

WCU v1.0 Datasheet

**A RP2040-based
Window Control Unit
From Ghost Town**



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About WCU version 1.0

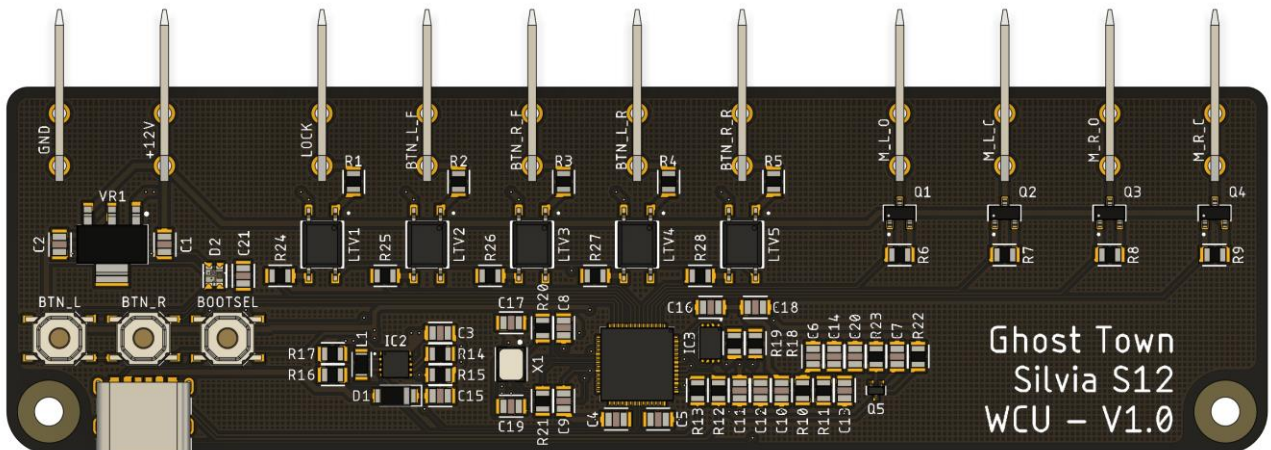
The WCU (Window Control Unit) was specifically developed for motorizing the rear windows of a Nissan Silvia S12. The goal of this development was to provide a reliable and efficient control unit that meets the requirements of this vehicle.

The main processor used is the RP2040, which is more than sufficient for this application due to its performance and flexibility. It is important to note that the output pins of the circuit board should not be connected directly to the window regulator motor. Instead, they should control a relay, which in turn controls the motor. This separation ensures safe and durable operation, as the motor current is routed through the relay, relieving the WCU's electronics.

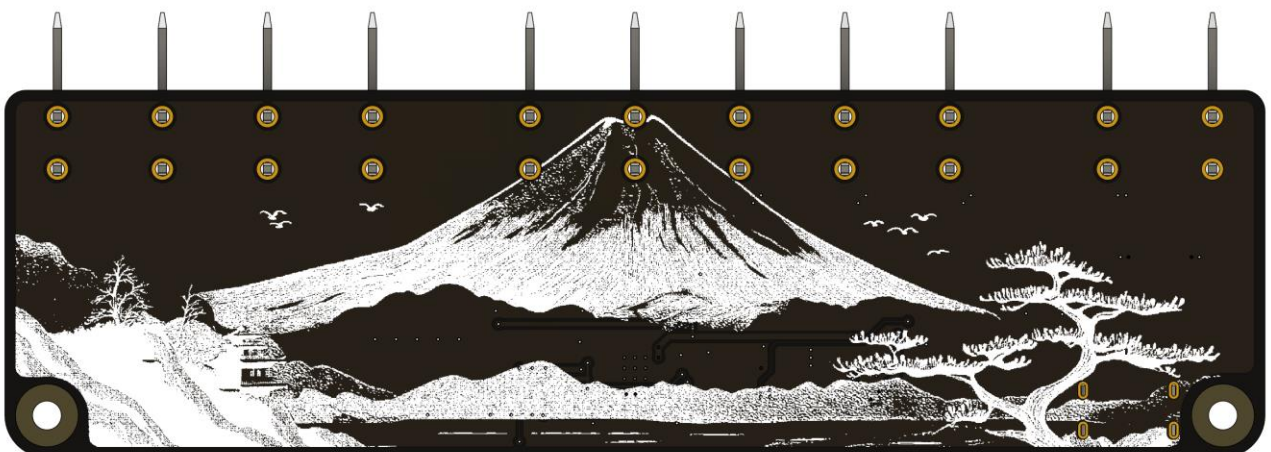
The current version 1.0 of the WCU was designed exclusively for the rear windows. However, future plans include expanding the unit's functionality. Later versions are intended to be more versatile and capable of controlling multiple windows. This would enable the WCU to be used in additional vehicle models or even universally.

