Advanced Micro Peripherals Ltd.

MPEG4000-XLP

4-Channel MPEG4 Encoder/Decoder for PC/104+

Hardware Reference Manual

Document Version A.01

31 July 2007

Revision History

Document Release	***Date***	***Description***	***Approved***
A.00	07/03/07	Initial release – Based on Rev A.00 PCB	LF
A.01	31/07/07	Corrected audio pinout names	

Contents

Figures

1 Introduction

The MPEG4000XLP is a 4-channel MPEG4 Codec on a single PC/104+ form factor. The MPEG4000XLP provides a low power and high performance solution for capturing and compressing up to 4 concurrent video inputs to MPEG4 standard. The MPEG4000XLP not only provides MPEG4 compression but can also decompress and playback recordings from storage to display. Utilising the 32-bit PCI architecture, the MPEG4000XLP allows high quality real-time video and audio capture and compression from 1,2, or 4 concurrent PAL or NTSC video sources to disk while at the same time providing an additional path for incoming video to be Previewed on the host screen. The high performance MPEG4 video data compression and reduced bus utilisation allows up to four MPEG4000XLP cards to be fitted in a PC/104+ system to provide up to 16 concurrent video streams to disk or across a network.

1.1 Features

- 4 Asynchronous Live Inputs
- Live input from NTSC/PAL
- 1 x D1 size MPEG4 Encode at full frame rate
- 4 x D1 size MPEG4 Encode at 1/4 frame rate
- 4 x CIF size MPEG4 Encode at full frame rate
- MPEG4 Decode/Playback
- Text Overlay - Time and Date Stamp
- Real-time Video Preview to system VGA, PAL/NTSC
- Up to 4 MPEG4000XLP Cards per systemPC/104+ DMA operation for low CPU usage
- High performance 132Mbytes DMA burst transfer on PC/104+
- Software support under Windows-NT/2000/XP, Linux, QNX
- Single +5V operation
- Compact 3.6in x 3.8in PC/104+ stackable card

1.2 Technical Specification

Video Input	1, 2 or 4 Channels Composite Video Monochrome/colour NTSC or PAL 2 software selectable video sources per Channel software selectable Brightness, Contrast and Saturation control 1V peak-to-peak (75 Ohms termination)
Video Compression	MPEG4 Video Compression ISO/IEC 14496-2, MPEG4 ASP @ LEVEL5 NTSC- 352x240 at 120fps, 720x480 at 30fps PAL – 352x288 at 100fps, 720x576 at 25fps Programmable Quantization value Constant Bit Rate (CBR), Variable Bit Rate (VBR) support Supports I, P Frame Compression
Audio Input	4 Channels Mono Input 1V peak-to-peak Sound Input from Line-out or VCR for each Channel
Audio Compression	8bit 8KHz u-Law 64Kbps 8bit 8KHz ADPCM 32Kbps
System File Record	AVI Formats
System File Playback	Windows Media Player (with MPEG4 video compliant decoder such as DivX)

PC/104+	132Mbytes/sec bus bandwidth PC/104+ bus master/initiator Compliant with 3.3V and 5V PC/104+ bus signalling Jumper-selectable PC/104+ stack level
Power	single +5V @ 500mA (max)
Environmental	0 to 60degC 40 to +85degC (option)
Physical Size	standard 3.6in x 3.8in PC/104+ stackable card form

1.3 Functional Summary

1.3.1 Signal Sources

The MPEG4000XLP is designed to capture and record from up to 4 separate and unrelated video sources simultaneously. Each of the 4 video input channels of the MPEG4000 features a video Frame Grabber and an Audio digitiser. Each Frame Grabber contains a digital PAL/NTSC video decoder with a built-in 2-input video multiplexer. Therefore each channel of the MPEG4000XLP is able to route in one-of-two analogue video sources under software control and each video channel has an associated Audio Input.
Up to 8 video sources can therefore be monitored using a single MPEG4000XLP controller A single Audio Input is associated with each live video channel.

1.3.2 Video Digitisation

Composite PAL or NTSC video is input to the MPEG4000XLP through the header VID1. The video is AC-couple and fed to the on-board decoders of the individual Frame Grabbers. The video decoders automatically detect whether the incoming video signal is PAL or NTSC and generates the correct timing output signals. Each Video Channel is first decoded to Chrominance and Luminance signals and then digitised by high speed analogue-to-digital (A2D) converters. The A2Ds output are passed to an internal digital video Quad Frame Store Controller (QFSC) where scaling, filtering, interpolation and channel re-timing operations are performed prior to MPEG4 encoding.

1.3.3 Digital Video Quad Frame Store Controller (QFSC)

The Quad Frame Store Controller contains 4 Mbytes of high speed SDRAM memory used as Frame Stores for each of the 4 digitised video streams. The QFSC co-ordinates writing of asynchronous video streams to the Frame Store and synchronous reading out of all 4 channels to the MPEG4 encoding engine.

