photon focus

THE PERFECT EYE

APPLICATION NOTE

AN001

Topic:

LinLog™

Summary:

This application note introduces the basics of the linear logarithmic sensor response LinLog™. It describes the configuration parameters and shows a procedure on how to get optimal results.

CONTENT

1. Introduction

The LinLog™ principle can be used to take the figures with high contrast ratios. This principle is time independent and is based on logarithmic compression of the upper luminance intensity values in the response curve. The transition point between the linear and logarithmic response curves can be adjusted by the user. With the combination of logarithmic compression and a global shutter, it is possible to take Figures of moving scenes. A disadvantage of the LinLog™ principle is a heavy compression of the intensity values in the area around the transition point which is not desired in every application.

The **LinLog2™** principle strongly improves the system's behaviour at the transition point. The camera now uses three values: A first threshold value for the strong LinLog compression LL1, a second threshold value for the weak LinLog compression LL2 and an additional parameter called COMP. COMP is a value that defines the ratio between strong and weak compression. Figure 1 shows the characteristic curves of a LinLog sensor.

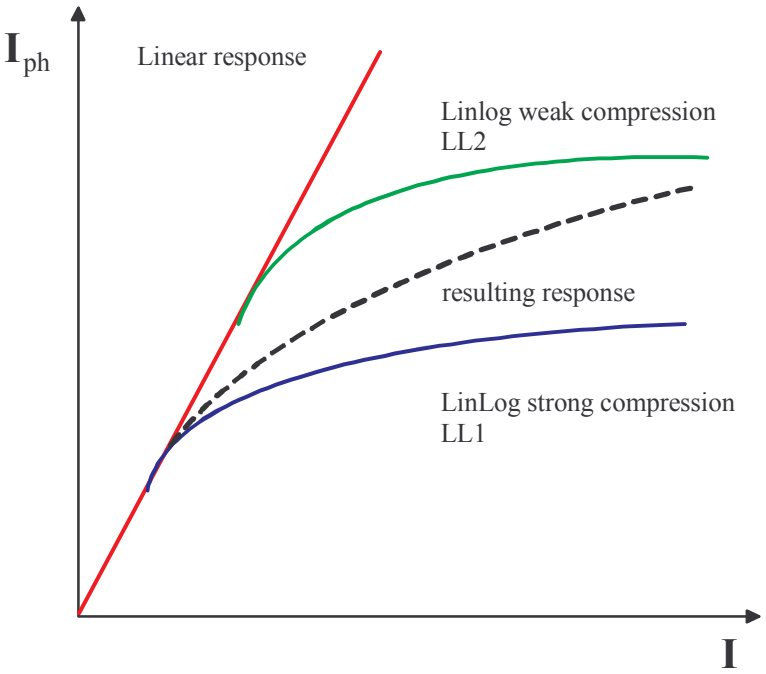


Figure 1: LinLog2 response curve (photo current Iph vs. light intensity I)

2. Optimising of the sensor characteristic curve

Figure 2 shows the procedure to optimise the sensor characteristics. A first Figure which is taken the LinLog parameters set to LL1 = LL2 = 0 and COMP = 0. This Figure can be used for detecting any overexposed Figure areas. Now it is possible to set the three parameters LL1, LL2 und COMP step by step. After this coarse adjustment, it is recommended to redo the black

adjustment in order to make use of the full range of the A/D converter. Alternating modifications of each parameter can be done to achieve an optimal result. A family of measured characteristic curves is shown in Diagram . The COMP ratio has a strong influence on the resulting signal.