NOTE: The Images in this Documentation are not the real size of the WCU.

Top view:



Bottom view:



Mechanical specification

Pinout

Name	Description
GND	Car Ground This pin serves as the grounding point and ensures the safe return path of the circuit.
+12V	Ignition Power Supplies the circuit with 12V as soon as the ignition is activated.
LOCK	Lock Signal for the Rear Seats This signal is used to disable the control of the rear windows.
BTN_L_F	Front Switch for the Rear Left Window Controls the opening and closing of the rear left window while considering the lock signal.
BTN_R_F	Front Switch for the Rear Right Window Controls the opening and closing of the rear right window while considering the lock signal.
BTN_L_R	Rear Switch for the Rear Left Window Controls the opening and closing of the rear left window.
BTN_R_R	Rear Switch for the Rear Right Window Controls the opening and closing of the rear right window.
M_L_O	Output for the Rear Left Motor to Open the Window Controls the rear left motor to open the window.
M_L_C	Output for the Rear Left Motor to Close the Window Controls the rear left motor to close the window.
M_R_O	Output for the Rear Right Motor to Open the Window Controls the rear right motor to open the window.
M_R_C	Output for the Rear Right Motor to Close the Window Controls the rear right motor to close the window.

Interne Pins

GPIO Pin	Name
8	Lock
7	Button left front
6	Button right front
5	Button left rear
4	Button right rear
3	Motor left open
2	Motor left close
1	Motor right open
0	Motor right close
9	Button left
10	Button right

Firmware

The entire firmware is freely accessible and can be viewed at the following link:

<https://github.com/Red05Jack/WCU/tree/v1.0>

The licensing terms for the firmware are defined directly in the Git repository and are not included in this documentation.

USB-C

The USB port can be used to program the board, but the output pins will not work in this case. The reason for this is that the USB port is only connected to the RP2040 chip and not to the main power supply or the 12V line, from which the MOSFETs receive their base voltage.

On the other hand, the input pins will work even without a voltage on the +12V line, as they are powered through the USB. However, these input pins require a minimum voltage of 11.2V to switch correctly.

Electrical specification

Operating conditions

Name	Recommend	Min	Max	IN/OUT
GND	0V	0V	0V	IN
+12V	12,0V	7,5V	35,0V	IN
LOCK	12,0V	11,2V	21,4V	IN
BTN_L_F	12,0V	11,2V	21,4V	IN
BTN_R_F	12,0V	11,2V	21,4V	IN
BTN_L_R	12,0V	11,2V	21,4V	IN
BTN_R_R	12,0V	11,2V	21,4V	IN

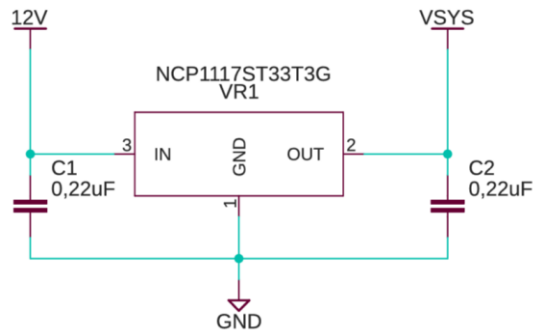
Name	Recommend	Min	Max	IN/OUT
M_L_O	12,0V	7,5V	35,0V	OUT
M_L_C	12,0V	7,5V	35,0V	OUT
M_R_O	12,0V	7,5V	35,0V	OUT
M_R_C	12,0V	7,5V	35,0V	OUT

Powerchain

The WCU (Window Control Unit) features two power converter chips that function as DC-DC step-down converters with fixed outputs:

