



Application Note

CS493xx Family for Digital TV application

[CS493xx Family]
[Multi-Standard Audio DSP]

1.1 Overview:

The CS493xx DSP family is a 24-bit fixed point audio DSP with 86MIPS (Mega Instruction per second). CS493xx family has been playing in AVR world since 1998 and already sold more than 10 million units worldwide. It is fully market proven and the most-cost effective audio DSP.

Digital TV is a high-profile and rapidly growing market and audio features are considered as a differentiated feature in Digital TV space. For this reason, the demand for audio DSP in Digital TV is getting higher and higher.

CS493xx family can be the best solution for digital TV using Cirrus's rich audio libraries that have been built for the last 8 years.

Key design criteria that CS493xx successfully accomplishes are as follows:

- CS4931xx family - Single chip standard broadcasting audio decoder (de-compression)
 - Dolby Digital for ATSC(Advanced Technology System Committee - US, Korea)
 - MPEG2 AAC for ISDB-T (Band Segmented Transmission - Japan)
 - MPEG1/2 audio for DVB-T(Digital Video Broadcasting – Europe and others)
 - Supports asynchronous data delivery (bursty delivery) via serial or parallel ports
 - Supports ES (Elementary Stream) and PES (Packetized Elementary Stream)

- CS4932xx family – Single chip standard Home Theater TV audio decoder (de-compression)
 - Home Theater TV = TV with AVR function
 - Dolby Digital, DTS, DTS-ES, MPEG, Pro-Logic II, DTS Neo:6
 - Supports only IEC61937 audio format

1.2 Key Features

- Hardware
 - 24-bit Fixed point processing DSP core at 86MIPS
 - 4 channel audio input (two I2S line)

- Compressed data input via CDI port / PCM data input thru DAI port
 - Asynchronous bursty data input support via CDI port for ES or PES
 - 8 channel audio output (four I2S line output)
 - 1 SPDIF output (Built-in SPDIF Transmitter)
 - Large on-chip memory to support all of standard decoders except AAC multi-channel
 - AAC multi-channel decoder needs external SRAM
- CS4931xx family
 - CS493105-CL Dolby Digital, AAC, MPEG Stereo
 - CS493115-CL: AAC, MPEG Stereo
 - CS493122-CL: AC3, MPEG Stereo
- CS4932xx family
 - CS493253-CL: Dolby Digital, Pro-Logic, Bass management
 - CS493254-CL: Dolby Digital, Pro-Logic II, Bass management
 - CS493263-CL, Dolby Digital, DTS, Pro-Logic, Bass management
 - CS493264-CL: Dolby Digital, DTS, Pro-LogicII, Bass management
 - CS493295-CL: AAC, Dolby Digital, DTS, Pro-LogicII, Bass management
 - Dolby Digital, DTS, Pro-Logic, Pro-Logic II codes are in on-chip ROM in CS493xx family (except CS493295)
- The following sound enhancement features are supported with CS493xx family.
 - Sound Enhancement Features for DTV
 - 9-band parametric equalizer
 - Tone control
 - Lip Sync Delay – up to 100ms/channel for stereo
 - Cirrus dynamic range compression (DVL – dynamic volume leveler)
 - Tru-surround XT
 - 2.1 Bass management

1.3 Target DTV application

1. Digital TV Monitor

- Digital TV-Ready is the one that does not have digital set-top box function. In other words, in the Digital TV-Ready, there is no digital TV tuner and no MPEG audio/video processor. Digital TV-Ready system is also known as big screen High Definition Monitor. The people who already have outboard cable/satellite set-top boxes tend to buy Digital TV-Ready. However, Digital TV-Ready should support legacy analog broadcasting (e.g NTSC) so legacy analog tuner is always in the Digital TV-Ready system. Since FCC (Federal Communications Commission) mandated that by July 1, 2006, 100% of 25

inches and above TV sets should integrated have digital tuner, the DTV monitor volume will be drastically decreased from next year.

2. Integrated Digital TV

- Integrated Digital TV has DTV with STB function built-in. Typically, the system has both digital tuner and legacy analog tuner. Along with digital tuner, the system requires DTV SoC to do system parsing AV decompression. Broadcom, STMicro, ATI, NEC Zoran are the major suppliers for the DTV SoC. The integrated Digital TV will be the main stream from 2006.

