QUICK START GUIDE

WT2003S-20N

V1.01
2015-12-18

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WT2003S-20N

WT2003S-20N is a kind of MP3 voice chip with powerful function and high quality, supporting MP3 audio decoding and satisfying customer's needs from many aspects. It has two play modes. One is the specified file-name play and the other is the specified index order play. It is available to build folder to classify, specify file-name play within folder or play according to the index order. It is built in SPI-FLASH, available to have external SD card and U disk.
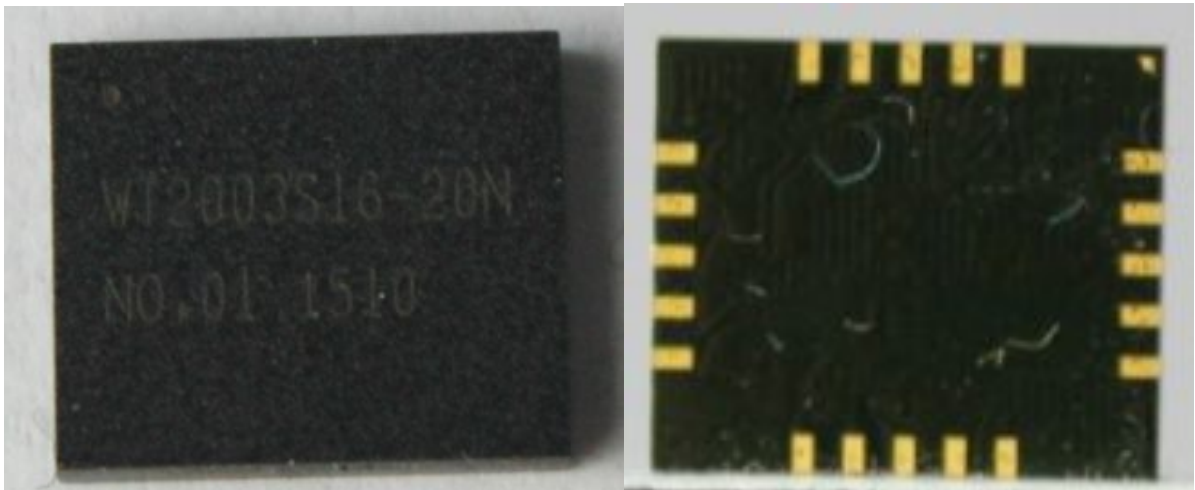
1. Features

➢ Support MP3 audio file, sample rate 8~48KHz, bit rate 8~320Kbps.

➢ SPI-FLASH, TF card or U disk as storage; change audio freely; maximum support 32G TF card and 32G U disk.

➢ SPI FLASH can store 2047 audios; WT2003S16-20N is built in 16MSPI-FLASH; WT2003S32-20N is built in 32M SPI-FLASH.

➢ Available to freely change the audio of TF card through USB interface (XP system, WIN7 system, WIN8 system).

➢ Can copy audio files to SPI-FLASH via TF card or U disk, offline audio changing.

➢ Simultaneously support key control and UART, universal standard interface protocols, more flexible to control.

➢ Support inter cut between different kinds of memory.

➢ Built in 1W amplifier, direct to drive 8ohm/1W speaker, with resonant voice and 32-level volume for option.

➢ DAC left and right channels output.

➢ DC 5V power supply.

