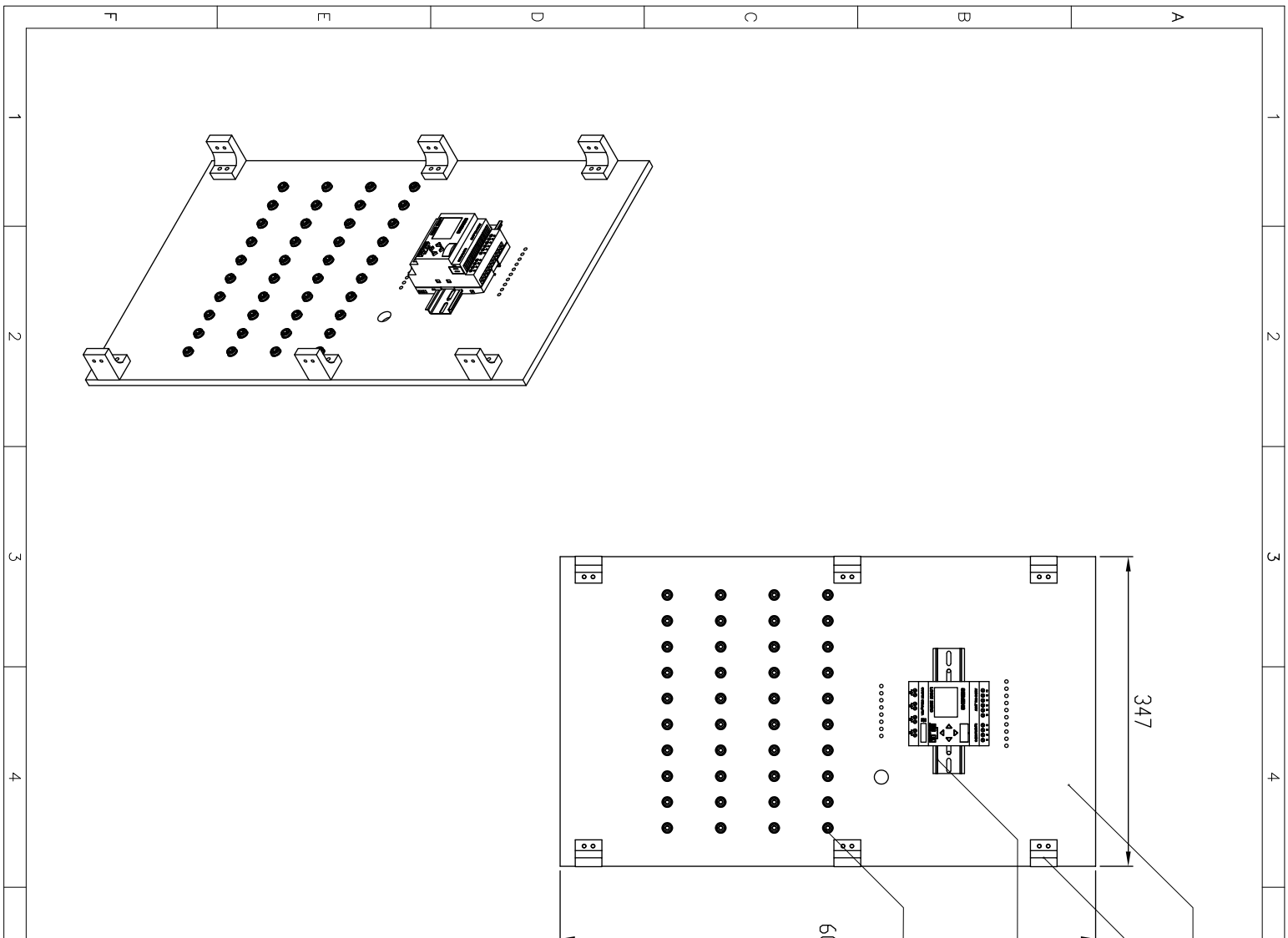
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			DIS: RIVERA A. p3/02/24
			REV: TIRIRA A. p3/02/24

CONTROL DESK

D01-004

SCALE:
1:10



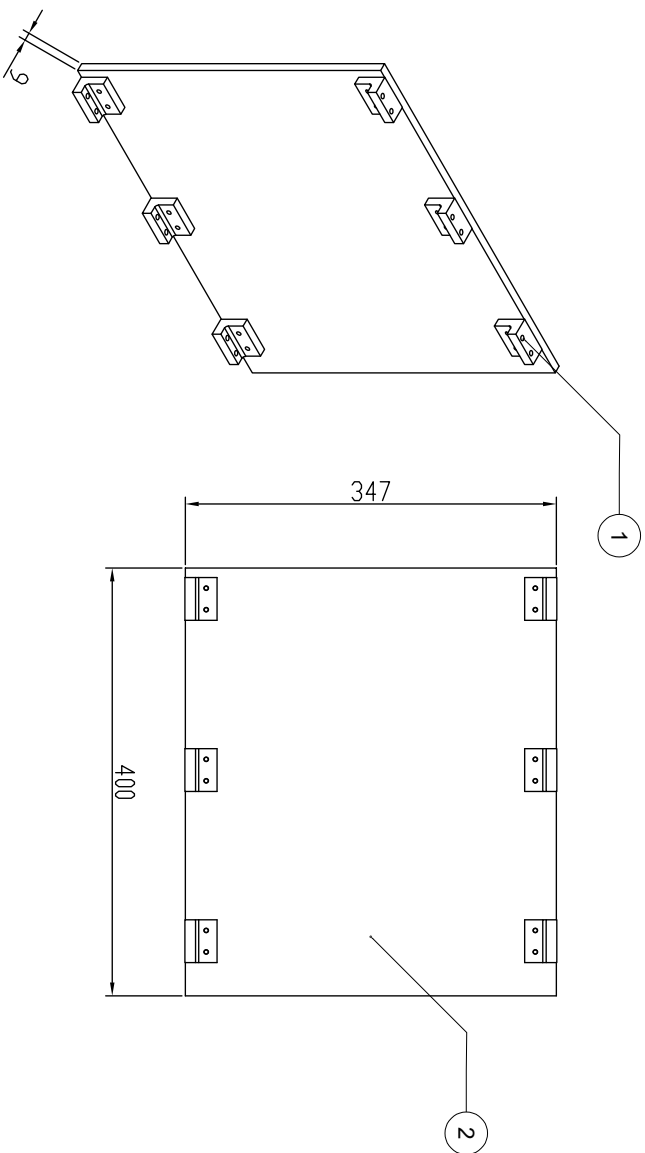


TEC SPECIFICATIONS	
MASS APPRO.	2.5 kg
HEIGHT	600
WIDTH	347
DEPTHD	49
POWER SUPPLY	12V


4	5B	JACK BANANA	40	PLASTIC	D01-005	----	15mmX35mm
3	5B	RIEL DIN	1	ALUMINIO	----		
2	5A	PANEL SUPPORT	6	PLASTIC	D01-107		PETG
1	5A	STRUCTURE OF CONTROL PANEL	1	WOOD	D01-108		MDF
POS	ZONA	DENOMINATION	CANT.	MATERIALS	PLANO/NORMA		OBSERVATION

UIIDE	MECHATRONICS ENGINEERING	DIBI RIVERA A. 03/02/24
		DISI RIVERA A. 03/02/24
		REVI TIRIRA A. 03/02/24

CONTROL PANEL TOTAL		D01-005
		SCALE: 1:10



TEC SPECIFICATIONS	
MASS APPRO.	1.5 kg
HEIGHT	347
WIDTH	400
DEPTH	9
POWER SUPPLY	110V AC

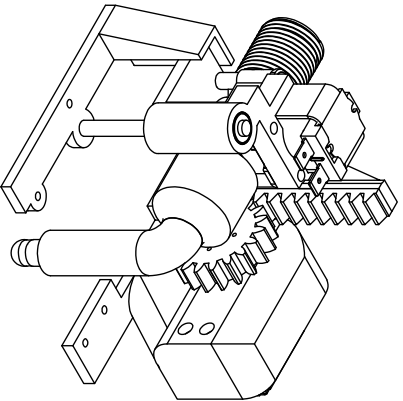
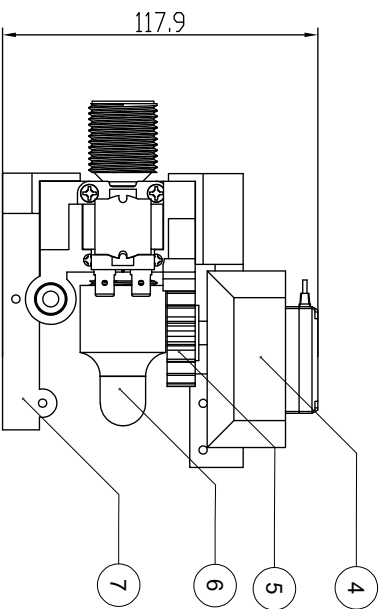
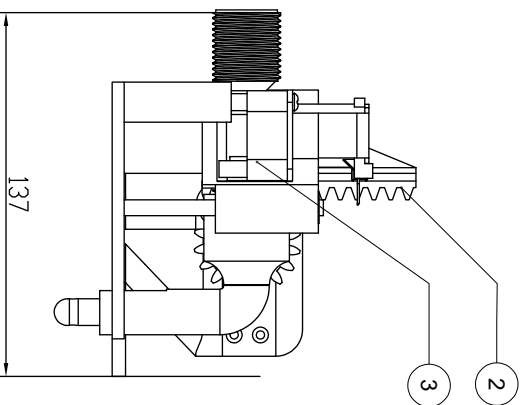
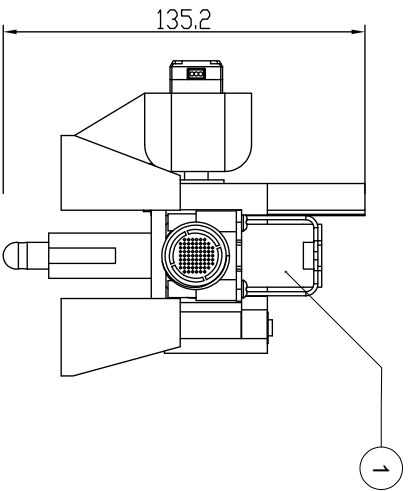
2	6C	ELECTRONIC BASE	1	WOOD	D01-101	MDF
1	4B	ELECTRONIC SUPPORT	6	PLASTIC	D01-106	PETG
POS	ZONA	DENOMINATION	CANT.	MATERIALS	PLANO/NORMA	OBSERVATION
UIIDE		 MECATRONICS ENGINEERING		DIB: RIVERA A. 03/02/24		
				DIS: RIVERA A. 03/02/24		
				REV: TIRIRA A. 03/02/24		

ELECTRONIC WOODEN BASE

D01-006

SCALE:
1:5





TEC SPECIFICATIONS			
MASS APPRO.	500	gr	
HEIGHT	135.2		
WIDTH	117.9		
DEPTH	137		
POWER SUPPLY	12V		

POS	ZONA	DENOMINATION	CANT.	MATERIALS	PLANO/NORMA	OBSERVATION
7	8B	RIGHT BASE GRIFO	1	PLASTIC	D01-114	PETG
6	8B	PICO DE BOTELLA	1	PLASTIC	----	----
5	8A	ENGRANE GRIFO	1	PLASTIC	D01-122	PETG
4	8A	LEFT BASE GRIFO	1	PLASTIC	D01-136	PETG
3	6A	UPPER BRACKET GRIFO	1	PLASTIC	D01-135	PETG
2	5A	CREVALLERA GRIFO	1	PLASTIC	D01-119	PETG
1	3A	SERVO VALVULA	1	OTHERS	----	----

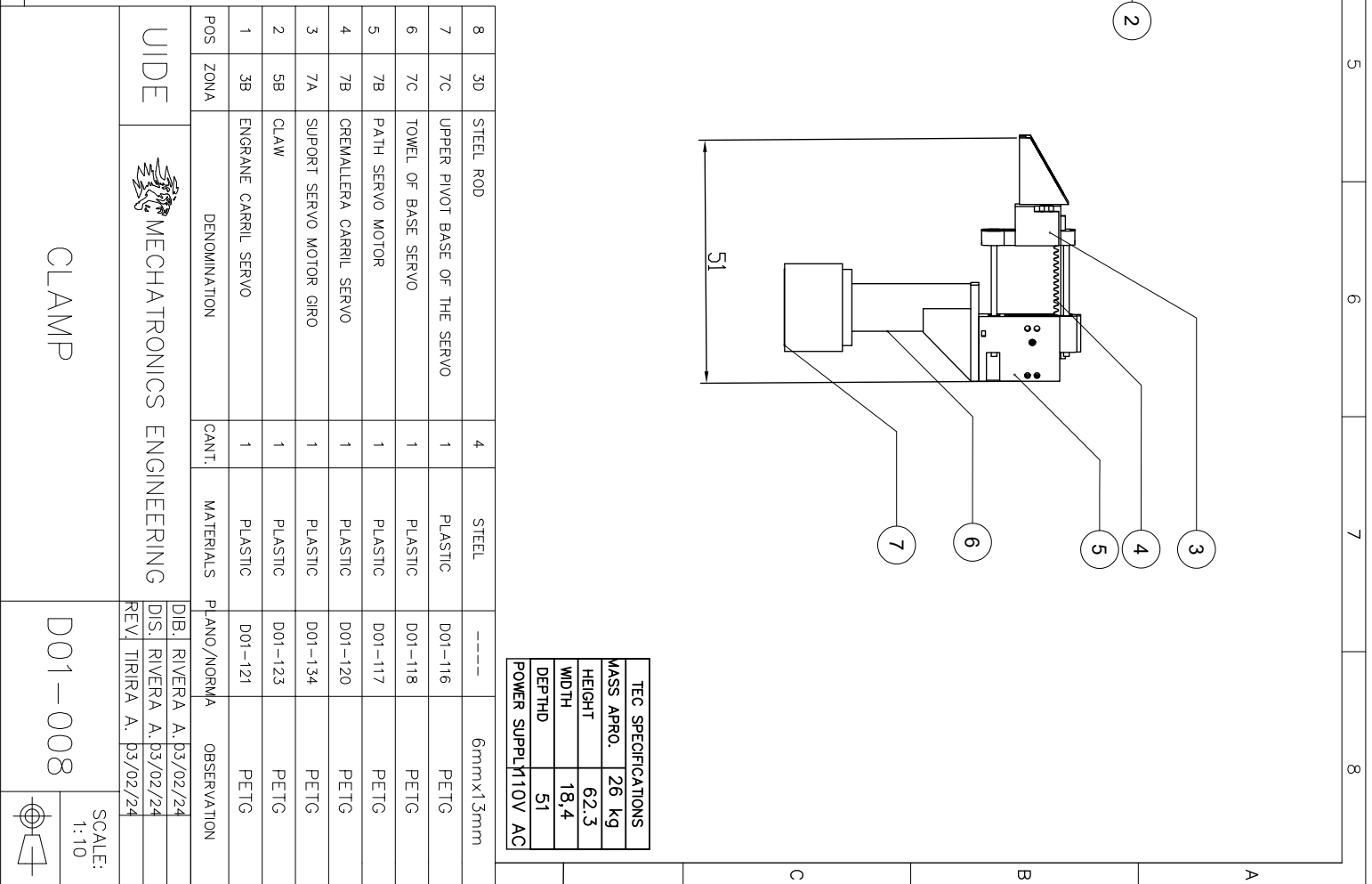
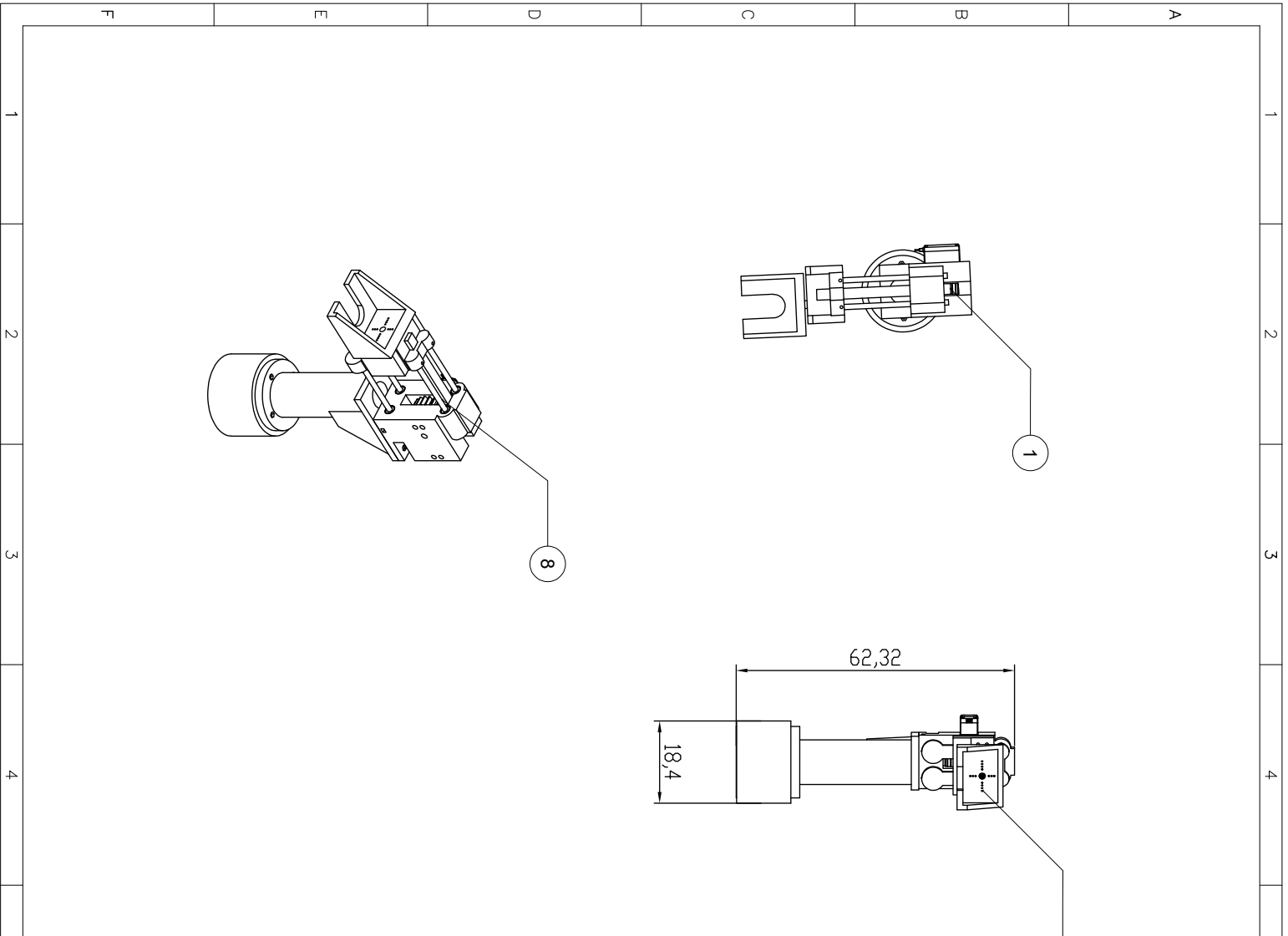
UIIDE	 MECATRONICS ENGINEERING	DIB: RIVERA A. 03/02/24
		DIS: RIVERA A. 03/02/24
		REV: TIRIRA A. 03/02/24

BASE AGUA

D01-007

SCALE:
1:10





TEC SPECIFICATIONS	
MASS APPRO.	26 kg
HEIGHT	62,3
WIDTH	18,4
DEPTH	51
POWER SUPPLY 110V AC	

POS	ZONA	DENOMINATION	CANT.	MATERIALS	PLANO/NORMA	OBSERVATION
8	3D	STEEL ROD	4	STEEL	----	6mmx13mm
7	7C	UPPER PIVOT BASE OF THE SERVO	1	PLASTIC	D01-116	PETG
6	7C	TOWEL OF BASE SERVO	1	PLASTIC	D01-118	PETG
5	7B	PATH SERVO MOTOR	1	PLASTIC	D01-117	PETG
4	7B	CREMALLERA CARRIL SERVO	1	PLASTIC	D01-120	PETG
3	7A	SUPPORT SERVO MOTOR GIRO	1	PLASTIC	D01-134	PETG
2	5B	CLAW	1	PLASTIC	D01-123	PETG
1	3B	ENGRANE CARRIL SERVO	1	PLASTIC	D01-121	PETG

UIIDE  MECHATRONICS ENGINEERING

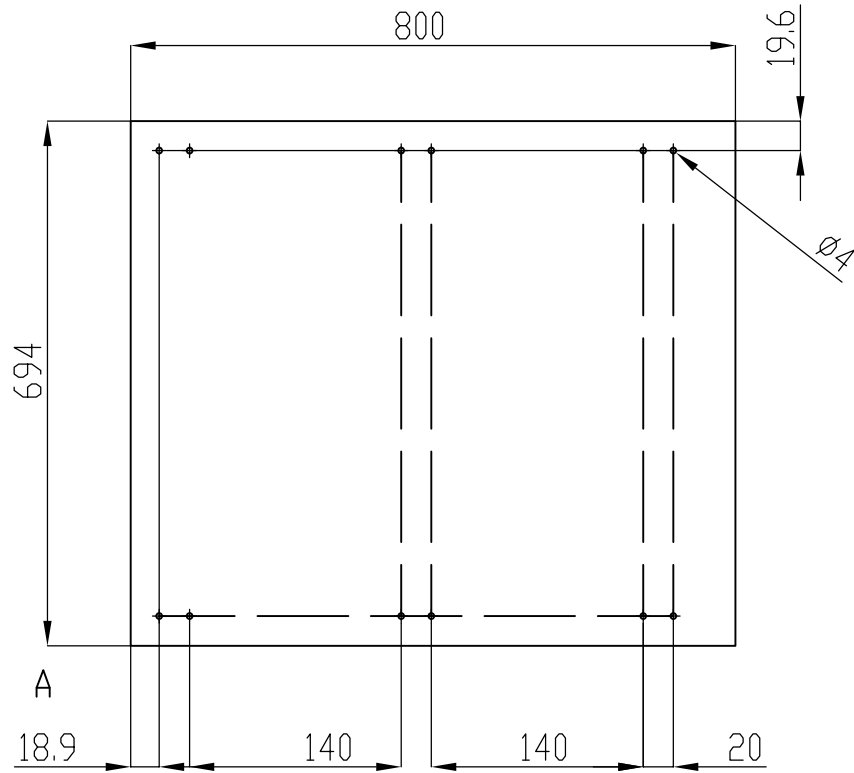
DIB: RIVERA A. 03/02/24
 DIS: RIVERA A. 03/02/24
 REV: TIRIRA A. 03/02/24

