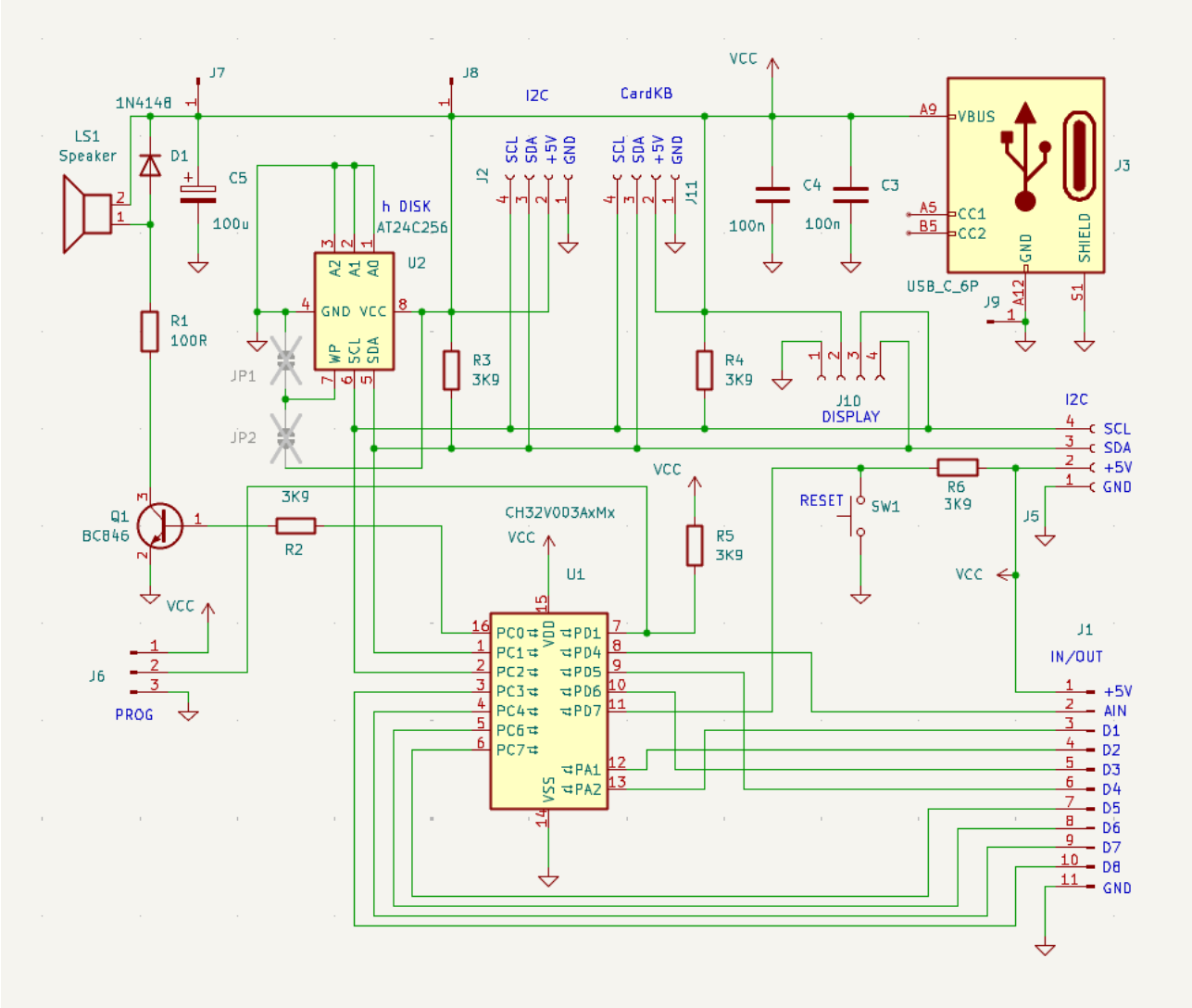
Hardware description TinyBasRO ver. 1.0

Parameters:

Supply voltage:	5 V
Current consumption:	200 mA max
Number of inputs and outputs:	8 x digital + 1 analog input
Expansion modules:	expander with PCF8575, module with I2C memory

The TinyBasRO microcomputer is a simple circuit that allows a novice electrician to build their own easy-to-use and programmable computer. To use it, you just need to connect a +5V power supply, an I2C CardKB keyboard from M5STACK, and a 128x128 OLED display.
All computer components are located on one side of a two-layer printed circuit board measuring 34 x 47 mm. The complete circuit diagram is shown in the following figure.