3. Dual Digital Tuner TV

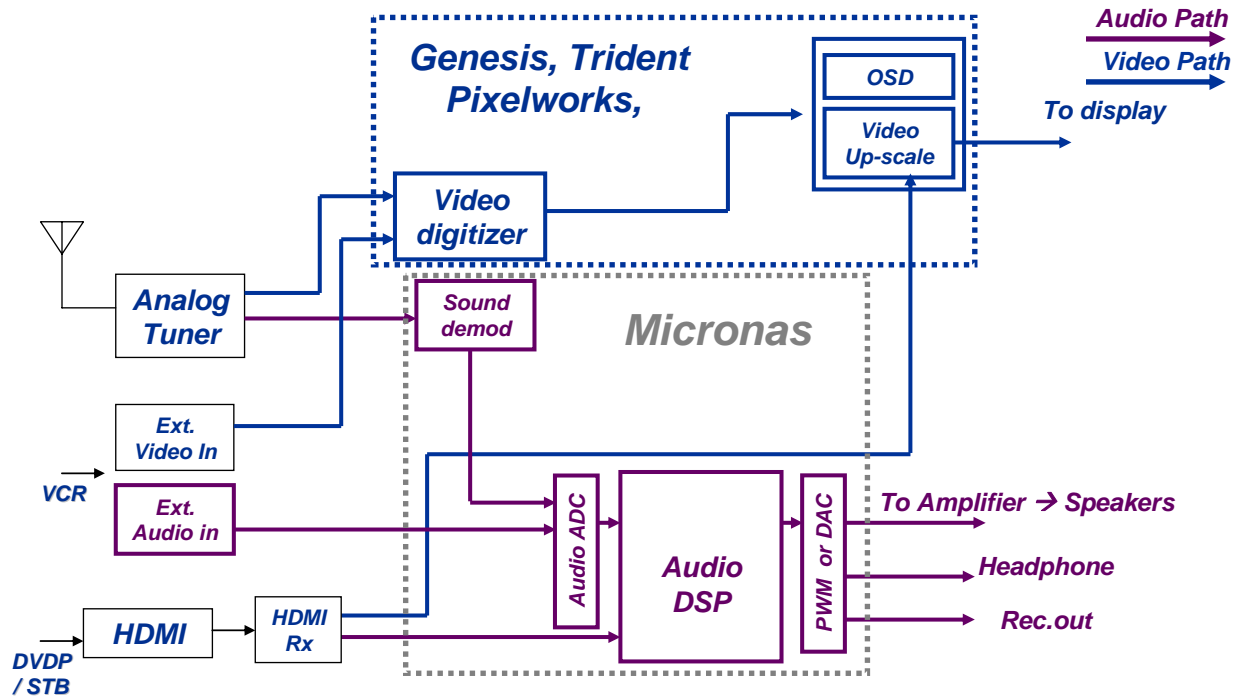
- High-end digital TV needs two digital tuners to support the background recording feature. Since most of DTV SoC already got dual HD video decoder in a single chip, the DTV customer can achieve this feature by just adding one more digital tuner. The background recording feature means while watching one channel, the system can either output the 2nd channel onto dual zone or recording the 2nd channel into HDD. This feature is getting popular in mid-high end DTV arena. The CS493xx family has been used for this purpose in Sony, Hitachi, Sharp, and Sanyo Digital TV.

The Solution

1. Digital TV Monitor

For Digital TV Monitor system, the minimum requirement was Video Up-scaling, Legacy terrestrial broadcasting (e.g. NTSC), and simple audio processing. From 2005, HDMI input is also getting requirement as a major digital AV interface.

As you can see in the block diagram below, Genesis Microchip, Trident, Pixelworks are the major players in the Video processor world, and Micronas has been dominating TV sound processing sockets with the sound demodulation technology.



Market Requirement for Digital TV Monitor

As HDMI is getting into DTV monitor system, it is required to have the capability of decoding the audio streams (e.g. AC3, DTS, AAC) coming over HDMI from external source, DVD Player, Set-top boxes. In spite of this market requirement, none of video processors neither Micronas TV sound processor in the current DTV monitor system does not have any decoding capability.

