

# WT2003HM02 MP3 Module Specification

Version: V1.00



**Note :**

WAYTRONIC ELECTRONIC CO.,LTD. reserves the right to change this document without prior notice. Information provided by WAYTRONIC is believed to be accurate and reliable. However, WAYTRONIC makes no warranty for any errors which may appear in this document. Contact WAYTRONIC to obtain the latest version of device specifications before placing your orders. No responsibility is assumed by WAYTRONIC for any infringement of patent or other rights of third parties which may result from its use. In addition,WAYTRONIC products are not authorized for use as critical components in life support devices/systems or aviation devices/systems, where a malfunction or failure of the product may reasonably be expected to result in significant injury to the user, without the express written approval of WAYTRONIC.

1. Overview.....	错误! 未定义书签。
2. Characteristics.....	错误! 未定义书签。
3. About PIN.....	2
3.1. PIN Description.....	错误! 未定义书签。
4. Introduction of Functions.....	错误! 未定义书签。
4.1. UART control protocol.....	错误! 未定义书签。
4.1.1. Protocol command format.....	错误! 未定义书签。
4.1.2. List of Command.....	错误! 未定义书签。
4.1.3. Write Operation Instructions.....	错误! 未定义书签。
4.1.3.1. Write operation instruction return code format.....	错误! 未定义书签。
4.1.3.2. Specify SPI Flash root index play (A0).....	错误! 未定义书签。
4.1.3.3. Flash Play by File Name (A1).....	错误! 未定义书签。
4.1.3.4. Specify the index play of U disk root directory (A6).....	错误! 未定义书签。
4.1.3.5. Specify the USB flash drive file name to play (A7).....	错误! 未定义书签。
4.1.3.6. Specify file index play in USB flash drive folder (A8).....	错误! 未定义书签。
4.1.3.7. Pause playback command (AA).....	错误! 未定义书签。
4.1.3.8. Stop command (AB).....	错误! 未定义书签。
4.1.3.9. Next command (AC).....	错误! 未定义书签。
4.1.3.10. Command of the previous song (AD).....	错误! 未定义书签。
4.1.3.11. Volume control command (AE).....	错误! 未定义书签。
4.1.3.12. Specify the playback mode (AF).....	错误! 未定义书签。
4.1.3.13. Insertion instruction (B1).....	错误! 未定义书签。
4.1.3.14. Audio output mode switching (B6).....	错误! 未定义书签。
4.1.3.15. Flash pin load and release (B7).....	错误! 未定义书签。
4.1.3.16. Switch the current working letter (D2).....	错误! 未定义书签。
4.1.4. Reading operation instructions.....	错误! 未定义书签。
4.1.4.1. Query the currently set volume (C1).....	错误! 未定义书签。
4.1.4.2. Read the current working state (C2).....	错误! 未定义书签。
Return Format.....	错误! 未定义书签。
4.1.4.3. Query the total number of music files in SPI Flash (C3).....	错误! 未定义书签。
Return Format.....	错误! 未定义书签。
4.1.4.4. Query the total number of music files in U disk (C7).....	错误! 未定义书签。
4.1.4.5. Query the total number of music files in the specified folder in U disk (C8).....	错误! 未定义书签。
4.1.4.6. Query the currently playing file track (C9).....	错误! 未定义书签。
4.1.4.7. Query the current peripheral connection status (CA).....	错误! 未定义书签。
4.1.4.8. Query the song name (CB) of the currently playing song.....	错误! 未定义书签。
4.2. Circuit design reference.....	错误! 未定义书签。
5. Electrical Parameter.....	错误! 未定义书签。
5.1. Absolute maximum rated parameter.....	错误! 未定义书签。
5.2. PMU Functions.....	错误! 未定义书签。
5.3. IO input/output electrical logic characteristics.....	错误! 未定义书签。
5.4. Characteristics of analog DAC.....	错误! 未定义书签。
6. Size of the Module.....	错误! 未定义书签。

## 1. Overview

WT2003HM02 is a powerful and high-quality voice module, which uses a high-performance 32-bit processor with a maximum frequency of 120MHz. It has the characteristics of low cost, low power consumption, high reliability and versatility, and can have built-in voice capacity of 100 seconds to 350 seconds. Flexible control mode: Support standard asynchronous serial communication (UART). TF card and U disk are supported as memory. With the functions of file index play, spot insertion, single loop, all tracks loop, random play, etc. Level 32 has adjustable volume, and can support 32G TF card and 32G USB stick at the maximum.