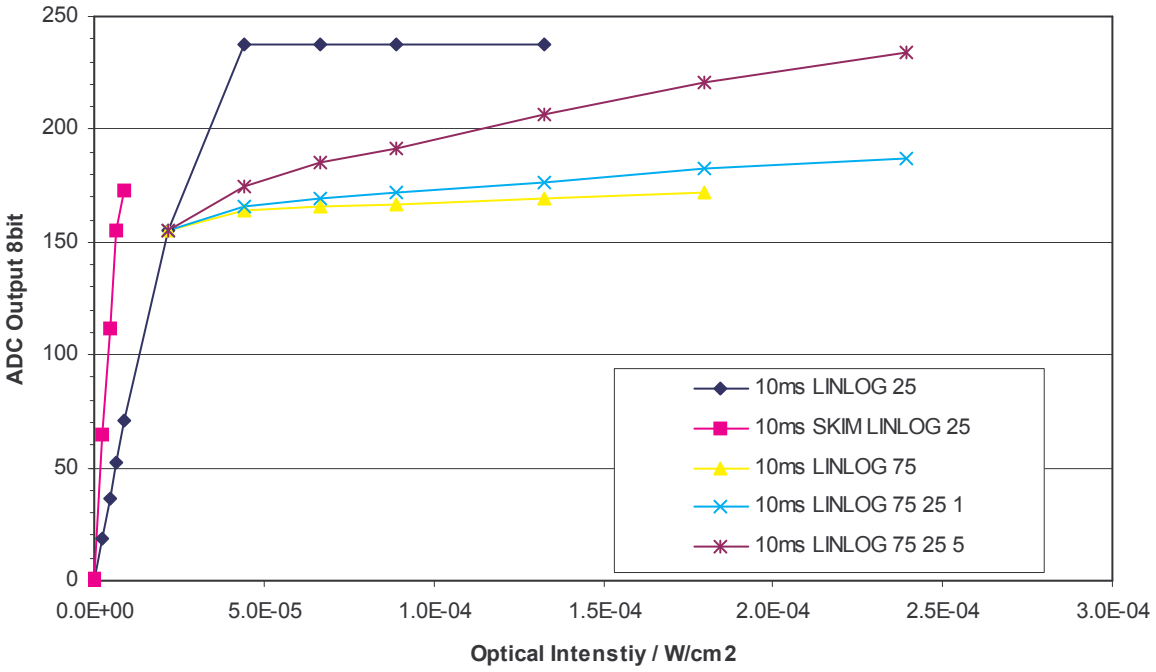


Diagram 1: Characteristic curves of MV-D1024-28 using an integration time of tint = 10 ms and a wavelength of λ = 850 nm

To modify these values, you have to use Photonfocus' software tool. Useful parameters are:

37.5 < LL1 < 75.0
0.0 < LL2 < 56.3
LL2 < LL1

The value LL1 has to be greater than LL2. Values (LL1, LL2) larger than 80.1 causes the Figure quality to be degraded. Setting values larger than 81.3 no longer influences the characteristic curve significantly (see Figure 2). In this case, unwanted effects like an offset between the two fields can happen.

