H.264 Base Profile Encoder on DM6467

User Guide

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Texas Instruments

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Read This First

About This Manual

This document describes how to install and work with Texas Instruments' (TI) H.264 Base Profile Encoder implementation on the DM6467 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 DM6467 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.

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 Interoperability 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.

The following documents describe TMS320 devices and related support tools:

- *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.
- *DaVinci Technology - Digital Video Innovation Product Bulletin (Rev. A) (*literature number SPRT378A*)*
- *The DaVinci Effect: Achieving Digital Video Without Complexity White Paper (*literature number SPRY079*)*
- *DaVinci Benchmarks Product Bulletin (*literature number SPRT379*)*

- *DaVinci Technology for Digital Video White Paper (*literature number SPRY067*)*
- *The Future of Digital Video White Paper (*literature number SPRY066*)*

Related Documentation

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

- *ITU-T Rec. H.264 | ISO/IEC 14496-10 AVC - Draft ITU-T Recommendation and Final Draft International Standard of Joint Video Specification*

Abbreviations

The following abbreviations are used in this document.

Table 1-1. List of Abbreviations

Abbreviation	Description
AVC	Advanced Video Coding
BP	Base Profile
CAVLC	Context Adaptive Variable Length Coding
CIF	Common Intermediate Format
COFF	Common Object File Format
DMA	Direct Memory Access
DMAN3	DMA Manager
DSP	Digital Signal Processing
EVM	Evaluation Module
GOP	Group Of Pictures
HDVICP	High Definition Imaging Co-Processors
HEC	Header Extension Code
HPI	Half Pixel Interpolation
MIR	Mandatory Intra Fresh
QCIF	Quarter Common Intermediate Format
QP	Quantization Parameter
QPI	Quarter Pixel Interpolation

Abbreviation	Description
QVGA	Quarter Video Graphics Array
SQCIF	Sub Quarter Common Intermediate Format
VGA	Video Graphics Array
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, quote the product name (H.264 Base Profile Encoder on DM6467) 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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Chapter 1

Introduction

This chapter provides a brief introduction to XDAIS and XDM. It also provides an overview of TI's implementation of the H.264 Base Profile Encoder on the DM6467 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

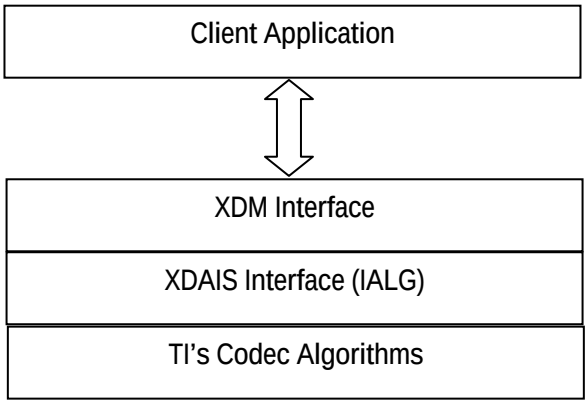
(for example audio, video, image, and speech). The XDM standard defines the following two APIs:

- `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 H.264 Base Profile Encoder

H.264 is the latest video compression standard from the ITU-T Video Coding Experts Group and the ISO/IEC Moving Picture Experts Group. H.264 provides greater compression ratios at a very low bit-rate. The new advancements and greater compression ratios at a very low bit-rate has made devices ranging from mobile and consumer electronics to set-top boxes and digital terrestrial broadcasting to use the H.264 standard.

Figure 1-1 depicts the working of the H.264 Encoder algorithm.

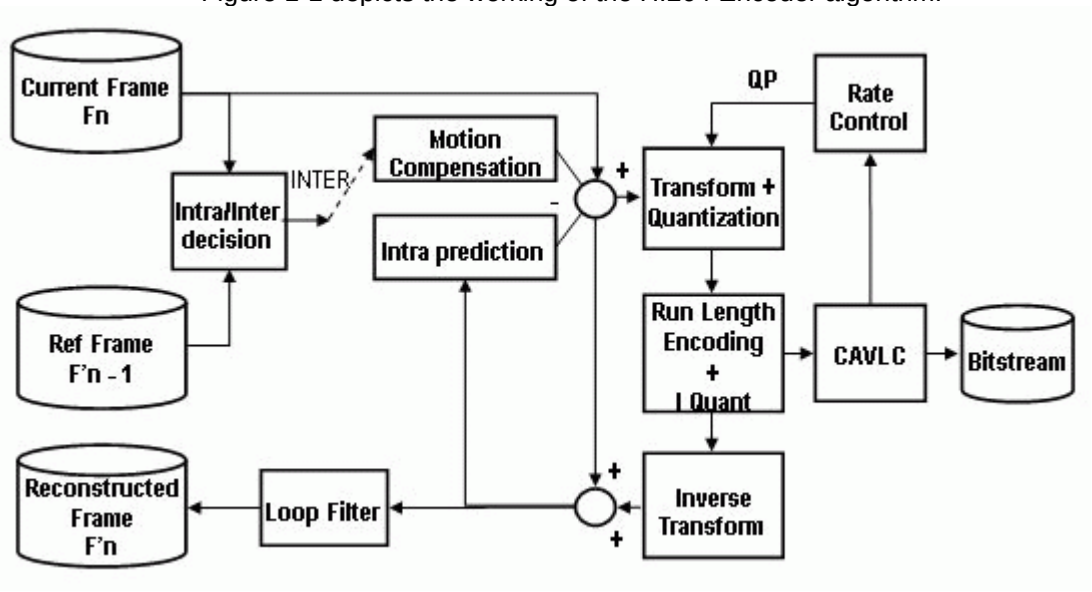


Figure 1-1. Working of H.264 Video Encoder

In H.264 Encoder, the operations are performed on a set of specific N macro blocks. The value of N at the most can be 2. The operations such as Motion Compensation, Transform and Quantization, Run Length Encoding and Inverse Quantization, and Inverse Transform Blocks are called once, for all the inter macro blocks in the set of N.

In motion estimation, the encoder searches for the best match in the available reference frame(s). After quantization, contents of some blocks become zero.

The H.264 Encoder defines in-loop filtering to avoid blocks across the 4x4 block boundaries. It is the second most computational task of H.264 encoding process after motion estimation. In-loop filtering is applied on all 4x4 edges as a post-process and the operations depend on the edge strength of the particular edge.

The H.264 Encoder applies entropy-coding methods to use context-based adaptivity, which improves the coding performance. All the macro blocks, which belong to a slice, must be encoded in a raster scan order. Baseline profile uses the Context Adaptive Variable Length Coding (CAVLC). CAVLC is the stage where transformed and quantized co-efficients are entropy coded using context adaptive table switching across different symbols. The syntax defined by the H.264 Encoder stores the information at 4x4 block level.

From this point onwards, all references to H.264 Encoder means H.264 Base Profile Encoder only.

1.3 Supported Services and Features

This user guide accompanies TI's implementation of H.264 Encoder on the DM6467 platform.

This engineering release version of the codec has the following supported features of the standard:

- eXpressDSP Digital Media (XDM 1.0 IVIDENC1) compliant
- Supports H.264 Baseline Profile for progressive I and P frames only
- Supports YUV420 interleaved color sub-sampling (Y as a single plane and U & V components interleaved to form the second plane) formats
- Supports Baseline Profile H.264 Encoder
- Supports limited Main Profile with CABAC method of entropy coding
- Supports limited High Profile with 8x8 transforms
- Supports skip macro-blocks
- Supports only 1 motion-vector per macro-block
- Supports rate control at frame level
- Supports DMA based framework
- Supports use of C64x+ and ARM968 of HDVICP0

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Chapter 2

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 is built and tested on the DM6467 EVM only.

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 3.3.49.
- **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 200_V_H264AVC_E_1_00, under which another directory named DM6467_BP_001 is created.

Figure 2-1 shows the sub-directories created in the DM6467_BP_001 directory.

Note:

The source folders under H264Encoder (`algSrc`) is not present in case of a library based (object code) release.

