

MPEG2 Main Profile Encoder (v01.00.00) on DM365

FEATURES

- eXpressDSP Digital Media (XDM1.0 IVIDENC1) interface compliant
- Validated on the DM365 EVM
- MPEG2 Main Profile up to High level compliant
- Resolutions up to 1920x1088 supported
- YUV420 semi planar input format for the frames supported
- Progressive picture encoding supported
- Interlace: only field picture encoding supported
- Generates bit-stream compliant with MPEG2 standard
- Frame based encoding with frame size being multiples of 2 supported
- Rate Control (CBR and VBR) supported
- Half Pel Interpolation for motion estimation supported

- Perceptual rate control supported
- Not-supported features
 - Adaptive Intra refresh
 - Field DCT
 - Adaptive frame field MB
 - Perceptual rate control

DESCRIPTION

MPEG2 (from ISO/IEC) is a popular video coding algorithm enabling high quality multimedia services on a limited bandwidth network. MPEG2 standard defines several profiles and levels, which specify restrictions on the bit stream, and hence limits the capabilities needed to encode/decode the bit-streams. This project is developed using Code Composer Studio version 3.3.81.6 and using the code generation tools version 4.1.4.

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Performance Summary

This section describes the performance of standalone MPEG2 Main Profile Decoder validated on DM365 EVM resulting in performance equivalent to 30fps.

Table 1. Configuration Table

CONFIGURATION	ID
MPEG2 simple profile levels @ High Level – progressive – Normal search ME	MPEG2_E_01
MPEG2 simple profile levels @ High Level – progressive – Low power ME	MPEG2_E_02
MPEG2 simple profile levels @ High Level – Interlace – Normal search ME	MPEG2_E_03
MPEG2 simple profile levels @ High Level – Interlace – Low power ME	MPEG2_E_04

Performance Measurement Procedure

- Measured with program memory and I/O buffers in external memory, I/D cache enabled, ARM @297 MHz, DDR @ 243 MHz, Monta Vista Linux 5.0
- Linux is used to measure the performance numbers in this Datasheet.
- The process time is measured across algActivate/process/algDeactivate function call using gettimeofday() utility of linux.
- NFS File system is used as an environment in performance measurement.

Table 2. Cycles Information for MPEG2_E_01

INPUT NAME	PERFORMANCE STATISTICS FOR MPEG2_E_01 SETTINGS						
	RESOLUTION	AVERAGE			PEAK		
		ARM926 PER FRAME	ENCODE FRAME MHZ	FPS(297 MHZ)	ARM926 PER FRAME	ENCODE FRAME MHZ	FPS(297 MHZ)
satonement_p1920x1056_24fps_420pl_60fr.yuv	1920x1056 @24fps, 12mbps	0.138	25.374	11.705	0.187	26.272	11.305
parkrun_p1280x720_30fps_420pl_300fr.yuv	720p@30fps, 9mbps	0.135	11.582	25.642	0.191	12.024	24.700
shields_p720x480_25fps_420pl_252fr.yuv	D1@30fps, 6mbps	0.135	4.503	65.950	0.189	4.723	62.881
foreman_p640x480_30fps_420pl_300fr.yuv	VGA @30fps, 3mbps	0.133	4.004	74.184	0.208	4.222	70.348
akiyo_p352x288_30fps_420pl_300fr.yuv	CIF@30fps, 1mbps	0.130	1.448	205.044	0.183	1.572	188.893

Table 3. Cycles Information for MPEG2_E_02

INPUT NAME	PERFORMANCE STATISTICS FOR MPEG2_E_02 SETTINGS						
	RESOLUTION	AVERAGE			PEAK		
		ARM926 PER FRAME	ENCODE FRAME MHZ	FPS(297 MHZ)	ARM926 PER FRAME	ENCODE FRAME MHZ	FPS(297 MHZ)
satonement_p1920x1056_24fps_420pl_60fr.yuv	1920x1056 @24fps, 12mbps	0.140	16.995	17.476	0.191	18.960	15.665
parkrun_p1280x720_30fps_420pl_300fr.yuv	720p@30fps, 9mbps	0.132	7.601	39.073	0.269	8.631	34.413
shields_p720x480_25fps_420pl_252fr.yuv	D1@30fps, 6mbps	0.133	3.107	95.584	0.270	3.462	85.778

Table 3. Cycles Information for MPEG2_E_02 (continued)