1.3.4 Real time Live Video MPEG4 Encoding

Digital video data stream from the 4 Frame Stores are routed to the hardware MPEG4 encoder engine where the video can be compressed in one of several framing modes.

Each of the video channels can be compressed to a separate MPEG4 stream resulting in 4 separate MPEG4 streams which can be written to disk (or LAN) as separate files. These streams can be either CIF resolution at full frame rate or full D1 at quarter frame rate.
Alternatively, each of channels can be regarded as occupying 1 quadrant of the picture frame thus allowing the four channels to be encoded to a single MPEG4 stream or file.

The encoding engine continuously encodes the video streams and uses its PC/104+ bus Master/Initiator interface to transfer data across the PC/104+ to the system memory or disk.

1.3.5 Real time MPEG4 Video Decoding

The MPEG4000XLP can take MPEG4 encoded video data over the PC/104+ bus and decode it to a raw digital video stream. This is fed into a high speed digital-to-analogue converter and then encoded to analogue composite video as either NTSC or PAL. Additionally, the raw digital video stream can be displayed on the system VGA using the real time video preview functionality.

1.3.6 Host Interface

The MPEG4000XLP has a full 32-bit PC/104+ (PCI Rev 2.1) host interface to the host computer. On board jumpers allow the MPEG4000XLP to be configured for any of the 4 logical PC/104+ stack levels of the host computer. The jumpers plus a number of solid-state switches help to route the appropriate PC/104+ control signals to the controller on the MPEG4000XLP. Signals routed include the PCI clocks and ID-selects, Interrupts and DMA handshakes.

1.4 Ordering Information

The following part number(s) can be used when ordering:

MPEG4000XLP	4 Channel MPEG4 Video Encoder
MPEG4000XLP-EXT	Extended temperature (-40 to +80DegC) 4 Channel MPEG4 Video Encoder

1.5 Related Documentation and Software

Other Documentation and software that may be of use whilst reading this document are described in the table below:

- MPEG4000XLP Video Recording SDK Software Reference Manual

2 Installation

Warning: The board(s) supplied contain electrostatic components that are susceptible to permanent damage from electrostatic discharge (static electricity). To prevent electrostatic discharge, the boards are supplied in anti-static packaging. When handling a board, following a few simple precautions can alleviate risk of damage.

- Remove a board from the packaging only when you are working on an anti-static, earthed surface and wearing an anti-static wrist strap.
- Retain the anti-static packaging that a board is supplied in. If you remove the board from a system store it in this packaging.

2.1 System Requirements

PC/104+ Host computer	Pentium-class CPU at 266MHz or faster 128 Mbytes memory or more PC/104+ bus Windows-NT/2000/XP-E or Linux Operating System

