



WT2003B03

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WT2003B03

WT2003 B03 is a new MP3 module with powerful function and high quality, satisfying customer's needs from many aspects. It has two play modes. One is the specified root directory filename play and the other is the specified index order play. It is available to build folder to classify, playing according to the file index order of the folder. SPI-FLASH(8~128Mbit), SD card(Max 32G) and U disk(Max 32G), these three kinds of memory are all supported.





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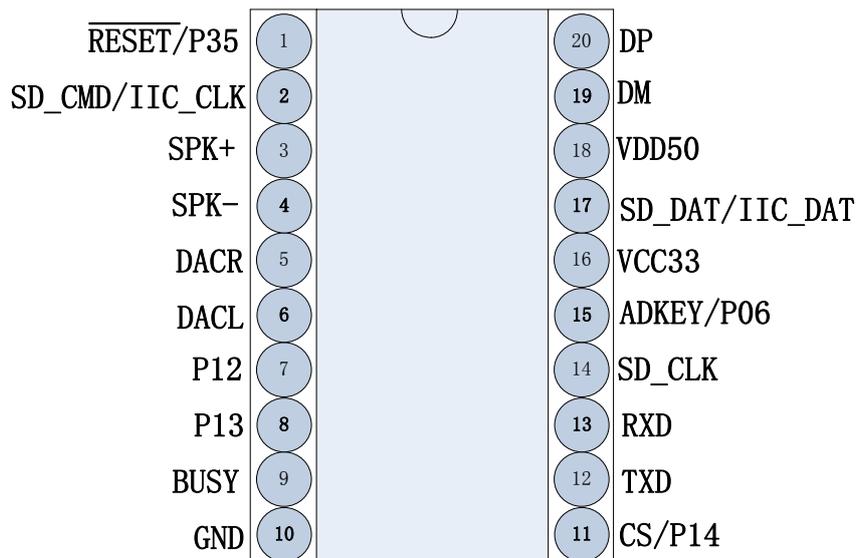
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1. Features

- Support sample rate 8~48KHz, bit rate 8~320KbpsMP3 audio file.
- SPI-FLASH, TF card and U disk as memory, free to change audios, maximum support 32G TF card and 32G U disk (FAT or FAT32).
- SPI FLASH can store 2047 pieces of audio.
- Free to change audio files of TF card through USB interface(XP system, WIN7 system, WIN8 system).
- Available to copy audio files to SPI-FLASH via TF card or U disk TF, offline audio changing.
- Support both key control and UARTasynchronous serial communication, universal standard interface protocols, more functional, more flexible to control.
- Support inter cut between different kinds of memory.
- Built in 1W amplifier, direct to drive 8 ohm/1W speaker, loud voice, 32 levels volume for option.
- DC 5V power supply.

2. WT2003 B03 Pin Introduction



WT2003 B03



Pin No.	Pin name	Type	Function description
1	RESET/P35	I	Internal memory control pin(push down I/O port, release SPI-Flash)
2	SD_CMD/IIC_CLK	PWP	Connect CMD of SD card
3	SPK+	AO	Speaker terminal
4	SPK-	AO	Speaker terminal
5	DACR	IO	DAC right channel output
6	DACL	IO	DAC left channel output
7	P12	I	SPI_CLK internal memory clock signal input terminal
8	P13	I	SPI_DATA internal memory interface data signal input terminal
9	BUSY	I/O	BUSY output(low level when not playing, high level at playing time)
10	GND	PWP	Power Ground
11	CS/P14	I/O	SPI-FLASH internal memory chip selection terminal
12	TXD	O	UART synchronous serial output terminal
13	RXD	I	UART synchronous serial input terminal
14	SD-CLK	I	External SD card interface clock signal input terminal
15	ADKEY/P06	I	ADC key connecting end (let I/O port trigger to ground to play/pause)
16	VCC33	PWP	LDO 3.3V power output terminal.
17	SD_DAT/IIC_DAT	I	UART synchronous serial input terminal
18	VDD50	PWP	Module power supply terminal(3.0V~5.5V)
19	DM	IO	USB data terminal DM
20	DP	IO	USB data terminal DP

