

MPEG4AAC HE Decoder on C64x+

User's Guide



Literature Number: SPRUED8D
August 2008

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Read This First

About This Manual

This document describes how to install and work with Texas Instruments' (TI) MPEG4AAC HE Decoder implementation on the C64x+ platform. It also provides a detailed Application Programming Interface (API) reference and information on the sample application that accompanies this component.

TI's codec implementations are based on the eXpressDSP Digital Media (XDM) standard. XDM is an extension of the eXpressDSP Algorithm Interface Standard (XDAIS).

Intended Audience

This document is intended for system engineers who want to integrate TI's codecs with other software to build a multimedia system based on the C64x+ platform.

This document assumes that you are fluent in the C language, have a good working knowledge of Digital Signal Processing (DSP), digital signal processors, and DSP applications. Good knowledge of eXpressDSP Algorithm Interface Standard (XDAIS) and eXpressDSP Digital Media (XDM) standard will be helpful.

How to Use This Manual

This document includes the following chapters:

- ❑ **Chapter 1 -- Introduction**, provides a brief introduction to the XDAIS and XDM standards. It also provides an overview of the codec and lists its supported features.
- ❑ **Chapter 2 -- Installation Overview**, describes how to install, build, and run the codec.
- ❑ **Chapter 3 -- Sample Usage**, describes the sample usage of the codec.
- ❑ **Chapter 4 -- API Reference**, describes the data structures and interface functions used in the codec.
- ❑ **Appendix A -- Optimal Function Placement Order for Minimizing Instruction Cache Penalty**
- ❑ **Appendix B -- Revision History**, highlights the changes made to the SPRUED8C codec specific user guide to make it SPRUED8D.

Related Documentation From Texas Instruments

The following documents describe TI's DSP algorithm standards such as, XDAIS and XDM. To obtain a copy of any of these TI documents, visit the Texas Instruments website at www.ti.com.

- ❑ *TMS320 DSP Algorithm Standard Rules and Guidelines* (literature number SPRU352) defines a set of requirements for DSP algorithms that, if followed, allow system integrators to quickly assemble production-quality systems from one or more such algorithms.
- ❑ *TMS320 DSP Algorithm Standard API Reference* (literature number SPRU360) describes all the APIs that are defined by the TMS320 DSP Algorithm Interface Standard (also known as XDAIS) specification.
- ❑ *Technical Overview of eXpressDSP - Compliant Algorithms for DSP Software Producers* (literature number SPRA579) describes how to make algorithms compliant with the TMS320 DSP Algorithm Standard which is part of TI's eXpressDSP technology initiative.
- ❑ *Using the TMS320 DSP Algorithm Standard in a Static DSP System* (literature number SPRA577) describes how an eXpressDSP-compliant algorithm may be used effectively in a static system with limited memory.
- ❑ *DMA Guide for eXpressDSP-Compliant Algorithm Producers and Consumers* (literature number SPRA445) describes the DMA architecture specified by the TMS320 DSP Algorithm Standard (XDAIS). It also describes two sets of APIs used for accessing DMA resources: the IDMA2 abstract interface and the ACPY2 library.
- ❑ *eXpressDSP Digital Media (XDM) Standard API Reference* (literature number SPRUEC8)

The following documents describe TMS320 devices and related support tools:

- ❑ *Design and Implementation of an eXpressDSP-Compliant DMA Manager for C6X1X* (literature number SPRA789) describes a C6x1x-optimized (C6211, C6711) ACPY2 library implementation and DMA Resource Manager.
- ❑ *TMS320c64x+ Megamodule* (literature number SPRAA68) describes the enhancements made to the internal memory and describes the new features which have been added to support the internal memory architecture's performance and protection.
- ❑ *TMS320C64x+ DSP Megamodule Reference Guide* (literature number SPRU871) describes the C64x+ megamodule peripherals.
- ❑ *TMS320C64x to TMS320C64x+ CPU Migration Guide* (literature number SPRAA84) describes migration from the Texas Instruments TMS320C64x™ digital signal processor (DSP) to the TMS320C64x+™ DSP.
- ❑ *TMS320C6000 Optimizing Compiler v 6.0 Beta User's Guide* (literature number SPRU187N) explains how to use compiler tools

such as compiler, assembly optimizer, standalone simulator, library-build utility, and C++ name demangler.

- ❑ *TMS320C64x/C64x+ DSP CPU and Instruction Set Reference Guide* (literature number SPRU732) describes the CPU architecture, pipeline, instruction set, and interrupts of the C64x and C64x+ DSPs.
- ❑ TMS320DM6446 Digital Media System-on-Chip (literature number SPRS283)
- ❑ *TMS320DM6446 Digital Media System-on-Chip Errata (Silicon Revision 1.0)* (literature number SPRZ241) describes the known exceptions to the functional specifications for the TMS320DM6446 Digital Media System-on-Chip (DMSoC).
- ❑ TMS320DM6443 Digital Media System-on-Chip (literature number SPRS282)
- ❑ *TMS320DM6443 Digital Media System-on-Chip Errata (Silicon Revision 1.0)* (literature number SPRZ240) describes the known exceptions to the functional specifications for the TMS320DM6443 Digital Media System-on-Chip (DMSoC).
- ❑ *TMS320DM644x DMSoC DSP Subsystem Reference Guide* (literature number SPRUE15) describes the digital signal processor (DSP) subsystem in the TMS320DM644x Digital Media System-on-Chip (DMSoC).
- ❑ *TMS320DM644x DMSoC ARM Subsystem Reference Guide* (literature number SPRUE14) describes the ARM subsystem in the TMS320DM644x Digital Media System on a Chip (DMSoC).

Related Documentation

You can use the following documents to supplement this user guide:

- ❑ MPEG2 AAC standards document [ISO/IEC 13818-7:2003]
- ❑ MPEG4 AAC standards document [ISO/IEC 14496-3:1999(E)]
- ❑ MPEG4 AAC-HE standards document [ISO/IEC 14496-3:2001 / AMENDMENT 1, Bandwidth Extension]

Abbreviations

The following abbreviations are used in this document:

Table 1-1. List of Abbreviations

Abbreviation	Description
AAC	Advance Audio Coding
ADIF	Audio Data Interchange Format
ADTS	Audio Data Transport Stream

Abbreviation	Description
HE	High Efficiency
HQ	High Quality
LC	Low Complexity
LP	Low Power
PNS	Perceptual Noise Substitution
PCM	Pulse Code Modulation
RMS	Root Mean Square
SBR	Spectral Band Replication
XDAIS	eXpressDSP Algorithm Interface Standard
XDM	eXpressDSP Digital Media

Text Conventions

The following conventions are used in this document:

- ❑ Text inside back-quotes (“”) represents pseudo-code.
- ❑ Program source code, function and macro names, parameters, and command line commands are shown in a mono-spaced font.

Product Support

When contacting TI for support on this codec, please quote the product name (MPEG4AAC HE Decoder on C64x+) and version number. The version number of the codec is included in the Title of the Release Notes that accompanies this codec.

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Introduction

This chapter provides a brief introduction to XDAIS and XDM. It also provides an overview of TI's implementation of the MPEG4AAC HE Decoder on the C64x+ platform and its supported features.

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1.1 Overview of XDAIS and XDM

TI's multimedia codec implementations are based on the eXpressDSP Digital Media (XDM) standard. XDM is an extension of the eXpressDSP Algorithm Interface Standard (XDAIS).

1.1.1 XDAIS Overview

An eXpressDSP-compliant algorithm is a module that implements the abstract interface IALG. The IALG API takes the memory management function away from the algorithm and places it in the hosting framework. Thus, an interaction occurs between the algorithm and the framework. This interaction allows the client application to allocate memory for the algorithm and also share memory between algorithms. It also allows the memory to be moved around while an algorithm is operating in the system. In order to facilitate these functionalities, the IALG interface defines the following APIs:

- ❑ `algAlloc()`
- ❑ `algInit()`
- ❑ `algActivate()`
- ❑ `algDeactivate()`
- ❑ `algFree()`

The `algAlloc()` API allows the algorithm to communicate its memory requirements to the client application. The `algInit()` API allows the algorithm to initialize the memory allocated by the client application. The `algFree()` API allows the algorithm to communicate the memory to be freed when an instance is no longer required.

Once an algorithm instance object is created, it can be used to process data in real-time. The `algActivate()` API provides a notification to the algorithm instance that one or more algorithm processing methods is about to be run zero or more times in succession. After the processing methods have been run, the client application calls the `algDeactivate()` API prior to reusing any of the instance's scratch memory.

The IALG interface also defines three more optional APIs `algControl()`, `algNumAlloc()`, and `algMoved()`. For more details on these APIs, see *TMS320 DSP Algorithm Standard API Reference* (literature number SPRU360).

