

ENCIRIS
TECHNOLOGIES

Model: LT-101-PCI-VC1

LT-101 for PCI/USB

Data Sheet

OCT 2009

Introduction	3
Input Video and Audio Connections	4
Host bus connectivity.....	6
Functional description	7
Video Front-end	7
Color Adjustment (CBHS)	8
Frame Rate Decimator Unit	8
Scaling Unit	8
De-Interlacing Unit.....	8
Noise reduction filter	8
Raw/Uncompressed Video Capture Unit.....	9
Text Overlay (OSD).....	9
Video Compression Engine	9
Audio Front-end.....	10
Audio Synchronization Unit	11
WMA8 Audio Compression (software).....	11
ASF/WMV Audio/Video Multiplexer (software).....	11
Drivers	12
Further information	13

Copyright © 2009 Enciris Technologies, SAS.

Other companies' product names that may be used in this document are for identification purposes only and may be trademarks of their respective companies.

INTRODUCTION

The LT-101-PCI-VC1 is an HD video capture board that compresses HDTV video in real-time without using the host computer's CPU resources. The board can either be placed in a **PCI slot** or connected **via USB** in OEM applications.

This board captures video from both analog and digital HD and SD video sources via **DVI, RGB, VGA, component, S-video, or composite** connectors. In addition to external video sources, the LT-101-PCI-VC1 can compress from host internal video sources such as files or **DirectShow** devices including USB and FireWire cameras. An **HD/SD-SDI** daughter board option is available.

The LT-101-PCI-VC1 compresses video in compliance with the VC-1 standard also referred to as **WMV-HD**. Originally developed by Microsoft, this format is supported natively by most software decoders.

This high performance board can compress **1080p/i at up to 30 frames per second (fps)**. 2048x2048 can be compressed at 15fps. At lower resolutions the maximum compression frame rate increases. If the frame rate is higher than the board can handle, frame decimation can be enabled allowing high frame rate source to be acquired at then compressed at a lower frame rate.

Compressed bitrates can vary between **64Kbit/s** and **80Mbit/s** depending on resolution, frame rate and quality desired.

An uncompressed/raw video capture function is also available for simultaneous snapshots or continuous uncompressed video acquisition.

The sections below introduce the many elements of the LT-101-PCI-VC1 board and detail their features and operation.

Main Features

- VC-1/SMPTE-421M advanced profile level 3 video compression
- I or IP encoding with variable GOP size
- VBR (variable) bitrate control
- 1024x512 motion vector search range covered
- Bitrates from 64Kbit/s to 80Mbit/s
- 1 frame maximum latency (can be reduced to a few milliseconds under special circumstances)
- ASF container format
- DVI, VGA, RGB, component, S-video, composite video inputs
- Optional HD/SD-SDI module
- PCI or USB host bus interface
- Simultaneous uncompressed video capture
- 2 channel audio capture
- Synchronized audio/video acquisition
- Advanced hardware deinterlacing
- Frame rate reduction feature available
- Video scaling (1, ½, ¼) prior to compression
- Smoothing filter prior to compression
- Text overlay prior to compression
- Bitrate reduction via monochrome mode when color is not needed
- Synchronization to external events
- Extensive Motion statistics for all frames
- Windows 2000/XP/Vista drivers
- DirectShow support as well as simple SDK
- Linux support
- Mac OS X support