3. Specification

Name	Function
Audio format	Support sample rate 8~48KHz, bit rate 8~320KbpsMP3 audio file
Memory capacity	Support 8Mbit~128Mbit SPI-FLASH Maximum support 32GB TF card Maximum support 32GB U disk Support file system:FAT16,FAT32(not support NTFS)
USB interface	Full speed 2.0
Voltage of power supply	DC3.0~5.5V
Rated current	20~250mA(related with load)
IO port level	3.3V TTL level
Working temperature	-40~85 degree
Humidity	5%~95%



4. Electrical parameters

Name	Remark	Condition	Min.	Typical value	Max.	Unit
VDD50	LDO input voltage	-	3.0	5.0	5.5	V
VDD33	LDO 3.3V output current	Vout3.3>3.1V	-	-	150	mA
Quiescent current	Current under no load	No load	-	30	-	mA
Working current	Current in playing state	8R/1W speaker, 32-level volume	-	390	-	mA
SNR	Signal to Noise Ratio	-	-	92	-	dB
THD+N	Total harmonic distortion	No-load	-	-70	-	dB
PWRAB	DAC output power	32 ohm speaker	-	-	16	mW
VPP	DAC max output amplitude voltage	10K ohm load	-	-	2.8	V
Ps1	Standby power consumption(with TF card)	Related with TF card power consumption	-	27.6	-	Ma
P	Power consumption when playing(no load)	Related with TF card power consumption	-	28.7	-	Ma
VPPLINE	External audio input swing		-	-	2.8	V

5. Control mode

5.1 Key control mode

Key name	ADKEY
Function	Next

Remark: please refer to application circuit for the connection method details.

5.2 Serial port control

5.2.1 Protocol command format

WT2003SB03 is built in standard UART asynchronous serial interface, belonging to 3.3V TTL level interface. Can convert to RS232 level by MAX232 chip.

Communication data format: 1start bit, 8 data bits, no parity bit, 1stop bit. When using computer serial debugging assistant, need to correctly set the serial port parameters, as shown in Figure:



Start code	Length	Command code	Parameters	Cumulative sum check	End code
0X7E	See below	See below	See below	See below	0XEF

Attention: "Length" means length(1 byte)+command code(several bytes)+parameter(several bytes)+check sum(1 byte). Cumulative sum check means the low byte of cumulative sum of length + command code + parameter .

5.2.2 Command list

Communication control command

CMD	Corresponding function	Parameters
A0	Specify SPI flash root directory index play	File index
A2	Specify SD card root directory index play	File index
A3	Specify SD card file name play	File name
A4	File index play in specified SD card folder	File name, file index
A6	Specify U disk root directory index play	File index
A7	Specify U disk file name play	File name
A8	File index play in specified U disk folder	File name, file index
AA	Pause command	No
AB	Stop command	No
AC	Next command	No
AD	Previous command	No
AE	Volume control command	Volume level
AF	Specified play mode	Loop mode
B1	Inter cut command	Work drive letter, file index
B3	Copy form SD card to SPI FLASH	No
B4	Copy form U disk to SPI FLASH	No



B8	Specified user area(Config data) logging data	Address, data
BA	Whether need return code	BA XX
D2	Switch the current work drive letter	Work drive letter

Communication query command

CMD	Corresponding function	Parameters
C1	Query current volumesetting	C1 XX
C2	Read current working state	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 specified folder of 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 specified folder of U disk	C8 XXXX
C9	Query the current audio playing	C9 XXXX
CA	Check the current external connection status	CA XX
CB	Query the name of audio playing currently	CB XX XX(only support SD card and U disk)
CF	Query "user cache data" of the specified address	CC xxxxxx

5.2.3 Write operation command

Operation code
XX

5.2.3.1 Return code format

Note: After executing each write command, return the corresponding one-byte operation code.



