



CONFIDENTIAL B

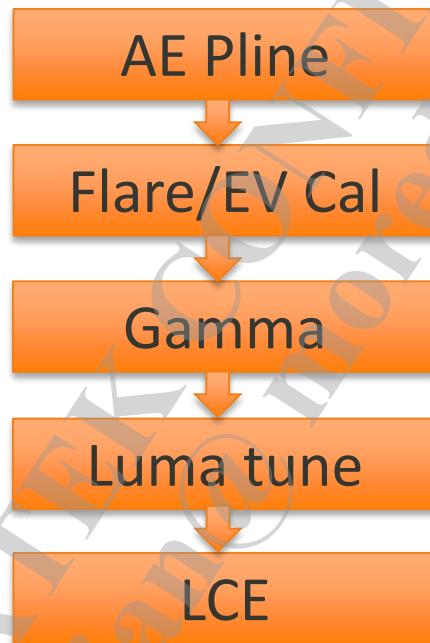
Basic Tuning Flow – AE Calibration

AE Contents

- AE Pline
 - Device Profile
 - Table Mapping
 - Generate code
 - Debug
- Flare/Target/EV calibration
 - Calibration
 - Generate code
 - Debug
- Gamma
 - Dynamic gamma calibration
 - ImagiqSimulator tool SOP for gamma
 - Debug
- AE tuning tool SOP
- LCE
 - LCE theory
 - ImagiqSimulator tool SOP for LCE
 - LCE debug

Read Before Reading

- Before AE calibration, make sure **OB** and **Shading** calibration done first.
- AE calibration must follow the blow steps:



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 - Tune LCE by ImageiqSimulator
 - LCE debug

Device Profile

- Device Profile Introduction (MTK provide)

The screenshot shows a software interface for managing device profiles. At the top, there are tabs: CDVT Sensor Test, CDVT Sensor Calibration, Sensor Register, Device Profile (which is selected), and Shading. Below the tabs are two main sections: Control and NVRAM Control. The Control section contains buttons for Import, Apply, and Save. The NVRAM Control section is currently empty.

Lens Profile

String	Value
LensPartNum	AD5823AF
u4LensFno	20

Sensor Profile

String	Value
SensorPartNum	S5K3M2MIPI
u4OBLevel	64
u4MinGain	1160
u4MaxGain	10240
u4MinISOGain	108
u4GainStepUnitInTotalRange	128
u4PreviewExposureLineUnit	10437
u4PreviewMaxFrameRate	30
u4VideoExposureLineUnit	10437
u4VideoMaxFrameRate	30
u4VideoToPreviewSensitivityRatio	1024
u4CaptureExposureLineUnit	10437
u4CaptureMaxFrameRate	30
u4CaptureToPreviewSensitivityRatio	1024
u4Video1ExposureLineUnit	10437
u4Video1MaxFrameRate	120
u4Video1ToPreviewSensitivityRatio	1024
u4Video2ExposureLineUnit	10437

Device Profile

➤ Device Profile Introduction (MTK provide)

- u4OBLevel : OB value (useless)
- u4MinGain : Minimum saturation gain
- u4MaxGain : Sensor support maximum gain
- u4MinISOGain : ISO value when sensor gain is 1024
- u4GainStepUnitInTotalRange : Sensor gain step based on 1024 (if sensor gain step is 8, x=1024/8=128)
- u4PreviewExposureLineUnit : Preview line unit in us
- u4PreviewMaxFrameRate : Preview max frame rate
- u4VideoExposureLineUnit : Video line unit in us
- u4VideoMaxFrameRate : Video max frame rate
- u4VideoToPreviewSensitivityRatio : Video / Preview sensitivity radio
- u4CaptureExposureLineUnit : Capture line unit in us
- u4CaptureMaxFrameRate : Capture max frame rate
- u4CaptureToPreviewSensitivityRatio : Capture / Preview sensitivity radio
- Fno : F number*10, ex: f2.2, u2LensFno=22
- Gain Step : Minimum step unit of sensor gain
- FixSensorGain : If the sensor gain is nonlinear, use fix sensor gain table.

