HD-SDI Express™

User's Manual

Revision History

RA01	Jan-11-2009	J. Egri	Initial Release
RA02	Feb-24-2009	J. Egri	Added RGB Lookup table description and Appendix A
RA03	Mar-12-2009	J. Egri	Added ‘Unity’ button to RGB Control dialog
RA04	Dec-16-2009	J. Egri	Updated Table 1 – YCrCb-20 bit mode pixel packing
RA05	Mar-26-2012	J. Egri	Added audio support
RA06	Jan-22-2013	J. Egri	Added VCE-HDPCIe01 card and features: COM port and SDI Loop-through
RA07	Jul-31-2013	J. Egri	Added SD and HD Color Space Converter dialogs

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Chapter 1

Introduction

This chapter outlines the key features of the Imperx HD-SDI Express series of SDI frame grabbers.

VCE-HDEX02

VCE-HDEX03

VCE-HDPCIe01

HD-SDI Express

The HD-SDI Express frame grabber series includes three models:

VCE-HDEX02 - an ExpressCard/34 card
VCE-HDEX03 - an ExpressCard/54 card
VCE-HDPCIe01 - a low-profile PCI Express x1 card

All cards include an SDI analog interface and a PCI Express x1 lane interface. They provide the ability to capture digital video and audio data, from an SD/HD SDI source, and transfer that data to host memory via a PCI Express x1 interface. All of the cards share the same software (i.e. application program, libraries and driver).

Functionality

- Supports an analog serial interface formatted per SMPTE 292M with:
  - SMPTE 274M framing providing 1080i (60 fields/sec) or 1080p (30 frames/sec).
  - SMPTE 296M framing providing 720p (60 frames/sec).
- Supports the 20 bit de-multiplexed HD format (4:2:2: YCrCb where Y = 10 bits and C = 10 bits)
- Captures video data from an SDI analog interface, formats this data and stores it into local FIFOs.
- Data can be formatted as 20 or 16 bit YCrCb 4:2:2 or as RGB-24 using a color space converter function.
- Supports two 48 KHz 24 bit embedded audio channels.
- Captures audio data from an SDI analog interface, formats this data and stores it into local FIFOs.
- Audio data can be formatted as 24 or 16 bits per sample.
- Retrieves the formatted video and audio data from the FIFOs and transfers it into host memory via a scatter/gather DMA over the x1 lane PCI Express interface.
- Provides the ability to upgrade the FPGA firmware in the field by the user.
- HDPCIe01 only: Provides an SDI Loop-through capability.
  A second BNC connector outputs a regenerated version of the SDI signal received from the first connector.
- HDPCIe01 only: Provides an RS232/RS485 serial communications COM port for the purpose of configuring an attached camera.

Interfaces

SDI interface

The HD-SDI Express provides an HD-SDI compliant receiver interface capable of acquiring SDI video/audio data at rates of 1.485 Gbps. The receiver provides full SMPTE processing for signals compliant with SMPTE 274M and 296M framing. The following formats are supported:

- 1080p 30/25/24 fps
- 1080i 60/50 fps
- 720p 60/50/30/25/24 fps
- SD

SDI Loop-Through interface (HDPCIe01 only)

The HD-SDI Express PCIe card provides an SDI output which is an electrically regenerated and retimed version of the input SDI signal. This is useful when the user requires that the frame grabber be in-line between a video source (i.e. camera) and a video sink (i.e. monitor).

PCI Express interface

The HD-SDI Express PCIe card complies with the x1 low-profile PCI Express add-in card dimensions as defined in the PCI Express Card Electromechanical Specification revision 2.0.

The HD-SDI Express/54 and HD-SDI Express/34 cards comply with the ExpressCard/54 and ExpressCard/34 package dimensions, respectively, as defined in the ExpressCard Standard release 1.2. Both cards include a 37mm x 20mm extension area used to house the BNC connector.

The HD-SDI Express provides a x1 lane ‘end-point’ PCI Express interface compliant with the PCI Express Release 1.2 specification. The design does not support any memory mapped or I/O mapped peripherals on the card. Access to the SDI Express’s FIFOs is achieved through DMA operations that move the data from the FIFOs into host memory. The host cannot directly access the contents of the FIFOs. The design supports host access into PCI Express configuration registers as well as application specific frame grabber registers.

The ExpressCard standard also defines a Universal Serial Bus (USB) and a Serial Management Bus (SMBus) interface on the ExpressCard connector. These interfaces are unused in the HD-SDI Express card design.

Serial COM interface (HDPCIe01 only)

The HD-SDI Express PCIe card provides an RS232/RS485 bi-directional Universal Asynchronous Receiver Transmitter (UART) for the purpose of configuring an attached camera. The UART transmits and receives ASYNC formatted characters with 1 Start bit, 8 data bits, no parity and 1 Stop bit. The baud rate of this interface can be configured by the user to be any one of a set of standard bit rates ranging from 4800 to 115.2K bits per second. The HD-SDI Express software exposes this interface as a standard COM port to the host operating system.

A functional block diagram of the HD-SDI Express card is illustrated in Figure 1.

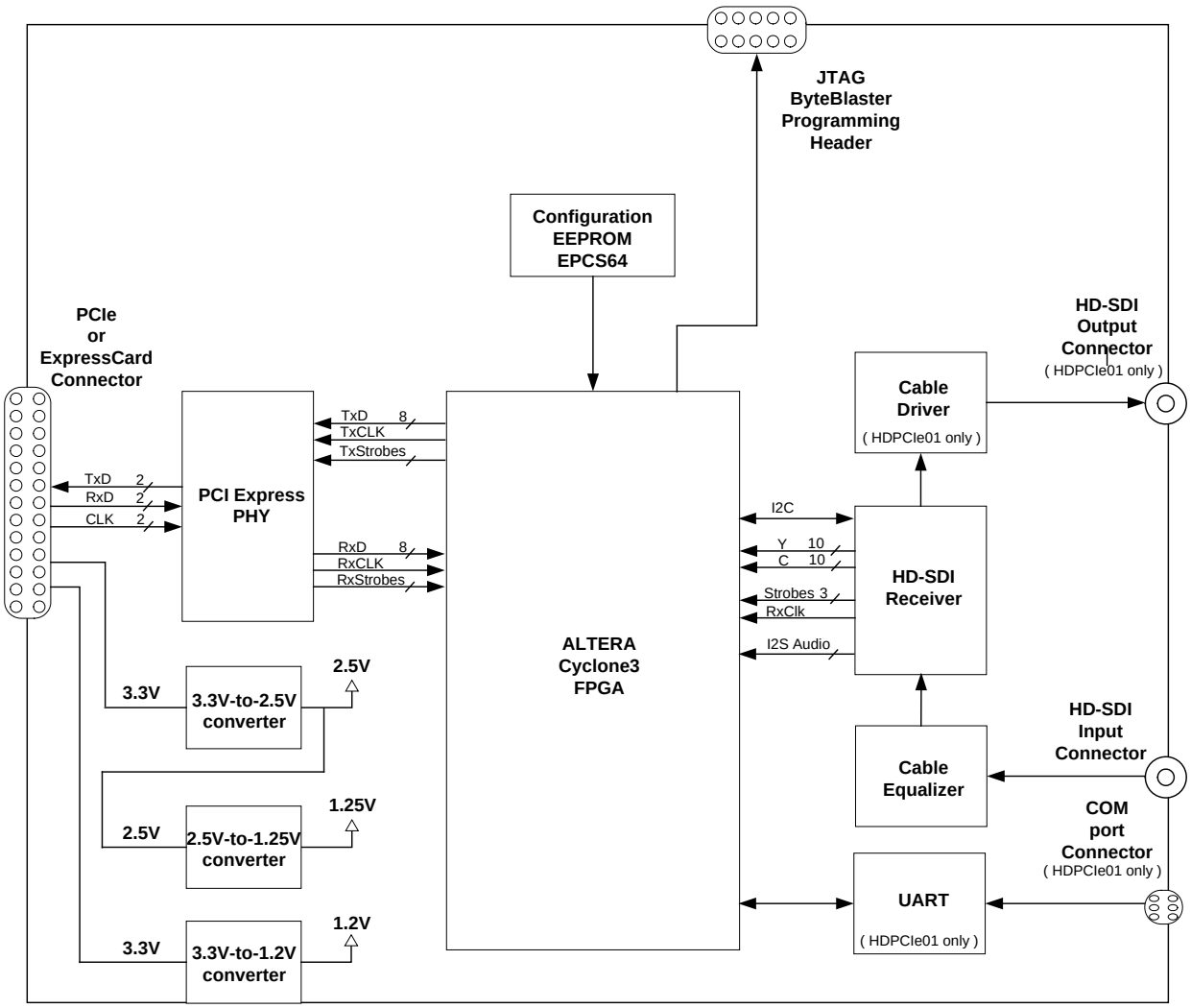


Figure 1 – HD-SDI Express Block Diagram

Video Capture

The video capture engine is responsible for receiving video pixel data and qualifiers from the SDI receiver, formatting the data and transferring it into on-board memory. The module receives 20 bits of video data organized as 10 bits of Luma data and 10 bits of Chroma data as well as VSYNC, HSYNC and DATA_EN strobes. The interface timing follows the CEA861 model. The received video data is formatted as YCrCb 4:2:2.

The video capture module supports three modes of operation, as configured by the user:

- YCrCb-20 mode – uses the 20 bit YCrCb 4:2:2 data received from the SDI receiver.

- YCrCb-16 mode – uses the 20 bit YCrCb 4:2:2 data received from the SDI receiver but truncates the 2 LSBs to form 16 bit data.

- RGB-24 mode – uses the 20 bit YCrCb 4:2:2 data received from the SDI receiver, translates it to 30 bit YCrCb 4:4:4 data using a chroma resampler function, then generates 30 bit RGB data using a color space converter function and finally truncates the 2 LSBs from each component to form 24 bit RGB data.

The video capture engine translates this data into doublewords (64 bits), as defined in Table 1 – Table 3. These tables reflect how the data will appear in host memory.

	d31	d30	d29	d28	d27	d26	d25	d24	d23	d22	d21	d20	d19	d18	d17	d16	d15	d14	d13	d12	d11	d10	d9	d8	d7	d6	d5	D4	d3	d2	d1	d0	
	d63	d62	d61	d60	d59	d58	d57	d56	d55	d54	d53	d52	d51	d50	d49	d48	d47	d46	d45	d44	d43	d42	d41	d40	d39	d38	d37	d36	d35	d34	d33	d32	
DW1	Cb1	Cb0	Y9	Y8	Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0	Cr9	Cr8	Cr7	Cr6	Cr5	Cr4	Cr3	Cr2	Cr1	Cr0	Y9	Y8	Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0	YCrCb
DW1	-	-	-	-	Cr9	Cr8	Cr7	Cr6	Cr5	Cr4	Cr3	Cr2	Cr1	Cr0	Y9	Y8	Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0	Cb9	Cb8	Cb7	Cb6	Cb5	Cb4	Cb3	Cb2	20 bit
DW2	Cr1	Cr0	Y9	Y8	Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0	Cb9	Cb8	Cb7	Cb6	Cb5	Cb4	Cb3	Cb2	Cb1	Cb0	Y9	Y8	Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0	
DW2	-	-	-	-	Cb9	Cb8	Cb7	Cb6	Cb5	Cb4	Cb3	Cb2	Cb1	Cb0	Y9	Y8	Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0	Cr9	Cr8	Cr7	Cr6	Cr5	Cr4	Cr3	Cr2	

Table 1 – Pixel mapping into memory : YCrCb-20 bit mode – 6 pixels / 2 DWs

d31	d30	d29	d28	d27	d26	d25	d24	d23	d22	d21	d20	d19	d18	d17	d16	d15	d14	d13	d12	d11	d10	d9	d8	d7	d6	d5	D4	d3	d2	d1	d0	
d63	d62	d61	d60	d59	d58	d57	d56	d55	d54	d53	d52	d51	d50	d49	d48	d47	d46	d45	d44	d43	d42	d41	d40	d39	d38	d37	d36	d35	d34	d33	d32	
Cb9	Cb8	Cb7	Cb6	Cb5	Cb4	Cb3	Cb2	Y9	Y8	Y7	Y6	Y5	Y4	Y3	Y2	Cr9	Cr8	Cr7	Cr6	Cr5	Cr4	Cr3	Cr2	Y9	Y8	Y7	Y6	Y5	Y4	Y3	Y2	YCrCb
Cb9	Cb8	Cb7	Cb6	Cb5	Cb4	Cb3	Cb2	Y9	Y8	Y7	Y6	Y5	Y4	Y3	Y2	Cr9	Cr8	Cr7	Cr6	Cr5	Cr4	Cr3	Cr2	Y9	Y8	Y7	Y6	Y5	Y4	Y3	Y2	16 bit

Table 2 – Pixel mapping into memory : YCrCb-16 bit mode – 4 pixels/DW

	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	
DW1	B7	B6	B5	B4	B3	B2	B1	B0	R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0	RGB
DW1	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0	R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	24 bit
DW2	R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0	R7	R6	R5	R4	R3	R2	R1	R0	
DW2	B7	B6	B5	B4	B3	B2	B1	B0	R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0	
DW3	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0	R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	
DW3	R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0	R7	R6	R5	R4	R3	R2	R1	R0	

Table 3 – Pixel mapping into memory : RGB-24 mode – 8 pixels / 3 DWs

Chroma Resampler

This module is responsible for receiving YCrCb 4:2:2 video pixel data from the SDI receiver, performing a coset function and delivering YCrCb 4:4:4 formatted data. For example:

Input 4:2:2 data : Y1/Cb1, Y2/Cr2, Y3/Cb3, Y4/Cr4 …
Output 4:4:4 data : Y1/Cb1/Cr2, Y2/Cb1/Cr2, Y3/Cb3/Cr4, Y4/Cb3/Cr4 …

Color Space Converter

This module is responsible for receiving YCrCb 4:4:4 video pixel data from the chroma_resampler module, performing color space conversion and delivering RGB-24 formatted data.

