

ASSEMBLY INSTRUCTIONS AND USER MANUAL

MyGamepad



DISCLAIMER

All information in this document is provided in good faith. However, we give no warranty and accept no responsibility or liability for the accuracy, or the completeness of the information and materials contained in this document.

Under no circumstances will we be held responsible or liable in any way for any claims, damages, losses, expenses, costs or liabilities whatsoever (including, without limitation, any direct or indirect damages for loss of profits, business interruption or loss of information) resulting or arising directly or indirectly from your use of or inability to use this document, or from your reliance on the information and material on this document, even if we have been advised of the possibility of such damages in advance.

All product and company names are trademarks™ or registered® trademarks of their respective holders. Use of them does not imply any affiliation with or endorsement by them.

Copyright © 2024 by Michael Reifges.

All rights reserved. No part of this publication may be reproduced, distributed, or transmitted in any form or by any means, including photocopying, recording, or other electronic or mechanical methods, without the prior written permission of the publisher.

<https://www.mygamepad.de>



Table of Contents

1	Preface	6
1.1	.... <i>Conventions used in this manual</i>	6
1.2	.... <i>Explanation of safety instructions</i>	7
1.3	.... <i>Retaining instructions</i>	7
1.4	.... <i>Obtaining documentations and information</i>	8
1.4.1	Internet	8
1.4.2	Documentation feedback	8
2	Description of the product	9
2.1	.... <i>Purpose of the device</i>	9
2.2	.... <i>Building the device</i>	9
2.3	.... <i>Technical data</i>	10
2.5	.... <i>Description of the device parts and components</i>	11
2.6	.... <i>Understanding the user interface</i>	15
2.6.1	Normal operation	15
2.6.2	Select profile mode	16
2.6.3	Analog stick calibration mode	17
2.6.4	Configuration mode	18
3	Safety instructions and advice	19
3.1	.... <i>Personal safety</i>	19
3.2	.... <i>Work area safety</i>	19
3.3	.... <i>Soldering safety</i>	19
4	Assembly	20
4.1	.... <i>Required tools</i>	20
4.2	.... <i>Bill of materials</i>	22
4.2.1	3D-printed parts	22
4.2.2	Micro controller/USB-Hub	31
4.2.3	Printed circuit boards (PCBs)	32
4.2.4	Electronic parts	33
4.2.5	Screws and other materials	37
4.3	.... <i>Printing and preparation of 3D parts</i>	39



4.3.1	Printing the parts	39
4.3.2	Threaded inserts	40
4.3.3	Square nuts	41
4.3.4	Pre-assembly of printed parts.....	43
4.4	<i>Electronics</i>	45
4.4.1	Main printed circuit board (Main-PCB).....	45
4.4.2	Preparation of the cable connectors	47
4.4.3	Finger key holders.....	49
4.4.4	Thumb stick PCB.....	52
4.4.5	Display.....	54
4.4.6	USB connectors for the microcontroller	56
4.4.7	USB hub.....	57
4.5	<i>Final assembly</i>	59
4.5.1	Finger key.....	59
4.5.2	Thumb.....	61
4.5.3	Base.....	62
5	Programming the microcontrollers (MC)	68
5.1	<i>Libraries and software components used</i>	68
5.2	<i>Preparing the software environment on your computer</i>	68
5.3	<i>Flashing the firmware</i>	68
5.3.1	Arduino Nano ESP32 (MC1)	69
5.3.2	Teensy 4.0 (MC2)	71
6	Setup and configuration of the assembled device	72
6.1	<i>Hardware setup and adjustment</i>	72
6.1.1	Individual adjustment options for the finger keys	72
6.1.2	Individual adjustment options for the thumb.....	73
6.2	<i>Software setup and operation</i>	75
6.2.1	Setting up the WIFI connection	75
6.2.2	Configuration through web-interface	77
7	Troubleshooting	82
7.1	<i>Identifying and resolving problems</i>	82
7.1.1	Troubleshooting and resolution during assembly and functional testing	82
7.1.2	Troubleshooting and resolutions during normal usage	82
8	References.....	83



8.1...	<i>Figures</i>	83
8.2...	<i>Tables</i>	86
9	Imprint.....	87

1 Preface

1.1 Conventions used in this manual

The following style conventions are used in this document:

Bold

- Names of product elements, commands, options, programs, processes, services, and utilities
- Names of interface elements (such windows, dialog boxes, buttons, fields, and menus)
- Interface elements the user selects, clicks, presses, or types

Italic

- Publication titles referenced in text
- Emphasis (for example a new term)
- Variables

Courier

- System input/output, such as an error message or script
- URLs, complete paths, filenames, prompts, and syntax

User input variables

< > Angle brackets surround user-supplied values-

[] Square brackets surround optional items.

| Vertical bar indicates alternate selections – the bar means “or”.

1.2 Explanation of safety instructions

DANGER! Danger indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.

WARNING! Warning indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.

CAUTION! Caution indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.

NOTICE Indicates information considered a hint, but not hazard-related.

1.3 Retaining instructions

Read and understand this manual and its safety instructions before assembling and using this product. Failure to do so can result in serious injury or product failure.

Follow all the instructions. This will avoid fire, electric shocks or other hazards that may result in damage to property and/or severe or fatal injuries.

Keep all safety information and instructions for future reference and pass them on to subsequent users of the product.



1.4 Obtaining documentations and information

1.4.1 Internet

The latest version of the documentation is available at the following address:

<https://www.mygamepad.de/mygamepad-your-diy-gaming-device-support.html>

1.4.2 Documentation feedback

Feedback is always welcome. Any comments can be submitted on the support website. Comments can also be sent to info@mygamepad.de.

We appreciate your comments.

2 Description of the product

2.1 Purpose of the device

MyGamepad is do-it-yourself (DIY) input device designed for gaming that is especially optimized for FPS games. It is a combination of different input devices, including keyboard, mouse, and controller. The device supports:

1. 25 functional keys.
 - Finger 1 with 6 keys.
 - Finger 2 with 5 keys.
 - Finger 3 with 5 keys.
 - Finger 4 with 6 keys.
 - Thumb with 3 keys.
2. 5 Way-Digital stick (DPAD) with center button.
3. Analog stick with 12-bit A/D precision and center button.

Each key and stick direction can be assigned a function of the different types of input devices. The assignments can be modified through a web-interface and are stored in the internal memory of the device. The internal memory can store up to 20 profiles. Furthermore, it's also possible to transfer configurations through the web-interface to PC or Mac.

It is possible to adjust the hardware configuration to support individual hand sizes and preferred handling positions. The device is designed to be used with the left hand in combination with a mouse operated with the right hand.

MyGamepad is connected to the computer or console via a free USB 2.0 port. No drivers or software need to be installed on the PC, Mac or console. However, functionality may be limited for certain devices and games. For example, the controller functions analog movement or typical X/Y buttons cannot be used on consoles because the device is recognized as a keyboard. But therefore, the analog stick input can be used in games with keyboard support to emulate the WASD key mappings.

The web-interface for configuration requires a modern web browser such as Safari, Chrome, Edge or mobile device browser.

2.2 Building the device

Building the device requires or having access to a 3D printer. Furthermore, some other tools like a soldering iron, screw drivers, and pliers are required. Details can be found in the tool section of this document (see Table 2 on page 20).

The level of difficulty of the build is medium, with a strong focus on soldering. While the printing time of the plastic parts is approximately 30 hours, the assembly time is around 5 – 8 hours depending on your soldering skill. This document describes the entire process step by step.

2.3 Technical data

Table 1 Technical data

Parameter	Unit
Power	1.2 W
Voltage	5 V provided through USB port
Weight	535 g
Software version	V1.00
Operating temperature	5 to 40 °C
Humidity range	30 to 80 % relative humidity (RH)

2.5 Description of the device parts and components

In Figure 2-1 to 2-9 you will find an overview of the main components of the fully assembled device and their position.



Figure 2-1 MyGamepad top front view.



Figure 2-2 MyGamepad side view.

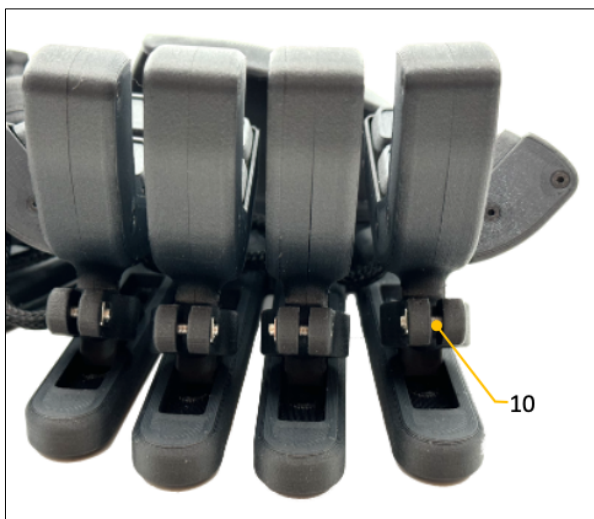


Figure 2-3 MyGamepad finger keys rear view.

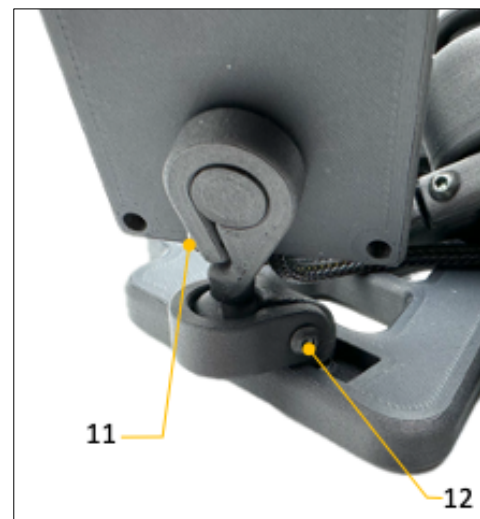


Figure 2-4 MyGamepad display rear view.



Figure 2-5 MyGamepad thumb stick side view.

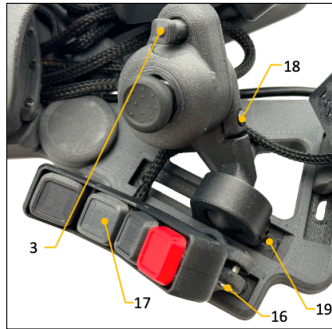


Figure 2-6 MyGamepad thumb stick top view.

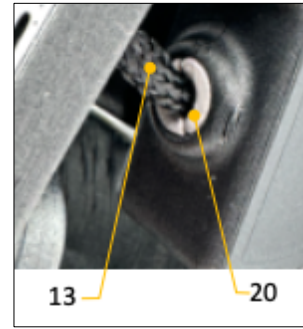


Figure 2-7 MyGamepad key shell bottom view

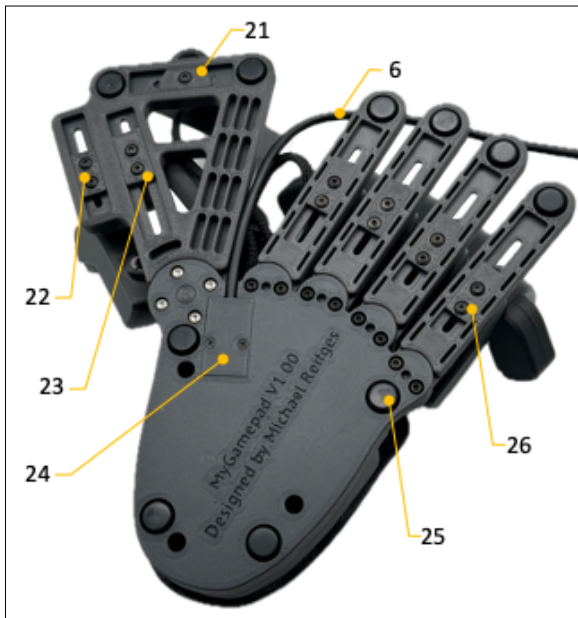


Figure 2-8 MyGamepad bottom view.

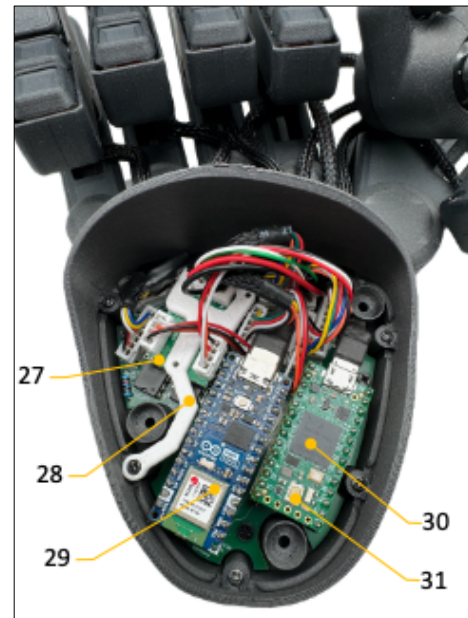


Figure 2-9 MyGamepad inside main body view.

Description of the parts and components:

- | | |
|--|--|
| <ol style="list-style-type: none"> 1. Hand rest 2. Finger keys 3. 5-way digital stick (DPAD) 4. Analog thumb stick 5. Display 6. Select key 7. Finger base 8. Joint finger base 9. Base strain relief | <ol style="list-style-type: none"> 10. Finger keys 360° adjustment 11. Display angle adjustment 12. Display 360° adjustment 13. Communication cable 14. Joint thumb base cap 15. Thumb base 16. Thumb key 360° adjustment 17. Thumb keys 18. Thumb stick angle adjustment |
|--|--|



19. Thumb stick 360° adjustment
20. Key strain relief
21. Display horizontal adjustment
22. Thumb key horizontal adjustment
23. Thumb stick horizontal adjustment
24. USB cable strain relief
25. Rubber feet
26. Finger key horizontal adjustment
27. USB hub
28. USB hub mount
29. Arduino Nano ESP32 micro controller
30. Teensy 4.0 micro controller
31. Reset button Teensy 4.0

2.6 Understanding the user interface

During normal operation the main screen on the 2.4 inch display shows an overview of the selected profile settings and key assignments.

By pressing the select key of the thumb key row you can toggle through the different modes.

2.6.1 Normal operation

During normal operation the individual main screen will be shown. Elements of and areas of the main screen are described in Figure 2-10 and Figure 2-11.

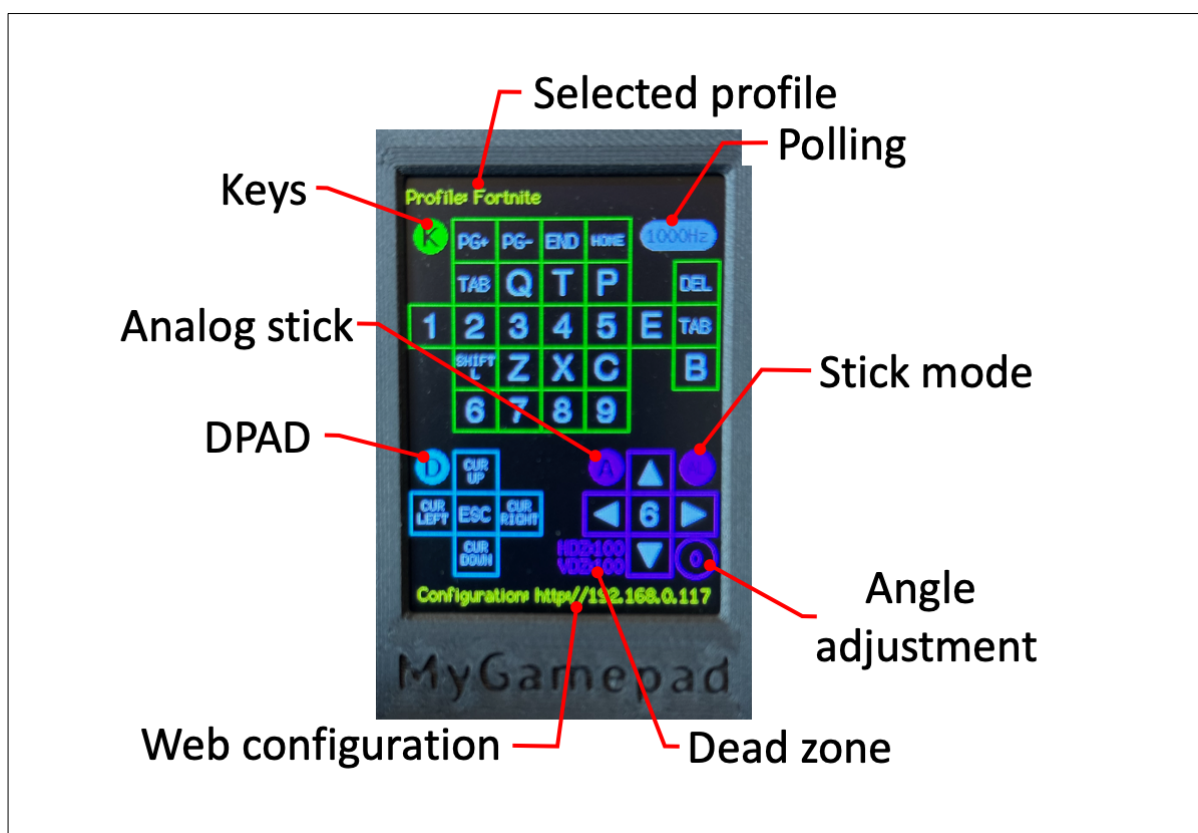


Figure 2-10 MyGamepad main screen – item descriptions.

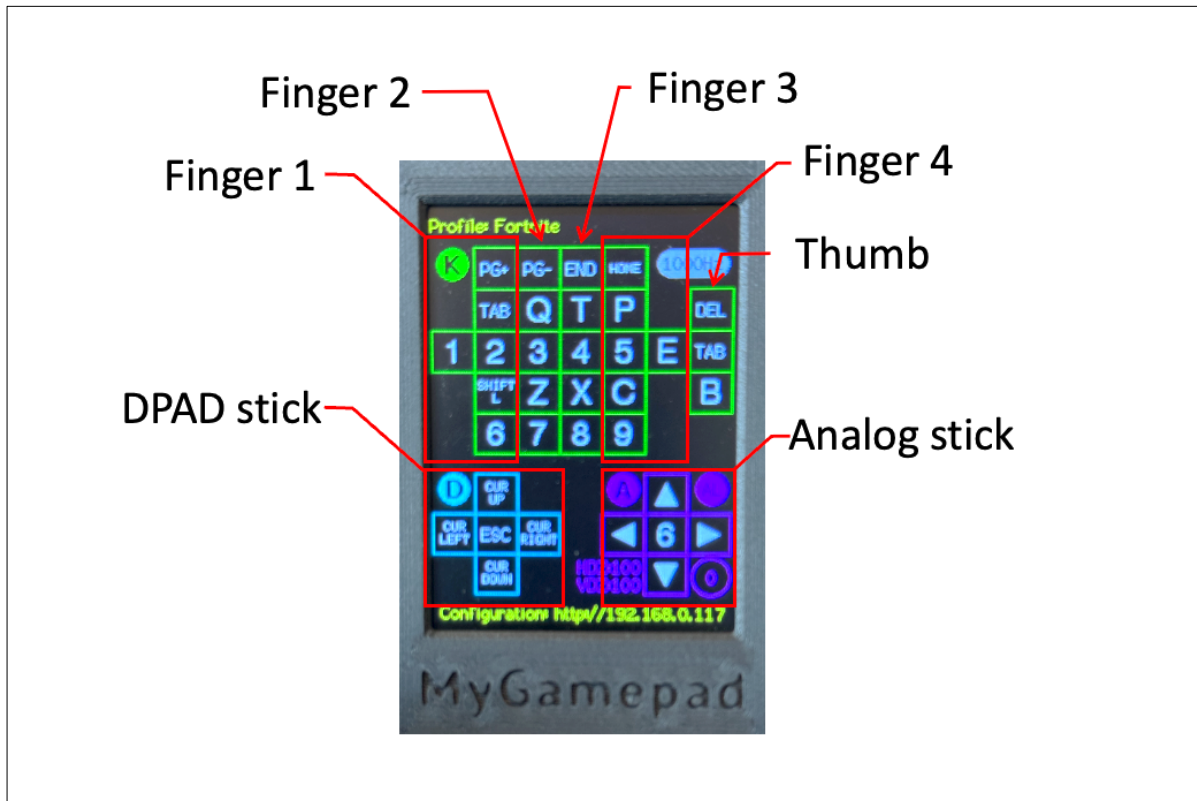


Figure 2-11 MyGamepad main screen – key assignments.

2.6.2 Select profile mode

You can change the profile in this mode. Use the 5-way digital stick up and down to select the desired profile and confirm your choice by pressing the center button of the stick.

You can switch to the next mode at any time by simultaneously pressing the 1st and 3rd key of the thumb key row (see Figure 2-12).



Figure 2-12 Profile selection screen.

2.6.3 Analog stick calibration mode

In this mode, you can calibrate the analog stick in 3 simple steps. You can leave this mode at any time using the select key.

2.6.3.1 Step 1 – Define the new center values

Leave the analog stick untouched in the center and press the DPAD center button to confirm (see Figure 2-13).



Figure 2-13 Analog stick calibration step 1.

2.6.3.2 Step 2 – Define the new center values

In this step, simply circle the stick 2 – 3 times in all direction as far as possible. (see Figure 2-14 and Figure 2-15) As soon as the min/max values no longer change, press the DPAD center button to proceed to step 3.