Table Mapping

➤ AE Pline Table main page

- a) Mode Menu : List of all sensor and selected for tuning.
- b) AE Table : Current AE scene mapping table.
- c) AE Scene : List of all AE scene with selected sensor mode.
- d) Table Detail : For each table detail tuning.
- e) Import from P-line Info : Import Pline table from csv file.
- f) Export to P-line Info : Export current Pline table to csv file.

The screenshot shows the AE Pline Table main page with the following interface elements:

- NVRAM Control:** Buttons for **Read**, **Apply**, and **Save**.
- Mapping Table:** A dropdown menu with options **Mapping Table** (selected) and **Table Detail** (highlighted with a red box and labeled **d**).
- Tuning Control:** Checkboxes for **Skip preview flicker**, **Skip common multiple flicker**, and **Skip odd exp line**. Below these are buttons for **Import** (highlighted with a red box and labeled **e**) and **Export** (highlighted with a red box and labeled **f**).
- AE Mapping Table:** A table with columns for **AE Scene** and **AE Table**. The table rows are:
 - AE_SCENE_AUTO**: **AETABLE_PREVIEW_AUTO** (highlighted with a red box and labeled **a**)
 - AE_SCENE_NIGHT**: **AETABLE_PREVIEW_AUTO**
 - AE_SCENE_ACTION**: **AETABLE_PREVIEW_AUTO**
 - AE_SCENE_BEACH**: **AETABLE_PREVIEW_AUTO**
 - AE_SCENE_CANDLELIGHT**: **AETABLE_PREVIEW_AUTO**
 - AE_SCENE_FIREWORKS**: **AETABLE_PREVIEW_AUTO**

Table Mapping

➤ Update Scene mapping

- Select sensor mode you want to update.
- Click combo box which is mapping to a scene you want to change. Then select the table name.

