

WT2003HX

Specification

Version: V1.04

Note:

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1. Brief Introduction

WT2003HX is a powerful and high-quality voice chip that uses a high-performance 32-bit processor with a maximum frequency of 120MHz. It has the characteristics of low cost, low power consumption, high reliability, and strong versatility. It can have a built-in voice capacity of 350 seconds\900 seconds. There are three packages of chips, WT2003HX-16S, WT2003HX-24SS, WT2003HP8-32N (small size 4*4MM). Flexible control mode: support UART control mode; support one-line serial port and two-line serial port control mode; support button control mode (button control mode requires micro customization). Each control mode has been fixed before leaving the factory, and the sample needs to be confirmed with our sales staff first.

2. Characteristics

- UART control mode: standard UART communication interface, the default baud rate is 9600; support SPI-Flash as memory. With file index playback, interlude, single cycle, all tracks cycle, random playback and other functions. 32 levels of volume can be adjusted, the maximum can support external 128Mbit Flash;
- One-line serial port control mode: you can control voice playback, stop, loop playback, and volume through the code sender; 8-level volume is adjustable, support SPI-Flash as memory: the maximum can support external 128Mbit Flash;
- Two-wire serial port control mode: you can control voice playback, stop, loop playback and volume through the code sender; 8-level volume is adjustable, support SPI-Flash as memory: the maximum can support external 128Mbit Flash;
- Button control mode: The trigger mode is flexible, and any button can be set as pulse repeatable trigger, pulse non-repeatable trigger, invalid button, level maintain non-recyclable, level maintain recyclable, level non-retainable repetitive, last song not 15 trigger methods including loop, next song not loop, previous song loopable, next song loopable, volume+, volume-, play/pause, stop, play/stop, etc., up to 10 keys can be used to trigger the control output;
- The default is not to play when power on; with BUSY status indicator, BUSY is usually low level, and high level during playback;
- Support switching the audio output mode, the sample defaults to SPK output, if you need DAC output, please refer to the audio output switching instruction;
- Support voice high-quality audio format, support MP3 and WAV format, (audio bit rate support 8kbps~320kbps) beautiful sound;
- Working voltage: 2.4-5.2V;
- Built-in 0.5W Class D power amplifier;
- Two 16-bit asynchronous divider timers;
- Digital audio streaming, IIS supports host and slave modes;
- An infrared remote control decoder;
- 16 bit high precision ADC and DAC;

- High-power IO drive capability, which can directly drive up to 64mA;
- When using a single chip (using built-in capacity), the built-in voice needs to be written before leaving the factory.

Support UART update program and voice. It is recommended to reserve UART serial port when drawing board. Please refer to serial port upgrade document for upgrade.

3. Selection Table

For samples: please select the corresponding chip model and function code according to the following selection table, and contact our sales staff

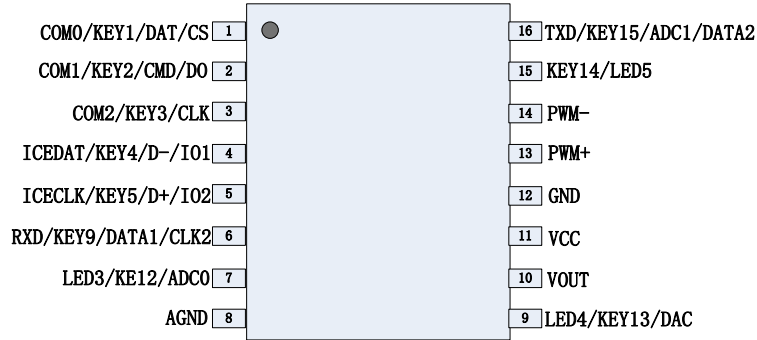
Function code	protocol	MODEL	Default output	Storage method	Voice capacity
A03	UART	WT2003H0-16S	PWM	External flash 4-128M	
		WT2003H0-24SS			
A04		WT2003H4-16S		Built-in storage	
		WT2003H4-24SS			
A05	One line Single byte	WT2003H4-16S		Built-in storage	
		WT2003H4-24SS			
A06		WT2003H0-16S		External flash 4-128M	
		WT2003H0-24SS			
A07	Two-line single byte	WT2003H4-16S		Built-in storage	
		WT2003H4-24SS			
A08		WT2003H0-16S		External flash 4-128M	
		WT2003H0-24SS			
A15	One-line double byte	WT2003H4-16S		Built-in storage	
		WT2003H4-24SS			
A16		WT2003H0-16S		External flash 4-128M	
		WT2003H0-24SS			
A17	One-line double byte	WT2003H4-16S		Built-in storage	
		WT2003H4-24SS			
A18		WT2003H0-16S	External flash 4-128M		
		WT2003H0-24SS			

4. Pin

WT2003H series chips are packaged with SOP16, TSSOP24 and QFN32 chips, which are suitable for various applications

In some cases, the pin diagram and pin definition are as follows:

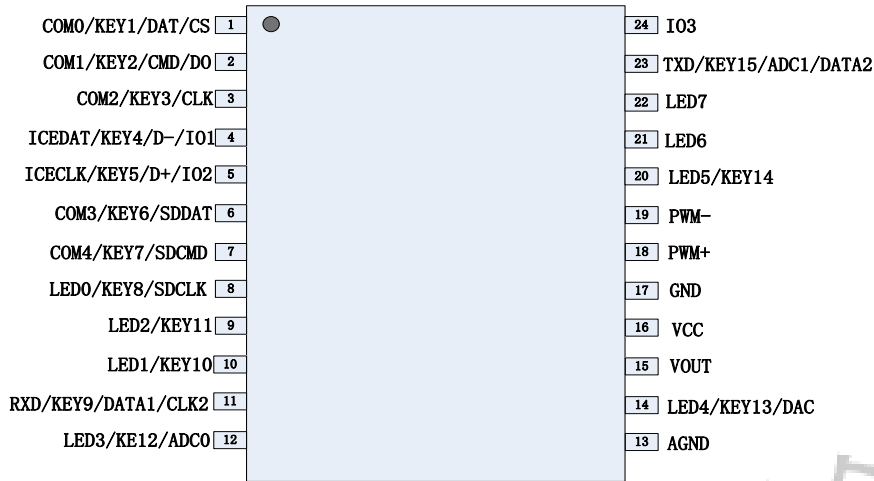
4.1. SOP16 Package Pin



WT2003HX-16S

PIN	NAME	TYPE	Description
1	COM0/KEY1/DAT/CS	I/O	Bit 0/Button 1/SD_DAT/SPI Flash chip select
2	COM1/KEY2/CMD/DO	I/O	Bit1/Button 2/SD_CMD/SPI Flash data
3	COM2/KEY3/CLK	I/O	Bit2/Button 3/SD_CLK/SPI Flash clock
4	ICEDAT/KEY4/D-/IO1	I/O	Download port/button 4/D-/IO port
5	ICECLK/KEY5/D+/IO2	I/O	Download port/button 5/D+/IO port
6	RXD/KEY9/DATA1/CL2K	I/O	RXD/Button 9/One-wire serial port data input/Two-wire serial port clock signal input
7	LED3/KEY12/ADC0	I/O	Segment 3/Button 12/ADC Channel 0
8	AGND	G	Analog ground
9	LED4/KEY13/DAC	I/O	Segment 4/Button 13/DAC output
10	VOUT	P	External memory power supply port (must
11	VCC	P	Power input (must connect 106 capacitor to
12	GND	G	Digitally
13	PWM+	O	Speaker terminal
14	PWM-	O	Speaker terminal
15	KEY14/LED5	I/O	Button 14/segment 5/Busy signal output
16	TXD/KEY15/ADC1/DATA2	I/O	Button 14/segment 5/Busy signal output

4.2. TSSOP24 package pin

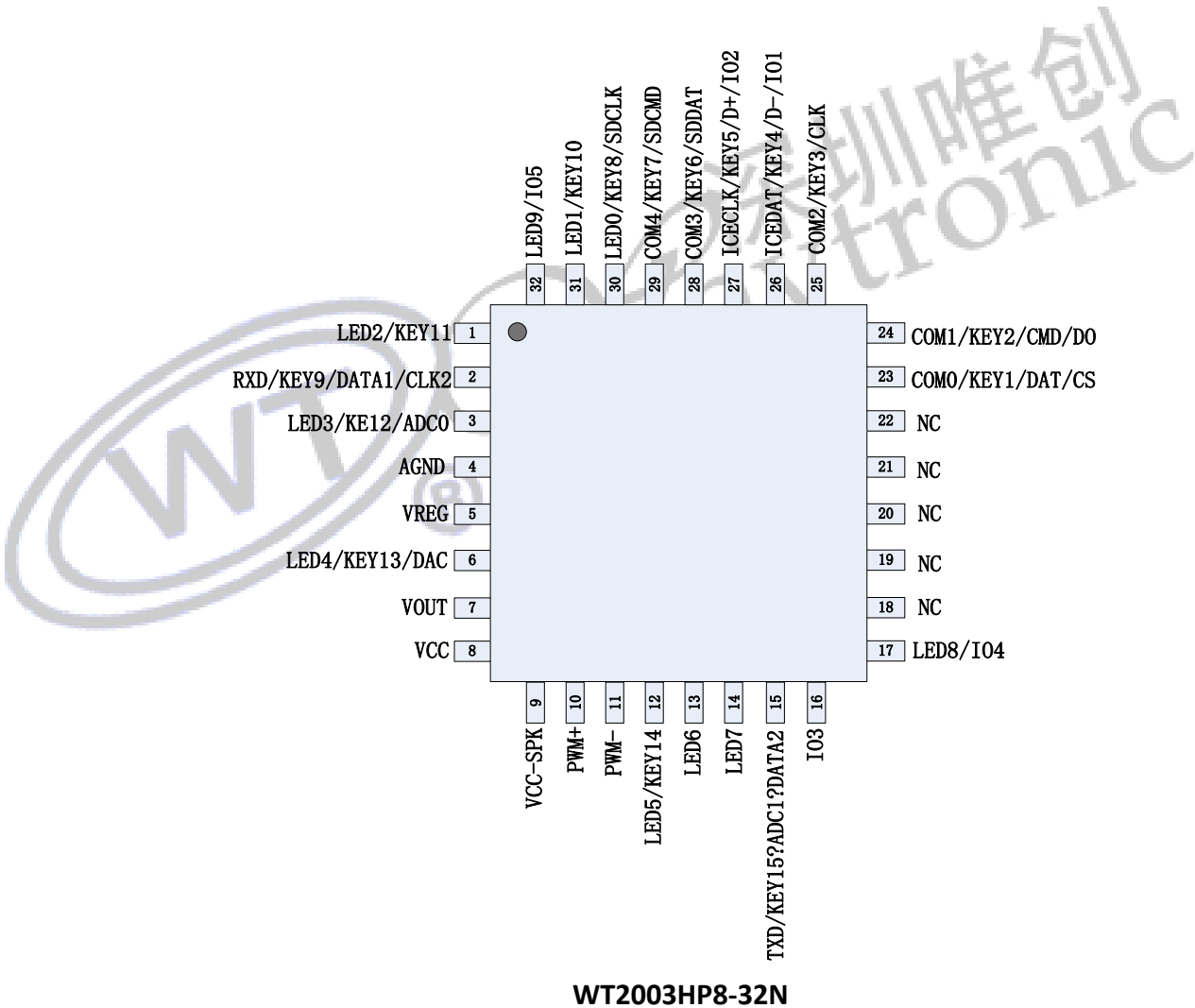


WT2003HX-24SS

PIN	Name	Type	Description
1	COM0/KEY1/DAT/CS	I/O	Bit 0/Button 1/SD_DAT/SPI Flash chip select
2	COM1/KEY2/CMD/DO	I/O	Bit1/Button/2SD_CMD/SPI Flash data
3	COM2/KEY3/CLK	I/O	Bit2/Button/3SD_CLK/SPI Flash clock
4	ICEDAT/KEY4/D-/IO1	I/O	Download port/button 4/D-/IO port
5	ICECLK/KEY5/D+/IO2	I/O	Download port/button 5/D+/IO port
6	COM3/KEY6/SDDAT	I/O	Bit 3/Button 6/SD card data
7	COM4/KEY7/SDCMD	I/O	Bit 4/Button 7/SD card selection
8	LED0/KEY8/SDCLK	I/O	Segment 0/Button 8/SD card clock
9	LED2/KEY11	I/O	Segment 2/Button 11
10	LED1/KEY10	I/O	Segment 1/Button 10
11	RXD/KEY9/DATA1/CL2K	I/O	RXD/Button 9/One-wire serial port data input/Two-wire serial port clock signal input
12	LED3/KEY12/ADC0	I/O	Segment 3/Button 12/ADC Channel 0
13	AGND	G	Analog ground
14	LED4/KEY13/DAC	I/O	Segment 4/Button 13/DAC output
15	VOUT	I/O	External memory power supply port (must connect 106 capacitor to ground)
16	VCC	P	Power input (must connect 106 capacitor to ground)
17	GND	G	Digitally

