

## Scope of this document

This document describes triggering basics for Allied Vision USB3 Vision cameras, from best-practice rules to general examples.



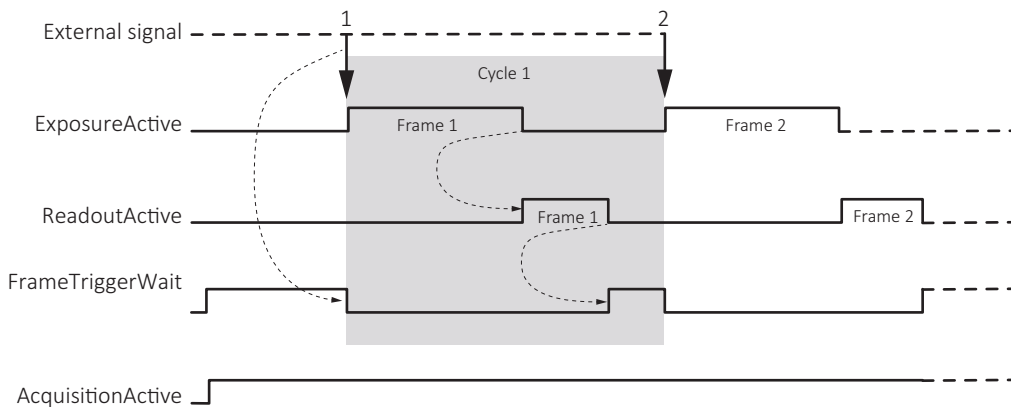
### Available features

Features vary between the different cameras.

For more information, see your Allied Vision USB camera's technical manual:  
<https://www.alliedvision.com/en/support/technical-documentation.html>

## Trigger signal flow

The following diagram shows the exposure of a frame started by an external signal. High levels show the active state of a signal. Proportions and dependencies are simplified to show the basic signal flow. Signal 1 starts Cycle 1.



**Figure 1:** Trigger signal flow

Term	Description
External signal	Electrical trigger signal starting the signal flow
<i>ExposureActive</i>	Exposing a frame
<i>ReadoutActive</i>	Reading out a frame, high when the image sensor is reading out data
<i>FrameTriggerWait</i>	Waiting for a trigger
<i>AcquisitionActive</i>	Acquiring of frames, needs to be high to start triggering High when the camera image sensor is either exposing, reading out data, or waiting for a trigger

**Table 3:** Legend for Trigger signal flow

## Trigger latency

Trigger latency is the time delay between the FrameStart trigger and the start of exposure. Trigger latency consists of:

- Jitter and delay of ExposureStart
- TriggerDelay

Term	Description
ExposureStart jitter	Deviation from the average periodical signal time Time range mainly caused by sensor line synchronization
ExposureStart delay	Deviation from the average periodical signal time Time range caused by camera internal timing
TriggerDelay	Value set by the user to extend the trigger latency

**Table 4:** Trigger latency -> Components

## Best practice rules for triggering

- Set the trigger to *RisingEdge* for fastest possible reaction time.
- Set the trigger pulse width in the supported range, see [Input timing delay and minimum pulse width](#) on page 74.
- Consider that the end of exposure triggers the next readout.
- Make sure the exposure of a frame ends after the readout of the previous frame.
- Start exposure only between the readouts of two lines.
- Consider that ExposureStart delay = readout time – ExposureTime.

## Triggering when ReadoutActive is low

Apply FrameStart trigger when *ReadoutActive* is low. This way, you keep trigger latency (including ExposureStart jitter) short.

## Triggering when ReadoutActive is high

For fastest triggering cycle time with simultaneous exposure and readout, apply FrameStart trigger immediately when *FrameTriggerWait* is high.

Because exposure must always begin at sensor line synchronization, the ExposureStart jitter can be up to 1 line cycle.



### Additional information

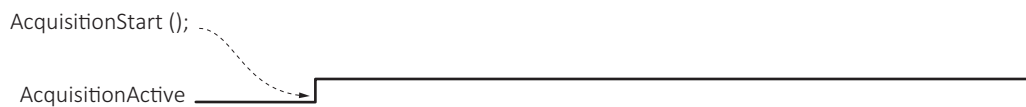
- For detailed camera control definitions, see your camera's technical manual: <https://www.alliedvision.com/en/support/technical-documentation.html>
- For detailed camera control definitions, see *USB3 Vision Features Reference* at **Additional Documents** for your USB camera: <https://www.alliedvision.com/en/support/technical-documentation.html>