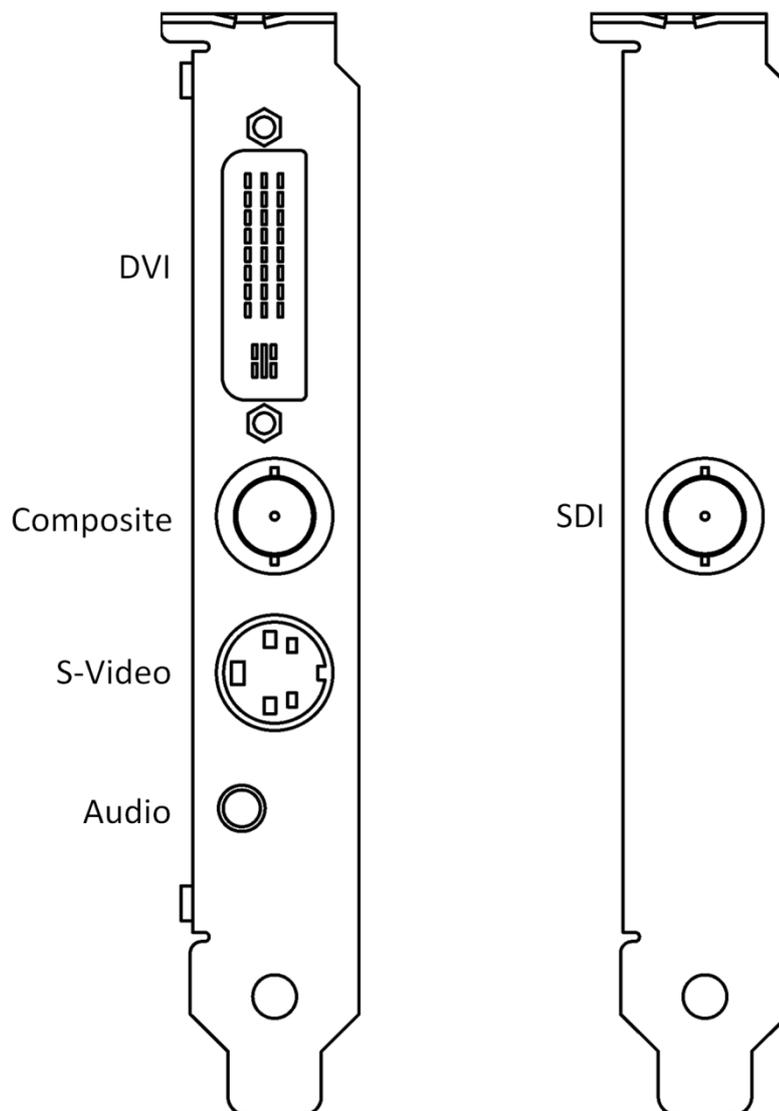
Common Applications

- HDTV capture and storage
- Digital video recorders
- Video Medical systems
- Endoscopy DVR
- Video surveillance systems
- Internet broadcasting
- Teleconferencing
- Video over LAN
- Inspection systems
- Machine vision video recorders

INPUT VIDEO AND AUDIO CONNECTIONS

Many different video and audio sources are supported by the LT-101-PCI-VC1. The physical connectors are shown below.

The bracket on the left shows the standard connector configuration. The DVI connector serves as an integrated analog component (YUV/YPrPb), RGB, RGBHV, VGA, and DVI-A as well as a digital DVI-D and HDMI compatible video input. To accommodate the numerous video sources various low cost, off the shelf, passive cable adapters might be required. However, the video signaling remains compliant with the, afore mentioned, inputs.



The bracket on the right shows the optional HD-SDI/SD-SDI connector.

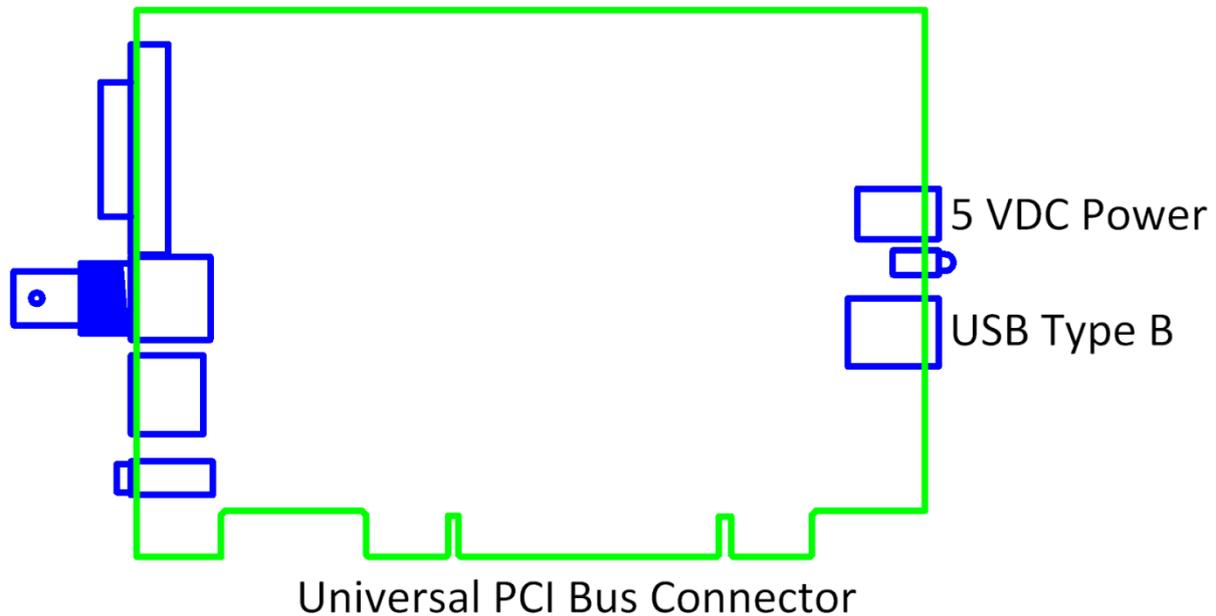
The following table summarizes the many possible input configurations. Additionally, please refer the document "LT-101 Input Formats" for an up to date list of all the video resolution and graphics modes supported.

