Quick Start Guide

QG000139

AS734x Eval Kit

Spectral Balance and Calibration

Example for ALS Calibration for AS734x EVK

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Content Guide

1 Introduction

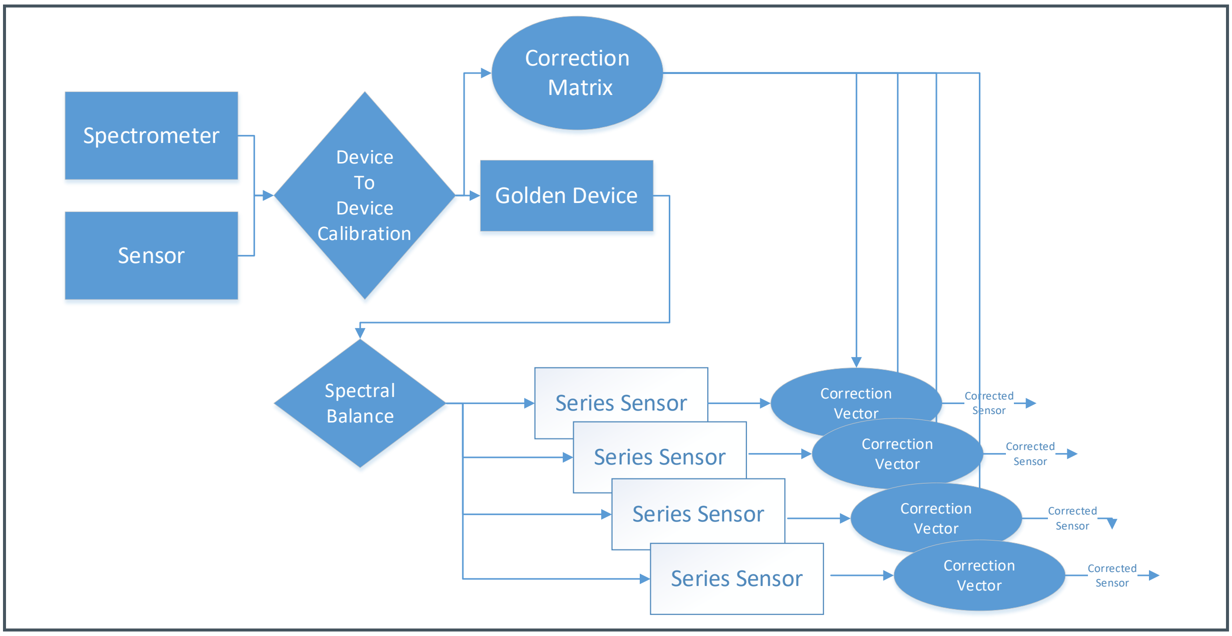
This application note for the AS7341 Evaluation Kit shows a calibration procedure called ‘Golden Device with Spectral Balance’ [1]. The goal of this calibration is to achieve higher accuracy for serial components without the need for a complex individual calibration by using a simple scaling or balancing method.

For further information, please refer to the following documents:

1. ams AG, “Calibration” in AS7341/42 11-Channel Spectral Sensor, 6th ed. Jena, DE, 2020, ch. 5, pp. 16.

The procedure is based on the use of special device-specific calibration data from a sensor defined as a Golden Device. These data are generated by a target and a spectrometer, using the linear regression method. It guarantees a good accuracy of the calibrated Golden Device. However, this method is costly for all the sensors of a series due to the large number of measurements required with special equipment. For these reasons, not all the sensors in the series can be calibrated device-specifically, like the Golden Device with this complex method. Therefore, sensors of the same type with their Raw-Values (ADC counts) and a constant light source are first approximated to the Golden Device, using the balance method. It is essential to always use the same conditions during the measurements with the Golden Device and the sensors in series. After balancing and approximating of the behavior of the sensor in series to the Golden Device, the calibration matrix for the Golden Device can be used with sufficient accuracy for this sensor. The balance method is possible with measurement on one or more light sources, depending on the required accuracy and conditions. Therefore, it requires lower effort in series production than a complex individual calibration.

Figure 1:
Method of Golden Device Calibration (Device-to-Device) with Spectral Balance



A typical example for the calibration method, Golden Sample with Spectral Balance, is shown in this guide.

