

Sequencer: Realization of a double shutter

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Description

This document describes the general approach of using the sequencer with Baumer industrial cameras. It explores the realization of a double shutter.

Products

Baumer VCXG cameras

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1 Sequencer basics

1.1 Introduction

The sequencer enables the possibility of image series recording including automated re-parameterization of the camera based on different events and signals. Therefore the desired camera settings for each step are stored in so-called sequencer sets. Stringing together a number of these sequencer sets results in a sequence. The connection of sequences is done by using different paths. Alongside the camera features the path related features are also part of a sequencer set.

1.2 Sequencer sets

Sequencer sets combine camera features – comparable with a user set – and sequencer (set and path) related parameters.

Settings for several camera features such as

- exposure time
- gain
- partial scan
- user output
- counter

...can be controlled by the sequencer and thus stored to a sequencer set as well as information for the set switch-over via four different paths.

Each path involves

- the destination for the set switch-over that is mapped by the 'SequencerSetNext' feature
- the signal, whose change of state is used for triggering the set switch-over and that is mapped as 'SequencerTriggerSource'
- the change of state triggering the set switch-over and that is mapped as 'SequencerTriggerActivation'

As with user sets the camera's current settings are overwritten once a sequencer set is loaded and the sequencer is activated.

1.3 Sequencer configuration

In order to avoid overwriting current camera settings while configuring a sequencer, the camera needs to be set to the sequencer configuration mode.

Once the camera is set to the sequencer configuration mode, the individual sequencer sets can be selected via the SequencerSetSelector, configured and saved by executing SequencerSetSave.

Starting the configured sequence requires to switch the sequencer configuration mode off and to enable the sequencer mode.

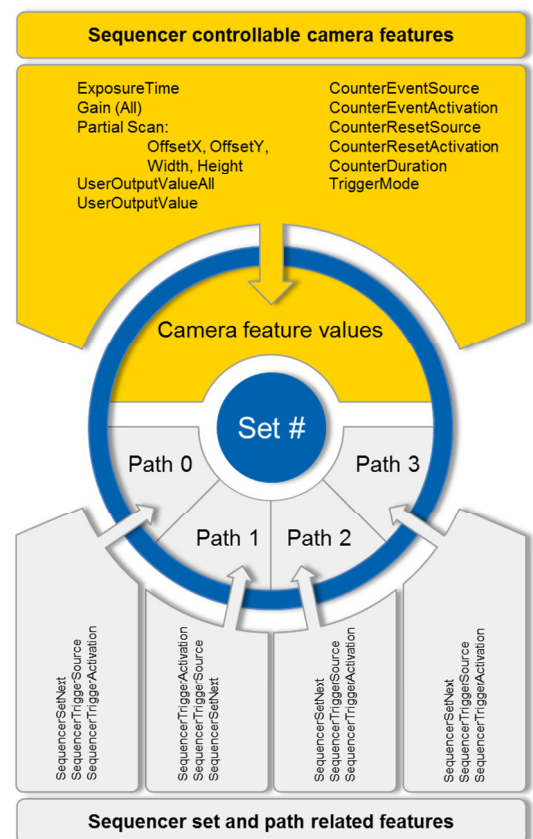


Figure 1: Structure of a sequencer set

1.4 Sequencer command overview

Features	Values	Description
SequencerMode	On/Off	Enables / disables the sequencer mechanism To use this feature, the SequencerConfigurationMode must be off.
SequencerConfigurationMode	On/Off	Enables / disables the sequencer configuration mode Here the sequencer configuration can take place but there is no image acquisition. To use this feature, the SequencerMode must be off.
SequencerFeatureSelector	ExposureTime Gain (All) OffsetX OffsetY Width Height UserOutputValueAll UserOutputValue CounterEventSource CounterEventActivation CounterResetSource CounterResetActivation CounterDuration TriggerMode	Selects the camera features that are controlled by the sequencer.
SequencerFeatureEnable	true/false [RO]	Enables / disables the selected feature.
SequencerSetSelector	0...127	Selects the sequencer set that contains the feature settings coming afterward.
SequencerSetSave		Stores the current device settings to the selected sequencer set.
SequencerSetLoad		Loads the currently selected sequencer set.
SequencerSetActive	0...127 [RO]	Displays the currently active sequencer set.
SequencerSetStart	0...127	Defines the initial sequencer set.
SequencerPathSelector	0...3	Selects the path that contains the settings coming afterward.
SequencerSetNext	0...127	Defines the Set, that will be next
SequencerTriggerSource	Counter1End Counter2End ExposureActive Line0 ReadoutActive Timer1End Off	Defines the internal or external event that is used as trigger source for the sequencer.
SequencerTriggerActivation	RisingEdge FallingEdge AnyEdge	Defines the signals edge that triggers the sequencer.

The blue marked features are only available in the sequencer configuration mode.

2 Double shutter

The described double shutter offers the possibility of capturing two very short exposed images within a short interval.

