FN-RM03 Audio Recorder and Player Module

Datasheet

V1.0

Contents

1. Overviews

1.1. Brief Introduction

FN-RM03 is a high-quality audio recorder and player module, designed and launched by Flyron Technology Co., Ltd. Flexible audio recording modes including MIC recording and Line-in recording and two formats of audio files playback supported including MP3 and WMA, and as well as simple communication control modes are the main advantages of this module, which can meet kinds of needs from customers.

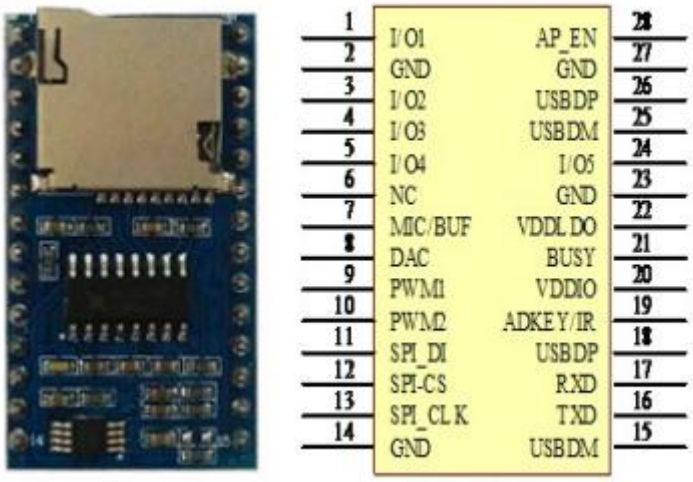
1.2. Product Features

1. Supports microphone(mono), and line-in(mono) audio recording modes.
2. Supports AD keys control mode(play/pause, next, previous, volume +&-, record, and stop).
3. Supports standard UART serial communication control mode.
4. Supports playback of MP3 and WAV formats audio files, with great sound quality.
5. Recording is WAV format at the sampling rate 32KHz.
6. Possible to connect an external USB flash drive through the related pinouts.
7. Use micro SD card and USB flash drive as the storage devices; supports max 32GB micro SD card and 32GB USB flash drive.
8. Supports FAT or FAT32 file systems.
9. Can freely replace sound files in the micro SD card via USB port.
10. Built-in a 1W amplifier that can direct drive 8Ω / 1W speaker.
11. 32 levels adjustable sound volume.
12. DC 5V power supply.
13. PCB size: 37.30mmx20.50mm

1.3. Technical Parameters

Item	Description
Audio Formats Supported at Playback Status	MP3: Supports 8K-48KHZ, 8-320Kbps WAV: 8K-44.1KHZ
Recording Format	WAV 32KHz
USB Port	USB2.0
Working Voltage	DC3.3-5V
Rated Current	20-250MA(with load)
Voltage of IO Port	3.3V TTL level
Operating Temp.	-40-85℃
Humidity	5%-95%

2. Pin Configuration



No.	Name	Attribute	Description	Notes
1	I/O1	IO	N/A(reserved)	
2	GND	GND	Power Ground	
3	I/O2	IO	N/A(reserved)	
4	I/O3	IO	N/A(reserved)	
5	I/O4	IO	N/A(reserved)	
6	NC	NC	Not connected/Idle	
7	MIC/BUF	AD	Microphone input	
8	DAC	DAC	DAC audio output	Connected to earphone or external active power amplifier
9	PWM1	PWR	PWM audio output port 1	Directly drive a 8ohm 1W speaker
10	PWM2	PWR	PWM audio output port 2	
11	SPI_DI	IO	SPI_DI	Reserved only, please ignore
12	SPI_CS	IO	SPI_CS	
13	SPI_CLK	IO	SPI_CLK	
14	GND	GND	Power Ground	
15	USBDM	IO	USB communication DM port	
16	TXD	IO	UART serial output	
17	RXD	IO	UART serial input	
18	USBDP	IO	USB communication DP port	
19	ADKEY	AD	AD key control port	to get different functions by using different value of resistors.