CLAMP

D01-008

SCALE:
1:10

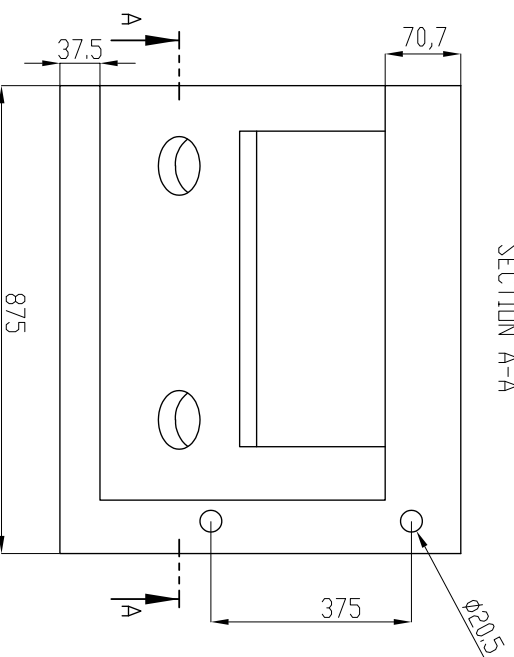
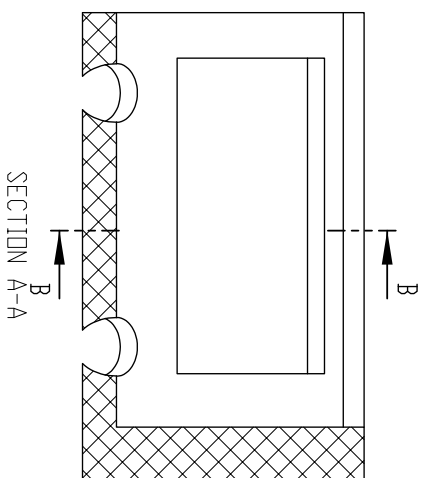
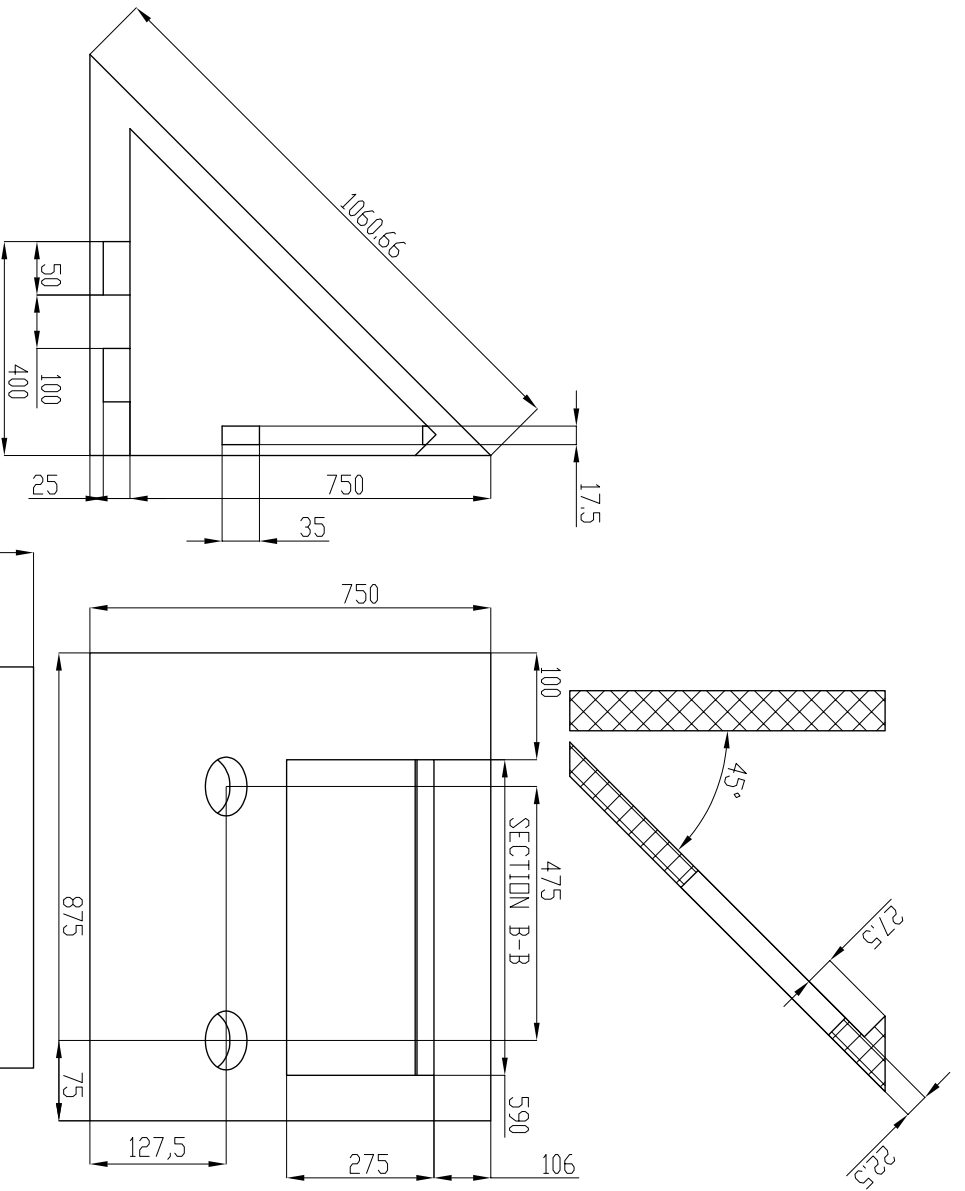




NOTES

THICKNESS: 9 mm

TREATMENT: NO TREATMENT		UIDE	MECHATRONICS ENGINEERING		
COVERING: NO COVERING					
MATERIAL: MDF	GENERAL TOLERANCE: $\pm 0,2$	SCALE: 1:5	DRA.	RIVERA.A	03/02/24
			DES.	RIVERA A.	03/02/24
			REV.	TIRIRA .A	03/02/24
ELECTRONIC BASE		D01-101			



SPECIFICATION FOR 3D PRINTING

MATERIALS: PETG
 PROCESS: FDM
 PRINTER: ENDER 5 PRO
 FILL TYPE: TRIANGULAR
 FILL PERCENTAGE: 29%
 COLOUR/BRAND: WHITE
 BED TEMPERATURE: 60 C°
 EXTRUSION TEMPERATURE: 215 C°
 LAYERS: INITIAL 3-FINAL 3

TREATMENT:	NO TREATMENT	UIDE	MECHATRONICS ENGINEERING
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COVERING:	CREAM-COLORED COVER	SCALE:	1:5
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MATERIAL:	PETG	GENERAL TOLERANCE:	±0,2
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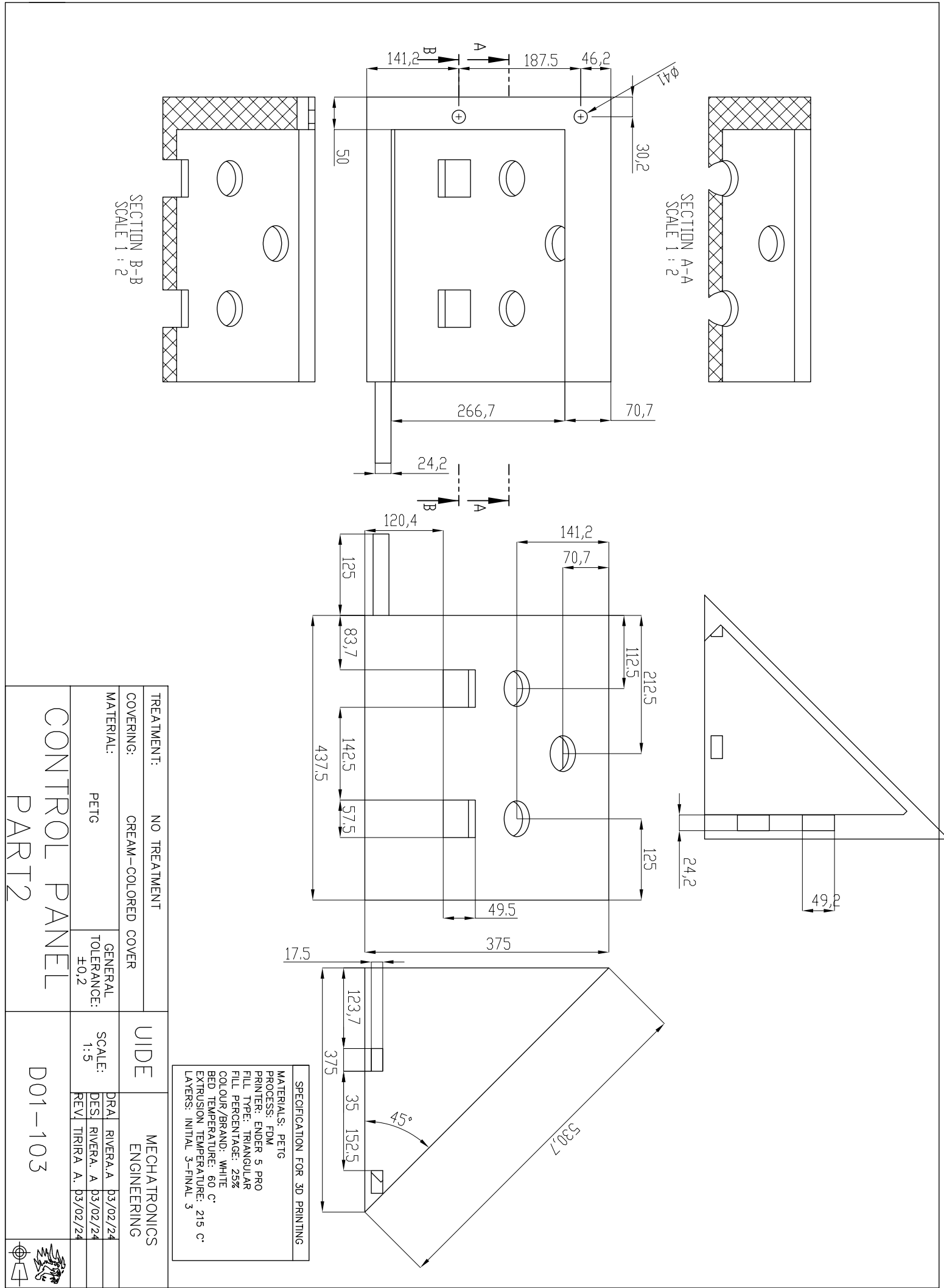
DR A	RIVERA A	03/02/24
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DESJ	RIVERA A	03/02/24
------	----------	----------

REVJ	TIRIRA A.	03/02/24
------	-----------	----------

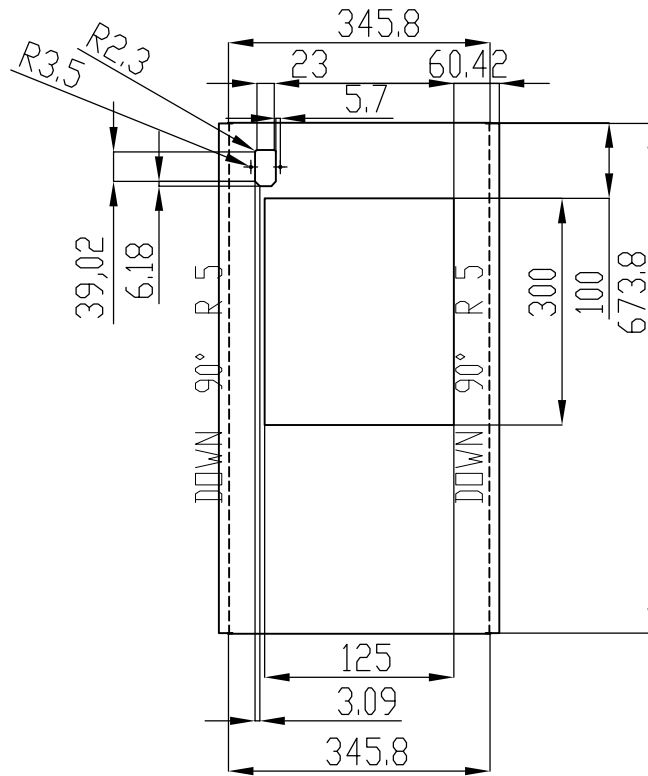
CONTROL PANEL PART1

D01-102



TREATMENT:	NO TREATMENT	UIDE	MECHATRONICS ENGINEERING
COVERING:	CREAM-COLORED COVER	SCALE:	1:5
MATERIAL:	PETG	GENERAL TOLERANCE:	±0,2
		DRA:	RIVERA A 03/02/24
		DES:	RIVERA A 03/02/24
		REV:	TIRIRA A. 03/02/24
<h1>CONTROL PANEL</h1> <h2>PART 2</h2>		<h3>D01-103</h3>	

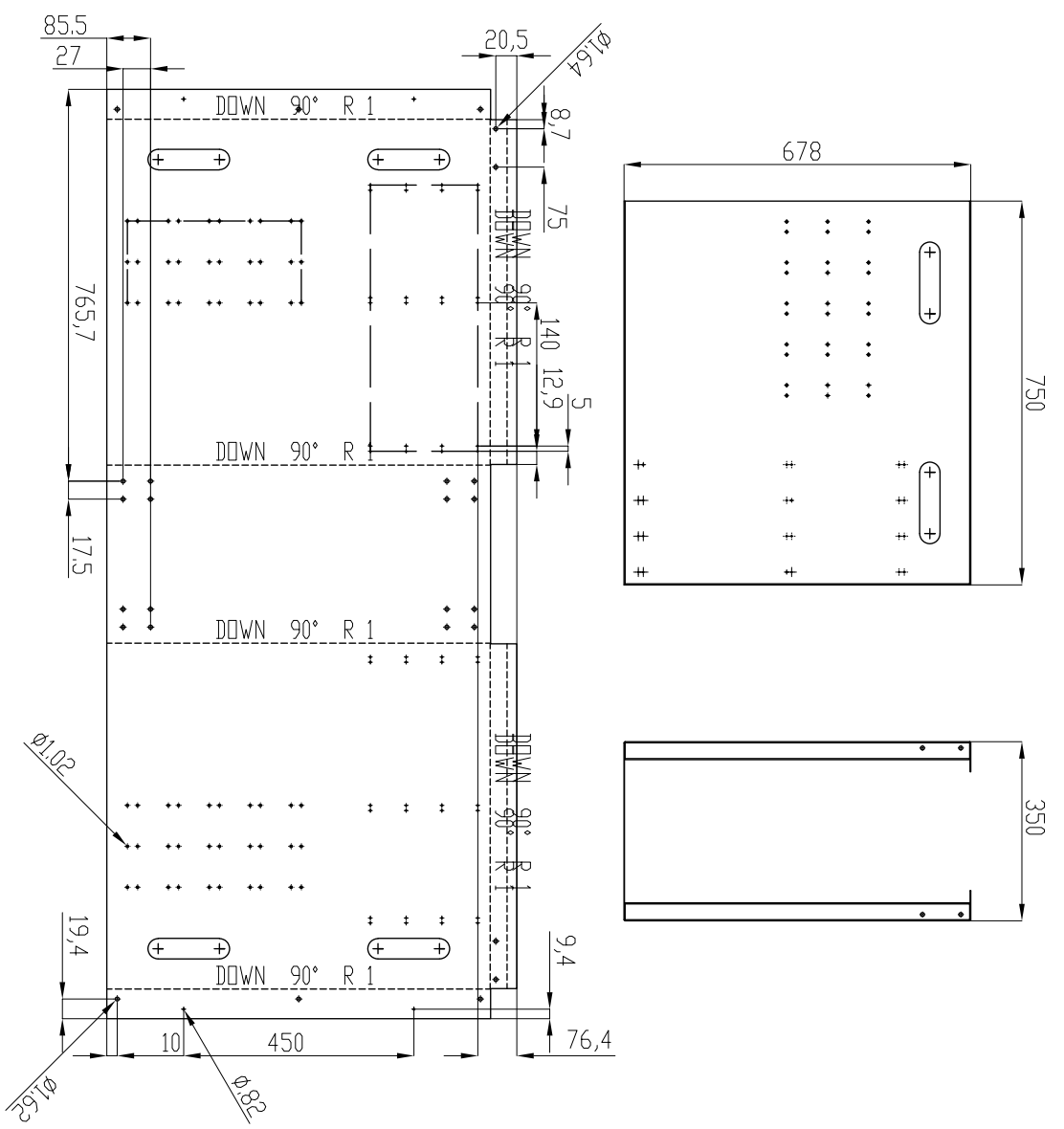
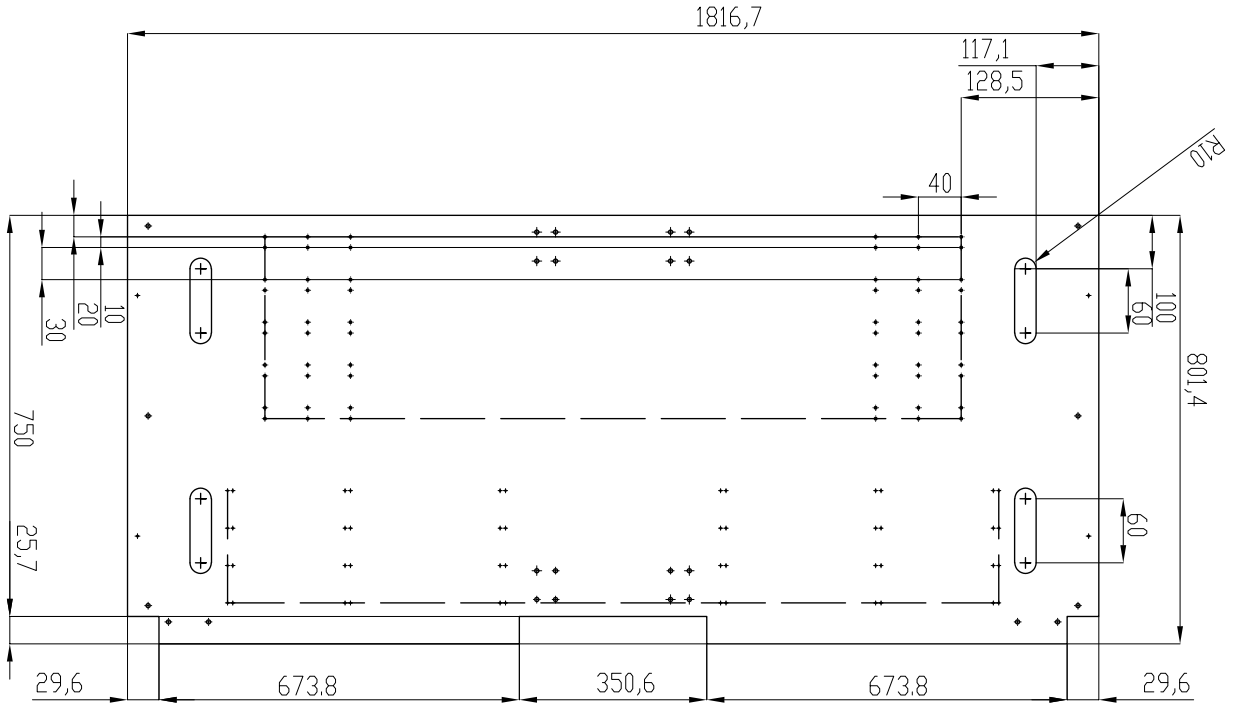
SPECIFICATION FOR 3D PRINTING
 MATERIALS: PETG
 PROCESS: FDM
 PRINTER: ENDER 5 PRO
 FILL TYPE: TRIANGULAR
 FILL PERCENTAGE: 25%
 COLOUR/BRAND: WHITE
 BED TEMPERATURE: 80 C°
 EXTRUSION TEMPERATURE: 215 C°
 LAYERS: INITIAL 3-FINAL 3



NOTES

THICKNESS: 1.1 mm

TREATMENT:	LASER CUTTING	UIDE	MECHATRONICS ENGINEERING			
COVERING:	CREAM-COLORED COVER					
MATERIAL:	STEEL A36	GENERAL TOLERANCE: ±0,2	SCALE: 1:10	DRA.	RIVERA.A	03/02/24
				DES.	RIVERA. A.	03/02/24
				REV	TIRIRA .A	03/02/24
BACK OF THE CONTROL DESK			D01-104			



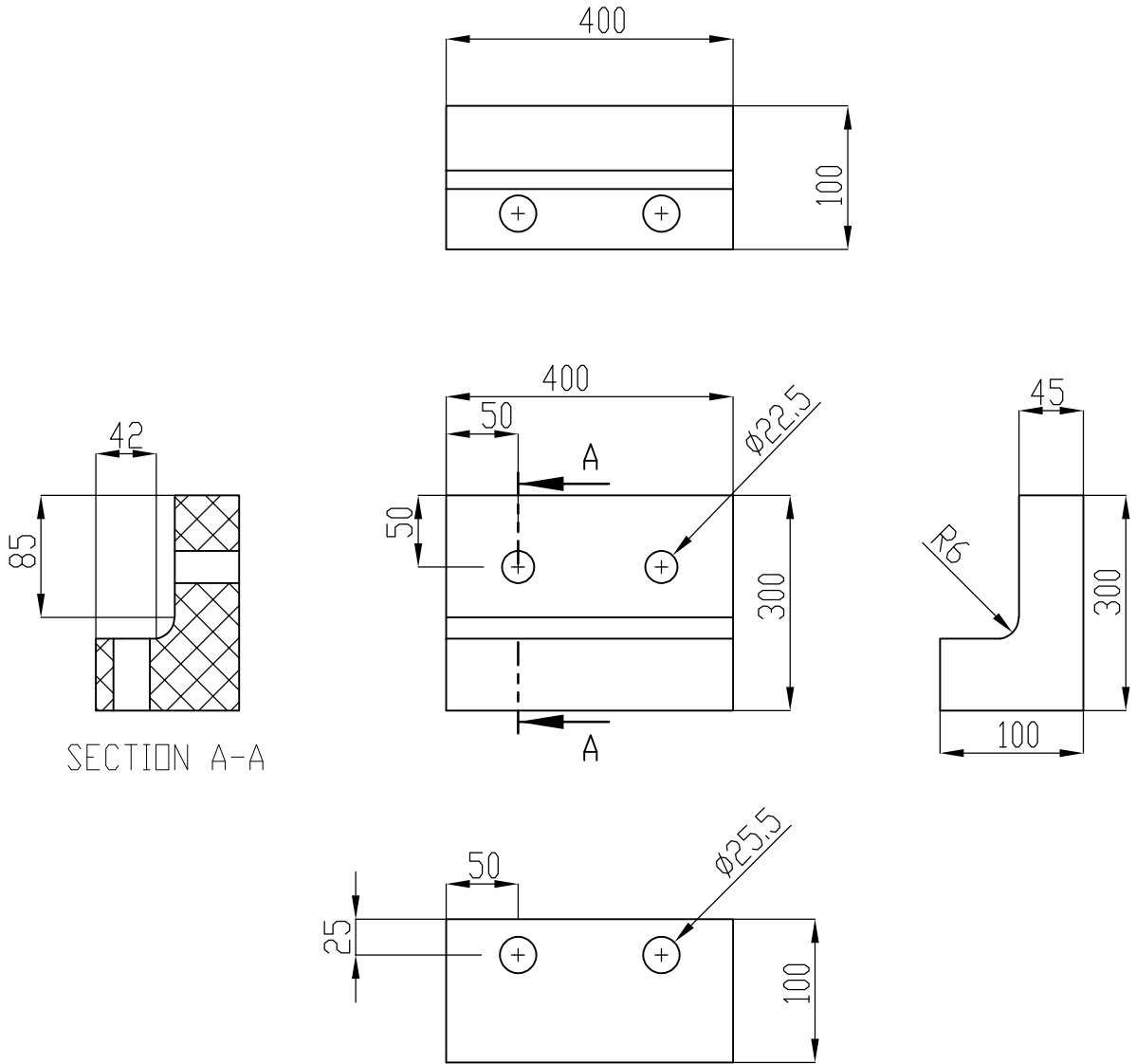
TREATMENT:		LASER CUTTING	
COVERING:		CREAM-COLOURED COVER	
MATERIAL:		STEEL A36	
GENERAL TOLERANCE:		±0,2	
SCALE:		1:20	
DR1	RIVERA A	03/02/24	
DES1	RIVERA A	03/02/24	
REV1	TIRRA A.	03/02/24	

