ELEKTRONICA-ICT
Project Ontwerpen

Design of a Soldering station

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Content

1 Introduction

This application note will be about the design of a soldering station, which we will be able to use in future projects as it is a quality product when it is finished.

A soldering station is a device which can be used to solder electronic components. The soldering station addressed in this application note will have a knob to set the temperature of the soldering tip.

To power on the device there is a switch on the back. When it is turned on the knob on the front needs to be toggled to heat up the soldering tip to the set temperature.

Starting the project electrical schematics were drawn and a PCB was designed based on the schematics. The program “Altium Designer” was used to draw and design the schematics and PCB. The final step in designing the device is drawing a case using the program “Autodesk Fusion 360”.

2 Material and methods

For this project Altium designer was the most used tool as it was used for drawing the schematic design for the device. The schematics from this project where based on the soldering station project from the magazine “Elektor”. Changes were made in the current project, the encoder and display for example are not soldered on the PCB but can now be connected via headers. This choice was made to ensure flexibility in the later design of the case. In the first version of this project the display and encoder were soldered on a separate PCB which limited the places it could be mounted to in the case. The schematics were also split up into 5 different pages to give a better overview of the project, this also made designing the PCB easier.

After designing the schematics the PCB was drawn. This PCB is also noticeably smaller than the last version, this was a conscious choice when designing the PCB for more flexibility in the case design. A simple but effective case was designed to make the device useful and user friendly.

Drawing the 3D design for the case Autodesk Fusion 360 was used, it is a simple creative tool to draw 3D projects so it is perfect for this instance. The design is a simple square device with a sloped top edge which holds the display to improve user experience. The rotary encoder is placed on the front of the device as this is the most logical place. The decision was made to order a rubber knob for the encoder to give a more quality experience of the device and the plug for the soldering tip was placed on the left side of the case for a better left and used experience.

As this is the second version of the soldering station, I had the advantage to compare components from last year and improve on mistakes that were made on version one.

I mainly used the same components for this version of the device. As some components are not made by the manufacturer anymore or simply were out of stock replacements were found and ordered.

Because a large part of the same components from the first version are used I tried to strip the first PCB from most components. The ATMEGA for example was placed in sockets witch means it could be removed and reused easily, the remaining components were desoldered from the old PCB.

In the table found below you will notice boxes of which the price, supplier and delivery date are blank, this means the component was provided by PXL. The list is a full list of components, the parts where ordered or reused from last years version.

Because of the reused components calculating the price is difficult. On the 2023 version €55,18 was spend on components, the transformer was a big cost that could be reused from last year saving €21,91.

Some problems were found during testing, the PCB used 7x as much current as it normally should. After inspection a broken ATMEGA was found to be the problem, lucky this component is placed on sockets so it could be switched out without desoldering.

