CRYSTAL ®

CS4932X/CS49330

Part Matrix vs. Code Matrix for AVR/Outboard Decoder-based Applications

1. CS4932X/CS49330: AVR/OUTBOARD DECODER SUBFAMILY

For AVR codes, all compressed inputs are expected to be packed according to IEC61937 while PCM is delivered according to IEC60958 in I^2S or Left-Justified digital audio format. DTS CDs are one exception as they deliver compressed data according to IEC60958.

Data delivery is:

I^2S or Left-Justified Compressed Digital audio according to the IEC61937 specification or PCM according to the IEC60958 specification and is typically delivered from a S/PDIF receiver.

Expected CLKIN = 12.288 MHz (Oscillator Value)

DSPCLK = Refer to AN163 (Application Code Dependent)

Standard Hardware Configuration: OUTPUTA1 (DSP is Slave to MCLK, DSP Masters SCLK and LRCLK)

Refer to AN163 and its appendices for how to control AVR/Outboard Decoder-based Standard Release Application Codes that run on the CS4932X Family and/or the CS49330.

The designer/manufacture should be aware that obtaining and/or evaluation of any/all application codes requires signing of a Crystal Ware Software Licensing Agreement (CWSEA). Additionally, a Crystal Ware Licensing Agreement (CWLA) must be signed before any/all application codes may be used in any production-level design. Please contact your Cirrus Logic Sales Representative or FAE in order to obtain the necessary contracts, application codes and application notes.

2. AVR/OUTBOARD DECODER-BASED STANDARD RELEASE APPLICATION CODES

2.1 Application Code Logo, Name, Description, and Notes

- AAC - Multichannel MPEG-2 AAC (LC, ADTS) decoder with 5.1 channel output.

- AAS_PROL2 - Stereo MPEG-2 AAC (LC, ADTS) with Dolby Pro Logic II decoder offering up to a 5.1 channel output.

- ACEQ - Dolby Digital™ with Dolby Pro Logic decoder and PCM input support. This code features a 5 Channel, 5 Band Graphic Equalizer.

- AC3 - Dolby Digital™ with Dolby Pro Logic decoder and PCM input support. This code features +/-12dB Tone Control.

Note: Tone Control is implemented as individual bass and treble control on the Left, Right, and Center output channels.

- AC3_CES - Dolby Digital™ with Dolby Pro Logic decoder and PCM input support. This code features Crystal Extra Surround™ which enables a 6.1 or 7.1 channel output.

- AC3_PROL2 - Dolby Digital with Dolby Pro Logic II™ decoder and PCM input support.

- AC3_PL2_CES - Dolby Digital with Dolby Pro Logic II decoder and PCM input support. This code features Crystal Extra Surround™ which enables a 6.1 or 7.1 channel output.

- AC3_PL2_REEQ - Dolby Digital with Dolby Pro Logic II decoder and PCM input support. This code features user-programmable 2nd Order IIR Biquads which are capable of offering Re-EQ™ functionality. Re-EQ coefficients are NOT supplied by Cirrus Logic, Inc. Use of Re-EQ technology requires a license from the THX Division of Lucasfilm, Ltd.

Note: The three 2nd order IIR Biquads are available on the Left, Right, and Center output channels only.

Contacting Cirrus Logic Support

For a complete listing of Direct Sales, Distributor, and Sales Representative contacts, visit the Cirrus Logic web site at:
http://www.cirrus.com/corporate/contacts/

• AC3D - Virtual Dolby Digital™ (Dolby Digital/Dolby Pro Logic decoder with PCM input support + Dolby Virtualizer Module). Offers ability to have virtualized 5.1 channel output using only 2 speakers. The virtualizer can be disabled, offering a full 5.1 channel output if desired.

VIRTUAL®
DOLBY
DIGITAL

• AC3I - Internal Boot Assist (IBA) program for loading Dolby Digital/Dolby Pro Logic decoder (with PCM input support) code from internal ROM. Included in the cost of the CS493253-CL or CS493263-CL.

DOLBY®
DIGITAL

Note: Please refer to AN163 for more detail regarding the differences between IBA and Full Download codes.

• AC3R - Virtual Dolby Digital using SRS TruSurround™ (Dolby Digital and Dolby Pro Logic decoder with PCM input support + SRS TruSurround Digital 5.1 Channel Virtualizer Module). Offers ability to have virtualized 5.1 channel output using only 2 speakers. The virtualizer can be disabled, offering a full 5.1 channel output if desired.

