Getting Started with the BitFlow SDK 6.5

Contents

General Information

Before Installation

1. You must log onto the computer using an account that has administrative privileges.

2. Uninstall any previous BitFlow SDK releases *before* installing this release. See "Installed components" on page 7 for more information.

3. You should install the SDK first, before installing any BitFlow boards in your computer. The installation process will be simpler if the Windows finds a new board after the drivers have been installed.

4. If you are upgrading from a previous release, please be sure to read the "\BitFlow SDK 6.5\Docs\changes.txt" file to see what is new and what has changed in this release.

5. This SDK is compatible with 32-bit and 64-bit versions of Windows 7, Windows 8 and Windows 10. The installer will automatically detect your operating system and install the correct 32-bit or 64-bit files.

Secure Boot

Starting Windows 10, Microsoft is requiring all drivers be attestation signed. This is an extra layering of driver signing that attempts to make Windows 10 more secure. Note that this requirement is only enforced if Windows 10 is installed an on system with secure boot turned on (in the BIOS). Starting with SDK 6.30 BitFlow drivers are attestation signed and are compatible with Windows 10 running in secure boot mode.

Serial Numbers

If you purchased the SDK, you will be emailed a serial number. If you are upgrading a computer from a previous release of the BitFlow SDK, your serial number will already appear in the installer dialog. If you are using a third party application (e.g. LabView, HALCON, MATLAB, VisionPro, etc) or just want to run our simple example applications, you can install the "drivers only" version of the SDK by using the serial number "0". There is no charge to use or install the SDK using the serial number "0".

Firmware Updates

New SDKs generally ship with updated firmware. The updates include any bug fixes that might have been found since the last release, as well as new features. For Gen 1 BitFlow boards (Karbon, Neon), new firmware is automatically downloaded to the board when the system powers up. For the Gen 2 boards (Aon, Axion, Claxon and Cyton), the firmware must be manually downloaded. See "Firmware Updates" on page 8 for further information.

Uninstalling Previous Versions of the SDK

Before installing SDK 6.5 you must uninstall the previous SDK using the following instructions:

1. Open the list of uninstall options

   Control Panel > Programs > Uninstall a program

2. Navigate to "BitFlow SDK X.XX" and click "Remove" or "Uninstall"

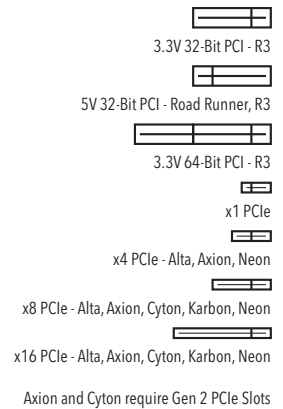3. Follow the instructions of the uninstaller

Installing the SDK

Install the SDK

1. Run the installer executable to start the process.

2. Follow the instructions of the installer.

3. When the installer is finished, turn the computer off and install your BitFlow board(s).

4. If you are upgrading and have left your boards in your system, you may be need to reboot your computer when the installation is complete.

Install your BitFlow Hardware

1. Make sure you observe proper static protection procedures when installing any hardware in a PC.

2. Make sure the PC is powered down and is not connected to the AC supply.

3. Open the PC. Locate an unused PCIe slot of the correct type for you board. See the illustration at right to help identify the correct type of slot.

4. Insert the BitFlow board in this slot. Make sure the board is firmly seated in the PCIe connector.

5. Secure the board to the PC with a screw on the edge connector.

6. Close the PC.

7. Connect your BitFlow board to your camera using a cable of the correct type.

8. Reconnect the AC power cord to your PC.

9. Power up your camera.

10. Power up and boot your PC.

3.3V 32-Bit PCI - R3

5V 32-Bit PCI - Road Runner, R3

3.3V 64-Bit PCI - R3

x1 PCIe

x4 PCIe - Alta, Axion, Neon

x8 PCIe - Alta, Axion, Cyton, Karbon, Neon

x16 PCIe - Alta, Axion, Cyton, Karbon, Neon

Axion and Cyton require Gen 2 PCIe Slots

A Note On Windows 10 Systems

By default, when you shut down a Windows 10 system, it really goes to sleep (this behavior can be turned off). In this case, "sleep" means that the system state is written to the hard drive and the components are powered down. When the system is subsequently turned back on, it actually wakes from sleep. If a new board is installed during this cycle, the operating system may not see the new device. The simple solution is to perform a restart (warm reboot) after the power up after installing new hardware.

