WT2003HB03 MP3 Module Specification

Version: V1.00

CONTENT

1. Overview

WT2003HB03 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). Support SPI-Flash, TF card and U disk 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 128Mbit Flash, 32G TF card and 32G USB stick at the maximum.

2. Characteristics

- Support SPI-Flash, 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 Flash can be connected to the computer to view or modify its contents through the USB interface of the module, and the voice in the computer can be directly downloaded to the removable drive letter (analog U disk) of Flash simulation (XP system, WIN7 system, WIN10 system);

- Support voice high-quality audio format, with beautiful sound (8kbps~320kbps);

- Up to 128Mbit Flash, 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.

3. About PIN

3.1. PIN Description

WT2003HB03
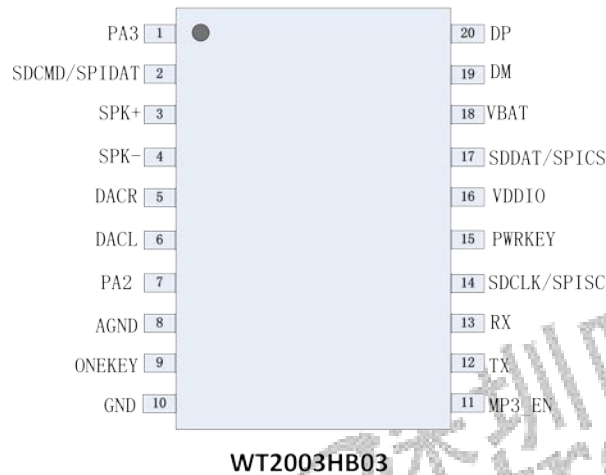
PIN	Name	Type	Description
1	PA3	I/O	IO port
2	SDCMD/SPIDAT	I/O	SD card selection
		I/O	SPI Flash data
3	SPK+	I/O	Horn terminal
4	SPK-	I/O	Horn terminal
5	DACR	I/O	DAC right channel output
6	DACL	I/O	DAC left channel output
7	PA2	I/O	IO port
8	AGND	G	Audio ground
9	ONEKEY	O	Next song
10	GND	P	GND
11	MP3_EN	P	Busy signal
12	TX	G	UART asynchronous serial port data output
13	RX	I/O	UART asynchronous serial port data input
14	SDCLK/SPICLK	I/O	SD card clock
		I/O	SPI Flash clock
15	PWRKEY	I/O	Key foot
16	VDDIO	I/O	3.3V power output

17	SDDAT/SPICS	I/O	SD card data
		I/O	SPI Flash chip selection
18	VBAT	I/O	Power input
19	DM	I/O	USB DM
20	DP	I/O	USB DP

4. Introduction of 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:

Serial Port COM1
Baud Rate 9600
Check Digit No parity
Data Bit 8
Stop Bit 1

○ 十六进制发送　Hexadecimal transmission
○ 字符格式发送　Character format transmission
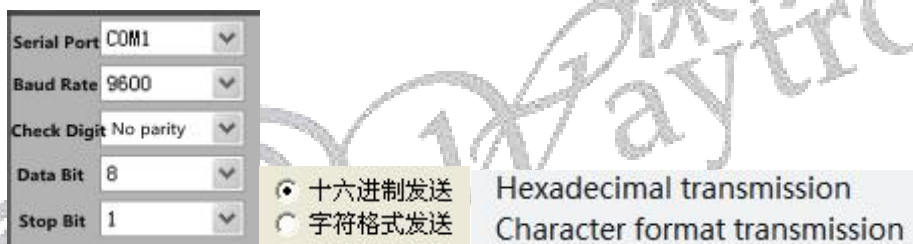
Start Code	Length	Command Code	Parameters	Accumulation and verification	Ending Code
0X7E	As follows	As follows	As follows	As follows	0XEF

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
A0	Specify SPI Flash root index playback	File index
A1	Flash play by file name	filename
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
B7	Flash pin loading and releasing	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

C3	Query the total number of music files in SPI Flash	C3 XXXX
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 specified folder in the U disk.	C8 XXXX
C9	Query the currently playing file tracks.	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,

操作码
XX

the operation code of one byte corresponding to the command is returned.

Return Code：→: 00 表示：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 SPI Flash root index play (A0)

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

Start Code	Length	Command	High Track	Low Track	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 play.

The order of file index is in the order in which files are copied to 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 file name in SPI to play (the file name must be 4 bytes)

Start Code	Length	Command	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 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 A1 54 30 30 32 8E EF □

receive←◆A1 00

4.1.3.4. 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	Command	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

4.1.3.5. 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	Command	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

4.1.3.6. 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	Length	Comm	File Name(high-low)	File Index(high-low)	Check	End Code

Code		and								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 → ◇ 7e0aA446 46 46 31 00 07E9EF□

receive←◆A4 00

4.1.3.7. 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

4.1.3.8.Specify the USB flash drive 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	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

4.1.3.9.Specify file index play 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	File 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

4.1.3.10. 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

4.1.3.11. 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

4.1.3.12.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

4.1.3.13. 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

4.1.3.14. 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

4.1.3.15. 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 return to 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

4.1.3.16. Insertion instruction (B1)

Start Code	Length	Command	Indicated Word	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.

