

H.264 Baseline Profile and Main Profile Decoder (v02.04.01) on C66x

FEATURES

- eXpressDSP™ Digital Media (XDM 1.0 IVIDDEC2) interface compliant
- Validated on the TMS320C6678 EVM
- Up to level 3.0 features of the Baseline Profile (BP) and Main Profile (MP) supported
- Progressive, interlaced, Picture Adaptive Frame Field (PicAFF) and Macroblock Adaptive frame Field (MBAFF) type picture decoding supported
- Multiple slices and multiple reference frames supported
- CAVLC and CABAC decoding supported
- Intra-prediction and inter-prediction modes supported
- Up to 16 MV per MB supported
- Frame size being non-multiples of 16 through frame cropping supported
- Frame width of the range 32 to 720 pixels supported
- Byte-stream syntax and NAL unit format for the input bit stream supported
- Long term reference frames supported
- Gaps in the frame_num supported
- Decoding of streams with IPCM coded macroblocks supported
- Skipping of non-reference pictures supported
- Configurable delay for display of frames supported
- Error resiliency supported
- Error concealment features for Baseline Profile (BP) and Main Profile (MP) supported
- Outputs are available in YUV 420 planar and 422 interleaved little endian formats
- Tested for compliance with JM version 12.4 reference decoder
- ASO and FMO error concealment feature supported
- Redundant slices supported
- Parsing of Supplemental Enhancement Information (SEI) and Video Usability Information (VUI) supported
- Adaptive reference picture marking supported
- Reference picture list reordering supported
- All resolutions up to D1 (PAL and NTSC) including CIF and QCIF supported
- MODE A (BP_ONLY) and MODE B (BP+MP) decoding mode supported
- Supports ELF ABI format
- Supports "ecpy" for EDMA and "IRES" interface

DESCRIPTION

H.264 (from ITU-T, also called as H.264/AVC) is a popular video coding algorithm enabling high quality multimedia services on a limited bandwidth network. H.264 standard defines several profiles and levels which specify restrictions on the bit stream and hence limits the capabilities needed to decode the bit streams. Each profile specifies a subset of algorithmic features and limits that all decoders conforming to that profile may support. Each level specifies a set of limits on the values that may be taken by the syntax elements in the profile.



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Performance Summary

This section describes performance of the H.264 Baseline Profile and Main Profile Decoder.

Table 1. Configuration Table

CONFIGURATION	ID
Level 1.0 Baseline Profile	H264_DEC_001
Level 2.0 Baseline Profile	H264_DEC_002
Level 3.0 Baseline Profile	H264_DEC_003
Level 3.0 Main Profile	H264_DEC_004

Table 2. Cycles Information – Profiled on TMS320C6678 EVM With Code Generation Tools Version 7.4.0

CONFIGURATION ID	PERFORMANCE STATISTICS ⁽¹⁾ (MEGA CYCLES PER SECOND) ⁽²⁾		
	TEST DESCRIPTION	AVERAGE ⁽³⁾	PEAK ⁽⁴⁾
H264_DEC_001	foreman_i_p1.264, YUV420P, 4 MV, QCIF (176 x 144), @ 300 kbps	25	26
	FM1_BT_B.264, YUV420P, FMO with all types of slice-groups, QCIF (176x144), @ 270 kbps	44	50
	FM1_FT_E.264, YUV420P, QCIF (176x144), @ 187 kbps	35	43
	FM2_SVA_B.264, YUV420P, QCIF (176x144), @ 151 kbps	43	44
	FM2_SVA_C.264, YUV420P, QCIF (176x144), @ 143 kbps	43	45
H264_DEC_002	BA1_FT_C.264, YUV420P, CIF (352 x 288), @ 500 kbps	82	89
	C11_FT_B.264, YUV420P, CIF (352 x 288), @ 340 kbps	78	95
H264_DEC_003	foreman_vga.264, VGA (640x480), @ 3 mbps	263	267
H264_DEC_004 (Progressive Mode)	D1p720x480_parkrun_420p_IBBP_CABAC_16mv_Progr_2Mbps.264	377	439
	D1p720x480_parkrun_420p_IBBP_CABAC_4mv_Progr_2Mbps.264	368	421
	D1p720x480_parkrun_420p_IBBP_CAVLC_4mv_Progr_2Mbps.264	289	322
	D1p720x480_parkrun_420p_IPP_CABAC_4mv_Progr_2Mbps.264	336	405
	D1p720x480_parkrun_420p_IPP_CAVLC_4mv_Progr_2Mbps.264	250	283
H264_DEC_004 (Interlaced Mode)	football_p704x480_IBBP_CABAC_16mv_Intlcd_2Mbps.264	227	335
	football_p704x480_IBBP_CABAC_4mv_Intlcd_2Mbps.264	220	311
	football_p704x480_IBBP_CAVLC_4mv_Intlcd_2Mbps.264	169	208
	football_p704x480_IPP_CABAC_16mv_Intlcd_2Mbps.264	193	287
	football_p704x480_IPP_CABAC_4mv_Intlcd_2Mbps.264	190	287
	football_p704x480_IPP_CAVLC_4mv_Intlcd_2Mbps.264	144	183
H264_DEC_004 (Mbaff)	football_p704x480_IBBP_CABAC_16mv_mbaff_2Mbps.264	506	575
	football_p704x480_IBBP_CABAC_4mv_mbaff_2Mbps.264	493	546
	football_p704x480_IBBP_CAVLC_4mv_mbaff_2Mbps.264	401	443
	football_p704x480_IPP_CABAC_16mv_mbaff_2Mbps.264	461	485
	football_p704x480_IPP_CABAC_4mv_mbaff_2Mbps.264	450	470
	football_p704x480_IPP_CAVLC_4mv_mbaff_2Mbps.264	350	364

