



- eXpressDSP Digital Media (XDM1.0 IVIDENC1) compliant
- Generates bit-streams compliant with the MPEG4 standard
- YUV420 format for input frames is supported
- MPEG4 Simple Profile levels 0, 0b, 1, 2, 3, 4A, and 5 supported
- H.263 baseline profile levels 10, 20, 30, 40 and 45 supported
- Half Pixel Interpolation (HPI) for motion estimation supported
- Unrestricted Motion Vectors (UMV) supported
- Two types of ME search algorithms supported
- Two modes of encoder quality are supported namely standard quality and high quality
- Adaptive Intra Refresh (AIR) up to PAL resolution (720x576)
- Packet mode encoding(Resync Marker) supported
- Addition of video sequence end code in the bit stream supported
- Resolutions up to Full HD (1920 x 1088) are supported
- Setting of Quantization Parameter (QP) for I-frames and P-frames supported
- Rate Control (CBR and VBR) supported
- Supported features in High quality mode
 - 4MV (four motion vectors) mode up to VGA (640x480) resolution
 - Data partition and RVLC upto CIF resolution
 - TI's proprietary motion estimation supported (2 types of search algorithms supported)
 - AC prediction supported
- Supported features in Standard quality mode
 - 1 MV mode
 - TI's proprietary motion estimation supported (2 types of search algorithms supported)
 - AC prediction supported only in I frames



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Description

MPEG4(from ISO/IEC) is a popular video coding algorithm enabling high quality multimedia services on a limited bandwidth network. MPEG4 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 3.3.38.2 and using the code generation tools version 4.1.3.

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.

Summary of performance

This section describes the performance of Standalone MPEG4 Encoder tested on DM365 EVM.

Table 1. Configuration Table

CONFIGURATION	ID
MPEG4 simple profile, UMV – ON, EncQuality_mode=1 (Standard Quality), IntraPeriod-15 MeType=0	MPEG4_ENC_001
MPEG4 simple profile, UMV – ON, EncQuality_mode=1 (Standard Quality), IntraPeriod-15 MeType=1	MPEG4_ENC_002
MPEG4 simple profile, UMV – ON, EncQuality_mode=0 (High Quality), IntraPeriod-15, MeType = 0,	MPEG4_ENC_003
MPEG4 simple profile, UMV – ON, , EncQuality_mode=0 (High Quality), IntraPeriod-15, MeType = 1,	MPEG4_ENC_004

Table 2. Cycles Information for MPEG4_ENC_001

INPUT NAME	PERFORMANCE STATISTICS FOR MPEG4_ENC_001						
	RESOLUTION	AVERAGE			PEAK		
		ARM 926 MHZ	ENCODE FRAME MHZ	FPS (297 MHZ)	ARM 926 MHZ	ENCODE FRAME MHZ	FPS (297 MHZ)

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INPUT NAME	PERFORMANCE STATISTICS FOR MPEG4_ENC_001						
	RESOLUTION	AVERAGE			PEAK		
		ARM 926 MHZ	ENCODE FRAME MHZ	FPS (297 MHZ)	ARM 926 MHZ	ENCODE FRAME MHZ	FPS (297 MHZ)
satonement_p1920x1056_24fps_420pl_60fr.yuv	1920x1056 @24fps, 8mbps	0.272	20.872	14.23	0.359	21.796	13.627
parkrun_p1280x720_30fps_420pl_300fr.yuv	720p@30fps, 4mbps	0.231	9.625	30.857	0.283	10.075	29.478
shields_p720x480_25fps_420pl_252fr.yuv	D1@30fps, 2mbps	0.201	3.896	76.237	0.308	4.098	72.474
foreman_p640x480_30fps_420pl_300fr.yuv	VGA @30fps, 3mbps	0.195	3.461	85.822	0.257	3.601	82.474
akiyo_p352x288_30fps_420pl_300fr.yuv	CIF@30fps, 512kbps	0.178	1.311	226.203	0.22	1.394	213.083

