Test Project

Module C – Modification and Measurement

Electronics

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Introduction to Test Project

This Test Project includes the following files:

- WSC2026_MMM_Datasheets.zip
- **WSC2026_Electronics_MMM_Test_Project(This File)**
- WSC2026_MMM_BLUE_Sheet
- WSC2026_MMM_GREEN_Sheet

Introduction

This product is a basic signal generator. Figure 1 shows the printed circuit board (PCB) of the signal generator.

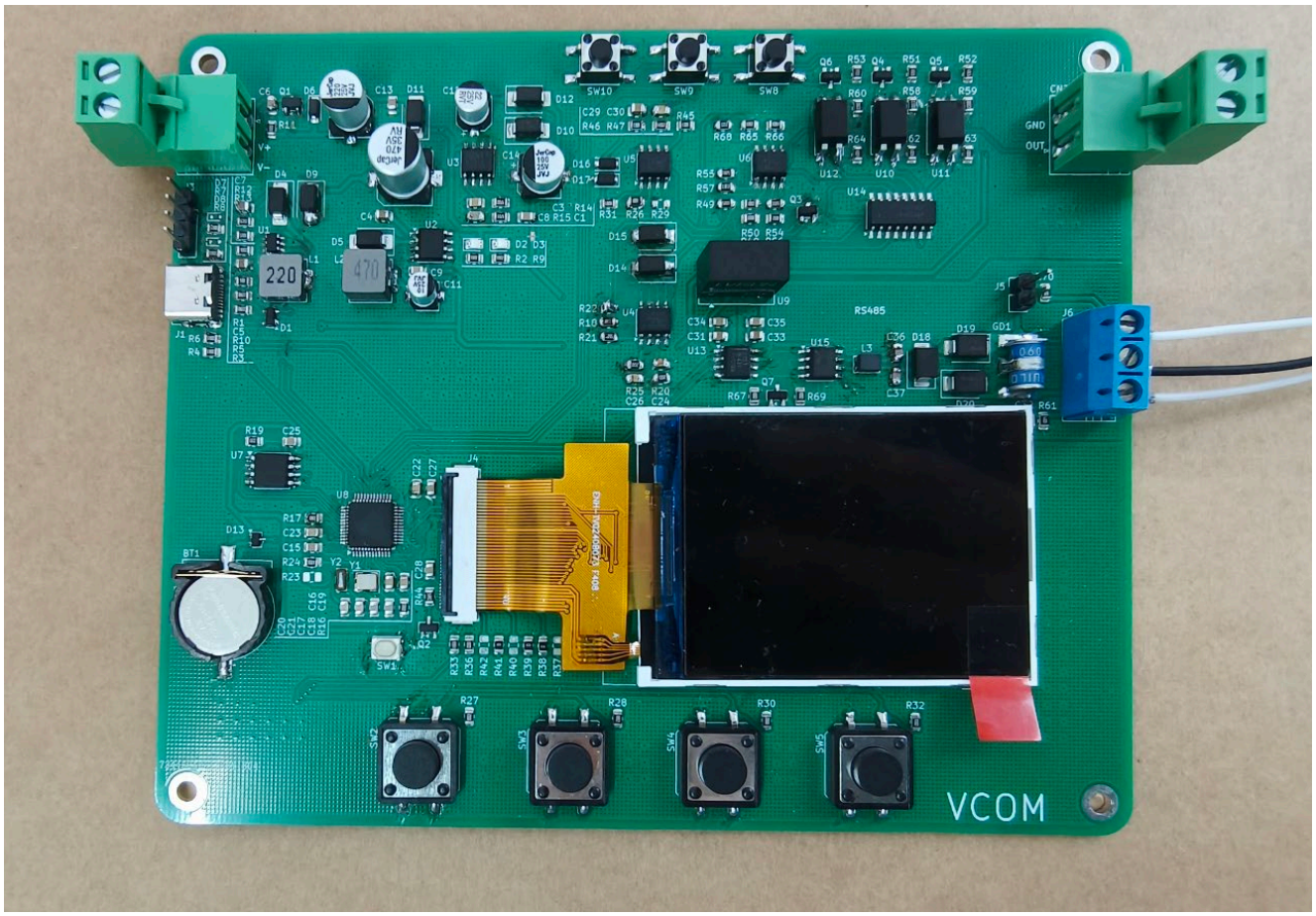


Figure 1：Signal Generator Printed Circuit Board (PCB)

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Figure 2 shows the block diagram of the system.

