CONESTOGA
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ENGINEERING CAPSTONE PROJECT

Intermediate Level Software Working

Program	**:** Embedded Systems Development	
Team Name	**:** The Spark	
Project Title	**:** Solar Cooler for Tesla Model 3	
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	03) Mohammad Abdul Muheet	
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	Sepideh Arabi	- Project Evaluator
	Mohammad Abdul Muheet	- Project Coordinator
Project Supervisor	**:** Prof. So-Ra Chung	
Project Sponsor	**:** Mr. Ian Grahhm	

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1) Software Part:

In our project as a part of software we are using solid works designed and trying to make a 3D solid works model which will be useful for the making moulding design of our Cooler. For our solid works we designing the different model and with the time by time we were improving design after discussion with our project supervisor and internal group member. We noticed that for our project the design is main concern so with time by time we are trying to make our design better for the moulding as well as less complex. The improved design is better and flexible in compare to the all previous designs. We are trying to make less number of parts in design and trying to make all the parts in to one mould. Which make our design stronger and less complicated for the mould. In starting our design consist nine components in to the whole cooler. But after improvement our design has only three part after combining those parts It will finish our whole cooler.

1.1) Solid Works Design:

For our Solar cooler, we started first step to design it in the Solid Works, we are using the perfect dimension of Tesla model 3 cavity. The dimensions are as follow, Cavity Top: Length= 27 Inches, Width= 18 Inches, Cavity Bottom: Length= 24 Inches, Width= 15 Inches, Total Height= 12 Inches. For these dimensions, we draw a basic design idea of a cooler box. The main idea about this deigns to bring our thoughts on to some real model so we chose the solid works to implement it. All these files contain the basic design of our solar cooler.