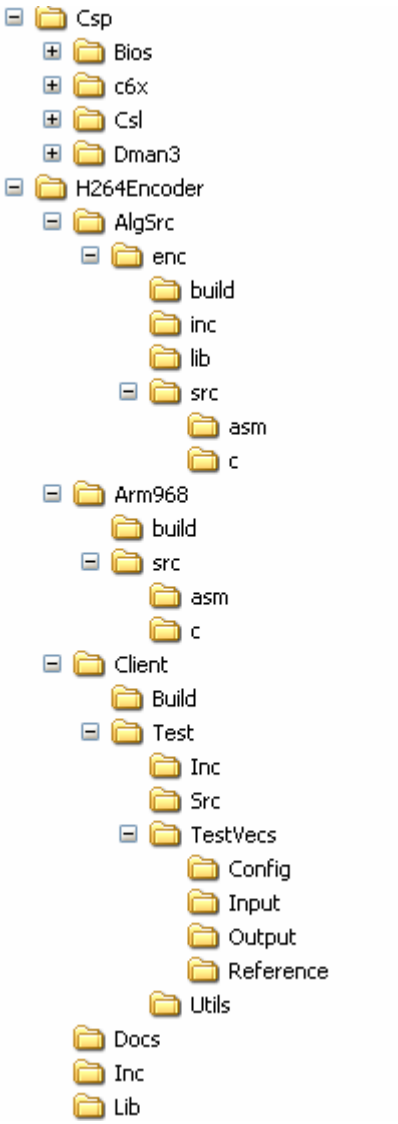

Figure 2-1. Component Directory Structure

Note:

If you are installing an evaluation version of this codec, the directory name will be 200E_V_H264AVC_E_1_00.

Table 2-1 provides a description of the sub-directories created in the DM6467_BP_001 directory.

Table 2-1. Component Directories

Sub-Directory	Description
Csp\Bios	Contains BIOS specific files
Csp\Csl	Contains CSL files
Csp\c6x	Contains CSL files
Csp\Dman3	Contains DMAN3 related files
\H264Encoder\AlgSrc\enc\build	Contains the algorithm application project (.pjt) file
\H264Encoder\AlgSrc\enc\inc	Contains algorithm header files
\H264Encoder\AlgSrc\enc\lib	Contains the algorithm lib file generated on compilation of the code
\H264Encoder\AlgSrc\enc\src\asm	Contains algorithm source assembly files
\H264Encoder\AlgSrc\enc\src\c	Contains algorithm source C files
\H264Encoder\Arm968\build	Contains the ARM968 project file
\H264Encoder\Arm968\src\asm	Contains the ARM968 source assembly files
\H264Encoder\Arm968\src\c	Contains the ARM968 source C files
\H264Encoder\Client\Build	Contains the sample test application project (.pjt) file
\H264Encoder\Client\Test\Inc	Contains header files needed for the application code
\H264Encoder\Client\Test\Src	Contains application C files
\H264Encoder\Client\Test\TestVecs\Config	Contains configuration parameter file
\H264Encoder\Client\Test\TestVecs\Input	Contains input test vectors
\H264Encoder \Client\Test\TestVecs\Output	Contains output generated by the codec
\H264Encoder\Client\Test\TestVecs\Reference	Contains reconstructed outputs generated by the encoder to verify conformance with decoder

Sub-Directory	Description
\H264Encoder\Client\Test\Utils	Folder that stores basic utilities like file compare and YUV display executables.
\H264Encoder\Docs	Contains user guide and datasheet
\H264Encoder\Inc	Contains XDM related header files which allow interface to the codec library
\H264Encoder\Lib	Contains the algorithm library file

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 and TI Codec Engine (CE) and HDVICP API. This version of the codec has been validated with DSP/BIOS version 5.31 and Codec Engine (CE) version 2.10.01 and HDVCIP API version 1.01.000

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 CodeComposer Studio. For example:<install directory>\CCStudio_v3.3

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

- Header file, bcache.h available in the <install directory>\CCStudio_v3.3\<bios_directory>\packages \ti\bios\include directory.
- Library file, biosDM420.a64P available in the <install directory>\CCStudio_v3.3\<bios_directory>\packages\ti\bios\lib directory.

2.3.2 Installing Codec Engine (CE)

Download CE version CE 2.10.01 or newer from TI external website:

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

The codec uses framework components and XDIAS version that are a part of CE 2.10.01 or newer.

1) Extract the CE zip file to the same location where the Code Composer Studio is installed. For example: <install directory>\CCStudio_v3.3.

   The test application uses the following RMAN files:

- Library file, rmand.a64P available in the <install directory>\CCStudio_v3.3\<ce_directory>\cetools\packages\ti\sdo\fc\rman directory.
- Header file, rman.h available in the <install directory>\CCStudio_v3.3 \<ce_directory>\cetools\packages\ti\sdo\fc\rman directory.
- Header file, ires.h available in the <install directory>\CCStudio_v3.3\ <ce_directory>\cetools\packages\ti\xdais directory.

2) Set a system environment variable named `FC_INSTALL_DIR` pointing to <install directory>\CCStudio_v3.3\<ce_directory>\cetools.

3) Set a system environment variable named `XDAIS_INSTALL_DIR` pointing to <install directory>\CCStudio_v3.3\<ce_directory>\cetools\packages\ti\xdais.

4) Set a system environment variable `EDMA3LLD_INSTALL_DIR` pointing to <install directory>\CCStudio_v3.3\<ce_directory>\cetools\packages\ti\sdo\edma3.

2.3.3 Installing HDVICP API

1) Extract the HDVICP API zip file to the same location where the Code Composer Studio is installed. For example: <install directory>\CCStudio_v3.3.

2) Set a system environment variable named `HDVICP_API` pointing to <install directory>\CCStudio_v3.3\<hdvicp>\200_V_HDVICP_X_1_01\DM6467_X_001\hdvicp_api

2.4 Building and Running the Sample Test Application

The sample test application that accompanies this codec component will run in TI's Code Composer Studio development environment. To build and run the sample test application in Code Composer Studio, follow these steps:

1) Extract the .zip file from the package.

2) Verify that you have installed TI's Code Composer Studio version 3.3.49 and code generation tools version 6.0.8. Start the Code Composer Studio to view the Parallel Debug Manager (PDM) window.

3) In the PDM window, open the window by double clicking on ARM926, load the GEL file davincihd_arm.gel and click **Debug > Connect**.

4) In the PDM window, open the window by double clicking on C6400PLUS, load the GEL file davincihd_dsp.gel and click **Debug > Connect**.

5) Open the test application project file – testh264encoderapp.pjt – in C6400PLUS window. This file is available in the \Client\Build sub-directory.

6) Select **Project > Build** to build the sample test application. This creates an executable file, TestEncoderApp.out in the \Client\Build\Out sub-directory.

7) Select **File > Load**, browse to the \Client\Build\Out sub-directory, select the codec executable created in step 6, and load it into Code Composer Studio in preparation for execution.

8) 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.

2.5 Configuration Files

This codec is shipped along with:

- Generic configuration file (ConfigParams.cfg) - specifies input and reference files for the sample test application, and the configuration parameters used by the test application to configure the Encoder.
- Encoder configuration file (ConfigParams.cfg) - contains the input and output filenames, and the configuration parameters required for the encoder. The ConfigParams.cfg file is available in the \Client\Test\TestVecs\Config sub-directory.