18	PWM+	I/O	Speaker terminal
19	PWM-	I/O	Speaker terminal
20	LED5/KEY14	I/O	Segment 5/Button 14/Busy signal output
21	LED6	I/O	Segment 6
22	LED7	I/O	Segment 7
23	TXD/KEY15/ADC1/DATA2	I/O	TXD/button 15/ADC channel 1/two-wire serial data input
24	IO3	I/O	IO port

4.3. QFN32 IO port



PIN	Name	Type	Description
1	LED2/KEY11	I/O	Segment 2/Button 11
2	RXD/KEY9/DATA1/CL2K	I/O	RXD/Button 9/One-wire serial port data input/Two-wire serial port clock signal input
3	LED3/KEY12/ADC0	I/O	Segment 3 / Button / ADC Channel 0
4	AGND	G	Analog ground
5	VREG	P	Coupling pin, (must connect 105 capacitor to ground)
6	LED4/KEY13/DAC	O	Segment 4/Button 13/DAC output
7	VOUT	P	External memory power supply port (must connect 106 capacitor to ground)
8	VCC	P	Power input (must connect 106 capacitor to ground)
9	VCC-SPK	P	Internal power amplifier power input
10	PWM+	O	Speaker terminal
11	PWM-	O	Speaker terminal
12	LED5/KEY14	I/O	Segment 5/Button 14/Busy signal output
13	LED6	I/O	Segment 6
14	LED7	I/O	Segment 7
15	TXD/KEY15/ADC1/DATA2	I/O	TXD/button 15/ADC channel 1/two-wire serial data input
16	IO3	I/O	IO port
17	LED8/IO4	I/O	Segment 8/IO port
18	NC	I/O	NC
19	NC	I/O	NC
20	NC	I/O	NC
21	NC	I/O	NC
22	NC	I/O	NC
23	COM0/KEY1/DAT/CS	I/O	Bit 0/Button 1/SD_DAT/SPI Flash chip select
24	COM1/KEY2/CMD/DO	I/O	Bit1/Button2/SD_CMD/SPI Flash data
25	COM2/KEY3/CLK	I/O	Bit1/Button2/SD_CMD/SPI Flash data
26	ICEDAT/KEY4/D-/IO1	I/O	Download port/button 4/D-/IO port
27	ICECLK/KEY5/D+/IO2	I/O	Download port/button 5/D+/IO port
28	COM3/KEY6/SDDAT	I/O	Bit 3/Button 6/SD card data
29	COM4/KEY7/SDCMD	I/O	Bit 4/Button 7/SD card selection
30	LED0/KEY8/SDCLK	I/O	Bit 4/Button 7/SD card selection
31	LED1/KEY10	I/O	Segment 1/Button 10

5. Control Mode

5.1. UART Control Mode

Standard UART communication interface, the default baud rate is 9600

5.1.1. Protocol command format

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



Start code	length	Command code	parameter	Accumulation and check	End code
0X7E	see below	see below	see below	see below	0XEF

Notice:

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

“ Length” refers

Note: Flash voice playback can implement FLASH index playback, combined playback, interstitial playback and other instructions; section.

Table 3 Communication control commands

CMD detailed	Corresponding function	parameter
A0	Specify FLASH index play (full disk)	File index
A1	Specify the file name of the Flash root directory	Track information
AA	Play pause command	
AB	Stop order	
AC	Next song command	

AD	Previous command	
AE	Volume control commands	Volume level
AF	Specify play mode	Cyclic mode
B0	Combination play	Track information
B1	Interstitial	Track information
B6 00	Switch audio output mode to SPK	B6 XX
B6 01	Audio output mode is switched to DAC	B6 XX
B8	Enter low power consumption	B8 XX

Table 4 Communication query command

CMD	Corresponding function	parameter
C0	Query the current software version	C0 XX XX XX XX
C1	Query the currently set volume	C1 XX
C2	Read current working status	C2 XX
C3	Query the total number of music files in Flash	C3 XX XX
C9	Query the address of the currently playing file	C9 XX XX

5.1.2. Operation instruction

5.1.2.1. Write operation instruction return code format

Start code	length	Command code	Result code	Accumulation and check	End Code
0X7E	see below	see below	see below	see below	0XEF

Note: After executing each write command, the result code corresponding to the command will be returned according to the communication protocol format

Result code: →: 00 means: OK command is executed;

→: 01 means: Flash command is wrong and will not be executed;

→: 02 means: EMP does not have this file;

→: 05 means: the device is not online

5.1.2.2. Specify Flash root directory index playback (A0)

This command indexes the files in Flash for playback, and the files are sorted according to the index order. The index sequence is set at the factory.

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

ex: send → ◇7E 05 A0 00 01 A6 EF □

get ← ◆7E 04 A0 00 A4 EF

High/low repertoire description: hexadecimal representation, the 300th voice is 0x012C, then the high bit of the song is 0x01, and the low bit of the song is 0x2C;

The 67th voice is 0x43, the high bit of the song is 0x00, and the low bit of the song is 0x43.

5.1.2.3. Specify the Flash root directory file name to play (A1)

This command can specify the file name in Flash for audio playback (the file name is fixed with 4 characters and does not support Chinese)

start	length	Order	file name				Check code	End code
7E	0A	A1	'30'	'30'	'30'	'31'	XX	EF

Among them: "30, 30, 30, 31" are respectively the ASCII code of 0001, only the file name uses the ASCII code value, and the other data is the hexadecimal value; the above command indicates the audio file named "0001" in the specified root directory. The file playback is as an example.

