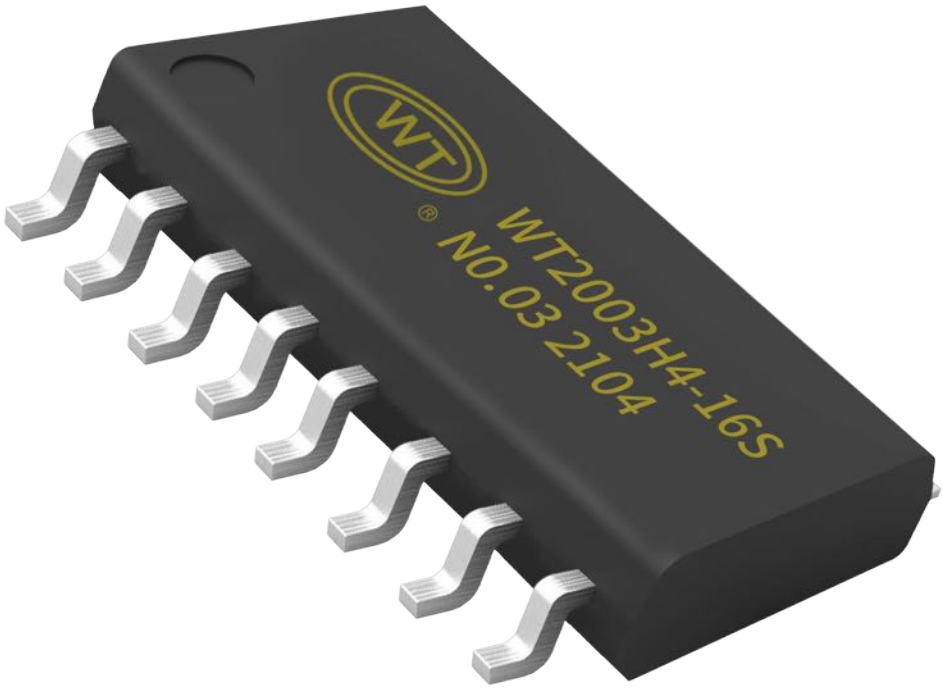
WT2003H4(SD Card)
MP3 Chip Specification

Version: V1.00



Note :

WAYTRONIC ELECTRONIC CO.,LTD. reserves the right to change this document without prior notice. Information provided by WAYTRONIC is believed to be accurate and reliable. However, WAYTRONIC makes no warranty for any errors which may appear in this document. Contact WAYTRONIC to obtain the latest version of device specifications before placing your orders. No responsibility is assumed by WAYTRONIC for any infringement of patent or other rights of third parties which may result from its use. In addition,WAYTRONIC products are not authorized for use as critical components in life support devices/systems or aviation devices/systems, where a malfunction or failure of the product may reasonably be expected to result in significant injury to the user, without the express written approval of WAYTRONIC.

CONTENT

1. Product Introduction

WT2003H4-16S is a multi-functional high-quality sound IC, it adopted high-performance processor, its highest rate can reach 120MHz with the characteristics of low-cost, low power consumption and strong versatility. It is built-in with the sound volume of 100 seconds or 350 seconds. The control way of this chip is very flexible: support normal UART. It supports TF card and USB drive as storage. It has the function of playing by clues, inserting, playing in circle. The sound volume is adjustable with 32 levels. It can support largest TF card or USB drive of 32 G.