Figure 2-14 Analog stick calibration step 2.



Figure 2-15 Calibration step 2 final.

2.6.3.3 Step 3 – Test the new values

In this step, you can validate the new values. While the analog stick is centered, the X and Y values must be around 2047, typically ± 50 . When moving the stick, the values in both dimensions should be in the range from 0 to 4095.

By pressing the DPAD center button, the new calibration values are saved in the device (see Figure 2-16).



Figure 2-16 Calibration step 3.

2.6.4 Configuration mode

The configuration menu gives you the following options (see Figure 2-17):

Connect WIFI: Allows you to connect with the WIFI network. It tries to connect to the saved network. If the connection cannot establish it is going into the network configuration mode and establish an access point with the SSID “MyGamepad”.

Start web configuration: If connected to the WIFI network you can start the web-configuration mode which allows you to connect to your device with a web browser for profile editing.

Reset WIFI settings: Deletes the saved WIFI settings. Use this in case you want to switch the network.

Restart device: Reboots the device.

Factory settings: Deletes all profile and WIFI settings.

About: Shows information about the device.



Figure 2-17 Configuration mode.

3 Safety instructions and advice

3.1 Personal safety

- Drink enough water to remain alert and avoid dehydration.
- Ensure sufficient air ventilation (6 – 12 air changes/ hour).
- Taking regular breaks allows your body to recover from the tasks at hand.

3.2 Work area safety

- Keep your workplace clear from clutter.
- Always wear the necessary safety equipment.
- Make sure that the tools used are working well and are in good condition.
- Use ergonomic desks or workbenches to avoid straining your wrists and arms.

3.3 Soldering safety







- Do not use soldering irons with obvious damage to the housing, cable, or plug.
- Work on a fire-proof or fire-resistant surface.
- Wear eye protection. Solder can spit!
- Fumes should be extracted using an enclosed hood (preferred) or tip extraction. Ideally, these should vent to the outside.
- Hold the wires to be heated with tweezers, pliers, or clamps to avoid burns. Keep the cleaning sponge wet during use. If possible, conduct soldering on a firm, level surface and always return the soldering iron to its stand when not in use.

4 Assembly

Before starting the assembly process, it is recommended that you read the entire document first.

4.1 Required tools

Table 2 Tools.

Tool name	Picture	Comment
Soldering iron		
Soldering tip for threaded inserts M2		Strongly recommended, but optional. Can also be done carefully with a soldering iron. Use ~290°C.
Screwdriver		Depends on the actually used screws.
Allen key 1.3 mm & 2.0 mm or Torx T8/10 key		Depends on the actually used screws.
Wire-cutting pliers		
Pliers		

Cutter		
Tool for stripping thin wires		
Tweezers		
Heat gun		Optional

4.2 Bill of materials

Besides the 3D-printed parts, further components such as micro controllers, keys, a display, wires, connectors, screws, etc. are required. We tried to use commonly available standard components at a reasonable cost without compromising on the overall quality and performance.

However, some components are not available to purchase as single parts (mainly due to the low value per piece). Others offer significant discounts of up to 20 % on larger or bulk orders. Depending on the interest, we might in future offer hardware part kits with the right quantity of the required components while passing on the discounts. This might also help to save on transport/shipping costs and is more environmentally friendly.

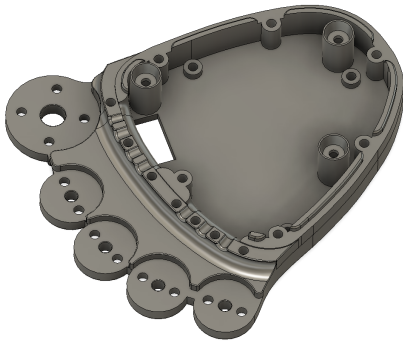

4.2.1 3D-printed parts

All parts can be ordered and downloaded on [Printables.com](https://www.printables.com). We recommend printing the parts in PETG. However, the best look and feel can be archived with Prusament PETG Carbon Fiber and Prusament PC Blend Carbon Fiber. The model used in the photos is printed in PC Blend Carbon Fiber.


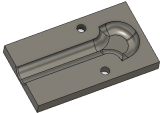

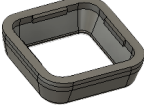
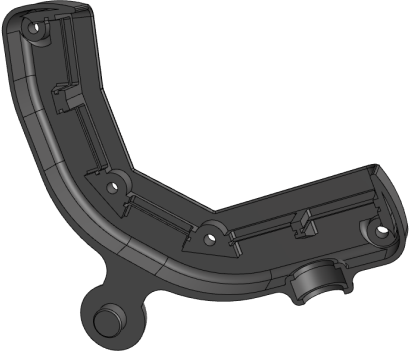
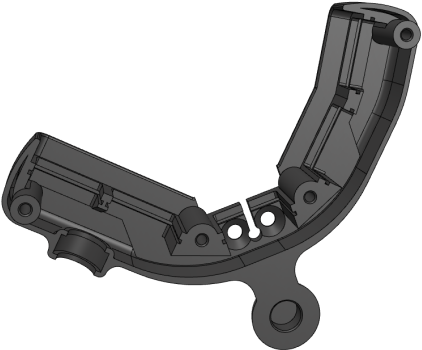
Printing all parts requires approx. 450 g of filament. Total print time on a Prusa XL with having all parts on one plate is approximately 30 hours (see Table 3).

Special hints on the print settings for individual components can be found in the comments.

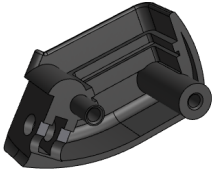
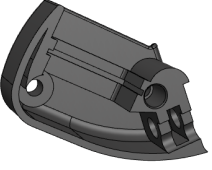
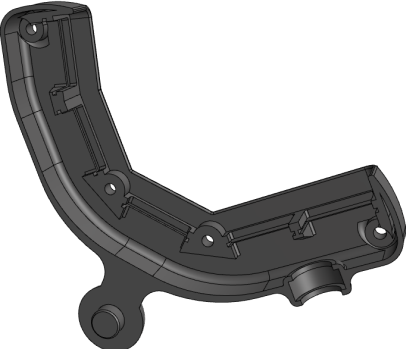
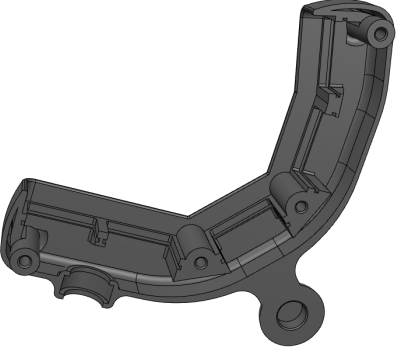
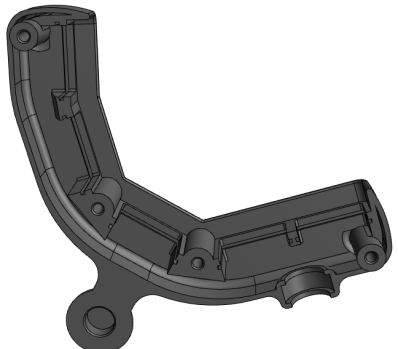
Table 3 Printed parts.

#	Part name	Qty.	Picture	Comment/hint
P01	Base	1		
P02	Base-Rise	1		

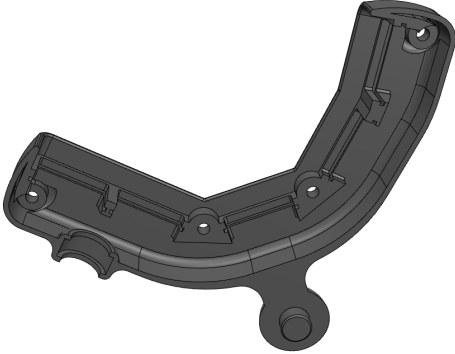
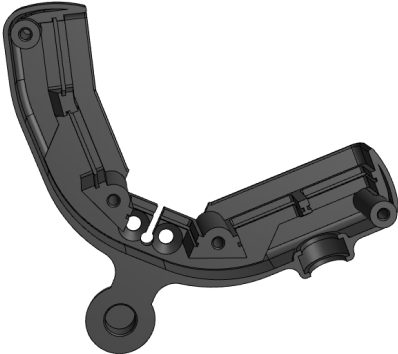
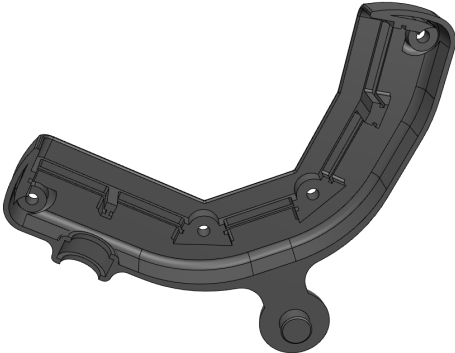
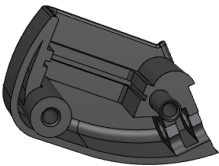
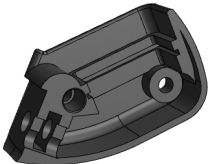


#	Part name	Qty.	Picture	Comment/hint
P03	Base-Key-Strain-Relief-Piece	1		Print without support. See alternative P51 and P52
P04	Base-USB-Strain-Relief-Piece	1		
P05	Base-Hand-Rest	1		Print 3 feet down. Hint for advanced users: In PrusaSlicer you can use a modifier to adjust the layer height on the valley and most top layers to get a smoother surface.
P06	Key-Cap-Inner-Core	26		Print as shown.
P07	Key-Cap-Outer-Frame	26		Print as shown.
P08	Finger-1-Key-Shell-Right	1		Print side face down.
P09	Finger-1-Key-Shell-Left	1		Print side face down.



#	Part name	Qty.	Picture	Comment/hint
P10	Finger-1- Key-Shell- Side-Front	1		Print side face down.
P11	Finger-1- Key-Shell- Side-Back	1		Print side face down.
P12	Finger-2- Key-Shell- Right	1		Print side face down.
P13	Finger-2- Key-Shell- Left	1		Print side face down.
P14	Finger-3- Key-Shell- Right	1		Print side face down.



#	Part name	Qty.	Picture	Comment/hint
P15	Finger-3- Key-Shell- Left	1		Print side face down.
P16	Finger-4- Key-Shell- Right	1		Print side face down.
P17	Finger-4- Key-Shell- Left	1		Print side face down.
P18	Finger-4- Key-Shell- Side-Front	1		Print side face down.
P19	Finger-4- Key-Shell- Side-Back	1		Print side face down.



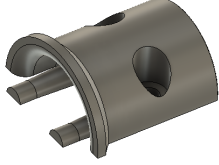
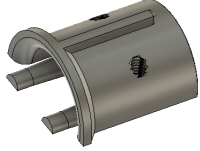




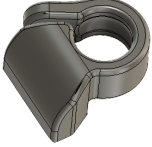
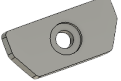
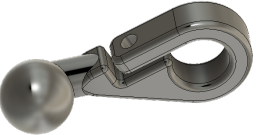
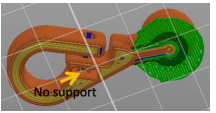


#	Part name	Qty.	Picture	Comment/hint
P20	Thumb-Key-Shell-Front	1		Print side face down.
P21	Thumb-Key-Shell-Back	1		Print side face down.
P22	Finger-Strain-Relief-Piece-1	5		Print without support.
P23	Finger-Strain-Relief-Piece-2	5		Print without support.
P24	Finger-Key-Base	4		Print top side down.
P25	Finger-Key-Base-Cap	4	 	Use paint-on support in PrusaSlicer.
P26	Finger-Key-Slider-1	2		Print upside down. Used for Finger 1 and 2.



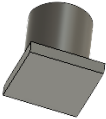

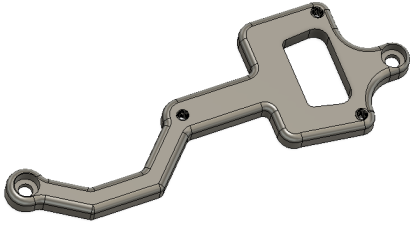
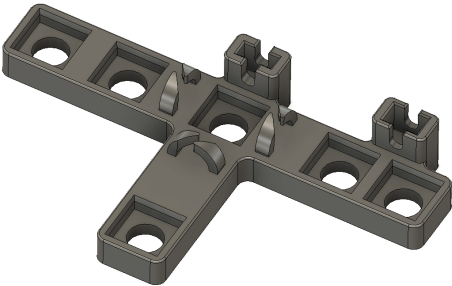


#	Part name	Qty.	Picture	Comment/hint
P27	Finger-Key-Slider-Lower-Counterpart	5		Print complete flat side down.
P28	Thumb-Base	1		Print top side down.
P29	Thumb-Base-Cap	1	 	Use paint-on support in PrusaSlicer.
P30	Thumb-Stick-Slider	1	 	
P31	Thumb-Stick-Slider-Lower-Counterpart	1		Print complete flat side down.
P32	Thumb-Stick-Lever	1	 	
P33	Thumb-Stick-Lower-Housing	1	 	



#	Part name	Qty.	Picture	Comment/hint
P34	Thumb-Stick-Upper-Housing	1		 Use paint-on support in PrusaSlicer.
P35	Thumb-Stick-Strain-Relief-Piece-1	1		Print without support.
P36	Thumb-Stick-Strain-Relief-Piece-2	1		Print without support.
P37	Thump-Stick-Ring	1		Optional.
P38	DPAD-Stick	1		 Print without support.
P39	Finger-Key-Slider-2	3		Print upside down. Used for Finger 3, 4 and thumb.
P40		0		Replaced, due to redesign.
P41	Display-Slider	1		Print top side down.
P42	Display-Slider-Lower-Counterpart	1		Print complete flat side down.
P43	Display-Lever	1		 Use paint-on support in PrusaSlicer.



#	Part name	Qty.	Picture	Comment/hint
P44	Display-Housing-Front	1		Print front face down.
P45	Display-Housing-Back	1		Print back side down.
P46	Display-Housing-Mounting-Pin	1		Print square face down.
P47	Display-Strain-Relief-Piece	1		
P48	USB-Hub-Mount	1		Suitable for bestep® 4 port USB hub.
P49	Key-Soldering-Jig	1		Optional, only used for assembly.



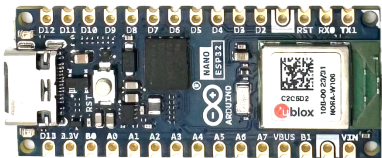
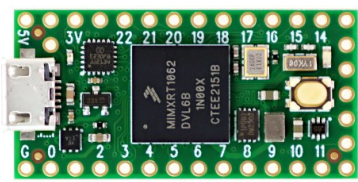
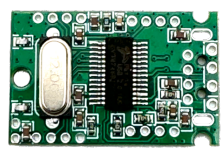
#	Part name	Qty.	Picture	Comment/hint
P51	Base-Key-Strain-Relief-Alt-Piece1	1		Print without support. Alternative "two-part" version part for P03.
P52	Base-Key-Strain-Relief-Alt-Piece2	1		Print without support. Alternative "two-part" version part for P03.
P53	Thumb-Stick-Octagon-Jig-Cap	1		 Optional

4.2.2 Micro controller/USB-Hub

For the minimum configuration you will need one Arduino Nana ESP32 microcontroller. An additional Teensy 4.0 is required for the full range of features including Xbox controller buttons and analog controller movement. We strongly recommend using original devices from trusted sources.

In case of a 2-microcontroller setup, it is recommended to use an internal USB hub. The bestep® USB-Hub is a good choice and used for this build, because it comes without connectors and has a very good availability (see Table 4).

Table 4 Micro controller/USB-Hub.

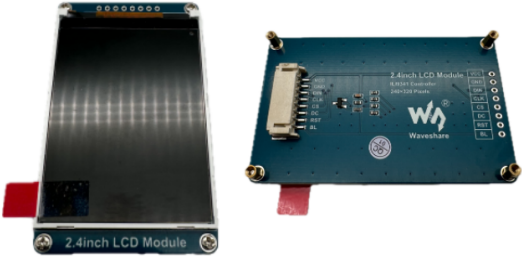



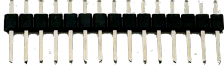

#	Part name	Qty.	Picture	Comment
B01	Arduino Nano ESP32	1		~19 €
B02	Teensy 4.0	1		Optional, to support controller features. ~20-30 €
B03	4 port mini USB hub	1		bestep®, eBay. Only needed for 2-microcontroller setup. <5 €





4.2.4 Electronic parts

Most of the electronic parts are mainstream and can be ordered online from eBay, Amazon or electronic stores (see Table 6).








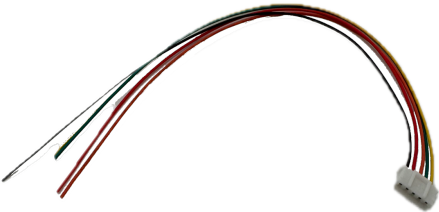
Table 6 List of electronic parts.

#	Part Name	Qty.	Picture	Comment
E01	WaveShare 2.4 inch LCD display module 240 x 320 pixels with ILI9341 controller, SPI bus	1		www-eckstein-shop.de, Amazon ~10-20 €
E02	USB-A cable	1		Amazon, eBay With 4 wires. ~2 €
E03	USB-C male connector	1		Amazon
E04	Micro-USB male connector	1		Amazon
E05	14-pin header male	2		Optional for Teensy, may be provided with the microcontroller.
E06	15-pin header male	2		May be provided with the microcontroller..

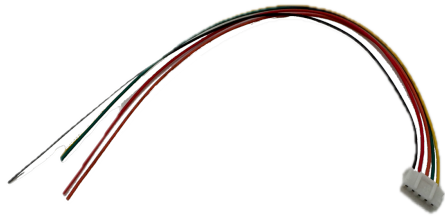
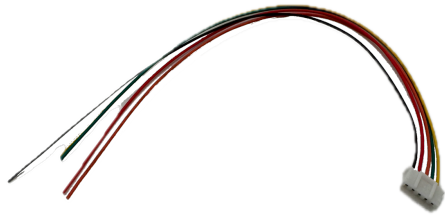
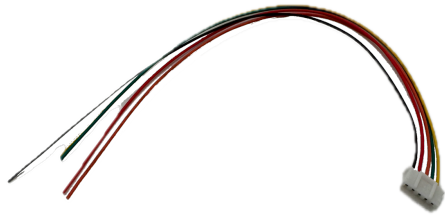
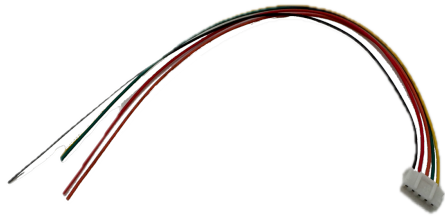



#	Part Name	Qty.	Picture	Comment
E07	14-pin header female	2		Optional, but strongly recommended.
E08	15-pin header female	2		Optional, but strongly recommended.
E09	MCP23017	2		~3 €
E10	Resistor 10KΩ	2		eBay, Amazon
E11	Cherry key low profile	26		You can use the silver or red version. ~15-20 €
E12	PS4 analog-stick	1		eBay, Amazon You can use resistor or hall-effect version. ~2-5 €
E13	Five-way switch/multi-direction switch	1		eBay <1 €



#	Part Name	Qty.	Picture	Comment
E14	4-pin JST PH2.0	2+1		eBay, Amazon See E19.
E15	5-pin JST PH2.0	1		eBay, Amazon, Reichelt
E16	6-pin JST PH2.0	2		eBay, Amazon, Reichelt
E17	7-pin JST PH2.0	2		eBay, Amazon, Reichelt
E25	8-pin JST PH2.0	1		eBay, Amazon, Reichelt
E18	10-pin JST PH2.0	1		eBay, Amazon, Reichelt
E19	4-pin JST PH2.0 with cable AWG28 10 cm	2+1		taja-elektronik If you want to connect USB-A cable (E02) to USB hub (B03) by JST connector (E14), you need one extra. Alternative is to solder the cable to the USB hub from top side. See chapter 4.4.7.1 on page 58. ~2,50 €
E20	5-pin JST PH2.0 with cable AWG28 20 cm	1		taja-elektronik ~1,50 €








#	Part Name	Qty.	Picture	Comment
E21	6-pin JST PH2.0 with cable AWG28 30 cm	2		taja-elektronik ~3 €
E22	7-pin JST PH2.0 with cable AWG28 30 cm	2		taja-elektronik ~3 €
E26	8-pin JST PH2.0 with cable AWG28 30 cm	1		taja-elektronik ~1,50 €
E23	10-pin JST PH2.0 with cable AWG28 30 cm	1		taja-elektronik ~2 €
E24	Blank single core wire 60 cm	1		Use an insulated single core wire.









4.2.5 Screws and other materials

All materials can be found on eBay or Amazon. Sometimes, e.g. for screws, it might be cheaper to buy a set (see Table 7).

Table 7 List of screws and other materials.

