

WT2003S-16S Chip

V1.03

2017-01-17

Note:

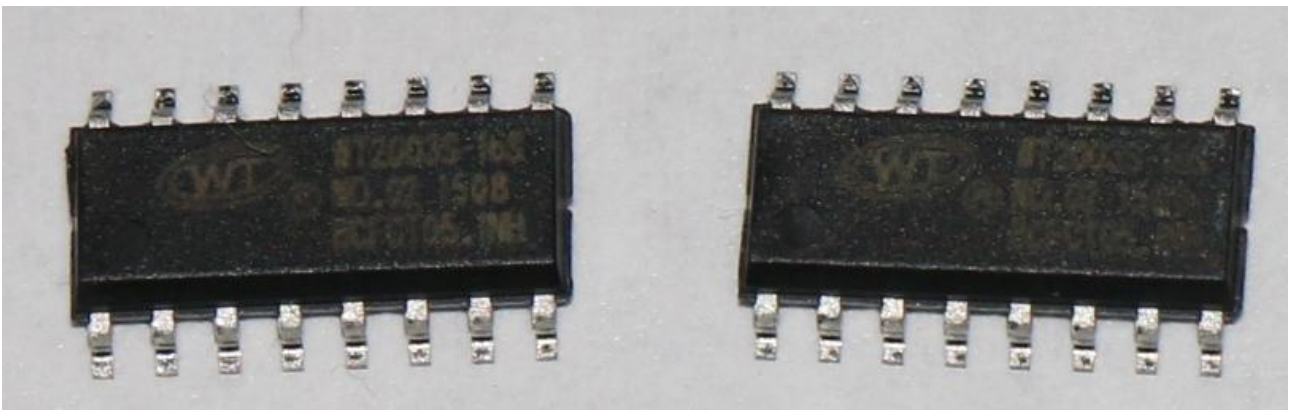
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WT2003S-16S Chip

Brief introduction

WT2003S-16S is a kind of new MP3 chip with powerful function and high quality, satisfying customer's needs from many aspects. Support standard asynchronous serial communication. Baud rate is 9600, flexible control method. Also support SPI-Flash as memory. It has many play modes: file index play, inter-cut play, single loop play and loop playback. 32 levels volume is adjustable. Stereo sound output. Mass memory, supporting 128M Flash drive maximally.





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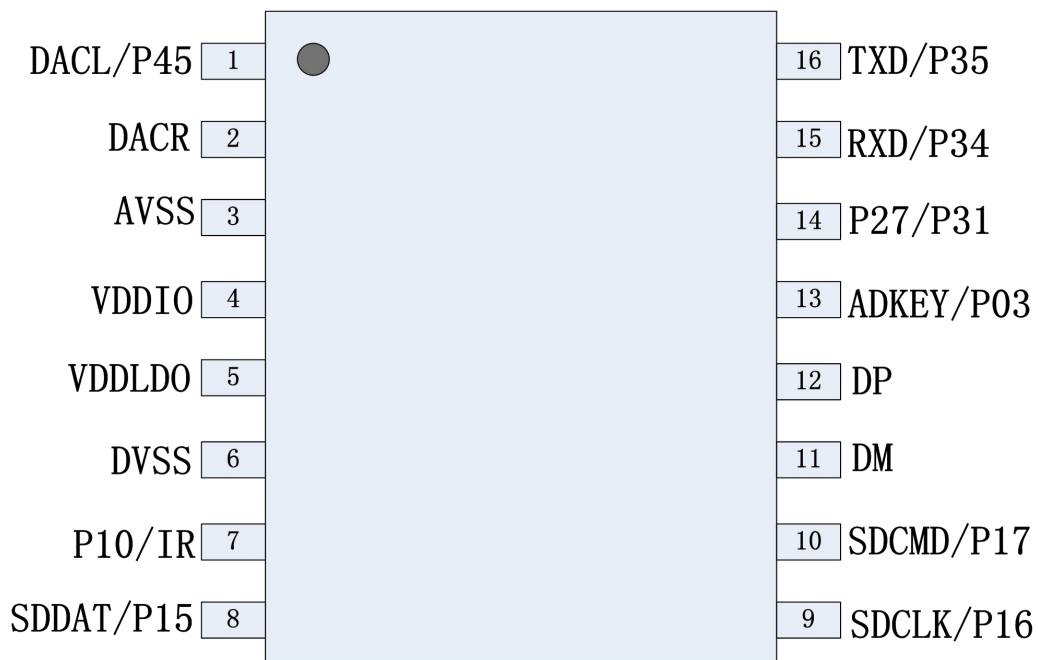
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1. Part 1

1.1. Chip Features

- Built in 48MHZ crystal oscillator
- Support MP3 audio decoding
- Built in watchdog
- Four multifunctional 16 bits timer
- One full-duplex standard UART serial interface
- Infrared remote control decoder
- SD card interface
- Support full-speed USB2.0
- Common I/O port can develop many kinds of customized functions

1.2. Chip I/O port



WT2003S-16S



1	DACL/P45	AO	Audio DAC left channel output/ P45 common I/O port
2	DACR	AO	Audio DAC right channel output
3	AVSS	AO	Ground
4	VDDIO	IO	3.3V output port
5	VDDLDO	IO	5V main power input port
6	DVSS	I	Ground
7	P10/IR	I	P10 common I/O port/ infrared remote control decoder
8	SDDAT/P15	I/O	DAT interface of SD card/ P15 common I/O port
9	SDCLK/P16	I/O	CLK interface of SD card/ P16 common I/O port
10	SDCMD/P17	I/O	CMD interface of SD card/ P17 common I/O port
11	DM	O	USB data port
12	DP	I	USB data port
13	ADKEY/P03	I	Key extended interface/ P03 common I/O port
14	P27/P31	I	P27 common I/O port/ P31 common I/O port
15	RXD/P34	I	UART serial port RXD receive/ P34 common I/O port
16	TXD/P35	PWP	UART serial port TXD send/ P35 common I/O port

Remark: Chip only has one VDDLDO power input port.

The pin introduction above is just about some hardware interfaces. For the detailed functions, need software development.

1.3. Specifications

Name	Function
Audio format	Support sampling rate 8~48KHz, bit rate 8~128Kbps MP3 audio file(FLASH supports) Support sampling rate 8~48KHz, bit rate 8~320Kbps MP3 audio file(Micro SD card and U disk support) Support sample rate 8~44.1KHz WAV audio file
Storage capacity	Support 4Mbit~128Mbit SPI-FLASH Maximally support 32GB Micro SD card Maximally support 32GB U disk Support file system: FAT16, FAT32 (not support NTFS)
USB interface	Full speed 2.0
Supply voltage	DC3.0~5.5V
IO port electric level	3.3V TTL electric level
Working temperature	-40~85 °C
Humidity	5%~95%



1.4. Electric Parameter

Name	Mark	Condition	Mini. value	Typical value	Max. value	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	Non-loaded	-	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 maximum output voltage swing	10K ohm load	-	-	2.8	V
Ps1	Standby power consumption (with micro SD card)	Related to the micro SD card power consumption	-	27.6	-	Ma
P	Playing power consumption (no load)	Related to the micro SD card power consumption	-	28.7	-	Ma
VPPLINE	External audio input swing		-	-	2.8	V

1.5. Function development for reference

If the following standard function can not meet your needs, we can develop some of customized functions. For customized function development, please list out the required functions, and send to us. The following are some common functions.