Note: The file name does not support Chinese. If the file name exceeds 4 characters, it will not be able to specify the file name to play

Example: Send → ◇7E 07 A1 30 30 30 31 69 EF □

Close ← ◆7E 04 A1 00 A5 EF

5.1.2.4. Pause playback command (AA)

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

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

Sending this command in stop state is invalid

Example: Send → ◇ 7E 03 AA AD EF □

Close ← ◆ 7E 04 AA 00 AE EF

5.1.2.5. Stop command (AB)

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

Send this command to stop playing the currently playing music.

ex: send → ◇ 7E 03 AB AE EF □

back ← ◆ 7E 04 AB 00 AF EF

5.1.2.6. Next song command (AC)

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

This instruction can trigger the playback of the next music in the current directory. When the last music is played, sending this instruction can trigger the playback of the first music.

ex: send → ◇ 7E 03 AC AF EF □

back ← ◆ 7E 04 AC 00 B0 EF

5.1.2.7. Previous song command (AD)

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

This instruction can trigger the playback of the previous music in the current directory. When the first music is played, sending this instruction can trigger the playback of the last music.

ex: send → ◇ 7E 03 AD B0 EF □

back ← ◆ 7E 04 AD 00 B1 EF

5.1.2.8. Volume control command (AE)

There are 32 levels of volume, ranging from 0 to 31, of which 0 is mute and 1F is the maximum volume.

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

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

ex: send → ◇ 7E 04 AE 1F D1 EF □

back ← ◆ 7E 04 AE 00 B2 EF

5.1.2.9. Designated Play Mode (AF)

This instruction modifies the play mode when the power is on, and the default mode will be restored after the power is off

start	length	command	parameter	Check code	End code
7E	04	AF	00: Single song non-loop playback mode (default)	B3	EF
			01: Single loop playback mode	B4	
			02: All tracks loop playback mode	B5	
			03: Random pattern	B6	

Example sent → ◇ 7E 04 AF 01 B4 EF □

receive ← ◆ 7E 04 AF 00 B3 EF

5.1.2.10. Combined play command (B0)

Start code	length	Command	Number of tracks	Track 1	Track 2	Track 3	Check code	End code
7E	07	B0	03	01	03	02	XX	EF

Note: When receiving this instruction, pause the track being played, and then execute the play track specified by this instruction. After the first specified track is played, the subsequent tracks that need to be combined will be automatically played until the end of the play. For all tracks, a maximum of 20 combined tracks are supported.

When the first multicast command has not been played, when the second multicast command is sent, the combined playing track will restart to play according to the new combined command.

Number of tracks: 03; means: the number of tracks to be combined is 3;

Track 1: 01; means: the first track played in combination is the first song in the memory;

Track 2: 03; means: the second track played in combination is the third song in the memory;

Track 3: 02; means: the third track played in combination is the second song in the memory;

In the example, the identifier 05 means that there are 5 songs in total, which are "01 01 0B 0A 02".

Example: Send → ◇ 7E 09 B0 05 01 01 0B 0A 02 D7 EF □

Close ← ◆ 7E 04 B0 00 B4 EF

5.1.2.11. Interrupt instruction (B1)

This instruction can only be inserted in the playing state, and it is invalid in the stopped state

start	length	command	Mark word	Repertoire high	Track low	Check code	End code
7E	06	B1	00	00	01	XX	EF

When this instruction is sent, the currently playing track will be paused, and then the play track specified by this instruction will be executed. When the play is over, the originally paused track will be played.

When the first interrupt command is not played, and the second interrupt command is sent, the command is invalid. You have to wait for the first interruption of music to be played before you can perform the interruption again.

Marking word: 00; means: the specified index address in the interstitial FLASH;

Example: Send → ◇ 7E 06 B1 02 00 07 C0 EF □

Close ← ◆ 7E 04 B1 00 B5 EF

5.1.2.12. Audio output mode switch (B6)

After sending this command, switch to SPK output or DAC output, this function has power-down memory (the chip defaults to SPK output)

start	length	command	parameter	Check code	End code
7E	04	B6	00	BA	EF
			01	BB	

Parameters: 00 means SPK output, 01 means DAC output

Note: The example command is to switch to DAC output based on the default SPK output

Example: Send → ◇ 7E 04 B6 01 BB EF □

Close ← ◆ 7E 04 B6 00 BA EF

5.1.2.13. Enter low power consumption (B8 00)

Send this command to make the chip enter the low-power sleep mode

start	length	Order	parameter	Check code	End code
7E	04	B8	00	BC	EF
			01	BD	

Command "00" power consumption is less than 2uA, command wake-up time is 100 milliseconds

Command "01" power consumption is less than 30uA, command wake-up time is 2 milliseconds

Note: The chip wakes up on the falling edge of the RXD pin. It is recommended to send 0x00 0x00 to wake up. When using the plug-in Flash solution, the sleep power consumption is related to the plug-in Flash.

Example: Send → ◇ 7E 04 B8 00 BC EF □

Close ← ◆ 7E 04 B8 00 BC EF

5.1.2.14. Query the current software version (C0)

This instruction is used for version confirmation, retrospective query of version issues, precise positioning, etc.

start	length	command	Check code	End code
7E	03	C0	C3	EF

Example: Send → ◇ 7E 03 C0 C3 EF □

Close ← ◆ 7E 07 C0 21 09 28 70 89 EF

5.1.2.15. Query the currently set volume (C1)

This command is used to query the current playback volume, the example indicates that the current volume is "1F" level 31

start	length	command	Check code	End code
7E	03	C1	C4	EF

Example: Send → ◇ 7E 03 C1 C4 EF □

Close ← ◆ 7E 04 C1 1F E4 EF

5.1.2.16. Read current working status (C2)

This command is used to query the current playback status, the example "02" means that the stop "AB" command has been sent during the playback process to stop playing audio

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

Result code: 01 means: play;

: 02 means: stop;

: 03 means: pause;

Example: Send → ◇ 7E 03 C2 C5 EF □

← ◆ 7E 04 C2 02 C8 EF

5.1.2.17. Query the total number of music files in FLASH (C3)

Start code	length	command	Check code	End code
7E	03	C3	C6	EF

The sample query quantity is 11 audios = "00 0B"

Example: Send → ◇ 7E 03 C3 C6 EF □

Close ← ◆ 7E 05 C3 00 0B D3 EF

5.1.2.18. Query the address of the currently playing file (C9)

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

The returned address is represented by two bytes

Note: The example "00 03" means that the current song is played, the address of the third song in the root directory

Example: Send → ◇ 7E 03 C9 CC EF □

← ◆ 7E 05 C9 00 03 D1 EF

5.2. One-line serial port control mode

One-line serial port mode can use MCU to send data to WT2003HX series voice chip through DATA line to achieve the purpose of control. It can control voice playback, stop, loop, etc.

