The Development Manual of Offline Speech Recognition Module (VDM-10)

2019.12

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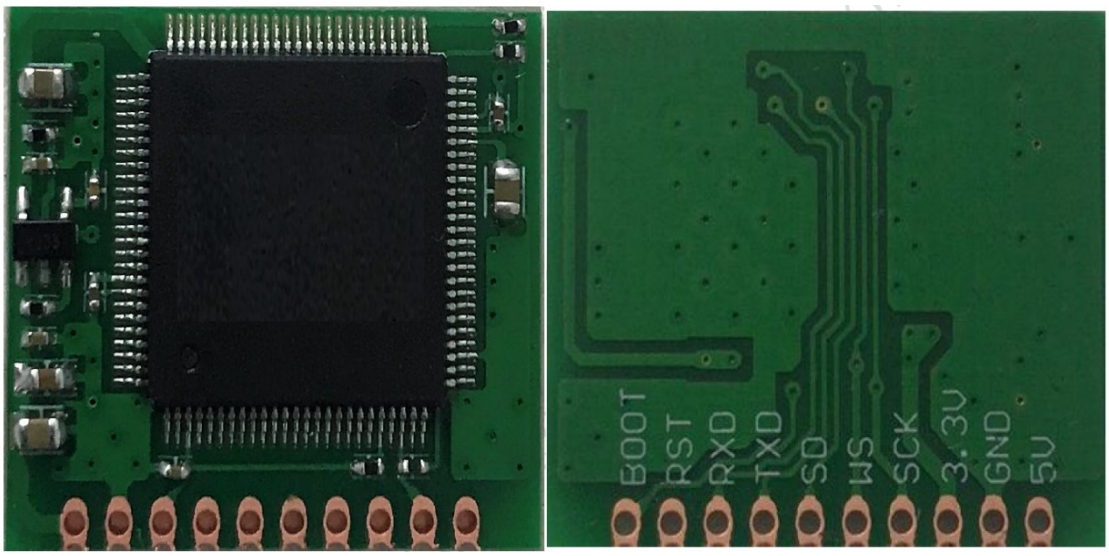
1 VDM-10 Specifications

1.1 Appearance



1.2 Speech Recognition Performance

Project	Typical value	Test conditions
Response speed	Response time less than 200ms	-
Recognition accuracy	More than 95%	Signal to noise ratio is 1:1

1.3 Electrical Characteristics

Project	Minimum value	Typical value	Maximum value	Unit	Test conditions
Power supply	3.6	5.0	5.5	V	-
Power consumption	-	50	120	mA	25℃，VCC = 5.0V