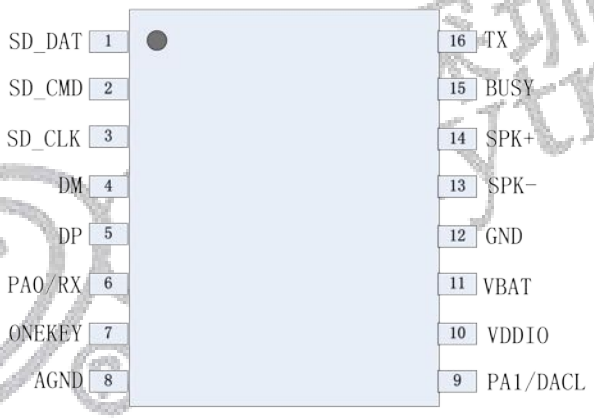
2. Product Features

- Support TF card and USB drive
- Support FAT，FAT32 file series
- Way of controlling: normal UART communicating interface, support DMA and flow control, tacitly approve 9600 baud rate.
- Tacitly approve off while power-on, with BUSY state indication、BUSY means high electrical level
- It supports switching the audio output mode. The sample defaults to SPK output. If DAC output is required, please refer to the audio output switching instruction (0xb6)
- The external TF card can be connected to the computer through the USB interface of the chip to view or modify its content, and directly download the voice in the computer to the removable drive letter simulated by the TF Card (simulated U disk) (XP system, win7 system, win10 system);
- Support high quality sound format, (8kbps~320kbps) of beautiful voice
- It can support maximum TF card and USD drive of 32 G
- Built-in 0.5W D type power amplifier
- The sound volume is adjustable with voice volume level of 32
- Two 16 bit asynchronous divider timers
- Digital sound flaw, IIS support host mode and subsidiary mode

- A IIC processor
- A infrared remote decoder
- 16 bit exquisite ADC；
- 16 bit exquisite DAC；
- High power IO driving capacity, up to 64ma
- When a single chip is used (using built-in capacity), the built-in voice needs to be written before leaving the factory

3. PIN Relevance

3.1. SOP16 PIN Package Description



WT2003H4-16S

PIN	Name	Type	Explanation
1	SD_DAT	I/O	SD card data
2	SD_CMD	I/O	SD card data
3	SD_CLK	I/O	SD card clock
4	DM	I/O	USB DM
5	DP	I/O	USB DP
6	PA0/RX	I/O	IO interface
		I/O	UART asynchronous serial port data input
7	ONEKEY	I/O	Next one

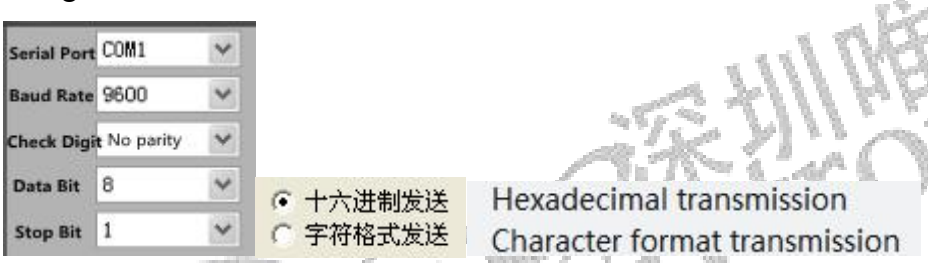
8	AGND	G	Audio
9	PA1	I/O	IO interface
	DACL	O	DAC left sound track output
10	VDDIO	P	3.3V mains output
11	VBAT	P	VBAT mains input
12	GND	G	GND
13	SPK-	I/O	Horn wiring
14	SPK+	I/O	Horn wiring
15	BUSY	I/O	Busy signal(to indicate state)
16	TX	I/O	UART asynchronous serial port data output

4. Function Introduction

4.1. UART Control Protocol

4.1.1. Protocol Command Format

The standard UART asynchronous serial port interface belongs to 3.3V TTL level interface. The format of communication data is: starting bit: 1 bit; Data bits: 8 bits; Parity bit: none; Stop bit: 1 bit. Using the computer serial port debugging assistant, you need to set the parameters of the serial port correctly, as shown in the figure below:



start code	Length	Command code	Parameter	Accumulation and verification	Ending code
0X7E	As follows	As follows	As follows	As follows	0XEF

Note: "Length" refers to length+command code+parameter+checksum, and "accumulation and check" refers to the low byte of length+command code+parameter accumulation sum.

4.1.2. Command List

Communication Control Instruction

CMD details	Corresponding function	Parameter
A2	Appointing SD card directory index play	File directory
A3	Specify SD card file name to play	File name
A4	Appointing SD card directory index play	Folder name, file directory
A6	Appointing USD drive directory index play	File directory
A7	Appointing folder name play	Folder name

A8	Appointing USB drive folder files directory index play	Folder name, folder index
AA	Pause command	Empty
AB	Stop commanding	Empty
AC	Next one	Empty
AD	Last one	Empty
AE	Sound volume command	Sound volume level
AF	Appointing play mode	Cyclical pattern
B1	Insertion instruction	Working drive letter, file index
B6	Audio output mode switching	Empty
D2	Changing current working drive letter	Working drive letter

Communication Query Command

CMD details	Corresponding function	Parameter
C1	Query the currently set volume	C1 XX
C2	Query the current working status	C2 XX
C5	Query the total number of music files in SD card	C5 XXXXX
C6	Query the total number of music files in the specified folder in SD card	C6 XXXX
C7	Query the total number of music files in U disk	C7 XXXX
C8	Query the total number of music files in the specified folder in U disk	C8 XXXX
C9	Query the currently playing file track	C9 XXXX
CA	Query the current peripheral connection status	CA XX
CB	Query the name of the currently playing track	CB XX XX

4.1.3. Writing Operation Instructions

4.1.3.1.Writing Operation Instruction Return Code Format

Note: After each write command is executed, one byte of operation code corresponding to the command is returned.

