Real 7.1 Sound Channel Dolby Digital EX, DTS-ES 96/24 Decoding Solution DA32VF

◆ Features

- CRYSTAL CS495313 32bit audio DSP, CS8416 low time base error 192 KHz digital receiver, CS42448A 192 KHz/24bit ADC and DAC is the chip combination of the highest performance AV reception power amplifier decoding nowadays.
- Support various decoding such as Dolby digital EX, DOLBY PRO-LOGIC, HDCD, PRO-LOGIC Ⅱ, DTS-ES Matrix, DTS-ES Discrete, DTS 96KHz/24bit, and DTS-ES 96KHz Matrix; at the same time have various sound field effect playback functions such as HALL, STADIUM, CLASSICA, PANORAMA, and THEATER..
- support various listening modes such as STEREO, BYPASS, AC-3 7.1, DTS ES 7.1, PLIIX MUSIC, PLIIX MOVIE, and DTS：Neo6.
- Support Dolby and DTS standard delay audio frequency effect setup and dynamic range regulation function, i.e. night mode.
- 256 milliseconds LIP SYNC DELAY synchronous delay time function, and audio-visual sync function with large-screen TV is excellent.
- Provide 8 groups of digital audio direct input, custom optical fiber input and coaxial input at most; provide many groups of analog input switch signal A/B/C and using switcher can switch 8 analog inputs.
- Adopt STL215 singlechip, can upgrade program directly online and directly drive many kinds of VFD displays, in addition single CPU can realize overall functions. Also can adopt CTB mode to communicate with external singlechip programmed by user.
- Have passed DTS and DOLBY certification and accord with the requirements of the environmental protection products completely.

◆ Application field

- Digital audio decoder or analogy audio decoder.
- AV reception power amplifier, computer multi-channel multimedia sound box, etc.
- Another high-class sound box or audio-visual products.

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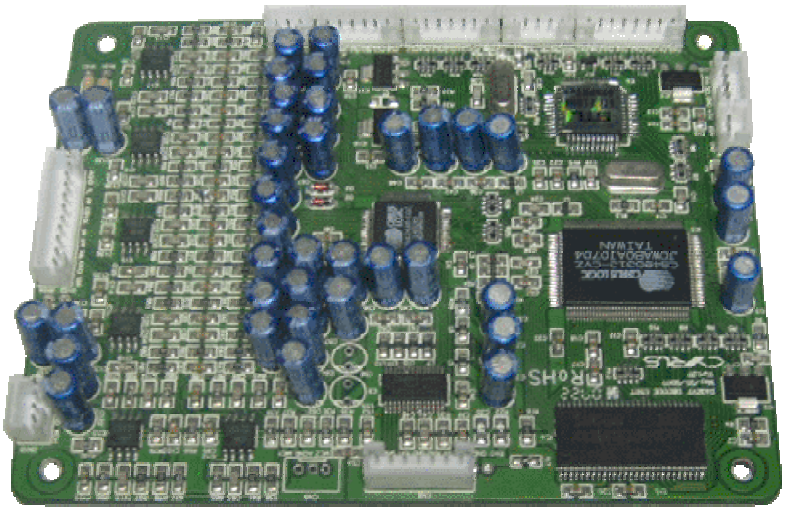
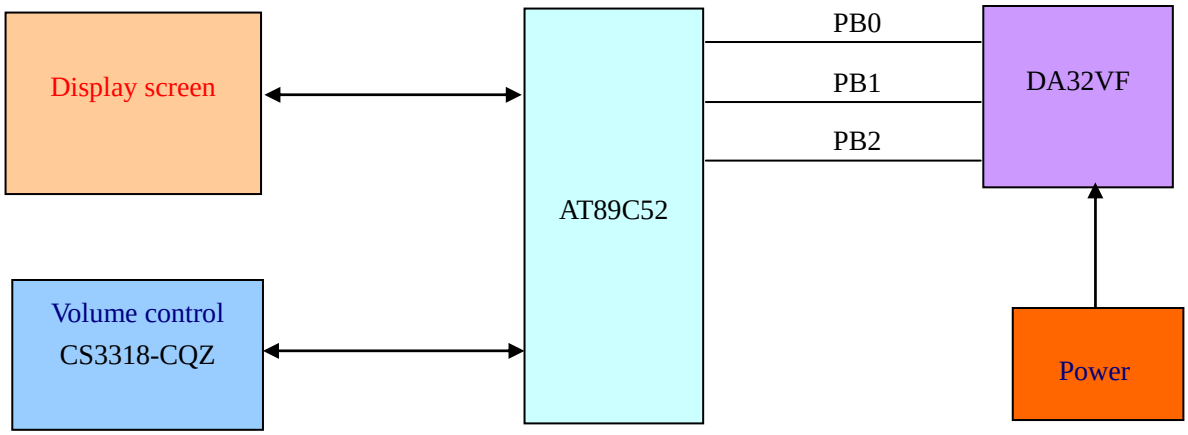
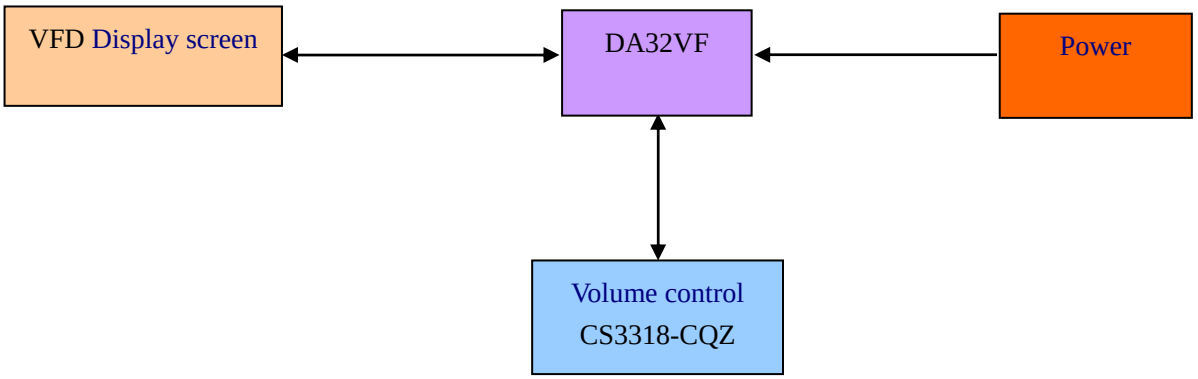