2.2 Physical Description

2.2.1 Connector Assignment and Configuration

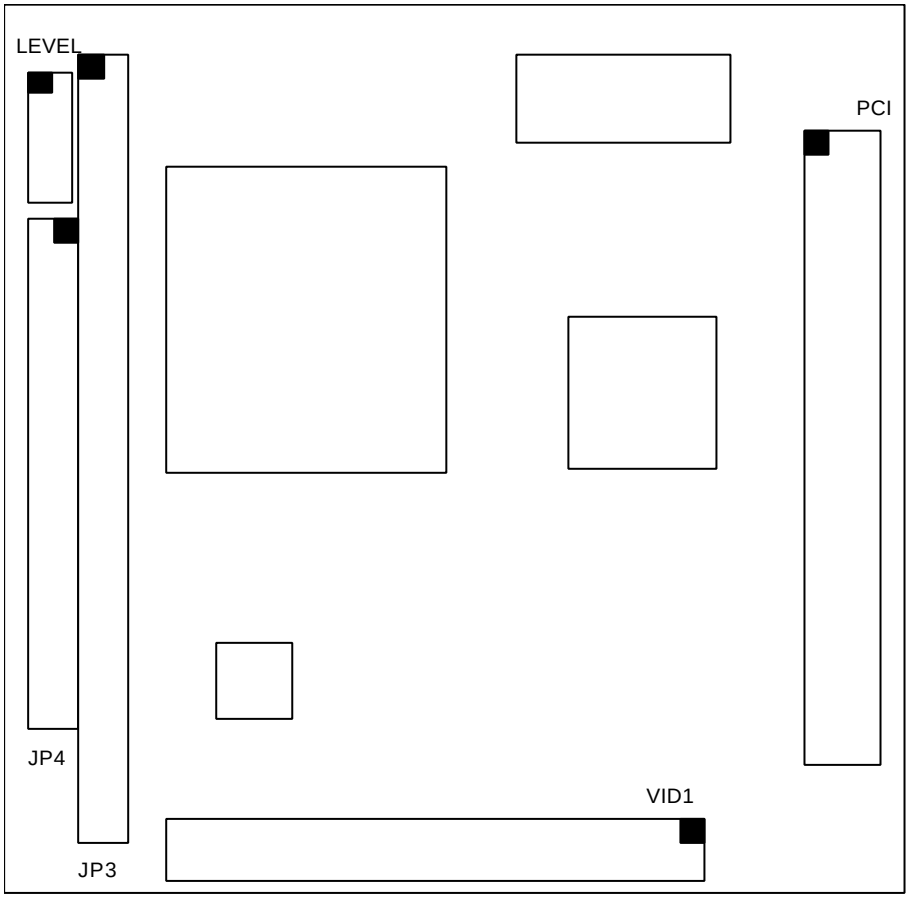


Figure 1 - MPEG4000XLP MPEG4 Encoding Video Frame Grabber

2.2.2 Main Analogue Video and Audio Inputs

2.2.2.1 VID1 Input and output for PAL/NTSC Video and Audio

This connector provides an easy way for attaching Video sources to the MPEG4000XLP.
An optional cable (Cable-MP4-XLP) is available with phono plugs for connecting cameras to the Composite Video Inputs of the header VIDEO_IN.

Pin-out of the VID1 header for the 4 four channels A, B, C, D is shown in following tables.
Note that Even number pins (2, 4, 6, 8, 10, etc) are Ground Returns from Camera and Audio source.

Channel-A

Pin	Signal	Pin	Signal
1	Video-In A1	2	GND
3	Video-In A2	4	GND
5	Video_Out1	6	GND
7	Audio_Out1	8	GND
9	Audio_In A	10	GND

Channel-B

Pin	Signal	Pin	Signal
11	Video-InB1	12	GND
13	Video-In B2	14	GND
15	Video_Out2	16	GND
17	Audio_Out2	18	GND
19	Audio_In B	20	GND

Channel-C

Pin	Signal	Pin	Signal
21	Video-In C1	22	GND
23	Video-In C2	24	GND
25	Reserved	26	GND
27	Audio_Out3	28	GND
29	Audio_In C	30	GND

Channel-D

Pin	Signal	Pin	Signal
31	Video-In D1	32	GND
33	Video-In D2	34	GND
35	Reserved	36	GND
37	Audio_Out4	38	GND
39	Audio_In D	40	GND

2.2.3 Bus Connectors

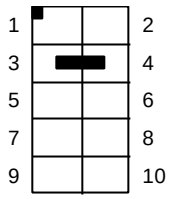
JP3 and **JP4** 16-bit PC/104 Bus
These connectors are currently not used on the MPEG4000 card except for routing signals to other PC/104 cards.

PCI PC/104+ Bus
Standard 32-bit PC/104+ bus PCI Rev 2.1 compliant, 3.3V and +5V tolerant operation.

2.3 Board Configuration

2.3.1.1 Card IDSEL selection

The setting of the first two links on the LEVEL header determines the logical stack position of the MPEG4000 on the PC/104+ stack. The setting on this header effectively routes the appropriate IDSEL, PCICLK, REQ and GNT signals to the MPEG4000 Frame Grabber.



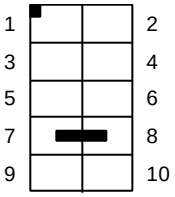
The following configurations are valid.

Pin3-4	Pin1-2	IDSEL	PCICLK	REQ/GNT	Comment
Closed	Closed	IDSEL0	PCICLK0	0/0	
Closed	Open	IDSEL1	PCICLK1	1/1	Default setting
Open	Closed	IDSEL2	PCICLK2	2/2	
Open	Open	IDSEL3	PCICLK3	2/2	

Note that when using multiple MPEG4000 devices in a system, each must have different REQ/GNT pair depending on the level of the device on the PC/104+ stack.

2.3.1.2 Card PCI Interrupt selection

The setting of the 3rd and 4th links on the LEVEL header determines which of the 4 PCI Interrupts would service the MPEG4000 card on the PC/104+ stack.



The following configurations are valid.

Pin7-8	**Pin5-6**	**INTERRUPT**	**Comment**
Closed	Closed	INTA	
Closed	Open	INTB	Default setting
Open	Closed	INTC	
Open	Open	INTD	

3 MPEG4000XLP Recording Options

3.1 Single channel recording

The MPEG4000XLP can perform recording of a single channel.
In this mode, one channel is recorded at full D1 resolution at configurable frame rates.

3.2 Multi-Channel recording Modes

The MPEG4000XLP can operate in three modes when performing multi-channel recording. These are Split Channel Mode, Merged Channel Mode or Multiplex Channel Mode. In all of these modes there is the option to record only video or both video and audio.