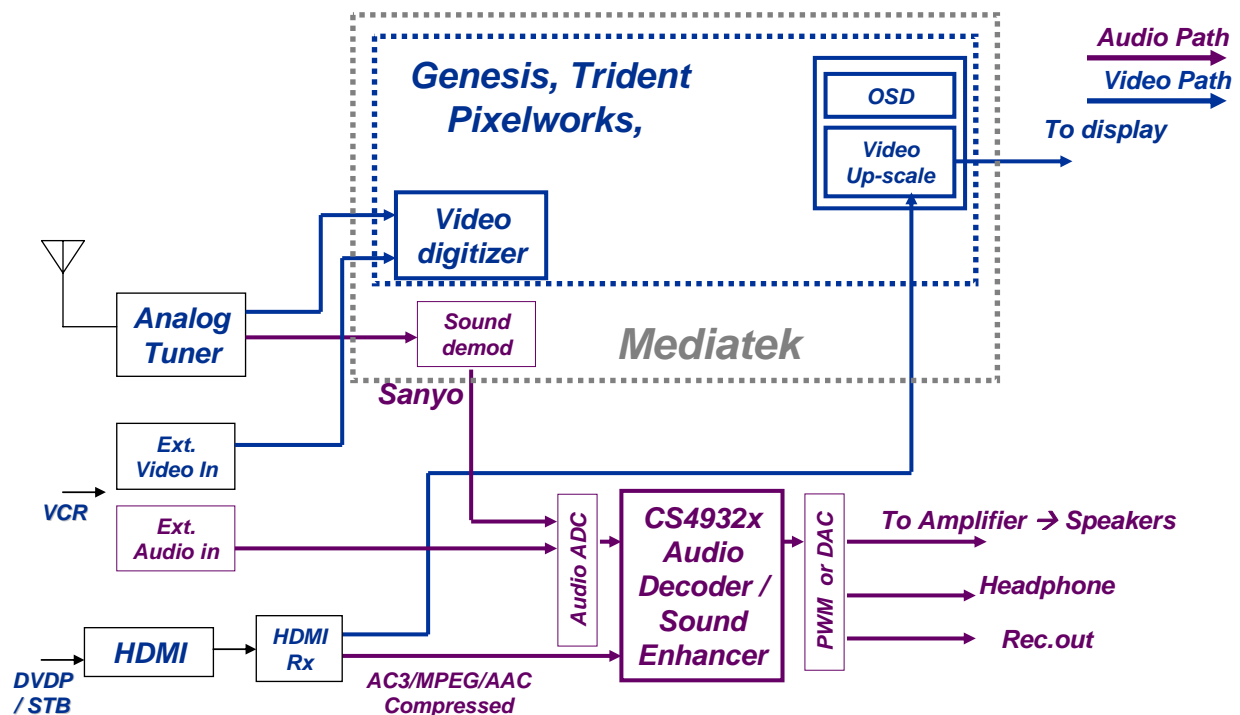
Solutions

. The current Digital TV systems mute the audio when the audio coming over HDMI is compressed and this is serious issue and the customer are trying to resolve this problem.

The CS4932x is the audio DSP that supports all standard audio decoders (AC3, DTS, AAC, MPEG) for the compressed streams coming over HDMI and also it can be used as a sound enhancing processor with Tru-Surround, Parametric EQ, Tone control for PCM audio data coming from sound demodulator or external audio inputs.

There are low-cost sound demodulation chips available from Sanyo (LA72670), Panasonic instead of Micronas DSP. So CS4932x+Cirrus mixed signal+Sanyo demod chip can replace Micronas sound processor with AC3/AAC/DTS/MPEG audio decoding capability.

Another trend is that the video processors are integrating sound demodulation into the chip. – Mediatek (MTK8205) video processor already has on-chip sound demodulator, so it may be well matched with CS4932x.

