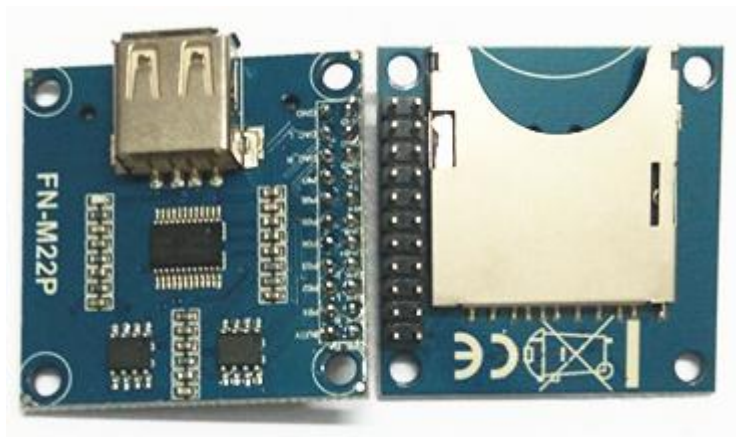


# FN-M22P Embedded MP3 Audio Module

## Datasheet

### V1.0



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## 1. Overviews

### 1.1. Brief Introduction

FN-M22P is a high quality audio playback module, which integrates MP3 and WAV decoder together perfectly, and supports parallel port control mode, UART serial port control and key control mode. It takes a SD card or USB flash drive as the storage device, which can be chosen by users freely. It can be controlled easily via MCU commands or external push buttons. Easy to operate and high performance.

### 1.2. Features

- 1). With a high quality audio decoder, supports MP3 and WAV audio formats.
- 2). Sampling rates supported: 8/11.025/12/16/22.05/24/32/44.1/48(KHz).
- 3). 24 bit DAC output and supports dynamic range 90dB and SNR 85dB.
- 4). Supports multiple key control modes, parallel control mode and UART serial port control mode.
- 5). Possible to update audio files in the SD card via the USB connecting with PC.
- 6). Supports playback of 63 audio files through binary encoding in parallel mode.
- 7). Supports maximum 3000 audio files in the root directory of the storage device in serial mode.
- 8). Supports maximum 99 folders and each folder stores maximum 255 audio files in serial mode.
- 9). Supports combination playback(plays a group of audio files one by one without pause) in serial mode.
- 10). Supports advertisement inter-cut function during playing a sound in serial mode.
- 11). Built-in double 3 watts amplifiers that can drive two 3 watts speakers directly.
- 12). Adjustable 30 levels sound volume.
- 13). Power input range: DC3.3-5V(5V is typical)
- 14). Module size: 40x40mm

### 1.3. Technical Parameters

| Item                    | Description   |
|-------------------------|---|
| MP3 audio format        | Supports 1172-3 and ISO13813-3 layer3 audio decoding                |
|                         | Supports sampling rate (KHZ):8/11.025/12/16/22.05/24/32/44.1/48     |
|                         | Supports Normal, Jazz, Classic, Pop, Rock, etc.                     |
| USB port                | Standard USB 2.0  |
| UART port               | Standard serial port and TTL level;                                 |
| Input voltage           | 3.3V-5V(5V is typical, and it's better to serially connect a diode) |
| Rated current           | 10mA(quiescent)   |
| Low consumption current | <200uA  |
| Working temp.           | -40~+80℃  |
| Humidity                | 5% ~ 95%  |

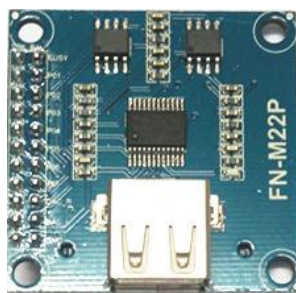
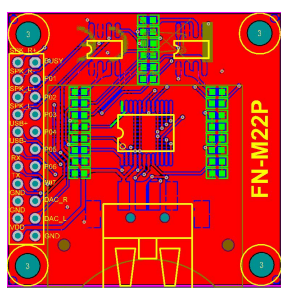
### 1.4. Naming Rules of Audio Files(Tracks) and Folders

1). Audio files directly stored in the root directory of the storage device(SD card or USB flash drive) need to be renamed as 0001.mp3/0001.wav, 0002.mp3/0002.wav, 0003.mp3/0003.wav, .....3000.mp3/3000.wav.

Here it works according to physical sequence when you copy the files from computer to SD card or USB flash drive. For example, when the module receives a command to play the track 0001.mp3, it will play the 1<sup>st</sup> track you copied from computer, probably 0001.mp3 or not (maybe it would play 0007.mp3 if it was the first one you copied from computer). In order to avoid this problem, when you make the copy, rename the audio files firstly on computer and put all the renamed files in a one folder, then press “Ctrl+A” on the key board to select all, and press “Ctrl+C” to copy, and go back to the SD card or the USB flash drive, and press “Ctrl+V” to past all the files into the SD card or USB flash drive. Or users just directly give up this way and just move the audio files to folders and choose to control and play them in a folder as below.

2). Folders must be renamed as 01, 02, 03.....99, and the audio files must be renamed as 001.mp3/001.wav, 002.mp3/002.wav, 003.mp3/003.wav, .....255.mp3/255.wav. It is also possible to keep the original audio file name when you rename a file. For example, the original audio file name is “Yesterday Once More.mp3”, you can rename it as “001Yesterday Once More.mp3”.

## 2. Pin Configuration and Summary



| No. | Pin   | Description                        | Note  |
|-----|-------|------------------------------------|---|
| 1   | VDD   | Power input                        | 3.3V-5V(5V is suggested and not higher than 5.2V)             |
| 2   | GND   | Ground                             | Power ground  |
| 3   | GND   | Ground                             | Power ground  |
| 4   | TX    | UART serial output                 | Baud rate is 9600   |
| 5   | RX    | UART serial input                  | Baud rate is 9600   |
| 6   | USB-  | USB- DM                            | USB Port(connected with a USB flash drive or connected to PC) |
| 7   | USB+  | USB+ DP                            |   |
| 8   | SPKL- | Connect speaker—for left channel   | Direct drive a 3 watts speaker                                |
| 9   | SPKL+ | Connect speaker+ for left channel  |   |
| 10  | SPKR- | Connect speaker—for right channel  | Direct drive a 3 watts speaker                                |
| 11  | SPKR+ | Connect speaker+ for right channel |   |
| 12  | BUSY  | Busy indication                    | High level when playing and low level when standby            |
| 13  | P01   | I/O port                           | I/O port  |
| 14  | P02   | I/O port                           | I/O port  |

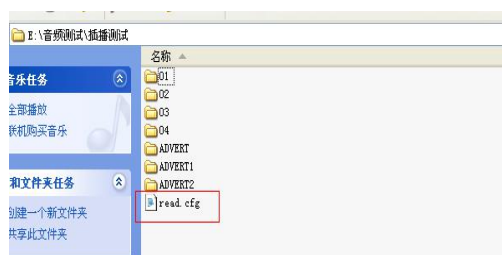
|    |       |                            |   |
|----|-------|----------------------------|---|
| 15 | P03   | I/O port                   | I/O port                                    |
| 16 | P04   | I/O port                   | I/O port                                    |
| 17 | P05   | I/O port                   | I/O port                                    |
| 18 | P06   | I/O port                   | I/O port                                    |
| 19 | P07   | SBT                        | Triggering port(SBT) used for parallel mode |
| 20 | DAC_R | Audio output right channel | Drive external earphone or amplifier        |
| 21 | DAC_L | Audio output left channel  | Drive external earphone or amplifier        |
| 22 | GND   | Ground                     | Audio ground                                |

**Note:** When you get this module, you can use a tweezers to short P01 and ground to test it simply.

### 3. Key Control and Parallel Control Modes

#### 3.1. Settings of Key Function

1). This module has 6 keys/buttons function assignment, and this can be set different many functions through a configuration file named “read.cfg”, which comes from a text file(.txt) originally. Users just need to fill in a digit/parameter to a corresponding function in a new built text file. Save it and rename it “read.cfg”, then put it in the root directory of the USB flash drive or the SD card. See as below.