## Examples

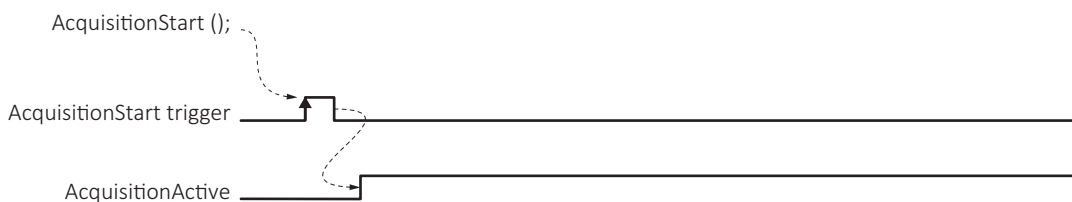
### AcquisitionStart trigger and FrameStart trigger

#### AcquisitionStart description

To acquire images, AcquisitionActive must be high. Even to trigger the start of an acquisition by a pulse through an I/O, you have to issue an AcquisitionStart command.



**Figure 2:** *TriggerMode = Off, software command: AcquisitionStart*



**Figure 3:** *TriggerMode = On, software command: AcquisitionStart*



#### **AcquisitionStop**

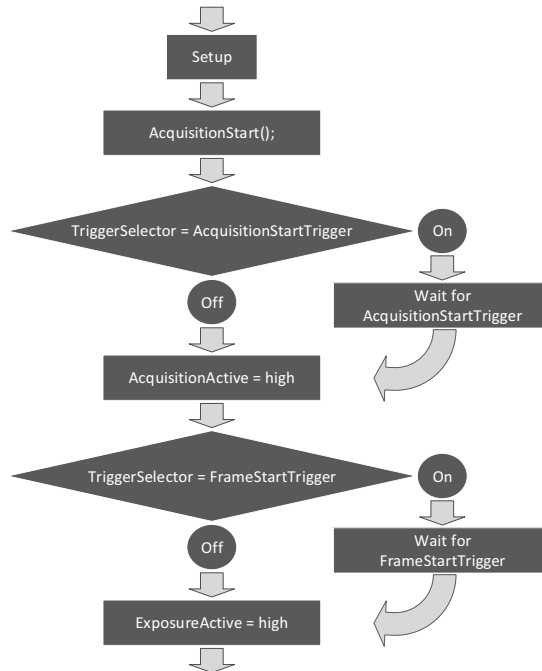
AcquisitionStop is mandatory to end acquisition.

With AcquisitionMode = SingleFrame or MultiFrame:

If no AcquisitionStop is signaled, after the selected number of frames has been acquired, the camera internally creates an AcquisitionStop command; this turns AcquisitionActive to low.

## AcquisitionStart trigger and FrameStart trigger influence

*Figure 4* shows the dependencies between AcquisitionStart and FrameStart trigger.



**Figure 4:** Dependencies of AcquisitionStartTrigger and FrameStartTrigger



### AcquisitionStart trigger and FrameStart trigger

See timing example for AcquisitionStart trigger and FrameStart trigger in [TriggerSelector = FrameBurstStart, FrameStart](#) on page 9.

## Modes for triggering

The following sections describe in general the main modes for triggering:

- TriggerModes
- AcquisitionModes
- ExposureModes

## TriggerSelector

The TriggerSelector examples in this section show triggering with AcquisitionMode = Continuous.

AcquisitionMode	TriggerSelector		
	AcquisitionStart	FrameStart	FrameBurstStart
Continuous	Off	Off	Off
Continuous	Off	On	Off
Continuous	Off	Off	On
Continuous	Off	On	On

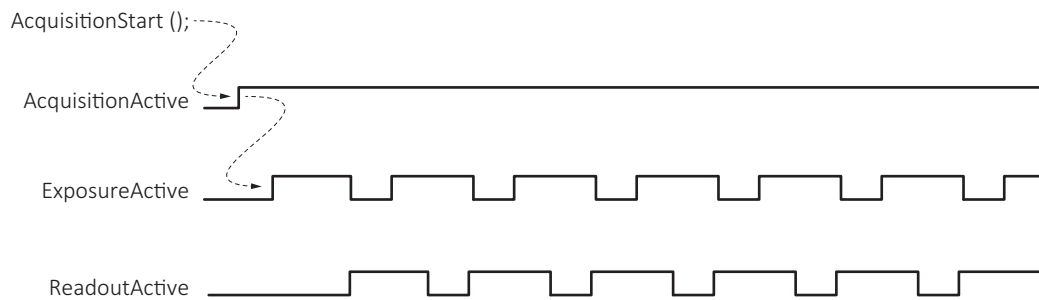
**Table 1:** TriggerSelector examples overview

An AcquisitionStart command sets ExposureActive to high. After this, the camera continues exposing with the maximum frame rate allowed. Maximum frame rate depends on factors, such as camera specifications and available bandwidth.