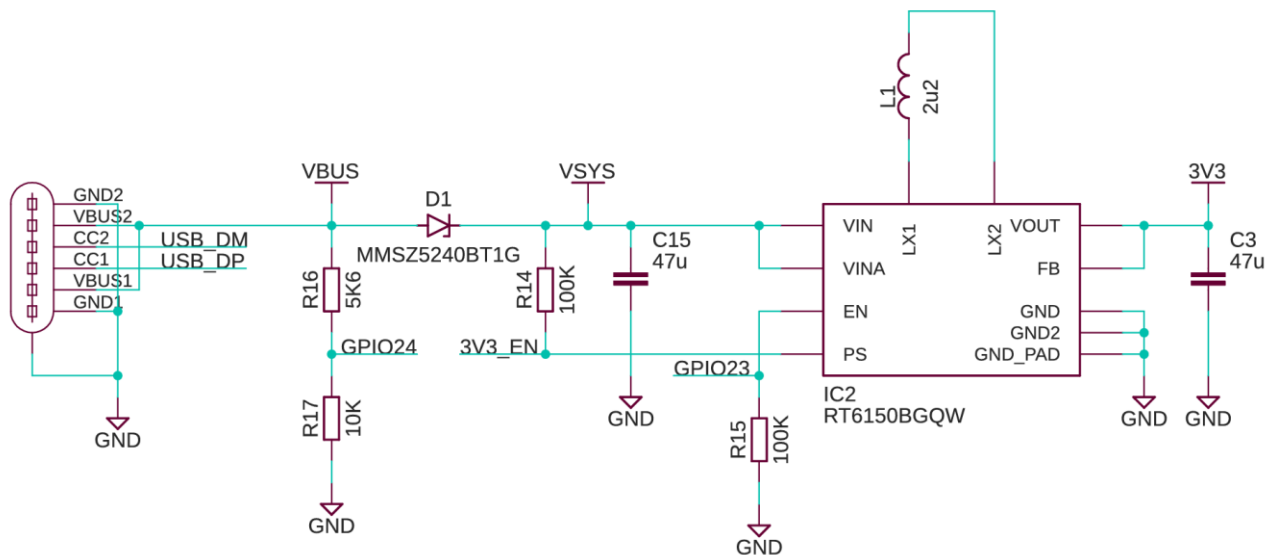
VR1 – Voltage Converter from 12V to 5V

The first chip, VR1, reduces the ignition voltage, which ideally measures 12 volts, to a stable output voltage of 5 volts. This ensures that the subsequent components receive a consistent supply voltage, regardless of potential fluctuations in the ignition voltage.



IC2 – Voltage Converter from 5V to 3.3V

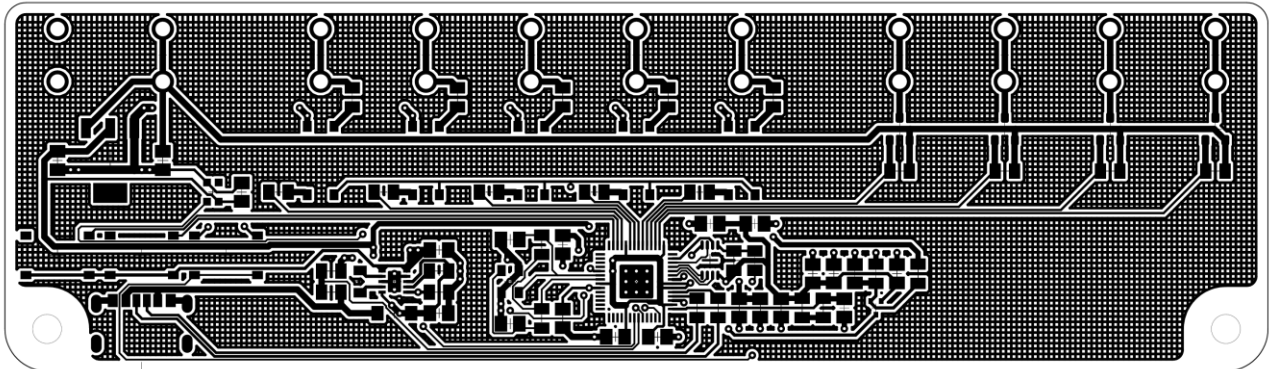
The second chip, IC2, steps down the 5 volts, supplied either by VR1 or the USB-C port, to 3.3 volts. This regulated 3.3-volt output is then forwarded to the RP2040 microcontroller to ensure its proper operation.