NOTES
THICKNESS: 1.1 mm

STRUCTURE OF THE CONTROL DESK

UIDE MECHATRONICS ENGINEERING
D01-105



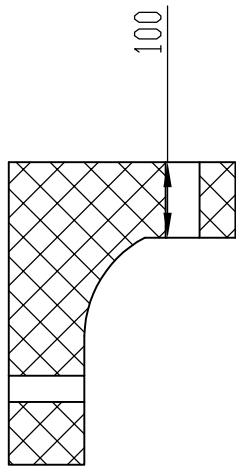


SECTION A-A

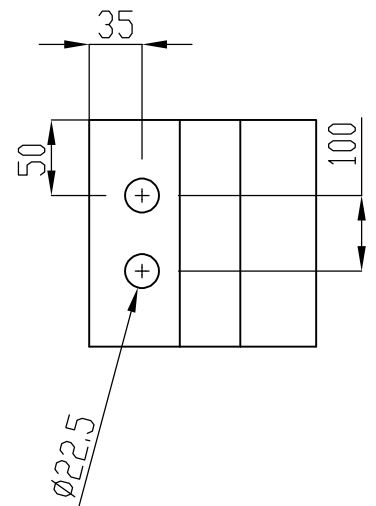
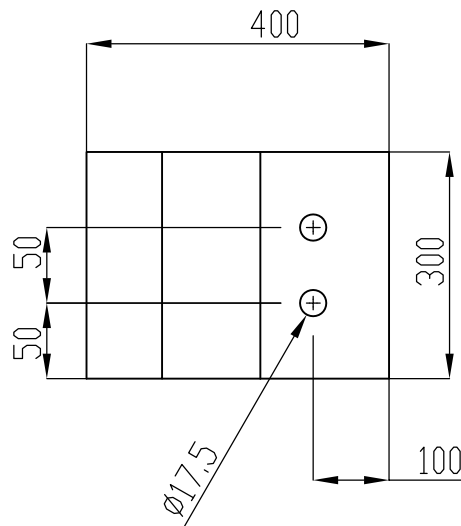
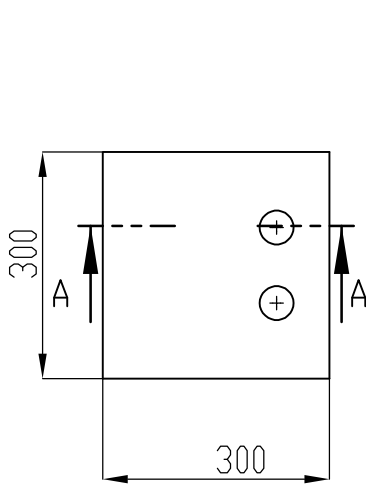
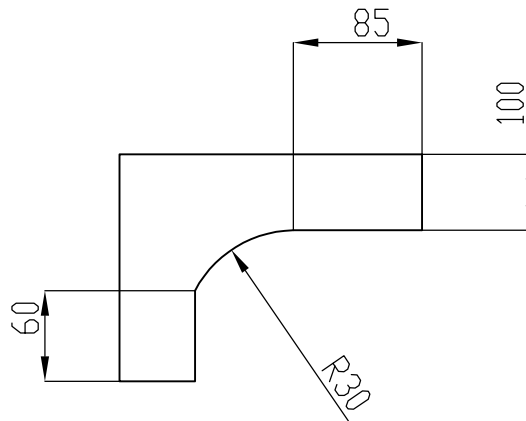
SPECIFICATION FOR 3D PRINTING			
MATERIALS: PETG			
PROCESS: FDM			
PRINTER: ENDER 5 PRO			
FILL TYPE: TRIANGULAR			
FILL PERCENTAGE: 25%			
COLOUR/BRAND: WHITE			
BED TEMPERATURE: 60 C°			
EXTRUSION TEMPERATURE: 215 C°			
LAYERS: INITIAL 3-FINAL 3			

TREATMENT: NO TREATMENT		UIDE	MECHATRONICS ENGINEERING		
COVERING: NO COVERING					
MATERIAL: PETG		SCALE: 1:1	DRA	RIVERA.A	03/02/24
GENERAL TOLERANCE: ±0,2			DES.	RIVERA A.	03/02/24
			REV	TIRIRA .A	03/02/24
ELECTRONIC SUPPORT			D01-106		





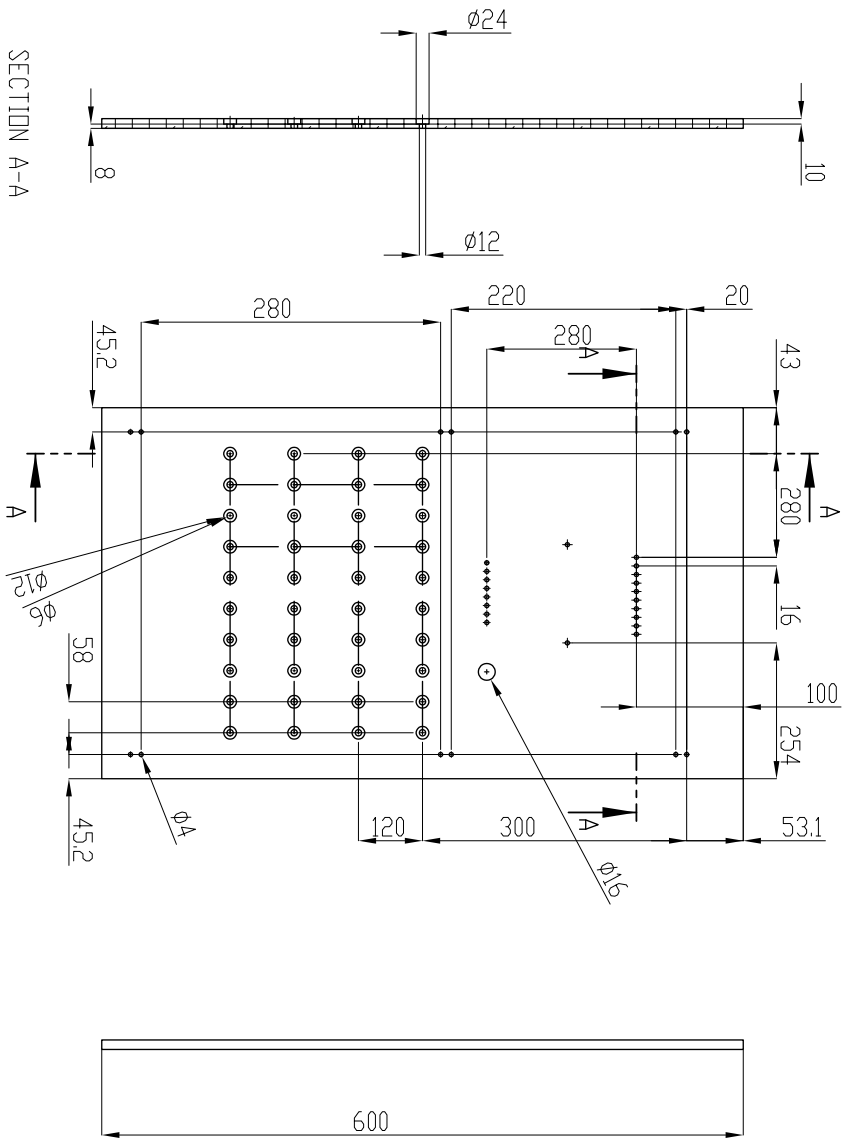
SECTION A-A



SPECIFICATION FOR 3D PRINTING

MATERIALS: PETG
 PROCESS: FDM
 PRINTER: ENDER 5 PRO
 FILL TYPE: TRIANGULAR
 FILL PERCENTAGE: 25%
 COLOUR/BRAND: WHITE
 BED TEMPERATURE: 60 C°
 EXTRUSION TEMPERATURE: 215 C°
 LAYERS: INITIAL 3-FINAL 3

TREATMENT: NO TREATMENT		UIDE	MECHATRONICS ENGINEERING		
COVERING: NO COVERING					
MATERIAL: PETG	GENERAL TOLERANCE: $\pm 0,2$	SCALE: 1:1	DRA. RIVERA.A	03/02/24	
			DES. RIVERA A.	03/02/24	
			REV. TIRIRA .A	03/02/24	
PANEL SUPPORT		D01-107			



NOTES
THICKNESS: 9 mm

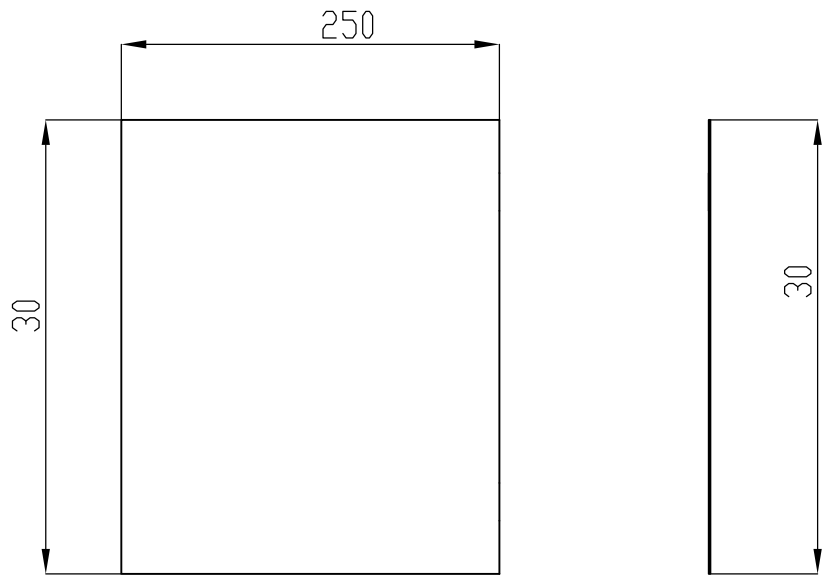
TREATMENT:	NO TREATMENT	UIDE	MECHATRONICS ENGINEERING
COVERING:	NO COVERING		

MATERIAL:	MDF	GENERAL TOLERANCE:	±0.2
		SCALE:	1:5
		DRAWN:	RIVERA A
		DESIGNED:	RIVERA A
		REVISION:	TRIRRA A
			03/02/24
			03/02/24
			03/02/24

STRUCTURE OF CONTROL PANEL

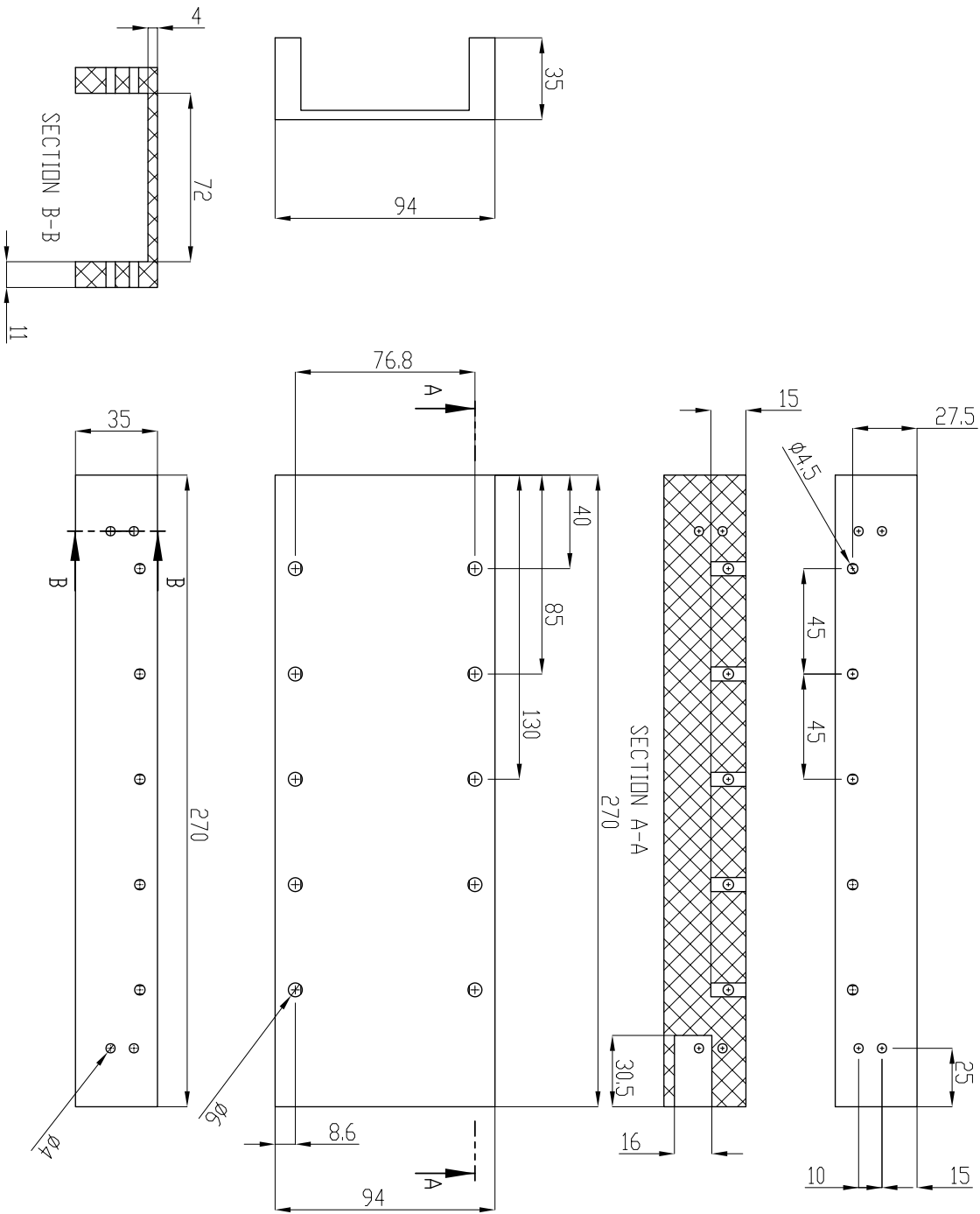
D01-108





NOTES
 THICKNESS: 1.1 mm

TREATMENT: LASER CUTTING		UIDE	MECHATRONICS ENGINEERING		
COVERING: CREAM-COLORED COVER					
MATERIAL: STEEL A36		SCALE: 1:5	DRA.	RIVERA.A	03/02/24
GENERAL TOLERANCE: ±0,2			DES.	RIVERA A.	03/02/24
			REV.	TIRIRA .A	03/02/24
BACK DOOR OF THE TABLE		D01-109			



SPECIFICATION FOR 3D PRINTING	
MATERIALS:	PETG
PROCESS:	FDM
PRINTER:	ENDER 5 PRO
FILL TYPE:	TRIANGULAR
FILL PERCENTAGE:	29%
COLOUR/BRAND:	WHITE
BED TEMPERATURE:	60 C°
EXTRUSION TEMPERATURE:	215 C°
LAYERS:	INITIAL 3-FINAL 3

TREATMENT: NO TREATMENT
COVERING: NO COVERING

UIDE MECHATRONICS
ENGINEERING

MATERIAL: PETG

SCALE: 1:2

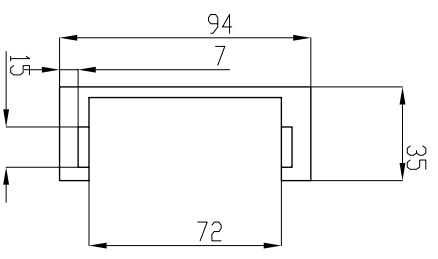
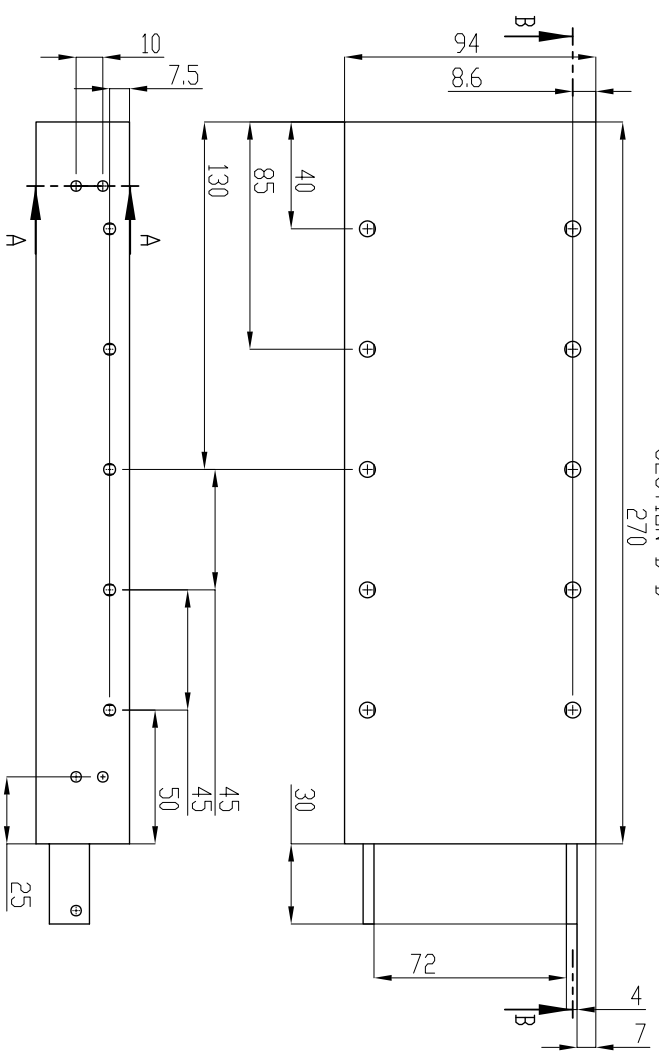
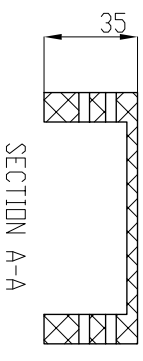
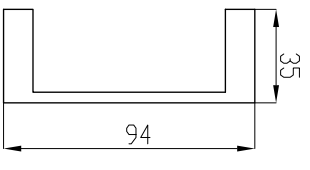
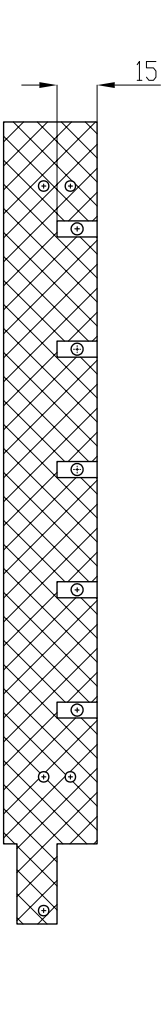
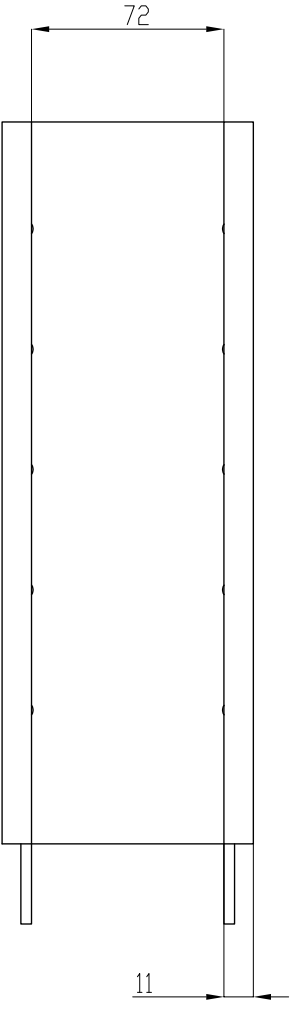
GENERAL TOLERANCE: ± 0.2

DRA RIVERA A 03/02/24
DES RIVERA A 03/02/24
REV TIRRA A 03/02/24

BASE CONVEYOR
BELT PART1

D01-110





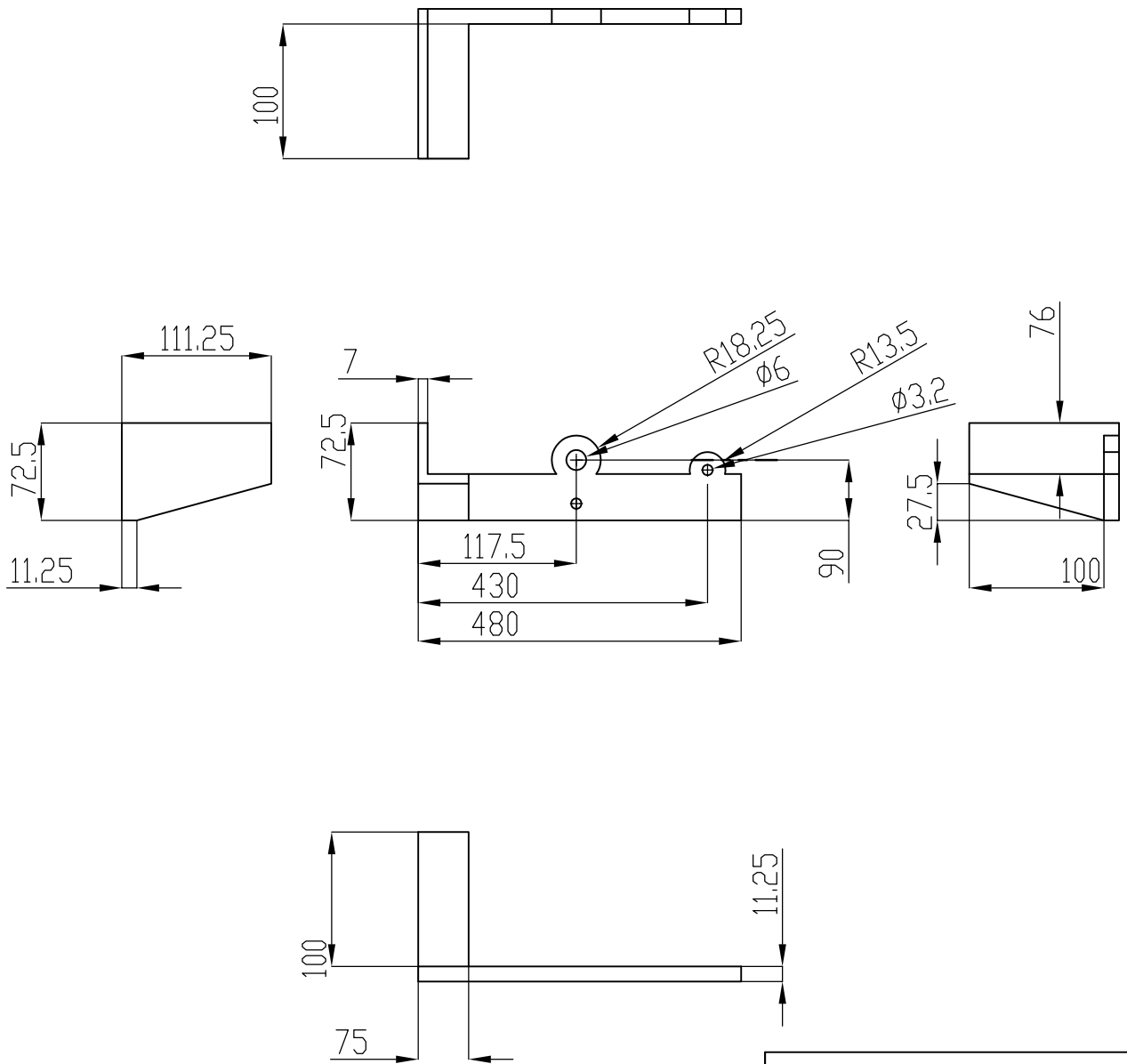
SPECIFICATION FOR 3D PRINTING

MATERIALS: PETG
 PROCESS: FDM
 PRINTER: ENDER 5 PRO
 FILL TYPE: TRIANGULAR
 FILL PERCENTAGE: 25%
 COLOUR/BRAND: WHITE
 BED TEMPERATURE: 60 C
 EXTRUSION TEMPERATURE: 215 C
 LAYERS: INITIAL 3-FINAL 3

TREATMENT:	NO TREATMENT	UIDE	MECHATRONICS ENGINEERING
COVERING:	NO COVERING	SCALE:	1:2
MATERIAL:	PETG	GENERAL TOLERANCE:	±0.2
		DRAWN:	RIVERA A. 03/02/24
		DESIGNED:	RIVERA A. 03/02/24
		REVISION:	TIRIRA A. 03/02/24
		D01-111	