Initial System Tests

Testing Your Board

1. Run SysReg (Start Menu > Programs > BitFlow > SDK 6.5 > SysReg).

2. Make sure the Camera configuration file path is correct. If you installed the SDK in the default directory, the configuration directory should be "C:\BitFlow SDK 6.5\Config".

3. All of the BitFlow boards in your system should appear in the "Boards installed" list. Highlight a board in this list then click the Board operation: **Configure** button to open the Board Details dialog. If no boards appear in this list or boards are marked "Missing", go to the trouble shooting section.

4. Click the Camera file operation: **Add** button to open the Choose Camera File dialog.

5. Navigate through the tree to the following entry:

For Aon, Axion, Claxon and Cyton models:

```
+ Make: BitFlow
    + Model: Synthetic Area Scan
        + Mode: Dynamic Diagonal Wedge, 1024x1024, Free Runn
            + Default@BitFlow-Synthetic-AreaScan-1024x1024.bfml
```

Click on "Default@BitFlow-Synthetic-AreaScan-1024x1024.bfml" and then click **OK**.

For Karbon and Neon Camera Link models:

```
+ Make: BitFlow
    + Model: Synthetic
        + Mode: 8-bit, 1024x1024, Free Run
            + BitFlow-Synthetic-1024x1024-E1.r64
```

Click on "BitFlow-Synthetic-1024x1024-E1.r64" and then click **OK**.

For Neon-Dif models:

```
+ Make: Generic
    + Model: Synthetic
        + Mode: 8-bit, 1024x1024, Free Run
            + Generic-Synthetic-1024x1024-E1.ndif
```

Click on "Generic-Synthetic-1024x1024-E1.ndif" and then click **OK**.

6. Click **OK** to the Board Details dialog.

7. Click **OK** to the SysReg dialog.

8. Now run BitFlowPreview.

9. The application will open and you should see a wedge pattern similar to the images on the right (the image will appear to continuously shift horizontally). If you see this image, the system is working fine. If you do not see this pattern, go to the Troubleshooting section.

Synthetic camera output

Configure Your Board for Your Camera

Auto-Configuration for CoaXPress Cameras

If you are using a CoaXpress camera that is version 1.1 or later, the software will automatically configure the board to acquire from you camera. There is no need to run SysReg or select a camera configuration file. However, if a camera configuration file is "attached" in SysReg, this file will take precedence, and the system will not auto-configure. In order to auto-configure, either leave the attached cameras list empty or attach the following configuration:

> + Make: Generic
> > + Model: CXP v1.1 or later
> > > + Mode: Default
> > > > + Generic-CXP.bfml

Note that there are many situations where you may want to override the automatic configuration settings. For example a cameras default settings might be four links at CXP-6 and you may want to run the camera with one link at CXP-3. In these situations, you can use a configuration file that specifies that configuration parameters that you want to change from the default. It is possible to set up a BFML file where some parameters are determined by the camera's settings and other parameters are manually in the file by the needs of your application.

Another situation where you may want to use a configuration file is if you need to set up the frame grabbers I/O functionality. Again, a BFML file can be set up where the camera parameters are automatically configured by the camera, but the frame grabber I/O parameters are configured by the BFML file.

If you need to attached a configuration file to your CoaXPress frame grabber, use the procedure below.

How to Specify a Camera Configuration File

1. Run SysReg.

2. Highlight the board in the BitFlow boards found list, then click the Board operation: **Configure** button to open the Board Details dialog.

3. Highlight the existing configuration file in the Attached camera list and click the **Change** button.

4. Navigate the configuration file tree to get the Make, Model, and Mode of your camera, click on the file name, then click the **OK** button.

6. Click **OK** to the Board Details dialog.

7. Click **OK** to the SysReg dialog.

8. Make sure your camera is powered up and connected to the board.

9. Run BitFlowPreview again. You should see live video from your camera. If you do not see an image, go to the Troubleshooting section.

INSTALLED COMPONENTS

The following components are copied to your computer when installing the full SDK.

Read Me - The latest information about the release

SysReg - System configuration utility: associates cameras with installed boards.

BitFlowPreview - Primary viewing application for all models and cameras.

BitFlowCapture - Sequence capture application based on the BufIn API

BFCom - HyperTerminal like application for camera communication through the Camera Link board's serial port.