◆ Function application block diagram

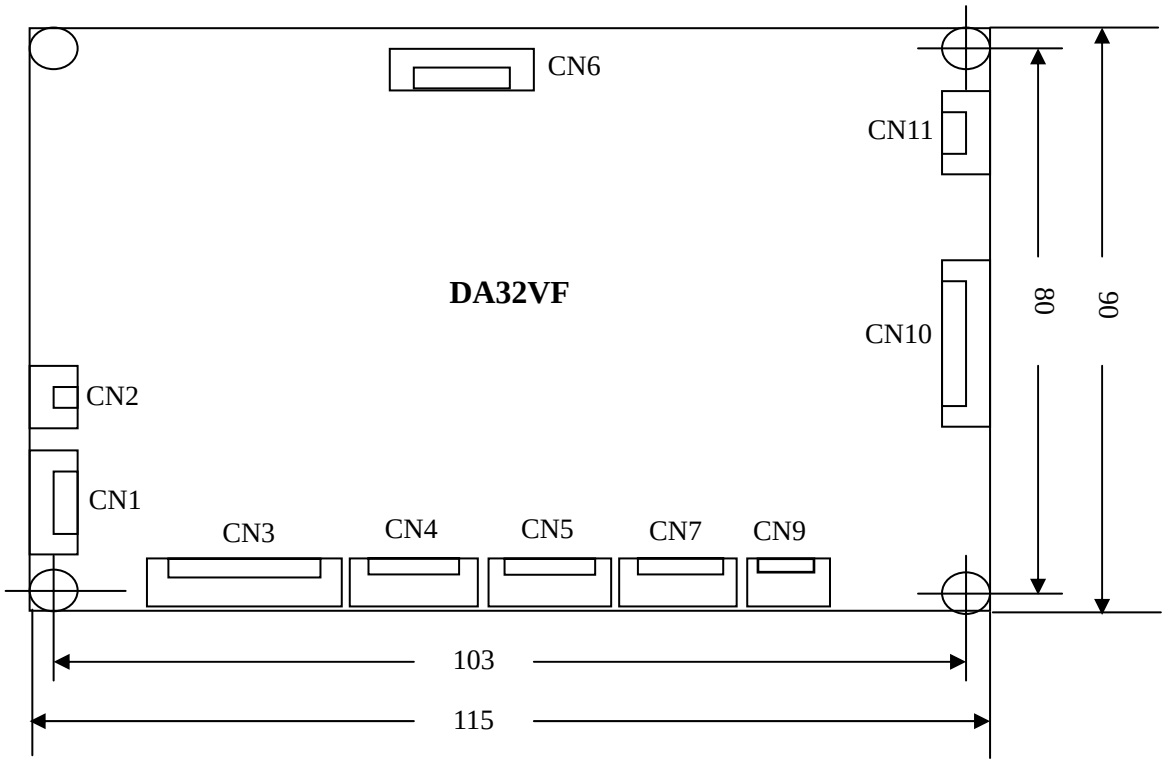


The function block diagram of external singlechip that user can program by yourself

