Camera Optical Zoom Calibration Specification Introduction

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About This Document

Purpose

This document describes the calibration environment of camera optical zoom and calibration operations.

Intended Audience

This document is intended primarily for the customers and UNISOC testers.

Symbol Conventions

The symbols that may be found in this guide are defined in the following table.

Symbol	Description
NOTE	Calls attention to important information, best practices and tips. NOTE is used to address information not related to personal injury, equipment damage, and environment deterioration.
CAUTION	Calls attention to error-prone operations. CAUTION is used to address information not related to personal injury, equipment damage, and environment deterioration.
WARNING	Calls attention to irreversible operations. WARNING is used to address information not related to personal injury and environment deterioration.

Acronyms and Abbreviations

Acronym and Abbreviation	Full Name
T	Tele lens
W	Wide lens
SW	Super Wide
AF	Auto Focus

Change History

Issue	Date	Description
V1.0	2019-09-05	The first official release.
V1.1	2020-01-03	Adjust the distance of the calibration.
V1.2	2021-02-09	Translate the Chinese into English.

Keywords

Optical Zoom, Calibration.

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1 Optical Zoom Calibration Introduction

Optical zoom calibration can measure the offset between two lenses with different focal lengths. It is used to reduce the image dislocation when the camera is switched in the process of optical zoom, to make the image switching smoother. Camera lens switching types are mainly divided into:

- Tele lens (T) switches to Wide lens (W).
- Wide lens (W) switches to Super Wide lens (SW)

This document takes SW to W as an example to introduce the optical zoom calibration.

NOTE

To calibrate T lens switches to W lens, please change W to T and SW to W in the following content.

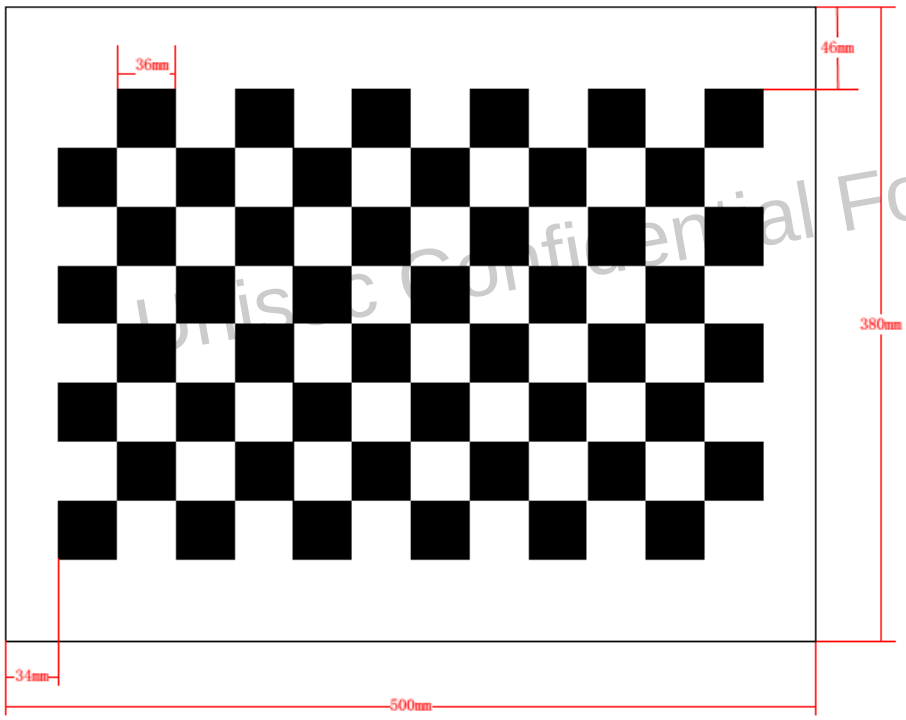
2 Optical Zoom Calibration

2.1 Calibration Environment

The elements of the optical zoom calibration environment include calibration board, the light source and the brightness of captured images.

- The board used for zoom calibration is as shown in **Figure 2-1**. The dimension of the chessboard is 432mm × 288mm with symmetrical blanks around, where the height of the upper and the lower blanks is 46mm (± 0.5mm), and the width of the left and the right blanks is 34mm (± 0.5mm). The side length of each grid in the chessboard is 36mm (± 0.1mm). The dimension of the entire board is 500mm × 380mm.

