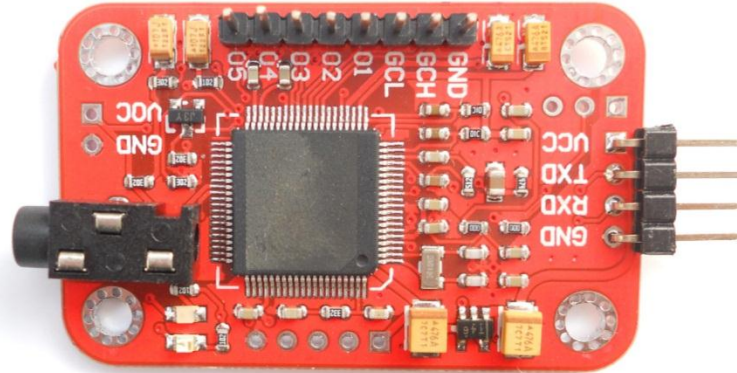


Voice Recognition Module V2

Speak to control (Arduino Compatible)



Introduction

The module could recognize your voice. It receives configuration commands or responds through serial port interface. With this module, we can control the car or other electrical devices by voice.

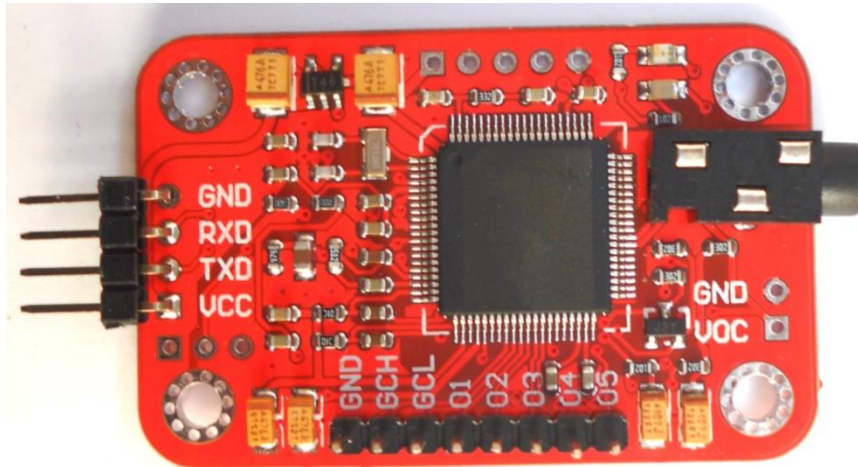
This module can store up to 15 pieces of voice instruction. Those 15 pieces are divided into 3 groups, with 5 in each group. First we should train the module with voice instructions group by group. After that, we should import one group before it could recognize the 5 voice instructions within that group. If we need to implement instructions in other groups, we should import the group first. This module is speaker dependent. If you trained the module, your friend might not be able to make it work.

What's new in V2

We've updated this module to V2. We made V2 easy to control. Except only serial input or output of V1, V2 has other useful ways to control and output the result.

You could find a new GOPI row on V2. GCH and GCL are used to import the voice group. And O1~O5 are pins which output the result of voice recognition. For example, if the first voice instruction in the working group is recognized, O1 could output HIGH signal. This output sometimes is very useful, such as while controlling the relay.

The O1~O5 output could be set as many type. You could set it by sending command to it through serial interface. Those setting will be recorded in memory. It will not lose even with power off. You could find the commands in later content.



V1 is black and V2 is red.

Technical

Parameters

- Voltage: 4.5-5.5V
- Current: <40mA
- Digital Interface: 5V TTL level UART interface and GPIO
- Analog Interface: 3.5mm mono-channel microphone connector + microphone pin interface
- Size: 30mm x 47.5mm
- Recognition accuracy: 99% (under ideal environment)

Serial Command

This module can be configured by sending commands via serial port. Configuration will be not erased after powered off.

Its interface is 5V TTL. The serial data format: 8 data bits, no parity, 1 stop bit. The default baud rate is 9600 and baud rate can be changed.