**BASE CONVEYOR
BELT PART2**

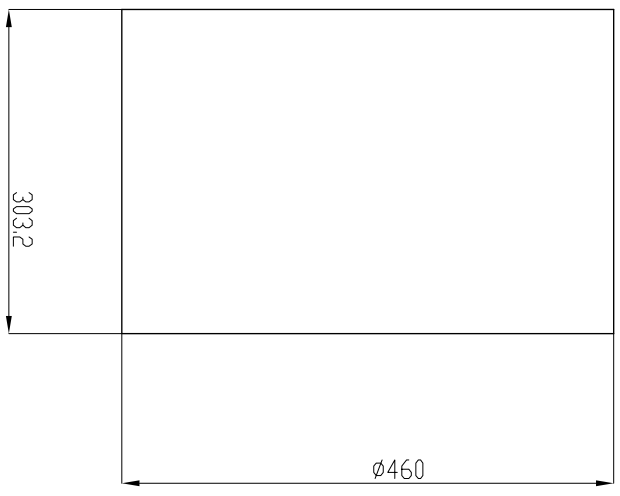
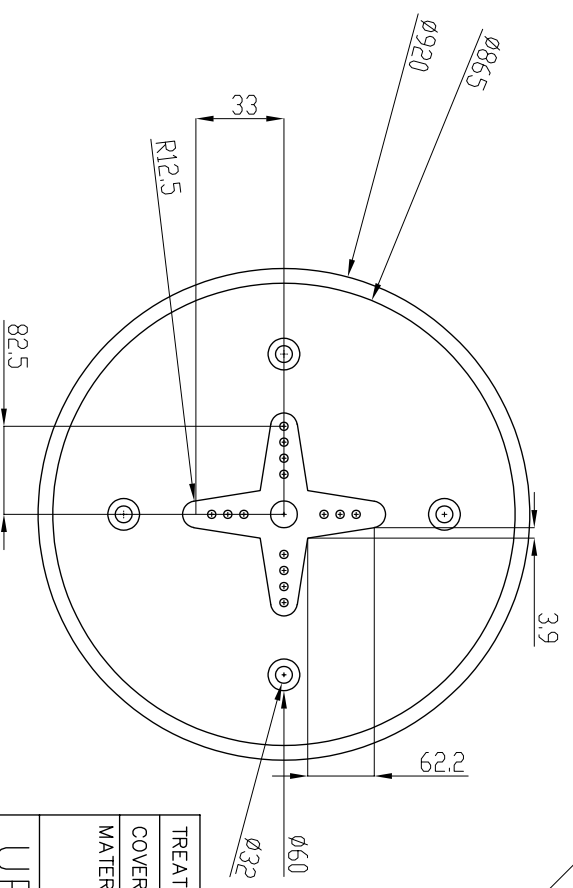
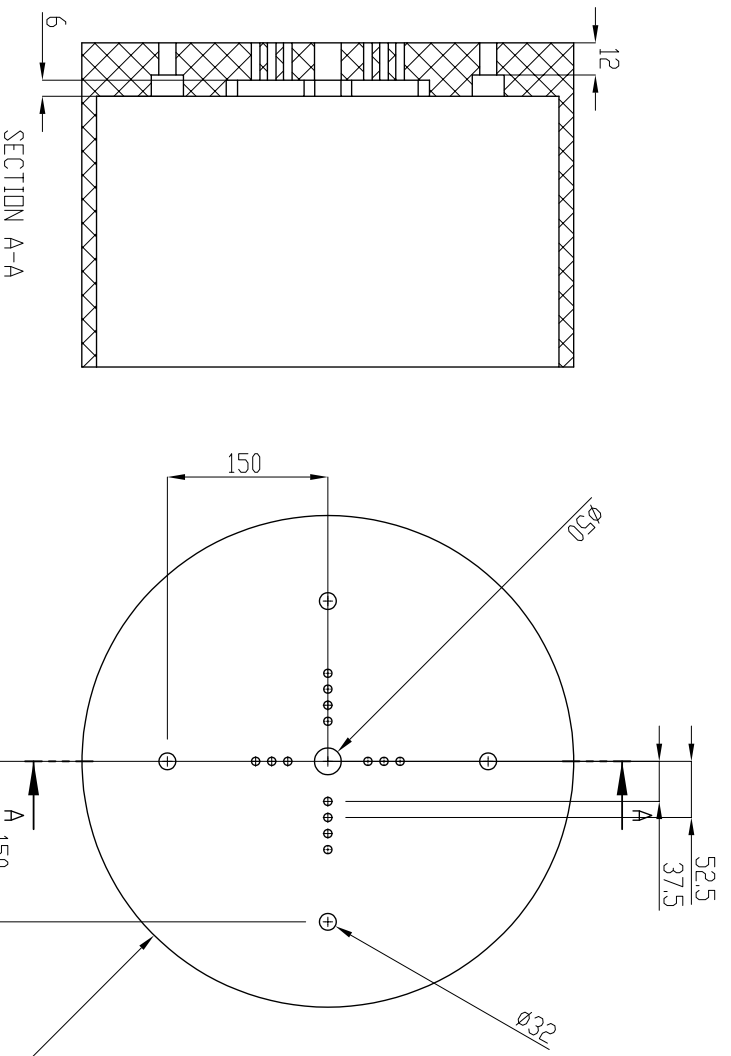




SPECIFICATION FOR 3D PRINTING

MATERIALS: PETG
 PROCESS: FDM
 PRINTER: ENDER 5 PRO
 FILL TYPE: TRIANGULAR
 FILL PERCENTAGE: 25%
 COLOUR/BRAND: WHITE
 BED TEMPERATURE: 60 C°
 EXTRUSION TEMPERATURE: 215 C°
 LAYERS: INITIAL 3-FINAL 3

TREATMENT: NO TREATMENT	UIDE	MECHATRONICS ENGINEERING		
COVERING: NO COVERING		SCALE: 1:2	DRA. RIVERA.A 03/02/24	DES. RIVERA.A 03/02/24
MATERIAL: PETG	GENERAL TOLERANCE: ±0,2	REV. TIRIRA .A 03/02/24		
RIGHT BASE GRIFO		D01-114		



SPECIFICATION FOR 3D PRINTING

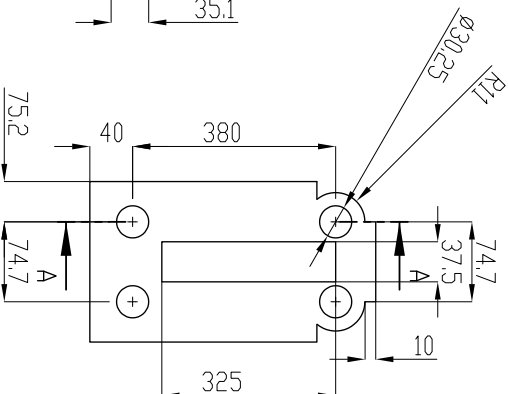
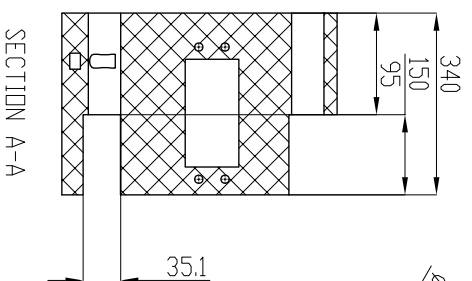
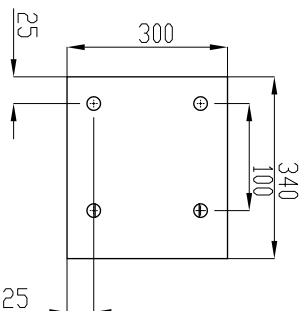
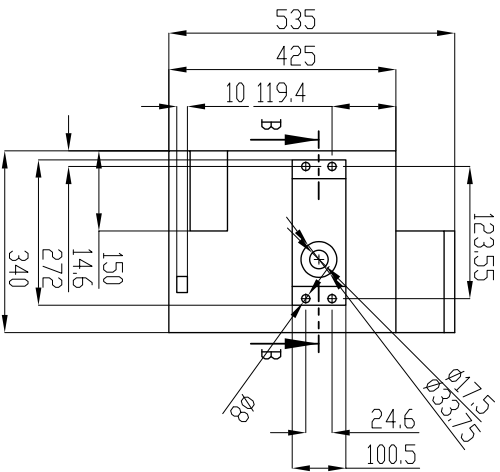
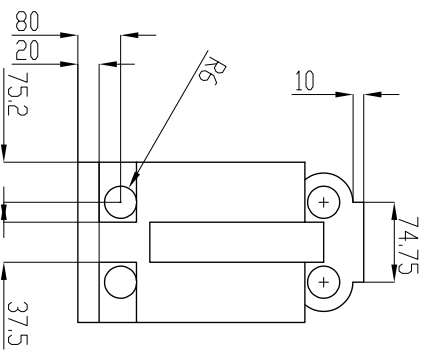
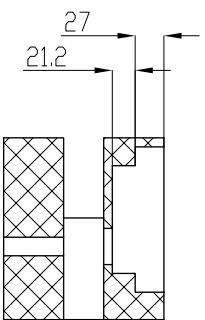
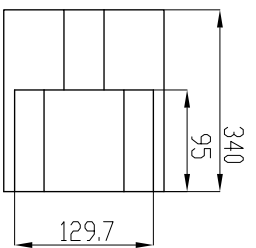
MATERIALS: PETG
 PROCESS: FDM
 PRINTER: ENDER 5 PRO
 FILL TYPE: TRIANGULAR
 FILL PERCENTAGE: 25%
 COLOUR/BRAND: WHITE
 BED TEMPERATURE: 60 C°
 EXTRUSION TEMPERATURE: 215 C°
 LAYERS: INITIAL 3-FINAL 3

TREATMENT:	NO TREATMENT		UIDE	MECHATRONICS ENGINEERING
COVERING:	NO COVERING			
MATERIAL:	PETG	GENERAL TOLERANCE: ±0.2	SCALE: 1:1	
	DRA	RIVERA A	03/02/24	
	DES	RIVERA A	03/02/24	
	REV	TIRIRA A.	03/02/24	

UPPER PIVOT BASE
OF THE SERVO

D01-116





SPECIFICATION FOR 3D PRINTING

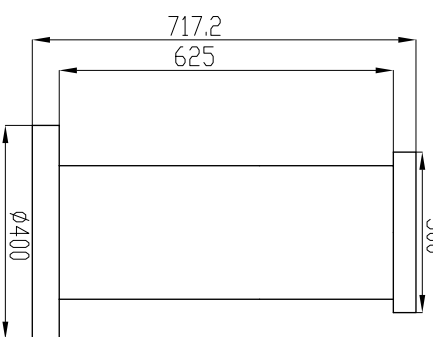
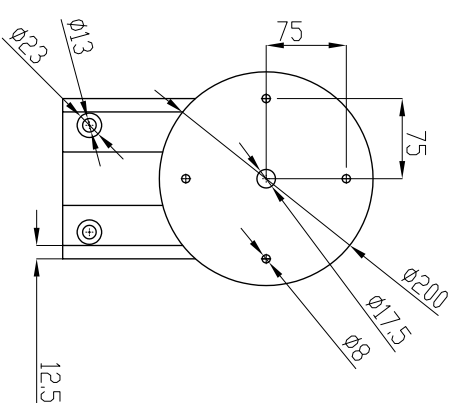
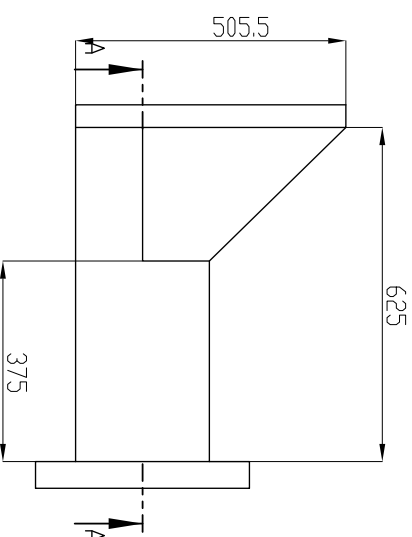
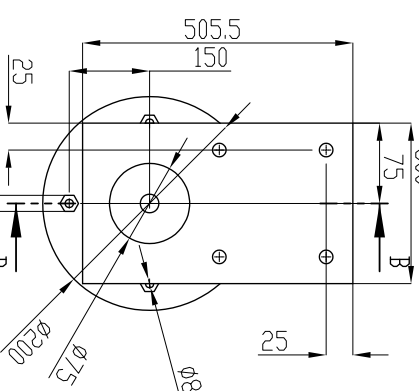
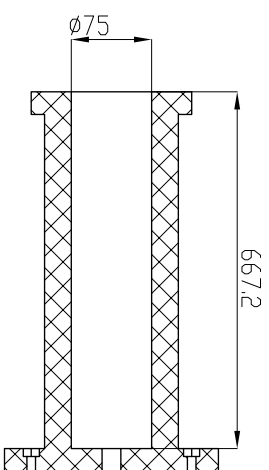
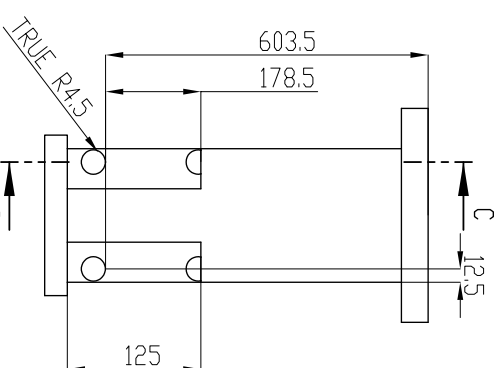
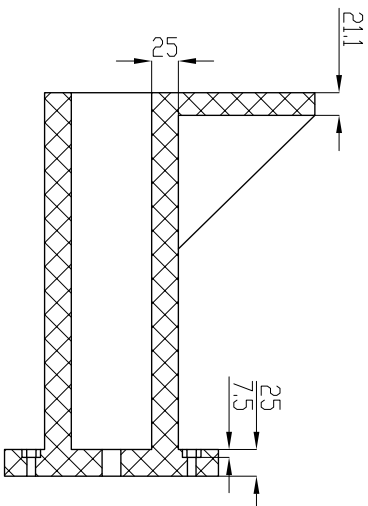
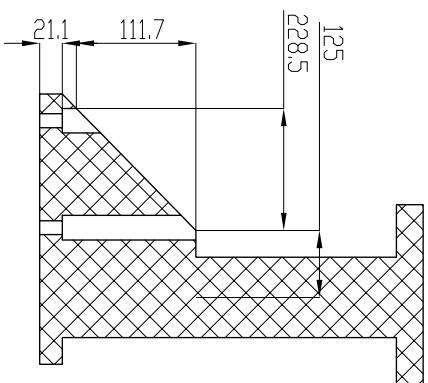
MATERIALS: PETG
 PROCESS: FDM
 PRINTER: ENDER 5 PRO
 FILL TYPE: TRIANGULAR
 FILL PERCENTAGE: 25%
 COLOUR/BRAND: WHITE
 BED TEMPERATURE: 60 C
 EXTRUSION TEMPERATURE: 215 C
 LAYERS: INITIAL 3-FINAL 3

TREATMENT: NO TREATMENT
 COVERING: NO COVERING
 MECHATRONICS ENGINEERING

MATERIAL: PETG
 GENERAL TOLERANCE: ± 0.2
 SCALE: 1:1
 DESI: RIVERA. A 03/02/24
 REV: TIRIRA. A. 03/02/24

PATH SERVO MOTOR
 D01-117





SPECIFICATION FOR 3D PRINTING

MATERIALS: PETG
 PROCESS: FDM
 PRINTER: ENDER 5 PRO
 FILL TYPE: TRIANGULAR
 FILL PERCENTAGE: 29%
 COLOUR/BRAND: WHITE
 BED TEMPERATURE: 60 C°
 EXTRUSION TEMPERATURE: 215 C°
 LAYERS: INITIAL 3-FINAL 3

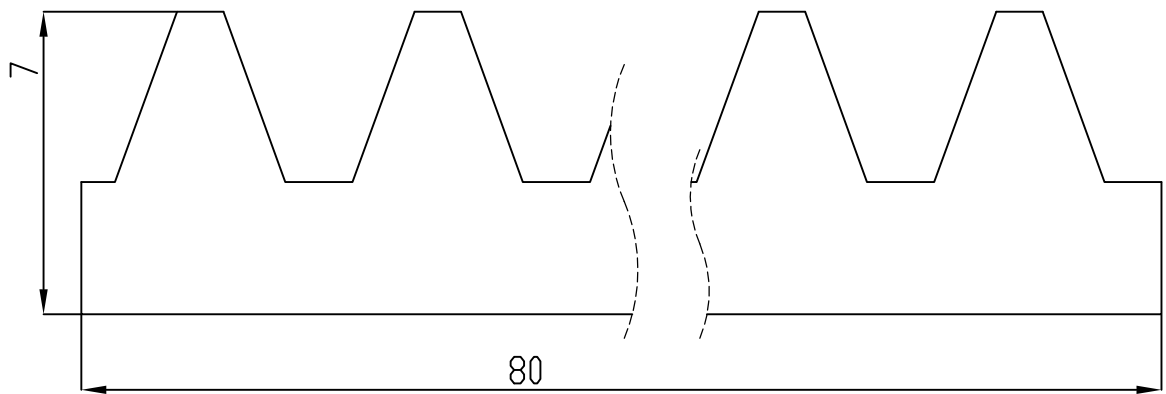
TREATMENT:	NO TREATMENT	UIDE	MECHATRONICS ENGINEERING
COVERING:	NO COVERING		

MATERIAL:	PETG	GENERAL TOLERANCE:	±0.2
		SCALE:	1:2
DRAWN BY:	RIVERA A.	DATE:	03/02/24
DESIGNED BY:	RIVERA A.	DATE:	03/02/24
REVISIONS:	TIRRA A.	DATE:	03/02/24

TOWEL OF BASE
SERVO

D01-118

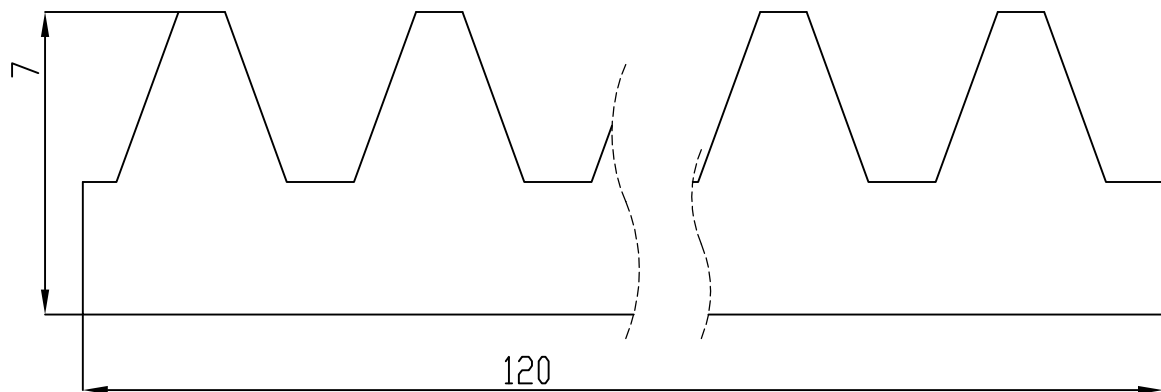




MÓDULO:	2
ANG. PRESIÓN	20
ANCHO CARA	7
ALTURA	12
LONGITUD	80
NO. DIENTES	13

SPECIFICATION FOR 3D PRINTING			
MATERIALS: PETG			
PROCESS: FDM			
PRINTER: ENDER 5 PRO			
FILL TYPE: TRIANGULAR			
FILL PERCENTAGE: 25%			
COLOUR/BRAND: WHITE			
BED TEMPERATURE: 60 C°			
EXTRUSION TEMPERATURE: 215 C°			
LAYERS: INITIAL 3-FINAL 3			

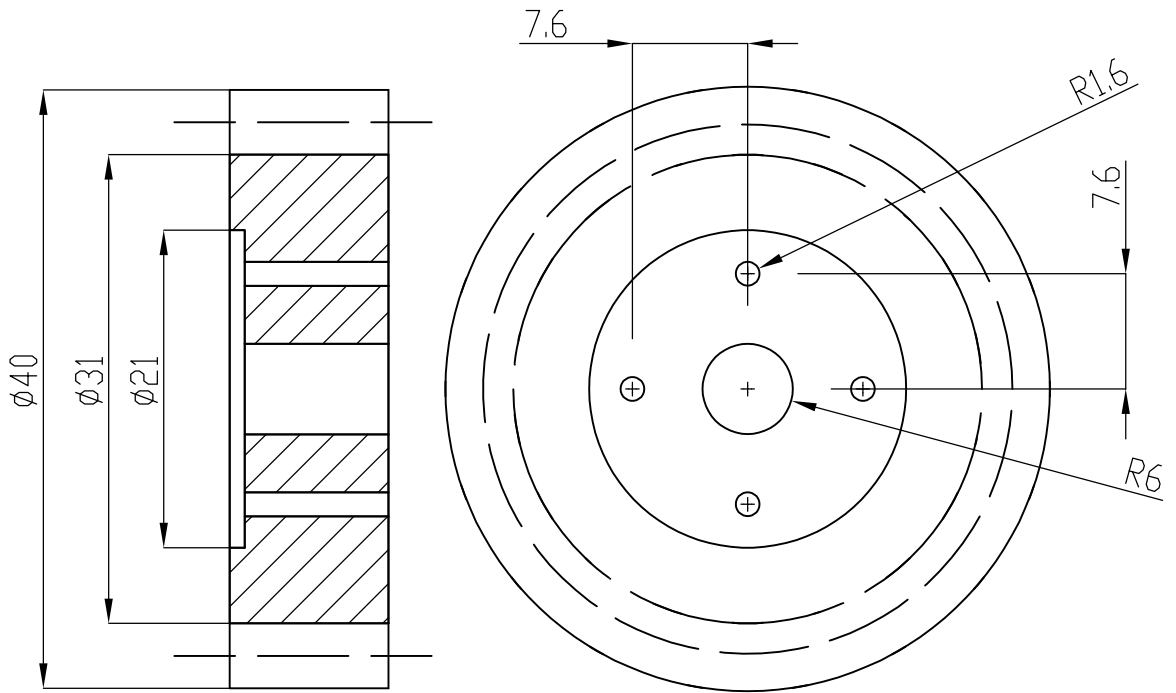
TREATMENT: NO TREATMENT		UIDE	MECHATRONICS ENGINEERING			
COVERING: NO COVERING						
MATERIAL: PETG		GENERAL TOLERANCE: ±0,2	SCALE: 2:1	DRA.	RIVERA.A	03/02/24
				DES.	RIVERA.A	03/02/24
				REV.	TIRIRA .A	03/02/24
CREMALLERA GRIFO			D01-119			



MÓDULO:	2
ANG. PRESIÓN	20
ANCHO CARA	7
ALTURA	12
LONGITUD	120
NO. DIENTES	19

SPECIFICATION FOR 3D PRINTING			
MATERIALS: PETG			
PROCESS: FDM			
PRINTER: ENDER 5 PRO			
FILL TYPE: TRIANGULAR			
FILL PERCENTAGE: 25%			
COLOUR/BRAND: WHITE			
BED TEMPERATURE: 60 C°			
EXTRUSION TEMPERATURE: 215 C°			
LAYERS: INITIAL 3-FINAL 3			

TREATMENT: NO TREATMENT		UIDE	MECHATRONICS ENGINEERING			
COVERING: NO COVERING						
MATERIAL: PETG		GENERAL TOLERANCE: ±0,2	SCALE: 2:1	DRA	RIVERA.A	03/02/24
				DES.	RIVERA.A	03/02/24
				REV	TIRIRA .A	03/02/24
CREMALLERA CARRIL SERVO			D01-120			

