



## Sequential JPEG Decoder (v1.10.000) on DM355

### FEATURES

- eXpressDSP™ Algorithm Interface Standard (XDAIS) compliant
- eXpressDSP™ Multimedia Interface (XDM) compliant
- IDMA3 compliant
- Supports baseline sequential process with the following limitations:
  - Cannot support non-interleaved scans
  - Only supports 1 and 3 components
  - Huffman tables and quantization tables for U and V components must be the same
- Supports a maximum of four (two tables each) for AC and DC DCT coefficients
- Supports YUV 422 interleaved output format only (Planar output is not supported)
- Supports YUV420, YUV422, YUV444, and gray level with 8x8 pixels MCU
- Supports 8-bit quantization tables
- Supports frame level decoding of images
- Images with resolutions up to 700 Mpixels can be decoded. This is the theoretical maximum; however, only images up to 64 Mpixels have been tested).
- Skips JPEG File Interchange Format (JFIF) header
- Supports frame level re-entrancy for multiple instance support
- Supports resizing by various factors from 1/8 to 7/8
- Supports frame pitch greater than picture width, as specified as display width parameter
- Supports Rotation and Decode area individually, but does not support both together
- Supports limited IDMA3 interface with configurable additional PaRamSet requirements
- Supports ring buffer configuration of bitstream buffer for reducing buffer size requirement
- Supports Rotation of 90, 180 and 270 degree
- Supports image width less than 64 pixels for YUV420/422 and 32 pixels for YUV444
- Ring buffer size should be multiple of 4096 bytes
- Validated on DM355 EVM (MV 4.0)
- Unsupported features: The limitations will not be removed in future releases. These limitations are not defects, but intentional or known deficiencies.
  - Extended DCT-based process
  - Lossless process
  - Hierarchical process
  - Progressive scan
  - Planar output
  - YUV411, gray level with 16x16 pixels MCU
  - Source images of 12-bits per sample
  - IDMA3 interface support is limited. Current implementation of the JPEG decoder uses the following TCCs for its DMA resource requirements along with its associated PaRamSets. Channel numbers 33-47 and 52-55 have the following associated PaRamSet Numbers: 33 – 47, 52 - 55 (PaRamSet number = channel number). Only eight additional PaRamSets are passed to the codec through the IDMA3 interface.

### DESCRIPTION

This sequential JPEG decoder accepts YUV4:2:0, YUV4:2:2, YUV4:4:4 planar, YUV4:2:2 interleaved, and Gray (with 8x8 pixels MCU) images. Output format is YUV4:2:2 interleaved. It is validated on the DM355 EVM with MontaVista kernel 2.6.10.

PRODUCT PREVIEW



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## Product Support

When contacting TI for support on this codec, please quote the product name (JPEG Decoder on DM355) and version number. The version number of the codec is included in the Title of the Release Notes that accompanies this codec.

## Validation

The decoder has been validated by running it on the DM355 EVM (MV 4.0) platform and measuring the resource usage during this process.

## Performance Summary

This section describes the performance of the Sequential JPEG Decoder (v1.10.000) on DM355.

**Table 1. Configuration Table**

CONFIGURATION	ID
Sequential JPEG Decoder, I/D Cache Enabled Input Format: YUV420P Output Format: YUV422ILE Rotation 0.	JPEG_DEC_001 (420P: Resolution Grouping)
Sequential JPEG Decoder, I/D Cache Enabled Input Format: YUV422P Output Format: YUV422ILE Rotation 0.	JPEG_DEC_002 (422P: Resolution Grouping)
Sequential JPEG Decoder, I/D Cache Enabled Input Format: YUV422P Output Format: YUV422ILE Rotation Enabled.	JPEG_DEC_003 (Rotation Grouping)

**Table 2. Cycles Information for JPEG\_DEC\_001 – Profiled on DM355 EVM (ARM=216 MHz, DDR=171 MHz, MV4.0 Kernel)**

Input name	Resolution	Compression Ratio	Total Process Time <sup>(1)</sup>	Time Across IMCOP (ms)	ARM Load (ms)	Total Process Load <sup>(2)</sup>	IMCOP Load (Mcycles)	ARM Load (Mcycles)	Process Time <sup>(3)</sup>
Fruitbasket.jpg	CIF (352x288)	3	6.13	2.85	2.92	1.32	0.62	0.63	5.77
		7	5.44	2.15	2.93	1.18	0.46	0.63	5.08
		11	5.21	1.9	2.95	1.13	0.41	0.64	4.85
test_2.jpg	VGA (640x480)	3	11.10	7.87	2.88	2.40	1.70	0.62	10.75
		7	9.74	6.42	2.98	2.10	1.39	0.64	9.40
		14	8.74	5.51	2.87	1.89	1.19	0.62	8.38
Chrsweep.jpg	D1 (720x480)	11	9.54	6.27	2.90	2.06	1.35	0.63	9.17
		18	9.22	5.86	2.99	1.99	1.27	0.65	8.85
		22	8.90	5.70	2.86	1.92	1.23	0.62	8.56
mobcal_tester.jpg	720p (1280x720)	2	30.15	26.86	2.93	6.51	5.80	0.63	29.79
		5	23.70	20.34	3.01	5.12	4.39	0.65	23.35
		10	20.96	17.55	3.05	4.53	3.79	0.66	20.60

(1) Total Process Time (Process + activate + deactivate) (ms/frame).

(2) Total Process Load in Mcycles (Process + activate + deactivate).

(3) Process Time (without activate/deactivate) (ms).

