



VCE Express™

User's Manual

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Chapter

1

Introduction

This chapter outlines the key features of the Imperx VCE Express card.



VCE Express

The VCE Express frame grabber is a 54mm ExpressCard with both an NTSC/PAL analog interface and a PCI Express x1 lane interface. It provides the ability to capture analog NTSC/PAL video data, from either a CVBS or S-Video source, and transfer that data to host memory via an ExpressCard (PCIe) interface.

Functionality

- Provides two composite or S-Video inputs.
- Captures video data from a standard NTSC, PAL, SECAM or RS170 analog source, formats this data and stores it into local FIFOs.
- Data can be formatted as 16 bit YCrCb 4:2:2, 16 bit YCrCb 4:4:4 or as 24 bit RGB.
- Retrieves the formatted data from the FIFOs and transfers it into host memory via a scatter/gather DMA over the x1 lane PCI Express interface.
- Provides an external triggering capability that can qualify image capture based on an external signal.
- Provides the ability to upgrade the FPGA firmware in the field by the user.

Interfaces

Analog interface

The VCE Express provides two CVBS (composite) or two S-Video inputs using either an 8-pin circular connector (model VCE-EXPRESS) or discrete embedded cables (model VCE-EXPRESS-F).

ExpressCard interface

The VCE Express provides a ExpressCard/54 compliant interface. This supports a x1 lane ‘end-point’ PCI Express interface as defined in the ExpressCard standard. The design does not support any memory mapped or I/O mapped peripherals on the card. Access to the card’s pixel data FIFOs is achieved through DMA operations that move the data from the FIFOs into host memory. Access to the card’s pointer queue FIFOs is achieved through DMA operations that move the data from host memory into the FIFOs. The host cannot directly access the contents of either of these 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 VCE Express card design.

A functional block diagram of the VCE Express card is illustrated in Figure 1.

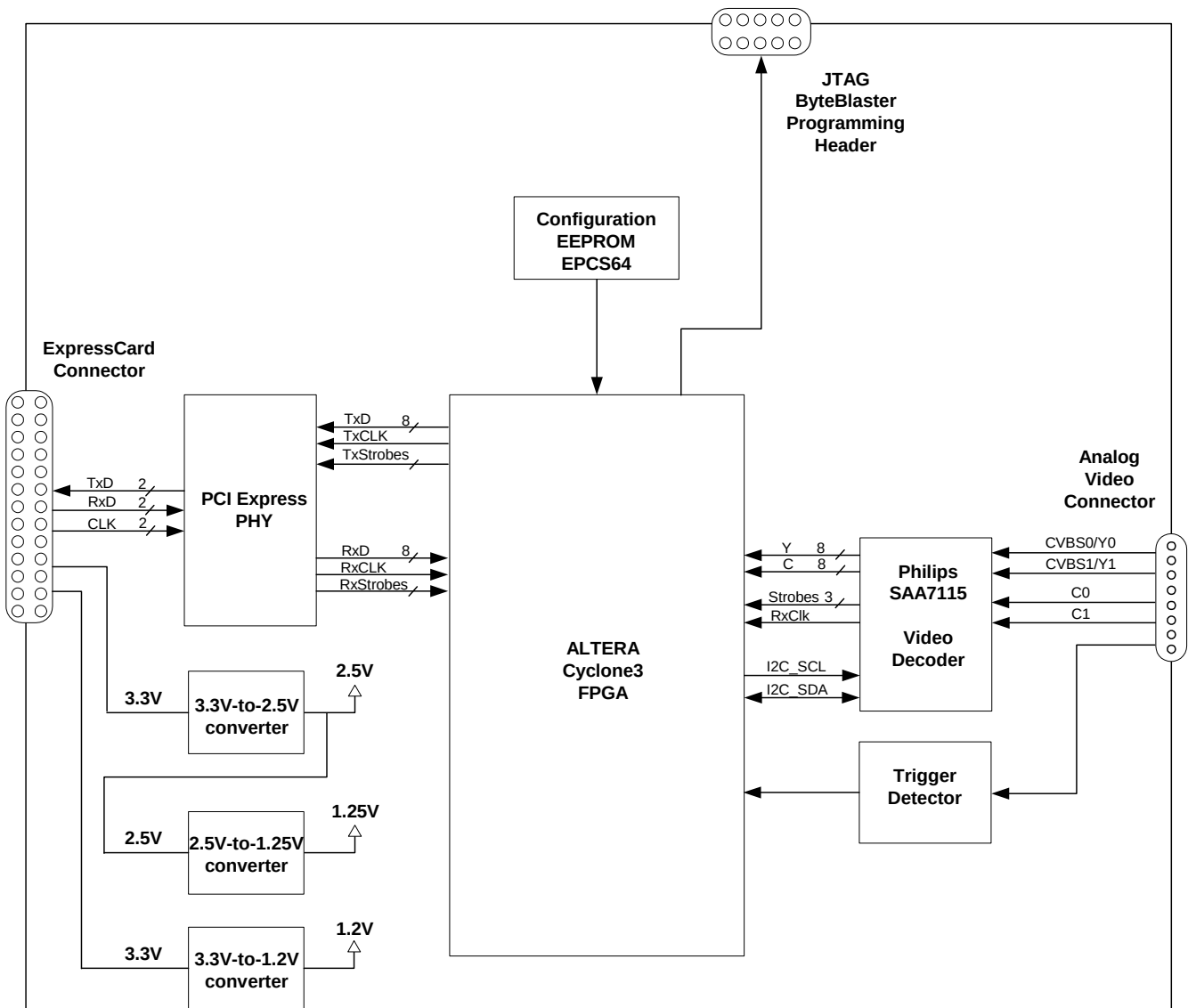


Figure 1 – VCE Express Block Diagram

Video Capture

The video capture engine is responsible for receiving video pixel data and qualifiers from the video decoder, formatting the data and transferring it into on-board memory. The module receives 16 bits of video data organized as 8 bits of Luma data and 8 bits of Chroma data as well as VSYNC, HSYNC and DATA_EN strobes. 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-4:2:2 mode – uses the 16 bit YCrCb 4:2:2 data received from the video decoder.
- YCrCb-4:4:4 mode – uses the 16 bit YCrCb 4:2:2 data received from the video decoder and translates it to 24 bit YCrCb 4:4:4 data using a chroma resampler function.
- RGB-24 mode – uses the 16 bit YCrCb 4:2:2 data received from the video decoder and translates it to 24 bit YCrCb 4:4:4 data using a chroma resampler function and then generates 24 bit RGB data using a color space converter function.

The video_capture module translates the video data into doublewords (64 bits) as defined in tables 3.2 thru 3.4. These formats 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	
Cr7	Cr6	Cr5	Cr4	Cr3	Cr2	Cr1	Cr0	Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0	Cb7	Cb6	Cb5	Cb4	Cb3	Cb2	Cb1	Cb0	Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0	YCrCb
Cr7	Cr6	Cr5	Cr4	Cr3	Cr2	Cr1	Cr0	Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0	Cb7	Cb6	Cb5	Cb4	Cb3	Cb2	Cb1	Cb0	Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0	4:2:2

Table 1 – Pixel mapping into memory : YCrCb 4:2:2 mode – 4 pixels/DW

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	
-	-	-	-	-	-	-	-	Cr7	Cr6	Cr5	Cr4	Cr3	Cr2	Cr1	Cr0	Cb7	Cb6	Cb5	Cb4	Cb3	Cb2	Cb1	Cb0	Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0	YCrCb
-	-	-	-	-	-	-	-	Cr7	Cr6	Cr5	Cr4	Cr3	Cr2	Cr1	Cr0	Cb7	Cb6	Cb5	Cb4	Cb3	Cb2	Cb1	Cb0	Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0	4:4:4

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

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	
-	-	-	-	-	-	-	-	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
-	-	-	-	-	-	-	-	R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0	24

Table 3 – Pixel mapping into memory : RGB-24 mode – 2 pixels/DW

Chroma Resampler

This module is responsible for receiving YCrCb 4:2:2 video pixel data from the video decoder, 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

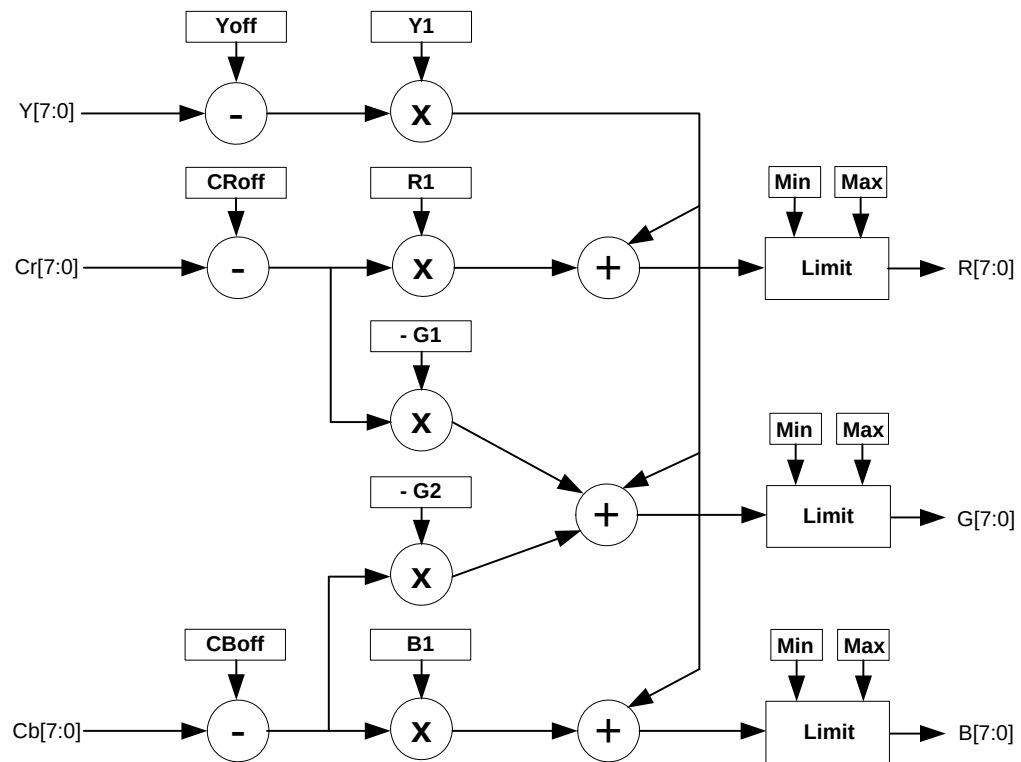


Figure 2 – Color Space Converter

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.
DMA	The DMA engine is responsible for reading formatted pixel 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 VCE 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 VCE Express card, you need the following:

- A computer with a ExpressCard/54 slot.
- Microsoft Windows XP/2000/Vista operating system software.
- A computer with at least 256M bytes of RAM.
- A CD drive, and a hard disk on which to install the VCE Express software.