1.1.2 XDM Overview

In the multimedia application space, you have the choice of integrating any codec into your multimedia system. For example, if you are building a video decoder system, you can use any of the available video decoders (such as MPEG4, H.263, or H.264) in your system. To enable easy integration with the client application, it is important that all codecs with similar functionality use similar APIs. XDM was primarily defined as an extension to XDAIS to ensure uniformity across different classes of codecs

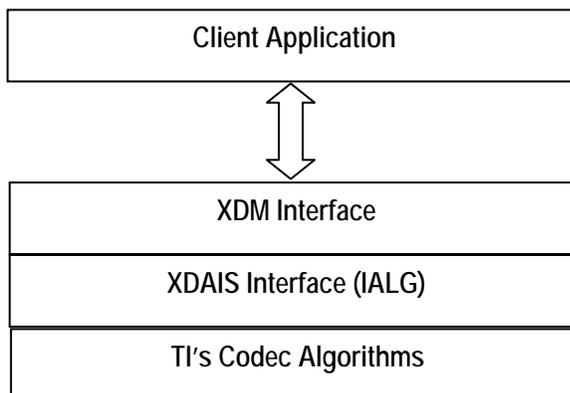
(for example audio, video, image, and speech). The XDM standard defines the following two APIs:

- ❑ `control()`
- ❑ `process()`

The `control()` API provides a standard way to control an algorithm instance and receive status information from the algorithm in real-time. The `control()` API replaces the `algControl()` API defined as part of the IALG interface. The `process()` API does the basic processing (encode/decode) of data.

Apart from defining standardized APIs for multimedia codecs, XDM also standardizes the generic parameters that the client application must pass to these APIs. The client application can define additional implementation specific parameters using extended data structures.

The following figure depicts the XDM interface to the client application.



As depicted in the figure, XDM is an extension to XDAIS and forms an interface between the client application and the codec component. XDM insulates the client application from component-level changes. Since TI's multimedia algorithms are XDM-compliant, it provides you with the flexibility to use any TI algorithm without changing the client application code. For example, if you have developed a client application using an XDM-compliant MPEG4 video decoder, then you can easily replace MPEG4 with another XDM-compliant video decoder, say H.263, with minimal changes to the client application.

For more details, see eXpressDSP Digital Media (XDM) Standard API Reference (literature number SPRUEC8).

1.2 Overview of MPEG4AAC HE Decoder

Advance Audio Coding (AAC) is an audio data compression format. This coding technique uses a perceptual filter bank, a sophisticated masking model, noise-shaping techniques, and channel coupling. It adopts noiseless coding and bit-allocation to provide the maximum compression within the constraints of providing the highest possible quality at smaller bit rates.

1.3 Supported Services and Features

This user guide accompanies TI's implementation of MPEG4AAC HE Decoder on the C64x+ platform.

This version of the codec has the following supported features:

- ❑ Supports MPEG4 AAC Low Complexity (LC) object type implementations
- ❑ Supports MPEG2 AAC Low Complexity (LC) object type implementations
- ❑ Supports MPEG4 AAC High Efficiency (HE) object type implementations
- ❑ Supports mono and stereo output
- ❑ Supports RAW data input format
- ❑ Supports Audio Data Interchange Format (ADIF) and Audio Data Transport Stream (ADTS) input formats. These files are encoded with ISO/IEC 13818-7 or 14496-3 compliant encoders.
- ❑ Supports High Quality AAC HE decode as per ISO/IEC 14496-3:AMENDMENT 1
- ❑ Supports sampling frequency range of 8 khz – 96 khz as per ISO/IEC 14496-3 standard.
- ❑ Supports maximum bit-rate based on the sampling frequency as per standard.
- ❑ Supports both ARIB and ISO/IEC 13818-8 standard downmixing.
- ❑ eXpressDSP Digital Media (XDM 0.9 IAUDDEC) compliant

Installation Overview

This chapter provides a brief description on the system requirements and instructions for installing the codec component. It also provides information on building and running the sample test application.

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2.1 System Requirements

This section describes the hardware and software requirements for the normal functioning of the codec component.

2.1.1 Hardware

This codec has been built and tested on the DM644x EVM.

This codec can be used on any C64x+ platforms like DM6446, DM6437, DM648, DRA446, DM6467, OMAP2430, OMAP3430, and OMAP3530.

2.1.2 Software

The following are the software requirements for the normal functioning of the codec:

- ❑ **Development Environment:** This project is developed using Code Composer Studio version 3.2.37.12 for C6000 from Texas Instruments.
- ❑ **Code Generation Tools:** This project is compiled, assembled, archived, and linked using the code generation tools version 6.0.8.

2.2 Installing the Component

The codec component is released as a compressed archive. To install the codec, extract the contents of the zip file onto your local hard disk. The zip file extraction creates a top-level directory called 100_A_AAC_D_1_23_00, under which another directory named DM644x_HE_MPEG4 is created.

Figure 2-1 shows the sub-directories created in DM644x_HE_MPEG4 directory.

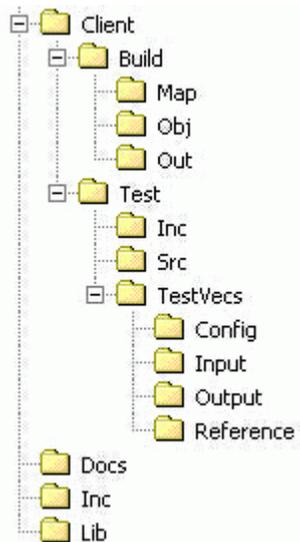


Figure 2-1. Component Directory Structure

Note:

If you are installing an evaluation version of this codec, the directory name will be 100E_A_AAC_D_1_23_00.

Table 2-1 provides a description of the sub-directories created in the DM644x_HE_MPEG4 directory.

Table 2-1. Component Directories

Sub-Directory	Description
\Inc	Contains XDM related header files which allow interface to the codec library
\Lib	Contains the codec library file
\Docs	Contains user guide, datasheet, and release notes
\Client\Build	Contains the sample test application project (.pj) file
\Client\Build\Map	Contains the memory map generated on compilation of the code
\Client\Build\Obj	Contains the intermediate .asm and/or .obj file generated on compilation of the code
\Client\Build\Out	Contains the final application executable (.out) file generated by the sample test application
\Client\Test\Src	Contains application C files
\Client\Test\Inc	Contains header files needed for the application code
\Client\Test\TestVecs\Input	Contains input test vectors
\Client\Test\TestVecs\Output	Contains output generated by the codec
\Client\Test\TestVecs\Reference	Contains read-only reference output to be used for cross-checking against codec output
\Client\Test\TestVecs\Config	Contains configuration parameter files

2.3 Before Building the Sample Test Application

This codec is accompanied by a sample test application. To run the sample test application, you need DSP/BIOS. This version of the codec has been validated with DSP/BIOS version 5.31.

2.3.1 Installing DSP/BIOS

You can download DSP/BIOS from the TI external website:

https://www-a.ti.com/downloads/sds_support/targetcontent/bios/index.html

Install DSP/BIOS at the same location where you have installed Code Composer Studio. For example:

<install directory>\CCStudio_v3.2

The sample test application uses the following DSP/BIOS files:

- ❑ Header file, bcache.h available in the <install directory>\CCStudio_v3.2<bios_directory>\packages\ti\bios\include directory.
- ❑ Library file, biosDM420.a64P available in the <install directory>\CCStudio_v3.2<bios_directory>\packages\ti\bios\lib directory.

2.4 Building and Running the Sample Test Application

This codec is accompanied by a sample test application. This application will run in TI's Code Composer Studio development environment. To build and run the sample application in Code Composer Studio, follow these steps:

- 1) Verify that you have an installation of TI's Code Composer Studio version 3.2.37.12 for C6000 and code generation tools version 6.0.8.
- 2) Verify that the codec object library aacdec_tii.l64P exists in the \Lib sub-directory.
- 3) Open the test application project file, TestAppDecoder.pjt in Code Composer Studio. This file is available in the \Client\Build sub-directory.
- 4) Select **Project > Build** to build the sample test application. This creates an executable file, TestAppDecoder.out in the \Client\Build\Out sub-directory.
- 5) Select **File > Load**, browse to the \Client\Build\Out sub-directory, select the codec executable created in step 4, and load it into Code Composer Studio in preparation for execution.
- 6) Select **Debug > Run** to execute the sample test application.

The sample test application takes the input files stored in the \Client\Test\TestVecs\Input sub-directory, runs the codec, and uses the reference files stored in the \Client\Test\TestVecs\Reference sub-directory to verify that the codec is functioning as expected.

- 7) On successful completion, the application displays one of the following messages for each frame:
 - "Decoder compliance test passed/failed" (for compliance check mode)
 - "Decoder output dump completed" (for output dump mode)

2.5 Configuration Files

This codec is shipped along with a generic configuration file (Testvecs.cfg) that specifies input and output/reference files for the sample test application.

2.5.1 Generic Configuration File

The sample test application shipped along with the codec uses the configuration file, Testvecs.cfg for determining the input and output/reference files for running the codec and checking for compliance. The Testvecs.cfg file is available in the \Client\Test\TestVecs\Config sub-directory.

The format of the Testvecs.cfg file is:

```
X
Input
Output/Reference
```

where:

- ❑ x may be set as:
 - 1 - for compliance checking, no output file is created
 - 0 - for writing the output to the output file
- ❑ Input is the input file name (use complete path).
- ❑ Output/Reference is the output file name (if x is 0) or reference file name (if x is 1).

A sample Testvecs.cfg file is as shown:

```
1
..\..\Test\TestVecs\Input\a100 44100.aac
..\..\Test\TestVecs\Reference\a100 44100 ref.pcm
0
..\..\Test\TestVecs\Input\a100 44100.aac
..\..\Test\TestVecs\Output\a100 44100.pcm
```

2.6 Standards Conformance and User-Defined Inputs

To check the conformance of the codec for the default input file shipped along with the codec, follow the steps as described in Section 2.4.

