



**MEDIATEK**

CONFIDENTIAL B

# Basic Tuning Flow – AF Calibraion

# Outline

- AF HW threshold
- AF Table
- Posture Compensation
- Laser mapping table
- Zoom effect calibration
- Subjective check

# AF Calibration

- The items are as follows:

Item		Test Scene	Test Distance	Limit
1	AF HW threshold	24 color chart	-	-
2	AF Table	A high contrast scene, e.g. Siemens star chart, ISO12233 chart	Refer following pages	-
3	Posture Compensation	Siemens star chart	3M 、 10 cm	-
4	Laser mapping table	A high contrast scene, e.g. Siemens star chart, ISO12233 chart	10 cm, 11 cm, 12 cm, 14 cm, 16 cm, 18 cm, 21 cm, 24 cm, 27 cm, 30 cm, 34 cm, 38 cm, 42 cm, 46 cm, 50 cm, 60 cm, ... , laser maximum effective distance	-

# HW Threshold – Environment Setup

- Target distance: depends on “color checker size should be about 80% of the screen”
- Tool: Camera EM mode
- Test target: Color checker
- Using tripod @ 300 lux



# HW Threshold – Get Calibration Data

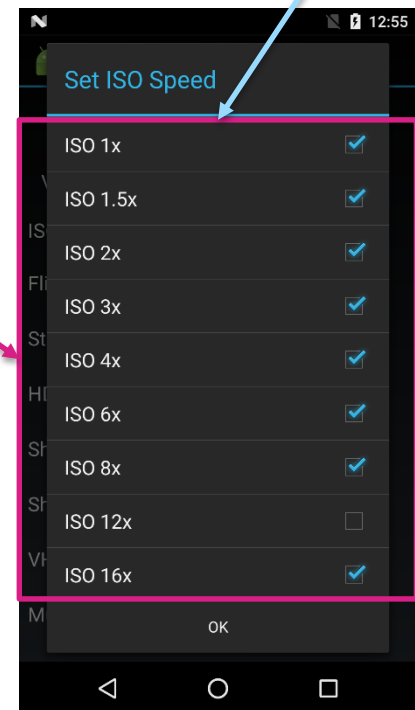
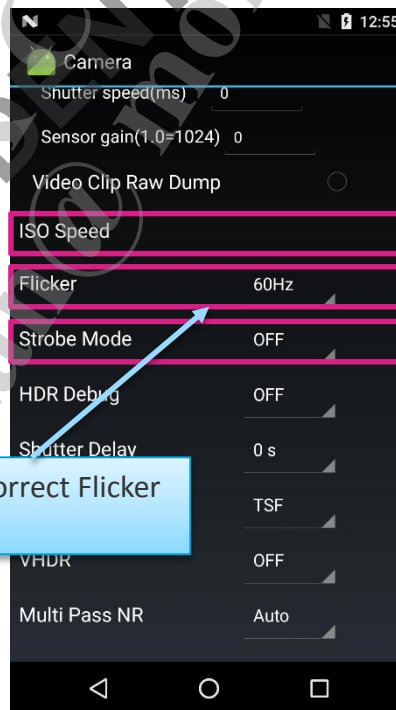
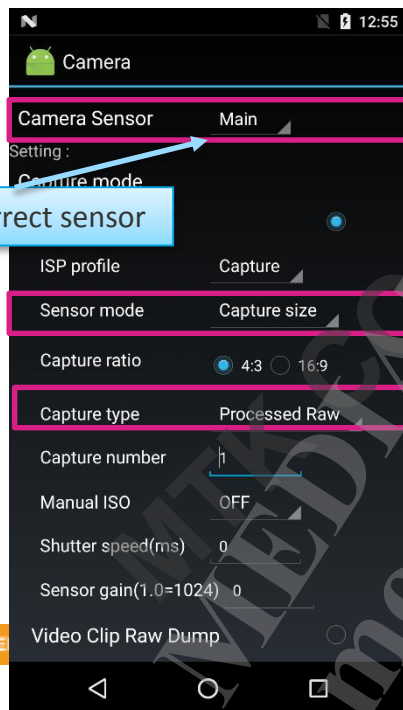
## 1. Enter camera EM mode

- In Dailer APP, enter `*##3646633#*##`
- Hardware Testing -> Camera

## 2. Apply below settings

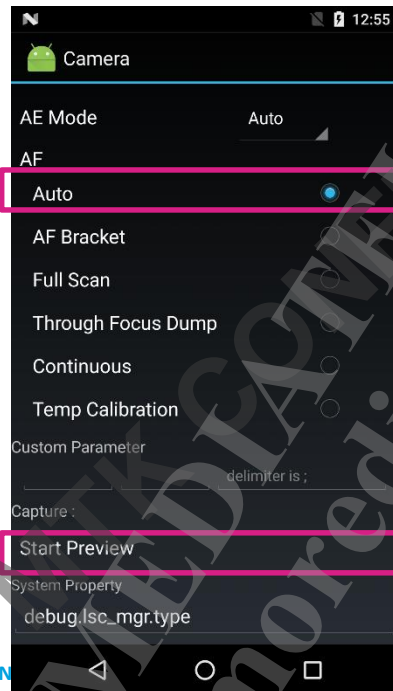
ISO的选择：从ISO100到手机支持的最大ISO，共支持8个档的ISO，根据实际情况选择。

Select 1x, 1.5x, 2x, 3x, 4x, 6x, 8x, 16x



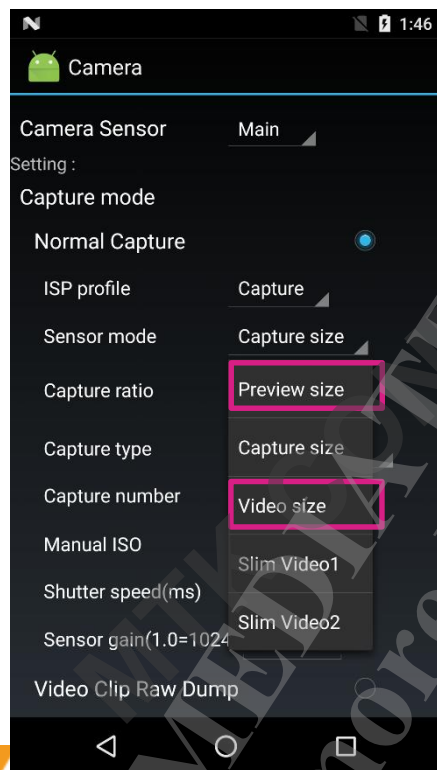
# HW Threshold – Get Calibration Data

3. Click “Start Preview” to enter capture window
4. Make sure color checker is about 80% of the screen, then press “Capture”



# HW Threshold – Get Calibration Data

- Repeat step 1~4 two times, but the sensor mode should be configured as “Preview size” and “Video Size” respectively
- The raw & jpeg files will be generated



<input type="checkbox"/> Capture20150101-041709ISO00100proc_5344x4016_10_0.raw	<input type="checkbox"/> Capture20150101-041709ISO00100.jpg
<input type="checkbox"/> Capture20150101-041733ISO00150proc_5344x4016_10_0.raw	<input type="checkbox"/> Capture20150101-041733ISO00150.jpg
<input type="checkbox"/> Capture20150101-041736ISO00200proc_5344x4016_10_0.raw	<input type="checkbox"/> Capture20150101-041736ISO00200.jpg
<input type="checkbox"/> Capture20150101-041738ISO00300proc_5344x4016_10_0.raw	<input type="checkbox"/> Capture20150101-041738ISO00300.jpg
<input type="checkbox"/> Capture20150101-041741ISO00400proc_5344x4016_10_0.raw	<input type="checkbox"/> Capture20150101-041741ISO00400.jpg
<input type="checkbox"/> Capture20150101-041744ISO00600proc_5344x4016_10_0.raw	<input type="checkbox"/> Capture20150101-041744ISO00600.jpg
<input type="checkbox"/> Capture20150101-041747ISO00800proc_5344x4016_10_0.raw	<input type="checkbox"/> Capture20150101-041747ISO00800.jpg
<input type="checkbox"/> Capture20150101-041753ISO01600proc_5344x4016_10_0.raw	<input type="checkbox"/> Capture20150101-041753ISO01600.jpg
<input type="checkbox"/> Preview20150101-041813ISO00100proc_2672x2008_10_0.raw	<input type="checkbox"/> Preview20150101-041813ISO00100.jpg
<input type="checkbox"/> Preview20150101-041817ISO00150proc_2672x2008_10_0.raw	<input type="checkbox"/> Preview20150101-041817ISO00150.jpg
<input type="checkbox"/> Preview20150101-041818ISO00200proc_2672x2008_10_0.raw	<input type="checkbox"/> Preview20150101-041818ISO00200.jpg
<input type="checkbox"/> Preview20150101-041820ISO00300proc_2672x2008_10_0.raw	<input type="checkbox"/> Preview20150101-041820ISO00300.jpg
<input type="checkbox"/> Preview20150101-041822ISO00400proc_2672x2008_10_0.raw	<input type="checkbox"/> Preview20150101-041822ISO00400.jpg
<input type="checkbox"/> Preview20150101-041824ISO00600proc_2672x2008_10_0.raw	<input type="checkbox"/> Preview20150101-041824ISO00600.jpg
<input type="checkbox"/> Preview20150101-041826ISO00800proc_2672x2008_10_0.raw	<input type="checkbox"/> Preview20150101-041826ISO00800.jpg
<input type="checkbox"/> Preview20150101-041830ISO01600proc_2672x2008_10_0.raw	<input type="checkbox"/> Preview20150101-041830ISO01600.jpg
<input type="checkbox"/> Video20150101-041843ISO00100proc_5344x3008_10_0.raw	<input type="checkbox"/> Video20150101-041843ISO00100.jpg
<input type="checkbox"/> Video20150101-041858ISO00150proc_5344x3008_10_0.raw	<input type="checkbox"/> Video20150101-041858ISO00150.jpg
<input type="checkbox"/> Video20150101-041900ISO00200proc_5344x3008_10_0.raw	<input type="checkbox"/> Video20150101-041900ISO00200.jpg
<input type="checkbox"/> Video20150101-041902ISO00300proc_5344x3008_10_0.raw	<input type="checkbox"/> Video20150101-041902ISO00300.jpg
<input type="checkbox"/> Video20150101-041904ISO00400proc_5344x3008_10_0.raw	<input type="checkbox"/> Video20150101-041904ISO00400.jpg
<input type="checkbox"/> Video20150101-041906ISO00600proc_5344x3008_10_0.raw	<input type="checkbox"/> Video20150101-041906ISO00600.jpg
<input type="checkbox"/> Video20150101-041908ISO00800proc_5344x3008_10_0.raw	<input type="checkbox"/> Video20150101-041908ISO00800.jpg
<input type="checkbox"/> Video20150101-041912ISO01600proc_5344x3008_10_0.raw	<input type="checkbox"/> Video20150101-041912ISO01600.jpg



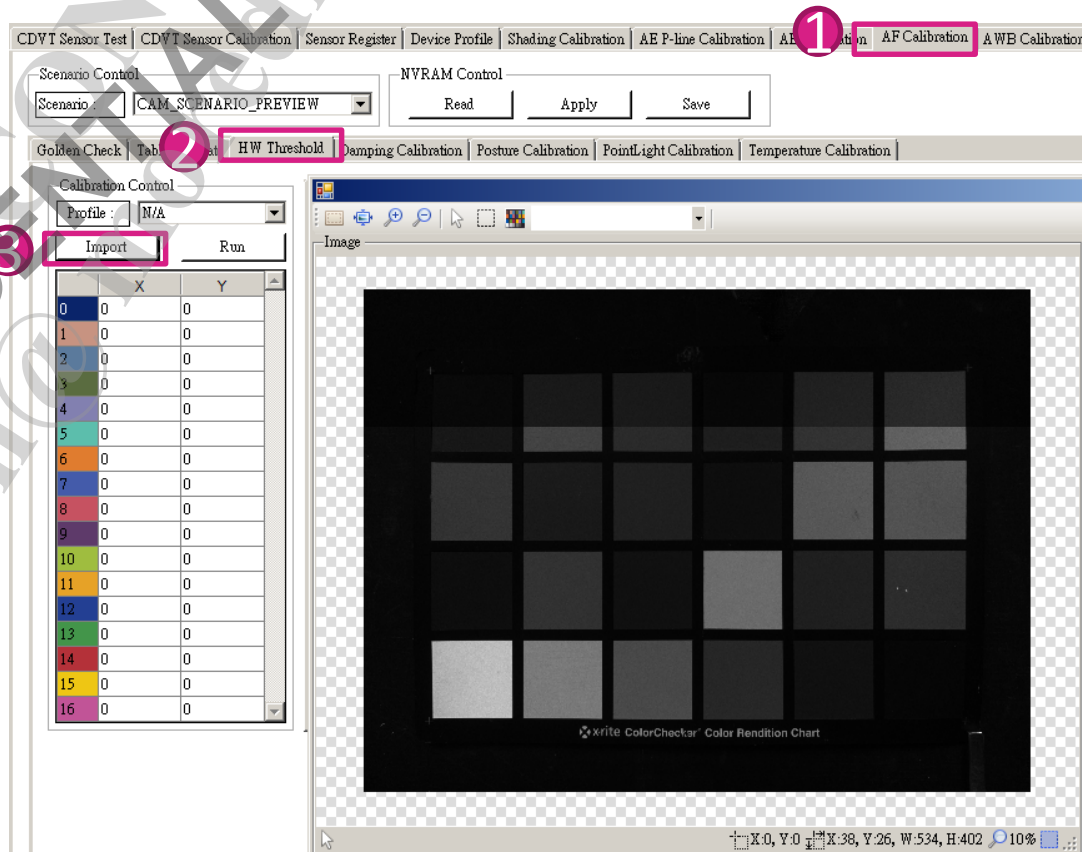
# HW Threshold – Generate Parameter

1. Get calibration data from phone
  - Connect phone to PC
  - Open command window, and use below command to get data
    - `adb pull /sdcard/DCIM/CameraEM`