VIRTUAL®   TruSurround™
DOLBY   DIGITAL 5.1CH
DIGITAL   by SRS(●)®

• AC3X - Virtual Dolby Digital using VMAx™ Virtual Theater (Dolby Digital/Dolby Pro Logic decoder with PCM input support + VMAx Virtualizer Module). Offers ability to have virtualized 5.1 channel output using only 2 speakers. The virtualizer can be disabled, offering a full 5.1 channel output if desired.

VIRTUAL®   VMAₓ®
DOLBY
DIGITAL

• CAR - Crystal Automotive DSP software is a multi-channel PCM post processor capable of accepting up to 8 PCM audio input channels. Audio is processed in 8 blocks using configurable audio processing modules. Each block can be configured with one of the modules or bypassed. The individual blocks are highly configurable to allow each to act as a: Fader, Dynamic Range Compressor (DRC), Filter, Mixer, or Trim. Fs of PCM input must be 48kHz, 44.1kHz or 32kHz.

• CS - SRS CircleSurround-5.1 is a PCM Enhancement algorithm which accepts a 2 channel input and outputs up to 5.1 discrete channels. This code also offers +/- 12dB of Tone Control. Fs of PCM input must be 48kHz, 44.1kHz or 32kHz.

CS-5.1™
by SRS(●)®

Note: Tone Control is implemented as individual bass and treble control on the Left, Right, and Center output channels.

• CS2 - SRS CircleSurround II with Focus™ is the next generation PCM Enhancement algorithm from SRS Labs which accepts a 2 channel input and outputs up to 6.1 discrete channels. This code also offers +/- 12dB of Tone Control. Fs of PCM input must be 48kHz, 44.1kHz or 32kHz.

CSII™
by SRS(●)®

Note: Tone Control is implemented as individual bass and treble control on the Left, Right, and Center output channels.

• DTEQ - DTS Digital Surround™ decoder with Dolby Pro Logic decoder (for when input is 2 channel DTS). This code features a 5 Channel, 5 Band Graphic Equalizer.

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dts®
SURROUND

- DTS - DTS Digital Surround™ decoder with Dolby Pro Logic decoder. This code features +/-12dB Tone Control.

Note: Tone Control is implemented as individual bass and treble control on the Left, Right, and Center output channels.

- DTS_6DOT1 - DTS-ES Extended Surround™ Discrete 6.1 and Matrix 6.1 decoder.

- DTS_CES - DTS Digital Surround™ decoder with Dolby Pro Logic decoder. This code features Crystal Extra Surround™ which enables a 6.1 or 7.1 channel output.

- DTS_NEO6 - DTS Neo:6™ PCM Processing Enhancement which accepts a 2 channel input and outputs up to 6.1 discrete channels in either a Music or Cinema mode. Fs of PCM input must be 48kHz, 44.1kHz or 32kHz.

- DTS_PL2 - DTS Digital Surround™ decoder with Dolby Pro Logic II decoder.

- DTS_PL2_REEQ - DTS Digital Surround™ decoder with Dolby Pro Logic II decoder. This code features user-programmable 2nd Order IIR Biquads which are capable of offering Re-EQ™ functionality. Re-EQ coefficients are NOT supplied by Cirrus Logic, Inc. Use of Re-EQ technology requires a license from the THX Division of Lucasfilm, Ltd.

- DTSI - Internal Boot Assist (IBA) program for loading DTS Digital Surround code from internal ROM

Note: Please refer to AN163 for more detail regarding the differences between IBA and Full Download codes.

- DTSR - DTS Virtual 5.1™ using SRS TruSurround (DTS Digital Surround decoder + SRS TruSurround Digital 5.1 Channel Virtualizer Module). Offers ability to have virtualized 5.1 channel output using only 2 speakers. The virtualizer can be disabled, offering a full 5.1 channel output if desired.

- DVDA_BASS_MGR - DVD Audio Bass Manager application code is capable performing advanced bass management for 2 channel 192kHz PCM audio data or 6 channel 96kHz PCM audio data. This code is designed for an AVR that is "SACD Multichannel or DVD Audio Ready" via high performance (192kHz) A/Ds.

- DPP - Crystal Digital Post-Processor 5.1 Channel Post-Processor features Tone Control, Parametric EQ, and dual-precision bass management. This code accepts a 5.1 channel input to the CS493302-CL from the output of a CS4932x Family DSP.

Note: Tone Control includes basic bass and treble control for each full bandwidth channel. The parametric EQ can not be changed after kickstart. Delays are all channel.

- DPP8 - Crystal Digital Post-Processor 7.1 Channel Post-Processor features Tone Control, Parametric EQ, and dual-precision bass management. This code accepts a 7.1 channel input to the CS493302-CL from the output of a CS4932x Family DSP.

