CH32M030 Evaluation Board Reference

Version: V1.0

https://wch-ic.com

1. Overview

This evaluation board is applied to the development of CH32M030 series chips, the IDE uses MounRiver compiler, supported only by MRS1.92 and above, and independent WCH-Link can be selected for simulation and download, and application reference examples and demos related to chip resources are provided.

2. Evaluation Board Hardware

Please refer to the CH32M030SCH.pdf document for the schematic of the evaluation board.
CH32M030 Evaluation Board
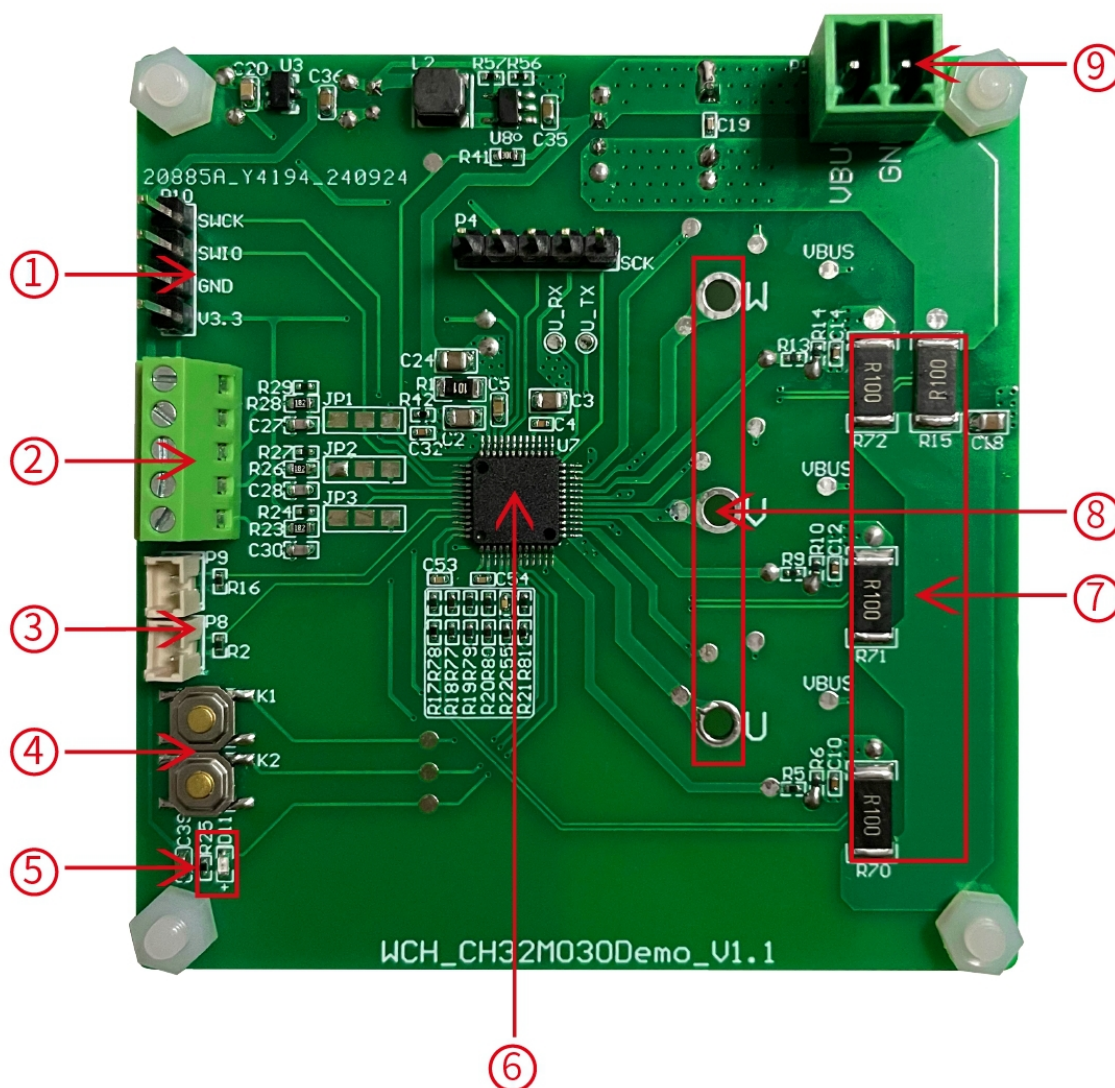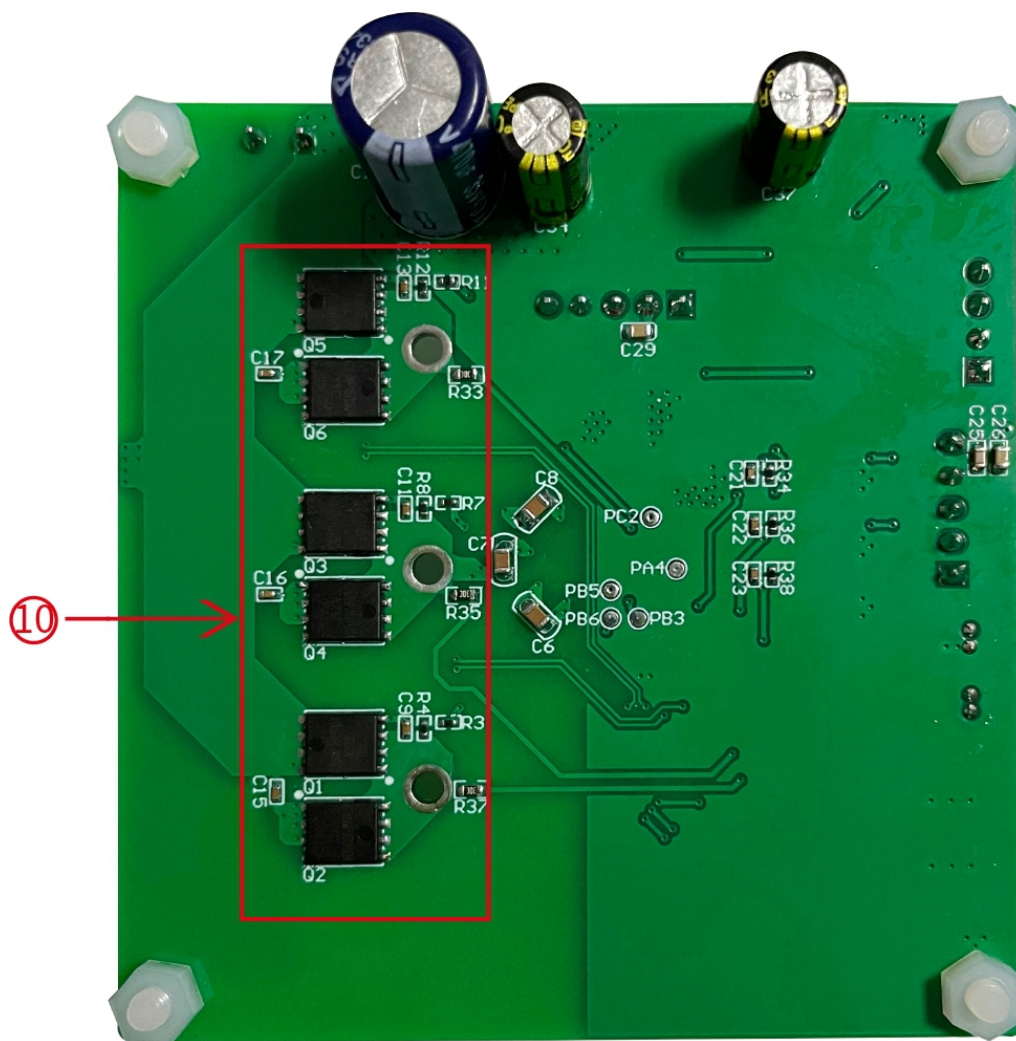
Descriptions