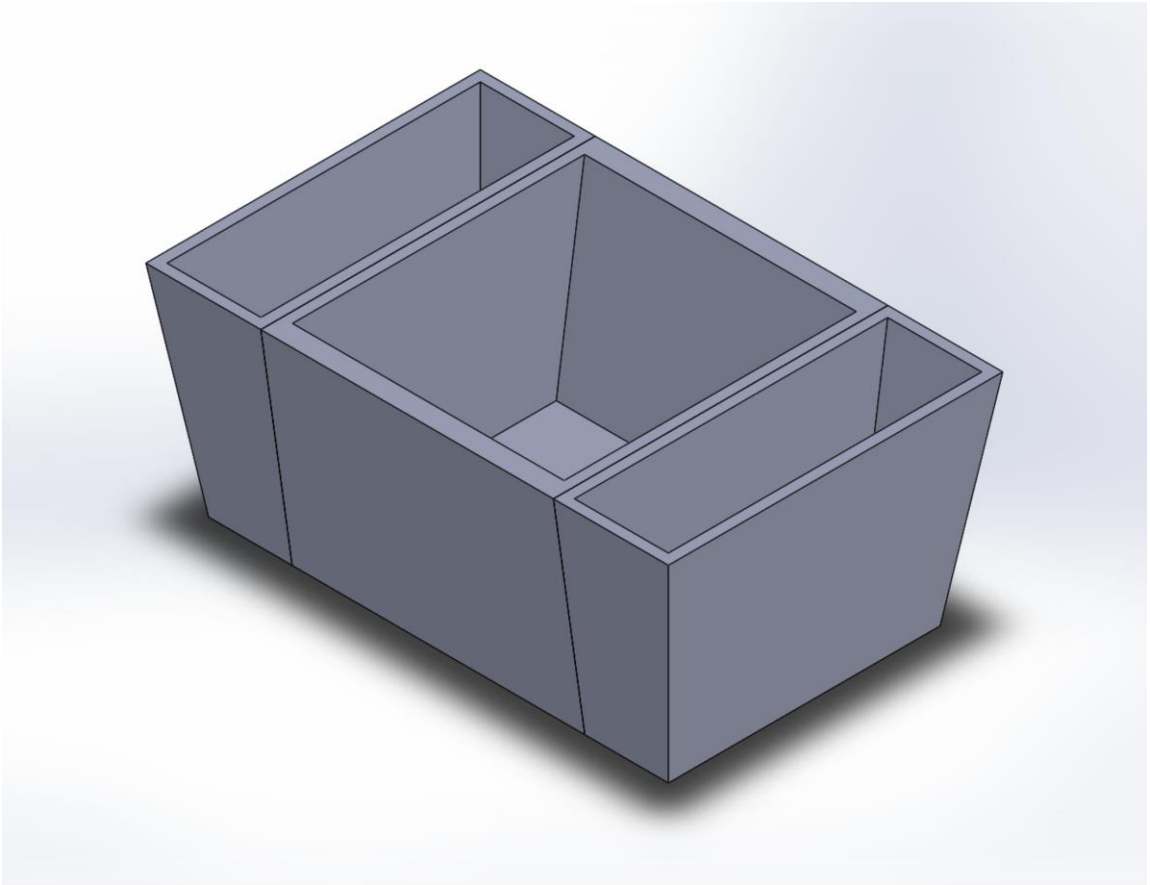


Image 1.1.1: Basic Design Implementation

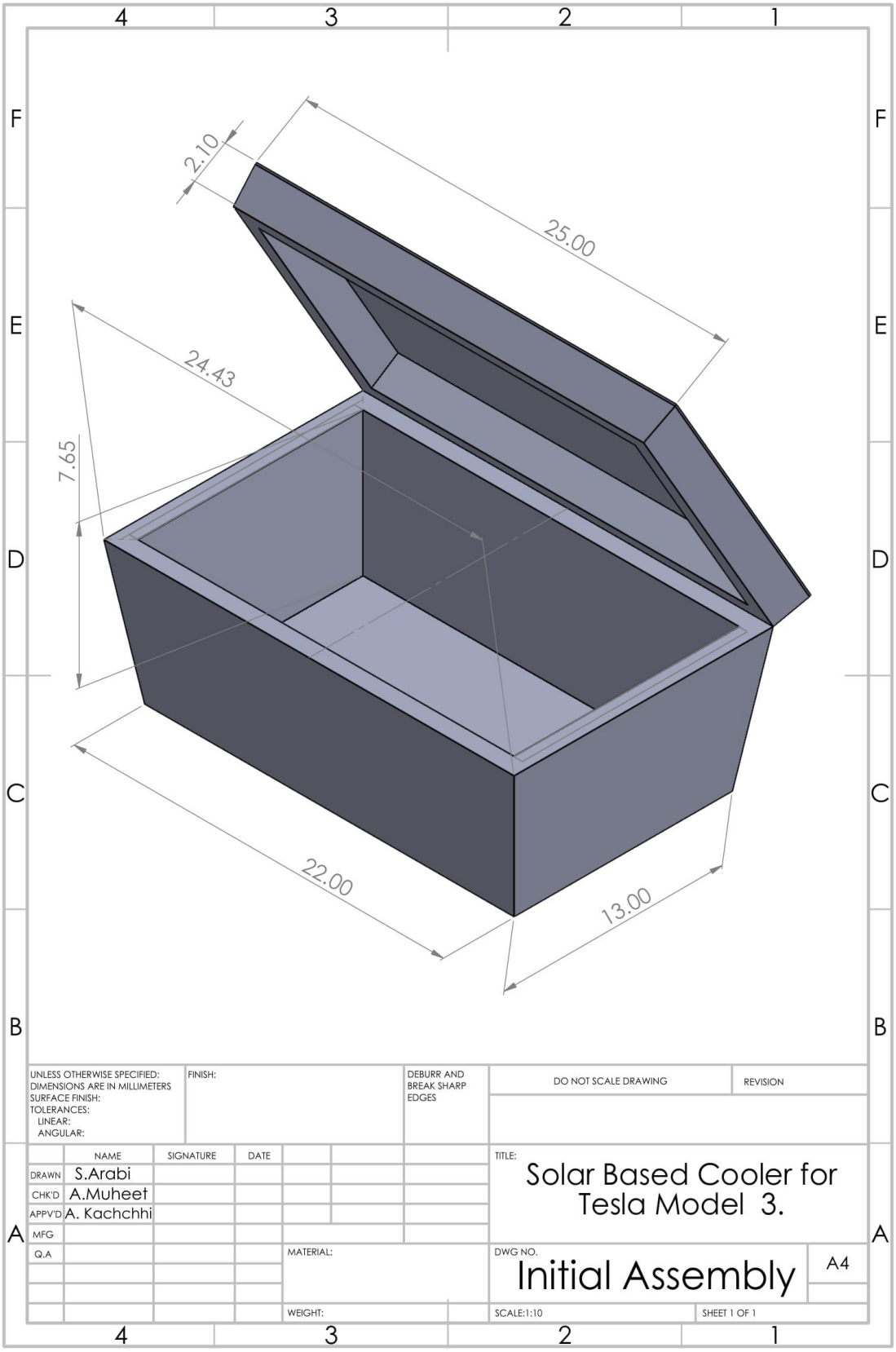


Image 1.1.2: Basic Design

1.2) Design Improvement:

In this design, we improve over design and try to make it more perfect for the setup of electronics devices. In this, we make a separate part for the cooling section and separate part for electronic section. In the middle area, we are going to use as storage of food and beverages. Both sides left and the right side we are going to design a removable portion which can contain all the electronics assembly. The main cooling box area is Length = 13 Inches, Width = 12 inches, Height= 12 Inches. The two separate portion for electronics components each box has a size of Top: Length= 05 Inches, Width= 16 Inches, Cavity Bottom: Length= 04 Inches, Width= 13 Inches, Total Height= 12 Inches.