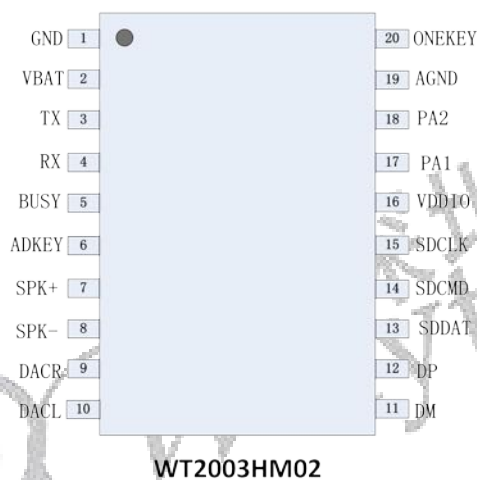
## 2. Characteristics

- Support TF card and U disk;
- Support FAT and FAT32 file systems;
- Control mode: standard UART communication interface, supports DMA and flow control, and the default baud rate is 9600;
- Power-on does not play by default; With BUSY status indication and high level when BUSY is playing;
- **Support switching audio output mode, SPK output is the default for samples. For DAC output, please refer to the audio output switching instruction (0xB6).** → [请参考音频输出切换指令 \(0xB6\)](#) ;
- The plug-in TF card can be connected to the computer through the USB interface of the module to view or modify its contents, and directly download the voice in the computer to the removable drive letter (analog U disk) simulated by TF card (XP system, WIN7 system, WIN10 system);
- Support voice high-quality audio format, with beautiful sound (8kbps~320kbps);
- Up to 32G TF card and 32G USB stick can be supported;
- Built-in 0.5w class D power amplifier;
- Adjustable volume, volume level 32;
- Two 16-bit asynchronous divider timers;
- Audio stream, IIS supports master and slave modes;
- An IIC controller;
- An infrared remote control decoder;
- 16bit high precision ADC; ;

- 16bit high precision DAC; ;
- High-power IO drive capability, up to 64mA; direct drive;
- When a single module is used (with built-in capacity), the built-in voice needs to be written before leaving the factory.

### 3. PIN

#### 3.1. Description of PIN



PIN	Name	Type	Description
1	GND	I/O	GND
2	VBAT	I/O	VBAT power input
3	TX	I/O	UART asynchronous serial port data input
4	RX	I/O	UART asynchronous serial port data output
5	BUSY	I/O	Busy signal (used to indicate the playing status)
6	ADKEY	I/O	Key input
7	SPK+	I/O	Horn terminal
8	SPK-	I/O	Horn terminal
9	DACR	I/O	DAC right channel output
10	DACL	I/O	DAC left channel output
11	DM	I/O	USB DM
12	DP	I/O	USB DP

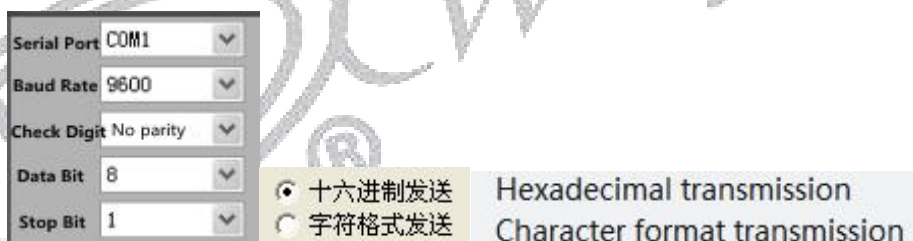
13	SD_DAT	I/O	SD card data
14	SD_CMD	I/O	SD card selection
15	SD_CLK/SPI_CLK	I/O	SD card clock
16	VDDIO	P	3.3V power output
17	PA1	G	IO port
18	PA2	I/O	IO port
19	AGND	I/O	Audio ground
20	ONEKEY	I/O	Next song

