

## Sequential JPEG Decoder (v01.00.00) on DM365

### FEATURES

- eXpressDSP™ Digital Media (XDM 1.0 IIMGDEC1) interface and IRES interface compliant
- Validated on DM365 EVM using Monta Vista® Linux® 5.0
- Baseline sequential process supported 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
- Maximum of four (two tables each) for AC and DC DCT coefficients supported
- YUV 4:2:2 interleaved data as an output supported
- YUV 4:2:0 semi-planar (NV12 format, that is, Y planar, Cb Cr interleaved) data as an output supported
- YUV4:2:0, YUV4:2:2, YUV4:4:4, gray level (with 8x8 pixels MCU) input format supported
- 8-bit quantization tables supported
- Frame level decoding of images supported
- Images with resolutions up to (Horizontal MCU size \* 1024)\*(Vertical MCU size \* 1024) pixels can be decoded. This is the theoretical maximum. However, only images up to 64 Mpixels have been tested. If the codec memory and I/O buffer requirements exceed the DDR memory availability for frame based decoding, use ring buffer and slice mode decoding to decode higher resolution images.
- JPEG File Interchange Format (JFIF) header is skipped
- Frame level re-entrance supported
- Resizing by various factors from 1/8 to 7/8 supported
- Frame pitch greater than picture width, specified as display width parameter supported
- Rotation and decode area supported individually, but does not support both together
- Ring buffer configuration of bit-stream buffer for reducing buffer size requirement supported. Ring buffer size should be multiple of 4096 bytes.
- Rotation of 90, 180, and 270 degree supported
- Multi-instance of JPEG Decoder, and single/multi instance of JPEG Decoder with other DM365 codecs supported
- This decoder does not support the following:
  - Extended DCT-based process
  - Lossless process
  - Hierarchical process
  - Progressive scan
  - Input format of YUV4:1:1, gray level with 16x16 pixels MCU
  - Decoded image width less than 64 pixels for YUV4:2:0/4:2:2 and 32 pixels for YUV4:4:4
  - Decoded height less than 32 pixels
  - Source images of 12-bits per sample

### 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 or YUV4:2:0 semi-planar. This JPEG Decoder is validated on DM365 EVM with Monta Vista Linux 5.0.



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## Performance Summary

This section describes the performance of the JPEG Decoder on DM365 EVM.

**Table 1. Configuration Table**

CONFIGURATION	ID
Sequential JPEG Decoder, I/D Cache Enabled Input Format: YUV_420P Output Format: YUV_422ILE Rotation 0.	JPEG_DEC_01
Sequential JPEG Decoder, I/D Cache Enabled Input Format: YUV_422P Output Format: YUV_422ILE Rotation 0.	JPEG_DEC_02
Sequential JPEG Decoder, I/D Cache Enabled Input Format: YUV_420P Output Format: YUV_420SP Rotation 0.	JPEG_DEC_03
Sequential JPEG Decoder, I/D Cache Enabled Input Format: YUV_422P Output Format: YUV_420SP Rotation 0.	JPEG_DEC_04
Sequential JPEG Decoder, I/D Cache Enabled Input Format: YUV_420P Output Format: YUV_422ILE Rotation Enabled.	JPEG_DEC_05
Sequential JPEG Decoder, I/D Cache Enabled Input Format: YUV_420P Output Format: YUV_420SP Rotation Enabled.	JPEG_DEC_06

### Performance Measurement Procedure

- Measured with program memory and I/O buffers in external memory, I/D cache enabled, ARM @297 MHz, MJCP @243 MHz, DDR @243 MHz, Monta Vista Linux 5.0
- DVTB 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.
- To avoid the impact of file I/O operation in performance measurement, file write operation is disabled and checksum calculation is included after fread() function to ensure that file read is successfully completed before process call.
- After rebooting the board, codec binary must be executed at least once before starting performance measurement.

**Note:** Frame Decode load can be divided in ARM load and MJCP load. ARM is idle during MJCP processing, and can be utilized to execute any other program in different thread during this time.