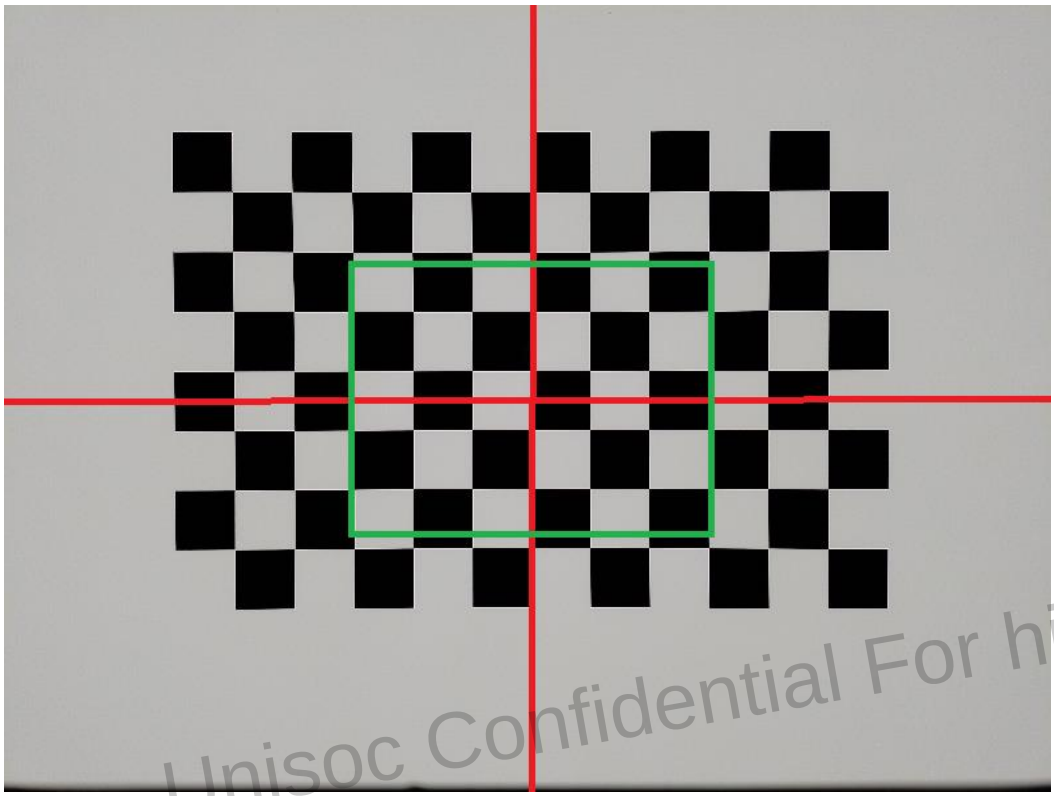
Figure 2-1 Size distribution of board



- The requirements for the light source are as follows.
  - Use a standard light source to illuminate the board. D65 light source with a color temperature of 6500K is recommended.
  - The light intensity ranges from 400Lux to 800Lux, and 400Lux is recommended.
  - The light source can be reflective or rear projection. The reflective light source should not cause glare on the image.

- The light irradiation should be well distributed. For the brightness of the captured image, the average gray value is required to be 40 ± 5 (0 - 255). For reference, the average gray value of the white block in the green box is 70 ± 5. The size and the location of the area are as shown in the green box in **Figure 2-2**. *This requirement only applies to module manufacturers.*