#### 2). Parameters of Configuration File

| Digit in file<br>“read.cfg” | Corresponding Function Mode   |
|-----------------------------|---|
| 0                           | Pulse interruptable one-on-one playback   |
| 1                           | Electric level holding one-on-one playback  |
| 2                           | Pulse uninterruptable one-on-one playback   |
| 3                           | Standard MP3 key mode playback  |
| 4                           | Plays 6 sound files one-one-on in folder 01   |
| 5                           | Plays a sound when the key is pressed and plays another sound when the key is released  |
| 6                           | Plays sound files in the root directory of the storage device based on parallel control |
| 7                           | Plays specified sound files in folder 01 based on parallel control                      |

**Notes:**1). A storage device can be put only one configuration file in the root directory of the storage device. It is allowed not to put this configuration file if you just use UART serial control mode only.

- 2). Digits 0-5 are used for settings of key control mode while 6-7 for settings of parallel control mode. When the digit is any of 0-5, key control function is valid and parallel control is invalid, and when the digit is any of 6-7, vice versa.

## 3.2. Key Control Mode

### 3.2.1 Pulse interruptable one-on-one playback

| Key | Short press                 | Long press(keep pressing) | Release |
|-----|-----------------------------|---------------------------|---------|
| S1  | Plays 1 <sup>st</sup> sound |                           |         |
| S2  | Plays 2 <sup>nd</sup> sound |                           |         |
| S3  | Plays 3 <sup>rd</sup> sound |                           |         |
| S4  | Plays 4 <sup>th</sup> sound |                           |         |
| S5  | Plays 5 <sup>th</sup> sound |                           |         |
| S6  | Plays 6 <sup>th</sup> sound |                           |         |

**Note:** The digit is 0 in the configuration file for this function mode.

### 3.2.2 Electric level holding one-on-one playback

| Key | Short press | Long press(keep pressing)             | Release |
|-----|-------------|---------------------------------------|---------|
| S1  |             | Plays and loops 1 <sup>st</sup> sound | Stop    |
| S2  |             | Plays and loops 2 <sup>nd</sup> sound | Stop    |
| S3  |             | Plays and loops 3 <sup>rd</sup> sound | Stop    |
| S4  |             | Plays and loops 4 <sup>th</sup> sound | Stop    |
| S5  |             | Plays and loops 5 <sup>th</sup> sound | Stop    |
| S6  |             | Plays and loops 6 <sup>th</sup> sound | Stop    |

**Note:** The digit is 1 in the configuration file for this function mode.

### 3.2.3 Pulse uninterruptable one-on-one playback

| Key | Short press                 | Long press(keep pressing) | Release |
|-----|-----------------------------|---------------------------|---------|
| S1  | Plays 1 <sup>st</sup> sound |                           |         |
| S2  | Plays 2 <sup>nd</sup> sound |                           |         |
| S3  | Plays 3 <sup>rd</sup> sound |                           |         |
| S4  | Plays 4 <sup>th</sup> sound |                           |         |
| S5  | Plays 5 <sup>th</sup> sound |                           |         |
| S6  | Plays 6 <sup>th</sup> sound |                           |         |

**Note:** The digit is 2 in the configuration file for this function mode.

### 3.2.4 Standard MP3 key mode playback

| Key | Short press | Long press(keep pressing) | Release |
|-----|-------------|---------------------------|---------|
|-----|-------------|---------------------------|---------|

|    |             |  |  |
|----|-------------|--|--|
| S1 | Next        |  |  |
| S2 | Previous    |  |  |
| S3 | Play/Pause  |  |  |
| S4 | Stop        |  |  |
| S5 | Volume up   |  |  |
| S6 | Volume down |  |  |

**Notes: 1). The digit is 3 in the configuration file.**

**2). Based on this mode if IO port P01 (S1) is shorted to ground, the module will play automatically when it is powered on, and in the mean time the keys are still workable.**

### 3.2.5 Plays 6 sound files one-on-one in folder 01

| Key | Short press                 | Long press(keep pressing) | Release |
|-----|-----------------------------|---------------------------|---------|
| S1  | Plays file 001 in folder 01 |                           |         |
| S2  | Plays file 002 in folder 01 |                           |         |
| S3  | Plays file 003 in folder 01 |                           |         |
| S4  | Plays file 004 in folder 01 |                           |         |
| S5  | Plays file 005 in folder 01 |                           |         |
| S6  | Plays file 006 in folder 01 |                           |         |

**Note: The digit is 4 in the configuration file for this function mode.**

### 3.2.6 Plays a sound when the key is pressed and plays another sound when the key is released

| Key | Short press                 | Long press(keep pressing) | Release                     |
|-----|-----------------------------|---------------------------|-----------------------------|
| S1  | Plays file 001 in folder 01 |                           | Plays file 001 in folder 02 |
| S2  | Plays file 002 in folder 01 |                           | Plays file 002 in folder 02 |
| S3  | Plays file 003 in folder 01 |                           | Plays file 003 in folder 02 |
| S4  | Plays file 004 in folder 01 |                           | Plays file 004 in folder 02 |
| S5  | Plays file 005 in folder 01 |                           | Plays file 005 in folder 02 |
| S6  | Plays file 006 in folder 01 |                           | Plays file 006 in folder 02 |

**Note: The digit is 5 in the configuration file for this function mode.**

## 3.3. Parallel Control Mode

### 3.3.1 Plays sound files in the root directory of the storage device

#### 1). I/O ports for parallel control

| I/O Port | P01 | P02 | P03 | P04 | P05 | P06 | P07 |
|----------|-----|-----|-----|-----|-----|-----|-----|
| Function | A0  | A1  | A2  | A3  | A4  | A5  | SBT |

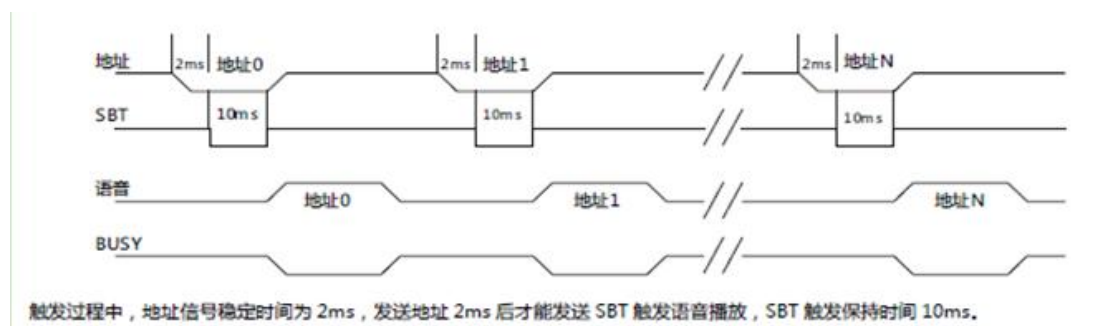
**Note: SBT is the triggering port.**

## 2). Corresponding triggering(as below list)

| Corresponding Sound          | Address Pins(I/O ports) |     |     |     |     |     | Hexadecimal Value |
|------------------------------|-------------------------|-----|-----|-----|-----|-----|-------------------|
|                              | A0                      | A1  | A2  | A3  | A4  | A5  |                   |
| Plays 1 <sup>st</sup> sound  | 0                       | 1   | 1   | 1   | 1   | 1   | 0x01              |
| Plays 2 <sup>nd</sup> sound  | 1                       | 0   | 1   | 1   | 1   | 1   | 0x02              |
| Plays 3 <sup>rd</sup> sound  | 0                       | 0   | 1   | 1   | 1   | 1   | 0x03              |
| Plays 4 <sup>th</sup> sound  | 1                       | 1   | 0   | 1   | 1   | 1   | 0x04              |
| .....                        | ...                     | ... | ... | ... | ... | ... |                   |
| Plays 20 <sup>th</sup> sound | 1                       | 1   | 0   | 1   | 0   | 1   | 0x14              |
| Plays 21 <sup>st</sup> sound | 0                       | 1   | 0   | 1   | 0   | 1   | 0x15              |
| .....                        | ...                     | ... | ... | ... | ... | ... |                   |
| Plays 63 <sup>rd</sup> sound | 0                       | 0   | 0   | 0   | 0   | 0   | 0x3F              |

**Note: 0 represents low level while 1 represents high level.**

## 3). Timing sequence



- After sending the address data, delay 2ms, and then send SBT to trigger.
- SBT needs to be kept for 10ms low level, then the triggering is valid.
- It's necessary to put down the relative pins when setting the address. For example, if the 3<sup>rd</sup> sound is needs to be played, please refer to the following.

| I/O Port       | P01 | P02 | P03  | P04  | P05  | P06  |
|----------------|-----|-----|------|------|------|------|
| Address        | A0  | A1  | A2   | A3   | A4   | A5   |
| Electric Level | Low | Low | High | High | High | High |

