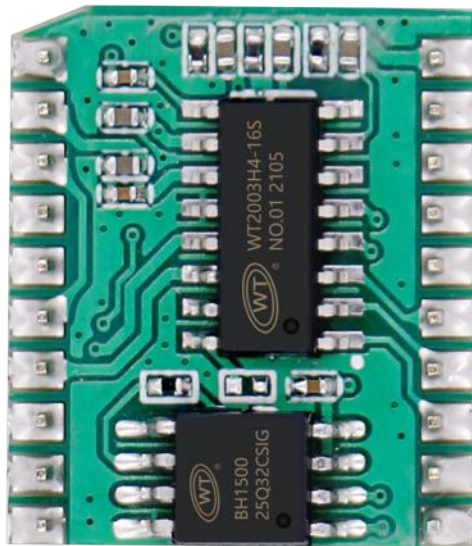


WT2003HB01 MP3 Module Specification

Version: V1.00



Note :

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1. Overview

WT2003HB01 is a powerful and high-quality voice module that 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 strong versatility. It can have a built-in voice capacity of 100 seconds\350 seconds. Flexible control mode: support standard asynchronous serial communication (UART). Support SPI-Flash, U disk as storage. With file index play, interstitial play, single loop, all track loop, random play and other functions. The volume is adjustable in 32 levels, and the maximum can support external 128Mbit Flash, and 32G U disk.

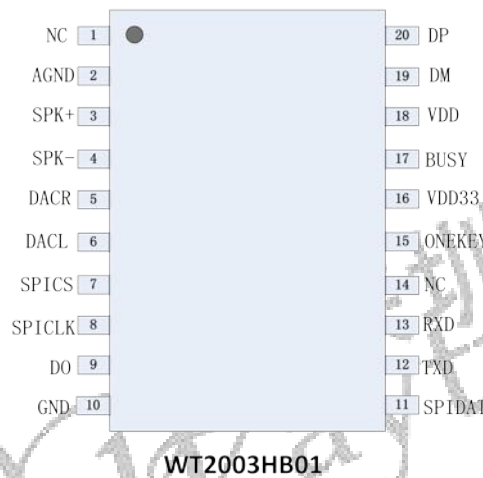
2. Characteristics

- Support SPI-Flash, U disk
- Support FAT, FAT32 file system
- Control mode: standard UART communication interface, support DMA and flow control, the default baud rate is 9600
- It is not played by default after power-on; with BUSY status indication, it is high level when BUSY is playing
- Support switching audio output mode, the sample defaults to SPK output, if you need DAC output, please refer to the audio output switching instruction (0xB6)
- The external Flash can be connected to the computer through the USB interface of the module to view or modify its content, and directly download the voice in the computer to the removable drive letter simulated by Flash (simulated U disk) (XP system, WIN7 system, WIN10 system)
- Support voice high-quality audio format, (8kbps~320kbps) beautiful sound
- It can support up to 128Mbit Flash, and 32G U disk
- Built-in 0.5W Class D power amplifier
- The volume is adjustable, the volume level is 32 levels
- Two 16-bit asynchronous divider timers
- Digital audio stream, IIS supports host and slave modes
- An IIC controller
- An infrared remote control decoder

- 16 bit high precision ADC
- High-power IO drive capability, which can directly drive up to 64mA
- When using a single module (using built-in capacity), the built-in voice needs to be written before leaving the factory

3. Pin

3.1. Pin description



Pin	name	type	explanation
1	NC	I/O	Empty
2	AGND	I/O	Analog ground
3	SPK+	I/O	Speaker terminal
4	SPK-	I/O	Speaker terminal
5	DACR	I/O	DAC right channel output
6	DACL	I/O	DAC left channel output
7	SPICS	I/O	SPI Flash chip selection
8	SPICLK	I/O	SPI Flash clock
9	DO	I/O	SPI DO
10	GND	I/O	GND
11	SPIDAT	I/O	SPI DI
12	TXD	I/O	UART asynchronous serial port data output
13	RXD	G	UART asynchronous serial port data input
14	NC	I/O	empty
15	ONEKEY	I/O	next track