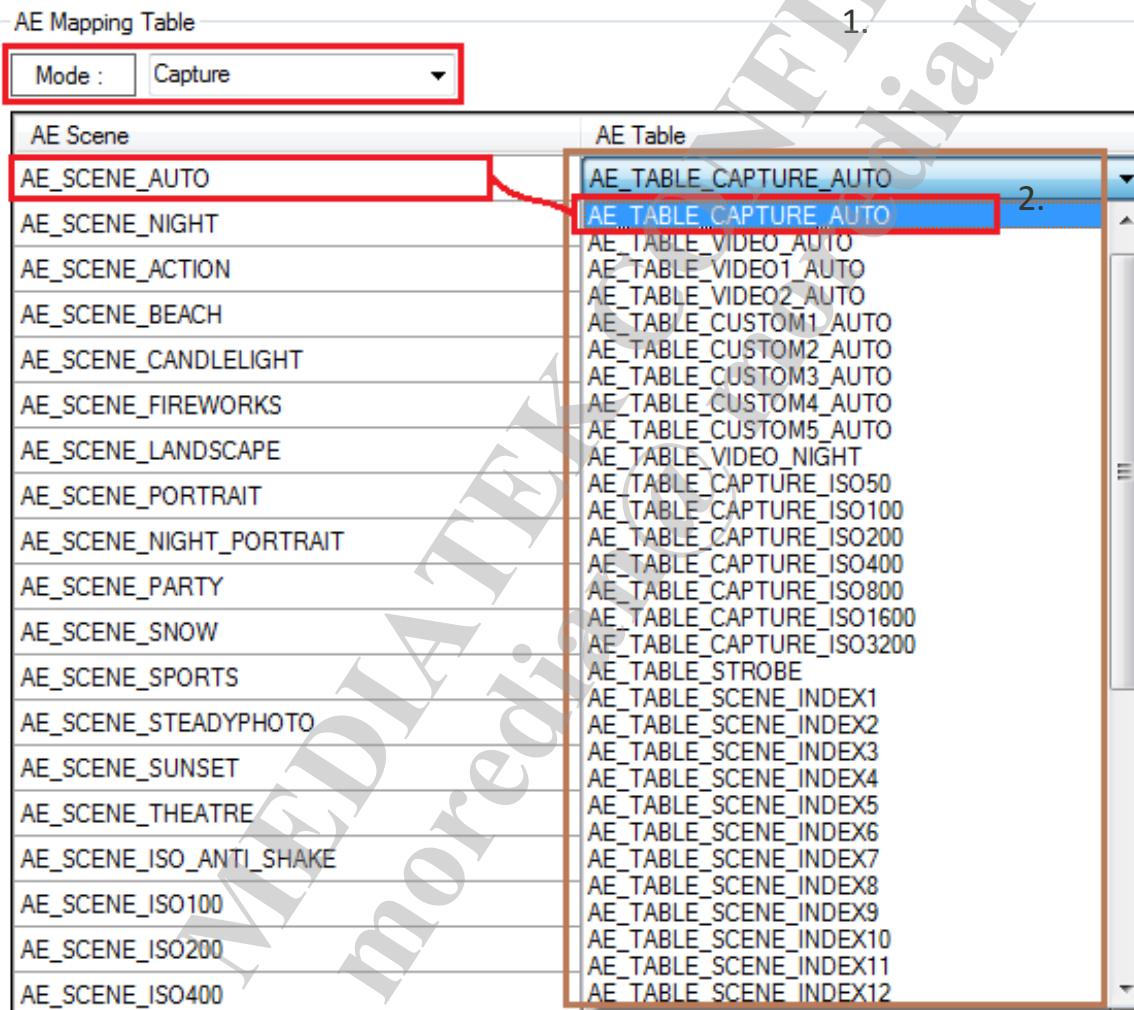
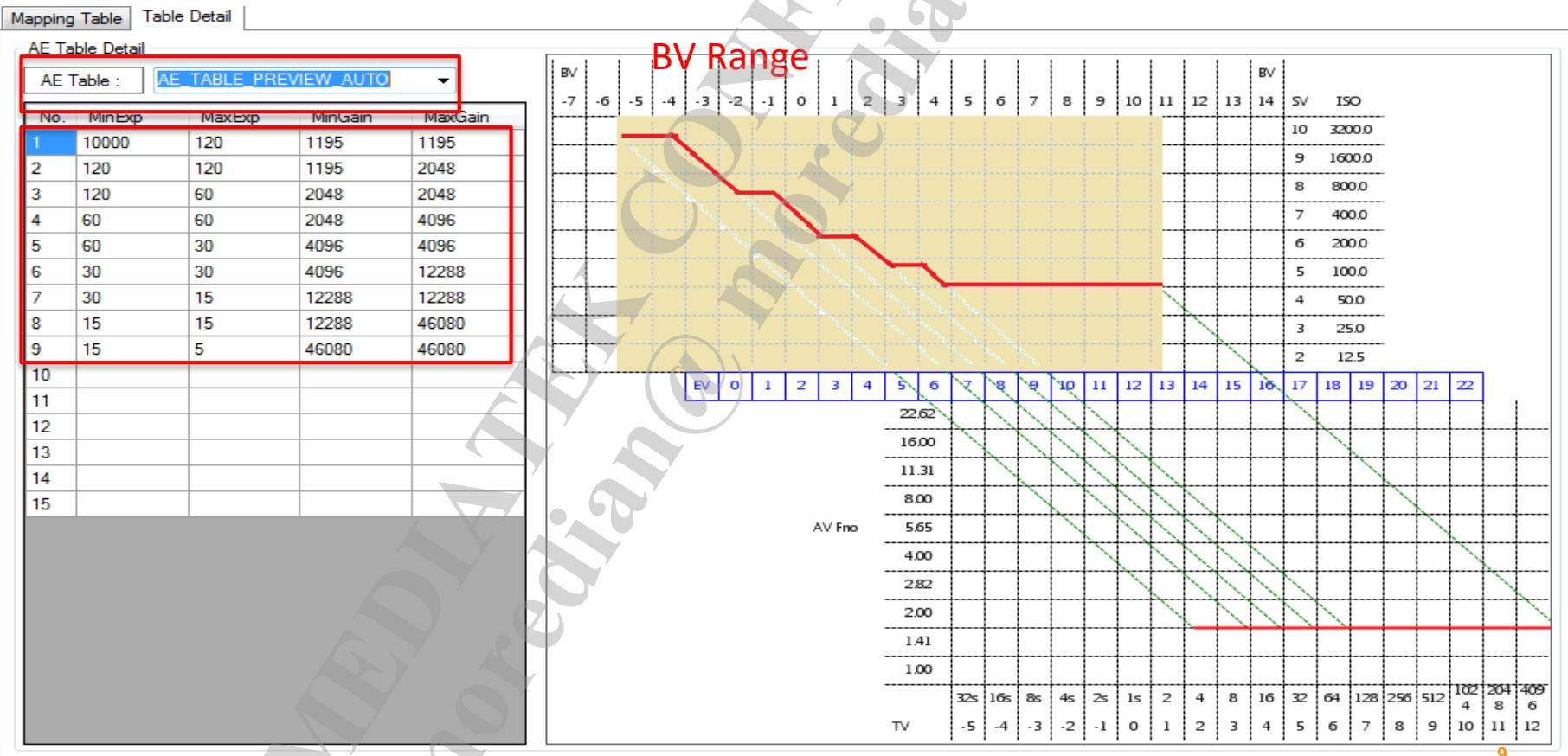


