

## Product Bulletin

# MPEG-2 Encoder and Decoder Software for TMS320C64x™ DSP-Based Processors

### Key Benefits

- Provides optimal performance on C64x™ DSP-based processors, enabling rapid time-to-market
- Saves cost by reducing time spent on creating, optimizing and testing software
- Offers custom solutions for specific applications supported and provided by TI Third Party Authorized Software Providers

### Overview

Texas Instruments' MPEG-2 Encoder and Decoder software for C64x DSPs and TMS320DM64x™ digital media processors compresses images using the well-known techniques of prediction, two-dimensional discrete cosine transform (DCT) performance on 8x8 blocks of pixels, quantization of DCT coefficients, as well as Huffman and run/level coding. The MPEG-2 standard builds on MPEG-1 to handle the highest quality video applications common in digital video transmission at all parts of the distribution chain. TI's MPEG-2 Encoder and Decoder software brings broadcast distribution equipment, point-to-point streaming devices, digital cable head-ends, video DVDs and satellite television to life.

### The MPEG-2 Standard

MPEG-2 is an ISO-defined standard for encoding and decoding digital video data. The standard allows for the encoding of video over a wide range of resolutions, including higher resolutions commonly known as HDTV.

### Key Features

#### Encoder

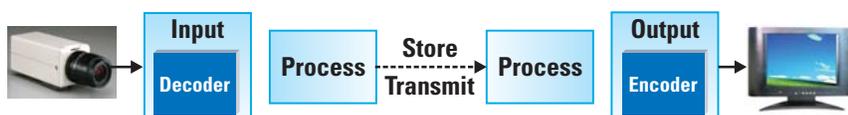
- Full D1 (720x480) real-time encoding for frame pictures with frame and field predictions.
- Variable group of picture (GOP) structure such as I, I/P, IBPBP and IBBPBBP and configurable intra-refresh periods with bidirectional predictions for B-frames
- Adaptive field and frame motion estimation with minimum effective search ranges of  $\pm 63$  pixels, which can increase as high as  $\pm 250$  pixels after taking motion vector predictors into consideration
- Generation of skipped and NO\_MC macroblocks (no motion vector encoding or compensation are required for the macroblock; macroblock is skipped when DCT coefficients are not coded)
- Adaptive frame/field-based DCT-type estimation decision at macroblock level
- Fixed-point implementation of TM-5 rate control algorithm
- 4:2:0 coded video format

#### Decoder

- Video decoding software-based for the programmable DSP; no hardware assistance for decoding, ensuring maximum flexibility
- MPEG-2 main-profile-at-main-level (MP@ML) compliant
- Adherence to TMS320™ DSP Algorithm Standard rules and guidelines ensures decoder algorithm can be easily integrated into different framework systems and environments
- Multi-channel enabled; decoder is re-entrant and can handle several decoding channels simultaneously
- Can be interrupted at any place other than the software pipeline code. Interrupt latency is  $< 10 \mu\text{s}$  at 500 MHz
- Supports 4:2:0 coded video format and maximum input bit rate of 15 Mbps

### Get Started Today

- Free 60-day evaluation period with four hours support provided by TI's Authorized Software Providers. For more information, contact your local TI sales representative
- Purchase a Digital Media Development Kit (DMDK) at the DSP eStore – [www.dspestore.com](http://www.dspestore.com)



Encoder and Decoder process

## Summary of Performance

### Configuration ID Table

#### Encoder

| Description            | Usage Conditions |    |   |    | Configuration ID |
|------------------------|------------------|----|---|----|------------------|
|                        | P                | N  | M | FP |                  |
| IBBP... frame pictures | 0                | 15 | 3 | 0  | Test001          |
| IBBP... frame pictures | 0                | 15 | 3 | 1  | Test002          |
| IBP... frame pictures  | 0                | 14 | 2 | 0  | Test003          |
| IBP... frame pictures  | 0                | 14 | 2 | 1  | Test004          |
| IP... frame pictures   | 0                | 15 | 1 | 0  | Test005          |
| IP... frame pictures   | 0                | 15 | 1 | 1  | Test006          |
| I only frame pictures  | 0                | 1  | 1 | 0  | Test007          |
| I only frame pictures  | 0                | 1  | 1 | 1  | Test008          |
| IBBP... field pictures | 1                | 15 | 3 | 0  | Test009          |
| IBBP... field pictures | 1                | 15 | 3 | 1  | Test010          |
| IBP... field pictures  | 1                | 14 | 2 | 0  | Test011          |
| IBP... field pictures  | 1                | 14 | 2 | 1  | Test012          |
| IP... field pictures   | 1                | 15 | 1 | 0  | Test013          |
| IP... field pictures   | 1                | 15 | 1 | 1  | Test014          |
| I only field pictures  | 1                | 1  | 1 | 0  | Test015          |
| I only field pictures  | 1                | 1  | 1 | 1  | Test016          |

P → Input picture type: 0: Frame/Progressive input; 1: Field/Interlaced input (encoder takes two fields merged into a frame as an input)

N → Number of frames in a group of pictures (GOP).