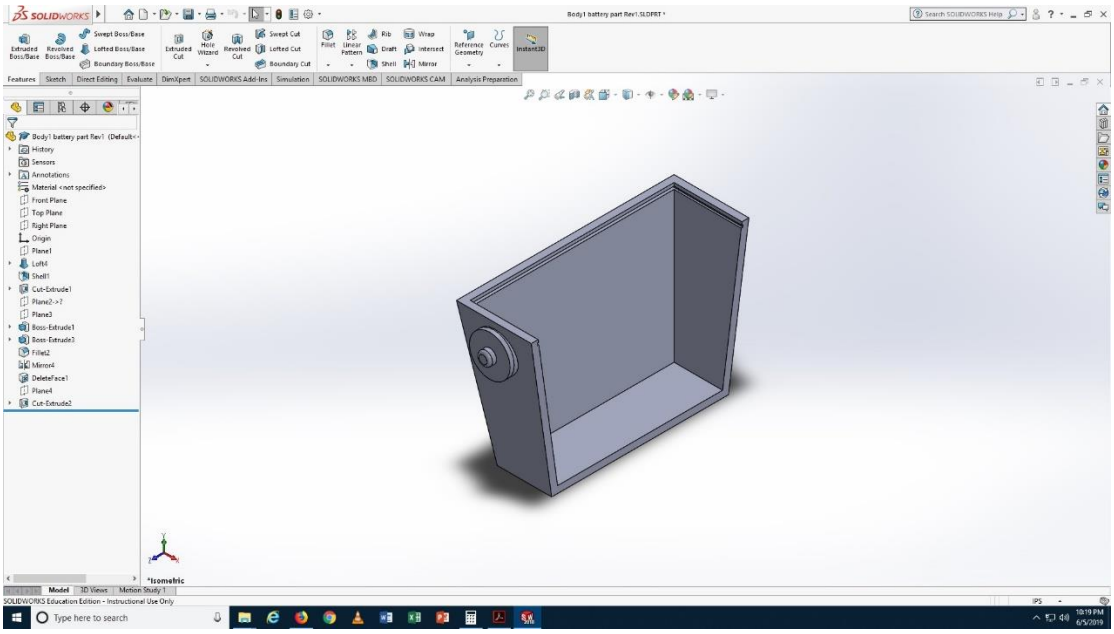


Image 1.2.1: Electronics Components Area

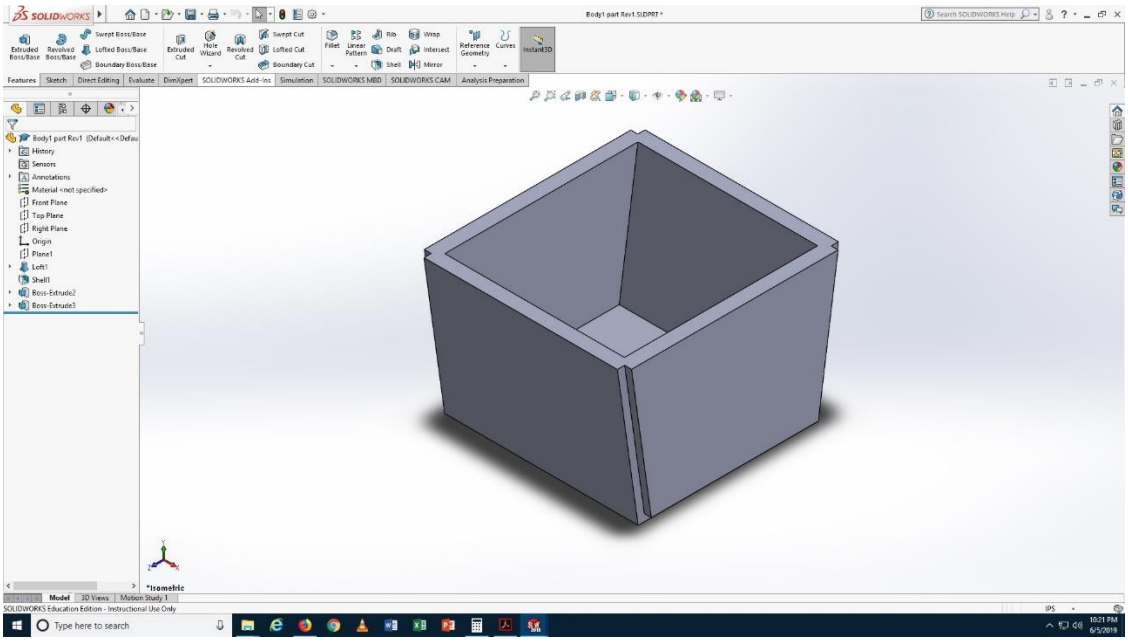


Image 1.2.2: Cooler Area

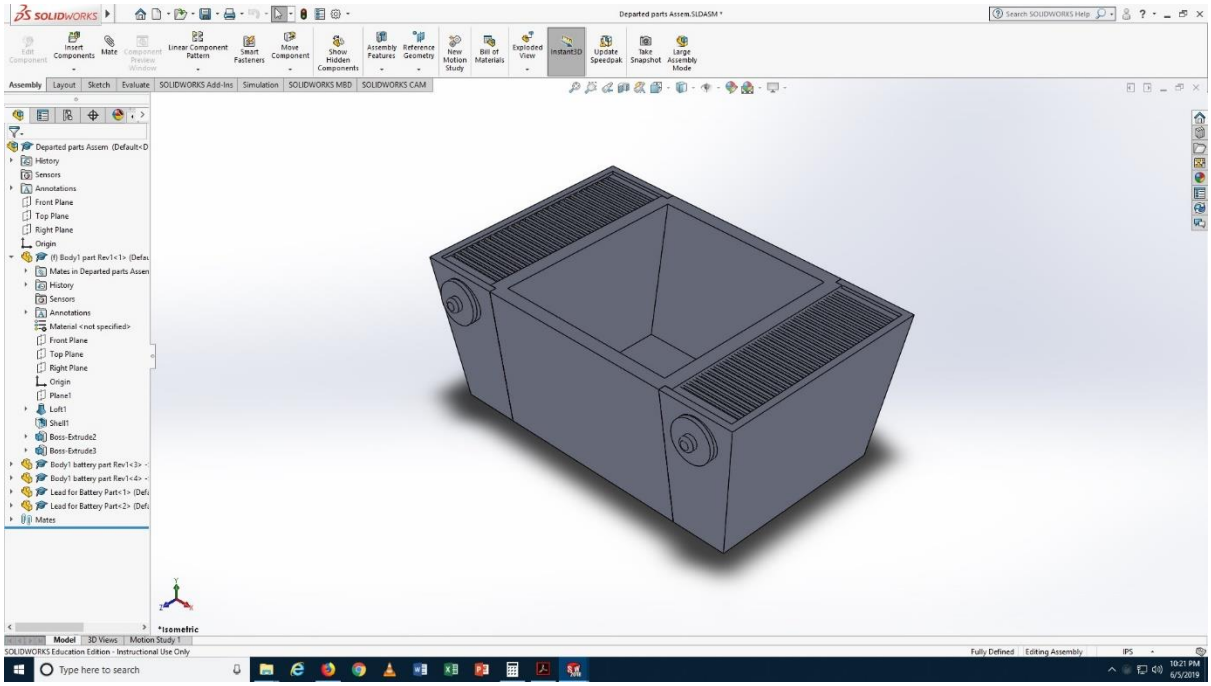
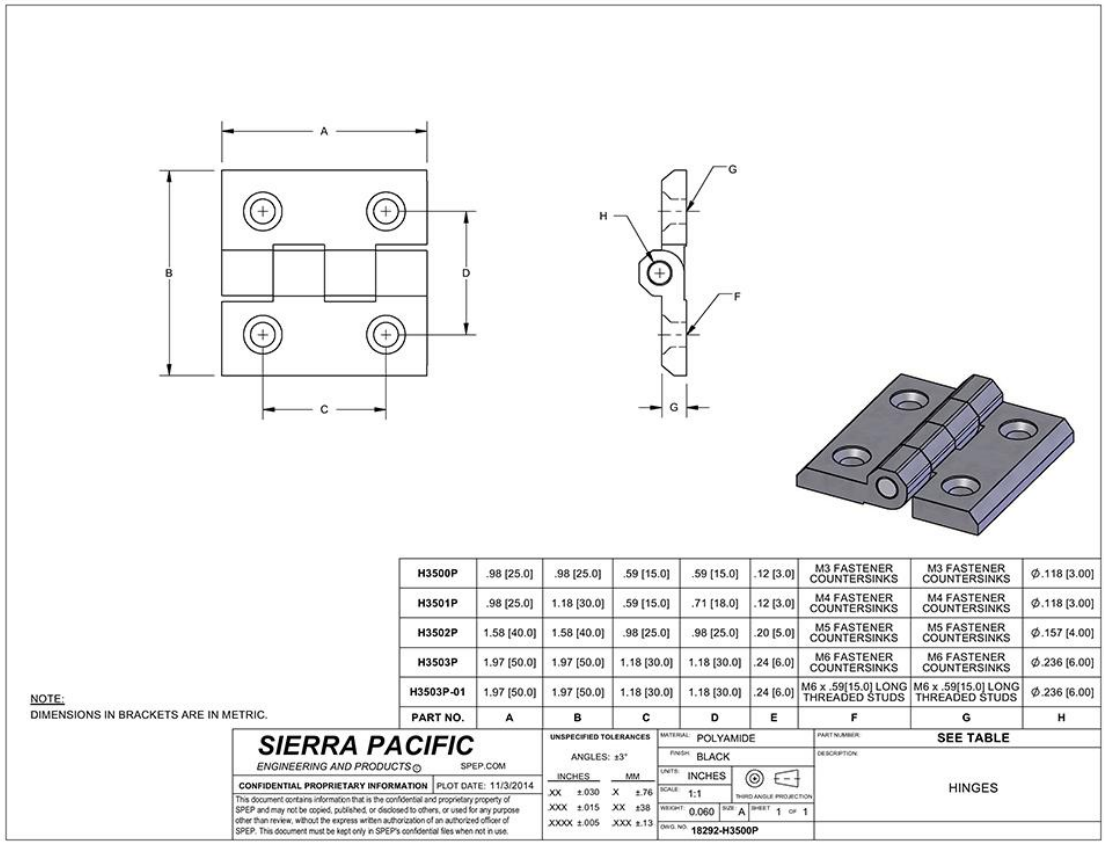


Image 1.2.3: Solar Cooler Improved Design

1.3) Complete Design:



PART NO.	A	B	C	D	E	F	G	H
H3500P	.98 [25.0]	.98 [25.0]	.59 [15.0]	.59 [15.0]	.12 [3.0]	M3 FASTENER COUNTERSINKS	M3 FASTENER COUNTERSINKS	Ø.118 [3.00]
H3501P	.98 [25.0]	1.18 [30.0]	.59 [15.0]	.71 [18.0]	.12 [3.0]	M4 FASTENER COUNTERSINKS	M4 FASTENER COUNTERSINKS	Ø.118 [3.00]
H3502P	1.58 [40.0]	1.58 [40.0]	.98 [25.0]	.98 [25.0]	.20 [5.0]	M5 FASTENER COUNTERSINKS	M5 FASTENER COUNTERSINKS	Ø.157 [4.00]
H3503P	1.97 [50.0]	1.97 [50.0]	1.18 [30.0]	1.18 [30.0]	.24 [6.0]	M6 FASTENER COUNTERSINKS	M6 FASTENER COUNTERSINKS	Ø.236 [6.00]
H3503P-01	1.97 [50.0]	1.97 [50.0]	1.18 [30.0]	1.18 [30.0]	.24 [6.0]	M6 x .59[15.0] LONG THREADED STUDS	M6 x .59[15.0] LONG THREADED STUDS	Ø.236 [6.00]

NOTE:
DIMENSIONS IN BRACKETS ARE IN METRIC.

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UNSPECIFIED TOLERANCES
ANGLES: ±3°
INCHES: XX ±.030, XXX ±.015, XXXX ±.005
MM: X ±.76, XX ±.38, XXX ±.13