The following parameters are configurable by the user:

Offsets : Yoff, CRoff and CBoff
Coefficients : Y1, R1, G1, G2 and B1
Limits : R_min, R_max, G_min, G_max, B_min and B_max

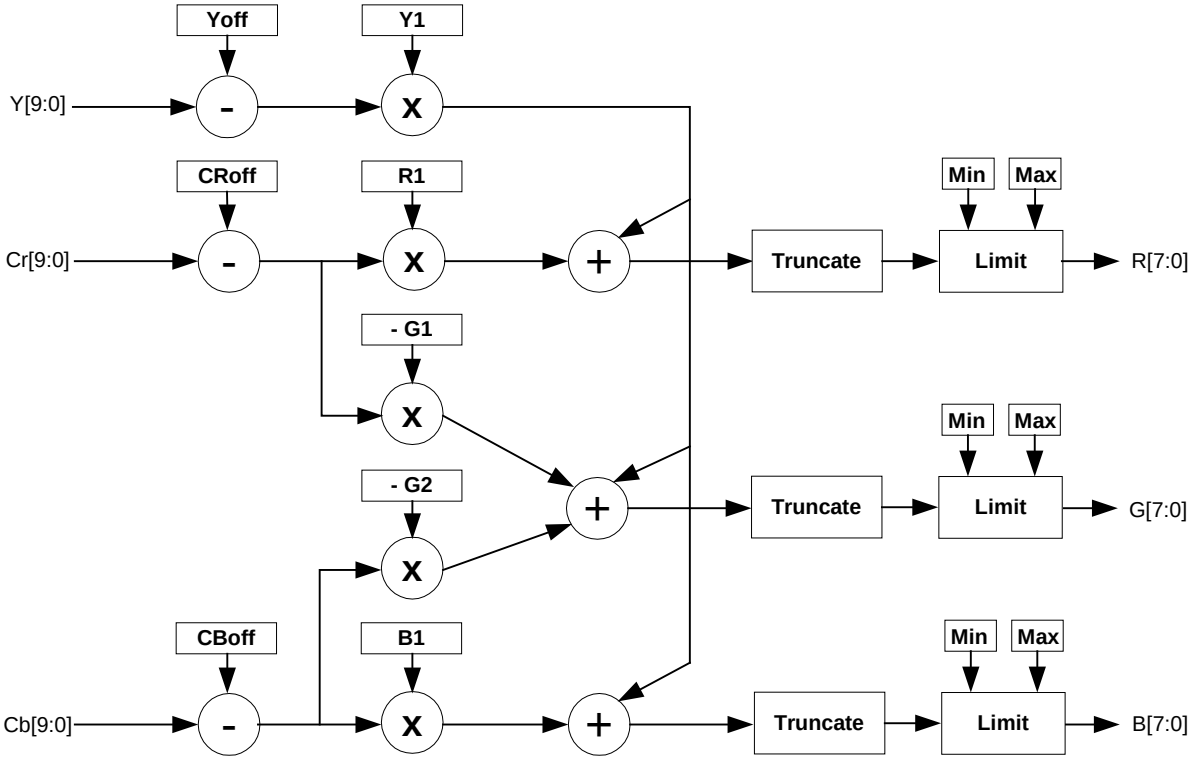


Figure 2 – Color Space Converter

Audio Capture

The audio capture engine is responsible for receiving de-embedded audio data, via an I2S interface, formatting the data and transferring it into on-board memory. The module receives two channels of audio data, at a 48 KHz rate, organized as 24 bits of left channel data and 24 bits of right channel data.

The audio capture module supports two modes of operation, as configured by the user:

- 24 bit mode – uses the 24 bits/sample per channel data received from the SDI receiver.

- 16 bit mode – uses the 24 bits/sample per channel received from the SDI receiver but truncates the 8 LSBs to form 16 bits/sample per channel.

The audio capture engine translates this data into doublewords (64 bits), as defined in Table 4 – Table 5. These tables reflect how the data will appear in host memory.

	d31	d30	d29	d28	d27	d26	d25	d24	d23	d22	d21	d20	d19	d18	d17	d16	d15	d14	d13	d12	d11	d10	d9	d8	d7	d6	d5	D4	d3	d2	d1	d0	
	d63	d62	d61	d60	d59	d58	d57	d56	d55	d54	d53	d52	d51	d50	d49	d48	d47	d46	d45	d44	d43	d42	d41	d40	d39	d38	d37	d36	d35	d34	d33	d32	
DW1	R0 7	R0 6	R0 5	R0 4	R0 3	R0 2	R0 1	R0 0	L0 23	L0 22	L0 21	L0 20	L0 19	L0 18	L0 17	L0 16	L0 15	L0 14	L0 13	L0 12	L0 11	L0 10	L0 9	L0 8	L0 7	L0 6	L0 5	L0 4	L0 3	L0 2	L0 1	L0 0	24 bit mode
DW1	L1 15	L1 14	L1 13	L1 12	L1 11	L1 10	L1 9	L1 8	L1 7	L1 6	L1 5	L1 4	L1 3	L1 2	L1 1	L1 0	R0 23	R0 22	R0 21	R0 20	R0 19	R0 18	R0 17	R0 16	R0 15	R0 14	R0 13	R0 12	R0 11	R0 10	R0 9	R0 8	
DW2	R1 23	R1 22	R1 21	R1 20	R1 19	R1 18	R1 17	R1 16	R1 15	R1 14	R1 13	R1 12	R1 11	R1 10	R1 9	R1 8	R1 7	R1 6	R1 5	R1 4	R1 3	R1 2	R1 1	R1 0	L1 23	L1 22	L1 21	L1 20	L1 19	L1 18	L1 17	L1 16	
DW2	R2 7	R2 6	R2 5	R2 4	R2 3	R2 2	R2 1	R2 0	L2 23	L2 22	L2 21	L2 20	L2 19	L2 18	L2 17	L2 16	L2 15	L2 14	L2 13	L2 12	L2 11	L2 10	L2 9	L2 8	L2 7	L2 6	L2 5	L2 4	L2 3	L2 2	L2 1	L2 0	
DW3	L3 15	L3 14	L3 13	L3 12	L3 11	L3 10	L3 9	L3 8	L3 7	L3 6	L3 5	L3 4	L3 3	L3 2	L3 1	L3 0	R3 23	R3 22	R3 21	R3 20	R3 19	R3 18	R3 17	R3 16	R2 15	R2 14	R2 13	R2 12	R2 11	R2 10	R2 9	R2 8	
DW3	R3 23	R3 22	R3 21	R3 20	R3 19	R3 18	R3 17	R3 16	R3 15	R3 14	R3 13	R3 12	R3 11	R3 10	R3 9	R3 8	R3 7	R3 6	R3 5	R3 4	R3 3	R3 2	R3 1	R3 0	L3 23	L3 22	L3 21	L3 20	L3 19	L3 18	L3 17	L3 16	

Table 4 – Audio mapping into memory : 24 bit mode – 4 samples / 3 DWs

	d31	d30	d29	d28	d27	d26	d25	d24	d23	d22	d21	d20	d19	d18	d17	d16	d15	d14	d13	d12	d11	d10	d9	d8	d7	d6	d5	D4	d3	d2	d1	d0	
	d63	d62	d61	d60	d59	d58	d57	d56	d55	d54	d53	d52	d51	d50	d49	d48	d47	d46	d45	d44	d43	d42	d41	d40	d39	d38	d37	d36	d35	d34	d33	d32	
DW1	R0 15	R0 14	R0 13	R0 12	R0 11	R0 10	R0 9	R0 8	R0 7	R0 6	R0 5	R0 4	R0 3	R0 2	R0 1	R0 0	L0 15	L0 14	L0 13	L0 12	L0 11	L0 10	L0 9	L0 8	L0 7	L0 6	L0 5	L0 4	L0 3	L0 2	L0 1	L0 0	16 bit mode
DW1	R1 15	R1 14	R1 13	R1 12	R1 11	R1 10	R1 9	R1 8	R1 7	R1 6	R1 5	R1 4	R1 3	R1 2	R1 1	R1 0	L1 15	L1 14	L1 13	L1 12	L1 11	L1 10	L1 9	L1 8	L1 7	L1 6	L1 5	L1 4	L1 3	L1 2	L1 1	L1 0	

Table 5 – Audio mapping into memory : 16 bit mode – 2 samples/DW

Pixel Buffering The pixel data formatted by the video capture engine is stored into two on-board FIFO memories. This memory serves as an elastic store for formatted video pixel data. The FIFOs are managed by an independent pair of controllers, implemented in the FPGA, supporting concurrent operation. The two FIFOs are utilized in a ping-pong fashion such that while one is being filled with new pixel data, the other is being emptied via DMA into host memory.

Audio Buffering The audio data formatted by the audio capture engine is stored into two on-board FIFO memories. This memory serves as an elastic store for formatted audio data. The FIFOs are managed by an independent pair of controllers, implemented in the FPGA, supporting concurrent operation. The two FIFOs are utilized in a ping-pong fashion such that while one is being filled with new audio data, the other is being emptied via DMA into host memory.

DMA The DMA engines are responsible for reading formatted pixel and audio data from the on-board FIFO memories and transferring them into host memory via the ExpressCard interface. An intelligent scatter-gather method is utilized, providing for an efficient use of the ExpressCard bandwidth. The use of non-contiguous 4Kbyte buffers provides support for the Windows operating system's memory allocation model.

FPGA The heart of the HD-SDI Express is a dense Field Programmable Gate Array (FPGA). This FPGA implements all of the functions related to video data capture, formatting, storage and DMA. The firmware contents of the FPGA can be upgraded while in the field by following the instruction outlined in Section 3 of this document entitled 'Firmware Upgrade from Web Site'.

What you need to get started

To begin using the HD-SDI Express card, you need the following:

- A computer with a PCIe x1 slot or a laptop with an ExpressCard/54 (or ExpressCard/34) slot.
- Microsoft Windows Win7/XP/Vista 32 or 64 bit operating system software.
- A computer with at least 256M bytes of RAM.
- A CD drive, and a hard disk on which to install the HD-SDI Express software.

Inspecting the HD-SDI Express package

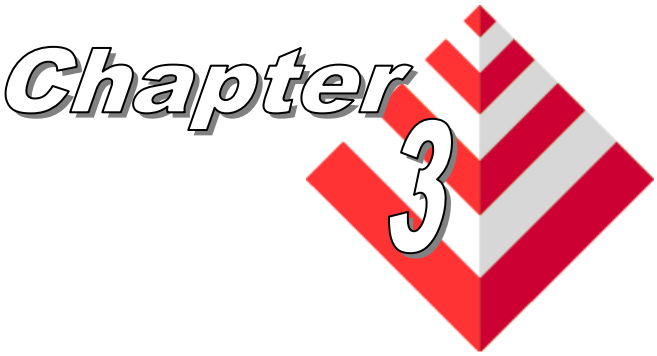
When you unpack your HD-SDI Express package, you should visually inspect all of its contents. If something is missing or damaged, contact your Imperx representative.

Package contents
You should have received the following items:

- The HD-SDI Express card
- A CD with the HD-SDI Express software suite
- A ‘Quick Start’ installation guide

Hardware Installation

Installing the HD-SDI Express card is as simple as plugging it into an available PCIe x1 slot on your desktop computer's motherboard or a ExpressCard/54 (or ExpressCard/34) slot on your laptop.



Software Installation

This chapter explains how to install the HD-SDI Express software.

Software Suite

The HD-SDI Express software suite consists of the following files:

Windows application files:
(located in *c:\Program Files\ImperX\HD-SDI_ Express\Application*)
\win32 folder contains binaries for 32bit versions of Windows
\x64 folder contains binaries for 64bit versions of Windows

HD-SDI_Express.exe	- Application program
HD-SDI_Express.chm	- Help file
DrvManager.exe	- Driver Manager utility
VCESDI.dll	- HD-SDI Express library
ippLib.dll	- Intel image processing library
IpxLog.dll	- ImperX logging library
IpxMisc.dll	- ImperX miscellaneous library
IpxMovieMaker.dll	- ImperX movie maker library

Windows Kernel Driver files:
(located in *c:\Program Files\ImperX\HD-SDI Express\drivers\kernel*)
\win32 folder contains binaries for 32bit versions of Windows
\x64 folder contains binaries for 64bit versions of Windows

sdi_ex.sys	- Win7/WinXP/Vista driver file
sdi_ex.inf	- Win7/WinXP/Vista driver info file
sdi_ex.cat	- Win7/WinXP/Vista driver catalog file
ipxinstdrv.exe	- driver installation utility

Software Development Kit (SDK) files:
(located in *c:\Program Files\ImperX\HD-SDI Express\SDK*)

/bin/ folder	- binaries
/inc/ folder	- include files
/lib/ folder	- libraries
/doc/ folder	- documentation
/SDK Examples/ folder	- samples
/Imperx.SdiExpress.NET/ folder	- .NET wrapper

Documentation files:
(located in *c:\Program Files\ImperX\HD-SDI Express\Doc*)

HD-SDI_Express_Users_Manual.pdf	- User manual document
HD-SDI_Express_Datasheet.pdf	- Technical datasheet
Quick Start HD-SDI_Express.pdf	- Quick start document

Third-party software support files:
(located in *c:\Program Files\ImperX\HD-SDI Express\drivers*)

\win32 folder contains binaries for 32bit versions of software
\x64 folder contains binaries for 64bit versions of software

Halcon	- files for MVTech Halcon support
DirectShow	- files for Microsoft DirectShow support
Matlab	- files for MathWorks Matlab support

Note that our HD-SDI Express application program was created using our SDK (software developer's kit). Our SDK is included in the standard HD-SDI Express software suite that comes with the card.