20	VDDIO	PWR	LDO power output	Supply 3.3V power
21	BUSY	IO	Busy indication	
22	VDDLDO	PWR	Power input(DC3.3V-5V)	**If you use a USB flash drive, 5V supply is required.**
23	GND	GND	Power Ground	
24	I/O5	IO	IO port 5	
25	USBDM	IO	USB communication DM port	
26	USBDP	IO	USB communication DP port	
27	GND	GND	Power Ground	
28	AP_EN	IO	Enable pin	When it works at low level, the amplifier will be turned off; and when it works at high level, the amplifier will be enabled to work.

3. AD Key Control Mode

Through AD key function(the pinout number 19) and connecting with specific values of resistors, users can lead out 7 different functional key control as below. Please refer to the application circuit at page 18 for the connection in details of this part.

Key	Operation	Function	Matched Resistor
Play/Pause	Short press	Play/Pause	0 ohm
Next	Short press	For next sound	2 Kohms
Previous	Short press	For previous sound	5.1 Kohms
Vol+	Short press	For volume up	10 Kohms
Vol-	Short press	For volume down	20 Kohms
Record	Short press	Short press to start recording and short press again to stop recording	47 Kohms
Stop	Short press	Stop playback	100 Kohms

Note: ADKEY function can be customized according to customer's special requirements.

4. Serial Control Mode

4.1. Serial Communication Protocol

FN-RM03 supports standard UART asynchronous serial control(communication baud rate is 9600bps), working at 3.3V TTL level. Possible to be converted to RS232 level via MAX3232 chip. The communication protocol format is as below.

Start code: 0x7E

Number: number of bytes from Number itself to check code

Command: a specific serial command byte

Parameter: to realize a specific function with a command byte together

Check code: it's a sum value of Number+Command+Parameter(it uses one byte only that is from the lower 8 bits)

End code: 0x7E

If use a serial assistant, you need to set the parameters correctly as below.

Note: All of the commands need to be sent in hex.

4.2. Serial Commands

4.2.1. Control Commands

Command	Function Description	Note
0xA2	Specify playback(of a file) by indexed sequence in the root directory of the storage device	See 4.3.1
0xA3	Specify playback(of a file) by file name in the root directory of the storage device	See 4.3.2
0xA4	Specify playback(of a file) by indexed sequence in a folder	See 4.3.3
0xA5	Specify playback(of a file) by file name in a folder	See 4.3.4
0xAA	Pause playback	See 4.3.5

0xAB	Stop playback	See 4.3.6
0xAC	Next	See 4.3.7
0xAD	Previous	See 4.3.8
0xAE	Volume control	See 4.3.9
0xAF	Specify a playback mode	See 4.3.10
0xD0	Fast forward	See 4.3.11
0xD1	Fast backward	See 4.3.12
0xD2	Choose a storage device(SD card or USB flash drive) to work with the module	See 4.3.13
0xD3	Choose audio-recording input mode	See 4.3.14
0xD5	Specify recording(of a file)by indexed sequence in the root directory of the storage device	See 4.3.16
0xD6	Specify recording(of a file)by file name in the root directory of the storage device	See 4.3.17
0xD7	Specify recording(of a file) by indexed sequence in a folder	See 4.3.18
0xD8	Specify recording(of a file) by file name in a folder	See 4.3.19
0xD9	Stop recording	See 4.3.20
0xDA	Delete a specified file in the storage device by indexed sequence	See 4.3.21
0xDB	Delete a specified file in the storage device by file name	See 4.3.22
0xDC	Delete a specified file in a folder by indexed sequence	See 4.3.23
0xDD	Delete a specified file in a folder by file name	See 4.3.24
0xDE	Delete all of the files	See 4.3.25&4.3.26
0xDF	Delete the specified folder	

4.2.2 Query Commands

Command	Function Description	Note
0xC1	Query current volume level	See 4.4.1
0xC2	Query current work status	See 4.4.2
0xC5	Query the total file numbers in the storage device	See 4.4.3