CamEd - Camera configuration file editor for Gen 1 boards.

CamML - Camera configuration file editor for Gen 2 boards.

BFLog - Debug messages logging utility.

VerCheck - Displays DLL and driver version information as well as key system parameters.

DLLs - Dynamic Link Libraries: these contain all of the functionality of the SDK.

BFGTL.cti - Gen<i>Cam GenTL producer. This is our generic Gen<i>Cam interface module. Any Gen<i>Cam application can open the producer and communicate with both the camera and the frame grabber. In other words, this module supports both Camera Control (see Ximilon on page 9) and Video Streaming.

clserbit.dll - Camera Link serial communications DLL. This is BitFlow product specific and is located in the "\BitFlow SDK 6.5\Bin32" and/or "\BitFlow SDK 6.5\Bin64" folder. On 32-bit systems, only the 32-bit version is installed. On 64-bit systems the 64-bit version is installed (same file name) and the 32-bit version is also installed if the option "Install 32-bit binaries on 64-bit Windows". is selected during the install process.

clallserial.dll - Camera Link serial communications middleware DLL. This is a generic DLL that goes between the Camera venders application and the frame grabber specific DLL (see above). This DLL is located in the "C:\Program Files\CameraLink\Serial" folder. On 64-bit Windows, there will be a 32-bit version of this DLL located in the "C:\Program Files (x86)\CameraLink\Serial" folder.

Camera Configuration Files - Used to configure the board for your cameras.

Kernel Driver - Provides access to the BitFlow hardware.

Documents - Text files with the detailed information about the release.

Source Code - Complete C and C++ source for all examples and user level DLLs.

Header files - Definitions required for the API.

Libraries - Link libraries for the Microsoft compliers.

Firmware - These files contain the logic that is download to the board's FPGAs. These are *.fsh files located in the "\Windows\System32\Drivers\BitFlowFlash" folder.

FIRMWARE UPDATES

Gen 1 Boards (Karbon, Neon)

The firmware for the Gen 1 boards is downloaded to the board automatically. The BitFlow driver downloads the appropriate firmware to the board during system boot. From time to time new firmware is released from BitFlow, either to fix known problems or to add features. All that is required to use the new firmware is to copy the files to the appropriate location (see below) and reboot the system.

Firmware location:

Alta/Karbon/Neon - "\Windows\System32\Drivers\BitFlowFlash\R64"

Gen 2 Boards (Aon, Axion, Cyton)

The firmware for Gen 2 boards (Aon, Axion, Claxon and Cyton) are stored in nonvolatile memory and do not require downloading during system boot. Further, the same firmware supports all known types of cameras, so there is no need to switch firmware when the camera type changes (as there is on our Gen 1 models). However, firmware updates may become available from time to time from BitFlow and you may be advised to update you board. The process below shows the steps required to update the firmware on your Gen 2 board.

If you are upgrading to a new version of the SDK, you should also update the firmware your board(s). The new SDK will install the latest firmware on your system.

Firmware location: "\Windows\System32\Drivers\BitFlowFlash\Gn2"

1. Open Command Prompt (console window) (Start > All Programs > Accessories > Command Prompt).

2. Enter the following command:

> FWDownload

3. Follow the instructions of the FWDownload program. Note that will take up t o 10 minutes to update the firmware on your board.

4. When FWDownload has finished, Shutdown your PC, then power it back up (cold reboot).

5. You can run the utility VerCheck to verify the your board has been updated.

Ximilon GenTL Consumer

Introduction

Ximilon is a graphical user interface tool for controlling cameras, exclusively through BitFlow frame grabbers; a "consumer" implementation of the Gen<i>Cam Transport Layer (GenTL) standard. The BitFlow GenTL "producer" (BFGTL), installed by the BitFlow SDK, provides the back-end for camera control, supporting all modern BitFlow frame grabbers. Direct control of any CoaXPress and Camera Link camera is possible (for cameras compatible with the Gen<i>Cam standard), usually with minimal technical knowledge on the part of the user; analog cameras will be listed, but cannot be controlled.
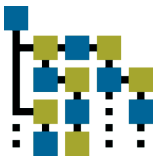
Where to Get Ximilon

Ximilon is not included as part of the normal SDK download. It can be downloaded separately from BitFlow website's download page.