Note: Tone Control includes basic bass and treble control for each full bandwidth channel. The parametric EQ can not be changed after kickstart. Delays are all channel.

- EFF - (a.k.a. C.O.S. - Crystal Original Sound) Reverberative and delay effects code for stereo to multichannel effects processing and +/-12dB Tone Control. This code allows for designers to generate such DSP modes as: Concert Hall, Theater, Jazz Club, etc.

Note: Tone Control is implemented as individual bass and treble control on the Left, Right, and Center output channels. There is an output mixer for each channel allowing for multiple speaker configuration settings. However, conventional downmixing is not applicable in the effects code.

- EFF_REEQ - Crystal Original Sound with +/-12dB Tone Control in addition to user-programmable 2nd Order IIR Biquads which are capable of offering Re-EQ^{TM} functionality. Re-EQ coefficients are NOT supplied by Cirrus Logic, Inc. Use of Re-EQ technology requires a license from the THX Division of Lucasfilm, Ltd.

Note: Tone Control is implemented as individual bass and treble control on the Left, Right, and Center output channels. Re-EQ is implemented on only the L, C, and R channels. There is an output mixer for each channel allowing for multiple speaker configuration settings. However, conventional downmixing is not applicable in the effects code.

- EFFI - Internal Boot Assist (IBA) program for loading Crystal Original Surround code

Note: There is an output mixer for each channel allowing for multiple speaker configuration settings. However, conventional downmixing is not applicable in the effects code. Please refer to AN163 for more detail regarding the differences between IBA and Full Download codes.

- HDC - Pacific Microsonics HDCD^{TM} PCM Enhancement offers upsampling and resolution enhancement.

Note: Autodetection for HDCD is a two step process, please see AN163D for details.The HDCD code is capable of accepting and autodetection HDCD and non-HDCD encoded PCM stereo inputs with an Fs from 32 kHz to 96 kHz. HDCD processing is only available for input streams 48kHz and lower. The HDCD is also capable of upsampling 32 kHz to 64 kHz, 44.1 kHz to 88.2 kHz, and 48kHz to 96kHz.

- LG7 - Logic 5^{TM} (previously called "Logic 7") is a PCM Enhancement algorithm created by Lexicon, a Harman International Companym which accepts a 2 channel input and outputs up to 5.1 discrete channels. Fs of PCM input must be 48kHz, 44.1kHz or 32kHz..

- LG7_7DOT1 - Logic 7^{TM} is the next generation PCM Enhancement algorithm from Lexicon, a Harman International Company, which accepts a 2 channel input and outputs up to 7.1 discrete channels. Fs of PCM input must be 96kHz, 88.2kHz, 64kHz, 48kHz, 44.1kHz or 32kHz..

- MPEQ - MPEG Multichannel with Dolby Pro Logic decoder. This code features a 5 Channel, 5 Band Parametric Equalizer

Note: The MPEQ code ONLY supports the following MPEG streams: MPEG-2, Layer 2 (with and without extension). MPEG-2 Low Sampling Frequencies are currently not supported. Please refer to AN163 for more details on stream support.

- MPG - MPEG Multichannel with Dolby Pro Logic decoder. This code features +/-12dB Tone Control.

MPEG)|(Multichannel®

Note: The MPG code ONLY supports the following MPEG streams: MPEG-2, Layer 2 (with and without extension). MPEG-2 Low Sampling Frequencies are currently not supported. Please refer to AN163 for more details on stream support. Tone Control is implemented as individual bass and treble control on the Left, Right, and Center output channels.

- MPG_CES - MPEG Multichannel with Dolby Pro Logic decoder. This code features Crystal Extra Surround™ which enables a 6.1 or 7.1 channel output.

MPEG)|(Multichannel®   **EXTRA CRYSTAL from CIRRUS LOGIC SURROUND**

Note: The MPG_CES code ONLY supports the following MPEG streams: MPEG-2, Layer 2 (with and without extension). MPEG-2 Low Sampling Frequencies are currently not supported. Please refer to AN163 for more details on stream support.

- MPG_PL2 - MPEG Multichannel with Dolby Pro Logic II decoder.

MPEG)|(Multichannel®

DOLBY SURROUND PRO LOGIC II®

Note: The MPG_PL2 code ONLY supports the following MPEG streams: MPEG-2, Layer 2 (with and without extension). MPEG-2 Low Sampling Frequencies are currently not supported. Please refer to AN163 for more details on stream support.