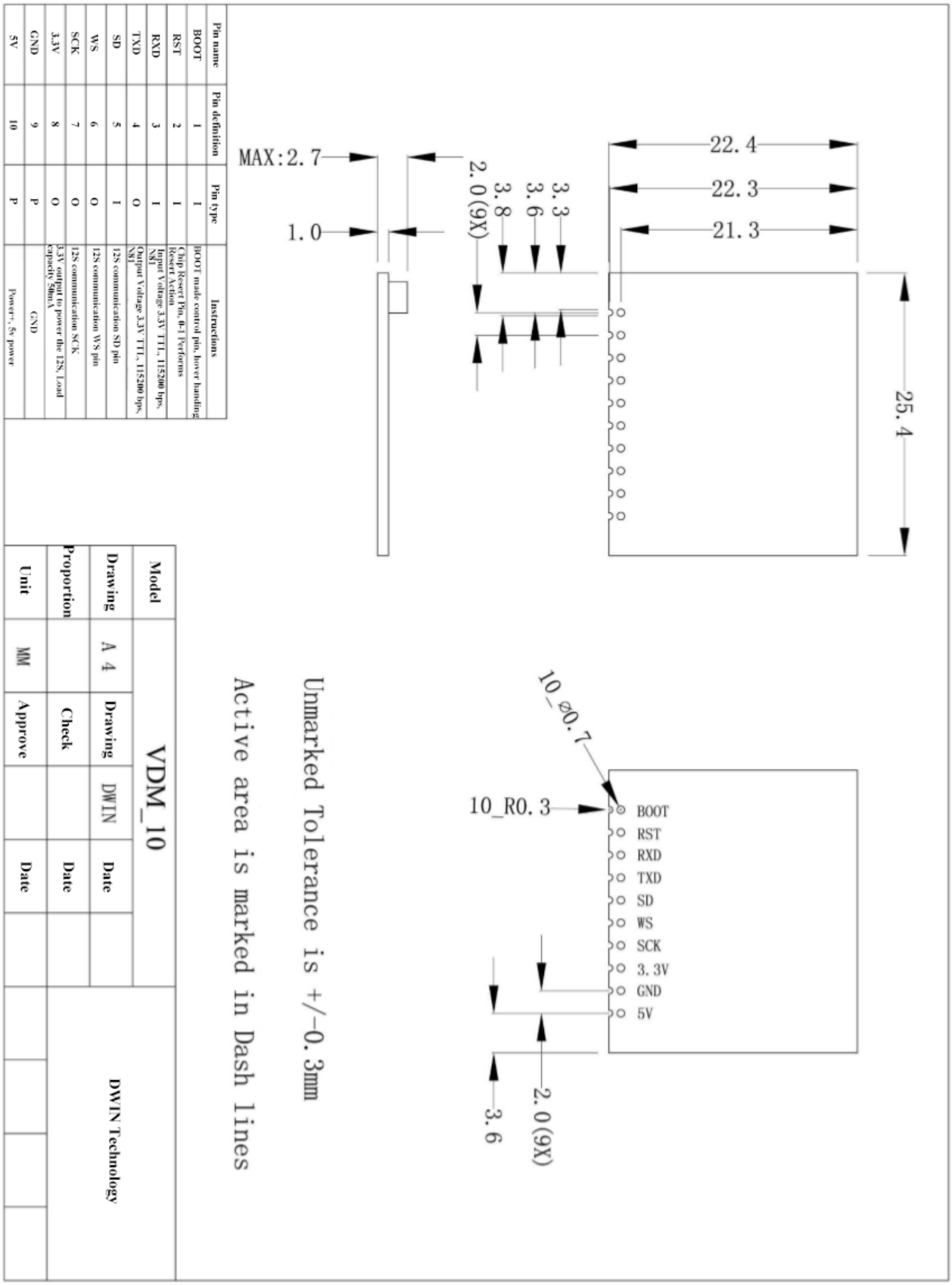
1.4 Reliability Test

Project	Minimum value	Typical value	Maximum value	Unit	Test conditions
Working temperature	-40	-	+70	℃	-
Storage temperature	-40	-	+85	℃	
prevention treatment		None			

1.5 Hardware parameters

Project	Minimum value	Typical value	Maximum value	Unit	Test conditions
Input logic low level VIL	-0.3	-	DVDD3×0.25	V	-
Input logic high level VIH	DVDD3×0.75	-	DVDD3+0.3	V	-
Output logic low level VOL	-	-	0.4	V	-
Output logic high level VOH	DVDD3-0.4			V	-
Data interface	UART				

1.6 Mechanical Drawing



Pin name	Pin definition	Pin type	Instructions
BOOT	1	I	BOOT mode control pin, hover handling
RST	2	I	Chip Reset Pin, 0-1 Performs Reset Action
RXD	3	I	Input Voltage 3.3V TTL, 115200 bps, N81
TXD	4	O	Output Voltage 3.3V TTL, 115200 bps, N81
SD	5	I	12S communication SD pin
WS	6	O	12S communication WS pin
SCK	7	O	12S communication SCK
3.3V	8	O	3.3V output to power the 12S, Load capacity 50mA
GND	9	P	GND
5V	10	P	Power+, 5v power

Model	VDM_10				DWIN Technology
Drawing	A 4	Drawing	DWIN	Date	
Proportion		Check		Date	
Unit	MM	Approve		Date	

2 Function Description

2.1 Wakeup

Reserve 3 wakeup words to set.