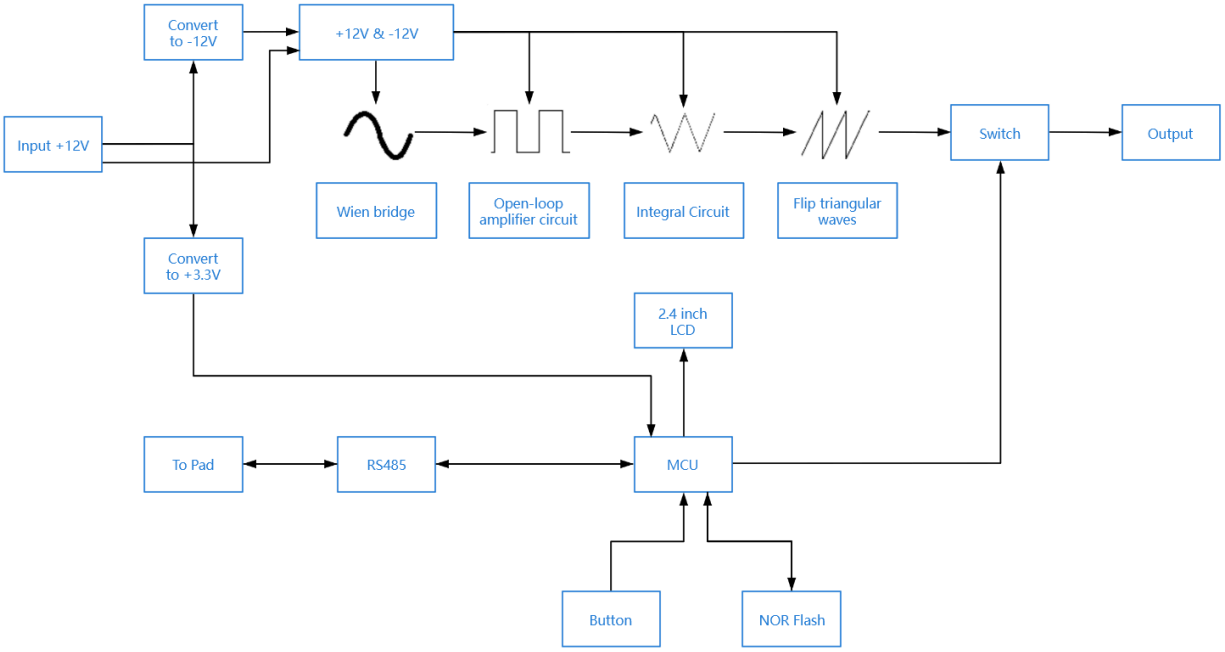


Figure 2： Block Diagram of the Signal Generator

The following is a brief description of each block in the diagram:
Power Supply:

1. A +12 V input is stepped down through a PWM (step-down) DC/DC converter to generate a +3.3 V supply, while a 555 circuit generates a –12 V supply.
2. A +5 V power supply can also be input through USB and boosted to generate a +12 V supply.
3. Either the +12 V input or the +5 V input can be selected for operation.

Signal Generation:

1. A sinusoidal signal is generated using a Wien bridge circuit.
2. The sinusoidal signal is passed through an open-loop amplifier to generate a square wave signal.
3. The square wave signal is integrated to generate a triangular wave signal.
4. The square wave signal is inverted and summed with the triangular wave signal to generate a frequency-doubled sawtooth waveform.

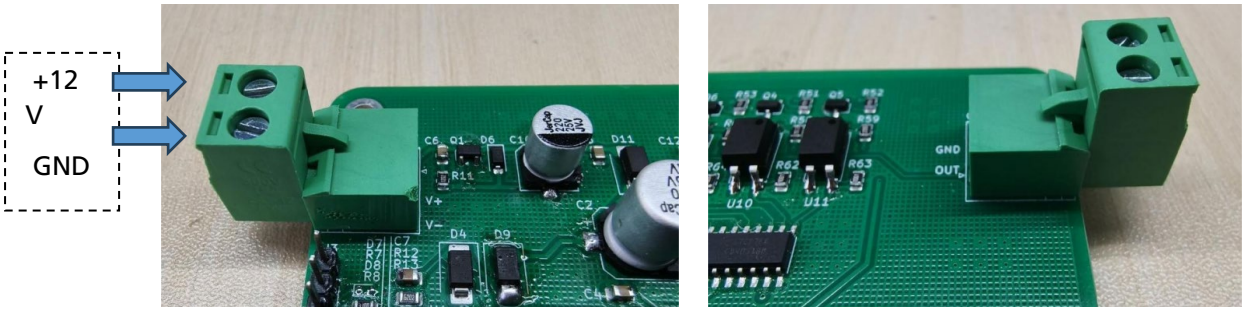
MCU:

1. The microcontroller communicates with a tablet via RS485, enabling remote control from the tablet.
2. Through keypad input, the desired output signal type can be selected on the LCD interface, allowing the electronic switch to route the target signal for output.

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Hardware Operation:

1. Connect the DC 12 V power supply at the upper-left port; the upper-right port is the waveform signal output terminal.

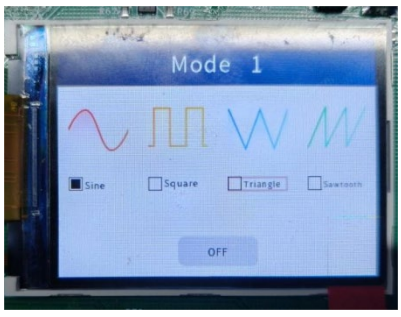


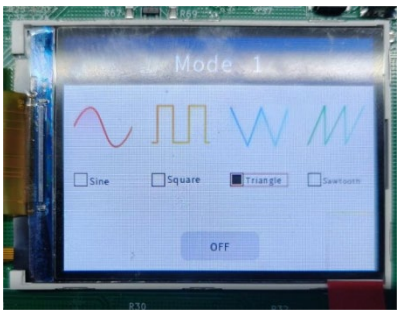
(Power Input) (Signal Output)

2. From left to right, the button functions are: Left, Right, Confirm, and Return.

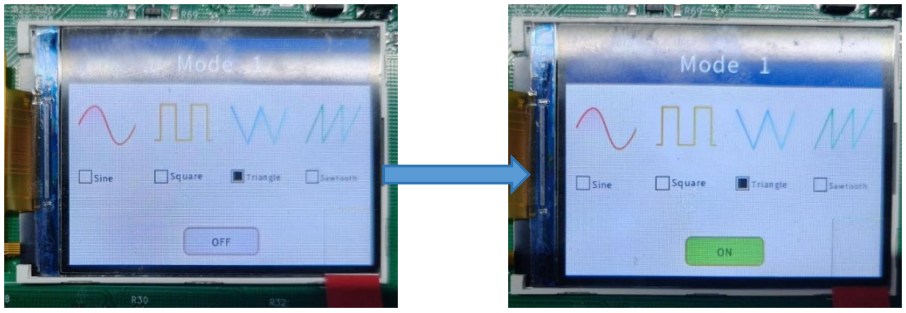


3. Select Mode 1. Use the buttons to move the selection box and choose the waveform to be output, then press the Confirm button. Move the selection box to “OFF” and press Confirm; “OFF” will switch to “ON,” enabling output of the corresponding signal. Press “ON” again, and it will switch to “OFF,” stopping the signal output.

