IPNC DM812x

JPEG Enc

Interface and Integration User Guide

Document Revision 0.1

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

1 Products		2 Applications	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
		Telephony	www.ti.com/telephony
		Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments
Post Office Box 655303 Dallas, Texas 75265

1 Contents

2 Abbreviations

DMA	Direct Memory Access
SIMCOP	Still Image Co-Processor
DCT	Discrete Cosine Transform H/w Block
VLCDJ	Variable Length Coding and Decoding for JPEG H/w Block
RM	Resource Manager
MSP	Multimedia Service Provider
APP Marker	Application Marker Eg: EXIF, JFIF
EXIF	Exchangeable Image file format
JFIF	JPEG File Interchange Format

3 Source and library location

In IPNC RDK, the MSP JPEG Enc interface and library are located in the ti_tools/iss_xx/packages/ti/psp/iss/alg/jpeg_enc/ folder.

The MSP JPEG Enc component has been integrated into the mjpeg link of IPNC RDK McFw. Example of using and configuring the JPEG Enc component can be found in the ipnc_rdk/ipnc_mcfw/mcfw/src_bios6/links_m3vpss/mjpeg/ folder.

4 Component Overview

MSP is a generic abstraction interface used in codec to abstract the codec specific services. In the current context, MSP is used to abstract the JPEG Enc component for SIMCOP on DM812x.

The client or the user of the MSP JPEG Enc component interfaces with the component via MSP API calls. These MSP API calls from the client in-turn use SIMCOP functional CSL APIs to achieve the desired functionality using the actual hardware accelerators. The client populates all the create time parameters of the encoder component. For example, encoder color format supported (420 NV12 and UYVY – 422 interleaved) is to be specified here.

The client uses the MSP APIs to process the input YUV buffer and stores the output in a client provided output buffer after the required processing. In addition to the actual processing, there are a host of control commands that can be supported as well. Eg: Query for the Quantization Table used by encoder etc.

The MSP JPEG Enc component will support the following listed features for encoding/compressing an input frame in to a JPEG bit stream.

4.1 Features

- Encoding of images in YUV4:2:0 NV12 format shall be supported
- Encoding of images in YUV4:2:2 interleaved format shall be supported
- JPEG encoder shall encode images with size up to 16 Mpixels
- Support EXIF and JFIF Headers
- JPEG Encoder shall support generation and insertion of thumbnail (compressed JPEG format) in JFIF extension compliant header in the generated jpeg bitstream when JFIF marker is requested
- The encoder shall support custom quantization tables
- The encoder shall support custom Huffman tables

5 Software Design Interfaces

5.1 MSP interface

The VNF driver is wrapped with the TI internal standard interface called MSP (Multimedia Service Provider). The client of the MSP interface will make use of the following APIs:

1. **MSP_init:** Used for initializing the component.
2. **MSP_deInit:** Used for de-initializing the component.
3. **MSP_open:** Used for opening the component handle with specific parameters.
4. **MSP_close:** Used for closing the component handle.
5. **MSP_process:** Used for processing of input buffers and write processed data into output buffers.
6. **Callback:** Callback implementation is necessary and the client is responsible to include it in implementation. The callback needs to be registered with the MSP component during **MSP_init** API call. The advantage of having callback is that it would make MSP API calls such as **MSP_process** non-blocking.

MSP API calls such as MSP_control, MSP_config and MSP_query are not supported for the MSP VNF component. They are currently implemented as dummy calls for the MSP VNF component.

5.2 Resource manager

Resource manager APIs have been integrated inside the **MSP_JPEGE_init** and **MSP_JPEGE_deint** calls for the MSP JPEG Enc component. The user of these MSP APIs must call RM_init() function before using these MSP API calls. Moreover, the user should call RM_deinit() function before exiting the application.

A typical sequence of API calls of using the MSP JPEG Enc component is shown as below.

For each processing frame

{

- MSP_init
- MSP_open
- MSP_process
- Callback reception
- MSP_close
- MSP_deInit

}

In the IPNC RDK, RM is needed, since VNF shares SIMCOP resources with the MJPEG encoder.

In addition, the user is required to call iss_init() and simcop_common_init() functions before using MSP APIs in order to initiate the interrupt framework at ISS and SIMCOP levels.

6 Data Structure Description

The following sub sections elaborates further on the MSP VNF component's create time parameters data structure which is passed by the user during MSP_open call.

6.1 Component Data Structure

```
typedef struct {
    MSP_U32                                  ulImageWidth;
    MSP_U32                                  ulImageHeight;
    MSP_U32                                  ulImageStrideHorizontal;
    MSP_U32                                  ulInputSliceHeight;
    MSP_U32                                  ulQualityFactor;
    MSP_U32                                  ulBurstLength;
    MSP_U32                                  ulOutputChunkSize;
    MSP_U32                                  nMaxNumOfBuf[NUM_OF_PORTS];
    MSP_JPEGE_COLORFORMAT_TYPE     eColorFormat;
    MSP_JPEGE_USECASETYPE              eUseCaseType;
    MSP_JPEGE_UNCOMPRESSEDBUFFER_OPERATINGMODE_TYPE   eUnComprsdOpMode;
    MSP_JPEGE_COMPRESSEDBUFFER_OPERATINGMODE_TYPE     eComprsdOpMode;
    MSP_JPEGE_ROTATION_TYPE          eRotationParam;
    MSP_BOOL                                 bCustomHuffTab;
    MSP_BOOL                                 bCustomQuantTab;
    MSP_JPEGE_HEADERTYPE               eHeaderFormat;
    MSP_BOOL                                 bDRIEnable;
    MSP_U32                                  ulRestartInterval;
    MSP_U32                                  nSdmaChannel;
    MSP_BOOL                                      bApp13MarkerEnable;
}MSP_JPEGE_CREATE_PARAM;
```

This is the create time parameter data structure specific to the MSP JPEG Enc component. Further details for each of these parameters are as follows or refer to file msp_jpege.h:

Parameter	Description
ulImageWidth	Input frame width
ulImageHeight	Input frame height
ulImageStrideHorizontal	Input Stride
ulInputSliceHeight	Input slice height, if used or else 0
ulQualityFactor	Quality Factor required at the output
ulBurstLength	Number of burst frames captured
nMaxNumOfBuf	Maximum number of buffers per port
ulOutputChunkSize	Size of the output bitstream, when operated in Chunk based mode at the output
eColorFormat	Color format used
eUseCaseType	Use-Case (HSS, HQ) type used
eUnComprsdOpMode	Input operating mode (Slice, frame, etc)
eComprsdOpMode	Output operation mode (chunk/non-chunk mode)
eRotationParam	Rotation param to be specified
bCustomQuantTab	Is MSP_TRUE, if client provides custom quantification or inverse quant table
bCustomHuffTab	Is MSP_TRUE, if application provides custom Huffman table
eHeaderFormat	Specifies whether EXIF or JFIF Header needs to be used
bDRIEnable	Specifies whether DRI Header needs to be encoded
nSdmaChannel	DMA Channel to be used

bApp13MarkerEnable	Flag to enable APP13 Marker

7 Known Limitations of MSP JPEG Enc Component

The MSP JPEG Enc component is known to have following limitations.

1) Not exhaustive testing done expect for the features enabled in the integration of MSP JPEG Enc Component in IPNC RDK
2) MSP JPEG Enc always generates a stream with restartInterval of 8 MCU.
3) Performance might degrade with the Image Width which is non multiple of 8 MCU.