Operating code
XX

Return code：→: 00 means：OK command carried out

→: 01 means：FAIL command is wrong, do not executed

→: 02 means：EMP no such files

4.1.3.2.Specify SD Card File Index Play（A2）

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

Start code	Length	Command	Track high position	Track low position	Check code	Ending code
7E	05	A2	00	01	XX	EF

Note: If the specified track does not exist during specified playback, it will not affect the current playback.

Examples: Send→◇7E 05 A2 00 01 A8 EF □

Take←◆A2 00

4.1.3.3.Specify SD Card File Name to Play（A3）

This command can specify the file name in the root directory of SD card to play (the file name must be 4 bytes)

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

Among them, "54, 30, 30, 32" are the ASCII codes of T002 respectively, only the file name adopts ASCII code values, and other data are hexadecimal values; The above instruction indicates that the audio file named "T002.mp3" under the specified root directory is played. examples：send→◇7E 07 A3 54 30 30 32 82 EF □

take←◆A3 00

4.1.3.4.Specify Index Play in SD Card Folder（A4）

This command can specify the file index in the folder under the root directory to play (the folder name is fixed to 5 characters)

Start code	length	comm and	Folder name (high-low)					File directory index (high-low)		Check code	Ending code
7E	0A	A4	'M'	'U'	'S'	'I'	'C'	00	01	XX	EF

Among them, only the folder name adopts ASCII code value, and other data are hexadecimal values; The above instruction indicates that the second audio file (index number 0001) in the folder named "MUSIC" under the specified root directory is played.

Eg. send→◇7E 0A A4 46 46 46 31 31 00 07 E9 EF □

take←◆A4 00

4.1.3.5.Specify the U disk Root Index to Play(A6)

This command can specify to play files in USB flash drive. Affected by the order in which files are stored. The files are sorted in index order.

Start code	length	command	Track high position	Track low position	Check code	Ending code
7E	05	A6	00	01	XX	EF

This command can specify to play files in USB flash drive. Affected by the order in which files are stored. The files are sorted in index order.

Eg.：send→◇7E 05 A6 00 02 AD EF □

take←◆A6 00

4.1.3.6.Specify the file name of USB flash drive to play(A7)

This command can specify the file name in the root directory of U disk to play (the file name must be 4 bytes).

Start code	length	Command	File name (high-low)				Check code	Ending code
7E	07	A7	54 'T'	30('0')	30('0')	32('2')	XX	EF

Where: "54", "30", "30" and "32" are ASCII codes of T002 respectively, only the file name adopts ASCII code value, and other data are hexadecimal values; The above instruction indicates that the audio file named "T002. Mp3" in the specified root directory is played

Eg. send→◇7E 07 A7 54 30 30 32 94 EF □

take←◆A7 00

4.1.3.7.Specify File Index Playback in USB Flash Disk Folder(A8)

This command can specify the file index in the folder under the root directory for playback (the folder name is fixed at 5 characters)

Start code	length	Command	File name (high-low)					File index (high-low)		Check code	Ending code
7E	0A	A8	'M'	'U'	'S'	'I'	'C'	00	01	XX	EF

Where: only the folder name adopts ASCII code value, and other data is hexadecimal value; The above instruction indicates the playback of the second (index number 0001) audio file in the folder named "music" in the specified root directory.

Eg. send→◇7E 0A A8 54 54 54 31 31 00 05 15 EF □

take←◆A8 00

4.1.3.8.The command of Pausing Playing (AA)

Start code	length	Command	Check code	Ending code
7E	03	AA	AD	EF

When the command is sent in the playback state, the playback is suspended; When the command is sent in the pause state, the music will continue to play from the pause.

Eg. send→◇7E 03 AA AD EF □

take←◆AA 00

4.1.3.9.The Command of Stopping(AB)

Start code	length	Command	Check code	Ending code
7E	03	AB	AE	EF

Send this command to stop playing the currently playing music.