To check the conformance of the codec for other input files of your choice, follow these steps:

- 1) Copy the input files to the \Client\Test\TestVecs\Inputs sub-directory.
- 2) Copy the reference files to the \Client\Test\TestVecs\Reference sub-directory.
- 3) Edit the configuration file, Testvecs.cfg available in the \Client\Test\TestVecs\Config sub-directory. For details on the format of the Testvecs.cfg file, see Section 2.5.1.
- 4) Execute the sample test application. On successful completion, the application displays one of the following message for each frame:
 - “Decoder compliance test passed/failed” (if x is 1)
 - “Decoder output dump completed” (if x is 0)

If you have chosen the option to write to an output file (x is 0), you can use any standard file comparison utility to compare the codec output with the reference output and check for conformance.

Note:

The comparison is valid only with a set of vectors provided as part of the release package.

2.7 Uninstalling the Component

To uninstall the component, delete the codec directory from your hard disk.

2.8 Evaluation Version

If you are using an evaluation version of this codec, an audible tone will be heard for every 300 frames.

Sample Usage

This chapter provides a detailed description of the sample test application that accompanies this codec component.

3.1 Overview of the Test Application

The test application exercises the IAUDDEC base class of the MPEG4AAC HE Decoder library. The main test application files are TestAppDecoder.c and TestAppDecoder.h. These files are available in the \Client\Test\Src and \Client\Test\Inc sub-directories respectively.

Figure 3-1 depicts the sequence of APIs exercised in the sample test application.

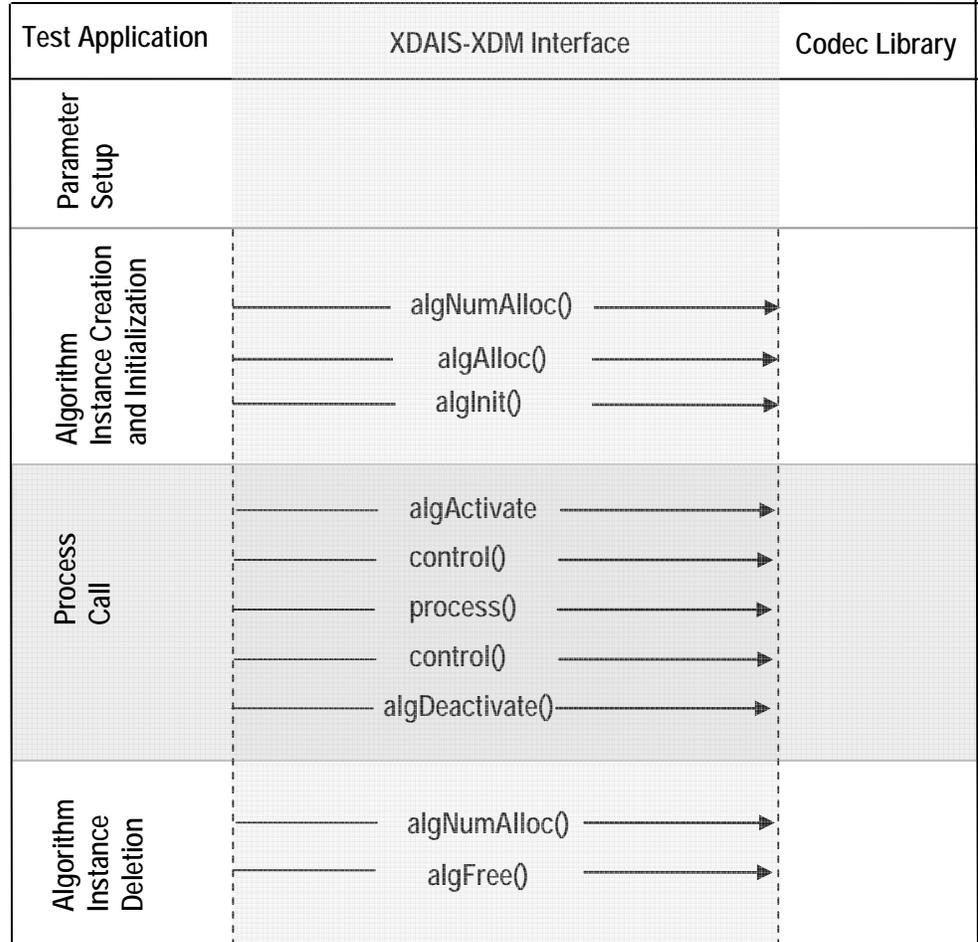


Figure 3-1. Test Application Sample Implementation

Note:

Audio codecs do not use `algActivate()` and `algDeactivate()` APIs.

The test application is divided into four logical blocks:

- ❑ Parameter setup
- ❑ Algorithm instance creation and initialization
- ❑ Process call
- ❑ Algorithm instance deletion

3.1.1 Parameter Setup

Each codec component requires various codec configuration parameters to be set at initialization. For example, a video codec requires parameters such as video height, video width, and so on. The test application obtains the required parameters from the Decoder configuration files.

In this logical block, the test application does the following:

- 1) Opens the generic configuration file, `Testvecs.cfg` and reads the input file name and output file name.

For more details on the configuration files, see Section 2.5.

- 2) Reads the input bit stream into the application input buffer.

After successful completion of the above steps, the test application does the algorithm instance creation and initialization.

3.1.2 Algorithm Instance Creation and Initialization

In this logical block, the test application accepts the various initialization parameters and returns an algorithm instance pointer. The following APIs are called in sequence:

- 1) `algNumAlloc()` - To query the algorithm about the number of memory records it requires.
- 2) `algAlloc()` - To query the algorithm about the memory requirement to be filled in the memory records.
- 3) `algInit()` - To initialize the algorithm with the memory structures provided by the application.

A sample implementation of the create function that calls `algNumAlloc()`, `algAlloc()`, and `algInit()` in sequence is provided in the `ALG_create()` function implemented in the `alg_create.c` file.

3.1.3 Process Call

After algorithm instance creation and initialization, the test application does the following:

- 1) Sets the dynamic parameters (if they change during run time) by calling the `control()` function with the `XDM_SETPARAMS` command.
- 2) Sets the input and output buffer descriptors required for the `process()` function call. The input and output buffer descriptors are obtained by calling the `control()` function with the `XDM_GETBUFINFO` command.
- 3) Calls the `process()` function to encode/decode a single frame of data. The behavior of the algorithm can be controlled using various dynamic parameters (see Section 4.2.1.6). The inputs to the process function are input and output buffer descriptors, pointer to the `IAUDDDEC_InArgs` and `IAUDDDEC_OutArgs` structures.

There could be any ordering of `control()` and `process()` functions. The following APIs are called in sequence:

- 1) `control()` (optional) - To query the algorithm on status or setting of dynamic parameters, and so on using the six available control commands.
- 2) `process()` - To call the Decoder with appropriate input/output buffer and arguments information.
- 3) `control()` (optional) - To query the algorithm on status or setting of dynamic parameters and so on., using the six available control commands.

The do-while loop encapsulates frame level `process()` call and updates the input buffer pointer every time before the next call. The do-while loop breaks off either when an error condition occurs or when the input buffer exhausts. It also protects the `process()` call from file operations by placing appropriate calls for cache operations as well. The test application does a cache invalidate for the valid input buffers before `process()` and a cache write back invalidate for output buffers after `process()`.

In the sample test application, after calling `process()`, the output data is either dumped to a file or compared with a reference file.

3.1.4 Algorithm Instance Deletion

Once decoding/encoding is complete, the test application must delete the current algorithm instance. The following APIs are called in sequence:

- 1) `algNumAlloc()` - To query the algorithm about the number of memory records it used.
- 2) `algFree()` - To query the algorithm to get the memory record information.

A sample implementation of the delete function that calls `algNumAlloc()` and `algFree()` in sequence is provided in the `ALG_delete()` function implemented in the `alg_create.c` file.

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API Reference

This chapter provides a detailed description of the data structures and interfaces functions used in the codec component.

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4.1 Symbolic Constants and Enumerated Data Types	4-2
4.2 Data Structures	4-4
4.3 Interface Functions	4-20

4.1 Symbolic Constants and Enumerated Data Types

This section summarizes all the symbolic constants specified as either #define macros and/or enumerated C data types. For each symbolic constant, the semantics or interpretation of the same is also provided.

