



## Image Tearing Causes and Solutions

Technical Application Note TAN2010003

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### 1.1 Subject

Technical Application Note (TAN2010003): Image Tearing Causes and Solutions

#### 1.1.1 Applicable Product(s)

- All Camera Products

#### 1.1.2 Application Note Description

This application note explains image tearing, its causes, recommended solutions, and how to detect torn images.

### 1.2 What is Image Tearing?

Image tearing refers to the display of images that appear broken or misaligned. Image tearing has been seen on both laptop and desktop systems, and across a variety of hardware platforms and operating systems. It is not specific to any particular system configuration, and has been known to occur with IEEE-1394a, IEEE-1394b and USB devices.

The following images show examples of image tearing. The first example shows an offset between the top and bottom halves of the image:

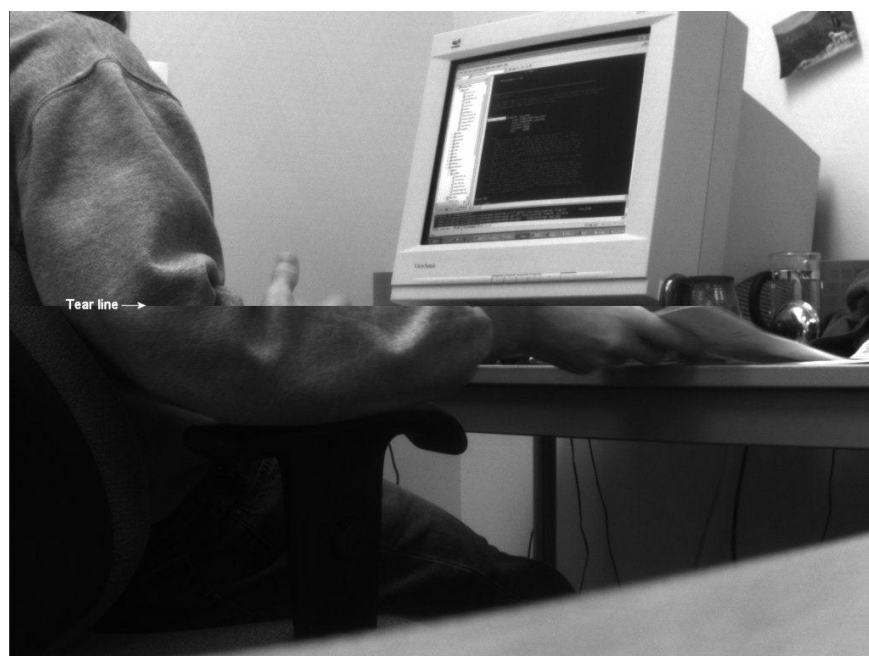
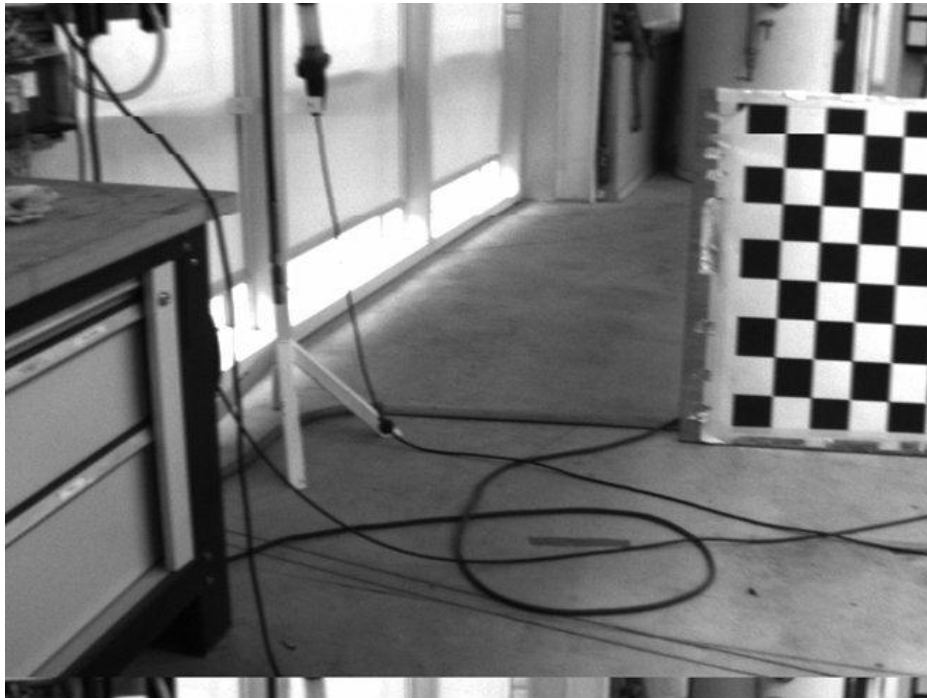