0xC6	Query the total file numbers in the specified folder	See 4.4.4
0xC7	Query the total file numbers in the root directory	
0xC9	Query current sound file being played	See 4.4.5
0xCA	Query current connection status regarding SD card and USB flash drive	See 4.4.6
0xCB	Query whether a sound file is in the root directory of a storage device or not	See 4.4.7
0xCC	Query whether a sound file is in a folder or not	See 4.4.8
0XCD	Read the name of the sound file being played	
0xCE	Query space left in the storage device	See 4.4.9

4.3. Detailed Annotation of Control Commands

4.3.1. Specify playback(of a file) by indexed sequence in the root directory of the storage device

Start Code	Number	Command	MSB of the Sound File	LSB of the Sound File	Check Code	End Code
7E	05	A2	00	01	A8	7E

This command is to play the 1st sound file in the root directory of the storage device. Please note the sound files here are ranked according to physical indexed sequence.

Returned data: 00 represents command is executed successfully; 01 represents no this file.

Note: If the specified sound file doesn't exist, the module will not work.

4.3.2. Specify playback(of a file) by file name in the root directory of the storage device

Start Code	Number	Command	File Name(from MSB to LSB)				Check Code	End Code
7E	07	A3	54(T)	30(0)	30（0）	32(2)	90	7E

This command is to play a sound file by file name in the root of the storage device. The file name here(T002) uses ASCII code to indicate. The hex codes 54, 30, 30, and 32 correspond to the characters T002 respectively, so it means the sound file named T002.mp3 is going to be played back in the root of the storage device.

Returned data: 00 represents the command is executed successfully; 01 represents no this file.

Note: When rename a sound file, it can't be more than 8 characters.

4.3.3. Specify playback(of a file) by indexed sequence in a folder

Start	Numb	Com	Folder Name(from MSB to LSB)	File Index(from MSB to LSB)	Check	End

Code	er	mand								Code	Code
7E	0A	A4	4D (M)	55 (U)	53 (S)	49 (I)	43 (C)	00	01	30	7E

This command is to play a sound file by indexed sequence in a folder. Here the folder name(MUSIC) uses ASCII code to indicate. The hex codes 4D, 55, 53, 49 and 43 respectively correspond to the characters MUSIC, so it means the 1st sound file(or 0001.mp3) in the folder named MUSIC is going to be played back.

Returned data: 00 represents the command is executed successfully; 01 represents no this file.

Note: When rename a folder, it must be 5 characters.

4.3.4. Specify playback(of a file) by file name in a folder

Start Code	Numb er	Com mand	Folder Name(from MSB to LSB)					File Name(from MSB to LSB)				Check Code	End Code
7E	0C	A5	4D (M)	55 (U)	53 (S)	49 (I)	43 (C)	54 (T)	30 (0)	30 (0)	32 (2)	18	7E

This command is to play a file by file name in a folder. Here the folder name(MUSIC) and the file name(T002) use ASCII code to indicate. The hex codes 4D, 55, 53 and 49 respectively correspond to the characters MUSIC, and the hex codes 54, 30, 30 and 32 respectively correspond to the characters T002, so it means the sound file named T002.mp3 in the folder named MUSIC is going to be played back.

Returned data: 00 represents the command is executed successfully; 01 represents no this file.

Note: When rename a folder, it must be 5 characters, and when rename a sound file, it can't be more than 8 characters.

4.3.5. Pause playback

Start Code	Number	Command	Check Code	End Code
7E	03	AA	AD	7E

Note: When this command is sent out first time during playback, the sound is paused, and if this command is sent out again, the sound continues to be played.

Returned data: 00 represents command is executed successfully; 01 represents command execution failed;

4.3.6. Stop playback

Start Code	Number	Command	Check Code	End Code

7E	03	AB	AE	7E

Returned data: 00 represents command is executed successfully; 01 represents command execution failed;

4.3.7. Next

Start Code	Number	Command	Check Code	End Code
7E	03	AC	AF	7E

Note: This command is to play the next sound. During the last sound is being played, if this command is sent out, the module will play the first sound.

Returned data: 00 represents command is executed successfully; 01 represents command execution failed;

4.3.8. Previous

Start Code	Number	Command	Check Code	End Code
7E	03	AD	B0	7E

This command is to play the previous sound. During the first sound is being played, if this command is sent out, the module will play the last sound.