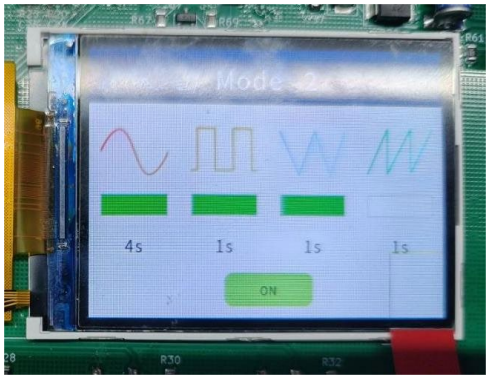




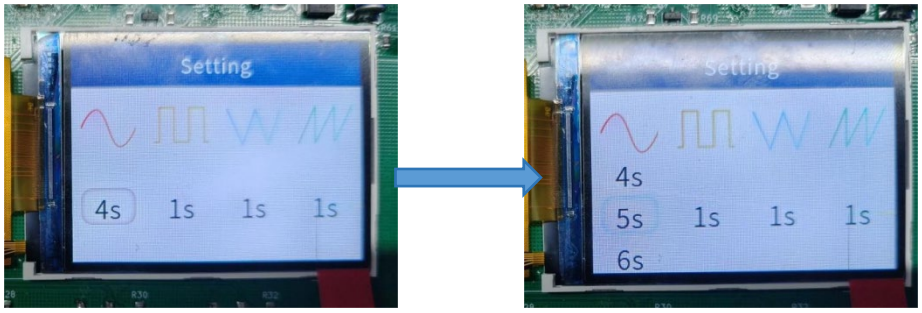
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4. Select Mode 2 and press the Confirm button directly; the signals will be automatically output once in sequence according to the preset timing. After the output cycle is completed, press the Confirm button again to restart signal output.

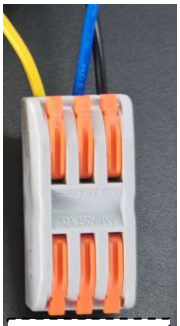


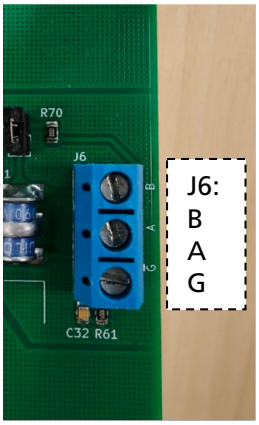
5. Select the Settings function to configure the output duration of the four signals in Mode 2. Use the buttons to move the selection box and choose the corresponding waveform. Press and hold the Confirm button to enter the time-setting menu, select the desired duration using the selection box, and press Return to save automatically.

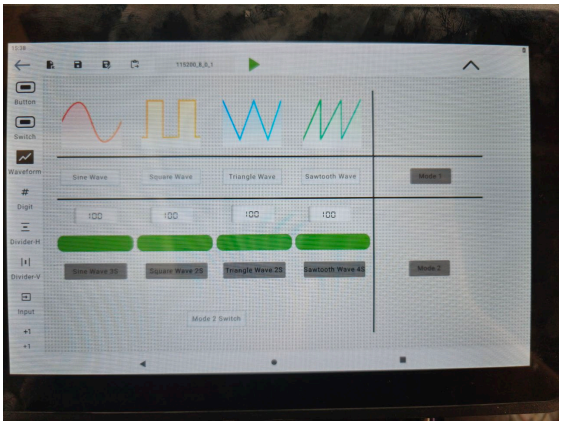


6. Connect the tablet via RS485. Using the 10-inch tablet, the same functions described above can be performed.

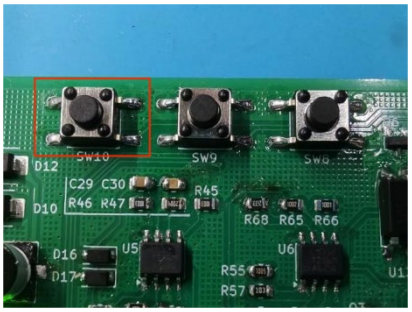
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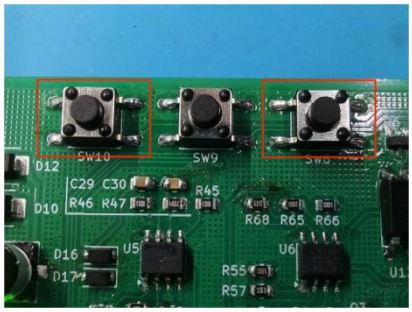




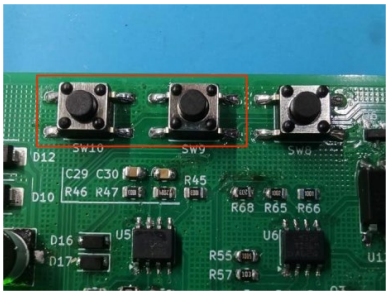
7. Press the test button according to different combinations to force the output of the corresponding waveform signal.



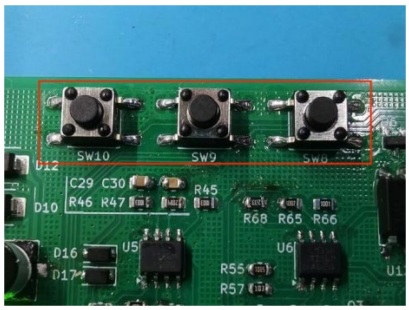
(Force Output of Sinusoidal Signal)



(Force Output of Square Wave Signal)

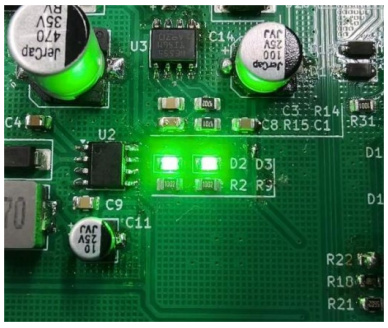


(Force Output of Triangular Wave Signal)



(Force Output of Sawtooth Signal)

8. Power indicator LEDs: D2 is the +12 V power indicator, and D3 is the –12 V power indicator.



(LED power indicators)

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Instructions to the Competitor

Time allowed: 3 hours.

- A +12 V power supply or +5 V power supply via USB interface is required.
- Identify 8 modifications and order new components from the experts where necessary. If a fault does not require component replacement, the fault must still be diagnosed or repaired.
- Once a fault is identified, record the modification in the Modification Record and Repair Sheet (WSC2026_MMM_GREEN_Sheet.docx) using symbols and technical notation.
- Take measurements for each modification/repair (when requested) using the appropriate instrument (oscilloscope and/or multimeter) and record them on the blue sheet (WSC2026_MMM_BLUE_Sheet.docx).
- After the first 2 hours:
    - Competitors may request the answers.
    - The marking team will collect the files from Competitors who request the answers.
- At the end of the allotted time, experts will collect your work for assessment. All files must be saved in the Competitor results directory. No additional time will be provided to generate files.