2. Pin Description

2.1. WT2003S-20N pin introduction
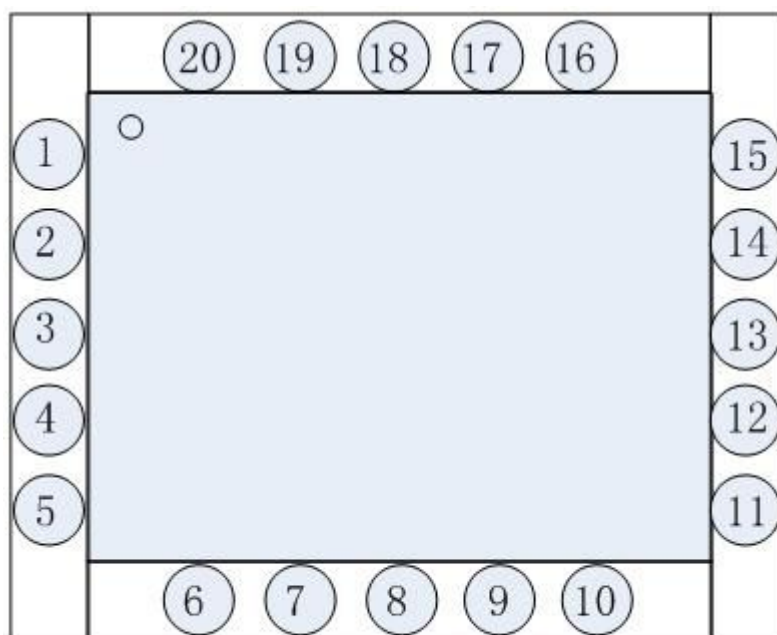
WT2003S-20N

Pin No.	Pin name	Type	Function description
1	LOUT	AO	Speaker terminal
2	ROUT	AO	Speaker terminal
3	SDDAT	I	DATA port of SD card
4	SDCLK	I/O	CLK port of SD card
5	SDCMD	I/O	CMD port of SD card
6	GND	PWP	GND
7	RST	I/O	Pull down to release FLASH
8	NC	I/O	Not used currently
9	NC	I/O	Not used currently
10	NC	I/O	Not used currently
11	VCC33	PWP	LDO 3.3V power output terminal
12	USBDM	I/O	DM data terminal of USB
13	USBDP	I/O	DP data terminal of USB
14	ADKEY/P06	I	ADKEY key connection terminal
15	BUSY	I/O	BUSY low when not playing, high when playing
16	RXD	I	UART asynchronous serial data input terminal
17	TXD	O	UART asynchronous serial data output terminal
18	DACL	IO	DAC left channel output
19	DACR	IO	DAC right channel output
20	VDD50	PWP	Module supply terminal(3.0V~5.5V)

3. Technical Specifications

Name	Function
Audio format	Support sampling rate 8~48KHz, bit rate8~320Kbps MP3 audio file
Storage capacity	WT2003S16-20N is built in 16M SPI-FLASH; WT2003S32-20N is built in 32M SPI-FLASH. Maximally support 32GB TF card Maximally support 32GB U disk Support file system: FAT16, FAT32 (not support NTFS)
USB interface	Full speed 2.0
Power supply voltage	DC3.0~5.5V
Rated current	20~250mA(related to load)
IO port electric level	3.3V TTL electric level
Dimension	1.00CM*0.85CM*0.14CM
Working temperature	-40~85 ℃
Humidity	5%~95%

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 amplitude	10K ohm load	-	-	2.8	V
Ps1	Standby power consumption (with TF card)	Related to the SD card power consumption	-	27.6	-	Ma
P	Playing power consumption (no load)	Related to the SD card power consumption	-	28.7	-	Ma

5. Control Mode

5.1. Key control

Key name	ADKEY
Function	Select the next file

5.2. Serial port control

5.2.1. Protocol command format

WT2003S-20N is built in standard UART asynchronous serial interface, which belongs to 3.3V TTL 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" = 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".

5.2.2. Command list

Communication control command

CMD	Corresponding Function	Parameter
A0	Index play in the specified SPI flash root directory	File index
A2	Index play in the specified SD card root directory	File index
A3	Specified SD card file-name play	File name
A4	File index play in the specified SD card folder	Folder name, file index
A6	Index play in the specified U disk root directory	File index
A7	File-name play in the specified U disk	File name
A8	File index play in the specified U disk folder	Folder name, file index
AA	Pause command	None
AB	Stop command	None
AC	Next command	None
AD	Previous command	None
AE	Volume control command	Volume level
AF	Specified play mode	Circulation mode
B1	Inter-cut command	Working drive letter, file index
B3	Copy audio files from SD card to SPI FLASH	None
B4	Copy audio files from U disk to SPI FLASH	None
B8	Specified user area (Config data) logging data	Address, data
BA	Whether need return code	BA XX
D2	Switch the current working drive letter	Working drive letter

Communication query command

CMD	Corresponding Function	Parameter
C1	Query the current volume setting	C1 XX
C2	Query the current working condition	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 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)
CF	Query user cache data of the specified address	CC xxxxxx

5.2.3. Write operation command

5.2.3.1. 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 mean EMP, no such file;

If SPI-FLASH exists, but neither TF card data nor U disk exist or there is data problem of TF card or U disk , it will return one "05" when power on.