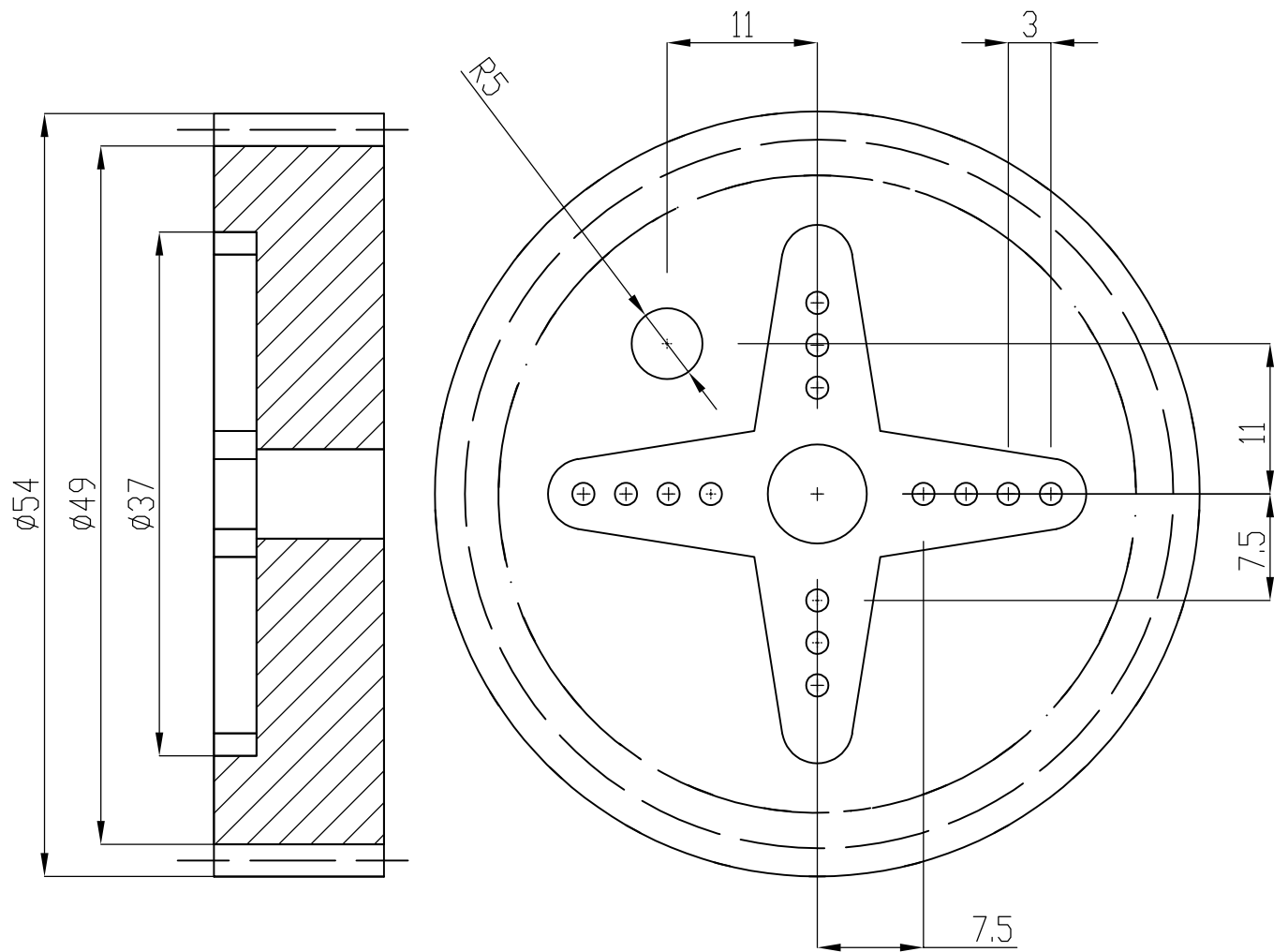


MÓDULO:	2
NO. DIENTES	26
ANG. PRESIÓN	20
ANCHO CARA	60
DIAM. DADO	N/A
DIAM. NOMINAL	270

SPECIFICATION FOR 3D PRINTING			
MATERIALS: PETG			
PROCESS: FDM			
PRINTER: ENDER 5 PRO			
FILL TYPE: TRIANGULAR			
FILL PERCENTAGE: 25%			
COLOUR/BRAND: WHITE			
BED TEMPERATURE: 60 C°			
EXTRUSION TEMPERATURE: 215 C°			
LAYERS: INITIAL 3-FINAL 3			

TREATMENT: NO TREATMENT		UIDE	MECHATRONICS ENGINEERING		
COVERING: NO COVERING					
MATERIAL: PETG		SCALE: 1:1	DRA	RIVERA.A	03/02/24
GENERAL TOLERANCE: ±0,2			DES.	RIVERA A.	03/02/24
			REV	TIRIRA .A	03/02/24
GEAR CARRIL SERVO			D01-121		



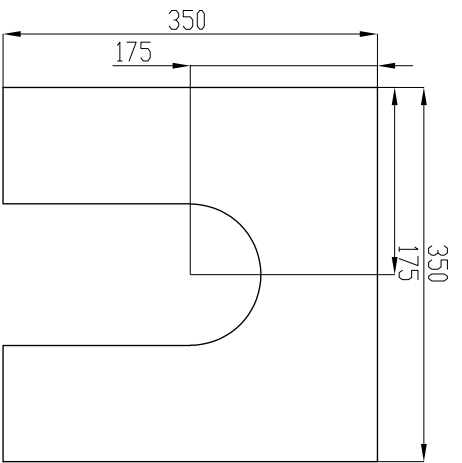
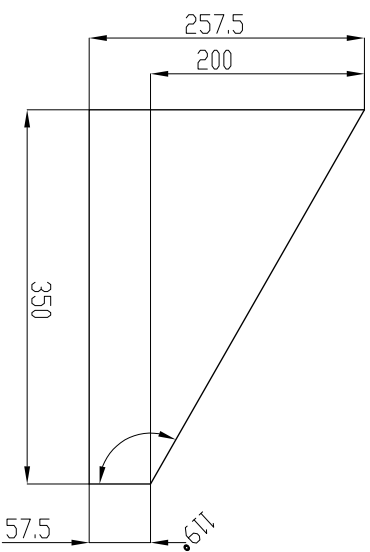
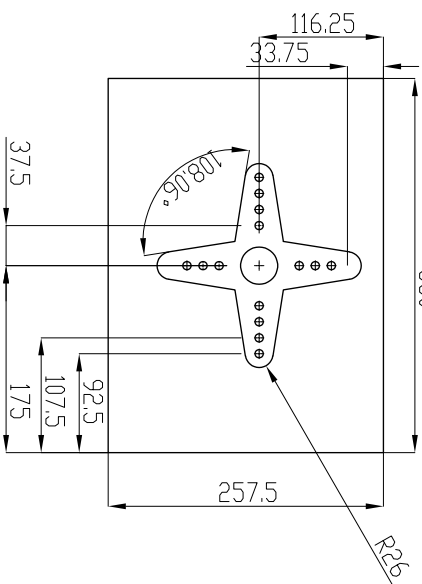
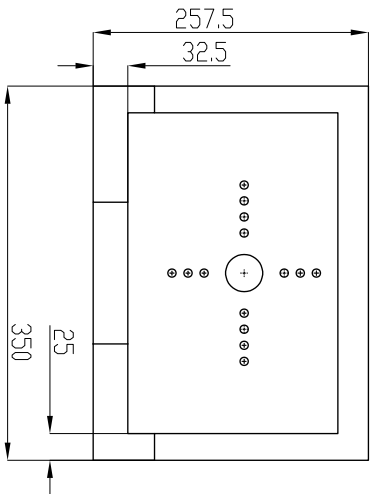
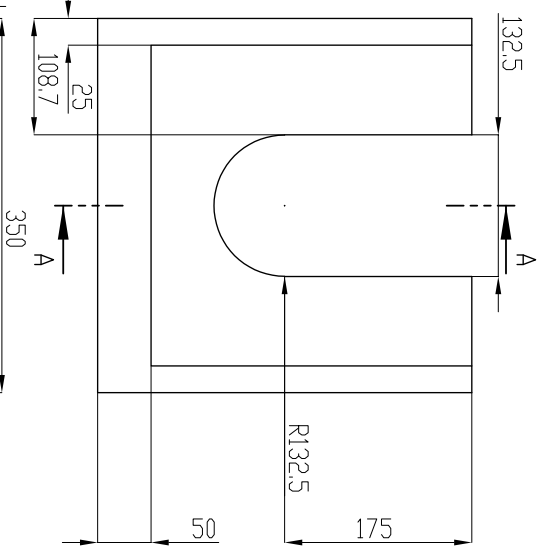
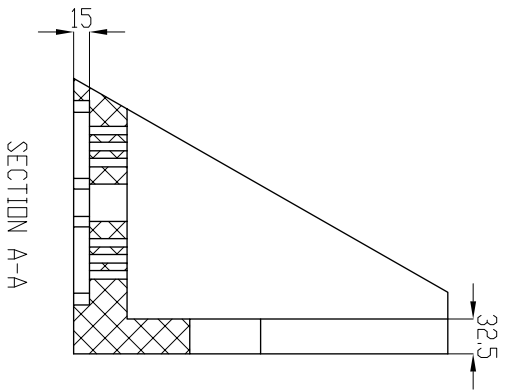


MÓDULO:	2
NO. DIENTES	18
ANG. PRESIÓN	20
ANCHO CARA	10
DIAM. DADO	N/A
DIAM. NOMINAL	16

SPECIFICATION FOR 3D PRINTING			
MATERIALS: PETG			
PROCESS: FDM			
PRINTER: ENDER 5 PRO			
FILL TYPE: TRIANGULAR			
FILL PERCENTAGE: 25%			
COLOUR/BRAND: WHITE			
BED TEMPERATURE: 60 C°			
EXTRUSION TEMPERATURE: 215 C°			
LAYERS: INITIAL 3-FINAL 3			

TREATMENT: NO TREATMENT		UIDE	MECHATRONICS ENGINEERING			
COVERING: NO COVERING						
MATERIAL: PETG		GENERAL TOLERANCE: ±0,2	SCALE: 2:1	DRA	RIVERA.A	03/02/24
				DES.	RIVERA A.	03/02/24
				REV	TIRIRA .A	03/02/24
GEAR GRIFO			D01-122			





SPECIFICATION FOR 3D PRINTING

MATERIALS: PETG
 PROCESS: FDM
 PRINTER: ENDER 5 PRO
 FILL TYPE: TRIANGULAR
 FILL PERCENTAGE: 29%
 COLOUR/BRAND: WHITE
 BED TEMPERATURE: 60 C°
 EXTRUSION TEMPERATURE: 215 C°
 LAYERS: INITIAL 3-FINAL 3

TREATMENT: NO TREATMENT
 COVERING: NO COVERING

UIDE MECHATRONICS
 ENGINEERING

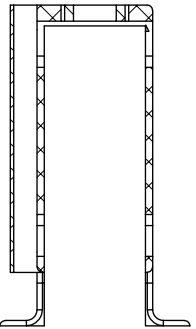
MATERIAL: PETG GENERAL TOLERANCE: ±0.2

SCALE: 1:5	DRA: RIVERA.A	03/02/24
	DES: RIVERA.A	03/02/24
	REV: TIRIRA.A	03/02/24

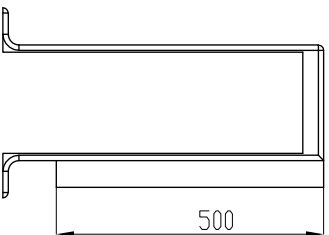
CLAW

D01-123

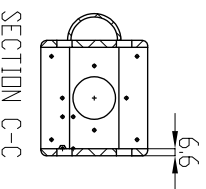
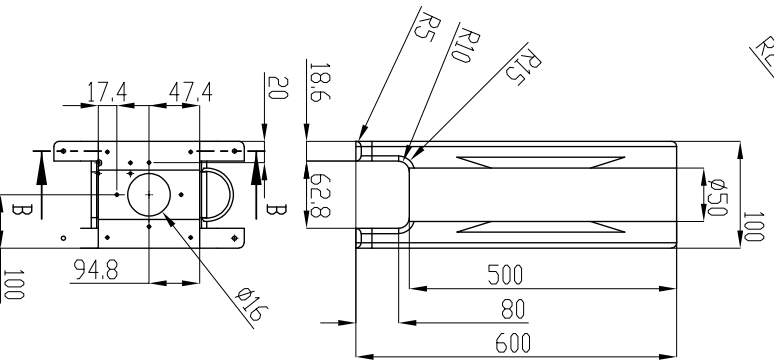
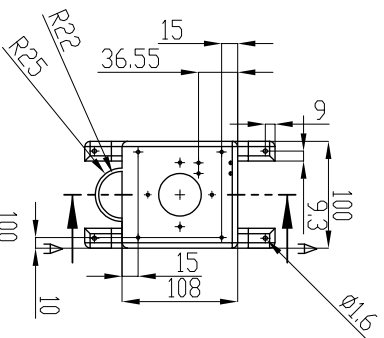




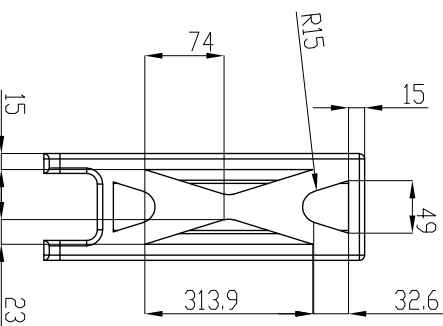
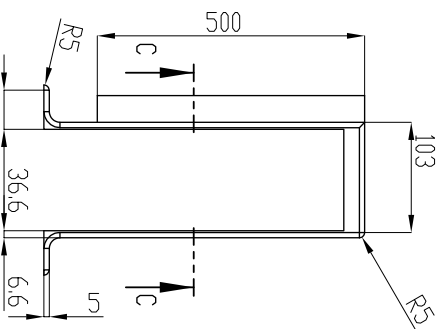
SECTION A-A



SECTION B-B



SECTION C-C



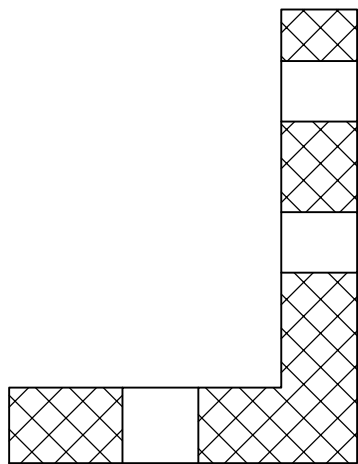
SPECIFICATION FOR 3D PRINTING	
MATERIALS:	PETG
PROCESS:	FDM
PRINTER:	ENDER 5 PRO
FILL TYPE:	TRIANGULAR
FILL PERCENTAGE:	25%
COLOR/BRAND:	WHITE
BED TEMPERATURE:	60 C°
EXTRUSION TEMPERATURE:	215 C°
LAYERS:	INITIAL 3-FINAL 3

TREATMENT:	NO TREATMENT	UIDE	MECHATRONICS ENGINEERING
COVERING:	NO COVERING		

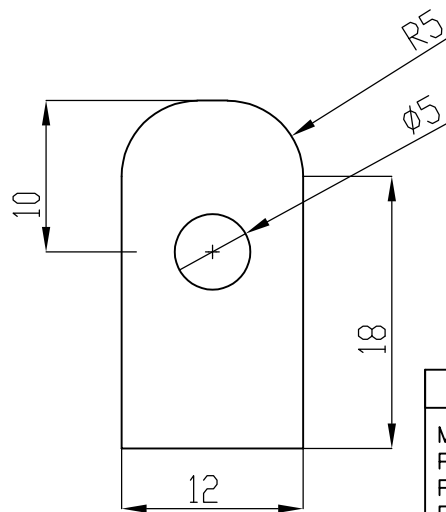
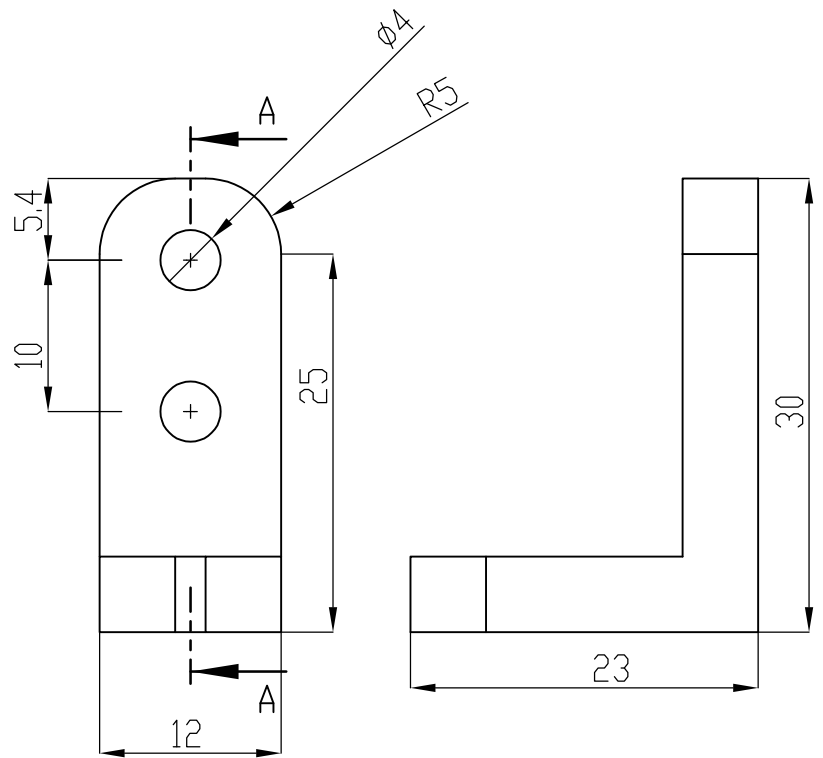
MATERIAL:	PETG	GENERAL TOLERANCE:	±0,2	SCALE:	1:5	DRA RIVERA A	03/02/24
						DES RIVERA A	03/02/24
						REV TIRRA A.	03/02/24

FRAME OF WATER D01-124





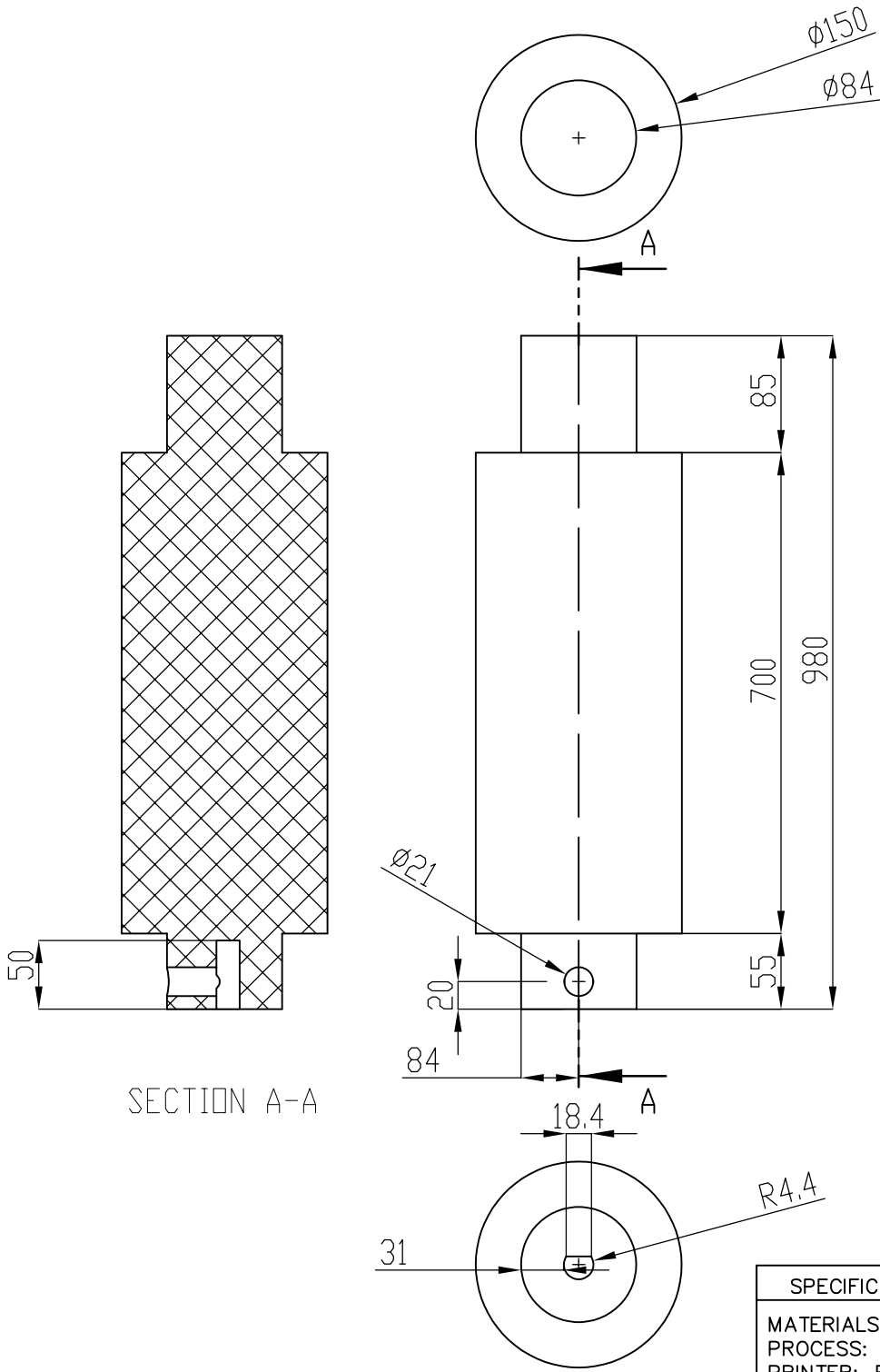
SECTION A-A



SPECIFICATION FOR 3D PRINTING			
MATERIALS: PETG			
PROCESS: FDM			
PRINTER: ENDER 5 PRO			
FILL TYPE: TRIANGULAR			
FILL PERCENTAGE: 25%			
COLOUR/BRAND: WHITE			
BED TEMPERATURE: 60 C°			
EXTRUSION TEMPERATURE: 215 C°			
LAYERS: INITIAL 3-FINAL 3			

TREATMENT: NO TREATMENT		UIDE	MECHATRONICS ENGINEERING			
COVERING: NO COVERING						
MATERIAL: PETG		GENERAL TOLERANCE: $\pm 0,2$	SCALE: 2:1	DRA	RIVERA.A	03/02/24
				DES.	RIVERA A.	03/02/24
			REV	TIRIRA .A	03/02/24	
RAIL RIB OF THE CONVEYOR BELT			D01-125			

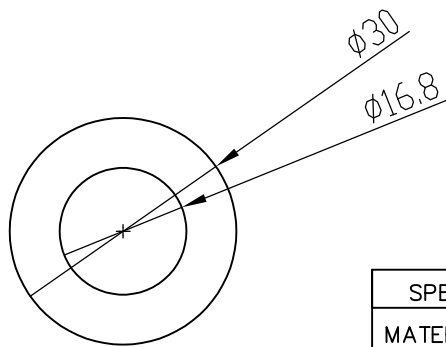
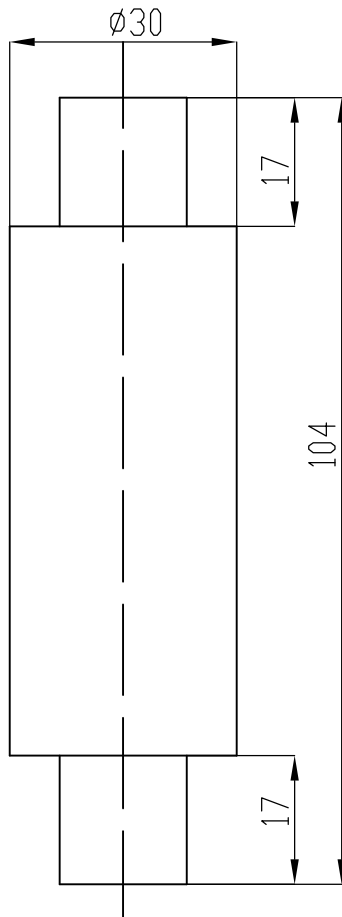