Figure 2-2 Diagram of the board brightness

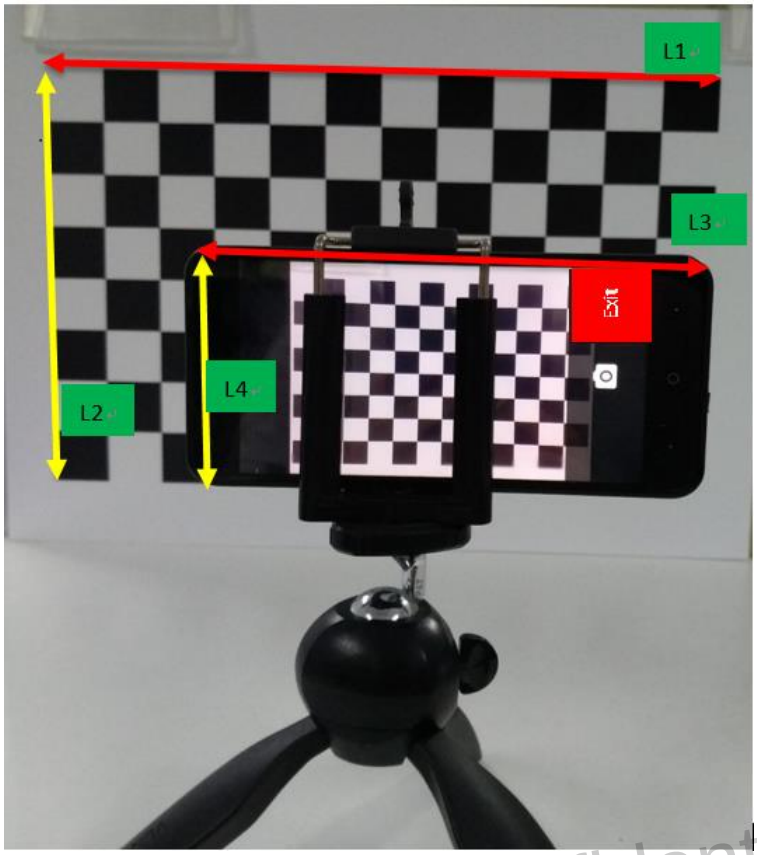


2.2 Calibration Process

The calibration steps are as follow.

Step 1 Turn on the mobile phone camera, keep the direction of L4 of the mobile phone and the L2 of the board consistent and parallel, and the plane of the calibration board is parallel to that of the mobile phone. The placement of the calibration board and the mobile phone is shown in **Figure 2-3**.

Figure 2-3 Placement of the calibration board and the mobile phone

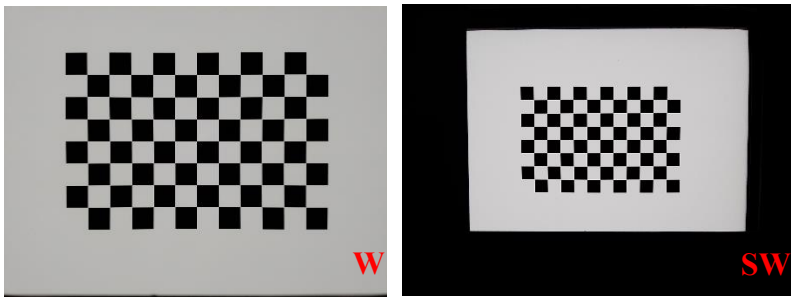


Step 2 Keep the mobile phone camera 40cm (± 1cm) away from the calibration board, and this distance is fixed.

Step 3 Capture two images as shown in **Figure 2-4** by the W lens and the SW lens. W image is on the left and SW image is on the right.

Step 4 Call the calibration function as shown in **3.1 Interface Function Description** to calculate the calibration result of images.

Figure 2-4 Images of the calibration board



NOTE

When a module with Auto Focus (AF) function, auto focus is required.

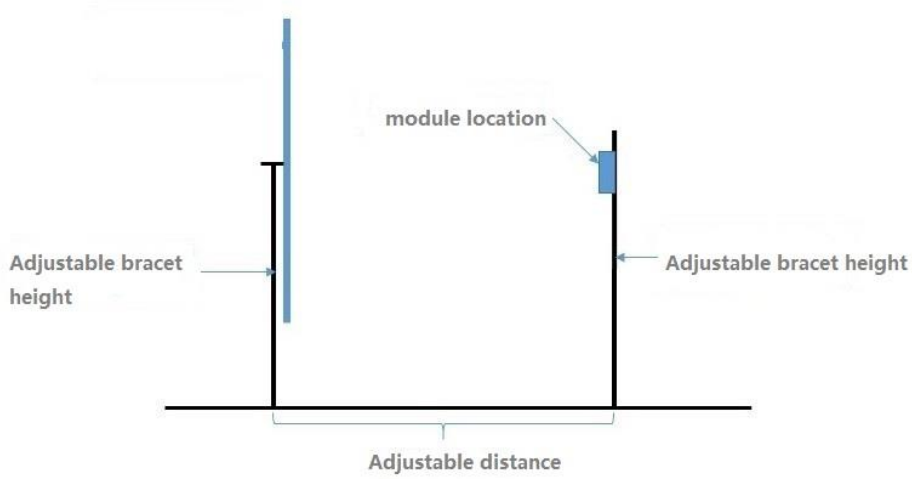
----End

2.3 Redefine Calibration Environment

In the production, the optical zoom calibration environment needs to be redefined, and the steps are as follow.