|		
1. SWD debug interface	2. Hall sensor interface	3. Voltage monitoring interface
4. Button	5. LED	6. CPU
7. Sample resistor	8. Motor interface	9. Power
10. Inverter circuit		

Tips: The debug interface of CH32M030 series chips supports free configuration; 1-wire debugging or 2-wire debugging is optional. Debugging interface pins PA3 (SWIO), PA2 (SWCLK 2-wire debugging optional)

The program adopts 32-bit RISC-V core MCU - CH32M030C8T7 as the control chip, with low loss, smooth operation, low BOM cost and other advantages, can drive 100000rpm 3-phase brushless ultra-high-speed motors, to provide customers with customizable and complete mass production program.

2.1 The Above Evaluation Board Consists of the Following Modules
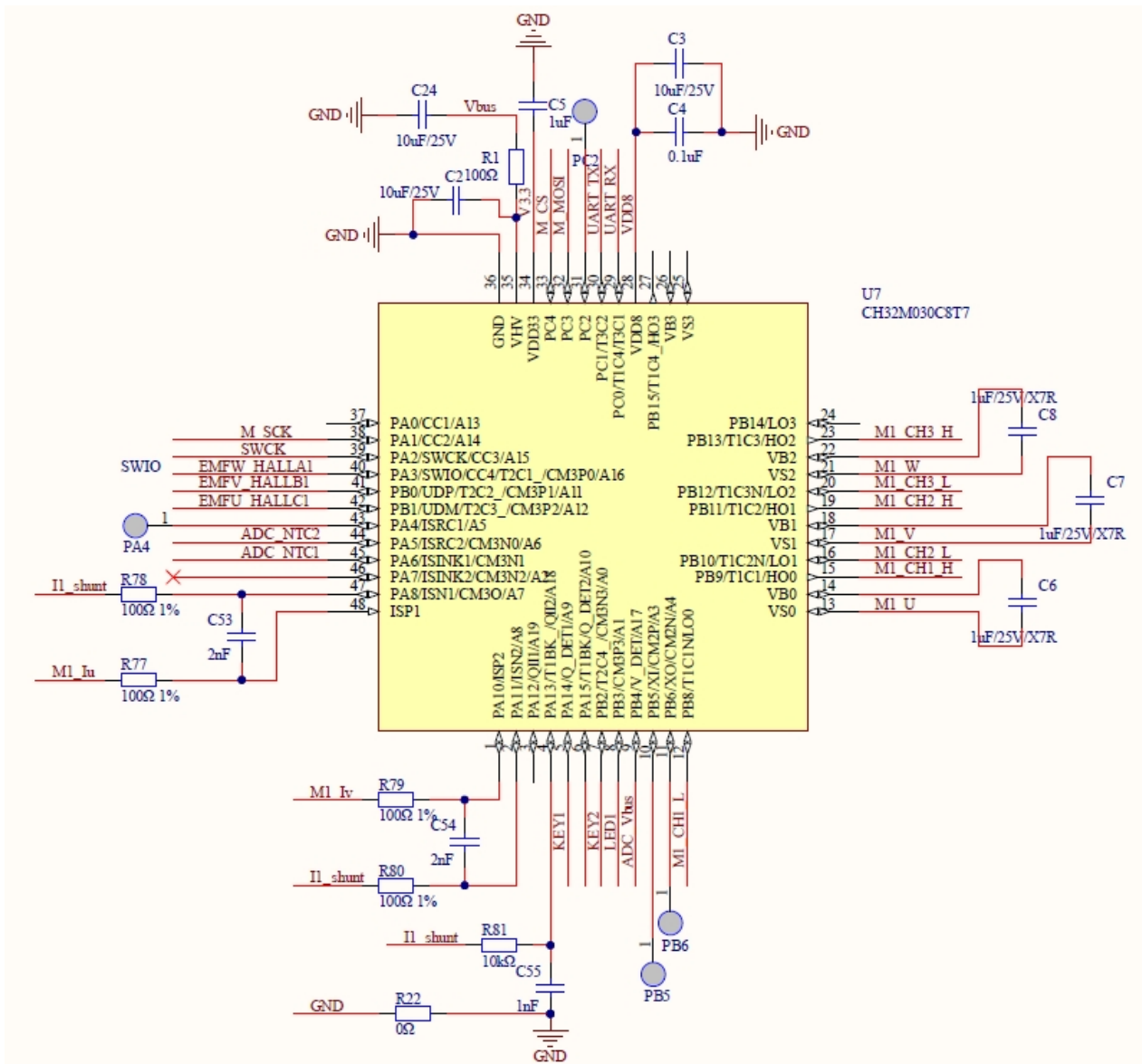
2.1.1 Power Module

Figure 1 Power input interface
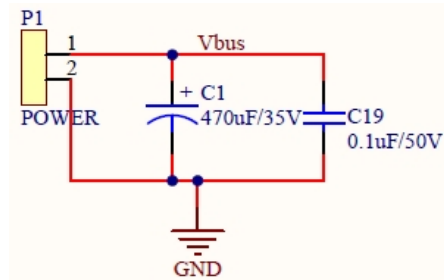
As in Figure 1, the input voltage of the power input connector is 12 to 24V DC.