Computer core

The components necessary for the computer to function are integrated circuits U1 and U2, resistors R3 and R4, capacitors C3 to C5 and connectors J10 and J11. This represents the minimum number of components that must be mounted on the printed circuit board.
The control 32-bit RISC-V processor U1 receives commands from the keyboard connected to connector J11. Resistors R3 and R4 maintain a level of log. 1 on the I2C bus for the keyboard and display. The output for the user is information displayed on the OLED display via connector J10. The processor has data with the program stored in the EEPROM of the serial memory U2. Communication with it takes place via the I2C bus. The memory U2, designated as "DISK h", has all address inputs A0 to A2 connected to log. 0 and thus has the address set to 0. The SMD memory and the processor are permanently soldered to the board. Tin jumpers JP1 and JP2 determine whether the U2 memory is in "Read only" mode when JP2 is connected, or whether its contents can be changed (jumper JP1).
The remaining components, i.e. capacitors C3 to C5, are used to block the supply voltage.

Computer power supply

The computer requires a stabilized +5V power supply. This can be connected directly to the printed circuit board using wires in the holes next to the OLED connector (J8 is +, J9 is GND). It is also possible to power the computer from a regular AC adapter with a USB Type-C connector. The board has contact areas for soldering a 6-pin Type-C power connector.

Optional parts:

Audio output

To emit various tones computers has a sound section. The basis is a miniature speaker LS1 driven by a transistor Q1. Resistor R1 limits the current flowing through the speaker and R2 determines the current to the base of the transistor. Diode D1 is protective and serves to suppress voltage peaks that would arise when the current through the speaker is turned off.

RESET

If the computer stops responding to user commands, it can be reset to its initial state by pressing the RESET button. Resistor R6 maintains a quiescent level of log. 1 on the processor reset input. After pressing the SW1 button, the level is changed to log. 0 and the computer is RESET.

I2C bus expansion

The computer has relatively few inputs and outputs in case the user wants to control larger peripherals. In this case, the I2C bus can be used, through which it communicates with the memory and display. If you install 4-pin connectors in positions J2 and J5, you can then expand the computer with an expander module or additional EEPROM memory.
The Tiny Basic language of this computer offers the possibility of directly controlling the connected PCF8575 expander board. This increases the number of digital inputs/outputs by 16. **Be careful when connecting external circuits to the I2C bus and always do it in the off state.** The bus transfers data between the processor and the memories and an interfering signal can damage the written program.
Memory expansion for storing multiple programs or for transferring programs between multiple TinyBasRO computers can be arranged by connecting an external module with serial I2C memory, such as those offered, for example, in Arduino parts stores, etc. The connected module must have address 1 set - i.e. A0 = 1, A1 and A2 = 0.

Inputs and outputs

On the J1 connector, the user can have several inputs and outputs for controlling various devices. One input AIN is analog and allows measuring voltages from 0 to 5V. Other inputs/outputs are digital and there are 8 of them in total. Whether a specific pin is an input or output is determined by the program. A special position is given to the digital output D1. Through D1 a string of programmable color LEDs of the WS2812 type can be controlled.