#	Part name	Qty.	Picture	Comment
M01	Cable fabric hose 4 –5 mm diameter, 1 meter long	1		
M02	Heat-shrink tube 3 mm diameter, 30 cm long	1		
M03	Heat-shrink tube 4 mm diameter, 20 cm long	1		
M04	Heat-shrink tube 10 mm diameter, 10 cm long	1		
M05	Insulation tape, 30 cm	1		



#	Part name	Qty.	Picture	Comment
M06	Rubber feet 12,7 x 3,5 mm (e.g. 3M Bumpons SJ 5012)	10		www.kleishop24.de ~2 €
M07	PS4 thumb stick cap	1		~2 €
M08	Threaded insert M2*3*3.5	24		Amazon
M10	Square thin nut M3 (DIN 562 or similar)	38		Max. height 1,75 mm
M11	Screw M1.4 x 4 mm	10		
M12	Countersunk head screw M2 x 12 mm	24		
M13	Screw M2 x 8 mm	13		
M14	Screw M2 x 6 mm	20		
M16	Countersunk head screw M3 x 4 mm	4		
M17	Screw M3 x 8 mm	9		
M18	Screw M3 x 10 mm	13		
M19	Screw M3 x 12 mm	17		

4.3 Printing and preparation of 3D parts

4.3.1 Printing the parts

General print setting:

Layer height: 0.2 mm

Perimeters: 4

Infill: 25 %

Support on build plate only

XY separation between an object and its support: 1 mm

Support pattern: Rectilinear grid

Although all parts would fit on one Prusa XL plate, we strongly recommend splitting the print into several batches (see Figure 4-1).

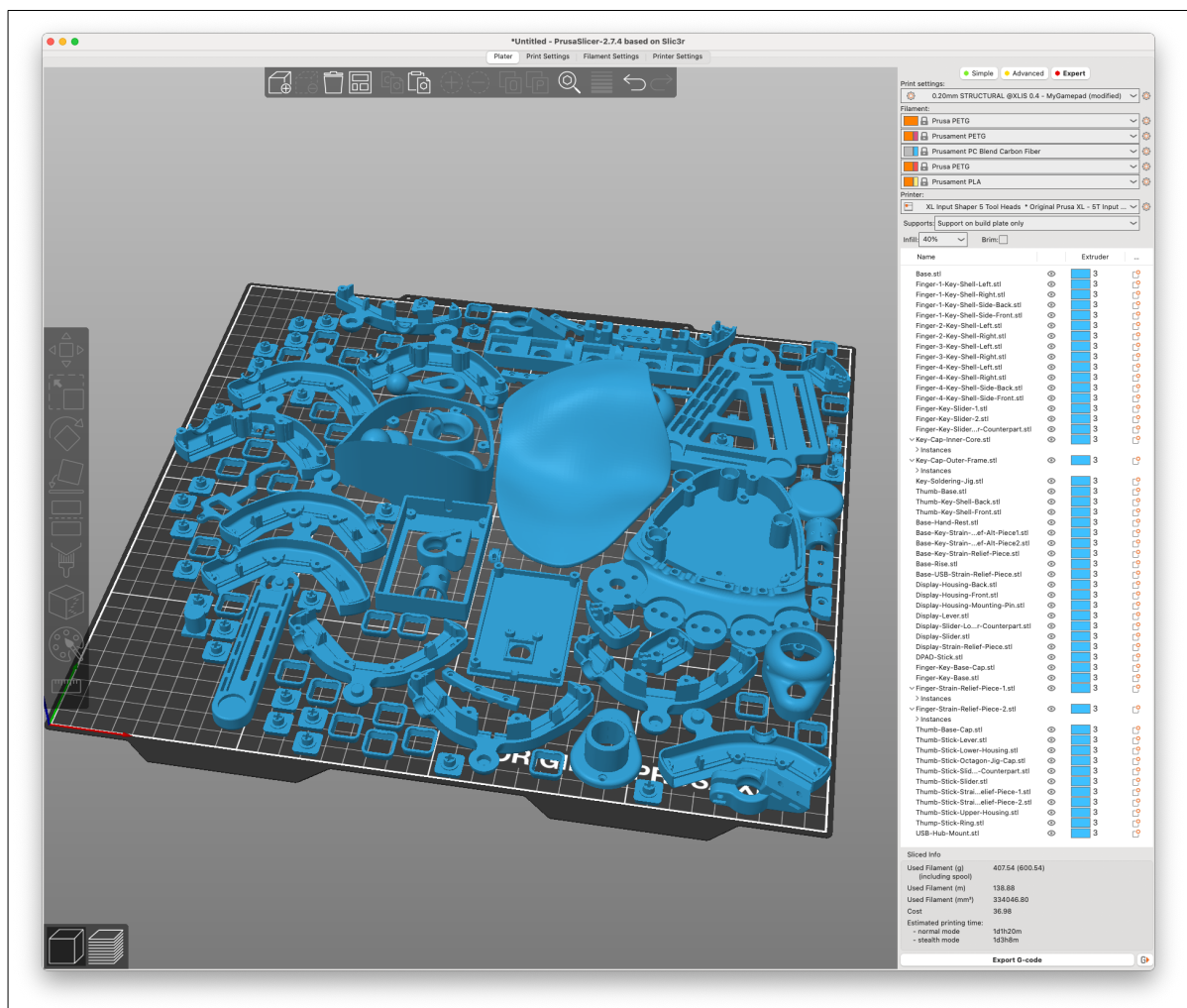


Figure 4-1 All parts on one Prusa XL plate.

4.3.2 Threaded inserts

Threaded inserts are used for some of the screws to ensure a long-term reliable and strong assembly (see Figure 4-2).

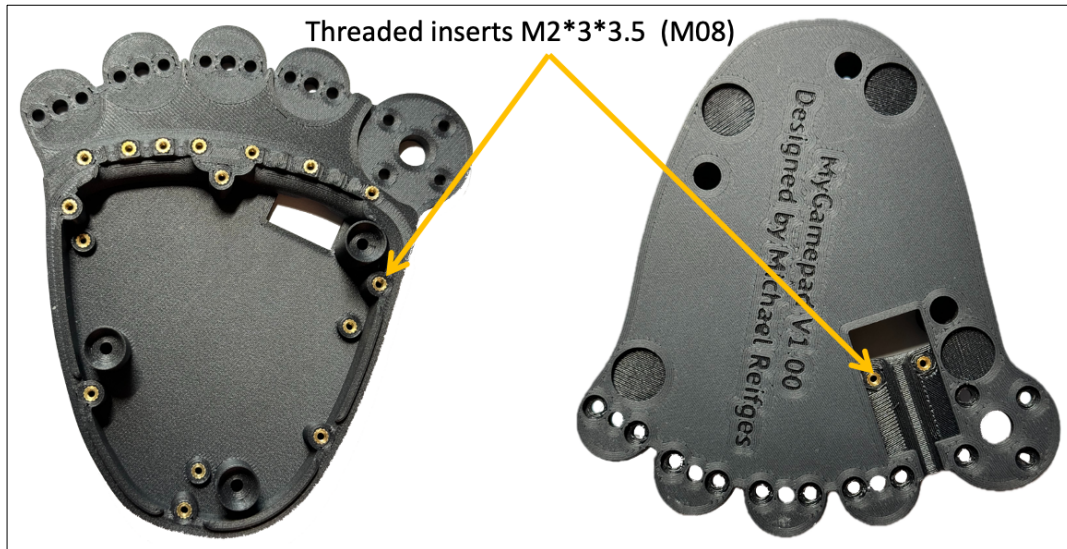


Figure 4-2 Placements of threaded inserts on base.

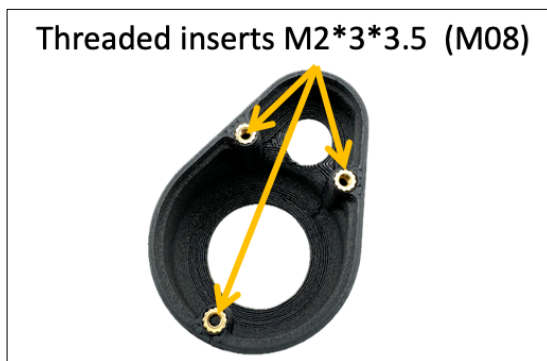


Figure 4-3 Placements of threaded inserts on Thumb-Stick-Upper-Housing.

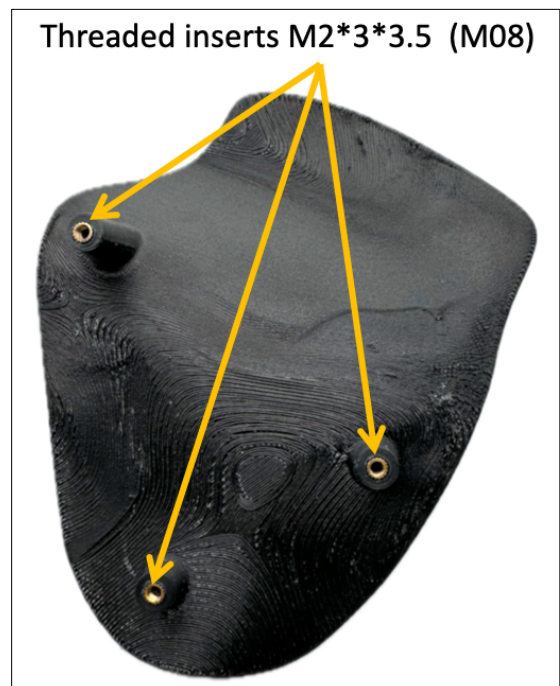


Figure 4-4 Placements of threaded inserts on Base-Hand-Rest.

4.3.3 Square nuts

The following parts are using M3 square thin nuts (M10).

- Finger-Key-Slider-1 (P26)
- Finger-Key-Slider-2 (P39)
- Thumb-Stick-Slider (P30)
- Thumb-Stick-Lever (P32)
- Display-Slider (P41)
- Display-Lever (P43)
- Finger-Key-Base-Cap (P25)
- Thumb-Base-Cap (P29)

Figure 4-5 to 4-12 show their positions in the parts.

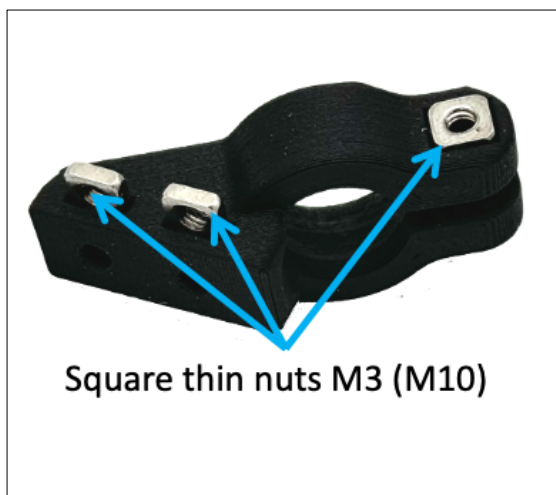


Figure 4-5 Square nut positions Finger-Key-Slider-1 (P26) / Finger-Key-Slider-2 (P39)



Figure 4-6 Square nut position Display-Lever (P43).



Figure 4-7 Square nut positions Display-Slider (P41).



Figure 4-8 Square nut position Thumb-Stick-Lever (P32).



Figure 4-9 Square nut positions Thumb-Stick-Slider (P30).

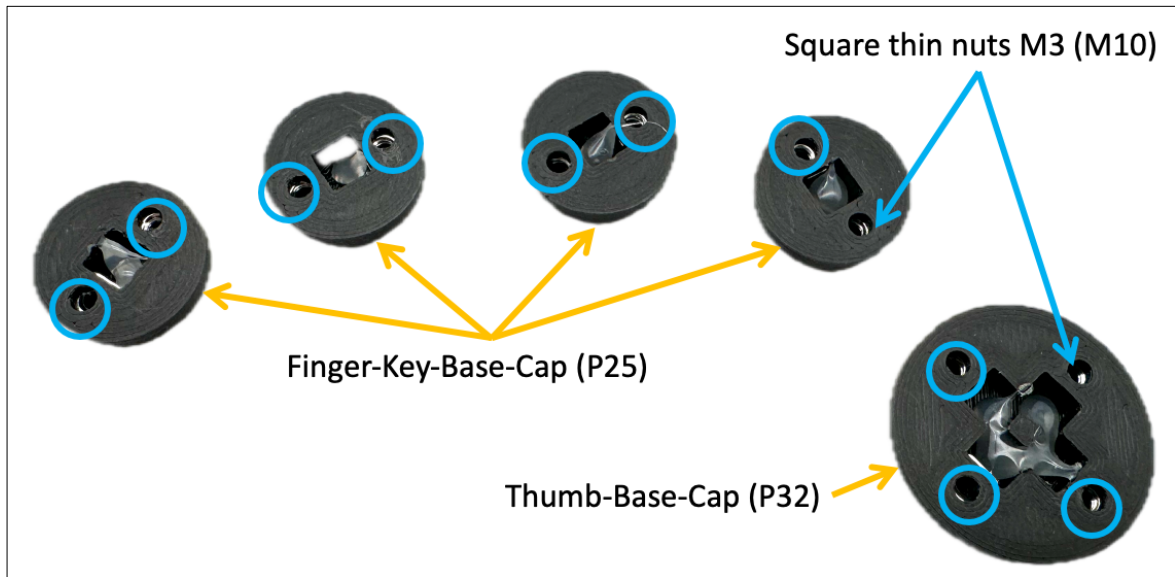


Figure 4-10 Square nut positions Finger-Key-Base-Cap (P25) and Thumb-Base-Cap (P29).

To prevent the square nut from falling out of the caps during assembly, you can apply a little bit of hot glue into the insertion slot.

4.3.4 Pre-assembly of printed parts

You can now already pre-assemble some parts to reduce the number of individual parts on the table.

4.3.4.1 Connecting the mounting pin to the display housing

Insert the Display-Housing-Mounting-Pin (P46) from the inside into the hole of the Display-Housing-Back (P45) and press-snap them together (see Figure 4-11). If it is too tight, you can scratch the edges of the pin a little bit with a knife. It is a good practice to place it on a small tape roll (see Figure 4-12) to apply enough pressure. In the end, it should look as shown in Figure 4-13.

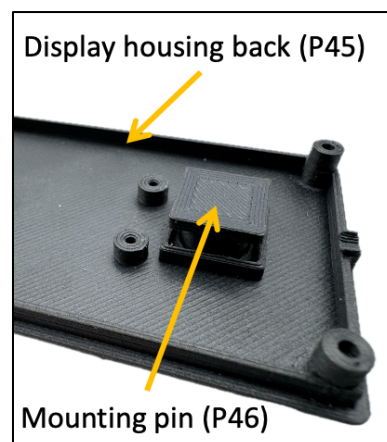


Figure 4-11 Inserting the mounting pin into the display housing.

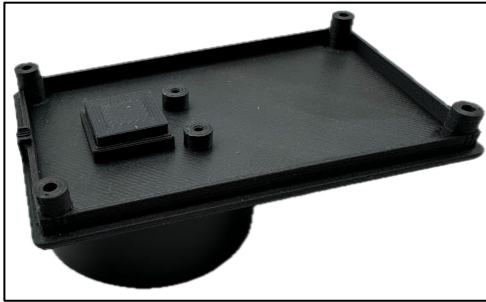


Figure 4-12 Display housing on tape roll.

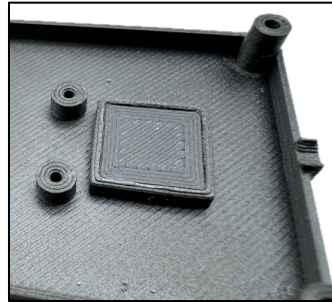


Figure 4-13 Mounting pin and display housing connected.

4.3.4.2 Assembly of the keys

Insert the inner core of the key into the outer frame (see Figure 4-14) and press them together. By using a 6 mm nut as shown in Figure 4-15 and pressing against a flat surface, like a table, this is very easy to do. Repeat this process for all 25 keys so that they all look as shown in Figure 4-16.

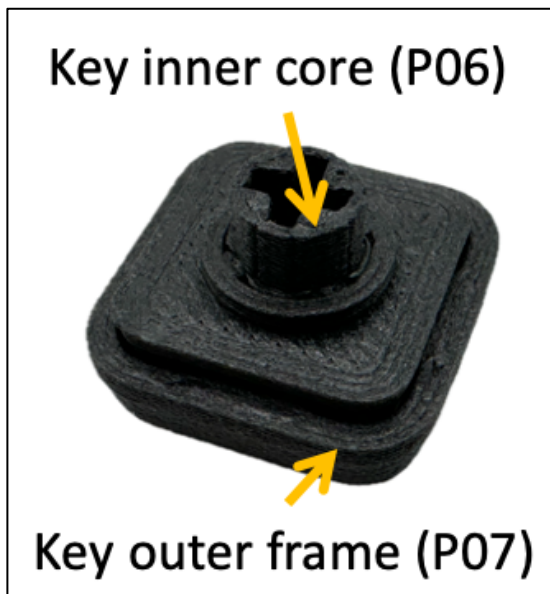


Figure 4-14 Connecting the inner core and outer frame of the keys.



Figure 4-15 Using a 6 mm nut to press the key parts together.

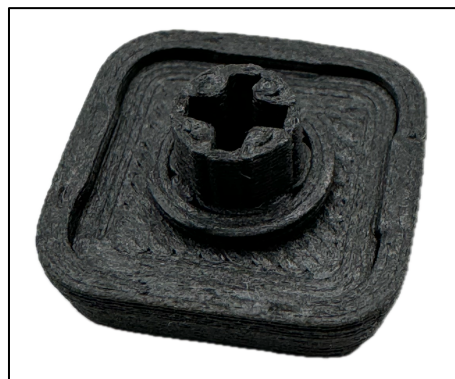


Figure 4-16 Properly connected key parts.

4.4 Electronics

4.4.1 Main printed circuit board (Main-PCB)

4.4.1.1 Step 1

Start with soldering in the two MCP23017 (E08) and the two 10K resistors (E09) onto the main PCB (C01) as shown in Figure 4-17.

NOTICE: Look for the right direction of the MCP23017. There is a small mark on the PCB indicating the right direction of the notch.

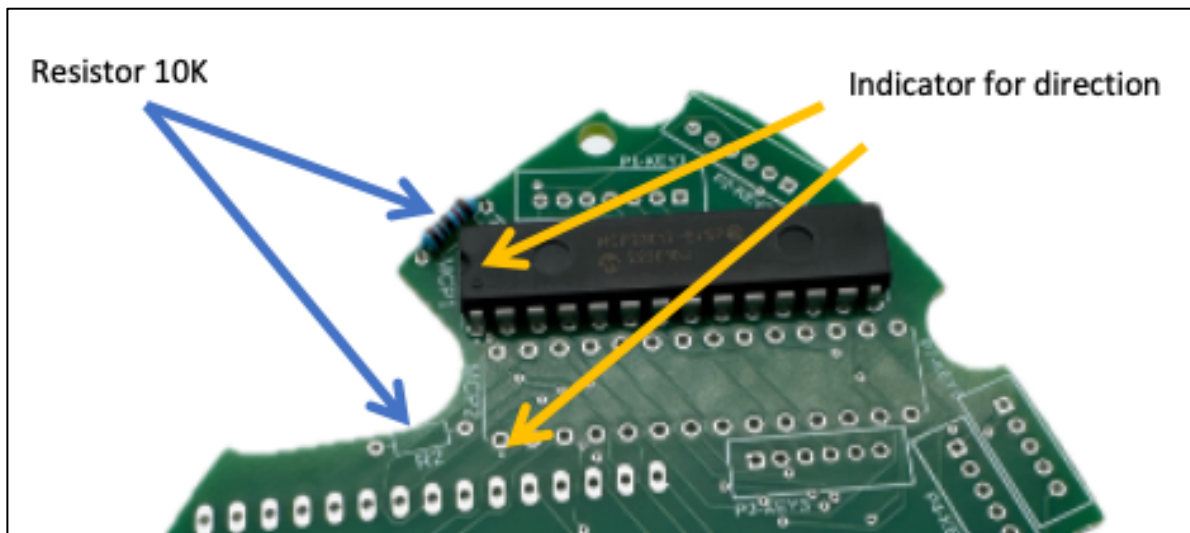


Figure 4-17 Resistor and MCP23017 placement on main PCB (C01).

4.4.1.2 Step 2

In this step we will solder in the 7 JST PH2.0 connectors:

- 1 x 5 pins (E14)
- 2 x 6 pins (E15)
- 2 x 7 pins (E16)
- 1 x 8 pins (E25)
- 1 x 10 pins (E17)

Pay attention to the correct direction, the connector should fit into the frame printed on the PCB (see Figure 4-18).