Command format is "Head + Key". "Head" is a 0xaa, and "Key" is as follows:

Key (HEX format)	Description	Respond in Common Mode	Respond in Compact Mode
0x00	Enter into "Waiting" state	"Waiting! \ n" : successful "ERROR! \ n" : Instruction error	0xcc : successful 0xe0 : Instruction error
0x01	Delete the instructions of group 1	"Group1 Deleted ! \ n" : successful "ERROR! \ n" : Instruction error	0xcc : successful 0xe0 : Instruction error
0x02	Delete the instructions of group 2	"Group2 Deleted ! \ n" : successful "ERROR! \ n" : Instruction error	0xcc : successful 0xe0 : Instruction error
0x03	Delete the instructions of group 3	"Group3 Deleted ! \ n" : successful "ERROR! \ n" : Instruction error	0xcc : successful 0xe0 : Instruction error
0x04	Delete the instructions of all the 3 groups	" All Groups Deleted !\ n " : successful "ERROR! \ n" : Instruction error	0xcc : successful 0xe0 : Instruction error
0x11	Begin to record instructions of group 1	"ERROR! \ n" : Instruction error "START \ n" : Ready for recording, you can speak	0xe0 : Instruction error 0x40 : Ready for recording, you

		<p><i>now</i></p> <p>"No voice \ n" : no voice detected</p> <p>"Again \ n" : Speak the voice instruction again. Do not speak until getting the START message</p> <p>"Too loud \ n" : Too loud to record</p> <p>"Different \ n" : voice instruction confirming failed. Voice for the second chance is different with the first one.</p> <p>"Finish one \ n" : recording one voice instruction successfully</p> <p>"Group1 finished! \ n" : finish recording group 1</p>	<p><i>can speak now</i></p> <p>0x41 : no voice detected</p> <p>0x42 : Speak the voice instruction again. Do not speak until getting the START message</p> <p>0x43 : Too loud to record</p> <p>0x44 : voice instruction confirming failed. Voice for the second chance is different with the first one.</p> <p>0x45 : recording one voice instruction successfully</p> <p>0x46 : finish recording group 1</p>
0x12	Begin to record instructions of group 2	<p>"ERROR! \ n" : Instruction error</p> <p>"START \ n" : Ready for recording, you can speak now</p> <p><i>now</i></p> <p>"No voice \ n" : no voice detected</p> <p>"Again \ n" : Speak the voice instruction again. Do not speak until getting the START message</p> <p>"Too loud \ n" : Too loud to record</p> <p>"Different \ n" : voice instruction confirming failed. Voice for the second chance is different with the first one.</p> <p>"Finish one \ n" : recording one voice instruction successfully</p> <p>"Group2 finished! \ n" : finish recording group 2</p>	<p>0xe0 : Instruction error</p> <p>0x40 : Ready for recording, you can speak now</p> <p>0x41 : no voice detected</p> <p>0x42 : Speak the voice instruction again. Do not speak until getting the START message</p> <p>0x43 : Too loud to record</p> <p>0x44 : voice instruction confirming failed. Voice for the second chance is different with the first one.</p> <p>0x45 : recording one voice instruction successfully</p> <p>0x47 : finish recording group 2</p>
0x13	Begin to record instructions of group 3	<p>"ERROR! \ n" : Instruction error</p> <p>"START \ n" : Ready for recording, you can speak now</p> <p><i>now</i></p> <p>"No voice \ n" : no voice detected</p> <p>"Again \ n" : Speak the voice instruction again. Do not speak until getting the START message</p> <p>"Too loud \ n" : Too loud to record</p> <p>"Different \ n" : voice instruction confirming failed. Voice for the second chance is different with the first one.</p> <p>"Finish one \ n" : recording one voice instruction successfully</p> <p>"Group3 finished! \ n" : finish recording group 3</p>	<p>0xe0 : Instruction error</p> <p>0x40 : Ready for recording, you can speak now</p> <p>0x41 : no voice detected</p> <p>0x42 : Speak the voice instruction again. Do not speak until getting the START message</p> <p>0x43 : Too loud to record</p> <p>0x44 : voice instruction confirming failed. Voice for the second chance is different with the first one.</p> <p>0x45 : recording one voice instruction successfully</p> <p>0x48 : finish recording group 3</p>
0x21	Import group 1 and be ready for voice instruction	<p>"Group1 Imported !\n" : Successful</p> <p>"ERROR! \ n" : Instruction error</p> <p>"Import failed !\n" : Importing voice group failed</p>	<p>0xcc : Successful</p> <p>0xe0 : Instruction error</p> <p>0xe1 : Importing voice group failed</p>
0x22	Import group 2 and be ready for voice instruction	<p>"Group2 Imported !\n" : Successful</p> <p>"ERROR! \ n" : Instruction error</p> <p>"Import failed !\n" : Importing voice group failed</p>	<p>0xcc : Successful</p> <p>0xe0 : Instruction error</p> <p>0xe1 : Importing voice group failed</p>
0x23	Import group 3 and be ready for voice instruction	<p>"Group3 Imported !\n" : Successful</p> <p>"ERROR! \ n" : Instruction error</p> <p>"Import failed !\n" : Importing voice group failed</p>	<p>0xcc : Successful</p> <p>0xe0 : Instruction error</p> <p>0xe1 : Importing voice group failed</p>