**Table 3. Cycles Information for JPEG\_DEC\_002 – Profiled on DM355 EVM (ARM=216 MHz, DDR=171 MHz, MV4.0 Kernel)**

Input name	Resolution	Compression Ratio	Total Process Time <sup>(1)</sup>	Time Across IMCOP (ms)	ARM Load (ms)	Total Process Load <sup>(2)</sup>	IMCOP Load (Mcycles)	ARM Load (Mcycles)	Process Time <sup>(3)</sup>
Fruitbasket.jpg	CIF (352x288)	2	7.44	4.05	3.03	1.61	0.87	0.65	7.08
		6	6.55	3.19	3.00	1.41	0.69	0.65	6.19
		10	6.25	2.97	2.92	1.35	0.64	0.63	5.89
test_2.jpg	VGA (640x480)	3	14.61	11.22	3.03	3.16	2.42	0.65	14.25
		5	13.06	9.82	2.88	2.82	2.12	0.62	12.70
		10	12.19	8.7	3.13	2.63	1.88	0.68	11.83
shrek.jpg	D1 (720x480)	12	12.99	9.74	2.88	2.81	2.10	0.62	12.62
		14	12.71	9.40	2.94	2.74	2.03	0.63	12.34
		16	12.60	9.27	2.96	2.72	2.00	0.64	12.23
mobcal_tester.jpg	720p <sup>(4)</sup> (1280x720)	3	29.50	26.87	2.34	6.38	5.81	0.50	29.22
		6	25.74	23.13	2.33	5.56	4.99	0.50	25.46
		9	23.93	21.30	2.34	5.17	4.60	0.50	23.63
mire_YUV422_Q90.jpg	SXVGA <sup>(4)</sup> (1280x960)	10	29.80	27.31	2.21	6.44	5.90	0.48	29.52

- (1) Total Process Time (Process + activate + deactivate) (ms/frame).  
 (2) Total Process Load in Mcycles (Process + activate + deactivate).  
 (3) Process Time (without activate/deactivate) (ms).  
 (4) Performance numbers for 720P and SXVGA are interpolated for the DM355UH part; i.e., ARM @270 MHz, DDR @216 MHz.

**Table 4. Cycles Information for JPEG\_DEC\_003 – Profiled on DM355 EVM (ARM=216 MHz, DDR=171 MHz, MV4.0 Kernel)**

Input name	Resolution	Rotation	Total Process Time <sup>(1)</sup>	Time Across IMCOP (ms)	ARM Load (ms)	Total Process Load <sup>(2)</sup>	IMCOP Load (Mcycles)	ARM Load (Mcycles)	Process Time <sup>(3)</sup>
Fruitbasket.jpg	CIF (352x288)	0	6.55	3.19	3.00	1.41	0.69	0.65	6.19
		90	8.59	4.41	3.82	1.86	0.95	0.83	8.23
		180	8.14	4.26	3.52	1.76	0.92	0.76	7.78
		270	8.62	4.44	3.82	1.86	0.96	0.83	8.26
shrek.jpg	D1 (720x480)	0	12.99	9.74	2.88	2.81	2.10	0.62	12.62
		90	18.35	14.37	3.62	3.96	3.10	0.78	17.99
		180	17.60	13.79	3.45	3.80	2.98	0.75	17.24
		270	18.44	14.46	3.63	3.98	3.12	0.78	18.09

- (1) Total Process Time (Process + activate + deactivate) (ms/frame).  
 (2) Total Process Load in Mcycles (Process + activate + deactivate).  
 (3) Process Time (without activate/deactivate) (ms).

**Table 5. DDR Bandwidth Usage for Worst Case**

Resolution	Number of MBs per Frame	DDR Bandwidth for One Frame (in KB)
CIF (352x288)	396	198
VGA (640x480)	1200	600
D1 (720x480)	1350	675
720p (1280x720)	3600	1800
SXVGA (1280x960)	4800	2400

**Table 6. Codec Memory Statistics Generated with Code Generation Tools v 6.0.3**

Resolution	MEMORY STATISTICS <sup>(1)</sup>				TOTAL
	PROGRAM MEMORY	DATA MEMORY			
		INTERNAL	EXTERNAL	STACK	
SXVGA (1280x960)	48.33	0	10.15	2	60.48
720P (1280x720)	48.33	0	10.15	2	60.48
D1 (720x480)	48.33	0	10.15	2	60.48
VGA (640x480)	48.33	0	10.15	2	60.48
CIF (352x288)	48.33	0	10.15	2	60.48

(1) All memory requirements are expressed in kilobytes (1 kilobyte = 1024 bytes) and there could be a variation of around 1-2% in numbers.

**Table 7. Codec Usage of External Memory via CMEM**

Buffer		
Input Buffer <sup>(1)</sup>	(FrameSize)*3 <sup>(2)</sup>	
Output Buffer	(FrameSize)*2	
External Memory	memTab[1]	8200
	memTab[2]	512

(1) Input buffer size is theoretical value based on 1:1 compression ratio. Actual size will be lower than this.

(2) FrameSize = (maxWidth \* maxHeight).

## References

- ISO/IEC 10918-1: *Digital compression and coding of continuous-tone still images (JPEG)*

## 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
Compression ratio	A compression ratio of N:1 indicates that compressed data occupies N times less space than original data

## Acronyms

Acronym	Description
CIF	Common Intermediate Format
DCT	Discrete Cosine Transform
DMA	Direct Memory Access
DMAN3	DMA Resource Manager
EVM	Evaluation Module
IDMA3	DMA Resource specification and negotiation protocol
JPEG	Joint Photographic Experts Group
MCU	Minimum Coded Unit
XDAIS	eXpressDSP Algorithm Interface Standard
XDM	eXpressDSP Digital Media
YUV	Raw Image format Y: Luminance component U,V : Chrominance components
Exif	Exchangeable image file format
JFIF	JPEG File Interchange Format

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