When the function is not turned on, the voice command is detected and output directly. When it is turned on, other command words can be recognized after wakeup.

Pay attention to:

The command word has the function of switching dictionary. If the switching dictionary is different from the current dictionary, the switching function is executed.

If the timeout function is turned on, waking up or switching the dictionary will lead to re-timing.

2.2 Timeout Turning Back

Timeout function will work after switching different dictionaries or waking up.

After the timeout, if it is not in the normal detection dictionary, it will switch back to the normal dictionary, and the wakeup state will change to the sleep state. If one of the above two actions is executed, 0x5A 0xA5 0x00 0x2A 0x83 is sent according to the protocol.

2.3 Dictionary Switching

Dictionary switching can be divided into VDM-10 automatic switching and MCU control switching, which can not exist at the same time.

The automatic switching is realized by setting the switch dictionary in the command word. It will not send data to MCU in automatic switching mode.

MCU control switching requires MCU to send 4 bytes data 0x5AA5 * * 55 according to relevant command words. ** is to switch the dictionary serial number. It is set according to the actual situation of the dictionary. The range is from 1 to 3 (the program cannot work normally, if it's set beyond the range). If the dictionary to be switched by MCU is different from the current dictionary, the switching action will be executed. After the handover, VDM-10 will send 5 bytes of data 0x5A 0xA5 0xFF 0x6A 0xC3.

2.4 Similar Words Support

If the two command words are very similar (not recommended), you can turn on the similar word function. After the similar word function is turned on, the memory occupied will increase dramatically, the recognition time will be prolonged, and the number of command words that can be recognized will reduce.

2.5 Handshake Restart

The handshake restart function is used for program burning. If it is necessary to update VDM-10 data through MCU, relevant protocols can be provided. In this case, the serial port can be avoided to be used in parallel.

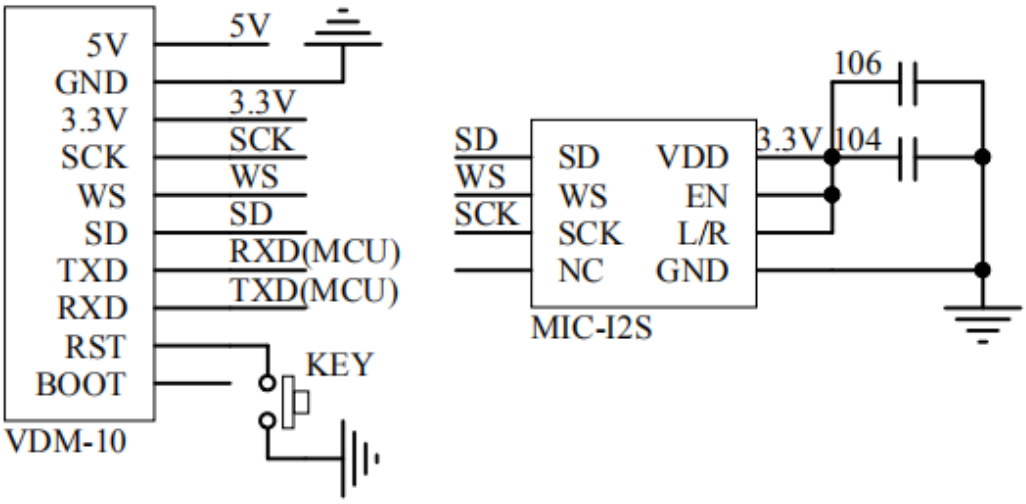
3 Hardware Design Reference

3.1 Pin Definition

Pin No.	Signal	Instructions
1	5V	Power supply +，5V power supply
2	GND	Power supply -，connect to GND
3	3.3V	3.3V output to power I²S mic
4	SCK	I²S communication SCK pin
5	WS	I²S communication WS pin
6	SD	I²S communication SD pin
7	TXD	Serial port output，3.3V TTL electrical level，115200 baud rate，N81
8	RXD	Serial port input，3.3V TTL electrical level，115200 baud rate，N81
9	RST	Chip reset pin, 0-1 performs reset action
10	BOOT	BOOT mode control pin, suspended processing

3.2 The Circuit Schematic Diagram

The voice module has reserved the I²S digital MIC interface, but it is not connected. Customers need to draw PCB circuit and add MIC according to their own application.