Signals on connector J1:

Pin:	**Use:**
+V	Supply voltage +5V
AIN	Analog input 0 to 5 V
D1	Digital input/output, controlling WS2812 LED string using the command "DOUT w"
D2	Digital input/output
D3	Digital input/output
D4	Digital input/output
D5	Digital input/output
D6	Digital input/output
D7	Digital input/output
D8	Digital input/output
GND	Common potential - ground

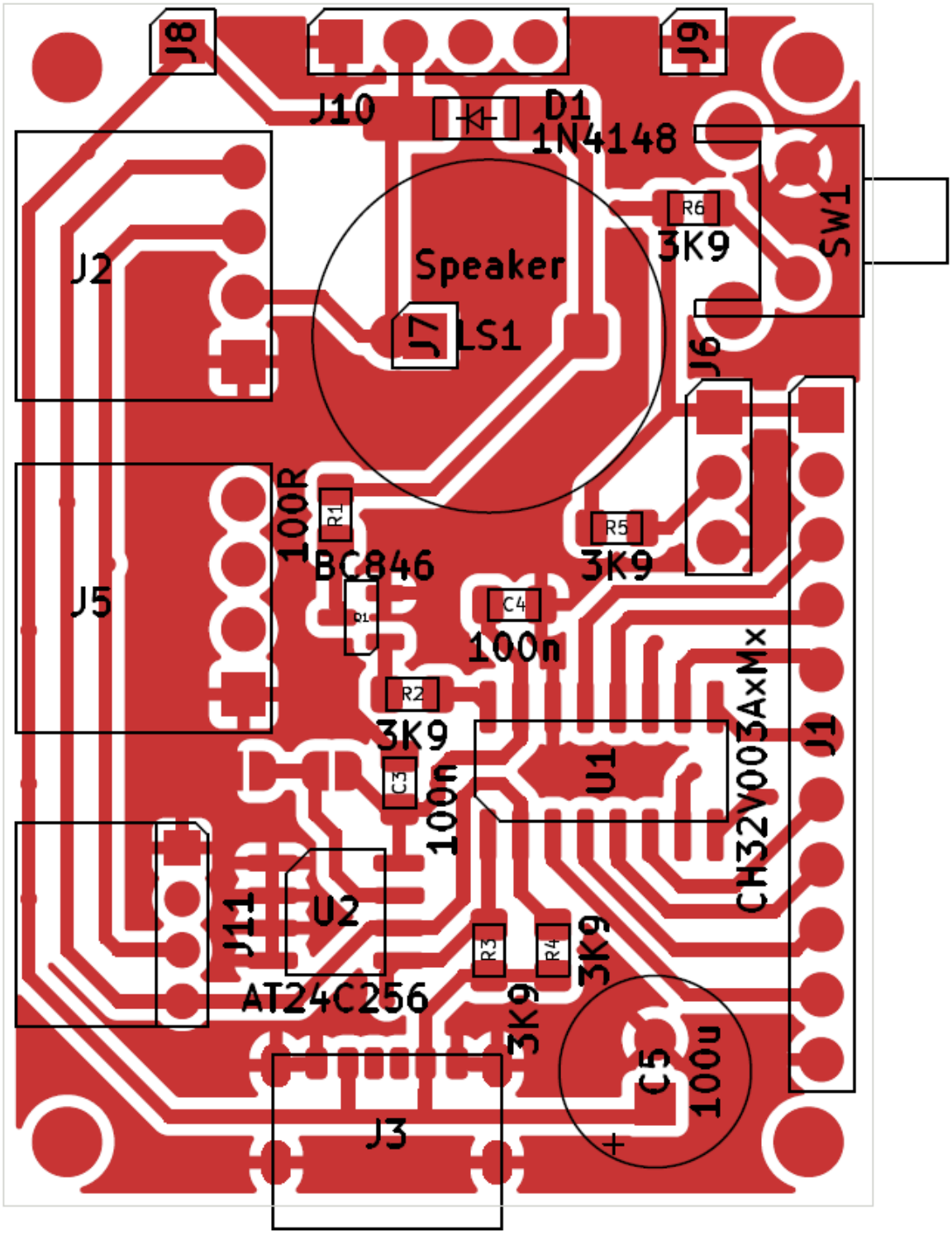
Note: Digital inputs can have a defined idle level. A so-called “Pull-up” or “Pull-down” resistor can be set on the input. The DOUT command sets the given pin to output mode and simultaneously sends a logic level to the given output. When changing the direction of the output to input using the DINP command, the pin changes to input. The last output value that was written to the given output then determines the idle value of the unconnected input.
For example, the DOUT 1,3 command causes the following DINP A,3 command to read the value 1 into the variable A of the unconnected input. After the DOUT 0,3 command, the following DINP A,3 command would read the value 0 into the variable A of the unconnected input.