## 4. Functions

### 4.1. UART control protocol

#### 4.1.1. Protocol command format

Standard UART asynchronous serial interface, which belongs to 3.3V TTL level interface. The format of communication data is: start bit: 1 bit; Data bits: 8 bits; Parity bit: none; Stop bit: 1 bit. To use the computer serial port debugging assistant, it is necessary to set the serial port parameters correctly, as shown in the figure:



Start Code	Length	Command Code	Parameters	Accumulation and verification	Ending Code
0X7E	As follows	As follows	As follows	As follows	0XEF

**Note:** "Length" refers to the length+command code+parameter+checksum, and "accumulation and checksum" refers to the low byte of the accumulated sum of length+command code+parameter.

#### 4.1.2. List of Command

Communication Control Instruction

CMD detailed explanation	Corresponding Function	Parameter
A2	Specify SD card root index playback	File index
A3	Specify SD card file name to play	filename
A4	Specify file index play in SD card folder.	Folder name, file index
A6	Specify the root directory index play of U disk.	File index
A7	Specify USB disk file name to play.	filename
A8	Specify file index play in U disk folder.	Folder name, file index
AA	Pause playback command	without
AB	Stop command	without
AC	Next song command	without
AD	Last song command	without
AE	Volume control command	Volume level
AF	Specify the playback mode.	cyclical pattern
B1	Insertion instruction	Work letter, file index
B6	Audio output mode switching	without
D2	Switch the current working letter.	Work drive letter

#### Communication Inquiry Command

CMD detailed explanation	Corresponding Function	Parameter
C1	Query the currently set volume.	C1 XX
C2	Query the current working status	C2 XX
C5	Query the total number of music files in SD card	C5 XXXXX
C6	Query the total number of music files in the specified folder in SD card.	C6 XXXX
C7	Query the total number of music files in U disk	C7 XXXX
C8	Query the total number of music files in the	C8 XXXX

	specified folder in the U disk.	
C9	Query the currently playing file track	C9 XXXX
CA	Query the current peripheral connection status.	CA XX
CB	Query the currently playing track name.	CB XX XX

### 4.1.3. Write operation instructions

#### 4.1.3.1. Write operation instruction return code format

**Note:** After each write command is executed, the command is returned.

Operati ng Code
XX

the operation code of one byte corresponding to

Return Code : →: 00 means : OK command execution

→: 01 means : The FAIL command has an error and will not be executed

→: 02 means : EMP does not have this file.

#### 4.1.3.2. Specify SD card file index play (A2)

This command can specify the files in SD card to be played, which is affected by the order in which the files are stored. The files are sorted in index order.

Start Code	Length	Comman d	High Track	Low Track	Check Code	End code
7E	05	A2	00	01	XX	EF

Note: When specified to play, if the specified track does not exist, it will not affect the current play.

Example: send → ◇ 7E 05 A2 00 01 A8 EF □

receive ← ◆ A2 00

#### 4.1.3.3. Specify SD card file name to play (A3)

This command can specify the file name in the root directory of SD card to play (the file name must be 4 bytes)

Start Code	Length	Comman d	File Name(high-low)			Check Code	End Code	
7E	07	A3	54 'T'	30( '0' )	30( '0' )	32( '2' )	XX	EF

Among them, "54, 30, 30, 32" are respectively the ASCII codes of T002, only the file names are ASCII codes, and other data are hexadecimal values; The above instruction indicates that the audio file named "T002.mp3" in the specified root directory will be played.

Example: send → ◇ 7E 07 A3 54 30 30 32 82 EF □  
 receive ← ◆ A3 00

#### 4.1.3.4. Specify index play in SD card folder (A4)

This command can specify the file index in the folder under the root directory to play (the folder name is fixed with 5 characters)

Start Code	Length	Command	File Name(high-low)					File Index(high-low)		Check Code	End Code
7E	0A	A4	'M'	'U'	'S'	'I'	'C'	00	01	XX	EF

Among them, only the folder name adopts ASCII code value, and other data are hexadecimal values; The above instruction indicates that the second audio file (index number 0001) in the folder named "MUSIC" in the specified root directory will be played.