**Note: The digit is 6 in the configuration file for this function mode.**

### 3.3.2 Plays specified sound files in folder 01

#### 1). I/O ports for parallel control

| I/O Port | P01 | P02 | P03 | P04 | P05 | P06 | P07 |
|----------|-----|-----|-----|-----|-----|-----|-----|
| Function | A0  | A1  | A2  | A3  | A4  | A5  | SBT |

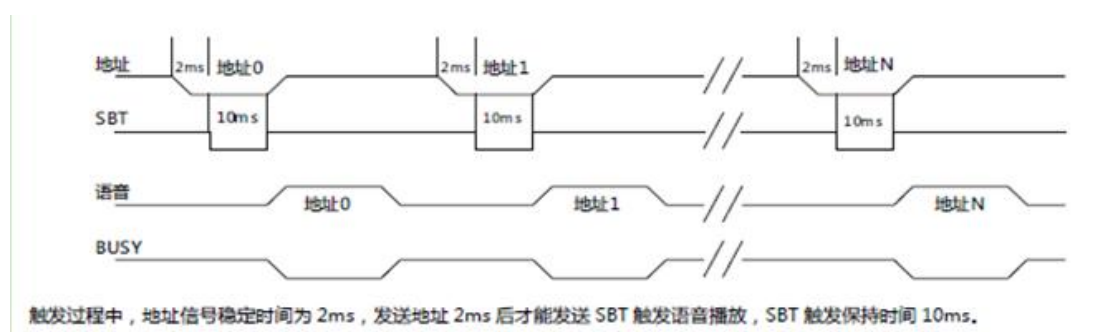
**Note: SBT is the triggering port.**

#### 2). Corresponding triggering(as below list)

| Corresponding Sound          | Address Pins(I/O ports) |     |     |     |     |     | Hexadecimal Value |
|------------------------------|-------------------------|-----|-----|-----|-----|-----|-------------------|
|                              | A0                      | A1  | A2  | A3  | A4  | A5  |                   |
| Plays sound 001 in folder 01 | 0                       | 1   | 1   | 1   | 1   | 1   | 0x01              |
| Plays sound 002 in folder 01 | 1                       | 0   | 1   | 1   | 1   | 1   | 0x02              |
| Plays sound 003 in folder 01 | 0                       | 0   | 1   | 1   | 1   | 1   | 0x03              |
| Plays sound 004 in folder 01 | 1                       | 1   | 0   | 1   | 1   | 1   | 0x04              |
| .....                        | ...                     | ... | ... | ... | ... | ... |                   |
| Plays sound 020 in folder 01 | 1                       | 1   | 0   | 1   | 0   | 1   | 0x14              |
| Plays sound 021 in folder 01 | 0                       | 1   | 0   | 1   | 0   | 1   | 0x15              |
| .....                        | ...                     | ... | ... | ... | ... | ... |                   |
| Plays sound 063 in folder 01 | 0                       | 0   | 0   | 0   | 0   | 0   | 0x3F              |

**Note: 0 represents low level while 1 represents high level.**

### 3). Timing sequence



- After sending the address data, delay 2ms, and then send SBT to trigger.
- SBT needs to be kept for 10ms low level, then the triggering is valid.
- It's necessary to put down the relative pins when setting the address. For example, if the 3<sup>rd</sup> sound is needs to be played, please refer to the following.

| I/O Port       | P01 | P02 | P03  | P04  | P05  | P06  |
|----------------|-----|-----|------|------|------|------|
| Address        | A0  | A1  | A2   | A3   | A4   | A5   |
| Electric Level | Low | Low | High | High | High | High |

**Note: The digit is 7 in the configuration file for this function mode.**

## 4. Serial Control Mode

### 4.1. Command Format

Supports asynchronous serial communication mode, via which accept serial commands sent by upper PC.

Communication Standard:9600 bps

Data bits :1

Checkout :none

Flow Control :none



| Format: \$\$ | Ver. | Number | Command   | Feedback | Param_MSB | Param_LSB | Check_MSB | Check_LSB | \$O |
|--------------|------|--------|---|----------|-----------|-----------|-----------|-----------|-----|
| \$\$         |      |        | Start byte 0x7E   |          |           |           |           |           |     |
| Ver.         |      |        | Version byte, 0xFF by default   |          |           |           |           |           |     |
| Number       |      |        | Number of bytes from version info to Check_LSB, typically 0x06 (checksum not counted) |          |           |           |           |           |     |
| Command      |      |        | Command byte  |          |           |           |           |           |     |
| Feedback     |      |        | 0x01: Need feedback--send confirmation back to MCU; 0x00: No need feedback            |          |           |           |           |           |     |
| Param_MSB    |      |        | Most significant byte of parameter  |          |           |           |           |           |     |
| Param_LSB    |      |        | Least significant byte of parameter   |          |           |           |           |           |     |
| Check_MSB    |      |        | Most significant byte of checksum   |          |           |           |           |           |     |
| Check_LSB    |      |        | Least significant byte of checksum  |          |           |           |           |           |     |
| \$O          |      |        | End byte 0xEF   |          |           |           |           |           |     |

For example, if we specify playback of SD card, we need to send the command “7E FF 06 09 00 00 02 FF F0 EF”. The number is 6 bytes, and these 6 bytes are “FF 06 09 00 00 02”. Start byte, end byte and checksum are not counted.

## 4.2. About Checksum

Regarding to calculating checksum, set your 16 bit checksum value to 0. For each byte from the Version byte until the Param\_LSB byte, subtract the byte from the checksum.

Normally it's okay whether users choose to use checksum or not, our module can receive a serial data with or without checksum, but some of users use a MCU without crystal oscillator, so if so we strongly suggest users to add checksum to make sure the communication stability.

## 4.3. Serial Communication Commands

### 4.3.1 Control commands

| Command | Function                       | Note                  |
|---------|--------------------------------|-----------------------|
| 0x01    | Play Next                      |                       |
| 0x02    | Play Previous                  |                       |
| 0x03    | Specify playback of a track    | See 4.5.1 for details |
| 0x04    | Increase volume                |                       |
| 0x05    | Decrease volume                |                       |
| 0x06    | Specify volume                 | See 4.5.2 for details |
| 0x07    | N/A(reserved)                  |                       |
| 0x08    | Specify single repeat playback | See 4.5.3 for details |
| 0x09    | Specify playback of a device   | See 4.5.4 for details |
| 0x0A    | Set sleep mode                 | See 4.5.5 for details |

|      |  |                        |
|------|--|------------------------|
| 0x0B | Awake from sleep   |                        |
| 0x0C | Reset  |                        |
| 0x0D | Play   |                        |
| 0x0E | Pause  |                        |
| 0x0F | Specify playback of a track in a folder                  | See 4.5.6 for details  |
| 0x13 | Inter cut an advertisement                               | See 4.5.7 for details  |
| 0x14 | N/A(reserved)  |                        |
| 0x15 | Stop playing inter-cut advertisement                     | See 4.5.8 for details  |
| 0x16 | Stop   |                        |
| 0x17 | Specify repeat playback of a folder                      | See 4.5.9 for details  |
| 0x18 | Set random playback                                      | See 4.5.10 for details |
| 0x19 | Set repeat playback of current track                     | See 4.5.11 for details |
| 0x1A | Set DAC  | See 4.5.12 for details |
| 0x21 | Combination playback(playback of a group)                | See 4.5.13 for details |
| 0x22 | Specify playback of a track with a specific volume level | See 4.5.14 for details |