# HW Threshold – Generate Parameter

2. Open CCT, goes to “AF Calibration” -> “HW Threshold”
3. Click “Import” to select the 8 raw files of capture mode (Capture\*.raw), and the 1<sup>st</sup> will be shown as popup window

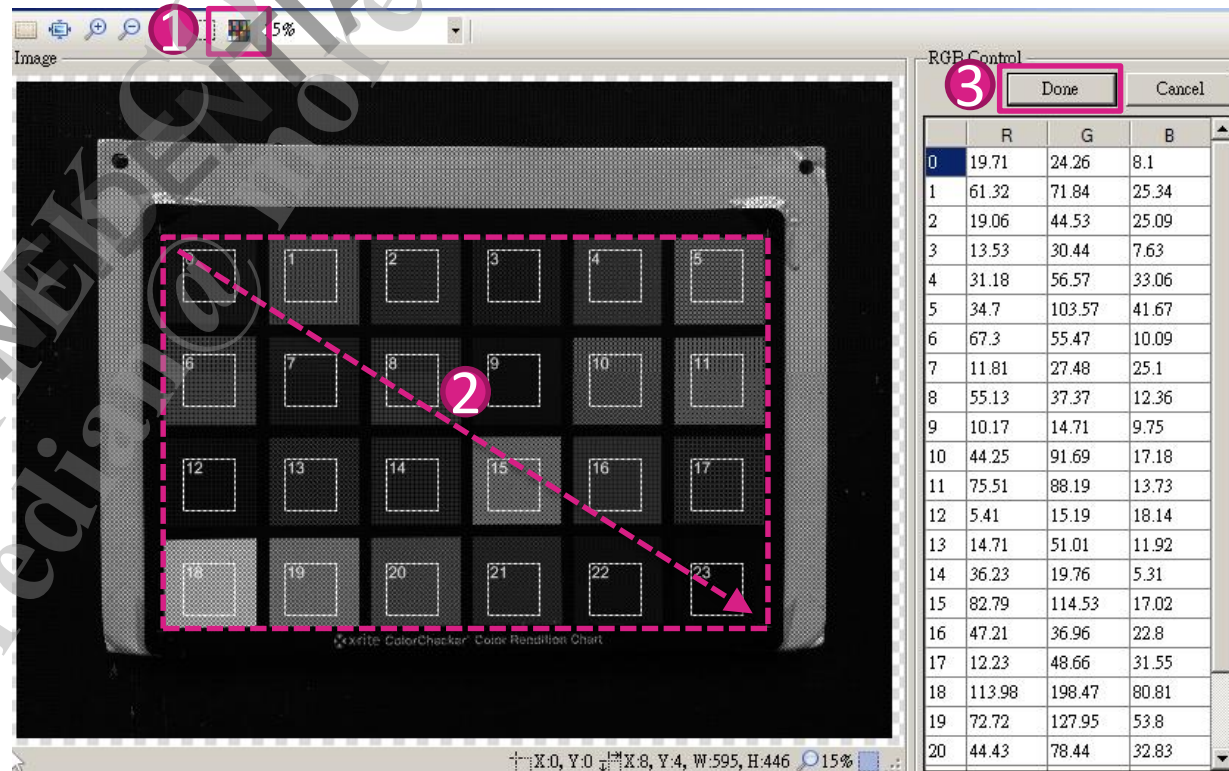


# HW Threshold – Generate Parameter

4. Click “Checker Mode” to select ROI
  - Make sure rectangles 0~23 must be positioned in each cell of color checker
5. Click “Done” to confirm the ROI

Select ROI:

Right-click in the left-top corner of color checker, then drag-and-move to the right-bottom corner.



# HW Threshold – Generate Parameter

6. Click “Run” to generate parameter

Calibration Control

Profile : N/A

Import Run

	X	Y
0	640	720
1	1370	720
2	2100	720
3	2830	720
4	3560	720
5	4290	720
6	640	1470
7	1370	1470
8	2100	1470
9	2830	1470
10	3560	1470
11	4290	1470
12	640	2220
13	1370	2220
14	2100	2220
15	2830	2220
16	3560	2220



# HW Threshold – Apply Parameter

1. After generating parameter, click “File” tag, and the parameters are shown in the UI

The screenshot displays the 'Calibration Control' application. On the left, the 'Import' tab is active, showing a table of ISO values (0 to 16) and their corresponding X and Y coordinates. On the right, the 'File' tab is active, showing a list of ISO values and their corresponding file names. A red box highlights the 'File' tab, and a red box highlights the list of ISO values and file names. A red box also highlights the parameter list in the 'File' tab.

**Calibration Control**

Profile : N/A

Import Run

	X	Y
0	720	800
1	1440	800
2	2160	800
3	2880	800
4	3600	800
5	4320	800
6	720	1520
7	1440	1520
8	2160	1520
9	2880	1520
10	3600	1520
11	4320	1520
12	720	2240
13	1440	2240
14	2160	2240
15	2880	2240
16	3600	2240

**File**

ISO	File
100	Capture20150101-041709ISO00100proc_5344x4016_10_0.raw
150	Capture20150101-041733ISO00150proc_5344x4016_10_0.raw
200	Capture20150101-041736ISO00200proc_5344x4016_10_0.raw
300	Capture20150101-041738ISO00300proc_5344x4016_10_0.raw
400	Capture20150101-041741ISO00400proc_5344x4016_10_0.raw
600	Capture20150101-041744ISO00600proc_5344x4016_10_0.raw
800	Capture20150101-041747ISO00800proc_5344x4016_10_0.raw

```
8, //i4ISONum;  
{100, 150, 200, 300, 400, 600, 800, 1600},  
  
//SGG1~7  
{20, 20, 19, 19, 18, 17, 17, 15,  
29, 29, 29, 28, 27, 27, 26, 24,  
43, 42, 42, 41, 41, 40, 39, 38,  
62, 61, 61, 60, 60, 59, 59, 57,  
89, 88, 88, 87, 87, 86, 86, 84,  
126, 126, 126, 126, 125, 125, 124, 123,  
180, 180, 180, 180, 179, 179, 179, 178},  
  
// horizontal FV1 min. threshold  
{2000, 2000, 2000, 1000, 1000, 1000, 800, 800},
```

# HW Threshold – Apply Parameter

## 2. Merge HW threshold to source code

- vendor/mediatek/proprietary/custom/\$project\$/hal/lens/\$lens\$/
  - **lens\_para\_\$lens\$\_cap.cpp** : for full-size preview
- Use parameters shown in CCT, to replace with the above file

Calibration Control		
Profile :	N/A	
Import	Run	
	X	Y
0	720	800
1	1440	800
2	2160	800
3	2880	800
4	3600	800
5	4320	800
6	720	1520
7	1440	1520
8	2160	1520
9	2880	1520
10	3600	1520
11	4320	1520
12	720	2240
13	1440	2240
14	2160	2240
15	2880	2240
16	3600	2240

ISO	File
100	Capture20150101-041709ISO00100proc_5344x4016_10_0.raw
150	Capture20150101-041733ISO00150proc_5344x4016_10_0.raw
200	Capture20150101-041736ISO00200proc_5344x4016_10_0.raw
300	Capture20150101-041738ISO00300proc_5344x4016_10_0.raw
400	Capture20150101-041741ISO00400proc_5344x4016_10_0.raw
600	Capture20150101-041744ISO00600proc_5344x4016_10_0.raw
800	Capture20150101-041747ISO00800proc_5344x4016_10_0.raw

```
8, // i4ISONum;
{100, 150, 200, 300, 400, 600, 800, 1600},

// SGG1~7
{20, 20, 19, 19, 18, 17, 17, 15,
 29, 29, 29, 28, 27, 27, 26, 24,
 43, 42, 42, 41, 41, 40, 39, 38,
 62, 61, 61, 60, 60, 59, 59, 57,
 89, 88, 88, 87, 87, 86, 86, 84,
 126, 126, 126, 126, 125, 125, 124, 123,
 180, 180, 180, 180, 179, 179, 179, 178},

// horizontal FV1 min. threshold
{2000, 2000, 2000, 1000, 1000, 1000, 800, 800},
```

```
// ----- sAF_TH -----
{
    8, // i4ISONum
    {100, 150, 200, 300, 400, 600, 800, 1600},

    // SGG1~7
    {
        20, 19, 19, 18, 18, 17, 17, 16,
        29, 29, 28, 28, 27, 27, 26, 25,
        42, 42, 42, 41, 41, 40, 40, 38,
        61, 61, 61, 60, 60, 59, 59, 57,
        88, 88, 88, 87, 87, 86, 86, 85,
        126, 126, 126, 125, 125, 125, 124, 123,
        180, 180, 180, 180, 179, 179, 179, 178
    },

    // horizontal FV1 min. threshold
    {2000, 2000, 2000, 1000, 1000, 1000, 800, 800},

    // horizontal FV1 threshold
    {2, 2, 2, 2, 2, 2, 3, 4},

    // horizontal FV2 min. threshold
    {2000, 2000, 2000, 1000, 1000, 1000, 800, 800},

    // horizontal FV2 threshold
    {2, 2, 2, 2, 2, 2, 3, 4},

    // vertical FV min. threshold
    {2000, 2000, 2000, 1000, 1000, 1000, 800, 800},

    // vertical FV threshold
    {2, 2, 2, 2, 2, 2, 3, 4},
},
```

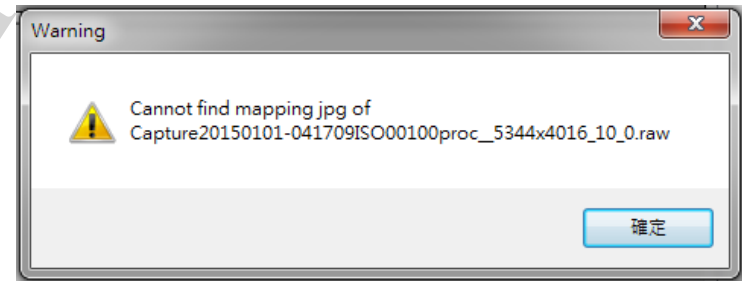
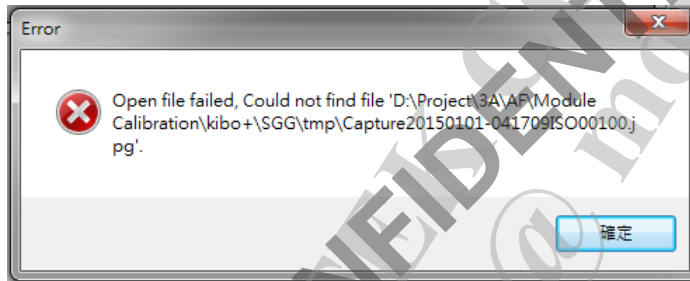
# HW Threshold – Repeat

1. Repeat “Generate Parameter” & “Apply Parameter”, but
  - import **Preview\*.raw**
  - Apply HW threshold to below source code
    - `lens_para_${lens$.cpp}` : for default value
    - `lens_para_${lens$.pv.cpp}` : for binning-size preview
    - `lens_para_${lens$.cus3.cpp}` : for binning-size video record
2. Repeat “Generate Parameter” & “Apply Parameter”, but
  - import **Video\*.raw**
  - Apply HW threshold to below source code
    - `lens_para_${lens$.vdo.cpp}` : for full-size video record

# HW Threshold – Trouble Shooting

- Error case:

- If you missed to put JPEG in the same directory with Raw, you will see below error message when “Import”, and result won’t be generated after “Run”



- Solution:

- Put JPEG & Raw files in the same directory before clicking “Import”



# AF Table – Environment Setup

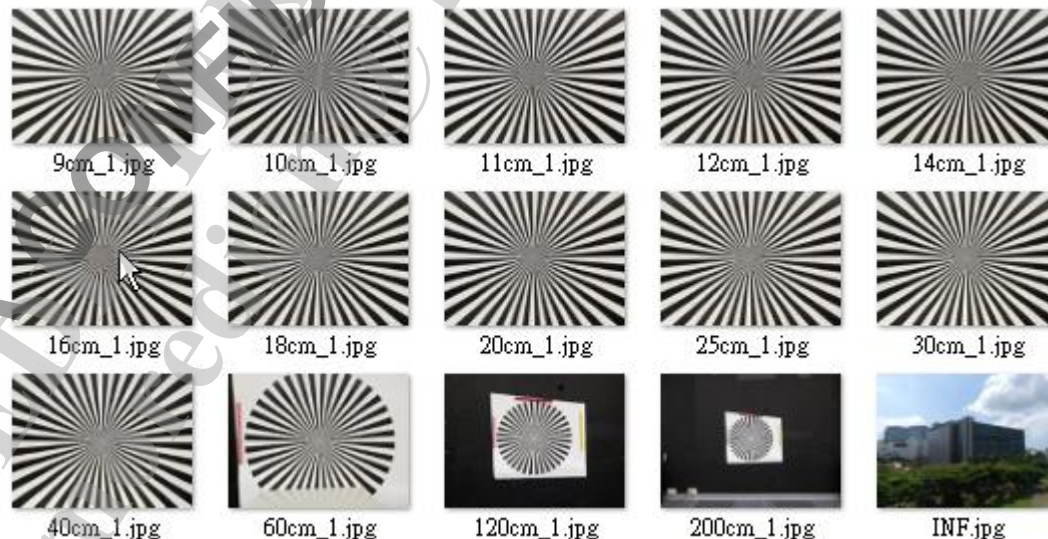
- Target distance



- The 2<sup>nd</sup> must be OTP\_MAC, the distance which the OTP MAC will use; the second last must be OTP\_INF, the distance which the OTP INF will use.
- The 1<sup>st</sup> must be Super\_MAC, which is nearer than OTP\_MAC, and the last must be Real\_INF, which should be very far away.
- For Wide Lens
  - 9cm/ OTP(10cm)/ 11cm/ 12cm/ 14cm/ 16cm/ 18cm/ 20cm/ 25cm/ 30cm/ 40cm/ 60cm/ 120cm/ OTP(200cm)/ INF
- For Tele Lens
  - 40cm/ OTP(50cm)/ 60cm/ 70cm/ 80cm/ 90cm/ 100cm/ 120cm/ 200cm/ 250cm/ 300cm/ 350cm/ 400cm/ 450cm/ OTP(500cm)/ INF