Competitors must complete the tasks sequentially. The waveform generator circuit should be addressed stage by stage, with earlier stages completed before proceeding to later ones. If the power supply voltages do not meet the required specifications, this will adversely affect waveform generation.

Description of project and tasks

- Modification/Repair 1: Under loaded conditions, the negative voltage circuit should output a voltage within the range of –9 V to –12 V. Inspect the circuit and carry out repair/modification.
- Modification/Repair 2: In the sinusoidal circuit, when the signal frequency is between 700–800 Hz, the amplitude of the sinusoidal signal should be below 8 V. Inspect the circuit and carry out repair/modification.
- Modification/Repair 3: The output frequency of the sinusoidal signal should be 300 Hz±10%. Inspect the circuit and carry out repair/modification.

- Modification/Repair 4: The triangular wave signal waveform is abnormal. Inspect the circuit and carry out repair/modification.
- Modification/Repair 5: The waveform selection circuit is not functioning properly. Inspect the circuit and carry out repair/modification.
- Modification/Repair 6: The output amplitude of the sinusoidal signal should be **2.4 times ±15%** of the original output signal. Inspect the circuit and carry out repair/modification.
- Modification/Repair 7: The LCD backlight is not functioning properly. Inspect the circuit and carry out repair/modification.
- Modification/Repair 8: RS485 communication is abnormal. Inspect the circuit and carry out repair/modification.

BOM List

NAME	SPECIFICATION	REFERENCE DESIGNATOR	QTY
Battery Holder	1220	BT1	1
Coin Cell Battery	CR1220	—	1
SMD Capacitor	100 nF	C1, C6, C11, C13	4
SMD Electrolytic Capacitor	470 µF	C2	1
SMD Capacitor	10 nF	C3, C24, C26, C30	4
SMD Capacitor	1 µF	C4, C29, C31, C33	4
SMD Capacitor	22 µF	C5, C7	2
SMD Capacitor	15 nF	C8	1
SMD Electrolytic Capacitor	10 µF	C9	1
SMD Electrolytic Capacitor	220 µF	C10	1
SMD Electrolytic Capacitor	22 µF	C12	1
SMD Electrolytic Capacitor	100 µF	C14	1
SMD Capacitor	0.1 µF	C15, C16, C19, C22, C23, C25, C27, C28, C34, C35	10

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NAME	SPECIFICATION	REFERENCE DESIGNATOR	QTY
SMD Capacitor	22 pF	C17, C18，C36，C37	4
SMD Capacitor	12 pF	C20, C21	2
SMD Capacitor	1 nF	C32	1
Pluggable Terminal Block	WJ2EDGRC-5.08-2P	CN1, CN2	2
Pluggable Terminal Block	WJ2EDGK-5.08-2P	—	2
Surge Protector	PRTR5V0U2X	D1	1
LED	LED_G	D2, D3	2
Schottky Diode	SS14	D4, D5, D9, D10, D11, D12	6
Zener Diode	MMSZ5242B	D6	1
Schottky Diode	BAT54CW	D13	1
Diode	SS14	D14, D15	2
Zener Diode	BZT52C3V3S	D16, D17	2
Surge Protector	SMBJ6.5CA	D18, D19, D20	3
Gas Discharge Tube	3R090A-5S	GD1	1

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NAME	SPECIFICATION	REFERENCE DESIGNATOR	QTY
USB Connector	Type-C 16 Pin	J1	1
Pin Header	4 Pin	J3	1
FPC Connector	FPC-05FB-40PH20	J4	1
LCD Display	2.4-inch / Color	—	1
Pin Header	2 Pin	J5	1
Screw Terminal Block	KF301-5.0-3P	J6	1
SMD Inductor	22 µH	L1	1
SMD Inductor	47 µH	L2	1
Common Mode Filter	ACP3225-102-2P-T000	L3	1
MOSFET	AO3407A	Q1	1
Transistor	S9014	Q3	1
Transistor	S8050	Q4, Q5, Q6	3
Transistor	SS8050	Q7	1
Transistor	SS8550	Q2	1

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NAME	SPECIFICATION	REFERENCE DESIGNATOR	QTY
SMD Resistor	10 kΩ	R1, R2, R9, R16, R17, R19, R27, R28, R30, R32, R36, R48, R50, R56, R57, R65, R67, R69	18
SMD Resistor	22 Ω	R3, R5	2
SMD Resistor	5.1 kΩ	R4, R10	2
SMD Resistor	43 kΩ	R6	1
SMD Resistor	12 kΩ	R11	1
SMD Resistor	62 kΩ	R12	1
SMD Resistor	3.3 kΩ	R13	1
SMD Resistor	47 kΩ	R14	1
SMD Resistor	4.7 kΩ	R15, R51, R52, R53	4
SMD Resistor	18 kΩ	R18	1
SMD Resistor	20 kΩ	R20, R25	2
SMD Resistor	56 kΩ	R21	1
SMD Resistor	51 kΩ	R22	1
SMD Resistor	100 kΩ	R45, R46	2