Table 4-1. List of Enumerated Data Types

Group or Enumeration Class	Symbolic Constant Name	Description or Evaluation
IAUDIO_ChannelId	IAUDIO_MONO	Single channel
	IAUDIO_STEREO	Two channel
	IAUDIO_THREE_ZERO	Three channel.
	IAUDIO_FIVE_ZERO	Five channel.
	IAUDIO_FIVE_ONE	5.1 channel.
	IAUDIO_SEVEN_ONE	7.1 channel. Not supported for MPEG4AAC HE Decoder.
	IAUDIO_PcmFormat	IAUDIO_BLOCK
IAUDIO_INTERLEAVED		Left and right channel data interleaved. Note: For single channel (mono), right channel data will be same as left channel data.
XDM_DataFormat	XDM_BYTE	Big endian stream
	XDM_LE_16	16-bit little endian stream
	XDM_LE_32	32-bit little endian stream
XDM_CmdId	XDM_GETSTATUS	Query algorithm instance to fill Status structure
	XDM_SETPARAMS	Set run time dynamic parameters through the DynamicParams structure
	XDM_RESET	Reset the algorithm
	XDM_SETDEFAULT	Initialize all fields in Params structure to default values specified in the library

Group or Enumeration Class	Symbolic Constant Name	Description or Evaluation
	XDM_FLUSH	Handle end of stream conditions. This command forces algorithm instance to output data without additional input. Not applicable for MPEG4AAC HE Decoder. Returns IALG_EOK.
	XDM_GETBUFINFO	Query algorithm instance regarding the properties of input and output buffers
XDM_ErrorBit		The bit fields in the 32-bit error code are interpreted as shown.
	XDM_APPLIEDCONCEALMENT	Bit 9 <input type="checkbox"/> 1 - Applied concealment <input type="checkbox"/> 0 - Ignore Not applicable for MPEG4AAC HE Decoder.
	XDM_INSUFFICIENTDATA	Bit 10 <input type="checkbox"/> 1 - Insufficient input data <input type="checkbox"/> 0 - Ignore
	XDM_CORRUPTEDDATA	Bit 11 <input type="checkbox"/> 1 - Invalid data <input type="checkbox"/> 0 - Ignore
	XDM_CORRUPTEDHEADER	Bit 12 <input type="checkbox"/> 1 - Corrupted frame header <input type="checkbox"/> 0 - Ignore
	XDM_UNSUPPORTEDINPUT	Bit 13 <input type="checkbox"/> 1 - Unsupported feature/parameter in input <input type="checkbox"/> 0 - Ignore
	XDM_UNSUPPORTEDPARAM	Bit 14 <input type="checkbox"/> 1 - Unsupported input parameter or configuration <input type="checkbox"/> 0 - Ignore Not applicable for MPEG4AAC HE Decoder.
	XDM_FATALERROR	Bit 15 <input type="checkbox"/> 1 - Fatal error (stop decoding) <input type="checkbox"/> 0 - Recoverable error

Note:

The remaining bits that are not mentioned in `XDM_ErrorBit` are interpreted as:

- ❑ Bit 16-32: Reserved
- ❑ Bit 8: Reserved
- ❑ Bit 0-7: Codec and implementation specific

The algorithm can set multiple bits to 1 depending on the error condition.

The MPEG4AAC HE Decoder specific error status messages are listed in Table 4-2. The Value column indicates the decimal value of the last 8-bits reserved for codec specific error statuses.

Group or Enumeration Class	Symbolic Constant Name	Description or Evaluation
IAACDEC_ChannelId	IAUDIO_DUALMONOaural	Dual Mono channels
	IAUDIO_TWO_ONE	Front stereo and side mono channel
	IAUDIO_TWO_TWO	Stereo front and stereo side channels
	IAUDIO_THREE_ONE	Stereo and mono front channels with a mono side channel
	IAUDIO_THREE_TWO	Stereo and mono front channels with a stereo side channel
	IAUDIO_THREE_TWO_LFE	Stereo and mono front channels with a stereo side channel and LFE.
	IAUDIO_DOWNMIXED_STEREO	Down mixed to stereo
	IAUDIO_ZERO_ONE	One mono side channel.
	IAUDIO_ONE_ONE	Mono front and mono side channels.
	IAUDIO_ZERO_TWO	Two side channels.
	IAUDIO_ONE_TWO	One front and two side channels.
	IAUDIO_LFE	LFE only channel.
	IAUDIO_ONE_ZERO_LFE	Mono front channel + LFE
	IAUDIO_TWO_ZERO_LFE	Two front channels + LFE
	IAUDIO_THREE_ZERO_LFE	Three front channels + LFE
	IAUDIO_ZERO_ONE_LFE	One side channel + LFE
	IAUDIO_ONE_ONE_LFE	One front and one side channel +LFE

Group or Enumeration Class	Symbolic Constant Name	Description or Evaluation
	IAUDIO_TWO_ONE_LFE	Two front and one side channel +LFE
	IAUDIO_THREE_ONE_LFE	Three front and one side channels +LFE
	IAUDIO_ZERO_TWO_LFE	Two side channels + LFE
	IAUDIO_ONE_TWO_LFE	One front and two side channels + LFE
	IAUDIO_TWO_TWO_LFE	Two front and two side channel +LFE
	IAUDIO_NOOUTPUT	No output is generated for all speakers.

Note:

- ❑ Among these extended Channel IDs, only `IAUDIO_DUALMONOAUURAL` is applicable to this version of MPEG4 HE Decoder.
- ❑ For Dual Mono streams, decoder returns `IAUDIO_DUALMONOAUURAL` as `numChannels`.

Table 4-2. MPEG4AAC HE Decoder Error Status

Symbolic Constant Name	Value	Description or Evaluation
AACDEC_TII_NO_ERROR	0	Successful decoding
AACDEC_TII_SYNC_NOT_FOUND	1	ADTS stream sync word not found
AACDEC_TII_ADTS_INVALID	2	Not a valid ADTS stream
AACDEC_TII_ADTS_LAY_ERROR	3	ADTS layer data error
AACDEC_TII_NOT_ENOUGH_CH	4	Not enough channels supported (multi-channel error for LC)
AACDEC_TII_PRED_DETECTED	5	Prediction detected, but not supported
AACDEC_TII_LFE_DETECTED	6	LFE channel detected, but not supported
AACDEC_TII_GAIN_DETECTED	7	Gain control not implemented
AACDEC_TII_CCE_DETECTED	8	Coupling channel detected, but not supported
AACDEC_TII_PULSE_NOT_ALLOWED	9	Pulse is not supported for short window
AACDEC_TII_SFB_LARGE_SHORT	10	Maximum scale factor band too large (Word16 window)
AACDEC_TII_SFB_LARGE_LONG	11	Maximum scale factor band too large (Word32 window)

Symbolic Constant Name	Value	Description or Evaluation
AACDEC_TII_DATA_CHANNEL_ERROR	12	Not used
AACDEC_TII_CH_ELE_PARSE_ERROR	13	Channel element parse error, SCE parse error, CPE parse error, or LFE parse error
AACDEC_TII_ADTS_PROFILE_ERROR	14	ADTS profile error
AACDEC_TII_ADIF_PROFILE_ERROR	15	ADIF profile error
AACDEC_TII_ELE_NOT_SUPPORTED	16	Incorrect <code>id_syn_ele</code> encountered
AACDEC_TII_SAM_FREQ_NOT_SUPPORTED	17	Sampling frequency is not supported
AACDEC_TII_ADTS_FRAME_LENGTH_INCORRECT	18	ADTS frame length incorrect
AACDEC_TII_ID_INCORRECT	19	Huffman codebook ID extracted is incorrect
AACDEC_TII_INSUFFICIENT_INPUT_DATA	20	Data in input buffer is insufficient to decode frame
AACDEC_TII_INVALID_SBR_STREAM	21	Invalid spectral band replication data
AACDEC_TII_INVALID_NOISE_BAND	22	Invalid noise band
AACDEC_TII_INVALID_START_STOP	23	Invalid start and stop band
AACDEC_TII_CH_ELE_COMBINATION_ERROR	24	Incorrect channel element combination
AACDEC_TII_INVALID_POINTER	25	Invalid pointer error
AACDEC_TII_CRC_ERROR	26	Cyclic redundancy check error
AACDEC_TII_INSTANCE_TAG_MISMATCH	27	Instance tag mismatch error
AACDEC_TII_SAM_FREQ_INCONSISTENCY	28	Inconsistency in sample rate between frames
AACDEC_TII_PROTECTION_ABSENT	29	CRC Protection absent
AACDEC_TII_CRC_MISMATCH_ERROR	30	Mismatch between CRC word in bit-stream and computed one
AACDEC_TII_INVALID_BUFFER_FULLNESS	31	VBR not supported

Symbolic Constant Name	Value	Description or Evaluation
AACDEC_TII_NUM_RAW_DATA_BLOCK_ERROR	32	Number of raw data block more than 1
AACDEC_TII_PCE_NOT_DETECTED	33	PCE not detected for channel config 0
AACDEC_TII_SIDE_CHANNEL_DETECTED	34	Side channel detected in PCE.
AACDEC_TII_INCORRECT_CHANNEL_ORDER	35	order of occurrence of elements incorrect for channel config !=0
AACDEC_TII_INCORRECT_PCE_NUMCHANNELS	36	Inconsistency in number of channels detected between PCE and actual one.
AACDEC_TII_MPEG2_ID_INCORRECT	37	MPEG2 stream but id is mpeg4
AACDEC_TII_SAM_FREQ_NOT_SUPPORTED_ARIB	38	Valid sample rate but not supported for ARIB compliance
AACDEC_TII_INVALID_NUM_BANDS	39	Invalid Number of Bands.
AACDEC_TII_INVALID_BANDS	40	Invalid Bands.
AACDEC_TII_INVALID_SIZE	41	Invalid InArgs or OutArgs size.

4.2 Data Structures

This section describes the XDM defined data structures that are common across codec classes. These XDM data structures can be extended to define any implementation specific parameters for a codec component.