Returned data: 00 represents command is executed successfully; 01 represents command execution failed;

4.3.9. Volume control

Start Code	Number	Command	Volume Level	Check Code	End Code
7E	04	AE	1F	D1	7E

There are total of 32 volume levels, i.e. 00-31. Level 00 is mute while level 31 is the maximum volume(level 30 is the default volume). As the example above, it is to send the maximum volume level 31.

Returned data: 00 represents command is executed successfully; 01 represents command execution failed;

4.3.10. Specify a playback mode

Start Code	Number	Command	Parameter	Check Code	End Code
7E	04	AF	00: Single non-repeat mode(by default)	B3	7E
			01: Single repeat(loop) mode	B4	
			02: All repeat(loop) mode	B5	
			03: Random mode	B6	

			04: All repeat(loop) mode in the folder	B7	

Once the playback mode is changed, it always keeps in the changed mode, but it will resume to the default mode when it gets reset or re-powered on.

Returned data: 00 represents command is executed successfully; 01 represents command execution failed;

4.3.11. Fast forward

Start Code	Number	Command	Check Code	End Code
7E	03	D0	D3	7E

Sending this command for the first time is to execute fast forward, and sending it for the second time to end fast forward.

Returned data: 00 represents command is executed successfully; 01 represents command execution failed;

4.3.12. Fast backward

Start Code	Number	Command	Check Code	End Code
7E	03	D1	D4	7E

Sending this command for the first time is to execute fast backward, and sending it for the second time to end fast backward.

Returned data: 00 represents command is executed successfully; 01 represents command execution failed;

4.3.13. Choose a storage device(SD card or USB flash drive) to work with the module

Start Code	Number	Command	Parameter	Check Code	End Code
7E	04	D2	00: shift to SD card(by default)	D6	7E
			01: shift to USB flash drive	D7	

FN-RM03 supports SD card and USB flash drive as the storage devices. When the two storage devices exist in the same time, choosing one of both to work with the module is required. By default, SD card is the priority storage device. Whenever a shift is made, it would be better to send the query command to confirm if the shift is successful firstly(refer to 4.5.6).

Returned data: 00 represents command is executed successfully; 01 represents command execution failed or the storage device unfound.

4.3.14. Choose audio-recording input mode

Start Code	Number	Command	Parameter	Check Code	End Code
7E	04	D3	00: connect with MIC(signal P03) 10DB(default)	D7	7E
			01: connect with LINE-IN(signal P03) 3DB	D8	
			02: connect with 2-channel Aux-in(signal P02/P37) 3DB	D9	

It's possible for FN-RM03 to choose an audio-recording input mode among 3 of them as above. By default, the module works with MIC audio-recording input mode.

Returned data: 00 represents command is executed successfully; 01 represents command execution failed;

4.3.15. Set audio-recording quality(bit rate)

Start Code	Number	Command	Parameter	Check Code	End Code
7E	04	D4	00: 128Kbps(by default)	D8	7E
			01: 96Kbps	D9	
			02: 64Kbps	DA	
			03: 32Kbps	DB	

It's possible for FN-RM03 to set audio-recording quality/choose audio-recording bit rate(code rate) as above. By default, it is 128Kbps. The fixed sampling rate is 48KHz.

Returned data: 00 represents command is executed successfully; 01 represents command execution failed;

4.3.16. Specify recording(of a file)by indexed sequence in the root directory of the storage device

Start Code	Number	Command	File Index(from MSB to LSB)		Check Code	End Code
7E	05	D5	00	02	DC	7E

This command is to record a file by indexed sequence in the root of the storage device. "00 02" represent the 2nd recording file that is going to be generated. If the 2nd recording file already exists(recorded previously), it will be covered directly with the new one.

Returned data: 00 represents command is executed successfully; 01 represents the storage device is full already; 02 represents command execution failed.

Note: Here the default recording file name format is RExxx.mp3. As the example above, the recording file name is RE002.mp3. It supports to record maximum 999 files(RE001-RE999).