M → Number of frames between I & P frames including P frame and excluding I frame.

FP → Frame pred frame DCT switches for I, P and B frames. Its interpretation is different for frame picture and field picture.

For frame/progressive input pictures:

0: Frame + Field motion estimation and all predictions are supported. DCT type estimation is performed to make field/frame dct\_type decisions.

1: Only frame motion estimation and prediction is done. DCT type estimation is not done.

For field/interlaced input pictures:

0: Field + 16x8 motion estimation and all predictions are supported.

1: Only field prediction is supported for motion estimation and predictions.

#### Decoder

| Usage Conditions  | Configuration ID |
|---|------------------|
| Public domain MPEG-2 bit-stream: Mobl_080.m2v, 704x576, 25 fps, bit rate = 7.629 Mbps | Test001          |
| MPEG-2 compliance test stream: gi_9.m2v, 720x480, 30 fps, bit rate = 14.305 Mbps      | Test002          |
| MPEG-2 compliance test stream: gi_stream, 720x480, 30 fps, bit rate = 14.98 Mbps      | Test003          |
| CIF case stream: sony-ct, 352x224, 30 fps, bit rate = 2 Mbps                          | Test004          |
| Generated test stream: seamless (I-P-P), 720x480, 30 fps, bit rate = 12 Mbps          | Test005          |

### Encoder Memory Statistics Generated with Code Generation Tools Included in Code Composer Studio™ IDE 2.2

| Configuration     | Memory Statistics <sup>†</sup> |          |             |          |       | Total |
|-------------------|--------------------------------|----------|-------------|----------|-------|-------|
|                   | Program Memory                 |          | Data Memory |          |       |       |
|                   | Internal                       | External | Internal    | External | Stack |       |
| Test001 – Test016 | 70                             | 71       | 93          | 3911     | 1     |       |

<sup>†</sup> All memory requirements are expressed in KB (1 KB = 1024 Bytes; 1 Byte = 8 bits).

### Cycles Performance in Megacycles per Second for TMS320DM642 Digital Media Processors Performed on an ATEME NVDK Board with 600-MHz CPU and 100-MHz EMIF Configuration for Specified MPEG-2 Test Parameters Encoder

| Configuration ID | Performance Statistics (in Megacycles/Sec) |
|------------------|--|
|                  | Average                                    |
| Test001          | 492.00                                     |
| Test002          | 399.00                                     |
| Test003          | 471.00                                     |
| Test004          | 387.00                                     |
| Test005          | 417.00                                     |
| Test006          | 358.50                                     |
| Test007          | 204.60                                     |
| Test008          | 198.00                                     |
| Test009          | 516.00                                     |
| Test010          | 487.80                                     |
| Test011          | 489.00                                     |
| Test012          | 465.00                                     |
| Test013          | 417.00                                     |
| Test014          | 399.00                                     |
| Test015          | 201.00                                     |
| Test016          | 201.00                                     |

#### Decoder

| Configuration ID | Performance Statistics (Megacycles per Second) |
|------------------|--|
|                  | Average  |
| Test001          | 144  |
| Test002          | 158  |
| Test003          | 160  |
| Test004          | 26   |
| Test005          | 108  |

### Decoder Memory Statistics Generated with Code Generation Tools Included in Code Composer Studio IDE 2.2

| Configuration     | Memory Statistics <sup>†</sup> |          |                       |                       |       | Total |
|-------------------|--------------------------------|----------|-----------------------|-----------------------|-------|-------|
|                   | Program Memory                 |          | Data Memory           |                       |       |       |
|                   | Internal                       | External | Internal <sup>‡</sup> | External <sup>§</sup> | Stack |       |
| Test001 – Test005 | 64                             | 28.2     | 65.7 / 55.7           | 2467.6                | 88    |       |

<sup>†</sup> All memory requirements are expressed in KB (1 KB = 1024 Bytes; 1 Byte = 8 bits).

<sup>‡</sup> With on-chip buffer for bitstream / without on-chip buffer for bitstream

<sup>§</sup> The external heap memory requirement mentioned is without taking bitstream buffer into consideration.



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