Software Installation from CD

Use the following steps to install the HD-SDI Express software supplied on a CD. Note that 'click' refers to the left mouse button.

1. If a version of HD-SDI Express was previously installed on this machine, then you must first remove it:

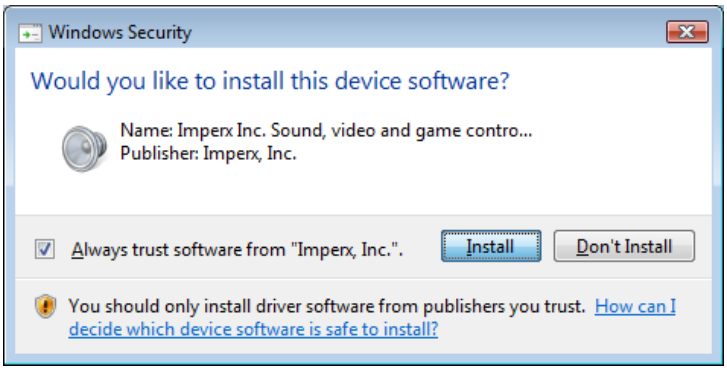
   To remove the application files:

   1.1 Click on *"Start"*
   1.2 Click on *"Settings"***.**
   1.3 Click on *"Control Panel"***.**
   1.4 Double click on *"Add or Remove Programs"***.**
   1.5 Click on *"HD-SDI Express"***.**
   1.6 Click on *"Remove"***.**
   1.7 If the 'HD-SDI Express – InstallShield Wizard' pops-up then do the following, otherwise go to step 1.8
   Click on *'Remove'*.
   Click *'Next'*.
   Click *'Yes'*.
   Click *'Finish'*.
   1.8 Click on *"Yes"***.**
   1.9 Click on *"Close"*.

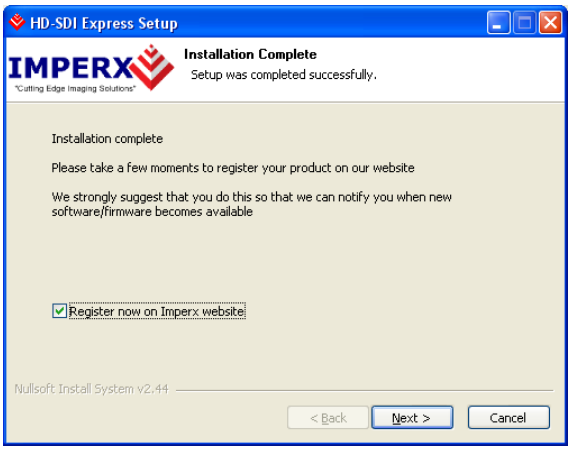
2. After having removed a previous version or if a version of HD-SDI Express was NOT previously installed on this machine then:

   The first step is to install the application files:

   2.1 Insert the HD-SDI Express CD into the appropriate drive; the setup.exe file will run automatically. Note: If it does not start automatically, then click on *"Start"***,** *"Run"***,** enter or browse to *"(CD drive): setup.exe"* and click *"OK"*.
   2.2 Wait for the "HD-SDI Express - InstallShield Wizard" screen to appear.
   2.3 Follow the on-screen instructions.
   2.4 For Windows Vista 32 bit and Windows Vista 64 bit, select *"Always trust software from Imperx, Inc."* and click on *"Install"* button, when the following message appears:



2.5 When the following message appears, choose if you would like to register online by clicking on *"Register now on Imperx website"*.



2.6 Click *"Next"* and then *"Finish"*. This completes the software installation.

2.7 Reboot your computer.

The next step is to install the driver files:

2.8 Insert the HD-SDI Express card into the laptop.

2.9 For XP:

Wait for the system to prompt you with a "Found New Hardware Wizard" dialog box. Proceed to Step 2.10.

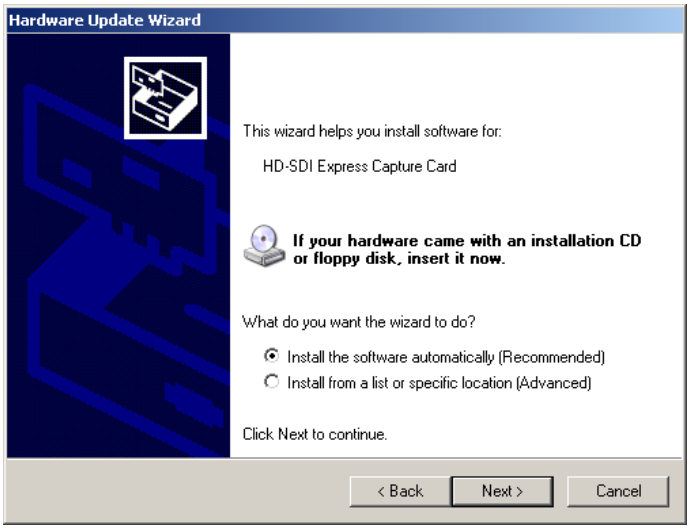
For Vista:

The driver will automatically be installed. Proceed to step 2.15.

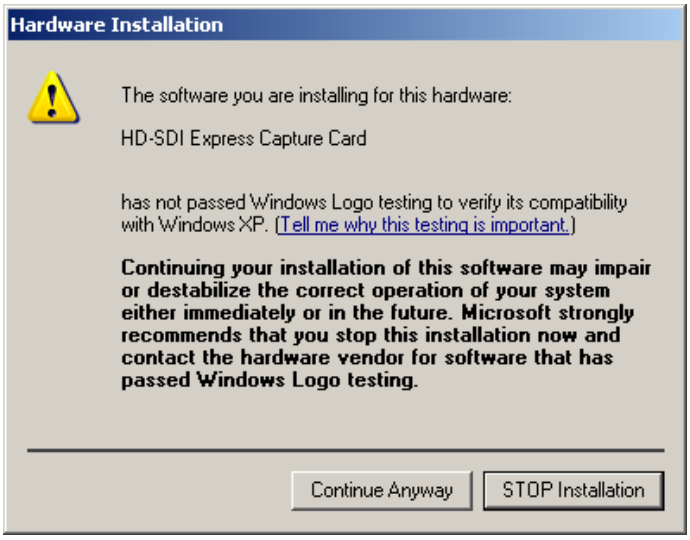
2.10 Under certain conditions, the following message may appear:

If this message appears, click *"No, not this time"*, then click "*Next*".

2.11 When the following message appears, select *"Install the software automatically (Recommended)"*, then click *"Next"*.



2.12 The following message will appear:



2.13 Click "*Continue Anyway*" to continue.

2.14 When "Click finish to close the wizard" appears, click on "*Finish*".

2.15 This completes the driver installation.

Software Upgrade from Web Site

New application and/or driver software may be released periodically to reflect improvements and/or functionality added to the HD-SDI Express. You can retrieve these updates by visiting the download page of our web site at:

http://www.imperx.com/frame_grabbers/HD-SDI Express/HD-SDI_Express_downloads.php

Use the following steps to install newly released application software:

3.1 Uninstall all application files by following the instructions in step 1. of the 'Software Installation from CD' section.

3.2 Download the SDI_Express_Installer.exe file from the Imperx web site to a new folder on your PC (we will use the folder C:\new_HD-SDI_Express as an example).

3.3 Left mouse click on *"Start"*, *"Run"*, enter or browse to *C:\new_HD-SDI_Express\HD-SDI_Express_Installer.exe*.

3.4 Left mouse click on *"Open"*, then *"OK"*.

3.5 Follow the instructions starting from step 2.2 above.

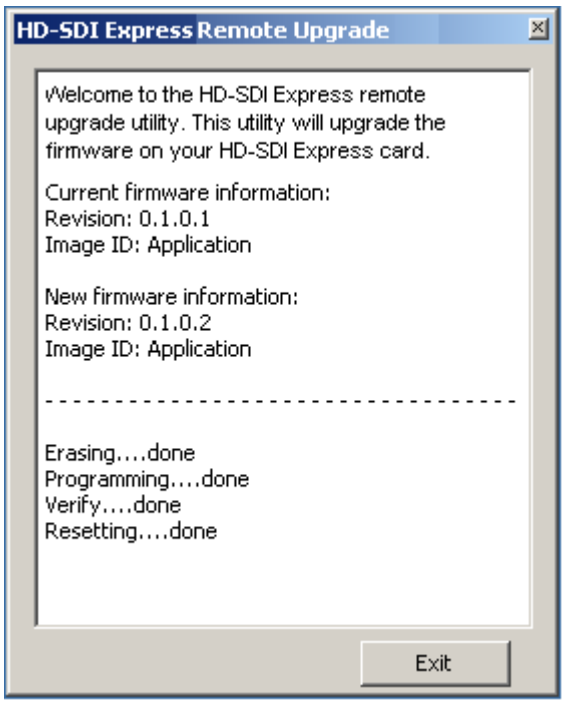
Firmware Upgrade from Web Site

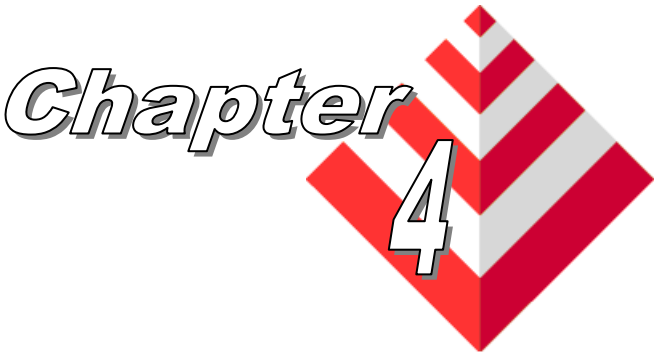
Your newly received HD-SDI Express card has been programmed in the factory with the latest firmware prior to shipping. New firmware, however, may be released periodically to reflect improvements and/or added functionality. You can retrieve these updates by visiting the download page of our web site at:

http://www.imperx.com/frame_grabbers/HD-SDI Express/HD-SDI_Express_downloads.php

Use the following steps to install newly released firmware:

1. Download and unzip the firmware Upgrade Utility file to a folder on your PC.
2. Insert the HD-SDI Express card into the laptop. Note that if your system has two ExpressCard slots, then you must insert the card into the slot in which it was placed during the original driver installation.
3. If the system prompts you with a “New Hardware Found” dialog box, then you have not previously installed the driver. You must follow the steps outlined in the section above titled “Software Installation from CD” to install the driver.
4. To run the Upgrade Utility simply double click on the icon. **Note: DO NOT POWER DOWN OR REMOVE THE CARD WHILE PROGRAMMING IS IN PROGRESS!**
5. The Upgrade Utility will display the following dialog box:





Using the HD-SDI Express card

This chapter contains information on how to configure and use the HD-SDI Express card.

Running the HD-SDI Express Application

The HD-SDI_Express.exe program supplied with the HD-SDI Express card is a stand-alone Windows based application. It provides an easy to use graphical user interface (GUI), allowing the user to configure the HD-SDI Express card and to view, record and playback video data received from the CameraLink interface. The application consists of a main window as well as several other dialogs which can be accessed from the main menu or from convenient icons.

Launching Application

To launch the HD-SDI Express program, simply double left mouse click on the 'HD-SDI Express Application' icon on the desktop.

Note

In the remainder of this chapter, references to 'clicking' on objects in the GUI refers to the left mouse button.

Main Window

When the HD-SDI Express application is executed, a main window titled ‘HD-SDI Express’ will appear. The main window provides the primary area for viewing real-time images received from the camera. This window can be sized and moved to suit your needs. When image viewing is active, the size of this window will be automatically scaled as a function of the input signal’s parameters (i.e. pixels/line and lines/frame) as reported in the ‘Camera Parameters’ dialog.

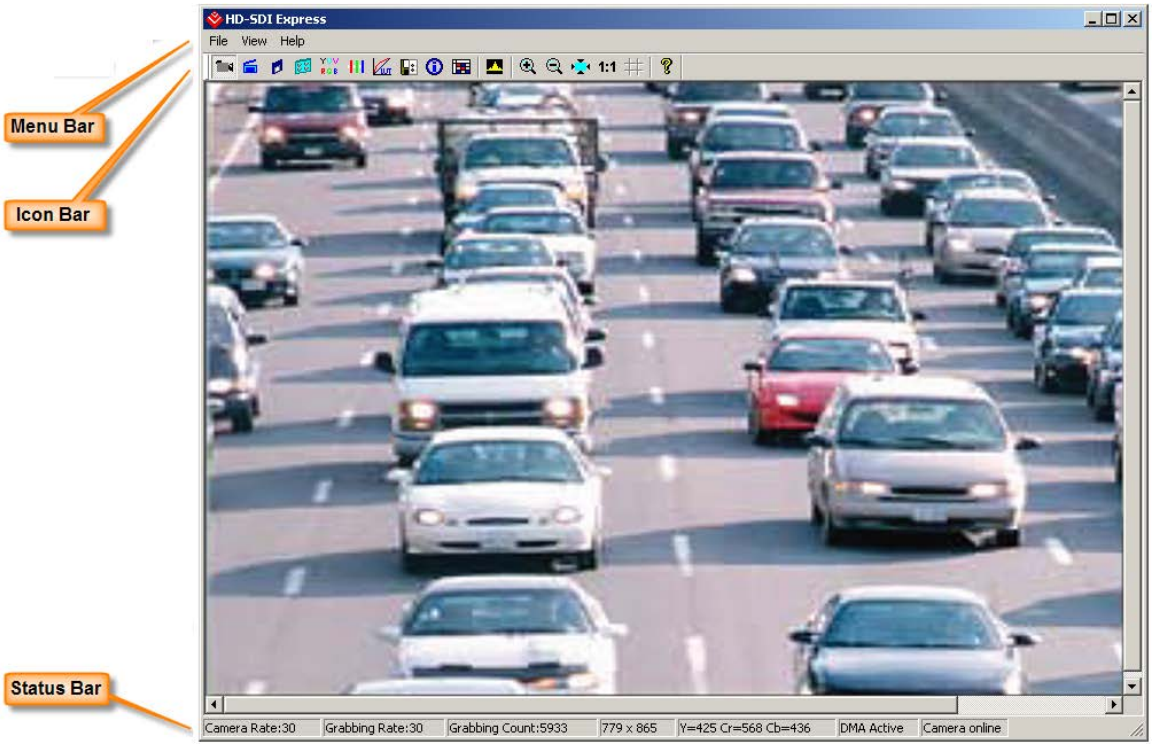


Figure 3 – Main dialog

The Main dialog contains a Menu bar, an Icon bar and a Status bar.