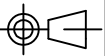
SECTION A-A

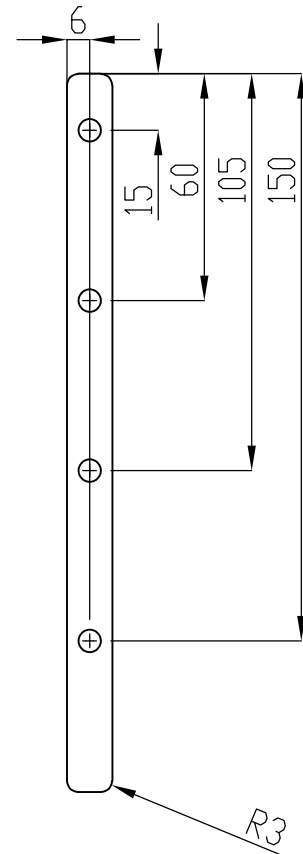
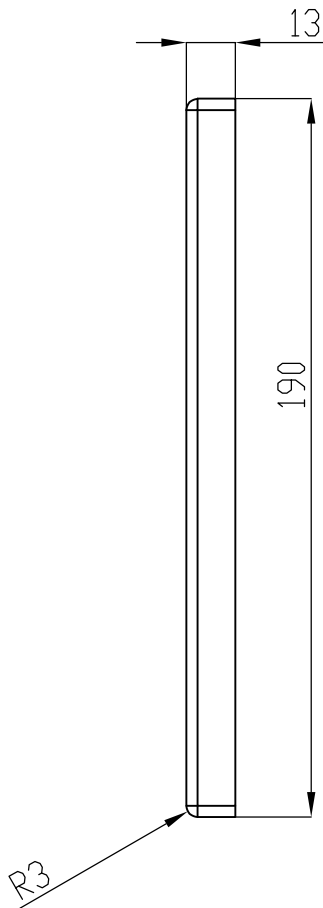
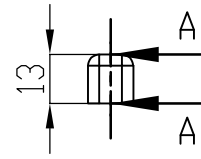
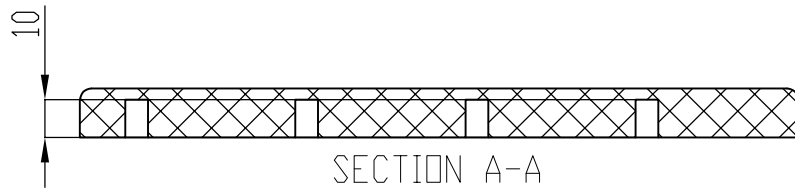
SPECIFICATION FOR 3D PRINTING			
MATERIALS: PETG			
PROCESS: FDM			
PRINTER: ENDER 5 PRO			
FILL TYPE: TRIANGULAR			
FILL PERCENTAGE: 25%			
COLOUR/BRAND: WHITE			
BED TEMPERATURE: 60 C°			
EXTRUSION TEMPERATURE: 215 C°			
LAYERS: INITIAL 3-FINAL 3			

TREATMENT: NO TREATMENT		UIDE	MECHATRONICS ENGINEERING		
COVERING: NO COVERING					
MATERIAL: PETG	GENERAL TOLERANCE: ±0,2	SCALE: 1:1	DRA	RIVERA.A	03/02/24
			DES.	RIVERA A.	03/02/24
			REV	TIRIRA .A	03/02/24
ROLLER MOTOR		D01-126			



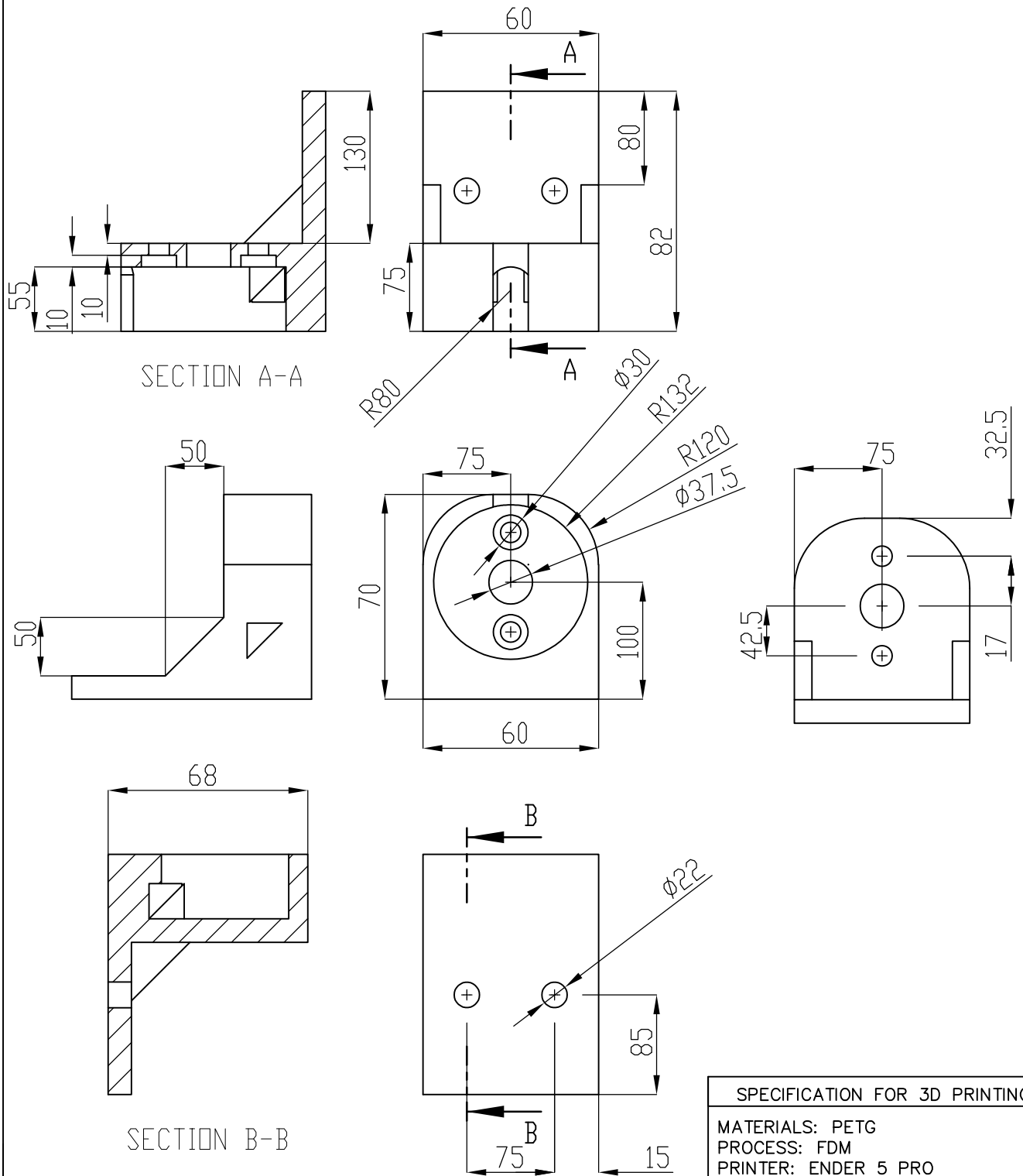
SPECIFICATION FOR 3D PRINTING			
MATERIALS: PETG			
PROCESS: FDM			
PRINTER: ENDER 5 PRO			
FILL TYPE: TRIANGULAR			
FILL PERCENTAGE: 25%			
COLOUR/BRAND: WHITE			
BED TEMPERATURE: 60 C°			
EXTRUSION TEMPERATURE: 215 C°			
LAYERS: INITIAL 3-FINAL 3			

TREATMENT: NO TREATMENT		UIDE	MECHATRONICS ENGINEERING			
COVERING: NO COVERING						
MATERIAL: PETG		GENERAL TOLERANCE: $\pm 0,2$	SCALE: 1:1	DRA	RIVERA.A	03/02/24
				DES.	RIVERA.A.	03/02/24
				REV	TIRIRA .A	03/02/24
ROLLER		D01-127			 	



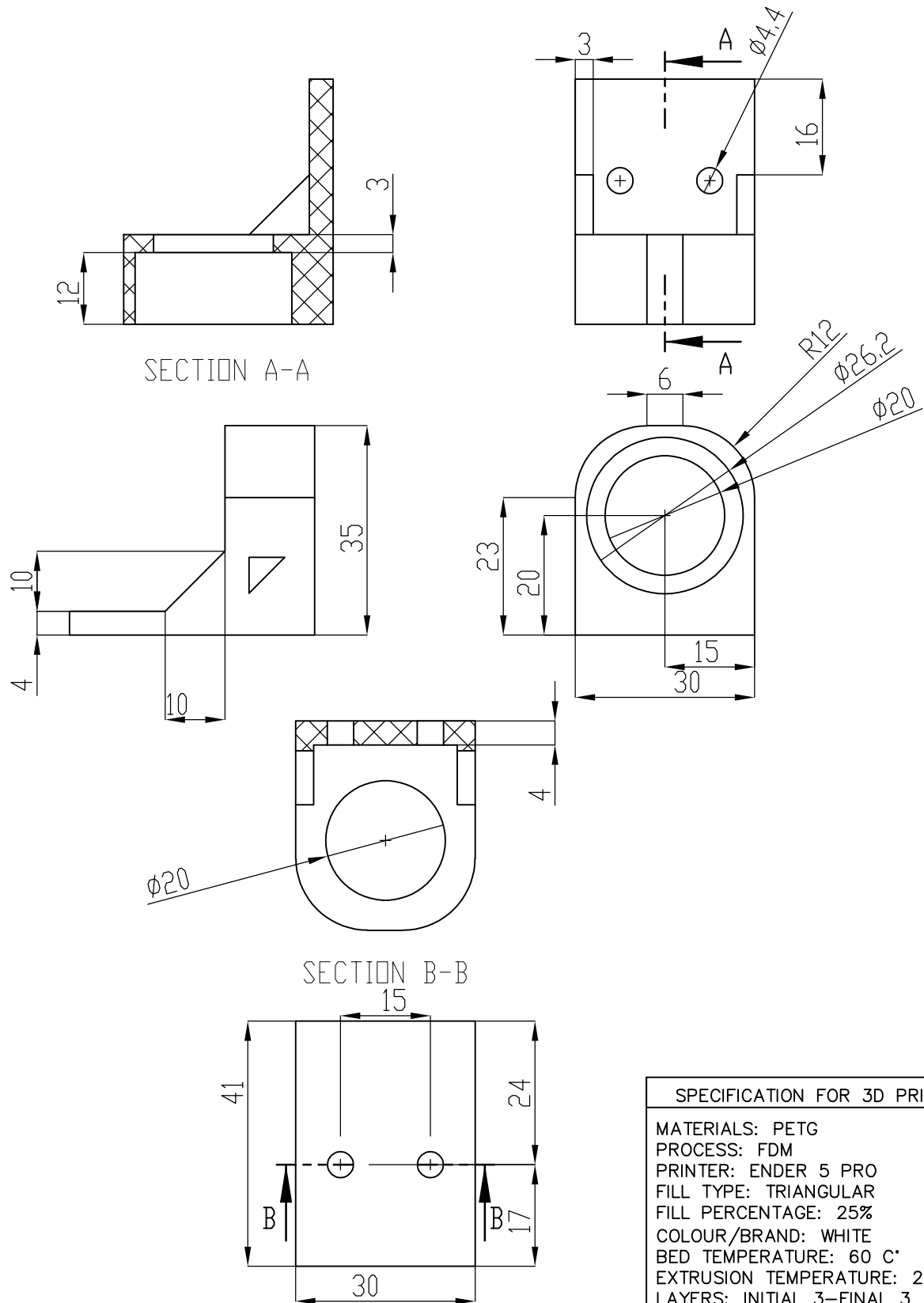
SPECIFICATION FOR 3D PRINTING			
MATERIALS: PETG			
PROCESS: FDM			
PRINTER: ENDER 5 PRO			
FILL TYPE: TRIANGULAR			
FILL PERCENTAGE: 25%			
COLOUR/BRAND: WHITE			
BED TEMPERATURE: 60 C°			
EXTRUSION TEMPERATURE: 215 C°			
LAYERS: INITIAL 3-FINAL 3			

TREATMENT: NO TREATMENT		UIDE	MECHATRONICS ENGINEERING		
COVERING: NO COVERING					
MATERIAL: PETG	GENERAL TOLERANCE: ±0,2	SCALE: 1:1	DRA. RIVERA.A	03/02/24	
			DES. RIVERA A.	03/02/24	
			REV. TIRIRA .A	03/02/24	
BORDER		D01-128			

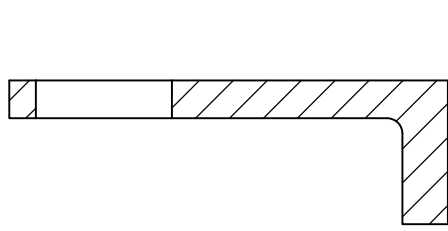


SPECIFICATION FOR 3D PRINTING			
MATERIALS: PETG			
PROCESS: FDM			
PRINTER: ENDER 5 PRO			
FILL TYPE: TRIANGULAR			
FILL PERCENTAGE: 25%			
COLOUR/BRAND: WHITE			
BED TEMPERATURE: 60 C°			
EXTRUSION TEMPERATURE: 215 C°			
LAYERS: INITIAL 3-FINAL 3			

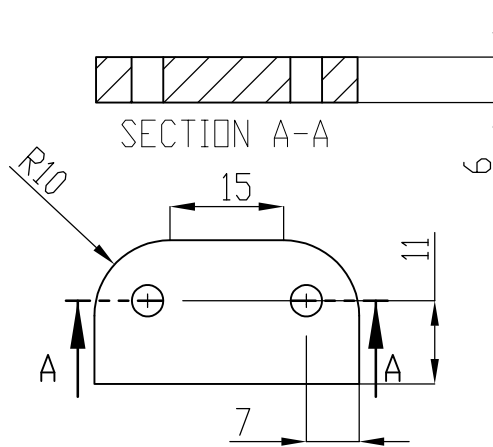
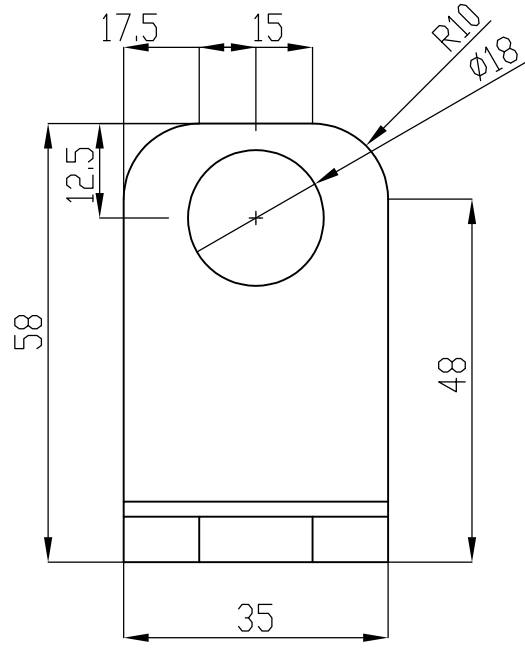
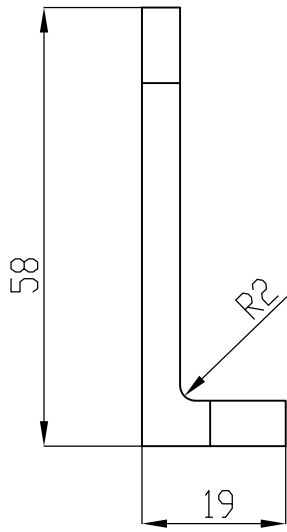
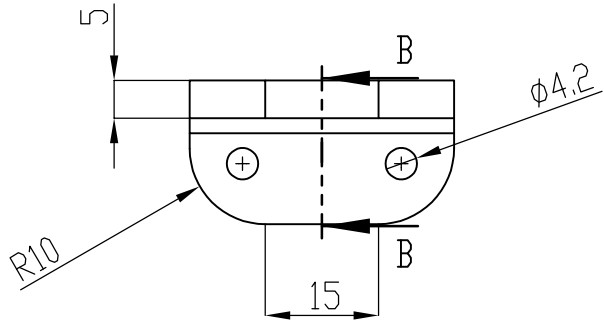
TREATMENT: NO TREATMENT		UIDE	MECHATRONICS ENGINEERING		
COVERING: NO COVERING					
MATERIAL: PETG	GENERAL TOLERANCE: ±0,2	SCALE: 1:1	DRA	RIVERA.A	03/02/24
			DES.	RIVERA A.	03/02/24
			REV	TIRIRA .A	03/02/24
SUPORT MOTOR		D01-129			



TREATMENT: NO TREATMENT		UIDE	MECHATRONICS ENGINEERING		
COVERING: NO COVERING					
MATERIAL: PETG	GENERAL TOLERANCE: $\pm 0,2$	SCALE: 1:1	DRA	RIVERA.A	03/02/24
			DES.	RIVERA A.	03/02/24
			REV	TIRIRA .A	03/02/24
ROLLER HOLDER		D01-130			



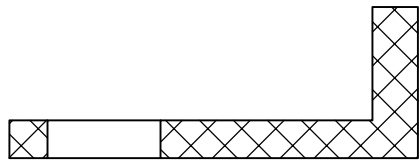
SECTION B-B



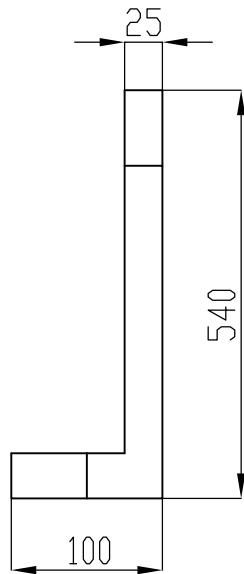
SPECIFICATION FOR 3D PRINTING			
MATERIALS: PETG			
PROCESS: FDM			
PRINTER: ENDER 5 PRO			
FILL TYPE: TRIANGULAR			
FILL PERCENTAGE: 25%			
COLOUR/BRAND: WHITE			
BED TEMPERATURE: 60 C°			
EXTRUSION TEMPERATURE: 215 C°			
LAYERS: INITIAL 3-FINAL 3			

TREATMENT: NO TREATMENT		UIDE	MECHATRONICS ENGINEERING		
COVERING: NO COVERING					
MATERIAL: PETG		SCALE: 1:1	DRA	RIVERA.A	03/02/24
GENERAL TOLERANCE: ±0,2			DES.	RIVERA A.	03/02/24
			REV	TIRIRA .A	03/02/24
SENSOR SUPPORT 1			D01-131		

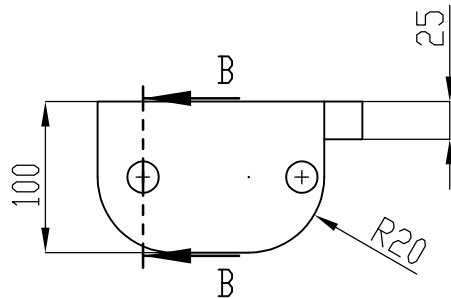
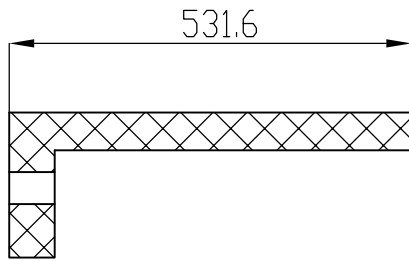
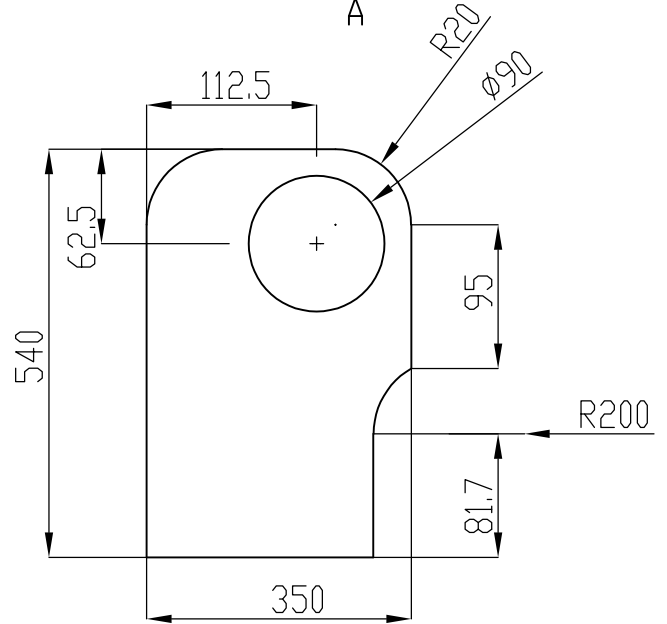
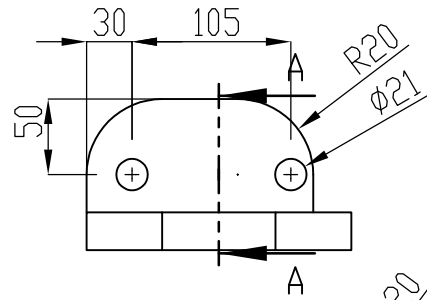




SECTION A-A




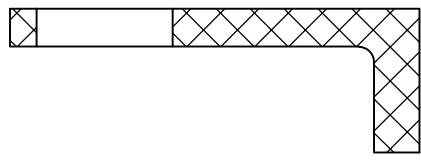
SECTION B-B



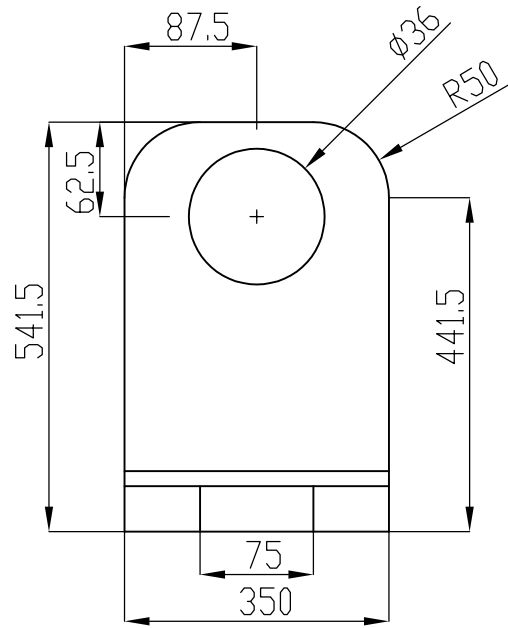
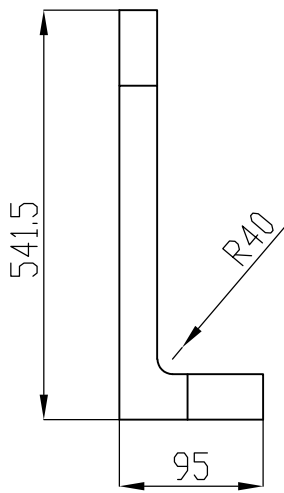
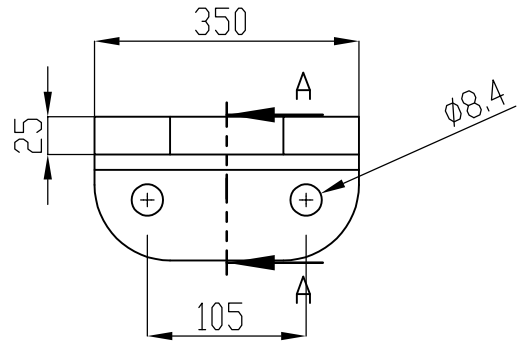
SPECIFICATION FOR 3D PRINTING

MATERIALS: PETG
 PROCESS: FDM
 PRINTER: ENDER 5 PRO
 FILL TYPE: TRIANGULAR
 FILL PERCENTAGE: 25%
 COLOUR/BRAND: WHITE
 BED TEMPERATURE: 60 C°
 EXTRUSION TEMPERATURE: 215 C°
 LAYERS: INITIAL 3-FINAL 3

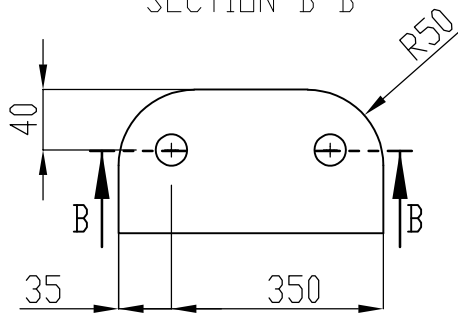
TREATMENT:	NO TREATMENT	UIDE	MECHATRONICS ENGINEERING			
COVERING:	NO COVERING					
MATERIAL:	PETG	GENERAL TOLERANCE: ±0,2	SCALE: 1:1	DRA.	RIVERA.A	03/02/24
				DES.	RIVERA A.	03/02/24
				REV	TIRIRA .A	03/02/24
SENSOR SUPPORT 2			D01-132			