### 2.1.2 MCU Circuit

Figure 2 MCU circuit

As shown in figure 2, the main control MCU is CH32M030C8T7, which integrates motor-related resources such as advanced-control timer, general-purpose timer, 1 multi-channel ADC, 4-channel OPA, 3-channel comparator and built-in pre-drive. The MCU can complete the functions of single and double resistance current amplification and sampling, overcurrent comparison and back emf comparison in very few peripheral scenes. The driving circuit with built-in double-N pre-driving only needs three external bootstrap capacitors to complete the driving. Built-in two LDOs enable MCU to work normally without external power supply.

Figure 3 OPA3 internal circuit
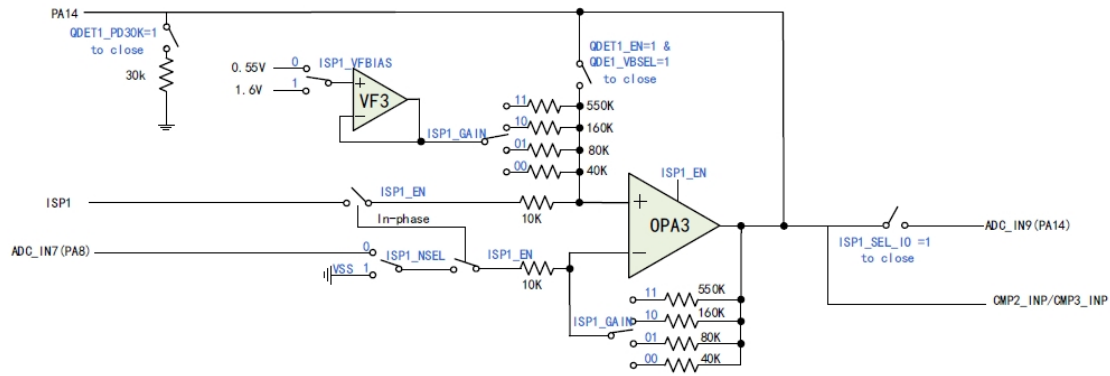
2.1.3 Inverter Circuit

Figure 4 Inverter circuit (electric control board)
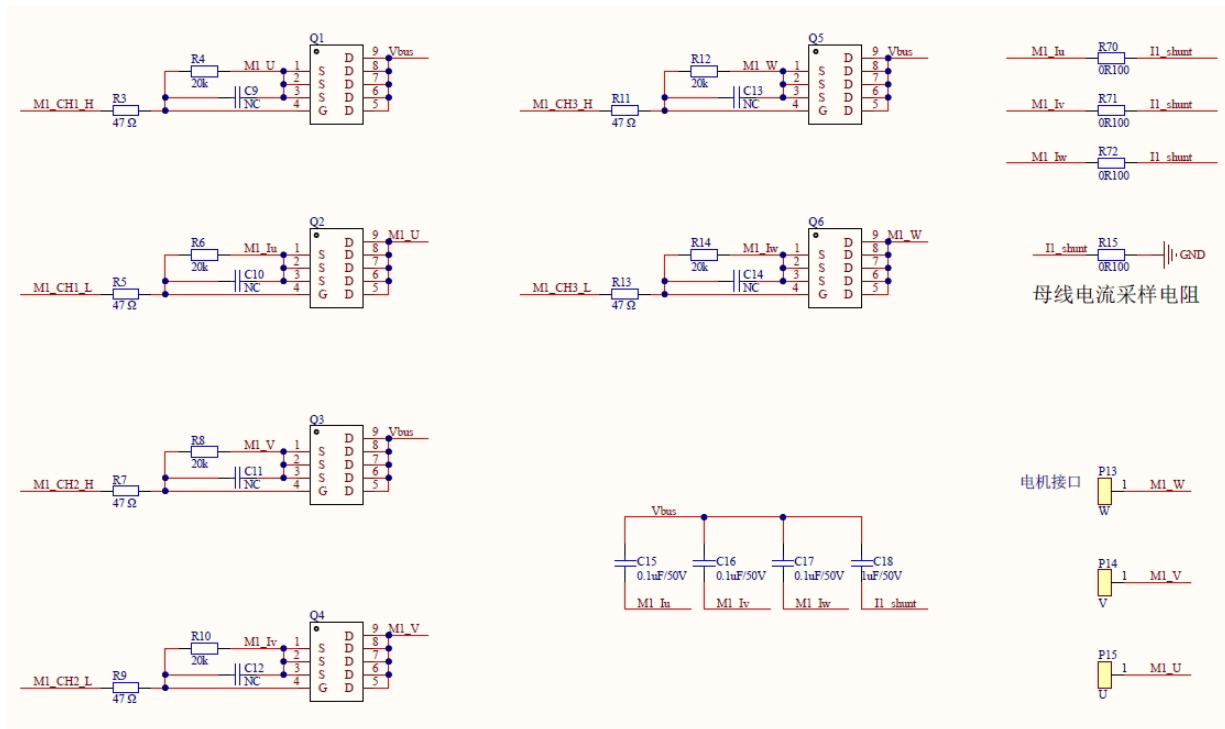
As shown in figure 4, an inverter circuit is composed of 6 N-MOS transistors NP160S04PD6, which is used to execute the instructions of the MCU, thus controlling the motor. R70&R71 are phase current sampling resistors, R72 can be used for 3-phase balance when the internal resistance of the motor is very small, or it can be cancelled, and R15 is bus current sampling resistor. Capacitors C15~C18 are usually connected to the upper bridge drain and the lower bridge source of the half bridge, which can improve the control performance and reduce the oscillation in the loop. P13~15 are motor 3-phase interfaces.