Menu Bar

The Menu bar includes a set of pull-down sub-menus as follows:

File Clicking on this item reveals a pull-down menu with two options: ‘Player’ and ‘Exit’.

Play Files This option opens the ‘Player Dialog’ and ‘Player Control’ windows.

Exit Clicking on this option causes the program to terminate.

View Clicking on this item reveals a pull-down menu with the following options:

- **Camera Parameters** Causes the ‘Camera Parameters’ dialog to appear.
- **Color Space Converter** Causes the ‘Color Space Converter’ dialog to appear.
- **RGB Control** Causes the ‘RGB Control’ dialog to appear.
- **RGB Lookup Table** Causes the ‘RGB Lookup Table’ dialog to appear.
- **Capture Settings** Causes the ‘Capture Settings’ dialog to appear.
- **Statistics** Causes the ‘Statistics’ dialog to appear.
- **Hex Pixel Dump** Causes the ‘Hex Pixel Dump’ dialog to appear.
- **Histogram** Causes the ‘Histogram’ dialog to appear.
- **Zoom** Causes the ‘Zoom’ menu to appear.

Help Clicking on this item reveals a pull-down menu with two options: ‘About’ and ‘Help Manual’.

- **About** Causes version information to be displayed including release identifiers for the application software, library, driver and firmware. This information should be provided to Imperx technical support personnel during a service call.
- **Help Manual** Causes an interactive point-and-click style help manual to be displayed. The help manual provides a summary description of all GUI controls and fields.

Icon Bar

The Icon bar contains a set of icons that act as shortcuts into the features located on the Menu bar.


Start/stop continuous **Grab**


Snap single frame


Start/stop **Capture** to disk


Open **Camera Parameters** dialog

Open **Color Space Converter** dialog


Open **RGB Control** dialog


Open **RGB Lookup Table** dialog


Open **Capture Settings** dialog


Open **Statistics** dialog


Open **Hex Pixel Dump** dialog


Open **Histogram** dialog


Zoom In


Zoom Out


Fit to Window

Zoom 1:1


Turn **Grid** on/off


Help

Status Bar

The Status bar reflects the real-time state of the current camera connection.

Camera Rate

Displays the real-time frame rate of the attached camera as measured at the input of the HD-SDI Express card.

Grabbing Rate

Displays the real-time rate at which frames are being transferred from the card into host memory.

Grabbing Count

Displays a running count of the total number of frames transferred into system memory. This counter is reset when ‘grabbing’ is stopped.

Pixel Position

Displays the x,y coordinates of the pixel at the current mouse position.

Pixel Value

Displays the decimal value of the pixel at the current mouse position. If the mode is YCrCb then the Y, Cr and Cb values will be displayed. If the mode is RGB-24, then the R, G and B values will be displayed.

DMA Status

Displays the real-time status of the DMA process as being either ‘**active**’ or ‘**inactive**’.

‘**Active**’ indicates that the user has commanded the HD-SDI Express to acquire video data by clicking on the ‘Start Grab’ button and that the camera is providing valid framing.

‘**Inactive**’ indicates that either the user has commanded the HD-SDI Express to stop acquiring video data by clicking on the ‘Stop Grab’ button or that grabbing is enabled but the camera is not providing valid framing.

Camera Status

Displays the real-time status of the attached camera as being either ‘**online**’ or ‘**offline**’.

‘**Online**’ indicates that the camera is powered on, attached and providing a video clock via the SDI interface.

‘**Offline**’ indicates that the HD-SDI Express card is not receiving a video clock from the camera either because the camera is powered off or the SDI cable is disconnected.

Camera Parameters Dialog

The Camera Parameters dialog reports the operating parameters of the attached camera. It also allows the user to instruct the card on how to process the incoming SDI video and audio data.

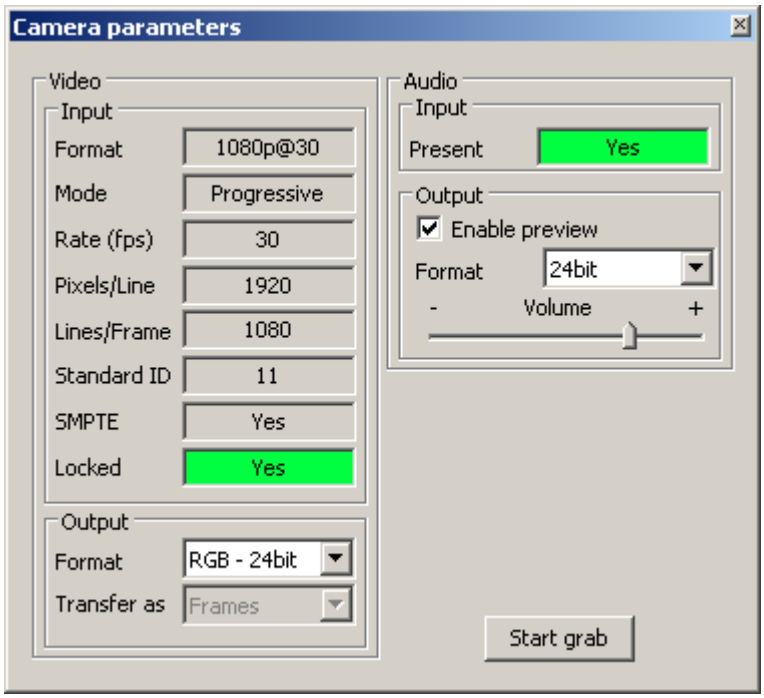


Figure 4 – Camera Parameters dialog

Video Input These fields describe the attributes of the currently connected SDI video source. The fields are automatically populated by the application program.

Format Indicates the format of the connected camera.

Mode Indicates the mode as ‘Progressive’ or ‘Interlaced’.

Rate (fps) Indicates the rate of the connected camera. If the mode is progressive then the rate is in units of ‘frames per second’. If the mode is interlaced, then the rate is in units of ‘fields per second’.

Pixels/Line Indicates the number of pixels per line.

Lines/Frame Indicates the number of lines per frame.

SMPTE Indicates that the received signal is SMPTE compliant.

Locked Indicates that the card is locked to an incoming signal.

Video Output These fields determine how the card should process the incoming SDI video data. These fields are set by the user.

Format Indicates how the card should format the video data prior to transferring it into host system memory.

YCrCb - 20 bit Use the 20 bit YCrCb 4:2:2 data received from the SDI receiver as is.

YCrCb - 16 bit Use the 20 bit YCrCb 4:2:2 data received from the SDI receiver but truncate the 4 LSBs to form 16 bit data.

RGB - 24 bit Use the 20 bit YCrCb 4:2:2 data received from the SDI receiver, translate it to 30 bit YCrCb 4:4:4 data using a chroma resampler function, then generate 30 bit RGB data using a color space converter function and finally truncate the 2 LSBs from each component to form 24 bit RGB data.

Transfer as Indicates how the card should transfer the video data into host system memory when the mode is 'interlaced'. Note that when the mode is 'progressive' then the 'frames' option is automatically selected.

Frames
- Interlaced: Transfer as a complete frame consisting of an odd field followed by an even field.
- Progressive: Transfer as a complete frame with odd and even fields interlaced (i.e. as received from the camera).

Fields Transfer each field individually.

Audio Input These fields describe the attributes of the currently connected SDI audio source. The fields are automatically populated by the application program.

Present Indicates that the received signal contains embedded audio data.

Audio Output These fields determine how the card should process the incoming SDI audio data. These fields are set by the user.

Enable Preview Instructs the card to process and play, through the PC's speakers, the received audio data.

Format Indicates how the card should format the audio data prior to transferring it into host system memory.

24 bit	Use the 24 bit audio data received from the SDI receiver as is.
16 bit	Use the 24 bit audio data received from the SDI receiver but truncate the 8 LSBs to form 16 bit data.

Volume	Controls the volume of the audio played through the PC's speakers.

Start/Stop Grab	This button will toggle between **'Start Grab'** and **'Stop Grab'** every time the user clicks on it. Clicking on 'Start Grab' enables the HD-SDI Express's DMA engine and causes the main window to display live images received from the camera. Clicking on 'Stop Grab' disables the DMA engine and causes the display to freeze.

Color Space Converter Dialog

The Color Space Converter dialog allows the user to adjust the behavior of the color space conversion function. This function is responsible for converting from YCrCb video data to the RGB-24 format.

Note that if either the YCrCb-20 or YCrCb-16 mode is selected, then YCrCb data is delivered from the card into host memory and therefore the color space conversion function is performed by software. However, if RGB-24 mode is selected, then the color space conversion is performed on the card and RGB-24 data is delivered from the card into host memory.

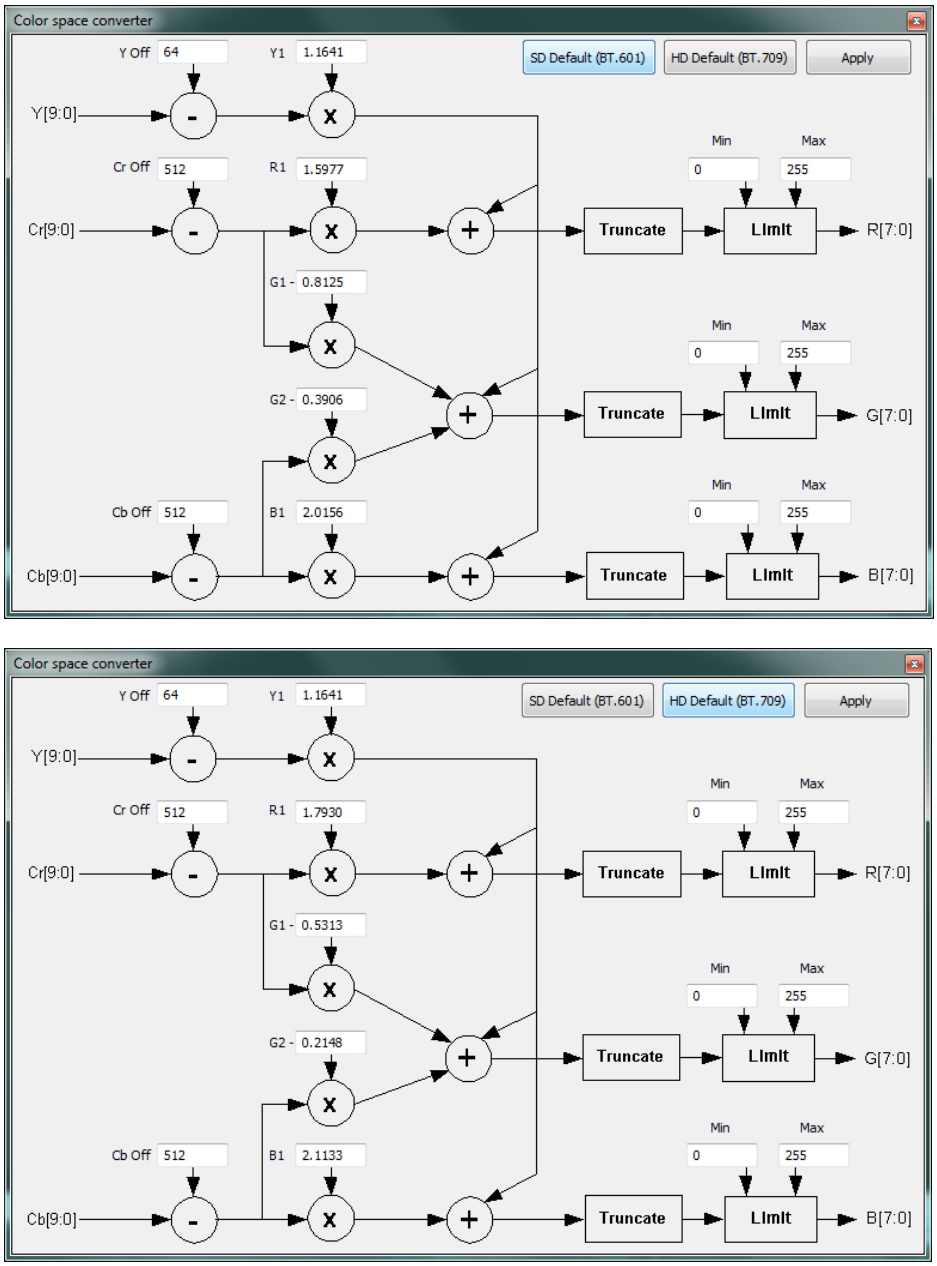


Figure 5 – Color Space Converter dialog

SD Default	Sets all parameters back to the BT.601default values for SD mode.
HD Default	Sets all parameters back to the BT.709 default values for HD mode.
Apply	Instructs the color space converter function to use the values entered into the various fields. Note that entering values into the fields will not have an effect on the image until the ‘Apply’ button is clicked.