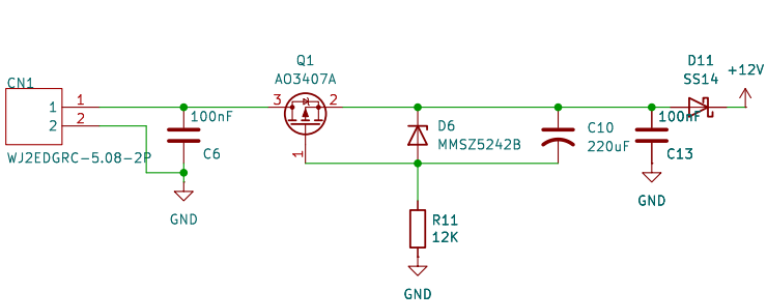
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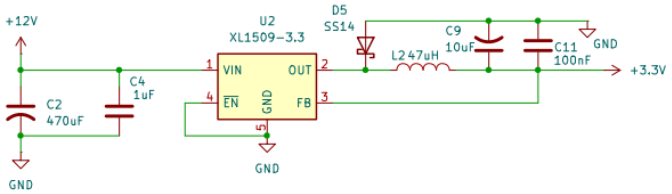
NAME	SPECIFICATION	REFERENCE DESIGNATOR	QTY
SMD Resistor	NC	R23, R37, R40, R42	4
SMD Resistor	1 kΩ	R24, R26, R31, R33, R66	6
SMD Resistor	0 Ω	R38, R39, R41	3
SMD Resistor	5.1 Ω	R44	1
SMD Resistor	2 MΩ	R47	1
SMD Resistor	5 kΩ	R49, R54, R55	3
SMD Resistor	220 Ω	R58, R59, R60	3
SMD Resistor	1 MΩ	R61	1
SMD Resistor	8.2 kΩ	R68	1
SMD Resistor	120 Ω	R70	1
Tact Switch	SW_SPST	SW1	1
Tact Switch	Button 12x12	SW2, SW3, SW4, SW5	4
Tact Switch	Button 6x6	SW8, SW9, SW10	3
DC-DC Power IC	MT3608	U1	1

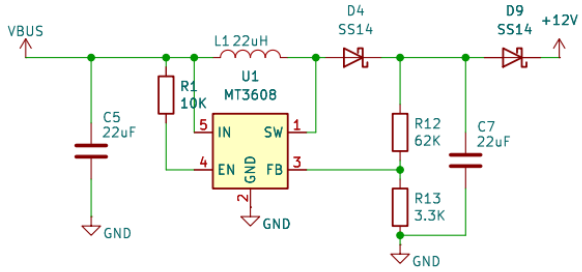
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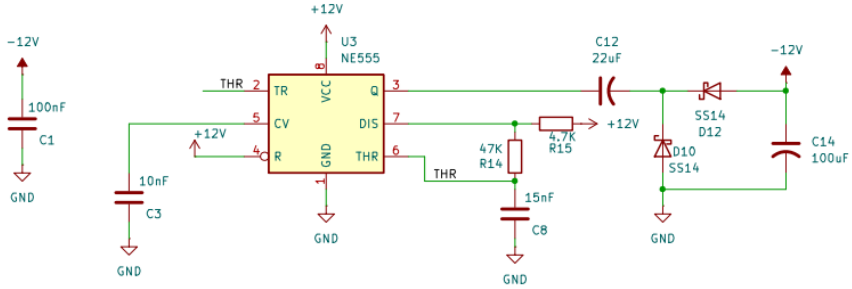
NAME	SPECIFICATION	REFERENCE DESIGNATOR	QTY
DC-DC Power IC	XL1509-3.3	U2	1
Timer	NA555D	U3	1
Operational Amplifier	LM358	U4, U5, U6	3
NOR Flash	W25Q64JVSS	U7	1
Microcontroller	MH22D3CSU6	U8	1
Isolated Power Module	IB0303S-W75R3	U9	1
Optocoupler	TLP521GB-S	U10, U11, U12	3
Digital Isolator	ISO7721	U13	1
Multiplexer	CD4051B	U14	1
RS485 Transceiver	MAX3485	U15	1
Crystal Oscillator	8 MHz	Y1	1
Crystal Oscillator	32.768 kHz	Y2	1

Schematic Diagram (Page 1)