Return code:00 means OK command execution;

01 means FAIL command error, no execution;

02 means EMP has no such file;

Remark: If SPI-FLASH exists while neither TF card nor U disk exist or either TF card or U disk data has something wrong,return 05 once there is power on.

If SPI-FLASH does not exist, neither TF card nor U disk exist or either TF card or U disk data has something wrong,return multiple 05 once there is power on.

5.2.3.2 Specify SPI FLASH root directory index play(A0)

This command can make specified operation for SPI Flash files. Files sorting is according to the index order.

Start code	Length	Command	High order of track	Low order of track	Check code	End code
7E	05	A0	00	01	XX	EF

Note: If specified song is not exist, it will not influence current playing.

5.2.3.3 Specify SD card file index play(A2)

This command can specify file play of SD card, influenced by the order of files stored. Files sort is according to the index order.

Start code	Length	Command	High order of track	Low order of track	Check code	End code
7E	05	A2	00	01	XX	EF

Note: If specified song is not exist, it will not influence current playing.

5.2.3.4. Specify SD card file name play(A3)

This command can according to file name to play audio in specified root directory of SD card.(File name no more than 8 characters)

Start code	Length	Command	File name (form high to low)			Check code	End code	
7E	07	A3	54('T')	30('0')	30('0')	32('2')	XX	EF

54,30,30,32 respectively stand for ASCII code of T002. Only file name adopts ASCII code value; other data is hexadecimal. The above commands means playing "T002XXX.MP3" in specified root directory. And the first four bits need to be corresponding.

5.2.3.5 Index play in specified SD card folder(A4)

This command can play audio in folder of specified root directory.(File name has fixed 8 characters)



Start code	Length	Command	Folder name(high-low)					File index(high-low)		Check code	End code
7E	07	A4	'M'	'U'	'S'	'I'	'C'	00	01	XX	EF

Only folder name is ASCII value; other data is hexadecimal. Above commands means playing the second audio which folder is named "MUSIC" in specified root directory(index number is 0001).

5.2.3.6 Specify U disk root directory index play(A6)

This command can specify file play of U disk, influenced by the order of files stored. Files sorting is according to the index order.

Start code	Length	Command	High order of track	Low order of track	Check code	End code
7E	05	A6	00	01	XX	EF

Note: If specified song is not exist, it will not influence current playing.

5.2.3.7 Specify U disk file name play(A7)

This command can according to file name to play audio in specified root directory of U disk.

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

54,30,30,32 respectively stand for ASCII code of T002. Only file name adopts ASCII code value; other data is hexadecimal. The above commands means playing "T002XXX.MP3" in specified root directory. And the first four bits need to be corresponding.

5.2.3.8 File index play in specified U disk folder(A8)

This command can play audio according to file index in folder of specified root directory.(File name is fixed 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

Only folder name is ASCII value; other data is hexadecimal. Above commands means playing the second audio which folder is named "MUSIC" in specified root directory(index number is 0001).

5.2.3.9 Pause command(AA)

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

In playing state, sending this command will pause, while in pause state, it will start playing music from the pause.



5.2.3.10 Stop command(AB)

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

Sending this command will stop playing the current music.

5.2.3.11 Next command(AC)

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

This command can trigger to play the next music. When playing the last music, sending this command will trigger to play the first music.

5.2.3.12 Previous command(AD)

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

This command can trigger to play the previous music. When playing the first music, sending this command will trigger to play the last music.

5.2.3.13 Volume control command(AE)

There are 32 volume levels in total, from 00 to 31(00 ~ 1F). 00 is mute; 31 is full volume.

Start code	Length	Command	Volume level	Check code	End code
7E	04	AE	1F	XX	EF

Example shows sending maximum volume 31 level. This command is available to adjust volume in real time.