Audio/Video Input Features	Connector				
	Composite	S-Video	DVI	HD/SD-SDI ¹	Audio Jack
Signal types					
Analog SDTV	•	•	•		
Digital SDTV			•	•	
Analog HDTV			•		
Digital HDTV			•	•	
Graphics Modes			•		
Color Spaces					
YUV 4:2:2			•	•	
YUV 4:4:4			•		
RGB			•		
Physical Connections					
SDI 75 ohm BNC				•	
S-Video 5-pin Mini-DIN		•			
Composite BNC	•				
Composite RCA	• ²				
DVI-I			•		
DVI-D			•		
DVI-A			•		
RGB via BNC (separate syncs)			• ³		
RGB via BNC (sync on green)			• ³		
RGB via RCA			• ⁴		
YUV via BNC			• ⁴		
YUV via RCA			• ³		
VGA DSUB-15			• ⁵		
HDMI			• ^{6,7}		
Audio Signals					
Stereo audio			•	•	•
Line level audio					• ⁸
Microphone					• ⁹
Digital Audio embedded with video			• ¹⁰	• ¹⁰	

1. Requires purchase of SDI option.
2. RCA to BNC adapter required.
3. BNC to VGA cable and VGA to DVI adapter required.
4. YUV/RCA to DVI adapter required.
5. VGA to DVI adapter required.
6. HDMI to DVI adapter required
7. HDCP not supported.
8. 3.5mm stereo jack. Optional RCA jack to 3.5mm plug cable available.
9. 3.5mm stereo jack. Microphone bias available (jumper setting required – see installation manual)
10. Under development. HDMI/SDI audio embedded in video stream. Multichannel audio: only L/R extracted.

HOST BUS CONNECTIVITY

The LT-101-PCI-VC1 board is normally placed in a standard PCI slot and can be used in either 5V or 3.3V signaling environments. Alternatively, the LT-101-PCI-VC1 can be connected to a USB bus using a standard USB cable. In this case an external 5V is required and is purchased separately. The positions of the connectors are shown in the diagram below.



For USB operation the LT-101-PCI-VC1-USB is also available. The LT-101-PCI-VC1-USB contains the same electronics and includes an enclosure and well as a 5V power supply and a USB2.0 cable.

