

## MPEG4 Simple Profile Encoder (v2.00) on DM6446

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### FEATURES

- eXpressDSP™ Digital Media (XDM 1.0 IVIDENC1) Interface compliant
- Validated on the DM6446 EVM
- MPEG4 simple profile levels 0, 1, 2, 3, 4A, and 5 compliant
- H.263 baseline profile levels 10, 20, 30, and 45 supported
- TI's proprietary rate control algorithms supported
- Generates bit streams compliant with the video buffering verifier as per MPEG4 standard
- Data Partitioning (DP) and Reversible Variable Length Code (RVLC) supported
- AC prediction supported
- Adaptive and mandatory intra refresh supported
- Image width and height which are non-multiple of 16 supported
- Unrestricted Motion Vectors (UMV) for both MPEG4 and H.263 supported
- Addition of video sequence end code in the bit stream supported
- TI's proprietary content adaptive motion estimation supported
- Resolutions up to PAL D1 (720 x 576)

supported

- Half Pel Interpolation (HPI) for motion estimation supported
- Setting of Quantization Parameter (QP) for I-frames and P-frames supported
- I-frame insertion and changing size of video packets at run time supported
- 422i or 420 input formats for the frames supported
- Motion vector access supported
- Provides high quality options using encoding preset
- Capture width supported
- Motion estimation is performed using the IMCOP hardware accelerator provided on the VICP

### DESCRIPTION

MPEG4 is the ISO/IEC recommended standard for video compression. It is validated on the DM6446 EVM with Code Composer Studio version 3.2.37.12 and code generation tools version 6.0.8.

**PRODUCT PREVIEW**



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## Performance Summary

This section describes performance of the MPEG4 Simple Profile Encoder on DM6446 EVM.

**Table 1. Configuration Table**

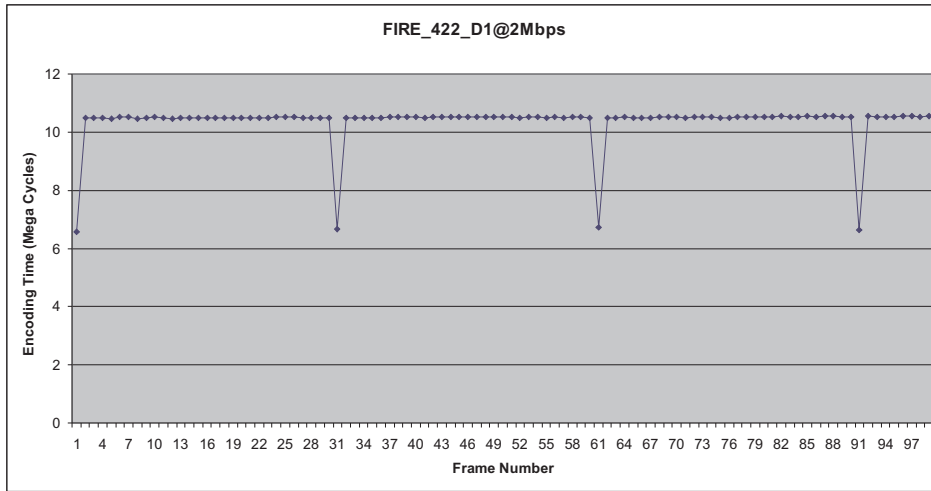
CONFIGURATION	ID
MPEG4 simple profile levels 0, 1, 2, 3, 4A, and 5; H263 baseline profiles 10, 20, 30, and 45	MPEG4_ENC_001

**Table 2. Cycles Information - Profiled on DM6446 EVM with Code Generation Tools Version 6.0.8**

CONFIGURATION ID	PERFORMANCE STATISTICS (MEGA CYCLES PER SECOND) <sup>(1)</sup>		
	TEST DESCRIPTION	AVERAGE <sup>(2)</sup>	PEAK <sup>(3)</sup>
MPEG4_ENC_001 (IMX ME and PLR4 rate control )	e-traffic.yuv, YUV420/PAL D1 @ 4 Mbps with 1MV, HPI on, UMV on	290.2	295.3
	Fire_420.yuv, YUV420/NTSC D1 @ 2 Mbps with 1MV, HPI on, UMV on	292.6	297.5
	Fire_422.yuv, YUV422/NTSC D1 @ 2 Mbps with 1MV, HPI on, UMV on	310.7	315.7
	Fire_420.yuv, YUV420/NTSC D1 @ 4 Mbps with 1MV, HPI on, UMV on	294.9	301.4
	Foreman.yuv, YUV420/VGA @ 4 Mbps with 1MV, HPI on, UMV on	260.3	265.9
	Mobile.yuv, YUV420/CIF @ 512 Kbps with 1MV, HPI on, UMV on	92.1	93.3
	Foreman.yuv, YUV420/QCIF @ 256 Kbps with 1MV, HPI on, UMV on	28.3	28.8

