Automatic Exposure Control

Revision History:

Version	*Date*	*Modifications*	*Author*
1.0.0	06-10-14	Document creation	João Santos
1.1.0	24-08-15	Added AEC algorithm image	João Santos

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1 Introduction

This document explains how to use the Automatic Exposure Control (AEC) algorithm.

This feature is available in Awaiba Viewer, and can also be used in the API, in either .NET (C# or C++/CLI) and in native C++.

When using the bin file `nanousb2_fpga_v06.bin` or newer, the user can use an Automatic Exposure Control algorithm to automate the sensor registers to the ambient conditions, allowing to prevent over-saturated or completely black images.

The user can choose different parameters to defined the range of digital numbers that the image is considered to be perfect.

This class is located in **awcorecs.dll** file in the **Awaiba.Drivers.Grabbers.NanEye** namespace.

2 AEC in Awaiba Viewer

On the **Awaiba Viewer document** is explained how this feature is used, and how to use the interface in Awaiba's Viewer.
You can access Awaiba's main software page in here.

3 AEC in the AwAPI

The Automatic Exposure Control can be used in either native C++ or in any .NET language (we provide a demo example for C# and C++/CLI, in AwAPI).

3.1 AEC in native C++

After creating the manager instance, and following all the steps that are described on the Awaiba Cpp project, that is in the AwAPI, that can be obtained in Awaiba's software webpage, the user can configure the AEC.

It should be used the **SetFPGAData** method, that requires the address and the value to send to that address, to configure the AEC algorithm settings.

The **base address** to use is the **0x00500000**.

On the tables below you can find the addresses for the different features and how to fill the values to send.

For example, according to table 1, to send the default data to the 0x00500000 register you need to send this:

manager.SetFPGAData (0x00500000, 0x02010200)

3.2 AEC in .NET

On .NET there is a specific class, **AutomaticExposureControlHardware**, that writes directly the settings to the lower level.
In this case, the user can change the features by changing the class's attributes, and not just by sending a 32 bit word to the corresponding address.

First, create and instance of **AutomaticExposureControlHardware**:

```
AutomaticExposureControlHardware AEC = new AutomaticExposureControlHardware(0);
```

It receives as argument the Sensor Id (it can be either 0 or 1, according to the sensor that you are creating the instance.

3.3 Registers Description

In the next tables will be the description of all the data that is sent to the FPGA in regard of this AEC algorithm.
In the C++ API, it should be used like in this tables.
In the C# (or C++/CLI) API, it is used by changing directly the properties of the "AutomaticExposureControlHardware" instance.

Address: 0x00500000

Bits	Access	Default	Value	Description
9:0	AEC.TargetGreyValue	512	[0..1023]	Value the algorithm will try to target (changing the gain and exposure) using the values inside the Region of Interest (configured on 0x00500001 and 0x00500002 registers)
16:12	AEC.Hysteresis	16	[0..31]	
25:22	AEC.StepSize	8	[0..15]	Adjusts the speed of the algorithm. Higher this value, the faster the algorithm will go to the target grey value. Too high could lead to the algorithm not stopping at the desired target grey value. Smaller this value, the slower the algorithm will go to the target grey value. Too small will take the algorithm to much time to get to the target grey value.
27:26	AEC.FrameNumber	0	[0..3]	0 → Uses only the current frame to calculate the values. 1..3 → Uses also the previous frames to calculate the values.
30	AEC.Enabled	0	[0..1]	0 → Enable the algorithm. 1 → Disable the algorithm.
31	AEC.ShowROI	0	[0..1]	0 → Does not show the ROI 1 → Show the ROI

Table 1: Automatic Exposure Control address 0x00500000

Address: 0x00500004

Bits	Access	Default	Value	Description
7:0	AEC.RightROI	200	[0..250]	Right border of the Region Of Interest [Column number]
19:12	AEC.LeftROI	50	[0..250]	Left border of the Region Of Interest [Column number]

Table 2: Automatic Exposure Control address 0x00500004

Address: 0x00500008

Bits	Access	Default	Value	Description
7:0	AEC.BottomROI	200	[0..250]	Bottom border of the Region Of Interest [Row number]
19:12	AEC.TopROI	50	[0..250]	Top border of the Region Of Interest [Row number]

Table 3: Automatic Exposure Control address 0x00500008

Address: 0x00500010

Bits	Access	Default	Value	Description
7:0	AEC.MinExpValueGain0	6	[0..250]	Minimum exposure value for Gain 0
23:16	AEC.HighExpValueGain0	175	[0..250]	High exposure value for Gain 0
31:24	AEC.MaxExpValueGain0	250	[0..250]	Maximum exposure value for Gain 0