- MPGR - MPEG + SRS TruSurround (MPEG Multichannel decoder + SRS TruSurround Virtualizer Module)

MPEG)|(Multichannel®

TruSurround™ DIGITAL 5.1CH by SRS(●)®

Note: The MPG code ONLY supports the following MPEG streams: MPEG-2, Layer 2 (with and without extension). MPEG-2 Low Sampling Frequencies currently not supported. Please refer to AN163 for more details on stream support.
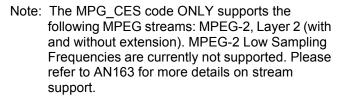
- MP3 - MPEG-1, Layer 3 (MP3) Decoder

Note: Due to the fact that the Pc value of 0x5 in the IEC61937 specifcation pertains to more than one type of MPEG stream type, autodetection of IEC61937-packed MP3 data is a two step process. Please refer to AN163 for details. Please refer to the legal section for more information about the use of this application code.

- PDF - Dolby Pro Logic Double Sampling Frequency Decoder (Fs = 64 kHz, 88.2 kHz, 96 kHz) and PCM Upsampler.

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Note: The PDF code is capable of accepting 32 kHz to 96 kHz PCM stereo input and can perform a Pro Logic decode. The PDF code can also upsample 32 kHz to 64 kHz, 44.1 kHz to 88.2 kHz, and 48kHz to 96kHz in addition to perform a Dolby Pro Logic decode of the upsampled PCM.

- PL2_2FS - Dolby Pro Logic II Double Sampling Frequency Decoder (Fs = 64 kHz, 88.2 kHz, 96 kHz) and PCM Upsampler.

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Note: The PL2_2FS code is capable of accepting 32 kHz to 96 kHz PCM stereo input and can perform a Pro Logic II decode. The PL2_2FS code can also upsample 32 kHz to 64 kHz, 44.1 kHz to 88.2 kHz, and 48kHz to 96kHz in addition to perform a Dolby Pro Logic II decode of the upsampled PCM.

• THX - Home THX Cinema™ 5.1 Channel Post-Processor offers: Re-Eq™, Timbre Matching™, Adaptive Decorrelation™ THX Bass Peak Limiter™, Loudspeaker Position Time Synchronization™ (all-channel delays), in addition to tone control and parametric equalization.

Note: The tone control includes basic bass and treble control for each full bandwidth channel, including Surround Back channel (Sb). The parametric EQ can not be changed after kickstart. Delays are all channel. Please refer to AN163H for more information about the Home THX Cinema 5.1 Channel Post-Processor code.

• THX8 - Home THX Cinema™ 7.1 Channel Post-Processor offers: Re-Eq™, Timbre Matching™, Adaptive Decorrelation™ THX Bass Peak Limiter™, Loudspeaker Position Time Synchronization™ (all-channel delays), in addition to tone control and parametric equalization. THX8 differs from the THX code in the sense that it can post process multichannel sources that have more than 5.1 discrete channels, such as DTS-ES Discrete 6.1 streams.

Note: The tone control includes basic bass and treble control for each full bandwidth channel, including Surround Back channel (Sb). The parametric EQ can not be changed after kickstart. Delays are all channel. Please refer to AN163O for more information about the Home THX Cinema 7.1 Channel Post-Processor code.

• TEX - THX Surround EX™ 5.1 Channel Post-Processor offers all of the post-processing features of the THX code, however TEX also offers the Surround EX module. The Surround EX module performs a matrix decode on Ls and Rs, using a Dolby Pro Logic decoder in 3 Channel Stereo mode, to create an additional back surround channel. This surround back channel is then copied to the output channels of Sbl and Sbr in order to give a 7.1 channel output.

Note: The tone control includes basic bass and treble control for each full bandwidth channel, including Surround Back channel. The parametric EQ can not be changed after kickstart. Delays are all channel. Surround EX decoding should only be enabled when material is Dolby Surround EX encoded. Please refer to AN163H for more information about the THX Surround EX 5.1 Channel Post-Processor code.

• TEXO - THX Surround EX™ 5.1 Channel Post-Processor offers all of the post-processing features of the TEX code, however TEXO also offers extended all channel delays (up to 105ms on all channels).

Note: The tone control includes basic bass and treble control for each full bandwidth channel, including Surround Back channel. The parametric EQ can not be changed after kickstart. Delays are all channel. A 1MBit External SRAM (70nS) is required to be connect to the CS49330 in order for this code to function. Surround EX decoding should only be enabled when material is Dolby Surround EX encoded. Please refer to AN163H for more information about the THX Surround EX 5.1 Channel Post-Processor code.