Table Mapping

➤ Update Table detail

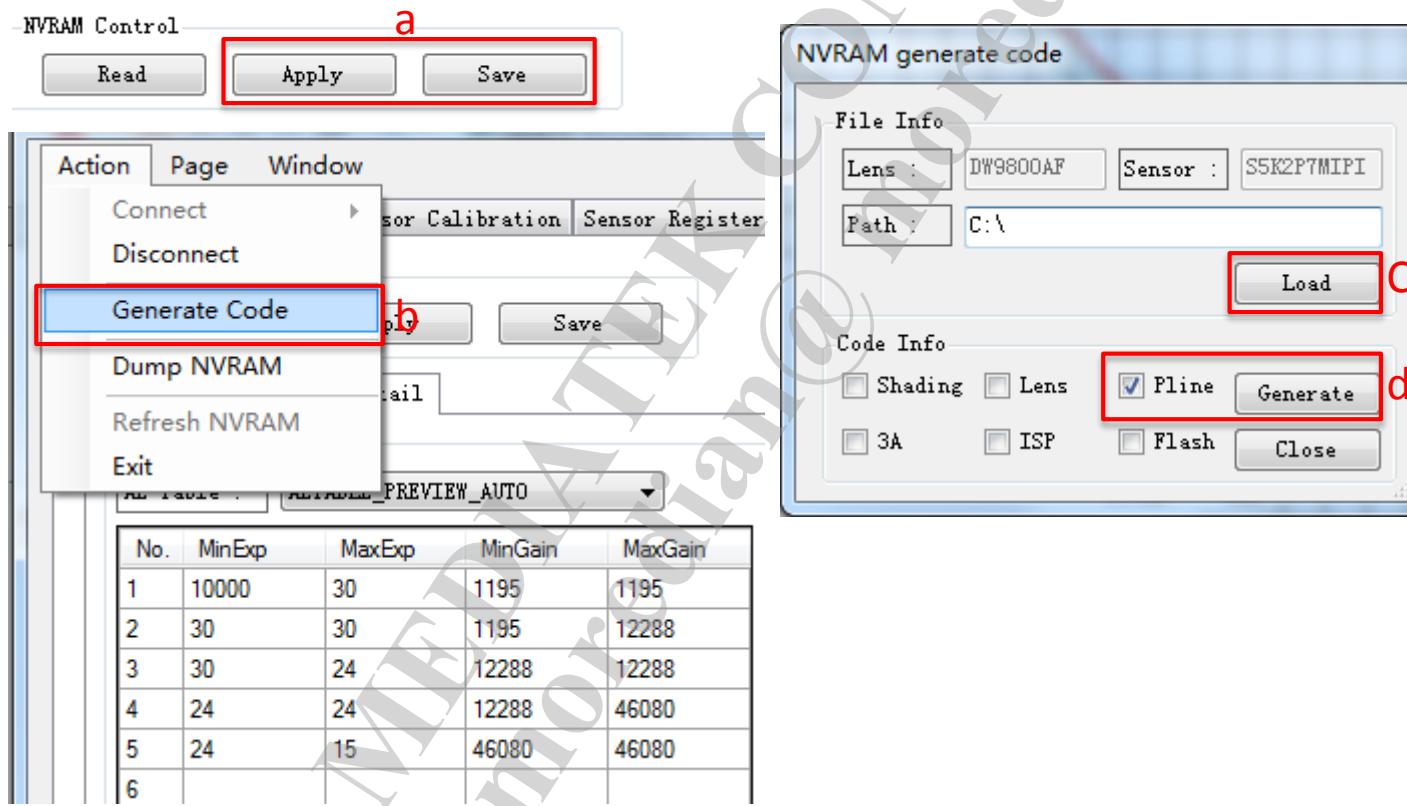
- Select a table from AE Table. Then right side will show the Pline chart automatically.
- Modify the table exposure information and Pline chart also updated after change value.