0x24	Query the recorded group	<p>"Used group:0\n" : No group is recorded "Used group:1\n" : Group 1 is recorded "Used group:2\n" : Group 2 is recorded "Used group:3\n" : Group 3 is recorded "Used group:12\n" : Group 1 and Group 2 are recorded "Used group:13\n" : Group 1 and Group 3 are recorded "Used group:23\n" : Group 2 and Group 3 are recorded "Used group:123\n" : All the 3 groups are recorded "ERROR! \n" : Instruction error</p>	<p>0x00 : No group is recorded 0x01 : Group 1 is recorded 0x02 : Group 2 is recorded 0x04 : Group 3 is recorded 0x03 : Group 1 and Group 2 are recorded 0x05 : Group 1 and Group 3 are recorded 0x06 : Group 2 and Group 3 are recorded 0x07 : All the 3 groups are recorded 0xe0 : Instruction error</p>
0x31	Change the baud rate to 2400bps	<p>"Baud: 2400\n" : Successful "ERROR! \n" : Instruction error</p>	<p>0xcc : successful 0xe0 : Instruction error</p>
0x32	Change the baud rate to 4800bps	<p>"Baud: 4800\n" : Successful "ERROR! \n" : Instruction error</p>	
0x33	Change the baud rate to 9600bps	<p>"Baud: 9600\n" : Successful "ERROR! \n" : Instruction error</p>	
0x34	Change the baud rate to 19200bps	<p>"Baud: 19200\n" : Successful "ERROR! \n" : Instruction error</p>	
0x35	Change the baud rate to 38400bps	<p>"Baud: 38400\n" : Successful "ERROR! \n" : Instruction error</p>	
0x36	Switch to Common Mode	<p>"Common Mode\n" : Successful "ERROR! \n" : Instruction error</p>	
0x37	Switch to Compact Mode	<p>"Compact Mode\n" : Successful "ERROR! \n" : Instruction error</p>	
0x41	Reset output of O1	<p>"Ok\n" : Successful "ERROR! \n" : Instruction error</p>	<p>0xcc : successful 0xe0 : Instruction error</p>
0x42	Reset output of O2		
0x43	Reset output of O3		
0x44	Reset output of O4		
0x45	Reset output of O5		
0x46	Reset output of O1~O5		
0x50	Set O1~O5 to Pulse Mode (negative pulse)	<p>"Ok\n" : Successful "ERROR! \n" : Instruction error</p>	<p>0xcc : successful 0xe0 : Instruction error</p>
0x51	Set O1~O5 to Flip Mode		
0x52	Set O1~O5 to Down Mode		
0x53	Set O1~O5 to Up Mode		
0x60	Set the output duty of O1~O5 in Pulse Mode	<p>"Ok\n" : Successful "ERROR! \n" : Instruction error</p>	<p>0xcc : successful 0xe0 : Instruction error</p>
0x61	0x60 -- 10ms		
0x62	0x61 -- 15ms		
0x63	0x62 -- 20ms		
0x64	0x63 -- 25ms		
0x65	0x64 -- 30ms 0x65 -- 50ms 0x66 -- 60ms		
0x66	0x67 -- 70ms 0x68 -- 80ms 0x69 -- 90ms		
0x67	0x6A -- 100ms 0x6B -- 200ms		
0x68	0x6C -- 300ms		

0x69	0x6D -- 400ms 0x6E -- 500ms 0x6F -- 1s		
0x6A			
0x6B			
0x6C			
0x6D			
0x6E			
0x6F			
0x70	Reset Serial Port to: 9600 baud rate, 8 data bits, no parity, 1 stop bit	"Ok\n" : Successful "ERROR! \n" : Instruction error	0xcc : successful 0xe0 : Instruction error
0xbb	Query version information	Version information	No respond

If you want to modify the serial baud rate to 38400, you need to send command: **0xaa35**. If successful, it will return "Baud: 38400 \n"(in Common Mode) or **0xcc** (in Compact Mode). The baud rate is set to 38400.