2.1.4 Hall Sensor Interface Circuit (Optional)

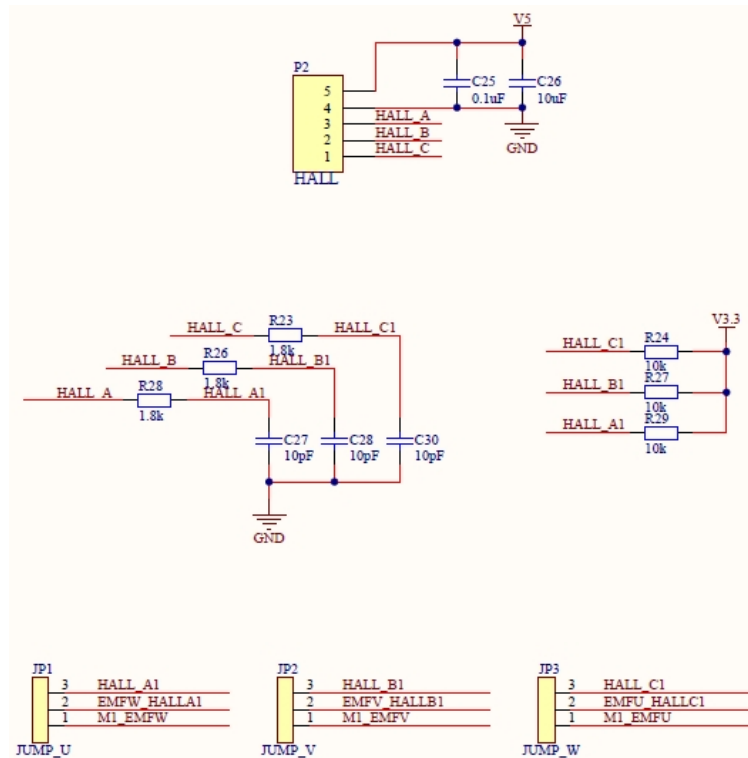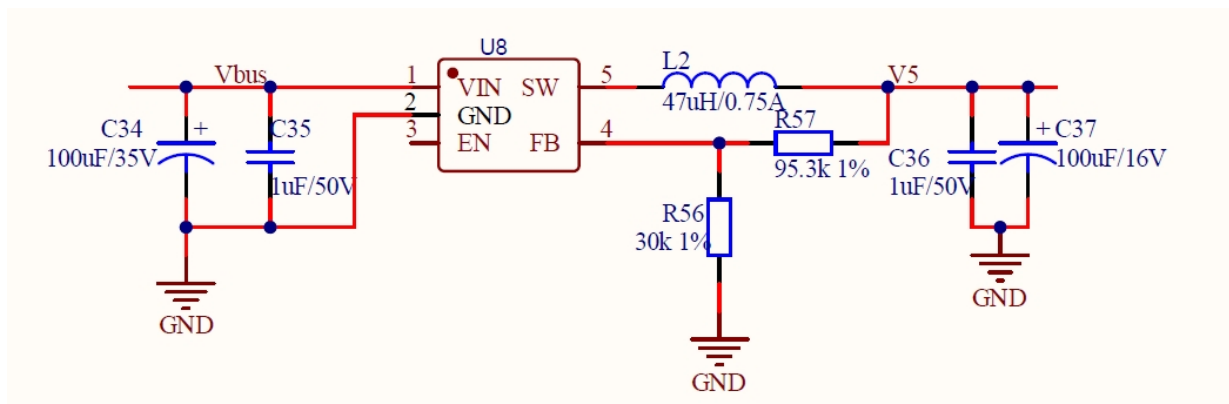Figure 5 Hall sensor interface circuit


Figure6 Independent 5V power

As shown in figure 5, P2 is the Hall sensor interface, which is output to MCU through HALL_A1, HALL_B1 and HALL_C1 after resistance-capacitance filtering and pull-up. Because it shares the interface with the back EMF detection mode, it reaches the PA3, PB0 and PB1 interfaces of MCU through EMFU_HALLA1, EMFV_HALLB1 and EMFW_HALLC1 through jumpers, which can be configured as the capture interface of general timer 2.

As shown in Figure 6, it is a DCDC step-down circuit to provide independent power supply for the encoder, which can be removed when there is no encoder.
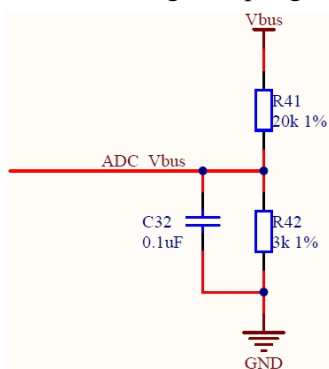
2.1.5 Back EMF Sampling Circuit

Figure 7 Back EMF sampling circuit
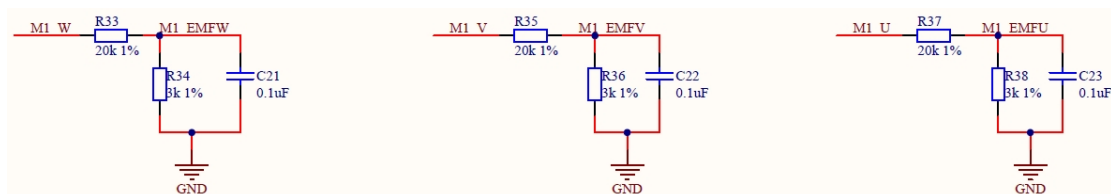
As shown in figure 7, in the scene of non-inductive BLDC application, it is usually necessary to judge the position by back EMF, which can generally be sampled by back EMF or compared with the virtual center point.

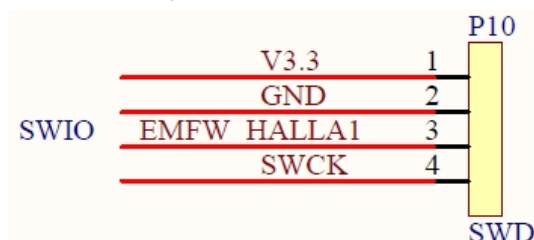## 2.1.6 Bus Voltage Sampling Circuit

Figure 8 Bus voltage sampling circuit

As shown in Figure 8, the bus voltage is divided and sampled.

2.1.7 SWD Interface

Figure 9 SWD interface

As shown in Figure 9, SWD interface can be used to simulate debugging and downloading. This type of MCU supports 4-wire download (as shown above) and is also compatible with 3-wire mode (power supply +SWIO).

2.1.8 Virtual Oscilloscope Isolated Observation Interface (Optional)

Figure 10 Virtual oscilloscope isolated observation interface
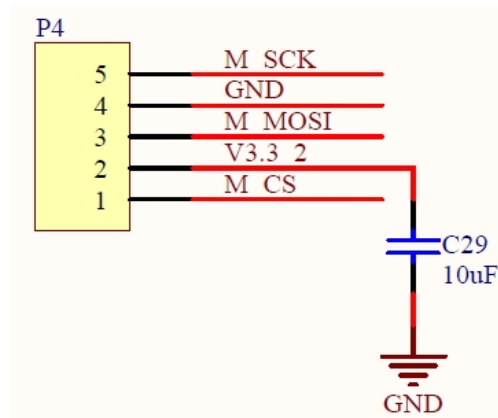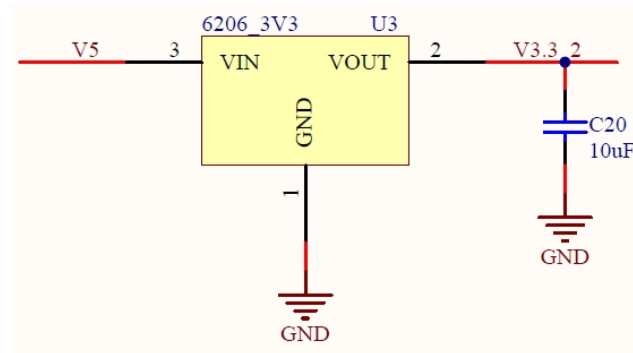

Figure 11 Virtual oscilloscope power supply (Optional)

As shown in Figure 10, this series of on-chip integrated SPI interface can be used to cooperate with the isolation adapter board to connect with a virtual oscilloscope for waveform observation. If there is no isolation requirement, it can also be directly connected to a computer with USB cable for observation.