Component name	Description	Quantity	Price (€)	Supplier	Delivery date
IRF9Z34NPBF	MOSFET (P-Channel)	1	0,91	Mouser	March 25th
RT424005	Relay	1	4,20	Mouser	March 25th
BC547	Transistor BJT NPN	3	1,04	Mouser	March 25th
GBU606-G	Bridge Rectifier	2	2,54	Mouser	March 25th
50PK4700MEFC18X40 - 4700uF	Capacitor Polarised	1	3,13	Mouser	March 25th
RGA101M1HBK-0811G - 100uF	Capacitor Polarised	2	0,32	Mouser	March 25th
860020672010 - 10uF	Capacitor Polarised	3	0,27	Mouser	March 25th
FM4007W-W	Bridge Rectifier	1	0,14	Mouser	March 25th
MMSZ4689T1G	Zener Diode	1	0,18	Mouser	March 25th
SMMDL914T1G	Diode SMMDL914T1G	1	0,36	Mouser	March 25th
PEC11R-4225F-S0024	rotary encoder with push button	1	1,53	Mouser	March 25th
TL780-05CKTTR	Integrated Circuit - voltage regulator	1	1,80	Mouser	March 25th
ATMEGA4809-PF	Integrated Circuit	1	2,85	Mouser	March 25th
MCP6002-E_P dual opamp	Integrated Circuit	1	0,48	Mouser	March 25th
cmsmoorspoel	Transformer CM2545X171B-10	1	1,52	Mouser	March 25th
Screw connector	Connector 1716020000	4	2,09	Mouser	March 25th
smoorspoel	Inductor VLS6045EX-100M-H	1	0,56	Mouser	March 25th
Pin connector set with strain relief	Grid size: 2.54 mm ; poles: 10 ; rows: 2 1	1	8,99	Conrad	April 1st
POWER INLET FLANGE MOUNT	Power inlet	1	10,99	Conrad	March 28th
TST 60/011 INDEL	Transformer toroidal	1	21,91	TME	March 25th
KW4-804CVB	Display	1	1,86	TME	
BC557	Transistor BJT PNP	1	0,03	Reichelt	March 28th
Glass fuse	Fuse	1	1,99	AlleKabels	April 19th
Power cord 230V with C13 plug	Power cord	1	3,25	Bits and Parts	March 25th
TM1637	Integrated Circuit	1	0,31	AliExpress	April 1st
100nF	Capacitor	6	\	\	\
10nF	Capacitor	7	\	\	\
1x3header	Connector	3	\	\	\
1x2header	Connector	1	\	\	\
1x4header	Connector	1	\	\	\
1x5header	Connector	1	\	\	\
2x3header	Connector	1	\	\	\

3 Results

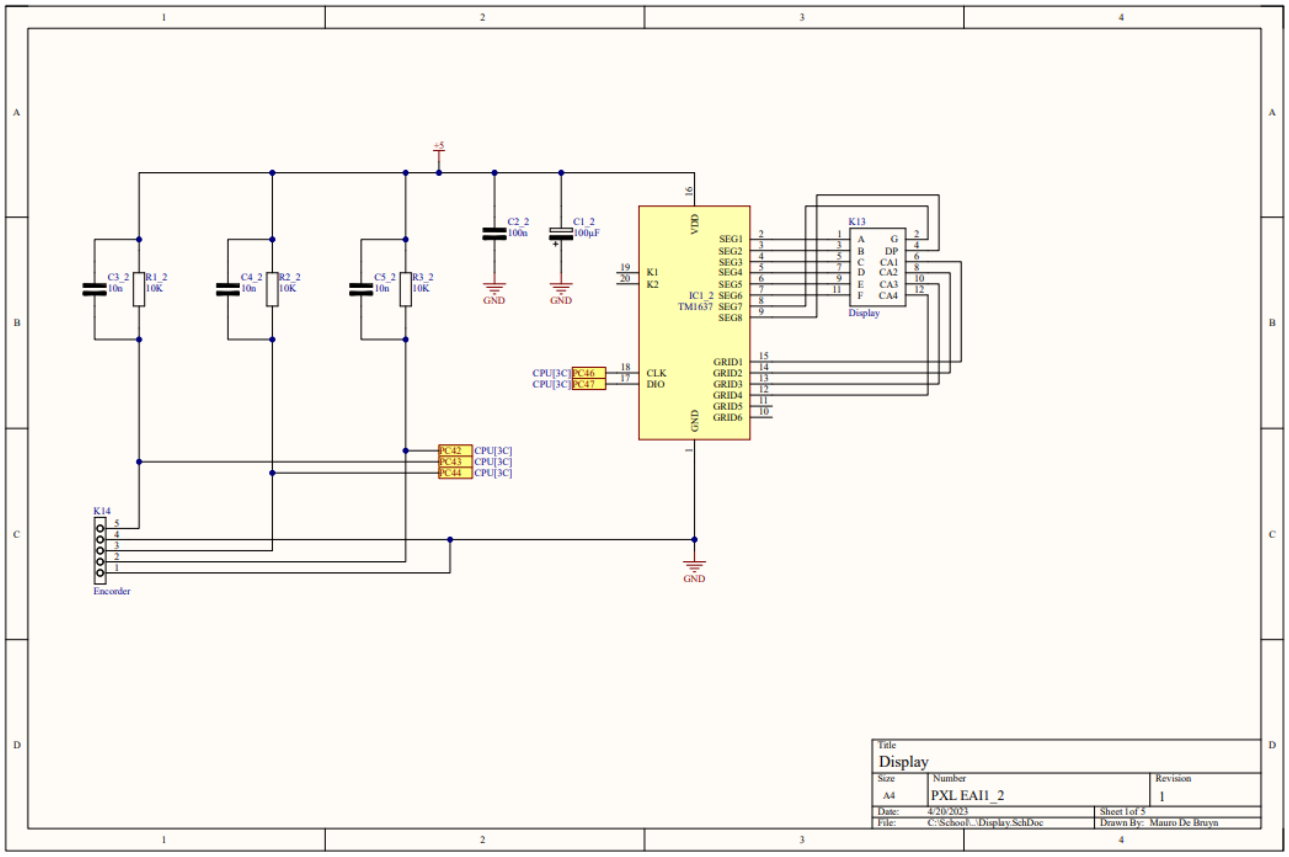
On the back an on/off-switch can be found to turn on the device. This switch sits in a housing with also holds a fuse and power cord plug. The fuse is used for safety reasons and is installed between the switch and transformer. The fuse will physically separate the power supply from the device and when the fuse is melted due to overcurrent or overvoltage it can be replaced because it sits in a handy slot that can be opened from the outside. The power cold needs to be removed to be able to open this slot, this is obviously for safety reasons.