- TEXO_2MB - THX Surround EX™ 5.1 Channel Post-Processor offers all of the post-processing features of the TEX code, however TEXO_2MB also offers extended all channel delays (up to 221ms on all channels).

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THX.
SURROUND EX™

Note: The tone control includes basic bass and treble control for each full bandwidth channel, including Surround Back channel. The parametric EQ can not be changed after kickstart. Delays are all channel. A 2MBit External SRAM (70nS) is required to be connect to the CS49330 in order for this code to function. Surround EX decoding should only be enabled when material is Dolby Surround EX encoded. Please refer to AN163H for more information about the THX Surround EX 5.1 Channel Post-Processor code.

- TEX8 - THX Surround EX™ 7.1 Channel Post-Processor offers all of the post-processing features of the THX8 code, however TEX also offers the Surround EX module. The Surround EX module performs a matrix decode on Ls and Rs, using a Dolby Pro Logic decoder in 3 Channel Stereo mode, to create an additional back surround channel. This surround back channel is then copied to the output channels of Sbl and Sbr in order to give a 7.1 channel output. TEX8 differs from the TEX code in the sense that it can post process multichannel sources that have more than 5.1 discrete channels, such as DTS-ES Discrete 6.1 streams.

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THX.
SURROUND EX™

Note: The tone control includes basic bass and treble control for each full bandwidth channel, including Surround Back channel. The parametric EQ can not be changed after kickstart. Delays are all channel. Surround EX decoding should only be enabled when material is Dolby Surround EX encoded. Please refer to AN163O for more information about THX Surround EX 7.1 Channel Post-Processor code.

- TEXO8 - THX Surround EX™ 7.1 Channel Post-Processor offers all of the post-processing features of the TEX code, however TEXO8 also offers extended all channel delays (up to 105ms on all channels).

LUCASFILM
THX.
SURROUND EX™

Note: The tone control includes basic bass and treble control for each full bandwidth channel, including Surround Back channel. The parametric EQ can not be changed after kickstart. Delays are all channel. A 1MBit External SRAM (70nS) is required to be connect to the CS49330 in order for this code to function. Surround EX decoding should only be enabled when material is Dolby Surround EX encoded. Please refer to AN163O for more information about the THX Surround EX 7.1 Channel Post-Processor code.

- TEXO8_2MB - THX Surround EX™ 7.1 Channel Post-Processor offers all of the post-processing features of the TEX code, however TEXO8_2MB also offers extended all channel delays (up to 221ms on all channels).

LUCASFILM
THX.
SURROUND EX™

Note: The tone control includes basic bass and treble control for each full bandwidth channel, including Surround Back channel. The parametric EQ can not be changed after kickstart. Delays are all channel. A 2MBit External SRAM (70nS) is required to be connect to the CS49330 in order for this code to function. Surround EX decoding should only be enabled when material is Dolby Surround EX encoded. Please refer to AN163O for more information about the THX Surround EX 7.1 Channel Post-Processor code.

Table 1. CS4932X/CS49330: AVR/Outboard Decoder Application Subfamily and Associated AVR/Outboard Decoder-based Application Codes available through the Crystal Ware Licensing Program

Part(ROMID)	AAC	AAS_PROL2	ACEQ	AC3	AC3_CES	AC3_PROL2	AC3_PL2_CES	AC3_PL2_REEQ	AC3D	AC3I	AC3R	AC3X	CAR	CS	CS2	DPP	DPP8	Licensing Required to Receive Samples/Production Quantities of IC
CS49325(3)			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Dolby Digital (with or without Pro Logic II) and Crystal Ware
CS49326(3)		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Dolby Digital (with or without Pro Logic II), DTS and Crystal Ware
CS49329(2)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Dolby Digital (with or without Pro Logic II), DTS, AAC and Crystal Ware
CS49330(2)													Y	Y	Y	Y	Y	Crystal Ware

Table 2. CS4932X/CS49330: AVR/Outboard Decoder Application Subfamily and Associated AVR/Outboard Decoder-based Application Codes available through the Crystal Ware Licensing Program (Continued)

Part(ROMID)	DTEQ	DTS	DTS_6DOT1	DTS_CES	DTS_NEO6	DTS_PL2	DTS_PL2_CES	DTS_PL2_REEQ	DTSI	DTSR	DVDA_BASS_MGR	EFF	EFF_REEQ	EFFI	HDC	Licensing Required to Receive Samples/Production Quantities of IC
CS49325(3)											Y	Y	Y	Y	Y	Dolby Digital (with or without Pro Logic II)
CS49326(3)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Dolby Digital (with or without Pro Logic II) and DTS
CS49329(2)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Dolby Digital (with or without Pro Logic II), DTS, and AAC
CS49330(2)											Y	Y	Y	Y	Y	License-Free Part