2.1 Desired camera behavior

The theoretical approach is to set the camera to trigger mode and for each incoming trigger signal two images (using the same exposure time) are captured.

2.2 Technical constraints

The approach described bases on the employment of a flash lighting – so every image acquisition is accompanied by a flash – and the exclusion of extraneous light.

The previously mentioned passage “very short exposed images” means that the set integration time is shorter than the sensor’s readout time.

In such cases the 2nd exposure time needs to be set to a value that is equal to or longer than the readout time.

Thus the pixels are receptive again shortly after the first exposure. In order to realize the second short exposure time without an overrun of the sensor, a second short flash must be employed, and any subsequent extraneous light prevented.

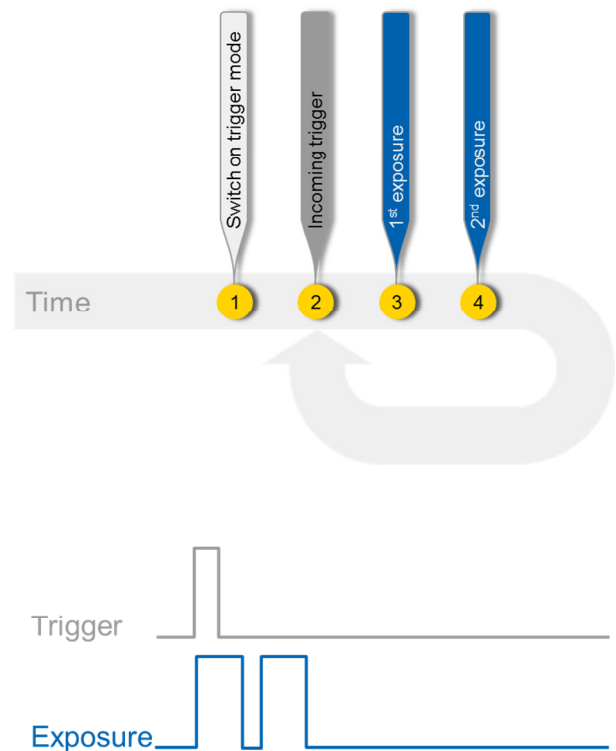


Figure 2: Desired camera behavior for a double shutter

2.3 Concept for the sequencer procedure

Taking the sequencer basics as well as the technical constraints of the double shutter into consideration makes the parameterization of the sequencer a lot more complex than originally expected:

- Since the 1st image acquisition is started via hardware trigger, 2nd image needs to be started automatically immediately afterwards and feature a different exposure time, two different sequencer sets are unavoidable.
- The first set (Set0) contains the necessary parameters for the Trigger Mode configuration as well as the desired exposure time for the 1st image.
- In the 2nd set (Set1) the camera will be set back to free-running operation. The exposure time for the image acquisition will be set to a value that is equal to or longer than the readout time.
- Besides that both sets need to contain sequencer set and path related information.

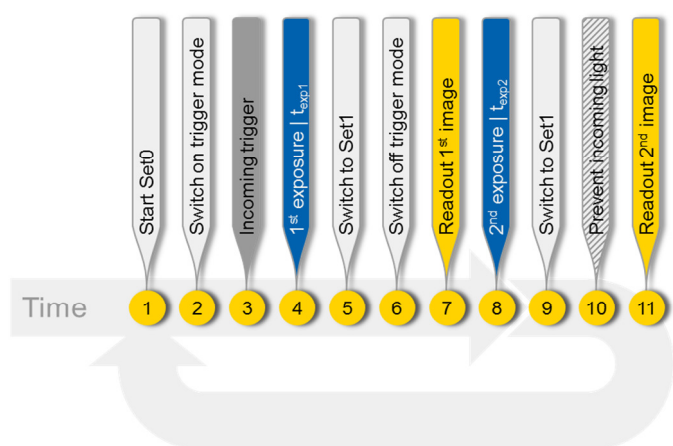
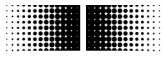


Figure 3: Concept for the sequencer parameterization



2.4 Implementation

Since the sequence should be started by an incoming trigger, a `TriggerSource` needs to be defined. For this example this is `Line0` where the hardware trigger is attached to.

2.4.1 First sequencer set

In `Set0` the sequencer controllable camera features are `ExposureTime` and the `TriggerMode` that is turned on. The sequencer set and path related features are

- `SequencerPathSelector = 0` Defines the path for switching to the next sequencer set. Here it is `Path0`.
- `SequencerTriggerSource = ExposureActive` Defines the internal or external signal that is used as sequencer trigger source. In this case it's the internal signal `ExposureActive`.
- `SequencerTriggerActivation = RisingEdge` Defines the signal's status change that triggers the sequencer set change. Here `RisingEdge` was selected.
- `SequencerSetNext = 1` Defines the sequencer set that will be next when this path is used. In this example this is `Set1`.