1. Increase the number of keys and the corresponding key functions. For example, increase 3 keys one-to-one function, increase cycle key, etc..
2. Change the default control mode. For example, chip start loop playback with power on.
3. Increase the status of LED light. For example, add 2 LED lights; when playing the first voice, the first light will be on; when playing the second voice, the second light will be on.
4. Add some commands. For example, add the delete command or formatting instructions.

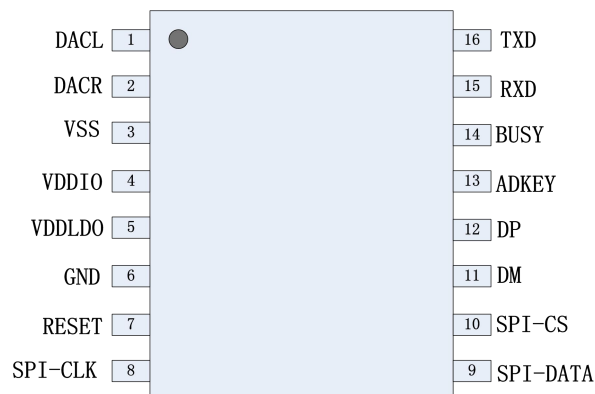
2. Part 2 Simulated U Disk version

This part mainly introduces current simulated U disk features.

2.1. Simulated U Disk version features

- Support SPI-FLASH, not support micro SD card.
- Standard UART communication interface. Can achieve special address play, special inter-cut address play, volume levels, next/ previous, play/ pause, cycle model, etc.
- Default bit rate is 9600.
- Not play by default with power on.
- BUSY status indication, high level when playing.
- Available to connect computer via USB interface. Download the audio of computer into FLASH simulated removable drive(simulated U disk) through USB interface (XP system, WIN7 system, WIN8 system).
- Support mp3 audio format, 8KBPS~128KBPS.
- SPI-FLASH support 128M maximally.
- DAC double channels output.
- 32 levels volume.

2.2. Pin introduction



WT2003S-16S

Pin No.	Pin name	Type	Function description
1	DACL	PWP	Audio DAC left channel output
2	DACR	AO	Audio DAC right channel output
3	VSS	AO	Ground
4	VDDIO	IO	3.3V output port
5	VDDLDO	IO	5V main power input port



6	GND	I	Ground
7	RESET	I	RESET pull down to release SPI-FLASH
8	SPI-CLK	I/O	SPI communication port CLK
9	SPI-DATA	I/O	SPI communication port DATA
10	SPI-CS	I/O	SPI communication port CS
11	DM	O	USB data port
12	DP	I	USB data port
13	ADKEY	I	Key extended port
14	BUSY	I	BUSY signal(status indicator light)
15	RXD	I	UART serial port RXD receive
16	TXD	PWP	UART serial port TXD send

Note: Power output port VDDIO can not supply power for external device, only for connection with pull-up resistor and other low power consumption device.

2.3. Function introduction

2.3.1. Key control mode

Key	Operation	Function and operation
K1	Short press	Play/pause
K2	Short press	Choose the next file
K3	Short press	Choose the previous file
K4	Short press	Stop

2.3.2. UART control protocol

2.3.3. Protocol command format

WT2003S is built in standard UART asynchronous serial interface, belonging to 3.3V TTL level interface that can be converted to RS232 level through MAX3232 chip.

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



Serial port :	COM1	▼
Baud rate :	9600	▼
Check bit :	None	▼
Stop bit :	8	▼
Data bit :	1	▼
	<input checked="" type="radio"/>	Send in Hex format
	<input type="radio"/>	Send in Chars format

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

Note: "Length" (number of bytes) = length (1 byte) + command code (several bytes) + parameters (several bytes) + check sum (1 byte);

Cumulative sum check means the low byte of the cumulative summation of "length + command code + parameter".

Communication Control Command

CMD	Corresponding Function	Parameters
A0	Specify SPI-FLASH index play.	File index
A1	Specify SPI-FLASH root directory file-name play	File name
AA	Play/Pause command	None
AB	Stop command	None
AC	Next audio command	None
AD	Previous audio command	None
AE	Volume control command	Volume levels
AF	Specify play mode	Loop mode
B1	Inter-cut play	Track information
B2	Specify EQ format	EQ format
BA	Set whether need to return code	BA XX

Communication Check Command

CMD	Corresponding Function	Parameters
C1	Query the current volume settings	C1 XX
C2	Query the current working status	C2 XX
C3	Query the total number of music files in SPI Flash	C3 XXXX



C9	Query the file track number currently playing	C9 XXXX
CA	Query current external device connection status	CA XX
CB	Query the song name currently playing	CB XX (8 bytes)

2.3.4. Write operation command

2.3.4.1. Return code format

Operation code
XX

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, no such file;

If FLASH does not exist, or FLASH data abnormal, it will return '05'.

2.3.4.2. Specify SPI file index play (A0)

This command can make specified operation for SPI Flash file. 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	A0	00	01	XX	EF

Note: If the specified track does not exist, it will not influence the current play.

File index sequence is according to the file copy sequence of copying into SPI.

2.3.4.3. Specify SPI root directory file name play (A1)

This command can make specified operation of file name play in SPI root directory(file name 8 characters at most).

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



“54, 30, 30, 32” are ASCII codes of T002. Only file names are in the form of ASCII code while other data is Hexadecimal; above commands mean T002XXX.mp3 audio file playing in the specified root directory; only corresponding to the first 4 bits is OK. If there are 2 audios and the front 4 audio are the same, it will not play to send this command.

2.3.4.4. Play/Pause command(AA)

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

Under playing state, sending this command will pause, while under pause state, it will play music from the pause.

2.3.4.5. 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.

2.3.4.6. 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.

2.3.4.7. 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.

2.3.4.8. Volume control command(AE)

There are 32 volume levels in total, from 00 to 31. 00 is mute; 31 is full volume.

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

It sends the maximum volume 31 level in this example. This command is available to adjust volume in real time.

2.3.4.9. Specified play mode (AF)

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

2.3.4.10. Inter-cut play command (B1)

Start code	Length	Command	Mark word	High order of track	Low order of track	Check code	End code
7E	06	B1	00	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. After finishing the first inter-cut play, waiting 50ms, then it can have the next inter-cut play. Support inter-cut play between the same devices or different devices.