### 4.3.2 Examples of sending control commands

| Command Description                                    | Serial Commands<br>[with checksum] | Serial Commands<br>[without checksum] | Note  |
|--|------------------------------------|---------------------------------------|---|
| Play Next  | 7E FF 06 01 00 00 00 FE FA EF      | 7E FF 06 01 00 00 00 EF               |   |
| Play Previous  | 7E FF 06 02 00 00 00 FE F9 EF      | 7E FF 06 02 00 00 00 EF               |   |
| Specify playback of a track (in the root directory)    | 7E FF 06 03 00 00 01 FE F7 EF      | 7E FF 06 03 00 00 01 EF               | Specify playback of the 1 <sup>st</sup> track |
|  | 7E FF 06 03 00 00 02 FE F6 EF      | 7E FF 06 03 00 00 02 EF               | Specify playback of the 2 <sup>nd</sup> track |
|  | 7E FF 06 03 00 00 0A FE EE EF      | 7E FF 06 03 00 00 0A EF               | Specify playback of the 10th track            |
| Increase volume  | 7E FF 06 04 00 00 00 FE F7 EF      | 7E FF 06 04 00 00 00 EF               |   |
| Decrease volume  | 7E FF 06 05 00 00 00 FE F6 EF      | 7E FF 06 05 00 00 00 EF               |   |
| Specify volume   | 7E FF 06 06 00 00 1E FE D7 EF      | 7E FF 06 06 00 00 1E EF               | Specified volume is level 30                  |
| Specify single repeat playback (in the root directory) | 7E FF 06 08 00 00 01 FE F2 EF      | 7E FF 06 08 00 00 01 EF               | Repeatedly play the 1 <sup>st</sup> track     |
|  | 7E FF 06 08 00 00 02 FE F1 EF      | 7E FF 06 08 00 00 02 EF               | Repeatedly play the 2nd track                 |
|  | 7E FF 06 08 00 00 0A FE E9 EF      | 7E FF 06 08 00 00 0A EF               | Repeatedly play the 10th track                |
| Specify playback of a device                           | 7E FF 06 09 00 00 01 FE F1 EF      | 7E FF 06 09 00 00 01 EF               | Specified device is USB flash drive           |
|  | 7E FF 06 09 00 00 02 FE F0 EF      | 7E FF 06 09 00 00 02 EF               | Specified device is SD card                   |
| Set sleep mode   | 7E FF 06 0A 00 00 00 FE F1 EF      | 7E FF 06 0A 00 00 00 EF               |   |
| Awake from sleep                                       | 7E FF 06 0B 00 00 00 FE F0 EF      | 7E FF 06 0B 00 00 00 EF               |   |
| Reset  | 7E FF 06 0C 00 00 00 FE EF EF      | 7E FF 06 0C 00 00 00 EF               |   |
| Play   | 7E FF 06 0D 00 00 00 FE EE EF      | 7E FF 06 0D 00 00 00 EF               |   |
| Pause  | 7E FF 06 0E 00 00 00 FE ED EF      | 7E FF 06 0E 00 00 00 EF               |   |



|  |                               |                         |  |
|--|-------------------------------|-------------------------|--|
| Specify playback of a track in a folder                  | 7E FF 06 0F 00 01 01 FE EA EF | 7E FF 06 0F 00 01 01 EF | Specify track "001" in the folder "01"             |
|  | 7E FF 06 0F 00 01 02 FE E9 EF | 7E FF 06 0F 00 01 02 EF | Specify track "002" in the folder "01"             |
| Inter cut an advertisement                               | 7E FF 06 13 00 00 01 FE E7 EF | 7E FF 06 13 00 00 01 EF | Inter cut track "0001" in the folder "ADVERT"      |
|  | 7E FF 06 13 00 00 02 FE E6 EF | 7E FF 06 13 00 00 02 EF | Inter cut track "0002" in the folder "ADVERT"      |
|  | 7E FF 06 13 00 00 FF FD E9 EF | 7E FF 06 13 00 00 FF EF | Inter cut track "0255" in the folder "ADVERT"      |
| Stop playing inter-cut advertisement                     | 7E FF 06 15 00 00 00 FE E6 EF | 7E FF 06 15 00 00 00 EF | Go back and continue to play the music interrupted |
| Stop   | 7E FF 06 16 00 00 00 FE E5 EF | 7E FF 06 16 00 00 00 EF | Stop all playback tasks                            |
| Specify repeat playback of a folder                      | 7E FF 06 17 00 02 00 FE E2 EF | 7E FF 06 17 00 02 00 EF | Specify repeat playback of the folder "02"         |
|  | 7E FF 06 17 00 01 00 FE E3 EF | 7E FF 06 17 00 01 00 EF | Specify repeat playback of the folder "01"         |
| Set random playback                                      | 7E FF 06 18 00 00 00 FE E3 EF | 7E FF 06 18 00 00 00 EF | Random playback of the whole device                |
| Set repeat playback of current track                     | 7E FF 06 19 00 00 00 FE E2 EF | 7E FF 06 19 00 00 00 EF | Turn on single repeat playback                     |
|  | 7E FF 06 19 00 00 01 FE E1 EF | 7E FF 06 19 00 00 01 EF | Turn off single repeat playback                    |
| Set DAC  | 7E FF 06 1A 00 00 00 FE E1 EF | 7E FF 06 1A 00 00 00 EF | Turn on DAC  |
|  | 7E FF 06 1A 00 00 01 FE E0 EF | 7E FF 06 1A 00 00 01 EF | Turn off DAC                                       |
| Specify playback of a track with a specific volume level | 7E FF 06 22 00 1E 01 FE BA EF | 7E FF 06 22 00 1E 01 EF | Play 1 <sup>st</sup> track with volume level 30    |
|  | 7E FF 06 22 00 0F 02 FE C8 EF | 7E FF 06 22 00 0F 02 EF | Play 2 <sup>nd</sup> track with volume level 15    |

#### 4.3.3 Query commands

| Command | Function                                       | Note                  |
|---------|--|-----------------------|
| 0x3F    | Query current online storage device            | See 4.6.1 for details |
| 0x40    | Module returns an error data with this command |                       |
| 0x41    | Module reports a feedback with this command    |                       |
| 0x42    | Query current status                           | See 4.6.2 for details |
| 0x43    | Query current volume                           |                       |
| 0x44    | N/A(Reserved)                                  |                       |
| 0x45    | N/A(Reserved)                                  |                       |
| 0x46    | N/A(Reserved)                                  |                       |
| 0x47    | Query total track numbers in USB flash drive   |                       |
| 0x48    | Query total track numbers in SD Card           |                       |
| 0x4B    | Query current track in USB flash drive         | by physical sequence  |
| 0x4C    | Query current track in SD Card                 | by physical sequence  |



|      |  |                       |
|------|--|-----------------------|
| 0x4E | Query total track numbers in a folder            | See 4.6.3 for details |
| 0x4F | Query total folder numbers in the storage device | See 4.6.4 for details |

#### 4.3.4 Examples of sending query commands

| Command Description                                  | Serial Commands<br>[with checksum] | Serial Commands<br>[without checksum] | Note                                 |
|--|------------------------------------|---------------------------------------|--------------------------------------|
| Query current online storage device                  | 7E FF 06 3F 00 00 00 FE BC EF      | 7E FF 06 3F 00 00 00 EF               |                                      |
| Query current status                                 | 7E FF 06 42 00 00 00 FE B9 EF      | 7E FF 06 42 00 00 00 EF               |                                      |
| Query current volume                                 | 7E FF 06 43 00 00 00 FE B8 EF      | 7E FF 06 43 00 00 00 EF               |                                      |
| Query total track numbers in USB flash drive         | 7E FF 06 47 00 00 00 FE B4 EF      | 7E FF 06 47 00 00 00 EF               | Total file numbers of current device |
| Query total track numbers in SD card                 | 7E FF 06 48 00 00 00 FE B3 EF      | 7E FF 06 48 00 00 00 EF               | Total file numbers of current device |
| Query current track in USB flash drive               | 7E FF 06 4B 00 00 00 FE B0 EF      | 7E FF 06 4B 00 00 00 EF               | Query the track being played         |
| Query current track in SD card                       | 7E FF 06 4C 00 00 00 FE AF EF      | 7E FF 06 4C 00 00 00 EF               | Query the track being played         |
| Query total track numbers in a folder                | 7E FF 06 4E 00 00 01 FE AC EF      | 7E FF 06 4E 00 01 00 EF               |                                      |
| Query total folder numbers in current storage device | 7E FF 06 4F 00 00 00 FE AC EF      | 7E FF 06 4F 00 00 00 EF               | SD card or USB flash drive           |

#### 4.4. Returned Data from Module

##### 4.4.1 Returned data after the module is powered on

1). After the module is powered on, normally it needs about no more than 500ms to 1500ms (depending on the actual track quantities in the storage device) initialization time. Once the initialization is done, the module returns a data to MCU. If it does not return a data after more than the initialization time, it means there is an error for initialization, and please check the hardware connections.

2). The returned data from module after initialization means the current effective storage device/online equipment. For example, the module returns 7E FF 06 3F 00 00 03 xx xx EF. 0x3F is the returned command by module, and 0x03 represents USB flash drive and SD card are effective/online at the same time. See the details as below.

| Online Equipment                   | Returned Data                 |
|------------------------------------|-------------------------------|
| USB flash drive online             | 7E FF 06 3F 00 00 01 xx xx EF |
| SD card online                     | 7E FF 06 3F 00 00 02 xx xx EF |
| PC online                          | 7E FF 06 3F 00 00 04 xx xx EF |
| USB flash drive and SD card online | 7E FF 06 3F 00 00 03 xx xx EF |

3). MCU can not send commands to control the module until the initialization of the module is done and a data is

returned, otherwise the commands sent by MCU will be ignored and also this will effect initializing of the module.