The main difference between Compact Mode and Common Mode is the returning message. Common Mode response is long string but Compact Mode response is a byte. For example, after sending **0xaa04** to delete all the contents of the 3 groups, in Common Mode it will return "**All Groups Deleted! \n**", but in Compact Mode it will return a concise bytes such as **0xcc** which means a successful operation.

Here we will introduce more about the output of O1~O5:

Pulse Mode: Output is negative pulse. The pulse duration time (pulse duty) could be set by command **0x60 ~ 0x6F**

Flip Mode: each time while the module recognizes voice command, it will change the state of the output pin.

Down Mode: The output will become LOW from HIGH once it detects voice command. It will never come back to HIGH again until the module receives output reset command **0x41 ~ 0x46**

Up Mode: The output will become HIGH from LOW once it detects voice command. It will never come back to LOW again until the module receives output reset command **0x41 ~ 0x46**

There will be an example:

A: Starting point while you import the voice group.

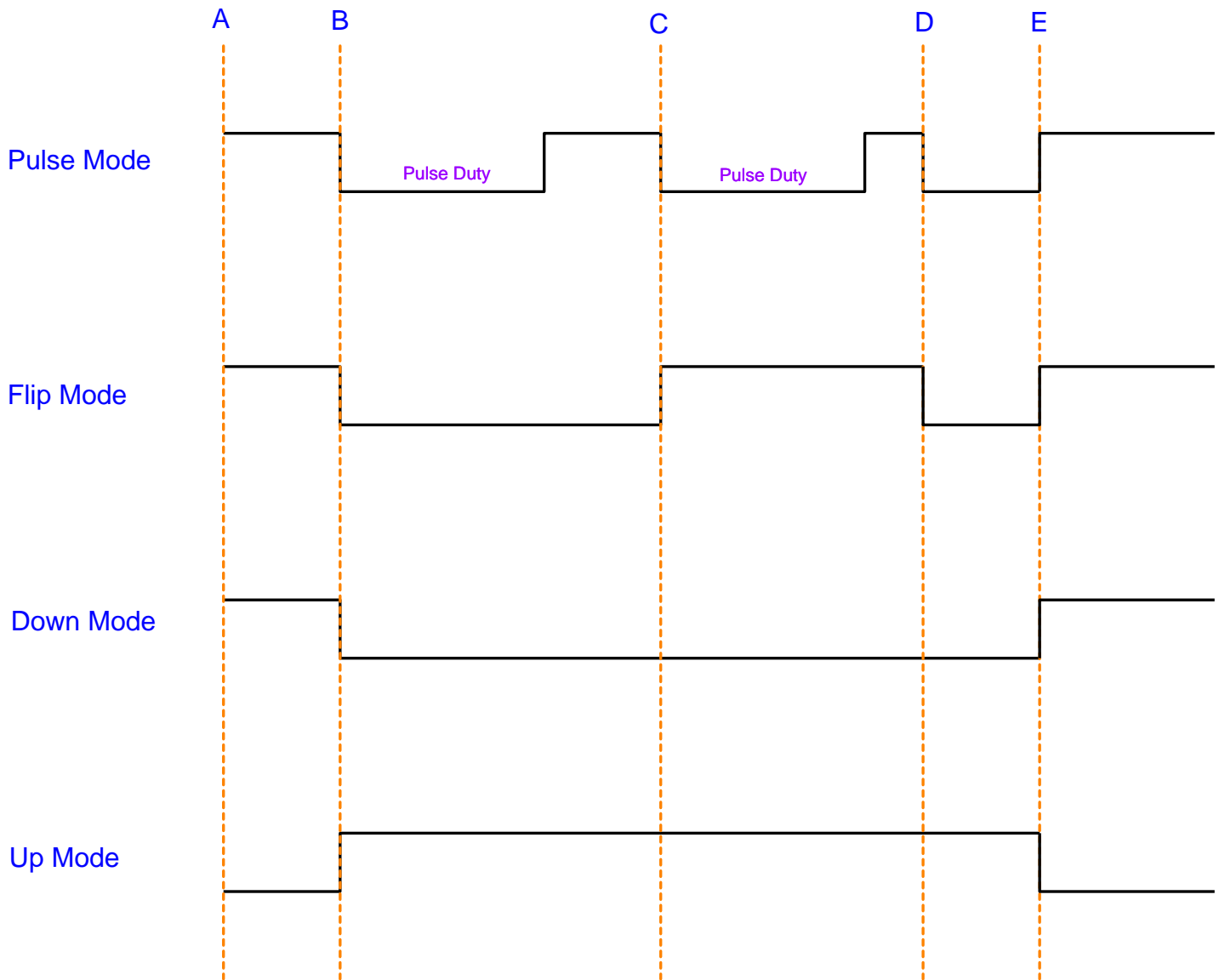
B: The 1st time it recognizes voice command.