Software Prerequisites

In order for Ximilon to work, and to be of use, some software prerequisites must be installed:

BitFlow SDK

Ximilon requires the BitFlow GenTL producer (BFGTL) to be installed, although the exact release will not typically matter. Additionally, Ximilon's CLProtocol Binding Tool will only run if the matching BitFlow SDK library installed. The driver only release is sufficient, in each case. Download the installer from the BitFlow website.

Gen<i>Cam GenApi reference implementation

New versions of Ximilon and BFGTL will always require the latest contemporary release, although a specific Gen<i>Cam version is necessary. The correct version of Gen<i>Cam will be installed by the Ximion installer.

CLProtocol DLL (Camera Link only)

A Camera Link only, vendor-specific requirement, facilitating Gen<i>Cam compatibility. Camera vendors typically bundle this with their own SDK or camera control utility, although the method of distribution is dependent upon the individual vendor.

Configuration

To use a camera, BitFlow frame grabbers require that a camera configuration file be attached to the corresponding board entry, matching the camera to be used. Open the BitFlow SDK's SysReg utility, select the appropriate port from the "Boards installed" list, and click "Configure." "Add" a camera file matching your camera's vendor and model, and click "OK"; click "OK" again, to close SysReg.

With a camera configuration file set, run the BitFlow BitFlowPreview application, to ensure that image acquisition is working. The camera will need to be connected to the computer, and depending upon the model, externally powered. If image acquisition in BitFlowPreview works, Ximilon is ready to be used.

Camera Link

Additional configuration is sometimes required to register the CLProtocol DLL for specific cameras; BFGTL will attempt to form this association automatically, but that is not always possible. To manually configure the binding, open Ximilon

and select the System Tools > CLProtocol Binding Tool main-menu entry. If the "Port ID" matching the relevant camera is not bound to the appropriate vendor "Device ID," select these from the combo boxes, and click "Bind." On success, a matching entry will appear in the "Current Bindings" list. Close the Tool, to use the camera.

CoaXPress

Usually, no manual configuration is required to control a CoaXPress camera using Ximilon. However, in some cases it is necessary or desirable to control the camera using an external GenTL XML file (provided by the camera vendor), if the camera dœs not include the file internally. Loading such a file is easy in Ximilon: Browse to BFGTL > [camera Interface] > Transport Layer Device, then Manually Cache an XML File (only available with "Guru" Visibility) using the File Browser. Upon success, BFGTL will reload, and a new Camera Features entry will appear under the camera Interface.

Application Use

Upon opening Ximilon, the user will be presented with one or more GenTL Interfaces, with either generic names, or names corresponding to the set camera file. With a camera file set, the user should select to the Interface, then Camera Features, to access the configuration features of the camera itself. The features available are specified by an XML file typically retrieved from the camera itself, and will vary from vendor-to-vendor, and model-to-model. If the Camera Features label includes the term "Fallback," no XML file could be loaded. This will always be the case for analog cameras; additional Configuration may be necessary to use Camera Link or CoaXPress cameras.

DEVELOPING YOUR APPLICATION

Once you are confident that your board is working correctly

The next step is to develop your application. The examples provided should allow you to quickly integrate the BitFlow SDK functionality into your program.

If you need something simple

CircularSimple - This programs show the minimum function calls required to get images into the host memory. It should be very easy to integrate these same function calls into your application. These applications do not provide a GUI. However, they are extremely easy to understand and build upon. Because the example CircularSimple uses the BufIn API, it works with all product families. It is recommended that you start with this example as it will provide the most flexibility in the future.

If you need to view and save live images

BitFlowPreview- This application demonstrates real-time display with a fully zoomable display window. Images can be saved to disk from the File menu. If you are using a Gen 2 board, you can switch between BFML modes. Raw output from Bayer color camera cameras will be de-mosaiced in software and display in full RGB color.

If you need real-time processing

BiProcess, BayView, Circ - These applications demonstrate multiple host buffer acquisition. The buffers are used in a circular manner. Each buffer in turn receives DMA data from the board, while the other buffers are available for processing. This allows the CPU to access an entire image without data being overwritten by the board. BiProcess dœs a simple histogram calculation, BayView performs a de-mosaicing operation on the incoming images and Circ simply displays each image in turn. All of these examples are good starting points for your application, you just need to plug in your own processing functions.

If you need to acquire sequences of images

BiFlow - This application acquires sequences of images in real time to host memory using the BufIn API. The resulting sequence can be displayed one at a time on the VGA, played back as a sequence and/or saved to disk. This application captures images in the cameras native format (i.e. pixel bit depth) for internal storage and for saving to disk.