INPUT NAME	PERFORMANCE STATISTICS FOR MPEG2_E_02 SETTINGS						
	RESOLUTION	AVERAGE			PEAK		
		ARM926 PER FRAME	ENCODE FRAME MHZ	FPS(297 MHZ)	ARM926 PER FRAME	ENCODE FRAME MHZ	FPS(297 MHZ)
foreman_p640x480_30fps_420pl_300fr.yuv	VGA @30fps, 3mbps	0.135	2.692	110.327	0.217	2.828	105.020
akiyo_p352x288_30fps_420pl_300fr.yuv	CIF@30fps, 1mbps	0.131	1.010	293.945	0.183	1.074	276.625

Table 4. Cycles Information for MPEG2_E_03

INPUT NAME	PERFORMANCE STATISTICS FOR MPEG2_E_03 SETTINGS						
	RESOLUTION	AVERAGE			PEAK		
		ARM926 PER FRAME	ENCODE FRAME MHZ	FPS(297 MHZ)	ARM926 PER FRAME	ENCODE FRAME MHZ	FPS(297 MHZ)
satonement_p1920x1056_24fps_420pl_60fr.yuv	1920x1056 @24fps, 12mbps	0.141	12.823	23.162	0.191	13.289	22.349
parkrun_p1280x720_30fps_420pl_300fr.yuv	720p@30fps, 9mbps	0.135	6.058	49.024	0.201	6.325	46.959
shields_p720x480_25fps_420pl_252fr.yuv	D1@30fps, 6mbps	0.134	2.349	126.422	0.217	2.487	119.403
foreman_p640x480_30fps_420pl_300fr.yuv	VGA @30fps, 3mbps	0.137	2.112	140.607	0.237	2.282	130.124
akiyo_p352x288_30fps_420pl_300fr.yuv	CIF@30fps, 1mbps	0.133	0.830	357.910	0.337	1.065	278.940

Table 5. Cycles Information for MPEG2_E_04

INPUT NAME	PERFORMANCE STATISTICS FOR MPEG2_E_04 SETTINGS						
	RESOLUTION	AVERAGE			PEAK		
		ARM926 PER FRAME	ENCODE FRAME MHZ	FPS(297 MHZ)	ARM926 PER FRAME	ENCODE FRAME MHZ	FPS(297 MHZ)
satonement_p1920x1056_24fps_420pl_60fr.yuv	1920x1056 @24fps, 12mbps	0.138	8.524	34.841	0.189	9.583	30.992
parkrun_p1280x720_30fps_420pl_300fr.yuv	720p@30fps, 9mbps	0.137	3.979	74.638	0.200	4.109	72.275
shields_p720x480_25fps_420pl_252fr.yuv	D1@30fps, 6mbps	0.132	1.641	180.995	0.181	1.874	158.453
foreman_p640x480_30fps_420pl_300fr.yuv	VGA @30fps, 3mbps	0.132	1.438	206.526	0.271	1.606	184.911
akiyo_p352x288_30fps_420pl_300fr.yuv	CIF@30fps, 1mbps	0.130	0.604	491.400	0.181	0.557	424.448

Note:

- Encode frame MHz depicts the cumulative the load on ARM926 and HDVICP
- They are measured in presence of Linux without any system traffic. CE overhead is also excluded.
- The version of the code used to collect these numbers have the following features included:
 - Interrupt mode of operation – one interrupt signal processing overhead per frame.

Table 6. Memory Statistics (Host ARM926)

CONFIGURATION ID (FOR ALL CONFIGURATIONS)	MEMORY STATISTICS(IN BYTES) ⁽¹⁾ ⁽²⁾					
	PROGRAM MEMORY	DATA MEMORY				
		CONSTANT	HEAP		STACK	TOTAL
			PERSISTENT	SCRATCH		
MPEG2_E_01 MPEG2_E_02 MPEG2_E_03 MPEG2_E_04	90638	1292	6824219	12864	12288	6941301

(1) The constant size is the sum of .cinit, .bss, and .const sections used by MPEG2 encoder library.

(2) All these memory requirements are for ARM926 encoder library(including DMA library). They do not include any memory requirements from test application side. Stack, heap and code requirements for test-application are extra. Constant memory size requirements include code memory of HDVICP since it forms a constant table on ARM926 before transfer.