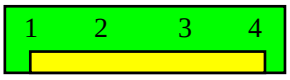


DA32VF function block diagram

◆ Outline dimension (unit: mm) and socket port instruction

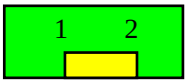


CN1



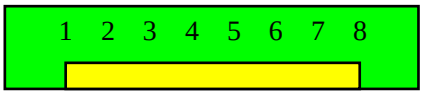
1. **SDA** the serial data input/output port that controls external volume chip, and it is reused with the clock used to debug download.
2. **SCL** The serial clock output port that controls external volume chip, and it is reused with the clock used to debug download.
3. **GND** Ground wire input and output.
4. **+5V** Power supply +5V output.

CN2



1. **B5V** Singlechip power supply 5V input. Don't pass through off/on switch, and supply power for singlechip for long time. Even if when decoder is standby singlechip still work normally.
2. **GND** Ground wire input and output.

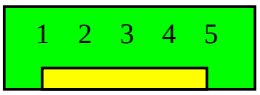
CN3



1. **PA7** Expansion singlechip I/O port, standard bi-directional, built-in pull-up resistor.
2. **PA6** Expansion singlechip I/O port, standard bi-directional, built-in pull-up resistor.
3. **PA5** Expansion singlechip I/O port, standard bi-directional, built-in pull-up resistor.
4. **PA4** Expansion singlechip I/O port, standard bi-directional, built-in pull-up resistor.
5. **PA3** Expansion singlechip I/O port, standard bi-directional, built-in pull-up resistor.

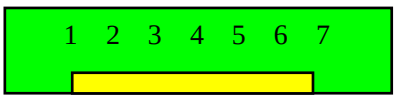
6. **PA2** Expansion singlechip I/O port, standard bi-directional, built-in pull-up resistor.
7. **PA1** Expansion singlechip I/O port, standard bi-directional, built-in pull-up resistor.
8. **PA0** Expansion singlechip I/O port, standard bi-directional, built-in pull-up resistor.

CN4



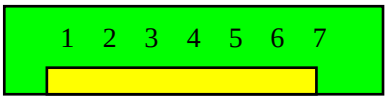
1. **REM** Remote control signal input port.
2. **PB7** Interrupt input port.
3. **PB3** Interrupt input port.
4. **PB1** Interrupt input port.
5. **PB0** Interrupt input port.

CN5



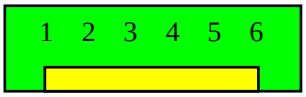
1. **PC7** Expansion singlechip I/O port, standard bi-directional, built-in pull-up resistor.
2. **PC4** Expansion singlechip I/O port, standard bi-directional, built-in pull-up resistor.
3. **PC3** Expansion singlechip I/O port, standard bi-directional, built-in pull-up resistor.
4. **PC2** Expansion singlechip I/O port, standard bi-directional, built-in pull-up resistor.
5. **PC1** Expansion singlechip I/O port, standard bi-directional, built-in pull-up resistor.
6. **PC0** Expansion singlechip I/O port, standard bi-directional, built-in pull-up resistor.
7. **PB6** Interrupt input port.

CN6



1. **RX3** The fourth group of digital input.
2. **+5V** Empty pin.
3. **RX0** The first group of digital input.
4. **GND** Ground wire input and output.
5. **RX1** The second group of digital input.
6. **GND** Ground wire input and output.
7. **RX2** The third group of digital input.

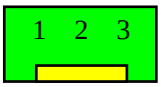
CN7



1. **+5V** Decoder power supply +5V input/output. Pass through off/on switch and supply power for the other parts except singlechip and operational amplifier. Dong like this is better to optimize the function of system, and prevent decoder from disturbing the other parts.
2. **GND** Ground wire input and output.
3. **PE2** Expansion singlechip I/O port, standard bi-directional, built-in pull-up resistor.
4. **PE0** Expansion singlechip I/O port, standard bi-directional, built-in pull-up resistor.

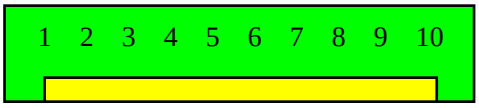
5. **PC5** Expansion singlechip I/O port, standard bi-directional, built-in pull-up resistor.
6. **PC6** Expansion singlechip I/O port, standard bi-directional, built-in pull-up resistor.