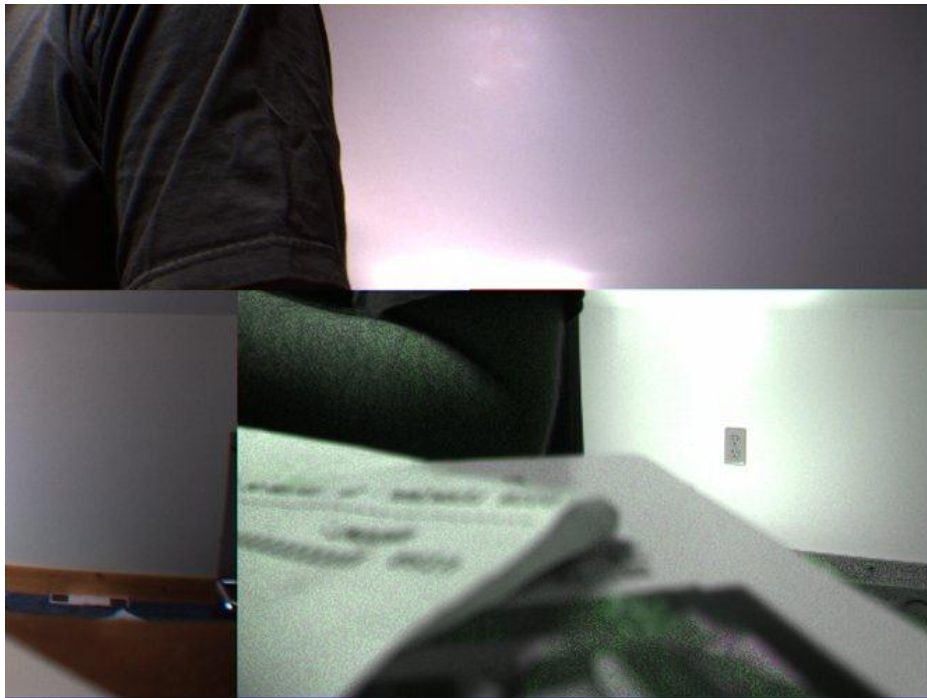
Figure 1

This example shows a broken image, in which the bottom portion contains data from another image:



**Figure 2**

The next example shows an image that appears torn both horizontally and vertically, and includes data from more than one image:



**Figure 3**

## 1.3 Causes of Image Tearing

The following sections explain some common causes of image tearing.

### 1.3.1 Video Display Issues

Horizontal tearing, such as the example shown in Figure 1, is often a video display issue, rather than a problem with the actual image data. To verify that the image data is not corrupted, run the SaveToAVI example available with the FlyCapture SDK, and analyze each frame of the AVI. If the image data is, in fact, corrupt, refer to the sections below.

If the image data is not corrupt, the most likely reason is that the frame rate of the image display is not synchronized with the refresh rate of the monitor. The monitor video display buffer fills with data, then gets displayed. However, sometimes the display buffer only partially fills before the monitor grabs it and displays it to the screen. This causes the tearing effect, and is more noticeable if the camera is being panned and there is a significant difference in image content between frames. For recommendations on how to reduce this image tearing, [contact our Technical Support team](#).

### 1.3.2 Power-Saving Features on Host Systems

Power saving features added to the chipsets of more recent CPUs can interfere with data transmission. Adjusting the settings of some of these features may address image tearing or corrupt images when running Point Grey cameras at higher data rates.