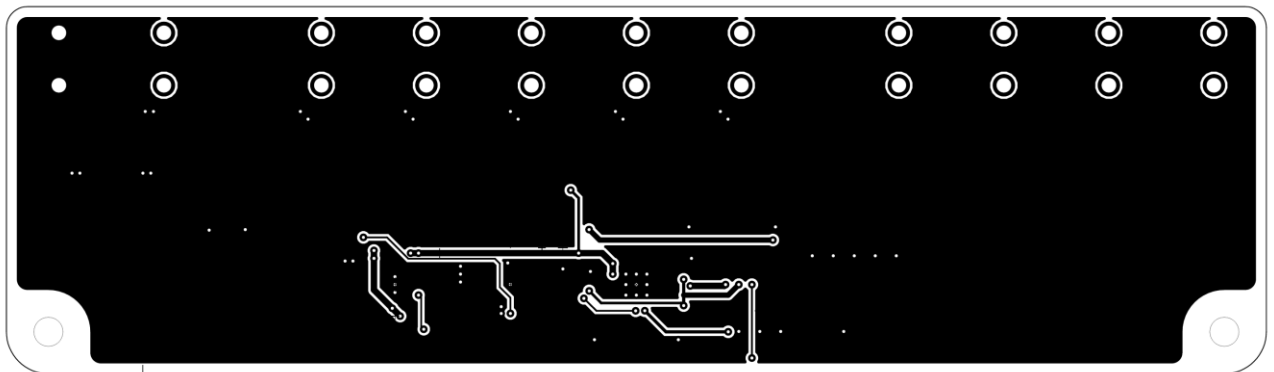
Design files

Layout

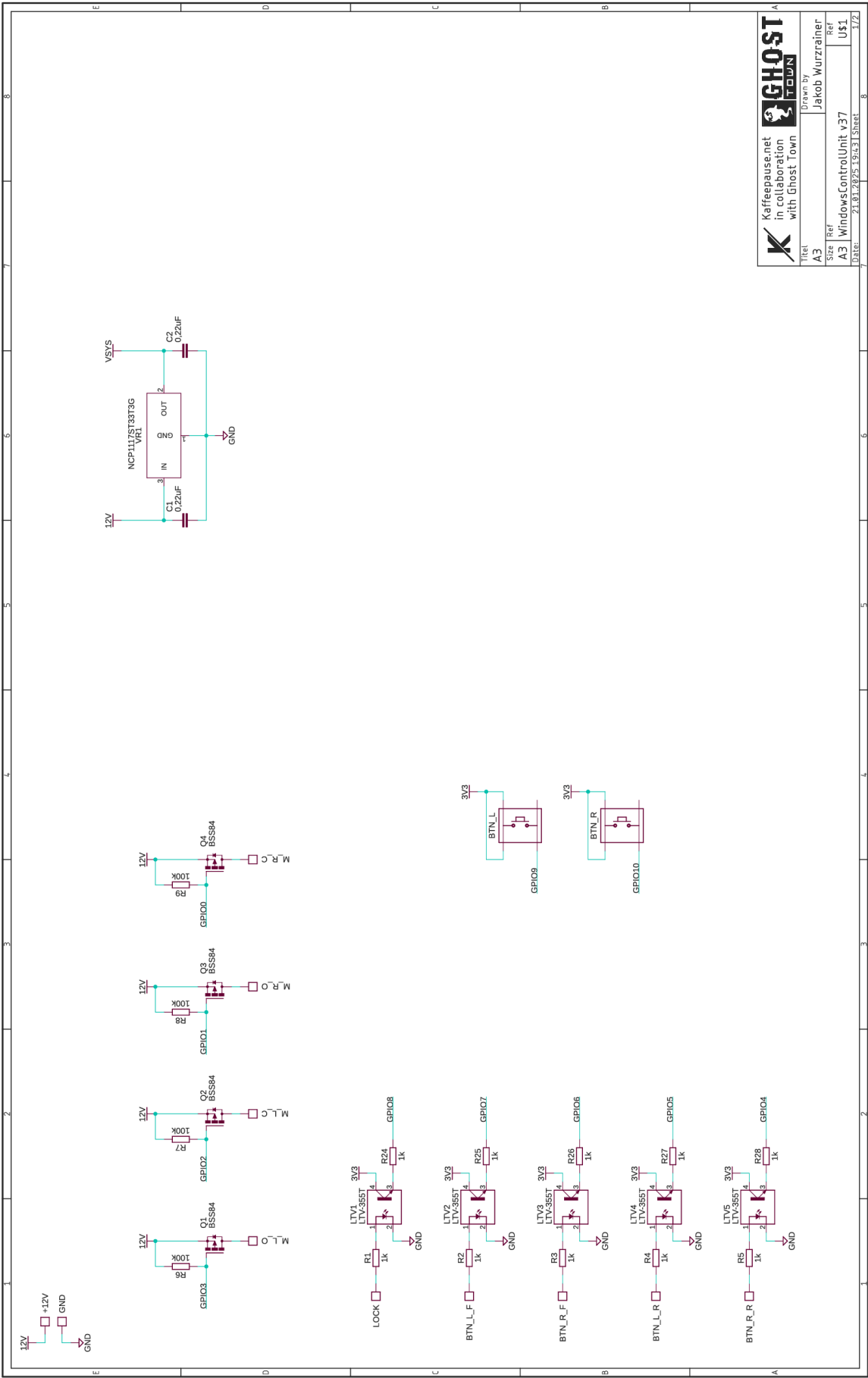
Top view:

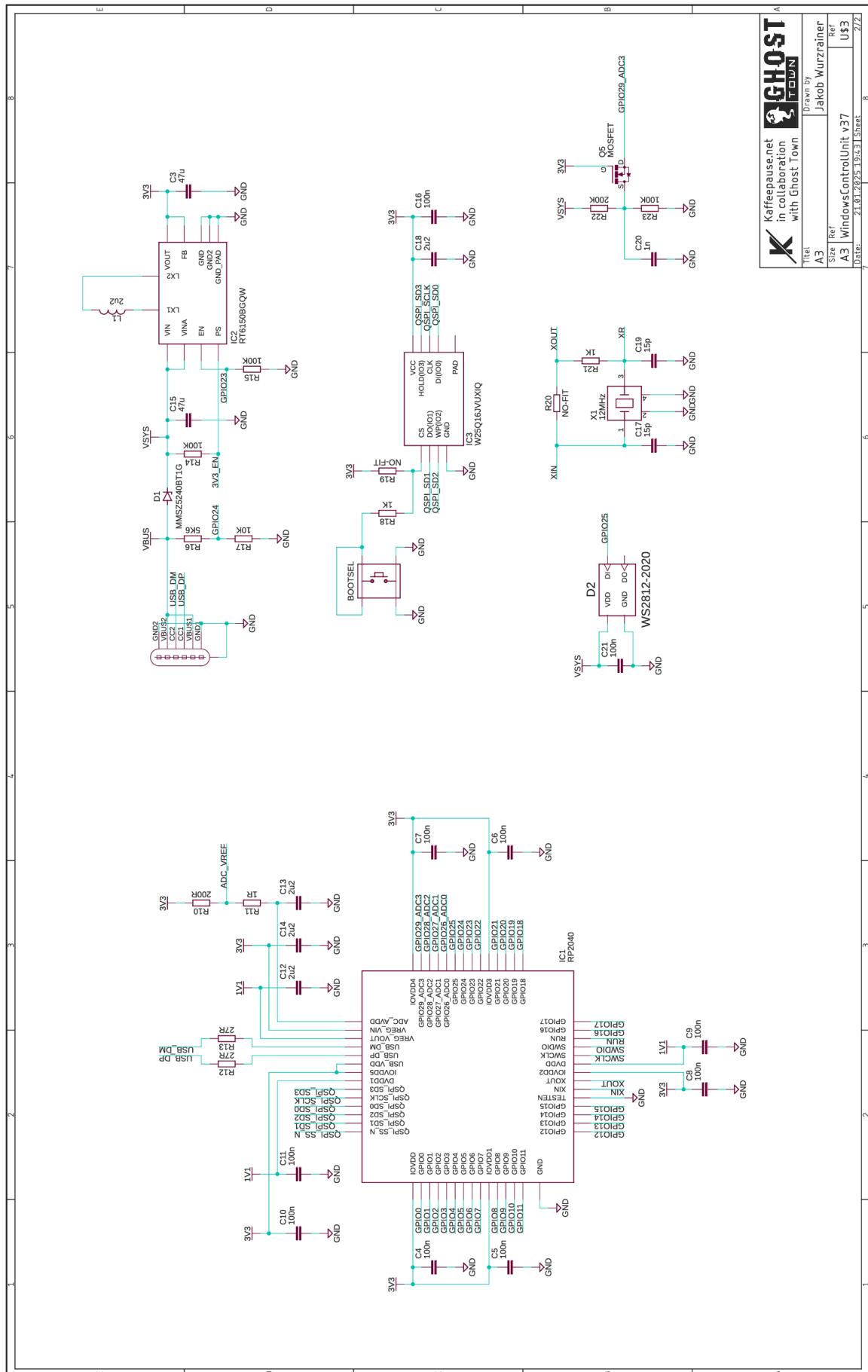


Bottom view:



Schematic

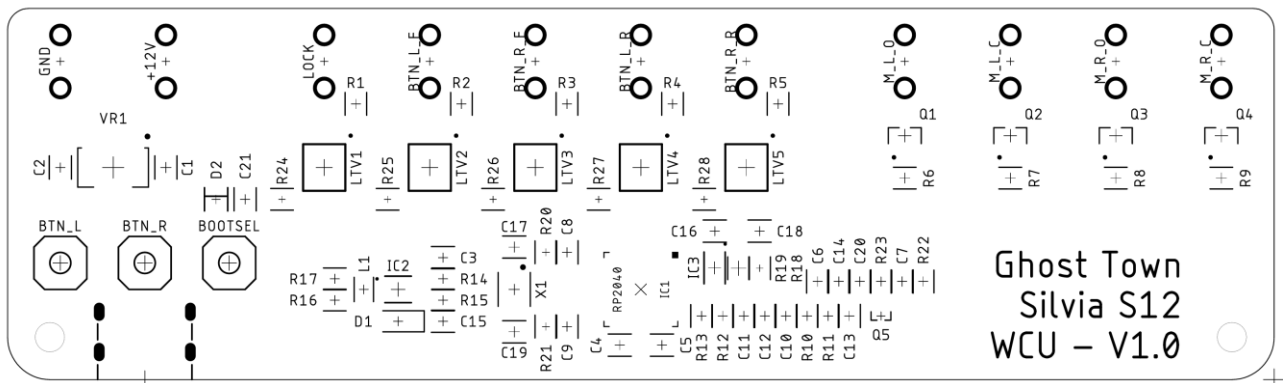




Component

Locations

Top view:



Part list

QTY	Parts	Value	Manufacturer	Mfr.Part Nr.	Footprint
1	IC1		Raspberry Pi	RP2040	LQFN-56(7x7)
1	IC2		Richtek Tech	RT6150BGQW	WS0N-10-EP(2.5x2.5)
1	IC3		Winbond Elec	W25Q16JVUX-IQ	US0N-8-EP(2x3)
1	VR1		Texas Instruments	LM7805MP/N OPB	SOT-223-4
2	C17, C19	15p			0805
1	C20	1n			0805
10	C4, C5, C6, C7, C8, C9, C10, C11, C16, C21	100n			0805
2	C1, C2	0,22u			0805
4	C12, C13, C14, C18	2u2			0805
2	C3, C15	47u			0805
2	R19, R20	NO-FIT			0805
1	R11	1R			0805
2	R12, R13	27R			0805
1	R10	200R			0805
12	R1, R2, R3, R4, R5, R18, R21, R24, R25, R26, R27, R28	1k			0805
1	R16	5k6			0805
1	R17	10k			0805
7	R6, R7, R8, R9, R14, R15, R23	100k			0805
1	R22	200k			0805
1	X1	12MHz	Suzhou Liming Elec	3225-12-18-10-10/A	SMD3225-4P
1	L1	2u2			0805

11	+12V, BTN_L_F, BTN_L_R, BTN_R_F, BTN_R_R, GND, LOCK, M_L_C, M_L_O, M_R_C, M_R_O		SAMZO	G630-10-1W	
4	Q1, Q2, Q3, Q4		HXY MOSFET	DMG2307L- HXY	SOT-23
3	BOOTSEL, BTN_L, BTN_R		XKB Connection	TS-1187A-B- A-B	
5	LTV1, LTV2, LTV3, LTV4, LTV5		Lite-On	LTV-355T	SOP-4-2.54mm
1	D1		onsemi	MBR120VLSF T1G	SOD-123FL
1	D2		Worldsemi	WS2812B- 2020	
1	Q5		TECH PUBLIC	DMG1012T	SOT-523-3
1			SHOU HAN	TYPE-C 6P(073)	

Release History

23 Jan 2025

Initial release.

05 Feb 2025

Internal wiring to the GPIOs added.

Minor text errors corrected.

Minor reformatting of the text.