CN9



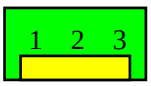
1. **－9V** Operational amplifier power supply –9V input/output.
2. **AGND** Analogy ground wire input/output.
3. **+9V** Operational amplifier power supply +9V input/output.

CN10



1. **SBR** Surround back right channel output.
2. **AGND** Analogy ground wire input and output.
3. **SBL** Surround back left channel output.
4. **SW** Extra bass channel signal output.
5. **SR** Surround right channel output.
6. **SL** Surround left channel output.
7. **CEN** Central channel output.
8. **FR** Front right channel output.
9. **FL** Front left channel output.
10. **AGND** Analogy ground wire input and output.

CN11



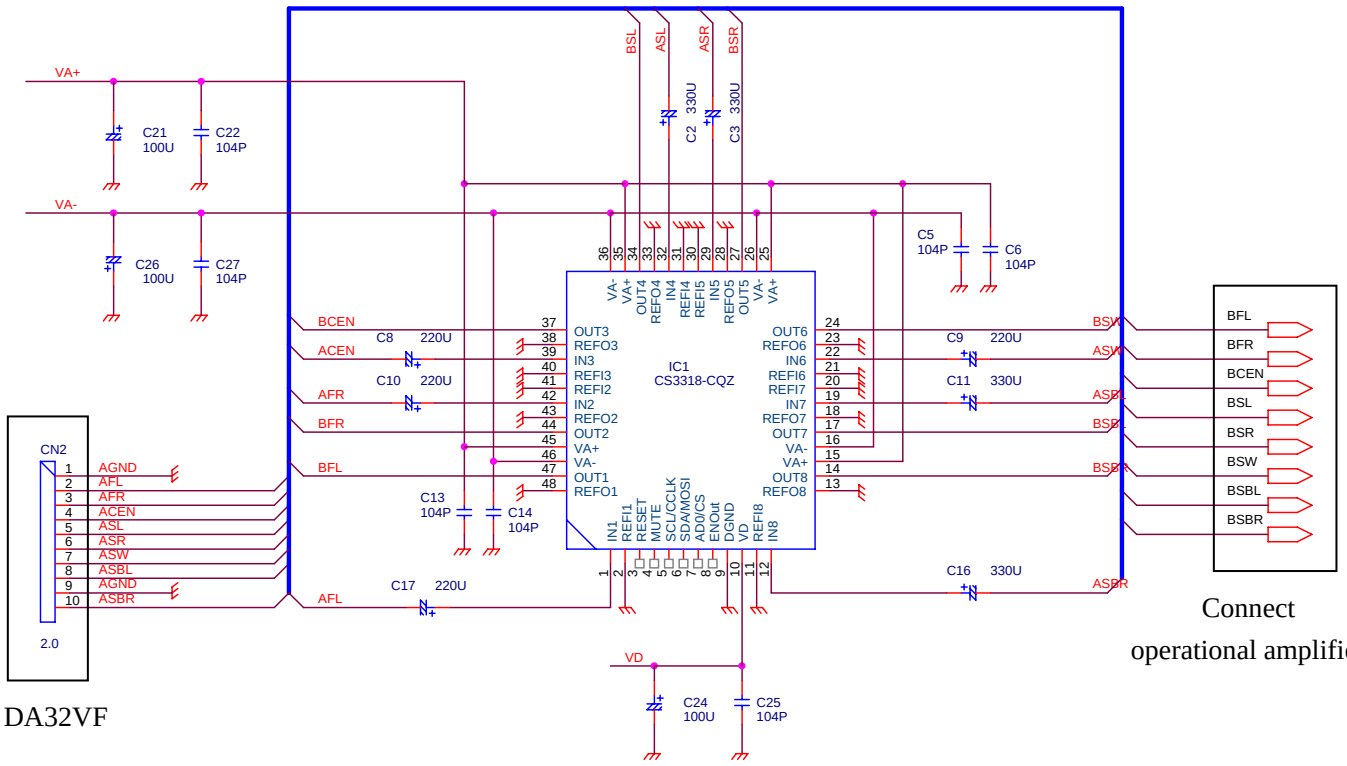
1. **RCH** Right sound channel input.
2. **AGND** Analogy ground wire input and output.
3. **LCH** Left sound channel input.

◆ Ground wire notes

There is no connection between AGND and GND in DA32VF, and connection on the user board is necessary. If +5V supply ground wire and analog ground wire are not in the power supply terminal, the connection point should near to the DA32VF pins. GND connects with ground wire of metal outer cover to keep the resistance of ground wire lower for a good effect. Or connecting at the place supplying is also acceptable, while the position nearing the DA32VF pins is preferable for a better effect.