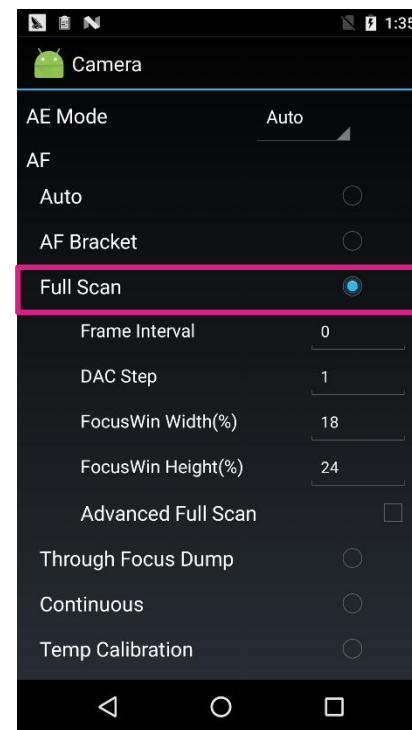
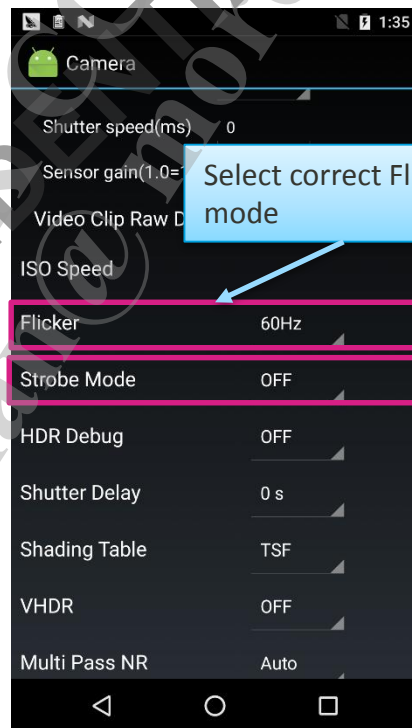
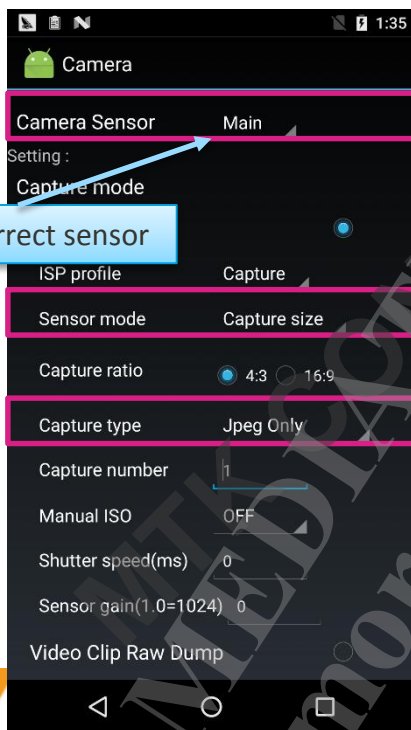
# AF Table – Environment Setup

- Tool: Camera EM mode
- Using tripod @ 300 lux
- Test target: Star chart (at least 70cm x 70cm)
  - Using star chart, even for different distance/ angle, the content in ROI keeps the same
  - For Real\_INF, you can use far way buildings as target



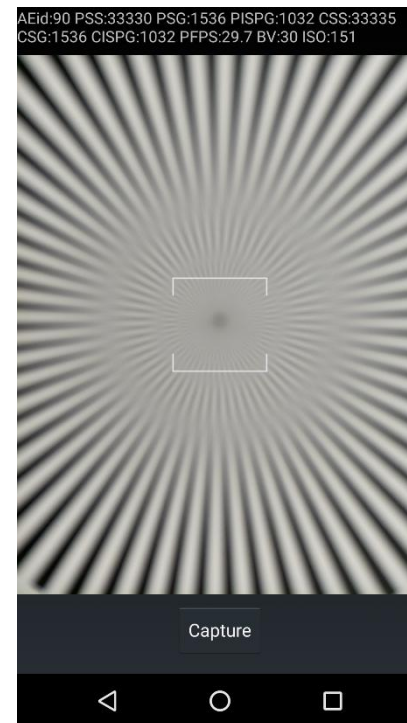
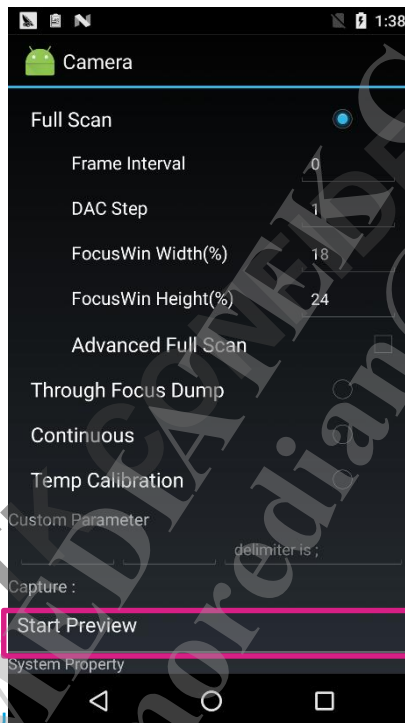
# AF Table – Get Calibration Data

1. Enter camera EM mode
  - In Dailer APP, enter `*##3646633##*`
  - Hardware Testing -> Camera
2. Apply below settings



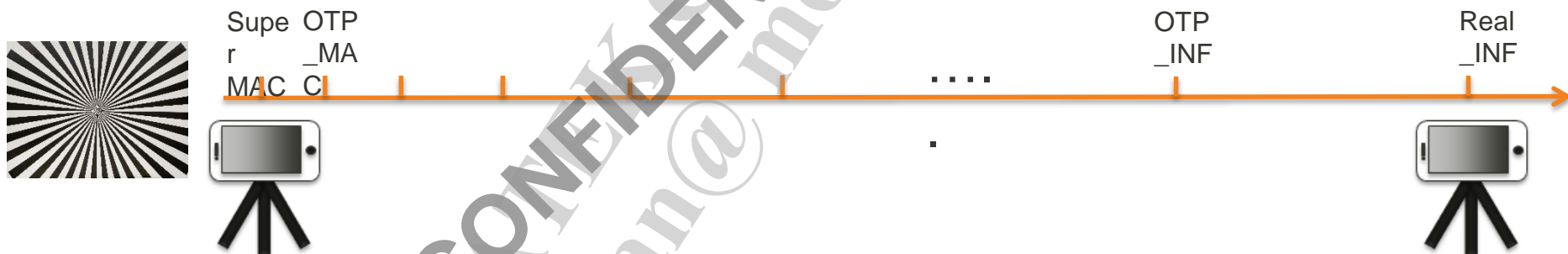
# AF Table – Get Calibration Data

3. Press “Start Preview”, then you will see the capture window.
- You have to **wait for 5 minutes** in the capture window, for lens module temperature stable



# AF Table – Get Calibration Data

4. Setup object distance as described in “AF Table – Environment Setup”, then click “Capture”
  - For each object distance, you have to move your phone at the correct distance, and click “Capture” to do fullscan.



# AF Table – Generate Parameter

1. Get calibration data from phone
  - Connect phone to PC
  - Open command window, and use below command to get data
    - `adb pull /sdcard/DCIM/CameraEM`

# AF Table – Generate Parameter

2. Open CCT, and select “AF Calibration”, then “Table Generate” page

The screenshot displays the 'AF Calibration' software interface. The top menu bar includes: T Sensor Test, CDVT Sensor Calibration, Sensor Register, Device Profile, Shading Calibration, AE P-line Calibration, AE Cali, **AF Calibration** (highlighted with a red box and a red circle with '1'), A WB Calibration, and Gamma T.

Below the menu bar, the 'Scenario Control' section shows a dropdown menu set to 'CAM\_SCENARIO\_PREVIEW'. The 'NVRAM Control' section includes 'Read', 'Apply', and 'Save' buttons.

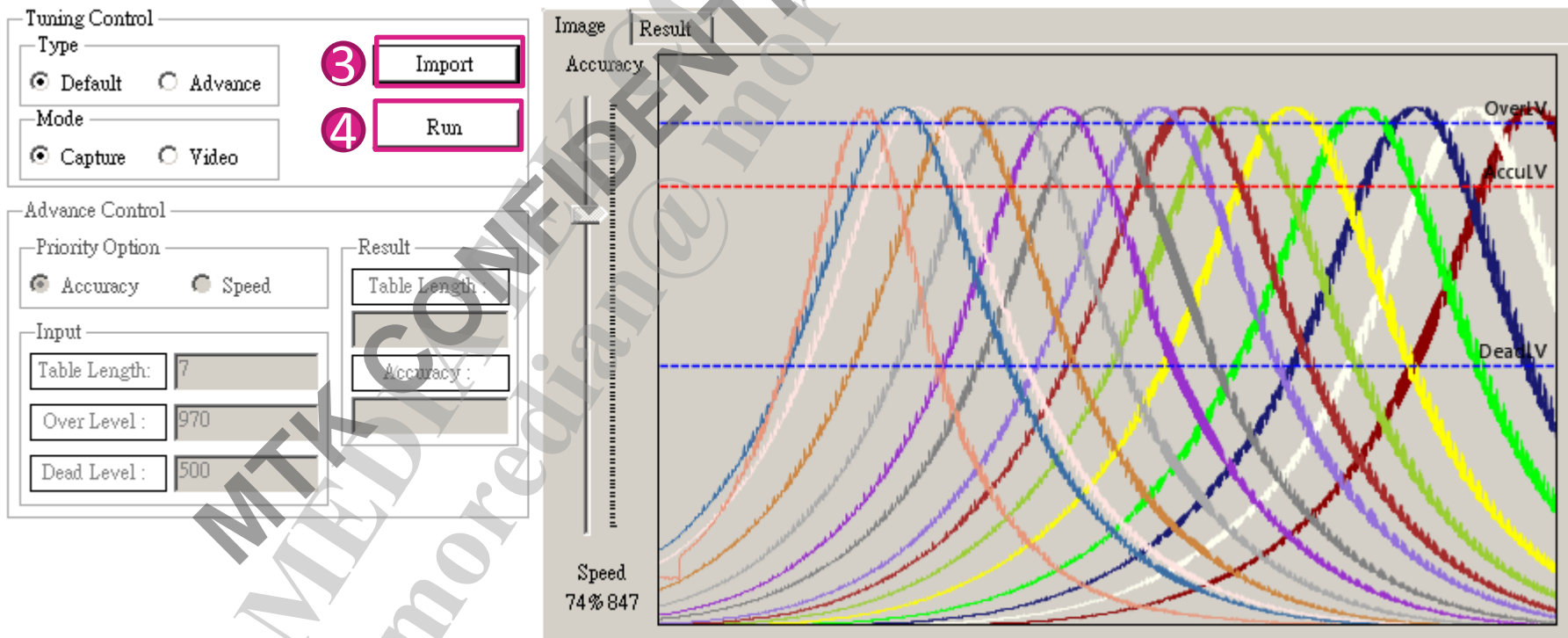
The 'Table Generate' page is selected in the top menu bar (highlighted with a red box and a red circle with '2'). The 'Tuning Control' section on the left includes 'Type' (Default, Advance) and 'Mode' (Capture, Video) radio buttons, along with 'Import' and 'Run' buttons. The 'Advance Control' section includes 'Priority Option' (Accuracy, Speed) radio buttons, 'Input' fields for 'Table Length' (7), 'Over Level' (970), and 'Dead Level' (600), and 'Result' fields for 'Table Length' and 'Accuracy'.

The main graph area on the right shows the 'AF Table' with a vertical axis labeled 'Speed' and a horizontal axis labeled 'Accuracy'. The graph displays three horizontal lines: 'OverLV' (blue dashed), 'AccuLV' (red dashed), and 'DeadLV' (blue dashed). The 'Speed' value is 74% 847.