As shown in Figure 11, for an independent 3.3V power supply, for debugging observations with a virtual oscilloscope adapter board to provide power, the circuit can be removed, debugging observations directly temporary external, no need for debugging observations, directly removed.

2.1.9 Man-machine Interaction Interface
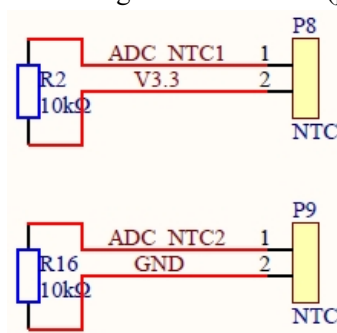
Figure 12 LED & Buttons
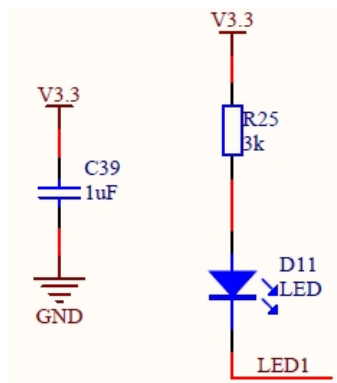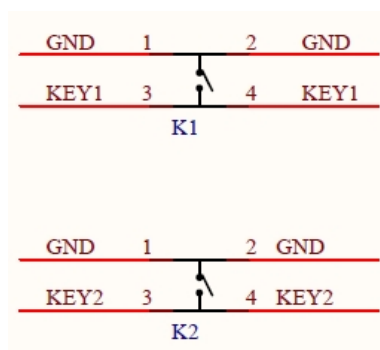
As shown in figure 12, the evaluation board is operated by buttons and LED lights, and the running status is indicated.

2.1.10 Current Source Detection Circuit

Figure 13 Zero-crossing detection circuit (power board)

As shown in figure 13, this circuit can detect the change of resistance by means of the internal current source flowing through the external resistor and the internal ADC, which can be used for temperature detection in practical applications.

3. Software Development

3.1 EVT package directory structure
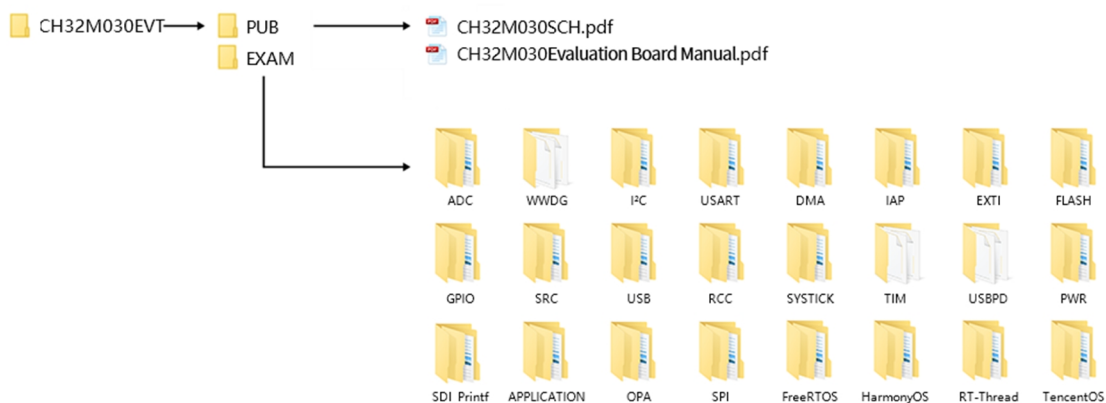
Description.

PUB folder: Provides evaluation board manuals, schematics for evaluation versions, and chip support package library files.

EXAM folder: Provides software development drivers and corresponding examples for the CH32M030 controller,

categorized by peripherals. Each type of peripheral folder contains one or more functional application routines folders.

3.2 IDE Use-MounRiver

Download MounRiver_Studio, double click to install it, and you can use it after installation. (MounRiver_Studio instructions are available at the path: MounRiver\MounRiver_Studio\ MounRiver_Help.pdf and MounRiver_ToolbarHelp.pdf)
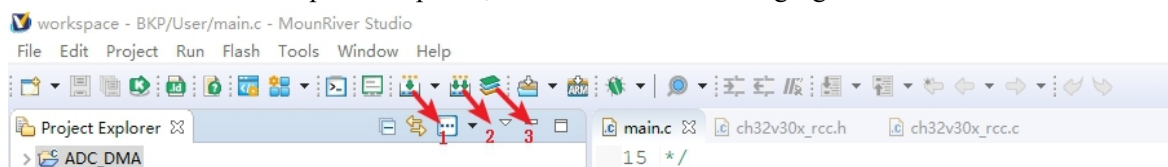
3.2.1 Open Project
➢   Open project:
1)   Double-click project file directly with the suffix name .wvproj under the corresponding project path.
2)   Click File in MounRiver IDE, click Load Project, select the .project file under the corresponding path, and click Confirm to apply it.

3.2.2 Compilation
MounRiver contains 3 compilation options, as shown in the following figure.

Compile option 1 is Incremental Build, which compiles the modified parts of the selected project.
Compile option 2 is ReBuild, which performs a global compilation of the selected project.
Compile option 3 is All Build, which performs global compilation for all projects.

3.2.3 Download/Simulation
➢   Download
1)   Debugger download
Connect to the hardware via WCH-Link (see WCH-Link instructions for details, path: MounRiver\MounRiver_Studio\ WCH-Link instructions.pdf), click the Download button on the IDE, and select Download in the pop-up interface, as shown in the figure below.

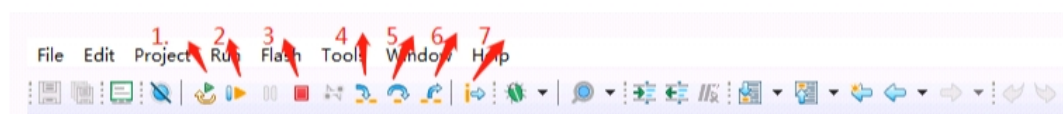1 for querying the chip read protection status.

2 for setting the chip read protection and re-powering the configuration to take effect.

3 for lifting the chip read protection and re-powering the configuration to take effect.

➢   Simulation

1)   Toolbar description

Click Debug button in the menu bar to enter the download, see the image below, the download toolbar.