Inspecting the VCE Express package

When you unpack your VCE 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 VCE Express card
- A VCE Express cable (circular plug to S-Video connectors)
- An adapter cable (S-Video to RCA)
- A CD with the VCE Express software suite
- A 'Quick Start' installation guide

Chapter

2



Hardware Installation

Installing the VCE Express card is as simple as plugging it into an available ExpressCard/54 slot on your computer.

Chapter 3

Software Installation

This chapter explains how to install the VCE Express software.

Software Suite

The VCE Express software suite consists of the following files:

Windows application files:

(located in *C:\Program Files\ImperX\VCE Express\Application\Win32* and *C:\Program Files\ImperX\VCE Express\Application\x64*)

VCE Express.exe	- Application program
VCEANCB.dll	- VCE Express SDK library
DrvManager.exe	- Driver debug utility
VCE Express.chm	- Help file
ippLib.dll	- Intel image processing library
IpxLog.dll	- Imperx logging library
IpxMisc.dll	- Imperx miscellaneous library
IpxMovieMaker.dll	- Imperx movie maker library
DSMovieWriter.ax	- Movie Writer DirectShow filter

Windows driver files:

(located in *C:\Program Files\ImperX\VCE Express\Drivers\Kernel*)

- WinXP/2000/Vista kernel driver files

Software Development Kit (SDK) files:

(located in *C:\Program Files\ImperX\VCE Express\SDK*)

/bin/ folder	- binaries
/doc/ folder	- documentation

/examples/ folder	- sample source code
/inc/ folder	- include files
/lib/ folder	- libraries

Documentation files:

(located in *C:\Program Files\ImperX\VCE Express\Doc*)

VCE_Express_Users_Manual.pdf	- User manual document
VCE_Express_Datasheet.pdf	- Technical datasheet
QUICK START VCE_EXPRESS.pdf	- Quick start manual

Note that our VCE Express application program was created using our SDK (software developers kit). Our SDK is included in the standard VCE Express software suite that comes with the card.

Software Installation from CD

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

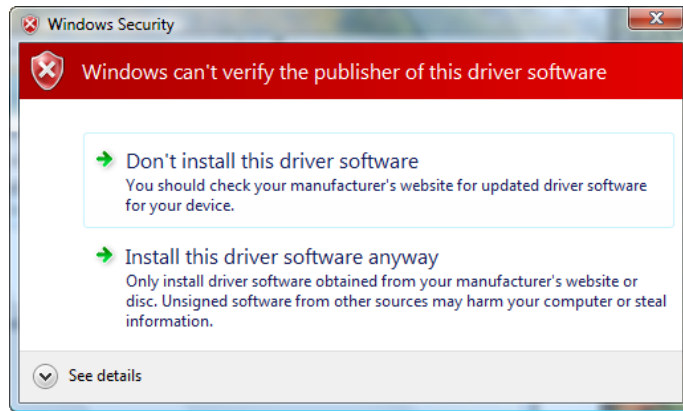
1. If a version of VCE Express was previously installed on this machine, then you must first remove it:

To remove the application files:

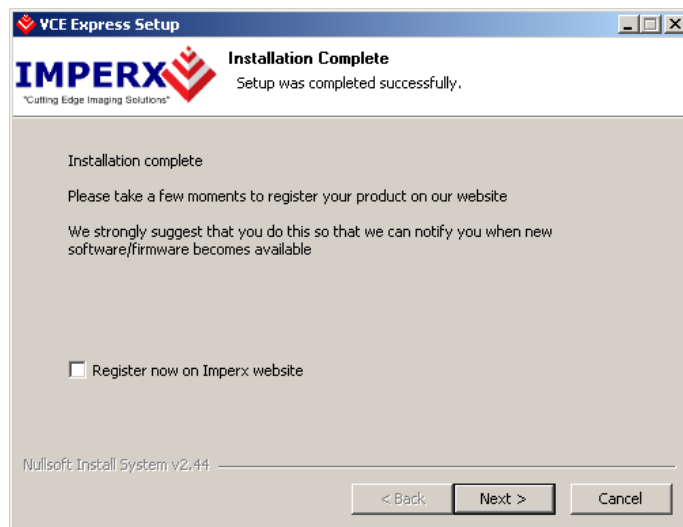
- 1.1 Click on "*Start*".
 - 1.2 Click on "*Settings*".
 - 1.3 Click on "*Control Panel*".
 - 1.4 Double click on "*Add or Remove Programs*".
 - 1.5 Click on "*VCE Express*".
 - 1.6 Click on "*Remove*".
 - 1.7 If the 'VCE Express – InstallShield Wizard' pops-up then do the following, otherwise go to 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 VCE Express was NOT previously installed on this machine then:

The first step is to install the application files:

- 2.1 Insert the VCE 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 "VCE Express - InstallShield Wizard" screen to appear.
- 2.3 Follow the on-screen instructions.
- 2.4 For Vista, click on "*Install this driver software anyway*" 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 “*Finish*”. This completes the software installation.
- 2.7 Reboot your computer.

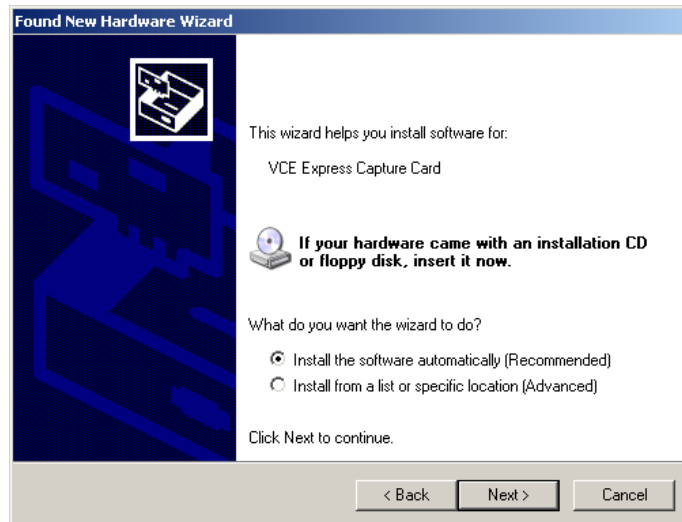
The next step is to install the driver files:

- 2.8 Insert the VCE 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:

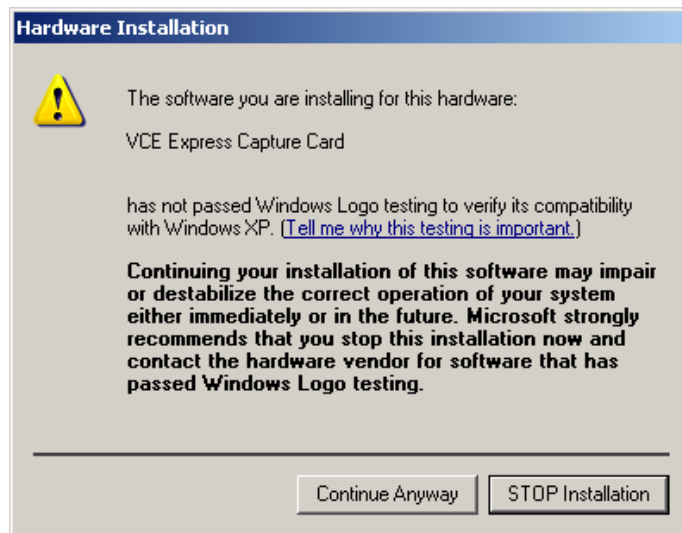


If this message appears, click *“No, not this time”*, then click *“Next”*.

- 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 VCE Express. You can retrieve these updates by visiting the download page of our web site at:

http://www.imperx.com/frame_grabbers/VCE_Express/VCE_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 VCE_Express_Installer.exe file from the Imperx web site to a new folder on your PC (we will use the folder C:\new_VCE_Express as an example).
- 3.3 Left mouse click on "*Start*", "*Run*", enter or browse to C:\new_VCE_Express\VCE_Express_Installer.exe.
- 3.4 Left mouse click on "*Open*", then "*OK*".
- 3.5 Follow the instructions starting from step 2.2 above.

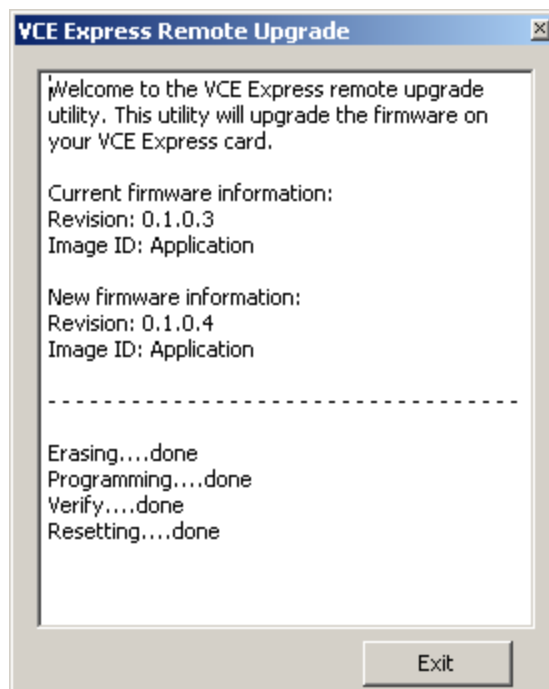
Firmware Upgrade from Web Site

Your newly received VCE 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/VCE Express/VCE_Express_downloads.php](http://www.imperx.com/frame_grabbers/VCE%20Express/VCE_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 VCE 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:



Chapter **4**



Using the VCE Express card

This chapter contains information on how to configure and use the VCE Express card.