(1) Average and peak MCPS measurements can vary by ±5%

(2) Measured with program memory and I/O buffers in external memory, stack in internal memory, 32K-bytes L1P Cache, 32K-bytes L1D Cache and 128 K-bytes L2 Cache, DDR speed at 666.7 Mhz, CPU speed at 1Ghz.

(3) Based on average number of cycles per frame @ 30 frames per second

(4) Based on worst case cycles per frame @ 30 frames per second (fps)

Table 2. Cycles Information – Profiled on TMS320C6678 EVM With Code Generation Tools Version 7.4.0 (continued)

CONFIGURATION ID	PERFORMANCE STATISTICS ⁽¹⁾ (MEGA CYCLES PER SECOND) ⁽²⁾		
	TEST DESCRIPTION	AVERAGE ⁽³⁾	PEAK ⁽⁴⁾
H264_DEC_004 (Progressive)	D1p720x480_parkrun_420p_IBBP_CABAC_16mv_Progr_3Mbps.264	417	466
	D1p720x480_parkrun_420p_IBBP_CABAC_4mv_Progr_3Mbps.264	403	453
	D1p720x480_parkrun_420p_IBBP_CAVLC_4mv_Progr_3Mbps.264	303	336
	D1p720x480_parkrun_420p_IPP_CABAC_4mv_Progr_3Mbps.264	391	447
	D1p720x480_parkrun_420p_IPP_CAVLC_4mv_Progr_3Mbps.264	273	303
H264_DEC_004 (Interlaced)	football_p704x480_IBBP_CABAC_16mv_Intlcd_3Mbps.264	248	381
	football_p704x480_IBBP_CABAC_4mv_Intlcd_3Mbps.264	239	361
	football_p704x480_IBBP_CAVLC_4mv_Intlcd_3Mbps.264	176	223
	football_p704x480_IPP_CABAC_16mv_Intlcd_3Mbps.264	218	327
	football_p704x480_IPP_CABAC_4mv_Intlcd_3Mbps.264	214	320
	football_p704x480_IPP_CAVLC_4mv_Intlcd_3Mbps.264	156	196
H264_DEC_004 (Mbaff)	football_p704x480_IBBP_CABAC_16mv_mbaff_3Mbps.264	569	629
	football_p704x480_IBBP_CABAC_4mv_mbaff_3Mbps.264	541	612
	football_p704x480_IBBP_CAVLC_4mv_mbaff_3Mbps.264	423	468
	football_p704x480_IPP_CABAC_16mv_mbaff_3Mbps.264	518	546
	football_p704x480_IPP_CABAC_4mv_mbaff_3Mbps.264	498	527
	football_p704x480_IPP_CAVLC_4mv_mbaff_3Mbps.264	376	390
H264_DEC_004 (Progressive)	D1p720x480_parkrun_420p_IBBP_CABAC_16mv_Progr_4Mbps.264	457	544
	D1p720x480_parkrun_420p_IBBP_CABAC_4mv_Progr_4Mbps.264	438	520
	D1p720x480_parkrun_420p_IBBP_CAVLC_4mv_Progr_4Mbps.264	317	355
	D1p720x480_parkrun_420p_IPP_CABAC_4mv_Progr_4Mbps.264	438	489
	D1p720x480_parkrun_420p_IPP_CAVLC_4mv_Progr_4Mbps.264	293	320
H264_DEC_004 (Interlaced)	football_p704x480_IBBP_CABAC_4mv_Intlcd_4Mbps.264	262	392
	football_p704x480_IBBP_CAVLC_4mv_Intlcd_4Mbps.264	183	243
	football_p704x480_IPP_CABAC_16mv_Intlcd_4Mbps.264	241	372
	football_p704x480_IPP_CABAC_4mv_Intlcd_4Mbps.264	235	357
	football_p704x480_IPP_CAVLC_4mv_Intlcd_4Mbps.264	166	210
H264_DEC_004 (Mbaff)	football_p704x480_IBBP_CABAC_16mv_mbaff_4Mbps.264	619	730
	football_p704x480_IBBP_CABAC_4mv_mbaff_4Mbps.264	586	661
	football_p704x480_IBBP_CAVLC_4mv_mbaff_4Mbps.264	445	508
	football_p704x480_IPP_CABAC_4mv_mbaff_4Mbps.264	541	581
	football_p704x480_IPP_CAVLC_4mv_mbaff_4Mbps.264	398	417