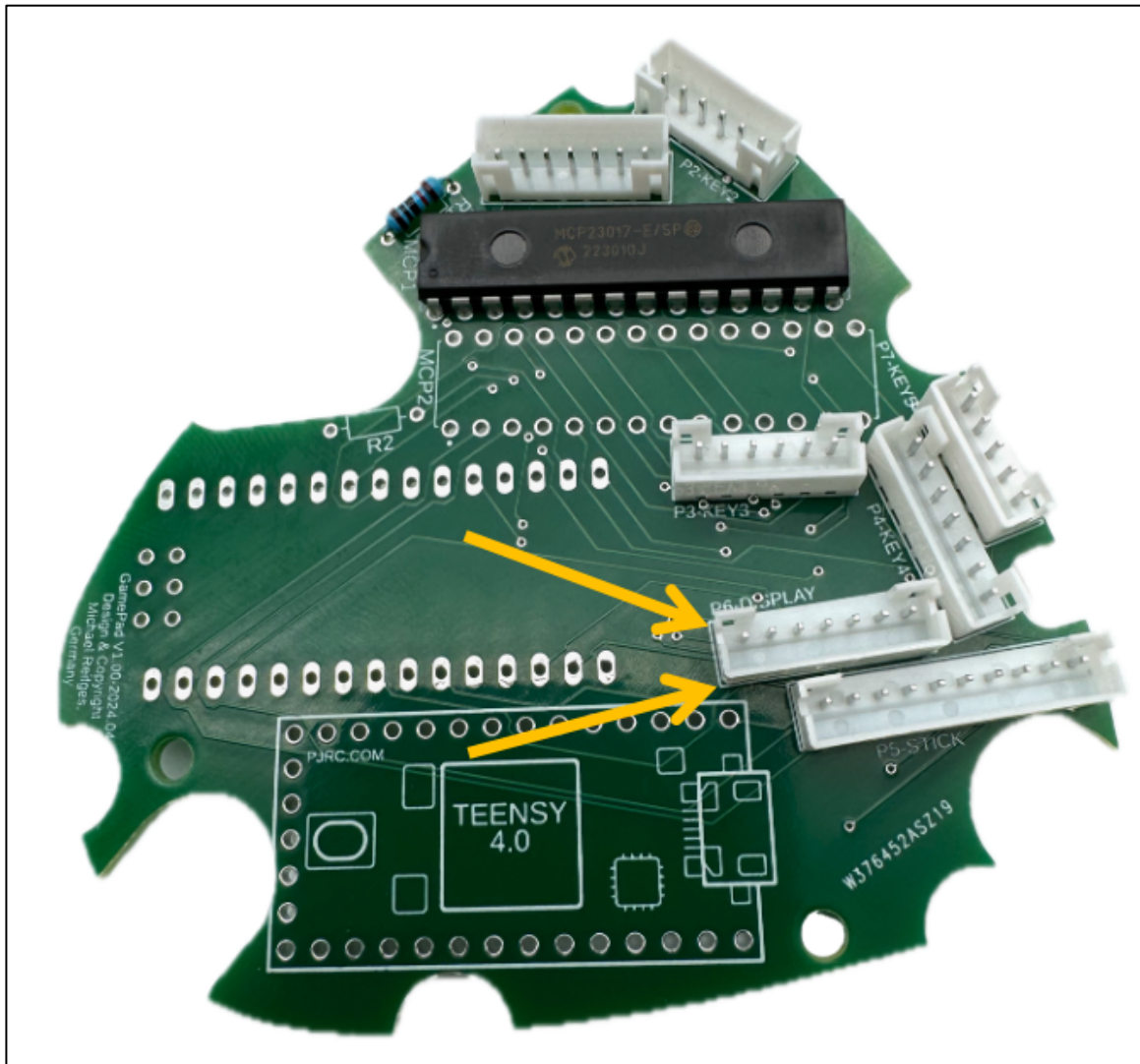


Figure 4-18 Placement of the JST PH2.0 connectors on main PCB (C01).

4.4.1.3 Step 3

In the last step, we focus on the micro controller. You can solder them directly onto the board with male pin connectors. However, it is strongly recommended to use female headers to make them exchangeable (see Figure 4-19).

First cut the female headers (E08) to the required length. We need pieces with 2 x 15 pins and 2 x 14 pins.

NOTICE: Make sure the headers are mounted perpendicular to the PCB surface for easy fit of the microcontrollers.

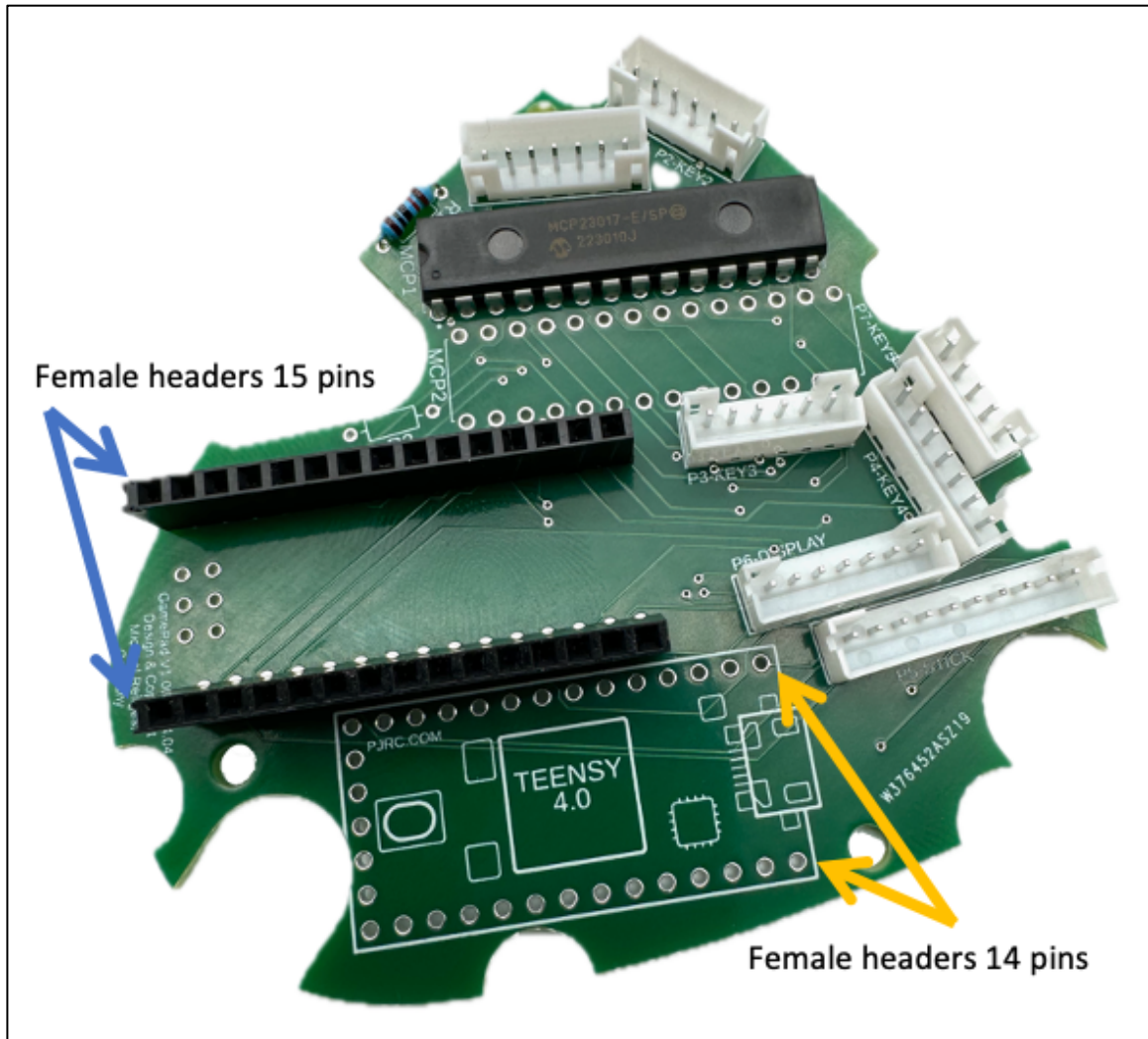


Figure 4-19 Installation of the female headers for microcontrollers.

4.4.2 Preparation of the cable connectors

The preparation of the cable connectors for the keys is always the same, just with changing measurements. For the stick and display, it is basically same cable, but with some minor differences (see Figure 4-20 and Table 9).

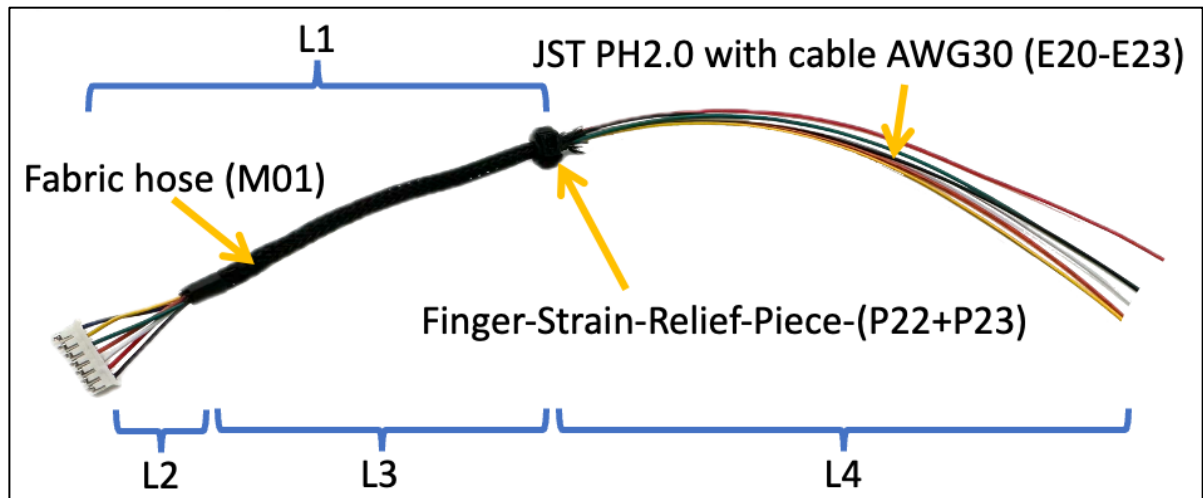


Figure 4-20 Measurements and items used for the cable connectors.

Table 8 Detailed measurements for the cable connectors.

#	Part	Connector/cable	L1	L2	L3	L4
1	Finger 1	7-pin JST PH2.0 with cable AWG28 30 cm (E22)	110 mm	20 mm	90 mm	See chapter 4.4.3 on page 49.
2	Finger 2	6-pin JST PH2.0 with cable AWG28 30 cm (E21)	120 mm	20 mm	100 mm	See chapter 4.4.3 on page 49.
3	Finger 3	6-pin JST PH2.0 with cable AWG28 30 cm (E21)	150 mm	20 mm	130 mm	See chapter 4.4.3 on page 49.
4	Finger 4	7-pin JST PH2.0 with cable AWG28 30 cm (E22)	150 mm	20 mm	130 mm	See chapter 4.4.3 on page 49.
5	Finger 5	5-pin JST PH2.0 with cable AWG28 20 cm (E20)	140 mm	25 mm	115 mm	See chapter 4.4.3 on page 49.
6	Stick	10-pin JST PH2.0 with cable AWG28 30 cm (E23)	n/a	30 mm	140 mm	80 mm
7	Display	8-pin JST PH2.0 with cable AWG28 30 cm (E26)	n/a	30 mm	160 mm	25 mm

4.4.2.1 Step 1 – Fabric hose

Cut the fabric hose (M01) into the right length (L3) and push the cable cores through. Keep the gap (L2) to the connector. You can fasten it with a 10 mm heat-shrink tube or insulation tape to avoid unwrapping of the fabric hose (see Table 8).

4.4.2.2 Step 2 – Strain relief for finger key connectors

For the finger key connectors (item #1 – 5 in Table 8) install the strain relief at the distance (L1). For the strain relief you need:

- 2 x Screw M1.4 x 4 mm (M11)
- 1 x Finger-Strain-Relief-Piece-1 (P22)
- 1 x Finger-Strain-Relief-Piece-2 (P23)

Tighten the screws until the strain relief can no longer move.

Use adhesive tape for the stick and display connectors to temporarily prevent the fabric hose from unwrapping and cut the cable to the correct length (L4) as listed in Table 8. Remove approximately 3 – 4 mm of the isolation and tin the endings with the soldering iron.

4.4.3 Finger key holders

There are 3 different finger key holders: 2 with 6 keys, 2 with 5 keys and one for the thumb with 3 keys. The Key-Soldering-Jig (P49) helps to deal with the assembly of all three types.

Besides the number of keys, the steps are always the same.

NOTICE: Please pay extra attention on the right orientation of the keys and pins in the jig for the different types. This is very important for the fitting in the shell.

4.4.3.1 Step 1 – Ground connection

First use the blank wire and solder it to one pin of each switch. This is the common ground (GND). Due to the limited space in the key shell, the recommended path of the cable is shown in Figure 4-21.

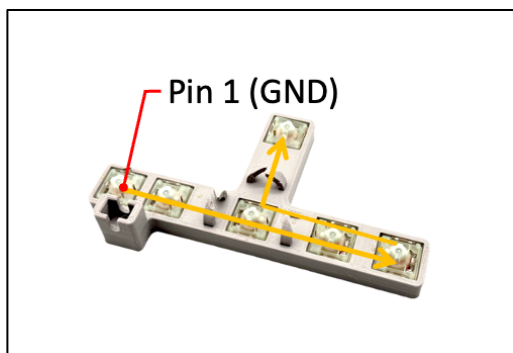


Figure 4-21 GND connection path for finger keys.

4.4.3.2 Step 2 – Signal wires

In this step, we attach the connector wires prepared in chapter 4.4.2 to the second pin of each key. Pin 1 represents the common ground and needs to be soldered to the ground pin of the key in the first position of the jig after cutting it to the right length (see Figure 4-21)

To cut all wires to the right length, insert the connector cable with the strain relief into the jig as shown in Figure 4-28. Pull the wire to the pin of the foreseen key using the guard rails. Give some extra 5 mm to the wire before cutting it off.

Remove the insulation by 2 – 3 mm and tin coat it. Before soldering the wire to the pin, cut a 3 – 4 mm piece from the 3 mm heat-shrink tube (M02) and pull the wire through it. Repeat this for all keys based on the pin assignments shown in Figure 4-22 to 4-30.

4.4.3.3 Setup of the 6-key finger

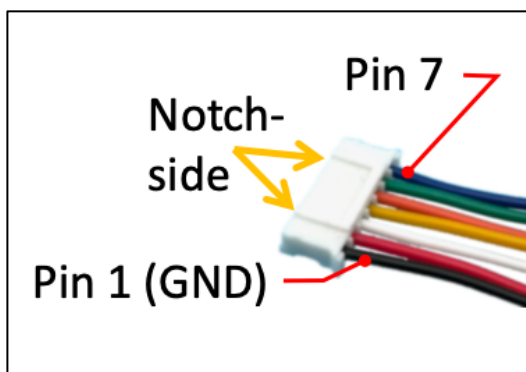


Figure 4-22 JST PH2.0 connector with 7 pins (E22).

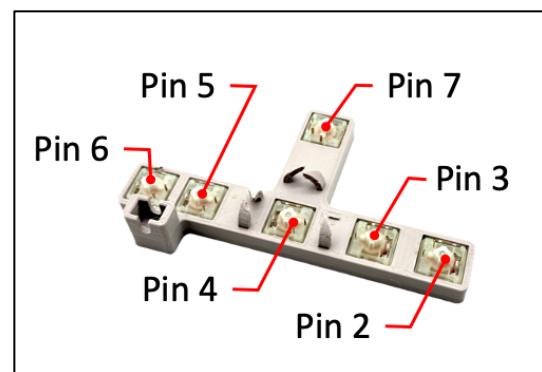


Figure 4-23 Setup in Key-Soldering-Jig for 6 keys.

4.4.3.4 Setup of the 5-key finger

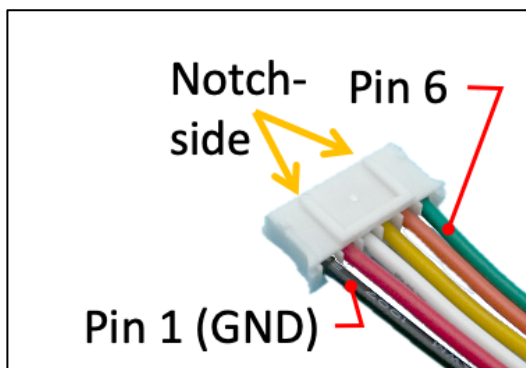


Figure 4-24 JST PH2.0 connector with 6 pins (E21).

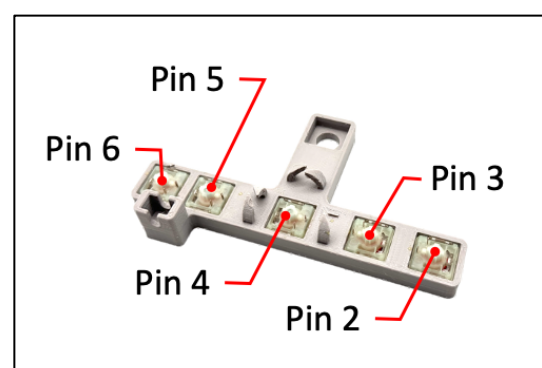


Figure 4-25 Setup in Key-Soldering-Jig for 5 keys.

4.4.3.5 Setup of the 4-key finger

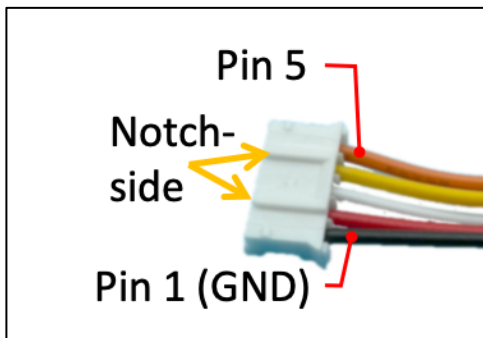


Figure 4-26 JST PH2.0 connector with 5 pins (E20).

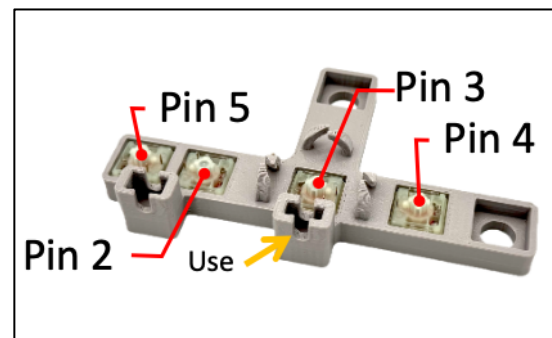


Figure 4-27 Setup in Key-Soldering-Jig for 4 keys.

4.4.3.6 Step 3

Slide the heat-shrink tube over the pin and carefully use the heat gun to shrink it. The result should look as shown in Figure 4-28. Take the finished connector string carefully out of the jig and place it in the prepared Finger-Key-Shell as shown in Figure 4-29.

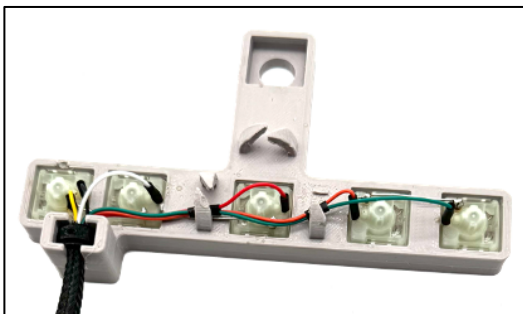


Figure 4-28 Finished connector in Key-Soldering-Jig.

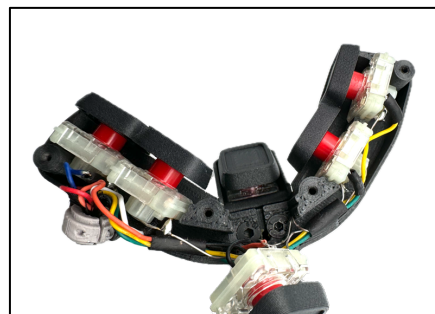


Figure 4-29 Placement of keys with wires in key shells.

For the 6-key version pull the cables into the slot to the side after you have put the side key into its housing. Make sure that they are in the correct position and fit into the designated gap in the side shells. Before inserting the middle key of the main row, mount the side shell and fasten it with two countersink screws M3 x 4 mm (M16).

Before closing the shell, put the strain relief into the special recess and make sure that all wires are inside the shell.

Use the M2 x 12 mm countersink screws (M12) to finish the assembly of the key housing.

4.4.4 Thumb stick PCB

For the assembly of the thumb stick we need the Thumb-Stick-PCB (C03), the 10-pin JST PH2.0 with cable AWG28 30 cm (prepared in chapter 4.4.2, see item 6 in Table 8), the five-way-Switch (E13), and the PS4 analog stick (E12).

4.4.4.1 Step 1 – Wires

We start with the soldering of the wires to the PCB from the bottom. Figure 4-30 shows how to identify the pins. In Figure 4-31 you can see where to connect them on the bottom side of the PCB.

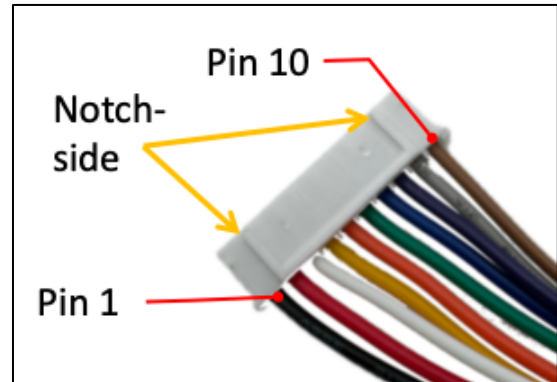


Figure 4-30 JST PH2.0 connector with 10 pins (E23).