◆ Audio frequency processing instruction

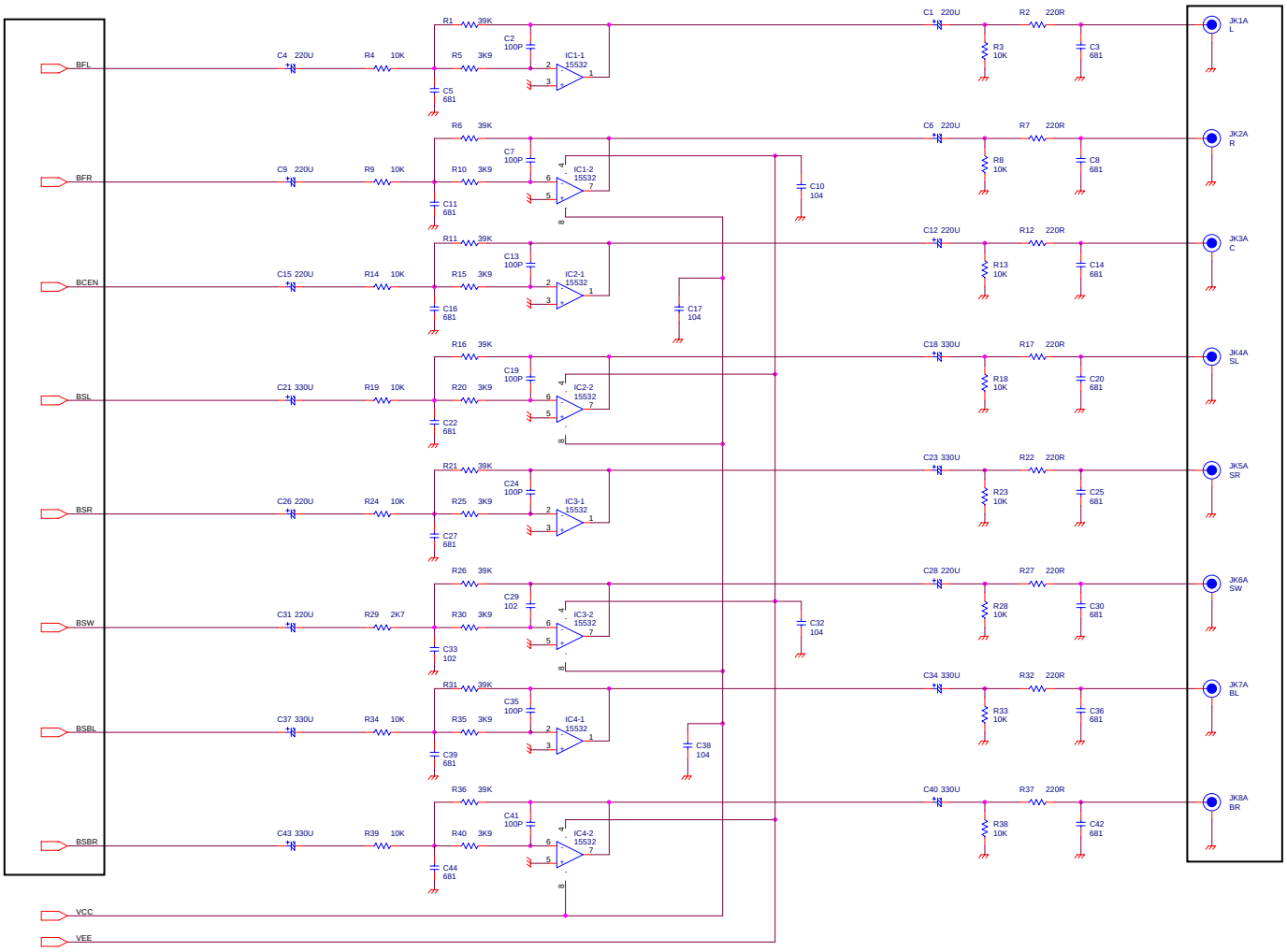
± Power supply is the best choice for the sake of a good effect ,if the power supply of the complete system is ±power supply. If there is not special requirement for sound, it is acceptable that operational amplifier is not used and directly use resistance and capacitor filter, but signal output amplitude and high frequency are not good.



Audio frequency out circuit that adopts CS3318-CQZ as volume control and bass management

Connect operational amplifier

After volume



Double power supply application audio frequency output circuit diagram

◆ Electrical specifications

Sequence number	Item	Minimum	Typical	Maximum
1	+5V power supply voltage			
2	+5V working current			
3	Digital RX input			
4	Analog input valid detection level			
5	0@0dB Analog signal output 0@0dB			
6	Analog signal output 0@0dB			
7	Output noise level (digital input CCIR/ARM)			
8	Output noise level (digital input, not weighted)			
9	Output noise level (analog input CCTR/ARM)			
10	Output noise level (digital input, not weighted)			
11	Frequency response (20Hz-20KHz)			

◆ The instruction about software with communication interface

DA32VF supplies user mainframe customization function and is able to independently finish whole machine function. If the user's product is with single-chip, can select SSB bus communication.