Detailed functions are as follows.

   (1) Restart: After restart, the program returns to the very beginning.

(2) Continue: Click to continue debugging.

(3) Terminate: Click to exit debugging.

(4) Single-step jump-in: Each time you tap a key, the program runs one step and encounters a function to enter and execute.

(5) Single-step skip: jump out of the function and prepare the next statement.

(6) Single-step return: return the function you jumped into

Instruction set single-step mode: click to enter instruction set debugging (need to use with 4, 5 and 6 functions).

2) Set breakpoints

Double-click on the left side of the code to set a breakpoint, double click again to cancel the breakpoint, set the breakpoint as shown in the following figure;
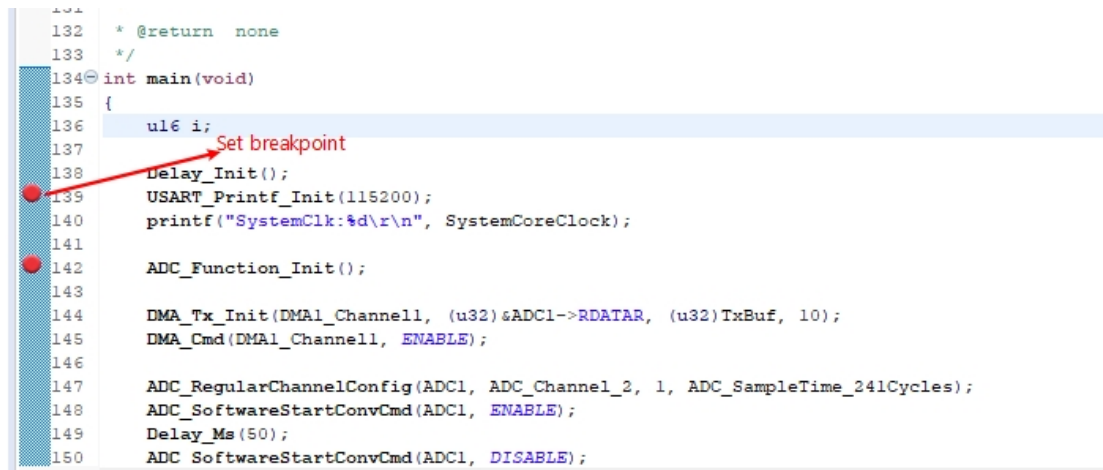

3) Interface display

(1) Instruction set interface

Click on the instruction set single-step debugging can enter the instruction debugging, to single-step jump in for example, click once to run once, the running cursor will move to view the program running, the instruction set interface is shown as follows.
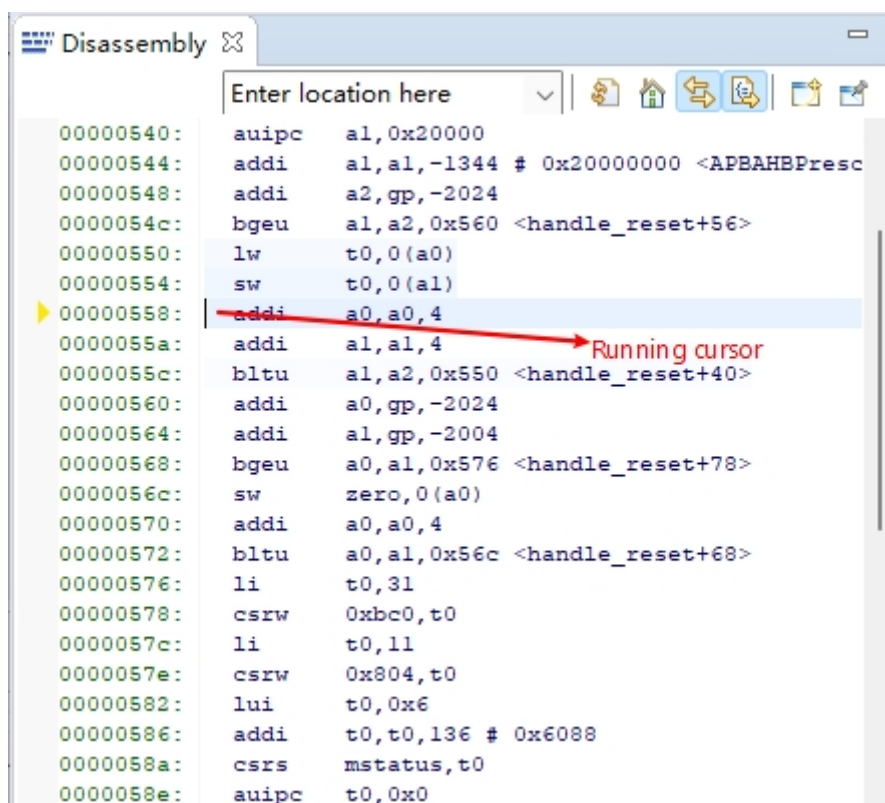
(2) Program running interface