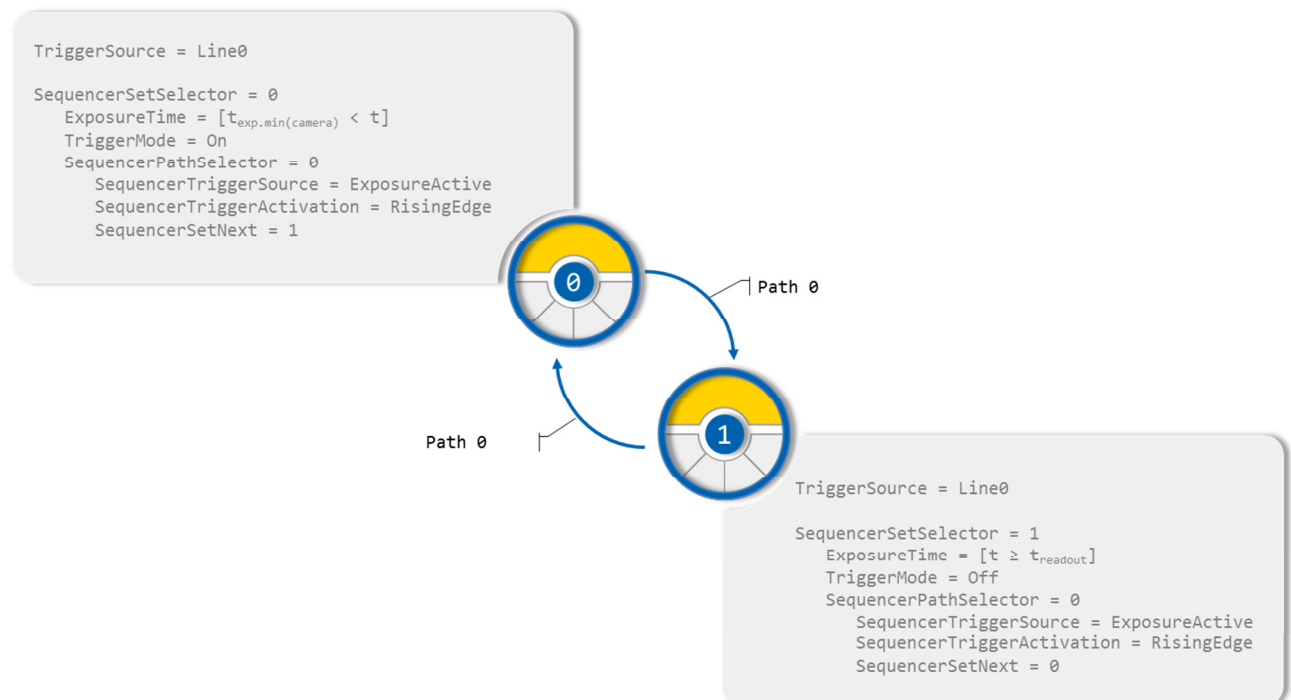


Figure 4: Implementation of the double shutter

2.4.2 Second sequencer set

Set1 contains the longer ExposureTime and switches the TriggerMode off. The sequencer set and path related features are

- SequencerPathSelector = 0
Defines the path for switching to the next sequencer set. For the way back to Set0 it is Path0.
- SequencerTriggerSource = ExposureActive
Defines the internal or external signal that is used as sequencer trigger source. In this case it's the internal signal ExposureActive.
- SequencerTriggerActivation = RisingEdge
Defines the signal's status change that triggers sequencer set change. Here RisingEdge was selected.
- SequencerSetNext = 0
Defines the sequencer set that will be next when this path is used. For the way back this is Set0.

2.5 Result

The opposite figure shows the resulting double shot as signal curves: Avoiding extraneous light (grey shaded area in the exposure signal) during the last part of the 2nd exposure leads to the desired camera behavior.

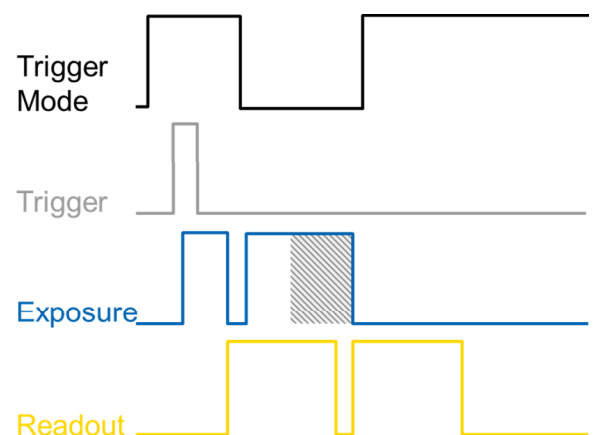


Figure 5: Resulting double shot

3 Related Topics

Sequencer: Multiple acquisitions on one incoming trigger
Realization of a “moving” Region of Interest (ROI)

4 Support

In the case of any questions or for troubleshooting please contact our support team.

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