- (1) There could be a variation of approximately +/-5% in values.
- (2) Based on average number of cycles per frame @ 30 frames per second (fps) except for PAL D1. For PAL D1, the frame rate is 25 fps. The intra frame period used is 1 second for all the sequences.
- (3) Based on worst case cycles per frame @ 30 fps. For PAL D1, the frame rate is 25 fps.

### Encoding Time for Individual Frames (Fire\_422.yuv, YUV422/720x480 @ 2 mbps @ 30 fps with 1 MV, UMV, and High Quality Preset)



PRODUCT PREVIEW

**Table 3. Memory Statistics - Generated with Code Generation Tools Version 6.0.8**

CONFIGURATION ID		MEMORY STATISTICS <sup>(1)</sup>						TOTAL
		PROGRAM MEMORY	DATA MEMORY					
			INTERNAL	EXTERNAL			STACK	
PERSISTENT	SCRATCH	CONSTANTS						
MPEG4_ENC_001	PAL-D1	163.4	57	1566.52	1563	19.81	8	3377.73
	NTSC-D1	163.4	57	1349.6	1318	19.81	8	2915.81
	VGA	163.4	57	1024.3	1179	19.81	8	2451.21
	CIF	163.4	57	483	431	19.81	8	1162.21
	QCIF	163.4	57	189.5	141	19.81	8	578.71

(1) All memory requirements are expressed in kilobytes (1K-byte = 1024 bytes) and there could be a variation of approximately 1-2% in values.

**Table 4. Internal Data Memory Split-Up**

CONFIGURATION ID	DATA MEMORY - INTERNAL <sup>(1)</sup>		
	SHARED		INSTANCE <sup>(2)</sup>
	CONSTANTS	SCRATCH	
MPEG4_ENC_001	0	57	0

(1) Internal memory refers to L1DRAM. All memory requirements are expressed in kilobytes and there could be a variation of approximately 1-2% in values.

(2) I/O buffers not included. Some of the instance memory buffers could be scratch.

**Table 5. Co - Processor(s) Memory Statistics**

CONFIGURATION ID	SEQ DATA MEMORY <sup>(1)</sup>	SEQ PROG MEMORY <sup>(1)</sup>	IMX WORKING MEM <sup>(1)</sup>	IMX IMG BUF <sup>(1)</sup>	IMX CMD MEM <sup>(1)</sup>
MPEG4_ENC_001	1	3.4	32	8	1

(1) All memory requirements are expressed in kilobytes and all are scratch buffers.

**Table 6. PSNR and Bit-Rate**

TEST SEQUENCE	BIT RATE RANGE	BIT RATE/AVERAGE LUMA PSNR								
		LOW RATE			MID RATE			HIGH RATE		
		P <sup>(1)</sup>	FD <sup>(2)</sup>	BD <sup>(3)</sup>	P <sup>(1)</sup>	FD <sup>(2)</sup>	BD <sup>(3)</sup>	P <sup>(1)</sup>	FD <sup>(2)</sup>	BD <sup>(3)</sup>
Mobile CIF (352x288), 30 fps, 300 frames		384 kbps			768 kbps			1280 kbps		
	Case 1 <sup>(4)</sup>	23.35	0	0.83	25.83	0	0.66	28	0	0.66
	Case 2 <sup>(5)</sup>	23.34	0	0.66	25.83	0	0.66	28	0	0.66
Tennis D1 (704x480), 30 fps, 150 frames		2000 kbps			3000 kbps			4000 kbps		
	Case 1 <sup>(4)</sup>	30.84	0	0.66	32.28	0	0.69	33.33	0	0.95
	Case 2 <sup>(5)</sup>	30.89	0	0.67	32.27	0	0.65	33.33	0	1.04

(1) PSNR in decibels. In case of frame drop, PSNR is measured by repeating previous frame.