5.2.3.14 Specified play mode(AF)

Start code	Length	Command	Parameter	Check code	End code
7E	04	AF	00: Single and no loop playback(default)	B3	EF
			01: Single loop play mode	B4	
			02: All loop play mode	B5	
			03: Random mode	B6	

Note: this command modifies the playing mode in the condition of no power down. After power down it will restore the default mode. When using this command, just setting MCU once in the module



initialization can realize to execute according to the settings with power on each time. If current play mode is all loop playback, send A4/A8 command to specify one audio play in folder and this time the audio will be loop playback in this folder.

5.2.3.15 Inter cut command(B1)

Start code	Length	Command	Mark word	High order of track	Low order of track	Check code	End code
7E	06	B1	01	00	01	XX	EF

Note: When this command is received, the current playing audio will pause and the specified audio will be played. After finishing playing, it will continue to play the pause audio (error within 1s is OK)

If the inter-cut play is not finished at the first time, the command will be invalid even sending the second command. It is not available to continue the next inter-cut play until finishing the first play, supporting inter-cut play between the same or different devices.

Remark:

- 00 stands for inter-cut specified index address in SPI-FLASH;
- 01 stands for inter-cut specified index address in SD card;
- 03 stands for inter-cut specified index address in U disk;

Note: only when playing he audio file of SD card or U disk, it can have inter-cut play. Support inter cut between multiple devices. When playing the audio of Flash, it does not support inter cut, and return 02.

5.2.3.16 Copy form SD card to SPI FLASH(B3)

Start code	Length	Command	Check code	End code
7E	03	B3	B6	EF

Note: when do some copying, BUSY changes at the frequency of 1HZ. The BUSY is low level when copying is finished. So you can judge copy status according to its changes. Besides, serial port check is also feasible. Send 0xC3 command to query the total number of songs in Flash. If return 0xC3 XX XX(XX XX is total number of songs in Flash), it means not in copy state; if return 05, it means in copy state now, unavailable to check total number of songs in Flash.

- ✧ If the MP3 file copy and config data copy are correct, return “00”.
- ✧ If the MP3 file copy are correct while config data copy is abnormal, return “01”.
- ✧ If the MP3 file copy is abnormal and config data copy is correct, return “02”.
- ✧ If neither MP3 file copy nor config data copy are abnormal, return “03”.

(return 02 or 03, that may be because files in device are too large and there is not enough Flash capacity)



5.2.3.17 Copy from U disk to SPI-FLASH(B4)

Start code	Length	Command	Check code	End code
7E	03	B4	B7	EF

Note: when do some copying, BUSY changes at the frequency of 1HZ. The BUSY is low level when copying is finished. So you can judge copy status according to its changes. Besides, serial port check is also feasible. Send 0xC3 command to query the total number of songs in Flash. If return 0xC3 XX XX(XX XX is total number of songs in Flash), it means not in copy state; if return 05, it means in copy state now, unavailable to check total number of songs in Flash.

- ✧ If the MP3 file copy and config data copy are correct, return "00".
- ✧ If the MP3 file copy are correct while config data copy is abnormal, return "01".
- ✧ If the MP3 file copy is abnormal and config data copy is correct, return "02".
- ✧ If neither MP3 file copy nor config data copy are abnormal, return "03".

(return 02 or 03, that may be because files in device are too large and there is not enough Flash capacity)

5.2.3.18 Specified user area(Config data) logging data(B8)

Log data to the specified address(0000H-0100H), 512 addresses in total. Can store at most 28 bytes at once.

Start code	Length	Command	Start address (0000H-0FFFH)	Data area (at most 200B)	Check code	End code
7E	09	B8	00 00	F1 E2 D3 04	6B	EF

Check code: Data accumulation, starting from the start address to the low-byte data of the last data sum in data field. Take above command as an example, 0X09+0XB8+0X00+0X00+0XF1+0XE2+0XD3+0X04 = 0X036B, so the check code is 0X6B.