SECTION A-A



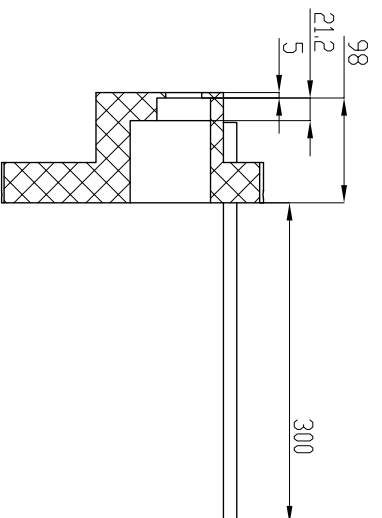
SECTION B-B



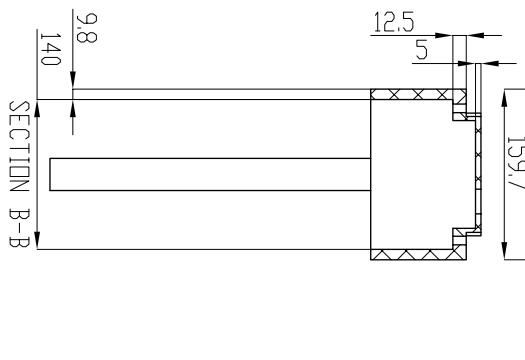
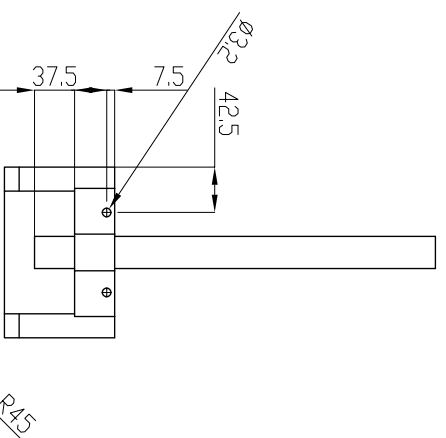
SPECIFICATION FOR 3D PRINTING

MATERIALS: PETG
 PROCESS: FDM
 PRINTER: ENDER 5 PRO
 FILL TYPE: TRIANGULAR
 FILL PERCENTAGE: 25%
 COLOUR/BRAND: WHITE
 BED TEMPERATURE: 60 C°
 EXTRUSION TEMPERATURE: 215 C°
 LAYERS: INITIAL 3-FINAL 3

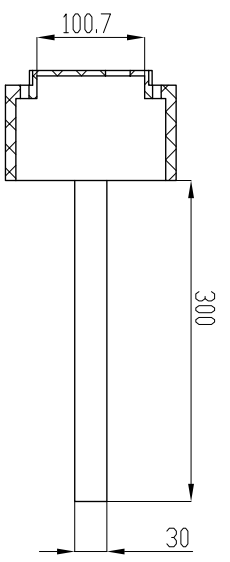
TREATMENT:	NO TREATMENT	UIDE	MECHATRONICS ENGINEERING		
COVERING:	NO COVERING				
MATERIAL:	PETG	SCALE: 1:1	DRA.	RIVERA.A	03/02/24
	GENERAL TOLERANCE: $\pm 0,2$		DES.	RIVERA A.	03/02/24
			REV	TIRIRA .A	03/02/24
SENSOR SUPPORT 3		D01-133			



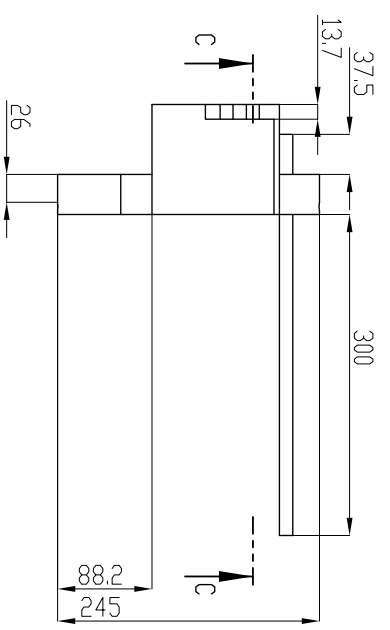
SECTION A-A



SECTION B-B



SECTION C-C

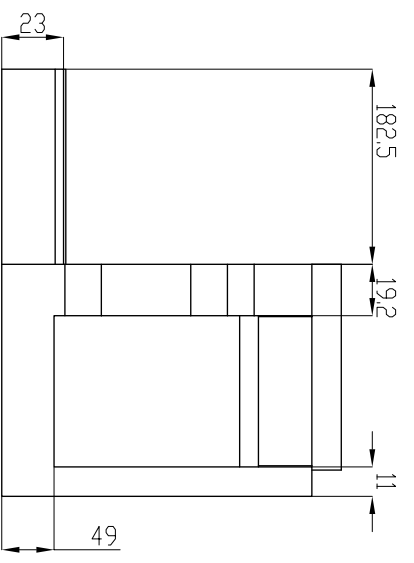
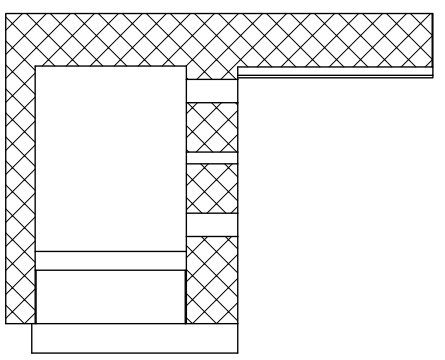
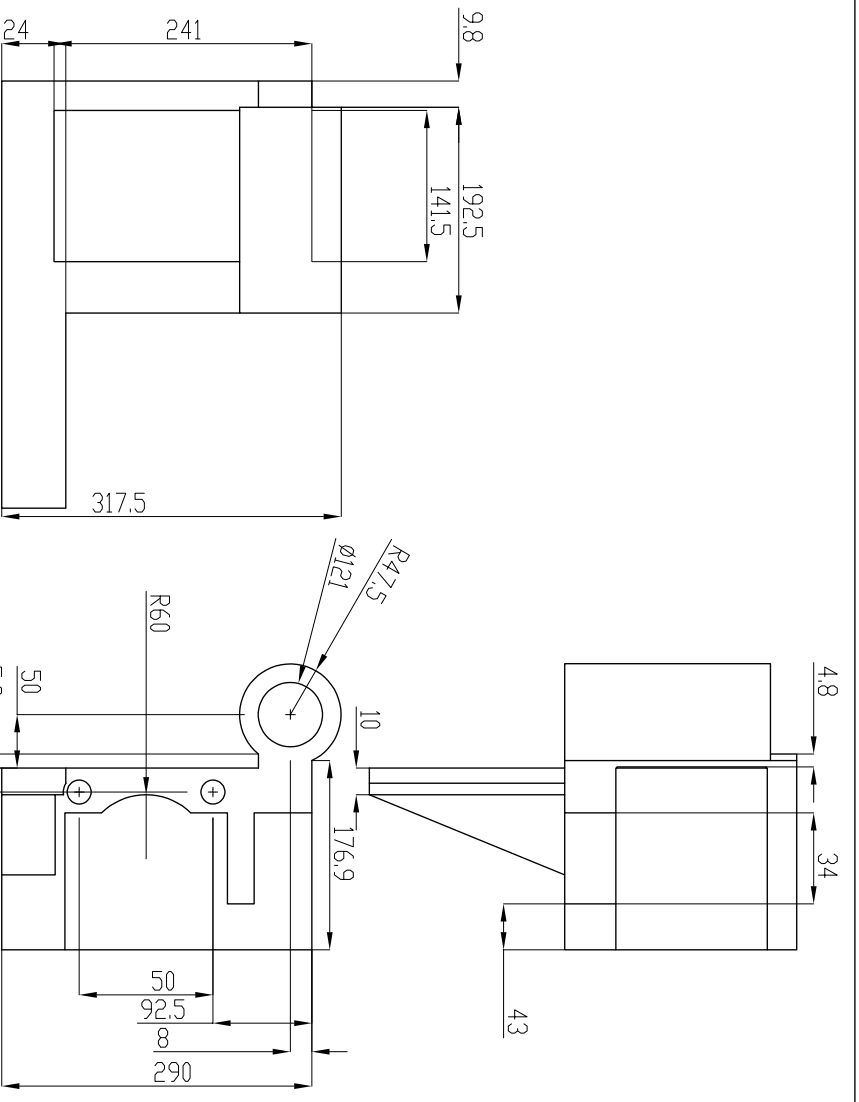


SPECIFICATION FOR 3D PRINTING

MATERIALS: PETG
 PROCESS: FDM
 PRINTER: ENDER 5 PRO
 FILL TYPE: TRIANGULAR
 FILL PERCENTAGE: 29%
 COLOUR/BRAND: WHITE
 BED TEMPERATURE: 60 C°
 EXTRUSION TEMPERATURE: 215 C°
 LAYERS: INITIAL 3-FINAL 3

TREATMENT:	NO TREATMENT	UIDE	MECHATRONICS ENGINEERING
COVERING:	NO COVERING	SCALE:	1:5
MATERIAL:	PETG	GENERAL TOLERANCE:	±0.2
		DRAWN:	RIVERA A. 03/02/24
		DESIGNED:	RIVERA A. 03/02/24
		REVISION:	TIRIRA A. 03/02/24
SUPORT SERVO MOTOR GIRO		D01-134	

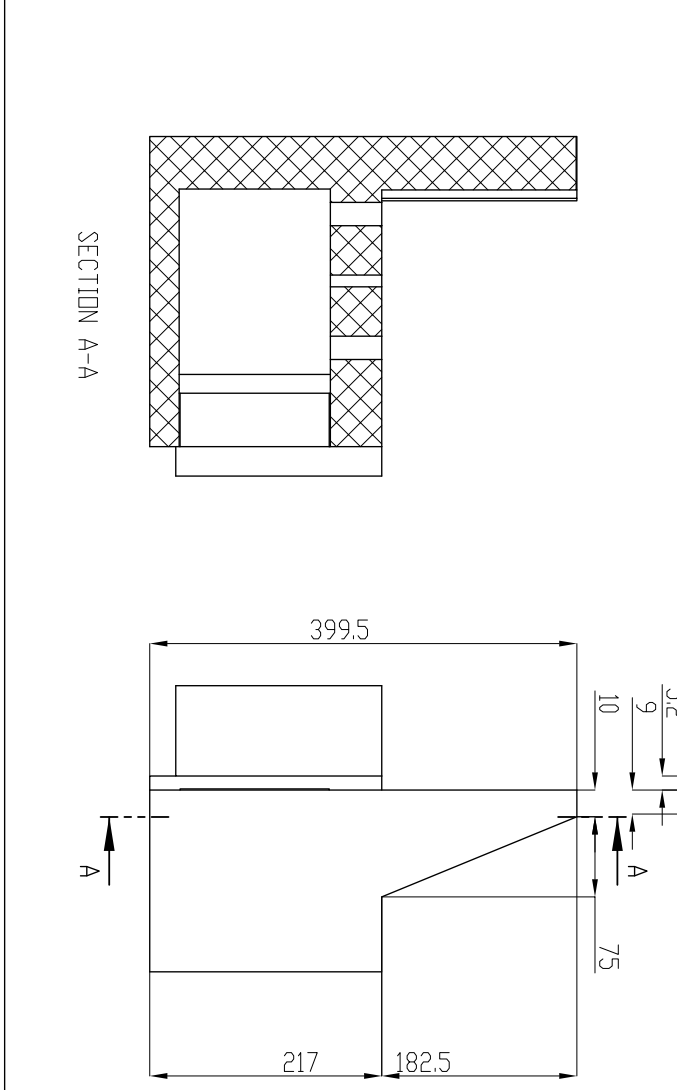


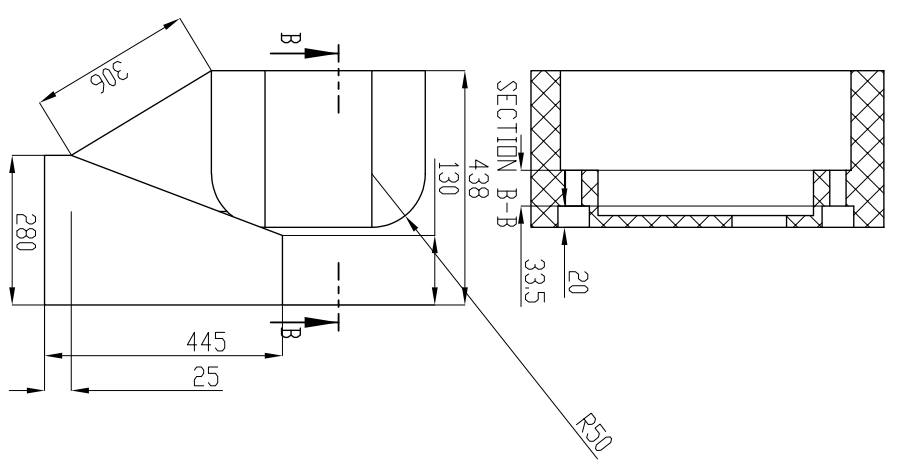
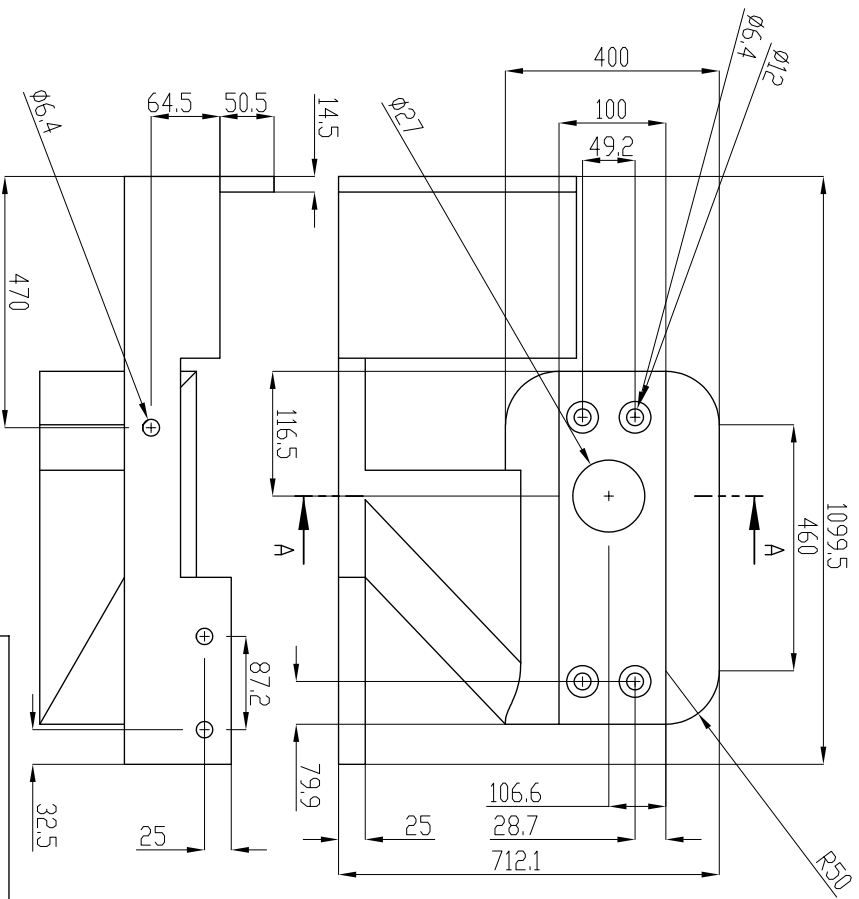
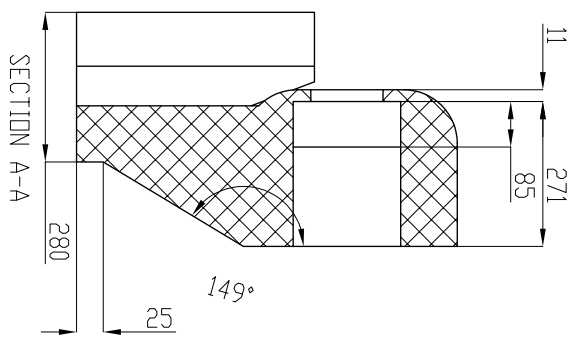
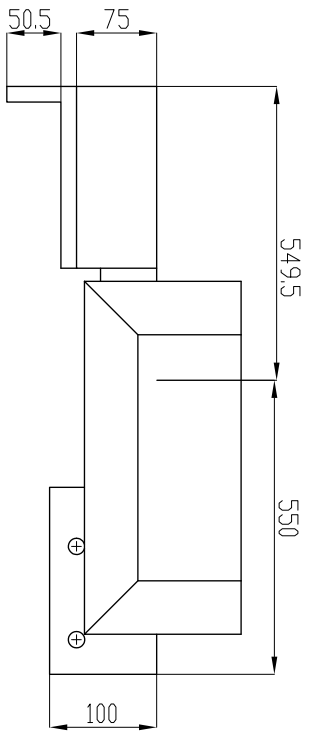


SPECIFICATION FOR 3D PRINTING

MATERIALS: PETG
 PROCESS: FDM
 PRINTER: ENDER 5 PRO
 FILL TYPE: TRIANGULAR
 FILL PERCENTAGE: 25%
 COLOUR/BRAND: WHITE
 BED TEMPERATURE: 60 C°
 EXTRUSION TEMPERATURE: 215 C°
 LAYERS: INITIAL 3-FINAL 3

TREATMENT:	NO TREATMENT	UIDE	MECHATRONICS ENGINEERING
COVERING:	NO COVERING	SCALE:	1:5
MATERIAL:	PETG	GENERAL TOLERANCE:	±0.2
		DRAWN:	RIVERA A. 03/02/24
		DESIGNED:	RIVERA A. 03/02/24
		REVISION:	TIRIRA A. 03/02/24
		D01-135	





SPECIFICATION FOR 3D PRINTING

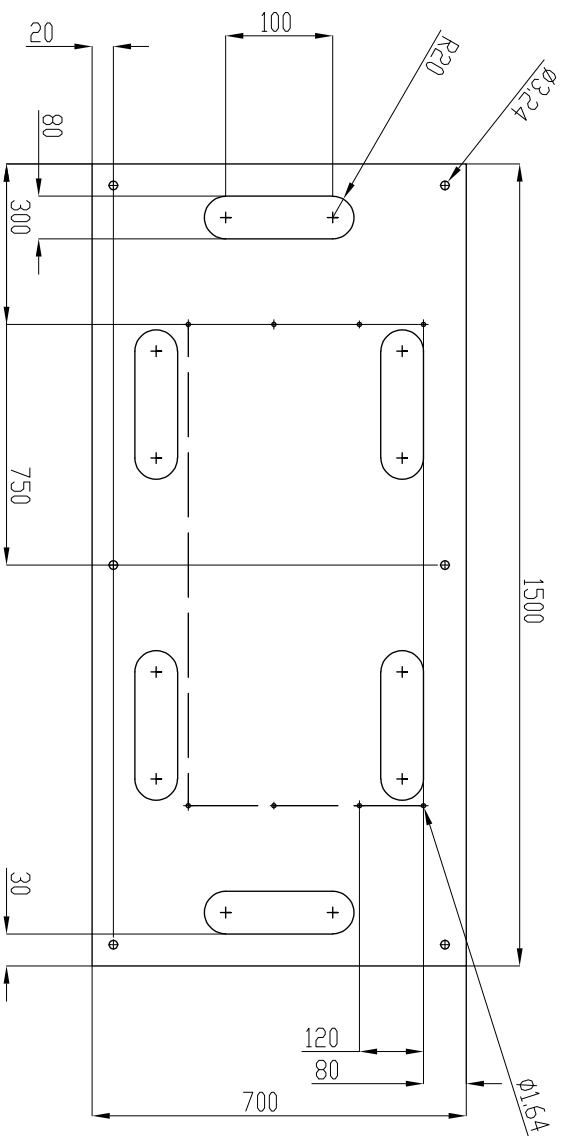
MATERIALS: PETG
 PROCESS: FDM
 PRINTER: ENDER 5 PRO
 FILL TYPE: TRIANGULAR
 FILL PERCENTAGE: 25%
 COLOUR/BRAND: WHITE
 BED TEMPERATURE: 60 C°
 EXTRUSION TEMPERATURE: 215 C°
 LAYERS: INITIAL 3-FINAL 3

TREATMENT:	NO TREATMENT	UIDE	MECHATRONICS ENGINEERING
COVERING:	NO COVERING	SCALE:	1:5
MATERIAL:	PETG	GENERAL TOLERANCE:	±0,2
		DRAWN:	RIVERA A
		DESIGNED:	RIVERA A
		REVISED:	TIRIRA A
			03/02/24
			03/02/24
			03/02/24

LEFT BASE GRIFO

D01-136





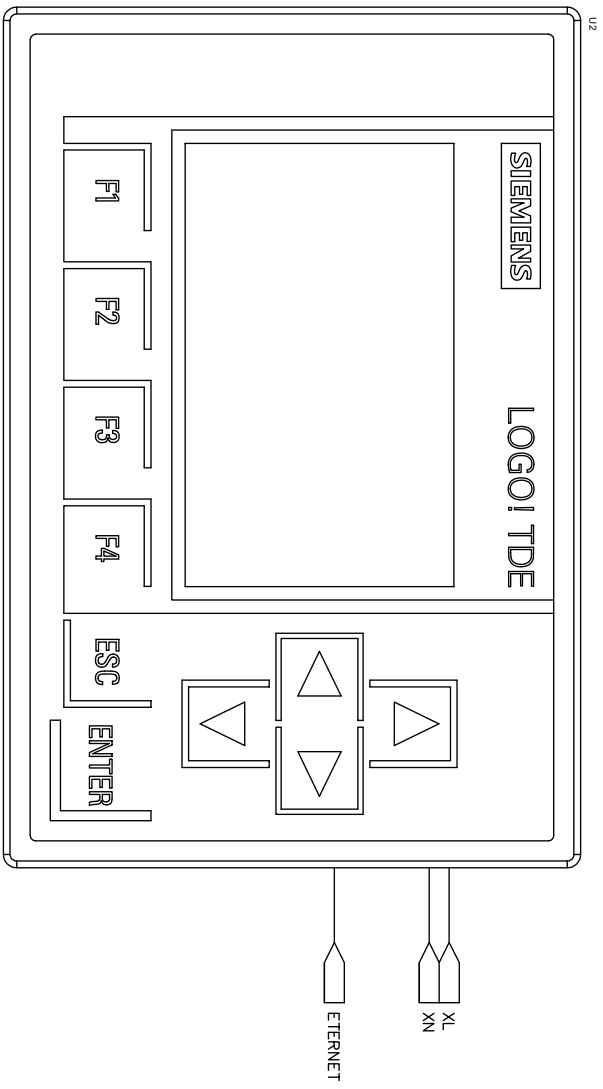
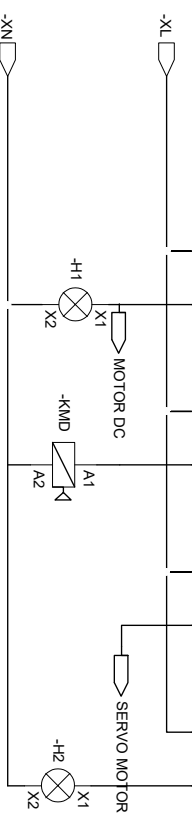
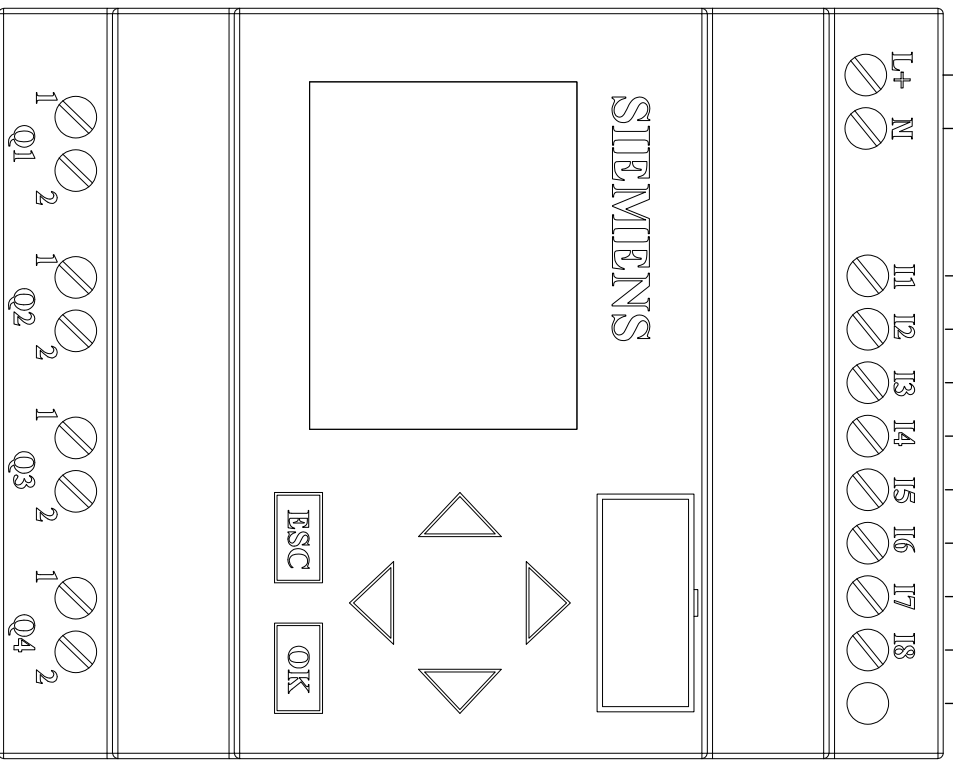
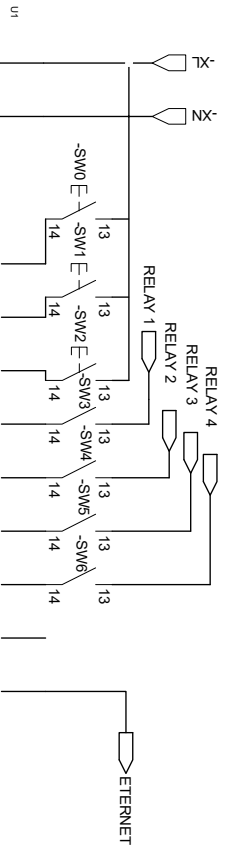
NOTES
THICKNESS: 1.1 mm