5.2.1. Correspondence of first-line voice address

Data (Hexadecimal)	function
00H	Play the 0th voice
01H	Play the 1th voice
02H	Play the 2th voice
.....	
DDH	Play the 221th voice
DEH	Play the 222th voice
DFH	Play the 223th voice

Note: If you want to play the voice of the address, just send the address to automatically play the voice of the address, and the time interval between the two address instructions must be greater than 4ms.

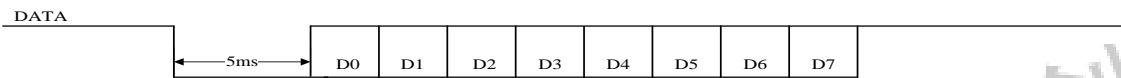
5.2.2. One Line voice and command code correspondence table

Start code	function	description
F0H	Automatically enter sleep mode (default state after power-on)	After executing this command, after the voice playback is over, the chip will automatically enter sleep mode after waiting for 5S; after entering sleep, the chip wakes up on the falling edge of the DATA pin. After waking up, it takes an interval of 100ms to receive the command effectively; this command has power-down memory, The setting is valid in the wake-up state.
F1H	Exit automatically enter sleep mode	After executing this command, the chip will always be in the standby state after the voice playback ends; this command has power-down memory. (This command is valid in the wake-up state, suitable for deep sleep and in-situ sleep)
E0H...E7H	E0 has the smallest volume, E7 has the largest volume, a total of 8 levels of volume adjustment	In the voice playback, send this command to adjust the volume when the playback is over or in the standby state
F2H	Loop current voice	Execute this command to play the current voice in a loop, and it can be sent when the voice is played/stopped. During the execution of the F2 loop command, it can be commanded by FE or ordinary address, and it is invalid; the playback command must be sent first, and then the loop playback command must be sent.
F3H	Continuous playback delay.	F3H+Voice Address A, F3H+Voice Address B, F3H+Voice Address C,... When playing address A, it will not interrupt after receiving the following code, after playing A, it will play B, and then play C.... A 2ms delay is required between F3 and the address.
FEH	Stop playing the current voice	Execute this command to stop playing the current voice
F4H 00/01	Audio output mode switch	F4H 00 is switched to DAC, F4H 01 is switched to PWM, and the setting is valid in the wake-up state

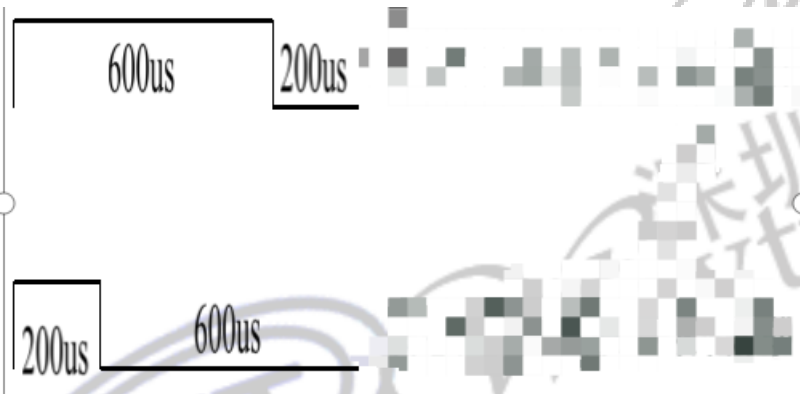
F4H 02	Deep sleep (within 3uA)	Deep sleep, the setting is valid in the wake-up state. Default deep sleep before leaving the factory
F4H 03	Sleep in place (within 30uA)	Sleep in place, the setting is valid in the wake-up state.

Note: Without stopping playback, if there is no command code F3H and only a voice address, the voice that was playing before will be interrupted. The consecutive code commands must be used in conjunction with the address (for example: F3H+00H+F3H+01H). F3H can easily combine different voices, F3H+address A+F3H+address B, up to 10 groups of content can be combined, the first group of commands must be F3+address; it can also be judged by the BUSY level when the voice is played and the BUSY level at the end of the playback. Change, complete the combined play.

5.2.3. Timing diagram of one-line serial port



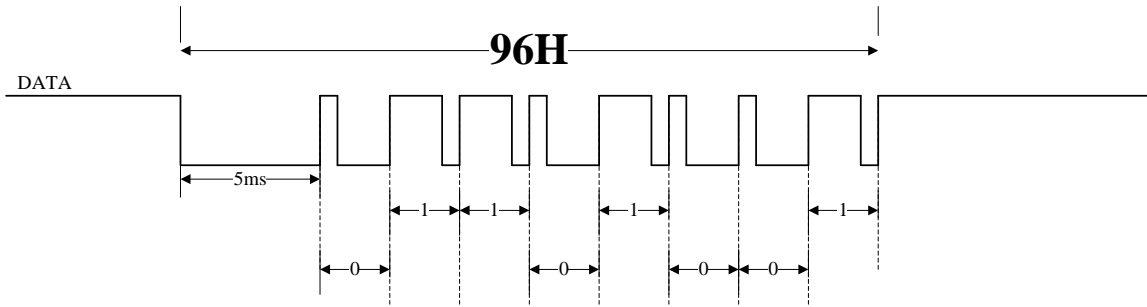
After pulling the data line low for 4-20ms, it is recommended to send 8 bits of data in 5ms. The low bit is sent first, then the high bit. The ratio of high level to low level is used to represent the value of each data bit.