It can be used with instruction set single-step debugging, still take single-step jumping in as an example, click once to run once, the running cursor will move to view the program running, the program running interface is shown as follows.
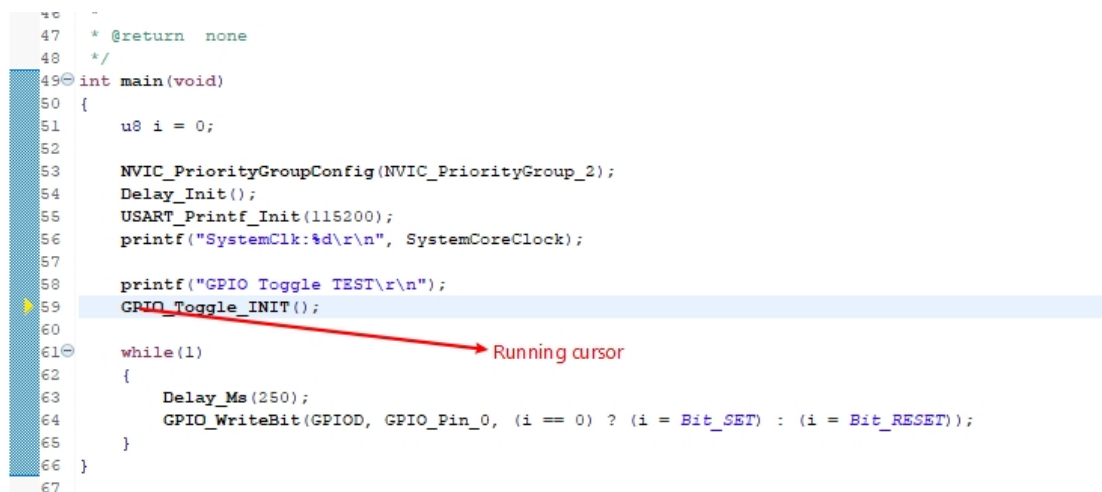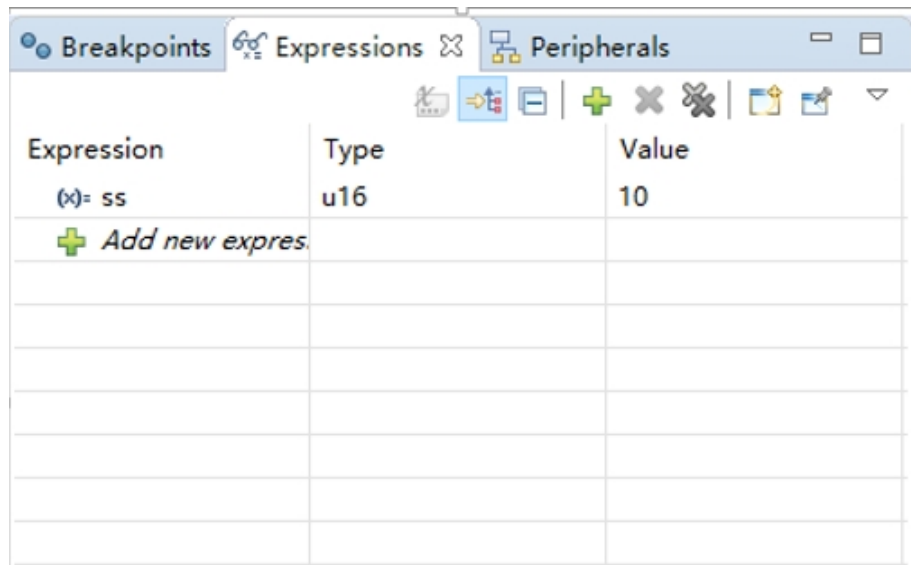

4) Variables

Hover over the variable in the source code to display the details, or select the variable and right-click add watch expression
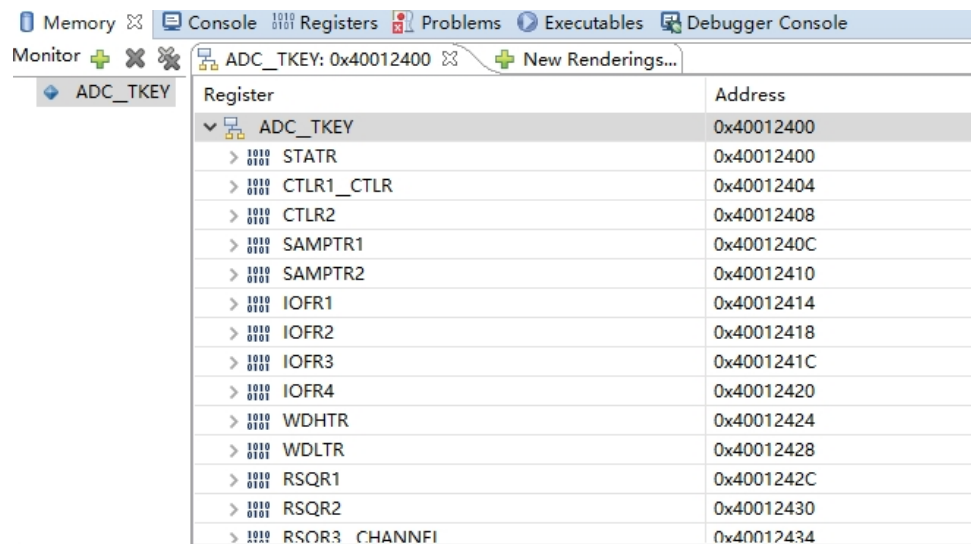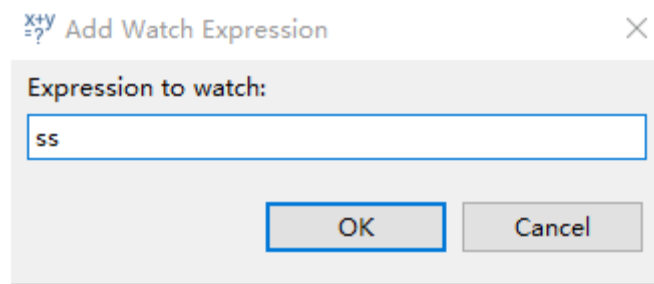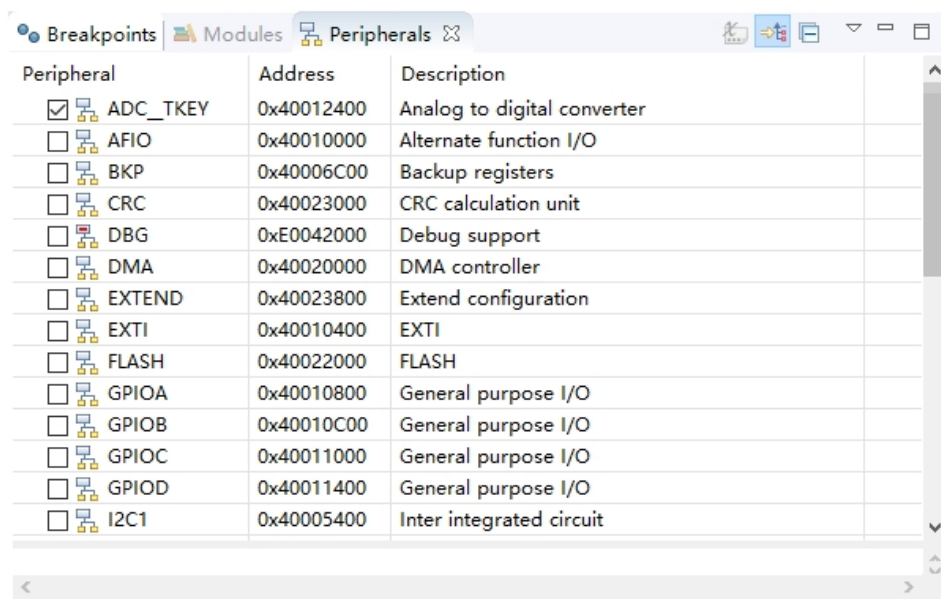
Fill in the variable name, or just click OK to add the variable you just selected to the pop-up.

5)   Peripheral registers

In the lower left corner of IDE interface Peripherals interface shows a list of peripherals, tick the peripherals will display its specific register name, address, value in the Memory window.