Example: send → ◇ 7E 0A A4 46 46 46 31 31 00 07 E9 EF □  
 receive ← ◆ A4 00

#### 4.1.3.5. Specify the index play of U disk root directory (A6)

This command can specify to play files in the U disk. Affected by the order in which files are stored. The files are sorted in index order.

Start Code	Length	Command	High Track	Low Track	Check Code	End code
7E	05	A6	00	01	XX	EF

Note: When specified to play, if the specified track does not exist, it will not affect the current play.

Example: send → ◇ 7E 05 A6 00 02 AD EF □  
 receive ← ◆ A6 00

#### 4.1.3.6. Specify the USB flash drive file name to play (A7)

Command can specify the file name in the root directory of U disk to play (the file name must be 4 bytes).

Start Code	Length	Command	File Name(high-low)				Check Code	End code
7E	07	A7	54 'T'	30( '0' )	30( '0' )	32( '2' )	XX	EF

Among them, "54, 30, 30, 32" are respectively the ASCII codes of T002, only the file names are ASCII codes, and other data are hexadecimal values; The above instruction indicates that the audio file named "T002.mp3" in the specified root directory is played.

Example: send → ◇ 7E 07 A7 54 30 30 32 94 EF □  
 receive ← ◆ A7 00



#### 4.1.3.7. Specify file index in USB flash drive folder (A8)

This command can specify the file index in the folder under the root directory to play (the folder name is fixed with 5 characters)

Start Code	Length	Command	Folder Name(high-low)					File Index(high-low)		Check Code	End code
7E	0A	A8	'M'	'U'	'S'	'I'	'C'	00	01	XX	EF

Among them, only the folder name adopts ASCII code value, and other data are hexadecimal values; The above instruction indicates that the second audio file (index number 0001) in the folder named "MUSIC" in the specified root directory will be played.

Example: send → ◇ 7E 0A A8 54 54 54 31 31 00 05 15 EF □

receive ← ◆ A8 00

#### 4.1.3.8. Pause playback command (AA)

Start Code	Length	Command	Check Code	End code
7E	03	AA	AD	EF

In the play state, if the instruction is sent, the play will be suspended; In the pause state, send this command, and then continue to play music from the pause.

Example: send → ◇ 7E 03 AA AD EF ☑

receive ← ◆ AA 00

#### 4.1.3.9. Stop command (AB)

Start Code	Length	Command	Check Code	End code
7E	03	AB	AE	EF

Send this command to stop playing the currently playing music.

Example: send → ◇ 7E 03 AB AE EF □

receive ← ◆ AB 00

#### 4.1.3.10. Next command (AC)

Start Code	Length	Command	Check Code	End code
7E	03	AC	AF	EF

This command can trigger the next piece of music to be played, and when the last piece of music is played, sending this command can trigger the first piece of music to be played.

Example: send → ◇7E 03 AC AF EF □

receive ← ◆AC 00

#### 4.1.3.11. Command of the previous song (AD)

Start Code	Length	Command	Check Code	End code
7E	03	AD	B0	EF

This command can trigger the last music to be played. When the first music is played, sending this command can trigger the last music to be played.

Example: send → ◇7E 03 AD B0 EF □

receive ← ◆AD 00

#### 4.1.3.12. Volume control command (AE)

There are 32 levels of volume, which are 00 ~ 31 (00 ~ 1F), of which 00 is silent and 31 is the maximum volume.

Start Code	Length	Command	Voice Volume Level	Check Code	End code
7E	04	AE	1F	XX	EF

In the example, in order to send the maximum volume to level 31, this instruction can modify and adjust the volume in real time.