Table 3. CS4932X/CS49330: AVR/Outboard Decoder Application Subfamily and Associated AVR/Outboard Decoder-based Application Codes available through the Crystal Ware Licensing Program (Continued)

Part(ROMID)	LG7	LG7_7DOT1	MPEQ	MPG	MPG_CES	MPG_PL2	MPGR	MP3	PDF	PL2	PL2_2FS	TEX	TEX8	TEXO	TEXO_2MB	TEXO8	TEXO8_2MB	THX	THX8	Licensing Required to Receive Samples/Production Quantities of IC
CS49325(3)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y									Dolby Digital (with or without Pro Logic II)
CS49326(3)	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y					Dolby Digital (with or without Pro Logic II) and DTS
CS49329(2)	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y		Dolby Digital (with or without Pro Logic II), DTS, and AAC
CS49330(2)	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	License-Free Part

Code Name	Required Licensing (in addition to signing of CrystalWare Licensing Agreements)	Documentation Required in Addition to CS49300 Data Sheet and AN163	Playable Input	Autodetection	Dolby Pro Logic or Dolby Pro Logic II	Virtualizer Module	Downmix	Dualzone Output	Pink Noise	Automatic Fs/Coefficient Change for Deemphasis (for 32kHz to 48kHz)	Tone Control	Re-EQ/Graphic EQ/Parametric EQ	Dual-Precision Bass Manager	Karaoke	Delays	Contains Crystal Extra Surround which offers 6.1/7.1 channel matrix decoded output	External SRAM Required
AAC	Dolby	N/A	AAC (ADTS, LC) 5.1 Channel	Normal	Pro Logic	N/A	Yes	Yes	No	N/A	No	No	Yes	No	No. Delays only available when in Pro Logic mode	No	Yes 32K x 8, 70ns
AAS_PL2	Dolby	AN163M	AAC (ADTS, LC) 2 Channel	Normal	Pro Logic II	N/A	Yes	Yes	No	N/A	No	No	Yes	No	Yes	No	No
ACEQ	Dolby	AN163K	AC3 + PCM	Normal	Pro Logic	N/A	Yes	Yes	Yes	Automatic	No	5 Channel, 5-Band Graphic	Yes	Capable, no mixing	Yes	No	No
AC3	Dolby	N/A	AC3 + PCM	Normal	Pro Logic	N/A	Yes	Yes	Yes	Automatic	Yes	No	Yes	Capable, no mixing	Yes	No	No
AC3_CES	Dolby	AN163R	AC3 + PCM	Normal	Pro Logic	N/A	No	No	No	Automatic	No	No	Yes	Capable, no mixing	Yes	Yes	No
AC3_PROL2	Dolby	AN163M	AC3 + PCM	Normal	Pro Logic II	N/A	Yes	Yes	Yes	Automatic	No	No	Yes	Capable, no mixing	Yes	No	No
AC3_PL2_CES	Dolby	AN163M, AN163R	AC3 + PCM	Normal	Pro Logic II	N/A	Yes	Yes	Yes	Automatic	No	No	Yes	Capable, no mixing	Yes	Yes	No