# AF Table – Generate Parameter

3. Click “Import” to select the calibration data
  - jpegs captured at each different distance
4. Click “Run” to generate AF table parameter



# AF Table – Apply Parameter

1. Select the “Result” tab, and the parameters are shown in the UI

Tuning Control

Type

☒ Default ☐ Advance

Mode

☒ Capture ☐ Video

Import

Run

Advance Control

Priority Option

☒ Accuracy ☐ Speed

Input

Table Length: 7

Over Level: 970

Dead Level: 500

Result

Table Length: 16

Accuracy: 847

Result

```
158,// i4Offset
16,// i4NormalNum
16,// i4MacroNum
2,// i4InfIdxOffset
2,// i4MacroIdxOffset
{
0,57,114,171,230,290,353,414,480,543,
606,669,734,775,816,857,0,0,0,0,
0,0,0,0,0,0,0,0,0,0
}
272,// i4InfPos;
847,// finalAccuracy;
16,// finalTableLength;
```

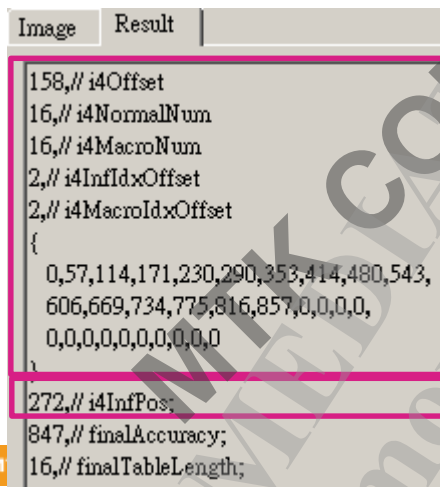
# AF Table – Apply Parameter

## 2. Merge AF Table parameter to source code

– vendor/mediatek/proprietary/custom/\$project\$/hal/lens/\$lens\$/

- lens\_para\_\$lens\$.cpp : for default value
- lens\_para\_\$lens\$\_cap.cpp : for full-size preview
- lens\_para\_\$lens\$\_pv.cpp : for binning-size preview
- lens\_para\_\$lens\$\_vdo.cpp : for full-size video record
- lens\_para\_\$lens\$\_cus3.cpp : for binning-size video record

## 3. Copy generated parameters to the above files, see below diagram for reference



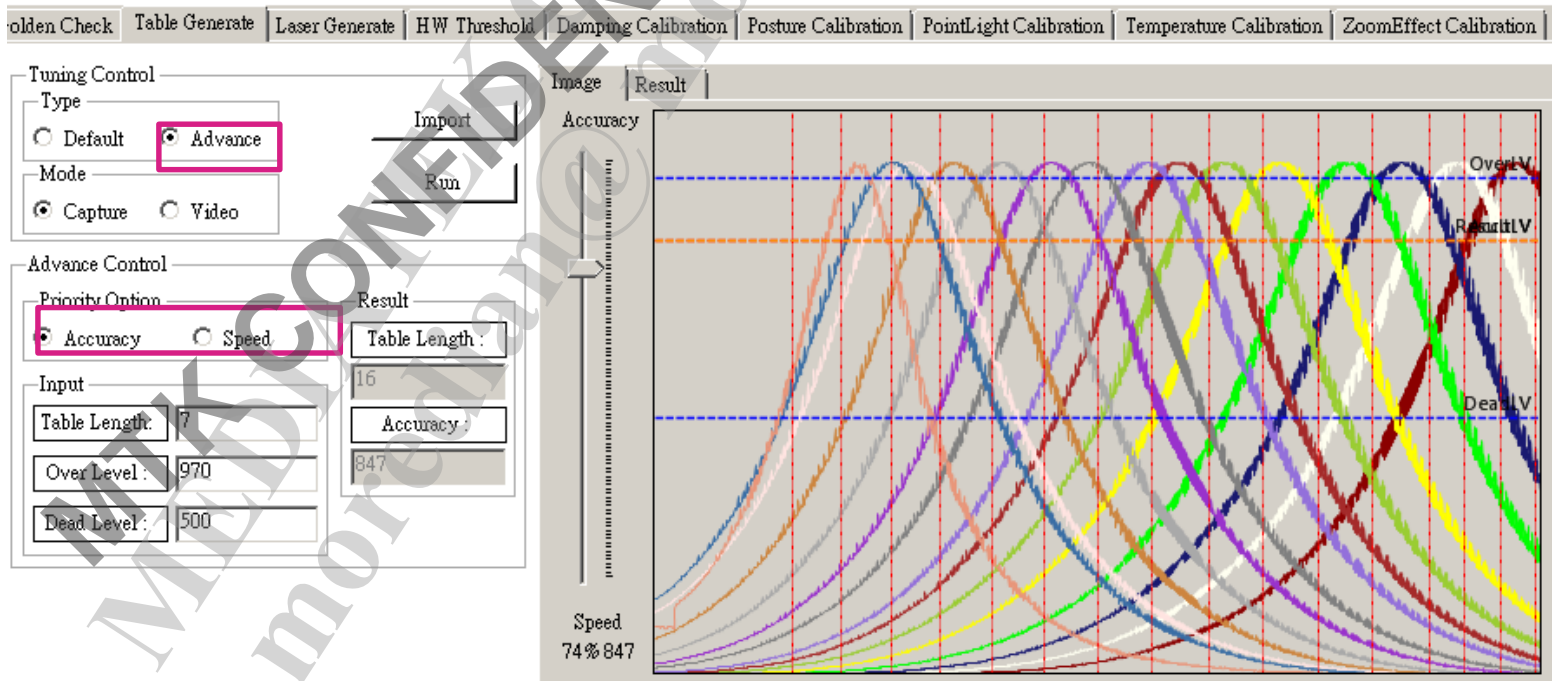
```
{
    165, //af_table_offset
    14,  //af_table_num
    14,  //af_table_num2
    1,   //af_table_inf_idx
    2,   //af_table_mac_idx

    //af_table
    {
        0,64,128,194,260,325,391,455,531,608,
        686,757,811,865,0,0,0,0,0,0,
        0,0,0,0,0,0,0,0,0,0
    }
},
```

```
//=====
// name: inf_mode_pos
// range: 0~1023
// effect: when AF mode set to infinity mode, move lens to this position.
//=====
229, // inf_mode_pos
```

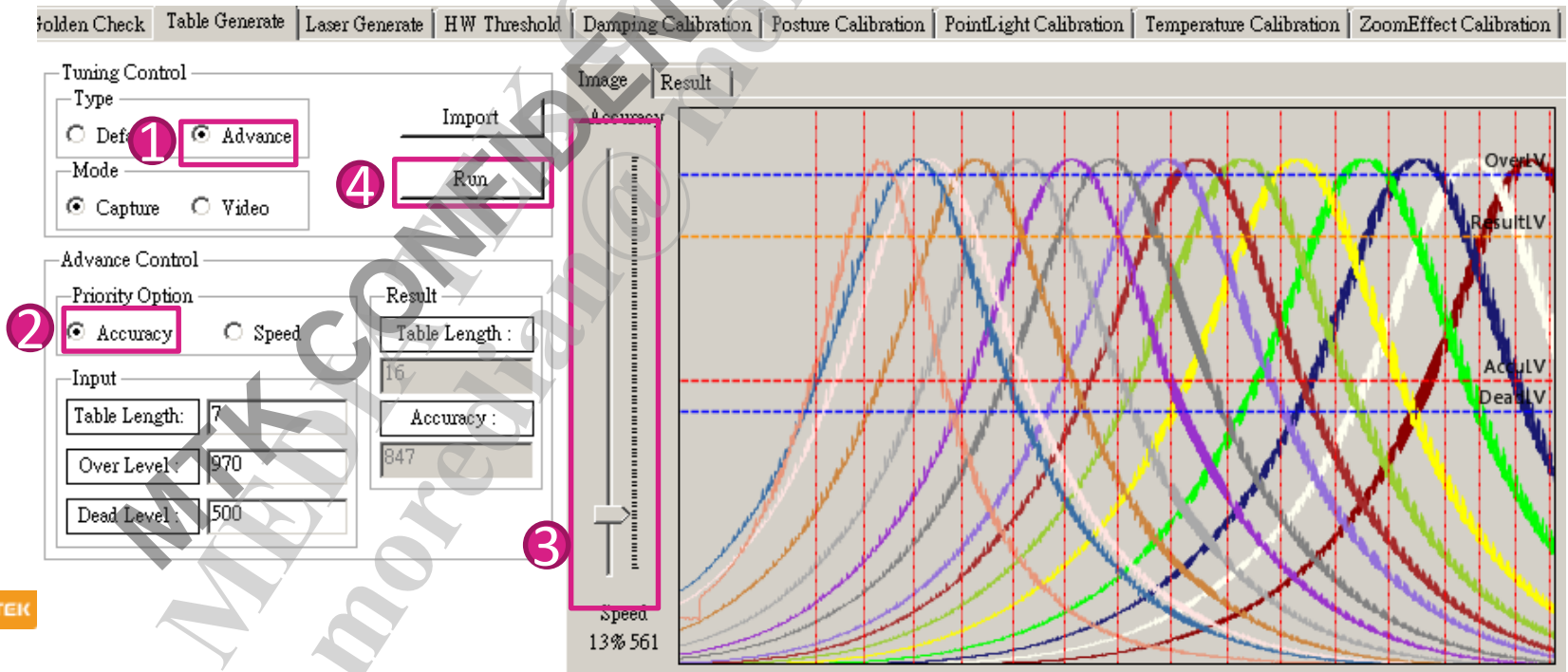
# AF Table – Advanced Option

- Caution: Be careful to use this feature, and make sure you know what the function is
- Select “Advance”, then you can choose “Accuracy” or “Speed” mode
  - Accuracy: Control AF table point accuracy
  - Speed: Control AF table point numbers



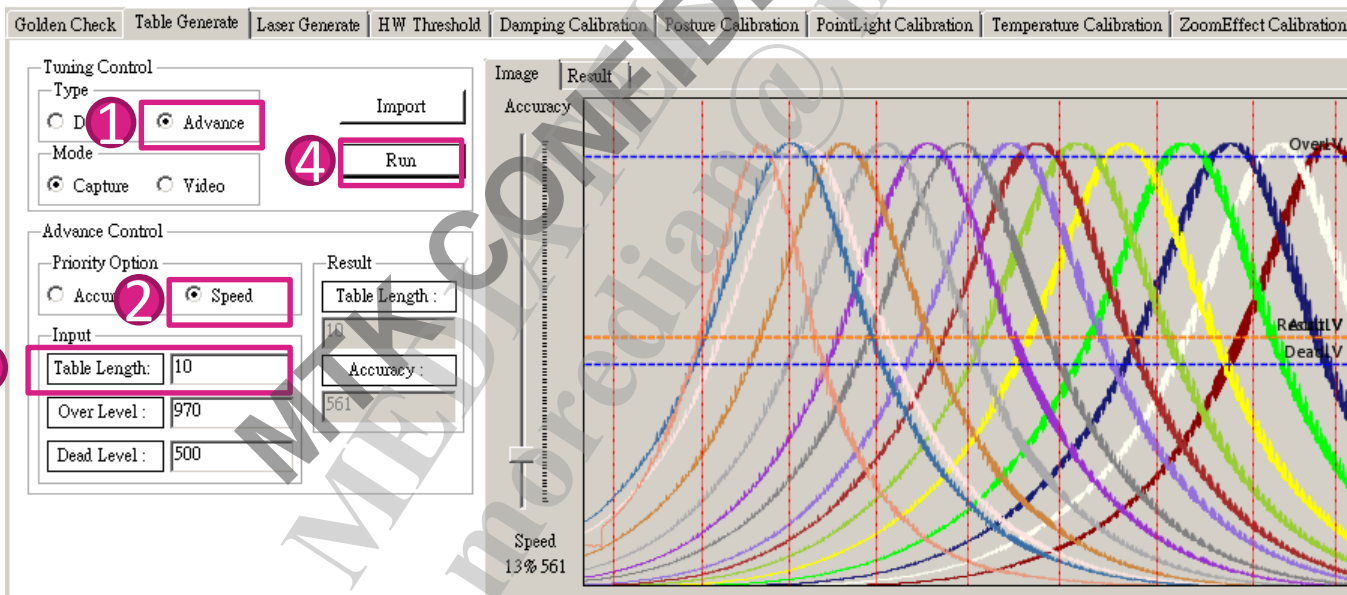
# AF Table – Advanced Option (Accuracy Mode)

- Move the slider bar, to set accuracy from 500 ~ 970
  - Higher accuracy -> more table length -> AF more accurate
  - Lower accuracy -> fewer table length -> AF faster
- Click “Run” to generate parameter



# AF Table – Advanced Option (Speed Mode)

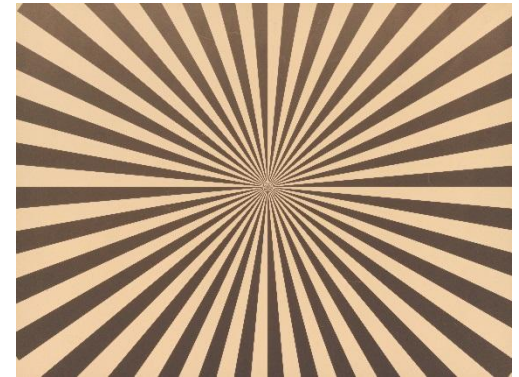
- Set the “Table Length”, to control the output result length
  - More length: AF more accurate
  - Fewer length: AF faster
- Click “Run” to generate parameter
- Table Length falls within 5 ~ 30, and the result Accuracy must fall within 500~ 970; otherwise error dialog will appear





# Posture Calibration – Environment Setup

- Target distance: 120cm
- Tool: Camera EM mode
- Test target: Star chart
- Using tripod @ 300 lux