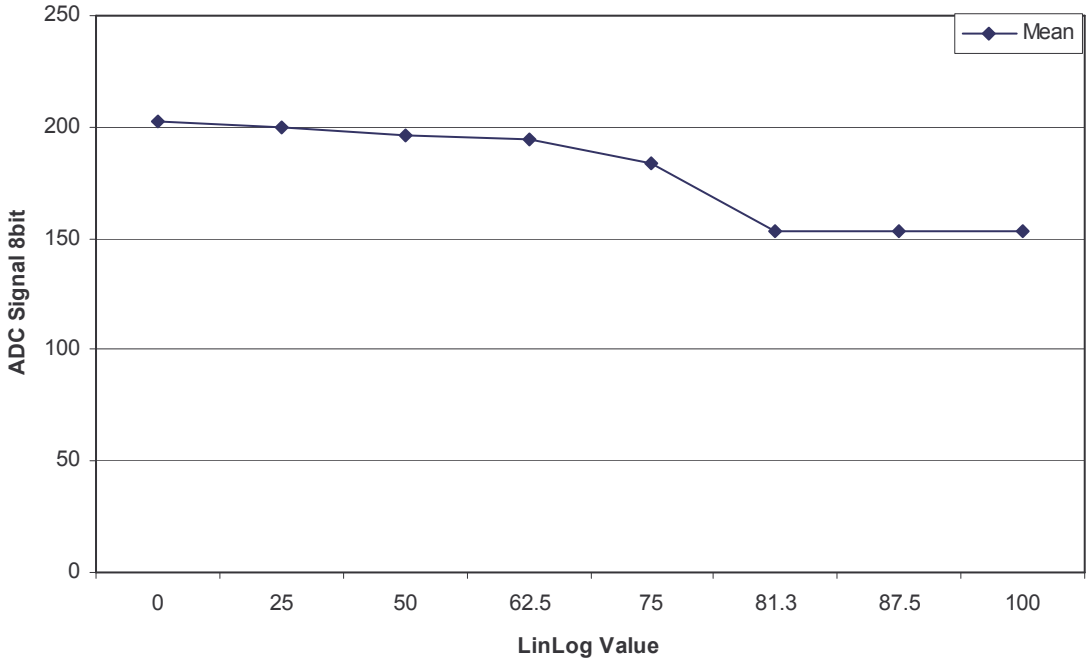
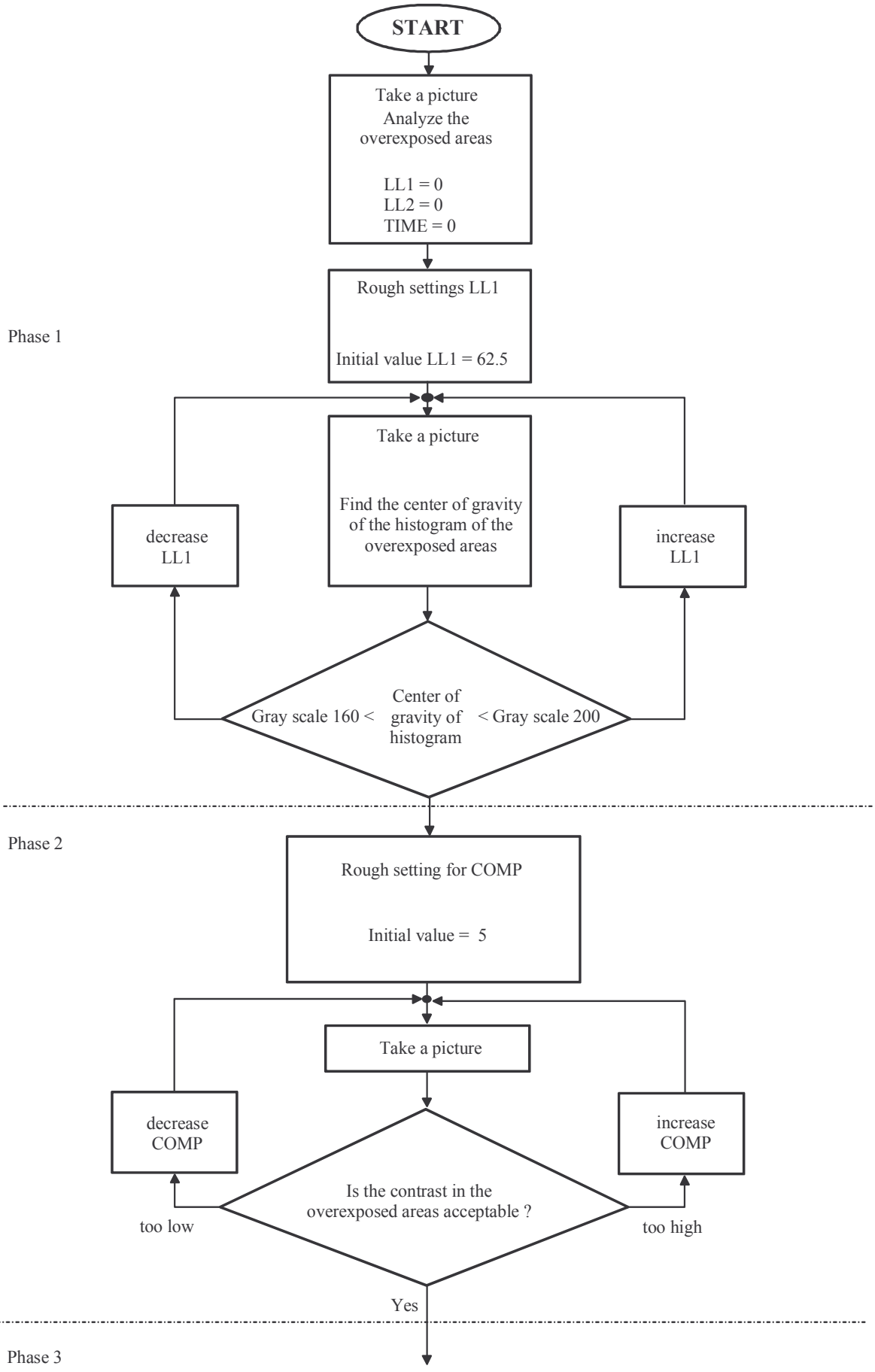