2 Setup, Tests and Calculations

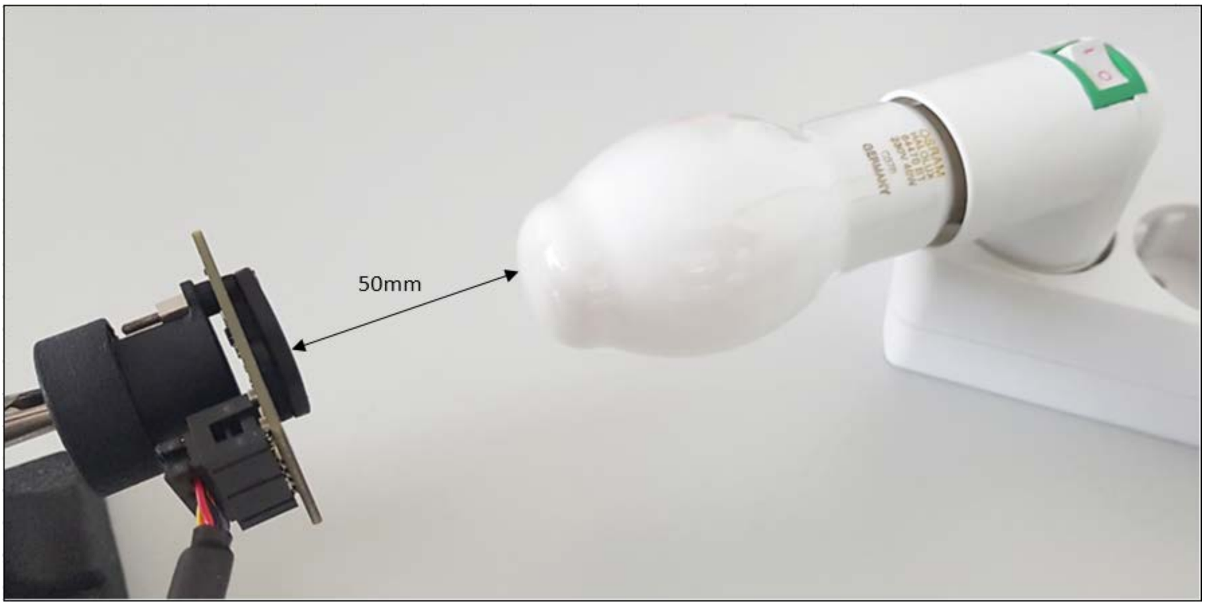
To verify the calibration method, Golden Device plus Spectral Balance, the following system components are required and/or must be installed:

- AS73xx Evaluation Kit Standard (includes a diffuser in front of the sensor).
- AS73xx GUI, Version V1.16 or higher (part of the Evaluation Kit).
- Correction matrix CM_L1_v1_0_0.csv General Calibration Matrix (see appendix, part of Evaluation Kit) – this file includes the correction matrix for the Golden Device.
- Target for White balance – OSRAM Halogen Bulb (OSRAM Halogen Halolux BT E27, 40W opal white).

The following describes the steps for Spectral Balance based on the set from the sensor and the bulb.

1. Install and connect the AS73xx hardware and software as described in the manual. Place the target for the white balance in front of the sensor (50 mm distance between top of the sensor and the bulb as in Figure 2) and start the AS73xx GUI. Switch on the bulb and shield the build (sensor plus bulb) from ambient light. The sensor should only detect and measure the light from the bulb.

Figure 2:
Bulb in Front of the Sensor (1)



(1) The measuring system must be shielded from ambient light to avoid errors based on the incident light. A non-identical setup between the measurements of the Golden Device and the sensor for adjustment results in brightness errors.

2. Start the software for the AS73xx Evaluation Kit and set the following parameters in the GUI and the main window: TINT = 182.1873 ms, GAIN = 16x, Mode = 4 (see Figure 3). Make a test to be sure the sensor is not in saturation or optimize GAIN to be in working range.
3. Start a log file from the menu Log and make ten continuous measurements with the AS73xx Evaluation Kit in front of the bulb.
4. Stop and save the CSV log file and open it with MS Excel, or similar software, to calculate the correction vector.
5. Use the Basic_Counts from the Golden Device Sensor to calculate the correction vector (see Figure 4).