# Posture Calibration – Environment Setup

- **G/Gyro calibration check** before posture calibration

# G/Gyro Sensor Calibration

- 1.Power off
- 2.volume down +power key to power on to factory mode
- 3.单项测试->选择：陀螺仪传感器校准
- 4.平放静置桌面->选择：进行校准(误差20%)
- 5.出现”执行成功”提示即完成
- 6.单项测试->选择：加速度传感器校准
- 7.平放静置桌面->选择：进行校准(误差20%)
- 8.出现”执行成功”提示即完成

注：上音量：返回上级目录；下音量：移至待选项；电源键：确定

# Posture Calibration

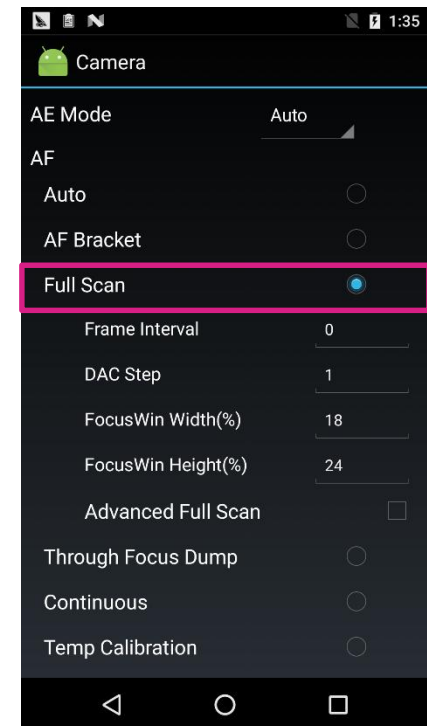
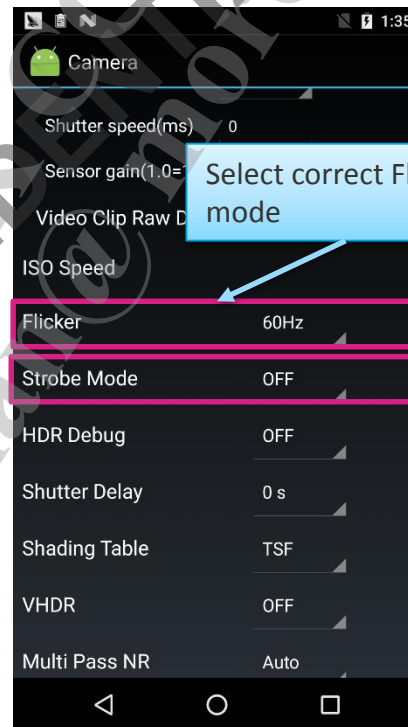
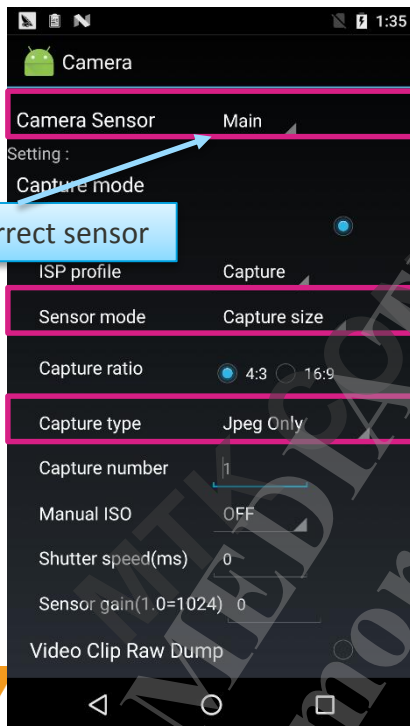
- You can do posture calibration by EM mode (recommended) or optional method
- **1.EM mode**
  - EM mode can support calibration.
- 2.Optional method (if EM mode is finished, skip optional method) [\[Link\]](#)
  - If your device's EM mode cannot support calibration, please check optional method.

# Posture Calibration – Get Calibration Data

## 1. Enter camera EM mode

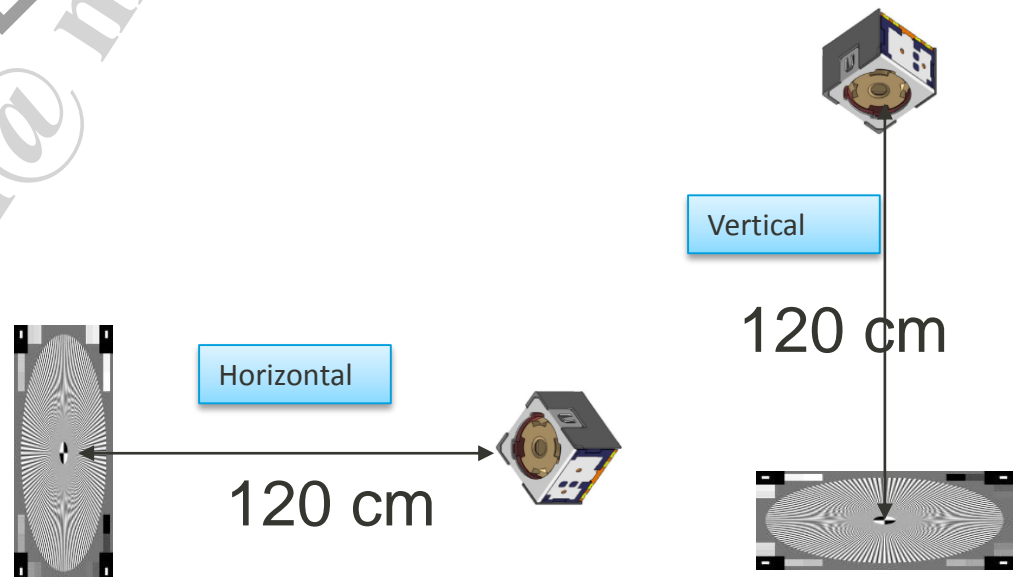
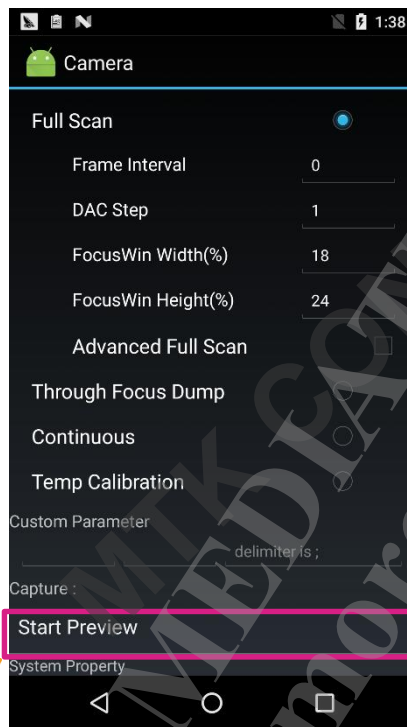
- In Dailer APP, enter `*##3646633#*##`
- Hardware Testing -> Camera

## 2. Apply below settings



# Posture Calibration – Get Calibration Data

3. Press “Start Preview”, then you will see the capture window.
  - Wait for 5 minutes in the capture window
4. Use tripod, and take picture horizontally & vertically at 120cm individually, by clicking “Capture” button



# Posture Calibration – Generate Parameters

1. Get calibration data from phone
  - Connect phone to PC
  - Open command window, and use below command to get data
    - `adb pull /sdcard/DCIM/CameraEM`

# Posture Calibration – Generate Parameters

2. Open CCT, goes to “AF Calibration” -> “Posture Calibration”
3. Load horizontal & vertical pictures by “Browse” button
4. Select “From Cam” or “Main Cam” according to your setting
5. Click “Run” to generate compensation value

The screenshot displays the CCT software interface with the following components and annotations:

- Top Tab Bar:** Contains tabs for CDVT Sensor Test, CDVT Sensor Calibration, Sensor Register, Device Profile, Shading Calibration, AE P-line Calibration, AE Calibration, and **AF Calibration** (annotated with a pink circle 1).
- Scenario Control:** Includes a dropdown menu set to "CAM\_SCENARIO\_PREVIEW" and an "NVRAM Control" section with "Read", "Apply", and "Save" buttons.
- Bottom Tab Bar:** Contains tabs for Golden Check, Table Generate, HW Threshold, Damping Calibration, **Posture Calibration** (annotated with a pink circle 2), PointLight Calibration, and Temperature Calibration.
- File Control:** Includes input fields for "Horizontal" (containing "120cm\_v\_2.jpg") and "Vertical" (containing "120cm.jpg"), each with a "Browse" button (annotated with a pink circle 3).
- OTP Check Result:** Includes radio buttons for "Front Cam" and **"Main Cam"** (annotated with a pink circle 4), and a **"Run"** button (annotated with a pink circle 5).
- Output Display:** Shows the results of the calibration: Horizontal : 296, Vertical : 292, and Result : 4.



# Posture Calibration – Apply Parameters

## 1. Merge Posture parameter to source code

- vendor/mediatek/proprietary/custom/\$project\$/hal/lens/\$lens\$/
  - lens\_para\_\$lens\$.cpp : for default value
  - lens\_para\_\$lens\$\_cap.cpp : for full-size preview
  - lens\_para\_\$lens\$\_pv.cpp : for binning-size preview
  - lens\_para\_\$lens\$\_vdo.cpp : for full-size video record
  - lens\_para\_\$lens\$\_cus3.cpp : for binning-size video record

## 2. Copy value in the “Result” field, and apply to the i4PostureComp field in the above files

```
//=====
// name: posture_comp
// range: integer
// default: 0
// effect: horizontal and vertical posture compensation
//=====
4, // posture_comp
```

File Control

Horizontal :	120cm_v_2.jpg	Browse
Vertical :	120cm.jpg	Browse

OTP Check Result

☐ Front Cam ☒ Main Cam

Horizontal :	296
Vertical :	292
Result :	4

# Posture Calibration

- You can do posture calibration by EM mode (recommended) or optional method
- 1.EM mode
  - EM mode can support calibration.
- 2.Optional method (if EM mode is finished, skip optional method) [\[Link\]](#)
  - If your device's EM mode cannot support calibration, please check optional method.

# Posture Compensation

- 準備工具:
  - 模組廠提供的模組變異性數據 (請參照Pre\_Check\_Report.xls)
- Calibration步驟:
  - Step 1:** 開啓模組廠提供的模組變異性數據
  - Step 2:** 檢查姿勢差 Max – Min是否小於50, 若大於50, 為了AF 整體品質考量, 建議三方向(水平、向上、向下)作Calibration

編號	Infinity 3M		Macro 10 CM		3M	10 cm
	水平	垂直向下	水平	垂直向下	姿勢差	姿勢差
#94	346	150	652	566	196	86
#95	220	160	718	534	60	184
#96	308	140	711	530	168	181
#97						
#98						
#99						
#100						
Max	385	240	770	590	249	258
Min	200	110	595	492	35	40
Avg	330.7	163.5	648.02	528.17	167.2	119.85
Post Comp					195.5	

$3M \text{ Max} - \text{Min} = 214 > 50$   
 $10 \text{ cm Max} - \text{Min} = 218 > 50$

# Posture Compensation

- Calibration步驟:

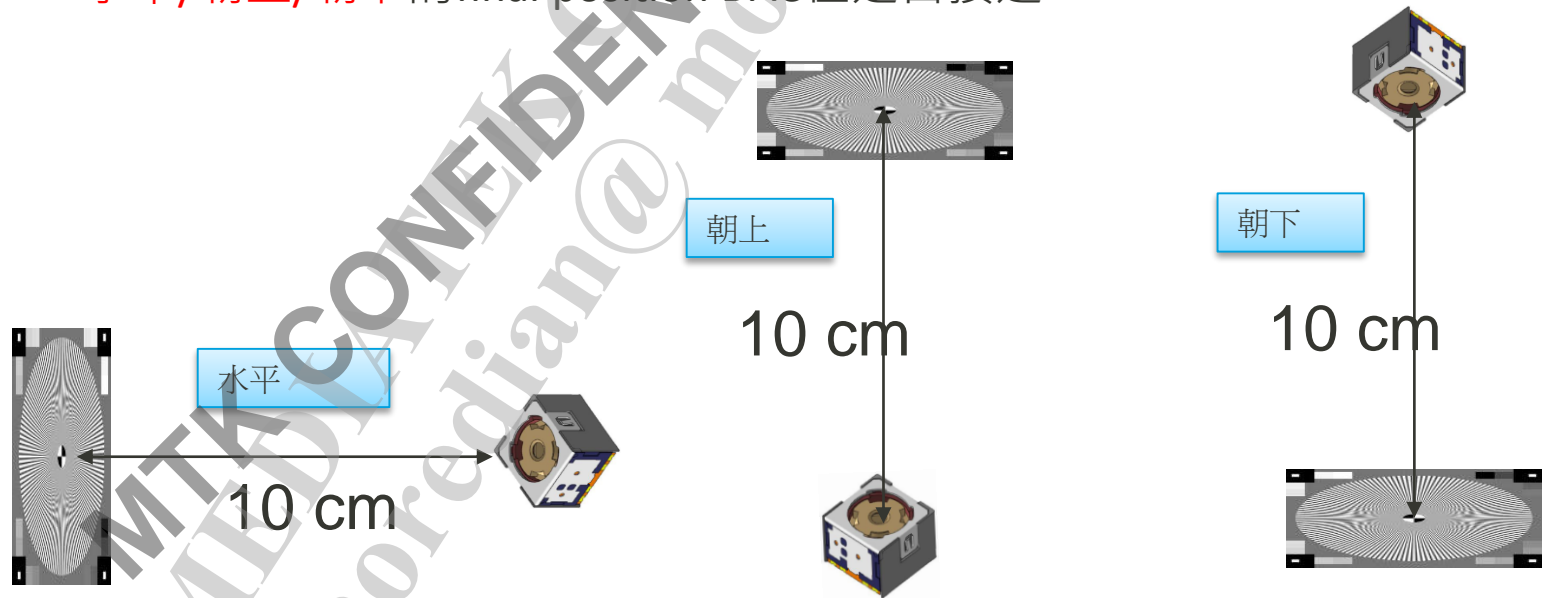
- Step 3:** 開啓lens\_para\_xxx.cpp, 尋找i4PostureComp。
- Step 4:** 將下方藍框的資料填入i4PostureComp。