Attention:

1. 3.3V power supply interface only supplies power to I²S digital MIC;
2. TXD and RXD interact with MCU;
3. 5V power supply for voice module;
4. The I²S digital MIC in the reference schematic adopts MSM261S4030H0R;
5. BOOT pin suspended (NC) processing;
6. RST pin is recommended to be connected to GND by a key. Generally, the burning process can be restarted automatically. If the program is damaged due to the failure during the burning process, the RST needs to be pulled down 2 seconds by hardware, and then pulled up to realize the restart.

4 Serial Port Protocol

4.1 Serial Port Mode

The serial port data is in 8N1 mode, and the baud rate is fixed at 115200.

4.2 Serial Port Protocol

A. Program memory

After power on, the VDM-10 voice module will output 3 bytes of data, indicating the maximum amount of memory required by the program. If the data is greater than 190K, the voice module will not work normally.

For example: 0x5A 0x00 0x09，The last two bytes constitute an integer of 16bit, which is less than 190, so it can work normally.

B. Identified command word output

After the command word is correctly recognized, the voice module will output the data of 0x5A 0xA5 ID+ CRC. CRC calculation is referred to appendix 1. When ID = 0, or ID = 0xFF, it indicates timeout return and dictionary switching is successful.

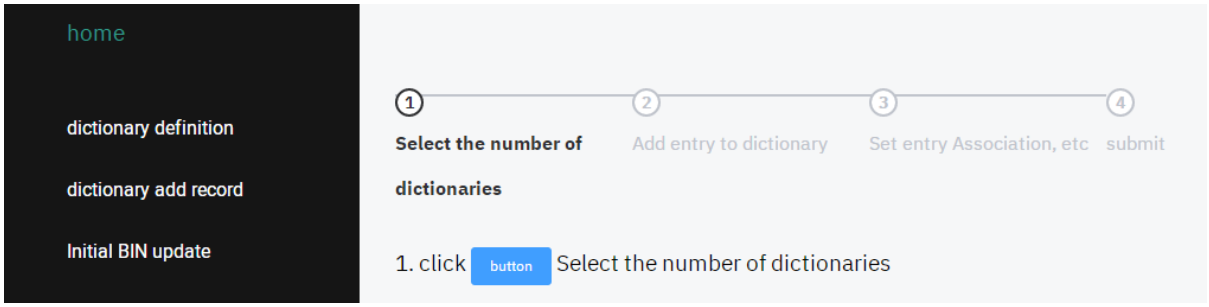
For example：0x5A 0xA5 0x01 0xEB 0x43.Indicates that a command word with ID 1 is recognized.