RGB Control Dialog

The RGB Control dialog allows the user to adjust the gain and offset for each of the RGB color components. Optionally, the gains can be set automatically by invoking a white balance function.

Note that if either the YCrCb-20 or YCrCb-16 mode is selected, then YCrCb data is delivered from the card into host memory and therefore the RGB control function is performed by software. However, if the RGB-24 mode is selected, then the RGB control is performed on the card and RGB-24 data is delivered from the card into host memory.

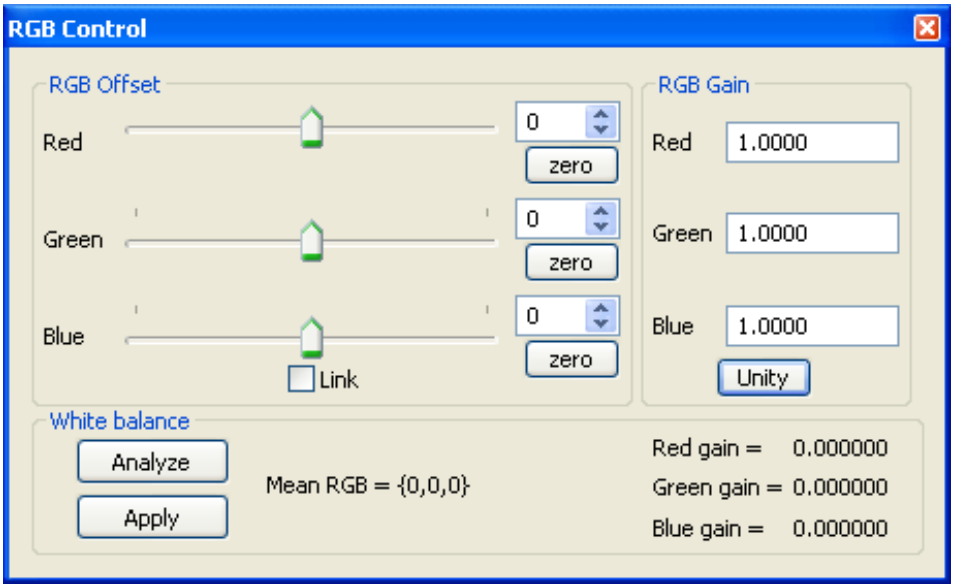


Figure 6 – RGB Control dialog

RGB Offset Specifies the amount of offset to apply to each of the R, G and B components.

RGB Gain Specifies the amount of gain to apply to each of the R, G and B components.

Unity This button sets all gains to a value of 1.0000.

White balance Performs an automatic white balancing procedure.

Analyze Instructs the HD-SDI Express card to analyze the current image received from the camera and to calculate a set of RGB Gain coefficients that will cause the sample image to be white balanced.

NOTE: Before clicking on 'Analyze', the user should reset all gains to unity and point the camera at a uniform white target.

Apply Instructs the HD-SDI Express card to use the calculated RGB Gain coefficients acquired during the 'analyze' procedure and to apply these to the received image prior to display.

RGB Lookup Table Dialog

The RGB Lookup Table feature allows the user to modify and transform the original video data. The pixel values for each of the R, G and B components can be mapped into new values. The mapping from input to output values is defined in a lookup table (LUT) file. The LUT file is an ASCII text file that can be created and modified by the user (see Appendix A for details) or can be automatically generated by the HD-SDI Express application.

Gamma Correction and custom Lookup Tables using the GUI

Gamma correction is the process of compensating for the non-linearity of CRT displays. The HD-SDI Express application can automatically create gamma lookup tables. It can also create custom lookup tables using an interactive drawing feature.

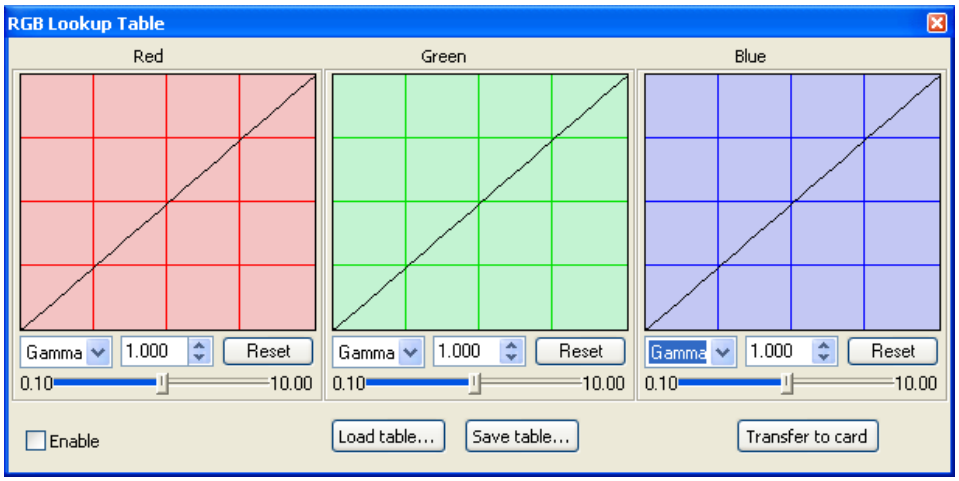


Figure 7 – RGB Lookup Table dialog

Gamma/Pencil This pull-down menu specifies the 'gamma' or 'pencil' mode of operation.

In the 'pencil' mode, the user can use the mouse to draw the desired transfer function directly on each graph.

In the 'gamma' mode, the user can enter an explicit gamma value or use the up/down arrows to increment/decrement the value or move the slider to the desired value. Using 'G' as the gamma coefficient, the gamma correction equation is:

$$\text{Output\_value} = [(\text{Input\_value}/255)^{G}] * 255$$

Reset This button sets the gamma edit box to a value of 1.000.

Enable Selecting this check box turns on LUT processing. Note that prior to enabling LUT processing, an LUT file must first be 'transferred' into the card.

Load table… Opens a Windows 'browse' box allowing the user to select a folder and filename for the LUT file to be opened. The lookup table specified will be opened and plotted in the three graphs. The LUT file can be any file, custom or gamma, that follows the format specified in Appendix A.

Save table… Opens a Windows 'browse' box allowing the user to select a folder and filename for the current LUT file to be saved. The filename extension, *.lut*, will automatically be added and therefore you do not need to include the filename extension.

Transfer to card Causes the current lookup table, displayed in the graphs, to be loaded into the HD-SDI Express card.

Custom Lookup Tables using an LUT file

Custom arbitrary transformations for the purposes of knee correction, contrast enhancement, negative image, etc. can also be implemented. This requires that the user specify the transformation via an LUT file (see Appendix A for details).

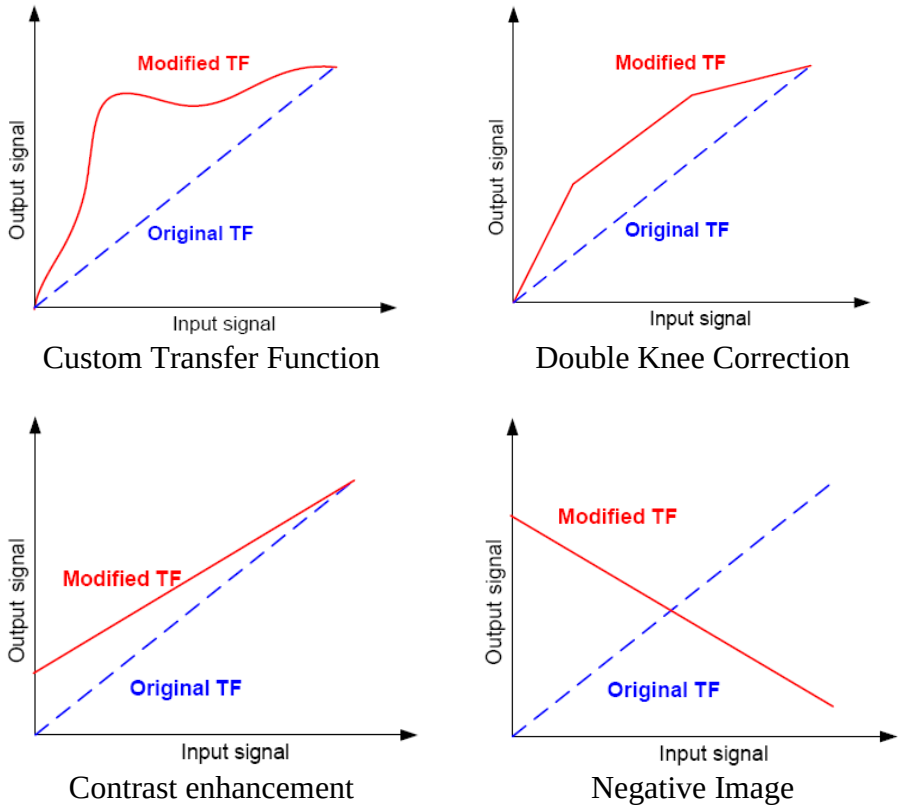


Figure 8 – Examples of custom lookup table transformations

Capture Settings Dialog

This dialog gives the user complete control over image storage.

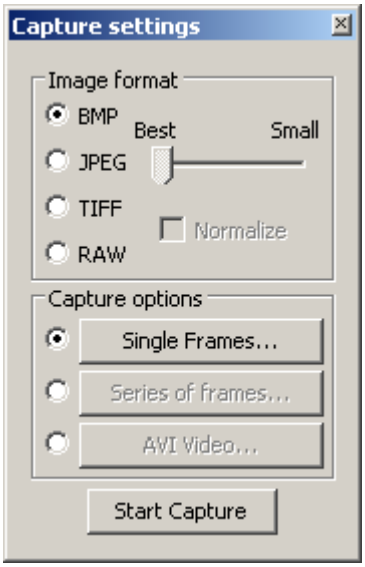


Figure 9 – Capture Settings dialog

Start/Stop Capture

This button will toggle between **'Start Capture'** and **'Stop Capture'** every time the user clicks on it. Clicking on 'Start Capture' starts the process of recording the images to disk. The options set in the 'Capture Options' field determine what, how and when actual recording is performed. Clicking on 'Stop Capture' causes recording to stop.

Close

This button will hide the Capture Settings Dialog screen. You can invoke it again by either hitting Ctrl-S or by selecting it from the Control Panel pull-down menu.

Image Format

When recording images to disk, this option selects the format, 'BMP', 'JPEG', 'TIFF' or 'RAW', that the image will be saved in. Selecting 'JPEG' activates a compression slider. 'Best' provides the least compression, while 'Small' provides the most compression.

Normalize

Normalize defines the way in which TIFF files are created. Since a TIFF file uses 16 bits to represent each pixel and cameras can produce less than 16 bit pixels, the normalize option is provided. If 'normalize' is disabled, then left pixel padding is used so that 16 bit TIFF data is produced by appending zeros to the MSB bits of the pixel data. For example, for a 10 bit pixel the resultant 16 bit TIFF data is "0,0,0,0,0,0,p10, p9….p2,p1" where p10..p1 represent the 10 bit pixel. Left padding is useful when the user wishes to post-process the TIFF data.

If ‘normalize’ is enabled, then right pixel padding is used so that 16 bit TIFF data is produced by shifting the pixel data left and appending zeros to the LSB bits of the pixel data. For example, for a 10 bit pixel the resultant 16 bit TIFF data is “p10, p9….p2,p1,0,0,0,0,0,0”. Right padding is useful when the user wishes to view the TIFF data using a standard TIFF viewer program.

Capture Options Determines how, when and where images are recorded to disk. Three choices are provided: ‘Single Frames’, ‘Series of Frames’ and ‘AVI Video’. Selecting the radio button and then clicking on each option box opens a new dialog providing additional options.

Single Frames Select this option when you wish to record one frame only. Clicking on this button causes the ‘Single Frame Settings’ dialog to open.

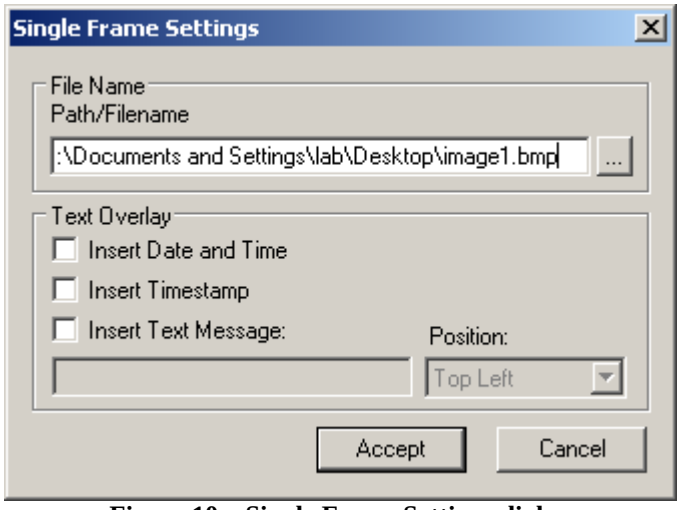


Figure 10 – Single Frame Settings dialog

Path/Filename This text field allows you to provide a path and filename for the recorded image file. Clicking on the ‘…’ box will cause a Windows ‘browse’ box to appear. The user can then browse to a folder and enter a file name. The filename extension, .BMP or .JPG, will automatically be added depending on the image format chosen and therefore you do not need to include the filename extension.

Text Overlay Enabling **‘Insert Date and Time’** automatically overlays the date and time, received from the PC’s operating system, on each image recorded. Date and time formats are the same as those used on your computer. Enabling **‘Insert Timestamp’** automatically overlays an accurate timestamp on each image recorded. The timestamp is a decimal

integer value indicating the time, in microseconds, when the card acquired the frame from the attached camera. Enabling **'Insert Text Message'** allows you to enter a text string to be automatically overlayed on each image recorded. Clicking on **'Position'** causes a pull-down menu to appear which defines the placement position of the date/time/text message within the image. Available options include: Top-Left, Top-Center, Top-Right, Bottom-Left, Bottom-Center and Bottom-Right.