#### Sleep State

Torn images may result from the CPU entering a sleep state. Point Grey provides a command prompt utility to disable CPU sleep states. The utility can be used with XP, Vista, and Windows 7. For information about usage and parameters, simply run `PGRIdleStateFix` from the command prompt. The parameters are:

- `disable` - Disables all processor sleep states
- `enable` - Enables processor sleep states
- `print` - Prints the current status of processor sleep states

 [Download Point Grey Research PGRIdleStateFix utility \(.zip\)](#)

#### Enhanced Halt State

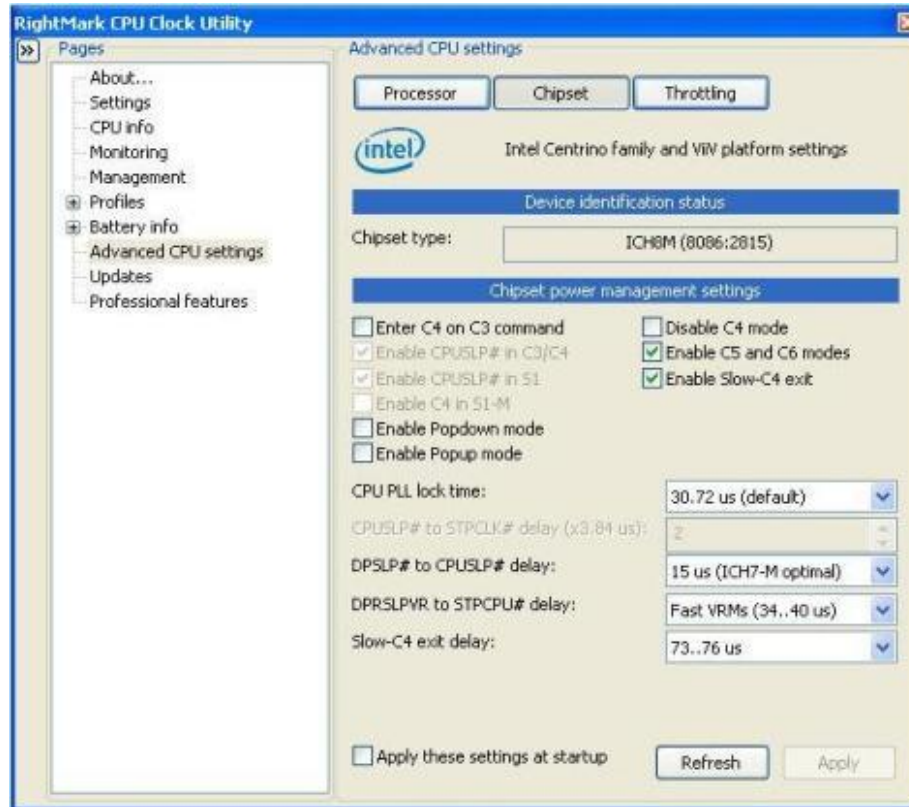
Point Grey has found that the C1E Enhanced Halt State can cause image tearing. This is primarily due to C1E slowing the transfer of image data off the FireWire host adapter card, which results in FIFO overflows. In some cases, it is possible to disable this feature in the host system's BIOS. If this is not possible, use the following utility to adjust the CPU settings to turn off the C1E state:

 [Download Point Grey Research EnhancedHaltState utility \(.zip\)](#)

The RightMark CPU Clock Utility, described in the following section, can also be used to disable the C1E state.

#### Popdown/Popup Mode on Laptop/Notebook Computers

On laptop/notebook systems, changing the Popdown or Popup Mode may fix the issue. To do this, use the RightMark CPU Clock Utility, downloadable from: [http://cpu.rightmark.org/download/rmclock\\_235\\_bin.exe](http://cpu.rightmark.org/download/rmclock_235_bin.exe). The relevant settings are found in the Advanced CPU settings window, as shown in the following screenshot:



### 1.3.3 Insufficient bandwidth

#### Bandwidth issues on FireWire systems

Another common cause of corrupt images is that the host system or PC cannot keep up with data rates across the 1394 PCI or laptop PCMCIA bus. Examples of these types of situations include:

- The PCI bus gets saturated.
- Memory bus bandwidth gets saturated.
- The PC cannot keep up with the interrupts being generated.

PCI bus saturation is a common situation and can happen for a number of reasons, including:

- Running multiple 1394 cameras at high frame rates that push 1394 bandwidth limits. For more information, see [Related Article 22](#) below.
- Large hard disk reads/writes.
- Heavy network traffic.

In particular, when the PCI bus saturates, the system cannot keep up with the data rates going across it. As a result, images cannot be pulled off the 1394 PCI card fast enough. The isochronous FIFO buffers on-board the card gradually fill with image data from the camera, and eventually a general FIFO overflow occurs. These overflows can result in:

- Tears through the middle of an image due to data packets being dropped and the current image being filled by data from the next image (Figure 2 above).
- Broken images that are made up of many different images (Figure 3 above).
- Images that are dropped completely (see [Related Article 141](#) below).