**Table 2. Cycles Information for JPEG\_DEC\_01**

INPUT NAME	RESOLUTION	COMPRESSION RATIO	ARM926 PER FRAME MHz	DECODE PER FRAME MHz	FPS
Fruitbasket.jpg	CIF (352x288)	3	1.13	2.01	147.54
		7	0.99	1.78	166.72
		11	1.04	1.64	180.57
Test_2.jpg	VGA (640x480)	3	1.00	3.12	95.22
		7	0.98	2.71	109.40
		14	0.99	2.48	119.67

**Table 2. Cycles Information for JPEG\_DEC\_01 (continued)**

INPUT NAME	RESOLUTION	COMPRESSION RATIO	ARM926 PER FRAME MHz	DECODE PER FRAME MHz	FPS
Chrsweep.jpg	D1 (720x480)	11	0.99	2.68	110.74
		18	1.02	2.61	113.64
		22	1.03	2.59	114.84
mobcal_ter.jpg	720p (1280x720)	2	0.99	8.08	36.74
		5	0.99	6.40	46.41
		10	0.99	5.67	52.37

**Table 3. Cycles Information for JPEG\_DEC\_02**

INPUT NAME	RESOLUTION	COMPRESSION RATIO	ARM926 PER FRAME MHz	DECODE PER FRAME MHz	FPS
Fruitbasket.jpg	CIF (352x288)	2	1.65	2.50	118.88
		6	1.03	2.15	138.10
		10	1.00	1.91	155.30
Test_2.jpg	VGA (640x480)	3	0.99	4.00	74.32
		5	1.03	3.67	80.88
		10	1.04	3.39	87.58
Shrek.jpg	D1 (720x480)	12	0.99	3.61	82.35
		14	1.07	3.59	82.83
		16	1.06	3.55	83.69
mobcal_ter.jpg	720p (1280x720)	3	1.00	9.91	29.96
		6	1.01	8.73	34.03
		9	1.01	8.10	36.64

**Table 4. Cycles Information for JPEG\_DEC\_03**

INPUT NAME	RESOLUTION	COMPRESSION RATIO	ARM926 PER FRAME MHz	DECODE PER FRAME MHz	FPS
Fruitbasket.jpg	CIF (352x288)	3	1.12	1.91	155.26
		7	1.13	1.74	170.56
		11	1.10	1.66	179.21
Test_2.jpg	VGA (640x480)	3	1.09	3.19	93.06
		7	1.12	2.85	104.31
		14	1.13	2.64	112.69
Chrsweep.jpg	D1 (720x480)	11	1.10	2.80	106.08
		18	1.10	2.72	109.24
		22	1.14	2.70	110.01
mobcal_ter.jpg	720p (1280x720)	2	1.14	8.17	36.35
		5	1.11	6.49	45.78
		10	1.10	5.77	51.48

**Table 5. Cycles Information for JPEG\_DEC\_04**

INPUT NAME	RESOLUTION	COMPRESSION RATIO	ARM926 PER FRAME MHz	DECODE PER FRAME MHz	FPS
Fruitbasket.jpg	CIF (352x288)	2	1.00	2.12	140.11
		6	1.05	1.94	153.21
		10	1.00	1.82	162.87

**Table 5. Cycles Information for JPEG\_DEC\_04 (continued)**

INPUT NAME	RESOLUTION	COMPRESSION RATIO	ARM926 PER FRAME MHz	DECODE PER FRAME MHz	FPS
Test_2.jpg	VGA (640x480)	3	0.99	4.00	74.28
		5	1.00	3.64	81.70
		10	1.01	3.36	88.40
Shrek.jpg	D1 (720x480)	12	0.99	3.61	82.26
		14	1.03	3.56	83.54
		16	1.00	3.49	85.16
mobcal_ter.jpg	720p (1280x720)	3	1.02	9.93	29.92
		6	1.04	8.74	33.98
		9	1.02	8.12	36.58

**Table 6. Cycles Information for JPEG\_DEC\_05**

INPUT NAME	RESOLUTION	ROTATION	ARM926 PER FRAME MHz	DECODE PER FRAME MHz	FPS
Fruitbasket.jpg	CIF (352x288)	90	1.11	2.11	141.06
		180	1.14	2.03	145.99
		270	1.15	2.00	148.52
Test_2.jpg	VGA (640x480)	90	1.18	3.75	79.20
		180	1.10	3.53	84.15
		270	1.15	3.57	83.13