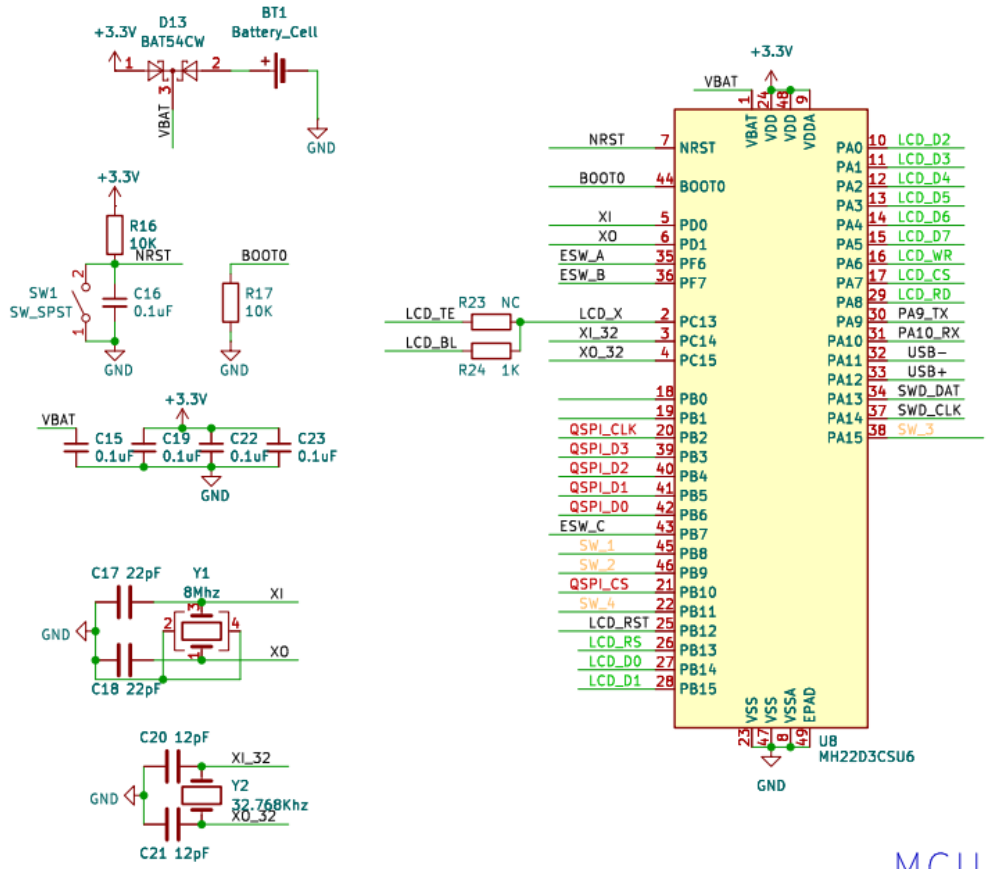


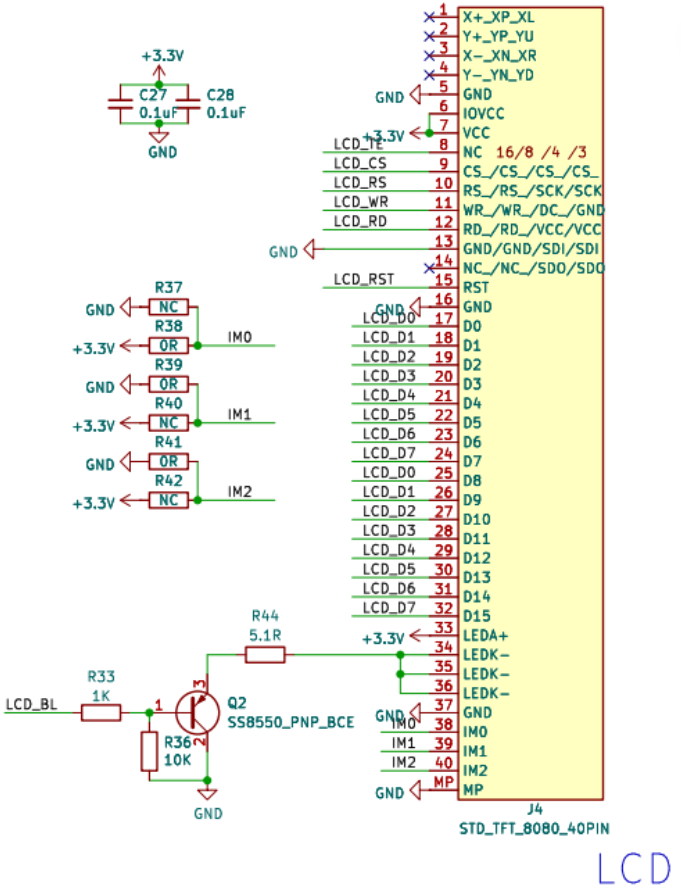




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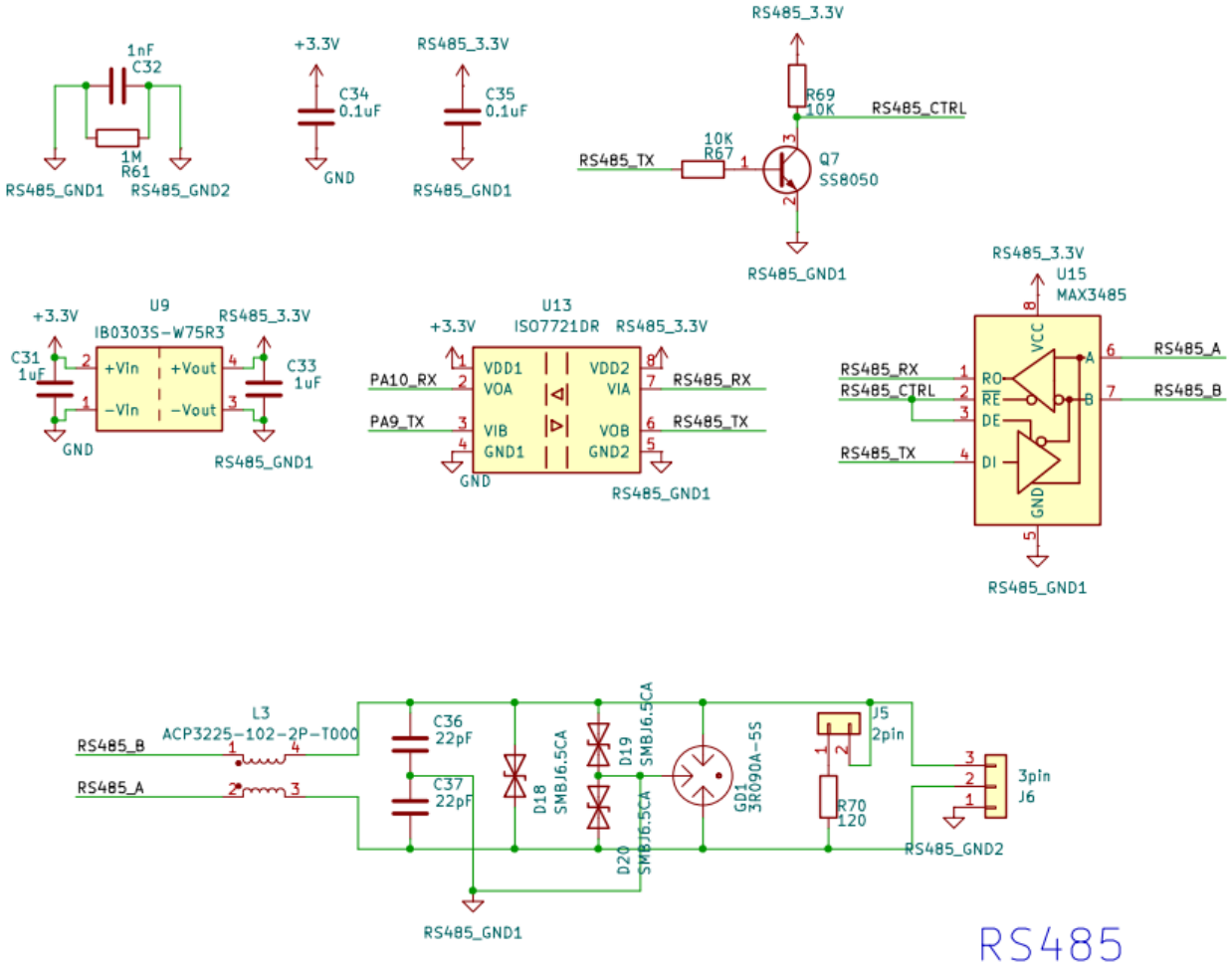
Schematic Diagram (Page 2)