Building a computer

All computer components are mounted on one side of a double-sided printed circuit board. Only the components marked above as the core of the computer need to be placed on the board and its power supply must be provided. Other components are optional.

Mechanical assembly of the computer

If you use a 128x128 OLED display with a SH1107 controller with 4 pins for the I2C bus, the mounting holes on the display board are in the same places as the mounting holes of the TinyBasRO computer. To connect the two boards, it is enough to use 4 pcs of 11 mm long spacers. In the described sample, 4 pcs of hexagonal posts with M2 thread were used for the connection, along with 4 M2 screws and nuts..

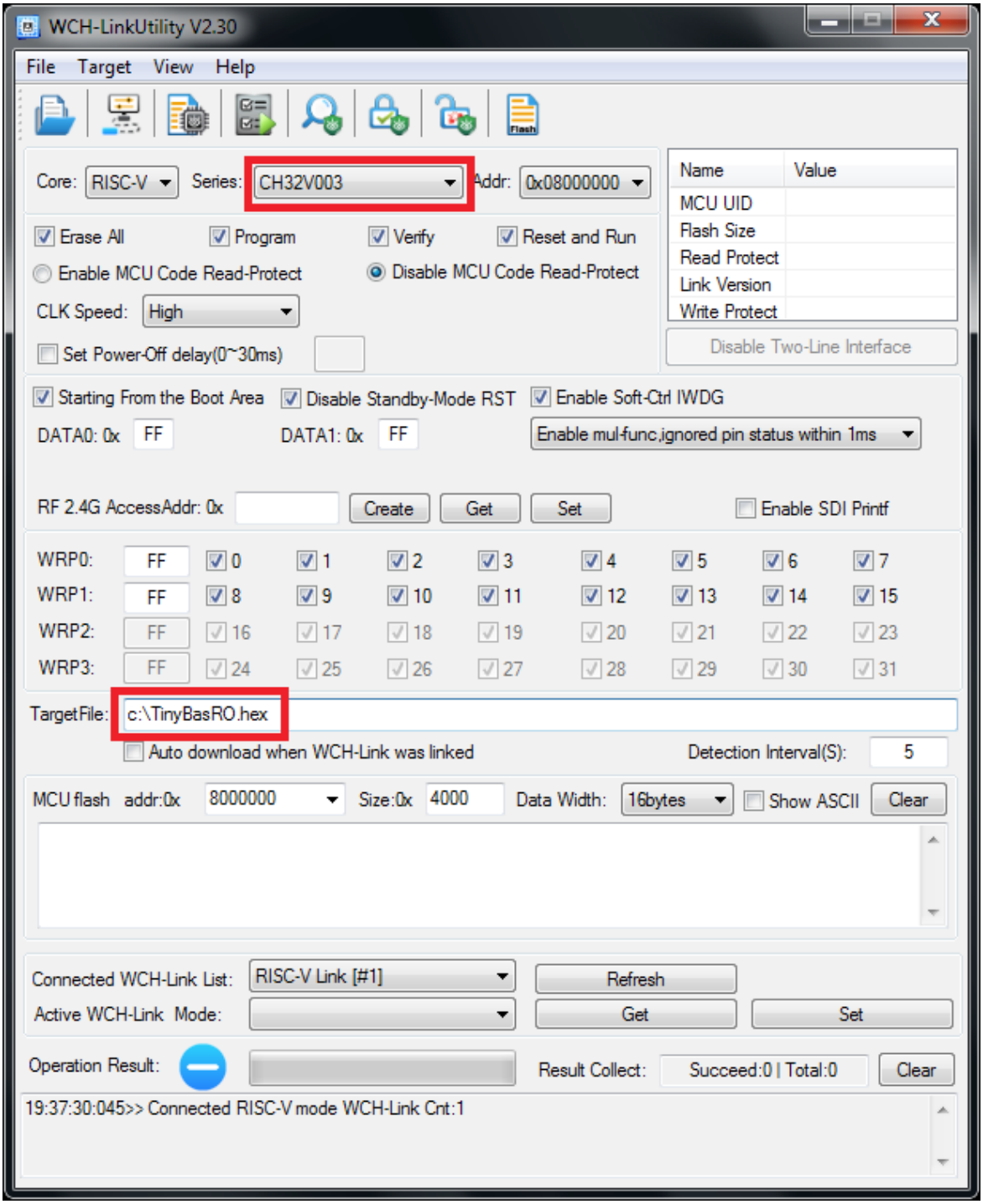


Recommended assembly procedure