Running the VCE Express Application

The VCE_Express.exe program supplied with the VCE 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 VCE Express card and to view, record and playback video data received from the analog 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 VCE Express program, simply double left mouse click on the 'VCE 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 VCE Express application is executed, a main window titled 'VCE Express' will appear. The main window provides the primary area for viewing real-time images received from the video source. This window can be sized and moved to suit your needs. When image viewing is active, the size of this window will automatically be scaled as a function of the input signal.

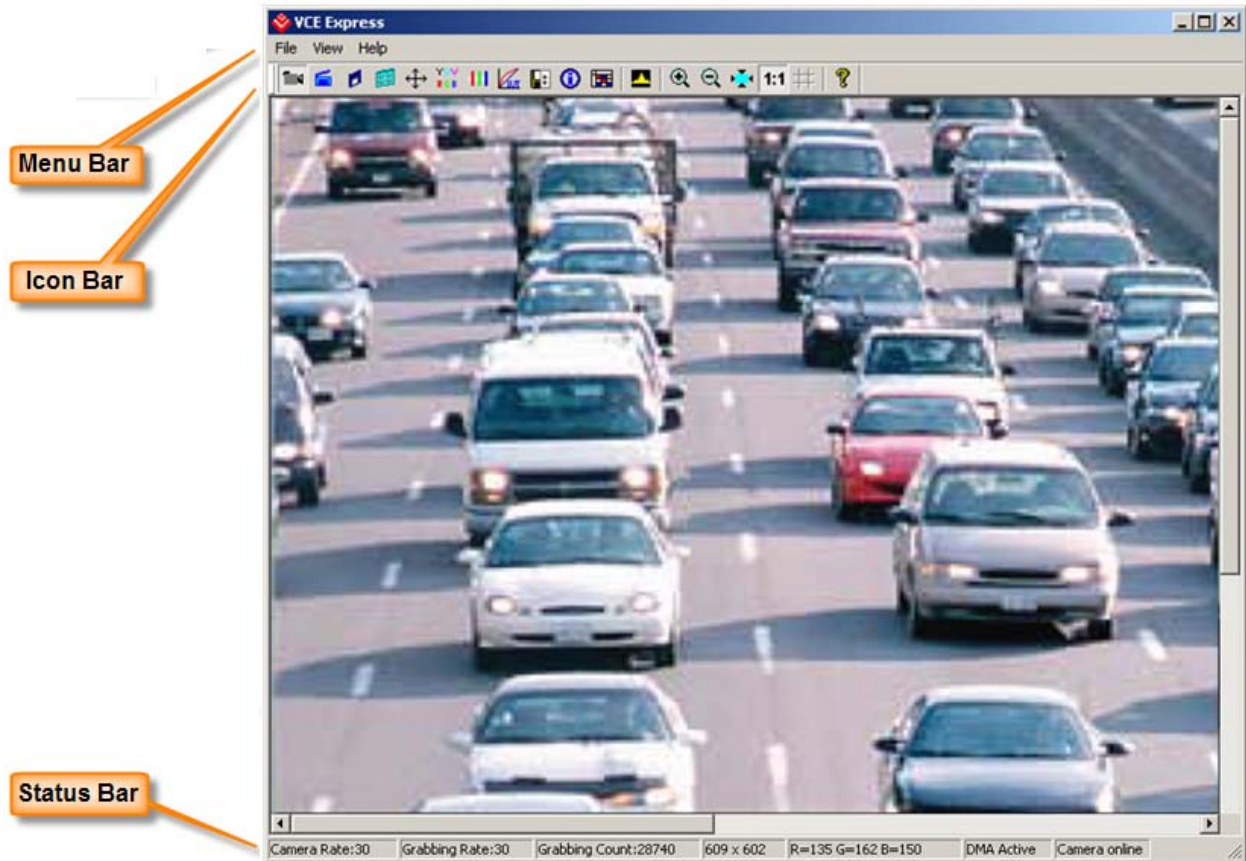


Figure 3 – Main dialog

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:
Control Panel	Causes the 'Control Panel' dialog to appear.
Video Size	Causes the 'Video Size' 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 **Control Panel** dialog



Open **Video Size** 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 video source connection.

Camera Rate

Displays the real-time frame rate of the attached video source as measured at the input of the VCE 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 VCE Express to acquire video data by clicking on the 'Start Grab' button and that the video source is providing valid framing.

'**Inactive**' indicates that either the user has commanded the VCE Express to stop acquiring video data by clicking on the 'Stop Grab' button or that grabbing is enabled but the video source is not providing valid framing.

Camera Status

Displays the real-time status of the attached video source as being either '**online**' or '**offline**'.

'**Online**' indicates that a video source is powered on, attached and providing a video clock via the analog interface.

'**Offline**' indicates that the VCE Express card is not receiving a video clock from the attached source either because the source is powered off or the video cable is disconnected.

Control Panel Dialog

The Control Panel dialog allows the user to control the operating parameters of the VCE-Express card and also reports the attributes of the attached video source.

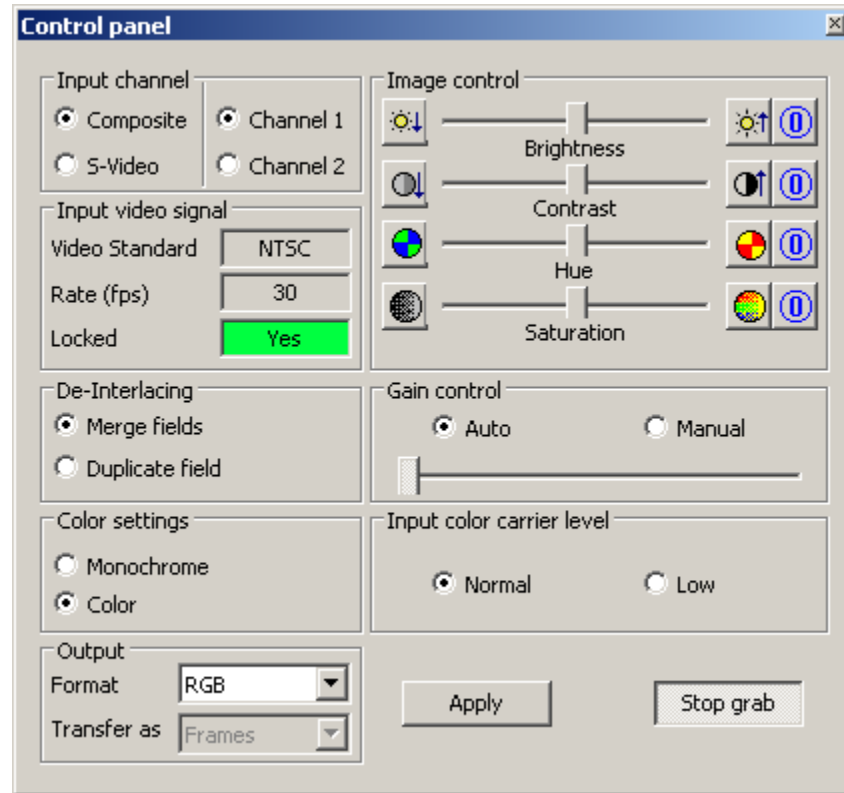


Figure 4 – Control Panel dialog

Input Channel

Controls the video source selection.

Composite

Select this if the video source is a composite signal.

S-Video

Select this if the video source is an S-Video signal.

Channel 1

Select this if the video source is connected to input channel #1.

Channel 2

Select this if the video source is connected to input channel #2.

Input video signal

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

Video Standard

Indicates the format of the connected video source as either 'NTSC' or 'PAL'.

Mode

Indicates the mode as either 'Progressive' or 'Interlaced'.

Rate (fps)	Indicates the rate of the connected video source. 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'.
Locked	Indicates that the card is locked to an incoming video signal.
De-Interlacing	These options control how to process the odd and even fields of an interlaced input video signal.
Merge Fields	Instructs the card to interleave lines from the odd and even fields to produce a progressive frame. For example: for a 640*480 input, the resultant progressive frame will consist of: <pre> Line1 = odd_field_line1 Line2 = even_field_line1 Line3 = odd_field_line2 Line4 = even_field_line2 : Line479 = odd_field_line240 Line480 = even_field_line240 </pre>
Duplicate Fields	Instructs the card to duplicate every line of the odd field to produce the resultant frame. The even field is ignored. For example: for a 640*480 input, the resultant frame will consist of: <pre> Line1 = odd_field_line1 Line2 = odd_field_line1 Line3 = odd_field_line2 Line4 = odd_field_line2 : Line479 = odd_field_line240 Line480 = odd_field_line240 </pre>
Input Color Carrier Level	This selection informs the card of the strength on the incoming color signal. If the input signal's strength is low (due to a worn VCR head or excessive cabling) then set this field to 'Low' otherwise set it to 'Normal'.
Color Settings	Specifies the video mode as either monochrome or color.
Output	These fields determine how the card should process the incoming video data.
Format	Indicates how the card should format the video data prior to transferring it into host system memory.

YCrCb – 4:2:2	Use the 16 bit YCrCb 4:2:2 data received from the video decoder as is.
YCrCb – 4:4:4	Use the YCrCb 4:2:2 data received from the video decoder and translate it to YCrCb 4:4:4 data using a chroma resampler function.
RGB - 24 bit	Use the YCrCb 4:2:2 data received from the video decoder, translate it to YCrCb 4:4:4 data using a chroma resampler function and then generate 24 bit RGB data using a color space converter function.

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 video source).

Fields Transfer each field individually.

Image Control These controls allow the user to adjust the brightness, contrast, hue and saturation of the image.



Brightness Moving the slider right increases brightness causing more white while moving it left decreases brightness causing less white.



Contrast Moving the slider right increases contrast causing greater differences between dark and light while moving the slider left decreases contrast causing fewer differences between dark and light.



Hue Moving the slider right increases hue causing an increase in the intensity of Red and Yellow while moving the slider left causes an increase in the intensity of Blue and Green.



Saturation Moving the slider right increases saturation causing white to be removed from the colors while moving the slider left decreases saturation causing white to be added to the colors.