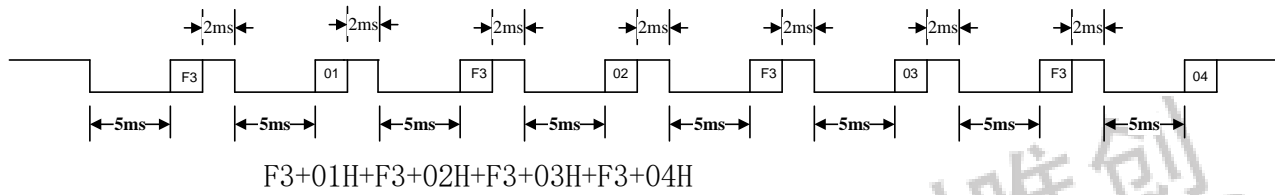
Note: The high level must be in the front and the low level in the back.

It is recommended to use 200us: 600us. Value range: 40us:120us ~ 400us:1200us. Pay attention to the use of 3:1 and 1:3 level ratios to ensure stable communication.

If we want to send 96H, then his corresponding sequence diagram is as follows:



Suppose we want the chip to play the voice content of address 01/02/03/04 in sequence. That is, the continuous code command play, F3+01+F3+02+F3+03+F3+04. The corresponding timing can be as shown in the following figure:



Notice:

When using the continuous code function, after a group of continuous code addresses are sent, delay 2ms before sending the next group of continuous code addresses; but the interval between F3 and the address is still 2ms; in the deep sleep mode, the chip must be awakened first, and it is recommended to send first The 0xFE command wakes up the chip and waits for 100ms before sending the command; in the in-situ sleep mode, you can directly send the voice address command to play; the factory default is the deep sleep mode.

After sleep, the chip is pulled up by default, and DATA is pulled high when the voice playback ends. 2.2. Two-wire serial port control mode

Two-wire serial port mode can use MCU to send data to WT2003HX series voice chip through CLK and DATA line to achieve the purpose of control. It can control voice playback, stop, loop, etc.

5.3. Two-line serial port control mode

5.3.1. Correspondence between two-line voice address

Data (Hexadecimal)	function
00H	Play the 0th voice
01H	Play the 1th voice
02H	Play the 2th voice
.....	
DDH	Play the 3th voice
DEH	Play the 4th voice

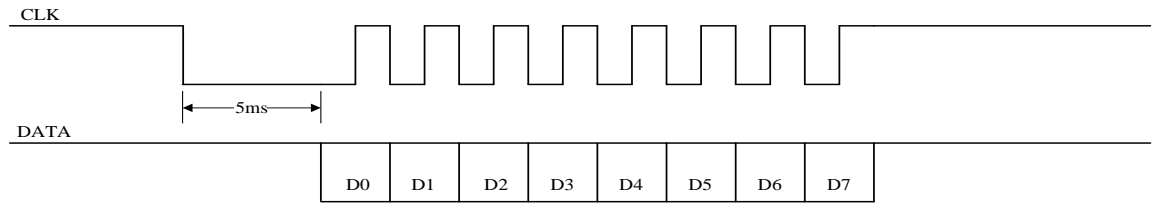
DFH	Play the 5th voice
-----	--------------------

Note: If you want to play the voice of the address, just send the address to automatically play the voice of the address, and the time interval between the two address instructions must be greater than 4ms.

5.3.2. Two-line voice and command code correspondence table

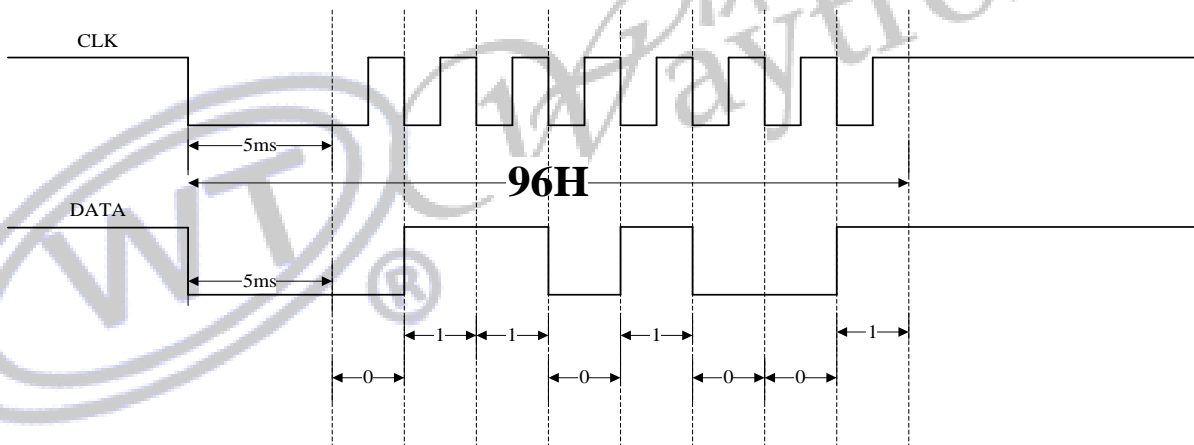
Command code	Features	describe
F0H	Automatically enter sleep mode (default state after power-on)	After executing this command, after the voice playback is over, the chip will automatically enter sleep mode after waiting for 5S; after entering sleep, the chip wakes up on the falling edge of the CLK pin. After waking up, it takes 100ms to receive the command effectively; this command has power-down memory, The setting is valid in the wake-up state.
F1H	Exit automatically enter sleep mode	After executing this command, the chip will always be in the standby state after the voice playback ends; this command has power-down memory. (This command is valid in the wake-up state, suitable for deep sleep and in-situ sleep)
E0H...E7H	E0 has the smallest volume, E7 has the largest volume, a total of 8 levels of volume adjustment	In voice playback, send this command to adjust the volume when the playback is over or in the standby state. The setting is valid in the wake-up state.
F2H	Loop current voice	Execute this command to play the current voice in a loop, and it can be sent when the voice is played/stopped. During the execution of the F2 loop command, it can be commanded by FE or ordinary address, and it is invalid; the playback command must be sent first, and then the loop playback command must be sent. The setting is valid in the wake-up state.
F3H	Play with code	F3H+Voice Address A, F3H+Voice Address B, F3H+Voice Address C,... When playing address A, it will not interrupt after receiving the following code, after playing A, it will play B, and then play C.... A 2ms delay is required between F3 and the address. The setting is valid in the wake-up state.
FEH	Stop playing the current voice	Execute this command to stop playing the current voice, and the setting is valid in the wake-up state
F4	Audio output mode switch	F4 00 is switched to DAC, F4 01 is switched to PWM, and the setting is valid in the wake-up state.
F4H 02	Deep sleep (within 3ua)	Deep sleep, the setting is valid in the wake-up state. Default deep sleep before leaving the factory
F4H 03	Hibernation in situ (within 30ua)	Sleep in place, setting is valid in wake-up state.