MATERIAL: POLYAMIDE
FINISH: BLACK
UNITS: INCHES
SCALE: 1:1
WEIGHT: 0.060
SIZE: A
SHEET 1 OF 1
DWG. NO. 18292-H3500P

PART NUMBER: SEE TABLE
DESCRIPTION: HINGES

Image 1.3.1: Hinge for Cooler

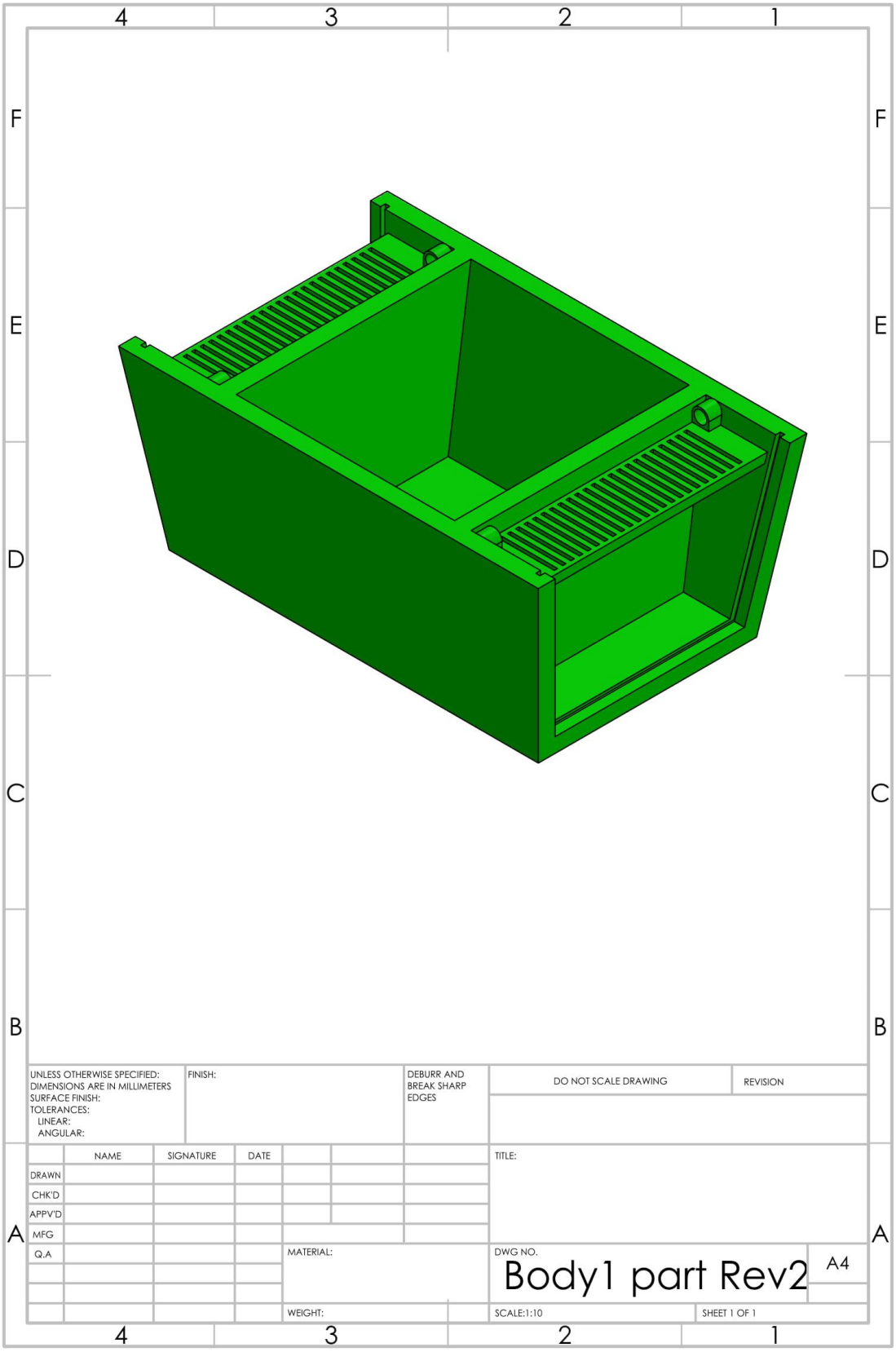

Image 1.3.2: Combined Cooler and Electronics Component Area

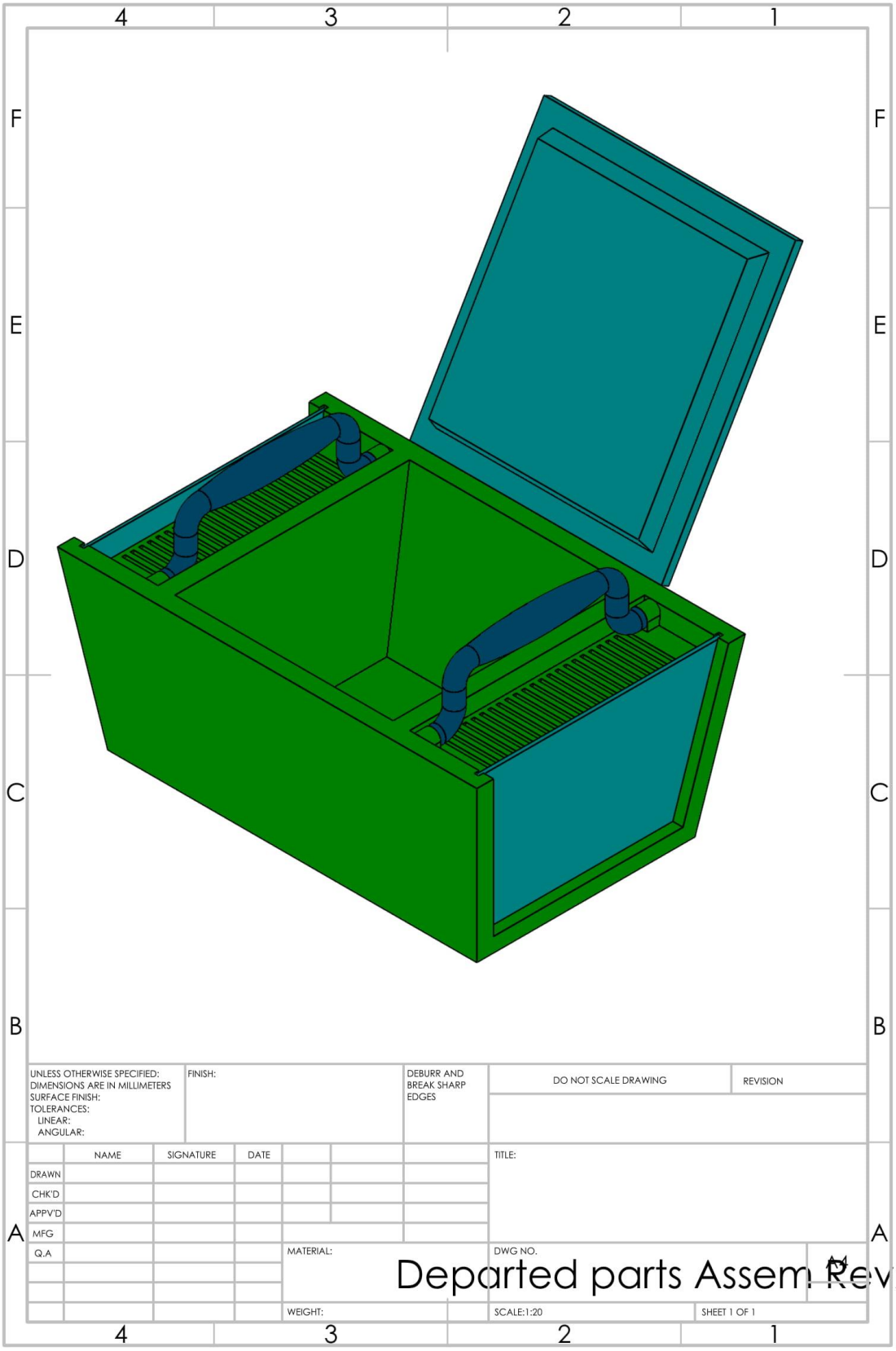

Image 1.3.3: Final Complete Design

2) Hardware Part:

For our project we are designing the solid works model and also making a prototype of our design in that one we are making a real cooler with help of the Styrofoam box and the Peltier module. For our design the basic idea is using the Peltier module and the temperature sensor to maintain the refrigeration temperature inside the cooler and which help to keep all the beverages item cold inside the cooler. The main advantage of using all this equipment is there is no requirement of any type of refrigeration gas or ice. In our design we are using very less component which are easy to replace and also maintenance is easy. In our design we are using following components which explained in to introduction.

2.1) Introduction:

- Temperature Controller: Temperature controller is used to control the temperature inside the cooling area which keeps the Peltier module turn on and off after every desire temperature.

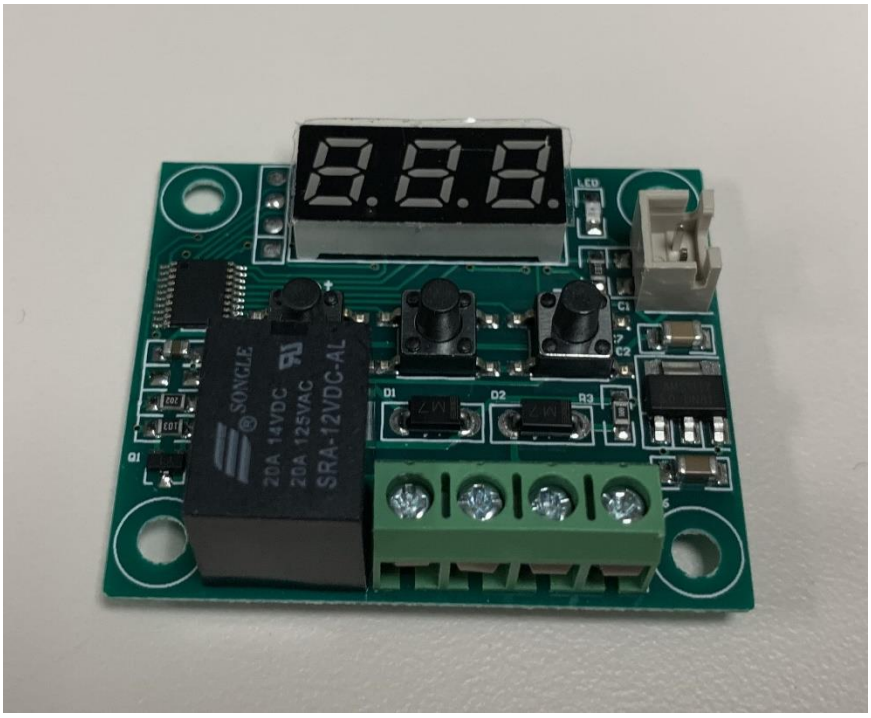

Image 2.1.1: Temperature Controller