Reset Causes the slider to revert back to its default setting.

Gain Control Determines how the video decoder's AGC (automatic gain control) circuit processes the incoming video signal.

Auto	Enables the video decoder's AGC circuit to automatically adjust the gain.
Manual	Disables the video decoder's AGC circuit and instead applies the gain selected by the slider.
Apply	Causes the application to apply the current settings to the VCE Express card.
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 VCE Express's DMA engine and causes the main window to display live images received from the video source. Clicking on 'Stop Grab' disables the DMA engine and causes the display to freeze.

Video Size Dialog

The Image Size dialog allows the user to 'crop' the size of the incoming image. Some video sources produce extra black columns or rows that the user may wish to remove from the image. There are two ways to remove these extraneous pixels: manually using the 'Input video signal' parameters or automatically using the 'Auto Crop' feature.

The Image Size dialog also allows the user to 'scale' the size of the output (displayed) image. The user can up-scale or down-scale the image in order to produce an image that matches his screen's resolution.

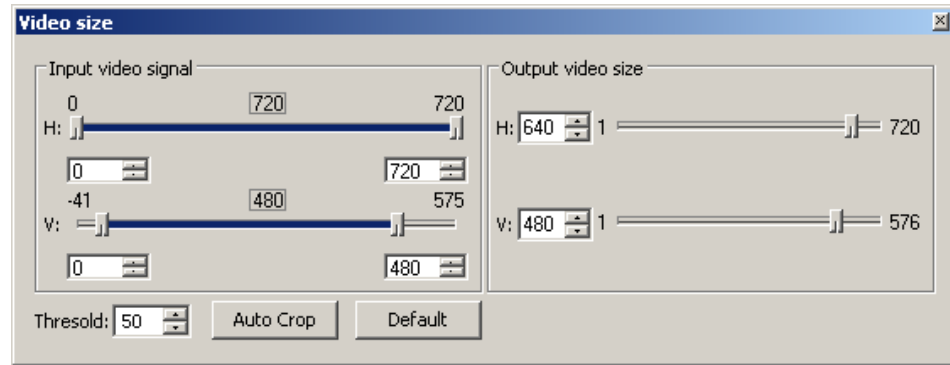


Figure 5 – Video Size dialog

- Input video signal** Allows the user to manually crop the image. Note that as an alternative to using the sliders, the user can enter the start and end values into the edit boxes.
- H:** This slider defines the starting and ending horizontal pixels in each row and thereby deletes any leading (left most) or trailing (right most) columns in the image.
- V:** This slider defines the starting and ending vertical lines and thereby deletes any leading (top most) and trailing (bottom most) rows in the image.
- Output video size** Allows the user to manually scale (up or down) the size of the image to be displayed. For example: the input size may be 720*480 but the image to be displayed can be down-scaled to 640*480. Note that as an alternative to using the sliders, the user can enter the width (H) and height (Y) values into the edit boxes.
- H:** This slider defines the width (i.e. number of horizontal pixels in each row) of the image to be displayed.
- V:** This slider defines the height (i.e. number of vertical lines) of the image to be displayed.
- Auto Crop** Clicking on this button invokes an algorithm performed by the VCE-Express software that scans an image from left-to-right, right-to-left, top-to-bottom and bottom-to-top looking for a transition in the pixel intensity from black to a threshold value. It will then note the number of black pixels and adjust the H: and V: parameters accordingly.
- Threshold** This field allows the user to define the threshold value to be used by the Auto Crop algorithm.
- Default** Click this button to revert back to the default H: and V: settings.

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-4:2:2 or YCrCb-4:4:4 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.

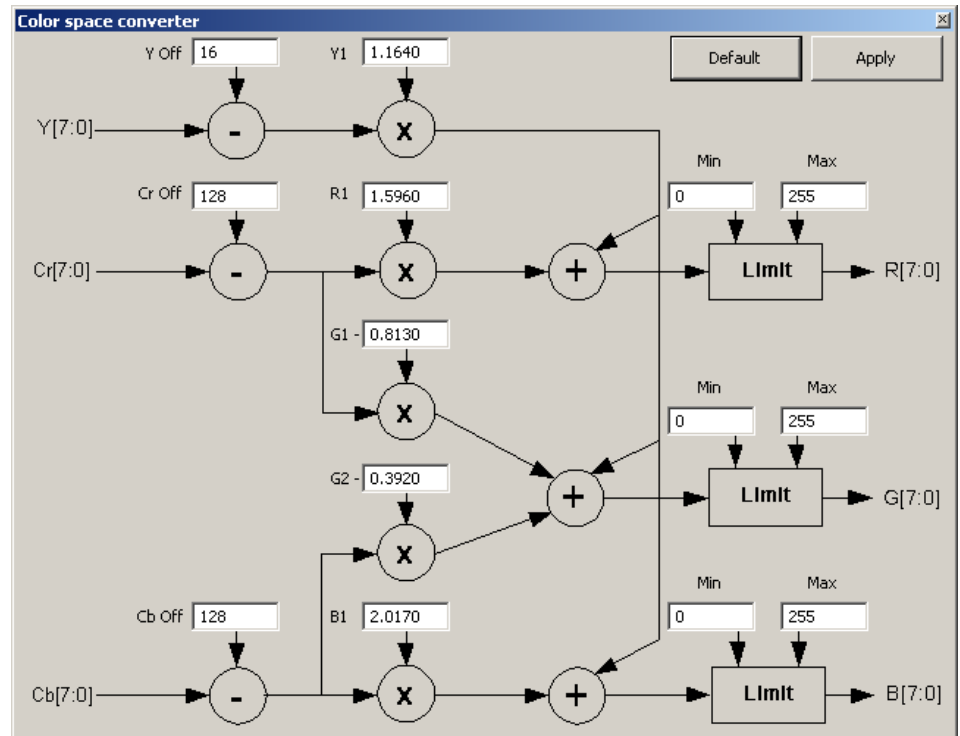


Figure 6 – Color Space Converter dialog

Default

Sets all parameters back to their default values.

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-4:2:2 or YCrCb-4:4:4 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.

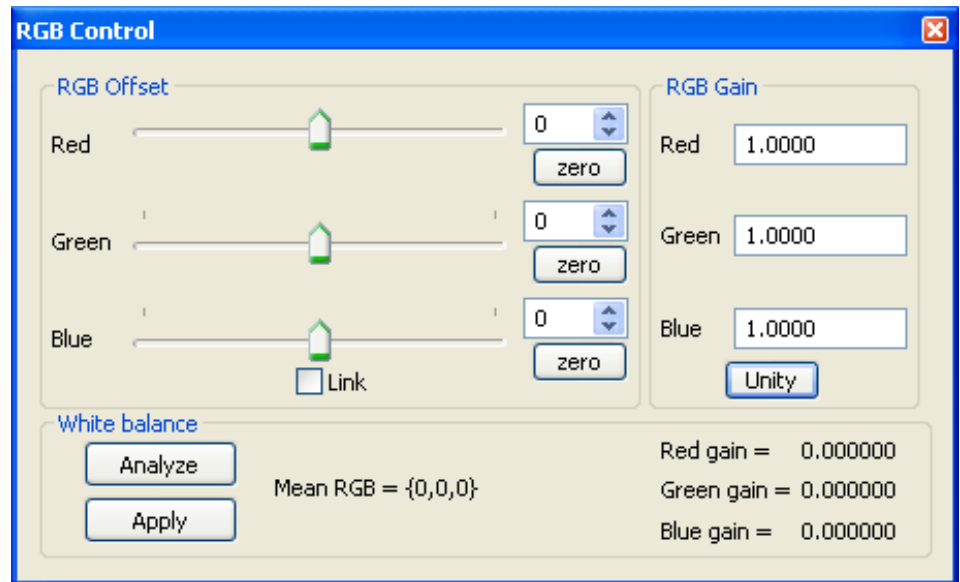


Figure 7 – RGB Control dialog

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 VCE Express card to analyze the current image received from the video source 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 video source at a uniform white target.
Apply	Instructs the VCE 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 VCE 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 VCE Express application can automatically create gamma lookup tables. It can also create custom lookup tables using an interactive drawing feature.

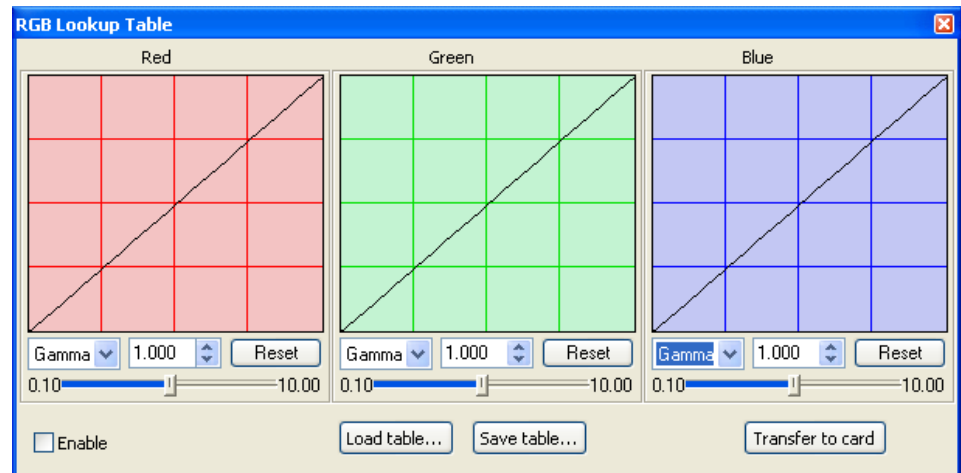


Figure 8 – RGB Lookup Table dialog

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 VCE 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).