Above commands mean that through WT2003S user write data 0XF1, 0XE2, 0XD3 and 0X04 to FLASH address 0000H, 0001H, 0002H, 0003H.

5.2.3.19 Switch current work drive letter(D2)

Start code	Length	Command	Parameters	Check code	End code
7E	04	D2	00: SPI-FLASH	D6	EF
			01: SD card(default)	D7	
			02: U disk	D8	



5.2.4 Read operation command

5.2.4.1 Query current volume setting(C1)

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

Return format

Operation code	Return value
0XC1	Volume value (00-1F)

5.2.4.2 Read current working state(C2)

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

Return format

Operation code	Return value
0XC2	01: Play 02:stop03: Pause

5.2.4.3 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 code

Operation code	Return value(2BYTE)
0XC3	The total number of files

5.2.4.4 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

Operation code	Return value(2BYTE)
0XC5	The total number of files

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

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



The folder name is in the form of ASCII code. The above commands mean reading the total number of audio files in "MUSIC" folder of root directory.

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

Operation code	Return value(2BYTE)
0XC6	The total number of files

5.2.4.6 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

Operation code	Return value(2BYTE)
0XC7	The total number of files

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

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

The folder name is in the form of ASCII code. The above commands mean reading the total number of audio files in "MUSIC" folder of root directory.

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

Operation code	Return value(2BYTE)
0XC8	The total number of files

5.2.4.8 Query the current audio playing(C9)

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

Return format

Operation Code	High byte of file number	Low byte of file number
0XC9	XX	XX

5.2.4.9 Check the current external connection status(CA)

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



Return format

Operation code	Return value
0XCA	XX

When insert or remove SD card or U disk, WT2000 will automatically return data to make prompt. Low 4BIT of return value stands for the status of PC connection (BIT3), U disk (BIT2), SD card (BIT1) and SPI-FLASH (BIT0).

0 stands for existence; 1 stands for inexistence.

For example:

0x01: without PC connection (BIT3=0), without U disk (BIT2=0), without SD card (BIT1=0), with SPI-FLASH (BIT0=1).

0x07: without PC connection (BIT3=0), with U disk (BIT2=1), with SD card (BIT1=1), with SPI-FLASH (BIT0=1).

5.2.4.10 Query the name of audio playing currently(CB)

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

Return format

Operation code	Return value
0XCB	XX(8 bytes)

The return data is in the form of ASCII code. If the song name is less than 8 bytes, those without 8 bytes will be supplemented with 20H to return.

5.2.4.11 Read “user cache data” of the specified address(CF)(only need to read config in Flash)

Read the data of Config.mp3 file in user area of SPI-FLASH.

Start code	Length	Command	Work drive letter	Start address 0000H~0100H	The length of return data(at most 512)	Check sum	End code
7E	08	CF	00	XX XX	XX XX	XX	EF

Return format:

Operation code	Work drive letter	Data length	Data content
0XCF	00	XX XX	XX XX XX XX

Note:



XX XX is the length of specified return value. Serial port command can specify the numbers of bytes of return data. Before reading, switch drive letter. If data length in Config.mp3 file is shorter than the total number of ordered data length, the insufficient data is replaced by "FF". For example, "OFF ON" is stored in Config.mp3 file. If sending read command "7E 08 CF00 00 00 00 08 DF EF", will return "CF 00 00 08 4F 46 46 00 4F 4E FF FF 03 7F" while If sending read command "7E 07 CF 00 00 02 00 02 DA EF", will return "CF 00 00 02 46 00 00 48".

In SPI-Flash driving letter, read user buffer data in Flash(the copied Config.mp3 data or the data wrote by user through AD command). Address range is 0x0000-0x0FFF.