C: The 2nd time it recognizes voice command.

D: The 3rd time it recognizes voice command.

E: The time while output reset command is received (**0x41 ~ 0x46**).

The back wire is output wave shape.



For the first-time use, we need to do some configuration:

1. Select the serial baud rate (default 9600)
2. Select the communication mode: Common Mode or Compact Mode
3. Recording five instructions of the first group(or 2nd or 3rd as required)
4. Import the group you need to use (only recognize 5 instructions within one group at the same time)

After all the setting above, you can speak or send voice instruction to it. If identified successfully, result will be returned via serial port in the format: group number + command number. For example, return **Result: 11** (Compact mode returns 0x11) means identified the first command of group 1.

If voice instruction is recorded, each time after you power it on, you need to import the group before letting it identify voice instructions.

LED

Recording stage:

1. *Record indication: D1 (RED) flashes 3 times within the 600ms, then off for 400ms, and then flashes quickly for 4 times within 600ms. Now the recording indication is over.*
2. *Begin to speak: D1 (RED) is off for 400ms, and then is on. Voice during the time while D1 (RED) is on will be recorded by this module.*
3. *Recording a voice instruction successfully for the first time: D1 (RED) off, D2 (ORANGE) on for 300ms.*
4. *Recording a voice instruction successfully for the first time: D1 (RED) off, D2 (ORANGE) on for 700ms.*
5. *Recording failure: D2 (ORANGE) flashes 4 times within the 600ms. In cases that voice instructions detected twice don't match, or the sound is too large, or there is no sound, recording will fail. You need to start over the recording process for that instruction.*

Waiting mode:

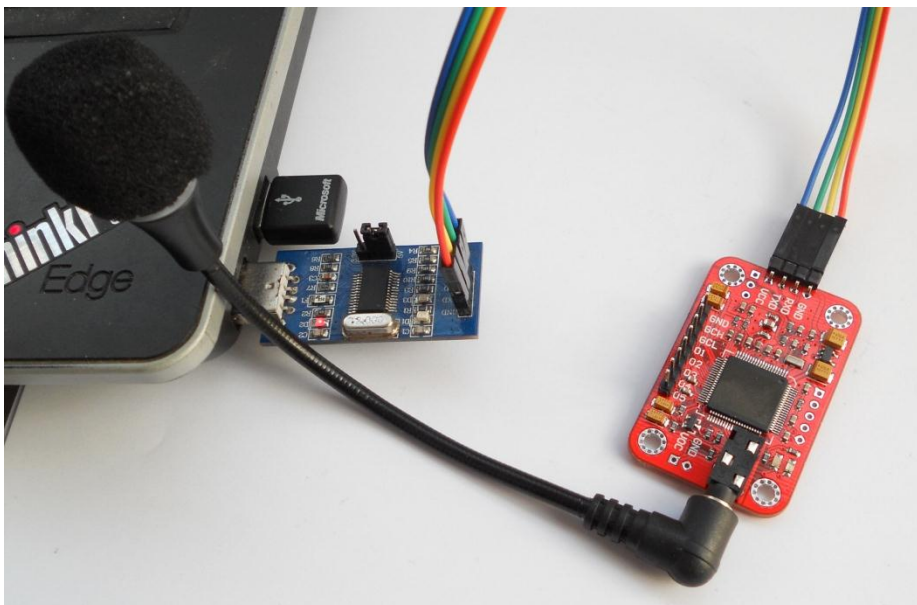
In waiting mode, D2 (ORANGE) is off, and D1 (RED) is on for 80ms every other 200ms, fast flashing. In this mode, it doesn't recognize voice command, only waiting for serial commands.

Recognition stage:

In identification stage, D2 (ORANGE) is off, and D1 (RED) is on for 100ms every other 1500ms, slow flashing. In this stage, this module is processing received voice signal, and if matching, it will send the result immediately via serial port.