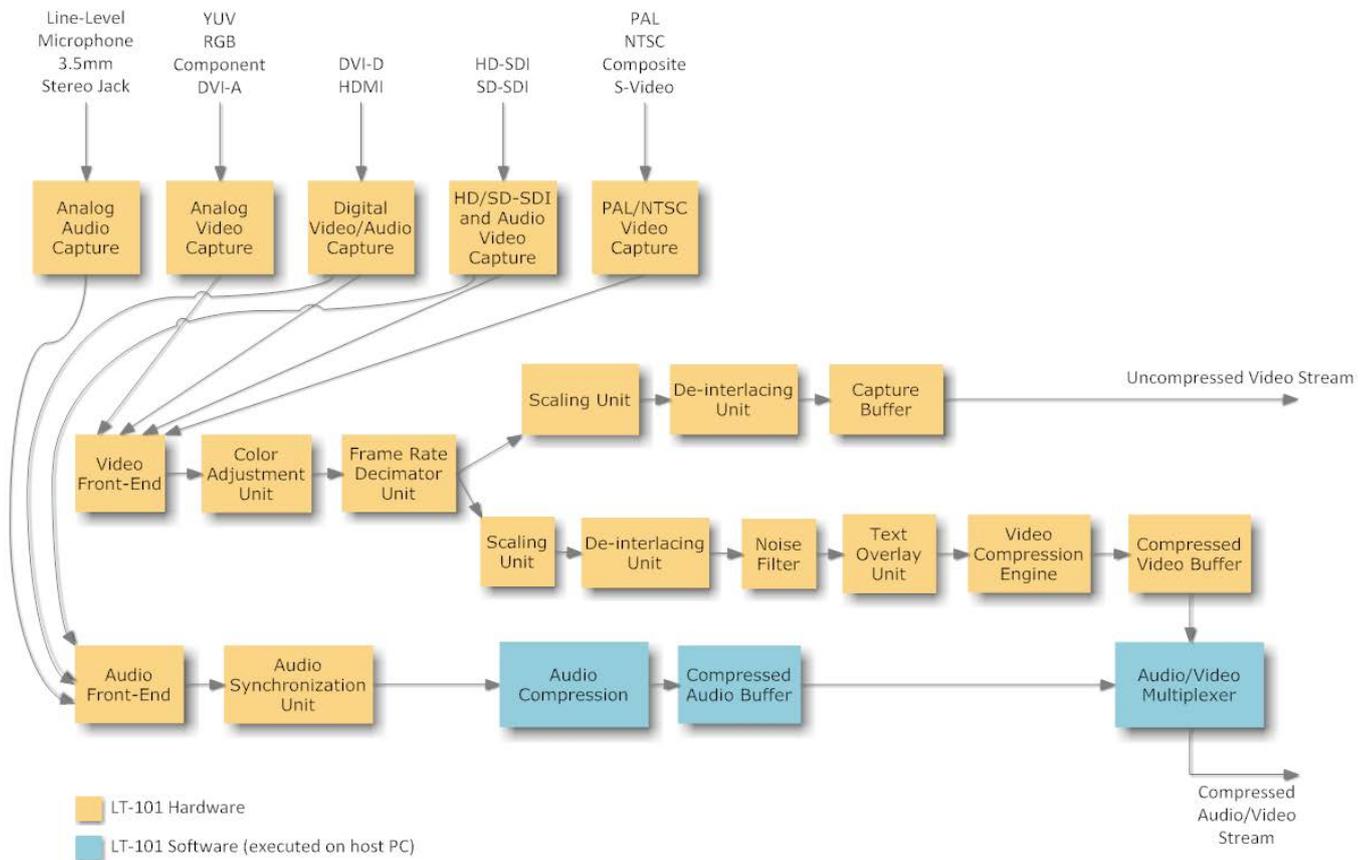
IMPORTANT: Never connect the USB to a host or apply 5 VDC to the power connector while the LT-101-PCI-VC1 is plugged into a PCI slot. This could result in serious damage to both the LT-101-PCI-VC1 and your host computer. Damage is not covered by our warranty.

The LT-101-PCI-VC1 does not rely on the host processor for video compression. The host processor does however use the processor for low CPU usage activities such as audio compression, audio/video multiplexing and data transfer. For an acquisition only system that does to play/decode the compressed or uncompressed audio/video streams, such as a small multimedia server, a 500MHz CPU with 64MB RAM should suffice. If stream decoding is involved, as would be typically required by a DVR or a system with video preview, a 2GHz processor would be recommended.

For further information see the LT-101-PCI-VC1 hardware installation manual.

FUNCTIONAL DESCRIPTION

The LT-101-PCI-VC1 is comprised of several functional elements. Their operation as well as their function is described in this section. The diagram below shows the various elements and their interconnections.



VIDEO FRONT-END

The video front-end can accept captured video at rates of over **150 megapixels** per second. This allows for the acquisition of high resolution and frame rate data such as **WUXGA (1920x1200) at 60 frames per second**.

It must be noted that the compression engine is limited to processing about **63 megapixels per second**. Consequently, either the scaling unit or the frame rate decimator must be activated when the input pixel rate exceeds the 63 megapixels per second limit in order to reduce the pixel rate. If the acquisition rate is too high the driver will report an acquisition overflow error. When using the auto-setup capabilities the LT-101-PCI-VC1 will automatically activate the frame rate decimator if required.