Eg. send→◇7E 03 AB AE EF □

take←◆AB 00

4.1.3.10.Next Command(AC)

Start code	length	Command	Check code	Ending code
7E	03	AC	AF	EF

This command can trigger the playing of the next music. When playing the last music, sending this command can trigger the playing of the first music.

Eg. send→◇7E 03 AC AF EF □

take←◆AC 00

4.1.3.11.Previous Command(AD)

Start code	length	Command	Check code	Ending code
7E	03	AD	B0	EF

This command can trigger the playback of the previous music. When playing the first music, sending this command can trigger the playback of the last music.

Eg. send→◇7E 03 AD B0 EF □

take←◆AD 00

4.1.3.12.Volume Control Command(AE)

There are 32 levels of volume, 00 ~ 31 (00 ~ 1F), of which 00 is mute and 31 is the maximum volume.

Start code	length	Command	Sound volume level	Check code	Ending code
7E	04	AE	1F	XX	EF

In the example, to send the maximum volume level 31, this command can modify and adjust the volume in real time.

Eg. send→◇7E 04 AE 1E D0 EF □

take←◆AE 00

4.1.3.13.Appointing Playing Mode(AF)

Start code	length	Command	parameter	Check code	Ending code
7E	04	AF	00 :Single non looping mode (default)	B3	EF
			01 : Single loop mode	B4	
			02 : All tracks looping mode	B5	
			03 : Random mode	B6	

Note: this command modifies the playback mode without power failure, and the default mode will be restored after power failure. When using this instruction, it is recommended that MCU set it once during module initialization to realize that it can be executed in the set way every time it is powered on. If the current playback mode is all track cycle, send A4 / A8 command to play a song in the specified folder. At this time, it will cycle in the current folder.

Eg. send→◇7E 04 AF 00 B3 EF □

take←◆AF 00

4.1.3.14.Intercut-cut Indication(B1)

Start code	length	Command	Indication	Track high position	Track low position	Check code	Ending code
7E	06	B1	01	00	01	XX	EF

Note: When this instruction is received, the playing track will be suspended, and then the playing track specified in this instruction will be executed. After the playing is finished, the originally suspended track will be played (the deviation can be within 1 second or whole second).

When the first insertion command is not played out and the second insertion command is sent, the command is invalid. It is necessary to wait for the first break music to be played before it can be interrupted again, which supports the break between the same device or different devices.

Indicative letters: →01 indicate: inter-cut SD card appointing index address

→02 indicate: inter-cut the appointing index address

Note: It can inter-cut between several equipment.

Eg. send→◇7E 06 B1 01 00 02 BA EF □

take←◆B1 00

4.1.3.15.Audio Output Mode Switching（B6）

Start code	length	Command	Parameter	Check code	Ending code
7E	04	B6	00	BA	EF
			01	BB	

Parameters: 00 means SPK output, 01 means DAC output

Eg. send→◇7E 04 B6 00 BA EF□ (without backing code)

4.1.3.16.Switch the Current Working Drive Letter（D2）

Start code	length	Command	Parameter	Check code	Ending code
7E	04	D2	01：SD 卡(tacitly approve)	D7	EF
			02：USB drive	D8	

Eg. send→◇7E 04 D2 01 D7 EF □

take←◆D2 00

4.2. Read the Operating Instructions

4.2.1. Query the Currently Set Volume（C1）

Start code	length	Command	Check code	Ending code
7E	03	C1	C4	EF

Back format

Operating code	**Backing value**
0XC1	Sound volume value (00-1F)

Eg. send→◇7E 03 C1 C4 EF □ （current sound volume is 20）

take←◆C1 14

4.2.2. Read the Current Working Status（C2）

Start code	length	Command	Check code	Ending code
7E	03	C2	C5	EF

Back format

Operating code	**Back value**
0XC2	01：play 02 stop； 03：pause

Eg. send→◇7E 03 C2 C5 EF □

take←◆C2 01

4.2.3. Query the Total Number of Music Files in SD Card (C5)

Start	length	Command	Check code	Ending code
	03	C5	C8	EF

Back format

Operating code	**Backing value(2BYTE)**
0XC5	Folder total number

Eg. send→◇7E 03 C5 C8 EF □

take←◆C5 00 07

4.2.4. Query the Total Number of Music Files in SD Card(C6)

Note: (The folder name is fixed to 5 characters)

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

Among them: the folder name exists in the form of ASCII code; The above instruction indicates reading the total number of audio files in the folder named "MUSIC" under the root directory