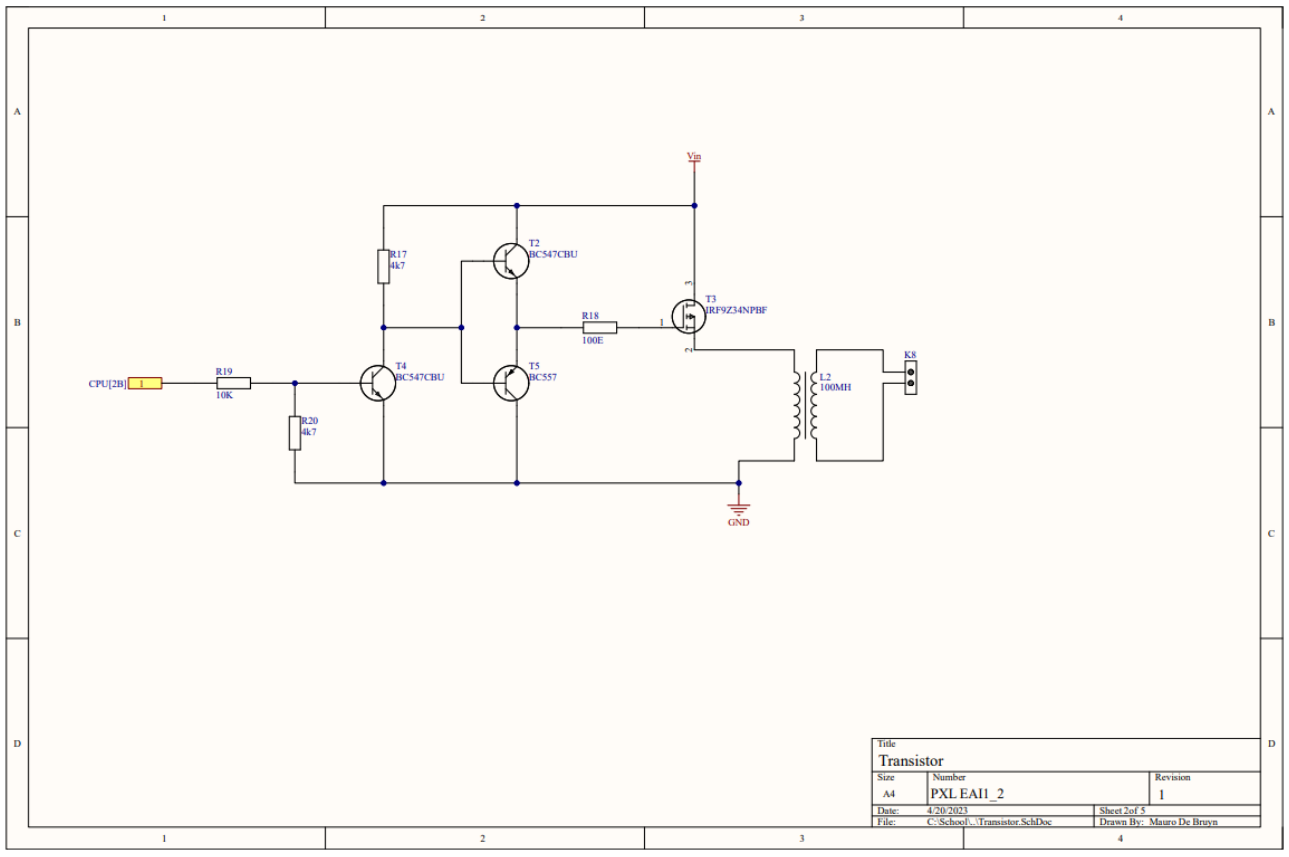
On the left side is a 3.5mm jack plug to connect the soldering tip to the device, this choice was made for a better experience for left hand users. The 3.5mm jack holds 3 cables, a ground, a wire for the heating element and a wire for the sensor in the soldering tip to check the current temperature of the tip.