4.3.17. Specify recording(of a file)by file name in the root directory of the storage device

Start Code	Number	Command	File Name(from MSB to LSB)				Check Code	End Code
7E	07	D6	54(T)	30(0)	30(0)	32(2)	C3	7E

This command is to record a file by file name in the root of the storage device. The file name(T002) uses ASCII code to indicate, and the hex codes 54, 30, 30, and 32 respectively correspond to the characters T002, it means the recording file named T002.mp3 is going to be generated .

Returned data: 00 represents command is executed successfully; 01 represents the storage device is full already; 02 represents command execution failed.

Note: Here the file name can't be more than 8 characters.

4.3.18. Specify recording(of a file) by indexed sequence in a folder

Start Code	Number	Command	Folder Name(from MSB to LSB)					File Index(from MSB to LSB)		Check Code	End Code
7E	0A	D7	4D (M)	55 (U)	53 (S)	49 (I)	43 (C)	00	02	64	7E

This command is to record a file by indexed sequence in a folder. The folder name(MUSIC) uses ASCII code to indicate, and the hex codes 4D, 55, 53, 49 and 43 respectively correspond to the characters MUSIC. "00 02" represent the 2nd recording file in the folder, so it means the 2nd recording file(RE002.mp3) is going to be generated in the folder named MUSIC.

Returned data: 00 represents command is executed successfully; 01 represents the storage device is full already; 02 represents command execution failed.

Note: 1). Here the folder name must be 5 characters. 2). Here the default recording file name format is RExxx.mp3. As the example above, the recording file name is RE002.mp3. It supports to record maximum 999 files(RE001-RE999).

4.3.19. Specify recording(of a file) by file name in a folder

Start Code	Number	Command	Folder Name(from MSB to LSB)	File Name(from MSB to LSB)	Check Code	End Code

7E	0C	D8	4D （M）	55 （U）	53 （S）	49 （I）	43 （C）	54 (T)	30 (0)	30 (0)	32 (2)	4B	7E

This command is to record a file by file name in a folder. The folder name(MUSIC) and the file name(T002) uses ASCII code to indicate. The hex codes 4D, 55, 53, 49 and 43 respectively correspond to the characters MUSIC, and 54, 30, 30, and 32 respectively correspond to the characters T002. So it means the recording file named T002.mp3 is going to be generated in the folder named MUSIC .

Returned data: 00 represents command is executed successfully; 01 represents the storage device is full already; 02 represents command execution failed.

Note: Here the folder name must be 5 characters and the file name can't be more than 8 characters.

4.3.20. Stop recording

Start Code	Number	Command	Check Code	End Code
7E	03	D9	DC	7E

This command is to stop recording and generate a recording file.

Returned data: 00 represents command is executed successfully; 01 represents command execution failed;

4.3.21. Delete a specified file in the storage device by indexed sequence

Start Code	Number	Command	File Index(from MSB to LSB)		Check Code	End Code
7E	05	DA	00	02	E1	7E

This command is to delete a sound file in the storage device by indexed sequence. "00 02" represents the 2nd sound file, so the 2nd sound file(or 0002.mp3) by physical sequence in the root of the storage device is going to be deleted.

Returned data: 00 represents the command is executed successfully; 01 represents no this file.

4.3.22. Delete a specified file in the storage device by file name

Start Code	Number	Command	File Name(from MSB to LSB)				Check Code	End Code
7E	07	DB	54(T)	30(0)	30(0)	32(2)	C8	7E

This command is to delete a sound file in the storage device by file name. The hex codes 54, 30, 30, and 32 correspond to the ASCII codes T002 respectively, so it means the file named T002.mp3 in the root of the storage device is going to be deleted.

Returned data: 00 represents the command is executed successfully; 01 represents no this file.

4.3.23. Delete a specified file in a folder by indexed sequence

Start Code	Number	Command	Folder Name(from MSB to LSB)					File Name(from MSB to LSB)		Check Code	End Code
7E	0A	DC	4D (M)	55 (U)	53 (S)	49 (I)	43 (C)	00	02	69	7E

This command is to delete a sound file in a folder by indexed sequence. Here the folder name uses ASCII code to indicate. The hex codes 4D, 55, 53, 49 and 43 respectively correspond to the characters MUSIC, so it means the 2nd sound file(or 0002.mp3) in the folder named MUSIC is going to be deleted.