Mark Word: →00 stands for inter-cut specified index address in SPI-FLASH

2.3.4.11. Specified EQ mode(B2)

Start code	Length	Command	Parameters	Check code	End code
7E	04	B2	00: Normal	B6	EF
			01: Pop	B7	
			02: Rock	B8	
			03: Jazz	B9	
			04: Classic	BA	
			05: Base	BB	

2.3.4.12. Specify whether need to return code after playing ends(BA)

Start code	Length	Command	Parameter	Check code	End code
7E	04	BA	00: no need to return information (default)	BE	EF
			01: need to return information	BF	

This command will decide whether need to return information after finishing every audio playing, to show the current song position. Return format: BA XX XX (return the index position, 2-byte data. If the song is in the folder, the song will be returned to the index position in the folder).

2.3.4.13. Query the 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)

2.3.4.14. Query the current operation 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: stop 03:pause

2.3.4.15. 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

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

2.3.4.16. Query the file track currently 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

2.3.4.17. Query 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, WT2003S will automatically return information to 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 nonexistence.

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).

2.3.4.18. Query the song name of the current play(CB)

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



Return format

Operation code	Return value
0XCB	XX(8bytes)

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.

2.3.5.Active feedback code

2.3.5.1. External storage connection status

Operation code	Return value
0XCA	XX

When insert or remove U disk, WT2003S 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 nonexistence.

For example:

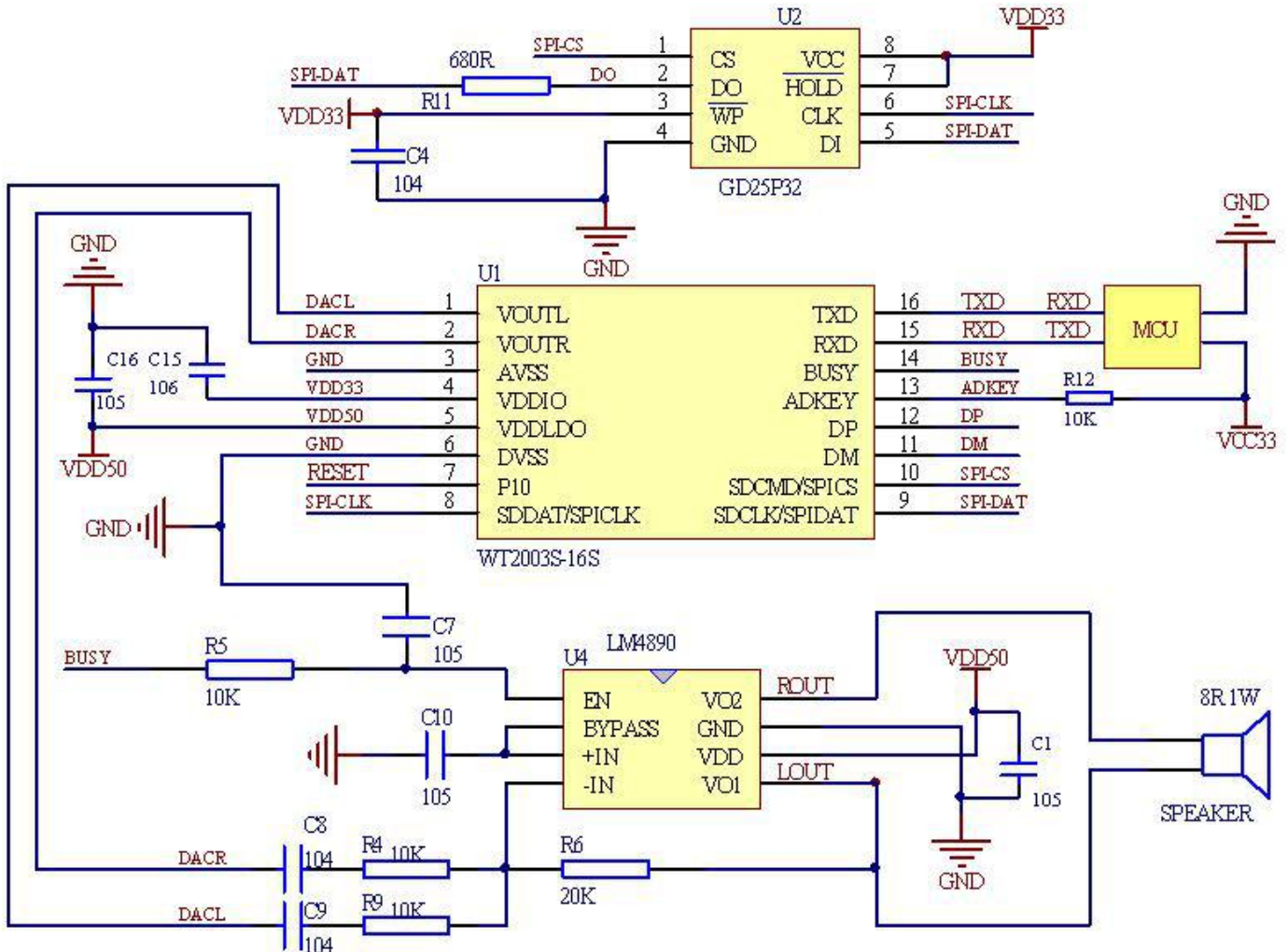
0x01: without PC connection (BIT3=0), without U disk (BIT2=0), without SD card (BIT1=0), with SPI-FLASH (BIT0=1).

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

This version does not support SD card, so the second bit is 0.