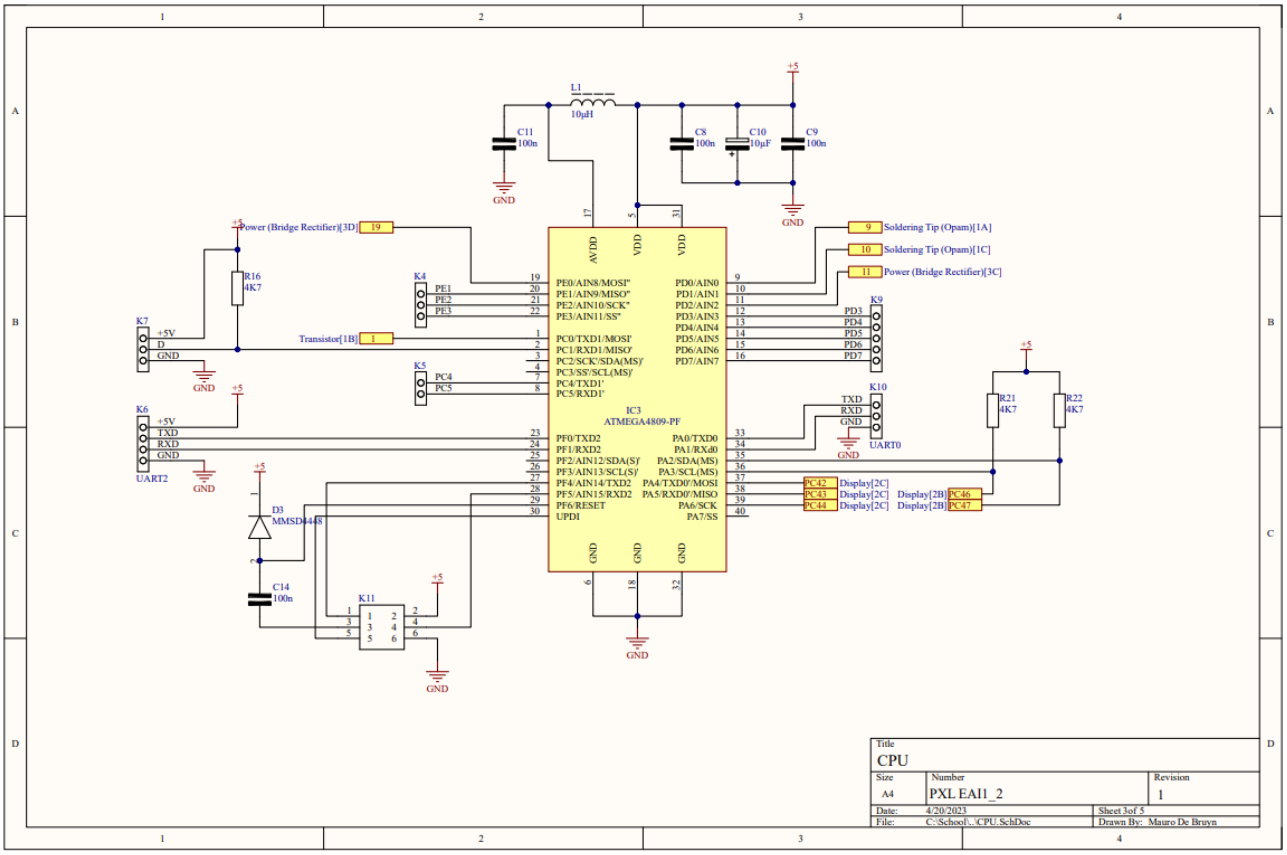
On the front is a 4-digit display to select the specified soldering tip and to read the temperature for this soldering tip. Knob is placed underneath tis display to set the temperature, turning it counterclockwise will decrease the temperature, turning it the other way will obviously increase temperature.