The table below shows the picture sizes supported for the Channel Modes under PAL and NTSC.

	Split Channel Mode	**Merged or Multiplexed Channel Modes**
PAL	352 x 288 per Channel	720 x 576 (default) or 720 x 288 (option)
NTSC	352 x 240 per Channel	720 x 480 (default) or 720 x 240 (option)

3.2.1 Split Channel Mode

In the Split Channel Mode, video from the 4 Frame Grabber channels A, B, C D are recorded as 4 separate and individual streams. In this mode, encoding parameters can be set for each channel on a per-channel basis allowing different settings for each of the channels. Each channel may be recorded with Audio in the Split Channel Mode. Each channel is recorded at CIF resolution.

3.2.2 Merged Channel Mode

In the Merged Channel Mode, each of the channels is positioned in a quadrant of a full frame video and MPEG4 encoding proceeds as if there were a single (composite) video frame. Thus the four channels are merged into the single frame (640x 480 for NTSC or 720 x 576 for PAL) and encoded to a single MPEG4 file. Note that only one Audio channel (software selectable) can be recorded in the Merged Channel Mode.

3.2.3 Multiplexed Channel Mode

In the Multiplexed Channel Mode, video from the 4 Frame Grabber channels A, B, C D are recorded as 4 separate and individual streams. In this mode, encoding parameters can be set for each channel on a per-channel basis allowing different settings for each of the channels. Each channel may be recorded with Audio in the Multiplexed Channel Mode. Each channel is recorded at full D1 resolution.

3.3 Frame Rates

The default frame rates are 25fps and 29.97fps for PAL and NTSC respectively. However, for increased flexibility the frame rate can be selected in 0.1 frames per second steps from 0.1 up to full rate.

3.4 Frame Type Encoding

The MPEG4000XLP supports two of frame encoding schemes within the MPEG4 requirements to provide flexibility and optimise encoding efficiency and storage space. The default is I/P encoding where I and P frame as are involved in the encoding. An alternative is I-only encoding. With I/P encoding, the I interval, which is the number of P-frames between I-frames, can be set to any number

between 1 and 32767. However, any error in the data stream between I-frames will propagate as visual distortion. For this reason, we recommend using a value below 256.

3.5 Video Bit Rate Control

The Video Bit Rate can be set separately for each channel Compression (and hence storage efficiency) can be affected by using one of the three bit rate control schemes – Variable Bit Rate (VBR), Constant Bit Rate (CBR) and Hybrid Bit Rate (HBR).

With VBR, the Quantization value (default of 5) can be set between 1 and 31 to optimise efficiency for a particular application (with 1 being highest and 31 being lowest quality). This mode strives to keep the quality constant and will change the bit rate accordingly.
The default bit rate for CBR is 512Kbits/sec. However, the actual bit rate may change by +/-10% around the set figure until the system 'settles down'.
CBR therefore does not guarantee that the bit rate in practice will be exactly as set – the MPEG4000XLP simply does its best to achieve the set CBR figure. The real life bit rate when in CBR mode will depend on the incoming video, motion and other environmental factors.
With HBR, the MPEG4000XLP is given an upper and lower bit rate limit and will attempt to avoid abrupt changes in bit rate by changing the picture quality gradually only when the bit rate limits are exceeded.

It may be worth finding out experimentally the optimum CBR setting for a particular application environment in order to make the best use of CBR configuration.

Hints for Reducing Bit Rates
In general there are 4 ways to reduce the bit rate and hence optimise storage.
Reduce the picture size
Increase the Quantization value
Reduce the Frame Rate
Increase the I picture interval

Note however that the above options might not be available under CBR.
In CBR, Quantization value is controlled by the MPEG4000XLP to meet the set bit rate once the picture size, frame rate and I picture interval are fixed.

4 MPEG4000XLP Card Installation

This section describes MPEG4000XLP hardware and software installation procedures. Software for the MPEG4000XLP is provided on a CDROM.

The optional Video Input cable (Cable-MP4-XLP) should be plugged into VID1 and live video provided to the Video_InA1 input the MPEG4000XLP.

For most recent BIOS and Operating System software, the MPEG4000XLP is automatically detected. Software driver installation should be done from the supplied CDROM.
Further instructions (and demo programmes) pertinent to particular Operating Systems are provided on the driver CDROM.

5 Technical Support

The AMP office can be reached in a number of ways. The preferred medium for support issues is via electronic mail using the address given at the end of this section.

Our address is:

Advanced Micro Peripherals Ltd.
Unit 1, Harrier House,
Sedgeway Business Park
Witchford,
Ely,
Cambridgeshire,
CB6 2HY

Fax: +44 (0)1353 659600

The Advanced Micro Peripherals web site can be found at http://www.ampltd.com

E-mail enquiries of a support manner can be sent to support@ampltd.com