### Acquisition without triggering

If no trigger is selected, the AcquisitionStart command starts exposure.

```
AcquisitionMode = Continuous;  
  
TriggerSelector = AcquisitionStart;  
TriggerMode = Off;  
  
TriggerSelector = FrameStart;  
TriggerMode = Off;  
  
TriggerSelector = FrameBurstStart;  
TriggerMode = Off;
```

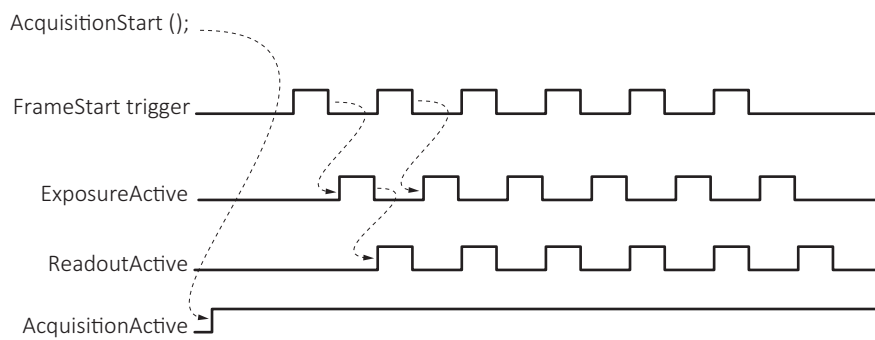


**Figure 5:** Acquisition without triggering

**TriggerSelector = FrameStart**

FrameStart triggers the exposure.

```
AcquisitionMode = Continuous;  
  
TriggerSelector = AcquisitionStart;  
TriggerMode = Off;  
  
TriggerSelector = FrameStart;  
TriggerMode = On;  
  
TriggerSelector = FrameBurstStart;  
TriggerMode = Off;
```



**Figure 6:** TriggerSelector = FrameStart trigger

## TriggerSelector = FrameBurstStart

FrameBurstStart starts exposure.

AcquisitionFrameBurstCount sets the number of frames for a burst.

```

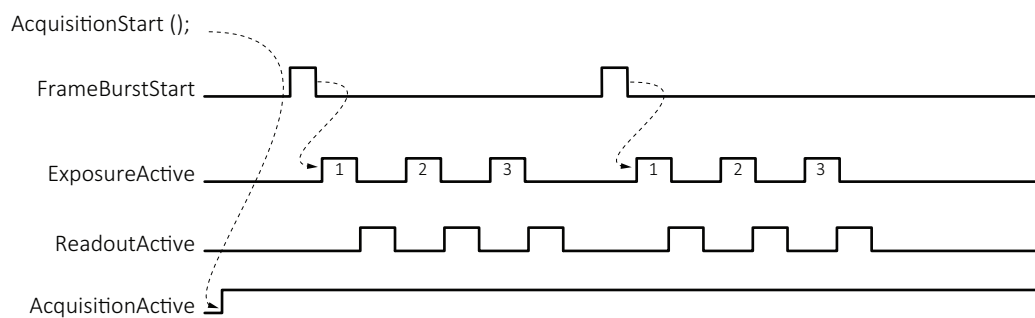
AcquisitionMode = Continuous;

AcquisitionFrameBurstCount = 3

TriggerSelector = AcquisitionStart;
TriggerMode = Off;

TriggerSelector = FrameStart
TriggerMode = Off;

TriggerSelector = FrameBurstStart
TriggerMode = On;
  
```



**Figure 7:** *TriggerSelector = FrameBurstStart trigger*



### TriggerSelector = FrameBurstStart, FrameStart

FrameStart (a) triggers exposure.

But it is ignored, as long as it is not enabled by a FrameBurstStart trigger (b).