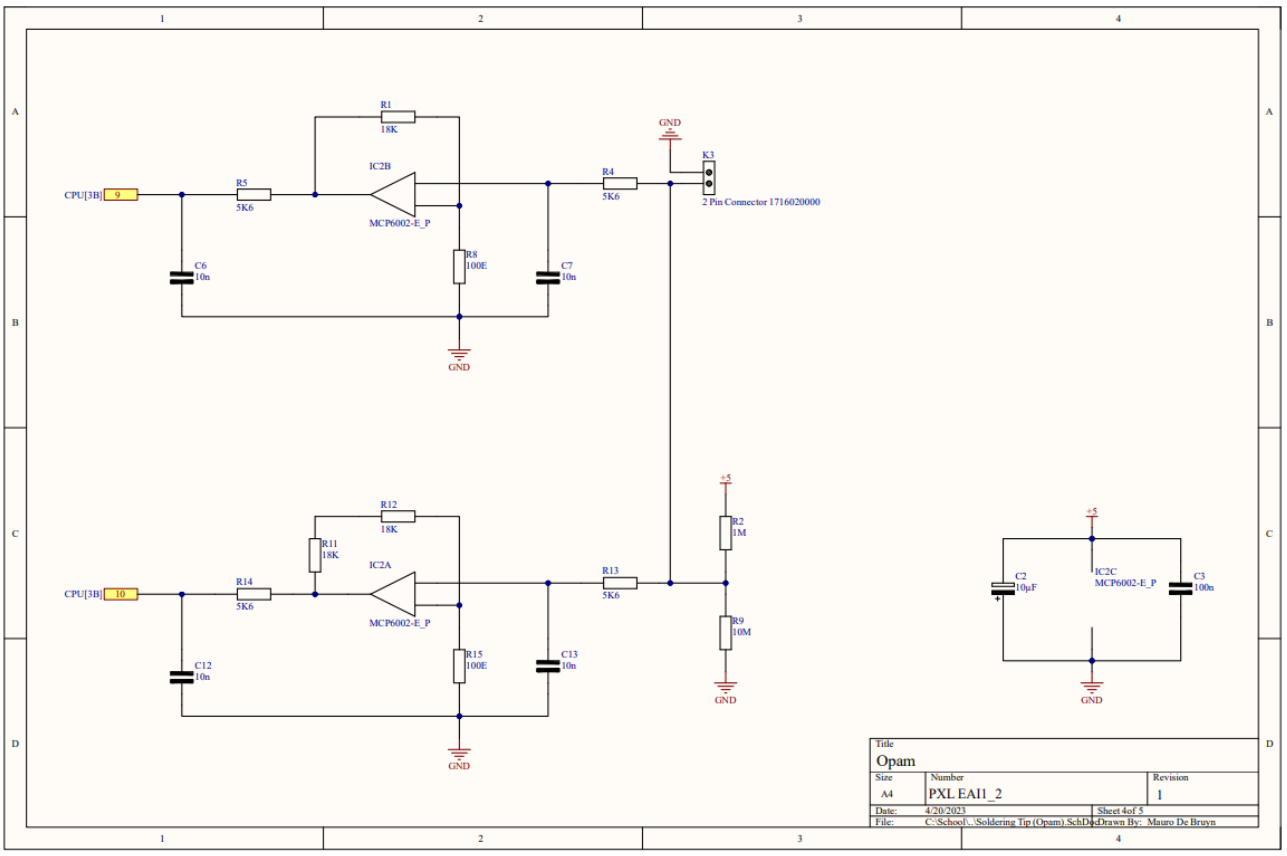
the knob also clicks to turn of the heating element for the tip. This is a quick way of taking the risk of burning yourself away without completely turning off the device.