Generate Code

➤ Save nram and generate Pline

- Apply and save.
- Select Action/Generate Code.
- Load save path
- Select Pline, Generate



Generate Code

➤ Parameter file

- /vendor MEDIATEK/proprietary/custom/[Platform]/hal/imgsensor/ver1/xxx_mipi_raw/camera_AE_PLineTable_xxxmipiraw.h

```
#ifndef _CAMERA_AE_PLINETABLE_IMX386MIPIRAW_H
#define _CAMERA_AE_PLINETABLE_IMX386MIPIRAW_H

#include <custom/aaa/AEplinetable.h>

static strEvPline sPreviewPLineTable_60Hz =
{
{
    {93, 1088, 1032, 0, 0, 0}, //TV = 13.39(5 lines) AV=2.00 SV=5.10 BV=10.29
    {93, 1152, 1032, 0, 0, 0}, //TV = 13.39(5 lines) AV=2.00 SV=5.18 BV=10.21
    {111, 1056, 1024, 0, 0, 0}, //TV = 13.14(6 lines) AV=2.00 SV=5.04 BV=10.09
    {111, 1120, 1032, 0, 0, 0}, //TV = 13.14(6 lines) AV=2.00 SV=5.14 BV=10.00
    {129, 1024, 1040, 0, 0, 0}, //TV = 12.92(7 lines) AV=2.00 SV=5.02 BV=9.90
    {129, 1120, 1032, 0, 0, 0}, //TV = 12.92(7 lines) AV=2.00 SV=5.14 BV=9.78
    {148, 1056, 1024, 0, 0, 0}, //TV = 12.72(8 lines) AV=2.00 SV=5.04 BV=9.68
    {166, 1024, 1024, 0, 0, 0}, //TV = 12.56(9 lines) AV=2.00 SV=5.00 BV=9.56
    {166, 1056, 1024, 0, 0, 0}, //TV = 12.56(9 lines) AV=2.00 SV=5.04 BV=9.51
    {185, 1024, 1032, 0, 0, 0}, //TV = 12.40(10 lines) AV=2.00 SV=5.01 BV=9.39
    {185, 1088, 1032, 0, 0, 0}, //TV = 12.40(10 lines) AV=2.00 SV=5.10 BV=9.30
    {203, 1056, 1032, 0, 0, 0}, //TV = 12.27(11 lines) AV=2.00 SV=5.06 BV=9.21
    {221, 1040, 1032, 0, 0, 0}, //TV = 12.14(12 lines) AV=2.00 SV=5.03 BV=9.11
    {240, 1024, 1040, 0, 0, 0}, //TV = 12.02(13 lines) AV=2.00 SV=5.02 BV=9.00
    {258, 1024, 1032, 0, 0, 0}, //TV = 11.92(14 lines) AV=2.00 SV=5.01 BV=8.91
    {277, 1024, 1032, 0, 0, 0}, //TV = 11.82(15 lines) AV=2.00 SV=5.01 BV=8.81
    {295, 1024, 1040, 0, 0, 0}, //TV = 11.73(16 lines) AV=2.00 SV=5.02 BV=8.70
}
```