Returned data: 00 represents the command is executed successfully; 01 represents no this file.

4.3.24. Delete a specified file in a folder by file name

Start Code	Number	Command	Folder Name(from MSB to LSB)					File Name(from MSB to LSB)				Check Code	End Code
7E	0C	DD	4D (M)	55 (U)	53 (S)	49 (I)	43 (C)	54 (T)	30 (0)	30 (0)	32 (2)	50	7E

This command is to delete a sound file in a folder by file name. Here both the folder name(MUSIC) and the file name use ASCII code to indicate. The hex codes 4D, 55, 53, 49 and 43 respectively correspond to the characters MUSIC, and 54, 30, 30 and 32 respectively correspond to the characters T002, so it means the sound file named T002.mp3 in the folder named MUSIC is going to be deleted.

Returned data: 00 represents the command is executed successfully; 01 represents no this file.

4.3.25. Delete all of the files in the storage device

Start Code	Number	Command	Check Code	End Code
7E	03	DE	E1	7E

This command is to delete all of the sound files in the storage device(SD card or USB flash drive)

Returned data: 00 represents command is executed successfully; 01 represents command execution failed;

4.3.26. Delete all of the files in the specific folder

Start Code	Number	Command	Folder Name(from MSB to LSB)	Check Code	End Code

7E	08	DE	4D（M）	55（U）	53（S）	49（I）	43（C）	67	7E

This command is to delete all of the sound files in the specific folder in the storage device.

Returned data: 00 represents command is executed successfully; 01 represents command execution failed;

4.4. Detailed Annotation of Query Commands

4.4.1. Query current volume level

Start Code	Number	Command	Check Code	End Code
7E	03	C1	C4	7E

Operation Code	Returned Data
0XC1	00-1F(Volume Value)

4.4.2. Query current work status

Start Code	Number	Command	Check Code	End Code
7E	03	C2	C5	7E

Operation Code	Returned Data
0XC2	01: Playing 02: Stopped 03: Paused 04: Recording 05: Fast forward/backward

4.4.3. Query the total file numbers in the root directory

Start Code	Number	Command	Check Code	End Code
7E	03	C5	C8	7E

Operation Code	Returned Data
0XC5	Total file numbers(hexadecimal)

4.4.4. Query the total file numbers in the specified folder in the storage device

Start Code	Number	Command	Folder Name(from MSB to LSB)					Check Code	End Code
7E	08	C6	4D（M）	55（U）	53（S）	49（I）	43（C）	4F	7E

Operation Code	Returned Data
0XC6	Total file numbers(hexadecimal)

4.4.5. Query current sound file being played

Start Code	Number	Command	Check Code	End Code
7E	03	C9	CC	7E

Operation Code	Returned Data
0XC9	0001(for example)

Note: 0001 represents the sound file 0001.mp3 actually.

4.4.6. Query current connection status regarding SD card and USB flash drive

Start Code	Number	Command	Check Code	End Code
7E	03	CA	CD	7E

Operation Code	Returned Data
0XCA	00/01/02/03

When SD card or USB flash drive is pulled out, FN-RM03 returns related data automatically to prompt. Also users can send the command 0xCA as above to query the connection status. The meaning of returned data is as below.

00: both SD card and USB flash drive connected;

01: SD card connected only;

02: USB flash drive connected only;

03: neither SD card nor USB flash drive connected;

4.4.7. Query whether a sound file is in the root directory of the storage device

Start Code	Number	Command	File Name(from MSB to LSB)				Check Code	End Code
7E	07	CB	54(T)	30(0)	30(0)	32(2)	B8	7E

Returned data: 00 represents the file exists; 01 represents no this file

4.4.8. Query whether a sound file is in a folder

Start Code	Number	Command	Folder Name(from MSB to LSB)					File Name(from MSB to LSB)				Check Code	End Code
7E	0C	CC	4D (M)	55 (U)	53 (S)	49 (I)	43 (C)	54 (T)	30 (0)	30 (0)	32 (2)	3F	7E