Example: send → ◇7E 04 AE 1E D0 EF □

receive ← ◆AE 00

#### 4.1.3.13. Specify the playback mode (AF)

Start Code	Length	Command	Parameter	Check Code	End code
------------	--------	---------	-----------	------------	----------

7E	04	AF	00: No-loop single playback mode (default)	B3	EF
			01: Single loop playback mode	B4	
			02: All tracks loop playback mode	B5	
			03: Random mode	B6	

Note: This instruction modifies the playback mode without power failure, and will restore the default mode after power failure. When using this instruction, it is recommended that MCU set it once when initializing the module, so that every power-on can be executed in the set way. If the current playing mode is all tracks loop, send A4/A8 instruction to specify a song in the folder to play, and then it will loop in the current folder.

Example: send → ◇7E 04 AF 00 B3 EF □

receive ← ◆AF 00

#### 4.1.3.14. Insertion instruction (B1)

Start Code	Length	Command	Indicated Words	high track	low track	Check Code	End code
7E	06	B1	01	00	01	XX	EF

Note: When receiving this instruction, pause the currently playing track, then execute the playing track specified in this instruction, and then play the originally paused track after playing (the deviation can be within 1 second or the whole second).

When the first insertion order is not finished, when the second insertion order is sent, the order is invalid. Only after the first interrupted music is played can the interrupted music be interrupted again. Interruptions between the same device or different devices are supported.

Indicated Words: →01; means: Designated index address in SD card insertion;

→02; means: Specify the index address in the inserted U disk;

**Note: Multiple devices can be inserted into each other.**

Example: send → ◇7E 06 B1 01 00 02 BA EF □

receive ← ◆B1 00

#### 4.1.4.15. Audio output mode switching (B6)

Start Code	Length	Command	Parameter	Check Code	End Code
------------	--------	---------	-----------	------------	----------

7E	04	B6	00	BA	EF
			01	BB	

Parameter: 00 means SPK output and 01 means DAC output.

Example: send → ◇7E 04 B6 00 BA EF □ (without return code)

#### 4.1.3.16. Switch the current working letter (D2)

Start Code	Length	Command	Parameter	Check Code	End Code
7E	04	D2	01 : SD 卡(default)	D7	EF
			02 : USB drive	D8	

Example: send → ◇7E 04 D2 01 D7 EF □

receive ← ◆D2 00

#### 4.1.4. Reading operation instructions

##### 4.1.4.1. Query the currently set volume (C1)

Start Code	Length	Command	Check Code	End Code
7E	03	C1	C4	EF

Return Format

Operating Code	Return Value
0XC1	Sound volume value (00-1F)

Example: send → ◇7E 03 C1 C4 EF □ (The current volume is 20.)

receive ← ◆C1 14

##### 4.1.4.2. Read the current working state (C2)

Start Code	Length	Command	Check Code	End Code
7E	03	C2	C5	EF

Return Format

Operating	Return Value
-----------	--------------

Code	
0XC2	01: play 02 stops; 03: Pause

Example: send → ◇ 7E 03 C2 C5 EF □

receive ← ◆ C2 01

#### 4.1.4.3. Query the total number of music files in SD card (C5)

Start Code	Length	Command	Check Code	End Code
7E	03	C5	C8	EF

Return Format

Operating Code	Return Value(2 Byte)
0XC5	total files

Example: send → ◇ 7E 03 C5 C8 EF □

receive ← ◆ C5 00 07

#### 4.1.4.4. Query the total number of music files in the specified folder in SD card (C6)

Note: (The folder name is fixed at 5 characters)

Start Code	Length	Command	Folder Name(high-low)					Check Code	End Code
7E	08	C6	'M'	'U'	'S'	'I'	'C'	XX	EF

Among them: the folder name exists in the form of ASCII code; The above instruction indicates the total number of audio files in the folder named "MUSIC" in the read root directory.

Return format (C6 00 00 means no audio file or this folder)

Operating Code	Return Value(2 Byte)
0XC6	total files

Example: send → ◇ 7E 08 C6 46 46 46 31 31 02 EF □

receive ← ◆ C6 00 03

#### 4.1.4.5. Query the total number of music files in U disk (C7)

Start Code	Length	Command	Check Code	End Code
7E	03	C7	CA	EF

Return Format

Operating Code	Return Value(2BYTE)
0XC7	total files

Example: send → ◇7E 03 C7 CA EF □

receive ← ◆C7 00 07

#### 4.1.4.6. Query the total number of music files in the specified folder in U disk (C8)

Note: (The folder name is fixed at 5 characters)

Start Code	Length	Command	Folder Name(high-low)					Check Code	End Code
7E	08	C8	'M'	'U'	'S'	'I'	'C'	XX	EF

Among them: the folder name exists in the form of ASCII code; The above instruction indicates the total number of audio files in the folder named "MUSIC" in the read root directory.