2.4. Reference circuit

2.4.1. Stimulated U disk version smallest system circuit (include amplifier circuit)



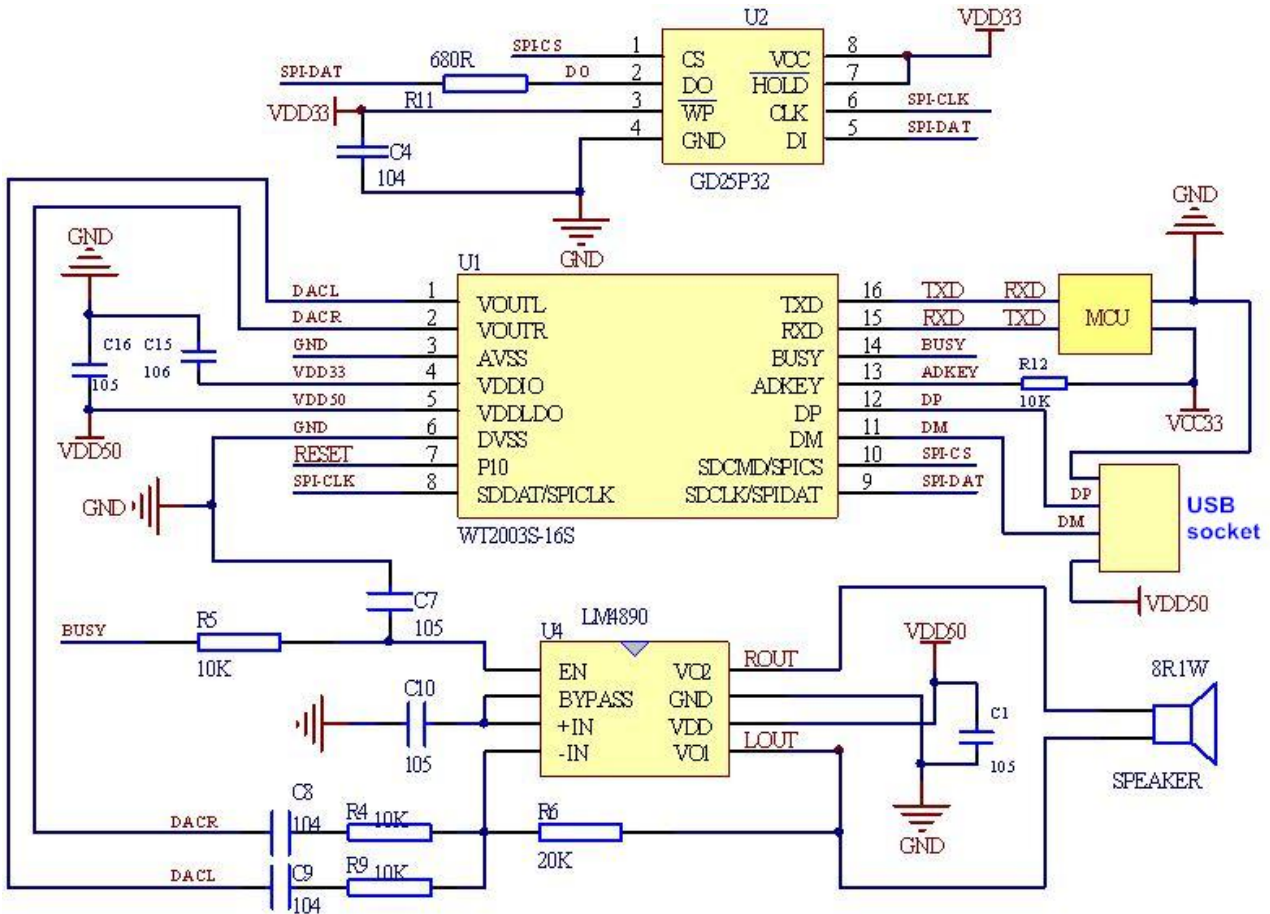
Remark: 1. VDDLDO is the only power input pin, input voltage 2.8V-5.5V.

2. VDDIO is the chip internal LDO output 3.3V, available to supply power for those with low power consumption, such as SPI, SD card, single chip pull-up, etc..

3. I/O port of chip is 3.3V. 5V single chip microcomputer communication. If there need to be communication between 5V single chip and WT2003S-16S, 470R resistance can be used to reduce voltage.

4. The ADK pin of chip has to connect to a 10k pull-up resistor, the power of chip needs to connect to a capacitance for output/ input to the ground.

2.4.2. USB connection circuit



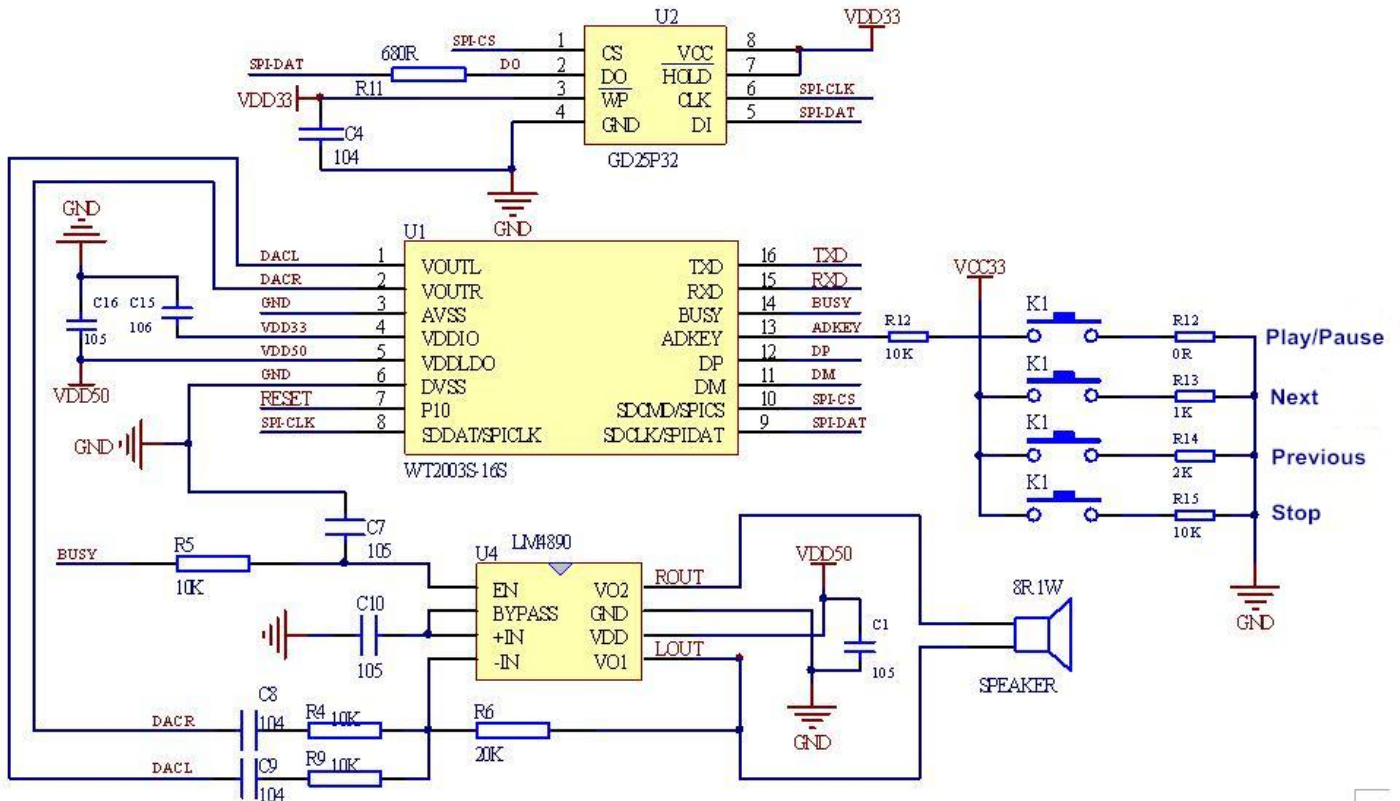
Remark: 1. VDDLDO is the only power input pin, input voltage 2.8V-5.5V.

2. VDDIO is the chip internal LDO output 3.3V, available to supply power for those with low power consumption, such as SPI, SD card, single chip pull-up etc..

3. I/O port of chip is 3.3V. 5V single chip microcomputer communication. If there need to be communication between 5V single chip and WT2003S-16S, 470R resistance can be used to reduce voltage.