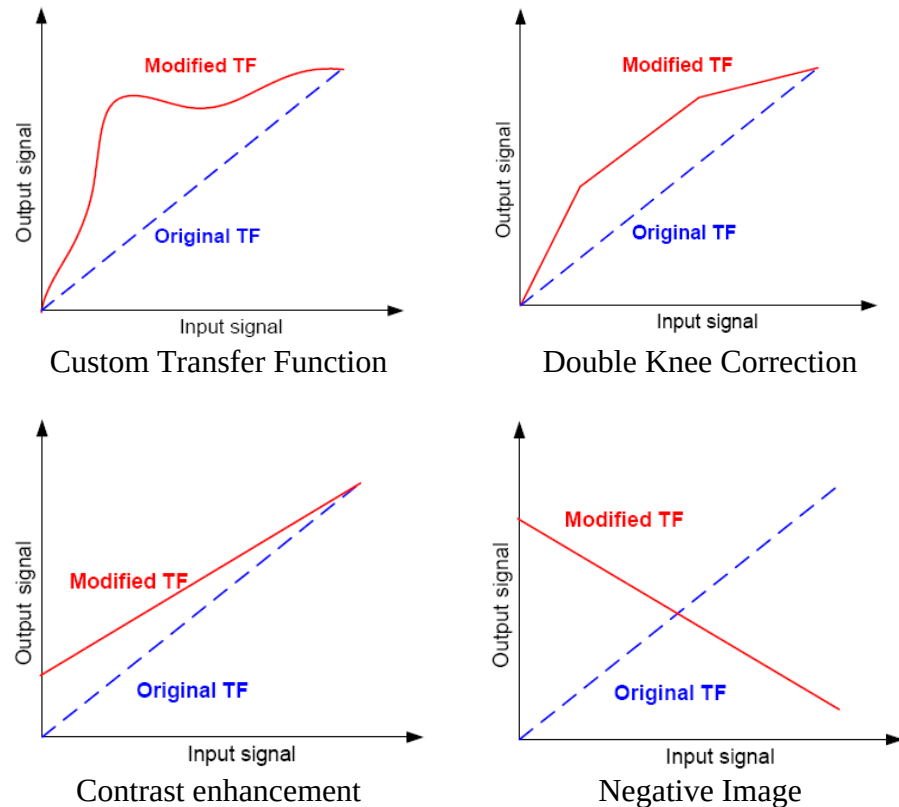


Figure 9 – Examples of custom lookup table transformations

Capture Settings Dialog

This dialog gives the user complete control over image storage.

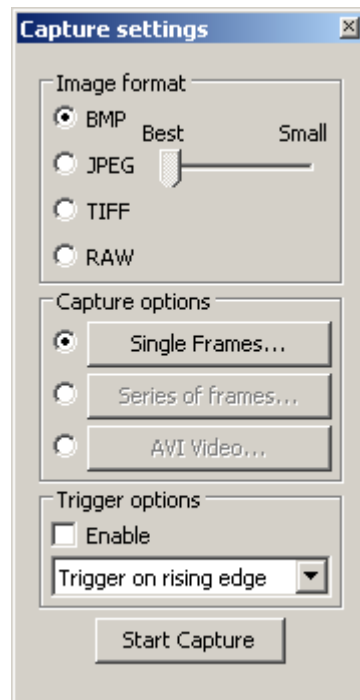


Figure 10 – Capture Settings dialog

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.

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.

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.

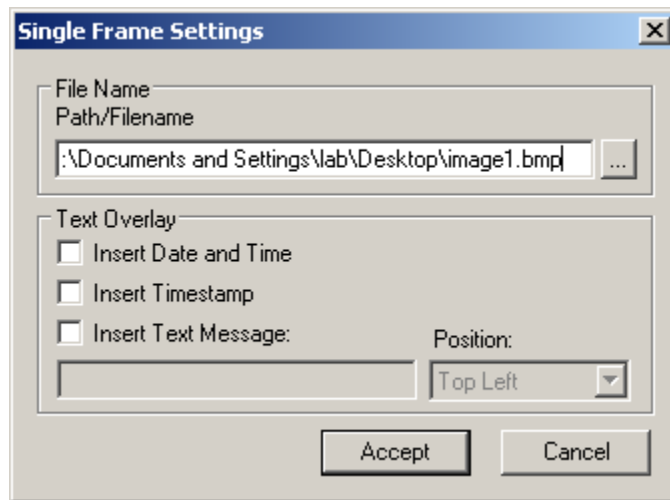


Figure 11 – Single Frame Settings dialog

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 video source. 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.

Series of Frames Settings

File Name:
Path/Filename
C:\Documents and Settings\lab\Desktop\image1 ...

Append to filename:
☒ Date and Time ☐ 3 Digit Number ☐ 5 Digit Number
☐ 2 Digit Number ☐ 4 Digit Number ☐ 6 Digit Number

Hours: Minutes: Seconds:
Capture event occurs:
☐ Capture every: 00 00 00
☒ Continuous

Capture duration for each event:
Limit capture time to: 00 00 00
Limit number of frames to: 0

Total capture:
Limit total capture time to: 00 00 00
Limit total number of frames to: 0

Buffering
☐ Buffer frames to memory

Display
☐ Freeze preview window while capturing

Text Overlay:
☐ Insert Date and Time
☐ Insert Timestamp
☐ Insert Text Message: Position: Top Left

Accept Cancel

Figure 12 – 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

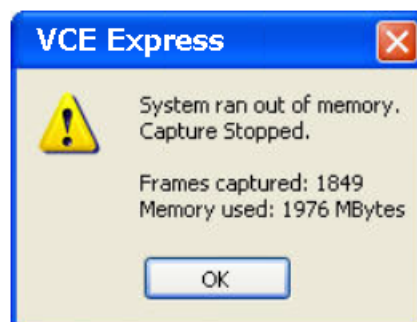
Same as in 'Single Frames'.

Cancel

Same as in 'Single Frames'.

NOTE:

While capturing is in progress, if the host operating system denies the VCE 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.

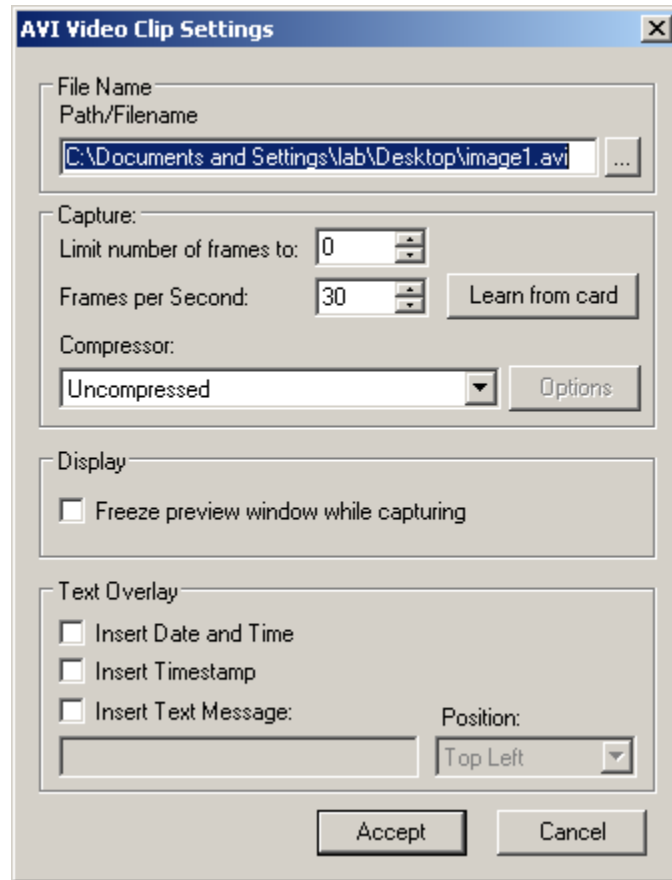


Figure 13 – AVI Video Clip Settings dialog

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.
Frames per Second:	Limits the frame rate of the recorded movie.
Learn from card	Clicking on this button causes the actual frame rate of the attached video source to be read from the card and automatically populated into the 'Frame per Second' field.
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.

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'.

Trigger Options

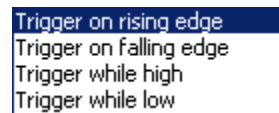
Determines how the recording process will be controlled by the state of the 'External Trigger' signal.

Enable

Enables the 'External Trigger' signal to be used to qualify image capture. When this box is checked, the selected capture option (i.e. single frames, series of frames or AVI video) will begin capturing images when the 'External Trigger' becomes active.

Trigger behavior

This drop-down box allows the user to specify the conditions, of the 'External Trigger' signal, necessary to start image capture. Note that all triggers work in conjunction with '*Limit capture time to:*' and '*Limit number of frames to:*'. If you do not want these settings to affect the trigger then set them to zero.



Trigger on rising edge

Start capturing images when the trigger goes from low (voltage absent) to high (voltage present).

Trigger on falling edge

Start capturing images when the trigger goes from high (voltage present) to low (voltage absent).

Trigger while high

Start capturing images when the trigger is high (voltage present) and continue capturing images until the trigger goes low (voltage absent).

Trigger while low

Start capturing images when the trigger is low (voltage absent) and continue capturing images until the trigger goes high (voltage present).

Statistics Dialog

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

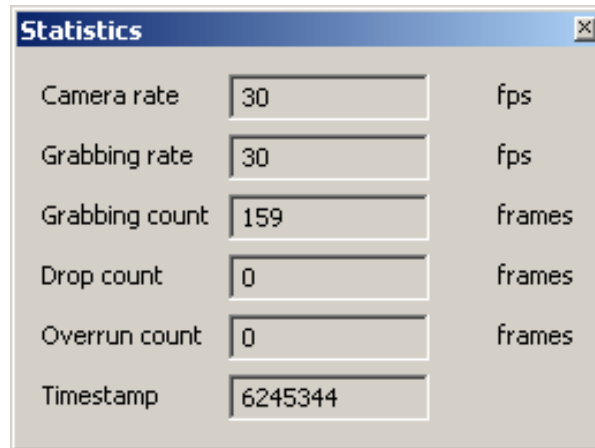


Figure 14 – Statistics dialog

- | | |
|-----------------------|--|
| Camera rate | Displays the real-time frame rate of the attached video source as measured at the input of the VCE 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 video source 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 VCE 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 video source 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 video source 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 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. For example, in the RGB-24 sample hex dump of Figure 17, with the mouse positioned at location 156,55 (X, Y), a box is revealed showing that the value of the R,G,B components for the pixel at that location are BF,AA,CC in hexadecimal and 191,170,204 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.