If SPI-FLASH does not exist, but neither TF card data nor U disk exist or there is data problem of TF card or U disk , it will return several "05" when power on.

5.2.3.2.Index play in the specified SPI flash root directory (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.

5.2.3.3. Specified 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.

5.2.3.4. Specified 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 from 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.

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

This command can play by file index under the specified root directory (folder names are 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 first audio play (index number is 0001) in the MUSIC folder under the specified root directory.

5.2.3.6. 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.

5.2.3.7. 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.

5.2.3.8. 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.

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 under pause state, it will play 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 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.

5.2.3.14. 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 tracks loop play mode	B5	
			03:Random playing 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.

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 inter-cut play, supporting 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 of SD card or U disk, support inter-cut play between several devices. When playing in Flash, not support inter-cut, return to 02.

5.2.3.16. Copy audio files from SD card to SPI FLASH (B3)

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

Detect that copy preparatory work is OK, return to B3 53

Note: When do some copying, the indicator lamp BUSY will have high-low level fluctuation with 1Hz frequency.

✧ 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 the MP3 file copy is abnormal and config data copy is abnormal, return "03".

Returning 02 or 03 maybe because the file is too big in device, and the capacity of Flash is not enough.

5.2.3.17. Copy audio files from U disk to SPI FLASH (B4)

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

Detect that copy preparatory work is OK, return to B4 53

Note: When do some copying, the indicator lamp BUSY will have high-low level fluctuation with 1Hz frequency.

✧ 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 the MP3 file copy is abnormal and config data copy is abnormal, return "03".

Returning 02 or 03 maybe because the file is too big in device, and the capacity of Flash is not enough.

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

Logging data to the specified address (0000H-0100H), which are 512 addresses in total, can store 28 bytes at most each time.

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

Check code: data will be accumulated (hexadecimal), from the start address to the low-byte data of the total sum in data area. For example, the above command 0X09 + 0XB8 + 0X00 + 0X00 + 0XF1 + 0XE2 + 0XD3 + 0X04 = 0X036B. Thus, check code is 0X6B.

Above commands mean that through WT2003S users write data 0XF1, 0XE2, 0XD3 and 0X04 into the SPI-FLASH address 0000H, 0001H, 0002H, 0003H.

5.2.3.19. Switch the current working drive letter(D2)

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

5.2.4.   Reading operation command

5.2.4.1. 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)

5.2.4.2. Read the current workring condition(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

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 format

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 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 stored 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

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 the 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 stored 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

5.2.4.8. 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

5.2.4.9. 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).

5.2.4.10. 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.

5.2.4.11. Read the user data cache of the specified address (CF) (Only read the config in Flash)

Read Config.mp3 data in SPI-FLASH user area.

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

Return format:

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

Note:

XX XX is the length of specified return data. 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 will be replaced by "FF". For example, "OFF ON" is stored in Config.mp3 file. If sending reading 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 reading 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: Only support to query config data in FLASH at present not support to query config data in SD card or U disk. (Return 02)

5.3. 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.