DA32VF configuration has hardware's SSB bus and user single-chip communication, and applies 8-bit address and 8-bit data. B7 means the seventh bit of the data, B6 means the sixth bit of the data, and the rest can be deduced by analogy.

The code selected by sound channel: 0x00 is FL (front left channel); 0x01 is CE (central channel); 0x02 is FR (Front right channel); 0x03 is SL (surrounded channel); 0x04 is SR (surrounded right channel); 0x05 is BL (back left channel); 0x06 is BR (back right channel); 0x07 is SW (extra bass channel).

DA32VF supports BL channel and BR channel. But the DA32UQ and the instructions of DA32UD and decoder supporting 7.1-channel are each other compatible.

DA32VF supports DSP EFFECT。

DA32VF supports speaker setting.

◆ The table of user mainframe write command

Address	Function (Usual value)	Data and detailed instruction
0x01	Selection of input port (0x00 is inputted through digital RX1)	When B7 is 1 the selected is analog signal input. When B7 is 0 the selected is digital input. From B1 to B0, choose the different digital ports. 0x00 is inputted through RX1;0x01 is inputted through RX2;0x02 is inputted through RX3.
0x02	listening mode switch（0×00 is automation）	If B7 is 1 it means the selected is TEST TONE function. B3 to B0 are corresponding choice of channels with the same code of channel choice. When 0x08 is chosen, all channels are mute, but enter TEST TONE state.
		When B7 is 0 and B6 is 1 choose DSP EFFECT。 B2 to B0 choose different effects. 0x00 is MATRIX; 0x01 is LIVE;0x02 is CHURCH;0x03 is STADIUM;0x04 is SIMULATED;0x05 is HALL;0x06 is CHORUS;0x07 is THEATRE.
		When B7 is 0 and B6 is 0 choose standard listening mode. B2 to B0 choose different effects. 0x00 is digital automation，if input is Dolby digital AC-3，the listening mode is AC-3 DIGITAL; If input is DTS, the listening mode is DTS DIGITAL. 0x01 is stereophonic sound. 0x02 is Dolby Pro logic mode.

0x03	Speaker setting (0×00 is standard configuration 1, all are small speakers with extra bass)	B7 is back channel speaker size selection, 1 is big speaker. B6 is surrounded channel speaker size selection, 1 is big speaker. B5 is central channel speaker size selection, 1 is big speaker. B4 is front channel speaker size selection, 1 is big speaker. B3 is extra bass channel setup selection, 1 means not being installed. B2 is back channel setup selection, 1 means not being installed. B1 is surrounded channel setup selection, 1 means not being installed. B0 is central channel setup selection, 1 means not being installed.
0x04	Dolby digital dynamic compression (0x00 is no-compression)	It will be effective only when the input digital flow is Dolby digital AC-3. When 0x00 is normal no-compression replay. The others value are dynamic compression mode replay.
0x10 to 0x17	Channel delay time adjustment	0x10 is FL channel; 0x11 is CE channel and so on. They correspond to the code of channel selection. (DA32VF only support central channel of 0x11 and surrounded channel of 0x13.) Delay time write of central channel is 0ms to 30ms; in the DTS and Dolby Digital mode it is 0ms to 30ms, and in the Dolby Pro logic mode is actually 0ms to 30ms. Attention: only when 1istening mode is digital automation or under the Dolby Pro logic mode can take effect.

◆ User mainframe interrupt and read command

Address	Function (Usual value)	Data and specification instruction
0x7f	Clear interrupt	Writing 0x80 will clear SIN application interrupt action caused by address 0x80. In general, only after reading right, the interrupts will be cleared.
0x80	Signal input status (Read only)	B6 to B4 is Dolby digital or DTS input sound code format. 0x00 is 1+1，0x01 is 1/0，0x02 is 2/0，0x03 is 3/0，0x04 is 2/1，0x05 is 3/1，0x06 is 2/2，0x07 is 3/2。 B3 is DTS digital signal input。 B2 is Dolby digital AC3 signal input。 B1 is PCM digital signal input。 B0 is no signal input。

◆ Simple Series Bus instruction

Simple **S**eries **B**us is called SSB for short, it is composed of SCK bit clock, and SDD bit data, SIN address locking and interrupt.

