USB 3.0 Camera Trigger Mode

rev 0.2

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1. Overview

This document describes the trigger functionality of Leopard Imaging USB3.0 cameras. In many applications, the camera is free running in video streaming mode, which continuously streams image frames through USB 3.0 interface. However, there are also many other cases that require the image to be synchronized with an external trigger signal or the software just wants to process snapshot images. Trigger mode is set up to meet such requirements.

2. Trigger Timing

Figure 1 and figure 2 show the sequence of trigger, exposure and readout.

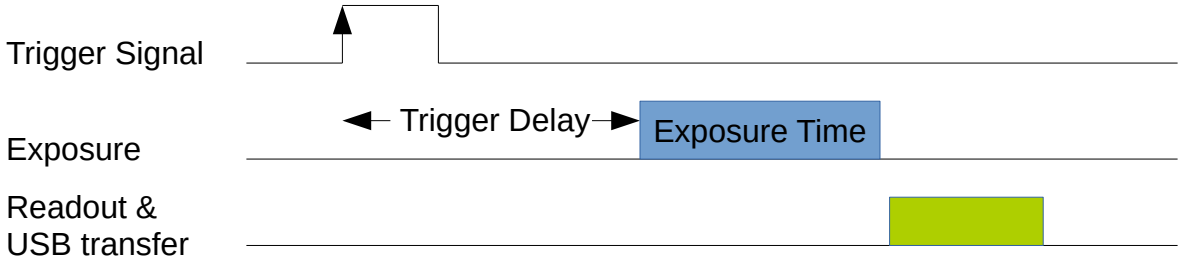

Figure 1. Trigger Timing (Rising Edge)

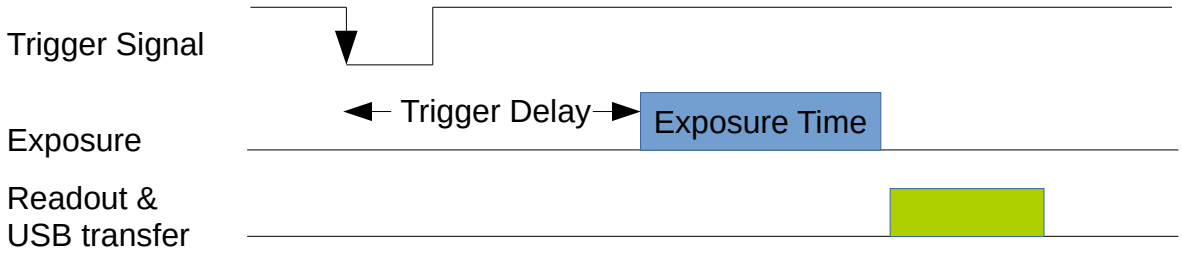

Figure 2. Trigger Timing (Falling Edge)

The trigger signal could be a rising or falling edge of an external voltage pulse, or a software command from the application. Once the camera receives a

trigger, it will delay for a configurable amount of time, and then start the exposure of the image sensor. When the exposure is done, it will read out the data and send it over USB 3.0 interface.

Trigger delay can be set by the application, ranging from 0 to 2^32 - 1 milliseconds. In the case of 0, the exposure will happen right after the rising edge of the trigger signal. Its unit is millisecond.

Exposure time is the length of time when the image sensor is exposed to light. It is also called integration time.

3. External Trigger and Software Trigger

There are two ways to trigger the camera: external trigger and software trigger.

External trigger is a voltage pulse from an external circuit. The hardware connection is described in section 4. It can be triggered on rising edge or falling edge depending on the configuration.

Software trigger can be used in PC software to snapshot an image by sending UVC extension commands.

4. External Trigger Connection

On a Leopard Imaging box USB 3.0 camera, the external trigger is on pin 1, with pin 5 as the ground. On a USB 3.0 camera module, they are on J3 pin 1 & pin 5 respectively. Both of them are isolated from the rest of the camera through an optocoupler.

Table 1. Trigger Pin Locations

	External Trigger	Trigger Ground
Box Camera	Connector Pin 1	Connector Pin 5
Camera Module	J3 pin 1	J3 pin 5

The recommended hardware connection is shown in figure 3.

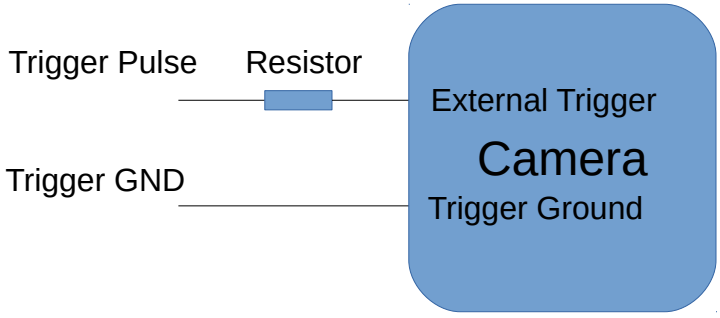

Figure 3. External Trigger Connection

The External Trigger is open-drain. With a resistor in serial, it can support wide range of voltage input.

The resistor should be calculated as:

Resistor = (Vpulse - 1.0) / Ipulse - 133

, where Vpulse is the voltage between Trigger Pulse and Trigger GND, Ipulse can be 1mA - 10mA. The following table gives some recommended values for the resistor under different voltages.

Table 2. Recommended Resistor Value

Vpulse	Resistor (Ohm)
1.8V	300
3.3V	1K
12V	2K
24V	5.1K

5. Trigger Mode Configuration

All Leopard Imaging cameras are UVC compliant. They also support user-defined UVC extension units to configure the camera. For Trigger mode, 3 UVC extension units are used.

XU_SOFT_TRIGGER, (0x09): software trigger command

XU_TRIGGER_MODE, (0x0b): enable/disable trigger mode

XU_TRIGGER_DELAY_TIME,(0x0a): set up delay time

By default, the camera is in video streaming mode. To switch to Trigger mode, send XU_TRIGGER_MODE with parameter 1 for rising edge trigger, 3 for falling edge trigger. To switch back to video streaming mode, send XU_TRIGGER_MODE with parameter 0.

XU_TRIGGER_DELAY_TIME takes a 32-bit parameter for the delay time in millisecond.

XU_SOFT_TRIGGER triggers one frame.

For the sample code of these extensions, please refer to software SDK.

Revision History

Revision number	Contents	Date	Author
0.1	Initial Draft	10/29/2014	Leon L.
0.2	Added rising/falling edge trigger 24V trigger voltage	10/31/2014	Leon L.