Recording

Before using it, we have train it by recording voice instructions. Each voice instruction has the maximum length of 1300ms, which ensures that most words can be recorded. Once you start recording, you can't stop the recording process until you finish all the 5 voice instructions recording of one group. Also, once you start recording, the previous voice instructions in that group will be erased. In training state, this module doesn't reply to any other serial commands.

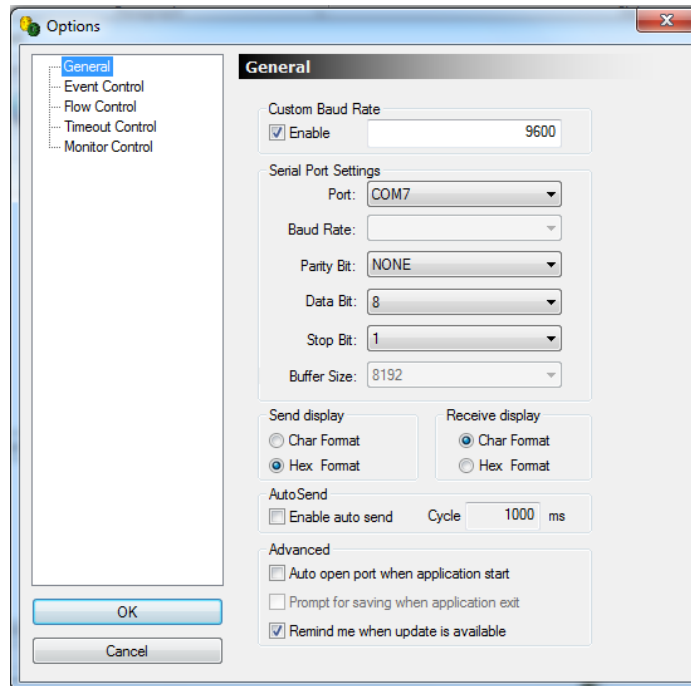


LED will flash to indicate state. Please refer to the LED part.

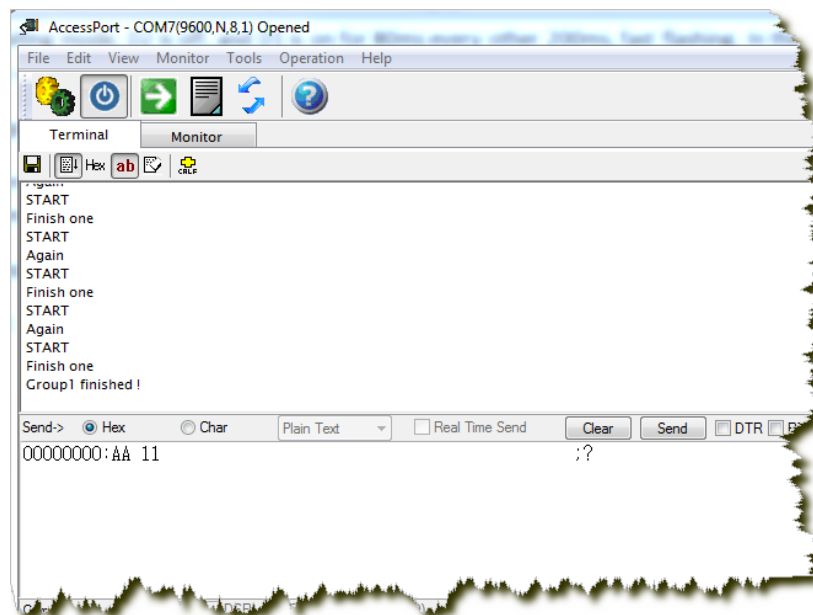
First, you need a serial tool. Here we use AccessPort ([Download page](#)).

1. Serial port setting:

- Baud rate: 9600
- Parity bit: None
- Data bit: 8
- Stop bit: 1
- Send format: Hex
- Receive format: Char



2. Send commands



Send: **0xaa11**

Receive (in Common Mode):

START

No voice // I did not make any sound. So it replied such message

START

Speak now

Again

START

Speak again now

Different // I spoke another words for the second time. So it replied such message

START

Speak now

Again

START

Speak again now

Finish one // recording one instruction successfully

START

Again

START

Finish one

START

Again

START

Finish one

START

Again

START

Finish one

START

Again

START

Finish one

Group1 finished! // recording group 1 successfully

By now, you've finished instruction recording for group 1.