6. Audio file sort

WT2003S-20N audio file index sort is according to the audio file sort order stored to TF card, not in accordance with the file name order. So when WT20003S 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 TF card or U disk. (If you want to download to SPI, you can first copy to TF 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 TF Card. (Note that what the right click on is the first file to send; the system will begin with this file to send.)
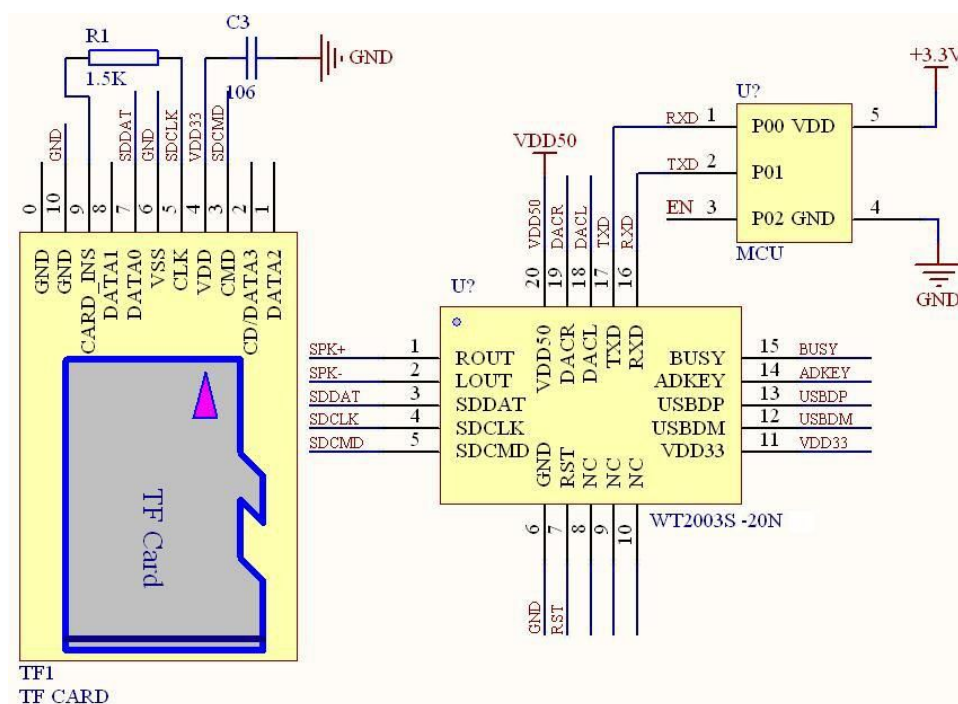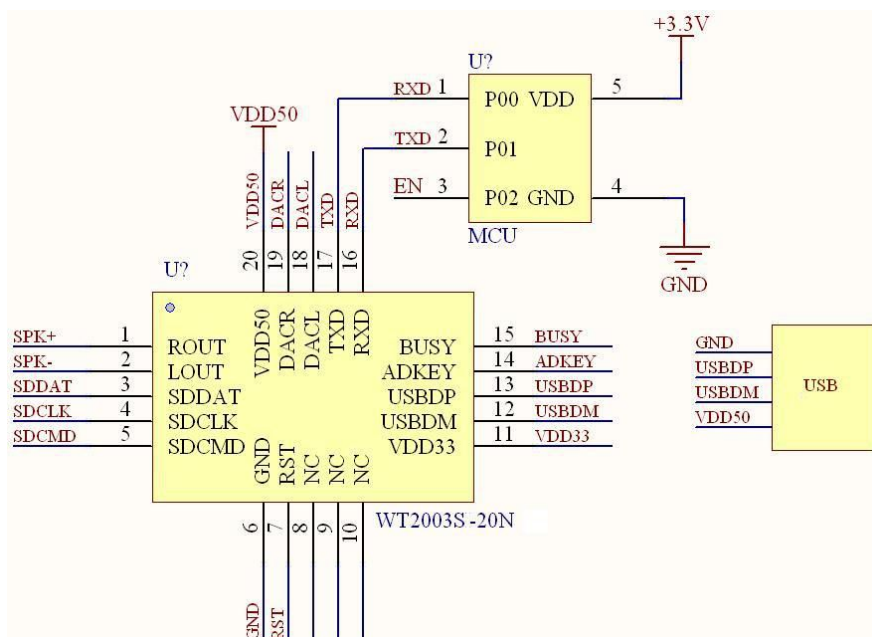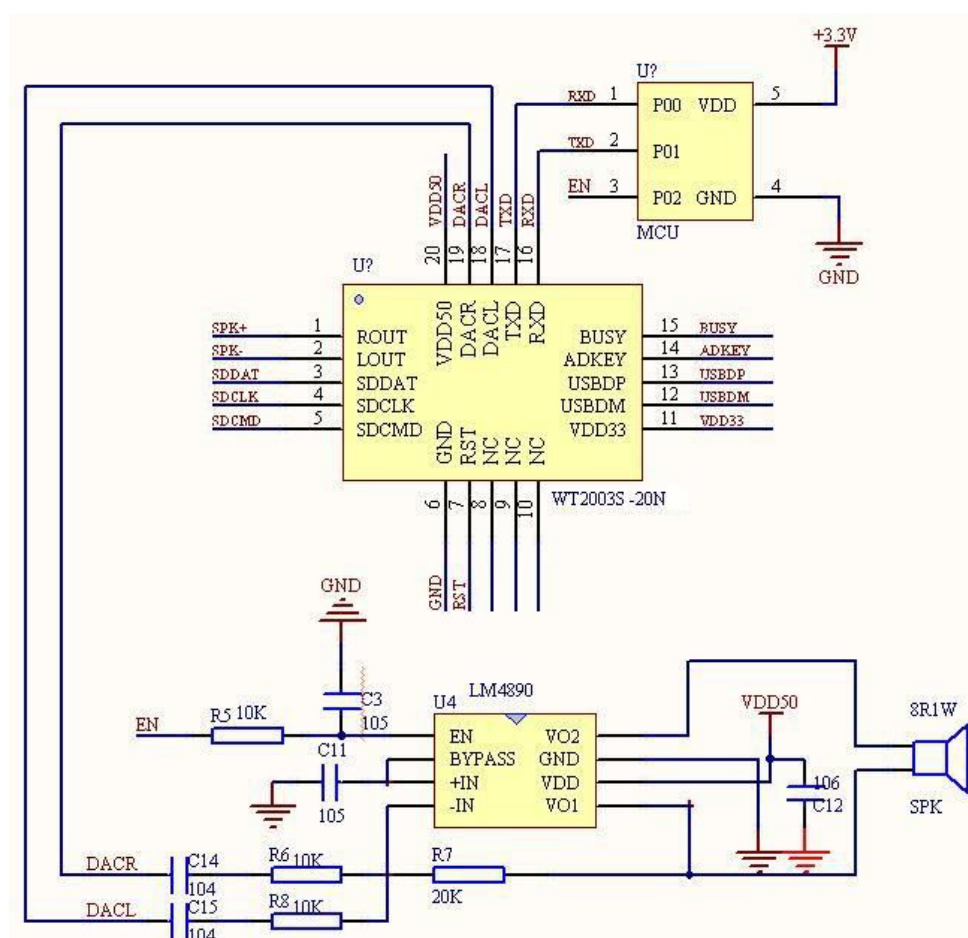
7. Application circuit