AC3_PL2_REEQ	Dolby	AN163M, AC3_PL2_REEQ Release Notes	AC3 + PCM	Normal	Pro Logic II	N/A	Yes	Yes	Yes	Automatic	No	Re-EQ (only on L, C, R Channels)	Yes	Capable, no mixing	Yes	No	No
AC3D	Dolby	AN163A	AC3 + PCM	Normal	Pro Logic	Dolby Virtualizer	Yes	Yes	Yes	Automatic	No	No	Yes	Capable, no mixing	Yes	No	No
AC3I	Dolby	N/A	AC3 + PCM	Normal	Pro Logic	N/A	Yes	Yes	Yes	Manual	No	No	Yes	Capable, no mixing	Yes	No	No
AC3R	Dolby & SRS Labs	AN163F	AC3 + PCM	Normal	Pro Logic	SRS TruSurround	Yes	Yes	Yes	Automatic	No	No	Yes	Capable, no mixing	Yes	No	No
AC3X	Dolby & Harman	AN163B	AC3 + PCM	Normal	Pro Logic	Harman VMAx	Yes	Yes	Yes	Automatic	No	No	Yes	Capable, no mixing	Yes	No	No
CAR	Only Crystal Ware	AN160	M/C + Stereo PCM	None	No	N/A	No	Yes, Pass-through	No	N/A	Yes	Multiband Parametric	Yes	No	Yes	No	No
CS	SRS Labs	AN163C	PCM	Normal	No	N/A	No	Yes, Pass-through	No	Automatic	Yes	No	Yes	No	Yes	No	No
CS2	SRS Labs	AN163T	PCM	Normal	No	N/A	No	Yes, Pass-through	Yes	Automatic	Yes	No	Yes	No	Yes	No	No
DPP	Only Crystal Ware	AN163G	M/C + Stereo PCM	None	No	N/A	Yes	Yes	Yes	N/A	Yes	5Channel, 3-Band Parametric	Yes	Capable, with mixing	Yes	No	No
DPP8	Only Crystal Ware	AN163Q	M/C + Stereo PCM	None	No	N/A	Yes	Yes	Yes	N/A	Yes	5Channel, 3-Band Parametric	Yes	Capable, with mixing	Yes	No	No
DTEQ	DTS	AN163K	DTS	Normal	Pro Logic	N/A	Yes	Yes	No	N/A	Yes	5 Channel, 5-Band Graphic	Yes	Yes	Yes	No	No
DTS	DTS	N/A	DTS	Normal	Pro Logic	N/A	Yes	Yes	No	N/A	Yes	No	Yes	Yes	Yes	No	No
DTS_6DOT1	DTS	AN163L	DTS, DTS-ES	Normal	No	N/A	No	No	No	N/A	No	No	Yes	Yes	Yes	No	No
DTS_CES	DTS	AN163K	DTS, DTS-ES	Normal	No	N/A	No	No	No	N/A	No	No	Yes	Yes	Yes	Yes	No
DTS_NEO6	DTS	AN163N	PCM	Normal	No	N/A	No	No	No	Automatic	No	No	Yes	No	Yes	No	No
DTS_PL2	DTS, Dolby	N/A	DTS	Normal	Pro Logic II	N/A	Yes	Yes	No	N/A	No	No	Yes	Yes	Yes	No	No
DTS_PL2_REEQ	DTS	N/A	DTS	Normal	Pro Logic II	N/A	Yes	Yes	No	N/A	No	Re-EQ	Yes	Yes	Yes	No	No
DTSI	DTS	N/A	DTS	Normal	No	N/A	Yes	Yes	No	N/A	No	No	Yes	Yes	Yes	No	No
DTSR	DTS & SRS Labs	AN163F	DTS	Normal	Pro Logic	SRS TruSurround	Yes	Yes	Yes	N/A	Yes	No	Yes	No	Yes	No	No
DVDA_BASS_MGR	Only Crystal Ware	AN163U	M/C + Stereo PCM	None	No	N/A	No, See notes	Yes, Pass-through	Yes	N/A	Yes	No	Yes	No	Yes	No	No
EFF	Only Crystal Ware	N/A		Normal	No	N/A	No, See notes	Yes, Pass-through	Yes	Automatic	Yes	No	Yes	Yes	Yes	No	No