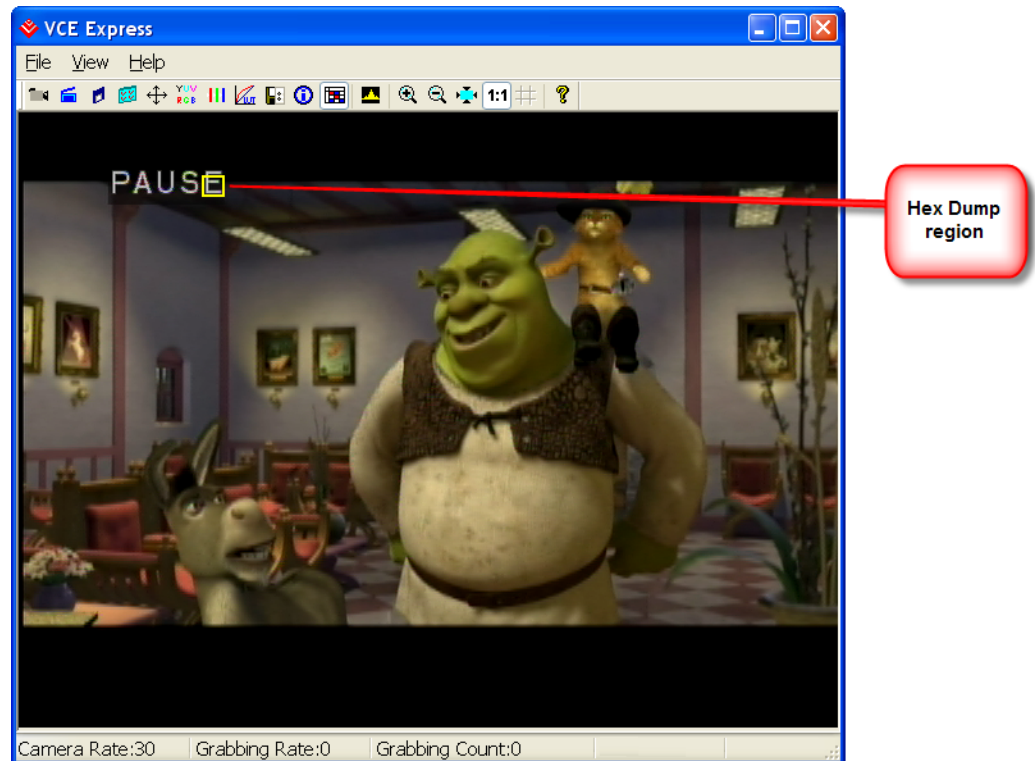


Figure 15 – Sample image with Hex Dump region

In the sample image above, a Hex Dump region was opened starting at the upper left pixel coordinate (X,Y) of 146,52 and ending at the lower right pixel coordinate of 159,64. The yellow square indicates the bounded region.

The Hex Pixel dumps for the YCrCb and RGB-24 modes are illustrated in Figures 16 and 17, respectively. Note that in these samples the mouse was hovering over position 156,55 causing the values for that pixel to be emphasized.

Hex dump												146	147	148	149	150	151	152	153	154	155	156	157	158	159
52	Y 1A	Y 93	Y C1	Y 41	Y 09	Y 0C	Y 0A	Y 0C	Y 0B	Y 0C	Y 0B	Y 0C	Y 0D	Y 0C	Y 0C	Y 0C	Y 0C	Y 0C	Y 0C	Y 0C	Y 0C	Y 0C	Y 0C	Y 0C	Y 0C
	Cr 81	Cr 00	Cr 00	Cr 00	Cr 00	Cr 00	Cr 00	Cr 00	Cr 7F	Cr 7F	Cr 7F	Cr 7F	Cr 7F	Cr 7F	Cr 7F	Cr 7F	Cr 7F	Cr 7F	Cr 7F	Cr 7F	Cr 7F	Cr 7F	Cr 7F	Cr 7F	Cr 7F
	Ch 7F	Ch 81	Ch 81	Ch 81	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80
53	Y 17	Y 91	Y C3	Y 48	Y 30	Y 37	Y 35	Y 38	Y 37	Y 38	Y 3A	Y 36	Y 15	Y 0D	Y 0D	Y 0D	Y 0D	Y 0D	Y 0D	Y 0D	Y 0D	Y 0D	Y 0D	Y 0D	Y 0D
	Cr 7F	Cr 7E	Cr 7E	Cr 7E	Cr 7E	Cr 7F	Cr 7F	Cr 80	Cr 80	Cr 7C	Cr 7C	Cr 7D	Cr 7D	Cr 7A	Cr 7A	Cr 7A	Cr 7A	Cr 7A	Cr 7A	Cr 7A	Cr 7A	Cr 7A	Cr 7A	Cr 7A	Cr 7A
	Ch 7F	Ch 00	Ch 00	Ch 7E	Ch 7E	Ch 80	Ch 80	Ch 7F	Ch 7F	Ch 80	Ch 80	Ch 7F	Ch 7F	Ch 80	Ch 80	Ch 7F	Ch 7F	Ch 80	Ch 80	Ch 7F	Ch 7F	Ch 80	Ch 80	Ch 80	Ch 80
54	Y 10	Y 92	Y C7	Y A2	Y A2	Y B1	Y B3	Y AB	Y B0	Y A9	Y AA	Y 5B	Y 21	Y 0F	Y 0F	Y 0F	Y 0F	Y 0F	Y 0F	Y 0F	Y 0F	Y 0F	Y 0F	Y 0F	Y 0F
	Cr 7C	Cr 80	Cr 80	Cr 81	Cr 81	Cr 82	Cr 82	Cr 7E	Cr 7E	Cr 7E	Cr 7E	Cr 7E	Cr 79	Cr 79	Cr 7C	Cr 7C	Cr 7C	Cr 7C	Cr 7C	Cr 7C	Cr 7C	Cr 7C	Cr 7C	Cr 7C	Cr 7C
	Ch 7D	Ch 72	Ch 72	Ch 76	Ch 76	Ch 74	Ch 74	Ch 7C	Ch 7C	Ch 6D	Ch 6D	Ch 74	Ch 74	Ch 68	Ch 68	Ch 68	Ch 68	Ch 68	Ch 68	Ch 68	Ch 68	Ch 68	Ch 68	Ch 68	Ch 68
55	Y 1B	Y 91	Y C7	Y A2	Y A3	Y B1	Y B3	Y AF	Y B1	Y A9	Y AA	Y 5B	Y 21	Y 0F	Y 0F	Y 0F	Y 0F	Y 0F	Y 0F	Y 0F	Y 0F	Y 0F	Y 0F	Y 0F	Y 0F
	Cr 7C	Cr 80	Cr 80	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 7E	Cr 7E	Cr 7E	Cr 7E	Cr 79	Cr 79	Cr 7C	Cr 7C	Cr 7C	Cr 7C	Cr 7C	Cr 7C	Cr 7C	Cr 7C	Cr 7C	Cr 7C	Cr 7C
	Ch 7C	Ch 00	Ch 00	Ch 80	Ch 7F	Ch 81	Ch 81	Ch 81	Ch 7E	Ch 7E	Ch 7E	Ch 7E	Ch 79	Ch 79	Ch 7C	Ch 7C	Ch 7C	Ch 7C	Ch 7C	Ch 7C	Ch 7C	Ch 7C	Ch 7C	Ch 7C	Ch 7C
56	Y 1E	Y 90	Y C2	Y 44	Y 2F	Y 37	Y 36	Y 38	Y 37	Y 39	Y 3A	Y 37	Y 20	Y 1E	Y 1E	Y 1E	Y 1E	Y 1E	Y 1E	Y 1E	Y 1E	Y 1E	Y 1E	Y 1E	Y 1E
	Cr 7E	Cr 7E	Cr 7E	Cr 7E	Cr 7D	Cr 7D	Cr 7F	Cr 7F	Cr 80	Cr 80	Cr 7D	Cr 7D	Cr 7F	Cr 7F	Cr 7D	Cr 7D	Cr 7D	Cr 7D	Cr 7D	Cr 7D	Cr 7D	Cr 7D	Cr 7D	Cr 7D	Cr 7D
	Ch 7F	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 82	Ch 82	Ch 82	Ch 82	Ch 82	Ch 82	Ch 82	Ch 82	Ch 82	Ch 82	Ch 82	Ch 82	Ch 82
57	Y 1E	Y 90	Y C2	Y 42	Y 16	Y 1D	Y 1B	Y 1D	Y 1C	Y 1D	Y 1D	Y 1D	Y 1D	Y 1D	Y 1D	Y 1D	Y 1D	Y 1D	Y 1D	Y 1D	Y 1D	Y 1D	Y 1D	Y 1D	Y 1D
	Cr 81	Cr 7F	Cr 7F	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 7F	Cr 7F	Cr 80	Cr 80	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81
	Ch 7E	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 81	Ch 81	Ch 81	Ch 81	Ch 81	Ch 81	Ch 81	Ch 81	Ch 81	Ch 81	Ch 81	Ch 81
58	Y 1F	Y 91	Y C0	Y 42	Y 19	Y 22	Y 1C	Y 1B	Y 1B	Y 1B	Y 1B	Y 1B	Y 1B	Y 1B	Y 1B	Y 1B	Y 1B	Y 1B	Y 1B	Y 1B	Y 1B	Y 1B	Y 1B	Y 1B	Y 1B
	Cr 80	Cr 80	Cr 80	Cr 80	Cr 80	Cr 80	Cr 80	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81
	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 81	Ch 81	Ch 81	Ch 81	Ch 81	Ch 81	Ch 81	Ch 81	Ch 81	Ch 81	Ch 81	Ch 81	Ch 81	Ch 81	Ch 81
59	Y 1F	Y 91	Y C0	Y 42	Y 19	Y 20	Y 1E	Y 1F	Y 1F	Y 1F	Y 1F	Y 1F	Y 1F	Y 1F	Y 1F	Y 1F	Y 1F	Y 1F	Y 1F	Y 1F	Y 1F	Y 1F	Y 1F	Y 1F	Y 1F
	Cr 80	Cr 80	Cr 80	Cr 81	Cr 81	Cr 7F	Cr 7F	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81	Cr 81
	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80
60	Y 1F	Y 91	Y C1	Y 43	Y 1B	Y 21	Y 1B	Y 1F	Y 1B	Y 1F	Y 1F	Y 1F	Y 20	Y 1F	Y 20	Y 20	Y 20	Y 20	Y 20	Y 20	Y 20	Y 20	Y 20	Y 20	Y 20
	Cr 80	Cr 80	Cr 80	Cr 81	Cr 81	Cr 81	Cr 81	Cr 82	Cr 82	Cr 82	Cr 82	Cr 82	Cr 82	Cr 82	Cr 82	Cr 82	Cr 82	Cr 82	Cr 82	Cr 82	Cr 82	Cr 82	Cr 82	Cr 82	Cr 82
	Ch 7E	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 82	Ch 82	Ch 82	Ch 82	Ch 82	Ch 82	Ch 82	Ch 82	Ch 82	Ch 82	Ch 82	Ch 82	Ch 82
61	Y 1F	Y 90	Y C2	Y 44	Y 2E	Y 39	Y 37	Y 3B	Y 37	Y 3B	Y 36	Y 3C	Y 39	Y 33	Y 33	Y 33	Y 33	Y 33	Y 33	Y 33	Y 33	Y 33	Y 33	Y 33	Y 33
	Cr 80	Cr 7F	Cr 7F	Cr 7F	Cr 7F	Cr 7F	Cr 7F	Cr 80	Cr 80	Cr 81	Cr 81	Cr 84	Cr 84	Cr 80	Cr 80	Cr 80	Cr 80	Cr 80	Cr 80	Cr 80	Cr 80	Cr 80	Cr 80	Cr 80	Cr 80
	Ch 7F	Ch 81	Ch 81	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 81	Ch 81	Ch 81	Ch 81	Ch 81	Ch 81	Ch 81	Ch 81	Ch 81	Ch 81	Ch 81	Ch 81	Ch 81
62	Y 22	Y 8D	Y BA	Y AA	Y AF	Y AC	Y AD	Y AC	Y AB	Y AF	Y B0	Y AA	Y A3	Y 4D	Y 4D	Y 4D	Y 4D	Y 4D	Y 4D	Y 4D	Y 4D	Y 4D	Y 4D	Y 4D	Y 4D
	Cr 81	Cr 80	Cr 80	Cr 80	Cr 80	Cr 80	Cr 80	Cr 80	Cr 80	Cr 84	Cr 84	Cr 85	Cr 85	Cr 86	Cr 86	Cr 86	Cr 86	Cr 86	Cr 86	Cr 86	Cr 86	Cr 86	Cr 86	Cr 86	Cr 86
	Ch 7E	Ch 81	Ch 81	Ch 81	Ch 7F	Ch 7F	Ch 7E	Ch 7E	Ch 7E	Ch 7E	Ch 82	Ch 82	Ch 96	Ch 96	Ch 96	Ch 96	Ch 96	Ch 96	Ch 96	Ch 96	Ch 96	Ch 96	Ch 96	Ch 96	Ch 96
63	Y 20	Y 0D	Y BA	Y AC	Y B0	Y AC	Y AD	Y AC	Y AE	Y AE	Y AD	Y AC	Y A2	Y 4F	Y 4F	Y 4F	Y 4F	Y 4F	Y 4F	Y 4F	Y 4F	Y 4F	Y 4F	Y 4F	Y 4F
	Cr 80	Cr 80	Cr 80	Cr 80	Cr 80	Cr 80	Cr 80	Cr 80	Cr 83	Cr 83	Cr 83	Cr 85	Cr 85	Cr 85	Cr 85	Cr 85	Cr 85	Cr 85	Cr 85	Cr 85	Cr 85	Cr 85	Cr 85	Cr 85	Cr 85
	Ch 7E	Ch 80	Ch 80	Ch 7F	Ch 7F	Ch 7E	Ch 7E	Ch 80	Ch 80	Ch 81	Ch 81	Ch 95	Ch 95	Ch 8C	Ch 8C	Ch 8C	Ch 8C	Ch 8C	Ch 8C	Ch 8C	Ch 8C	Ch 8C	Ch 8C	Ch 8C	Ch 8C
64	Y 2B	Y 3B	Y 37	Y 3B	Y 3B	Y 3B	Y 37	Y 37	Y 37	Y 37	Y 3B	Y 39	Y 39	Y 33	Y 33	Y 33	Y 33	Y 33	Y 33	Y 33	Y 33	Y 33	Y 33	Y 33	Y 33
	Cr 81	Cr 80	Cr 80	Cr 80	Cr 80	Cr 80	Cr 80	Cr 80	Cr 80	Cr 80	Cr 80	Cr 80	Cr 80	Cr 82	Cr 82	Cr 82	Cr 82	Cr 82	Cr 82	Cr 82	Cr 82	Cr 82	Cr 82	Cr 82	Cr 82
	Ch 81	Ch 82	Ch 82	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 80	Ch 82	Ch 82	Ch 82	Ch 82	Ch 82	Ch 82	Ch 82	Ch 82	Ch 82	Ch 82	Ch 82	Ch 82