Recognition

We added another way to import the voice instruction group on V2. For V1, the only way is to send command to it through serial port, for example:

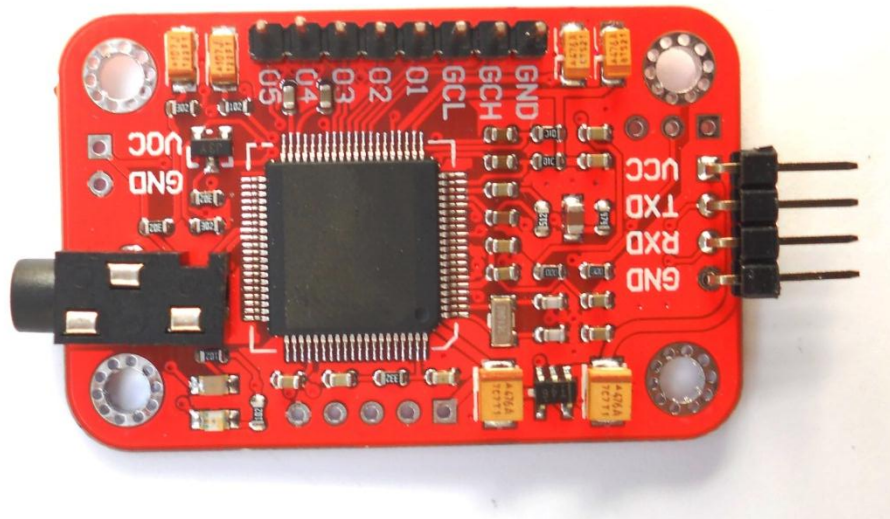
- Send command **0xAA21** to import group 1.
- Send command **0xAA22** to import group 2.
- Send command **0xAA23** to import group 3.

On V2, we added an easy way to import the group:

Look at the following picture, you could control GCH and GCL pins. Those two pins are all 5V TTL.

GCH	GCL	Working State
LOW	LOW	No Change
LOW	HIGH	Import Group 2
HIGH	LOW	Import Group 1
HIGH	HIGH	Import Group 3

Try to connect GND to make sure they have the common ground.



Once the group is important, it will output message through serial port. It could have 15 voice instructions in 3 groups. Each time you need to import the group before it could recognize instructions in that group. That means, this module could recognize 5 voice instructions at the same time. In recognition stage, this module could receive other serial commands. It will not exit the recognition stage until you send **0xAA00**, or delete that group, or begin recording instructions.

Group 1

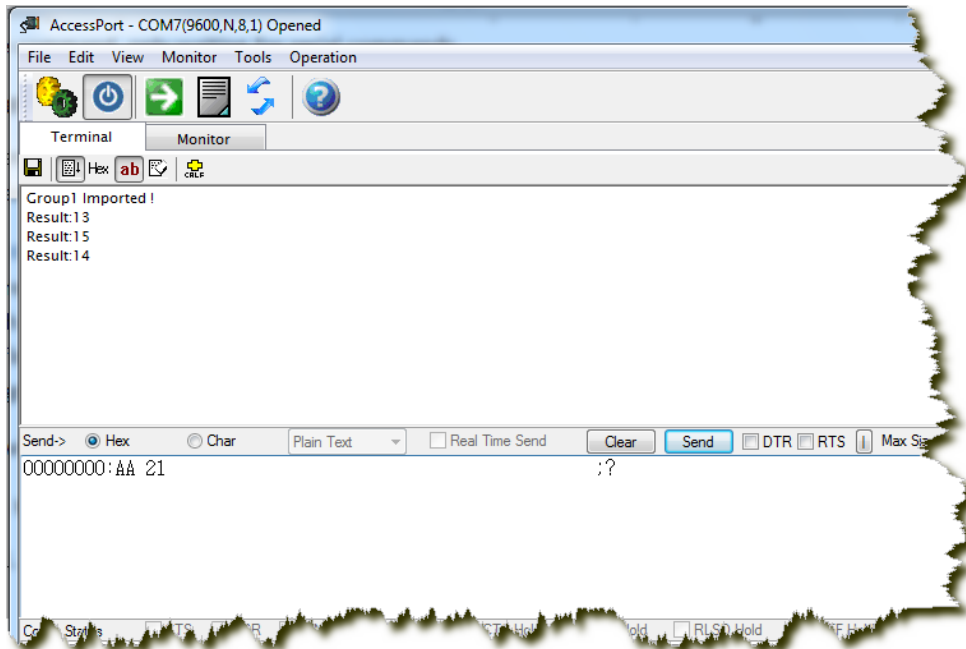
Command A1
Command A2
Command A3
Command A4
Command A5

Group 2

Command B1
Command B2
Command B3
Command B4
Command B5

Group 3

Command C1
Command C2
Command C3
Command C4
Command C5



Output

Video: http://www.youtube.com/watch?v=OZidu_HSr00

There are some tricks to improve the recognition rate.