Table 4. CS4932X/CS49330: AVR/Outboard Decoder Application Code Functionality and Feature Overview

Code Name	Required Licensing (in addition to signing of CrystalWare Licensing Agreements)	Documentation Required in Addition to CS49300 Data Sheet and AN163	Playable Input	Autodetection	Dolby Pro Logic or Dolby Pro Logic II	Virtualizer Module	Downmix	Dualzone Output	Pink Noise	Automatic Fs/Coefficient Change for Deemphasis (for 32kHz to 48kHz)	Tone Control	Re-EQ/Graphic EQ/Parametric EQ	Dual-Precision Bass Manager	Karaoke	Delays	Contains Crystal Extra Surround which offers 6.1/7.1 channel matrix decoded output	External SRAM Required
EFF_REEQ	Only Crystal Ware	N/A	PCM	Normal	No	N/A	No. See notes	Yes, Pass-through	No	Automatic	Yes	Re-EQ	Yes	Yes	Yes	No	No
EFFI	Only Crystal Ware	N/A	PCM	Normal	No	N/A	No. See notes	Yes, Pass-through	No	Manual	No	No	Yes	Yes	Yes	No	No
HDC	Pacific Microsonics	AN163D	PCM	See Notes	No	N/A	No	Yes, Pass-through	No	Automatic	No	No	Yes	No	Yes	No	No
LG7	Lexicon	AN163E	PCM	Normal	No	N/A	No	Yes, Pass-through	No	Automatic	No	No	Yes	No	Yes	No	No
LG7_7DOT1	Lexicon	AN163S	PCM	Normal	No	N/A	No	Yes, Pass-through	No	Automatic	No	No	Yes	No	Yes	No	No
MP3	Only Crystal Ware[a]	N/A	MPEG. See Notes	See Notes	No	N/A	Yes	No	No	N/A	No	No	Yes	No	Yes	No	No
MPEQ	Only Crystal Ware	AN163K	MPEG. See Notes	Normal	Pro Logic	N/A	Yes	Yes	No	N/A	No	5 Channel, 5-Band Graphic	Yes	No	Yes	No	No
MPG	Only Crystal Ware	N/A	MPEG. See Notes	Normal	Pro Logic	N/A	Yes	Yes	No	N/A	Yes	No	Yes	No	Yes	No	No
MPG_CES	Only Crystal Ware	N/A	MPEG. See Notes	Normal	Pro Logic	N/A	No	Yes	No	N/A	No	No	Yes	No	Yes	Yes	No
MPG_PL2	Dolby	N/A	MPEG. See Notes	Normal	Pro Logic II	N/A	Yes	Yes	No	N/A	No	No	Yes	No	Yes	No	No
MPGR	SRS Labs	AN163F	MPEG. See Notes	Normal	Pro Logic	SRS TruSurround	Yes	Yes	No	N/A	No	No	Yes	No	Yes	No	No
PDF	Dolby	AN163I	PCM	Normal	Pro Logic	N/A	Yes	Yes, Pass-through /Upsampled	No	Automatic	No	No	Yes	No	Yes	No	No
PL2_2FS	Dolby	AN163P	PCM	Normal	Pro Logic II	N/A	Yes	Yes, Pass-through /Upsampled	No	Automatic	No	No	Yes	No	Yes	No	No
TEX	THX	AN163H	M/C + Stereo PCM Mixer Input (5.1 + 2)	None	No	N/A	Yes	Yes	Yes + THX	N/A	Yes	3-Band Parametric + Re-EQ	Yes + THX Bass Limiter	Capable, no mixing	Yes	No	No
TEX8	THX	AN163O	M/C + Stereo PCM Input (7.1)	None	No	N/A	Yes	Yes	Yes + THX	N/A	Yes	3-Band Parametric + Re-EQ	Yes + THX Bass Limiter	Capable, no mixing	Yes	No	No
TEXO	THX	AN163H	M/C + Stereo PCM Mixer Input (5.1 + 2)	None	No	N/A	Yes	Yes	Yes + THX	N/A	Yes	3-Band Parametric + Re-EQ	Yes + THX Bass Limiter	Capable, no mixing	Yes (105ms on all channels)	No	Yes 128K x 8, 70ns
TEXO_2MB	THX	AN163H	M/C + Stereo PCM Mixer Input (5.1 + 2)	None	No	N/A	Yes	Yes	Yes + THX	N/A	Yes	3-Band Parametric + Re-EQ	Yes + THX Bass Limiter	Capable, no mixing	Yes (221ms on all channels)	No	Yes 256K x 8, 70ns
TEXO8	THX	AN163O	M/C + Stereo PCM Input (7.1)	None	No	N/A	Yes	Yes	Yes + THX	N/A	Yes	3-Band Parametric + Re-EQ	Yes + THX Bass Limiter	Capable, no mixing	Yes (105ms on all channels)	No	Yes 128K x 8, 70ns
TEXO8_2MB	THX	AN163O	M/C + Stereo PCM Input (7.1)	None	No	N/A	Yes	Yes	Yes + THX	N/A	Yes	3-Band Parametric + Re-EQ	Yes + THX Bass Limiter	Capable, no mixing	Yes (221ms on all channels)	No	Yes 256K x 8, 70ns
THX	THX	AN163H	M/C + Stereo PCM Mixer Input (5.1 + 2)	None	No	N/A	Yes	Yes	Yes + THX	N/A	Yes	3-Band Parametric + Re-EQ	Yes + THX Bass Limiter	Capable, no mixing	Yes	No	No
THX8	THX	AN163O	M/C + Stereo PCM Input (7.1)	None	No	N/A	Yes	Yes	Yes + THX	N/A	Yes	3-Band Parametric + Re-EQ	Yes + THX Bass Limiter	Capable, no mixing	Yes	No	No

Table 4. CS4932X/CS49330: AVR/Outboard Decoder Application Code Functionality and Feature Overview (Continued)

a. The associated licensing fees for using MPEG, Layer 3 technology licensed from Fraunhofer IIS and THOMSON multimedia are covered by the Crystal Ware Licensing Program. No additional contracts need to be signed by the OEM or end-customer in order to use the MP3 firmware.

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