In addition to the external video inputs the LT-101-PCI-VC1 can also take uncompressed video from the host system. In this configuration the LT-101-PCI-VC1 can perform as a compression coprocessor relieving the host CPU resources. Due to the bandwidth

requirements involved in sending uncompressed video to the LT-101-PCI-VC1, it is recommended to use PCI and not the slower USB bus.

COLOR ADJUSTMENT (CBHS)

The LT-101-PCI-VC1 allows for the adjustment of **hue, saturation, brightness** and **contrast** in real-time.

FRAME RATE DECIMATOR UNIT

The LT-101-PCI-VC1 has a flexible frame rate decimator that reduces the frame rate of incoming video to an arbitrary value. This is primarily used to reduce the frame rate for high resolution images to meet the requirements of the compression engine but can also be used to reduce the amount of compressed or uncompressed data. At this time there is only a single frame rate decimator unit for both the compressed and uncompressed video paths.

SCALING UNIT

If scaling is needed, the LT-101-PCI-VC1 incorporates **two scaling units** that allow the user to reduce the image size by one half or one quarter. This is primarily used to reduce either or both compressed or uncompressed video bandwidth. The two scaling units can be controlled individually. The first is for the compressed video path and the second is for the uncompressed video path.

In order to have full frame rate uncompressed video data transferred to the host system it may be necessary to reduce the image size. If the size of a very high resolution image is not reduced, the acquisition frame rate will automatically drop to meet the host bus (your PC) bandwidth limitations. This is particularly noticeable when attempting to transfer uncompressed HD over USB.

DE-INTERLACING UNIT

The LT-101-PCI-VC1 de-interlacing unit uses a high performance **adaptive de-interlacing** algorithm to convert interlaced images to progressive images for compression or uncompressed capture. Saw tooth effects are removed, even for high motion interlaced video, without affecting detail.

NOISE REDUCTION FILTER

A pre-compression filter can be enabled to help remove noise and some high frequency components and thus improve the video compression quality. This filter may reduce some image sharpness and its usage should be determined experimentally.

RAW/UNCOMPRESSED VIDEO CAPTURE UNIT

The LT-101-PCI-VC1 can simultaneously capture compressed and uncompressed video. The uncompressed video capture unit uses double buffering to allow for efficient video acquisition.

If your host bus or processor does not have sufficient performance to transfer video data at the uncompressed rate, the capture unit cleanly drops frames to meet your host system's limitations. This effectively limits your capture frame rate. This is particularly noticeable when attempting to transfer uncompressed HD video over USB or a poorly performing PCI bus.

TEXT OVERLAY (OSD)

Text overlay is available to the compressed video path. The overlay is applied prior to compression and can be used to place a date/time stamp, watermark, or identification label. The user can arbitrarily place four 16 character text windows within the video frame. If long strings are required, the windows can be placed side by side.

VIDEO COMPRESSION ENGINE

The video compression engine is designed for high quality low latency video compression and is capable of processing up to 247,000 (16x16 pixels) macroblocks, or over 63 megapixels, per second.

Low latency is achieved by beginning compression during the acquisition of the frame itself. Compressed video for the current frame becomes available after about eight macroblock rows have been acquired. This equates to a **latency of about 3ms for 1080p** video. Compressed data can be transferred to the host as soon as there are 2048 (default value) bytes in the buffer. In systems that are using frame based processing (e.g. DirectShow) it is usually more efficient to wait until a whole frame is available before transferring it to the host. Frame based systems have inherently a latency of at least one frame.

There are three primary components to the compression engine. The first is the motion estimation block. The second is the VC-1 bitstream generation block. And the third is the bitrate control block. The features of the three blocks are described below.

- **MOTION ESTIMATION**

The motion estimation block uses an advanced algorithm that gives very high quality block matching with a large search range. The search range is 1024 horizontally and 512 vertically.

- **VC-1 BITSTREAM GENERATOR**

The LT-101-PCI-VC1 produces a VC-1/SMPTE-421M advanced profile level 3 compliant bitstream.

The video can be encoded either as I-frame VC-1 only or as IP GOP structures. The number of P-frames per I-frame (GOP length) is programmable. The GOP length can vary from 1 (i.e. I-frame only) to 4095.