Register	Address
∨ 🖥 ADC_TKEY	0x40012400
> STATR	0x40012400
> CTLR1_CTLR	0x40012404
> CTLR2	0x40012408
> SAMPTR1	0x4001240C
> SAMPTR2	0x40012410
> IOFR1	0x40012414
> IOFR2	0x40012418
> IOFR3	0x4001241C
> IOFR4	0x40012420
> WDHTR	0x40012424
> WDLTR	0x40012428
> RSQR1	0x4001242C
> RSQR2	0x40012430
> RSQR3_CHANNEL	0x40012434

Note:

(1) When debugging, click the icon in the upper right corner to enter the original interface.
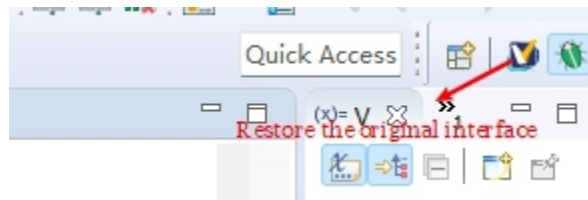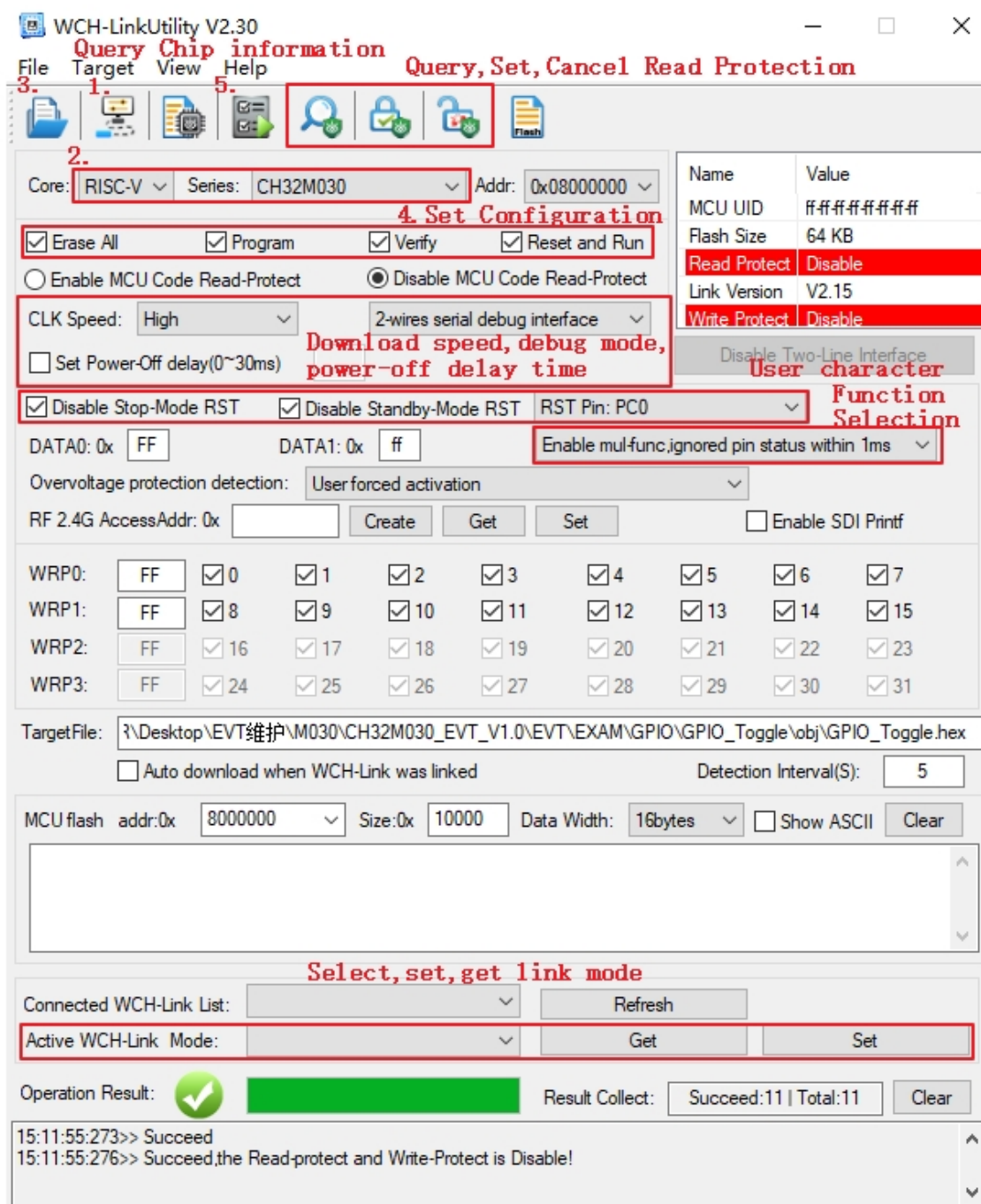

(2) For documentation to access the compiler, click F1 to access the help documentation for detailed instructions.
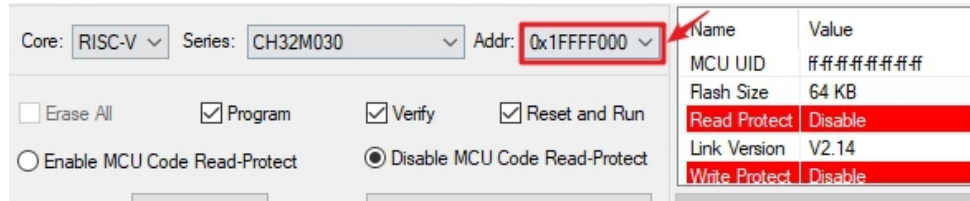
4. WCH-LinkUtility.exe Download

The download process for the chip using the WCH-LinkUtility tool is:

1) Connect WCH-Link

2) Select chip information

3) Add firmware

4) If the chip is read protected, you need to release the chip read protection.

5) Execute

The CH32M030 chip supports a 512-byte DATA FLASH area, and the data will not be lost when power is off. The address range is 0x1FFFF000~0x1FFFF1FF; Only the LinkUtility tool can be used to operate the DATA FLASH area. Select the download address as 0x1FFFF000 (as shown in the figure), and select the custom bin file to be stored. After downloading, the values in the bin file can be stored in the DATA FLASH area. Follow steps 3, 4, and

5 to add firmware, select configuration, and perform download.

Tips: Note that the custom bin file size must be 512 bytes, and the unused area is written as 1 by default.

5. Statement of Attention

1) If you use WCH-Link to download, refer to WCH-Link instructions for specific switching mode. Detailed inquiries/questions can be logged in the following.

WCH official website: https://www.wch-ic.com/

WCH-LINK instructions for use: https://www.wch-ic.com/products/WCH-Link.html