

MPEG-4 HE-AAC V2 Decoder (with DAB support) for the Blackfin ADSP-BF5xx processor family

Product Description

MPEG-4 HE-AAC v2 (with DAB support) is the combination of Advanced Audio Coding (AAC), Spectral Band Replication (SBR) and Parametric Stereo (PS), standardized as the High-Efficiency v2 profile in MPEG-4 (HE AAC v2). SBR is a unique bandwidth extension technique which enables audio codecs to deliver the same quality at a significant bit rate reduction. PS is a coding tool that is able to capture a stereo signal as a monaural downmixed signal plus a limited number of parameters requiring low-overhead.

This version of the HE-AAC v2 decoder implements the baseline version of the PS tool. For streams not containing Parametric Stereo data, this decoder uses the High Quality (HQ) SBR tool. The ADI decoder supports the ETSI DAB standard, which specifies a Digital Audio Broadcasting system requiring a HE-AAC v2 decoder that can handle 960 samples per frame within the core AAC-LC codec, and implementation of error concealment to handle corrupted audio frames. In addition, this decoder provides optional processing of Dynamic Range Control (DRC) to make use of any DRC information signalled in the bitstream.

Product Highlights

The HE-AAC v2 Decoder (with DAB support) has been highly optimised to run on the Analog Devices' Blackfin processor family. It is a self-contained software module that is fully compliant with ISO/IEC 14496-3 MPEG-4 specification and rigorously tested and field-proven in commercial application.

It contains a standard C-callable 'push' API with the added flexibility using 'pull' (or 'poll') by adding a light wrapper. The code has been implemented using Instruction and Data cache, and has no dependencies on processor peripherals or registers, adding greater system flexibility and ease of use.

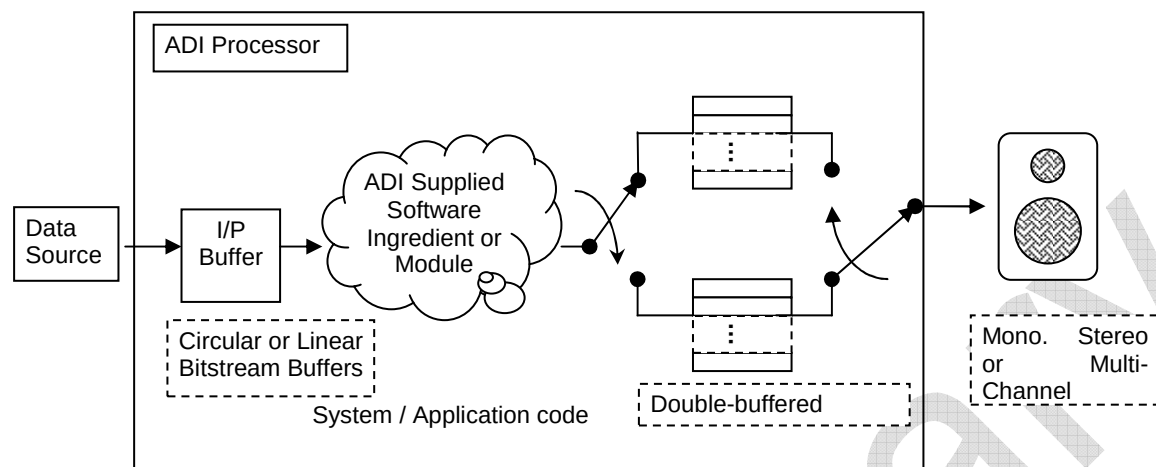


Figure 1 Typical Decoder Application Overview

MIPS/Memory Summary Table

Code memory (KiB)	Data RAM (KiB)	Constant Data Tables (KiB)	MIPS*	
			Average	Peak
76.8	85.7	37.8	34.50	38.33

- MIPS measured using typical bit rates 32 kbps, $F_s = 32$ kHz, 2 channels, optimal memory layout, worst case test vector, ADSP-BF533
- "Data RAM" for one instance, includes Stack, Scratch, Instance/Stage, Minimum Input and Output Single Buffers.
- 1 KiB = 1024 Bytes.

Specifications

Codec Functions	MPEG4 HE-AAC v2 Decoder (with DAB support)
Conformance Standard	ISO/IEC 14496-3 (MPEG-4) HE-AAC v2 Profile at Level 2
Reference Code Revision	ISO/IEC 14496-5:2001, March 2006
Target Processor	ADSP-BF533, Code compatible across the Blackfin Processor Family ADSP-BF5xx
Framework dependencies	None
Release format	Object code module with C source wrapper
Input format	Supports streams with • MPEG-2 AAC-LC profile (ISO/IEC 13818-7) • MPEG-4 AAC-LC audio object (ISO/IEC 14496-3:2005) • MPEG-4 SBR audio object (ISO/IEC 14496-3:2005) • MPEG-4 PS audio object (ISO/IEC 14496-3:2005)
Output format	Supports mono and two channels (Stereo) 16-bit PCM with configurable output buffer location and stride (interleaved LR samples or separate L/R buffers)
Output buffer samples per block	1920 or 2048 samples when the bit stream contains SBR information, otherwise 960 or 1024 samples.
Sample Rate	All sample frequencies specified by the standard ISO/IEC 14496-3 - up to 96 kHz
Bit Rate	All bit rates specified by the standard
Multi-channel	Fully re-entrant and multi-instancing capable