Return format (C8 00 00 means no audio file or this folder)

Operating Code	Return Value(2BYTE)
0XC8	total files

Example ◇7E 08 C8 4D 55 53 49 43 51 EF □

receive ← ◆C8 00 03

#### 4.1.4.7. Query the currently playing file track (C9)

Start Code	Length	Command	Check Code	End Code
7E	03	C9	CC	EF

Return Format

Operating Code	File number high byte	File number low byte
0XC9	XX	XX

Example: send → ◇7E 03 C9 CC EF □

receive ← ◆C9 00 02

#### 4.1.4.8. Query the current peripheral connection status (CA)

Start Code	Length	Command	Check Code	End Code
7E	03	CA	CD	EF

Return Format

Operating Code	Return Value
0XCA	XX

When SD card and U disk are inserted or pulled out, WT2003H will actively return data to prompt; The lower 4 bits of the return value indicate the existence status of PC connection (BIT3), U disk (BIT2) and SD card (BIT1) respectively.

1-exist , 0 - doesn't exist.

Example: 0X01: without PC connection (BIT3=0), without USB drive(BIT2=0), without SD card(BIT1=0);

0X06: without PC connection (BIT3=0), with USB drive(BIT2=1), with SD card(BIT1=1);

Example: send → ◇7E 03 CA CD EF □ (USB drive connection)