- Temperature Sensor: Thermistors are thermally sensitive resistors whose prime function is to exhibit a large, predictable and precise change in electrical resistance when subjected to a corresponding change in body temperature. Negative Temperature Coefficient (NTC) thermistors exhibit a decrease in electrical resistance when subjected to an increase in body temperature and Positive Temperature Coefficient (PTC) thermistors exhibit an increase in electrical resistance when subjected to an increase in body temperature.

Image 2.1.2: Temperature Sensor

- Battery Bank: A rechargeable battery, storage battery, secondary cell, or accumulator is a type of electrical battery which can be charged, discharged into a load, and recharged many times, as opposed to a disposable or primary battery, which is supplied fully charged and discarded after use. It is composed of one or more electrochemical cells. The term "accumulator" is used as it accumulates and stores energy through a reversible electrochemical reaction. Rechargeable batteries are useful in our project to supply the voltages to the Peltier module and the electric fans.

Image 2.1.3: Battery Bank

- Electric CPU Fan: A computer fan is any fan inside, or attached to, a computer case used for active cooling. Fans are used to draw cooler air into the case from the outside, expel warm air from inside, and move air across a heat sink to cool a particular component. Both axial and sometimes centrifugal (blower/squirrel-cage) fans are used in computers. Computer fans commonly come in standard sizes, and are powered and controlled using 3- or 4-pin fan connectors.