A sample ConfigParams.cfg file is as shown.

```
# New Input File Format is as follows
# <ParameterName> = <ParameterValue> # Comment

###############################################################
# Parameters
###############################################################
InputFile      =
..\\..\\Test\\TestVecs\\Input\\Profile_CIF.yuv
EncodedFile    =
..\\..\\Test\\TestVecs\\Output\\KaleidoH264Out_CIF.264
ReconFile      =
..\\..\\Test\\TestVecs\\Reference\\KaleidoH264Recon_CIF.yuv
ImageWidth     = 352       # Image width in Pels, must be
multiple of 16
ImageHeight    = 288       # Image height in Pels, must be
multiple of 16
FrameRate      = 30000     # Frame Rate per second*1000 (1-
100)
BitRate        = 2196608   # Bitrate(bps)  #if ZERO=>> RC
                                                is OFF
ChromaFormat   = 1         # 1 => XMI_YUV_420P only
                             supported
```

```
IntraPeriod    = 3         # Period of I-Frames
FramesToEncode = 1          # Number of frames to be coded
RC_PRESET      = 1          # Rate control preset
                           #1=>IVIDEO_LOW_DELAY
                            2=>IVIDEO_STORAGE
                            4=>IVIDEO_NONE
ENC_PRESET   = 0      #Not supported : Default-0
################################################################
# Encoder Control
################################################################
ProfileIDC      = 66 # Profile IDC (66=baseline, 77=main,
                     100=high)
LevelIDC        = 30 # Level IDC   (e.g. 20 = level 2.0)
QPISlice        = 14 # Quant. param for I Slices (0-51)
QPSlice         = 16 # Quant. param for non - I slices (0-
51)
ChromaQPOffset   = 0 # Chroma QP offset (-12..12)
SecChromaQPOffset = 0# Second Chroma QP offset (-12..12)
EntropyCodingMode = 0# CAVLC = 0 , CABAC = 1
RateCtrlQpMax  = 45   # Qp range max for Rate Control
                       (Max: 51)
RateCtrlQpMin   = 5   # Qp range min  for Rate Control
                       (Min: 0)
NumRowsInSlice  = 0   # Number of rows in a Slice
                       (0..Max no. of rows in the frame)

################################################################
# Loop filter parameters
################################################################

LoopFilterDisable  = 0     # Disable loop filter in slice
                             header (0=Filter, 1=No Filter,
                                     2= Disable filter
                                     across slice boundary)
LoopFilterAlphaC0Offset  = 5      # Alpha & C0 offset div.
2, {-6, -5, ... 0, +1, .. +6}
LoopFilterBetaOffset     = -3     # Beta offset div. 2, {-
6, -5, ... 0, +1, .. +6}
```

Any field in the `IVIDENC1_Params` structure (see Section 4.2.1.10) can be set in the Testparams.cfg file using the syntax shown above. If you specify additional fields in the ConfigParams.cfg file, ensure to modify the test application appropriately to handle these fields.

2.6 Uninstalling the Component

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

2.7 Evaluation Version

If you are using an evaluation version of this codec, there will be a limit of encoding up to 54000 frames in the usage of the encoder.

Chapter 3

Sample Usage

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

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3.1 Overview of the Test Application

The test application exercises the `IH264VENC_Params` extended class of the H264 Encoder library. The main test application files are TestEncoderApp.c and TestEncoderApp.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.

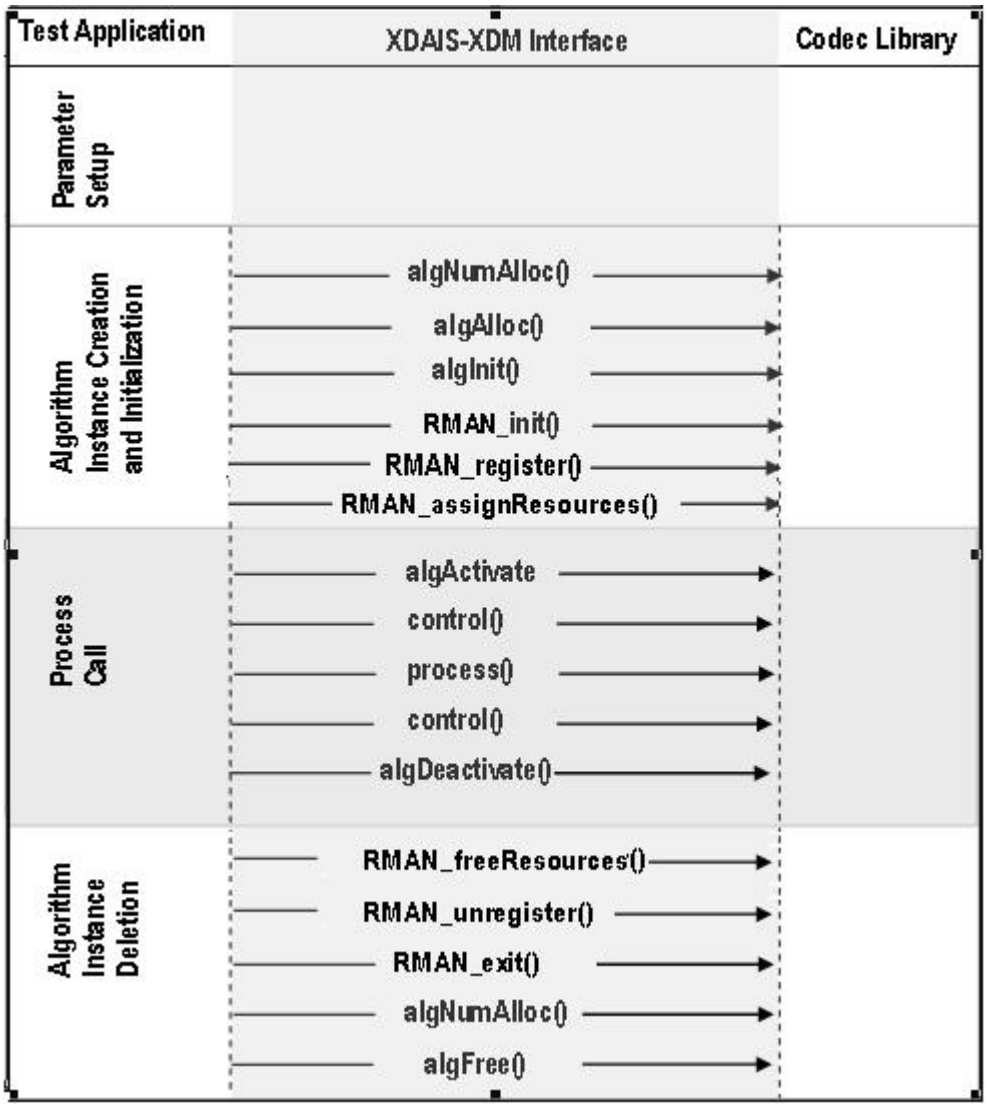

Figure 3-1. Test Application Sample Implementation

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, etc. The test application obtains the required parameters from the Encoder configuration files.

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

1) Opens the configuration file, ConfigParams.cfg and reads the input file name, and output/reference file name, and the various configuration parameters required for the algorithm.

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

2) `Sets` the `IVIDENC1_Params` structure based on the values it reads from the ConfigParams.cfg file.

3) 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 a 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 a sequence is provided in the `ALG_create()` function implemented in the alg_create.c file.

After successful creation of the algorithm instance, the test application does DMA and HDVICP Resource allocation for the algorithm. This requires initialization of Resource Manager Module (RMAN) and grant of DMA and HDVICP resources. This is implemented by calling the RMAN interface functions in the following sequence:

1) `RMAN_init()` – To initialize the RMAN module.

2) `RMAN_register()` – To register the HDVICP protocol/resource manager with the generic resource manager.

3) `RMAN_assignResources()` – To register resources to the algorithm as requested HDVICP protocol/resource manager with the generic resource manager.

Note:

RMAN function implementations are provided in rmand.a64P library.

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 a single frame of data. The behavior of the algorithm can be controlled using various dynamic parameters (see Section 4.2.1.11). The inputs to the process function are input and output buffer descriptors, pointer to the `IVIDENC1_InArgs` and `IVIDENC1_OutArgs` structures.

4) On calling the `process()` function to encode a single frame of data, the video task can be put to SEM-pend state using semaphores after triggering the start of the encode/decode frame start. On receipt of interrupt signal for the end of frame encode/decode, the application should release the semaphore and resume the video task which will do any book-keeping operations by the codec and updating the output parameters structure -`IVIDENC1_OutArgs`.