If you need to acquire and process images via a circular set of buffers

Circ - This application demonstrates the circular buffer processing portion of the BufIn API. The concept is that the board is acquiring continuously into a set of buffers. Unsynchronized with acquisition, the host is processing the images in the buffers. The number of buffers required is dependent on the variability of acquisition and processing time. The BufIn API makes this type of an application very easy to write. Circ fully demonstrates the power of this API. You can also click on any buffer to remove it from the list of available buffers. Clicking on this same buffer again, re-inserts into the buffer list. This process demonstrates the new Add/Drop buffer functionality.

If you want to use the buffer management functions (BufIn)

BiSimple, BiSimplePlusPlus, CircClassExample, CircHoldSimple - These project folders contain a wealth of example console program. Because they are console programs the code is simple and easy to understand, unencumbered by messy GUI code. These examples illustrate most of the major components of the BufIn interface, in both C and C++. Each example is a self-contained lesson in an important feature of the BufIn API.

Whatever example you decide to start with, you must build and modify it with a C compiler. We provide source and project files to build all of our examples with Microsoft Visual Studio 2012 or later. However the BitFlow API is fully WIN32 compliant and can be called from any WIN32 programming environment, for example Microsoft Visual Basic. Please refer to the "readme.txt" file to see how to get started with this and other environments.

If you want to use another programming language

The SDK installs all the files that are needed to write applications in both C and C++. If you wish to build your application in another programming language, please visit the downloads page of our web site. There you will find support for various other languages and environments. For example, there is a .NET download which supports programming in C# and VB (as well as other languages). There is also a driver for other environments like NI's LabView, MVTec's HALCON and Cognex's Vision Pro. If you can't fine what you need, contact our technical support department to see if they can help you.

If you need to understand how your board works

There is a hardware reference manual for each family of boards. These manuals are available on the SDK CD and can also be downloaded from our web site. The following manuals are available:

Karbon-CL - Covers all Karbon Camera Link models

Aon/Claxon/Cyton-CXP - Covers the Cyton CoaXPress model

Axion-CL - Covers the Axion-Camera Link model

Neon - Covers all Neon models

Alta - Covers all the Alta models.

If you need to understand how the software works

There is a comprehensive software manual, The Software Reference Manual, available from our web site This manual describes every function in the BitFlow SDK API in detail. Also included are overview chapters which describe how to use the different APIs from a high level.

If you are using the BufIn C++ interface the documentation can be found in HTML form on our web site. As the BufIn C++ class is just a wrapper around the BufIn class, it will be helpful to see the BufIn functions in the The Software Reference Manual

WORKING WITH THIRD PARTY SOFTWARE

The functionality of the BitFlow SDK is greatly extended by the addition of third party software. If you are going to use one of these products, then you will need to install a driver that provides an interface between the third party product and the BitFlow SDK. Usually you will have to install the BitFlow SDK before installing the individual 3rd party imaging software product driver. However, some imaging software products install the driver and/or the SDK automatically. Please consult the documentation of the individual imaging software product for details.

When installing the BitFlow SDK for use with third party software, you can enter the serial number "0", which will tell he installer to just install the BitFlow driver and other binary components.

Drivers for third party software packages are available from the download sections of our web site or from their respective vendors. All of our drivers are based on BitFlow's Common Interface library (Ci) and will work with whichever BitFlow board is installed in your system (i.e a single driver for all models of BitFlow frame grabbers).

TROUBLESHOOTING YOUR SYSTEM

Here are some simple things you can check if your system is not working correctly:

If computer does not boot, or the computer hangs during the boot process:

This problem is usually caused by another device conflicting with the board. Try removing or disabling all other non-critical PCIe devices.

Try put the board in another PCIe slot.

Try reserving the IRQ of the device conflicting with the board, this can be done in some BIOS's.

LEDs are all blinking red (Cyton only)

The board is plugged into a PCIe slot that it is not compatible with. Please plug the board into a compatible slot.

If SysReg shows an error message and does not run or no boards appears in SysReg, or only some of your boards appear in SysReg, or boards are marked as "Missing":

These symptoms may be seen when upgrading a system which has a previous version of the BitFlow SDK on it. On some system the Plug and Play Wizard gets confused. These problems are easily solved using the device manager as follows.