Image 2.1.4: Cooling Fan

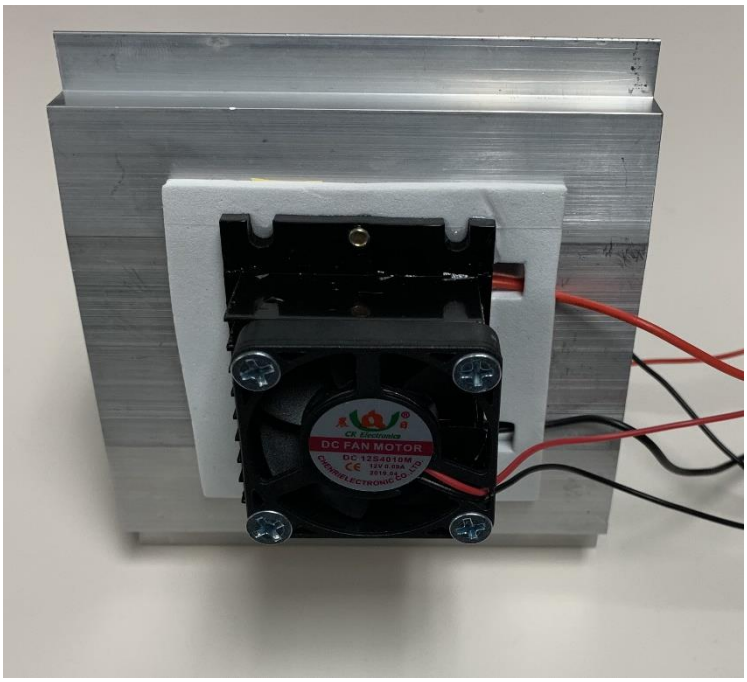

Image 2.1.5: Small Size Cooling Fan

- Peltier Device: Thermoelectric cooling uses the Peltier effect to create a heat flux at the junction of two different types of materials. A Peltier cooler, heater, or thermoelectric heat pump is a solid-state active heat pump which transfers heat from one side of the device to the other, with consumption of electrical energy, depending on the direction of the current. Such an instrument is also called a Peltier device, Peltier heat pump, solid state refrigerator, or thermoelectric cooler (TEC). It can be used either for heating or for cooling, although in practice the main application is cooling. It can also be used as a temperature controller that either heats or cools.

Image 2.1.6: Peltier Device

2.2) Component Testing:

For the testing we start connect the Peltier module with the power supply and then we were trying to measure the temperature but we noticed that the temperature was not going below 14 C. we tried by changing the Peltier module and temperature sensor but it was not working below 14 C. After measuring the voltage and current we got idea Peltier module needs more current we have only power supply until 1 amp. That means it could not able to draw the current more than amp.