Accept Clicking on this causes the entries made to the various fields to be accepted and then closes the 'Single Frame Settings' dialog window.

Cancel Clicking on this causes the entries made to the various fields to be rejected and then closes the 'Single Frame Settings' dialog window.

Series of Frames Select this option when you wish to record multiple frames. Clicking on this button causes the 'Series of Frames Settings' dialog to open.

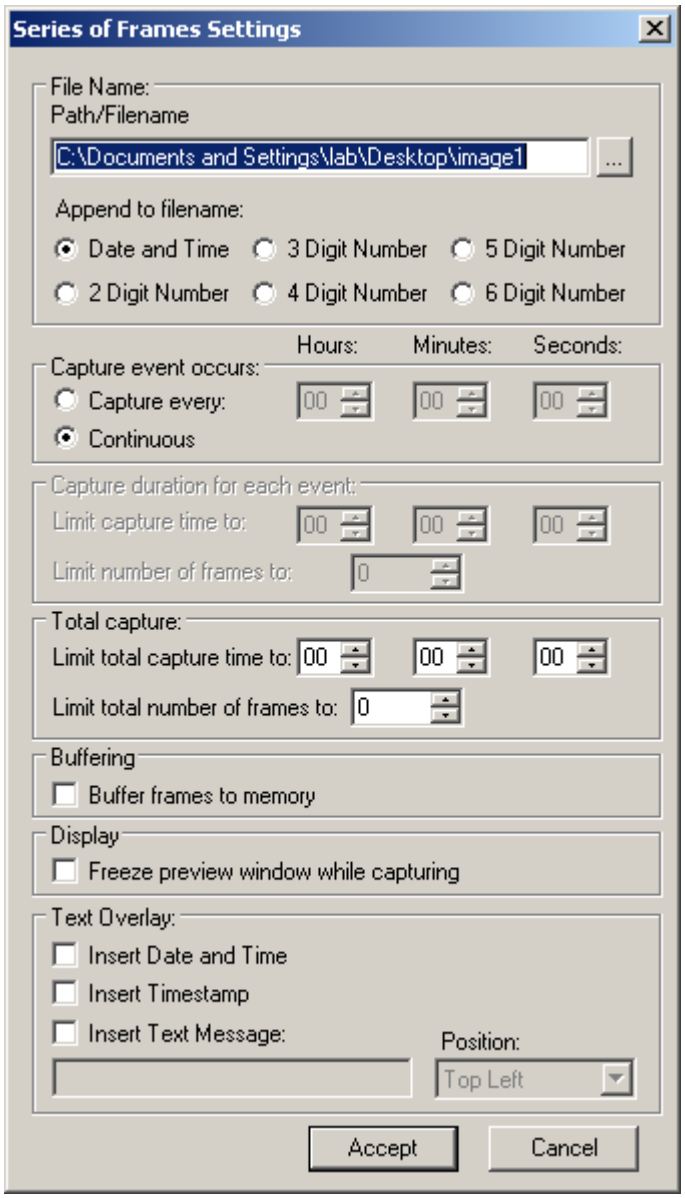


Figure 11 – Series of Frames Settings dialog

Path/Filename This text field allows you to provide a path to a folder where the recorded image files will be saved to. Clicking on the '…' box will cause a Windows 'browse' box to appear. The user can then browse to a folder. The filename will automatically be created based on the choice made in the 'Append to filename' option. The filename extension, .BMP or .JPG, will automatically be added depending on the image format chosen.

Append to filename

Allows the user to choose the format of the text filename to be created. Every time a recording file is created, the filename suffix will automatically be updated (for the 'Date and Time' option) or incremented (for the 'N Digit Number' option).

Date and Time

This option will create files named as YYYYMMDDhhmmssnnn where:

Y - year (4 digits)
M - month (2 digits)
D - day (2 digits)
h - hour (2 digits)
m - minute (2 digits)
s - second (2 digits)
n - millisecond (3 digits)

'N' Digit Number

This option will create numerically named files. The filename starts at 0 and is incremented by one after each frame is captured. If the number of frames captured exceeds the number of digits selected then the filename will continue to increment.

For example:

If '2 Digit Number' is selected then the files will be named as:

'00.bmp', '01.bmp' … '99.bmp', '100.bmp', '101.bmp', etc.

If '4 Digit Number' is selected then the files will be named as:

'0000.bmp', '0001.bmp' … '9999.bmp', '10000.bmp', '10001.bmp', etc.

Capture event occurs:

Allows you to control how often to start capturing images.

Capture every

Specifies how often, in time, to start capturing images. Use this feature to take snapshots at regular intervals in order to create a time-lapse series of images. This option is mutually exclusive with the 'Continuous' option.

Continuous Specifies that image capture is free-running.

Capture duration for each event: Allows you to control how much to capture with each capture event specified above. Limits can be specified by either time or number of frames, whichever occurs first.

- **Limit capture time to** Allows you to limit the duration of the recording by the amount of time specified.
- **Limit number of frames to** Allows you to limit the duration of the recording by the number of frames specified.

Total capture: Allows you to control how much to capture over all events specified above. Limits can be specified by either time or number of frames, whichever occurs first.

- **Limit total capture time to** Allows you to limit the duration of the total recording by the amount of time specified.
- **Limit total number of frames to** Allows you to limit the duration of the total recording by the number of frames specified

Examples of how to use Capture timers and counters:

Example #1: To capture 5 frames, every 1.5 hours, over a 12 hour period.

Capture event occurs:
Capture every: 01 Hr 30 Min 00 Sec

Capture duration for each event:
Limit number of frames to: 5

Total capture:
Limit total capture time to: 12 Hr 00 Min 00 Sec

Example #2: To capture 5 minutes worth of images, every 15 minutes and not to exceed a total of 250 images.

Capture event occurs:
Capture every: 00 Hr 15 Min 00 Sec

Capture duration for each event:
Limit capture time to: 00 Hr 05 Min 00 Sec

Total capture:
Limit total number of frames to: 250

Example #3: To capture 10 frames, every 1 hour, over a 6 hour period and not to exceed a total of 300 images.

Capture event occurs:
Capture every: 01 Hr 00 Min 00 Sec

Capture duration for each event:
Limit number of frames to: 10

Total capture:
Limit total capture time to: 06 Hr 00 Min 00 Sec
Limit total number of frames to: 300

Example #4: To capture continuously for a period of 2 hours and not to exceed a total of 100 images.

Capture event occurs:
Continuous

Total capture:
Limit total capture time to: 02 Hr 00 Min 00 Sec
Limit total number of frames to: 100

Buffer frames to memory — When selected will store images in system memory during capturing. When capturing is complete, the images in memory will be flushed to the disk drive. Select this option to improve capture performance (i.e. the number of frames per second stored to disk). If this option is not selected, images will be stored directly to disk and therefore capture performance will be limited by the disk's transfer rate.

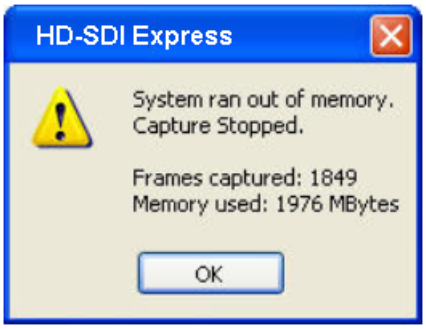
Freeze preview window while capturing — When selected will stop the live image in the main window from updating during capture, otherwise the image will remain live. Selecting this option improves capture performance (i.e. the number of frames per second stored to disk).

Text Overlay — Same as in 'Single Frames'.

Accept — Same as in 'Single Frames'.

Cancel — Same as in 'Single Frames'.

NOTE: While capturing is in progress, if the host operating system denies the HD-SDI Express application's request to allocate more frame buffers in host memory then the following error message will appear.



AVI Video Select this option when you wish to create an AVI movie file. An AVI movie is a series of images assembled into a single AVI file. Clicking on this button causes the 'AVI Video Clip Settings' dialog to open.

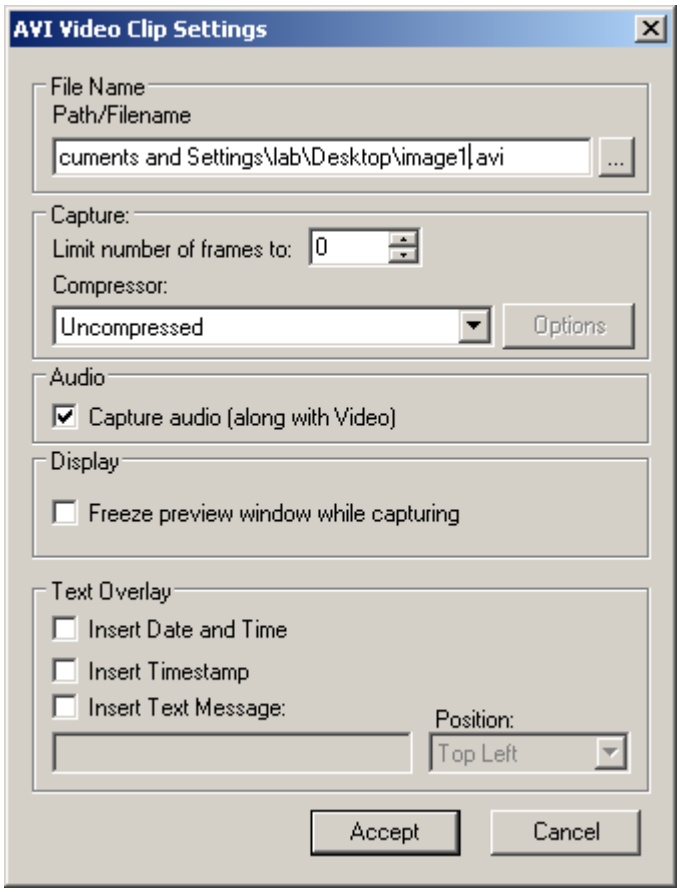


Figure 12 – AVI Video Clip Settings dialog

Path/Filename Same as in 'Single Frames'.

Limit number of frames to: Allows you to limit the duration of the recording by the number of frames specified.

Compressor: Allows you to choose between a variety of compressor implementations and options. This pull-down menu lists several different implementations of AVI compressors. Each has its own set of configuration options.

Capture Audio: Allows you to create an AVI file with video only or with both video & audio.

Freeze preview window while capturing Same as in 'Series of Frames'.

Text Overlay	Same as in ‘Single Frames’.
Accept	Same as in ‘Single Frames’.
Cancel	Same as in ‘Single Frames’.

Statistics Dialog

The Statistics dialog displays real-time status information about the current camera connection.

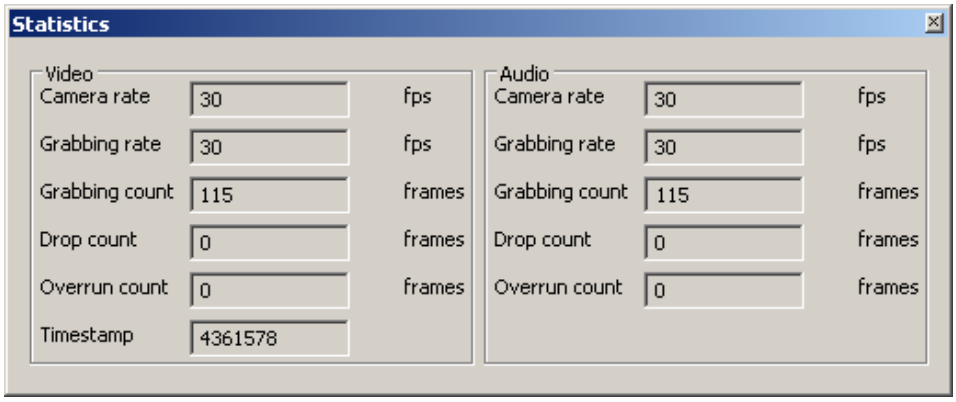


Figure 13 – Statistics dialog

Camera rate Displays the real-time frame rate of the attached camera as measured at the input of the HD-SDI Express card.

Grabbing rate Displays the real-time rate at which frames are being transferred from the card into host memory.

Grabbing count Displays a running count of the total number of frames transferred into system memory. This counter is reset when 'grabbing' is stopped.

Drop count Displays a running count of the total number of dropped frames. Dropped frames are defined as frames that were received from the camera but due to a lack of host buffers could not be transferred into host memory. It is the host computer's responsibility to provide the card with pointers into host buffers. If the host computer cannot keep up with the incoming frame rate then the card will drop frames. The primary cause of this is background applications that are competing for the host processor's time and preventing it from servicing the HD-SDI Express card.

Overrun count Displays a running count of the total number of receiver buffer overruns. Overruns are defined as pixel data that was received from the camera but due to a lack of space, in the card's on-board receiver FIFOs, had to be discarded. Buffer overruns are an indication that the incoming pixel rate exceeds the bandwidth available on the ExpressCard interface.

Timestamp Displays a running timestamp counter. Each frame that is received from the camera and transferred into host memory is time stamped. This field shows the timestamp value for the last frame processed.

Hex Pixel Dump Window

The Hex Pixel Dump window displays a two-dimensional table of pixel values, plotting row (Y) vs. column (X), for a bounded region of pixels. The hexadecimal value of each pixel is displayed in each cell. For YCrCb-20 and YCrCb-16 formatted images, three values representing Y, Cr and Cb are displayed per pixel. For RGB-24 formatted images, three values representing R, G and B are displayed per pixel. Additionally, the background color of each cell is color encoded.