4.2.1 Common XDM Data Structures

This section includes the following common XDM data structures:

- ❑ XDM_BufDesc
- ❑ XDM_AlgBufInfo
- ❑ IAUDDEC_Fxns
- ❑ IAUDDEC_Params
- ❑ IAUDDEC_DynamicParams
- ❑ IAUDDEC_InArgs
- ❑ IAUDDEC_Status
- ❑ IAUDDEC_OutArgs

4.2.1.1 XDM_BufDesc

|| Description

This structure defines the buffer descriptor for input and output buffers.

|| Fields

Field	Datatype	Input/ Output	Description
**bufs	XDAS_Int8	Input	Pointer to the vector containing buffer addresses
numBufs	XDAS_Int32	Input	Number of buffers
*bufSizes	XDAS_Int32	Input	Size of each buffer in bytes

4.2.1.2 XDM_AlgoBufInfo

|| Description

This structure defines the buffer information descriptor for input and output buffers. This structure is filled when you invoke the control() function with the XDM_GETBUFINFO command.

|| Fields

Field	Datatype	Input/ Output	Description
minNumInBufs	XDAS_Int32	Output	Number of input buffers
minNumOutBufs	XDAS_Int32	Output	Number of output buffers
minInBufSize[XDM_MAX_IO_BUFFERS]	XDAS_Int32	Output	Size in bytes required for each input buffer
minOutBufSize[XDM_MAX_IO_BUFFERS]	XDAS_Int32	Output	Size in bytes required for each output buffer

Note:

For MPEG4AAC HE Decoder, the buffer details are:

- ❑ Number of input buffer required is 1.
- ❑ Number of output buffer required is 1.
- ❑ The input buffer size (in bytes) is 1648 bytes.
- ❑ The output buffer size (in bytes) is 8192 bytes for 16 bit audio sample size, 2 channel output (stereo).

4.2.1.3 IAUDDEC_Fxns

|| Description

This structure contains pointers to all the XDAIS and XDM interface functions.

|| Fields

Field	Datatype	Input/ Output	Description
ialg	IALG_Fxns	Input	Structure containing pointers to all the XDAIS interface functions. For more details, see <i>TMS320 DSP Algorithm Standard API Reference</i> (literature number SPRU360).
*process	XDAS_Int32	Input	Pointer to the process() function
*control	XDAS_Int32	Input	Pointer to the control() function

4.2.1.4 IAUDDEC_Params

|| Description

This structure defines the creation parameters for an algorithm instance object. Set this data structure to NULL, if you are not sure of the values to specify for these parameters.

|| Fields

Field	Datatype	Input/ Output	Description
size	XDAS_Int32	Input	Size of the basic or extended (if being used) data structure in bytes.
maxSampleRate	XDAS_Int32	Input	Maximum sampling frequency to be supported in Hertz (Hz). For example, if maximum sampling frequency is 44.1 kHz, set this field to 44100.
maxBitrate	XDAS_Int32	Input	Maximum bit rate to be supported in bits per second. For example, if maximum bit rate is 128 kbps, set this field to 128000.
maxNoOfCh	XDAS_Int32	Input	Maximum channels to be supported. See IAUDIO_ChannelId enumeration for details
dataEndianness	XDAS_Int32	Input	Endianness of input data. See XDM_DataFormat enumeration for details.

Note:

- ❑ The current MPEG4AAC_HE Decoder implementation supports XDM_BYTE format. Input data is big endian as per standard and output is little endian.
- ❑ For the supported `maxBitrate` and `maxSampleRate` values, see ISO/IEC 14496-3:1999(E) Information technology -- Coding of audio-visual objects -- Part 3: Audio (MPEG4 AAC standards document) listed in the Related Documentation section.
- ❑ The `maxBitrate`, `maxSampleRate`, and `maxNoOfCh` are only used during initialization for checking the capability of the decoder by the application. During actual decoding, the AAC Decoder will decode all the sampling frequencies, bit-rate, and channels as mentioned in the user guide.

4.2.1.5 IAUDDEC_DynamicParams**|| Description**

This structure defines the run time parameters for an algorithm instance object. Set this data structure to NULL, if you are not sure of the values to be specified for these parameters.

|| Fields

Field	Datatype	Input/ Output	Description
<code>size</code>	<code>XDAS_Int32</code>	Input	Size of the basic or extended (if being used) data structure in bytes.
<code>outputFormat</code>	<code>XDAS_Int32</code>	Input	To set interleaved/block format for output. See <code>IAUDIO_PcmFormat</code> enumeration for details.

4.2.1.6 IAUDDEC_InArgs**|| Description**

This structure defines the run time input arguments for an algorithm instance object.

|| Fields

Field	Datatype	Input/ Output	Description
<code>size</code>	<code>XDAS_Int32</code>	Input	Size of the basic or extended (if being used) data structure in bytes.
<code>numBytes</code>	<code>XDAS_Int32</code>	Input	Number of valid input data (in bytes) in input buffer. For example, if number of valid input data in input buffer is 128 bytes, set this field to 128.

4.2.1.7 IAUDDEC_Status

|| Description

This structure defines parameters that describe the status of the algorithm instance object.

|| Fields

Field	Datatype	Input/ Output	Description
size	XDAS_Int32	Input	Size of the basic or extended (if being used) data structure in bytes.
extendedError	XDAS_Int32	Output	Extended error enumeration for XDM compliant encoders and decoders. See <code>XDM_ErrorBit</code> enumeration for details.
bitRate	XDAS_Int32	Output	Bit rate in bits per second. For example, if the value of this field is 128000, it indicates that bit rate is 128 kbps.
sampleRate	XDAS_Int32	Output	Sampling frequency in Hertz (Hz). For example, if the value of this field is 44100, it indicates that the sample rate is 44.1kHz.
numChannels	XDAS_Int32	Output	Number of channels. See <code>IAUDIO_ChannelId</code> enumeration for details.
numLFEChannels	XDAS_Int32	Output	Number of Low Frequency Effects (LFE) channels in the PCM output.
outputFormat	XDAS_Int32	Output	The output PCM format. See <code>IAUDIO_PcmFormat</code> enumeration for details.
autoPosition	XDAS_Int32	Output	Flag to indicate support for random position decoding, which means that a stream can be decoded from any point: <ul style="list-style-type: none"> <input type="checkbox"/> 1 - Supports random position decoding <input type="checkbox"/> 0 - Does not support random position decoding
fastFwdLen	XDAS_Int32	Output	Recommended Fast Forward length in bytes in case of random position decoding.
frameLen	XDAS_Int32	Output	Number of samples decoded per decode call
outputBitsPerSample	XDAS_Int32	Output	Number of output bits per output sample. For example, if the value of the field is 16, it indicates 16 output bits per PCM sample.
bufInfo	XDM_AlgbufInfo	Output	Input and output buffer information. See <code>XDM_AlgbufInfo</code> data structure for details.

Note:

For dual mono streams, the decoder returns `IAUDIO_DUALMONOaural` as `numChannels`.

4.2.1.8 IAUDDEC_OutArgs**|| Description**

This structure defines the run time output arguments for the algorithm instance object.

|| Fields

Field	Datatype	Input/ Output	Description
<code>size</code>	<code>XDAS_Int32</code>	Input	Size of the basic or extended (if being used) data structure in bytes.
<code>extendedError</code>	<code>XDAS_Int32</code>	Output	Extended error enumeration for XDM compliant encoders and decoders. See <code>XDM_ErrorBit</code> data structure for details.
<code>bytesConsumed</code>	<code>XDAS_Int32</code>	Output	Bytes consumed during the process call

4.2.2 MPEG4AAC HE Decoder Data Structures

This section includes the following MPEG4AAC HE Decoder specific extended data structures:

- ❑ IAACDEC_Params
- ❑ IAACDEC_DynamicParams
- ❑ IAACDEC_InArgs
- ❑ IAACDEC_Status
- ❑ IAACDEC_OutArgs

4.2.2.1 IAACDEC_Params

|| Description

This structure defines the creation parameters and any other implementation specific parameters for the MPEG4AAC HE Decoder instance object. The creation parameters are defined in the XDM data structure, IAUDDEC_Params.

|| Fields

Field	Datatype	Input/Output	Description
auddec_params	IAUDDEC_Params	Input	See IAUDDEC_Params data structure for details.
Output24Bit	XDAS_Int32	Input	Output format: <input type="checkbox"/> 0 - 16 bit <input type="checkbox"/> 1 - 24 bit [Only 16-bit output format is supported for MPEG4AAC HE Decoder, 24-bit output format is not supported]
sixChannelMode	XDAS_Int32	Input	Multi-channel mode: <input type="checkbox"/> 0 - off <input type="checkbox"/> 1 - on

4.2.2.2 IAACDEC_DynamicParams

|| Description

This structure defines the run time parameters and any other implementation specific parameters for the MPEG4AAC HE Decoder instance object. The run time parameters are defined in the XDM data structure, IAUDDEC_DynamicParams.

|| Fields

Field	Datatype	Input/Output	Description
auddec_dynamicparams	IAUDDEC_DynamicParams	Input	See IAUDDEC_DynamicParams data structure for details.
DownSampleSbr	XDAS_Int32	Input	Down sampler flag for AAC-HE: <input type="checkbox"/> 0 - Down sampler off <input type="checkbox"/> 1 - Down sampler on If the flag is set, the output is down sampled by a factor of 2.
EnablePS	XDAS_Int32	Input	Parametric stereo (PS) flag: <input type="checkbox"/> 0 - Disables PS <input type="checkbox"/> 1 - Enables PS [Not supported for MPEG4AAC HE Decoder]