receive ← ◆CA 04

#### 4.1.4.9. Query the song name (CB) of the currently playing song.

Start Code	Length	Command	Check Code	End Code
7E	03	CB	CE	EF

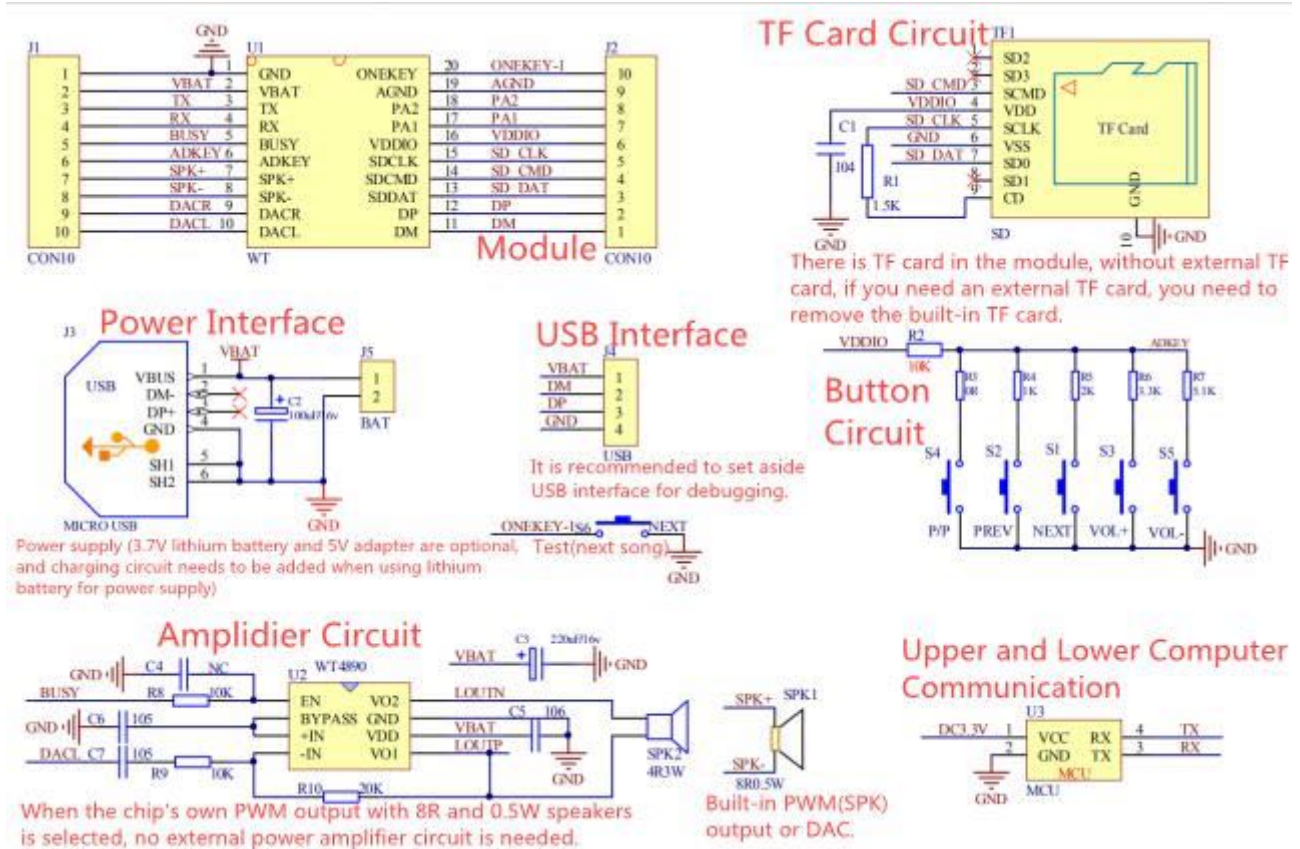
Return Format

Operating Code	Return Value
0XCB	XX ( 8 bytes )

The returned data is represented by ASCLL code. If the song name is less than 8 bytes, the insufficient data will be returned in 20H.

Example: send → ◇7E 03 CB CE EF □

## 4.2. Circuit design reference



## 5. Electrical Parameter

### 5.1. Absolute maximum rated parameter

Symbol	Parameter	Min	Max	Unit
Tamb	Ambient Temperature	-40	+85	°C
Tstg	Storage temperature	-65	+150	°C
VBAT	Supply Voltage	-0.3	5.5	V
VDDIO33	3.3V IO Input Voltage	-0.3	3.6	V



## 5.2. PMU characteristics

Symbol	Parameter	Min	Typ	Max	Unit	Test Conditions
V <sub>BAT</sub>	Voltage Input	2.8	3.7	5.5	V	–
V <sub>VDDIO</sub>	Voltage output	2.2	3.0	3.4	V	V <sub>BAT</sub> = 3.7V, 100mA loading
I <sub>VDDIO</sub>	Loading current	–	–	100	mA	V <sub>BAT</sub> =3.7V

## 5.3. IO input/output electrical logic characteristics

IO input characteristics						
Symbol	Parameter	Min	Typ	Max	Unit	Test Conditions
V <sub>IL</sub>	Low-Level Input Voltage	-0.3	–	0.3* V <sub>D</sub> DIO	V	V <sub>D</sub> DIO = 3.3V
V <sub>IH</sub>	High-Level Input Voltage	0.7* V <sub>D</sub> DIO	–	V <sub>D</sub> DIO+0.3	V	V <sub>D</sub> DIO = 3.3V
IO output characteristics						
V <sub>OL</sub>	Low-Level Output Voltage	–	–	0.33	V	V <sub>D</sub> DIO = 3.3V
V <sub>OH</sub>	High-Level Output Voltage	2.7	–	–	V	V <sub>D</sub> DIO = 3.3V

## 5.4. Characteristics of analog DAC

Parameter	Min	Typ	Max	Unit	Test Conditions
Frequency Response	20	–	16K	Hz	1KHz/0dB 100kohm loading A-Weighted Filter
THD+N	–	-65	–	dB	
S/N	–	95	–	dB	
Output Swing	–	0.54	–	V <sub>rms</sub>	
Dynamic Range	–	92	–	dB	1KHz/-60dB 100kohm loading

					With A-Weighted Filter
Output Resistance	-	8.3	-	K	-

## 6. Size of the Module

The module size is 21.01\*18.21MM, and the pin spacing is 2.0MM The size definition is as shown in the figure:

Unit: mm