Figure 16 – Hex Dump for YCrCb mode

Hex dump																								146	147	148	149	150	151	152	153	154	155	156	157	158	159	:																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
52	R	07	R	94	R	CE	R	3C	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R	00	R</

Histogram Window

The Histogram window displays three graphs: one per component. When the YCrCb-4:2:2 or YCrCb-4:4:4 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, is 0 to 255 (8 bits).

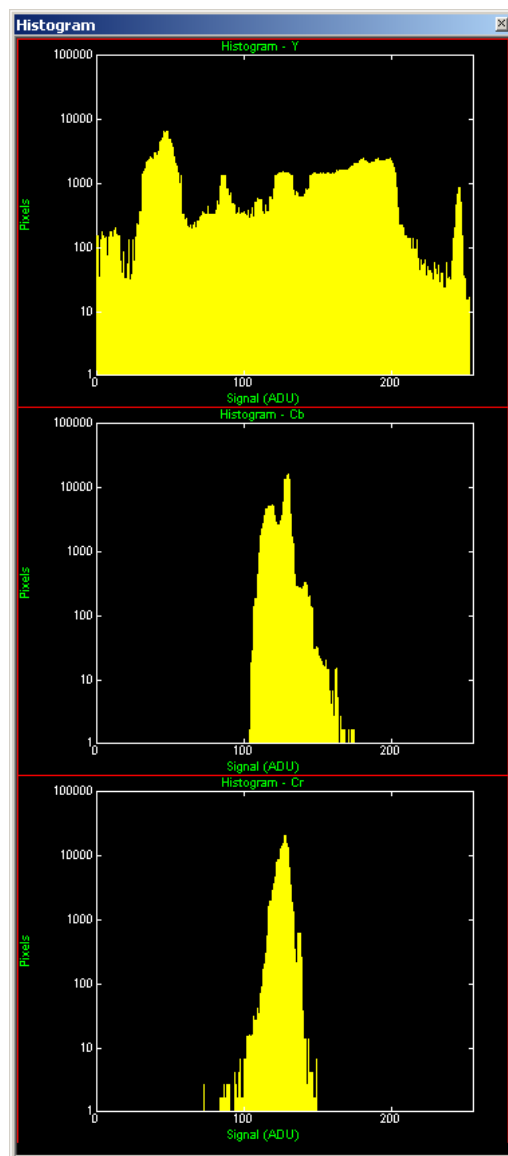


Figure 18 – Histogram window

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..

Zoom in	Ctrl+'+'
Zoom out	Ctrl+'-'
Fit to window	Ctrl+0
25%	Alt+4
50%	Alt+2
✓ 100%	Ctrl+1
200%	Ctrl+2
400%	Ctrl+4

Figure 19 – 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 its 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 VCE 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.

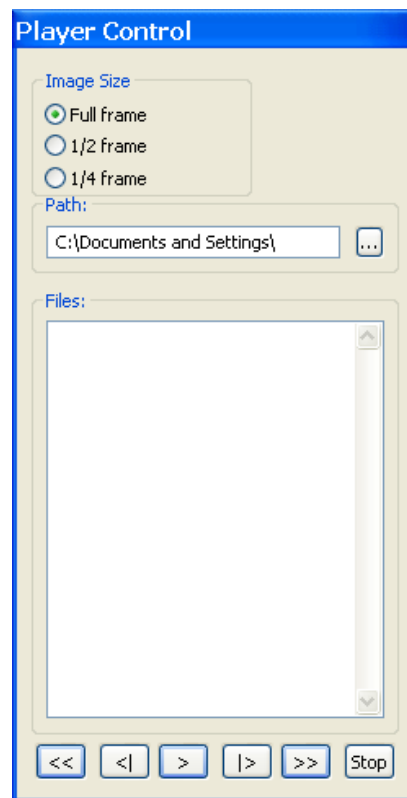
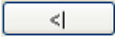


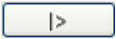
Figure 20 – Player Control dialog

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 VCE 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 640x480 resolution camera, then the 'Full frame' window size will be 640x480. In this example, selecting ' $\frac{1}{2}$ frame' produces a window size of 320x240 and selecting ' $\frac{1}{4}$ frame' produces a size of 160x120.