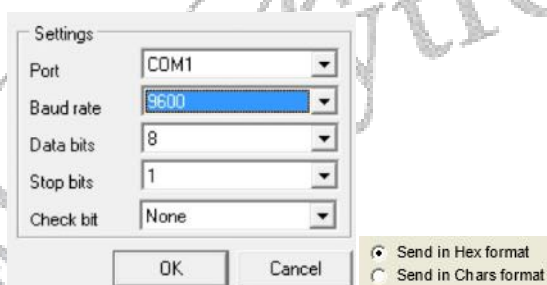
16	VDD33	P	3.3Vpower out put
17	BUSY	G	Busy signal (used to indicate playback status)
18	VDD	I/O	power input
19	DM	I/O	USB DM
20	DP	I/O	USB DP

4. Function introduction

4.1. UART Control protocol

4.1.1. Protocol command format

The standard UART asynchronous serial interface is a 3.3V TTL level interface. The communication data format is: start bit: 1 bit; data bit: 8 bits; parity bit: none; stop bit: 1 bit. To use the computer serial debugging assistant, you need to set the parameters of the serial port correctly, as shown in the figure:



Start code	Length	Command code	parameter	Accumulation and check	End code
0X7E	as follows	as follows	as follows	as follows	0XEF

Notice: "Length" refers to the length of length + command code + parameters + checksum length, and "accumulated sum check" refers to the low byte of the cumulative sum of length + command code + parameters.

4.1.2. Command List

Communication control instructions

CMD	Corresponding function	parameter
-----	------------------------	-----------

A0	Specify SPI Flash root directory index play	File index
A1	Flash play by file name	file name
A6	Specify the U disk root directory index playback	File index
A7	Specify the U disk file name to play	file name
A8	Index playback of files in the designated U disk folder	Folder name, file index
AA	Pause playback command	NO
AB	Stop order	NO
AC	Next song command	NO
AD	Previous command	NO
AE	Volume control commands	Volume level
AF	Specify play mode	Cyclic mode
B1	Interrupt instruction	Work drive letter, file index
B6	Audio output mode switch	NO
B7	Flash pin loading and release	NO
D2	Switch current work drive letter	Work drive letter

Communication query command

CMD	Corresponding function	parameter
C1	Query the currently set volume	C1 XX
C2	Query current working status	C2 XX
C3	Query the total number of music files in SPI Flash	C3 XXXX
C7	Query the total number of music files in the U disk	C7 XXXX
C8	Query the total number of music files in the specified folder in the U disk	C8 XXXX
C9	Query the track of the currently playing file	C9 XXXX
CA	Query the current peripheral connection status	CA XX
CB	Query the name of the currently playing track	CB XX XX

4.1.3. Write operation instructions

Write operation command return code format

Note: After executing each write operation command, the one-byte opcode corresponding to the command will be returned

operation command
XX

- Return code:
- : 00 means: OK command is executed ;
 - 01 means: FAIL command is wrong and will not be executed;
 - 02 means: EMP does not have this file;

4.1.3.2. Specify SPI Flash root directory index play (A0)

This command can specify to play files in SPI Flash, which is affected by the order in which the files are stored. The files are sorted according to the index order.

Start code	length	CMD	Repertoire high	Track low	Check code	End code
7E	05	A0	00	01	XX	EF

Note: When specified to play, if the specified track does not exist, it will not affect the current playback. The order of the file index is the order in which the files are copied to the SPI.

Example: Send → ◇ 7E 05 A0 00 01 A6 EF □.
 receive ← ◆ A0 00

4.1.3.3. Flash play by file name (A1)

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

Start code	length	CMD	File name (high-low)				Check code	End code
7E	07	A1	54 'T'	30('0')	30('0')	32('2')	XX	EF

Among them: "54, 30, 30, 32" are respectively the ASCII code of T002, only the file name adopts the ASCII code value, and the other data is the hexadecimal value; the above command indicates that the file name in the specified root directory is "T002.mp3" The audio file is played.

4.1.3.4. Specified U Disk Root Directory Index Play (A6)

This command can specify to play files in the U disk. Affected by the order in which the files are stored. File sorting according to index order

Start code	length	CMD	Repertoire high	Track low	Check code	End code
7E	05	A6	00	01	XX	EF

Note: During the specified playback, if the specified track does not exist, the current playback will not be affected.