3.1 Schematics






L1
10µH
C11
100n
C8
100n
C10
10µF
C9
100n
GND
+5
IC3
ATMEGA4809-PF
AVDD
VDD
VDD
GND
GND
GND
PE0/AIN8/MOSI*
PE1/AIN9/MISO*
PE2/AIN10/SCK*
PE3/AIN11/SS*
PC0/TXD1/MOSI'
PC1/RXD1/MISO'
PC2/SCK'/SDA(MS)'
PC3/SS'/SCL(MS)'
PC4/TXD1'
PC5/RXD1'
PF0/TXD2
PF1/RXD2
PF2/AIN12/SDA(S)'
PF3/AIN13/SCL(S)'
PF4/AIN14/TXD2
PF5/AIN15/RXD2
PF6/RESET
UPDI
PD0/AIN0
PD1/AIN1
PD2/AIN2
PD3/AIN3
PD4/AIN4
PD5/AIN5
PD6/AIN6
PD7/AIN7
PA0/TXD0
PA1/RXd0
PA2/SDA(MS)
PA3/SCL(MS)
PA4/TXD0'/MOSI
PA5/RXD0'/MISO
PA6/SCK
PA7/SS
Power (Bridge Rectifier)[3D]
Transistor[1B]
Soldering Tip (Opam)[1A]
Soldering Tip (Opam)[1C]
Power (Bridge Rectifier)[3C]
Display[2C]
Display[2B]
R16
4K7
K4
K5
K7
K6
K9
K10
UART2
UART0
D3
MMSD4448
C14
100n
K11
R21
4K7
R22
4K7
Title
CPU
Size
A4
Number
PXL EAI1_2
Revision
1
Date:
4/20/2023
Sheet 3of 5
File:
C:\School\...\CPU.SchDoc
Drawn By:
Mauro De Bruyn