Note: at present only support to query config data in FLASH, not support to query config data in SD card and U disk(return 02).

5.3 Attention

- ✧ The interval time of sending each command should not be less than 300ms.
- ✧ After sending control command, confirm the command execution by detecting return code, to make sure whether it is executed correctly.
- ✧ When you send copy command but cannot copy normally, write programs according to the following logic(U disk copying as an example)

```
: /*****/
: //Function name:U_DISK_Flash_copy(void)
: //Function: send com mand to make the audio files of U disk and config data copy to Flash.
: //Variables using instruction:
: //1.uart_receive_buff: serial data receiving buffer
: //2.
:
: //Function using instruction
: // 1.send_uart() This function will clear the buffer of serial receiving, then send corresponding data
: //
: /*****/
:
: #define FLASH_BIT      0
: #define SD_BIT        1
: #define U_DISK_BIT    2
```



```
void U_DISK_Flash_copy(void)
{
    bool U_disk_online = false; //true U disk online false U disk offline
    bool copy_status = false;
    for(u8 i = 0; i < 3; i++) //Usually when starting up and testing equipment, there will be a few times of instability; need cycle judgment,
    { // usually not needed.
        send_uart(0x7E,0x03,0xCA,0xCD,0xEF); // Internal functions first clear buffer of serial receiving.
        //Then send the command of equipment online status query.
        delay_1ms(50); //Delay 50ms to receive serial data.
        if((uart_receive_buff[0] == 0xCA) && (uart_receive_buff[1] & BIT(U_DISK_BIT)))
        {
            U_disk_online = true;
            break;
        }
        else
            U_disk_online = false;
    }
    if(U_disk_online) //U disk is plugged in.
    {
        for(u8 i = 0; i < 5; i++)
        {
            delay_1ms(200); //Delay 200ms
            send_uart(0x7E,0x03,0xB4,0xB7,0xEF); //Flash copy command
            delay_1ms(200); //Delay 200ms
            send_uart(0x7E,0x03,0xC3,0xC6,0xEF); //Query the number of Flash track
            delay_1ms(50); //Delay 50ms to receive serial data.
            if(uart_receive_buff[0] == 0x05) //It means that not support Flash track query and already start copying.
            {
                copy_status = true; //Usually it will judge there is no problem at this time, or you can know by
                //judging whether BUSY,port changes in 2HZ. It will be very correct by
                //judging together.
                break;
            }
        }
        //The behind is the program waiting for finishing copying, which can judge BUSY status. When copying is finished, BUSY is low level;
        //for judge by querying 0xC3 command. If return 0xC3 xx xx, it means the copying is finished and support flash track querying.
    }
} // ? end send_uart ?
```

6. Audio file sort

WT2003S audio file index sort is according to the audio file sort order stored to SD card, not in accordance with the file name order. So when WT2003S is playing file in index, the sort order is not related to the file name, but is related to the order copied to the memory.

We can build a folder on the computer and copy all the files to the folder, and then sort the files in this folder according to what you want or like. Next, according to the following two methods copy the files to SD card or U disk. (If you want to download to SPI, you can first copy to SD card or U disk, and then send commands or copy to SPI by pressing copying keys.)

Two common copying methods:

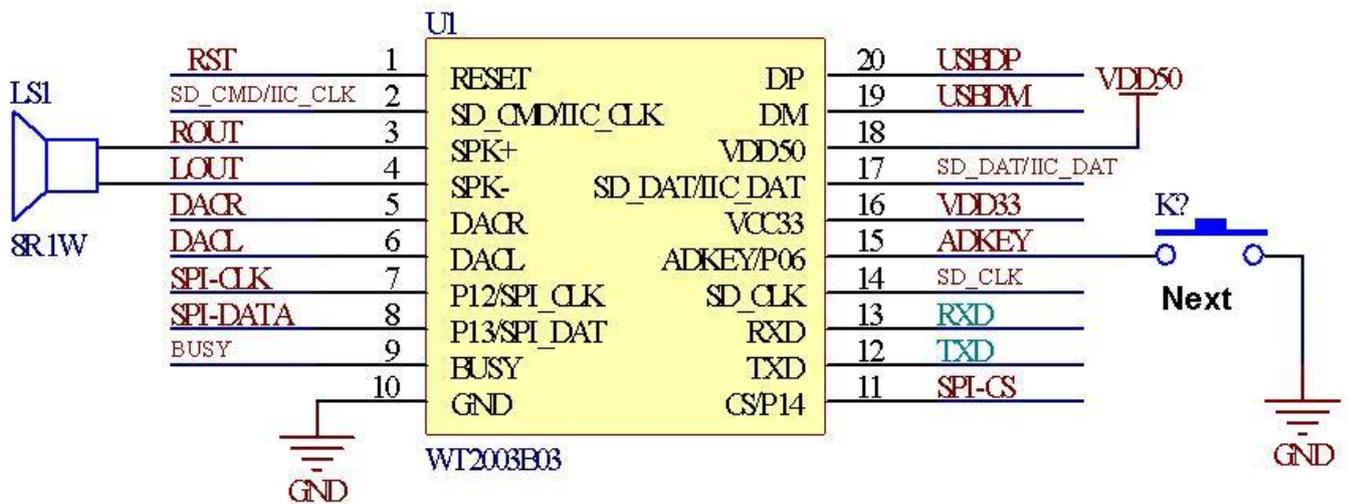
First is use shortcut key "Ctrl+C" and "Ctrl+V". But note that the mouse can not click on any of the files selected to be sent, otherwise it will start sending the file that mouse click on. This would upset file order.

Second is sorting file orderly. select the files to be sent and right click on the first file (for example, 0001 Ode to the motherland. MP3), in the right-click menu select to send to the root directory of SD Card. (Note that what the right click on is the first file to send; the system will begin with this file to send.)