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

4.1.3.5. Specify U disk file name to play (A7)

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

Start code	length	CMD	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 code of T002, only the file name adopts the ASCII code value, and the other data is the hexadecimal value; the above command indicates that the file name in the specified root directory is "T002.mp3" Audio file playback

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

4.1.3.6. Index playback of files in the designated U disk folder (A8)

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

Start code	length	CMD	File name (high-low)					File index (high-low)		Check code	End code
7E	0A	A8	'M'	'U'	'S'	'T'	'C'	00	01	XX	EF

Among them: only folder name adopts ASCII code value, and other data is hexadecimal value; the above description means that the second audio file named "Music" (index number 0001) under the designated root directory is played.

Example: Send → ◇ 7E 0A A8 54 54 54 31 31 00 05 15 EF □
 Close ← ◆ A8 00

4.1.3.7. Pause playback command (AA)

Start code	length	CMD	Check code	End code
7E	03	AA	AD	EF

In the playback state, if the instruction is sent, the playback will be paused; in the pause state, if the instruction is sent, the music will continue to be played from the pause.

Example: Send → ◇ 7E 03 AA AD EF □

Close ← ◆ AA 00

4.1.3.8. Stop command (AB)

Start code	length	CMD	Check code	End code
7E	03	AB	AE	EF

Send this command to stop playing the music currently being played.

Example: Send → ◇ 7E 03 AB AE EF □

Feedback ← ◆ AB 00

4.1.3.9. Next song command (AC)

Start code	length	CMD	Check code	End code
7E	03	AC	AF	EF

The instruction can trigger the playback of the next music, and when the last music is played, sending the instruction can trigger the playback of the first music.

Example: Send → ◇ 7E 03 AC AF EF □

Feedback ← ◆ AC 00

4.1.3.10. Previous song command (AD)

Start code	length	CMD	Check code	End code
7E	03	AD	B0	EF

The instruction can trigger the playback of the previous music, and when the first music is played, sending the instruction can trigger the playback of the last music.

Example: Send → ◇ 7E 03 AD B0 EF □

Feedback: Close ← ◆ AD 00

4.1.3.11. Volume control command (AE)

There are 32 levels of volume, ranging from 00 to 31 (00 to 1F), among which 00 is mute and 31 is the maximum

volume.

Start code	length	CMD	Volume level	Check code	End code
7E	04	AE	1F	XX	EF

In the example, the maximum volume is 31 levels. This command can modify and adjust the volume in real time.

Example: Send → ◇ 7E 04 AE 1E D0 EF □

feedback ← ◆ AE 00

4.1.3.15. Specify the playback mode (AF)

Start code	length	CMD	parameter	Check code	End code
7E	04	AF	00: Single song does not play in loop mode (default)	B3	EF
			01: Single loop playback mode	B4	
			02: Loop playback mode for all tracks	B5	
			03: Random mode	B6	

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

Example: Send → ◇ 7E 04 AF 00 B3 EF □

feedback ← ◆ AF 00

4.1.3.16. Interrupt instruction (B1)

Start code	length	CMD	Mark word	Repertoire high	Track low	Check code	结束码
7E	06	B1	01	00	01	XX	End code

Note: When receiving this instruction, pause the track being played, and then execute the play track specified by this instruction. When the play is over, then play the originally paused track (the deviation can be within 1 second or rounded up to a whole second)

When the first interrupt command has not been played, the command will be invalid when the second interrupt command is sent. It is necessary to wait for the first interruption of the music to be played before the interruption can be performed again, and the interruption between the same device or between different devices is supported.