Table 7. Internal Data Memory Split-up

CONFIGURATION ID (FOR ALL CONFIGURATIONS)	DATA MEMORY – INTERNAL		
	SHARED		INSTANCE
	CONSTANTS	SCRATCH	
MPEG2_E_01 MPEG2_E_02 MPEG2_E_03 MPEG2_E_04	NA	NA	NA

Table 8. Co Processor(s) Memory Statistics (HDVICP TCM)

CONFIGURATION ID (FOR ALL CONFIGURATIONS)	DATA MEMORY – VICP AND HDVICP			VICP (BYTES)
	HDVICP			
	HDVICP PROGRAM MEMORY(BYTES)	HDVICP DATA MEMORY(BYTES)	HDVICP BUFFERS (BYTES)	
MPEG2_E_01 MPEG2_E_02 MPEG2_E_03 MPEG2_E_04	29000	32768	ALL	0

Note:Persistent memory on DTCM of HDVICP constitutes interrupt vectors, decoder state handle structure, DMA state handle structure and other elements required for frame level processing.

Below are the details of codecs usage of memory via CMEM. Height' and 'Width' used in equations are the parameter specified at the creation time. The memory requirement calculation is theoretical worst case for a particular resolution.

Table 9. DM365 MPEG2 Encoder usage of Memory via CMEM

BUFFER	YUV420P
Input Buffer	3,133,440 (for 1920x1088) (InputWidth * InputHeight * 1.5)
Output Buffer	1,044,480 (for 1920x1088) for bit stream buffer 70,080 for ME export information
MEMTAB NUMBER	SIZE IN BYTES
Memtab 0	1320
Memtab 1	11264
Memtab 2	20480
Memtab 3	6761472
Memtab 4	1840
Memtab 5	37567
Memtab 6	1108

Table 9. DM365 MPEG2 Encoder usage of Memory via CMEM (continued)

BUFFER	YUV420P
Memtab 7	36
Memtab 8	1600
Memtab 9	396

Memtab 3 is calculated based on the resolution. Here is the formula
 If(interlaced) uHeight = maxHeight + (PAD_VERT << 2)
 else uHeight = maxHeight + (PAD_VERT << 1)
 uWidth = maxWidth + (PAD_HORIZ << 1)
 uSize = (uHeight * uWidth * 3)

Example: For QCIF maxHeight = 144, maxWidth = 176 PAD_VERT - 26 and PAD_HORIZ - 32 uSize = (240*196*3) = 141120

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Notes

- HDVICP
- The entire HDVICP is a video resource and is used by the codec

Table 10. DMA Configuration

TC Q's	TC 0	TC 1	TC 2	TC 3	Total
Usage	Used by Codec	Used by Codec	Used by Codec	Reserved for system	-
Priority	0	1	2	-	-
EDMA channels	19	12	5	NA	36
PaRAM Entries	32	38	5	NA	75
QDMA channels	0	0	0	0	0/8

- The HDVICP/EDMA resources are acquired using a generic resource manager known as Framework component. Please refer user guide for details.
- Code Placement
 - All the algorithm code are placed in external memory. The performance quoted is not sensitive to algorithm code placement.

References

- ISO/IEC 13818-2:2000(E), Information Technology – Coding Of Audio-Visual Objects – Part 2: Visual
- User Guide for MPEG2 Main Profile Encoder on DM365 User's guide (Literature Number: SPRUGS9)

Glossary

Term	Description
Constants	Elements that go into .const memory section
Scratch	Memory space that can be reused across different instances of the algorithm
Shared	Sum of Constants and Scratch
Instance	Persistent-memory that contains persistent information - allocated for each instance of the algorithm

Acronyms

Acronym	Description
AC	Alternate Current
CIF	Common Intermediate Format (352x288 resolution)
CBR	Constant Bit Rate control
DMA	Direct Memory Access
DP	Data Partitioning
D1	720x576 resolution for PAL and 720x480 resolution for NTSC
DSP	Digital Signal Processor
EVM	Evaluation Module
FPS	Frames Per Second
HDVICP	High Definition Video and Imaging co-processor
ITU	International Telecommunication Union
MPEG	Motion Picture Expert Group
MV	Motion Vector
NTSC	National Television Standards Committee (Television standard)
PAL	Phase Alteration by Line (Television standard)

Acronym	Description
PSNR	Peak Signal to Noise Ratio
QP	Quantization Parameter
QCIF	Quarter Common Intermediate Format (176x144 resolution)
SQCIF	Sub Quarter Common Intermediate Format
TCM	Tightly Coupled Memory
VBR	Variable Bit Rate control
VGA	Video Graphics Array (640x480 resolution)
WVGA	Wide VGA resolution (864x480)
XDAIS	eXpressDSP Algorithm Interface Standard
XDM	eXpressDSP Digital Media
YUV	Raw video format Y(luminance) UV (Chrominance)

Revision History

There are no changes in the Datasheet for this release

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