Figure 2: Output signal (MV-D1024-28) at different LinLog values. Integration time: tint = 1 ms, intensity: I = 535 μW/cm2 and wavelength: λ = 850 nm

When using the 4x hardware gain option (HIGH_GAIN = ON), it is possible that the compression is ineffective (the A/D converter is out of range) because the logarithmic compression is only effective on the upper intensity values. If a camera with a logarithmic response curve is necessary, the LinLog™ technology will not replace it completely. On demand, Photonfocus' camera can be changed to fulfil these needs.

If the result does not completely satisfy the user, a look-up table (LUT) can be used to improve and adjust the characteristics to the application. Please ask our support for more information.


START
Take a picture
Analyze the overexposed areas
LL1 = 0
LL2 = 0
TIME = 0
Rough settings LL1
Initial value LL1 = 62.5
Phase 1
Take a picture
Find the center of gravity of the histogram of the overexposed areas
decrease LL1
increase LL1
Gray scale 160 <
Center of gravity of histogram
< Gray scale 200
Phase 2
Rough setting for COMP
Initial value = 5
Take a picture
decrease COMP
increase COMP
Is the contrast in the overexposed areas acceptable ?
too low
too high
Yes
Phase 3

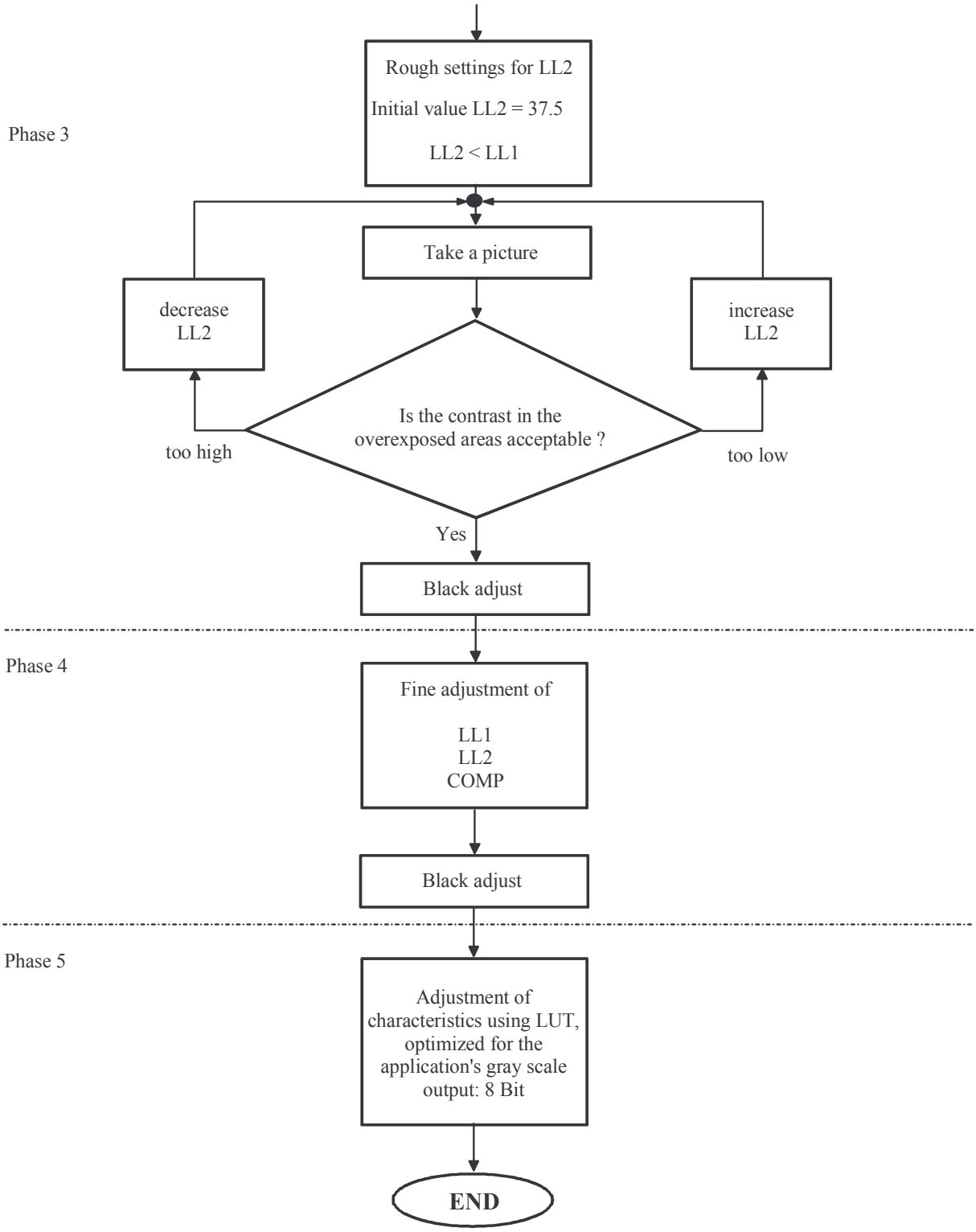


Figure 3: Parameter adjustment procedure for LinLog2 (LL2)