All three lines of SSB are high level when they are idle. Generally adopt ports of open-drain structure such as 8051 series ports, and take advantage of pull-up resistor to make the level high. If ports with input and output selection are adopted, the port will be set to input when idle and output are high, and only when output low level the port will switch to output, which is convenient for procedure processing.

SSB must adapt to various ports from 2.5V to 5.0V. If connection wire between master and slave is too long, pull-ups can be added or capacitors from several P to hundreds of P can be connected with ground wire to filter disturbance from the circuit.

SSB bus adopts SCK as serial synchronous clock that is outputted by master, SDD as serial synchronous data and it is bi-directional data, and SIN as interrupt port slave applying from master and address locking signal from master to slave. When master is sending signals to the address, the level is low.

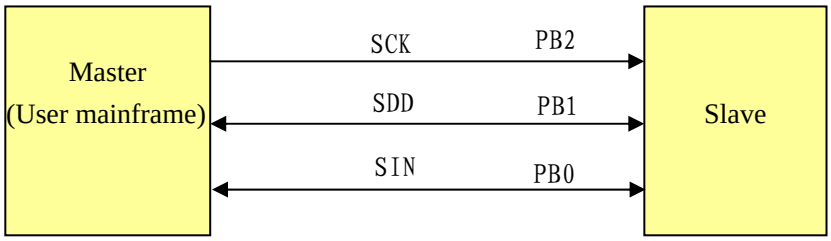
SSB is composed of address, data and response signal, among which the address is outputted by master and inputted by slave unchangeably; the data is bi-directional transmission, when master writes register it is output and reads register it is input; And response signal offers a mechanism to confirm whether the transmission is right or not; The confirmation signal is initiated by slave and its value is fixed unchangeably as the contrary value of the last data bite. If master doesn't receive the correct response signal, then it requires re-sending.

In the transmission of SSB, low bit outputs first. During the transmission of address signal， principal has to put SIN low, while in the process of transmission data and answering must make SIN high.

There are two kinds of SSB: low speed type and high speed type, two kinds of control modes are identical. The communication speed of the low type is 33Kbps, namely, each SCK time is 30US (one falling margin to next falling margin). The communication speed of the high type is 1Mbps, namely, each SCK time is 1us.

SSB address is composed of 4 to 8 bits. According to different address bits, there are SSB4 with 4 bits and SSB8 with 16 bits. DA32VF applies the low speed bus of SSB8.

DA32VF uses low speed SSB with 8-bit address and 8-bit data.



The connection diagram of master and slave

◆ DA32VF SSB8 Low-speed bus instructions

In process of communication, the master is singlechip used by user mainframe and called for short user mainframe. The slave is DSP used by DA32VF and called for short DA32VF.

It is suggested to apply the port without input and output control port to communication. If user mainframe has input and output direction selections, only when output low level the selection is output. Such can automatically adapt to SSB level.

Time order of SSB8 write register Instructions

DA32VF adopts low-speed SSB8. Address length is 8 bits and data length is 1 byte each 8 bits.

When the user mainframe writes register, 8-bit address should be written first and low bit should output first.

Time order of write register is as follows:

Make SIN low.

Output A0 bit of the address first.

Make SCK low and delay time to the corresponding time (low speed is 15us, high speed is 0.5us).

Make SCK high and delay time to the corresponding time (low speed is 15us, high speed is 0.5us).

Output A1 bit of the address.

Repeat 3 to 5 until finishing A7 bit.

Make SIN high.

Output D0 bit and repeat the action of SCK until finishing D7 bit.

Make SDD high and turn SDD into input, which is in order to prepare for receiving response bit.

Make SCK low and delay time, when slave will output the opposite code of D7 as confirmation signal.

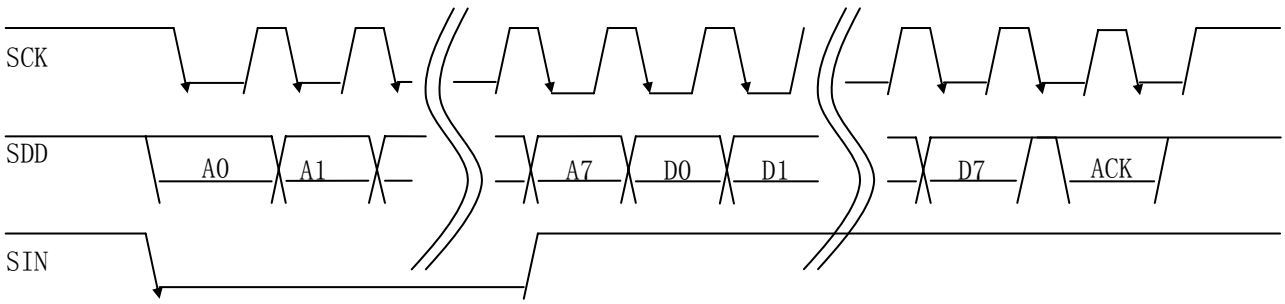
Make SCK high and compare with the value reading SDD after delaying, if values are opposite, it means reading data succeeds.