Typically, synchronization packets prevent repeated image tearing. When data is dropped, the current image is torn, but the image corrects itself for the next frame, unless data is dropped from that image as well. Note that general FIFO overflows occur at the lowest level of the Windows IEEE-1394 substructure, making them beyond the control of Point Grey drivers and software.

### **Why is my FireWire camera not tearing but my USB camera is?**

Image tearing can happen on both FireWire and USB cameras, but from different causes. Tearing may occur on a USB system and not on a FireWire system, or vice versa. The reason tearing may occur differently between interfaces is due to the difference in how image data is transferred to the PC.

FireWire transfers a complete image to the PC at one time. Image data feeds into the FIFO buffer on the host adapter, where it is picked up. If the PC cannot keep up with grabbing the data from the controller's FIFO, the FIFO overflows and data is dropped.

USB transfers data differently. Data is stored in a FIFO on the USB camera, and polled by the PC directly. The data is sent in 512-byte packets. The PC polls the device every time it wants to receive the next packet. If the PC does not grab the data from the camera's FIFO quickly enough, the FIFO overflows and data is dropped.

The main limitation of USB, and the reason it may tear more often than FireWire, is the limited amount of resources on the camera, which keeps the FIFO buffer relatively small. Since USB cameras depend on the PC to ask for data, if the PC is too busy, the camera's FIFO can overflow quickly. FireWire cameras do not depend on the PC to ask for data; it is simply sent to the host adapter at the proper rate, and the camera's FIFO does not overflow. Since there are more resources on the host adapter, FIFO buffers are larger, reducing the chance for overflow.

### **Why do some USB cameras tear and others don't?**

The FIFO buffers on current Point Grey USB cameras are the same size. However, different cameras may be filling their FIFOs at different data rates, so one camera may fill up quicker than another. Any property that affects the data rate can contribute to this overflowing, such as pixel clock, frame rate, line rate, and valid pixels in a line. In general, the slower the data rate, the less likelihood of a FIFO overflow, even if the PC is not polling as quickly as it should sometimes. For example, a Firefly MV-03MT may tear less than a Chameleon because it runs at a slower pixel clock and lower resolution (assuming the Chameleon is running at full resolution). On the other hand, a Firefly MV 13S2 may tear more than a Chameleon, since it runs at a higher pixel clock, assuming the same resolution.

## **1.3.4 Laptop (Notebook) C3 Power State Transition**

Corrupted data when using the IEEE 1394 port on a laptop (notebook) computer can be caused by too much latency in the C3 power state transition, which causes buffer underruns. In other words, the interrupts associated with the processor's ability to dynamically change speeds conflict with the high demand on the processor that is needed when streaming video or data across the IEEE 1394 port. This has been seen on laptops from various manufacturers.

## 1.4 Fixing Image Tearing

Avoiding corrupt images depends on system components and configuration, speed and/or hardware. The following suggestions may help with avoiding corrupt images. Note that some combination of suggestions may be required to completely minimize occurrences.

1. Verify if the issue is related to the video display refresh rate. See 1.3.1 above.
2. Disable power-saving features, as discussed in 1.3.2 above.
3. If possible, lower the overall data rate, such as by lowering the frame rate, or by using a Format\_7 mode that transmits lower-resolution images using region of interest and/or pixel binning.
4. If using a 64-bit 1394 PCI card, connect the card to a 64-bit 66 MHz PCI or PCI-X bus. This will allow you to take full advantage of the wider bus bandwidth, and has been known to significantly reduce corrupt images. Alternatively, use a 1394 PCI Express card, which provides far greater data bandwidth than conventional PCI. Note that when using a PCIe card, performance can also improve by lowering the bit depth of the display monitor.
5. Avoid motherboards that use integrated graphics controllers. Integrated graphics usually allocate a portion of available physical memory for moving image data, which reduces the amount of memory available for 1394 operations. Use an AGP video card with dedicated video memory. This is also true of most other on-board devices, such as audio cards. Disabling onboard devices can improve image tearing.
6. Avoid PCMCIA 1394 host controllers on laptop/notebook systems. PCMCIA or CardBus controllers often have difficulty keeping up with required data transfer rates. If the laptop supports a 4-pin built-in 1394 connector, use this together with a powered hub. See [Related Article 93](#) below for information on powering 1394 devices connected to laptops.
7. Ensure the host system has a fast CPU. A fast processor should help with the speed at which data can be pulled off the PCI bus.
8. Limit any heavy IO operations, such as those described above, that might occur while running 1394 devices.
9. Try a different 1394 card that provides larger FIFO buffers. See [Related Article 146](#) below.
10. Avoid any troublesome hardware issues, such as those described above or those outlined in [Related Article 21](#) below. This includes trying different powered hubs/repeaters, shorter cables, and different power supplies.
11. Ensure adequate power is provided to the camera. Power consumption specifications can be found in the camera's *Technical Reference* or *Getting Started* manual. For more information, see [Related Article 295](#) below.
12. Turn off the power saving features of USB root hubs on the system, as follows:
  - Open Device Manager
  - Expand the *Universal Serial Bus Controllers* group
  - Right click *USB Root Hub* and choose *Properties*
  - Select *Power Management*
  - Uncheck *Allow the computer to turn off this device to save power*
  - Repeat these last 3 steps for each USB Root Hub