R1
18K
IC2B
MCP6002-E_P
R5
5K6
R4
5K6
K3
2 Pin Connector 1716020000
C6
10n
R8
100E
C7
10n
CPU[3B]
R12
18K
R11
18K
IC2A
MCP6002-E_P
R14
5K6
R13
5K6
R2
1M
R9
10M
C12
10n
R15
100E
C13
10n
IC2C
MCP6002-E_P
C2
10µF
C3
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Opam
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Number
PXL EAI1_2
Revision
1
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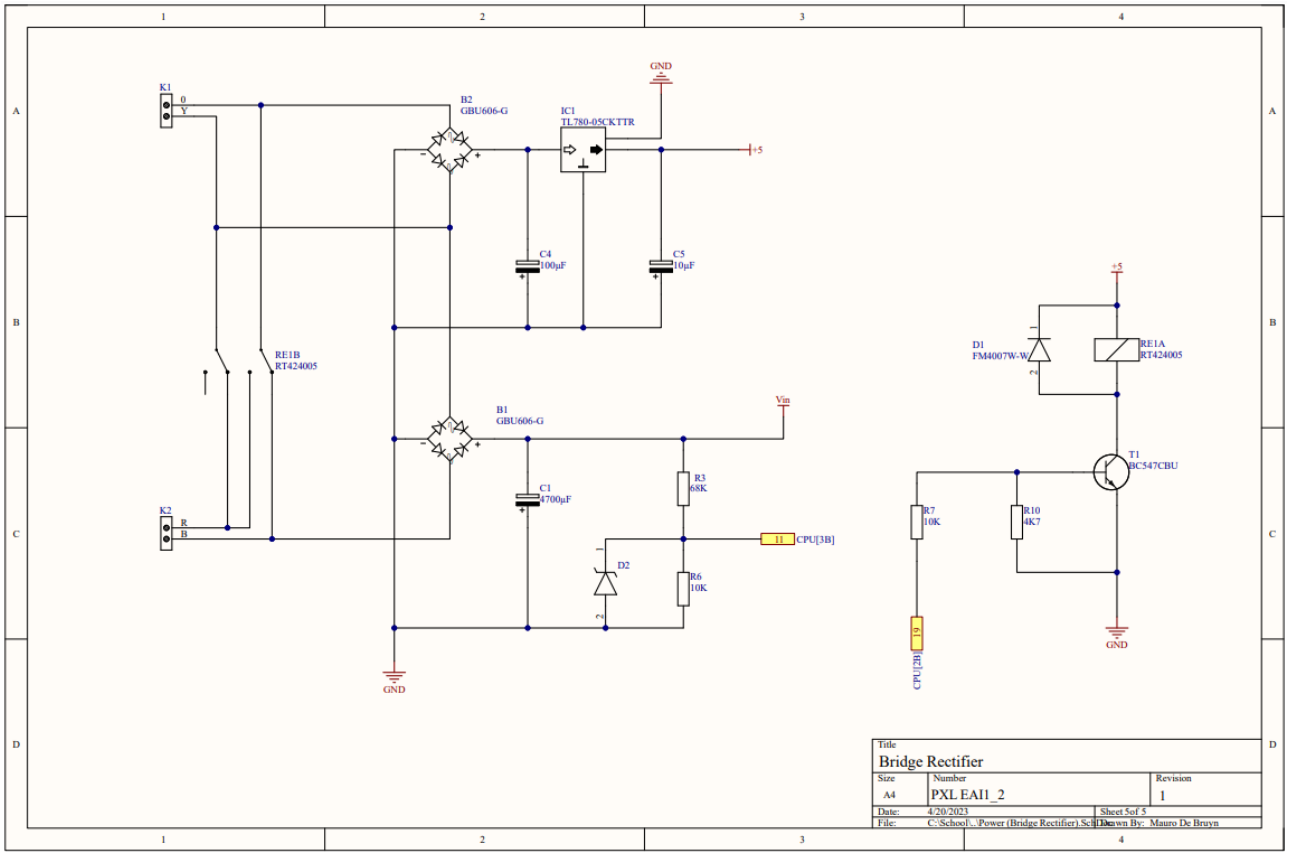
4/20/2023
Sheet 4of 5
File:
C:\School\...\Soldering Tip (Opam).SchDoc
Drawn By:
Mauro De Bruyn