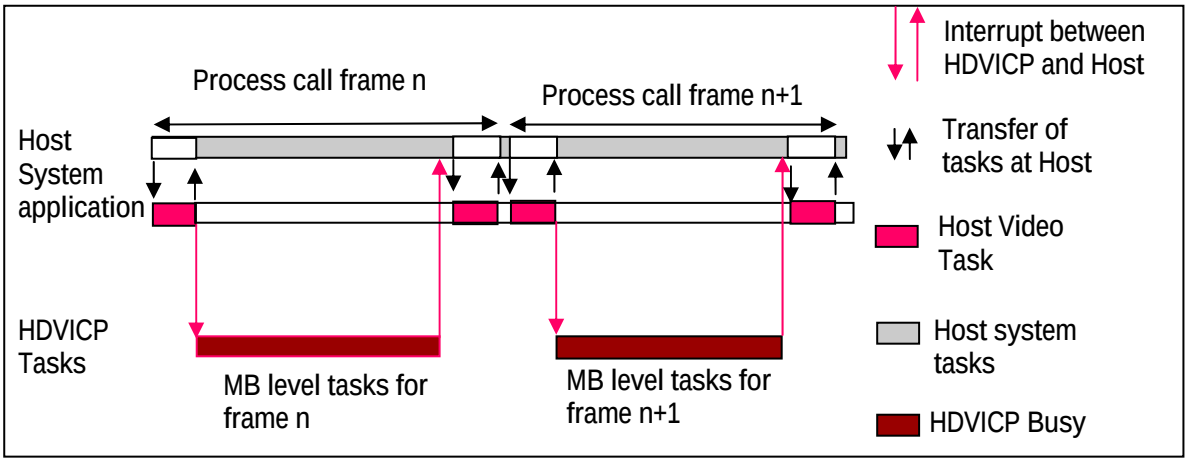

Figure 3-2. Process Call with Host Release

Note:

- The process call returns the control to the application after the initial setup related tasks are completed
- Application can schedule a different task to use the freed up Host resource
- All service requests from HDVICP are handled via interrupts
- Application resumes the suspended process call after the last service request for HDVICP has been handled
- Application can now complete concluding portions of the process call and return

The `control()` and `process()` functions should be called only within the scope of the `algActivate()` and `algDeactivate()` XDAIS functions which activate and deactivate the algorithm instance respectively. Once an algorithm is activated, there could be any ordering of `control()` and `process()` functions. The following APIs are called in a sequence:

1) `algActivate()` - To activate the algorithm instance.

2) `control()` (optional) - To query the algorithm on status or setting of dynamic parameters etc., using the seven available control commands.

3) `process()` - To call the Encoder with appropriate input/output buffer and arguments information.

4) `control()` (optional) - To query the algorithm on status or setting of dynamic parameters etc., using the seven available control commands.

5) `algDeactivate()` - To deactivate the algorithm instance.

6) 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 encoding of the required number of frames is completed. 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 `algDeactivate()`, the output data is dumped to a file.

3.1.4 Algorithm Instance Deletion

Once decoding/encoding is complete, the test application must release the memory. 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 a sequence is provided in the `ALG_delete()` function implemented in the alg_create.c file.

After successful execution of the algorithm, the test application frees up the DMA and HDVICP Resource allocated for the algorithm. This is implemented by calling the RMAN interface functions in the following sequence:

1) `RMAN_freeResources ()` - To free the resources that were allocated to the algorithm before process call.

2) `RMAN_unregister()` – To unregister the HDVICP protocol/resource manager with the generic resource manager.

3) `RMAN_exit()` - To delete the generic IRES RMAN and release memory.

3.2 Handshaking Between Application and Algorithm

Application provides the algorithm with its implementation of functions for the video task to move to SEM-pend state, when the execution happens in the co-processor. The algorithm calls these application functions to move the video task to SEM-pend state.

Framework Provided HDVICP Callback APIs

```
int _doneSemaphore;

HDVICP_start(handle, hdVicpHandle, ISRFunction)
{
 installNonBiosISR ( handle, hdvicpHandle, ISRFunction
);
}
HDVICP_wait(handle, hdVicpHandle)
{
    SEM_pend(_doneSemaphore);
}

HDVICP_done(handle, hdVicpHandle) {

    SEM_post(_doneSemaphore)
}
```

Codec

process ()

```
#include <…/ires_hdvicp.h>
void _MyCodecISRFunction();

MYCODEC::IVIDENC1::process()
{
  // …. set up for frame encode
  HDVICP_configure(h264venc, h264venc ->hdvicpHandle,
              H264VENCISRFunction);
// … Hand over the DSP to application
HDVICP_wait(h264venc, h264venc ->hdvicpHandle);
  // Release of HOST
  …. End of frame processing
}

void H264VENCISRFunction(IALG_Handle handle)
{  H264VENC_TI_Obj * h264venc = (void *)handle;

     HDVICP_done(h264venc, h264venc ->hdvicpHandle);
```

Figure 3-3. Interaction between Application and Codec.

Note:

- Process call architecture to share Host resource among multiple threads
- ISR ownership is with the Host layer resource manager – outside the codec

- The actual codec routine to be executed during ISR is provided by the codec
- OS/System related calls (`SEM_pend, SEM_post`) are also performed outside the codec
- Codec implementation is OS independent

The functions to be implemented by applications are:

1) `HDVICP_initHandle(void *hdvicpHandle)`

   This is the top-level function, which initializes hdvicp handle that will be useful when `HDVICP_Wait` and `HDVICP_Done` functions are called by algorithm.

2) `HDVICP_configure(IALG_Handle handle, void *hdvicpHandle, void (*ISRfunctionptr)(IALG_Handle handle))`

   This function is called by the algorithm to register its ISR function, which the application needs to call when it receives interrupts pertaining to the video task.

3) `HDVICP_wait (void *hdvicpHandle)`

   This function is called by the algorithm to put the video task in SEM-pend state.

4) `HDVICP_done (void *hdvicpHandle)`

   This function is called by algorithm to release the video task from SEM-pend state.

In the sample test application, these functions are implemented in hdvicp_framework.c file using polling. The application can implement it in its own way considering the underlying system.

3.3 Sample Test Application

The test application exercises the `IH264VENC_Params` extended class of the H.264 Encoder.

Table 3-1. Process ( ) Implementation.

```
/* Main Function acting as a client for Video Encode Call*/

  H264VENC_setinitparams (&params);
  H264VENC_setrunparams (&dynamicparams);
  HDVICP_initHandle(&hdvicpObj);

/*---------------- Encoder creation -----------------*/
 handle = (IALG_Handle) h264VENC_create();

  /*-------------- Get Buffer information -------------*/
  H264VENC_control(handle, XDM_GETBUFINFO);

  /*-Do-While Loop for Encode Call  for a given stream-*/
  do
  {
/* Read the Input Frame in the Application Input Buffer */
    validBytes = ReadInputData(inFile);

/* Optional: Set Run time parameters in the Algorithm via
control() */
    h264VENC_control(handle, XDM_SETPARAMS);

/*------ Start the process to start encoding a frame.----*/
   retVal = h264VENC_encode
              (
                handle,
                (IVIDEO1_BufDescIn *)&inputBufDesc,
                (XDM_BufDesc *)&outputBufDesc,
                (IVIDENC1_InArgs *)&inArgs,
                (IVIDENC1_OutArgs *)&outArgs
               );

/* Get the status of the encoder using control call */
       h264VENC_control(handle, XDM_GETSTATUS);

}  while(1);
//End of Do-While loop - which encodes frames.

ALG_delete (handle);
```

Note:

This sample test application does not depict the actual function parameter or control code. It shows the basic flow of the code.