4. The ADK pin of chip has to connect to a 10k pull-up resistor, the power of chip needs to connect to a capacitance for output/ input to the ground.

2.4.3. Key control circuit



Remark: 1. VDDLDO is the only power input pin, input voltage 2.8V-5.5V.

2. VDDIO is the chip internal LDO output 3.3V, available to supply power for those with low power consumption, such as SPI, SD card, single chip pull-up etc..

3. I/O port of chip is 3.3V. 5V single chip microcomputer communication. If there need to be communication between 5V single chip and WT2003S-16S, 470R resistance can be used to reduce voltage.

4. The ADK pin of chip has to connect to a 10k pull-up resistor, the power of chip needs to connect to a capacitance for output/ input to the ground.

2.5. Audio file sorting

Can connect to the computer through USB. There will be a removable drive on computer. First, format the drive into FAT or FAT32 system.

WT2003S audio file is sorted by the file index. It is sorted by the sequential order that the file was put into the reservoir instead of the file name. So when WT2003S is playing file in index, the sort order is not related to the file name.

For the file sorting of Windows system is sorted by file name usually. Thus, we suggest naming files in number + file name (for example, 0001 Ode to the Motherland. mp3, 0002 Story of Spring. mp3). It is

convenient for Windows system to sort. You can copy all the files to the root of reservoir after naming all the audio files and arranging in good order.

There are two common copying methods:

First is to 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 the right click is to send the first file; the system will begin with this file to send.)



3. Part 3 Micro SD card version

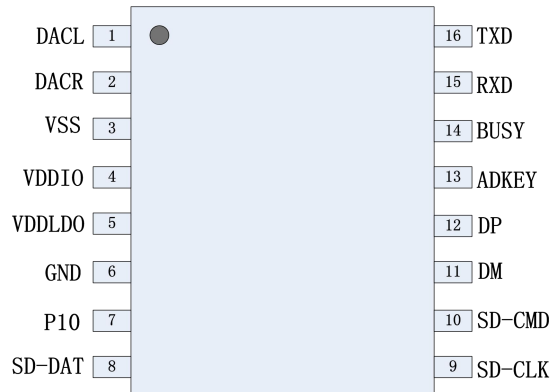
This part mainly introduces current micro SD card function about this chip.

3.1. Micro SD card version features

- Support MP3 audio file, 8KBPS~320KBPS, beautiful voice.
- Support sample rate 8~44.1KHz WAV audio file.
- Micro SD card or U disk as storage; change audio files freely, maximally support 32G micro SD card and 32G U disk.
- Available to freely change the audio files of SD card through USB interface (XP system, WIN7 system, WIN8 system).
- Simultaneously support key control and UART serial communication, universal standard interface protocol, more flexible to control.
- Support inter-cut play between different memories.

- Support combination play.
- Support index in folder and specify file name to play.
- 32 levels volume. DAC double channel output.
- DC 5V power supply.

3.2. SD card version pin introduction



WT2003S-16S

Pin No.	Pin name	Type	Function description
1	DACL	PWP	Audio DAC left channel output
2	DACR	AO	Audio DAC right channel output
3	VSS	AO	Ground
4	VDDIO	IO	3.3V output port
5	VDDLDO	IO	Chip main power input port(3.0~5.5V)
6	GND	I	Ground
7	P10	I	Can be used to control amplifier enable, low level when not playing, high level when playing
8	SD-DAT	I/O	DATA interface of SD card
9	SD-CLK	I/O	CLK interface of SD card
10	SD-CMD	I/O	CMD interface of SD card
11	DM	O	USB data port
12	DP	I	USB data port
13	ADKEY	I	Key extended port
14	BUSY	I	BUSY signal (low level when not playing, high level when playing)
15	RXD	I	UART serial port RXD receive
16	TXD	PWP	UART serial port TXD send

3.3. Control mode

3.3.1. Key control

Key	Corresponding resistor	Function and operation
K1	0R	short press, play/pause
K2	1K	Short press, next audio
K3	2K	Short press, previous audio
K4	3.3K	Short press, volume up
K5	5.1K	Short press, volume down
K6	10K	Short press, stop playing

3.4. Serial port control

3.4.1. Protocol command format

WT2003S is built in standard UART asynchronous serial interface, which belongs to 3.3V TTL electric level interface and can be converted to RS232 level through MAX3232 chip.

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



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

Note: “Length” (number of bytes)= length (1 byte) +command code (several bytes) + parameter (several bytes) + check sum (1 byte);

Cumulative sum check means the low byte of the cumulative summation of “length+ command code+ parameter”.

3.4.2.Command list

Communication control command

CMD	Corresponding function	Parameters
A2	Specify SD card root directory index play	File index
A3	Specify SD card file name play	File name
A4	Specify file index play in SD card folder	Folder name, file index
A5	Specify file name play in SD card folder	Folder, file name
A6	Specify U disk root directory index play	File index
A7	Specify U disk file name play	File name
A8	Specify file index play in U disk folder	Folder name, file index
A9	Specify file name play in U disk folder	Folder, file name
AA	Pause command	None
AB	Stop command	None
AC	Next command	None
AD	Previous command	None
AE	Volume control command	Volume levels
AF	Specified play mode	Cycle mode
B0	Combination play	File index
B1	Inter-cut play command	Working drive, file index
B2	Specified EQ mode	EQ mode
BA	Whether need to return code	BA XX
D2	Switch current working drive	working drive

Communication query command

CMD	Corresponding function	Parameters
C1	Query the current volume setting	C1 XX
C2	Query the current operation state	C2 XX
C5	Query the total number of music files in SD card	C5 XXXXX
C6	Query the total number of music files in specified SD card folder	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 U disk folder	C8 XXXX
C9	Query the file track currently playing	C9 XXXX
CA	Query current external connection status	CA XX
CB	Query the song name currently playing	CB XX XX(only support SD card and U disk)

3.4.3. Write operation command

3.4.3.1. Return code format of write operation command

Operation code
XX

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 mean EMP, no such file;

Remark: If no micro SD card data or micro SD card circuit abnormal or SD card data abnormal, it will return one '05' to send command.



3.4.3.2. Specify SD card file index play(A2)

This command can specify to play the audio file in the SD card, influenced by the file storage order, sorting files 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 the specified track does not exist, it will not influence the current play.

3.4.3.3. Specify SD card file name play(A3)

This command can specify file-name play under the root directory of SD card. (The file name supports 8 characters at most.)

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

"54, 30, 30, 32" are ASCII codes of T002. Only file names are in the form of ASCII code while other data is Hexadecimal; above commands mean T002XXX.mp3 audio file playing in the specified root directory; only corresponding to the first 4 bits is OK.

3.4.3.4. Index play in the specified SD card folder (A4)

This command can play by file index under the specified root directory (folder name is fixed 5 characters).