7.1. WT2003S-20N minimum circuit
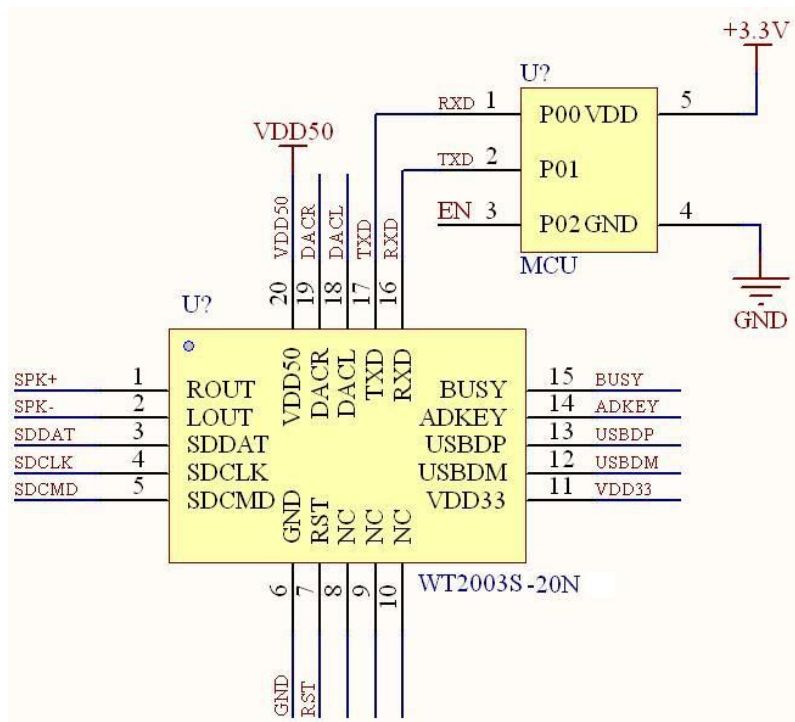
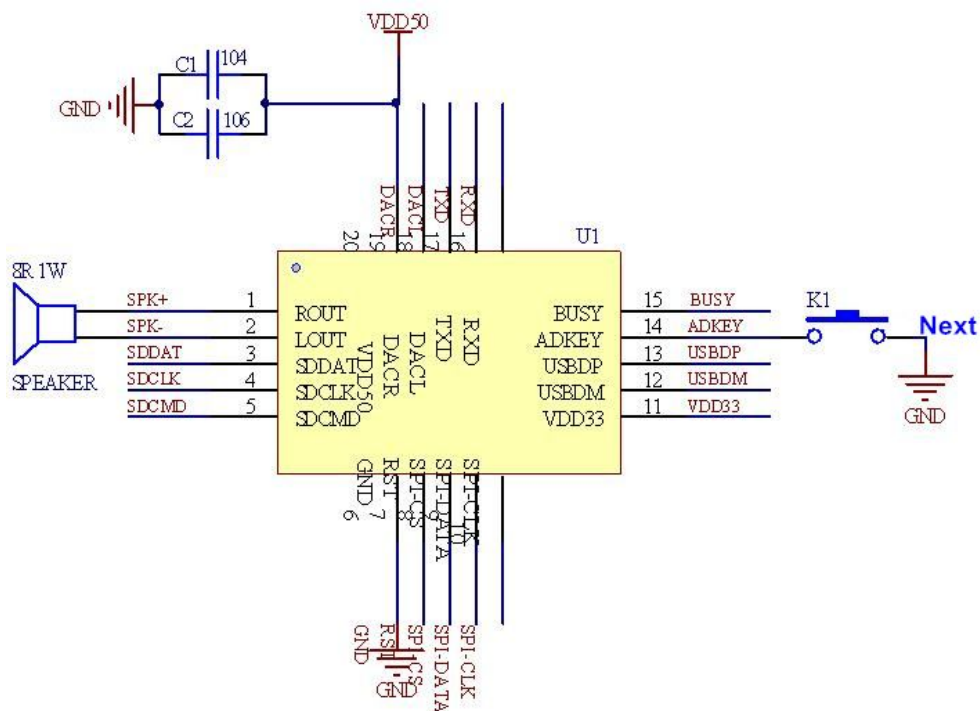## 7.2. WT2003S-20N with external TF card circuit
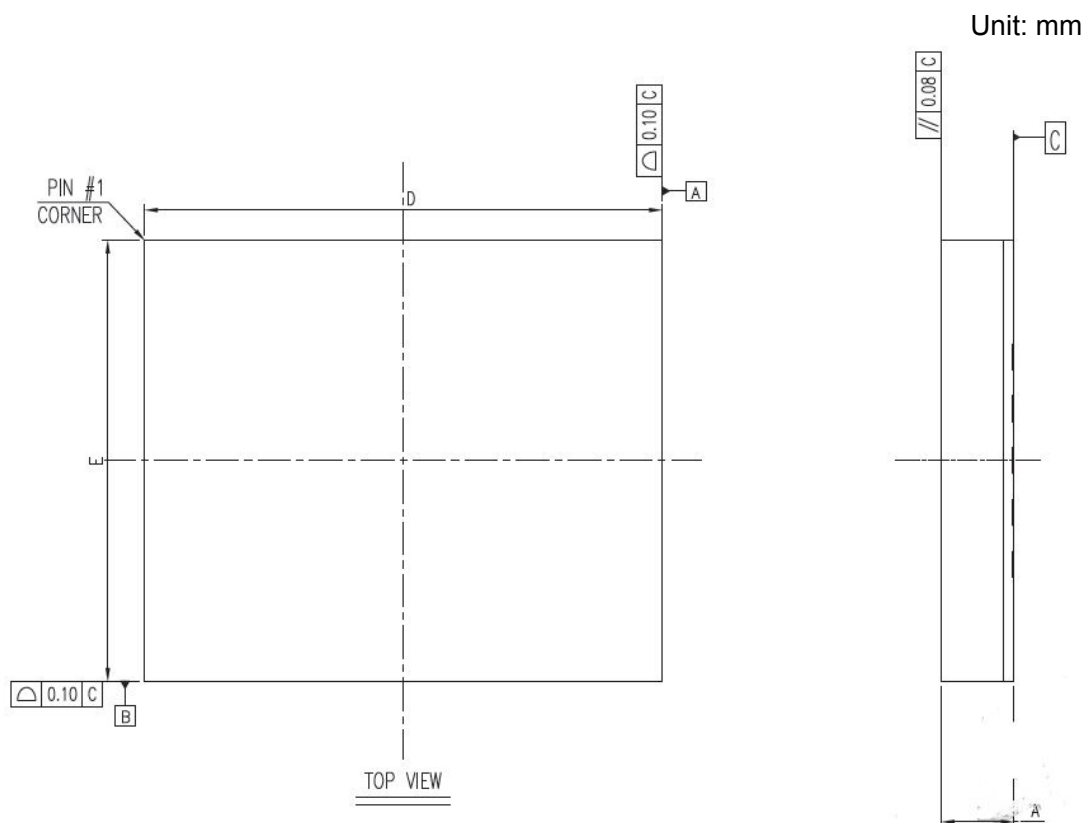
7.3. WT2003S-20N with external USB circuit