編號	Infinity 3M		Macro 10 CM		3M	10 cm
	水平	垂直向下	水平	垂直向下	姿勢差	姿勢差
#94	346	150	652	566	196	86
#95	220	160	718	534	60	184
#96	308	140	711	530	168	181
#97						
#98						
#99						
#100						
Max	385	240	770	590	249	258
Min	200	110	595	492	35	40
Avg	330.7	163.5	648.02	528.17	167.2	119.85
Post Comp					195.5	

196, // i4PostureComp: post comp max offset [0:disable, others:enable] @basic

# Posture Compensation

- 手動微調與驗證方式：
  - Step 1:** 先對著手機做G/Gyro Sensor 校正。
  - Step 2:** 將太陽圖固定於牆上 & 手機**水平/朝上/朝下**固定在腳架上。
  - Step 3:** 將腳架放置在離chart 10 cm 的位置上拍照, 每個距離各拍5張, 確認**水平/朝上/朝下**的final position DAC值是否接近。



# Laser Calibration

## ■ Laser introduction

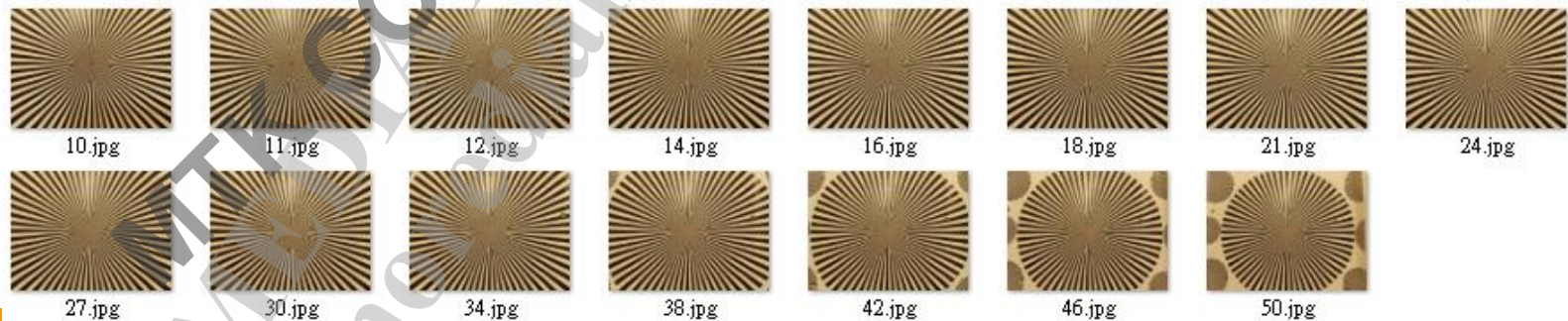
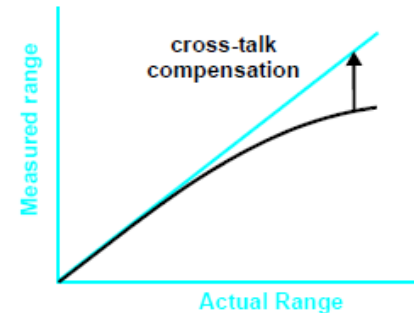
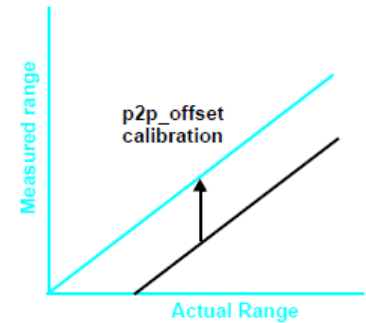
- To estimate distance for fast AF, it applies measuring distance by Laser component.
- Measuring the time the light takes to travel to the nearest object and reflect back to the sensor ([Time-of-Flight](#)).
- Laser module can only estimate distance < 50cm or 100cm; when out of this range, the estimation confidence level will be low and unstable

## ■ Laser AF

- The Laser AF control method is similar to the PDAF.
- The focusing speed of Laser AF is very fast within the valid distance
- In CAF mode, it supports laser focusing within the valid distance
- In TAF mode, it can't support laser focusing.

# Laser Calibration

- Laser offset
  - The offset between laser response and real distance
- Laser crosstalk
  - Range error by cover lens, is proportional to the ratio of the cross-talk to the signal return from the target.
- Laser mapping table
  - Mapping laser distance (mm) to lens position (DAC)

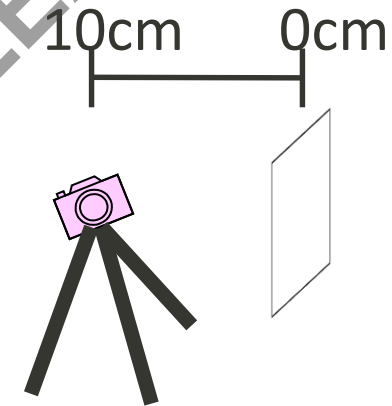




# Offset – Get Calibration Data

- Environment

- Target: white target with 88% reflectance
- Distance: 10cm
- Using tripod @ 300lux



- Do calibration

1. Connect Phone to PC using USB
2. Enter normal camera
3. adb shell setprop laser.calib.mode 1
4. Do TAF to trigger offset calibration
5. adb shell setprop laser.calib.mode 0

- Output parameter

```
LaserCali : getLaserOffsetCalib Start  
LaserCali : getLaserOffsetCalib : 14  
LaserCali : getLaserOffsetCalib End
```

# Cross-Talk – Get Calibration Data

- Environment

- Target: 17% grey target
- Distance: 40cm
- Using tripod @ 300lux

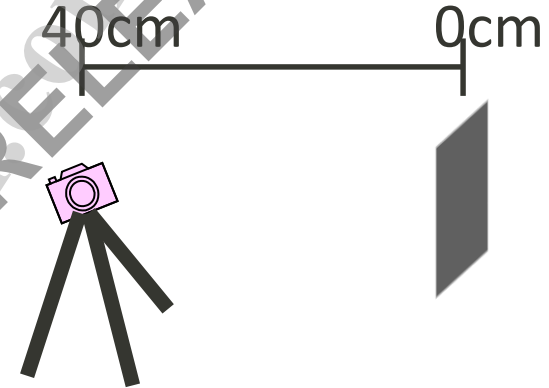
- Do calibration

1. Connect Phone to PC using USB
2. Enter normal camera
3. adb shell setprop laser.calib.mode 2
4. Do TAF to trigger cross-talk calibration
5. adb shell setprop laser.calib.mode 0

- Output parameter

- **XTalk must  $\leq 52$ , otherwise you must confirm the “Cover glass design”**

```
LaserCali : getLaserXTalkCalib Start  
LaserCali : getLaserXTalkCalib : 0  
LaserCali : getLaserXTalkCalib End
```



# Offset/ XTalk – Apply Parameters

Apply Offset/ XTalk parameter to source code

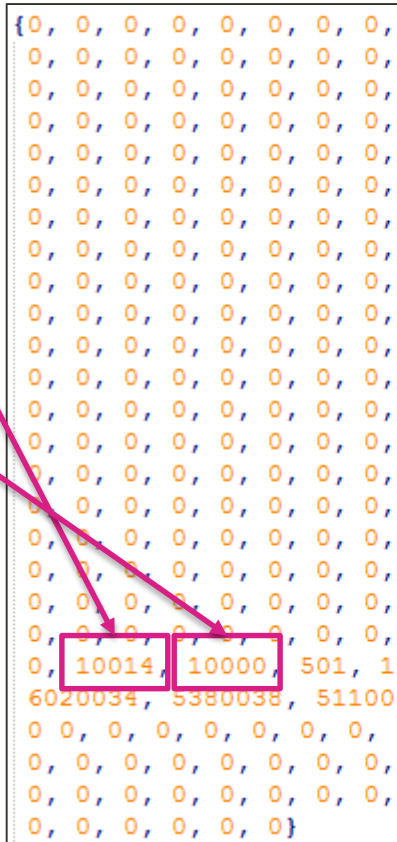
for/mediatek/proprietary/custom/\$project\$/hal/lens/\$lens\$

ns\_para\_\$lens\$.cpp : for default value  
ns\_para\_\$lens\$\_cap.cpp : for full-size preview  
ns\_para\_\$lens\$\_pv.cpp : for binning-size preview  
ns\_para\_\$lens\$\_vdo.cpp : for full-size video record  
ns\_para\_\$lens\$\_cus3.cpp : for binning-size video record

## Calculate & apply parameters

$i4Revs[201] = Enable * 10000 + Offset$   
Example: LaserEnable = 1, Offset = 14  
•  $i4Revs[201] = 1 * 10000 + 14 = 10014$

$i4Revs[202] = Enable * 10000 + Xtalk$   
Example: LaserEnable = 1, Xtalk = 0  
•  $i4Revs[202] = 1 * 10000 + 0 = 10000$



INTERNAL USE

## 2. Calculate & apply parameters

# Max Distance – Apply Parameters

1. Merge Offset/ XTalk parameter to source code

- vendor/mediatek/proprietary/custom/\$project\$/hal/lens/\$lens\$/
  - lens\_para\_\$lens\$.cpp : for default value
  - lens\_para\_\$lens\$\_cap.cpp : for full-size preview
  - lens\_para\_\$lens\$\_pv.cpp : for binning-size preview
  - lens\_para\_\$lens\$\_vdo.cpp : for full-size video record
  - lens\_para\_\$lens\$\_cus3.cpp : for binning-size video record

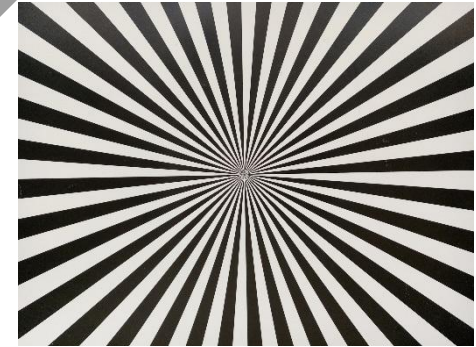
## 2. Depends on Laser module capability

- $i4Revs[203] = \text{max distance (in mm)} + 1$
- Example
  - Max distance 50cm (ex: VL6180)
    - $i4Revs[203] = 501$
  - Max distance 100cm (ex: VL53L0)
    - $i4Revs[203] = 1001$

```
{0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, //reserved[256]
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 10014, 10000, 501, 15, 9320010, 8880013, 840
6020034, 5380038, 5110040, 4720043, 4450045, 42
0 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0}
```

# Laser Mapping Table – Environment Setup

- Tool: Camera EM mode
- Using tripod @ 300 lux
- Test target: Star chart
- Distance (cm):
  - Max Laser distance 50cm:
    - 10, 11, 12, 14, 16, 18, 21, 24, 27, 30, 34, 38, 42, 46, 50
  - Max Laser distance 100cm:
    - 10, 11, 12, 14, 16, 18, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100

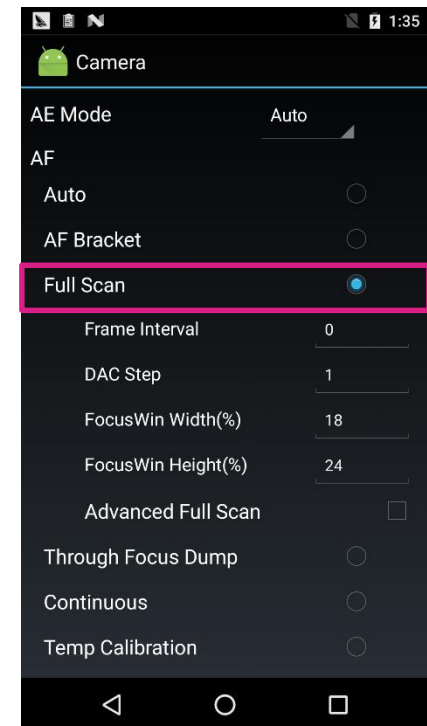
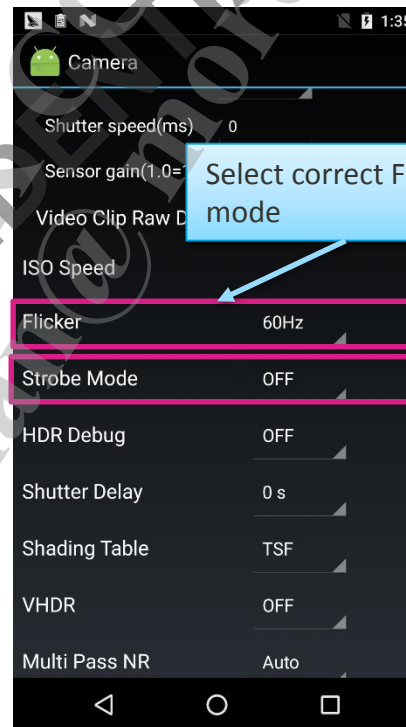
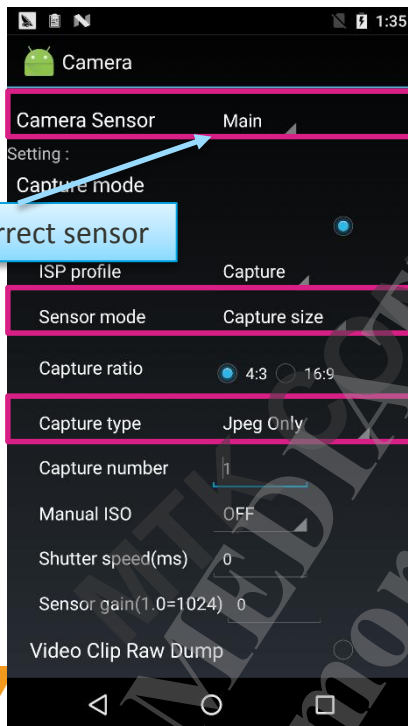