When building a microcomputer, it is advisable to start by soldering the U1 processor and the C4 capacitor to the board. Then, you can use the WCH-LinkUtility program to write Tiny BASIC into the computer's memory. To write the program into the memory, you need the WCHLinkE programmer (**Caution! A programmer without an "E" will not work!**). The WCH-LinkUtility program can be found on the website of the CH32V003 processor manufacturer and is freely downloadable. In the program window, you usually just need to select the correct processor type

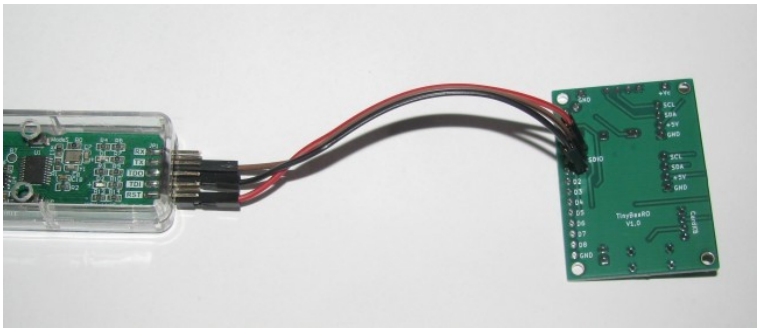
and enter the HEX file with the programming data.
The WCH-LinkUtility program is also part of the MounRiver Studio programming environment. However, it is well hidden. In version 2.10, you can find it in the folder:

c:\MounRiver\MounRiver_Studio2\resources\app\resources\win32\components\WCH\Others\SWDTool\default\WCH-LinkUtility.exe