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

Operating code	Return value(2BYTE)
0XC6	Folder total number

Eg. send→◇7E 08 C6 46 46 46 31 31 02 EF □

take←◆C6 00 03

4.2.5. Query the Total Number of Music Files in U Disk(C7)

Start code	length	command	Check code	Ending code
7E	03	C7	CA	EF

Return format

Operating code	Return value(2BYTE)
0XC7	Folder total number

Eg. send→◇7E 03 C7 CA EF □

take←◆C7 00 07

4.2.6. Query the Total Number of Music Files in the Specified Folder in U Disk(C8)

Note: (The folder name is fixed to 5 characters)

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

Among them: the folder name exists in the form of ASCII code; The above instruction indicates reading the total number of audio files in the folder named "MUSIC" under the root directory Return format (C8 00 00 means no audio file or this folder)

Operating code	Return value(2BYTE)
0XC8	Folder total number

Eg.◇7E 08 C8 4D 55 53 49 43 51 EF □

take←◆C8 00 03

4.2.7. Query the Current Peripheral Connection Status(C9)

Start code	length	Command	Check code	Ending code
7E	03	C9	CC	EF

Return format

Operating code	File number high byte	File number low byte
0XC9	XX	XX

Eg. send→◇7E 03 C9 CC EF □

take←◆C9 00 02

4.2.8. Query the Current Peripheral Connection Status（CA）

Start code	length	Command	Check code	Ending code
7E	03	CA	CD	EF

Back mode

Operating code	Back value
0XCA	XX

When SD card and U disk are inserted or pulled out, WT2003H will actively return data for prompting; The lower 4 bits of the return value respectively represent the existing States of PC connection (BIT3), USB flash drive (BIT2) and SD card (BIT1)

1- existed，0 - do not exist。

例：0X01：Connected without PC（BIT3=0）, without USB drive (BIT2=0), without SD card(BIT1=0)；

0X06：Connected without PC（BIT3=0），with USB drive (BIT2=1)，with SD card (BIT1=1)；

eg. send→◇7E 03 CA CD EF □ （connected by USB drive）

take←◆CA 04

4.2.9. Query the Song Name of the Currently Playing Song（CB）

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

Back format

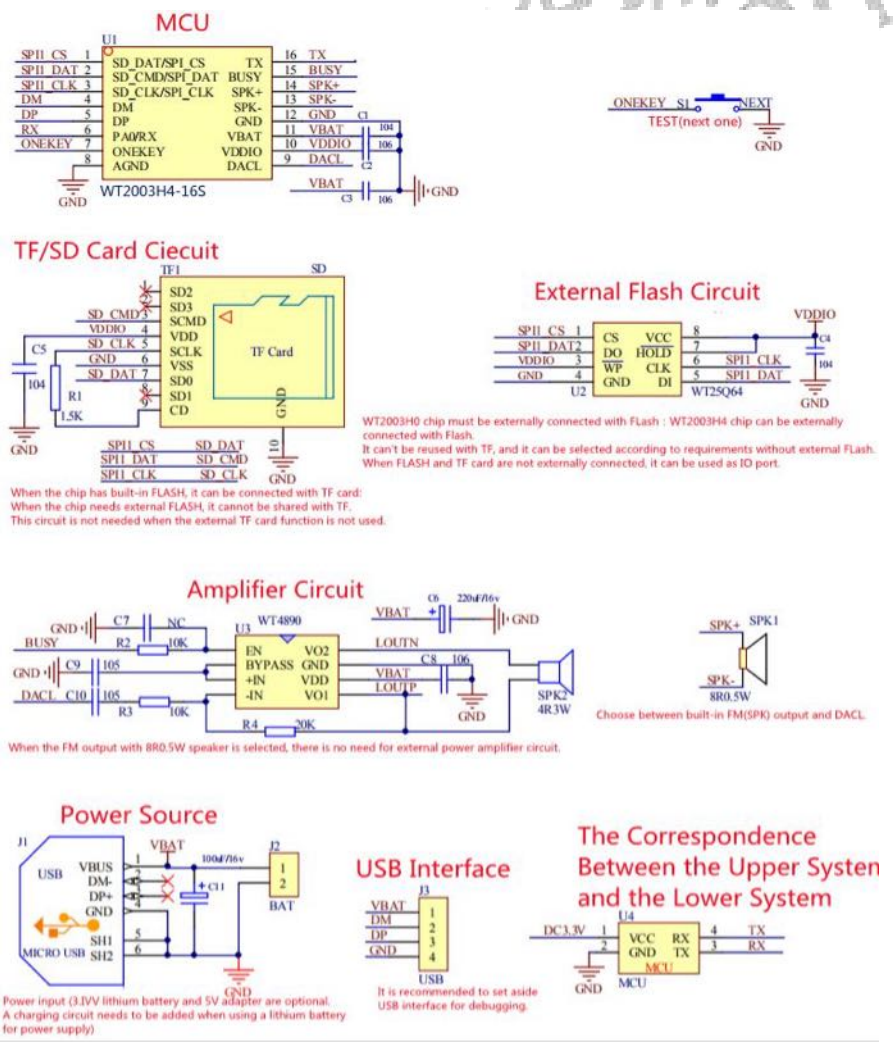
Operating code	**Back value**
0XCB	XX (8 bytes)