Figure 3:
Main Window AS73xx GUI Including Setup Parameters

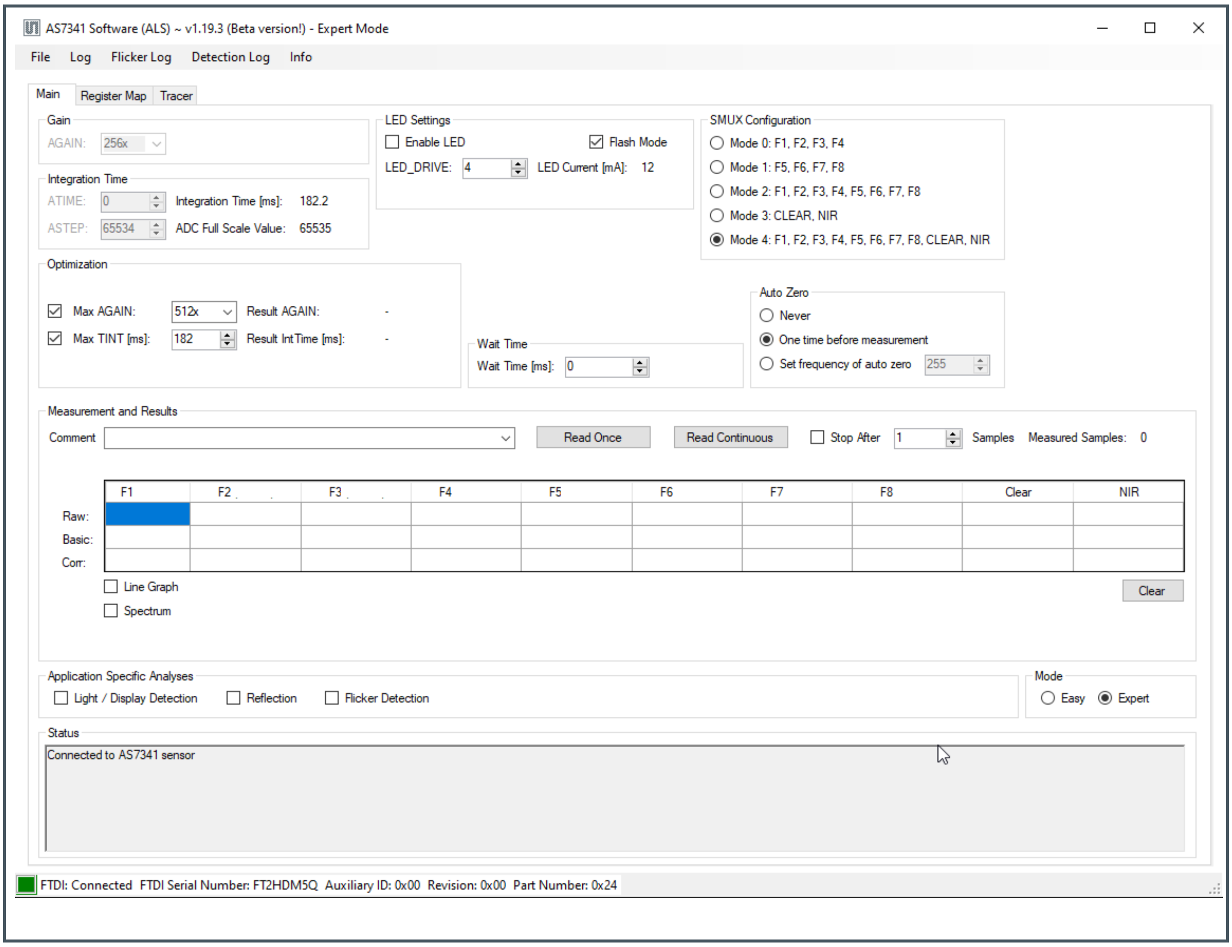


Figure 4:
Calculation Correction Vector based on Basic Counts

Sensor (to be balanced) Data										
	F1	F2	F3	F4	F5	F6	F7	F8	CLEAR	NIR
Counts averaged	1462.5	1759.05	2111.95	2747.25	3208.7	4756.35	6502.85	9451.45	28272.05	42674.65
Basic_Counts averaged	0.5727	0.6700	0.7860	1.0497	1.2774	1.8607	2.4627	3.5780	9.5544	14.2668
Golden Device Reference Data (must be generated/measured before)										
	F1	F2	F3	F4	F5	F6	F7	F8	CLEAR	NIR
Counts averaged	1714.7	2012.4	2360.85	3152.25	3845.95	5604.9	7422.95	10769	34328	52737.15
Basic_Counts averaged	0.5888	0.6911	0.8107	1.0825	1.3207	1.9248	2.5491	3.6982	11.7886	18.1105
Correction vector	1.02811	1.0314	1.03142	1.0312	1.03389	1.03444	1.03508	1.03359	0.1233	1.26941

Insert the calculated correction vector into the correction matrix file using the keyword ‘CorrectionFactor’ (see Figure 5). The GUI will consider this correction value to correct all Raw_Counts before starting the calibration process with the calibration matrix of the Golden Device.