5 Debug

5.1 Online Debug Tool

Online debug tool website：http://tool.dwin.com.cn/voice/index

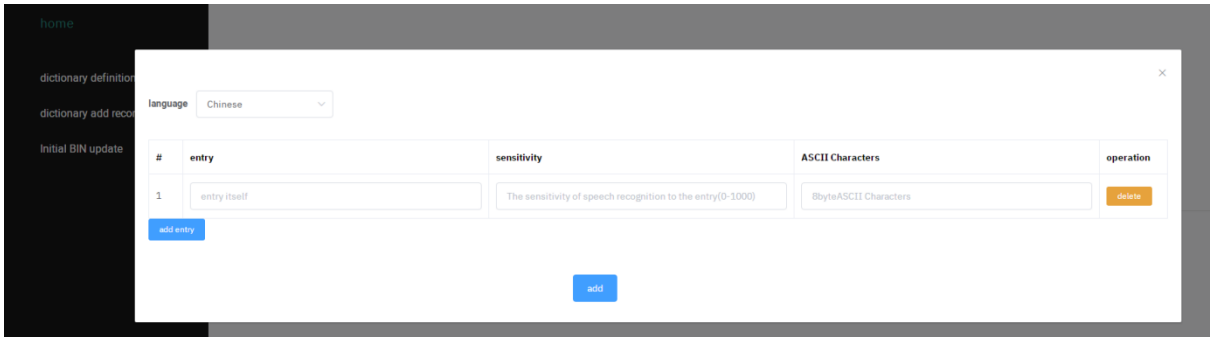
Open the website to see the following pages, you can add dictionaries and modify dictionaries. No matter there are several dictionaries (1-3) in practical application, single dictionary needs to be debugged successfully, after that, you can combine all dictionaries in one project. The dictionary supports Chinese, English and Japanese.



5.2 Development Process

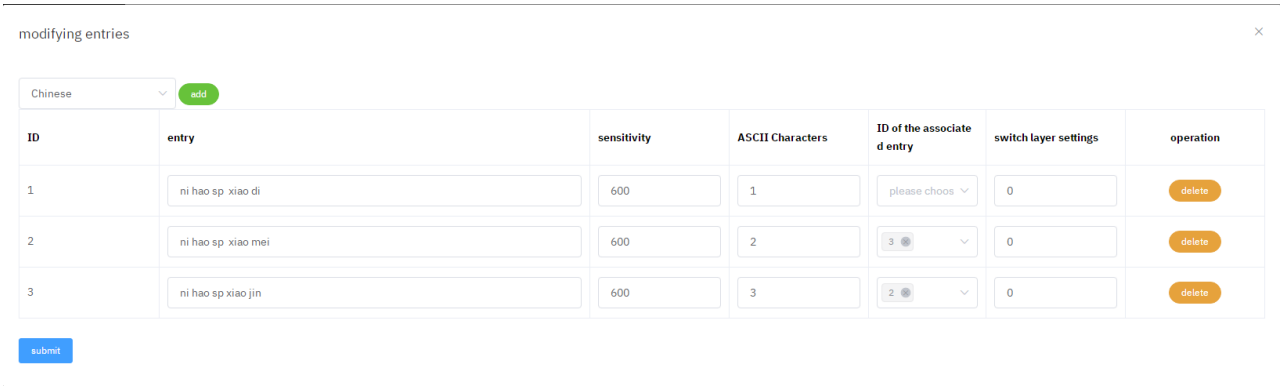
A. Single dictionary addition

Click the add button, and then select 1 dictionary. Click add entry button to select the language type of the dictionary and add related voice instructions. It's as follows.