In the example, every frame of the preselected burst is started by a FrameStart trigger.

```

AcquisitionMode = Continuous;

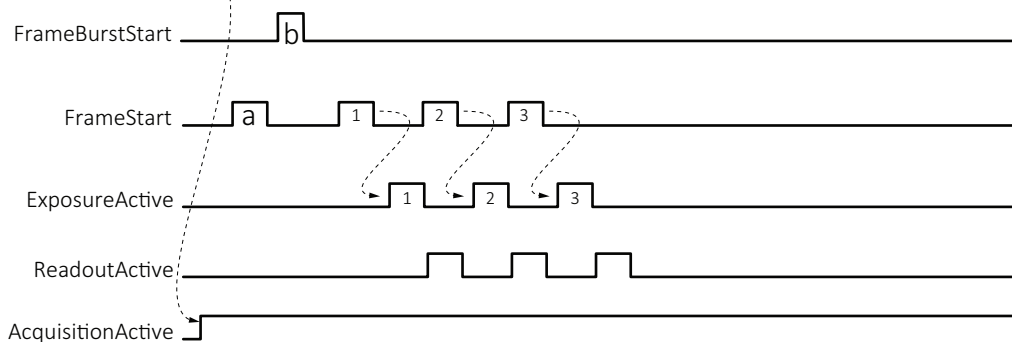
AcquisitionFrameBurstCount = 3

TriggerSelector = AcquisitionStart;
TriggerMode = Off;

TriggerSelector = FrameStart
TriggerMode = On;

TriggerSelector = FrameBurstStart
TriggerMode = On;
  
```

AcquisitionStart ();



**Figure 8:** FrameBurstStart and FrameStart trigger

## AcquisitionModes

### AcquisitionMode = SingleFrame

The AcquisitionStart command triggers the exposure of a single frame.

Every frame needs a separate AcquisitionStart command.

```

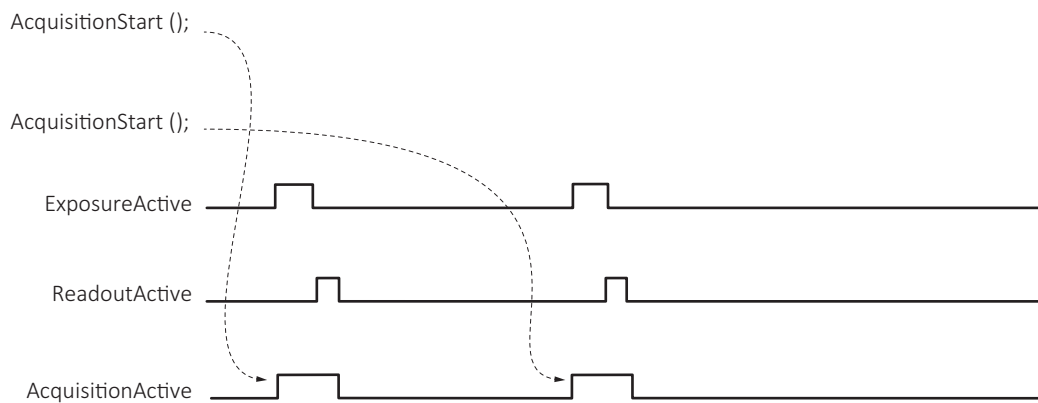
AcquisitionMode = SingleFrame;

TriggerSelector = AcquisitionStart;
TriggerMode = Off;

TriggerSelector = FrameStart;
TriggerMode = Off;

TriggerSelector = FrameBurstStart;
TriggerMode = Off;

ExposureMode = Timed;
  
```



**Figure 9:** *AcquisitionMode = SingleFrame*

### AcquisitionMode = MultiFrame

AcquisitionStart triggers exposure.

FrameCount sets the number of images.

```

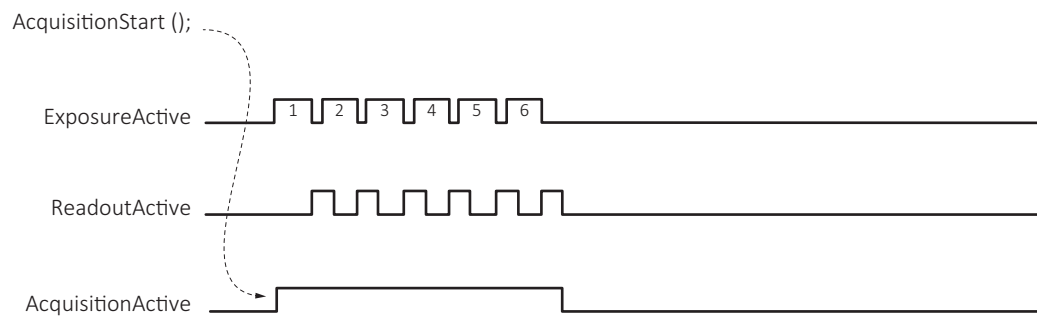
AcquisitionMode = MultiFrame;
  FrameCount = 6;

TriggerSelector = AcquisitionStart;
  TriggerMode = Off;

TriggerSelector = FrameStart;
  TriggerMode = Off;

TriggerSelector = FrameBurstStart;
  TriggerMode = Off;

ExposureMode = Timed;
  
```



**Figure 10:** AcquisitionMode = MultiFrame

## ExposureModes

### ExposureMode = Timed

FrameStart triggers exposure.