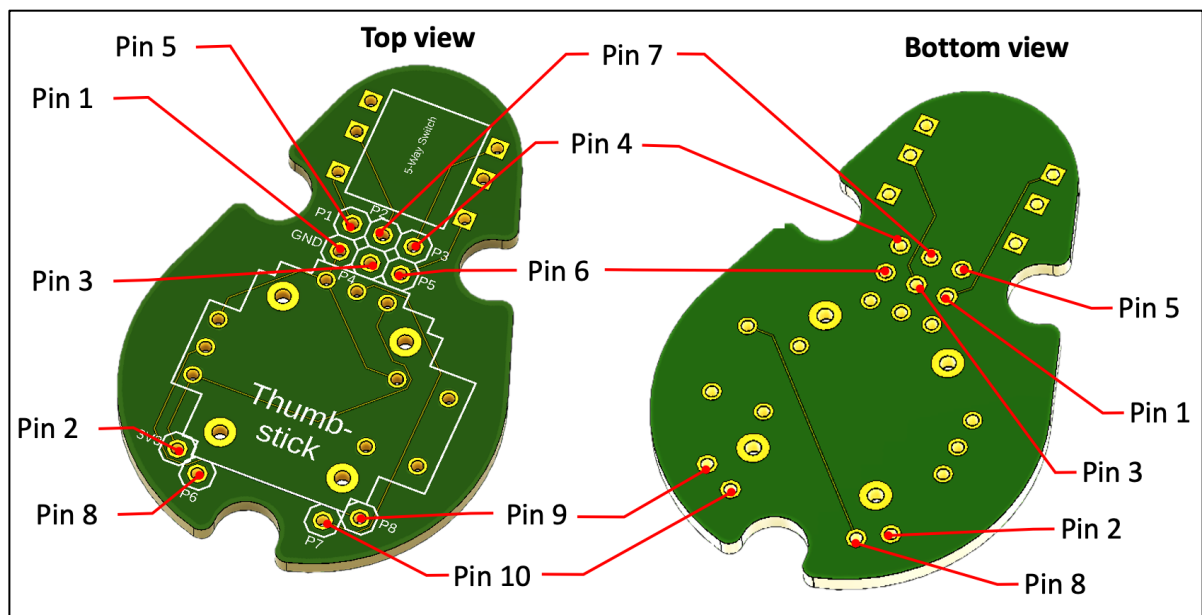


Figure 4-31 Pin assignment of the Thumb-Stick-PCB.

4.4.4.2 Step 2 – Adding the components

In this step, we are position and soldering the two components on the top side of the Thumb-Stick-PCB, as shown in Figure 4-32. Make sure that they are mounted 100 % flat on the surface, as this affects their position in the housing.



Figure 4-32 Placement of components on the Thumb-Stick-PCB.

4.4.4.3 Step 3 – Installing the strain relief

Fasten the two strain relief pieces P35 and P36 with two M2 x 6 mm screws next to the PCB around the wires (see Figure 4-33). Tighten the screws before adding the thumb stick housing and make sure you installed the PS4 thumb stick cap. You can also add the DPAD stick (P38) to the 5-way switch.

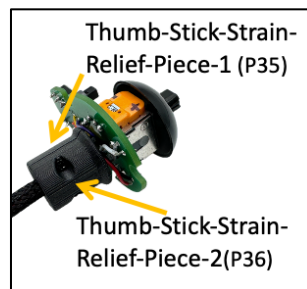


Figure 4-33 Adding the strain relief.

Pay attention to the small notch and make sure that it points towards the 5-way switch (see Figure 4-34).

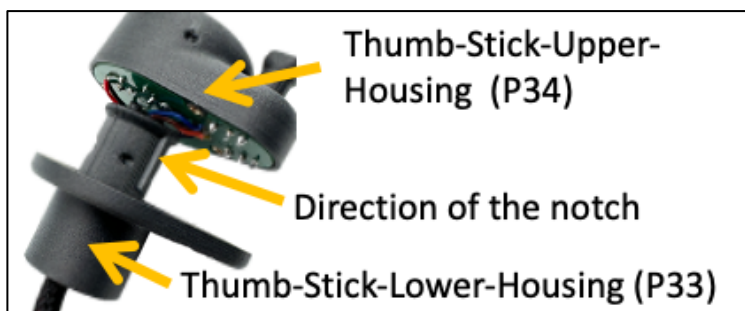


Figure 4-34 Notch position on strain relief.

4.4.4.4 Step 4 – Closing the thumb stick housing

Slide to two housing parts together and insert three M2 x 6 mm screws (M14) from the bottom (see Figure 4-35 and

Figure 4-36).



Figure 4-35 Sliding the thumb stick housing together.



Figure 4-36 Inserting screws from the bottom side.

NOTICE: Apply pressure carefully and make sure that no wire is clamped under the strain relief.

4.4.5 Display

4.4.5.1 Step 1 – Soldering the wires to the PCB

For the display we need the WaveShare 2.4 inch LCD display module 240 x 320 pixels with ILI9341 controller (E01) and the 8-pin JST PH2.0 with Cable AWG28 30 cm (E26) without strain relief (prepared in chapter 4.4.2, see item 7 in Table 8).

The wires are soldered from the bottom side of the display PCB. Figure 4-37 shows how to identify the pins and in Figure 4-38 you can see where to connect them on the bottom side of the PCB.

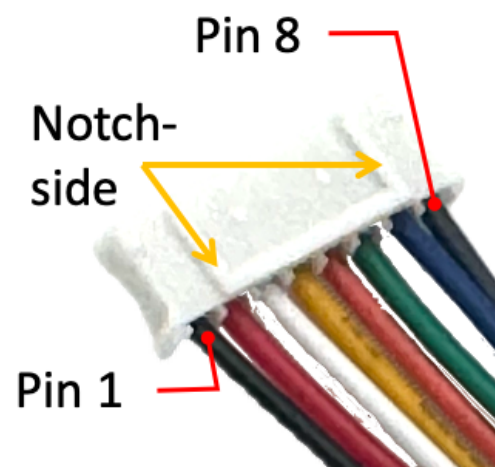


Figure 4-37 JST PH2.0 connector with 8 pins (E26).

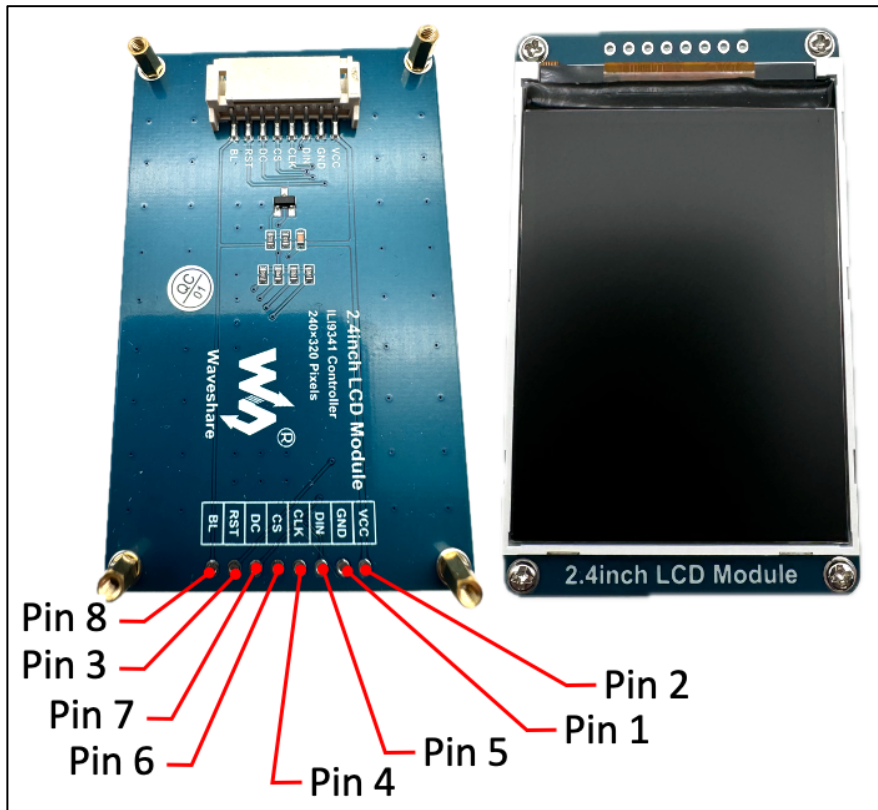


Figure 4-38 Pin assignment of the display module.

4.4.5.2 Step 2 – Adding the strain relief

Insert the connector into the strain relief and fasten it with the two screws M2 x 6 mm (M14) using the strain relief piece (P47) as shown in Figure 4-39.

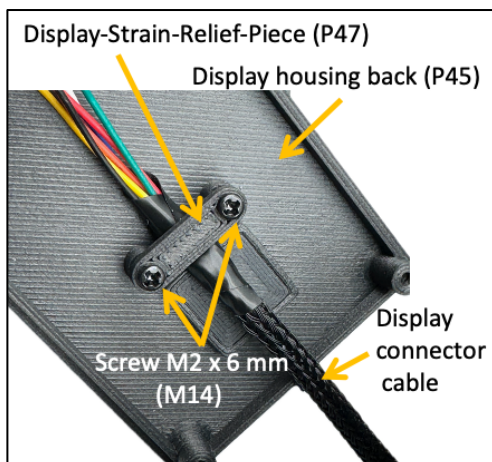


Figure 4-39 Installation of the display strain relief.

4.4.5.3 Step 3 – Closing the display housing

Slide the back part of the display housing into the front part. Make sure that the display connector cable is inserted into the designated slot (see Figure 4-40). Finally, insert four screws M2 x 6 mm (M14) from the rear (see Figure 4-41).

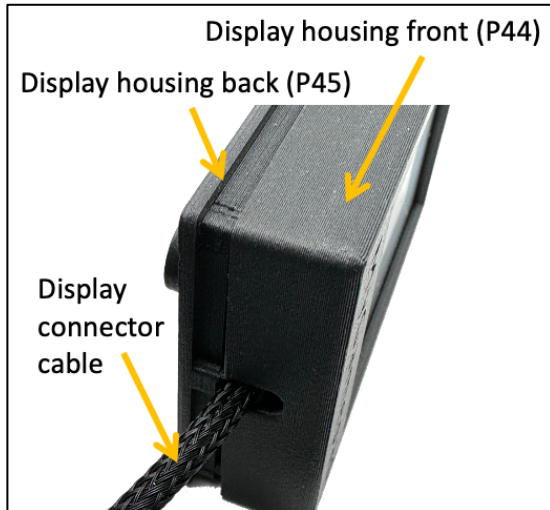


Figure 4-40 Closing the display housing.

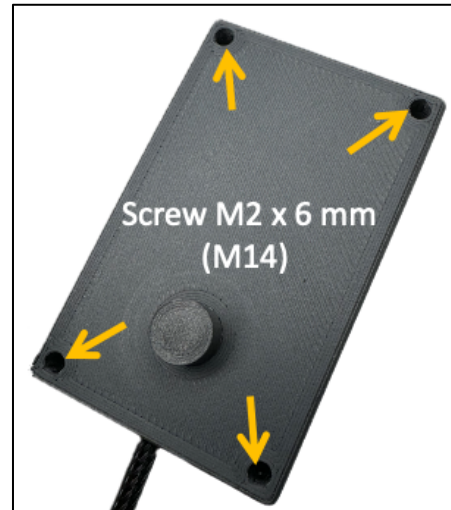


Figure 4-41 Inserting the screws into the display housing.

4.4.6 USB connectors for the microcontroller

4.4.6.1 Step 1 – Connecting the cables to the USB connectors

Use the pin assignment of the USB hub connector as shown in Figure 4-42 when soldering the wires of the 4-pin JST PH2.0 with cable AWG28 10 cm to the USB-C (see Figure 4-43) and Micro-USB (see Figure 4-44) connectors. In case the cables are longer, cut them to 8-10 cm first.

The same pin assignment shown in Figure 4-42 is used for the connection to the USB-A cable. Read more details in chapter 4.4.7 on page 57.

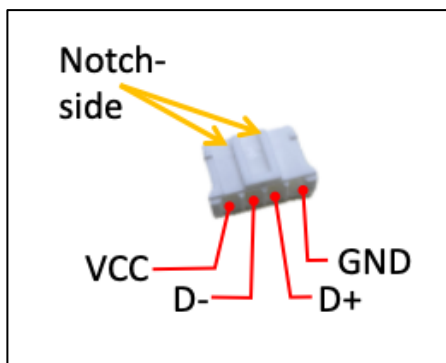


Figure 4-42 Pin out JST PH2.0 for the USB hub.

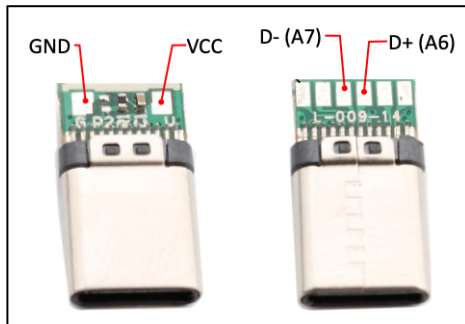


Figure 4-43 Pin assignment of the USB-C male connector.

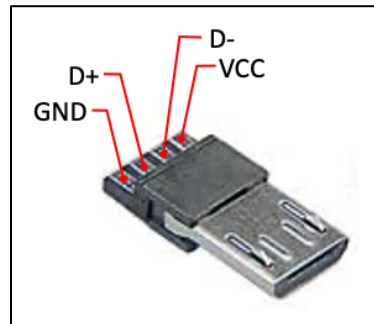


Figure 4-44 Pin assignment of the Micro-USB connector.

4.4.6.2 Step 2 – Adding heat-shrink tube

To provide more stability to the connectors, it is strongly recommended to place a 10 mm heat-shrink tube over the soldering area of the connectors, as shown in Figure 4-45 and Figure 4-46.

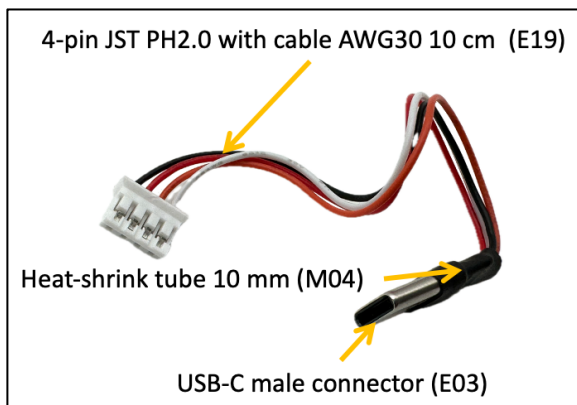


Figure 4-45 Finalized USB-C connector cable.

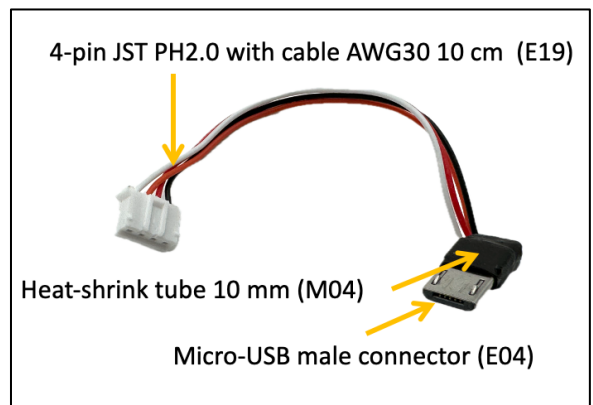


Figure 4-46 Finalized Micro-USB connector cable.

4.4.7 USB hub

You have two options for connecting the USB-A cable to the USB hub:

1. Soldering directly on the PCB from the top.
2. Using the JST PH2.0 connector.

This needs to be considered when ordering the material. For option 2, you need an additional 4-pin JST PH2.0 cable (E19) and a connector (E14).

The specification of the USB-A cable, the plug and the wire colors can be found in Figure 4-47 and Figure 4-48. They have been taken from Wikipedia: https://en.wikipedia.org/wiki/USB_hardware

Type-A and -B pinout				
Pin	Name	Wire color ^[a]		Description
1	V _{BUS}	Red or	Orange	+5 V
2	D-	White or	Gold	Data-
3	D+	Green		Data+
4	GND	Black or	Blue	Ground

Figure 4-47 USB-A connector pinout and wire colors.

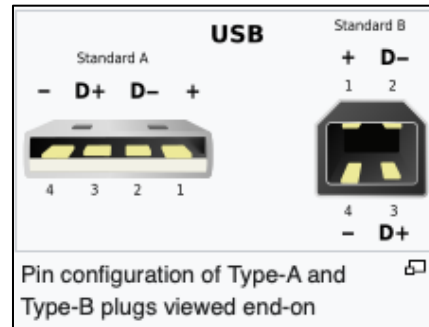


Figure 4-48 USB-A plug pin configuration.

NOTICE: For option 1, it is important to solder the USB-A cable onto the PCB from the top (side with the crystal) to allow installation with the USB-Hub-Mount (P48) and fitting the cable into the base.

11

4.4.7.1 Step 1- Placing the JST connectors on the USB hub PCB

Add the JST connectors to the bottom side (the side without components) as shown in Figure 4-49. Solder the pins from the top. In case you want to connect the USB-A cable directly to the PCB, use the alternative pins on the edge of the PCB next to the host connector area and solder them in from the top side (the one with the crystal).

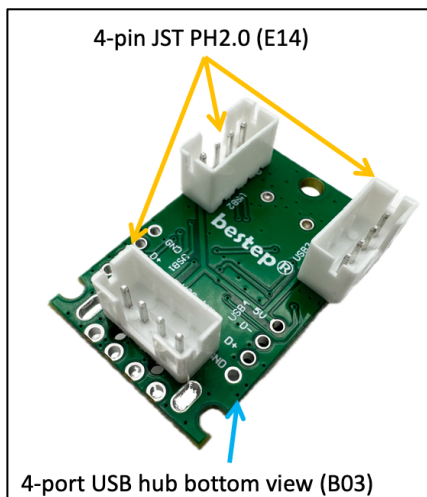


Figure 4-49 Placement of the JST PH2.0 connectors on the USB hub.

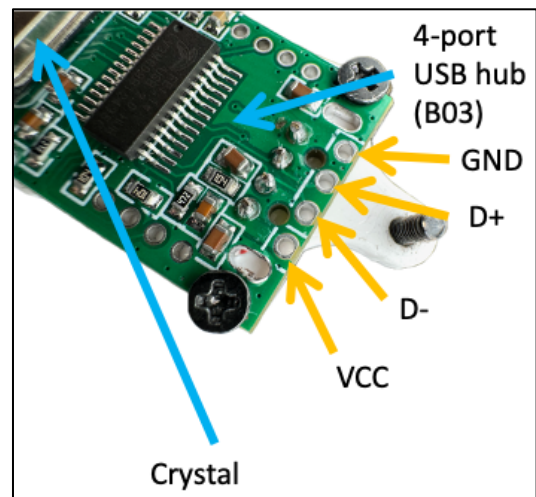


Figure 4-50 Alternative pins to connect USB-A cable to the USB hub.

4.4.7.2 Step 2 – Finishing the USB hub

Inserts the previously prepared USB cable connectors into the connectors. For the two connectors to the microcontrollers, you can freely choose if the cables are long enough. Add the USB mount piece (P48) and fasten it with three screws M2 x 6 mm (M14) as shown in Figure 4-51.

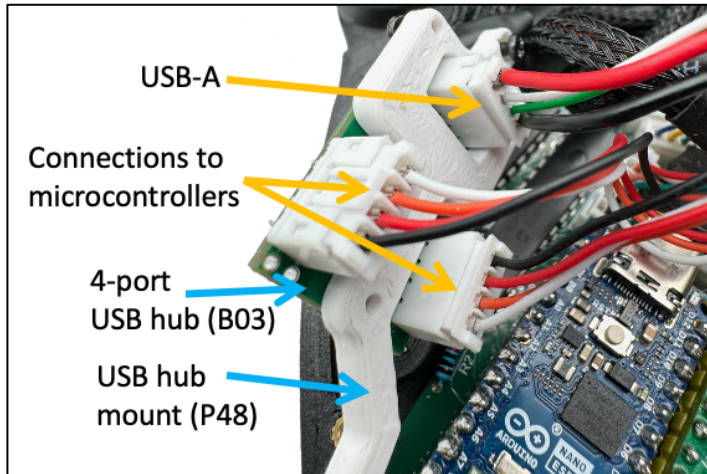


Figure 4-51 Finished USB hub.

22

4.5 Final assembly

Now it is time to put the individual components together. First prepare the lower slider counterparts (P27, P31 and P42) with M3 x 10 mm (M18) screws (see Figure 4-52).

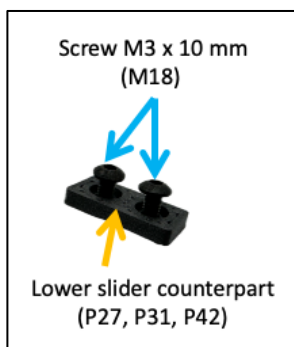


Figure 4-52 Preparing the lower slider counterparts.

4.5.1 Finger key

Insert the Finger-Key-Slider-1 (P26) and Finger-Key-Slider-2 (P39) of the already prepared finger key elements into the slot in the Finger-Key-Base (P24) from the top side (see Figure 4-53). From the bottom side, add the prepared Finger-Key-Slider-Lower-Counterpart (P27) as shown in Figure 4-54 and tighten the screws. Use screw M3 x 12 mm (M19) to clamp the key shell 360° mount.

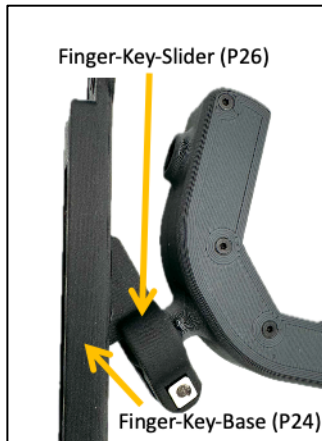


Figure 4-53 Adding the finger key slider to the base.