Hovering the mouse over a given pixel reveals both the pixel's hexadecimal and integer values. In the RGB-24 sample hex dump (see Figure 14) , with the mouse positioned at location 1778,508 (X, Y), a box is revealed showing that the value of the R,G,B components for the pixel at that location is 3C,3B,8E in hexadecimal and 60,59,142 in integer.

A yellow square, overlayed on the main image window, shows the position of the bounded region. Horizontal and vertical scroll bars allow the user to move the position of the bounded region of pixels anywhere within the entire frame.

Another method of opening the Hex Pixel Dump window is to drag the mouse over the main image window while holding down the left mouse button. This creates the yellow box that defines the pixel dump's bounded region and automatically open the Hex Pixel Dump window.

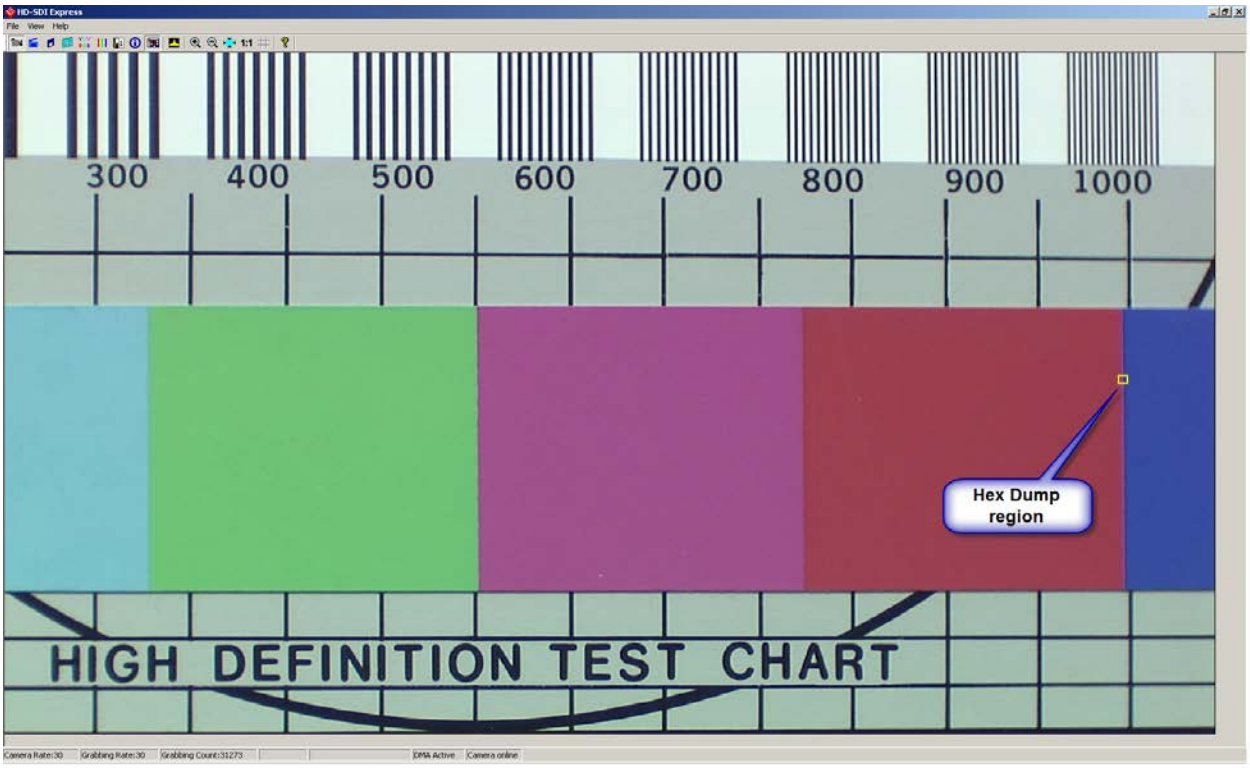


Figure 14 – Sample image with Hex Dump region

In the sample image above, a Hex Dump region was opened starting at the upper left pixel coordinate (X,Y) of 1767,508 and ending at the lower right pixel coordinate of 1780,509. The yellow square indicates the bounded region.

The Hex Pixel dumps for the YCrCb-20 and RGB-24 modes are illustrated in Figures 13 and 14, respectively. Note that in these samples the mouse was hovering over position 1778,508 causing the values for that pixel to be emphasized.

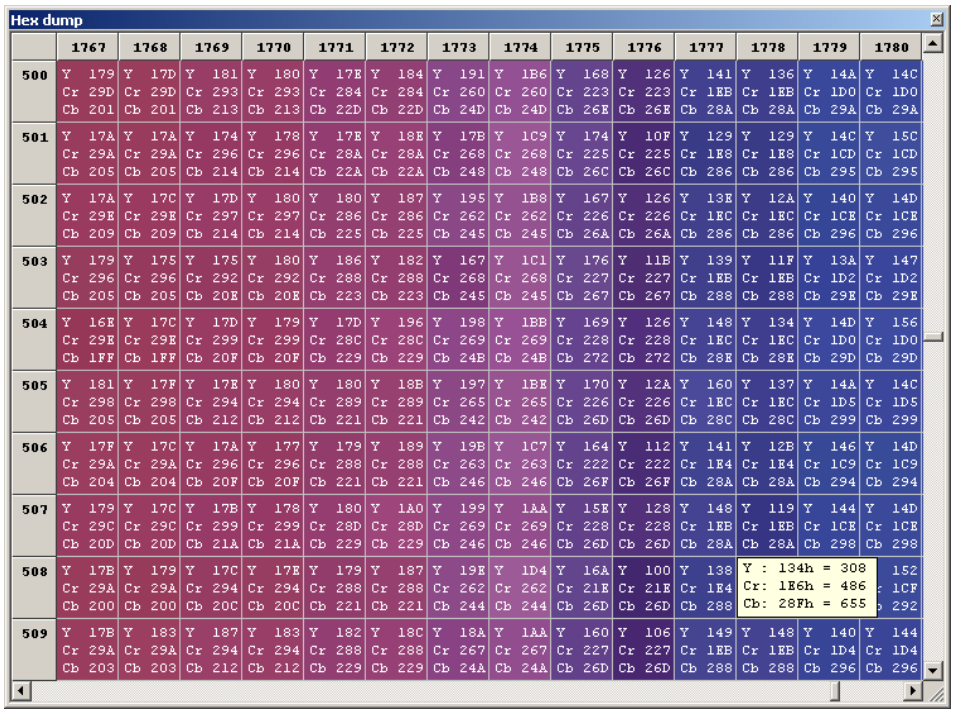


Figure 15 – Hex Dump for YCrCb-20 mode

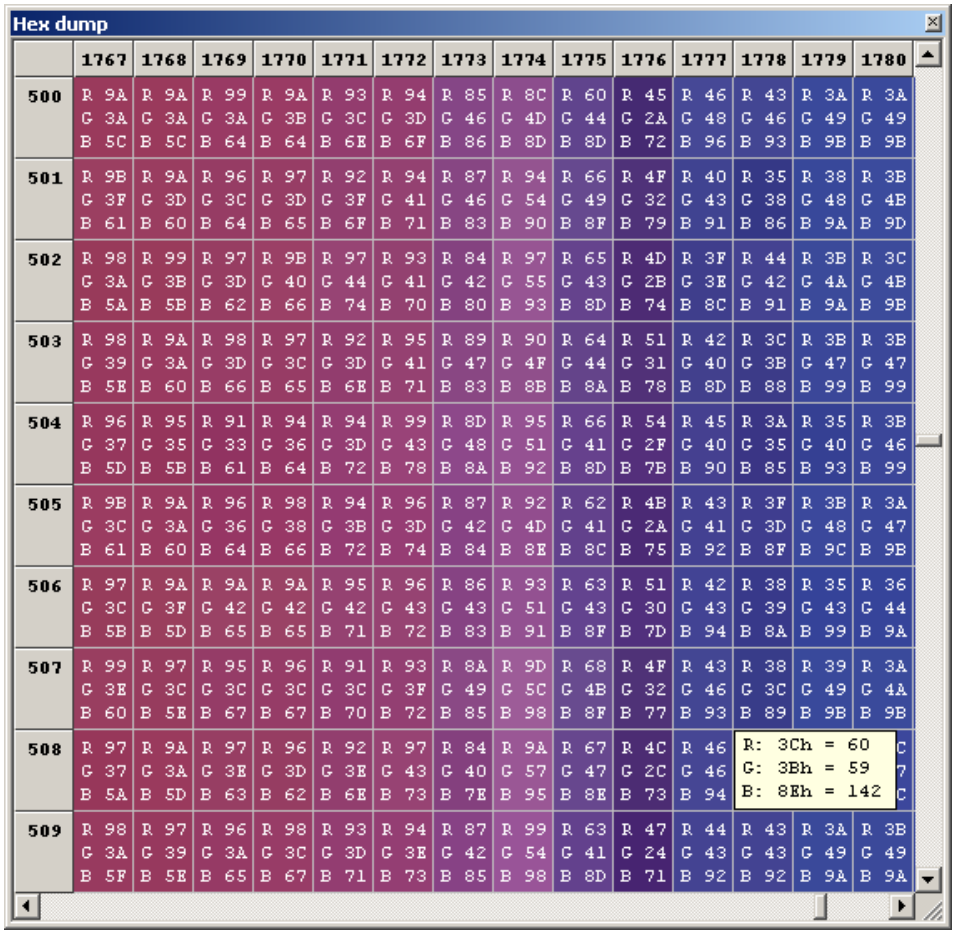


Figure 16 – Hex Dump for RGB-24 mode

Histogram Window

The Histogram window displays three graphs: one per component. When the YCrCb-20 or YCrCb-16 modes are selected, it will display plots for the Y, Cr and Cb components. When the RGB-24 mode is selected, it will display plots for the R, G and B components.

Each plot is a histogram of the current frame, being displayed in the image window, as a function of pixel frequency (Y-axis) vs. pixel value (X-axis). The pixel frequency, in the Y-axis, represents the total number of pixels for a given pixel value. The range of the pixel value, in the X-axis, depends on the mode selected. The range is 1024 (10 bits) for the YCrCb-20 mode and 256 (8 bits) for the YCrCb-16 and RGB-24 modes.

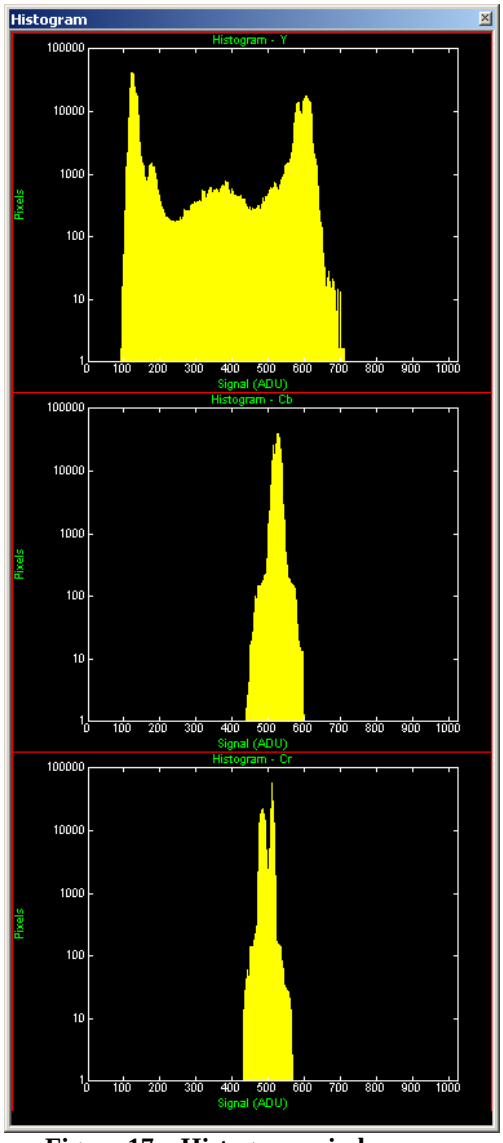


Figure 17 – Histogram window

Zoom Menu

The Zoom menu allows the user to select various zooming and scaling functions. The zoom menu can be invoked via the View item on the Menu bar or by right clicking the mouse over the image window..

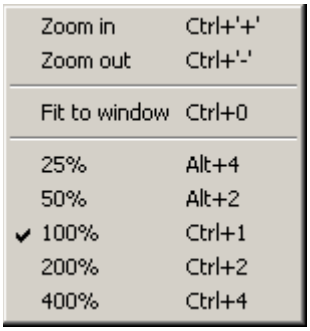


Figure 18 – Zoom menu

Zoom in Causes the displayed image zoom to be increased. The user can hit the 'Ctrl' and '+' keys or the icon from the icon bar as shortcuts.

Zoom out Causes the displayed image zoom to be decreased. The user can hit the 'Ctrl' and '-' keys or the icon from the icon bar as shortcuts.

Fit to window Causes the displayed image to be scaled to fill the entire image window. The user can change the image window by dragging is sides or corners. Note that the Fit to Window function will maintain the aspect ratio of the original image.

25% Causes the displayed image to be 25% of the original image. This scaling factor will also be applied to the saved image files.

50% Causes the displayed image to be 50% of the original image. This scaling factor will also be applied to the saved image files.

100% Causes the displayed image to be 100% of the original image. This scaling factor will also be applied to the saved image files.

200% Causes the displayed image to be 200% of the original image. This scaling factor will also be applied to the saved image files.

400% Causes the displayed image to be 400% of the original image. This scaling factor will also be applied to the saved image files.

Player Control

Clicking on the ‘Play Files’ item under the ‘File’ pull-down menu at the top of the HD-SDI Express main window causes two windows to appear: the ‘Player Control’ and ‘Player Dialog’ windows. These windows can be moved anywhere around the screen to suit your needs.