5.3.3. Two-wire serial port timing diagram:

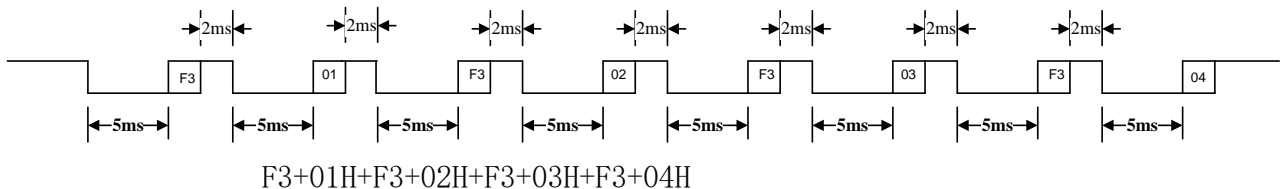


The two-wire serial port control mode is controlled by the chip clock CLK and data DATA. Before sending a byte of data, the clock signal CLK is pulled down 4ms to 20ms. It is recommended to use 5ms to wake up the WT2003HX voice chip. Receive data on the rising edge of. The clock cycle is between 200us and 1ms, and it is recommended to use 300us for each of the high and low levels (that is, the clock cycle for one bit transmission is 600us). When sending data, send the low bit first, then the high bit. 00H~DFH in the data are voice address commands, E0H~EFH are volume adjustment commands, F2H is a loop playback command, and FEH is a stop playback command.

If we want to send 96H, then his corresponding sequence diagram is as follows:



Suppose we want the chip to play the voice content of address 01/02/03/04 in sequence. That is, the continuous code command play, F3+01+F3+02+F3+03+F3+04. The corresponding timing can be as shown in the following figure:



Remark:

When using the continuous code function, after a group of continuous code addresses are sent, delay 2ms before

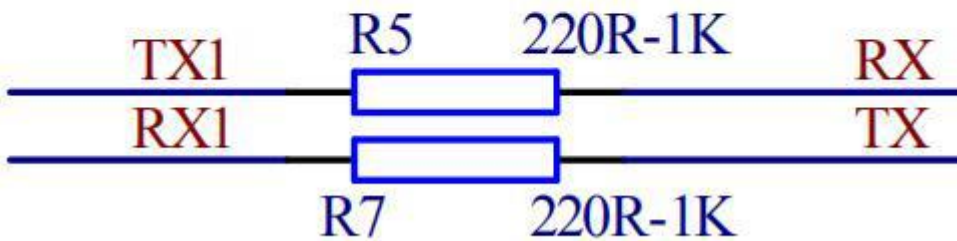
sending the next group of continuous code addresses; but the interval between F3 and the address is still 2ms; in the deep sleep mode, the chip must be awakened first, and it is recommended to send 0xFE first. The command wakes up the chip and waits for 100ms before sending the command; in the in-situ sleep mode, you can directly send the voice address command to play; the factory default is the deep sleep mode.

6. Circuit design considerations

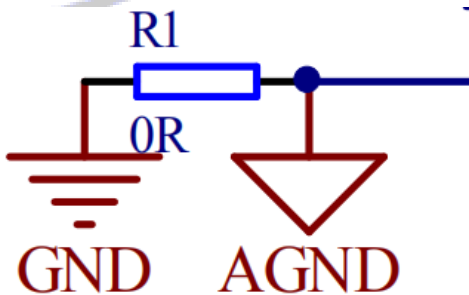
(1) Circuit reference design reference document "WT2003HX Chip Application Circuit"

When the MCU level does not match the voice chip level, please add a level conversion circuit, as follows

Level conversion circuit



When AGND and GND are connected to an external power amplifier, they need to be isolated by a 0R resistor, as shown in the figure below:



7. Electrical Parameters

7.1. Absolute maximum ratings

Symbol	Parameter	Min	Max	Unit
T _{amb}	Ambient Temperature	-40	+85	°C
T _{stg}	Storage temperature	-65	+150	°C
V _{CC}	Supply Voltage	-0.3	5.2	V
V _{Vout33}	3.3V IO Input Voltage	-0.3	3.6	V

7.2. PMU features

Symbol	Parameter	Min	Typ	Max	Unit	Test Conditions
V _{CC}	Voltage Input	2.4	3.7	5.2	V	—
V _{VOUT}	Voltage output	2.4	3.0	3.4	V	V _{CC} = 3.7V, 100mA loading
I _{VOUT}	Loading current	—	—	100	mA	V _{CC} =3.7V

7.3. IO input/output electrical logic characteristics

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

7.4. Analog DAC characteristics

Parameter	Min	Typ	Max	Unit	Test Conditions
Frequency Response	20	–	16K	Hz	1KHz/0dB 100kohm loading A-Weighted Filter
THD+N	–	-65	–	dB	
S/N	–	95	–	dB	
Output Swing	–	0.54	–	Vrms	
Dynamic Range	–	92	–	dB	1KHz/-60dB 100kohm loading With A-Weighted Filter
Output Resistance	–	8.3	–	K	–