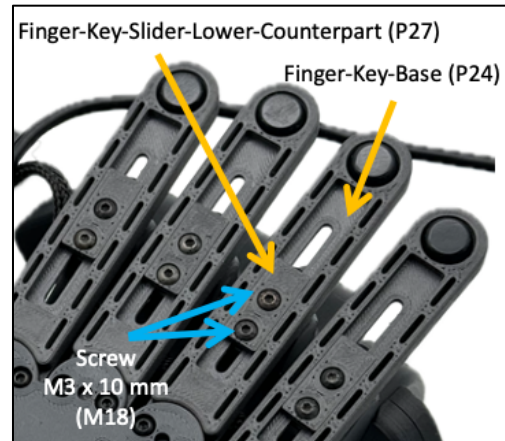


Figure 4-54 Adding the lower counterpart to the finger base.

Now we install the finger elements on the base. Insert two screws M3 x 12 mm (M19) from the bottom side into the base (see Figure 4-55). Put the respective finger elements from the top into place. Add the Finger-Key-Base-Cap (P25) prepared with square nuts to the top as shown in Figure 4-56. After tightening the screws, continue with the next finger elements until all are done.

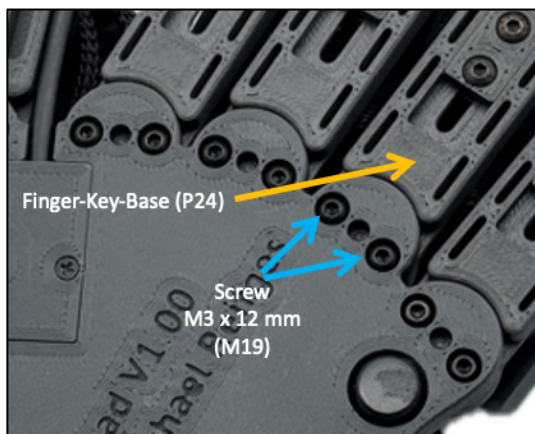


Figure 4-55 Bottom view: Adding finger elements to the base.

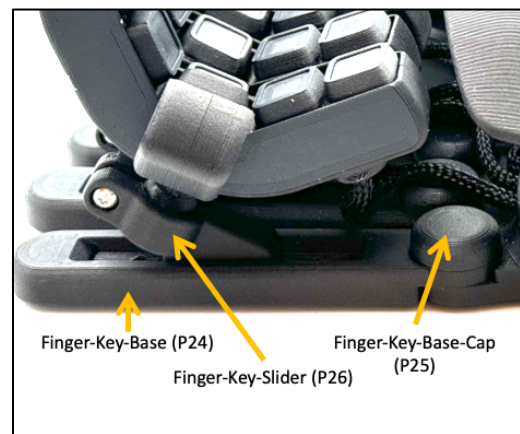


Figure 4-56 Side view: Adding finger elements to the base.

4.5.2 Thumb

The thumb base features three slider areas for installing the thumb stick, the thumb keys and the display (see Figure 4-57). The thumb base is connected to the base with four M3 x 12 mm screws (M19) topped with Thumb-Base-Cap (P29), which holds four square nuts as shown in Figure 4-58 and Figure 4-59.

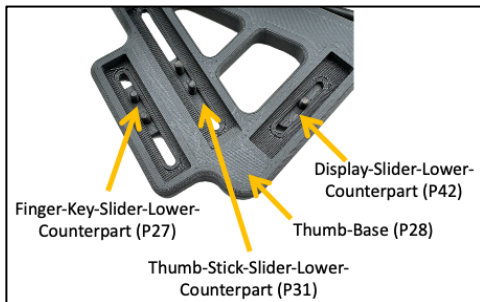


Figure 4-57 The thumb base has three slider areas.

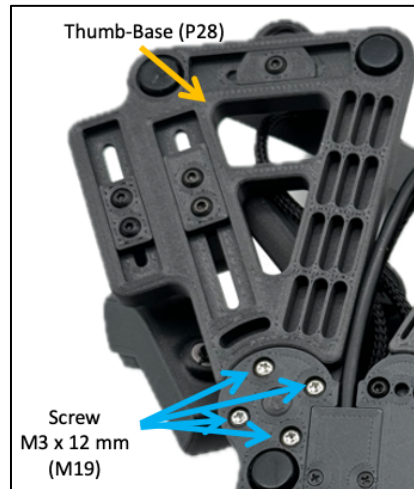


Figure 4-58 Screw position for the thumb base.

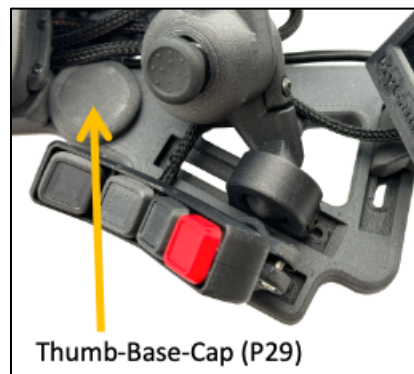


Figure 4-59 The thumb base cap is installed from the top.

4.5.2.1 Thumb stick

Add the thumb stick to the lever and connect them to the thumb stick slider as shown in Figure 4-60. Place this element on the thumb base and tighten the screws for the slider.



Figure 4-60 Complete thumb stick element.

4.5.2.2 Thumb key

Snap the thumb key shell into the thumb key slider (P39) and mount this element on the thumb stick base (see Figure 4-61).

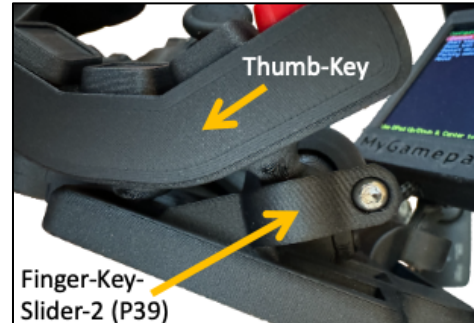


Figure 4-61 Thumb key element.

4.5.2.3 Display

Connect the display housing with the lever to the display slider as shown in Figure 4-62. Add it to the thumb base.

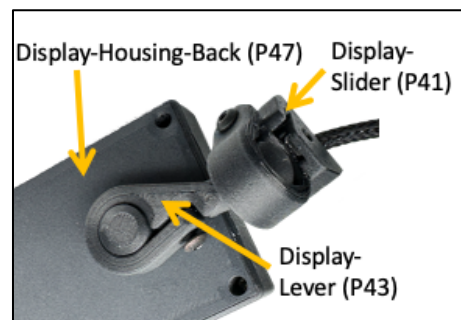


Figure 4-62 Display element.

4.5.3 Base

Before installing the main PCB into the base, you need to insert the USB-A cable (see Figure 4-63).

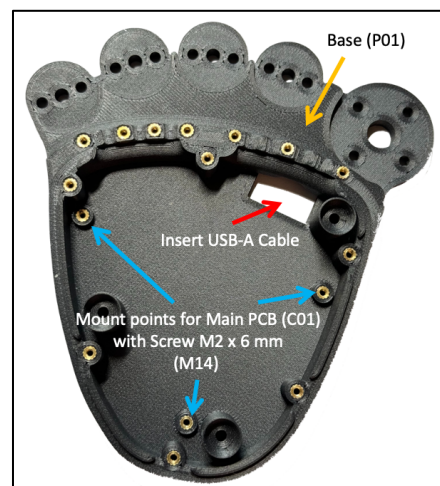


Figure 4-63 Mounting points for main PCB and USB-A cable outlet in base element.

4.5.3.1 Step 1 – USB-A cable

The USB-A cable can be inserted into the hole in the base from the inside (see Figure 4-64).

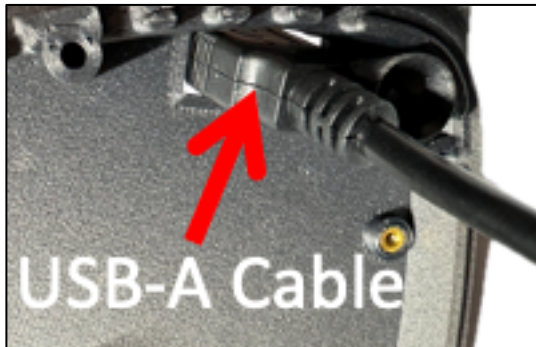


Figure 4-64 Inserting the UBS-A connector through the hole.

Put the strain relief into place and position the USB-A cable as shown in Figure 4-65.

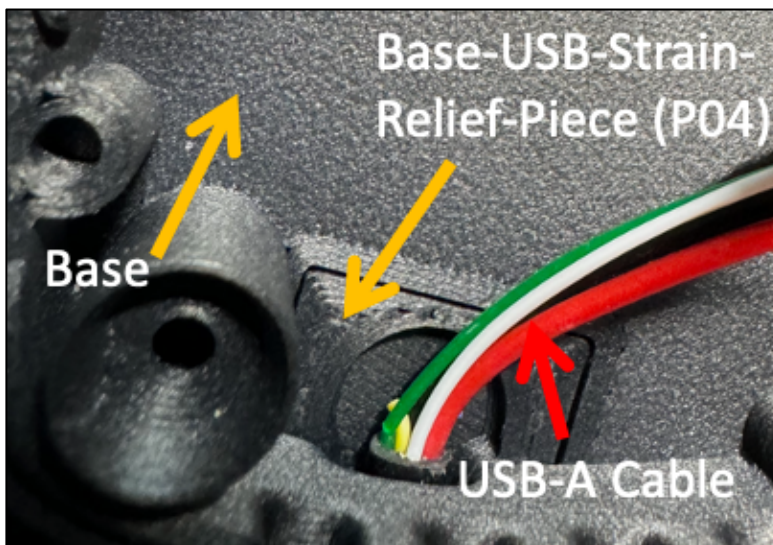


Figure 4-65 Inside view: Base area with strain relief for USB-A cable.

Insert two M2 x 6 mm (M14) screws from the bottom side and tighten them to secure the strain relief (see Figure 4-66).

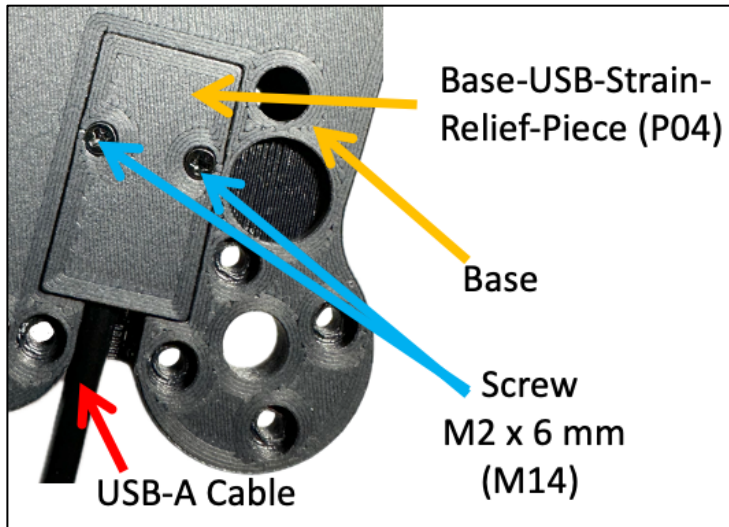


Figure 4-66 Bottom view: USB-A strain relief in base.

4.5.3.2 Step 2 – Inserting main PCB into the base

Insert the pre-assembled main PCB into the base and secure it with three screws M2 x 6 mm (M14). Then insert the connectors of all outside elements as shown in Figure 4-67.

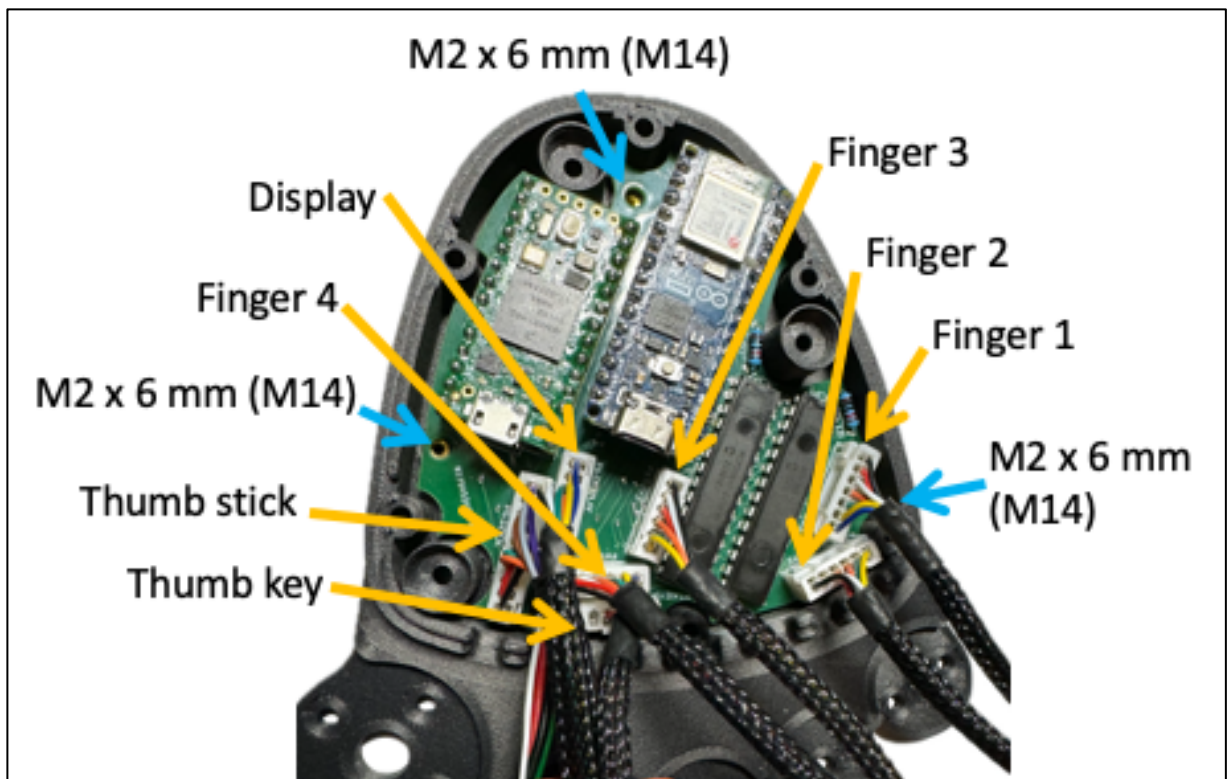


Figure 4-67 Main PCB mount in base and position of connectors.

Prepare the Base-Key-Strain-Relief-Piece (P03) with 8 screws M2 x 8 mm as shown in Figure 4-68. You can also use the two-piece alternative with P51 and P52 which may be easier to handle.

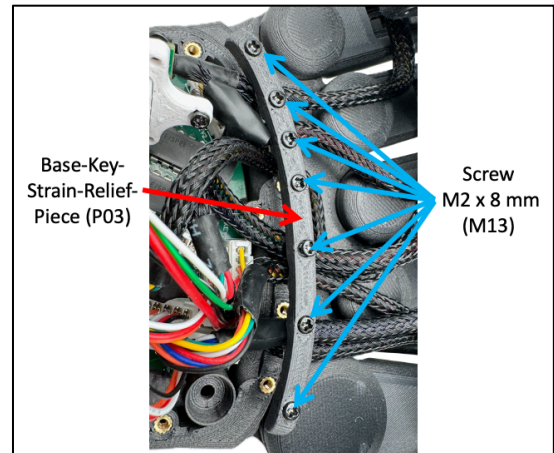


Figure 4-68 Preparation of the base key strain relief.

Place the connector cables in the correct position as shown in Figure 4-69 and tighten the 8 screws.

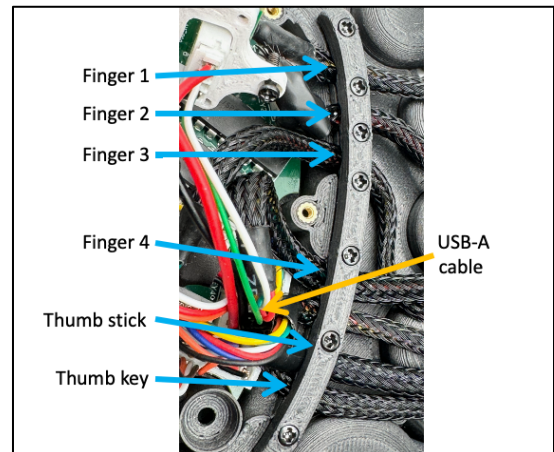


Figure 4-69 Cable positions in base key strain relief.

Put four screws M2 x 6 mm (M14) into the Base-Rise (P02) as shown in Figure 4-70.

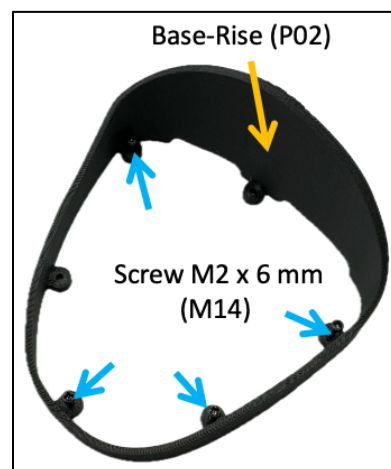


Figure 4-70 Screw positions in base rise.

The last two screws are used to fasten the USB Hub Mount (P48) as shown in Figure 4-71. Put the USB hub mount into place as shown in Figure 4-72 and tighten all screws. Check that your assembly looks similar as shown in Figure 4-73.

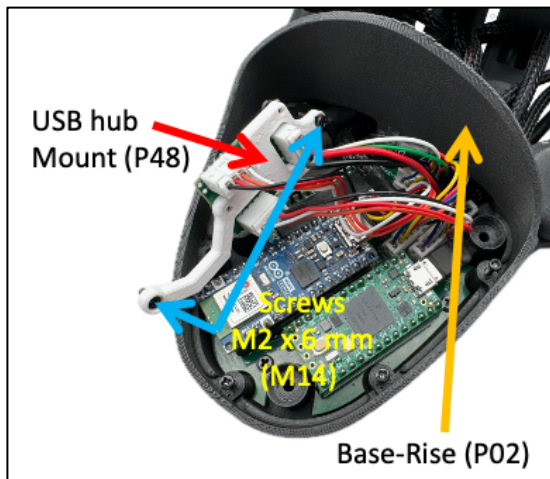


Figure 4-71 Screw positions in USB mount.

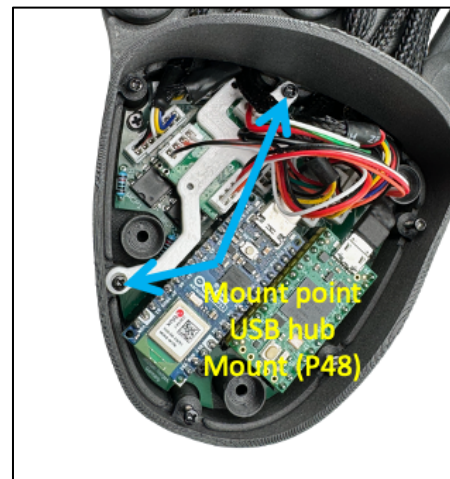


Figure 4-72 Mounting points for the USB Hub.

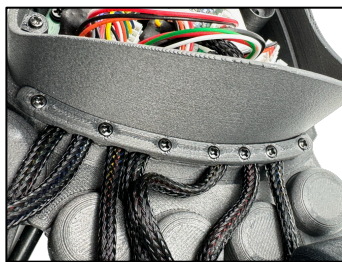


Figure 4-73 Final result of installed base rise and key strain relief.

If you have not already done so, connect the USB hub to the microcontrollers (see Figure 4-74).

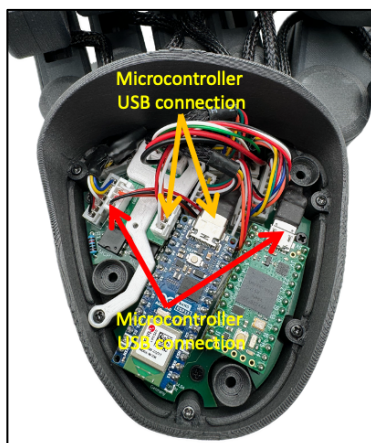


Figure 4-74 USB hub connections to microcontrollers.

4.5.3.3 Step 3 – Rubber feet

Now it is time to insert the 10 rubber feet into the designated holes on the bottom side (see Figure 4-75).

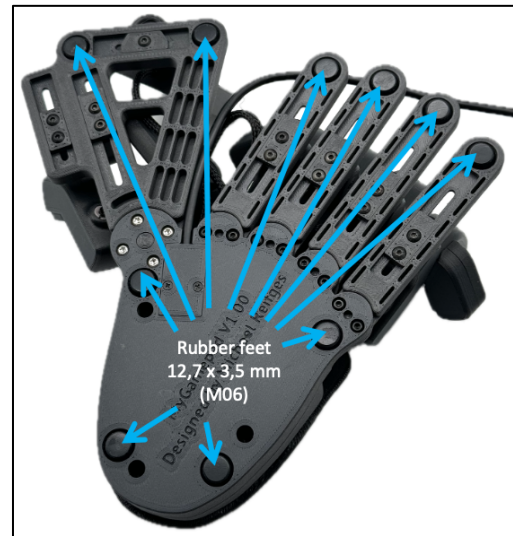


Figure 4-75 Position of the 10 rubber feet.