Step 1 Fix the calibration board on the bracket as shown in **Figure 2-5**, and fix the bracket to the platform. Adjust the angle of the platform to the horizontal direction to be about 90º (± 5%).

Figure 2-5 Redefining the calibration environment



Step 2 Fix the module vertically on another bracket on the platform away from the first bracket 40cm (± 1cm), and the bracket can move up, down, left and right.

Step 3 Adjust the distance between the two brackets, and adjust the up, down, left to make the image display similar to **Figure 2-4**, and then fix each component.

----End

3 Calibration Interface Function

3.1 Interface Function Description

Call corresponding function for calibration.

- The function for module manufacturer is as follows.

```
int WT_Calibration_VerificationRaw(const unsigned short* pLeftImage, const unsigned short* pRightImage,
INPUT_WT_PARAM_DATA_T stInputParam, WT_OTP_DATA_T* pOutOTP, int swVCM, int wVCM)
```

Description of the interface function parameters are shown in **Table 3-1**.

Table 3-1 Interface function parameter description for module manufacturers

Parameter	Description
pLeftImage	the storage path of the image captured by W lens
pRightImage	the storage path of the image captured by SW lens
stInputParam	input the parameters
pOutOTP	output the OTP parameters
swVCM, wVCM	VCM value corresponding to the W lens and SW lens when capture the image

- The function for mobile phone manufacturer is as follows.

```
int WT_Calibration_VerificationYUV(const unsigned char* filename_left, const char* filename_right,
INPUT_WT_PARAM_DATA_T stInputParam, WT_OTP_DATA_T* pOutOTP, int swVCM, int wVCM)
```

Description of the interface function parameters are shown in **Table 3-2**.

Table 3-2 Interface function parameter description for mobile phone manufacturers

Parameter	Description
filename_left	the storage path of the image captured by W lens
filename_right	the storage path of the image captured by SW lens
stInputParam	input the parameters
pOutOTP	output the OTP parameters
swVCM, wVCM	VCM value corresponding to the W lens and SW lens when capture the image

3.2 Precautions

- Define the left image as a W image and the right image as a SW image. The view angle of the SW image is larger than that of the T image, which cannot be reversed. Both images are stored in the same path.
- The calibration of module manufacturers needs to be carried out in Raw10 format, and the resolution of the primary and secondary lenses should be modified according to the specific sensor.
- The calibration of mobile phone manufacturers needs to be carried out in YUV (NV21) format.
- When the module manufacturers carry out the calibration, the Bayer Pattern setting of the image should correspond to the proper sensor pixel arrangement. The sensor pixel arrangement for different Bayer Pattern value is shown in **Table 3-3**.

Table 3-3 Sensor pixel arrangement for different Bayer Pattern values

Value	Sensor Pixel Arrangement
0	RGGB
1	GRBG
2	GBRG
3	BGGR

- The setting of input_parameters_values.txt is shown in **Figure 3-1**. The parameter in the last row of the figure is the optical magnification, which needs to be configured according to the specific project.

Figure 3-1 input_parameters_values.txt configuration

```
1  0, 24.000000
2  1, 0.300000
3  2, 0.300000
4  3, 10.000000
5  4, 10.000000
6  5, 10.000000
7  6, 1.500000
8  7, 1.500000
9  8, 1.500000
10 9, 20.000000
11 10, 0.500000
12 11, 0.500000
13 12, 0.500000
14 13, 0.500000
15 14, 0.600000
16 15, 0.600000
17 16, 0.300000
18 17, 0.300000
19 18, 10.000000
20 19, 10.000000
21 20, 0.000000
22 21, 1.000000
23 22, 1.0000
24 23, 1.00
25 24, 1.0
26 25, -2
27 26, 90
28 27, 50
29 28, 4.5000
30 29, 0.5
31 30, 3
32 31, 2.1   optical magnification
33
```

4 OTP Format Description

If the calibration function returns **0** or the mobile phone interface displays **Pass**, it indicates the calibration is successful, and 118 integer data will be generated and stored in a .bin file.