The returned data is represented by ASCLL code. If the song name is less than 8 bytes, it will be supplemented by 20H.

Eg. send→◇7E 03 CB CE EF □

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

4.3. SOP16 Package Circuit Design Reference



5. Electrical Parameter

5.1. Absolute Maximum Rated Parameter

Symbol	Parameter	Min	Max	Unit
Tamb	Ambient Temperature	-40	+85	°C
Tstg	Storage temperature	-65	+150	°C
VBAT	Supply Voltage	-0.3	5.5	V
$V_{VDDIO33}$	3.3V IO Input Voltage	-0.3	3.6	V

5.2. PMU Feature

Symbol	Parameter	Min	Typ	Max	Unit	Test Conditions
VBAT	Voltage Input	2.2	3.7	5.5	V	_
V_{VDDIO}	Voltage output	2.2	3.0	3.4	V	VBAT = 3.7V, 100mA loading
I_{VDDIO}	Loading current	_	_	100	mA	VBAT=3.7V

5.3. IO Input/Output Electrical Logical Feature

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

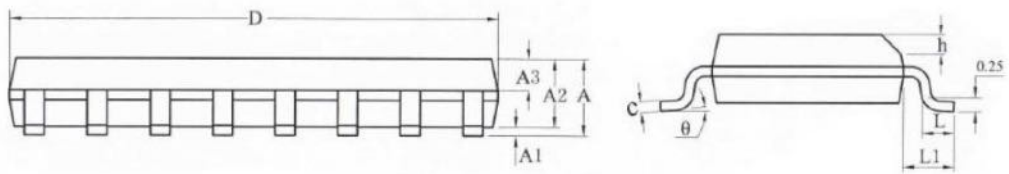
5.4. Stimulative DAC Feature

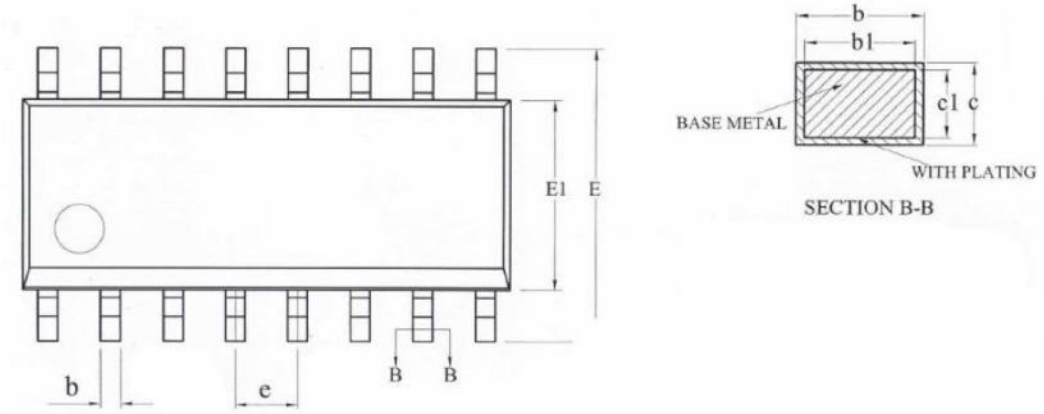
Parameter	Min	Typ	Max	Unit	Test Conditions
Frequency Response	20	_	16K	Hz	1KHz/0dB 100kohm loading A-Weighted Filter
THD+N	_	-65	_	dB	
S/N	_	95	_	dB	
Output Swing	_	0.54	_	Vrms	
Dynamic Range	_	92	_	dB	1KHz/-60dB 100kohm loading With A-Weighted Filter
Output Resistance	_	8.3	_	K	_

6. Package Information

6.1. SOP16 Package Size

Unit：mm





Name	Minimum	Typical value	Maximum
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°