#### 4.4.2 Returned data after a track is finished playing

| Track Played   | Returned Data                 |
|--|-------------------------------|
| 1 <sup>st</sup> track is finished playing in USB flash drive | 7E FF 06 3C 00 00 01 xx xx EF |
| 2 <sup>nd</sup> track is finished playing in USB flash drive | 7E FF 06 3C 00 00 02 xx xx EF |
| 1 <sup>st</sup> track is finished playing in SD card         | 7E FF 06 3D 00 00 01 xx xx EF |
| 2 <sup>nd</sup> track is finished playing in SD card         | 7E FF 06 3D 00 00 02 xx xx EF |

1). There is a returned data after a track is finished playing. For example, the returned data is 7E FF 06 3C 00 00 01 xx xx EF. 0x3C represents USB flash drive and 0x3D represents SD card. 0x00 and 0x01 represents the 1<sup>st</sup> track. 0x01 and 0xF4 represents the 500<sup>th</sup> track(0x01F4=500).

2). Because all of the files(tracks) in the storage device are read in physical sequence, the returned data still follow the physical sequence, which needs to be noted.

#### 4.4.3 Returned data of feedback from module

|                    |                               |
|--------------------|-------------------------------|
| Module returns ACK | 7E FF 06 41 00 00 00 xx xx EF |
|--------------------|-------------------------------|

1). In order to enhance stability between data communication, the function of a feedback from module is added. Once there is a feedback to MCU from the module, it means the module has successfully received the command that MCU sent out. 0x41 is the returned command by module.

2). Users are free to choose this feedback or not. It's also fine not to choose this function.

#### 4.4.4 Returned data of errors

| Returned Data of Errors       | Meaning Description  |
|-------------------------------|--|
| 7E FF 06 40 00 00 01 xx xx EF | Module busy(this info is returned when the initialization is not done)               |
| 7E FF 06 40 00 00 02 xx xx EF | Currently sleep mode(supports only specified device in sleep mode)                   |
| 7E FF 06 40 00 00 03 xx xx EF | Serial receiving error(a frame has not been received completely yet)                 |
| 7E FF 06 40 00 00 04 xx xx EF | Checksum incorrect   |
| 7E FF 06 40 00 00 05 xx xx EF | Specified track is out of current track scope  |
| 7E FF 06 40 00 00 06 xx xx EF | Specified track is not found   |
| 7E FF 06 40 00 00 07 xx xx EF | Inter-cut error(a inter-cut operation only can be done when a track is being played) |
| 7E FF 06 40 00 00 08 xx xx EF | SD card reading failed(SD card pulled out or damaged)                                |

7E FF 06 40 00 00 0A xx xx EF

Entered into sleep mode

When the module is powered on, it reads SD card first and if SD card is not available it goes to USB flash drive.

#### 4.4.5 Returned data after a storage device is plugged in or pull out

| Status                                  | Returned Data                 |
|---|-------------------------------|
| USB flash drive is plugged in           | 7E FF 06 3A 00 00 01 xx xx EF |
| SD card is plugged in                   | 7E FF 06 3A 00 00 02 xx xx EF |
| USB cable connected to PC is plugged in | 7E FF 06 3A 00 00 04 xx xx EF |
| USB flash drive is pulled out           | 7E FF 06 3B 00 00 01 xx xx EF |
| SD card is pulled out                   | 7E FF 06 3B 00 00 02 xx xx EF |
| USB cable connected to PC is pulled out | 7E FF 06 3B 00 00 04 xx xx EF |

0x3A represents a device is plugged in while 0x3B represents a device is pull out. 0x01, 0x02, 0x04 represent USB flash drive, SD card and USB cable connected to PC respectively.

### 4.5. Detailed Annotation of Control Commands

#### 4.5.1 Specify playback of a track(in the root directory of the storage device)

The available selective tracks is from 1<sup>st</sup> to 3000<sup>th</sup> in the root directory of the storage device. Actually it can support more, but if we make it support more, the operation speed will become slow. Usually most of applications do not need to support much more files. Normally if the total track quantity is in 1000 in the storage device, the response speed of the module is quicker than 50ms. If the total track quantity is more than 1000, the response speed is a little slower than 100ms.

1).For example, if set the first track to be played, send the command 7E FF 06 03 00 00 01 FF E7 EF

7E --- Start byte

FF --- Version Information

06 --- Number of bytes

03 --- Actual command(specify playback of a track)

00 --- 0x01: need feedback; 0x00: no need feedback

00 --- Most significant byte of the track(MSB of Parameter)

01 --- Least significant byte of the track(LSB of Parameter)

FF --- Most significant byte of checksum(MSB of checksum)

E7 --- Least significant byte of checksum(LSB of checksum)

EF --- End byte 0xEF

2).Regarding track selection, if the 100<sup>th</sup> song(track) is selected to be played, firstly convert 100 to hexadecimal. It is double-byte by default, i.e. 0x0064. MSB=0x00; LSB=0x64

#### 4.5.2 Specify volume

1).Our system power-on default volume is level 30, if you want to set the volume, then directly send the corresponding command.

2).For example, if specify the volume to level 15, send the command 7E FF 06 06 00 00 0F FF D5 EF.

3).MSB=0x00; LSB=0x0F, 15 is converted to hexadecimal 0x000F.

#### 4.5.3 Specify single repeat playback (in the root directory of the storage device)

|                                       |                               |
|---------------------------------------|-------------------------------|
| Repeatedly play 1 <sup>st</sup> track | 7E FF 06 08 00 00 01 xx xx EF |
| Repeatedly play 2 <sup>nd</sup> track | 7E FF 06 08 00 00 02 xx xx EF |
| Repeatedly play 3 <sup>rd</sup> track | 7E FF 06 08 00 00 03 xx xx EF |

During single repeat playback, you can still normally execute the operations Play/Pause, Previous, Next, Volume+/-, and so on, and the status is also repeat playback. Users can specify single track playback or send the stop command to turn off single repeat playback status.

#### 4.5.4 Specify playback of a device

|                                     |                               |
|-------------------------------------|-------------------------------|
| Specify playback of USB flash drive | 7E FF 06 09 00 00 01 FE F1 EF |
| Specify playback of SD card         | 7E FF 06 09 00 00 02 FE F0 EF |

1).The module supports two types of playback devices(USB flash drive and SD card). The device must be on-line, so it can be specified playback. It automatically detects if a device is on-line or not. No need users' attention.

2).It automatically enters into the standby status after specifying a device, waiting MCU to specify a track to play. It takes about 200ms from specifying device to the module finishes initialization of file system. Please wait for 200ms and then send the specified command to play a track.

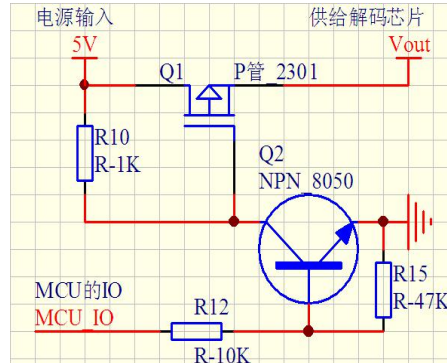
#### 4.5.5 Set sleep mode, awake from sleep and reset

|                  |                               |
|------------------|-------------------------------|
| Set sleep mode   | 7E FF 06 0A 00 00 00 FE F1 EF |
| Awake from sleep | 7E FF 06 0B 00 00 00 FE F0 EF |
| Reset            | 7E FF 06 0C 00 00 00 FE EF EF |

1). After set the module enter into sleep mode, there is also other two ways other than sending the command to awake the module a). Specify playback of the storage device, either USB flash drive or SD card. b). Pull out the storage device and re-plug it in.

2). Regarding the reset, it's a soft reset, and the reset time is 5-8 seconds. It is allowed to send the reset command under any status.

**Note:** When the module enters into the sleep mode, the standby power consumption is about 10mA. If users are very strict to the power consumption, you can use a MOS and a transistor to control power supply of the module. It is possible to cut off the power supply completely when standby is not necessary. Please refer to the schematic as below.