Marked word：→00；means：Specify the index address in SPI-Flash;

→01；means：Specify the index address in SPI-Flash;

→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

4.1.4.17.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□　　（no return code）

4.1.4.18Flash pin load and release (B7)

Start Code	Length	Command	Parameter	Check Code	End Code
7E	04	B7	00	XX	EF

			01		

Parameter: 00 means releasing the Flash pin 01 means loading the Flash pin.

Example: send→◇7E 04 B7 00 BB EF 　　（no return code）

4.1.3.19. Switch the current working letter (D2)

Start Code	Length	Command	Parameter	Check Code	End Code
7E	04	D2	00：SPI-Flash	D6	EF
			01：SD 卡(default)	D7	
			02：USB drive	D8	

Example: send→◇7E 04 D2 00 D6 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 Code	Return Value
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 SPI Flash (C3)

Start Code	Length	Command	Check Code	End Code
7E	03	C3	C6	EF

Return Format

Operating Code	Return Value(2 byte)
0XC3	total files

Example: send→◇7E 03 C3 C6 EF □

receive←◆C3 00 04

4.1.4.4. 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

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

Note: (The folder name must be 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

4.1.4.6. 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(2 Byte)
0XC7	total files

Example: send→◇7E 03 C7 CA EF □

receive←◆C7 00 07

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

Note: (The folder name must be 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(2 Byte)
0XC8	total files

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

receive←◆C8 00 03

4.1.4.8. 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

4.1.4.9. 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), SD card (BIT1) and SPI-Flash(BIT0) respectively.

1- exists, 0-does not exist.

example：0X01：with PC connection（BIT3=0），without USB Drive(BIT2=0)，without SD card (BIT1=0)，

with SPI-Flash(BIT0=1)；

0X07：without PC connection （BIT3=0）， with USB drive(BIT2=1)， with SD card(BIT1=1)， with SPI-Flash(BIT0=1)；

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

receive←◆CA 04

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

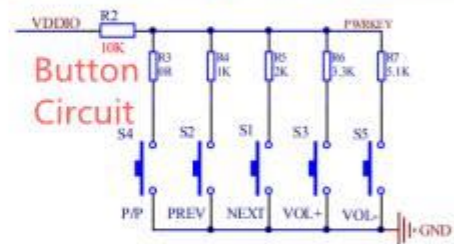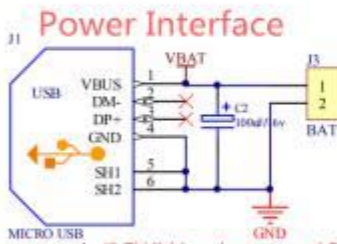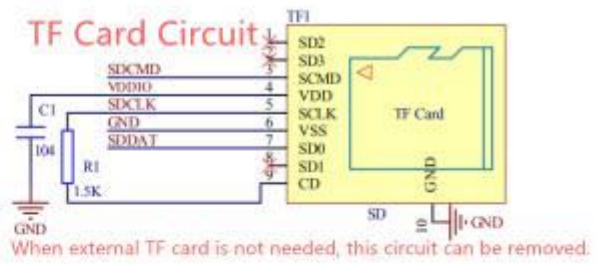| Start Code	Length	Command	Check Code	End Code
7E	03	CB	CE	EF

Return Format

Operating Code	Return Value
0XCB	XX（8 byte）

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.
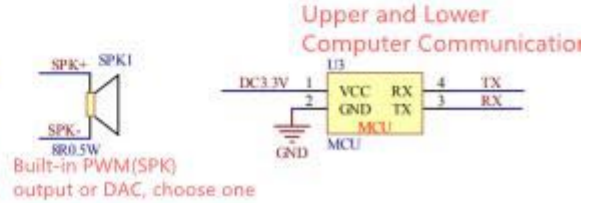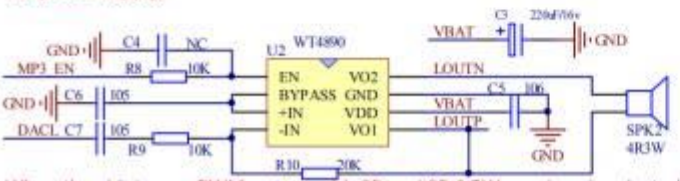
Example: send→◇7E 03 CB CE EF □

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

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
$V_{VDDIO33}$	3.3V IO Input Voltage	-0.3	3.6	V

5.2. PMU characteristics

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 intput characteristics						
Symbol	Parameter	Min	Typ	Max	Unit	Test Conditions
V$_{IL}$	Low-Level Input Voltage	-0.3	_	0.3* VDDIO	V	VDDIO = 3.3V
V$_{IH}$	High-Level Input Voltage	0.7* VDDIO	_	VDDIO+0.3	V	VDDIO = 3.3V
IO output characteristics						
V$_{OL}$	Low-Level Output Voltage	_	_	0.33	V	VDDIO = 3.3V
V$_{OH}$	High-Level Output Voltage	2.7	_	_	V	VDDIO = 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	_	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 * 3.35 mm 0.3 mm, the pin spacing is 2.0MM, and the size definition is shown in the figure:

Unit：mm