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Chapter 4

API Reference

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

Topic **Page**

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
IVIDEO_FrameType	IVIDEO_NA_FRAME	Frame type not available
	IVIDEO_I_FRAME	Intra coded frame
	IVIDEO_P_FRAME	Forward inter coded frame
	IVIDEO_B_FRAME	Bi-directional inter coded frame. Not supported in this version of H264 encoder.
	IVIDEO_IDR_FRAME	Intra Coded Frame that can be used for refreshing video content
	IVIDEO_II_FRAME	Interlaced Frame, both fields are I frames. Not supported in this version of H264 Encoder.
	IVIDEO_IP_FRAME	Interlaced Frame, first field is an I frame, second field is a P frame. Not supported in this version of H264 Encoder.
	IVIDEO_IB_FRAME	Interlaced Frame, first field is an I frame, second field is a B frame. Not supported in this version of H264 Encoder.
	IVIDEO_PI_FRAME	Interlaced Frame, first field is a P frame, second field is a I frame. Not supported in this version of H264 Encoder.
	IVIDEO_PP_FRAME	Interlaced Frame, both fields are P frames. Not supported in this version of H264 Encoder.
	IVIDEO_PB_FRAME	Interlaced Frame, first field is a P frame, second field is a B frame. Not supported in this version of H264 Encoder.
	IVIDEO_BI_FRAME	Interlaced Frame, first field is a B frame, second field is an I frame. Not supported in this version of H264 Encoder.

Group or Enumeration Class	Symbolic Constant Name	Description or Evaluation
	IVIDEO_BP_FRAME	Interlaced Frame, first field is a B frame, second field is a P frame. Not supported in this version of H264 Encoder.
	IVIDEO_BB_FRAME	Interlaced Frame, both fields are B frames. Not supported in this version of H264 Encoder.
	IVIDEO_MBAFF_I_FRAME	Intra coded MBAFF frame. Not supported in this version of H264 Encoder
	IVIDEO_MBAFF_P_FRAME	Forward inter coded MBAFF frame. Not supported in this version of H264 Encoder
	IVIDEO_MBAFF_B_FRAME	Bi-directional inter coded MBAFF frame. Not supported in this version of H264 Encoder.
	IVIDEO_MBAFF_IDR_FRAME	Intra coded MBAFF frame that can be used for refreshing video content. Not supported in this version of H264 Encoder.
	IVIDEO_FRAMETYPE_DEFAULT	Default is set to IVIDEO_I_FRAME
IVIDEO_ContentType	IVIDEO_CONTENTTYPE_NA	Content type is not applicable
	IVIDEO_PROGRESSIVE	Progressive video content
	IVIDEO_PROGRESSIVE_FRAME	Progressive video content
	IVIDEO_INTERLACED	Interlaced video content. Not supported in this version of H264 Encoder.
	IVIDEO_INTERLACED_FRAME	Interlaced video content. Not supported in this version of H264 Encoder.
	IVIDEO_INTERLACED_TOPFIELD	Interlaced picture, top field. Not supported in this version of H264 Encoder.
	IVIDEO_INTERLACED_BOTTOMFIELD	Interlaced picture, bottom field. Not supported in this version of H264 Encoder.
	IVIDEO_CONTENTTYPE_DEFAULT	Default value is set to IVIDEO_PROGRESSIVE

Group or Enumeration Class	Symbolic Constant Name	Description or Evaluation
IVIDEO_RateControlPreset	IVIDEO_NONE	No rate control is used
	IVIDEO_LOW_DELAY	Constant Bit Rate (CBR) control for video conferencing. PLR3 rate control algorithm is used in CBR. This is the default value.
	IVIDEO_STORAGE	Variable Bit Rate (VBR) control for local storage (DVD) recording. PLR4 rate control algorithm is used in VBR.
	IVIDEO_TWOPASS	Two pass rate control for non real time applications. Not supported in this version of H264 Encoder.
	IVIDEO_USER_DEFINED	User defined configuration using advanced parameters. Not supported in this version of H264 Encoder.
	IVIDEO_RATECONTROLPRESET_DEFAULT	Default value is set to IVIDEO_LOW_DELAY. Not supported in this version of H264 Encoder.
IVIDEO_SkipMode	IVIDEO_FRAME_ENCODED	Input content encoded
	IVIDEO_FRAME_SKIPPED	Input content skipped, that is, not encoded
	IVIDEO_SKIPMODE_DEFAULT	Default value is set to IVIDEO_FRAME_ENCODED.
XDM_DataFormat	XDM_BYTE	Big endian stream (default value). Not supported in this version of H264 Encoder.
	XDM_LE_16	16-bit little endian stream. Not supported in this version of H264 Encoder.
	XDM_LE_32	32-bit little endian stream
	XDM_LE_64	64-bit little endian stream. Not supported in this version of H264 Encoder.
	XDM_BE_16	16-bit big endian stream. Not supported in this version of H264 Encoder.
	XDM_BE_32	32-bit big endian stream. Not supported in this version of H264 Encoder.

Group or Enumeration Class	Symbolic Constant Name	Description or Evaluation
	XDM_BE_64	64-bit big endian stream. Not supported in this version of H264 Encoder.
XDM_ChromaFormat	XDM_CHROMA_NA	Chroma format is not applicable
	XDM_YUV_420P	YUV 4:2:0 planar
	XDM_YUV_422P	YUV 4:2:2 planar. Not supported in this version of H264 Encoder.
	XDM_YUV_422IBE	YUV 4:2:2 interleaved (big endian). Not supported in this version of H264 Encoder.
	XDM_YUV_422ILE	YUV 4:2:2 interleaved (little endian). This is the default value. Not supported in this version of H264 Encoder.
	XDM_YUV_444P	YUV 4:4:4 planar. Not supported in this version of H264 Encoder.
	XDM_YUV_411P	YUV 4:1:1 planar. Not supported in this version of H264 Encoder.
	XDM_GRAY	Gray format. Not supported in this version of H264 Encoder.
	XDM_RGB	RGB color format. Not supported in this version of H264 Encoder.
	XDM_CHROMAFORMAT_DEFAULT	Default value is set to XDM_YUV_422ILE.
XDM_CmdId	XDM_GETSTATUS	Query algorithm instance to fill Status structure
	XDM_SETPARAMS	Set run-time dynamic parameters via the DynamicParams structure
	XDM_RESET	Reset the algorithm
	XDM_SETDEFAULT	Initialize all fields in Params structure to default values specified in the library
	XDM_FLUSH	Handle end of stream conditions. This command forces algorithm instance to output data without additional input.

Group or Enumeration Class	Symbolic Constant Name	Description or Evaluation
	XDM_GETBUFINFO	Query algorithm instance regarding the properties of input and output buffers
	XDM_GETVERSION	Query the version of the algorithm
XDM_EncodingPreset	XDM_DEFAULT	Default setting of the algorithm specific creation time parameters.
	XDM_HIGH_QUALITY	Set algorithm specific creation time parameters for high quality (default setting)
	XDM_HIGH_SPEED	Set algorithm specific creation time parameters for high speed
	XDM_USER_DEFINED	User defined configuration using advanced parameters
XDM_EncMode	XDM_ENCODE_AU	Encode entire access unit (default value).
	XDM_GENERATE_HEADER	Encode only header
	XDM_PARAMSCHANGE	Bit 9 ❑ 1 - Parameters changed ❑ 0 - Ignore
XDM_ErrorBit	XDM_APPLIEDCONCEALMENT	Bit 9 ❑ 1 - Applied concealment ❑ 0 - Ignore
	XDM_INSUFFICIENTDATA	Bit 10 ❑ 1 - Insufficient data ❑ 0 - Ignore
	XDM_CORRUPTEDDATA	Bit 11 ❑ 1 - Data problem/corruption ❑ 0 - Ignore
	XDM_CORRUPTEDHEADER	Bit 12 ❑ 1 - Header problem/corruption ❑ 0 - Ignore
	XDM_UNSUPPORTEDINPUT	Bit 13 ❑ 1 - Unsupported feature/parameter in input ❑ 0 - Ignore
	XDM_UNSUPPORTEDPARAM	Bit 14 ❑ 1 - Unsupported input parameter or configuration ❑ 0 - Ignore
	XDM_FATALERROR	Bit 15 ❑ 1 - Fatal error (stop encoding) ❑ 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.