Debug

Test Setup:

Low light scene.

Test Procedure:

Step1.

Open AE log: adb shell setprop debug.ae.enable 9

Enter preview mode.

Step2.

Switch to video preview or recording, capture.

Step3.

Confirm max shutter and gain fulfill demand.

Step4.

If the shutter/gain not satisfy requirement, please send mtklog for MTK.

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Flare/Target/EV Calibration

- AE calibration page
 - a) Pline initial index
 - b) Target mean
 - c) Mode tuning
 - d) EV calibration
 - e) Flare calibration

The screenshot shows the 'NVRAM Control' interface with the following sections:

- NVRAM Control:** Buttons for 'Read', 'Apply', and 'Save'.
- AE metering:** A group of controls:
 - a**: Pline initial idx :
 - b**: Target mean :
 - c**: Checkboxes for Histogram Stretch, Back Light, Anti-over Exposure, and Night Mode.
- EV Calibration:** A group of controls:
 - d**: Target EV :
 - d**: EV offset :
 - d**: Calibration button.
- Fixed Flare:** A group of controls:
 - e**: Flare threshold :
 - e**: Flare offset :
 - e**: Calibration button.

Flare/Target/EV Calibration

➤ Flare Offset Tuning

- Modify “threshold”, deduct histogram dark area percentage, 1 mean 0.1%.
- Click “Calibration”.
- Calculate flare offset.

NVRAM Control

Read Apply Save

AE metering

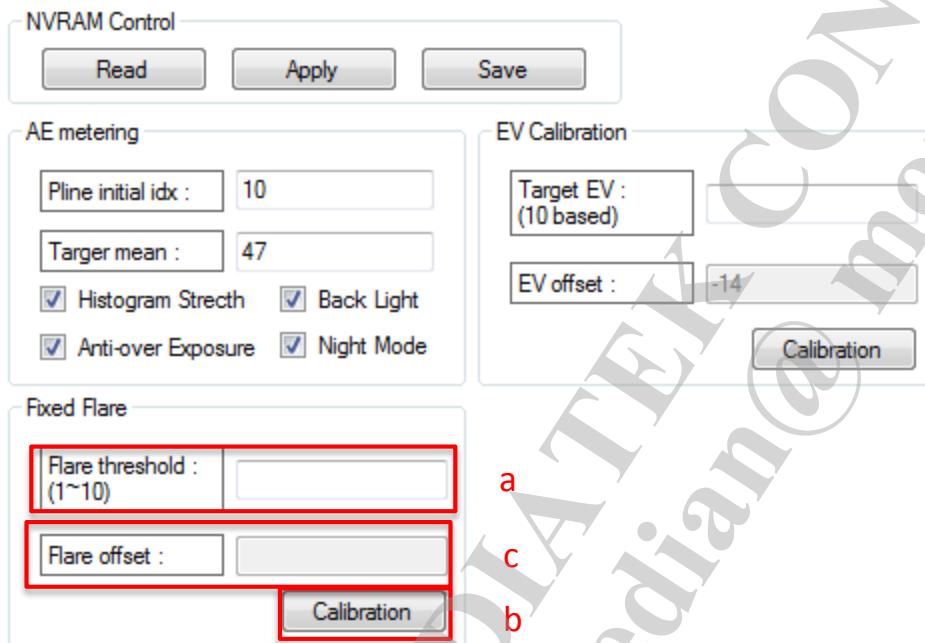
Pline initial idx : 10
Targer mean : 47
 Histogram Strech Back Light
 Anti-over Exposure Night Mode