Field	Datatype	Input/ Output	Description
ulSamplingRateIdx	XDAS_Int32	Input	<p>Sampling rate required for raw input data format:</p> <ul style="list-style-type: none"> <input type="checkbox"/> 0 - 96.000 khz <input type="checkbox"/> 1 - 88.200 khz <input type="checkbox"/> 2 - 64.000 khz <input type="checkbox"/> 3 - 48.000 khz <input type="checkbox"/> 4 - 44.100 khz <input type="checkbox"/> 5 - 32.000 khz <input type="checkbox"/> 6 - 24.000 khz <input type="checkbox"/> 7 - 22.050 khz <input type="checkbox"/> 8 - 16.000 khz <input type="checkbox"/> 9 - 12.000 khz <input type="checkbox"/> 10 - 11.025 khz <input type="checkbox"/> 11 - 8.000 khz
nProfile	XDAS_Int32	Input	<p>Decoder profile required for raw input data format:</p> <ul style="list-style-type: none"> <input type="checkbox"/> 0 - MAIN <input type="checkbox"/> 1 - LC <input type="checkbox"/> 2 - SSR <input type="checkbox"/> 3 - LTP
bRawFormat	XDAS_Int32	Input	<p>Raw input format indicator flag:</p> <ul style="list-style-type: none"> <input type="checkbox"/> 0 - Indicates input format is not raw (that is, ADIF or ADTS formats) <input type="checkbox"/> 1 - Indicates input format is raw
monotoSteoro	XDAS_UInt8	Input	<p>monotoSteoro indicator flag:</p> <ul style="list-style-type: none"> <input type="checkbox"/> 0 - Indicates monotostereo conversion of mono files for stereo output is off . <input type="checkbox"/> 1 - Indicates monotostereo conversion of mono files for stereo output is on .
stereoToMono	XDAS_UInt8	Input	<p>steorotoMono indicator flag:</p> <ul style="list-style-type: none"> <input type="checkbox"/> 0 - Indicates stereotoMono conversion of stereo files for mono output is off . <input type="checkbox"/> 1 - Indicates stereotoMono conversion of stereo files for mono output is on .
MatrixMixdownEnableFlag	XDAS_Int32	Input	<p>Matrix Mix down enable for 3/1, 3/2 and 3/2+LFE channel streams.</p> <ul style="list-style-type: none"> <input type="checkbox"/> 0 - Mixdown off <input type="checkbox"/> 1 - Mixdown on <p>This flag will be ignored for other than 3/1, 3/2, and 3/2+LFE channels. This flag will be ignored for MPEG4 HE Decoder as down-mixing is always done for multi-channel streams.</p>

Field	Datatype	Input/ Output	Description
PseudoSurroundEnableFlag	XDAS_Int32	Input	Pseudo surround enable flag to use Set2 type of down mixing. <ul style="list-style-type: none"> <input type="checkbox"/> 0 - Disables Pseudo surround enable flag <input type="checkbox"/> 1 - Enables Pseudo surround enable flag Ignored if EnableARIBDownmix is off
EnableARIBDownmix	XDAS_Int32	Input	ARIB down-mix enable for 3/1, 3/2 and 3/2+LFE channel streams. <ul style="list-style-type: none"> <input type="checkbox"/> 0 – ARIB downmix off <input type="checkbox"/> 1 - ARIB downmix on

Note:

For decoding ADIF and ADTS streams, set the field `bRawFormat` to 0 and ignore the `ulSamplingRateIdx` and `nProfile` fields.

For decoding raw streams, set the field `bRawFormat` to 1 and the fields `ulSamplingRateIdx` and `nProfile` to one of the values given above.

`PseudoSurroundEnableFlag` is to select between Set1 and Set2 formulas when `pseudo_surround_enable` field in bit-stream is 1.

- 0 – Set1 is used if `pseudo_surround_enable` is 1.
- 1 – Set2 is used if `pseudo_surround_enable` is 1.

`EnableARIBDownmix` is to select between ARIB down-mix and ISO/IEC 13818-8 standard down-mix.

ARIB down-mixing will be done only if the channel configuration is 3/1 or 3/2 or 3/2+LFE, otherwise ISO/IEC 13818-8 standard down-mixing will be done.

Down-mixing is supported only for 16bit PCM sample and not supported for 24-bit samples.

If `stereoToMono` flag is ON for multi-channel streams, down-mixed stereo PCM output will be converted to mono.

4.2.2.3 IAACDEC_InArgs

|| Description

This structure defines the run time input arguments for the MPEG4AAC HE Decoder instance object.

|| Fields

Field	Datatype	Input/ Output	Description
auddec_inArgs	IAUDDDEC_InArgs	Input	See IAUDDDEC_InArgs data structure for details.

4.2.2.4 IAACDEC_Status

|| Description

This structure defines parameters that describe the status of the MPEG4AAC HE Decoder and any other implementation specific parameters. The status parameters are defined in the XDM data structure, IAUDDDEC_Status.

|| Fields

Field	Datatype	Input/ Output	Description
auddec_status	IAUDDDEC_Status	Output	See IAUDDDEC_Status data structure for details.
isValid	XDAS_Int32	Output	Flag indicating if the last decode call was successful: <ul style="list-style-type: none"> <input type="checkbox"/> 1 - Indicates last decode call was successful and the values of the fields in the IAUDDDEC_Status structure are valid. <input type="checkbox"/> 0 - Indicates last decode call was not successful and the values are not valid.
SbrPresent	XDAS_Int16	Output	Indicates if SBR is present in bit-stream or not : <ul style="list-style-type: none"> <input type="checkbox"/> 0 – Indicates SBR is not present in the bit-stream <input type="checkbox"/> 1 – Indicates SBR is present in the bit-stream
psPresent	XDAS_Int16	Output	Indicates if PS is present in bit-stream or not : <ul style="list-style-type: none"> <input type="checkbox"/> 0 – Indicates PS is not present in the bit-stream <input type="checkbox"/> 1 – Indicates PS is present in the bit-stream
SixChannelMode	XDAS_Int32	Output	Indicates the multi-channel mode ON or OFF: <ul style="list-style-type: none"> <input type="checkbox"/> 0 – Indicates multichannel mode is off <input type="checkbox"/> 1 – Indicates multichannel mode is on

Field	Datatype	Input/ Output	Description
outputBufInfoStatus	XDAS_Int16	Output	6-bit output buffer information status. <input type="checkbox"/> != 0 - Indicates that output available for the speaker. <input type="checkbox"/> 0 - Indicates that no output is available for the speaker. Not supported for MPEG4HE Decoder
isARIBDownMixed	XDAS_Int32	Output	Flag to indicate type of down-mixing <input type="checkbox"/> 1 – Indicates ARIB downmixed. <input type="checkbox"/> 0 – Indicates ISO/IEC 13818-8 standard downmixed. isARIBDownMixed should be interpreted only for the streams with more than two channels.
PseudoSurroundEnable	XDAS_Int32	Output	Flag to indicate if pseudo_surround_enable field in the bit-stream is set or not. <input type="checkbox"/> 1 – Indicates pseudo_surround_enable is not set. <input type="checkbox"/> 0 – Indicates pseudo_surround_enable is set..

4.2.2.5 IAACDEC_OutArgs

|| Description

This structure defines the run time output arguments for the MPEG4AAC HE Decoder instance object.

|| Fields

Field	Datatype	Input/ Output	Description
auddec_outArgs	IAUDDDEC_OutArgs	Output	See IAUDDDEC_OutArgs data structure for details.

4.3 Interface Functions

This section describes the Application Programming Interfaces (APIs) used in the MPEG4AAC HE Decoder. The APIs are logically grouped into the following categories:

- ❑ **Creation** – `algNumAlloc()`, `algAlloc()`
- ❑ **Initialization** – `algInit()`
- ❑ **Control** – `control()`
- ❑ **Data processing** – `algActivate()`, `process()`, `algDeactivate()`
- ❑ **Termination** – `algFree()`

You must call these APIs in the following sequence:

- 1) `algNumAlloc()`
- 2) `algAlloc()`
- 3) `algInit()`
- 4) `algActivate()`
- 5) `process()`
- 6) `algDeactivate()`
- 7) `algFree()`

`control()` can be called any time after calling the `algInit()` API.

`algNumAlloc()`, `algAlloc()`, `algInit()`, `algActivate()`, `algDeactivate()`, and `algFree()` are standard XDAIS APIs. This document includes only a brief description for the standard XDAIS APIs. For more details, see *TMS320 DSP Algorithm Standard API Reference* (literature number SPRU360).

Note:

Audio codecs do not use `algActivate()` and `algDeactivate()` APIs.

4.3.1 Creation APIs

Creation APIs are used to create an instance of the component. The term creation could mean allocating system resources, typically memory.

|| Name

`algNumAlloc()` – determine the number of buffers that an algorithm requires

|| Synopsis

```
XDAS_Int32 algNumAlloc(Void);
```

|| Arguments

Void

|| Return Value

```
XDAS_Int32; /* number of buffers required */
```

|| Description

`algNumAlloc()` returns the number of buffers that the `algAlloc()` method requires. This operation allows you to allocate sufficient space to call the `algAlloc()` method.

`algNumAlloc()` may be called at any time and can be called repeatedly without any side effects. It always returns the same result. The `algNumAlloc()` API is optional.