Table 3. Cycles Information for MPEG4_ENC_002

INPUT NAME	PERFORMANCE STATISTICS FOR MPEG4_ENC_002						
	RESOLUTION	AVERAGE			PEAK		
		ARM 926 MHZ	ENCODE FRAME MHZ	FPS (297 MHZ)	ARM 926 MHZ	ENCODE FRAME MHZ	FPS (297 MHZ)
satonement_p1920x1056_24fps_420pl_60fr.yuv	1920x1056 @24fps, 8mbps	0.272	22.19	13.384	0.352	22.857	12.994
parkrun_p1280x720_30fps_420pl_300fr.yuv	720p@30fps, 4mbps	0.232	10.215	29.074	0.273	10.58	28.071
shields_p720x480_25fps_420pl_252fr.yuv	D1@30fps, 2mbps	0.201	4.115	72.181	0.265	4.266	69.623
foreman_p640x480_30fps_420pl_300fr.yuv	VGA @30fps, 3mbps	0.198	3.659	81.169	0.234	3.802	78.119
akiyo_p352x288_30fps_420pl_300fr.yuv	CIF@30fps, 512kbps	0.179	1.342	221.239	0.223	1.444	205.677

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Table 4. Cycles Information for MPEG4_ENC_003

INPUT NAME	PERFORMANCE STATISTICS FOR MPEG4_ENC_003						
	RESOLUTION	AVERAGE			PEAK		
		ARM 926 MHZ	ENCODE FRAME MHZ	FPS (297 MHZ)	ARM 926 MHZ	ENCODE FRAME MHZ	FPS (297 MHZ)
satonement_p1920x1056_24fps_420pl_60fr.yuv	1920x1056 @24fps, 8mbps	0.277	28.467	10.433	0.404	29.718	9.994
parkrun_p1280x720_30fps_420pl_300fr.yuv	720p@30fps, 4mbps	0.237	13.211	22.482	0.302	13.529	21.510
shields_p720x480_25fps_420pl_252fr.yuv	D1@30fps, 2mbps	0.208	5.30	56.022	0.260	5.312	53.680
foreman_p640x480_30fps_420pl_300fr.yuv	VGA @30fps, 3mbps	0.2	4.678	63.484	0.259	4.822	60.835
akiyo_p352x288_30fps_420pl_300fr.yuv	CIF@30fps, 512kbps	0.183	1.715	173.160	0.227	1.832	162.10186

Table 5. Cycles Information for MPEG4_ENC_004

INPUT NAME	PERFORMANCE STATISTICS FOR MPEG4_ENC_004						
	RESOLUTION	AVERAGE			PEAK		
		ARM 926 MHZ	ENCODE FRAME MHZ	FPS (297 MHZ)	ARM 926 MHZ	ENCODE FRAME MHZ	FPS (297 MHZ)
satonement_p1920x1056_24fps_420pl_60fr.yuv	1920x1056 @24fps, 8mbps	0.279	31.084	9.555	0.310	33.200	8.944
parkrun_p1280x720_30fps_420pl_300fr.yuv	720p@30fps, 4mbps	0.237	14.516	20.460	0.289	15.373	19.32
shields_p720x480_25fps_420pl_252fr.yuv	D1@30fps, 2mbps	0.208	5.845	50.810	0.295	6.166	48.167
foreman_p640x480_30fps_420pl_300fr.yuv	VGA @30fps, 3mbps	0.204	5.151	57.660	0.278	5.427	54.729
akiyo_p352x288_30fps_420pl_300fr.yuv	CIF@30fps, 512kbps	0.183	1.773	167.532	0.225	1.937	153.327

Note:



1. These figures depict the load on ARM926 and HDVICP separately. For calculating FPS, both the loads have been added as these operations will happen sequentially. These are actual cycles as seen from host on DM365 EVM and will be close to cycles seen on the final system (for average case).
2. These figures are with Cache enabled on ARM926 side.
3. They are measured in standalone mode without actual framework.
4. All numbers are collected [both average and peak] at frame level processing
5. All numbers are collected [both average and peak] at frame-level processing.
6. The version of the code used to collect these numbers have the following features included:
 - a. Interrupt mode of operation – one interrupt signal processing overhead per frame.
 - b. Resetting of Kaleido and loading of code into HDVICP memory – once per instance creation

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Table 6. Memory Statistics (Host ARM926)