#### 4.5.6 Specify playback of a track in a folder

|  |                               |
|--|-------------------------------|
| Specify playback of track 001 in the folder 01 | 7E FF 06 0F 00 01 01 xx xx EF |
| Specify playback of track 100 in the folder 11 | 7E FF 06 0F 00 0B 64 xx xx EF |
| Specify playback of track 255 in the folder 99 | 7E FF 06 0F 00 63 FF xx xx EF |

1).The default folders are named as "01", "11", "99" in this way. In order to be with a better system stability, it is made to support maximum 99 folders and maximum 255 tracks in each folder..

2).For example, if specify to play "100.mp3" in the folder "01", send the command 7E FF 06 0F 00 01 64 xx xx EF  
MSB: represents the name of the folder, maximum supports 99 folders from 01 - 99.

LSB: represents the track, maximum supports 255 tracks from 0x01 to 0xFF.

3).You must specify both the folder and the file name to target a track. This feature supports MP3 and WAV audio formats.

4).The following two images illustrates the naming method of folders and files.





#### 4.5.7 Inter cut an advertisement

|   |                               |
|---|-------------------------------|
| Inter cut track "0001" in the folder "ADVERT" | 7E FF 06 13 00 00 01 FE E7 EF |
| Inter cut track "0002" in the folder "ADVERT" | 7E FF 06 13 00 00 02 FE E6 EF |
| Inter cut track "0255" in the folder "ADVERT" | 7E FF 06 13 00 00 FF FD E9 EF |
| Inter cut track "1999" in the folder "ADVERT" | 7E FF 06 13 00 07 CF FE 12 EF |
| Inter cut track "3000" in the folder "ADVERT" | 7E FF 06 13 00 0B B8 FE 25 EF |

1). This module supports inter-cut advertisements during playback of a track, so that it can meet some special needs for some applications.

2). After sending the command 0x13, the system will save the IDV3 information of the track being played and pause, then it will play the specified inter-cut track(advertisement). When the inter-cut track is finished, the system will go back and continue to play the track that was interrupted until to the end.

3). The setting method is build a folder named "ADVERT" in the storage device, and put the tracks(ads) you need in the folder, and name the files as "0001.mp3/wav", 0002.mp3/wav.

4). If you send an inter-cut command when the module is at Pause status or Stop status, it will not work and there will be an returned error information. In the course of an inter-cut, you can continue to inter cut the other tracks(ads). When the last inter-cut track goes to the end, the system still goes back to the IDV3 position saved at the first time.

#### 4.5.8 Stop

|                                      |                               |
|--------------------------------------|-------------------------------|
| Stop playing inter-cut advertisement | 7E FF 06 15 00 00 00 FE E6 EF |
| Stop                                 | 7E FF 06 16 00 00 00 FE E5 EF |

During playback of the module, there is two modes to stop. One is to stop playing the inter-cut advertisement, and go back and continue to play the music interrupted, and the other mode is to stop all playback(stop decoding). For example, suppose the module is playing an inter-cut advertisement, and now if send a stop command 0x16, it will stop all playback tasks.

#### 4.5.9 Specify repeat playback of a folder

|  |                               |
|--|-------------------------------|
| Specify repeat playback of the folder "02" | 7E FF 06 17 00 00 02 FE E2 EF |
| Specify repeat playback of the folder "01" | 7E FF 06 17 00 00 01 FE E3 EF |

The folder names must be 01-99, and no more than 99. After sending the command, it repeatedly plays the tracks in the specific folder, and it will not stop until it receives a command to stop.

#### 4.5.10 Set random playback

|   |                               |
|---|-------------------------------|
| Random playback of the whole storage device | 7E FF 06 18 00 00 00 FE E3 EF |
|---|-------------------------------|

This command is used to randomly play all of the tracks in the storage device according to physical sequence and no matter if there is a folder or not in the device.

#### 4.5.11 Set repeat playback of current track

|                                 |                               |
|---------------------------------|-------------------------------|
| Turn on single repeat playback  | 7E FF 06 19 00 00 00 FE E2 EF |
| Turn off single repeat playback | 7E FF 06 19 00 00 01 FE E1 EF |

During playback, send the turn-on command, and it will repeatedly play the current track. If the module is at Pause or Stop status, it will not respond to this command. If you need to turn off repeat playback, just send the turn-off command.

#### 4.5.12 Set DAC

|                               |                               |
|-------------------------------|-------------------------------|
| Turn on DAC                   | 7E FF 06 1A 00 00 00 FE E1 EF |
| Turn off DAC(high resistance) | 7E FF 06 1A 00 00 01 FE E0 EF |

When the module is powered on, DAC is turned on by default. It is not turned off until it is set by sending the command.

#### 4.5.13 Combination playback(playback of a group)

1). We added this function to meet some users' special need that when users need to send only one frame data to play multiple tracks one by one without pause. It supports maximum 15 tracks together for combination playback. All of the sound files used for combination playback need to be put in folders(folder 01-folder 99).

2). If MCU sends a frame data as **7E FF 15 21 01 02 01 03 01 04 01 05 01 06 02 01 03 05 04 07 05 09 EF**, see the analysis as below.

Command: 0x21

Number of bytes: 0x15=21 bytes --- **FF 15 21 01 02 01 03 01 04 01 05 01 06 02 01 03 05 04 07 05 09**(two parameters for one track, i.e. the folder number and the track number)

The module will play track 002 in folder 01, track 003 in folder 01, track 004 in folder 01, track 005 in folder 01, track 006 in folder 01, track 001 in folder 02, track 005 in folder 03, track 007 in folder 04, and track 009 in folder 05.

3). During combination playback, it is allowed to Play/Pause and set volume, but not allowed to set Previous and Next. If need to stop, just direct send the stop command. And it is not allowed to play another group of combination during it is working. Users need to send the stop command to stop the current combination playback before start another group of combination playback.

4). If a track specified to be played in combination is not in the folder, it will stop playing at this track position, so please make sure the track specified to play must be available in the folder.

5). If users are very strict to the combination playback, please edit the sound sources with some audio edit software like Adobe Audition or GoldWave to cut off the silence at the beginning and the end of the sound.

#### 4.5.14 Specify playback of a track with a specific volume level(in the root directory)

|   |                               |
|---|-------------------------------|
| Play 1 <sup>st</sup> track at volume level 30 | 7E FF 06 22 00 1E 01 FE BA EF |
| Play 2 <sup>nd</sup> track at volume level 15 | 7E FF 06 22 00 0F 02 FE C8 EF |

1). This function is added to meet some users' needs to play a track at a specific volume level with one command only, but this only can be executed for the tracks in the root directory of the storage device. The command is 0x22.

2). For normal operations, users still need to send the volume command first and then specify playback of a track with the corresponding command like most of MP3 players.

## 4.6. Detailed Annotation of Query Commands

### 4.6.1 Query current online storage device

|                                     |                               |
|-------------------------------------|-------------------------------|
| Query current online storage device | 7E FF 06 3F 00 00 00 FE BC EF |
|-------------------------------------|-------------------------------|

When the module is working, users can use the command as above (0x3F) to query the status of the online storage devices. For example, if the module returns the data 7E FF 06 3F 00 00 0A xx xx EF, LSB 0x0A(0000 1010) represents SD card online. If LSB is 0x1F(0000 1111), it represents all of USB flash drive, SD card, and PC online(PC online means module is connecting with PC via a USB cable).

### 4.6.2 Query current status

|                      |                               |
|----------------------|-------------------------------|
| Query current status | 7E FF 06 42 00 00 00 FE B9 EF |
|----------------------|-------------------------------|

There are 4 status(playing, paused playing, stopped playing, and in sleep) that can be queried during the module is decoding. Users can query the current status via sending the command as above(0x42).

2). Interpretation of returned data

| Returned Data                 | Status                             |
|-------------------------------|------------------------------------|
| 7E FF 06 42 00 01 01 xx xx EF | USB flash drive is being played    |
| 7E FF 06 42 00 02 02 xx xx EF | SD card is paused playing          |
| 7E FF 06 42 00 01 00 xx xx EF | USB flash drive is stopped playing |
| 7E FF 06 42 00 10 00 xx xx EF | Module in sleep                    |

### 3). MSB and LSB Representations

| MSB Representation |                      | LSB Representation |         |
|--------------------|----------------------|--------------------|---------|
| 0x01               | USB flash drive      | 0x00               | Stopped |
| 0x02               | SD card              | 0x01               | Playing |
| 0x10               | Module in sleep mode | 0x02               | Paused  |

#### 4.6.3 Query total track numbers in a folder

|  |                               |
|--|-------------------------------|
| Query total track numbers in folder 01 | 7E FF 06 4E 00 00 01 FE AC EF |
| Query total track numbers in folder 11 | 7E FF 06 4E 00 00 0B FE A2 EF |

If the folder queried is empty without any files, the module will report an error, and the data 7E FF 06 40 00 00 06 FE B5 EF will be returned.