ExposureTime sets exposure time.

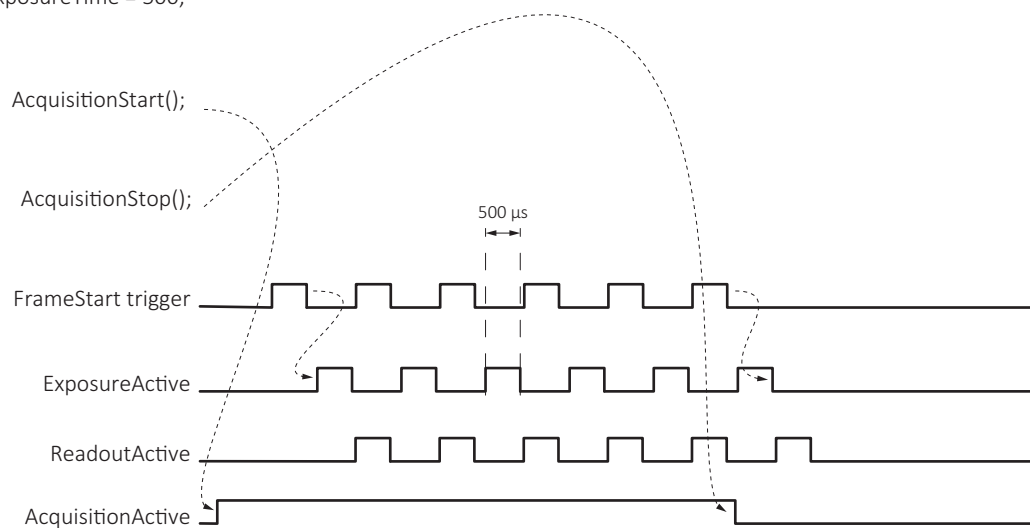
```
AcquisitionMode = Continuous;
```

```
TriggerSelector = AcquisitionStart;
TriggerMode = Off;
```

```
TriggerSelector = FrameStart
TriggerMode = On;
```

```
TriggerSelector = FrameBurstStart
TriggerMode = Off;
```

```
ExposureMode = Timed;
ExposureTime = 500;
```



**Figure 11:** *ExposureMode = Timed*

## ExposureMode = TriggerWidth

FrameStart triggers exposure.

The duration of the FrameStart trigger sets the exposure time.

```

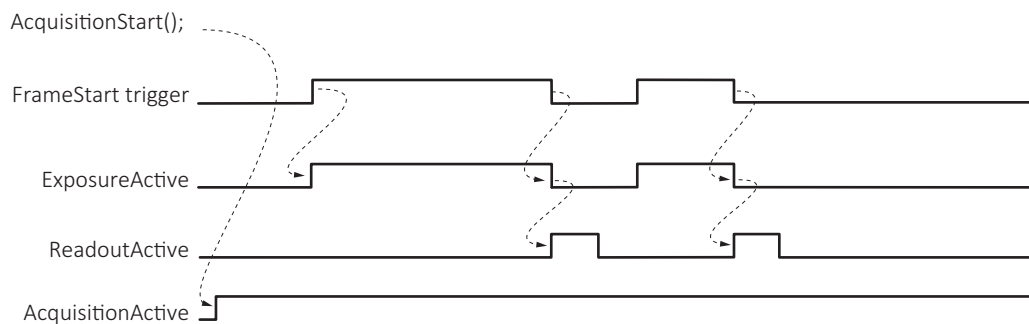
AcquisitionMode = Continuous;

TriggerSelector = AcquisitionStart;
TriggerMode = Off;

TriggerSelector = FrameStart
TriggerMode = On;

TriggerSelector = FrameBurstStart
TriggerMode = Off;

ExposureMode = TriggerWidth;
  
```



**Figure 12:** ExposureMode = TriggerWidth



### TriggerWidth and TriggerActivation

If the frame or line TriggerActivation[TriggerSelector] is RisingEdge or LevelHigh, the camera exposes as long as the trigger is high. If TriggerActivation[TriggerSelector] is FallingEdge or LevelLow, the camera exposes as long as the trigger is low.

## Contact

For technical support, please contact [support@alliedvision.com](mailto:support@alliedvision.com).

For comments or suggestions regarding this document, please contact [info@alliedvision.com](mailto:info@alliedvision.com).

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