3. Example LinLog™ (use of PFRemote.exe for an optimised contrast)

Camera:PF MV-D1024 ROI: 300*300
Integration time: 10ms Lens: Compulsar 1.25mm
Shutter 1.3 Scene: Office window Photonfocus AG
Exposure: daylight Frame grabber: Silicon Software Micro-Enable III

LL1 = 0.0
LL2 = 0.0
COMP = 0

Remark:
The window is strongly overexposed

LL1 = 69.0
LL2 = 0.0
COMP = 0

Remark:
The pixels in window region are no longer overexposed because of the logarithmic compression. There is nearly no contrast in the window. The center of gravity of the histogram in the selected area (red rectangle) is 190.

LL1 = 69.0
LL2 = 50.0
COMP = 5

Remark:
The pixels in the window are slightly overexposed, still weak contrast.

LL1 = 69.0
LL2 = 20.0
COMP = 2

Remark:
The pixels in the window are slightly overexposed, better contrast.

LL1 = 69.0
LL2 = 50.0
COMP = 1

Remark:
The pixels in the window are slightly overexposed, fine contrast.

LL1 = 70.3
LL2 = 58.2
COMP = 1

Remark:
The pixels in the window are well exposed, fine contrast.

4. Contact

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5. Revision History

REV	Description of the modification	Date
1.0	First Release	08/20/02
1.1	Konversion Linlog Values for pf.exe to pf.remote (c500 >- 77)	06/12/02

Table 1: Document revisions