Start code	Length	Command	Folder name(from high to low)					File index(from high to low)		Check code	End code
7E	0A	A4	'M'	'U'	'S'	'I'	'C'	00	01	XX	EF

Only folder name are in the form of ASCII code while other data is Hexadecimal; above commands mean the second audio play (index number is 0001) in the MUSIC folder under the specified root directory.

3.4.3.5. Index play in the specified U disk root directory (A6)

This command can specify to play the audio file of U disk, influenced by the file order, sorting files 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 the specified track does not exist, it will not influence the current play.



3.4.3.6. File name play in the specified U disk (A7)

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

“54, 30, 30, 32” are ASCII codes of T002, and only file names are in the form of ASCII code while other data is hexadecimal; above commands mean T002XXX.mp3 audio play under the specified root directory; only corresponding to the first 4 bits is OK.

3.4.3.7. File index play in the specified U disk folder (A8)

This command can play by file index under the specified root directory(folder name is fixed 5 characters)

Start code	Length	Command	Folder name(from high to low)					Folder name(from high to low)		Check code	End code
7E	0A	A8	'M'	'U'	'S'	'I'	'C'	00	01	XX	EF

Only file names are in the form of ASCII code; above commands mean the first audio play (index number is 0001) in the MUSIC folder under the specified root directory.

3.4.3.8. Play/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 under pause state, it will play music from the pause.

3.4.3.9. 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.

3.4.3.10. 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.

3.4.3.11. 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.

3.4.3.12. 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

It sends the maximum volume 31 level in this example. It is available to adjust volume in real time.

3.4.3.13. Specified play mode (AF)

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

3.4.3.14. Combination Play Command (B0)

This command can specify to continue playing some files in current directory. This command is only used for index play.

Start Code	Length	Command	Mark Word	Check Code	End Code
7E	04	B0	01	XX	EF

Start Code	Length	Command	High order of audio	Low order of audio	Check Code	End Code
7E	05	B0	00	01	XX	EF

Start Code	Length	Command	Mark Word	Check Code	End Code
7E	04	B0	FF	XX	EF



Combination play means that continue sending 10 or less music group code to WT200S-16S. WT2003S-16S plays audio in turn, according to the sequence of receiving code. The difference from directly sending file name to control music play is that before finishing playing music, send the next code, it will not be interrupted. After receiving command, it will do FIFO processing.

For example: When WT2003S-16S continues receiving seven groups of data "7E 04 B0 01 B5 EF", "7E 05 B0 00 01 B6 EF", "7E 05 B0 00 02 B7 EF", "7E 05 B0 00 03 B8 EF", "7E 05 B0 00 04 B9 EF", "7E 05 B0 00 05 BA EF", "7E 04 B0 FF B3 EF", it will specify to play the first, second, third, fourth, fifth audio file in SD card. 7E 04 B0 01 B5 EF is start code, 7E 04 B0 FF B3 EF is end code.

Note:

1. Before combination play, if want to play file in other storage, you must first send specified storage play command (that is, mark word of start code), then send the latter audio command to realize combination play or directly switch mode.

Mark word: →00 stands for inserting the specified index address in SPI-FLASH.

→01 stands for inserting the specified index address in SD card.

→02 stands for inserting the specified index address in U disk.

2. For continuous combination play, support 10 groups at most. During playing, if there is new play command, it will be interrupted and execute new command.

Note:

1. Timeout judgment: for example: if only send the code 7E 04 B0 01 XX EF, after code receiving is finished, start timing; if timekeeping over 3s with no response, need to delete relative information.
2. After sending 7E 04 B0 01 XX EF, if receiving 7E 06 B0 01 00 01 XX EF and other command, delete the recorded time and re-timing again until exceeding 10 groups, or receiving the end code or waiting more than 3s. If start code and address code are received, but end code is not received, after overtime or over 10 commands, it will directly start to play audio according the command. In other words, if the address code of combination play has been sent, even the timer expires, it will not directly empty out all, but start to play the received data.
3. During combination playing, sending other command will interrupt the play.

3.4.3.15. Inter-cut play 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. After finishing the first inter-cut play, waiting 50ms, then it can have the next inter-cut play.

Support inter-cut play between the same devices or different devices.



Mark Word:

00 stands for inter-cut specified index address in SPI-FLASH

01 stands for inter-cut specified index address in SD card

02 stands for inter-cut specified index address in U disk

Note: Only support inter-cut function when playing audio files in SD card or U disk, support inter-cut play between several devices. When playing in Flash, not support inter-cut, return to 02.

After inter-cut audio play is finished, BUSY will have a low pulse 50MS.

3.4.3.16. Switch the current work drive letter (D2)

Start code	Length	Command	Parameter	Check code	End code
7E	04	D2	01: SD card(default)	D7	EF
			02: U disk	D8	

3.4.4. Reading operation command

3.4.4.1. Read the 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)

3.4.4.2. Read the current operation 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: stop 03:pause

3.4.4.3. 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

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

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

Start code	Length	Command	Folder Name (from high to 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 such folder)

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

3.4.4.5. 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

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

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

Start code	Length	Command	Folder name(from high to 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 file in "MUSIC" file of root directory.

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

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

3.4.4.7. Query the file track currently 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

3.4.4.8. Query 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 information 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 nonexistence.

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).

3.4.4.9. Query the song name of the current play(CB)

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

Return format

Operation code	Return value
0XCB	XX(8bytes)

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.

3.4.5.Attention

- ◇ The interval time of sending command should not be less than 300ms.
- ◇ After sending control command, ensure the command execution by checking the return code to make sure whether it is executed correctly.

3.5. Audio file sorting

WT2003S audio file index sort is according to the audio file sort order stored to micro SD card instead of the file name order. So when WT20003S is playing file in index, the sort sequence is not related to the file name.

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 micro SD card or U disk. (If you want to download to SPI, you can first copy to micro SD card or U disk, and then send commands or copy to SPI by pressing copying keys.)