4.5.3.4 Step 3 – Hand rest

To close the base housing, add the hand rest from the top. The 3 feet of the hand rest shall fit into the screw anchors. Insert three screws M2 x 6 mm (M14) from the bottom side as shown in Figure 4-76 and tighten them.

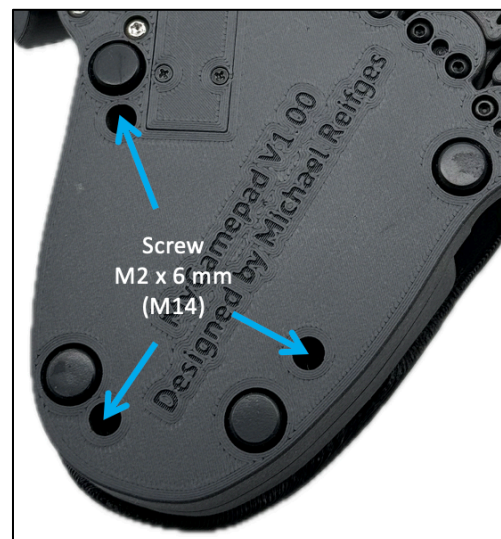


Figure 4-76 Screw holes on the bottom side for the hand rest.

5 Programming the microcontrollers (MC)

5.1 Libraries and software components used

The software for the microcontrollers has been developed utilizing Arduino and Teensyduino tools and frameworks.

The software is utilizing the following libraries:

Table 9 Overview of the software libraries used (last accessed on 22 May 2024).

Library	Reference
WiFi.h	https://www.arduino.cc/reference/en/libraries/wifi/
WiFiManager.h	https://github.com/tzapu/WiFiManager
USBHIDKeyboard.h	Arduino
Joystick_ESP32S2.h	https://github.com/schnoog/Joystick_ESP32S2
Adafruit_MCP23X17.h	https://github.com/adafruit/Adafruit-MCP23017-Arduino-Library
TFT_eSPI.h	https://github.com/Bodmer/TFT_eSPI
ArduinoJson.h	https://github.com/bblanchon/ArduinoJson
SPIFFS.h	Espressif (http://www.apache.org/licenses/LICENSE-2.0)
WebServer.h	By Ivan Grokhotkov

5.2 Preparing the software environment on your computer

For the installation of the Arduino IDE, please refer to <https://www.arduino.cc/en/software> and follow the instructions for your respective target platform.

A few more steps are necessary for the Teensy: Please refer to <https://www.pjrc.com/teensy/tutorial.html> and continue with the next step after the “Install Arduino IDE Software”.

5.3 Flashing the firmware

You have received two binary files that represent the firmware for the microcontrollers. They need to be uploaded with the respective development tools. Therefore, the MyGamepad device needs to be connected to the computer with the USB-A connector.

5.3.1 Arduino Nano ESP32 (MC1)

5.3.1.1 Preparing the bootloader and file system

Before installing the MyGamepad firmware for the first time, a special procedure must be followed to prepare the internal file system of the Arduino Nano ESP32.

This procedure is described here: <https://docs.arduino.cc/tutorials/nano-esp32/spiff/>

Please follow the to outlined steps closely, including uploading and running the **SPIFFS_Test example**.

The MyGamepad firmware requires a proper setup of the SPIFFS partition (advanced) of the microcontroller.

5.3.1.2 How to find the necessary dfu-util tool

The **dfu-util** tools is required to transfer a binary firmware to the microcontroller. It will be installed with the Arduino IDE. However, the exact location may vary depending on your operation system and user account setting. An easy way to find this is to activate the option “Show verbose during compile and upload” in the Arduino IDE settings/preferences (see Figure 5-1).

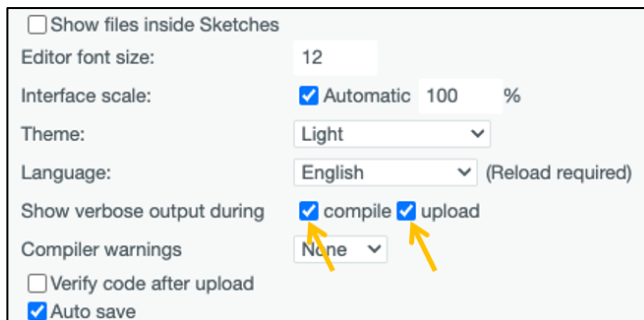


Figure 5-1 Activating show verbose in the Arduino EDI settings.

When compiling and uploading the required **SPIFFS_Test example** as described in the previous paragraph, it will show the **dfu-util** tool path in the output (see Figure 5-2).

```
Output Serial Monitor
Sketch uses 1221081 bytes (38%) of program storage space. Maximum is 3145728 bytes.
Global variables use 71732 bytes (22%) of dynamic memory, leaving 253000 bytes for local variables. Maximum is 327680 bytes.
"/Users/michaelreifges/Library/Arduino15/packages/arduino/tools/dfu-util/0.11.0-arduino5/dfu-util" --device 0x2341:0x0070 -D
dfu-util 0.11-arduino5

Copyright 2005-2009 Weston Schmidt, Harald Welte and OpenMoko Inc.
Copyright 2010-2021 Tormod Volden and Stefan Schmidt
This program is Free Software and has ABSOLUTELY NO WARRANTY
Please report bugs to http://sourceforge.net/p/dfu-util/tickets/

Opening DFU capable USB device...
Device ID 2341:0070
Device DFU version 0101
Claiming USB DFU Interface...
Setting Alternate Interface #0 ...
Determining device status...
DFU state(2) = dfuIDLE, status(0) = No error condition is present
DFU mode device DFU version 0101
Device returned transfer size 4096
Copying data from PC to DFU device
```

Figure 5-2 Arduino IDE upload output.

5.3.1.3 Uploading the firmware

Open a command line shell (Terminal on Mac or CMD.exe on PC) window and enter the following command, while MyGamepad is connected.

```
"<TOOL-PATH>/dfu-util" --device 0x2341:0x0070 -D "<FIRMWARE-PATH>/MyGamepad_MC1_ESP32.ino.bin"
```

Replace <TOOL-PATH> with the right path as described in chapter 5.3.1.2 and <FIRMWARE-PATH> with the path where you stored the firmware.

NOTICE: In case the upload is getting interrupted, press the reset button of the Arduino Nano EPS32 twice with approximately half a second break in between. When the RGB LED is slowly flashing green start the upload...

5.3.2 Teensy 4.0 (MC2)

5.3.2.1 *Uploading the firmware*

The upload process is easier for the Teensy. Open the **Teensy App** on Mac or **Teensy.exe** on PC.

Open the file “<FIRMWARE-PATH>/MyGamepad_MC2_Teensy40.ino.hex” and select in the menu operation->program.

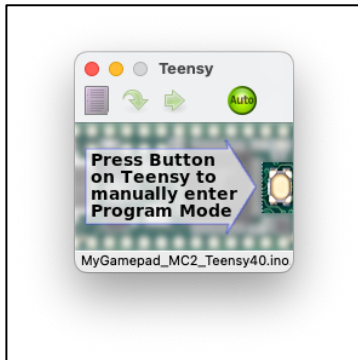


Figure 5-3 Teensy App.

NOTICE: The MyGamepad firmware will setup the Teensy 4.0 in controller/Xinput, mode which makes it invisible for the USB device selection. After the first upload, there are two more steps that must be followed: Deactivate the “Automatic” function in the Teensy App and open the MyGamepad base housing and press the reset button on the Teensy microcontroller to put it into program mode.

6 Setup and configuration of the assembled device

6.1 Hardware setup and adjustment

MyGamepad offers very versatile adjustment options to support your individual hand size and handling preferences.

6.1.1 Individual adjustment options for the finger keys

6.1.1.1 Finger key distance

With the finger key distance slider, you can adjust the position of the keys to the individual lengths of each finger. Loosen the two screws on the bottom side of the finger slider, as shown in Figure 6-1 and slide it into the desired position. Then tighten the screws again to secure the position and proceed with the next finger until they are all done.

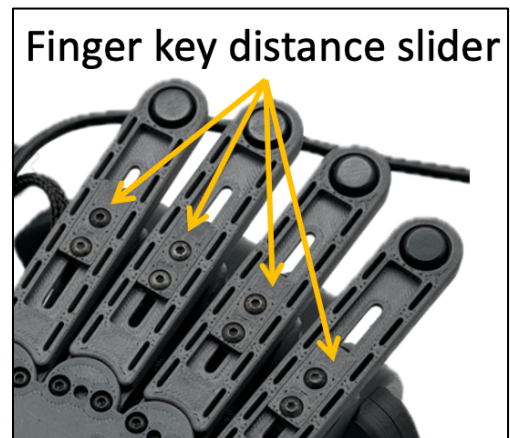


Figure 6-1 Position of the screws to change the finger distance.

6.1.1.2 Finger key direction angle

For better comfort MyGamepad allows to adjust the direction angle for each finger. To do so, loosen the two screws on the bottom side as shown in Figure 6-2. Turn the keys left or right. Once you have found the right position, tighten the screws again.

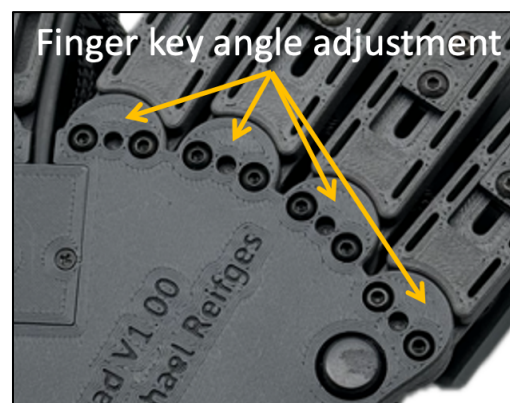


Figure 6-2 Position of the screws to change the direction angle.

6.1.1.3 Adjusting the finger and thumb keys 360° angle

It is also possible to adjust the angle of the finger and thumb keys. For this purpose, you will find a screw on the backside of each slider as shown in Figure 6-3.

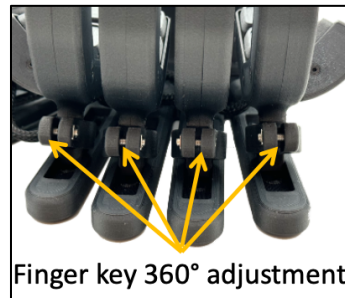


Figure 6-3 Position of the screws for vertical adjustment of the finger keys.

6.1.2 Individual adjustment options for the thumb

6.1.2.1 Adjusting the thumb keys, thumb stick and display slider positions

As illustrated in Figure 6-4, you can access the screws for changing the overall direction and the three sliders for the thumb keys, the thumb stick, and the display from the bottom of the device.

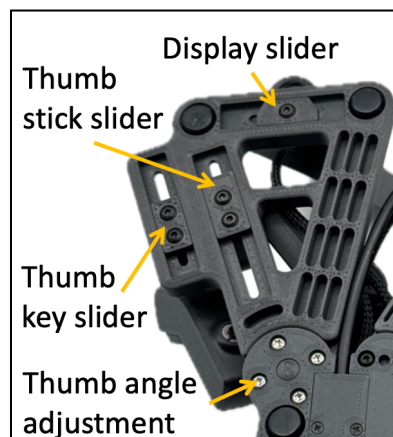


Figure 6-4 Bottom view of the adjustment options for the thumb.

6.1.2.2 Adjusting the thumb stick 360° angle

The stick panel is also equipped with a 360° adjustment option, which can be accessed using the screw on the back of the thumb stick slider, as shown in Figure 6-5.



Figure 6-5 Position of the 360° thumb stick adjustment.

6.1.2.3 *Adjusting the thumb stick direction and depth*

Use the thumb stick direction and depth controls to further adjust the position of the thumb sticks to suit your needs. To change it, use the screw on the thumb stick lever as shown in Figure 6-6.



Figure 6-6 Position of the thumb stick depth and direction control.

6.1.2.4 *Adjusting the display 360° and horizontal angle*

Figure 6-7 shows the position of the two screws used to adjust the display.

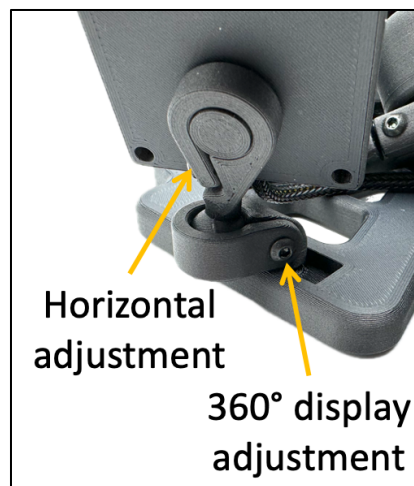


Figure 6-7 Position of the screws for display control.

6.2 Software setup and operation

6.2.1 Setting up the WIFI connection

Open WLAN settings on your mobile phone. The network “MyGamepad” should be shown as available option (see Figure 6-8). Select it and wait for a few seconds until the MyGamepad’s WIFI manager will open as shown in Figure 6-9.

Click [**Configure WIFI**] to continue. In the next page enter or selected the SSID of your WLAN you want to connect to as shown in Figure 6-10. Next type in a device name, username, and password in the designated input field (see Figure 6-11) before pressing the [**Save**] button.

After that you can switch back to your home WLAN on your mobile phone.

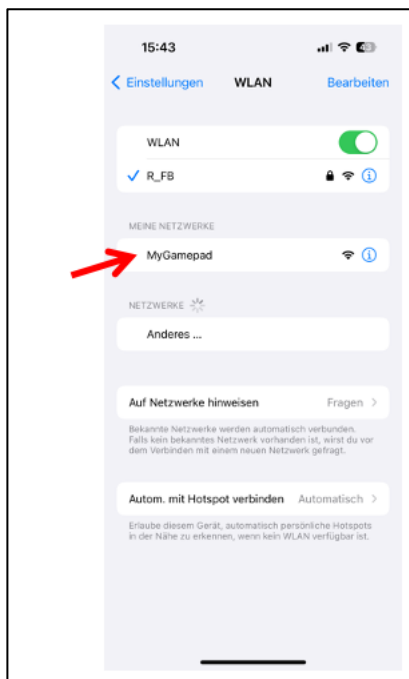


Figure 6-8 Connecting to MyGamepad WLAN



Figure 6-9 Start WIFI configuration.

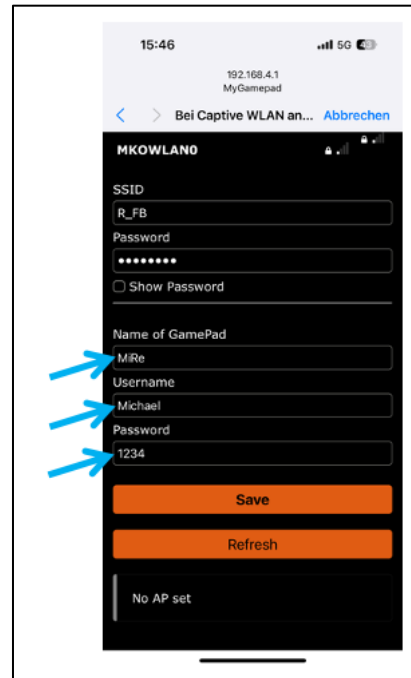


Figure 6-11 Enter additional information before saving.

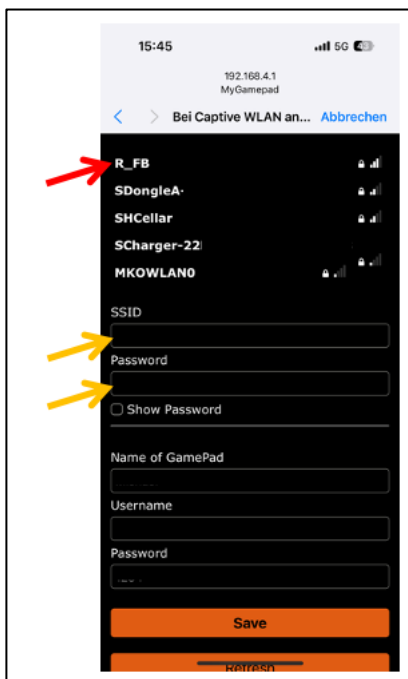


Figure 6-10 Select WIFI and enter password.

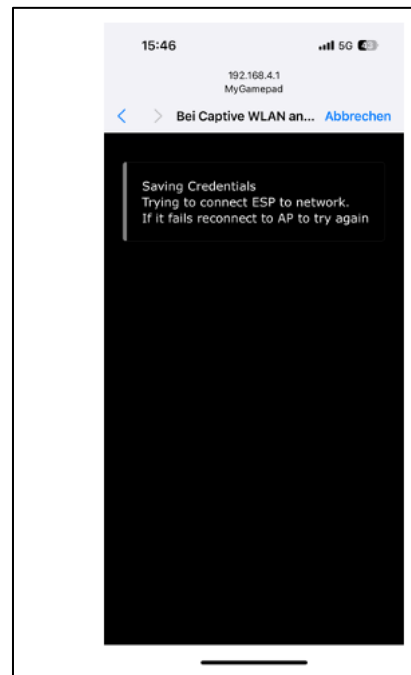


Figure 6-12 WIFI configuration finished.

6.2.2 Configuration through web-interface

6.2.2.1 Login

Open your Internet browser and type <http://> followed by your device's <IP address> and press enter (see Figure 6-13). The link is also displayed in the footer on the main screen of your MyGamepad device (see Figure 2-10).

1. Select the **[Username]** input field and enter the <username> defined during WLAN setup process (see chapter 6.2.1).
2. Enter your <password> into the **[Password]** input field.
3. Click the **[Submit]** button.

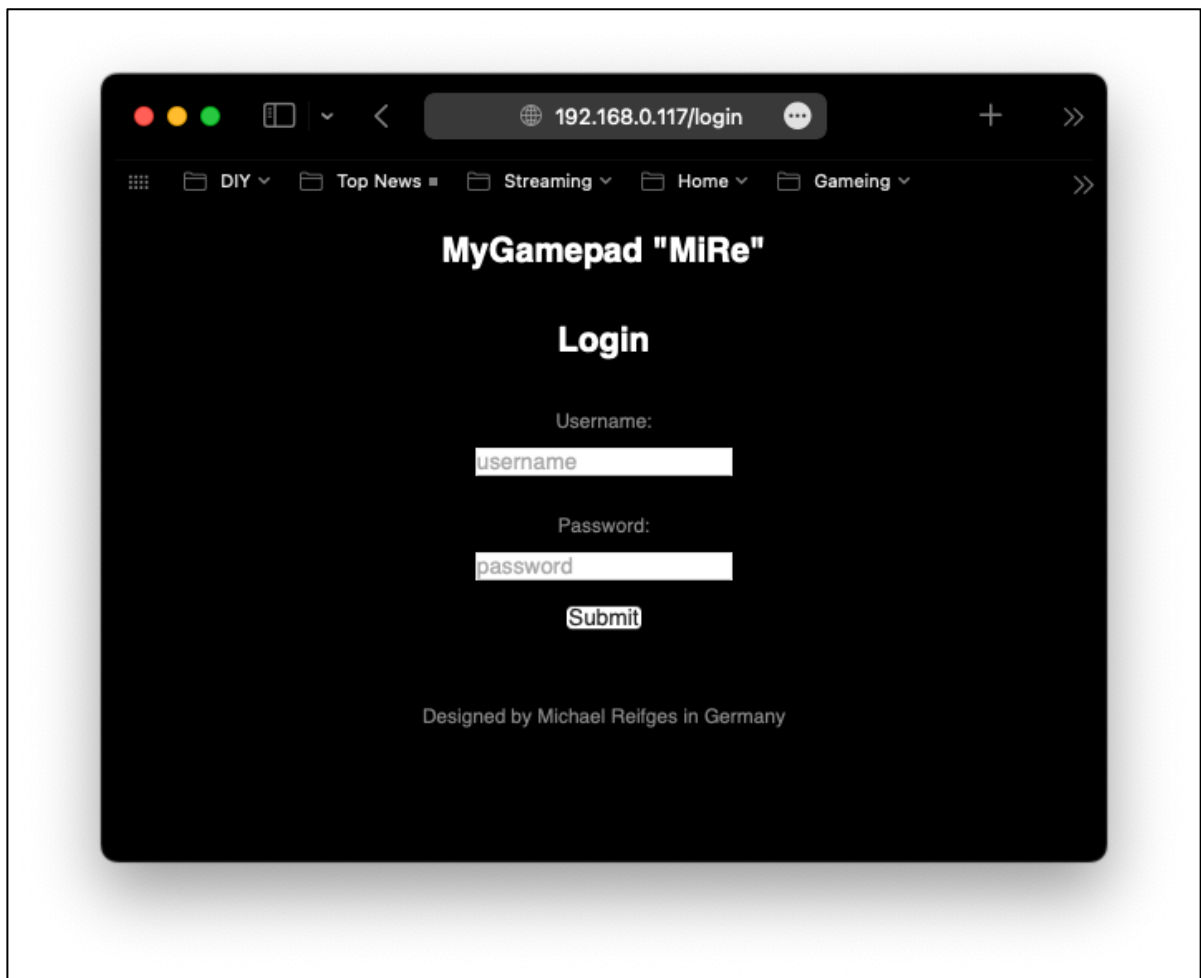


Figure 6-13 Configuration web-interface login page.