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`
- `XDM1_BufDesc`
- `XDM_SingleBufDesc`
- `XDM1_SingleBufDesc`
- `XDM_AlgBufInfo`
- `IVIDEO_BufDesc`
- `IVIDEO1_BufDesc`
- `IVIDEO1_BufDescIn`
- `IVIDENC1_Fxns`
- `IVIDENC1_Params`
- `IVIDENC1_DynamicParams`
- `IVIDENC1_InArgs`
- `IVIDENC1_Status`
- `IVIDENC1_OutArgs`
- `IVIDENC1_MbData`

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 XDM1_BufDesc

Description

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

Fields

Field	Datatype	Input/ Output	Description
numBufs	XDAS_Int32	Input	Number of buffers
descs[XDM_MAX_IO_BUFFERS]	XDM1_SingleBufDesc	Input	Array of buffer descriptors.

4.2.1.3 XDM_SingleBufDesc

Description

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

Fields

Field	Datatype	Input/ Output	Description
*bufs	XDAS_Int8	Input	Pointer to the buffer
bufSize	XDAS_Int32	Input	Size of the buffer in bytes

4.2.1.4 XDM1_SingleBufDesc

Description

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

Fields

Field	Datatype	Input/ Output	Description
*bufs	XDAS_Int8	Input	Pointer to the buffer
bufSize	XDAS_Int32	Input	Size of the buffer in bytes
accessMask	XDAS_Int32	Output	If the buffer was not accessed by the algorithm processor (for example, it was filled by DMA or other hardware accelerator that does not write through the algorithm CPU), then no bits in this mask should be set.

4.2.1.5 XDM_AlgBufInfo

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 H.264 Encoder, the buffer details are:

- Number of input buffer required is 1 for YUV 422ILE and 2 for YUV420P
- Number of output buffer required is 1
- The input buffer sizes (in bytes) for worst case NTSC 720p format are:

For YUV 420:
Y buffer = 1280 * 720
UV buffer = 1280 * 360

For YUV 422ILE:
Buffer = 1280 * 720 * 2

- There is no restriction on output buffer size except that it should contain atleast one frame of encoded data.

These are the maximum buffer sizes but you can reconfigure depending on the input format.

4.2.1.6 IVIDEO_BufDesc

Description

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

Fields

Field	Datatype	Input/ Output	Description
numBufs	XDAS_Int32	Input	Number of buffers
width	XDAS_Int32	Input	Padded width of the video data
*bufs[XDM_MAX_IO_BUFFERS]	XDAS_Int8	Input	Pointer to the vector containing buffer addresses
bufSizes[XDM_MAX_IO_BUFFERS]	XDAS_Int32	Input	Size of each buffer in bytes

4.2.1.7 IVIDEO1_BufDesc

Description

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

Fields

Field	Datatype	Input/ Output	Description
numBufs	XDAS_Int32	Input	Number of buffers
frameWidth	XDAS_Int32	Input	Width of the video frame
frameHeight	XDAS_Int32	Input	Height of the video frame
framePitch	XDAS_Int32	Input	Frame pitch used to store the frame
bufDesc[IVIDEO_MAX_YUV_BUFFERS]	XDM1_SingleBufDesc	Input	Pointer to the vector containing

Field	Datatype	Input/ Output	Description
			buffer addresses
extendedError	XDAS_Int32	Input	Extended error field
frameType	XDAS_Int32	Input	copydoc IVIDEO_FrameType
topFieldFirstFlag	XDAS_Int32	Input	Flag to indicate when the application should display the top field first
repeatFirstFieldFlag	XDAS_Int32	Input	Flag to indicate when the first field should be repeated
frameStatus	XDAS_Int32	Input	IVIDEO_OutputFrameStatus
repeatFrame	XDAS_Int32	Input	Number of times the display process needs to repeat the displayed progressive frame
contentType	XDAS_Int32	Input	Content type of the buffer
chromaFormat	XDAS_Int32	Input	XDM_ChromaFormat

4.2.1.8 IVIDEO1_BufDescIn

Description

This structure defines the buffer descriptor for input buffers.

Fields

Field	Datatype	Input/ Output	Description
numBufs	XDAS_Int32	Input	Number of buffers
frameWidth	XDAS_Int32	Input	Width of the video frame
frameHeight	XDAS_Int32	Input	Height of the video frame
framePitch	XDAS_Int32	Input	Frame pitch used to store the frame
bufDesc[IVIDEO_MAX_YUV_BUFFERS]	XDM1_SingleBufDesc	Input	Pointer to the vector containing buffer addresses

4.2.1.9 IVIDENC1_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 TMS320 DSP Algorithm Standard API Reference (literature number SPRU360).
*process	XDAS_Int32	Input	Pointer to the process() function.
*control	XDAS_Int32	Input	Pointer to the control() function.

4.2.1.10 IVIDENC1_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 be specified 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.
encodingPreset	XDAS_Int32	Input	Encoding preset. See XDM_EncodingPreset enumeration for details. Not supported in this version of H264 Encoder. Default : XDM_DEFAULT
rateControlPreset	XDAS_Int32	Input	Rate control preset: Only IVIDEO_LOW_DELAY, IVIDEO_STORAGE, IVIDEO_NONE presets are supported. See IVIDEO_RateControlPreset enumeration for details. Default : IVIDEO_LOW_DELAY

Field	Datatype	Input/ Output	Description
maxHeight	XDAS_Int32	Input	Maximum video height to be supported in pixels. Default : 720 Note: Only resolutions that are multiples of 16 are supported.
maxWidth	XDAS_Int32	Input	Maximum video width to be supported in pixels. Default : 1280 Note: Only resolutions that are multiples of 16 are supported.
maxFrameRate	XDAS_Int32	Input	Maximum frame rate in fps * 1000 to be supported. Default : 30000
maxBitRate	XDAS_Int32	Input	Maximum bit-rate to be supported in bits per second. Default : 10000000
dataEndianness	XDAS_Int32	Input	Endianness of input data. See XDM_DataFormat enumeration for details. Default : XDM_LE_32 Only the default value XDM_LE_32 is supported.
maxInterFrameInterval	XDAS_Int32	Input	Distance from I-frame to P-frame: ❑ 1 - If no B-frames ❑ 2 - To insert one B-frame Not supported in this version of H264 Encoder. Default : 0
inputChromaFormat	XDAS_Int32	Input	Input chroma format. See XDM_ChromaFormat enumeration for details. The default value XDM_YUV_420P is only supported.
inputContentType	XDAS_Int32	Input	Input content type. See IVIDEO_ContentType enumeration for details. The default value IVIDEO_PROGRESSIVE is only supported.
reconChromaFormat	XDAS_Int32	Input	Chroma formats for the reconstruction buffers. See XDM_ChromaFormat enumeration for details. The default value XDM_CHROMA_NA is only supported.

Note:

- For the supported `maxBitRate` values, see Table A.1 – Level limits in *ISO/IEC 14496-10*.

The following fields of `IVIDENC1_Params` data structure are level dependent:

```
maxHeight
maxWidth
maxFrameRate
maxBitRate
```

To check the values supported for `maxHeight` and `maxWidth` use the following expression:

```
maxFrameSizeinMbs >= (maxHeight*maxWidth) / 256;
```

See Table A.1 – Level limits in *ISO/IEC 14496-10* for the supported `maxFrameSizeinMbs` values.

For example, consider you have to check if the following values are supported for level 2.0:

```
maxHeight = 480
maxWidth = 720
```

The supported `maxFrameSizeinMbs` value for level 2.0 as per Table A.1 – Level limits is 396.

Compute the expression as:

```
maxFrameSizeinMbs >= (480*720) / 256
```

The value of `maxFrameSizeinMbs` is 1350 and hence the condition is not true. Therefore, the above values of `maxHeight` and `maxWidth` are not supported for level 2.0.