(2) Number of frame drops

(3) Percentage deviation in bit-rate

(4) Rate control used is IVIDEO\_LOW\_DELAY, High Quality Preset, intra frame period = 1 second

(5) Rate control used is IVIDEO\_STORAGE, High Quality Preset, intra frame period = 1 second

**Table 7. PSNR Comparison with Reference Encoder <sup>(1)</sup>**

TEST SEQUENCE	BIT RATE/AVERAGE LUMA PSNR			
	BIT RATE RANGE	LOW RATE	MID RATE	HIGH RATE
Mobile CIF (352x288), 30 fps, 300 frames		PD <sup>(2)</sup>	PD <sup>(2)</sup>	PD <sup>(2)</sup>
		<b>384 kbps</b>	<b>768 kbps</b>	<b>1280 kbps</b>
	Case 1 <sup>(3)</sup>	0.05	0.10	0.03
	Case 2 <sup>(4)</sup>	0.06	0.10	0.03
Tennis D1 (704x480), 30 fps, 150 frames		<b>2000 kbps</b>	<b>3000 kbps</b>	<b>4000 kbps</b>
	Case 1 <sup>(3)</sup>	0.22	0.31	0.46
	Case 2 <sup>(4)</sup>	0.17	0.32	0.46

(1) Reference encoder is xVID version 1.1.0 configured for single pass, quality level = 2, intra frame period = 1 second

(2) PSNR differences of TI encoder and xVID encoder in decibels

(3) Rate control used is IVIDEO\_LOW\_DELAY, High Quality Preset

(4) Rate control used is IVIDEO\_STORAGE, High Quality Preset

## Notes

- Evaluation version performance may be off by up to 30 MHz
- I/O buffers:
  - Input buffer size = 810K-bytes (PAL D1 (720 x 576), one YUV422 interleaved frame)
  - Output buffer size = 256K-bytes (for encoding one PAL D1 (720 x 576) frame)
- Memory Configuration
  - L1P : 32K-bytes program cache
  - L1D : 64K-bytes data memory and 16K-bytes data cache
  - L2 : 64K-bytes cache
- The algorithm uses 6 QDMA channels and parameter space equal to 35 parameter entries. The algorithm uses DMAN3 interface for logical allocation of these channels
- The following QDMA properties are not programmed/configured inside the codec. They need to be programmed by application:
  - Mapping of QDMA channels to queues
  - Mapping of queues to transfer controllers
  - Queue priorities
- Total data memory for N non pre-emptive instances = Constants + Runtime Tables + Scratch + N \* (Instance + I/O buffers + Stack)
- Total data memory for N pre-emptive instances = Constants + Runtime Tables + N \* (Instance + I/O buffers + Stack + Scratch)

## 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
- *MPEG4 Simple Profile Encoder on DM6446 User's Guide* (literature number SPRUEA2C)

## 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

ACRONYMS	DESCRIPTION
CIF	Common Intermediate Format
EVM	Evaluation Module
HPI	Half Pel Interpolation
MV	Motion Vector
QP	Quantization Parameter
QCIF	Quarter Common Intermediate Format
QVGA	Quarter Video Graphics Array
SQCIF	Sub Quarter Common Intermediate Format
TM5	Test Model 5
TMN5	Test Model Near Term, version 5
UMV	Unrestricted Motion Vectors
VGA	Video Graphics Array
VM4	Verification Model 4
XDM	eXpressDSP Digital Media

## Revision History

This data sheet revision history highlights the changes made to the SPRS316B codec specific data sheet to make it SPRS316C.

**Table 8. Revision History of MPEG4 Simple Profile Encoder on DM6446**

SECTION	ADDITIONS/MODIFICATIONS/DELETIONS
Global	<ul style="list-style-type: none"> <li>Modified CCS version to 3.2.37.12</li> </ul>
Section 1	Features: <ul style="list-style-type: none"> <li>Removed XDAIS compliant</li> <li>Updated XDM version to XDM 1.0</li> </ul>
Table 2	Cycles Information: <ul style="list-style-type: none"> <li>Updated values for average and peak</li> <li>Added foot note 'There could be a variation of approximately +/-5% in values'.</li> </ul>
Table 3	Memory Statistics: <ul style="list-style-type: none"> <li>Updated values for Program, Internal, External and Stack Memory</li> </ul>
SubSec1 2.2	Notes: <ul style="list-style-type: none"> <li>Added 'The algorithm uses 6 QDMA channels and parameter space equal to 35 parameter entries.'</li> <li>Added 'The algorithm uses DMAN3 interface for logical allocation of these channels'</li> <li>Added: The following QDMA properties are not programmed/configured inside the codec. They need to be programmed by application:               <ul style="list-style-type: none"> <li>Mapping of QDMA channels to queues</li> <li>Mapping of queues to transfer controllers</li> <li>Queue priorities</li> </ul> </li> </ul>

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Military	<a href="http://www.ti.com/military">www.ti.com/military</a>
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Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
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