Two common copying methods:

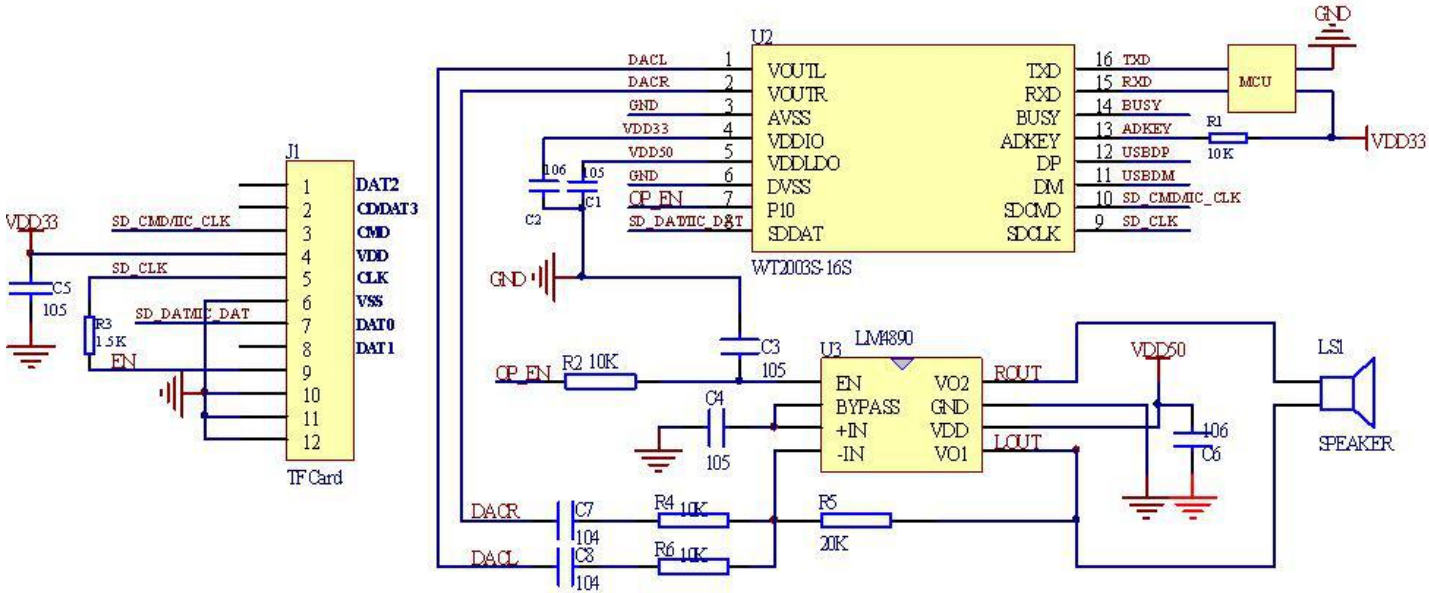
First is to use shortcut key"Ctrl+C" and "Ctrl+V". But note that the mouse can not click on any of the files selected to be sent, otherwise it will start sending the file that mouse click on. This would upset file order.

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 the right click is the first file to send; the system will begin with this file to send.)



3.6. Reference circuit

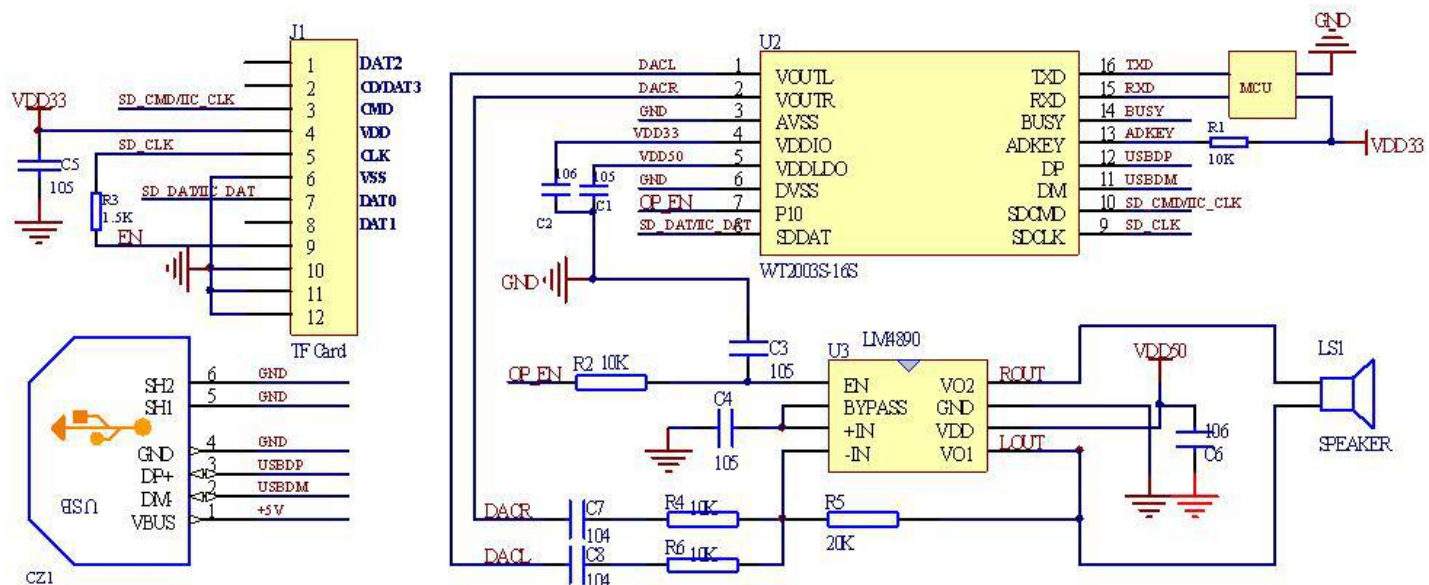
3.6.1. Micro SD card version smallest system circuit(include amplifier)



Remark:

1. WT2003S-16S chip has no internal amplifier. DACR and DACL can directly connect earphone for output. If you want to connect speaker, need connect the corresponding amplifier chip.
2. I/O port of WT2003S-16S chip I/O: 3.3V.

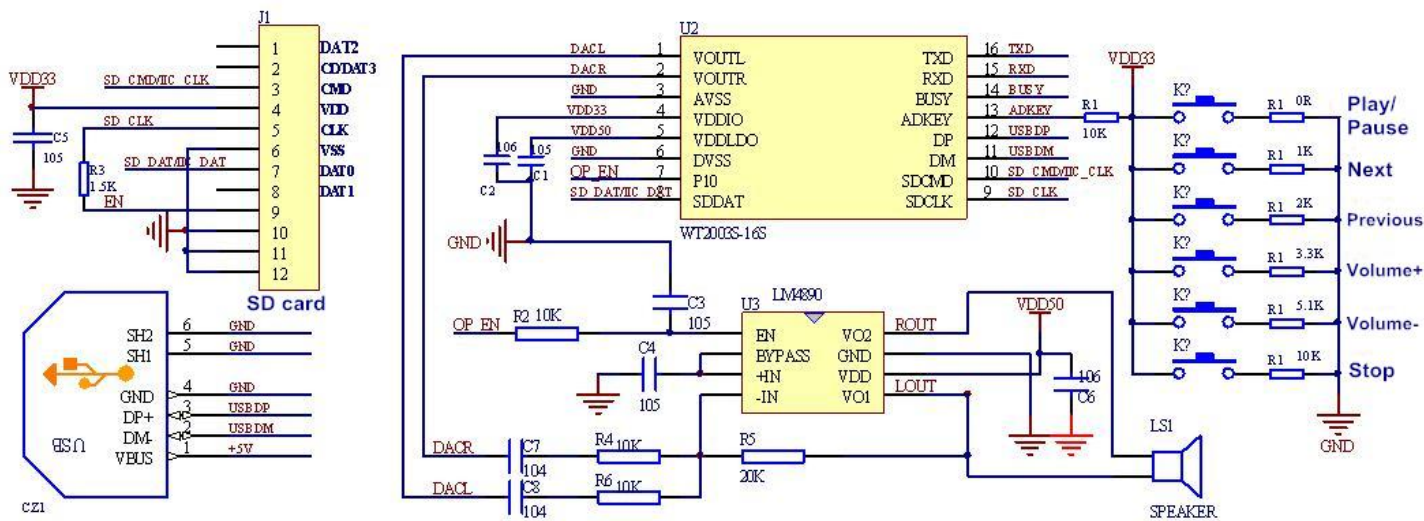
3.6.2. USB socket connection circuit



Remark:

1. WT2003S-16S chip has no internal amplifier. DACR and DACL can directly connect earphone for output. If you want to connect speaker, need connect the corresponding amplifier chip.
2. I/O port of WT2003S-16S chip I/O: 3.3V, the ADK pin of chip has to connect to a 10k pull-up resistor, the power of chip needs to connect to a capacitance for output/ input to the ground.

3.6.3.Key circuit

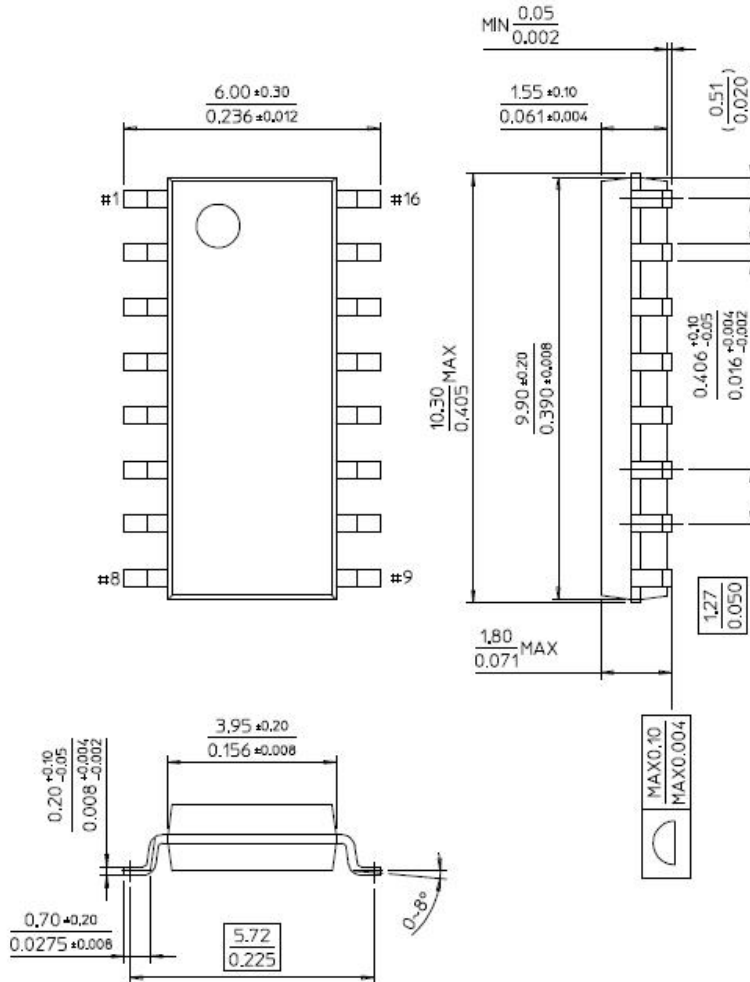


Remark:

1. WT2003S-16S chip has no internal amplifier. DACR and DACL can directly connect earphone for output. If you want to connect speaker, need connect the corresponding amplifier chip.
2. I/O port of WT2003S-16S chip I/O: 3.3V, the ADK pin of chip has to connect to a 10k pull-up resistor, the power of chip needs to connect to a capacitance for output/ input to the ground.

4. Chip package dimension

Unit: mm



5. History version

Version	Modification date	Description
V1.00	2016-01-09	Original version
V1.01	2016-2-19	Modify some incorrect description
V1.02	2016-10-17	Modify some equivocal description of ADK pin
V1.03	2016-01-17	Modify company address



Shenzhen Waytronic Electronics Co., Ltd. (previously named Guangzhou Waytronic Electronics Co., Ltd.)-founded in 1999, is a high-tech company specializing in voice technology research, audio product design & control and other software & hardware design. Business scope relates to telephone recording of automotive electronics, multimedia, home security, communications, household appliances, medical equipment, industrial automation control, toys, interactive consumer products and other fields. With excellent IC software and hardware development capability and design experience, Waytronic upholds the concept of "Positive innovation, Courage to open up, Customer satisfaction, Teamwork ", and strives to build the leading brands in voice industry.

Our company is a excellent voice chip manufacturer, engaged in the research and development of voice chip and peripheral circuit. At the same time, we formulate voice product development plans for the customers with special needs, carry out the plans effectively, and complete product development, testing, sound processing, and the practical application guidance and other services. After developing for many years, our company has formed a completely new product procedure system, with the ability to quickly develop new products and improve the products. Voice chip has a series of WT2000, WT2003, WT5001, WT588D, WTH, WTV, WTN, etc., each with our pursuit of perfect and continuous development and improvement, in order to make better quality and better practical value of voice IC. The human design of product, module, editing software, enables customers to use more conveniently. In 2006 Beijing Waytronic Hongtai branch company was established, mainly with the purpose of selling complete program and mature products, to provide better service for the domestic northern customer.

Not only that, a variety of voice modules are also introduced, such as WT2000 recording module, closer to the needs of customers through the expansion of the external circuit.

Our company is also a manufacturer of MP3 chip development. With the expansion of the company's external technology, in 2004 we began to produce MP3 chip, and provide MP3 programs. We have got high popularity in the same industry, worked out 8 MP3 solutions until now (2014-4), and widely recognized by the market. The WT2000, WT2003 and other chips have been continuously accepted and used by customers for the good sound quality and excellent performance.

In regard of audio player, we are engaged in manufacturing audio players. After many years of technical storage, we begin to expand the field of audio player and obtain the gratifying achievement, becoming a member of the audio player manufacturers. According to the probe categories, there are ultrasonic audio player, infrared human body induction audio player and photoinduction audio player. At the same time we have developed many products in different areas: self-service banking audio player, welcome alarm, voice advertising machine, doorbell and so on. It is sure that there will be more new products to be marketed to meet the majority of customers. Let our life be more intelligent and humanized.

Head Office: Shenzhen Waytronic Electronics Co., Ltd.

Tel: +86-755-29605099

Fax: 0755-29606626

Web: www.waytronic.com

Add:4th Floor, Building No.11, COFOC (Fu'an) Robotics Industrial Park, No.90 Dayang Road, Fuyong Town, Bao'an District, Shenzhen, Guangdong, China.