For more details, see *TMS320 DSP Algorithm Standard API Reference* (literature number SPRU360).

|| See Also

`algAlloc()`

|| Name

`algAlloc()` – determine the attributes of all buffers that an algorithm requires

|| Synopsis

```
XDAS_Int32 algAlloc(const IALG_Params *params, IALG_Fxns  
**parentFxns, IALG_MemRec memTab[]);
```

|| Arguments

```
IALG_Params *params; /* algorithm specific attributes */
```

```
IALG_Fxns **parentFxns; /* output parent algorithm  
functions */
```

```
IALG_MemRec memTab[]; /* output array of memory records */
```

|| Return Value

```
XDAS_Int32 /* number of buffers required */
```

|| Description

`algAlloc()` returns a table of memory records that describe the size, alignment, type, and memory space of all buffers required by an algorithm. If successful, this function returns a positive non-zero value indicating the number of records initialized.

The first argument to `algAlloc()` is a pointer to a structure that defines the creation parameters. This pointer may be NULL; however, in this case, `algAlloc()` must assume default creation parameters and must not fail.

The second argument to `algAlloc()` is an output parameter. `algAlloc()` may return a pointer to its parent's IALG functions. If an algorithm does not require a parent object to be created, this pointer must be set to NULL.

The third argument is a pointer to a memory space of size `nbufs * sizeof(IALG_MemRec)` where, `nbufs` is the number of buffers returned by `algNumAlloc()` and `IALG_MemRec` is the buffer-descriptor structure defined in `ialg.h`.

After calling this function, `memTab[]` is filled up with the memory requirements of an algorithm.

For more details, see *TMS320 DSP Algorithm Standard API Reference* (literature number SPRU360).

|| See Also

```
algNumAlloc(), algFree()
```

4.3.2 Initialization API

Initialization API is used to initialize an instance of the algorithm. The initialization parameters are defined in the `Params` structure (see Data Structures section for details).

|| Name

`algInit()` – initialize an algorithm instance

|| Synopsis

```
XDAS_Int32 algInit(IALG_Handle handle, IALG_MemRec
memTab[], IALG_Handle parent, IALG_Params *params);
```

|| Arguments

```
IALG_Handle handle; /* algorithm instance handle*/
IALG_memRec memTab[]; /* array of allocated buffers */
IALG_Handle parent; /* handle to the parent instance */
IALG_Params *params; /* algorithm initialization
parameters */
```

|| Return Value

```
IALG_EOK; /* status indicating success */
IALG_EFAIL; /* status indicating failure */
```

|| Description

`algInit()` performs all initialization necessary to complete the run time creation of an algorithm instance object. After a successful return from `algInit()`, the instance object is ready to be used to process data.

The first argument to `algInit()` is a handle to an algorithm instance. This value is initialized to the base field of `memTab[0]`.

The second argument is a table of memory records that describe the base address, size, alignment, type, and memory space of all buffers allocated for an algorithm instance. The number of initialized records is identical to the number returned by a prior call to `algAlloc()`.

The third argument is a handle to the parent instance object. If there is no parent object, this parameter must be set to `NULL`.

The last argument is a pointer to a structure that defines the algorithm initialization parameters.

For more details, see *TMS320 DSP Algorithm Standard API Reference* (literature number SPRU360).

|| See Also

`algAlloc()`, `algMoved()`

4.3.3 Control API

Control API is used for controlling the functioning of the algorithm instance during run time. This is done by changing the status of the controllable parameters of the algorithm during run time. These controllable parameters are defined in the `Status` data structure (see Data Structures section for details).

|| Name

`control()` – change run time parameters and query the status

|| Synopsis

```
XDAS_Int32 (*control) (IAUDDDEC_Handle handle, IAUDDDEC_Cmd
id, IAUDDDEC_DynamicParams *params, IAUDDDEC_Status
*status);
```

|| Arguments

```
IAUDDDEC_Handle handle; /* algorithm instance handle */
IAUDDDEC_Cmd id; /* algorithm specific control commands*/
IAUDDDEC_DynamicParams *params /* algorithm run time
parameters */
IAUDDDEC_Status *status /* algorithm instance status
parameters */
```

|| Return Value

```
IALG_EOK; /* status indicating success */
IALG_EFAIL; /* status indicating failure */
```

|| Description

This function changes the run time parameters of an algorithm instance and queries the algorithm's status. `control()` must only be called after a successful call to `algInit()` and must never be called after a call to `algFree()`.

The first argument to `control()` is a handle to an algorithm instance.

The second argument is an algorithm specific control command. See `XDM_CmdId` enumeration for details.

The third and fourth arguments are pointers to the `IAUDDDEC_DynamicParams` and `IAUDDDEC_Status` data structures respectively.

Note:

If you are using extended data structures, the third and fourth arguments must be pointers to the extended `DynamicParams` and `Status` data structures respectively. Also, ensure that the size field is set to the size of the extended data structure. Depending on the value set for the size field, the algorithm uses either basic or extended parameters.

|| Preconditions

The following conditions must be true prior to calling this function; otherwise, its operation is undefined.

- ❑ `control()` can only be called after a successful return from `algInit()` and `algActivate()`.
- ❑ If algorithm uses DMA resources, `control()` can only be called after a successful return from `DMAN3_init()`.
- ❑ `handle` must be a valid handle for the algorithm's instance object.

|| Postconditions

The following conditions are true immediately after returning from this function.

- ❑ If the control operation is successful, the return value from this operation is equal to `IALG_EOK`; otherwise it is equal to either `IALG_EFAIL` or an algorithm specific return value.
- ❑ If the control command is not recognized, the return value from this operation is not equal to `IALG_EOK`.

|| Example

See test application file, `TestAppDecoder.c` available in the `\Client\Test\Src` sub-directory.

|| See Also

`algInit()`, `algActivate()`, `process()`

Note:

Audio codecs do not use `algActivate()`, `algDeactivate()`, and `DMAN3_init()` APIs.

4.3.4 Data Processing API

Data processing API is used for processing the input data.

|| Name

`process()` – basic encoding/decoding call

|| Synopsis

```
XDAS_Int32 (*process)(IAUDDDEC_Handle handle, XDM_BufDesc
*inBufs, XDM_BufDesc *outBufs, IAUDDDEC_InArgs *inargs,
IAUDDDEC_OutArgs *outargs);
```

|| Arguments

IAUDDDEC_Handle handle; /* algorithm instance handle */

XDM_BufDesc *inBufs; /* algorithm input buffer descriptor */

XDM_BufDesc *outBufs; /* algorithm output buffer descriptor */

IAUDDDEC_InArgs *inargs /* algorithm runtime input arguments */

IAUDDDEC_OutArgs *outargs /* algorithm runtime output arguments */

|| Return Value

IALG_EOK; /* status indicating success */

IALG_EFAIL; /* status indicating failure */

|| Description

This function does the basic encoding/decoding. The first argument to `process()` is a handle to an algorithm instance.

The second and third arguments are pointers to the input and output buffer descriptor data structures respectively (see `XDM_BufDesc` data structure for details).

The fourth argument is a pointer to the `IAUDDDEC_InArgs` data structure that defines the run time input arguments for an algorithm instance object.

The last argument is a pointer to the `IAUDDDEC_OutArgs` data structure that defines the run-time output arguments for an algorithm instance object.

Note:

If you are using extended data structures, the fourth and fifth arguments must be pointers to the extended `InArgs` and `OutArgs` data structures respectively. Also, ensure that the `size` field is set to the size of the extended data structure. Depending on the value set for the `size` field, the algorithm uses either basic or extended parameters.

|| Preconditions

The following conditions must be true prior to calling this function; otherwise, its operation is undefined.

- ❑ `process()` can only be called after a successful return from `algInit()` and `algActivate()`.
- ❑ If algorithm uses DMA resources, `process()` can only be called after a successful return from `DMAN3_init()`.

- ❑ handle must be a valid handle for the algorithm's instance object.
- ❑ Buffer descriptor for input and output buffers must be valid.
- ❑ Input buffers must have valid input data.

|| Postconditions

The following conditions are true immediately after returning from this function.

- ❑ If the process operation is successful, the return value from this operation is equal to `IALG_EOK`; otherwise it is equal to either `IALG_EFAIL` or an algorithm specific return value.
- ❑ After successful return from `process()` function, `algDeactivate()` can be called.

|| Example

See test application file, `TestAppDecoder.c` available in the `\Client\Test\Src` sub-directory.

|| See Also

`algInit()`, `algDeactivate()`, `control()`

Note:

- ❑ Audio codecs do not use `algActivate()`, `algDeactivate()`, and `DMAN3_init()` APIs.
- ❑ The input data for MPEG4AAC HE Decoder is in byte format. The decoder outputs 16-bit or 24-bit (not supported) raw PCM samples in the little-endian format. The output data is either in block or interleaved format. In the block format, samples of the left channels are stored contiguously first, followed by right channel samples (that is, LLLRRRRR). In the interleaved format, left channel samples are stored followed by the right channel samples (that is, LRLRLRLR).

4.3.5 Termination API

Termination API is used to terminate the MPEG4AAC HE Decoder and free up the memory space that it uses.

|| Name

`algFree()` – determine the addresses of all memory buffers used by the algorithm

|| Synopsis

```
XDAS_Int32 algFree(IALG_Handle handle, IALG_MemRec  
memTab[]);
```

|| Arguments

```
IALG_Handle handle; /* handle to the algorithm instance */  
IALG_MemRec memTab[]; /* output array of memory records */
```

|| Return Value

```
XDAS_Int32; /* Number of buffers used by the algorithm */
```

|| Description

`algFree()` determines the addresses of all memory buffers used by the algorithm. The primary aim of doing so is to free up these memory regions after closing an instance of the algorithm.