Use the following expression to check the supported `maxFrameRate` values for each level:

```
maxFrameRate <= maxMbsPerSecond / FrameSizeinMbs;
```

See Table A.1 – Level Limits in *ISO/IEC 14496-10* for the supported values of `maxMbsPerSecond`.

Use the following expression to calculate `FrameSizeinMbs`:

```
FrameSizeinMbs = (inputWidth * inputHeight) / 256;
```

- When the rate control preset is configured to `IVIDEO_LOW_DELAY` (CBR mode), the encoder can skip frames, and the encoder does not support any SEI messages in the bit-strem to indicate the frame skip.

4.2.1.11 IVIDENC1_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
`size`	`XDAS_Int32`	Input	Size of the basic or extended (if being used) data structure in bytes.
`inputHeight`	`XDAS_Int32`	Input	Height of input frame in pixels. Minimum supported input height : 64 Note: Only resolutions that are multiples of 16 are supported.
`inputWidth`	`XDAS_Int32`	Input	Width of input frame in pixels. Minimum supported input width: 64 Note: Only resolutions that are multiples of 16 are supported.
`refFrameRate`	`XDAS_Int32`	Input	Reference or input frame rate in fps * 1000. For example, if the frame rate is 30, set this field to 30000. Default : 30000
`targetFrameRate`	`XDAS_Int32`	Input	Target frame rate in fps * 1000. For example, if the frame rate is 30, set this field to 30000. Default: 30000
`targetBitRate`	`XDAS_Int32`	Input	Target bit-rate in bits per second. For example, if the bit-rate is 2 Mbps, set this field to 2097152. Default: 1000000
`intraFrameInterval`	`XDAS_Int32`	Input	Interval between two consecutive intra frames. ❑ 1 - No inter frames (all intra frames) ❑ n - Intra frame after 'n' inter frames
`generateHeader`	`XDAS_Int32`	Input	Encode entire access unit or only header. See `XDM_EncMode` enumeration for details. Default: `XDM_ENCODE_AU`
`captureWidth`	`XDAS_Int32`	Input	If the field is set to: ❑ 0 - Encoded image width is used as pitch. ❑ Any non-zero value, capture width is used as pitch (if capture width is greater than image width). Default: 0 Not supported in this version of H264 Encoder.

Field	Datatype	Input/ Output	Description
forceFrame	XDAS_Int32	Input	Force the current (immediate) frame to be encoded as a specific frame type. See IVIDEO_FrameType enumeration for details Default: IVIDEO_NA_FRAME
interFrameInterval	XDAS_Int32	Input	Number of B frames between two reference frames; that is, the number of B frames between two P frames or I/P frames. Not supported in this version of H264 Encoder. Default: 0
mbDataFlag	XDAS_Int32	Input	Flag to indicate that the algorithm should use MB data supplied in additional buffer within inBufs. Not supported in this version of H264 Encoder. Default: 0

Note:

- The following are the limitations on the parameters of IVIDENC1_DynamicParams data structure:

```
inputHeight <= maxHeight
inputWidth <= maxWidth
refFrameRate <= maxFrameRate
targetFrameRate <= maxFrameRate
targetBitRate <= maxBitRate
```

The rate control used in H.264 Encoder can work for a target bit-rate of a minimum of 32 kbps and a maximum of 10 mbps up to level 3. However, the recommended range varies with the format. For example, for NTSC D1, the recommended range is 1.5 mbps to 6.0 mbps.

- The bit-rate achieved by the encoder may deviate largely from the value specified by the targetBitRate field of the IVIDENC1_DynamicParams data structure when the content is highly static and the bitrate is high.
- The targetFrameRate and refFrameRate should be equal as frame rate up-conversion and down-conversion is not supported/used.
- The rate control presets IVIDEO_LOW_DELAY /IVIDEO_LOW_STORAGE takes at least 1-2 seconds for the rate control algorithm to stabilize the target bit-rate.

4.2.1.12 IVIDENC1_InArgs

Description

This structure defines the run-time input arguments for an 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.
inputID	XDAS_Int32	Input	Identifier to attach with the corresponding encoded bit-stream frames.
topFieldFirstFlag	XDAS_Int32	Input	Flag to indicate the field order in interlaced content. Not supported in this version of H264 Encoder.

4.2.1.13 IVIDENC1_Status

Description

This structure defines parameters that describe the status of an 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 code. See XDM_ErrorBit enumeration for details.
data	XDM1_SingleBufDesc	Output	Buffer descriptor for passing the data
bufInfo	XDM_AlgBufInfo	Output	Input and output buffer information. See XDM_AlgBufInfo data structure for details.

4.2.1.14 IVIDENC1_OutArgs

Description

This structure defines the run-time output arguments for an 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 code. See XDM_ErrorBit enumeration for details.
bytesGenerated	XDAS_Int32	Output	The number of bytes generated.
encodedFrameType	XDAS_Int32	Output	Frame types for video. See IVIDEO_FrameType enumeration for details.
inputFrameSkip	XDAS_Int32	Output	Frame skipping modes for video. See IVIDEO_SkipMode enumeration for details.
outputID	XDAS_Int32	Output	Output ID corresponding with the encoded buffer. This shall also be used to free up the corresponding image buffer for further use by client application code.
encodedBuf	XDM1_SingleBufDesc	Output	The Encoder fills the buffer with the encoded bit-stream. In case of sequences having I and P frames only, these values are identical to outBufs passed in IVIDENC1_Fxns::process().
reconBufs	IVIDEO1_BufDesc	Output	Pointer to reconstruction buffer descriptor.

4.2.1.15 IVIDENC1_MbData

Description

This structure defines the structure that contains macroblock related encoding parameter estimates.

This Structure is not supported in this version of H264 Encoder

Fields

Field	Datatype	Input/ Output	Description
mbMode	XDAS_Int32	Input	MB encoding mode 0x00 for skip macroblock 0x01 for I Frame macroblock 0x02 for P Frame macroblock 0x03 for B Frame macroblock 0x04 for I Field macroblock 0x05 for P Field macroblock 0x06 for B Field macroblock 0xFF for mbMode not specified
QP	XDAS_Int32	Output	QP estimate Value of 0xFF for QP is not specified
mvFwdXY	XDAS_Int32	Output	Forward motion vector estimate. If MVx (XDAS_Int16) and MVy (XDAS_Int16) are the motion vectors in the x and y directions, in quarter pel units, then mvFwdXY = ((MVx & 0x0000FFFF) << 16) | (MVy & 0x0000FFFF)
mvBwdXY	XDAS_Int32	Output	Backward motion vector estimate The format is the same as IVIDENC1_MbData::mvFwdXY.

4.2.2 H.264 Encoder Data Structures

This section includes the following H.264 Encoder specific extended data structures:

- IH264VENC_Params
- IH264VENC_DynamicParams
- IH264VENC_InArgs
- IH264VENC_Status
- IH264VENC_OutArgs

4.2.2.1 IH264VENC_Params

Description

This structure defines the creation parameters and any other implementation specific parameters for a H.264 Encoder instance object. The creation parameters are defined in the XDM data structure, IVIDENC1_Params.

Fields

Field	Datatype	Input/ Output	Description
videncParams	IVIDENC1_Params	Input	See IVIDENC1_Params data structure for details.
profileIdc	XDAS_Int32	Input	Profile identification for the Encoder. Default : 66 (BASELINE_PROFILE)
levelIdc	XDAS_Int32	Input	Level identification for the Encoder. Default : 31
EntropyCodingMode	XDAS_Int32	Input	Mode of entropy coding to be used for encoding. ❑ 0 : CAVLC ❑ 1 : CABAC Default : 0

Note:

When basic structure mode is configured, only default values are used for extended parameters irrespective of the value specified by the user.

4.2.2.2 IH264VENC_DynamicParams

‖ Description

This structure defines the run-time parameters and any other implementation specific parameters for a H.264 Encoder instance object. The run-time parameters are defined in the XDM data structure, `IVIDENC1_DynamicParams`.