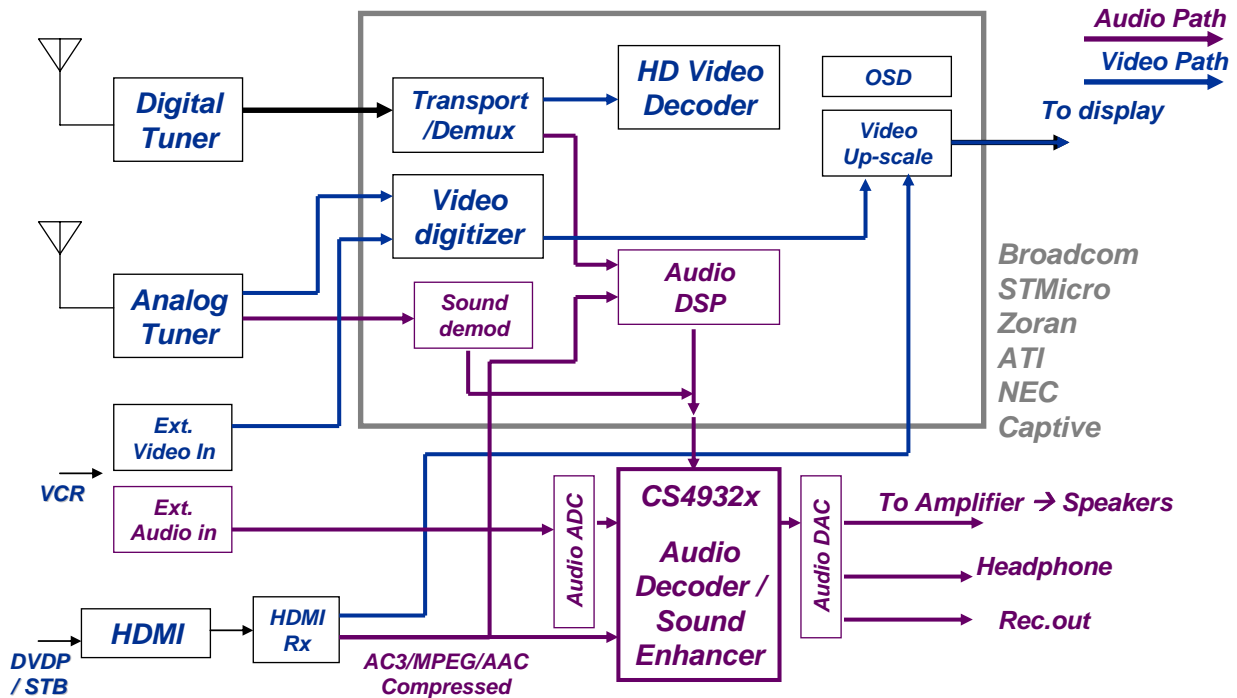


2. Integrated Digital TV

Broadcom, STMicro, ATI, Zoran, NEC are the DTV SoC major supplier for the integrated DTV market. These DTV SoC already integrated audio decoders but some of them are not capable to decode the compressed audio stream coming over HDMI or SPDIF. It only decodes the audio stream coming from the digital tuner. This is the opportunity for us to sell CS4932x DSP. The current Digital TV systems mute the audio when the audio coming over HDMI is compressed and this is serious issue and the customer are trying to resolve this problem.

Solutions

The CS4932x is the audio DSP that supports all standard audio decoders (AC3, DTS, AAC, MPEG) for the compressed streams coming over HDMI and also it can be used as a sound enhancing processor with Tru-Surround, Parametric EQ, Tone control for PCM audio data coming from sound demodulator in the DTV SoC or external audio inputs.



3. Dual Tuner Digital TV

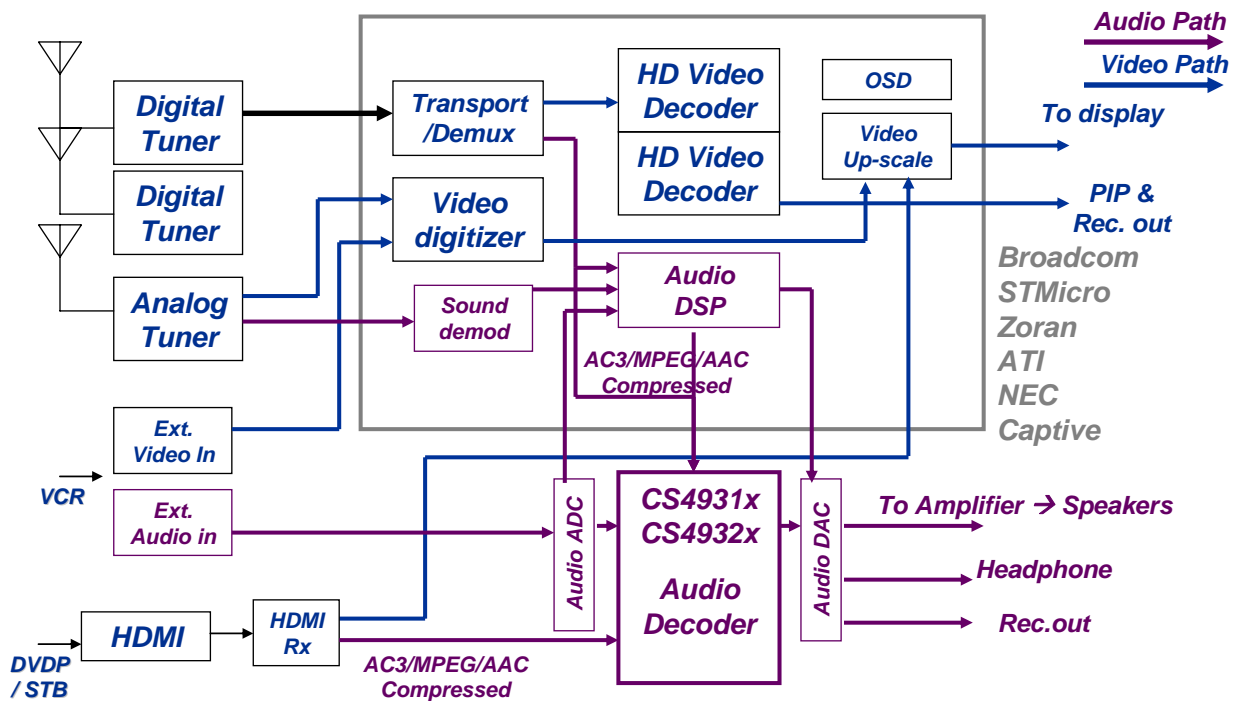
The demand for dual audio/video decoding is getting higher for PIP (Picture-in-Picture) or back-ground recording feature thru recording audio line output– recording out different channel while watching another channel. High-end Digital TV system will have dual digital tuner to support dual decoding but these days, most of HD MPEG decoders like Zoran, ATI, NEC have only one audio decoder in their SoC even though it is capable of doing dual HD MPEG video decoding.