Features:	
Transport Stream	Raw audio stream, ADIFF, ADTS. A separate parser is required to decode audio from the MPEG-4 File Format ¹
Supported Systems	• ETSI TS 102 563 V1.1.1 (2007-02) "Digital Audio Broadcasting (DAB); Transport of Advanced Audio Coding (AAC) audio" • ISMA version 2.0, Profile 2
Output Status	Sample rate, average & maximum bit rates, etc
Fast Forward / Rewind	The decoder provides 'hooks' to seek forward or backward to desired position in a CBR or VBR streams. Users can also rewind into a previous track.
Extended Test Vector Testing	Compliant with ISO/IEC test vectors and additional test vectors with unusual content
Error Codes	Reports up to 9 unique error codes. Such as protected files, non-compliant streams etc

¹ A MP4 File Format parser/demultiplexer module is available from ADI

Memory & Performance

This section presents the MIPS & memory usage of the decoder and some performance figures based on several common memory configurations. This provides developers with a range of processing requirements and overhead estimates.

System Configuration

The MIPS performance are based on worst case test vectors & expressed as Average and Peak figures. Developers will need to budget MIPS requirements according to system and memory layout conditions.

- 1) Processor used: ADSP-BF533
- 2) CCLK = 594 MHz
- 3) SCLK = 119 MHz
- 4) The minimum input buffer required is 1536 bytes per instance.
- 5) The size of the output PCM buffer required is 2048 16-bit words per audio channel per instance. (1 instance of the decoder is used, setup to output 2 channels)

Total Memory Usage (Bytes)

<i>Code</i>	<i>C Standard Library</i>	<i>Stack Depth</i>	<i>Scratch</i>	<i>Per Instance</i>	<i>Data Tables</i>	<i>Input Buffer</i>	<i>Output Buffer</i>
78612	1660	1331	44208	32540	38700	1536	8192

Notes:

- o In typical use, the input and output must be double-buffered, increasing the memory use to 3072 bytes and 16384 bytes respectively.
- o The "C Standard Library" memory figures will vary with VisualDSP++ tool versions
- o The "Stack Depth" figures are typical values and may vary with VisualDSP++ tool versions
- o Sizes indicated for input and output buffers are minimum requirements
- o Heap (or Malloc) is not used

MIPS

MIPS have been measured using the following placement schemes:

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1. *Optimal Memory Layout* – Maximum usage of available internal memory (L1) for BF533: 62 KiB code and 32 KiB data; input/output buffers and remaining objects allocated to SDRAM: 15 KiB code and 91 KiB data.
2. *Typical memory layout* – All code and data placed in cached SDRAM, except 16 KiB of scratch memory and 4 KiB stack which are placed in internal memory (L1).

Notes:

- o 16 KiB Code Memory of Blackfin is dedicated for the Instruction Cache.
- o 16 KiB Data Memory of Bank A and 16 KiB Data Memory of Bank B of the Blackfin is dedicated for the Data Cache.
- o Cache configuration – write-through mode

Test Vector Name	Sample Rate (kHz)	Bit Rate (kbps)	Channel Config	Memory Scheme	Avg MIPS	Peak MIPS
al_sbr_ps_00.mp4	32	32	2	1	33.61	37.3
al_sbr_ps_03.mp4	32	32	2	1	34.50	38.3
al_sbr_ps_04.mp4	32	32	2	1	33.66	37.4
al_sbr_ps_05.mp4	32	32	2	1	34.24	38.0

MIPS Requirements for decoding HE-AAC v2 Bitstreams

Test Vector Name	Sample Rate (kHz)	Bit Rate (kbps)	Channel Config	Memory Scheme	Avg MIPS	Peak MIPS
al19_16.mp4	16	40	1	1	4.32	4.59
al05_16.mp4	16	80	2	1	6.47	7.05
al19_24.mp4	24	64	1	1	6.52	6.95
al05_24.mp4	24	128	2	1	9.85	10.67
al18_32.mp4	32	64	1	1	8.28	9.04
al05_32.mp4	32	128	2	1	12.66	14.1
al19_48.mp4	48	64	1	1	12.11	12.85
al05_48.mp4	48	128	2	1	16.67	19.16

MIPS Requirements for decoding AAC-LC Bitstreams

(GRAPH TO BE ADDED)

MIPS Requirements: MIPS required under example configurations

Notes:

- The graph above was obtained by using a mixture of ISO and ADI test vectors at each sampling frequency and bit rate. The MIPS listed in the table are the worst case average and peak MIPS

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within this vector set. All ADI test vectors comprise a mixture of speech and music that are indicative of the type of audio encountered in practice

Deliverables

- o ADSP-BF5xx (Blackfin) library module with a C-callable API (application programming interface) consistent with other ADI software modules
- o C source application example which calls the above library module
- o Real-time demonstration executable running on ADI evaluation boards
- o Documentation, including Application Note and detailed Developer's Guide, with test report made available on request

Availability

This module is available in object code format after acceptance of ADI's Software License Agreement. For more information, email software.module.support@analog.com or complete an online request form at www.analog.com/processors/support.

Other available software modules from ADI;

Stereo Codecs: MP3, MPEG-4 AAC, MPEG-4 AAC BSAC, Ogg Vorbis and WMA

Multi-channel Audio Codecs: Dolby Digital®, DTS

Video Codecs: MPEG-2, MPEG-4, H.264, WMV, JPEG / M-JPEG

Post Processings: Dolby Headphone v2, Dolby Virtual Speaker, Dolby Prologic IIx / ES, DTS Neo:6 / ES, VisualAudio Tool, Asynchronous Sample Rate Converter (ASCR), General Audio and Video Post Processing Algorithms

Please visit www.analog.com/processors, for the latest product information.

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