Figure 5:
Excerpt from CM_L1.CSV Calibration File to Include Calculated Correction Vector

```
// The calibration matrix was calculated based on a Golden Device and its real filters. Use it to match sensor results values into a spect

CorrectionFactor=1.02811245;1.031492537;1.031424936;1.031247023;1.033896978;1.034449401;1.035083445;1.033594187;0.123383991;1.269415706

Wavelength;F1;F2;F3;F4;F5;F6;F7;F8;Clear;NIR
380;0.19414;-0.033867;0.0094998;-0.0018512;0.0015809;-0.00036234;0.00077408;-0.00028147;-0.0069538;-0.00024839
381;0.19611;-0.034209;0.0095958;-0.0018699;0.0015969;-0.000366;0.0007819;-0.00028432;-0.007024;-0.0002509
382;0.19809;-0.034555;0.0096927;-0.0018888;0.001613;-0.00036969;0.00078979;-0.00028719;-0.007095;-0.00025343
```

3 Results

Figure 6 :
Results of Light Detection without Spectral Balance

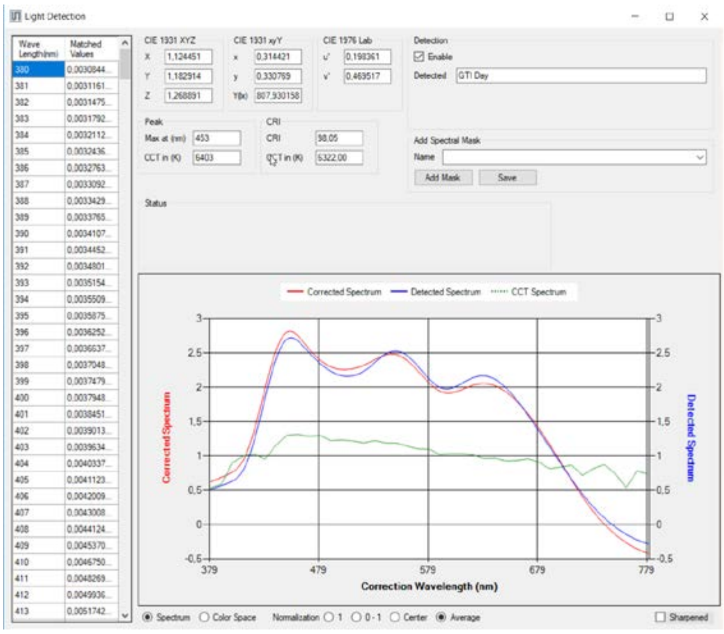
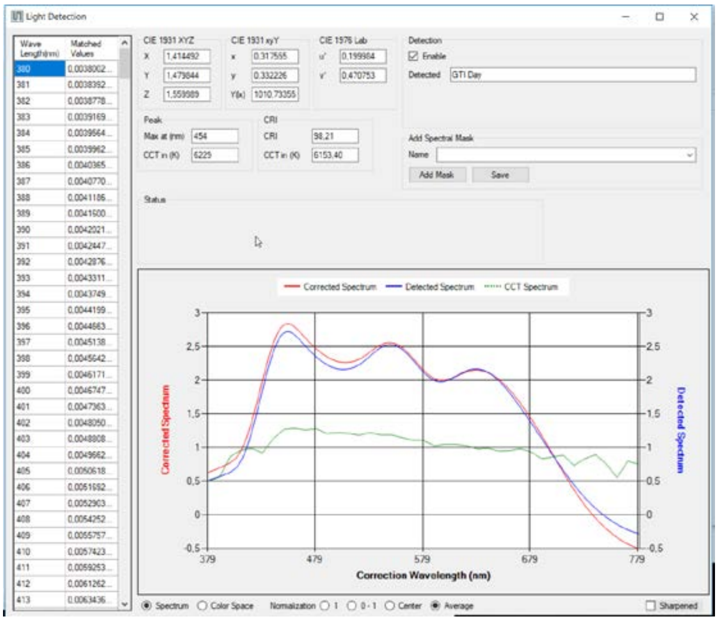


Figure 7 :
Results of Light Detection with Spectral Balance



Although the use of the general calibration matrix on the Golden Device of the test sensor shows good results, they can be improved, by using the Spectral Balance. The value of 6050 K, displayed by the spectrometer in the lightbox with Daylight (similar to D65), is measured by the sensor with 6322 K before correction and with 6229K after balance. Thus, the error in this example can be corrected, from 4.5% to 3%.

This is an excellent result of using an indirect device calibration method. Such results always depend on the light source, the reference for balance (the bulb used here), the original calibration matrix, all deviations and disruptions, and many other effects. Therefore, a typical result of success cannot be given by using such a calibration method. The results should be better with a balance than without such a balance. Nevertheless, a choice of an unfavorable light source (e.g. with narrow-band peaks and bad overlapping with the sensor) can lead to more distortions than improvements. Therefore, we suggest testing more than one light source and comparing the results to find the optimum. Width-banded light sources (e.g. D65, A, or high CRI LED) should be suitable as a target for such balancing.

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