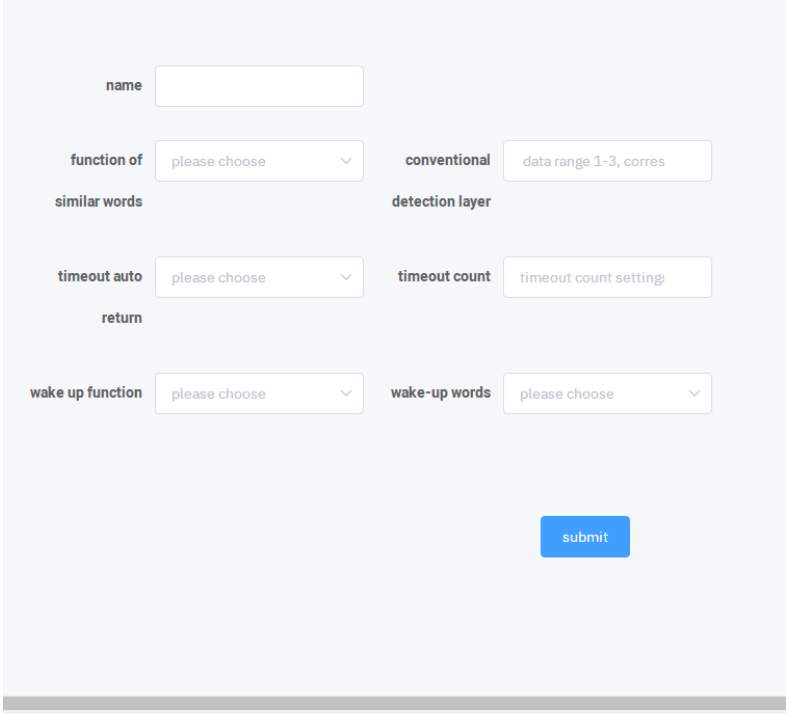
B. Command word addition

For Chinese dictionaries, entries are entered in pinyin, and each two pinyin is separated by sp. The sensitivity is firstly entered into 600 (the subsequent adjustment is mainly to adjust the sensitivity to achieve optimal identification). 8 ASCII characters can be entered. Click add after entering. The related word ID is the function of similar words. The sensitivity of two similar words must be the same. As shown in the figure below, if 2 and 3 are similar, you need to write the related ID in 2, selecting 3, in 3, selecting 2, and you can select multiple words. Switch layer settings, that is, which dictionary to jump to when the current command word is recognized. Each dictionary can only use one language.



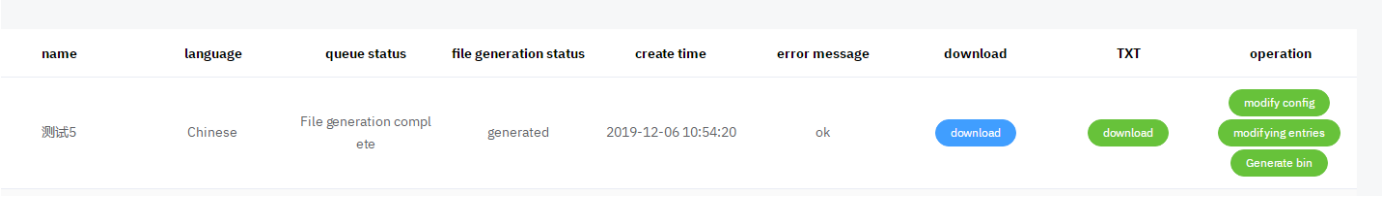
C. Parameter configuration

The name can be set by yourself. According to the actual situation, the function of similar words, the function of timeout automatic return, the function of wakeup and the general detection layer must be set. During debugging, the timeout auto return and waking up function can be turned off. The normal detection layer range is from 1 to 3, and the unit of the timeout count is 0.5s. Click submit after design.



D. Generate bin file

Find the dictionary just added in the dictionary adding record, wait until the queue status is file generation finished, then click download program bin file. You can also modify entries and configuration.



E. Identification sensitivity debugging

Use the burning tool to download the generated bin file, and then read each command word 5 to 10 times within the appropriate distance range (1 to 2 miter), during which the ID and recognition accuracy of error recognition are recorded, which can be recorded in the following table.

Command word	Reading 5 times of misidentification	Sensitivity	Adjust sensitivity
1	5(0)	600	600
2	3(2),2(3)	600	600
3	5(0)	600	580