‖ Fields

Field	Datatype	Input/ Output	Description
`videncDynamicParams`	`IVIDENC1_DynamicParams`	Input	See `IVIDENC1_DynamicParams` data structure for details.
`QPISlice`	`XDAS_UInt8`	Input	Initial Quantization Parameter (QP) of I-frames. The valid range is [0 , 51]. Default : 28
`QPSlice`	`XDAS_UInt8`	Input	Initial Quantization Parameter (QP) of P-frames. The valid range is [0 , 51]. Default : 28
RateCtrlQpMax	`XDAS_UInt8`	Input	This is the maximum value of the QP that can be used by the rate control module. This value should be greater than `RateCtrlQpMin`. The valid range is [0,51]. Default : 51
RateCtrlQpMin	`XDAS_UInt8`	Input	This is the minimum value of the QP that can be used by the rate control module. This value should be less than `RateCtrlQpMax`. The valid range is [0,51]. Default : 0
NumRowsInSlice	`XDAS_UInt8`	Input	The number of slices that has to be created in a single frame. Each slice is a multiple of MB rows. The valid range is [0, Number of MB Rows in the input frame.] Default : 0
`LfDisableIdc`	`XDAS_UInt8`	Input	❑ 0 - Enable loop filter ❑ 1 - Disable loop filter ❑ 2 - Disable filter across slice boundaries. Default : 0

Field	Datatype	Input/ Output	Description
LFAlphaC0Offset	XDAS_Int8	Input	This is the Alpha and C0 offset for the H.264 loop filter value divided by 2. The valid range is[-6,+6]. Default : 0
LFBetaOffset	XDAS_Int8	Input	This is the beta offset for the H.264 loop filter value divided by 2. The valid range [-6,+6]. Default : 0
ChromaQPOffset	XDAS_Int8	Input	The Chroma QP offset for determining the QP of the chrominance blocks based on the QP of the luminance blocks. Valid range is [-12, 12] Default : 0
SecChromaQPOffset	XDAS_Int8	Input	The Second Chroma QP Offset for determining the QP of the Cr blocks based on the QP of the luminance blocks. This is used in High profile only. The valid range is [-12, 12]. Default : 0

Note:

- When basic structure mode is configured, only default values are used for extended parameters irrespective of the value specified by the user.
- When rateControlPreset is configured to IVIDEO_LOW_DELAY (CBR) or IVIDEO_STORAGE (VBR), the QPISlice value is used as the initial QP.

When rateControlPreset is configured to IVIDEO_NONE, rate control is disabled and all the I frames are encoded with QPISlice value as the QP and all the P frames are encoded with QPSlice value as the QP.

4.2.2.3 IH264VENC_InArgs

Description

This structure defines the run-time input arguments for H.264 Encoder instance object.

Fields

Field	Datatype	Input/ Output	Description
videncInArgs	IVIDENC1_InArgs	Input	See IVIDENC1_InArgs data structure for details.

4.2.2.4 IH264VENC_Status

Description

This structure defines parameters that describe the status of the H.264 Encoder and any other implementation specific parameters. The status parameters are defined in the XDM data structure, IVIDENC1_Status.

Fields

Field	Datatype	Input/ Output	Description
videncStatus	IVIDENC1_Status	Output	See IVIDENC1_Status data structure for details.

4.2.2.5 IH264VENC_OutArgs

Description

This structure defines the run-time output arguments for the H.264 Encoder instance object.

Fields

Field	Datatype	Input/ Output	Description
videncOutArgs	IVIDENC1_OutArgs	Output	See IVIDENC1_OutArgs data structure for details.

4.3 Interface Functions

This section describes the Application Programming Interfaces (APIs) used in the H.264 Encoder. 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).

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 `IVIDENC1_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()`

> **Note:**
>
> If the fourth argument is set to `NULL`, default parameters are used.

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 `IVIDENC1_DynamicParams` data structure (see Data Structures section for details).

‖ Name

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

‖ Synopsis

```
XDAS_Int32 (*control) (IVIDENC1_Handle handle,
IVIDENC1_Cmd id, IVIDENC1_DynamicParams *params,
IVIDENC1_Status *status);
```

‖ Arguments

```
IVIDENC1_Handle handle; /* algorithm instance handle */

IVIDENC1_Cmd id; /* algorithm specific control commands*/

IVIDENC1_DynamicParams *params; /* algorithm run-time
parameters */

IVIDENC1_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 `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 `IVIDENC1_DynamicParams` and `IVIDENC1_Status` data structures respectively.

Note:

- If the third and the fourth arguments point to the base data structure of `DynamicParams` and `status`, then the basic parameters are used.
- If the third and the fourth arguments point to the extended data structure of `DynamicParams` and `status`, then the extended parameters are used.

‖ 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 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, TestAppEncoder.c available in the \Client\Test\Src sub-directory.

‖ See Also

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

4.3.4 Data Processing API

Data processing API is used for processing the input data.

‖ Name

`algActivate()` – initialize scratch memory buffers prior to processing.

‖ Synopsis

```
Void algActivate(IALG_Handle handle);
```

‖ Arguments

```
IALG_Handle handle; /* algorithm instance handle */
```

‖ Return Value

```
Void
```

‖ Description

`algActivate()` initializes any of the instance scratch buffers using the persistent memory that is part of the algorithm instance object.

The first (and only) argument to `algActivate()` is an algorithm instance handle. This handle is used by the algorithm to identify various buffers that must be initialized prior to calling any of the algorithm processing methods.

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

‖ See Also

`algDeactivate()`

‖ Name

`process()` – basic encoding/decoding call

‖ Synopsis

```
XDAS_Int32 (*process)(IVIDENC1_Handle handle,
IVIDEO1_BufDescIn *inBufs, XDM_BufDesc *outBufs,
IVIDENC1_InArgs *inargs, IVIDENC1_OutArgs *outargs);
```

‖ Arguments

```
IVIDENC1_Handle handle; /* algorithm instance handle */

IVIDEO1_BufDescIn *inBufs; /* algorithm input buffer
descriptor */

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

IVIDENC1_InArgs *inargs /* algorithm runtime input
arguments */

IVIDENC1_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 argument is a pointer to the input buffer descriptor data structure. (see `IVIDEO1_BufDescIn` data structure for details).

The third argument is a pointer to the output buffer descriptor data structure. (see `XDM_BufDesc` data structure for details).

The fourth argument is a pointer to the `IVIDENC1_InArgs` data structure that defines the run-time input arguments for an algorithm instance object.

The last argument is a pointer to the `IVIDENC1_OutArgs` data structure that defines the run-time output arguments for an algorithm instance object.

Note:

- If the fourth and the fifth arguments point to the base data structure of `InArgs` and `OutArgs`, then the basic parameters are used.
- If the fourth and the fifth arguments point to the extended data structure of `InArgs` and `OutArgs`, then the extended parameters are used.

‖ 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 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, TestAppEncoder.c available in the \Client\Test\Src sub-directory.

‖ See Also

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

Note:

- A video encoder or decoder cannot be pre-empted by any other video Encoder or decoder instance. That is, the user cannot perform task switching while encode/decode of a particular frame is in progress. Pre-emption can happen only at frame boundaries and after `algDeactivate()` is called.
- The input data is an uncompressed video frame in one of the format defined by `inputChromaFormat` of `IVIDENC1_Params` structure.The Encoder outputs H.264 compressed bit-stream in the little-endian format.

‖ Name

`algDeactivate()` – save all persistent data to non-scratch memory

‖ Synopsis

```
Void algDeactivate(IALG_Handle handle);
```

‖ Arguments

```
IALG_Handle handle; /* algorithm instance handle */
```

‖ Return Value

```
Void
```

‖ Description

`algDeactivate()` saves any persistent information to non-scratch buffers using the persistent memory that is part of the algorithm instance object.

The first (and only) argument to `algDeactivate()` is an algorithm instance handle. This handle is used by the algorithm to identify various buffers that must be saved prior to next cycle of `algActivate()` and processing.

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

‖ See Also

`algActivate()`

4.3.5 Termination API

Termination API is used to terminate the algorithm instance 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()`