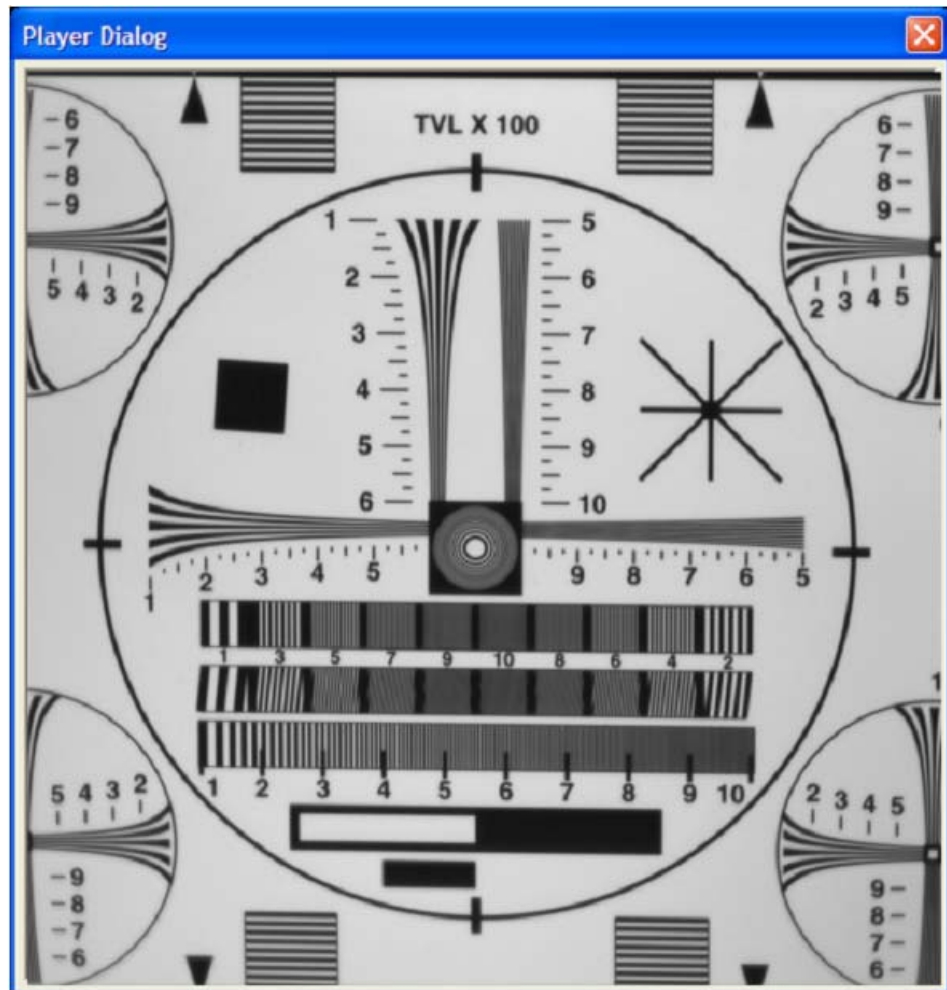


Figure 21 – Player Dialog

Chapter **5**



Electrical Interfaces

This chapter contains information on the VCE Express card's connectors.

Video Connector

The video connector is an 8 pin, panel mount, circular male receptacle (SwitchCraft part# TRAPC8MX). The mating plug (on the cable) is a SwitchCraft part# TA8FLX. The pins are used for the analog video and trigger inputs as indicated below.

Pin #	Signal	Description
1	CVBS2/Y2	A composite signal, or the luminance component of an S-Video signal, for Channel #2
2	ANALOG GND2	A shield/ground signal for Channel #2
3	CVBS1/Y1	A composite signal, or the luminance component of an S-Video signal, for Channel #1
4	C1	The Chrominance component of an S-Video signal for Channel #1
5	ANALOG GND1	A shield/ground signal for Channel #1
6	C2	The Chrominance component of an S-Video signal for Channel #2
7	Trigger_In +	An optically isolated Trigger input
8	Trigger_In -	An optically isolated Trigger return

Table 4 – Video Connector Pin-out

Electrical Considerations

The external trigger input is optically isolated from the rest of the VCE-Express hardware. An internal 300 ohm series resistor is used to limit the input current. The input signals “Trigger_In +” and “Trigger_In -” are used to connect to an external trigger source.

A ‘logic-0’ is considered a positive voltage (between Trigger_In + and Trigger_In -) of 0v to 1.0v.

A ‘logic-1’ is considered a positive voltage (between Trigger_In + and Trigger_In -) of 4.0v to 5.0v.

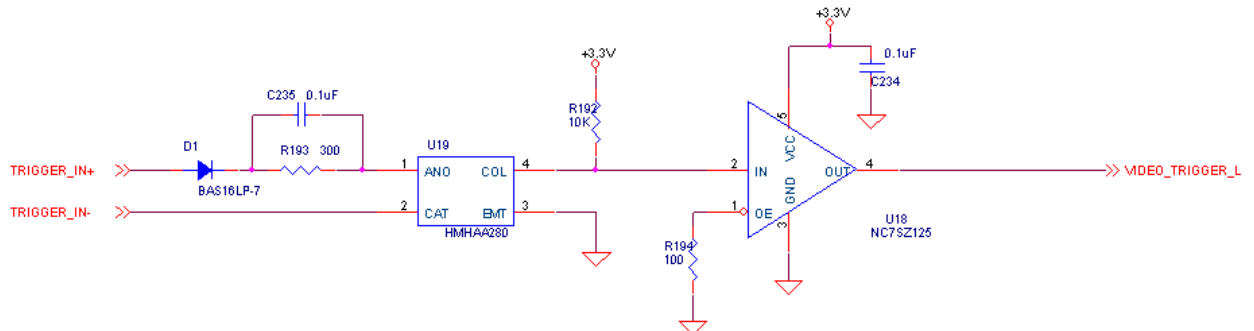


Figure 22 – External trigger schematic

CAUTION NOTE

The maximum Trigger input current **MUST NOT** exceed 10mA or else damage may occur to the card!

ExpressCard Connector

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 5 – ExpressCard Connector Pin-out

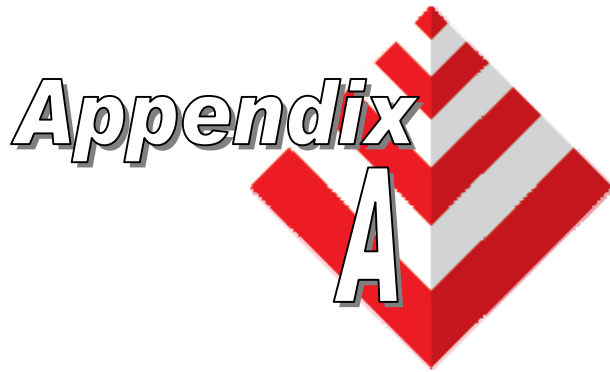
Notes:

- 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 VCE 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 VCE 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 VCE Express.

Chapter 6

Specifications

Video Source	NTSC/PAL/SECAM/RS170	
External Trigger	$V_{lo_{min}} = 0.0V$ minimum forward voltage for logic-0 $V_{lo_{max}} = 1.0V$ maximum forward voltage for logic-0 $V_{hi_{min}} = 4.0V$ minimum forward voltage for logic-1 $V_{hi_{max}} = 6.0V$ maximum forward voltage for logic-1 $V_{r_{max}} = 5.0V$ maximum reverse voltage $I_{min} = 5.0mA$ minimum current $I_{max} = 10.0mA$ maximum current... MUST NOT BE EXCEEDED!	
Physical Dimensions	VCE-EXPRESS : ExpressCard/54 : 108mm(4.28in) x 54mm(2.1in) x 18mm(.7in). VCE-EXPRESS-F: ExpressCard/54 : 75mm(2.97in) x 54mm(2.1in) x 4.93mm(.2in).	
Weight	53.6 grams (1.91 oz)	
Electrical Characteristics	Operating voltage: 3.3V +/- 5% Operating current: 700mA	
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
```

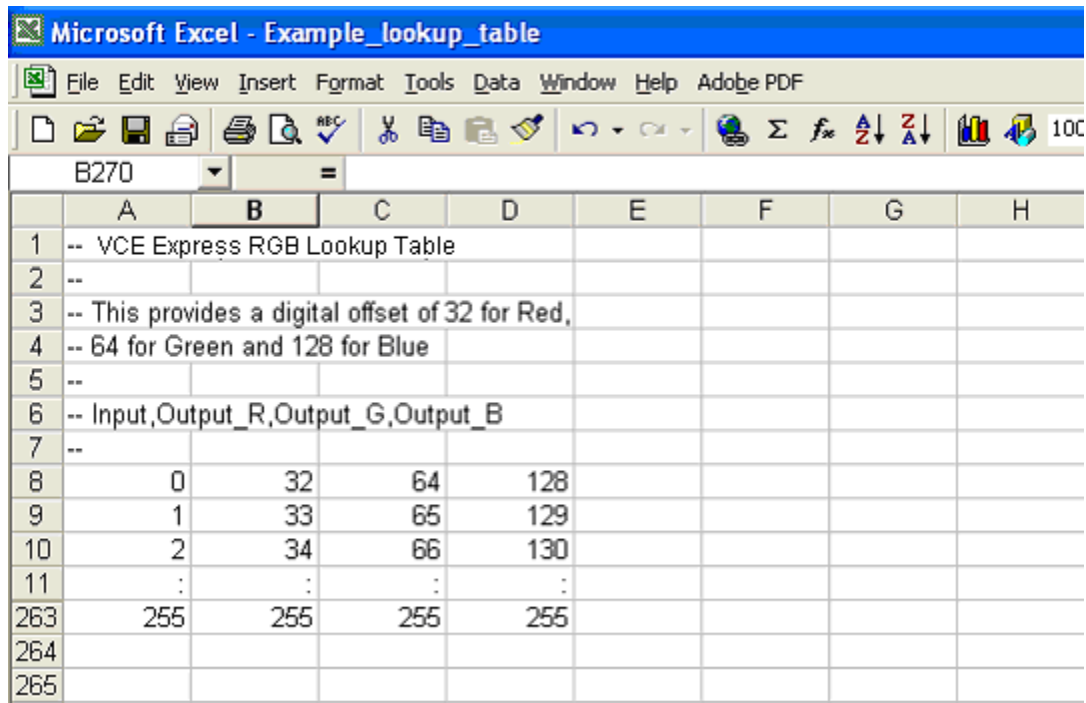
For example:

```
-- VCE 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.



The screenshot shows a Microsoft Excel window titled "Microsoft Excel - Example_lookup_table". The spreadsheet contains a VCE Express RGB Lookup Table. The table has columns A through H and rows 1 through 265. The data is as follows:

	A	B	C	D	E	F	G	H
1	--	VCE Express RGB Lookup Table						
2	--							
3	--	This provides a digital offset of 32 for Red,						
4	--	64 for Green and 128 for Blue						
5	--							
6	--	Input,Output_R,Output_G,Output_B						
7	--							
8		0	32	64	128			
9		1	33	65	129			
10		2	34	66	130			
11		:	:	:	:			
263		255	255	255	255			
264								
265								