Mark word: →00;Means: insert the specified index address in SPI-Flash;

→02; means: the designated index address in the interstitial U disk;

Note: It can be inserted between multiple devices

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

feedback ←◆B1 00

4.1.4.14. Audio output mode switch (B6)

Start code	length	CMD	parameter	Check code	End code
7E	04	B6	00	BA	EF
			01	BB	

Parameters: 00 means SPK output, 01 means DAC output

Example: Send→◇7E 04 B6 00 BA EF□ (No return code)

4.1.4.15. Flash pin loading and release (B7)

Start code	length	CMD	parameter	Check code	End code
7E	04	B7	00	XX	EF
			01		

Parameter: 00 means to release the Flash pin 01 means to load the Flash pin

4.1.3.16. Switch the current working drive letter (D2)

Start code	length	CMD	parameter	Check code	End code
7E	04	D2	00 : SPI-Flash	D6	EF
			02 : U -disk	D8	

Example: Send→◇7E 04 D2 00 D6 EF □

Feedback C←◆D2 00

4.1.4. Read operation instructions

4.1.4.1. Query the currently set volume (C1)

Start code	length	CMD	Check	End code
7E	03	C1	C4	EF

Return format

Opcode	return
0XC1	Tone volume value (00-1F)

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

Close ← ◆C1 14

4.1.4.2. Read current working status (C2)

Start code	length	CMD	Check	End code
7E	03	C2	C5	EF

Return format

Opcode	Return
0XC2	01: Play 02 stop; 03: Pause

Example: Send → ◇7E 03 C2 C5 EF □

Close → ◆C2 01

4.1.4.3. Query the total number of music files in SPI Flash (C3)

Start code	length	CMD	校验码	结束码
7E	03	C3	C6	EF

Return format

Opcode	Return value (2BYTE)
0XC3	Total number of files

Example: Send → ◇7E 03 C3 C6 EF □

feedback ← ◆C3 00 04

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

Start code	length	CMD	Check code	End code
7E	03	C7	CA	EF

Return format

Opcode	Return value (2BYTE)
0XC7	Total number of files

Example: Send → ◇ 7E 03 C7 CA EF □

Return ← ◆ C7 00 07

4.1.4.5. Query the total number of music files in the designated folder in the U disk (C8)

Note: (The folder name must be 5 characters)

Start code	length	CMD	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 command means to read the total number of audio files in the folder named "MUSIC" in the root directory

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

Opcode	Return value (2BYTE)
0XC8	Total number of files

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

feedback ← ◆ C8 00 03

4.1.4.6. Query the track of the currently playing file (C9)

Start code	length	CMD	Check code	End code
7E	03	C9	CC	EF

Return format

Start code	File number high byte	File number low byte
0XC9	XX	XX

Example: Send → ◇ 7E 03 C9 CC EF □

Close ← ◆ C9 00 02

4.1.4.7. Query the current peripheral connection status (CA)

Start code	length	CMD	Check code	End code
7E	03	CA	CD	EF

Return format

Opcode	return value
0XCA	XX

When the U disk are inserted or removed, WT2003H will actively return data as a reminder; the lower 4BIT of the return value means PC connection (BIT3), U disk (BIT2), and SPI-Flash (BIT0) the state of existence,

1- exists, 0-does not exist.

Example: 0X01: No PC connection (BIT3=0), no U disk (BIT2=0), and SPI-Flash (BIT0=1);

0X05: No PC connection (BIT3=0), U disk (BIT2=1), SPI-Flash (BIT0=1);

Example: Send → ◇ 7E 03 CA CD EF □ (current U disk connection)