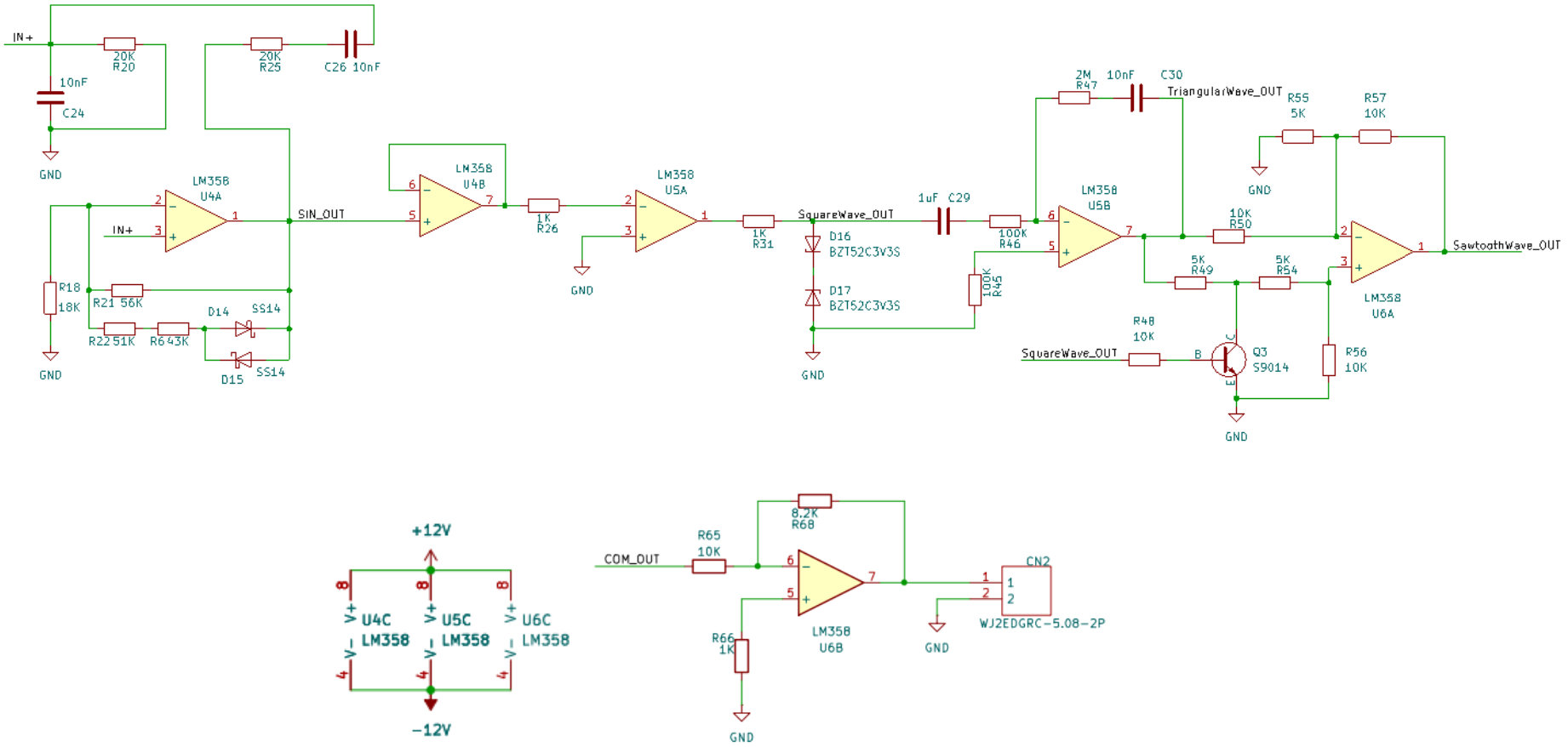
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Schematic Diagram (Page 3)



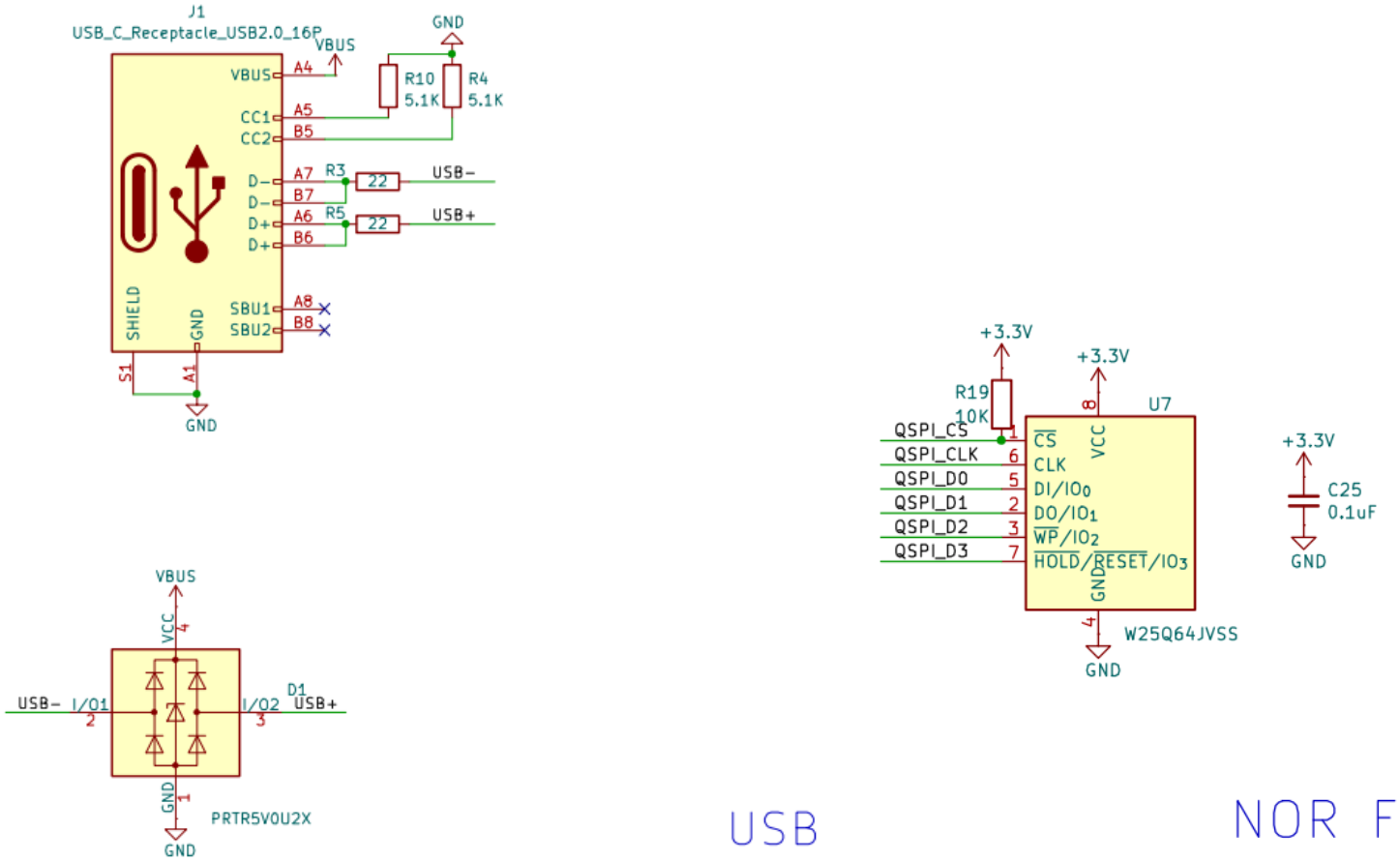
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Schematic Diagram (Page 4)