The user can reset the GOP counter on the fly when an I-frame is required. This is useful if the GOP structure is long and an entry point into the stream is needed with minimal delay.

Skip frames are supported to reduced bandwidth while the input video stream remain static. If the current image varies imperceptibly from the previous image, it is not compressed and a skip code is sent to effectively inform the decoder that it needs to repeat the previous image.

- **BITRATE CONTROL**

The bitrate control system uses a VBR (variable bitrate) algorithm. Bitrates can vary from **64Kbits/s to 80Mbits/s**. The actual bitrate range will depend on resolution and frame rate. Obtaining very low bitrates on high resolution/frame rate video or very high bitrate on low resolution/frame rate video is generally not possible.

In cases where the compressed video is not evacuated from the LT-101-PCI-VC1 sufficiently rapidly, the bitrate control system will automatically reduce the programmed bitrate to prevent buffer overflow. If this action is not sufficient, the system will begin the insertion of forced skip frames until the situation is rectified. Once the buffer level has returned to a normal level the programmed bitrate is reactivated. This feature is useful when sending data over a poorly performing network where the bandwidth is suddenly reduced.

It must be noted that compression latency increases as the compressed video buffer level grows. Low latency systems the data must be evacuated efficiently.

Complete **motion vectors for each macroblock are available** and can be obtained from the compression engine. These motion vectors (giving magnitude and direction) indicate the motion that has occurred between two consecutive frames with macroblock granularity. As a result of our advanced motion estimation algorithm, the vectors generated by the LT-101 tend to reflect true motion. Consequently, interested users can use our motion vectors as a basis for implementing an **advanced motion detection system**. Less sophisticated, but more commonly used, algorithms produce vectors that do not necessarily represent true motion.

AUDIO FRONT-END

Incoming audio from the analog to digital converter (A/D), HDMI source, or SDI source is normalized to 16-bit stereo (2-channel) audio, and then forwarded to audio synchronization unit by this block.

AUDIO SYNCHRONIZATION UNIT

This unit synchronizes the audio captured by the LT-101-PCI-VC1 to the video. This is done to ensure that the audio does not drift with respect to the video and cause poor lip-sync. Audio leaving this unit can be safely multiplexed with video without the need to resample.

WMA8 AUDIO COMPRESSION (SOFTWARE)

Audio compression is done on the host processor and not in the LT-101-PCI-VC1 hardware. **WMA version 8** is the audio CODEC used. Uncompressed audio can also be accessed. The audio tools are included in the driver package that comes with the LT-101-PCI-VC1.

ASF/WMV AUDIO/VIDEO MULTIPLEXER (SOFTWARE)

The multiplexing of audio and video is done by the host processor and not by the LT-101-PCI-VC1 hardware. The VC-1 elementary stream and compressed audio stream are combined into a single ASF (.wmv) stream by this unit. The ASF can then be saved to a file or sent over a network. ASF is identical to WMV and the file extensions can be used interchangeably.

Drivers

The table below gives our current driver support for the LT-101-PCI-VC1. Contact us if you have a special driver requirement.

Operating System	Supported Driver Features					
	PCI	USB	SDK	Direct Show	Video4Linux	Quick Time
Microsoft						
Windows XP ¹	●	●	●	●		
Windows Vista 32 ¹	●	●	●	●		
Windows Vista 64 ²	●	●	●	●		
Windows 7 ³	●	●	●	●		
Linux						
Linux 2.6.18	●		●		● ⁵	
Linux 2.6.27	●	●	●		● ⁵	
Linux 2.6.x ⁴	●	●	●		● ⁵	
Apple						
OS X Snow Leopard		● ⁶	● ⁶			● ⁷
Other OS X 86 ⁸		●	●			●

¹ Release candidates available

² Beta available

³ Beta available soon (Q4/2009)

⁴ Not tested. Source code provided. Contributions welcome.

⁵ Under development. Contributions welcome.

⁶ Beta available

⁷ Beta available soon (Q4/2009)

⁸ Under development, will depend on need.

Further information

To contact us for further information on this or any other Enciris Product:

Enciris Technologies
42, Avenue de l'Europe
81600 Gaillac
France

Tel: +33 (0)5 81 18 01 12

Email: tech@enciris.com

Web: <http://www.enciris.com>