NOTICE: If you did not disconnect during a previous session and your login is still valid, the main configuration page will open.

6.2.2.2 Main configuration page

The page is divided into six areas as outlined in Figure 6-14.

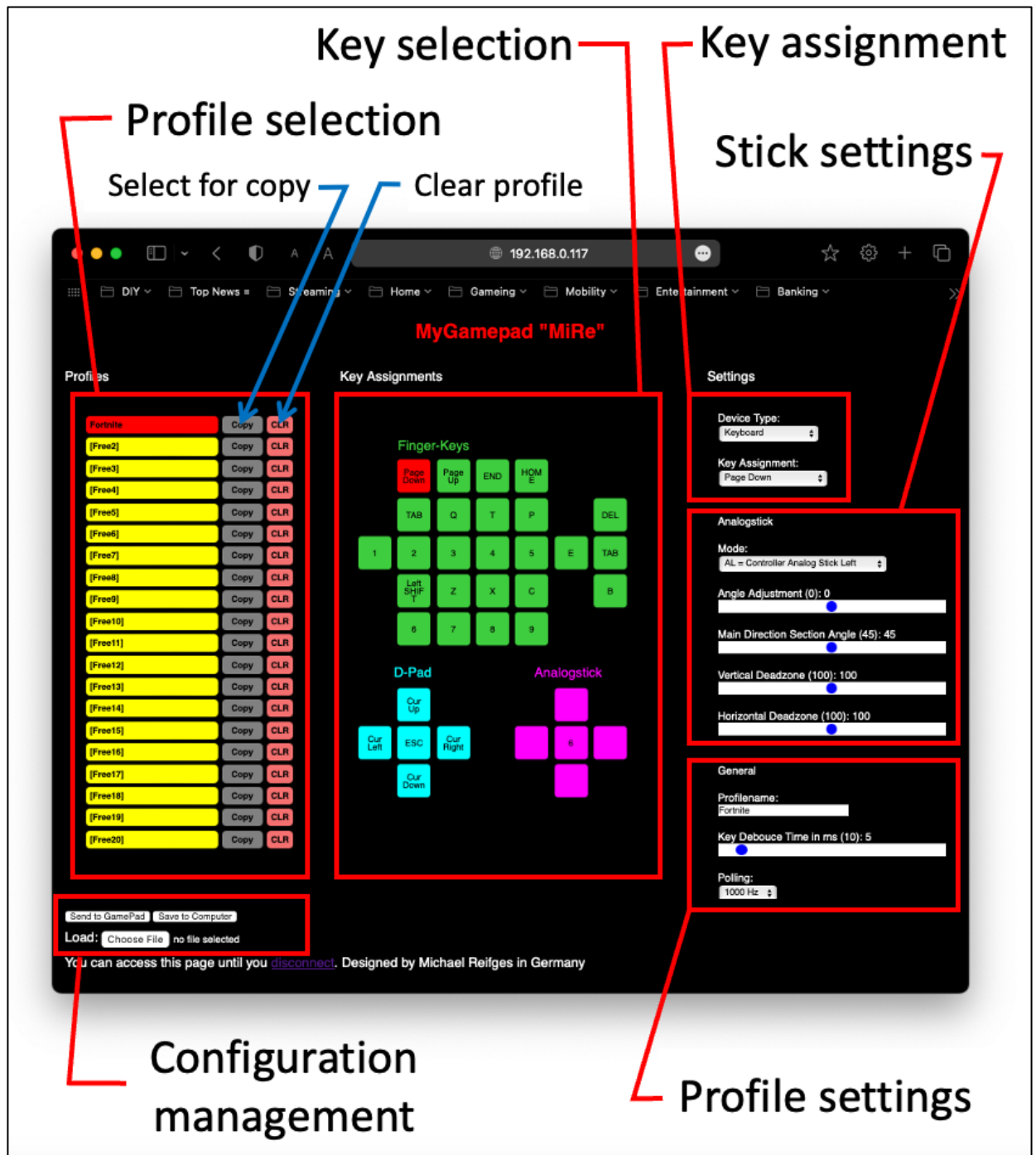


Figure 6-14 Overview web interface main configuration page.

6.2.2.3 Profiles selection area

In the [Profiles selection] area, the active profile is selected by clicking the [profile name] button. When selected it is highlighted red. Clicking on one of the [CLR] buttons will reset the respective profile to the default values after confirmation.

Clicking one of the [Copy] buttons activates the copy/paste mode (see Figure 6-15). The button will change to a [Cancel] button to cancel the operation. The [Copy] buttons of all other profiles will change to [Paste] buttons. By clicking on one of the [Paste] buttons, the values are transferred after confirmation and the process is completed.

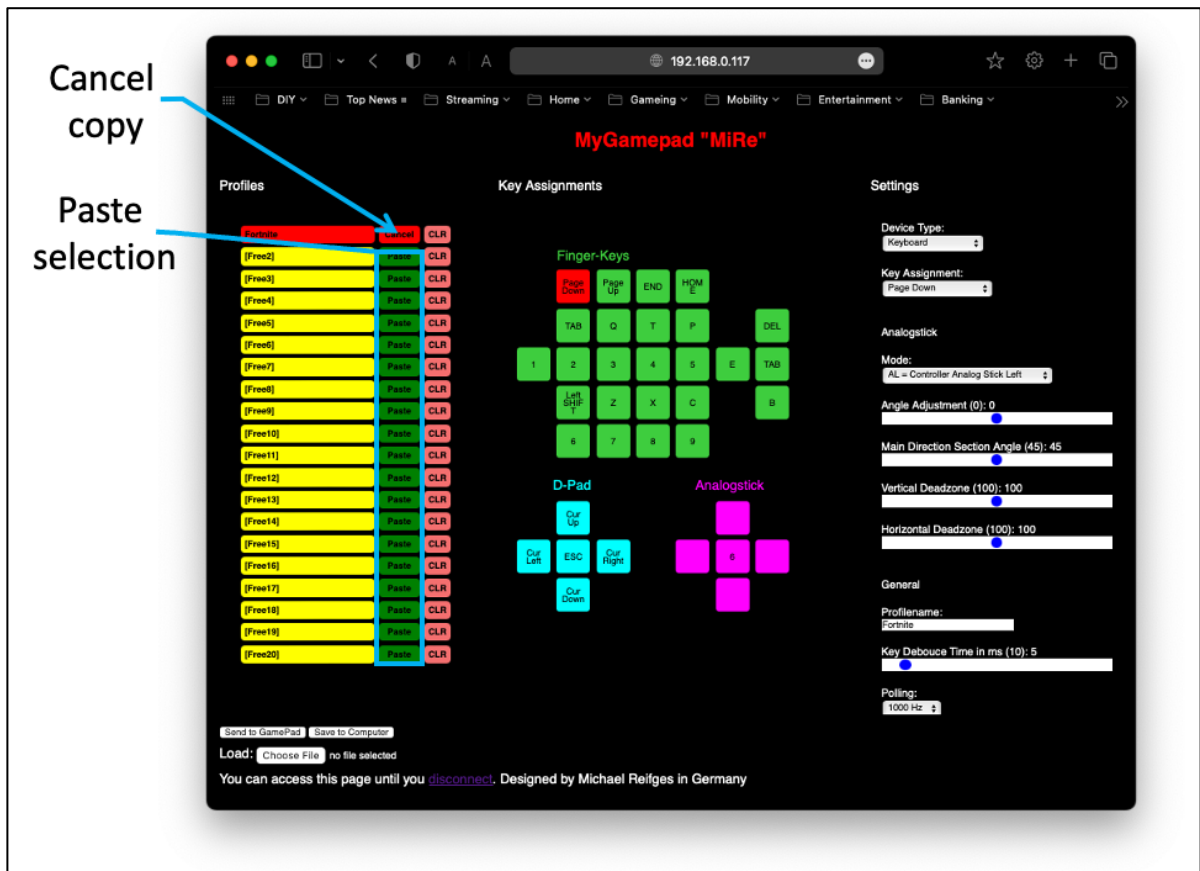


Figure 6-15 Web interface main configuration page copy/paste mode

6.2.2.4 Key selection area

Use the buttons in the [Key selection] area to select the active the key to be changed. The activated key is highlighted in red. Selectable keys are highlighted in orange when the mouse-cursor passes over them.

6.2.2.5 Key assignment area

In the [Key assignment] area, you can select the device/type and function to be triggered when pressed/activated on the device.

6.2.2.6 Stick settings

6.2.2.6.1 Stick mode

Select one of the available analog stick modes:

- Analog stick left (AL)
- Analog stick right (AR)
- Digital as key H/V direction (D1)
- Digital as circular angle (D2)
- Joystick (J)

6.2.2.6.2 Angle adjustment

The angle setting allows you to turn the analog stick left or right using software instead of hardware. Default value is 0°.

6.2.2.6.3 Main direction angle

This is a customizing feature for the stick mode “digital as circular angle (D2)”. In this mode, MyGamepad calculates the circular angle position of a vector representing the stick direction.

By default, the 360° of the circle are divided into 8 equal pieces of 45°. Up, down, left and right are considered the main directions, while the space in between are the diagonal directions, which always trigger two keys of the main directions.

This parameter allows you to change the angular size of the main directions. If you increase it by 5°, the diagonal angles also decrease by the 5°.

6.2.2.6.4 Vertical and horizontal dead zone

The analog stick signal will be converted to a digital 12-bit value. This means that each stick position is represented by a value from 0 to 4095, where the neutral position is 2047. Due to the high resolution and some other factors like noise or just touching the stick, the center position value will not be 100 % stable. To avoid jerky or unwanted movements, you can define a dead zone. Only if the stick goes beyond this value in one direction, a movement information will be sent to the computer or console. The default value is 100.

6.2.2.7 Profile settings

6.2.2.7.1 Profile name

You can give each profile a unique name to identify it on the device during the profile section. Each name can be up to 29 characters long.

6.2.2.7.2 Key debounce time

Debouncing is the removal of unwanted input noise from buttons, switches or other user input. Debouncing prevents extra activations or slow functions from being triggering too often. Debouncing can be done through hardware or software. The MyGamepad has a software debounce function. With this parameter you can set the amount of time it waits to determine if a key has been pressed or not.

6.2.2.7.3 Polling frequency

Sets the polling speed to determine how often updates are sent to the computer or console. The default value is 1,000 hz, which means up to 1,000 updates per second.

6.2.2.8 Configuration management

6.2.2.8.1 Send to MyGamepad

Sends the configuration data to the MyGamepad device and stores it in the internal memory. The previous configuration will be overwritten.

6.2.2.8.2 Save to computer

Saves the configuration as a download file to the computer.

6.2.2.8.3 Load from computer

Opens a configuration file from the computer.

7 Troubleshooting

7.1 Identifying and resolving problems

7.1.1 Troubleshooting and resolution during assembly and functional testing

Table 10 Selected problems and resolutions during assembly and functional testing

Problem	Possible cause	Solution
Device does not start	No or wrong firmware	Re-program microcontrollers
Display does not light up	No connection	Check all connections
Display lights up, but no picture is visible	No or wrong firmware	Re-program microcontrollers
Device is not recognized by the computer	Wrong USB pinout and assignment	Check and correct USB pinout and assignment

To be continued ...

7.1.2 Troubleshooting and resolutions during normal usage

Table 11 Selected problems and resolutions during normal operation

Problem	Possible cause	Solution
Device does not start	Broken cable	Check cables
A key does not respond	Lost connection	Check connection & soldering
Does not connect to WiFi	Signal problems	Reset and reconfigure WiFi

To be continued ...

8 References

Index

- Angle, 6, 80
- Arduino Nano ESP32, 14, 31, 69
- Button, 9, 14, 16, 17, 18, 71, 75, 77, 79
- Calibrate, 17
- Computer, 81
- Configuration, 9, 31, 58, 72, 76, 77, 78, 79, 81
- Connector, 35, 45, 48, 50, 51, 52, 54, 55, 56, 57, 58, 59, 63, 68
- Dead zone, 80
- Debounce, 81
- Display, 12, 13, 14, 15, 22, 28, 29, 33, 43, 44, 47, 48, 54, 55, 56, 61, 62, 73, 74
- DPAD, 13, 17, 18, 28, 53
- Fabric hose, 37, 48
- Firmware, 68, 70, 71
- GND, 49
- Ground connection. *See* GND
- Heat-shrink tube, 37
- Housing, 43, 44, 51, 53, 54, 56, 62, 67
- Internal memory, 9, 81
- JST PH2.0, 35, 36, 45, 46, 48, 50, 51, 52, 54, 56, 57, 58
- Key, 13, 14, 20, 23, 24, 25, 26, 27, 28, 29, 30, 34, 41, 43, 49, 50, 51, 59, 60, 65, 79, 80, 81
- Mac, 9, 70, 71
- MCP23017, 34, 45, 68
- Micro controller, 31, 46, 47, 68
- PC, 9, 22, 70, 71
- PCB, 32, 45, 46, 52, 53, 54, 57, 58
- Pooling, 81
- Power, 10
- Prusament, 22
- Rubber feet, 14, 38, 67
- Safety, 7, 19
- Screw, 37, 38, 49
- Software, 10, 68, 75
- Square Nut. *See* Square Thin Nut
- Square Thin Nut, 38
- Stick, 13, 27, 28, 30, 32, 34, 38, 40, 41, 42, 48, 52, 53, 80
- Strain relief, 13, 14, 49, 50, 51, 53, 54, 55, 63, 64, 65, 66
- Teensy 4.0, 14, 31, 71
- Thumb stick, 13, 14, 52
- Tools, 20
- USB, 10, 14, 23, 29, 31, 33, 35, 56, 57, 58, 59, 62, 63, 64, 66, 68, 71
- Voltage, 10
- Weight, 10
- WIFI, 75
- WLAN. *See* WIFI

8.1 Figures

Figure 2-1 MyGamepad top front view.	11
Figure 2-2 MyGamepad side view.	12
Figure 2-3 MyGamepad finger keys rear view.	12
Figure 2-4 MyGamepad display rear view.	12
Figure 2-5 MyGamepad thumb stick side view.....	13
Figure 2-6 MyGamepad thumb stick top view.....	13
Figure 2-7 MyGamepad key shell bottom view	13
Figure 2-8 MyGamepad bottom view.	13
Figure 2-9 MyGamepad inside main body view.....	13
Figure 2-10 MyGamepad main screen – item descriptions.	15
Figure 2-11 MyGamepad main screen – key assignments.....	16
Figure 2-12 Profile selection screen.....	16
Figure 2-13 Analog stick calibration step 1.....	17

Figure 2-14 Analog stick calibration step 2.	17
Figure 2-15 Calibration step 2 final.	17
Figure 2-16 Calibration step 3.	18
Figure 2-17 Configuration mode.	18
Figure 4-1 All parts on one Prusa XL plate.	39
Figure 4-2 Placements of threaded inserts on base.	40
Figure 4-3 Placements of threaded inserts on Thumb-Stick-Upper-Housing.	40
Figure 4-4 Placements of threaded inserts on Base-Hand-Rest.	40
Figure 4-5 Square nut positions Finger-Key-Slider-1 (P26) / Finger-Key-Slider-2 (P39).....	41
Figure 4-6 Square nut position Display-Lever (P43).	41
Figure 4-7 Square nut positions Display-Slider (P41).	42
Figure 4-8 Square nut position Thumb-Stick-Lever (P32).	42
Figure 4-9 Square nut positions Thumb-Stick-Slider (P30).	42
Figure 4-10 Square nut positions Finger-Key-Base-Cap (P25) and Thumb-Base-Cap (P29).	43
Figure 4-11 Inserting the mounting pin	43
Figure 4-12 Display housing on tape roll.	44
Figure 4-13 Mounting pin and display	44
Figure 4-14 Connecting the inner core and outer frame of the keys.....	44
Figure 4-15 Using a 6 mm nut to press the key	44
Figure 4-16 Properly connected key parts.	44
Figure 4-17 Resistor and MCP23017 placement on main PCB (C01).	45
Figure 4-18 Placement of the JST PH2.0 connectors on main PCB (C01).	46
Figure 4-19 Installation of the female headers for microcontrollers.	47
Figure 4-20 Measurements and items used for the cable connectors.	48
Figure 4-21 GND connection path for finger keys.	49
Figure 4-22 JST PH2.0 connector with 7 pins (E22).	50
Figure 4-23 Setup in Key-Soldering-Jig for 6 keys.	50
Figure 4-24 JST PH2.0 connector with 6 pins (E21).	50
Figure 4-25 Setup in Key-Soldering-Jig for 5 keys.	50
Figure 4-26 JST PH2.0 connector with 5 pins (E20).	51
Figure 4-27 Setup in Key-Soldering-Jig for 4 keys.	51
Figure 4-28 Finished connector in Key-Soldering-Jig.	51
Figure 4-29 Placement of keys with wires	51
Figure 4-30 JST PH2.0 connector with 10 pins (E23).	52
Figure 4-31 Pin assignment of the Thumb-Stick-PCB.	52
Figure 4-32 Placement of components on the Thumb-Stick-PCB.	53
Figure 4-33 Adding the strain relief.	53
Figure 4-34 Notch position on strain relief.	53
Figure 4-35 Sliding the thumb stick housing.	54
Figure 4-36 Inserting screws from the	54
Figure 4-37 JST PH2.0 connector with 7 pins (E22).	54
Figure 4-38 Pin assignment of the display module.	55
Figure 4-39 Installation of the display strain relief.	55

Figure 4-40 Closing the display housing.....	56
Figure 4-41 Inserting the screws into the display housing.	56
Figure 4-42 Pin out JST PH2.0 for the USB hub.....	56
Figure 4-43 Pin assignment of the USB-C male connector.	57
Figure 4-44 Pin assignment of the	57
Figure 4-45 Finalized USB-C connector cable.	57
Figure 4-46 Finalized Micro-USB connector cable.	57
Figure 4-47 USB-A connector pinout and wire colors.....	58
Figure 4-48 USB-A plug pin configuration.....	58
Figure 4-49 Placement of the JST PH2.0	58
Figure 4-50 Alternative pins to connect USB-A cable to the USB hub.	58
Figure 4-51 Finished USB hub.	59
Figure 4-52 Preparing the lower slider counterparts.....	59
Figure 4-53 Adding the finger key.....	60
Figure 4-54 Adding the lower counterpart to the.....	60
Figure 4-55 Bottom view: Adding finger elements to the base.	60
Figure 4-56 Side view: Adding finger elements	60
Figure 4-57 The thumb base has three slider areas.....	61
Figure 4-58 Screw position for the thumb base.....	61
Figure 4-59 The thumb base cap is installed.....	61
Figure 4-60 Complete thumb stick element.	61
Figure 4-61 Thumb key element.	62
Figure 4-62 Display element.	62
Figure 4-63 Mounting points for main PCB.....	62
Figure 4-64 Inserting the UBS-A connector through the hole.	63
Figure 4-65 Inside view: Base area with strain relief for USB-A cable.	63
Figure 4-66 Bottom view: USB-A strain relief in base.	64
Figure 4-67 Main PCB mount in base and position of connectors.....	64
Figure 4-68 Preparation of the base key strain relief.	65
Figure 4-69 Cable positions in base key strain relief.....	65
Figure 4-70 Screw positions in base rise.....	65
Figure 4-71 Screw positions in USB mount.....	66
Figure 4-72 Mounting points for.....	66
Figure 4-73 Final result of installed base rise and key strain relief.....	66
Figure 4-74 USB hub connections to microcontrollers.	66
Figure 4-75 Position of the 10 rubber feet.	67
Figure 4-76 Screw holes on the bottom side for the hand rest.	67
Figure 5-1 Activating show verbose in the Arduino EDI settings.	69
Figure 5-2 Arduino IDE upload output.	70
Figure 5-3 Teensy App.	71
Figure 6-1 Position of the screws to change the finger distance.	72
Figure 6-2 Position of the screws to change the direction angle.....	72
Figure 6-3 Position of the screws for	73

Figure 6-4 Bottom view of the adjustment.....	73
Figure 6-5 Position of the 360° thumb stick adjustment.	73
Figure 6-6 Position of the thumb stick depth	74
Figure 6-7 Position of the screws for display control.....	74
Figure 6-8 Connecting to MyGamepad WLAN	75
Figure 6-9 Start WIFI configuration.....	76
Figure 6-10 Select WIFI and enter password.	76
Figure 6-11 Enter additional information before saving.....	76
Figure 6-12 WIFI configuration finished.	76
Figure 6-13 Configuration web-interface login page.	77
Figure 6-14 Overview web interface main configuration page.....	78
Figure 6-15 Web interface main configuration page copy/paste mode	79

8.2 Tables

Table 1 Technical data	10
Table 2 Tools.	20
Table 3 Printed parts.....	22
Table 4 Micro controller/USB-Hub.	31
Table 5 Printed circuit boards (PCBs).....	32
Table 6 List of electronic parts.....	33
Table 7 List of screws and other materials.	37
Table 8 Detailed measurements for the cable connectors.....	48
Table 9 Overview of the software libraries used (last accessed on 22 May 2024).	68
Table 10 Selected problems and resolutions during assembly and functional testing.....	82
Table 11 Selected problems and resolutions during normal operation	82



9 Imprint

Michael Reifges
Marie-Curie-Strasse 6
91448 Emskirchen
Germany

E-Mail: info@mygamepad.de
Internet: www.mygamepad.de

Editing and Proofreading: Markus Linden, Duisburg, Germany