The Player Control window is used to select the pre-recorded image or movie files that you wish to view.

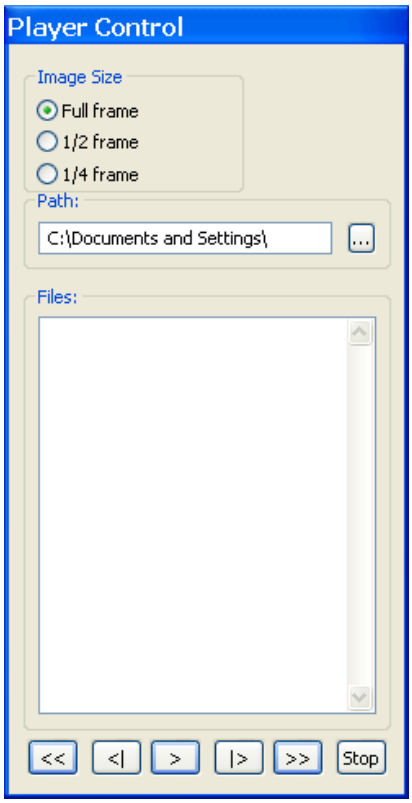


Figure 19 – Player Control dialog

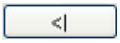
Image Size Determines the size of the Player Dialog window and the playback image. Changing from one scale to another automatically updates the Player Dialog window and image size.

Path This text field allows you to enter the name of the folder or directory containing the image or movie files. Clicking on the ‘…’ box will cause a Windows ‘browse’ box to appear.

Files This box lists all of the image or movie files that are in the folder selected under ‘Path’.

Rewind 

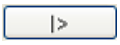
Displays the first image in the series.

Step Backwards 

Displays the previous frame or image. Use this button to back through individual frames of an AVI Movie. Play must be paused for this button to work on AVI Movies.

Play 

Begins playing the AVI movie. If you are viewing JPEG or BMP images, clicking this button displays a series of images (one after another) starting from the current file selected in the Player Control dialog.

Step Forward 

Displays the next frame or image. Use this button to advance through individual frames of an AVI Movie. Play must be paused for this button to work on AVI Movies.

Fast Forward 

Displays the last image in the series.

Stop 

Halts current playback.

Player Dialog

The Player Dialog window appears when the user selects the ‘Play Files’ item under the ‘File’ pull-down menu at the top of the HD-SDI Express main window. The Player Dialog window provides the primary area for viewing playback of pre-recorded images or movies. This window can be moved anywhere around the screen to suit your needs.

The size of the window (and image) is determined by the size of the image file selected in the ‘Player Control’ window and can be scaled using the ‘Image Size’ option. For example, if the user selects an image file that was produced by a 1920x1080 resolution camera, then the ‘Full frame’ window size will be 1920x1080. In this example, selecting ‘½ frame’ produces a window size of 960x540 and selecting ‘¼ frame’ produces a size of 480x270.

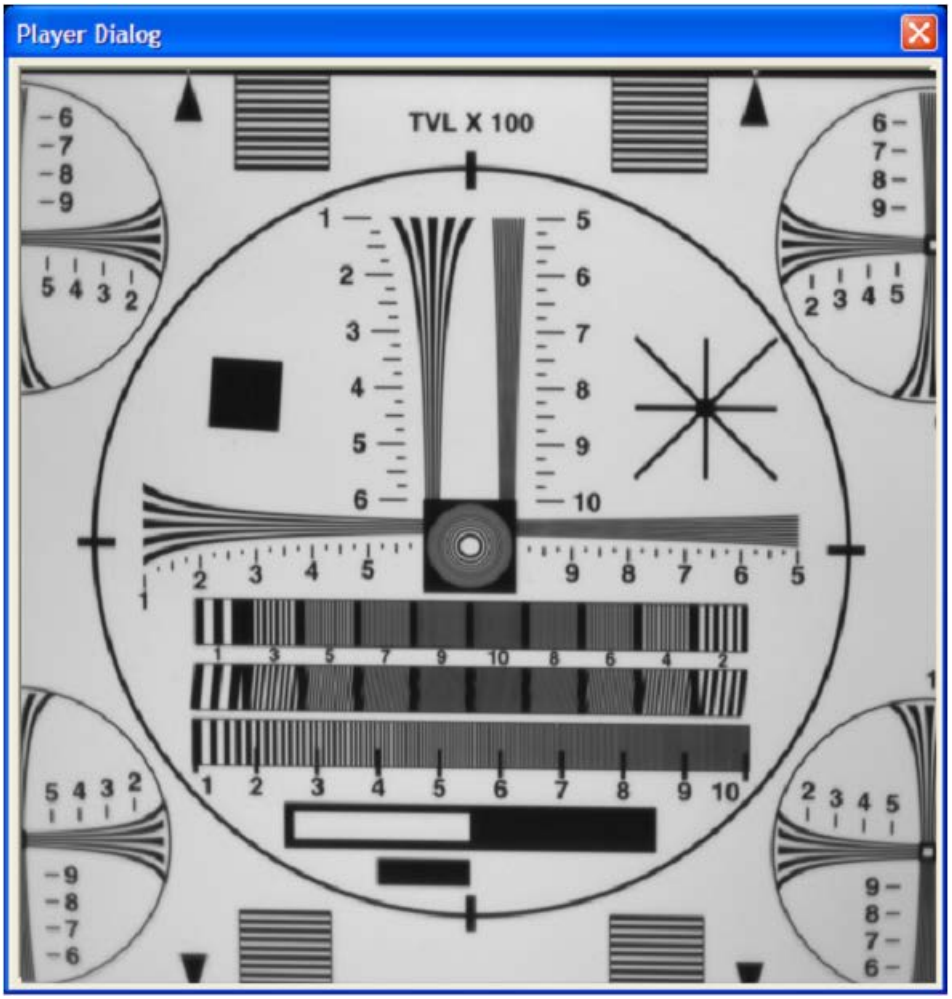
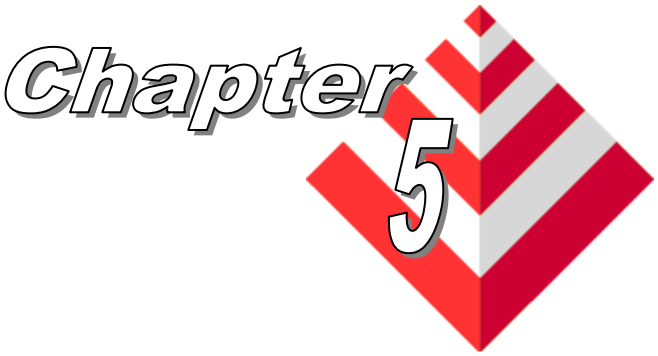


Figure 20 – Player Dialog



Electrical Interfaces

This chapter contains information on the HD-SDI Express card’s connectors.

SDI Connector

The SDI connector is a 75 ohm, right angle, coax BNC jack.
The manufacturer is Trompeter Electronics, part number UCBBJR29.

ExpressCard Connector (VCE-HDEX02/HDEX03 only)

The ExpressCard connector is a surface mount, right angle, 26 position, female connector.

Pin #	Signal name	In/Out	Note
1	GND		
2	USBD-	I/O	not used
3	USBD+	I/O	not used
4	CPUSB#	O	not used
5	reserved		
6	reserved		
7	SMBCLK	I/O	not used
8	SMBDATA	I/O	not used
9	+1.5V		
10	+1.5V		
11	WAKE#	O	3
12	3.3VAUX		5
13	PERST#	I	4
14	+3.3V		
15	+3.3V		
16	CLKREQ#	O	2
17	CPPE#	O	1
18	REFCLK-	I	
19	REFCLK+	I	
20	GND		
21	PERn0	O	
22	PERp0	O	
23	GND		
24	PETn0	I	
25	PETp0	I	
26	GND		

Table 6 – ExpressCard Connector Pin-out

Notes:

1 – CPPE# indicates to the host that the card has been inserted.

2 – CLKREQ# indicates to the host that the card is requesting that the REFCLK be provided. This is a Power Management function and is not implemented on the HD-SDI Express.

3 – WAKE# is used to notify the host that it should re-apply power to the card. This is a Power Management function and is not implemented on the HD-SDI Express.

4 – PERST# is a reset signal driven by the host to reset the card.

5 – 3.3VAUX is used to power the WAKE# circuitry. This is a Power Management function and is not implemented on the HD-SDI Express.

PCIe x1 Connector (VCE-HDPCIe01 only)

The PCIe x1 connector is a vertical, edge-finger, two-sided, 36 position connector. Side B is on the primary (component) side and Side A is on the secondary (solder) side. Both pins A1 and B1 are closet to the I/O bracket.

	Side B				Side A		
Pin #	Signal name	In/Out	Note	Pin #	Signal name	In/Out	Note
B1	+12V			A1	PRSNT1#	O	5
B2	+12V			A2	+12V		
B3	+12V			A3	+12V		
B4	GND			A4	GND		
B5	SMBCLK	I	1	A5	JTAG_TCK		2
B6	SMBDAT	I/O	1	A6	JTAG_TDI		2
B7	GND			A7	JTAG_TDO		2
B8	+3.3V			A8	JTAG_TMS		2
B9	JTAG_TRST#	I	2	A9	+3.3V		
B10	3.3Vaux		3	A10	+3.3V		
B11	WAKE#	O	2	A11	PERST#	I	6
B12	reserved			A12	GND		
B13	GND			A13	REFCLK+	I	
B14	PETp0	I	7	A14	REFCLK-	I	
B15	PETn0	I	7	A15	GND		
B16	GND			A16	PERp0	O	7
B17	PRSNT2#	O	5	A17	PERn0	O	7
B18	GND			A18	GND		

Table 7 – PCIe x1 Connector Pin-out

Notes:

1 – The SMB Bus is not implemented.

2 – The JTAG interface is not implemented.

3 – 3.3Vaux is used to power the WAKE# circuitry. This is a Power Management function and is not implemented.

4 – WAKE# is used to notify the host that it should re-apply power to the card. This is a Power Management function and is not implemented.

5 – PRSNT1# is tied to PRSNT2# and is used by the host to sense card insertion/removal.

6 – PERST# is a reset signal driven by the host to reset the card.

7 – Direction for transmit and receive signals are relative to the host.

COM Port Connector (VCE-HDPCIe01 only)

The COM Port connector is a 6-pin circular Hirose-style male jack. It includes both RS232 and RS485 interfaces.

Pin #	Signal Name	Pin #	Signal Name
1	RS232_Rx	2	RS485+
3	RS232_Tx	4	RS485_COM
5	RS232_COM	6	RS485-

Table 8 – COM Port Connector Pin-out

Specifications

Video Source

SDI with video data at rates of 1.485 Gbps via a single BNC connector.

Analog serial interface formatted per SMPTE 292M with:

- SMPTE 274M framing providing 1080i (60 fields/sec)
- SMPTE 274M framing providing 1080p (30 frames/sec).
- SMPTE 296M framing providing 720p (60 frames/sec).

Formats supported:

- 1080p 30/25/24 fps
- 1080i 60/50 fps
- 720p 60/50/30/25/24 fps
- SD

Physical Dimensions

PCIe	: 84mm x 69mm (3.3 x 2.7 in).
ExpressCard/54	: 108mm x 54mm x 18mm (4.3 x 2.1 x .7 in).
ExpressCard/34	: 108mm x 34mm x 18mm (4.3 x 1.3 x .7 in).

Weight

PCIe	: 45.0 grams (1.59 oz)
ExpressCard/54	: 53.6 grams (1.91 oz)
ExpressCard/34	: 35.9 grams (1.27 oz)

Electrical Characteristics

Operating voltage:	3.3V +/- 5%
Operating current:	500mA

Operating Environment

Operating temperature:	0°C to 65°C
Relative humidity:	90% non-condensing

Regulatory

FCC 15 part B, CE, RoHS

Creating Lookup Tables

This appendix provides a reference on how to create a lookup table using both an ASCII editor and an Excel spreadsheet.

A.1 Overview

The Lookup Table file can be created using any standard ASCII text editor or by using Microsoft Excel. Additionally, any spreadsheet or mathematical program capable of generating a comma delimited file can be used.

A.2 Using an ASCII text editor

A custom LUT can be prepared using any ASCII text editor. Alternatively, any spreadsheet program (i.e. Microsoft Excel) can be used by converting the spreadsheet into a comma delimited (.csv) file. In either case, the file must be renamed to include the .lut extension.

Each line in the file represents an input value and a set of three output values for R, G and B. The type of the inputs and outputs is decimal with a range 0 to 255. The input values represent incoming pixels and the output values represent what each incoming pixel should be converted to. Lines preceded by two dashes are comment lines and are ignored by the parser.

The format of the .LUT file is as follows:

```
--
-- Lines beginning with two dashes are comments
-- and are ignored by the parser
--
-- Input,Output_R,Output_G,Output_B
--
0,r0,g0,b0
1,r1,g1,b1
2,r2,g2,b2
:
255,r255,g255,b255
```

For example:

```
-- HD-SDI Express RGB Lookup Table
--
-- This provides a digital offset of 32 for Red,
-- 64 for Green and 128 for Blue
--
-- Input,Output_R,Output_G,Output_B
--
0,32,64,128
1,33,65,129
2,34,66,130
:
255,255,255,255
```

A.3 Using Microsoft Excel

The .LUT file can be created in Excel as follows:

1 - create the spreadsheet as shown below (note that 256 rows are required in the pixel table).

2 - add the necessary equations into the output cells to generate the transfer function required.

3 - save the file as a .csv (comma delimited format).

4 - rename the .csv file to an extension of .lut.