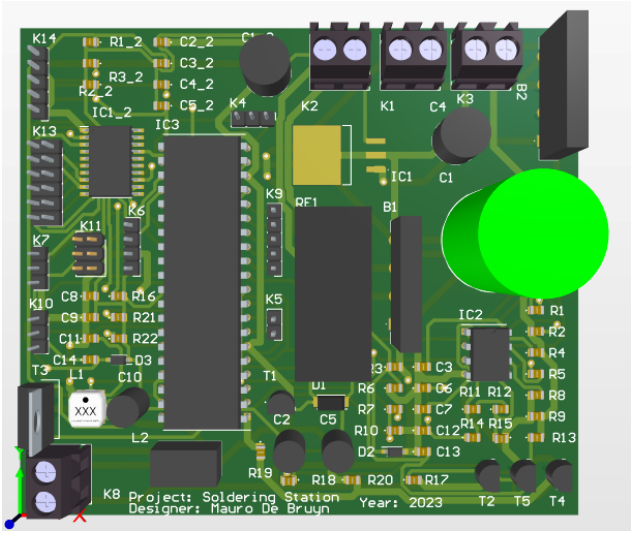
3.1.1 Explanation schematics

The images above show the schematics for this project split up into 5 different sections.

3.2 PCB

3.2.1 PCB

The image shows a 3D render of the designed PCB which is notably smaller than last years version.



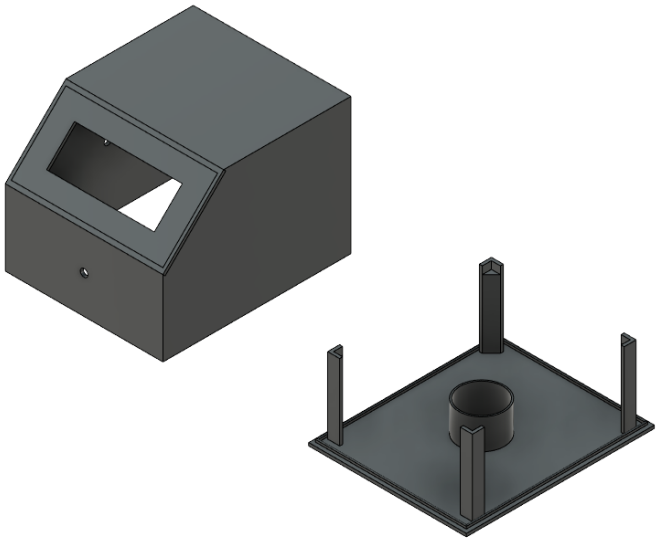
3.2.2 Autorouting

The PCB was routed by using the autoroute function in Altium Designer, the PCB shown in the image above is the second version as the first version had troubles routing because the components where too close together. The next version did autoroute perfectly but minor adjustments still needed to be done manually

3.3 Mechanical design

3.3.1 Drawing

The image below shows the rendering of the case, it was drawn in Autodesk Fusion 360.



3.3.2 Display

The square cut-out on the sloped side of the device is made to house the display, this hole was bigger in the first design but was made smaller at the end because the display was replaced last second with a smaller one.

3.3.3 Functionality

The case is made out of two parts, a bottom plate and a to shell.

On the bottom plate the transformer will be placed over the cylinder, this was designed to minimize sliding of the component. The PCB will sit over this transformer on the long triangle extrudes.

The connector for the soldering tip, the encoder and the display are mounted on the shell and can be connected to the main board when closing up the device.

4 Discussion

The overall project went smoothly as the experience of last years project helped a lot but there were still a couple of problems that needed to be tackled along the way.

The design of the schematics and PCB went on without any problem. The component libraries from last year were mostly reused so this made designing a lot faster as the library did not need to be made from scratch but adjusted.

Soldering the PCB a couple of problems did come up as I made a couple of human mistakes and soldered a polarized capacitor the wrong way around and also soldered the wrong transistor in place. Luckily these mistakes were fixed quickly with low effort. During testing a broken processor was replaced and the project could be resumed.

During designing the choice was made to make the decoder and display external with no PCB soldered to it, this made wiring the components a time consuming effort and is something to keep in mind for future projects.

Being occupied with the soldering and testing of the circuit I lost time to work on the case, as of writing this application note the case is yet to be printed but I am still working on getting the design printed.

I enjoyed this years project a lot more than last years because I had more freedom designing the case and PCB with all the knowledge from last years version. Also the PCB size was a big thing for me, a small yet effective design made this project a lot more professional.