Returned data: 00 represents the file exists; 01 represents no this file

4.4.9. Query space left in the storage device

Start Code	Number	Command	Check Code	End Code
7E	03	CE	D1	7E

Operation Code	Returned Data
0XCE	XXXX capacity left (Mb)

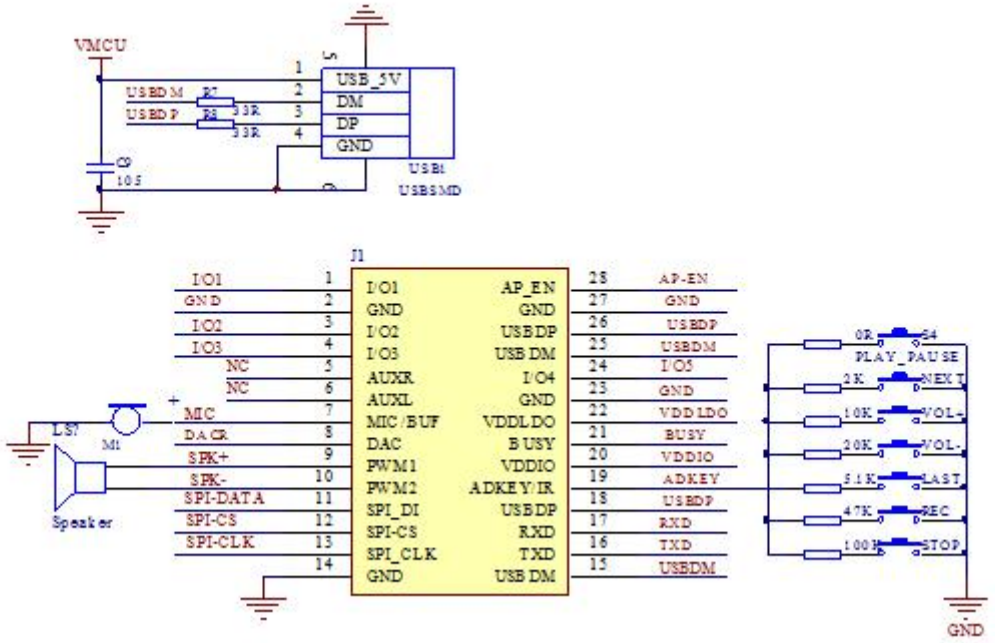
4.4.10. Notes for Using Serial Commands

1). During recording, if the storage device(SD card or USB flash drive) is full, the module will automatically stop recording and return the data 01 00 to warn.

2). When a recording file is needed to be deleted, please don't disconnect power or pull out the storage device, otherwise the recording files or even the file system will probably get damaged.

3). During sending serial commands, please delay 100ms at least between two commands.

5. Applications Circuits



Notes:

1). As the working voltage of the I/O ports(TXD&RXD) is 3.3V, it can be direct connected with a 3.3V MCU.

2). If use a 5V MCU, RXD needs to be current-limited and TXD needs to be separated with a diode.

3). When use Aux-in for stereo audio recording, the external input signal needs to be within 2.8V, otherwise it fails to record.

6. GPIO Features

Description	Function	Min. Value	Typical Value	Max. Value	Unit	Condition
VDD50	LDO Input Voltage	3.4	5.0	5.5	V	-
VCC33	LDO3.3V Input current	-	-	150	mA	Vout3.3>3.1V
SNR	SNR	-	92	-	dB	-
THD+N	Total harmonic distortion	-	-70	-	dB	No-load
PWRAB	DAC output power	-	-	16	mW	16Ω load, mono
Vpp	DAC Max. Output amplitude voltage	-	-	2.8	V	-
Psl	Standby	-	27.6	-	mA	related to power

	consumption(with micro SD card)					consumption of micro SD card
Prec	Standby consumption(with micro SD card)	-	28.1	-	mA	Same as above
P	Consumption during playback(with load)	-	28.7	-	mA	Same as above
Vppline	External audio input	-	-	2.8	v	-

7. PCB Size