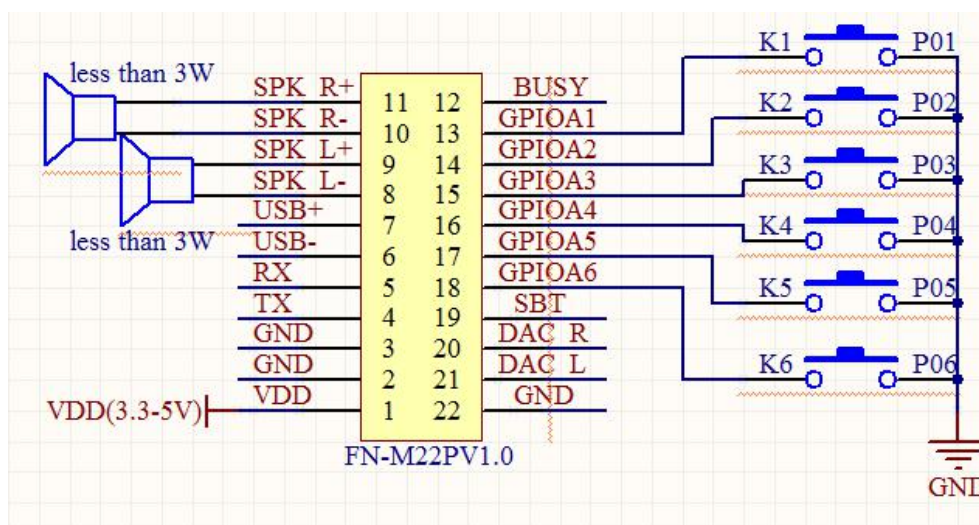
#### 4.6.4 Query total folder numbers in current storage device

|  |                               |
|--|-------------------------------|
| Query total folder numbers in current storage device | 7E FF 06 4F 00 00 00 FE AC EF |
|--|-------------------------------|

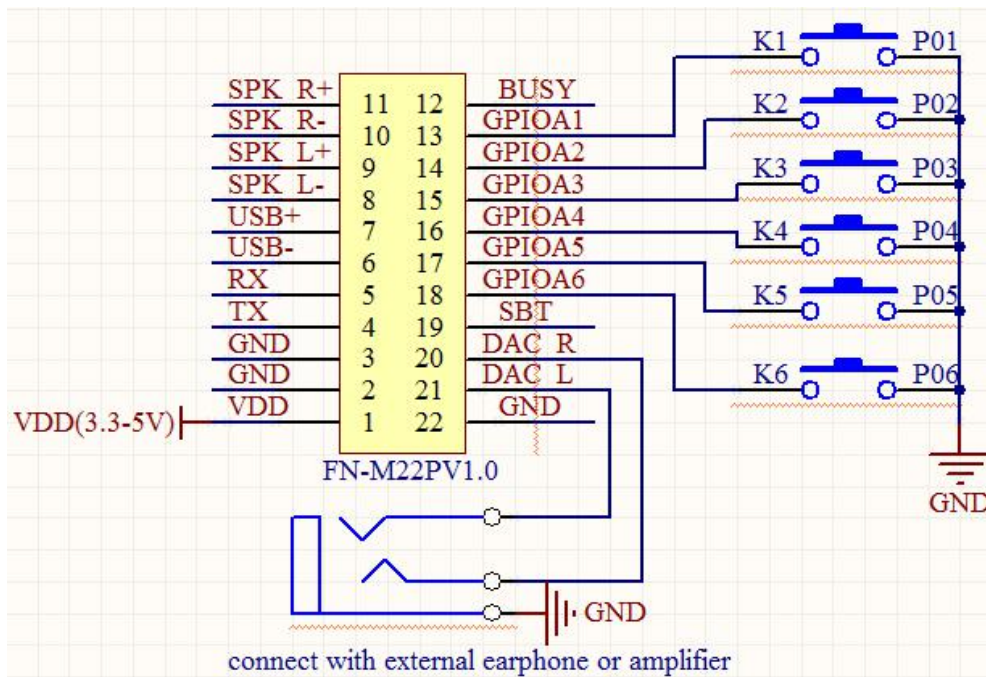
Users can query the total folder numbers of the current storage device through sending the command above. This just supports to query the folder numbers in the root directory of the device. Not possible to query the sub-folder numbers (Please don't build any sub-folders in a folder).