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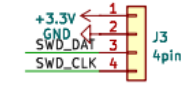
Schematic Diagram (Page 5)



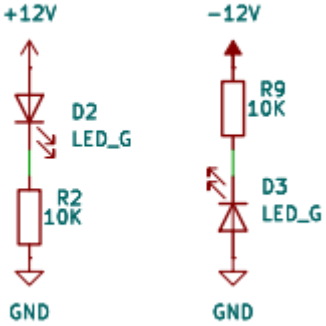
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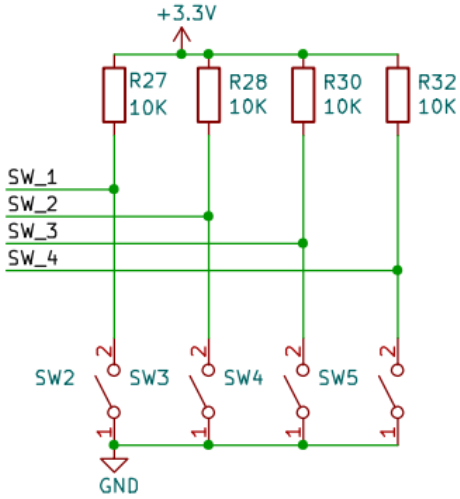
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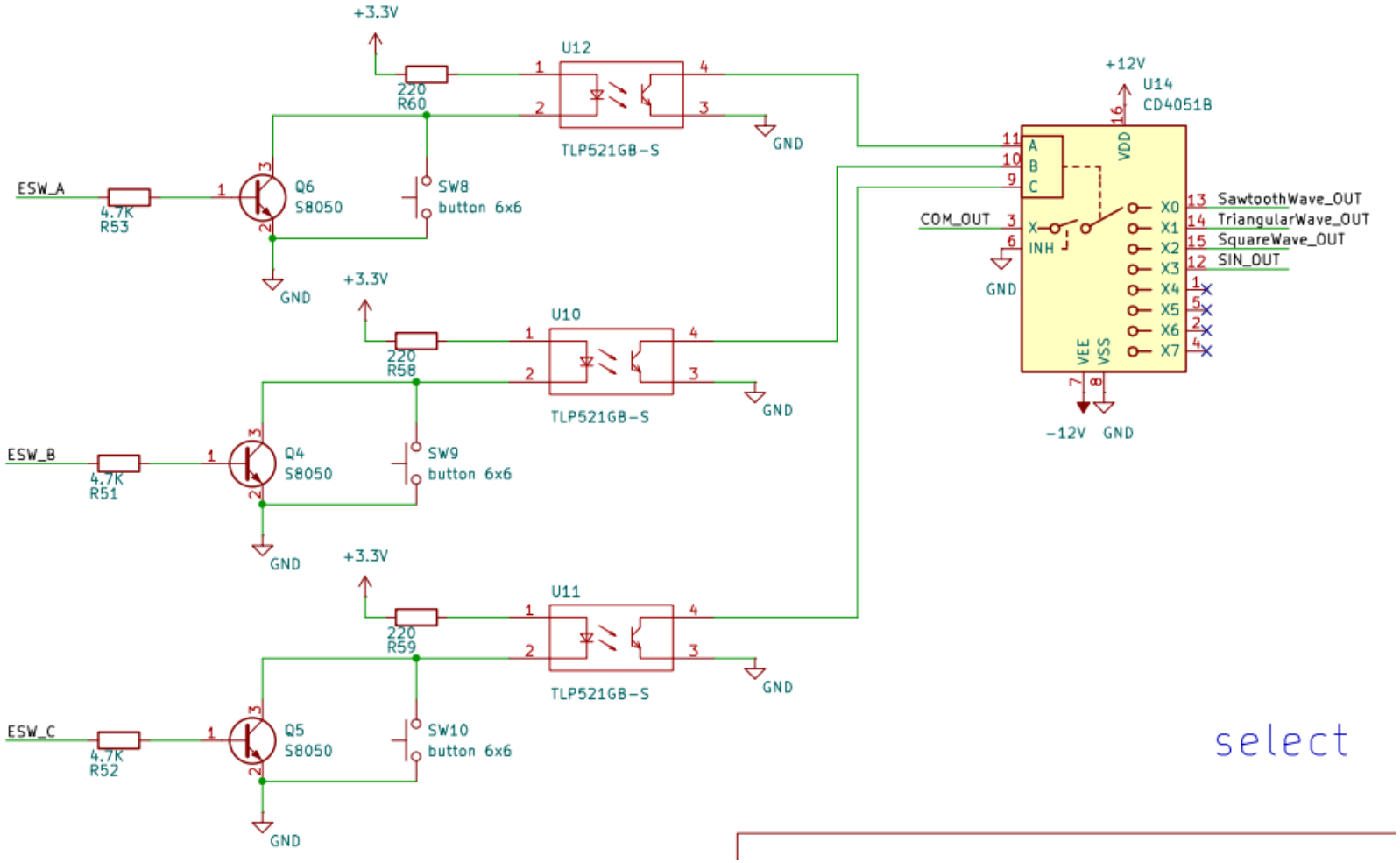






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Schematic Diagram (Page 7)



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