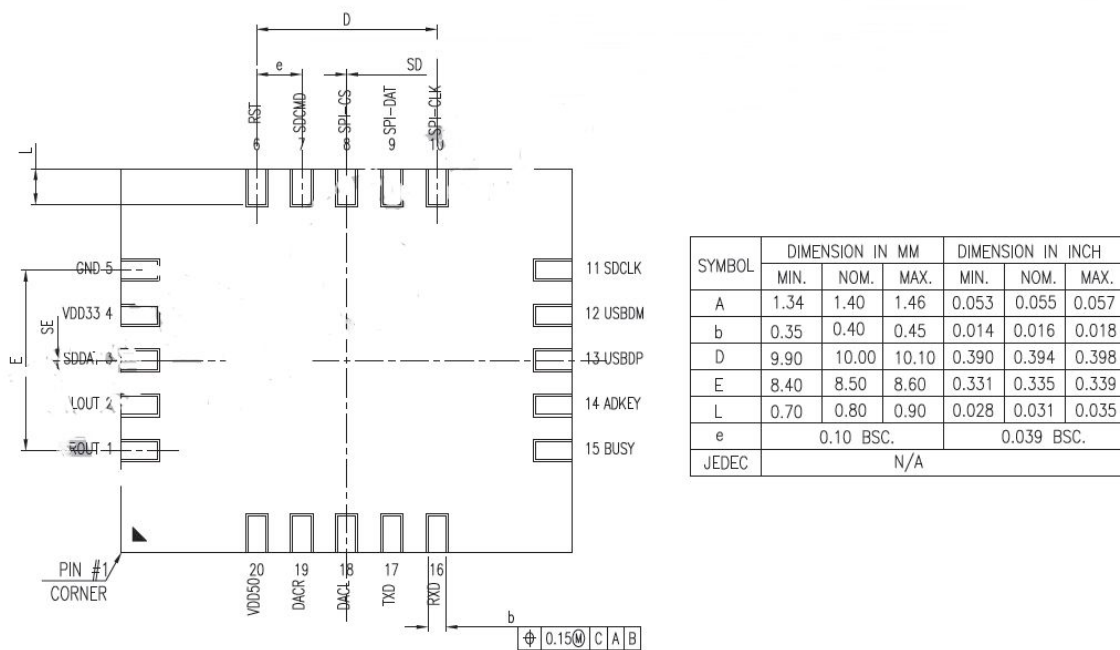## 7.4. WT2003S-20N with external power amplifier reference circuit

7.5. WT2003S-20N with external key control circuit

8. WT2003S-20N dimension

Unit: mm

TOP VIEW

SYMBOL	DIMENSION IN MM			DIMENSION IN INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	1.34	1.40	1.46	0.053	0.055	0.057
b	0.35	0.40	0.45	0.014	0.016	0.018
D	9.90	10.00	10.10	0.390	0.394	0.398
E	8.40	8.50	8.60	0.331	0.335	0.339
L	0.70	0.80	0.90	0.028	0.031	0.035
e	0.10 BSC.			0.039 BSC.		
JEDEC	N/A					

BOTTOM VIEW

N	SE (mm)	SD (mm)	E (mm)	D (mm)
20	0.00 BSC.	0.00 BSC.	4.00 BSC.	4.00 BSC.

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9. History version

Version No.	Modify date	Description
V1.00	2015-12-05	Original version
V1.01	2015-12-18	Modify some incorrect description