Make SCK low and delay time, at this moment slave will output SDD as high.

After making SCK high and delaying time, write register is finished.

If write is not successful, then begin rewriting until commands are written correctly.

Attention: No matter SIN is high or low, when SCK turns into low for the first time, DA32VF will output SIN as high. If write and read make a mistake, the slave will turn into low again in order to send interrupt signals to the master when the bus is idle.



User mainframe write register command

◆ Multimedia No.1 source code and SSB routine

Download “Da32vf communication routine. ZIP” file. After decompressing, directly running F71.bat can generate HEX, BIN and AR5 burning and recording file.

Among the example, the generated file ROM part have been used is less than 4 K, and RAM part is less than 128bytes. The file can operate in AT89C51AK or single-chip that is compatible with AT89C51AK.

F71_SSB.c can be directly transplanted to user mainframe.

Files that can be edited and modified are as follows:

F71.bat	batch file, directly operate F71.bat to generate HEX and BIN files.
F71_main.c	Master module file, main function, main circulation and interrupt processing.
F71_sub.c	Slave module file, key-press processing, initialization and VFD17 display control.
F71_aud.c	Audio frequency processing module file, audio frequency and CS3318-CQZ volume control.
F71_ssb.c	SSB bus module file, can be directly transplanted to user mainframe.
F71_main.h	Header file, all variables are defined in this file.
F71_main.lin	Connection configuration file.

The files that cannot be edited or modified are as follows:

Da32vf.mak and da32vf.vcp	MSVC project file
F71_main.hex、F71_main.bin 、F71_main.Ar5	Generated burning and recording file.

LIB file folder is devices header file and library file.

BIN file folder is executable files and relevant tools.

◆ HSAV principles using C language compiles source code

1、Naming principle

Naming of all variable, constant or function is composed of three portions.

For example, FAUD_Mute is divided to three parts, namely, F, AUD, and _Mute.

The first portion is composed of one letter or one letter and one number, which mean the type of the definition.

Content	Meaning
Capital ‘M’	Means function.
Capital ‘F’	Means indexed variable, 1-bit variable.
Lowercase ‘g’	Means 8-bit variable.
Lowercase ‘g2’	Means 16-bit variable.
Lowercase ‘g4’	Means 32-bit variable.
Lowercase ‘g8’	Means 64-bit variable.
Lowercase ‘c’	Means constant.
Lowercase ‘p’	Means IO port.

The second part is composed of three to four English capital letters that mean the file the naming belongs to. For example, H06_AUD.C, the second part is AUD.files in common used are as following,

Content	Meaning
AUD	Universal audio frequency processing file
VOL	Multi-channel volume processing file
SUR	Multi-channel with surrounded sound processing file
SUB	Means expanding functions of main file. Because there shouldn't be too many functions in the main file to prevent being effected.
DOS	Processing file of operating system with USB mainframe or hard disk interface.
MED	Processing files with multi-media audio frequency playing, such as mp3

The third part is concrete content that have one word or several words normally. The first letter of each word is capitalized and underline can be added to each word. As the capitalized letters separate each word, there is no need for underline. The principle is that if it doesn't look good or the word is abbreviated (It's usually capitalized) underline can be used.

2、Principles of global and local variables

Content	Meaning (compatible with VC++)	C language standard
1-bit indexed variable	EXTR BOOL FAUD_Mute	Free.
8-bit non-mark variable	EXTR BYTE gAUO_Volume	Unsigned char
16-bit non-mark variable	EXTR WORD g2AUO_EQ_Mode	Unsigned into
32-bit non-mark variable	EXTR DWORD g4AUO_Mute_Timer	Unsigned long
Pointer variable	EXTR BYTE *gpAUD_Pointer	Unsigned char
Local variable	EXTR BYTE gLocal_1	Unsigned char

Local variable absolutely forbids using 1 or several letters, e.g., when 'X' is the variable, it is difficult to copy and point out how many bits, there are. All writing should be first-time named and copying is necessary in the process of application, rewriting the same name is not suggested.

As for indexed local variable BOOL FLocal_1 and 8-bit local variable BYTE gLocal_1 etc, the first part of local variable and global variable are the same. For the second part, when 'Local_' is applied means local variable. And the third part is composed of numbers from 1 to 9 and lower case letters from "a" to "z".