Close ← ◆ CA 04

4.1.4.10. Query the song name of the currently playing song (CB)

Start code	length	CMD	Check	End code
7E	03	CB	CE	EF

Return format

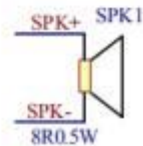
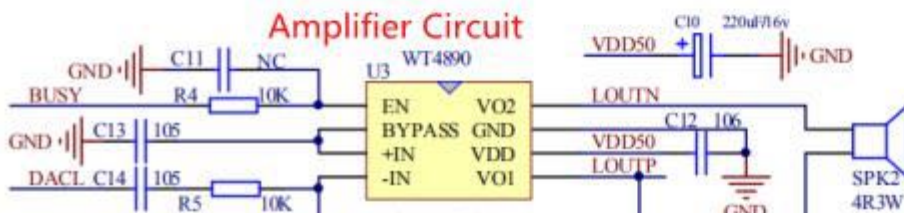
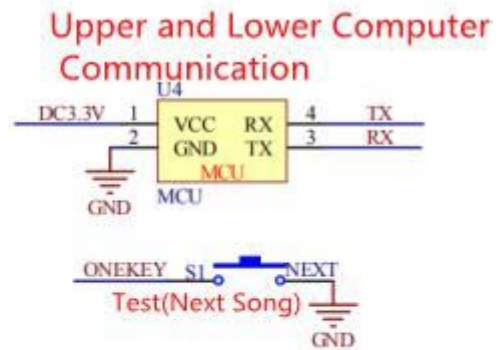
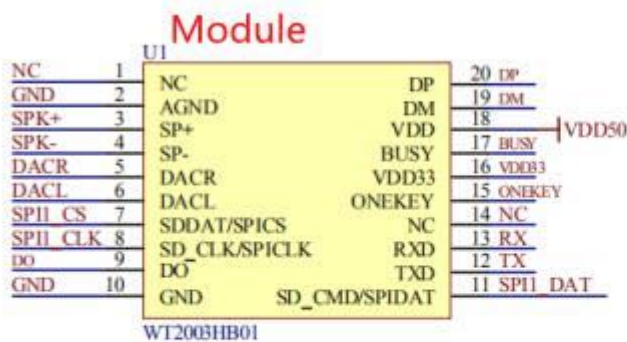
Opcode	return value
0XCB	XX (8 bytes)

The returned data is represented by ASCLL code, if the song name is not enough 8 bytes, then the insufficient will be supplemented and returned with 20H.

Example: Send → ◇ 7E 03 CB CE EF □

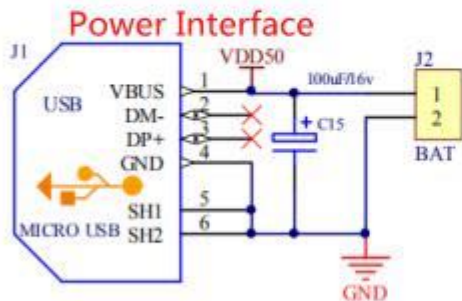
Receiving ← ◆ CB 46 30 31 31 2E 6D 70 33 (song name: F011.mp3)

4.2. Circuit design reference

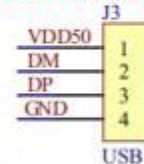


When the chip's own PWM output with 8R and 0.5W speakers is selected, no external power amplifier circuit is needed.

Choose between built-in PWM(SPK)output and DAC



USB Interface



It is recommended to set asid USB interface for debugging.

Power supply (3.7V lithium battery and 5V adapter are optional, and charging circuit needs to be added when using lithium battery for power supply)

5. Electrical parameters

5.1. Absolute maximum ratings

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
V _{VDDIO33}	3.3V IO Input Voltage	-0.3	3.6	V

5.2. PMU features

Symbol	Parameter	Min	Typ	Max	Unit	Test Conditions
VBAT	Voltage Input	2.8	3.7	5.5	V	—
V _{VDDIO}	Voltage output	2.2	3.0	3.4	V	VBAT = 3.7V, 100mA loading
I _{VDDIO}	Loading current	—	—	100	mA	VBAT=3.7V

5.3. IO input/output electrical logic characteristics

IO input characteristics						
Symbol	Parameter	Min	Typ	Max	Unit	Test Conditions
V _{IL}	Low-Level Input Voltage	-0.3	—	0.3* V _{VDDIO}	V	V _{VDDIO} = 3.3V
V _{IH}	High-Level Input Voltage	0.7* V _{VDDIO}	—	V _{VDDIO} +0.3	V	V _{VDDIO} = 3.3V
IO output characteristics						
V _{OL}	Low-Level Output Voltage	—	—	0.33	V	V _{VDDIO} = 3.3V
V _{OH}	High-Level Output Voltage	2.7	—	—	V	V _{VDDIO} = 3.3V

5.4. Analog DAC characteristics

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	-	Vrms	
Dynamic Range	-	92	-	dB	1KHz/-60dB 100kohm loading With A-Weighted Filter
Output Resistance	-	8.3	-	K	-

6. Module size

The module size is 21.21*18.24*3.35MM±0.3MM, The pin pitch is 2.0MM, and the size definition is shown in the figure:

Unit: mm