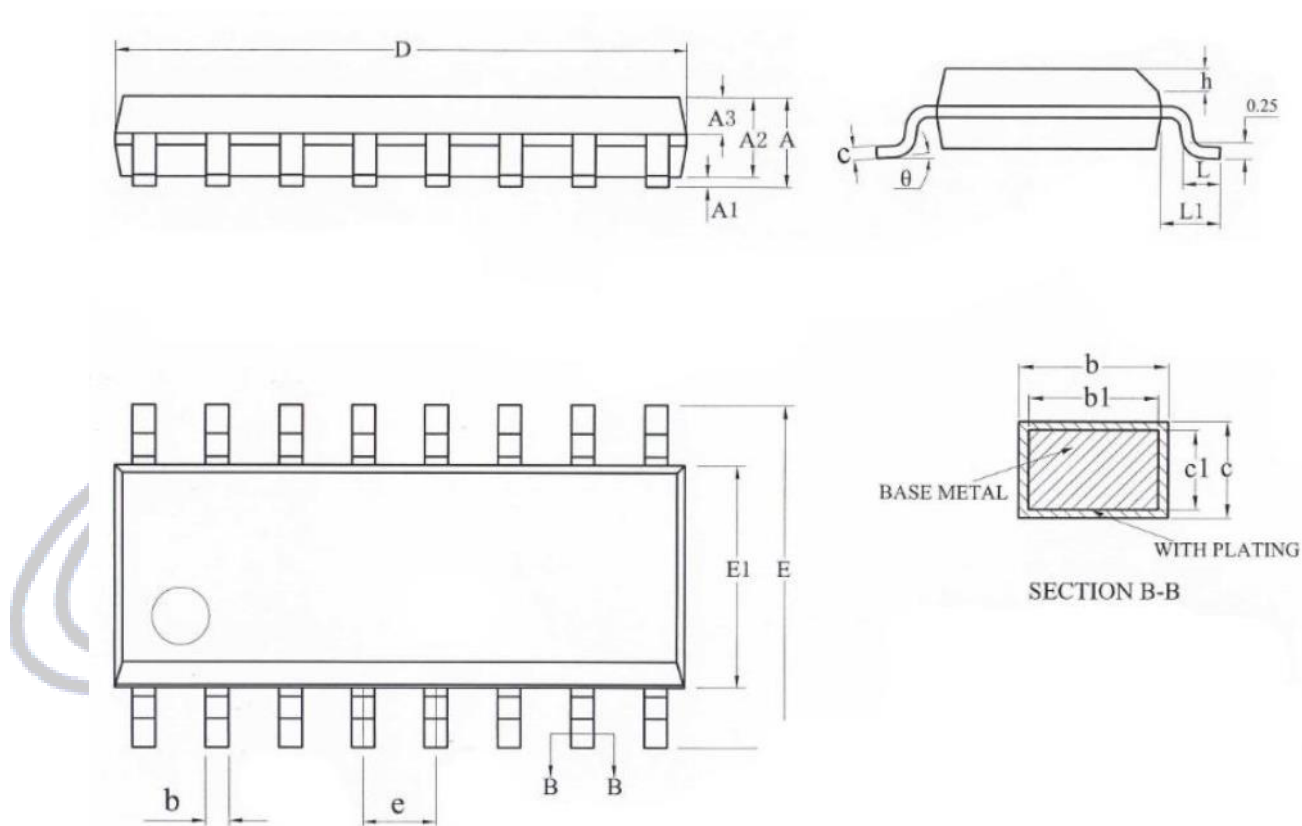
7.5. ADC Characteristics

Parameter	Min	Typ	Max	Unit	Test Conditions
Dynamic Range	–	75	–	dB	1KHz/210mVrms
S/N	–	79	–	dB	line mode :6dB with cap
THD+N	–	-70	–	dB	PGAIS=2

8. Packaging information

8.1. SOP16 package size

unit: mm



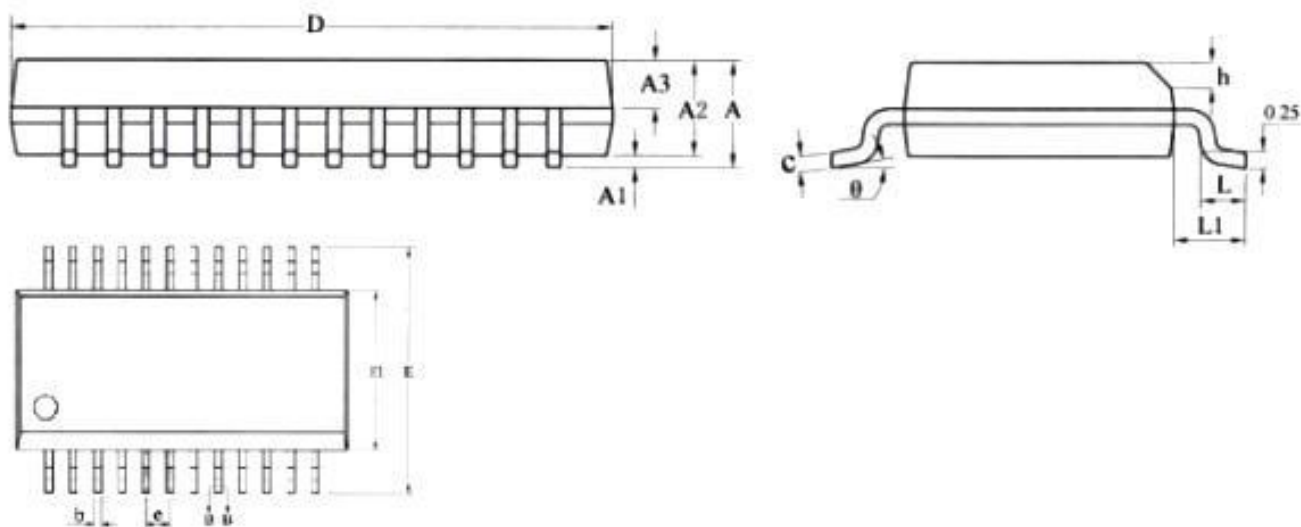
name	mim	Typical value	Max
A	-	-	1.75
A1	0.10	0.15	0.225
A2	1.30	1.40	1.50
A3	0.60	0.65	0.70
b	0.39	-	0.47
b1	0.38	0.41	0.44
c	0.20	-	0.24

c1	0.19	0.20	0.21
D	9.80	9.99	10.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27BSC		
h	0.25	-	0.50
L	0.50	-	0.80
L1	1.05REF		
θ	0	-	8°

8.2. TSSOP24 package size



Unit : mm



name	Minimum	Typical value	Maximum value
A	-	-	1.75
A1	0.10	0.15	0.25
A2	1.30	1.40	1.50
A3	0.60	0.65	0.70
b	0.23	-	0.31
b1	0.22	0.25	0.28
c	0.20	-	0.24
c1	0.19	0.20	0.21
D	8.55	8.65	8.75
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	0.635BSC		
h	0.30	-	0.50
L	0.50	-	0.80
L1	1.05REF		
θ	0	-	8°

8.3. QFN32 package size

Unit: mm