## 1.5 Detecting Torn Images

Beginning with FlyCapture SDK version 2.0.3.19, you can detect when a USB camera transmits a torn image. To use this feature, the following additional components are required:

- Firmware version 1.3.3.0 (or later) for the Chameleon or Firefly MV FMVU cameras. This version of firmware provides a mechanism for USB cameras to re-synchronize after a FIFO overflow, so that subsequent image transmissions are not torn.

- Version 2.0.3.19 (or later) of the pgrUSB driver. This version allows torn images to be detected in RetrieveBuffer() calls. On versions earlier than 2.1, a PGRERROR\_ISOCH\_RETRIEVE\_BUFFER\_FAILED error is returned, along with the string, "There was an image consistency issue with this image." On versions 2.1 or later, the error is PGRERROR\_IMAGE\_CONSISTENCY\_ERROR.

Torn image detection can also be used in FlyCapture 1.x applications, through the translation layer provided in FlyCapture 2.0.3.19. However, there is no equivalent PGRERROR\_IMAGE\_CONSISTENCY\_ERROR in the FlyCapture 1.x API. Torn frames that are detected in flycaptureGrabImage2 (or flycaptureLockNext) calls return only a FLYCAPTURE\_FAILED error, along with the string, "Flycapture operation failed."

To get the necessary software and firmware updates, visit the [Point Grey downloads page](#).

## 1.6 Other Resources

Description	Link
Troublesome hardware configurations	<a href="#">Knowledge Base Article 21</a>
Maximum number of IEEE-1394 cameras on a single 1394 bus	<a href="#">Knowledge Base Article 22</a>
My laptop's IEEE-1394 port or PCMCIA card doesn't supply power to my camera	<a href="#">Knowledge Base Article 93</a>
Avoiding dropped or missed images using FlyCapture	<a href="#">Knowledge Base Article 141</a>
Differences to consider when selecting an IEEE-1394 PCI/PCMCIA host adapter card	<a href="#">Knowledge Base Article 146</a>
Providing power to Point Grey cameras	<a href="#">Knowledge Base Article 295</a>

## 1.7 Additional Downloads and Support

Access more Technical Application Notes on the web at [www.ptgrey.com/support/downloads](http://www.ptgrey.com/support/downloads).

Point Grey Research Inc. endeavors to provide the highest level of technical support possible to our customers. Most support resources can be accessed through the Product Support section of our website: [www.ptgrey.com/support](http://www.ptgrey.com/support).

### Creating a Customer Login Account

The first step in accessing our technical support resources is to obtain a Customer Login Account. This requires a valid name, e-mail address, and camera serial number. To apply for a Customer Login Account go to [www.ptgrey.com/support/downloads/](http://www.ptgrey.com/support/downloads/).

### Knowledge Base

Our on-line knowledge base at [www.ptgrey.com/support/kb/](http://www.ptgrey.com/support/kb/) contains answers to some of the most common support questions. It is constantly updated, expanded, and refined to ensure that our customers have access to the latest information.

### Product Downloads

Customers with a Customer Login Account can access the latest software and firmware for their cameras from our downloads site at [www.ptgrey.com/support/downloads](http://www.ptgrey.com/support/downloads). We encourage our customers to keep their software and firmware up-to-date by downloading and installing the latest versions.

### Contacting Technical Support

Before contacting Technical Support, have you:

1. *Read the product documentation and user manual?*
2. *Searched the Knowledge Base?*
3. *Downloaded and installed the latest version of software and/or firmware?*

If you have done all the above and still can't find an answer to your question, contact our Technical Support team at [www.ptgrey.com/support/contact/](http://www.ptgrey.com/support/contact/).