PRODUCT PREVIEW
Table 3. Memory Statistics - Generated With Code Generation Tools Version 7.4.0

CONFIGURATION ID	MEMORY STATISTICS ⁽¹⁾				TOTAL
	PROGRAM MEMORY	DATA MEMORY			
		INTERNAL	EXTERNAL	STACK	
H264_DEC_001	544	62.5	1713.5	24	2344
H264_DEC_002	544	62.5	4852.5	24	5483
H264_DEC_003	544	62.5	14779.5	24	15410
H264_DEC_004	544	62.5	14779.5	24	15410

(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 ⁽¹⁾		
	SHARED		INSTANCE ⁽²⁾
	CONSTANTS	SCRATCH	
H264_DEC_001	0	62.5	0
H264_DEC_002	0	62.5	0
H264_DEC_003	0	62.5	0
H264_DEC_004	0	62.5	0

(1) Internal memory refers to L1D RAM. 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. External Data Memory Split-Up

CONFIGURATION ID	DATA MEMORY-EXTERNAL		
	CONSTANT	FAR	PERSISTENT
H264_DEC_001	8.5	13	1692
H264_DEC_002	8.5	13	4831
H264_DEC_003	8.5	13	14758
H264_DEC_004	8.5	13	14758

Notes

- Evaluation version performance values may be higher than the values specified in the performance table.
- Display buffer for YUV422 interleaved format is 810K-bytes for 625 SD format (720 x 576)
- Input buffer to algorithm is assumed to have at least one encoded frame data. Otherwise, the application must provide CPB buffer size amount of valid data to the algorithm. For a specific level, the CPB size could be referred from the standard.
- Memory Configuration
 - L1P : 32K-bytes program cache
 - L1D : 32 K-bytes data cache
 - L2 : 128K-bytes cache
- The performances obtained in [Table 2](#) are sensitive to algorithm code placement. See the sample linker file provided in the test application setup for algorithm code placement. This is used for profiling in [Table 2](#).
- The algorithm uses 4 EDMA channels. Channels 0, 2, and 3 each require upto a maximum of 6 linked transfers. Channel 1 requires 24 PARAM sets to perform 24 linked transfers
- 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 14496-10:2005 (E) Rec. - Information technology – Coding of audio-visual objects – H.264 (E) ITU-T Recommendation
- *H.264 Baseline Profile and Main Profile Decoder (v02.04.00) on C66x User's Guide* (SPRUH67)

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/Abbreviation	Description
625SD	Level 3.0 maximum resolution format size 720 x 576
ABI	Application binary Interface
CIF	Common intermediate format
CPB	Coded picture buffer
D1	SDTV image resolution (720x480)
DMA	Direct memory access
DMAN3	DMA manager
EDMA	Enhanced direct memory access
ELF	Executable and Linkable Format
EVM	Evaluation module
IRES	Resource Interface
QCIF	Quarter common intermediate format
QDMA	Quick direct memory access
SDTV	Standard definition television
SEI	Supplemental enhancement information
VGA	Video graphics array (640 x 480 resolution)
VUI	Video usability information
XDAIS	eXpressDSP Algorithm Interface Standard