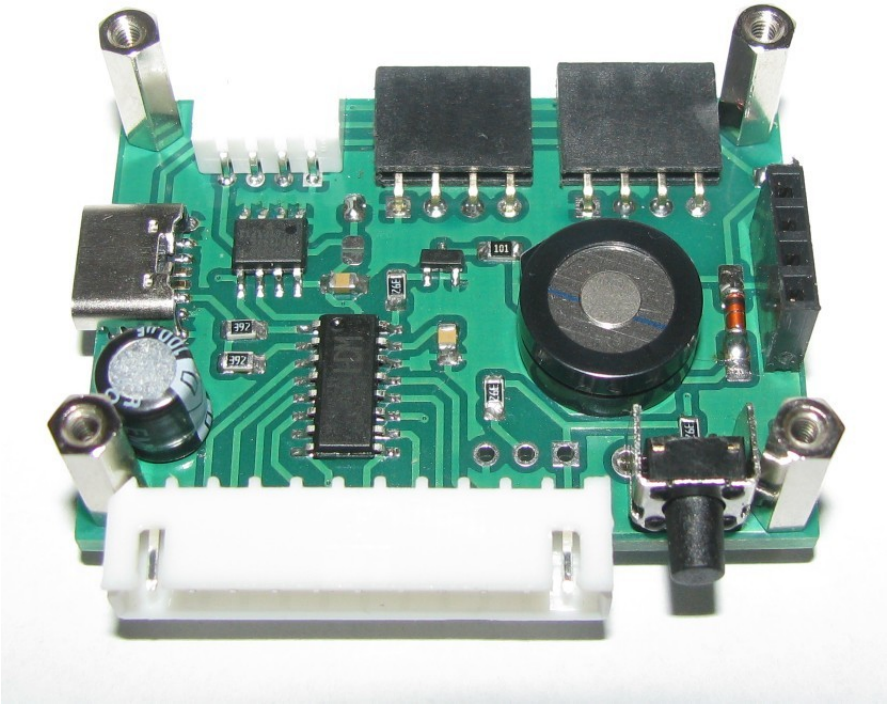


For programming purposes, the J6 connector is prepared on the board. If you do not plan to rewrite new versions of Tiny BASIC frequently, there is no need to install the connector. The WCHLinkE programmer can be connected with 3 wires directly to the holes for J6 on the board. The GND, SDIO and +5V signals on the programmer are connected to the board. Select the TinyBasRO.hex

file. Then just enter Target – Program.
If necessary, the processor content can be overwritten with a new version in the future.



After successfully programming the processor, we can proceed to installing other components. As mentioned above, it is necessary to install the computer core (U1, U2, C3 to C5, R3 and R4, J10, J11). The remaining parts of the computer and their components are optional, they are not necessary for the basic functioning of the device. For a complete computer, it is still necessary to set the permission for writing to the memory by shorting the jumper JP1 with a drop of tin.



Parts list

Position	Type	Note
U1	CH32V003A4M6	32bit RISC-V SOIC16
U2	EEPROM I2C – see next	SOIC8
Q1	BC846	SOT23 or similar NPN
D1	4148	Or a similar type
R1	100R	0805
R2 to R6	3K9	0805
C3,C4	100n	Ceramic 0805

C5	100u/16	Electrolyte (lower type is suitable)
LS1	Miniature speaker 16Ω	Diameter 12 mm
SW1	Side microswitch	E.g. TS6606-8.0-180
J1	JST XH 2,54 mm 11 pin	Male to pcb or pin header
J2, J5	Pin header 4 terminals	To pcb 90° female
J3	USB C 6 pins	E.g. USB4125
J10	Pin header 4 terminals	To pcb upright
J11	Grove 4 pin 2 mm	To pcb 90° (for CardKB)
-	Display OLED 128x128	Driver SH1107 for I2C
-	Keyboard CardKB	Producer M5STACK

Memory types and number of programs

It is possible to connect various serial I2C EEPROM memories to the computer board according to current availability and user requirements. When choosing a memory, check whether the memory manufacturer allows a supply voltage of 5V and a bus speed of 400 kHz. Different manufacturers mark their type series differently, e.g. 24LC256, 24AA256, M24512, etc. The table therefore shows the basic numerical marking, which is usually supplemented by other letter combinations.

Type	Size	Number of programs	Program designations
2432	32 Kbit / 4 KByte	1	0
2464	64 Kbit / 8 KByte	2	0,1
24128	128 Kbit / 16 KByte	4	0,1,2,3
24256	256 Kbit / 32 KByte	8	0,1,2,3,4,5,6,7
24512	512 Kbit / 64 KByte	16	0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15

The "Number of programs" column indicates how many separate Tiny BASIC programs can be stored in memory. The last column then refers to the numerical marking of individual programs written in memory.
If you have a serial I2C EEPROM programmer, you can use the I2C bus on connector J5. If you correctly connect the 4 wires from the connector to the EEPROM programmer socket, you can load the contents of the ExampleBasRO.hex file, which is in the EEPROM_examples folder, into the EEPROM. The file is 32 KByte in size, so it is suitable for 24256 and 24512 memories. If you succeed, you will get 8 sample Tiny BASIC programs. You can also write the examples to external memory. For more information about the programs, see the TinyBasExamples manual.
If you are going to connect an external module with EEPROM memory to the I2C bus, do not forget that you need to set the address bit A0 to logical 1!