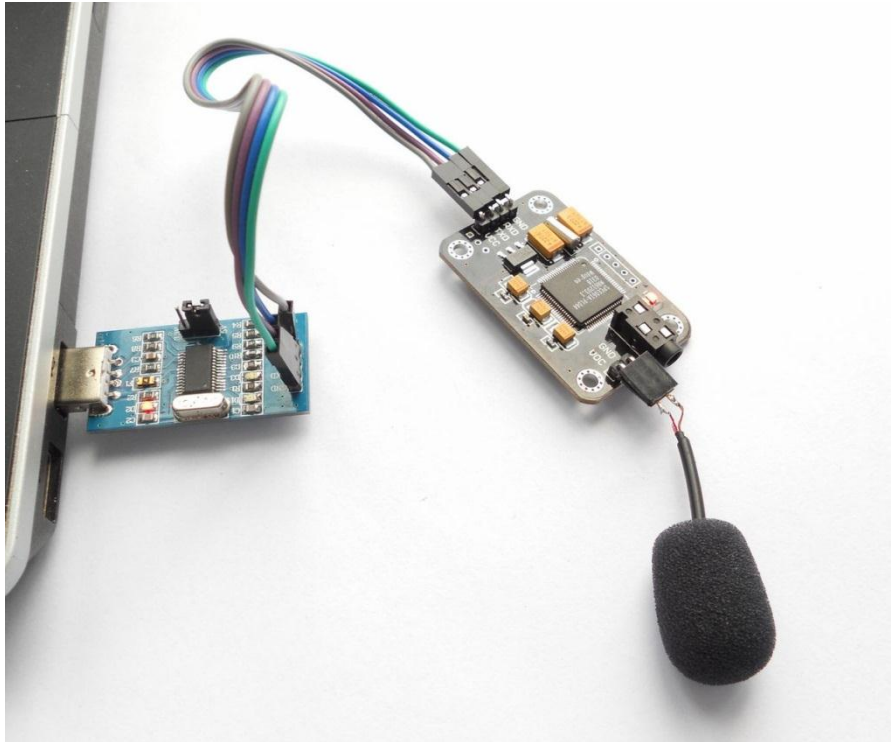
Try to record and use it in the same environment. And noise could greatly reduce the recognition rate. MIC plays very important role. As for the MIC wire connection to this module, the shorter, the better.

In this test, I recorded 5 voice instructions: white, red, green, blue, off.

First time I use a simple MIC as follows:



I found occasionally this module could not distinguish “red” and “green”. Then I changed the MIC as follows:



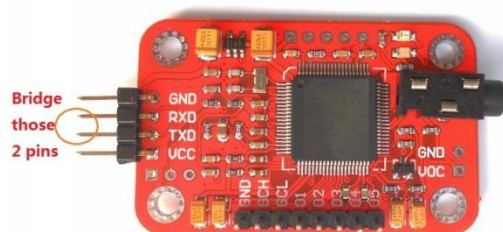
Then the recognition rate is greatly improved.

Also I find that it is a little hard for this module to distinguish “of” and “off”. To distinguish those two similar pronunciations, high-sensitive MIC is required and speaking must be very clear, as well as in quiet environment. All those limitation makes low practicality. But there are simple ways to solve it. Make your voice instructions distinctive. Do not use voice instructions of similar pronunciation.

Reset the Serial Port

On V2, we added a way to reset the serial port since many customers would forget the serial parameter some time later after they changed it.

Before powering on the module, bridge the TX and RX pins



Then Power the module on.

Contact information

Disclaimer and Revisions

The information in this document may change without notice.

Revision History

Rev.	Date	Author	Description
A	Sep. 29 th , 2011	Wilson Shen	Initial version
B	Mar. 4 th , 2013	Wilson Shen	V2