COFIGURATION ID	MEMORY STATISTICS in bytes ^{1,2}					TOTAL
	PROGRAM MEMORY (Bytes)	CONSTANT (Bytes)	HEAP (Bytes)		STACK (Bytes)	
			PERSISTENT	SCRATCH		
MPEG4_ENC_001	2,60,136	1,584	5,79,884	90,060	12,288	9,43,952
MPEG4_ENC_002	2,60,136	1,584	5,79,884	90,060	12288	9,43,952
MPEG4_ENC_003	2,60,136	1,584	5,79,884	90,060	12288	9,43,952
MPEG4_ENC_004	2,60,136	1,584	5,79,884	90,060	12288	9,43,952

¹All these memory requirements are for ARM926 encoder library only for 1920x1088. Program memory size includes DMA library also. They do not include any memory requirements from test application side. Stack, heap and code requirements for test-application are extra. Constant memory size includes code size of HDVICP since it forms constant table on ARM926 to enable code transfer from ARM926 to HDVICP.

²The constant size is the sum of .cinit, .bss, and .const sections used by MPEG4 encoder library.

Table 7. Internal Data Memory Split-up

CONFIGURATION ID	DATA MEMORY – INTERNAL		
	SHARED		INSTANCE
	CONSTANTS	SCRATCH	
MPEG4_ENC_001	NA	NA	NA
MPEG4_ENC_002	NA	NA	NA
MPEG4_ENC_003	NA	NA	NA
MPEG4_ENC_004	NA	NA	NA

Table 8. Co Processor(s) Memory Statistics

CONFIGURATION ID	DATA MEMORY – VICP AND HDVICP			VICP (BYTES)
	HDVICP			
	PROGRAM MEMORY (BYTES)	DATA MEMORY(BYTES)	HDVICP BUFFERS (BYTES)	

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MPEG4_ENC_001	49152	32768	ALL	0
MPEG4_ENC_002	49152	32768	ALL	0
MPEG4_ENC_003	49152	32768	ALL	0
MPEG4_ENC_004	49152	32768	ALL	0

Table 9. DM365 MPEG4 Encoder usage of Memory via CMEM

BUFFER	YUV420P
Input Buffer	3133440 (for 1920x1088) (InputWidth * InputHeight * 1.5)
Output Buffer	3133440 (for 1920x1088) (InputWidth * InputHeight * 1.5)

MEMTAB	SIZE In Bytes
Memtab 0	1400
Memtab 1	10240
Memtab 2	20480
Memtab 3	6761472
Memtab 4	1352
Memtab 5	32768
Memtab 6	4096
Memtab 7	90483

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MEMTAB	SIZE In Bytes
Memtab 8	1136
Memtab 9	36
Memtab 10	36
Memtab 11	1600
Memtab 12	36
Memtab 13	1620

Memtab 3 is calculated based on the resolution. Here is the formula

$$uHeight = maxHeight + (PAD_VERT \ll 1)$$

$$uWidth = maxWidth + (PAD_HORIZ \ll 1)$$

$$uSize = (uHeight * uWidth * 3)$$

Example:

For QCIF maxHeight = 144, maxWidth = 176 PAD_VERT - 24 and PAD_HORIZ - 32
 uSize = (240*192*3) = 138240

Notes

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

- DMA configuration

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/MJCP/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.

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References

- ISO/IEC 14496-2:2004, Information technology - Coding of audio-visual objects -- Part 2: Visual (Approved in 2004-05-24)
- H.263 ITU-T Standard - Video Coding for low bit rate communication
- User Guide for MPEG4 HDVICP Simple Profile Encoder on DM365 (literature number: SPRUGR43)

Glossary

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

AC	Alternate Current
AIR	Adaptive Intra Refresh
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
H263	ITU-T video compression standard
HPI	Half Pixel Interpolation
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)
PSNR	Peak Signal to Noise Ratio
QP	Quantization Parameter
QCIF	Quarter Common Intermediate Format (176x144 resolution)



QVGA	Quarter Video Graphics Array (320x240 resolution)
RVLC	Reversible Variable Length Coding
SQCIF	Sub Quarter Common Intermediate Format
UMV	Unrestricted Motion Vectors
VBR	Variable Bit Rate control
VGA	Video Graphics Array (640x480 resolution)
vIMCOP	Video and Imaging co-processor
WVGA	Wide VGA resolution (864x480)
XDAIS	eXpressDSP Algorithm Interface Standard
XDM	eXpressDSP Digital Media
YUV	Raw video format Y(luminance) UV (Chrominance)

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