# Laser Mapping Table – Get Calibration Data

## 1. Enter camera EM mode

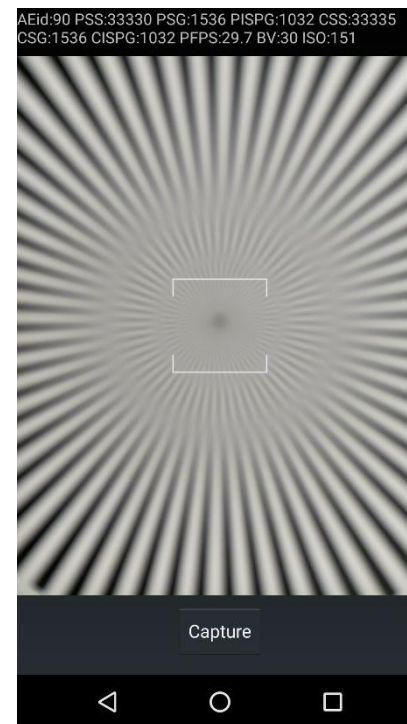
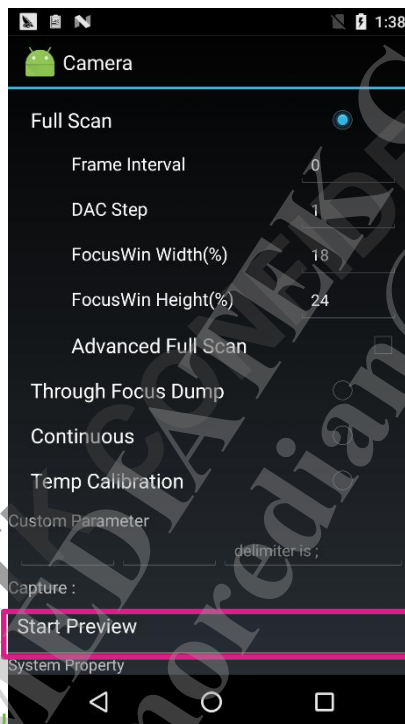
- In Dailer APP, enter \*##3646633##\*
- Hardware Testing -> Camera

## 2. Apply below settings



# Laser Mapping Table – Get Calibration Data

3. Press “Start Preview”, then you will see the capture window.
- You have to **wait for 5 minutes** in the capture window, for lens module temperature stable





# Laser Mapping Table – Get Calibration Data

4. Setup object distance as described in “Laser Mapping Table - Distance”, then click “Capture”
- For each object distance, you have to move your phone at the correct distance, and click “Capture” to do fullscan.

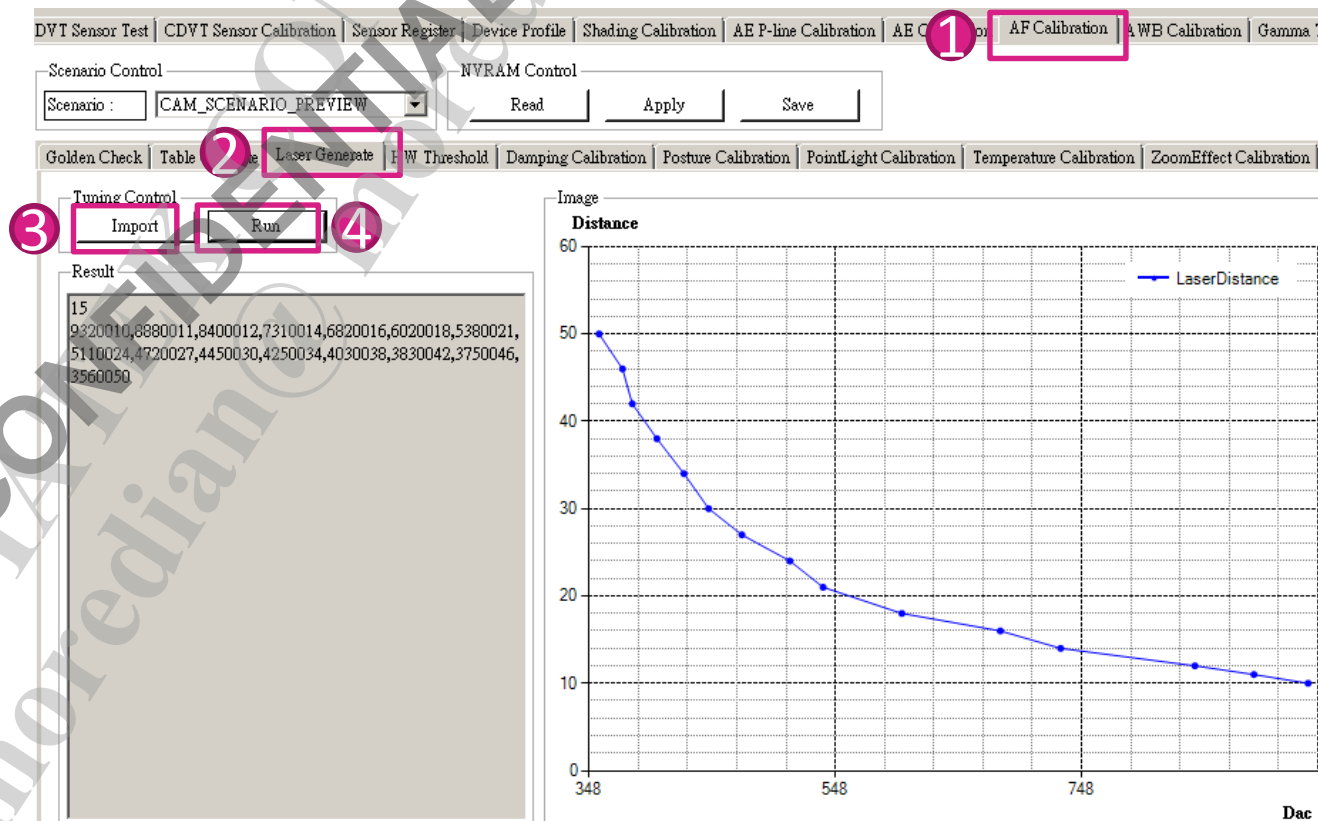


# Laser Mapping Table – Generate Parameters

1. Get calibration data from phone
  - Connect phone to PC
  - Open command window, and use below command to get data
    - `adb pull /sdcard/DCIM/CameraEM`

# Laser Mapping Table – Generate Parameters

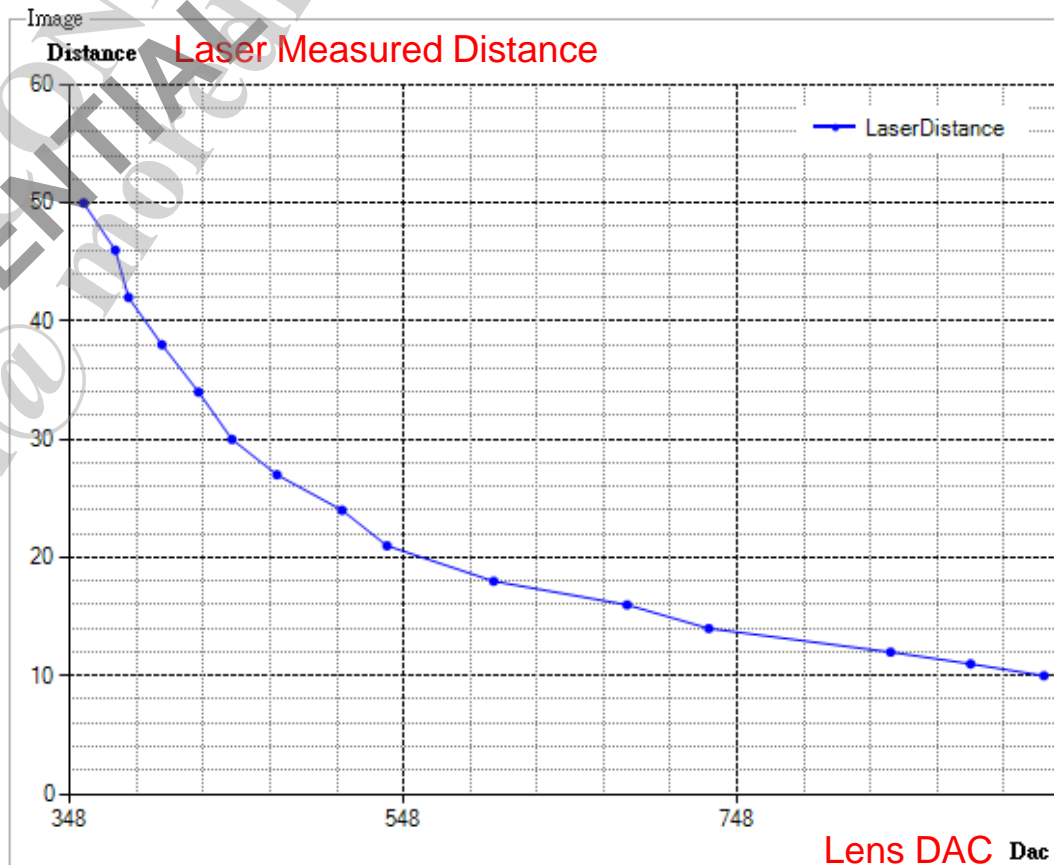
2. Open CCT, goes to “AF Calibration” -> “Laser Generate”
3. Click “Import” to select jpeg files **(30 files at most)**
4. Click “Run” to generate parameters



# Laser Mapping Table – Generate Parameters

## 5. Result curve check

- The curve must be decline, otherwise you should remove the abnormal jpeg and take pictures again.



# Laser Mapping Table – Apply Parameters

## 1. Merge AF Table parameter to source code

- vendor/mediatek/proprietary/custom/\$project\$/hal/lens/\$lens\$/
  - lens\_para\_\$lens\$.cpp : for default value
  - lens\_para\_\$lens\$\_cap.cpp : for full-size preview
  - lens\_para\_\$lens\$\_pv.cpp : for binning-size preview
  - lens\_para\_\$lens\$\_vdo.cpp : for full-size video record
  - lens\_para\_\$lens\$\_cus3.cpp : for binning-size video record

## 2. Copy generated parameters to the above files

- Copy TableLength to i4Revs[204]
- Copy TableContent to i4Revs[205~234]

Result

TableLen

15

gth

9320010,8880011,8400012,7310014,6820016,6020018,5380021,  
5110024,4720027,4450030,4250034,4030038,3830042,3750046,  
3560050

TableCo

ntent

CONFIDENTIAL

morixian@mtk.com.tw

INTERNAL USE

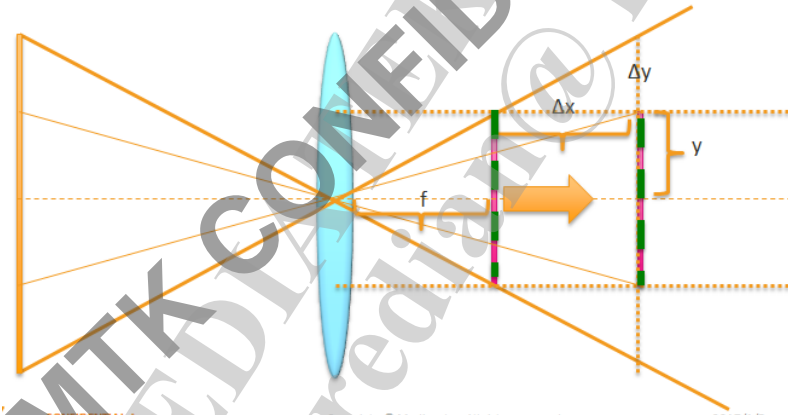
15, 9320010,8880011,8400012,7310014,6820016,  
6020018,5380021,5110024,4720027,4450030,4250034,4030038,3830042,3750046,3560050,

//reserved[256]