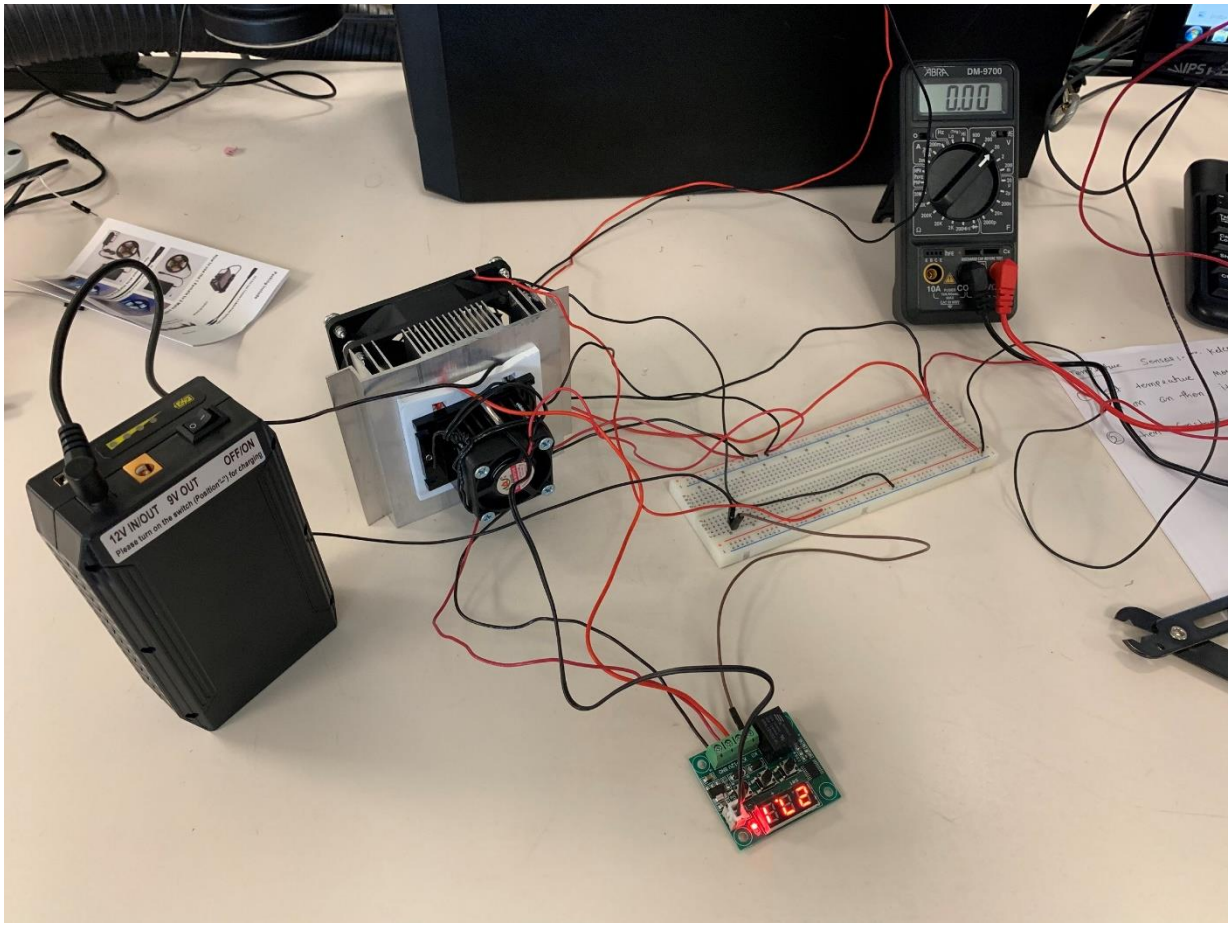

Image 2.2.1: Peltier Device Testing at 14C

For solving this issue, we need to provide more current to the Peltier module for that we decided to change the Lab so we went in to the another lab where the power supply was available until 3 amps. After connecting the Peltier module with the power supply of 3 Amp we noticed that it can easily going 9 C in to the open environment. So we noticed that if we will use the Styrofoam box then we can easily achieve the desired temperature which require for the refrigeration.

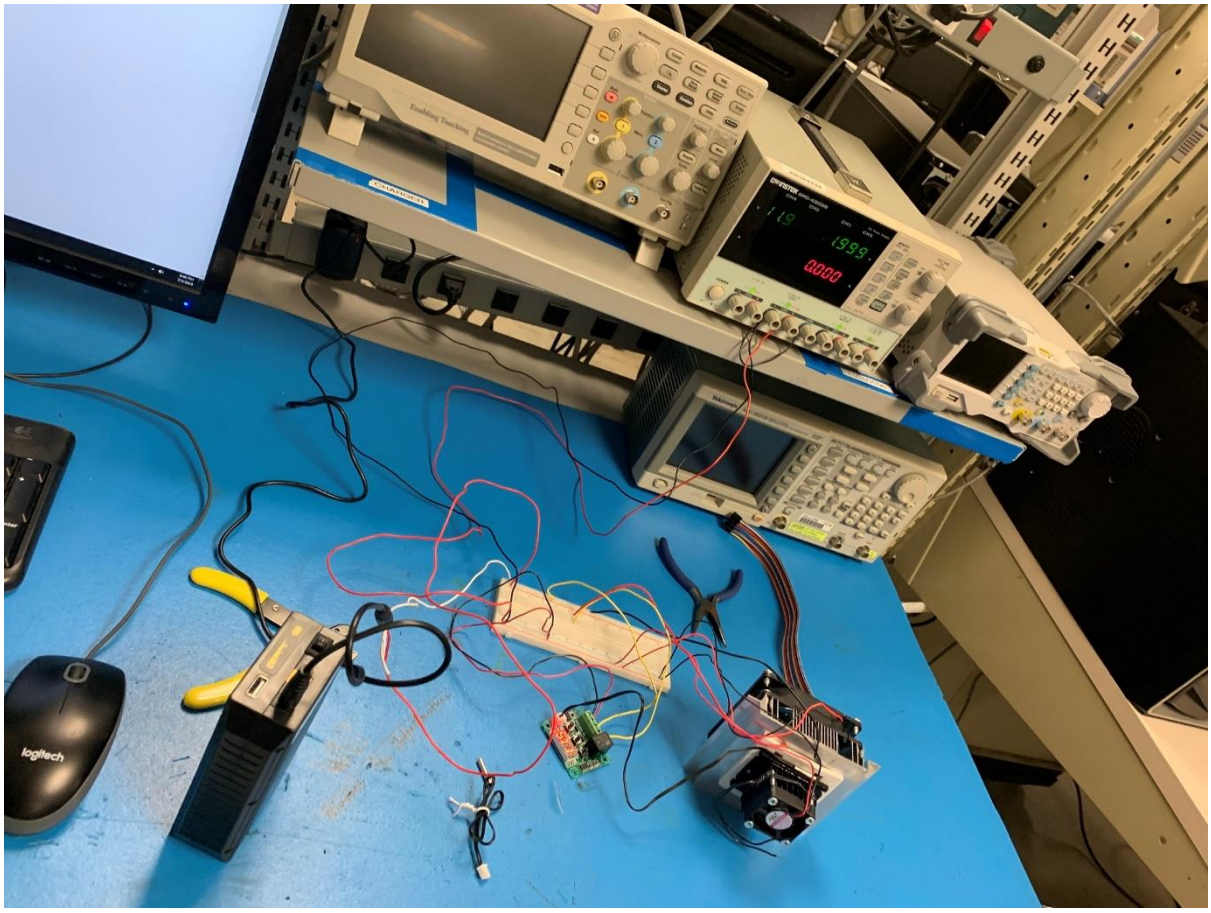

Image 2.2.2: Peltier Device Testing at 9C

2.3) Basic Design Implementation:

For basic design implementation we are going to use the temperature sensor with both Peltier module and try to control the temperature of the Styrofoam box with help of temperature controller. The temperature controller will help us to hold the desire temperature which we need to keep our beverages cold inside the cooler. His basic design is based on the W1209 that control after testing the temperature.

2.4) Design Improvement:

For improvement of our design we are trying to implement is based on microcontroller. Presently we are looking on to the two different types of Nucleo which is based on ARM cortex and also very popular one is Arduino neon. We are collecting data based on the research which we can use with our cooler and work best in all the way.

3) Conclusion: As per testing we got idea that in room temperature we can get successfully reach at the temperature of 9C. For refrigeration we need temperature of 5C which is easy to get if we will put the Peltier device in to the Styrofoam box. That is better to hold the cooling inside the temperature. That way we can implement the refrigeration system for our Tesla Model 3.