TREATMENT:	LASER CUTTING	UIDE	MECHATRONICS ENGINEERING
COVERING:	CREAM-COLORED COVER	SCALE:	
MATERIAL:	STEEL A36	1:5	
	GENERAL TOLERANCE: ±0.2	DRA	RIVERA A 03/02/24
		DES	RIVERA A 03/02/24
		REV	TIRIRA A. 03/02/24

BASE OF
COMPONENTS
D01-137



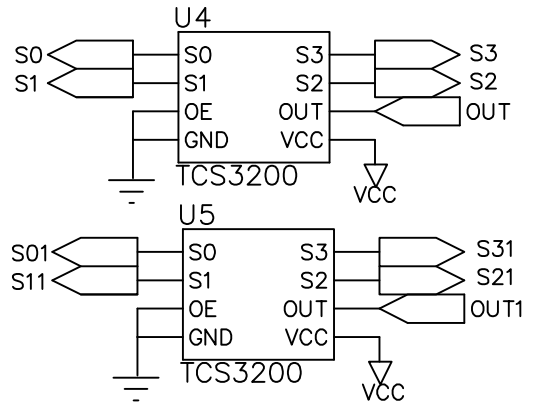
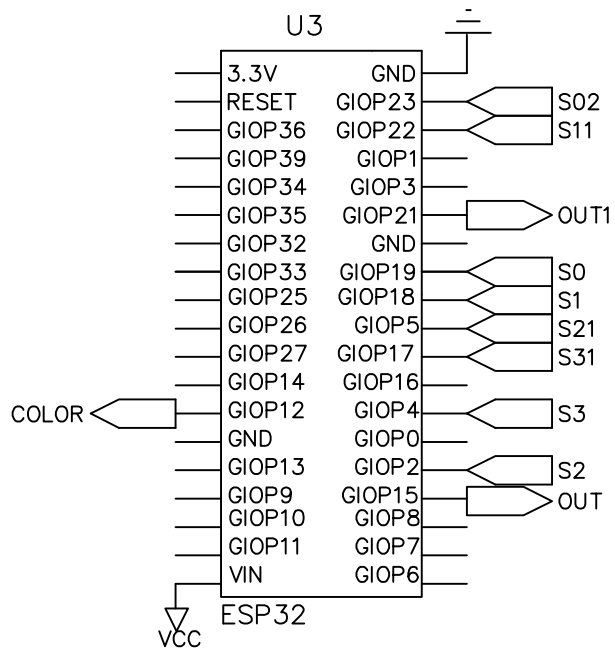
Appendix B
Electronic Engineering Drawings




POWER SUPPLY	
XL	+12 V
XN	0 V

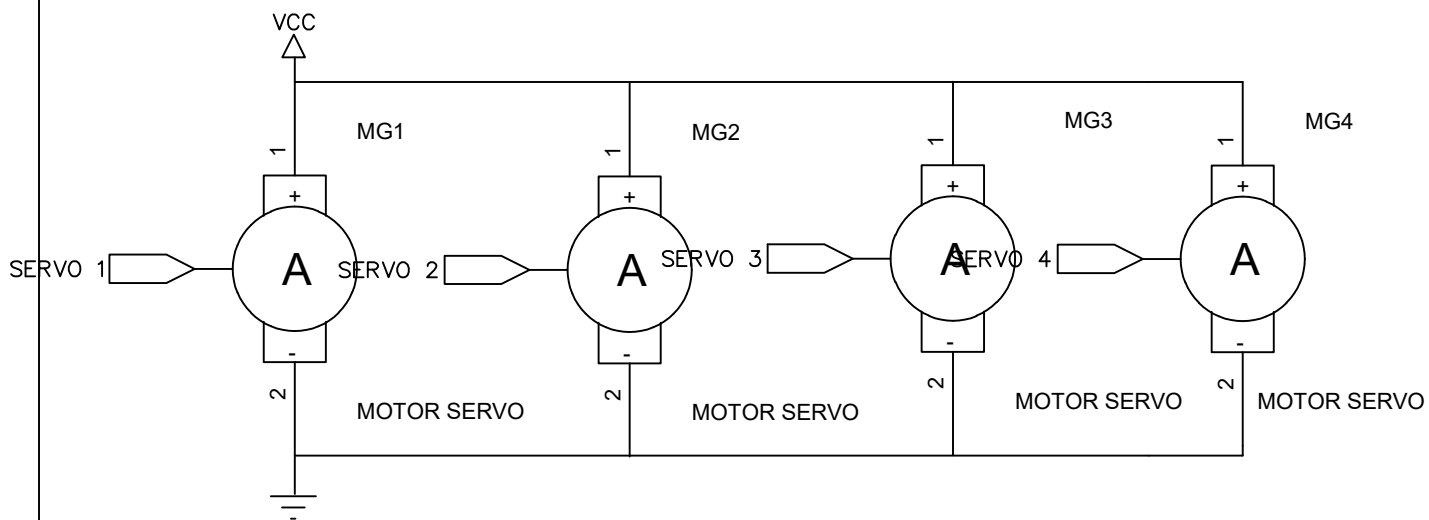
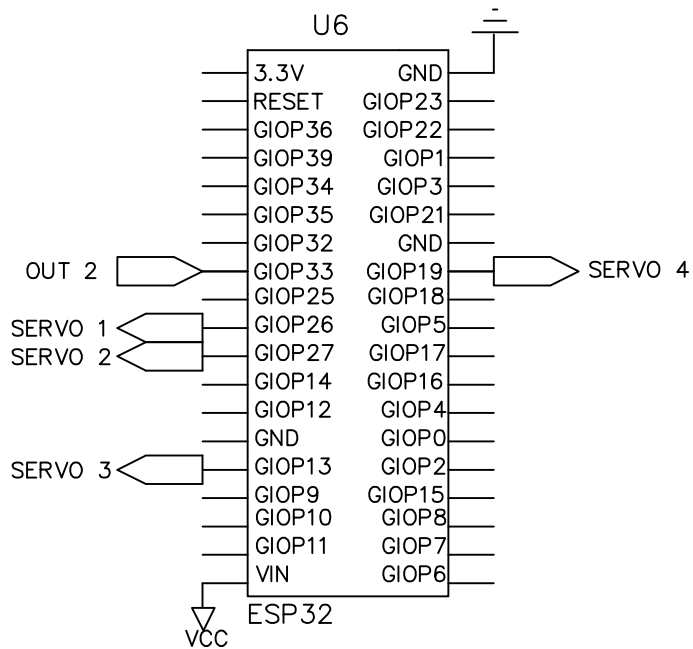
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		DIS. RIVERA A.
		REV.

PLC LOGO 8!		D02-001	SCALE
ELECTRONIC PLAN			
			N/A



POWER SUPPLY	
VCC	+5 V
VCC1	+12 V
GND	+0 V

UIDE	 MECHATRONICS ENGINEERING	DIB.	RIVERA A.	08/12/23
		DIS.	RIVERA A.	
COLOR SENSOR ELECTRONIC PLAN		REV.		
		D02-002		SCALE
				N/A
				N/A



POWER SUPPLY	
VCC	+5 V
GND	+0 V

UIDE



MECHATRONICS ENGINEERING

DIB.	RIVERA A.	08/12/23
DIS.	RIVERA A.	
REV.		

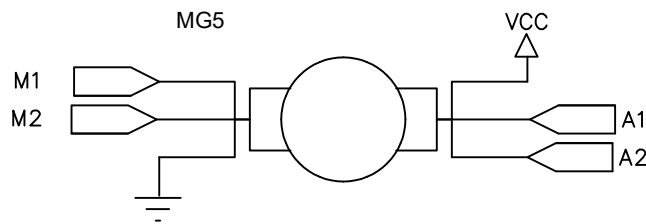
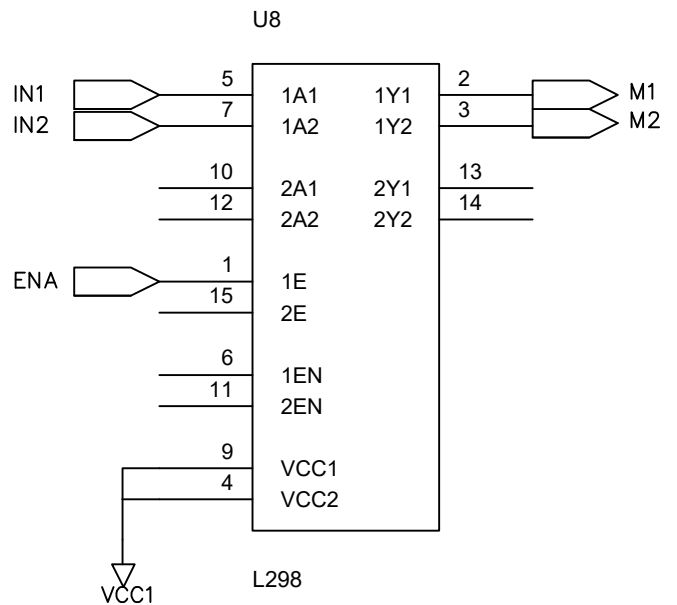
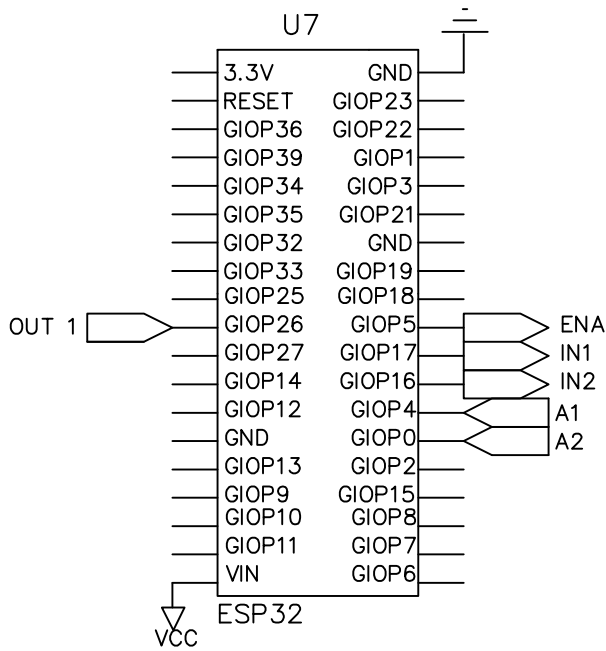
SERVO MOTOR
ELECTRONIC PLAN

D02-003

SCALE

N/A

N/A



POWER SUPPLY	
VCC	+5 V
VCC1	+12 V
GND	+0 V

UIDE



MECHATRONICS ENGINEERING

DIB. RIVERA A. 08/12/23

DIS. RIVERA A.

REV.


MOTOR DC
ELECTRONIC PLAN

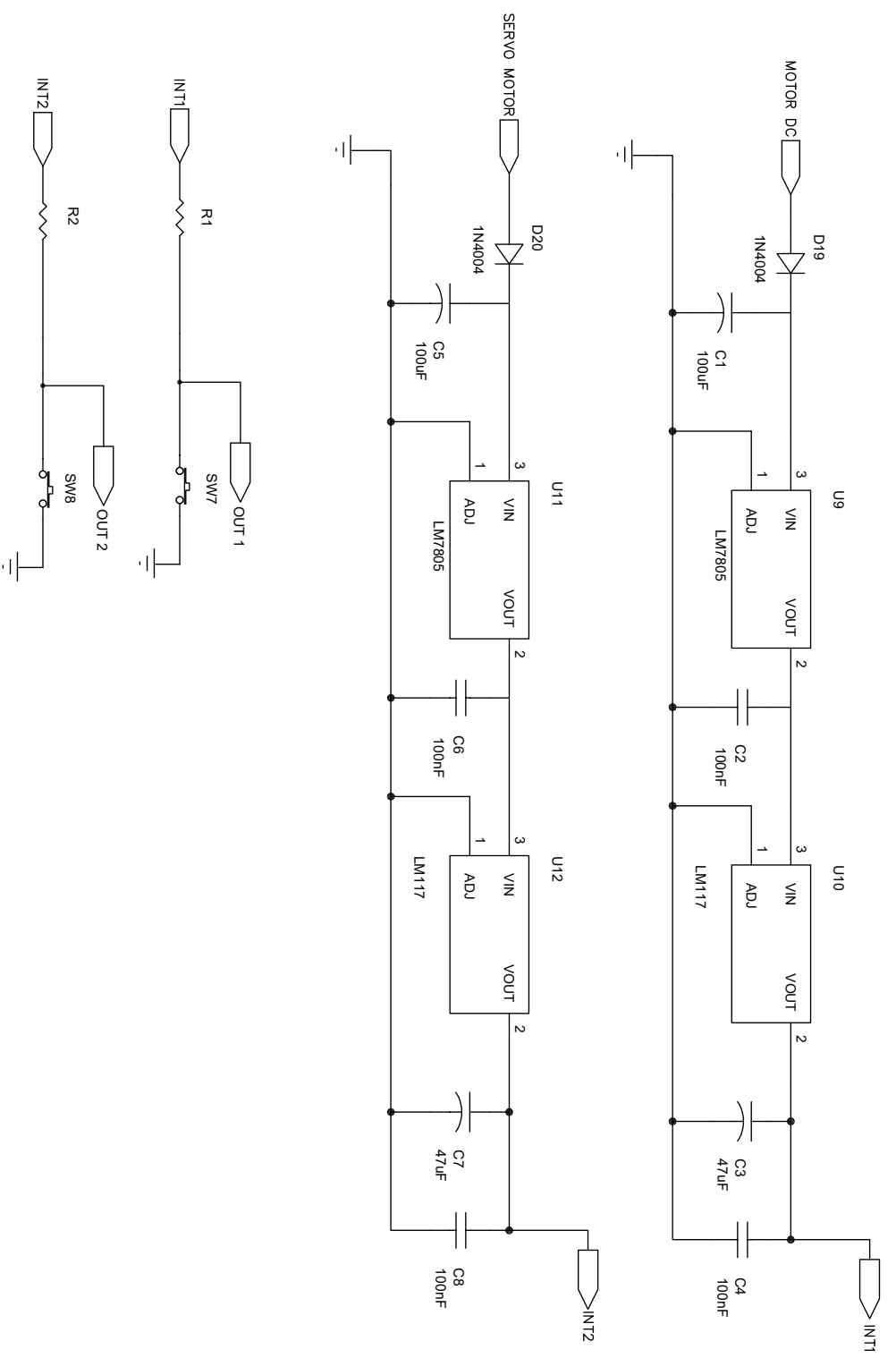
D02-004

SCALE

N/A

N/A

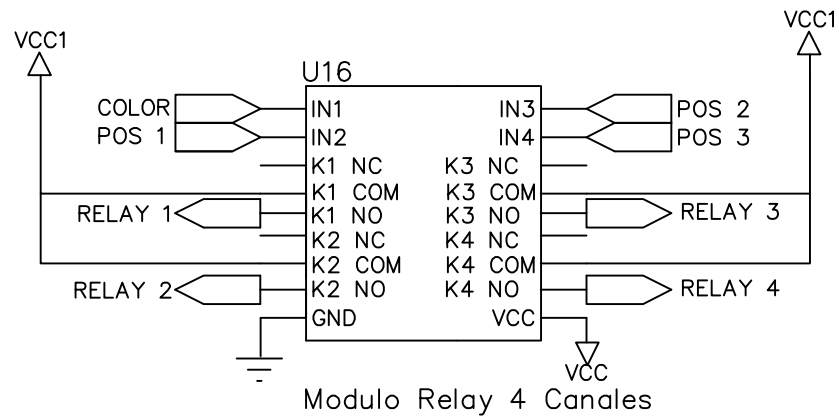
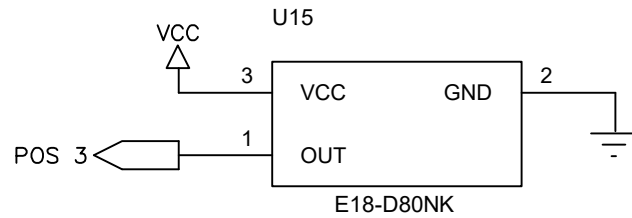
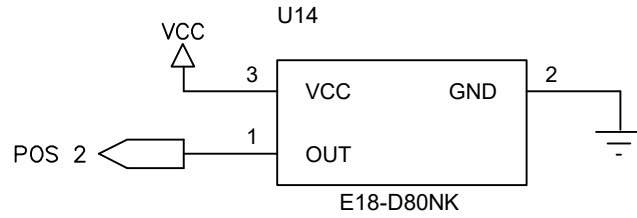
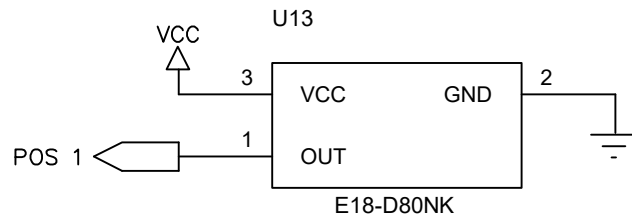
POS.	DESCRIPTION	CANT.	OBSERVATIONS
INTEGRATED CIRCUITS			
U9-U11	LM7805	2	
U10-U12	LM117	2	
CAPACITORS			
C1-C5	CAPACITOR DE 100uF	2	
C2-C6	CAPACITOR DE 100nF	2	
C3-C7	CAPACITOR DE 47uF	2	
C4-C8	CAPACITOR DE 100nF	2	
DIODOS			
D19-D20	DIODO 1N4004	2	
SWITCHES			
SW7-SW8	PUSH BUTTON	2	
RESISTOR			
R1-R2	RESISTOR OF 10 K OHMIONS	2	
UIDE	 MECHATRONICS ENGINEERING	DIB. RIVERA A	08/12/23
		DIS. RIVERA A	
		REV.	
VOLTAGE LIST OF COMPONENTS		D02-501	SCALE: N/A
			N/A




POWER SUPPLY	
VCC	+12 V
GND	0 V

13/11/20	UIDE	MECHATRONICS ENGINEERING	DIB. RIVERA A. 08/12/23
			DIS. RIVERA A.
			REV.

VOLTAGE		SCALE
ELECTRONIC PLAN		
D02-005		N/A
		N/A



POWER SUPPLY	
VCC	+5 V
VCC1	+12 V
GND	+0 V

UIDE	 MECHATRONICS ENGINEERING	DIB.	RIVERA A.	08/12/23
		DIS.	RIVERA A.	
POSITION ELECTRONIC PLAN		REV.		
		D02-006		SCALE N/A
				N/A

Appendix c

BUDGET

Elements	Unit(uni)	Cost(\$)	Total cost(\$)
Servo Motor MG996R	3	10	30
Servo Motor FT5330M	1	23,99	23,99
Color sensor tcs230	2	15	30
Copper Cable Set	16	1,79	28,64
Connector Set JS-XH	1	15	15
Red Pilot Light	1	2,23	2,23
Green Pilot Light	1	2,23	2,23
ESP32	3	9,49	28,47
Display Logo TDE	1	169,26	169,26
PLC Logo 8	1	155,62	155,62
Source24V 10 A	1	19	19
Motor 12V of 12RMP	1	15	15
Step Down Dc-dc XL4015	1	4,19	4,19
Step Down Dc-dc XL4016	2	11,7	23,4
LM6UU	9	2,41	21,69
Bearing 6803	3	2	6
PETG	3	23	69
Steel shaft of 6mm x 600mm	4	5,8	23,2
Steel Table A36 de 750x350x750	1	350	350
Alumino Profiles V 20x80	1	50,47	50,47
Alumino Profiles V 20x40	1	31,89	31,89
T-nuts for M4	40	0,18	7,2
PCB	1	8,5	8,5
4-channel Relay Module	1	4,99	4,99
Push button	2	0,1	0,2
Electrical switch	2	0,5	1
2N2222	3	0,2	0,6
Resistance of 10k ohmions	8	0,2	1,6
Diodo 4A10	2	0,6	1,2
Infrared Sensor E18-D80NK	3	8	24
MDF board of 9mm	2	3,53	7,06
Plug Conector Banana Macho 4mm	40	0,2	8
Conector Banana Male 4mm	40	0,2	8
Cable 2 Plug Banana to 2 Lizards 50 Centimetres	15	2	30
Ceramic Capacitor 0,1 uF 100nF (104)	4	0,1	0,4
Electrolytic Capacitor 47uF 50V	2	0,2	0,4
Electrolytic Capacitor 100uF 50V	2	0,25	0,5
LM7805 DE 5V	2	0,6	1,2
LM1117T DE 3.3V	2	1,35	2,7
Aluminium Heat Sink	4	0,75	3
40 pin male terminal strip 2mm spacing	1	0,5	0,5
40 pin female terminal strip 2mm spacing	6	0,5	3

Black Terminal Block with Transparent Cover 6 poles 15A	1	2,9	2,9
2-pin terminal block Kf301-2p Blue	21	0,25	5,25
Module Bridge H L298n	1	3,5	3,5
Push button for panel	2	0,85	1,7
Plastic Mushroom Push Button with detent 22mm Red NC	1	4,5	4,5
Spade cable connectors	20	0,2	4
MDD5.5-250 Electrical Cable Connectors male	20	0,2	4
MDD5.5-250 Electrical Cable Connectors female	16	0,2	3,2
Pressed Electrical Terminals	18	0,2	3,6
ETHERNET cable	1	3,5	3,5
JACK AC 3 PINES 250V 15A with switch, light and fuse	1	1,99	1,99
PCV conveyor belt	1	35	35
1meter of Nema 17 cable	10	2,99	29,9
Cream coloured paint 1L	1	9,99	9,99
DIN rail of 15mm	1	10	10
Grillon of 35x40mm	1	10	10
Solenoid valve of 12VDC	1	9,9	9,9
Bolts M3x12mm	40	0,1	4
Nut M3x12mm	40	0,1	4
Bolts M4x12mm	20	0,15	3
Nut M4x12mm	20	0,15	3
Bolts M8x12mm	20	0,4	8
Nut M8x12mm	20	0,4	8
Labor	1	430	430
Computer Power Cable 1.8 Metros	1	2,75	2,75
Total			1819,01