**Table 7. Cycles Information for JPEG\_DEC\_06**

INPUT NAME	RESOLUTION	ROTATION	ARM926 PER FRAME MHz	DECODE PER FRAME MHz	FPS
Fruitbasket.jpg	CIF (352x288)	90	1.23	2.67	111.33
		180	1.26	2.63	113.05
		270	1.23	2.58	115.23
Test_2.jpg	VGA (640x480)	90	1.25	5.24	56.71
		180	1.22	5.12	57.96
		270	1.25	5.17	57.48

**Note:**

- The values in Table 2, 3, 4, 5, 6, and 7 are as measured on the ARM 926 side. These are the actual cycles as seen from the host on the DM365 EVM board and will be close to cycles seen on the final system (for average case).
- ARM926 represents mega cycles per frame spend on ARM926.
- Decode frame time is the time seen from ARM926 only. Since most of the processing happens at MJCP, the active load on ARM926 is the value mentioned in ARM926 column. Decode frame time has no connection with MJCP running at 243 MHz.
- All values are collected (both average and peak) at frame-level processing.
- They are measured with Linux without any system traffic.

**Table 8. Memory Statistics**

RESOLUTION	MEMORY STATISTICS (IN BYTES)					TOTAL
	PROGRAM MEMORY	DATA MEMORY				
		CONSTANT	INTERNAL	EXTERNAL	STACK	
SXVGA (1280x960)	70946	18560	0	9608	8192	99114
720P (1280x720)	70946	18560	0	9608	8192	99114

**Table 8. Memory Statistics (continued)**

RESOLUTION	MEMORY STATISTICS (IN BYTES)					TOTAL
	PROGRAM MEMORY	DATA MEMORY			STACK	
		CONSTANT	INTERNAL	EXTERNAL		
D1 (720x480)	70946	18560	0	9608	8192	99114
VGA (640x480)	70946	18560	0	9608	8192	99114
CIF (352x288)	70946	18560	0	9608	8192	99114

**Table 9. Codec Usage of External Memory through CMEM**

BUFFER	SIZE	
Input Buffer <sup>(1)</sup>	frameSize <sup>(2)</sup> *2	
Output Buffer	YUV_422_ILE	Buffer1: frameSize*2
	YUV_420_SP	Buffer1: frameSize Buffer2: frameSize/2
External Memory	MemTab[1]	9096 Bytes
	MemTab[2]	512 Bytes

(1) Input buffer size is theoretical value based on 1:1 compression ratio (for 422 format). Actual size may be different than this.

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

## Notes

- The entire MJCP is a video resource and is used by the codec.
- DMA configuration

**Table 10. DMA Configuration**

TC Qs	TC 0	TC 1	TC 2	TC 3	TOTAL
Usage	Reserved for system	Used by codec	Not used by codec	Not used by codec	-
Priority	0	Not touched by codec (Default – 7)	-	-	-
EDMA Channels	0	22	0	0	22/64
PaRAM Entries	0	33	0	0	33/256
QDMA Channels	0	0	0	0	0/8

- The MJCP/EDMA resources are acquired using a generic resource manager known as Framework component. See *Sequential JPEG Decoder on DM365 User's 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 10918-1 Digital compression and coding of continuous-tone still images (JPEG)
- *Sequential JPEG Decoder on DM365 User's Guide* (literature number: SPRUEV3B)

## 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	Compression ratio of N:1 means 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
Exif	Exchangeable image file format
IDMA3	DMA Resource specification and negotiation protocol
JFIF	JPEG File Interchange Format
JPEG	Joint Photographic Experts Group
MCU	Minimum Coded Unit
MJCP	MPEG4-JPEG co-processor
NV12	YUV 420 format with Y plane and CbCr plane
XDM	eXpressDSP Digital Media
YUV	Raw Image format, Y: Luminance Component U,V : Chrominance components

## Revision History

There are no changes in the data sheet as compared to the previous version.

**PRODUCT PREVIEW**

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Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
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