Table 4: Automatic Exposure Control address 0x00500010

Address: 0x00500014

Bits	Access	Default	Value	Description
7:0	AEC.MinExpValueGain1	125	[0..250]	Minimum exposure value for Gain 1
15:8	AEC.LowExpValueGain1	150	[0..250]	Low exposure value for Gain 1
23:16	AEC.HighExpValueGain1	175	[0..250]	High exposure value for Gain 1
31:24	AEC.MaxExpValueGain1	250	[0..250]	Maximum exposure value for Gain 1

Table 5: Automatic Exposure Control address 0x00500014

Address: 0x00500018

Bits	Access	Default	Value	Description
7:0	AEC.MinExpValueGain2	125	[0..250]	Minimum exposure value for Gain 2
15:8	AEC.LowExpValueGain2	150	[0..250]	Low exposure value for Gain 2
23:16	AEC.HighExpValueGain2	175	[0..250]	High exposure value for Gain 2
31:24	AEC.MaxExpValueGain2	250	[0..250]	Maximum exposure value for Gain 2

Table 6: Automatic Exposure Control address 0x00500018

Address: 0x0050001C

Bits	Access	Default	Value	Description
7:0	AEC.MinExpValueGain3	125	[0..250]	Minimum exposure value for Gain 3
15:8	AEC.LowExpValueGain3	150	[0..250]	Low exposure value for Gain 3
31:24	AEC.MaxExpValueGain3	250	[0..250]	Maximum exposure value for Gain 3

Table 7: Automatic Exposure Control address 0x0050001C

3.4 Algorithm Procedure

In Figure 1 there is explained how the algorithm works, when changing between the different gains.

When the sensor is over-exposed, it follows the “control down”, and when it is under-exposed, it follows the “control up”.

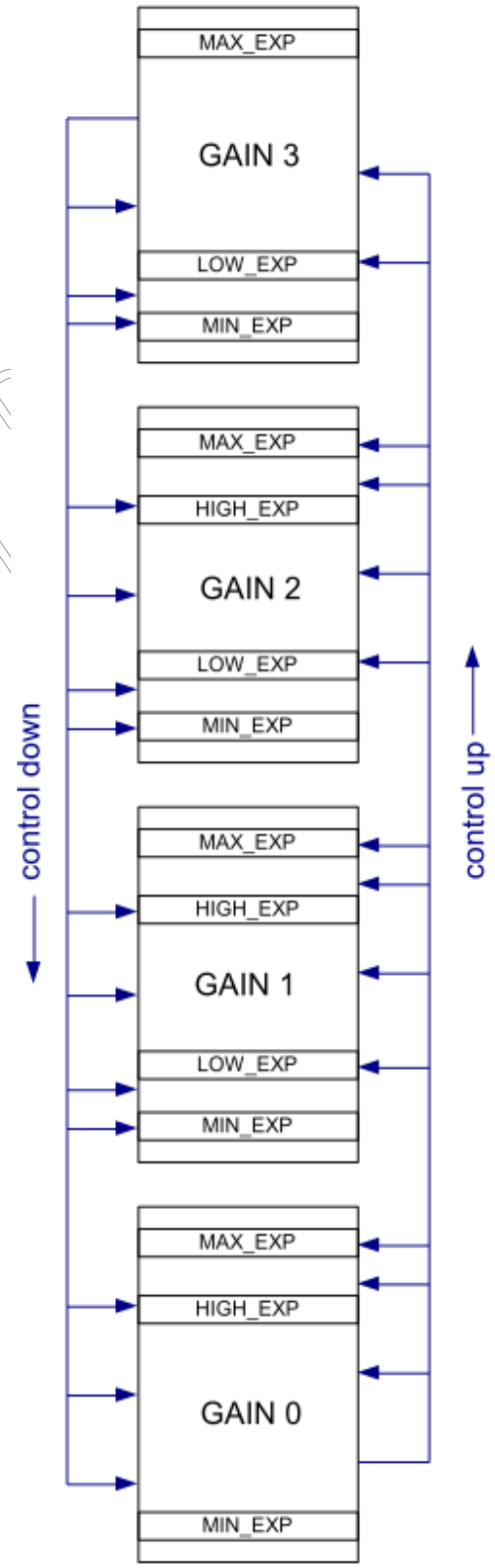

Figure 1: AEC Algorithm Procedure