Solutions

Therefore, in order to support dual audio decoding along with dual HD MPEG video decoding, the system needs external audio DSP for 2ndary decoding. Below is the system block diagram for dual decoding Digital TV. In this case, CS4931x or CS4932x family is the best fit.

DSP selection among CS4931xx and CS4932xx depends on what kind of data format can be supported in main MPEG chip. If main chip outputs compressed audio data (Dolby, AAC, MPEG) with IEC61937 format, CS4932xx is the right part. If main chip generates compressed audio data as PES or ES, CS4931xx is the appropriate part.

And also CS4932x can decode the compressed audio stream coming over HDMI as well.



Summary

CS493xx family is the DTV Audio processor that is capable of decoding all of compressed audio format (AC3, DTS, AAC, MPEG) coming over HDMI or digital transmission as well as sound enhancing features.

The CS493xx family feature can be dynamically switched between audio decoder and sound enhancement by downloading the appropriate DSP software depending on audio data format (compressed or PCM) in the DTV application.

1.5 Features and Benefits

CS493xx family is the DTV Audio processor that is capable of decoding all of compressed audio format (AC3, DTS, AAC, MPEG) coming over HDMI or digital transmission as well as sound enhancing features at the low cost.

The CS493xx family is the multi-function audio DSP of which feature can be dynamically switched between audio decoder and sound enhancement by downloading the appropriate DSP software. By the audio data format (compressed or PCM) for Digital TV

Cirrus Logic is the only supplier who can support broadcasting audio formats which are PES (Packetized Elementary Stream) and ES (Elementary Stream) with CS4931x family

1.6 Sound Enhancement Feature

As described in section 1.2, the followings are the sound enhancement modules that are available today.

- 9-band parametric equalizer
- Tone control
- Lip Sync Delay – up to 100ms/channel for stereo
- Cirrus dynamic range compression (DVL – dynamic volume leveler)
- Tru-surround XT
- 2.1 Bass management

Since every customer has different audio feature requirement, the division policy is that the DTV customer picks and chose the features that are needed among the modules above, and Cirrus makes one combined DSP code upon their request. The followings are the modules that are demo-able.

- 9-band parametric equalizer with Window based GUI
- Cirrus dynamic range compression (DVL – dynamic volume leveler)
- Tru-surround XT
- Demo board – CDB49300

Cirrus Mixed Signal Solutions along with CS493xx Family

The CS493xx DSP family complements the Cirrus Total Solution. Items to look for are:

Cirrus IC Function	Example Part Number
ADC	CS5340, CS5361
Surround Codec	CS42528, CS42526
Multi-Channel DAC	CS4382A, CS4362A
Stereo DAC	CS4391, CS4392, CS4398
S/PDIF Receiver	CS8416
PWM Controller	CS44600/CS44800

Packaging

CS493xx DSP family will be available in only one package.

CS4931xx-CLZ family – 44pin PLCC – Lead-free

CS4932xx-CLZ family – 44pin PLCC – Lead-free

CS493302-CLZ – 44 pin PLCC – Lead-free

FAQ's

Does CS493xx families are all pin-compatible?

Answer: Yes.

Does the CS493xx require external memory for 5.1ch AAC decoding?

Answer: Yes, it requires external SRAM. However, SRAM is not required for 2ch AAC decoding.

Does Cirrus provide GUI tool for Parametric EQ

Answer: Yes, it is window based Parametric EQ GUI. Gain, Q, Center Frequency are configurable.