## 5. Application Circuits References

### 5.1. For Key Control

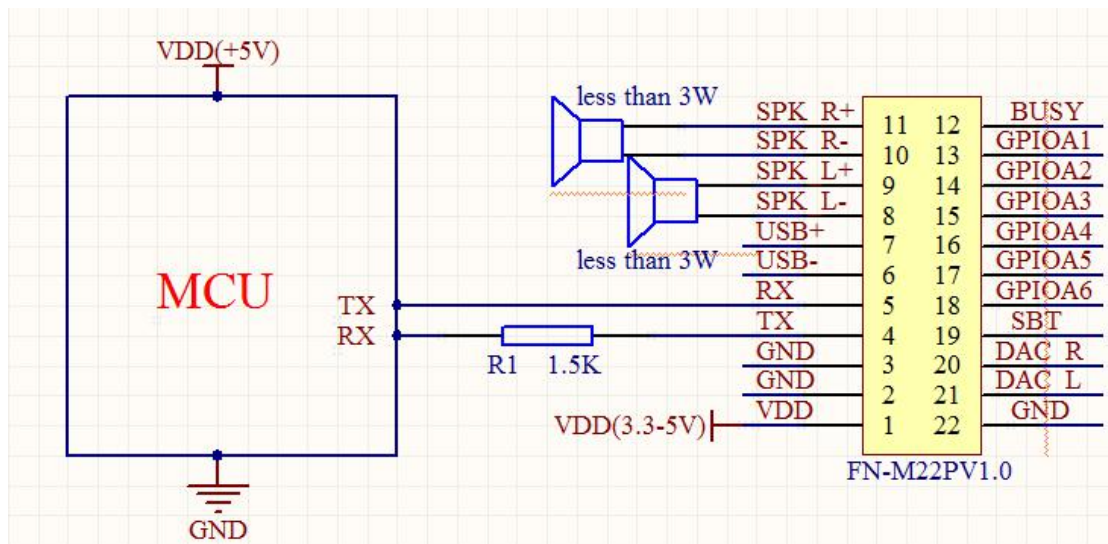


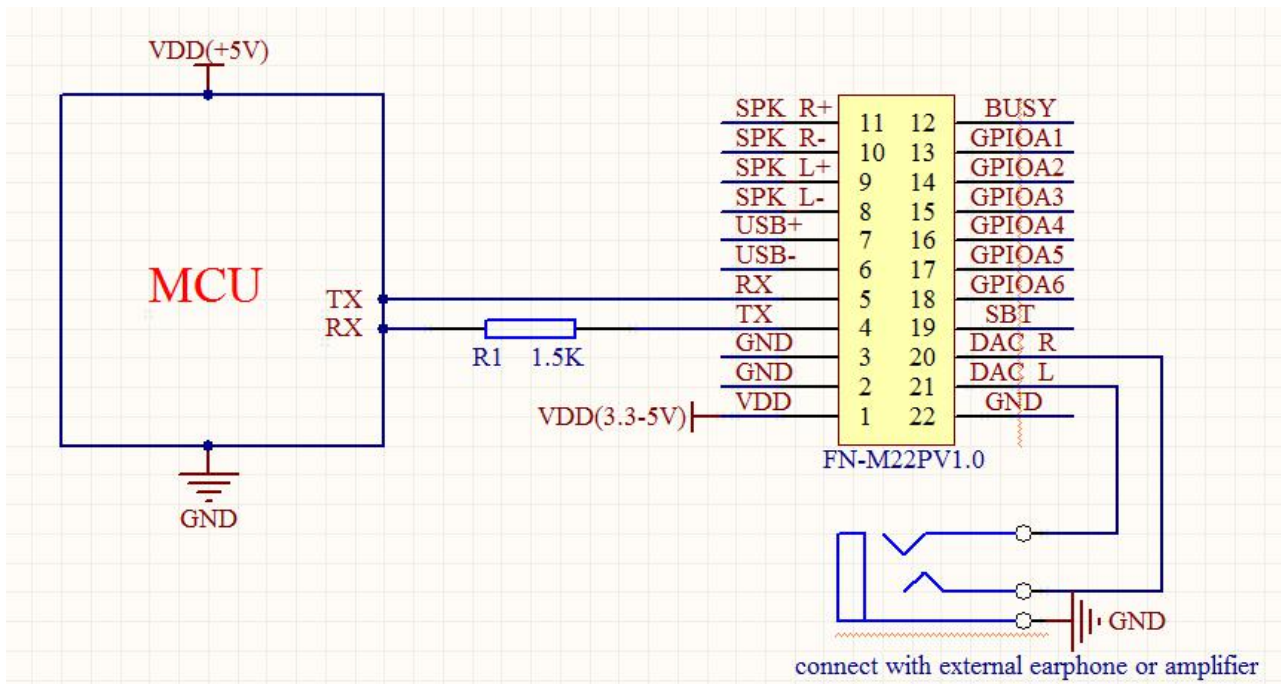
Connection with two 3 Watts speakers



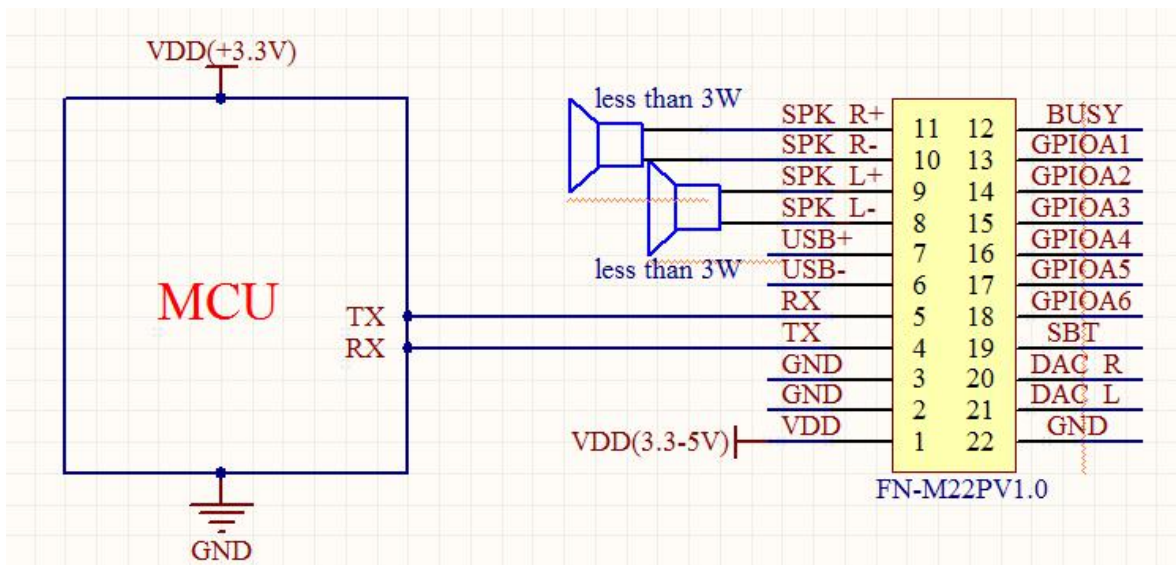
Connection with external earphone or amplifier

## 5.2. For Serial Control



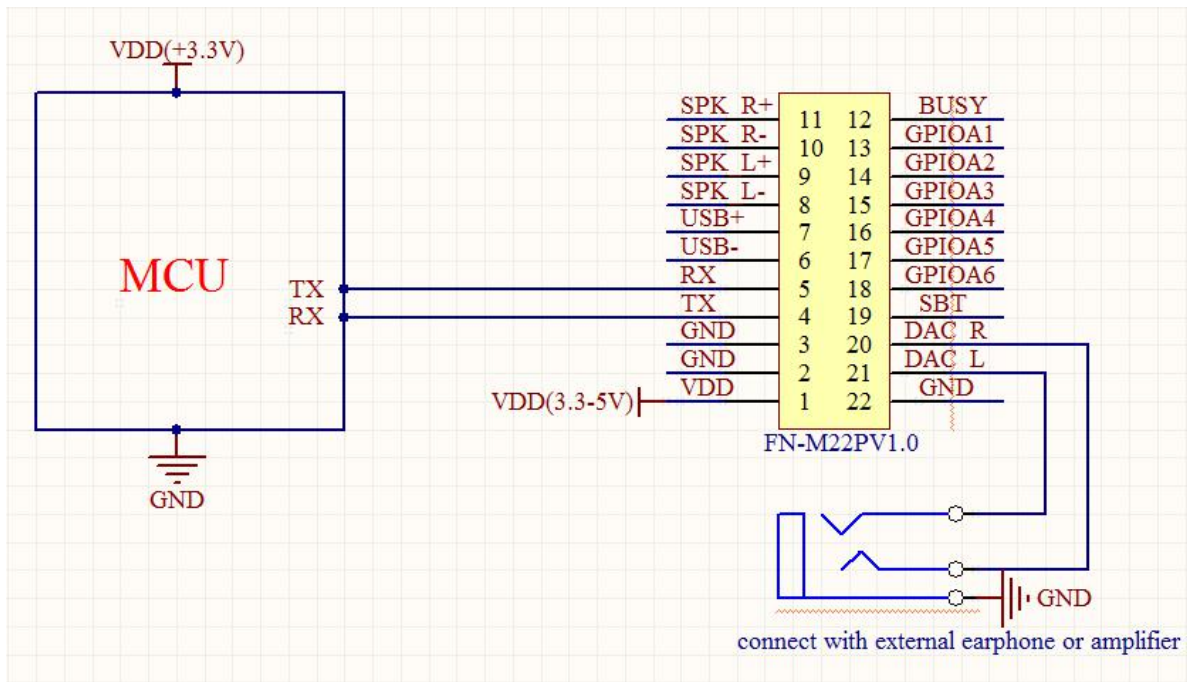


5V MCU and connection with external earphone or amplifier



3.3V MCU and connection with two 3 Watts speaker





3.3V MCU and connection with external earphone or amplifier

**Notes:** As the serial port of module uses 3.3V TTL level by default, please note level switch when use a 5V MCU. If use 5V MCU, we suggest users connect a 1.5K resistor between RX port of MCU and TX port of FN-M22P as you can see the circuit references. Of course, it would be better to connect a 1.5K resistor for each of communication port between RX port of MCU and TX port of FN-M22P, and TX port of MCU and RX port of FN-M22P.

## 6. Other Notices

### 6.1. GPIO Features

| IO Input Features  |                           |        |         |         |      |                |
|--------------------|---------------------------|--------|---------|---------|------|----------------|
| Item               | Description               | Min    | Typical | Max     | Unit | Test Condition |
| VIL                | Low-Level Input Voltage   | -0.3   | -       | 0.3*VDD | V    | VDD=3.3V       |
| VIH                | High-Level Input Voltage  | 0.7VDD | -       | VDD+0.3 | V    | VDD=3.3V       |
| IO Output Features |                           |        |         |         |      |                |
| Item               | Description               | Min    | Typical | Max     | Unit | Test Condition |
| VOL                | Low-Level Output Voltage  | -      | -       | 0.33    | V    | VDD=3.3V       |
| VOH                | High-Level Output Voltage | 2.7    | -       | -       | V    | VDD=3.3V       |

## 6.2. Indicator Status

| Module Work Status             | Update sound from PC | Playing a sound     | Pause    | Sleep |
|--------------------------------|----------------------|---------------------|----------|-------|
| Corresponding Indicator Status | Quickly blinks       | Slowly blinks 500ms | Keeps ON | OFF   |

1). If the module does not detect available online SD card or USB flash drive, the indicator will turn off. In this way users can judge if the plugged-in SD card or USB flash drive is workable or not.

2). If users don't need this indicator, just remove it, which will not bring any effect on the module.

## 6.3. About Delay of Serial Programming

1). After the module is powered on, it needs about 500ms to 1500ms (depending on the track quantities in the storage device) to initialize. After that, some data related to initialization returns to MCU. Users can choose to ignore these data.

2). After specifying playback of a device (SD card or USB flash), it needs 200ms delay before sending the command to execute the relative operation.

3). The module processes a serial data per 10ms, so when MCU continuously sends commands one by one, 20ms delay must be added before sending next command, otherwise the command MCU sends out will not be executed.

4). If specifying playback of a track in a folder, the delay must be longer than 40ms, as it needs time to target a track in a folder. And even so song as sending the commands related to query a track or a folder, 40ms delay is required.

## 7. PCB Dimensions