# Zoom Effect Calibration

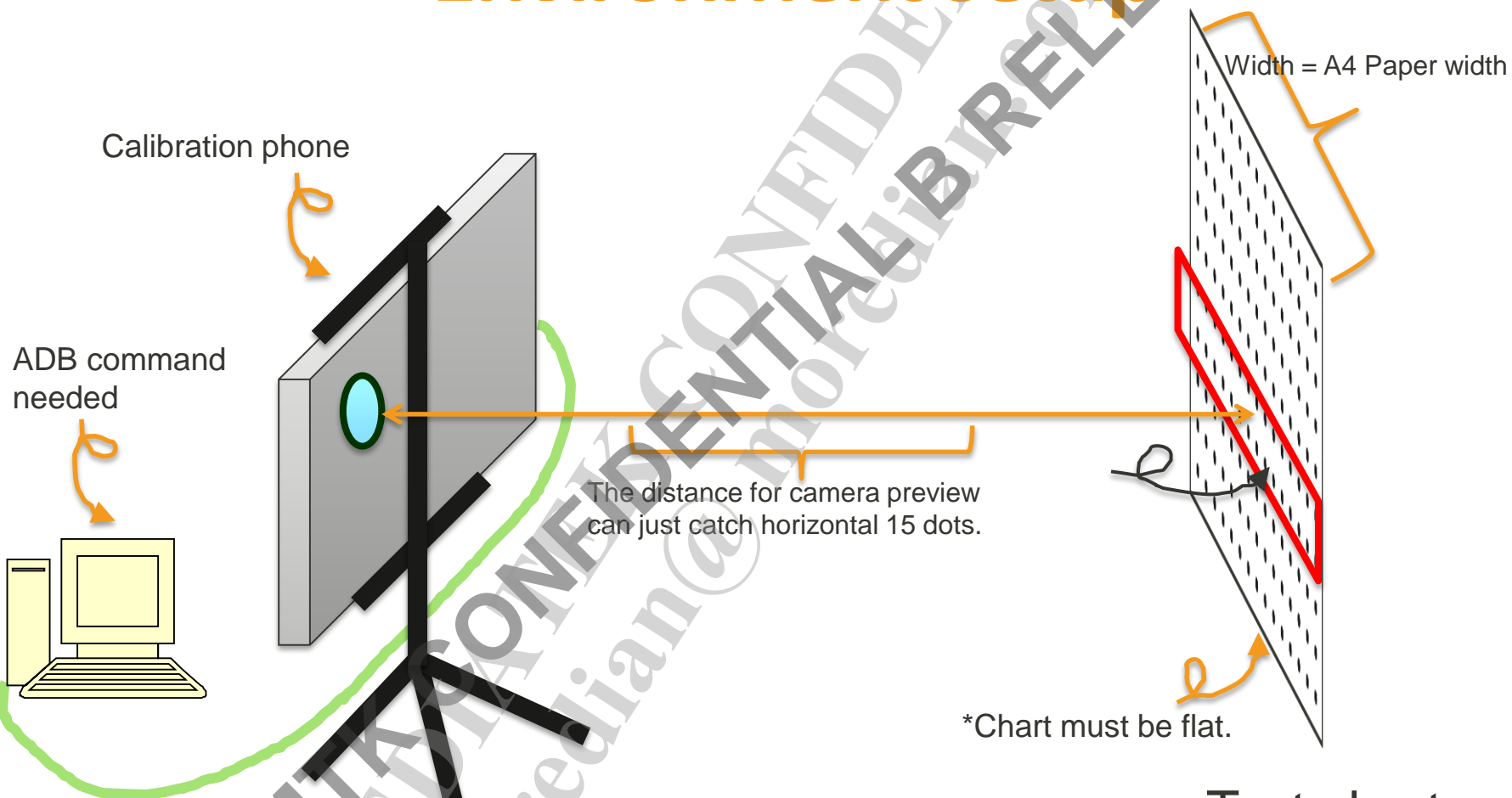
- What is zoom effect?

- When camera change focus distance (between lens and image sensor), the image field of view (FOV) will change, and image preview shows a small zoom in/out effect.
- Zoom effect is happened while focusing.



Push 'Shift+F5' for ppt full screen mode  
and check moving GIF

# Zoom Effect Calibration – Environment setup

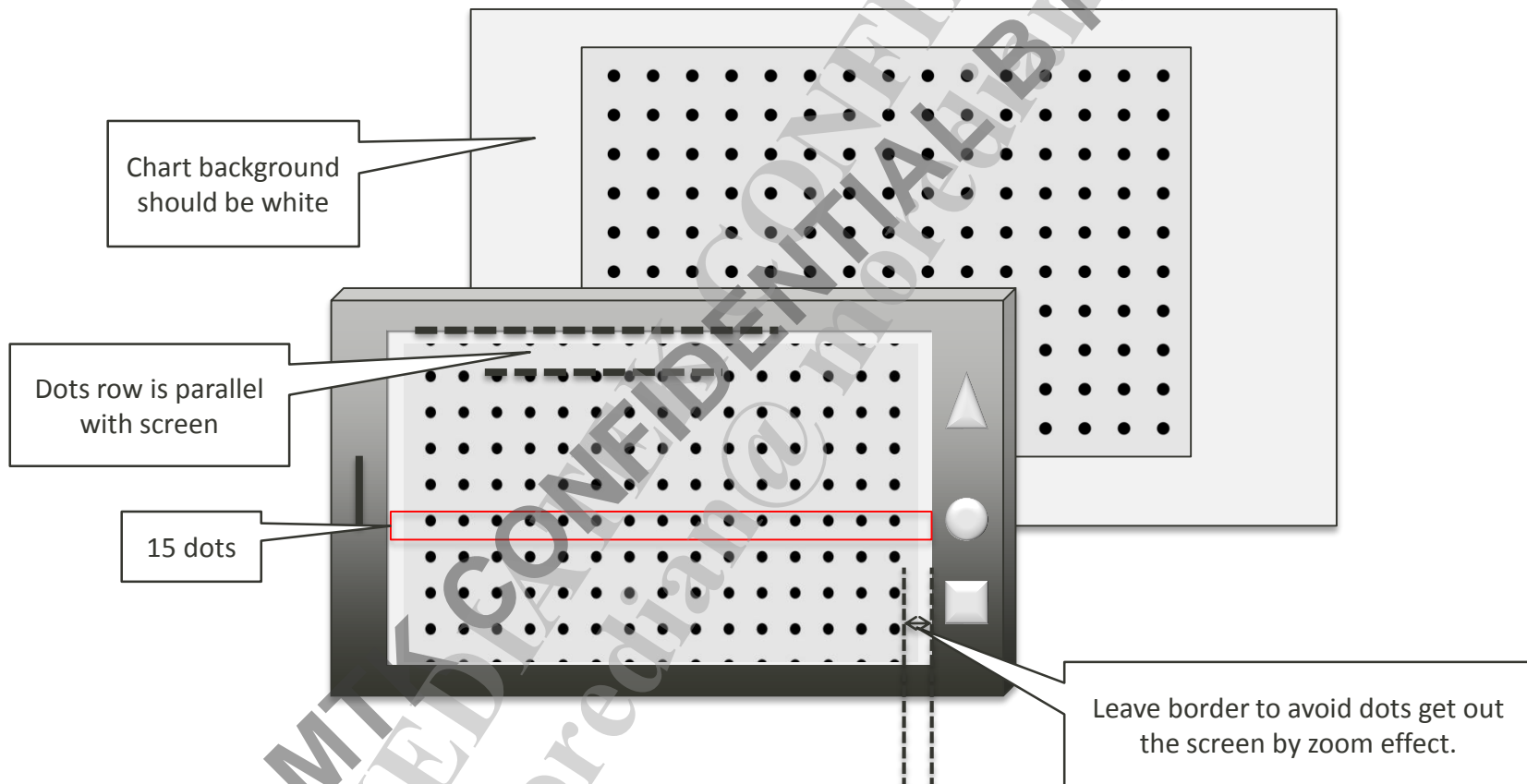


Test chart

ZEC\_dot\_chart.jpg



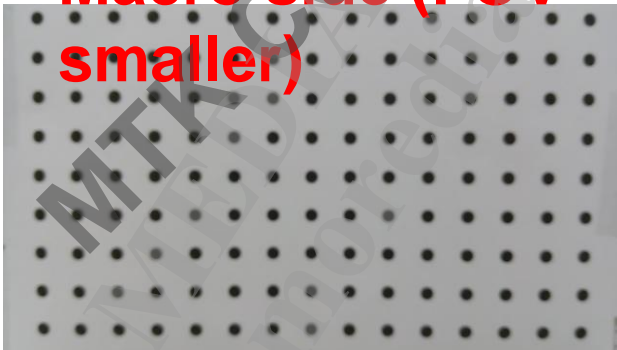
# Zoom Effect Calibration – Environment setup



# Zoom Effect Calibration – Get calibration data

- ZEC calibration tool needs 2 jpeg images:
  - Before zoom effect calibration we need do AF table calibration first
  - If we changed AF table zoom effect calibration need do it again
  - How to get these 2 images?
    - Step1: Enter camera app and set to ZSD preview.
    - Step2: Do TAF (no matter AF OK or fail, don't care)
    - Step3: Type adb command “setprop debug.af.zeccalib 1” then capture image1
    - Step4: Close and re-open camera app
    - Step5: Do TAF (no matter AF OK or fail, don't care)
    - Step6: Type adb command “setprop debug.af.zeccalib 2” then capture image2
  - Sample image as below

**Macro side (FOV smaller)**

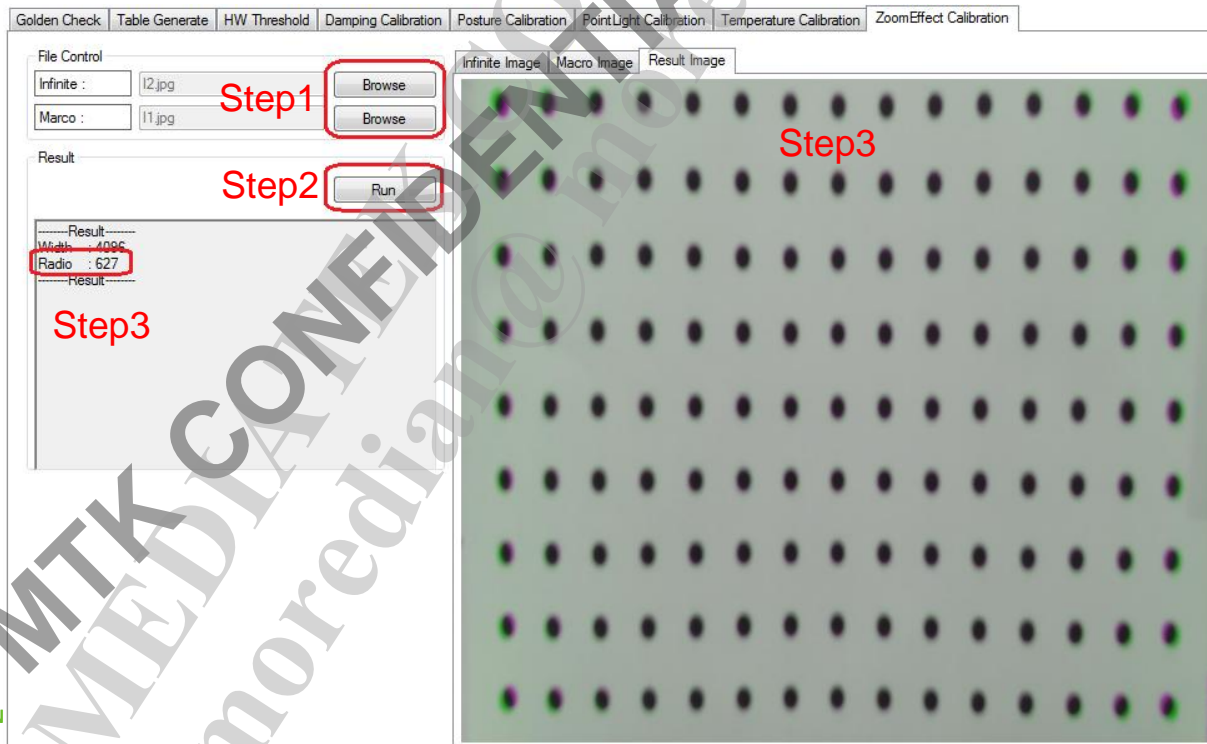


**Infinity side (FOV larger)**



# Zoom Effect Calibration – Generate parameters

- Step1: Load 2 images in CCT tool
- Step2: Press “Run” bottom
- Step3: Get match image and final zoom effect ratio back
  - Match image's R & B channel come from macro image and G channel come from infinity image with crop and resize by final ratio.
  - Match image as below we need check match well or not ( over half circle has color)
  - Due to image distortion, the dot around image can't be matched well.

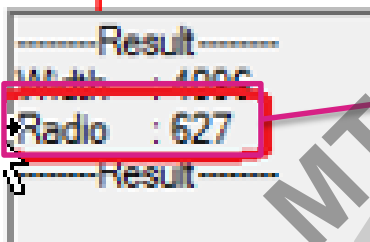


# Zoom Effect Calibration – Apply parameters

## 1. Merge Zoom Effect parameter to source code

- vendor/mediatek/proprietary/custom/\$project\$/hal/lens/\$lens\$/
  - lens\_para\_\$lens\$.cpp : for default value
  - lens\_para\_\$lens\$\_cap.cpp : for full-size preview
  - lens\_para\_\$lens\$\_pv.cpp : for binning-size preview
  - lens\_para\_\$lens\$\_vdo.cpp : for full-size video record
  - lens\_para\_\$lens\$\_cus3.cpp : for binning-size video record

## 2. Fill final zoom effect ratio to below



```
//=====//  
// Section: Zoom effect ROI compensation tuning data  
// Description: Zoom effect scale ratio. This parameters generated by tuning tool  
// [5] name: ZE_ratio  
// range: 400~800  
// default: 618  
// constraints:  
// effect: Need generate by tuning tool  
//=====//  
618,  
}, //i4ZoEffect[64]
```

# Subjective Check - Flow

- Follow below steps, to make sure your calibration data is fine
  - Push new calibration data into FW
  - In normal camera, take images on the tripod using touch-AF
    - Switch to ZSD mode
    - Touch the center of preview frame
  - Subjective check AF results

Item	Test distance	Test target
HW threshold	15cm (ISO400)	Grid chart or low contrast scene
	15cm (ISO800)	
AF table	10cm	Star chart
	> 3M	Daylight Building

# Subjective Check - Example

HW threshold

15cm grid-chart with iso 400



15cm grid-chart with iso 800



AF table

> 3m building



10cm star chart

