Introduction

This document describes the basic and advanced triggering concepts for Allied Vision GigE cameras.

Basic Triggering concepts

Trigger timing diagram

![Triggering Concept Diagram](image)

**Figure 1:** Allied Vision GigE camera internal signal timing waveforms

Note: Jitter at the beginning of an exposure has no effect on the length of exposure.
Notes on triggering

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logic trigger</td>
<td>Trigger signal seen by the camera internal logic (not visible to the user)</td>
</tr>
<tr>
<td>Tpd</td>
<td>Propagation delay between the user trigger and the logic trigger</td>
</tr>
<tr>
<td>Exposure</td>
<td>High when the camera image sensor is integrating light</td>
</tr>
<tr>
<td>Readout</td>
<td>High when the camera image sensor is reading out data</td>
</tr>
<tr>
<td>Trigger latency</td>
<td>Time delay between the user trigger and the start of exposure</td>
</tr>
<tr>
<td>Trigger jitter</td>
<td>Error in the trigger latency time</td>
</tr>
<tr>
<td>Trigger ready</td>
<td>Indicates to the user that the camera will accept the next trigger</td>
</tr>
<tr>
<td>Registered exposure time</td>
<td>Exposure time value currently stored in the camera memory</td>
</tr>
<tr>
<td>Exposure start delay</td>
<td>Registered exposure time subtracted from the readout time and indicates</td>
</tr>
<tr>
<td>Interline time</td>
<td>Time between sensor row readout cycles</td>
</tr>
<tr>
<td>Imaging</td>
<td>High when the camera image sensor is either exposing and/or reading out data</td>
</tr>
<tr>
<td>Idle</td>
<td>High if the camera image sensor is not exposing and/or reading out data</td>
</tr>
</tbody>
</table>

**Table 3:** Notes on triggering

The user trigger pulse width should be at least three times the width of the trigger latency as indicated *Specifications* chapter of the camera technical manual.

- The end of exposure will always trigger the next readout.
- The end of exposure must always end after the current readout.
- The start of exposure must always correspond with the interline time if readout is true.
- Exposure start delay equals the readout time minus the registered exposure time.

Triggering during the idle state

For applications requiring the shortest possible *Trigger Latency* and the smallest possible *Trigger Jitter* the *User Trigger* signal should be applied when *Imaging* is false and *Idle* is true. In this case, *Trigger Latency* and *Trigger Jitter* are as indicated in the *Specifications* chapter of the camera technical manual.

Triggering during the readout state

For applications requiring the fastest triggering cycle time whereby the camera image sensor is exposing and reading out simultaneously, apply the *User Trigger* signal as soon as a valid *Trigger Ready* is detected. In this case, *Trigger Latency* and *Trigger Jitter* can be up to 1 row time since *Exposure* must always begin on an *Interline* boundary.
Advanced triggering concepts

This section provides a detailed description of the trigger concept for advanced users and special scenarios. See GigE Camera and Driver Attributes document for detailed camera control definitions:

https://www.alliedvision.com/fileadmin/content/documents/products/cameras/various/features/GigE_Camera_and_Driver_Attributes.pdf

The acquisition/frame concept

Frames within acquisition, determined by FrameStartTrigger mode, i.e. FixedRate, Freerun, SyncIn1, SyncIn2, Software

Number of frames within acquisition stream determined by AcquisitionMode:

- **Continuous**
  - Go until AcquisitionStop() or TTL signal when AcqEndTriggerMode = SyncIn1 or SyncIn2

- **Multiframe**
  - Fixed number of frames

- **SingleFrame**
  - One Frame

- **Recorder**
  - Fixed number of frames. Cycle images in camera memory, don’t return to API until recorder trigger event.

Must call AcquisitionStop() or TTL signal when AcqEndTriggerMode = SyncIn1 or SyncIn2 and restart stream to capture frames.

**Figure 2: AcquisitionStart and AcquisitionAbort**
Scenario 1: Acquisition controlled by hardware trigger (Freerun)

AcqStartTriggerMode = SyncIn1
FrameStartTriggerMode = Freerun
AcquisitionMode = Freerun
AcqEndTriggerMode = SyncIn1
AcqEndTriggerEvent = EdgeFalling or LevelLow

AcqStartTriggerEvent = EdgeRising or LevelHigh

FrameStartTriggerMode = Freerun

gigE camera

Figure 3: Trigger scenario 1: Acquisition controlled by hardware trigger (Freerun)

Figure 3: Trigger scenario 1: Acquisition controlled by hardware trigger (Freerun)

Scenario 2: Controlling exposure duration by external trigger

AcqStartTriggerMode/AcqEndTriggerMode = Disabled
FrameStartTriggerMode = SyncIn1
AcquisitionMode = MultiFrame
ExposureMode = External
AcquisitionFrameCount = 3

FrameStartTriggerMode = Freerun

AcquistionStart() API CALL

AcquistionStop() API CALL

Pulse width determines exposure time

Figure 4: Trigger scenario 2: Controlling exposure duration by external trigger

Figure 4: Trigger scenario 2: Controlling exposure duration by external trigger
Scenario 3: Recorder mode

### Figure 5: Trigger scenario 3: Recorder mode

If host reports occasional dropped frames/packets (reported as StatFramesDropped/StatPacketsMissed) with an optimized NIC, you may need to decrease StreamBytesPerSecond attribute.

In Recorder mode, AcquisitionFrameCount cannot exceed StreamHoldCapacity.
Which command controls frames?

You have to distinguish between `AcqStart` and `FrameStart`. Only `FrameStartTriggerMode` controls frames.

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**Problem:** Customer thinks `AcqStart` controls frames: But it does **not**!

=> `FrameStartTriggerMode` controls frames (within the acquisition).

In this case, acquisition started by first TTL EdgeRising, and does not end (because `AcqEndTriggerMode` = Disabled).

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**Figure 6:** Which command controls frames?
Additional References
Technical manuals and GigE feature reference
https://www.alliedvision.com/en/support/technical-documentation

For technical support, please contact support@alliedvision.com.
For comments or suggestions regarding this document, please contact info@alliedvision.com.

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