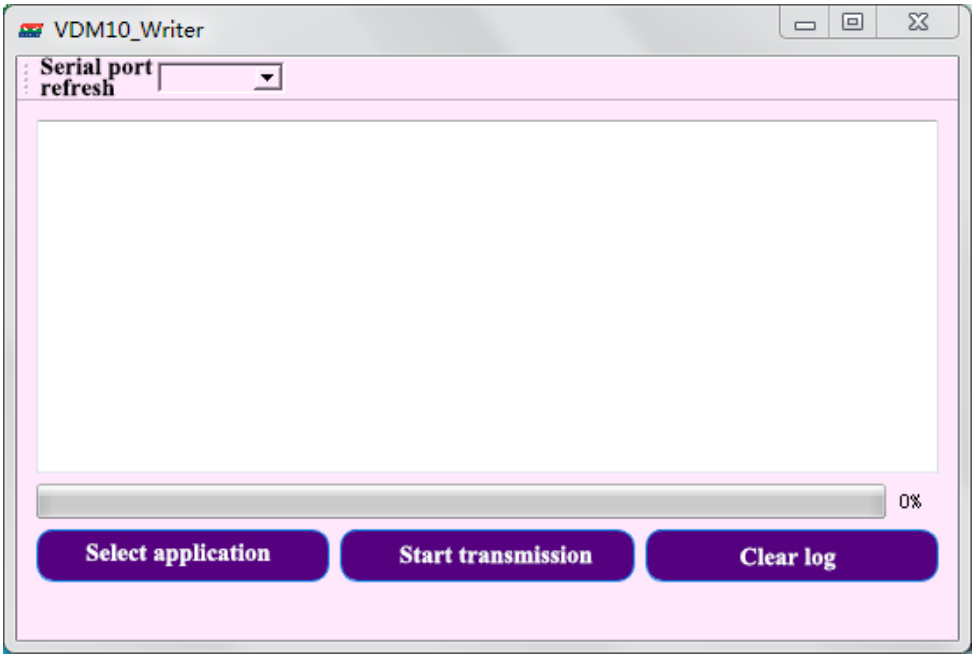
Adjustment principle: the sensitivity of the command word corresponding to the ID that is easy to be misidentified needs to be reduced, and the sensitivity of the command word that is not easy to be recognized needs to be increased.

For example: as shown in the table below, 5 (1) represents 5 times of recognition as command word 1, that is, the results of 5 times of recognition are consistent with the actual command word. Similarly, 3 (2) stands for 3 times of recognition of command word 2, and 2 (3) stands for 2 times of recognition of command word 3, that is, 2 times of recognition error. In this case, the sensitivity of command word 3 may be too high, which can be reduced appropriately, and the sensitivity before and after adjustment can be recorded for callback. After adjusting the sensitivity, modify the configuration in the add record, modify the entry, and regenerate the download file. Until the appropriate effect is achieved.

Command word	Reading 5 times of misidentification	Sensitivity	Adjust sensitivity
1	5(1)	600	600
2	3(2),2(3)	600	600
3	5(3)	600	580

F. Program burning

After the voice debugging is completed, it can be distributed to the VDM-10 module through the VDM-10 Writer tool. The PC tools are shown below.



Step 1: TX of serial assistant is connected to RX of VDM-10, RX of serial assistant is connected to TX of VDM-10, GND and GND are short circuited. It is better to let VDM-10 module work alone, because if other MCU works, it will lead to serial port work in parallel, which may affect the interaction process.

Step 2: connect the serial port assistant to the computer, open the PC software, click the serial port to refresh, and then select the serial port COM number connected with VDM-10.

Step 3: Click to select the application, open the bin file generated on the web page, and click to start the transmission. In general, the module will restart itself and then start the transmission of data. Wait until the data transmission is completed.

In case of failure during the burning process, it is necessary to reset the hardware and burn it again. Note that after the hardware is reset, you need to click to start the transmission within 1s, otherwise you cannot burn it.

Appendix 1: CRC Data Calculation Reference

```
void Calculate_CRC16(unsigned char *updata, unsigned char len)
{
    unsigned int Reg_CRC=0xffff;
    unsigned char i,j;
    for (i=0;i<len;i++)
    {
        Reg_CRC^=*updata++;
        for (j=0;j<8;j++)
        {
            if (Reg_CRC & 0x0001)
            {
                Reg_CRC=Reg_CRC>>1^0XA001;
            }
            else
            {
                Reg_CRC>>=1;
            }
        }
    }
    *updata++ = (unsigned char)Reg_CRC;
    *updata++ = (unsigned char)(Reg_CRC>>8);
}
```