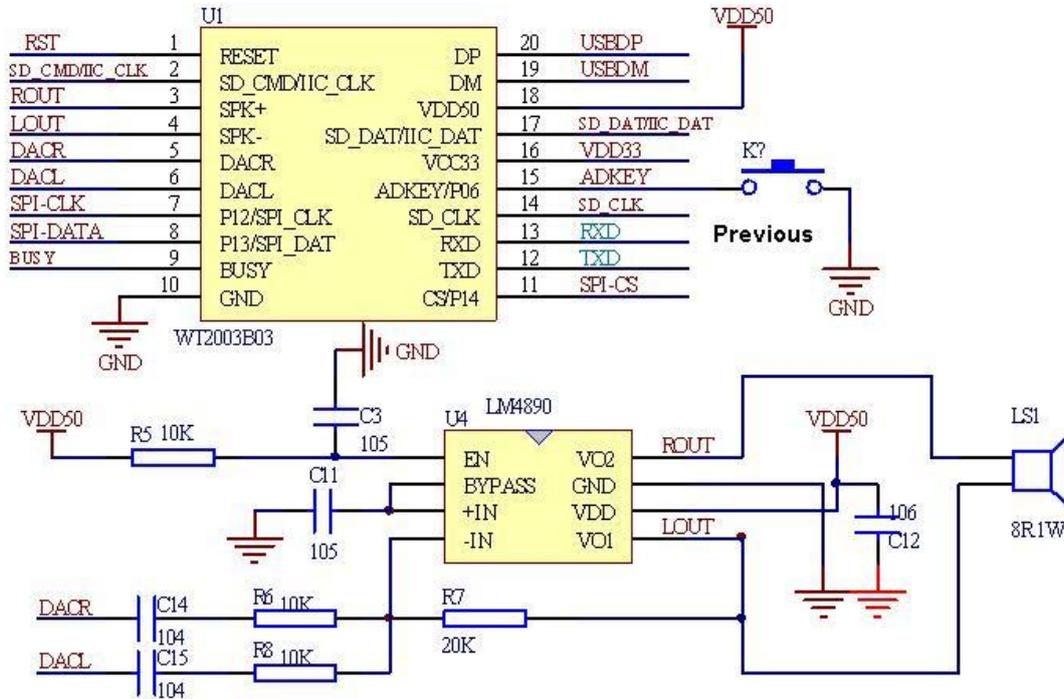


7. Application circuit

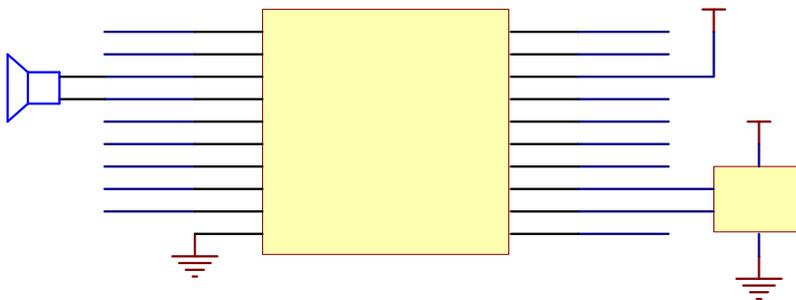
7.1 WT2003 B03minimum circuit



7.4 Reference circuit of WT2003 B03 with external amplifier



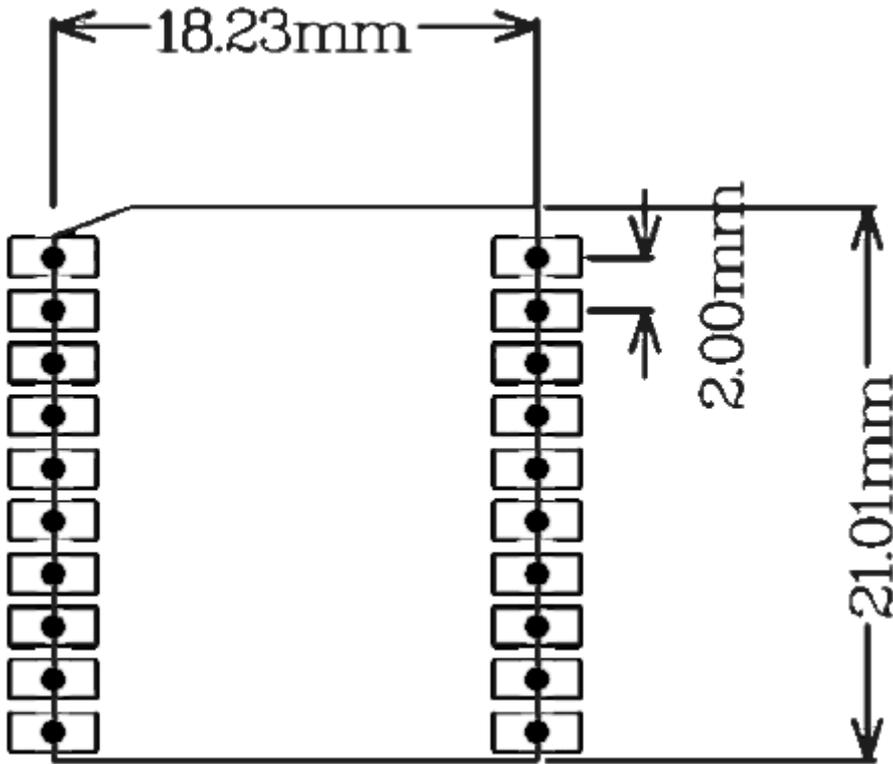
7.5 Reference circuit of WT2003 B03 with single chip



Remark: voice chip I/O port is 3.3V.

8. Dimension

WT2003 B03



9. History version

Version	Modified date	Description
V1.00	2016-01-06	Original version