First try rebooting your computer, this often clears up many problems.
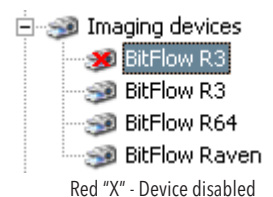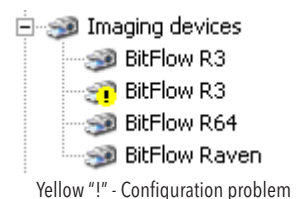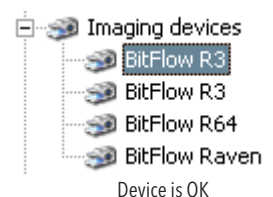
If this does not work try the following procedure:

1. Run the device manager (Start > Control Panel > Administrative Tools > Computer Management).

2. Navigate to the BitFlow devices (Computer Management > System Tools > Devices > Imaging Devices OR Computer Management > System Tools > Devices > Other Devices).

3. All of the BitFlow boards should look like the image at top-right.

4. If any boards appear with the error icons as shown in the three lower images at the right, then there is a problem with the plug and play configuration. To fix this problem right click on the device in question and select **Update** or **Enable**. Follow the instructions of the New Hardware Wizard (select "Install the software automatically"). You will see a Windows warning dialog, click continue. After the Hardware Wizard is finish, the device should work properly.

5. Repeat step 4 for all devices that have error icons.

6. You may need to reboot your computer after making these changes.

If the synthetic image does not appear in one of the viewing applications:

Try the board in another PCIe slot.

Remove all PCIe cards except the BitFlow board and your display card.

Try the BitFlow board in another PC.

Device is OK

Yellow "!" - Configuration problem

Red "X" - Device disabled

Yellow "!" in other devices - Configuration problem

Try updating the drivers for you display card.

If you get time out errors in one of the viewing applications with your camera:

Make sure your camera has power.

Check the cable between the camera and the board to ensure all the connectors are tight.

Make sure you have selected the correct configuration file for your camera.

Make sure your camera is set in the mode for which configuration file was designed.

If you are using an encoder or trigger, make sure that they are sending the correct signals to the board (see the hardware reference manual for interface specifications). Confirm that the camera works in free running mode first.

Your system should be at least 20% faster than your camera's data rate. If you are unsure of your camera's data rate use the following formula:

DataRate (MB/S) = *CameraTaps* × *PixelClockFrequency* × *BytesPerPixel*

Where:

CameraTaps = The number of data streams coming out of the camera (usually correlates with the sensor design).

PixelClockFrequency = The frequency of the data strobe clocking out the pixel data.

BytesPerPixel = 1 (for monochrome or 8-bit cameras)

BytesPerPixel = 2 (for cameras with 9 to 16-bit pixels)

BytesPerPixel = 3 (for packed (RGB) color cameras)

BytesPerPixel = 4 (For unpacked (ARGB) color cameras)

MB/S = Megabytes per second

The formulas define the maximum possible data rate produced by the camera, the average data rate may be somewhat slower.

If the video display is blank and you don't get time out errors in one of the viewing applications:

Check the lens cap and F-Stop settings.

Try pointing the camera directly at a light or window. Some cameras need a very bright light to provide an image.

Check your camera's gain and other adjustments.

If you get video but it is skewed, scrolling or looks out of sync:

Double check that you are using the correct camera file for the camera you have attached to the board and for the mode that the camera is in. If you are not sure which camera file to use, edit the file in CamEd, and check to make sure the comments in the file agree with your camera/mode.

Make sure that you are using the correct firmware for your camera .

If your camera has a binning mode, make sure that your are using a binning camera file.

Getting help

There are many resources, beyond this document, that are available to you if you have trouble getting started:

The manuals There is a wealth of information in both the SDK manual as well as the individual hardware manuals.

Our web site: www.bitflow.com

E-mail: support@bitflow.com

Telephone 781-932-2900 (9 AM–6 PM EST)

Facsimile 781-933-9965

Please have the following available when seeking support:

Model and serial number (on a small yellow sticker) of your board.

Make and model of camera and mode being used.

Manufacturer and model of camera cable.

Installation information, run VerCheck, save the output to a text file.

Computer CPU model, mother board make and model.

Operating system, service pack.

Example code (if applicable).

The Windows Event Viewer System log from the period of time when the problem occurred. Save the file as a *.evt or *.evtx file.