The first argument to `algFree()` is a handle to the algorithm instance.

The second argument is a table of memory records that describe the base address, size, alignment, type, and memory space of all buffers previously allocated for the algorithm instance.

For more details, see *TMS320 DSP Algorithm Standard API Reference* (literature number SPRU360).

|| See Also

```
algAlloc()
```

Optimal Function Placement Order for Minimizing Instruction Cache Penalty

This appendix contains the optimal function placement order for minimizing cache penalty due to instruction cache misses. The program memory and MCPS performance numbers quoted in the datasheet are based on this placement. The user's application linker command file should contain the following.

```
GROUP : {
    /* Functions in call order */
    .text:_AACDEC_TII_decode
    .text:_AACDEC_TII_GetAdifHeader
    .text:_AACDEC_TII_GetBits
    .text:_AACDEC_TII_GetProgConfig
    .text:_AACDEC_TII_DecodeBlock
    .text:_AACDEC_TII_ParseBlock
    .text:_AACDEC_TII_CRCInit
    .text:_AACDEC_TII_ResetSbrBitstream
    .text:_AACDEC_TII_BitstreamSetBookmark
    .text:_AACDEC_TII_ParseChannelElement
    .text:_AACDEC_TII_EnterChannel
    .text:_AACDEC_TII_GetIcsInfo
    .text:_AACDEC_TII_Infoint
    .text:_AACDEC_TII_CalcGsfbTable
    .text:_AACDEC_TII_GetMask
    .text:_AACDEC_TII_GetIcs
    .text:_AACDEC_TII_Huffcb
    .text:_AACDEC_TII_Hufffac
    .text:_AACDEC_TII_Huffspec
    .text:_AACDEC_TII_BitstreamDistanceFromBookmark
    .text:_AACDEC_TII_AccumulateCRCWord
    .text:_AACDEC_TII_SbrSetElementType
    .text:_AACDEC_TII_Intensity
    .text:_AACDEC_TII_InverseQuantize
    .text:_AACDEC_TII_FindMaxOptInCh
    .text:_AACDEC_TII_AdjustOptInCh
    .text:_AACDEC_TII_deinterleave
    .text:_AACDEC_TII_ApplyPNS
    .text:_AACDEC_TII_TnsDecodeSubblock2
    .text:_AACDEC_TII_TnsPostscale
    .text:_AACDEC_TII_DetermineQpt
    .text:_AACDEC_TII_IFilterBank
    .text:_AACDEC_TII_PreTwiddle
    .text:_AACDEC_TII_BitReverse
}
```

```
.text:_AACDEC_TII_IFFT
.text:_AACDEC_TII_IFFTStage1and2
.text:_AACDEC_TII_IFFTStage3
.text:_AACDEC_TII_IFFTStagex
.text:_AACDEC_TII_PostTwiddle
.text:_AACDEC_TII_StateBookkeeping
.text:_AACDEC_TII_LargeWindowExpand
.text:_AACDEC_TII_OpenSbr
.text:_AACDEC_TII_InitSbrDec
.text:_AACDEC_TII_ApplySbr
.text:_AACDEC_TII_ReadSbr
.text:_AACDEC_TII_InitBitBuffer
.text:_AACDEC_TII_BufGetBits
.text:_AACDEC_TII_SbrGetHeaderData
.text:_AACDEC_TII_InitFrameData
.text:_AACDEC_TII_ResetSbrDec
.text:_AACDEC_TII_ResetSbrFreqBandTables
.text:_AACDEC_TII_SbrDecFindStartAndStopBand
.text:_AACDEC_TII_GetStartFreq
.text:_AACDEC_TII_GetStopFreq
.text:_AACDEC_TII_ShellSort
.text:_AACDEC_TII_SbrDecUpdateFreqScale
.text:_AACDEC_TII_NumberOfBands
.text:_AACDEC_TII_CalcBands
.text:_AACDEC_TII_ConstPart
.text:_AACDEC_TII_Sum
.text:_AACDEC_TII_SbrDecUpdateHiRes
.text:_AACDEC_TII_SbrDecUpdateLoRes
.text:_AACDEC_TII_SbrDecDownSampleLoRes
.text:_AACDEC_TII_SbrGetChannelPairElement
.text:_AACDEC_TII_ExtractFrameInfo
.text:_AACDEC_TII_SbrGetDirectionControlData
.text:_AACDEC_TII_SbrGetEnvelope
.text:_AACDEC_TII_DecodeHuffcw
.text:_AACDEC_TII_SbrGetNoiseFloorData
.text:_AACDEC_TII_SbrGetAdditionalData
.text:_AACDEC_TII_ExtractExtendedData
.text:_AACDEC_TII_DecodeSbrData
.text:_AACDEC_TII_DecodeEnvelope
.text:_AACDEC_TII_MapLowResEnergyVal
.text:_AACDEC_TII_RequantizeEnvelopeData
.text:_AACDEC_TII_SbrDecoder
.text:_AACDEC_TII_CalculateSbrAnaFilterbank
.text:_AACDEC_TII_32_POINT_IDCT
.text:_AACDEC_TII_16_POINT_IDCT
.text:_AACDEC_TII_8_POINT_IDCT
.text:_AACDEC_TII_32_POINT_IDST
.text:_AACDEC_TII_16_POINT_IDST
.text:_AACDEC_TII_8_POINT_IDST
.text:_AACDEC_TII_GenerateHF
.text:_AACDEC_TII_InvFilteringLevelEmphasis
.text:_AACDEC_TII_CalcAutoCorr
.text:_AACDEC_TII_FindClosestEntry
.text:_AAC_TII_FractSignDiv64
.text:_AACDEC_TII_CalculateSbrEnvelope
.text:_AACDEC_TII_CreateLimiterBands
```

```

.text:_AACDEC_TII_CalculateSbrSynFilterbank
.text:_AACDEC_TII_64_POINT_DCT
.text:_AACDEC_TII_32_POINT_DCT
.text:_AACDEC_TII_16_POINT_DCT
.text:_AACDEC_TII_8_POINT_DCT
.text:_AACDEC_TII_64_POINT_DST
.text:_AACDEC_TII_32_POINT_DST
.text:_AACDEC_TII_16_POINT_DST
.text:_AACDEC_TII_8_POINT_DST
/* Other functions */
.text:_AACDEC_TII_Decoder
.text:_AACDEC_TII_setjmp
.text:_AACDEC_TII_Rounding
.text:_AACDEC_TII_SbrEnvelopeUnmapping
.text:_AACDEC_TII_WindowIPOverlapAddButterfly
.text:_AACDEC_TII_reset
.text:_AACDEC_TII_GenRandVector
.text:_AACDEC_TII_GetTns
.text:_AACDEC_TII_Rescale
.text:_AACDEC_TII_GetSbr
.text:_AACDEC_TII_CB_11_Handler
.text:_AACDEC_TII_TnsArFilter
.text:_AACDEC_TII_GetAdtsHeader
.text:_AACDEC_TII_getStatus
.text:_AACDEC_TII_control
.text:_AACDEC_TII_HuffDecodeLoop4
.text:_AACDEC_TII_HuffDecodeLoop2
.text:_AACDEC_TII_TnsDecodeCoef
.text:_AACDEC_TII_HuffDecodeLoop1
.text:_AACDEC_TII_SbrCrcCheck
.text:algAlloc:_AACDEC_TII_algAlloc
.text:_AACDEC_TII_HuffDecodeLoop0
.text:_AACDEC_TII_AccumulateCRCFromStream
.text:_AACDEC_TII_HuffDecodeLoop3
.text:_AACDEC_TII_HuffDecodeLoop5
.text:_AACDEC_TII_MSTool
.text:_AAC_TII_FractDiv64
.text:_AACDEC_TII_SbrGetSingleChannElelement
.text:_AACDEC_TII_init
.text:_AACDEC_TII_GetData
.text:_AACDEC_TII_SyncSeek
.text:_AACDEC_TII_DecodeNoiseFloorLevels
.text:_AAC_TII_GetBits_inline
.text:_AACDEC_TII_pulse_nc
.text:algInit:_AACDEC_TII_algInit
.text:_AACDEC_TII_SaturateLoop
.text:algFree:_AACDEC_TII_algFree
.text:_AACDEC_TII_IMDCTWrapper
.text:_AACDEC_TII_GetGroup
.text:_AACDEC_TII_CalcCRC
.text:_AACDEC_TII_MapMask
.text:_AACDEC_TII_CopyBitBufferState
.text:_AACDEC_TII_Random
.text:_AACDEC_TII_DecodeErrorHandler
.text:_AACDEC_TII_longjmp
.text:algNumAlloc:_AACDEC_TII_algNumAlloc

```

```
.text:_AACDEC_TII_SuperSyncSeek  
.text:_AACDEC_TII_GetNrBitsAvailable  
.text:_AACDEC_TII_Restarttio  
.text:_AACDEC_TII_BitstreamGotoBookmark  
.text:_AACDEC_TII_SmallWindowExpand  
} > PROG_MEM_SECTION
```

Revision History

This user guide revision history highlights the changes made to the SPRUED8C codec specific user guide to make it SPRUED8D.

Table B-1. Revision History of MPEG4AAC HE Decoder on C64x+

Section I	Additions/Modifications/Deletions
Section 2.2	Installing the Component: <input type="checkbox"/> Changed top level directory name to 100_A_AAC_D_1_23_00