EV Calibration

Target EV : (10 based)
EV offset : -14
Calibration

Fixed Flare

Flare threshold : (1~10) a
Flare offset : c
Calibration b



Flare/Target/EV Calibration

➤ Flare Offset Tuning

- a) Flare threshold=1 vs =10:

Normal AE Dualcam AE

AE metering

Pline initial : 70

Target mean : 47

Histogram Stretch Back Light

Anti-over Exposure Night Mode

Fixed Flare

Flare threshold : 1

Flare offset : 64

Calibration

Normal AE Dualcam AE

AE metering

Pline initial : 70

Target mean : 47

Histogram Stretch Back Light

Anti-over Exposure Night Mode

Fixed Flare

Flare threshold : 10

Flare offset : 80

Calibration

Offset=64



Offset=80



Flare/Target/EV Calibration

- Flare Offset Tuning
 - b) Recommended initial value:

```
64,           // u4PreviewFlareOffset
64,           // u4CaptureFlareOffset
10,           // u4CaptureFlareThres
64,           // u4VideoFlareOffset
10,           // u4VideoFlareThres
64,           // u4CustomFlareOffset
10,           // u4CustomFlareThres
64,           // u4StrobeFlareOffset //12 bit
3,            // u4StrobeFlareThres // 0.5%
16,           // u4PrvMaxFlareThres //12 bit
0,            // u4PrvMinFlareThres
16,           // u4VideoMaxFlareThres // 12 bit
0,            // u4VideoMinFlareThres
```

Flare/Target/EV Calibration

➤ AE Target Tuning

- Modify “Target mean”
- Click “Apply”
- Click “Save”

NVRAM Control

b c

Read **Apply** **Save**

AE metering

a

Pline initial idx : 10

Targer mean : **47**

Histogram Strech Back Light

Anti-over Exposure Night Mode

EV Calibration

Target EV : (10 based)

EV offset : -14

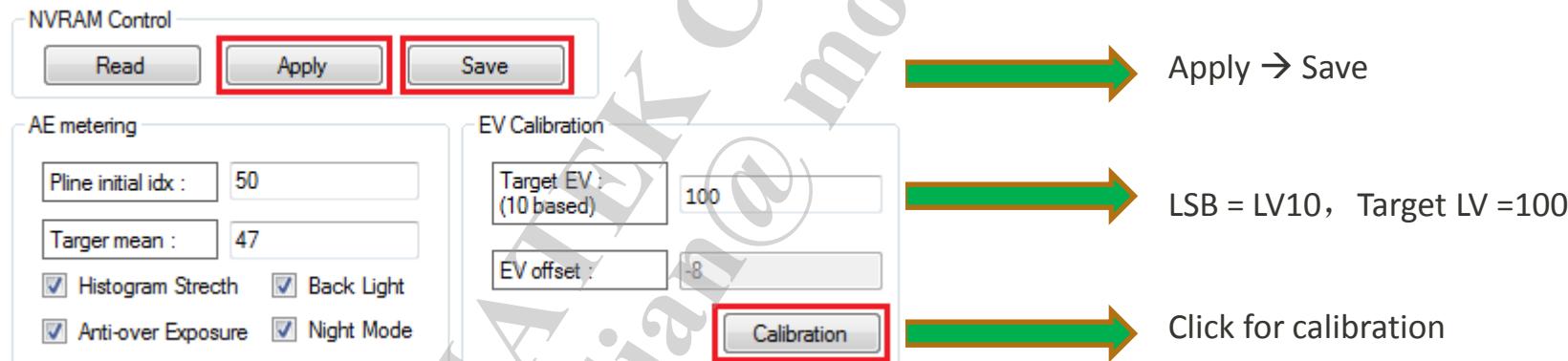
Calibration



Flare/Target/EV Calibration

➤ EV offset (AE calibration page)

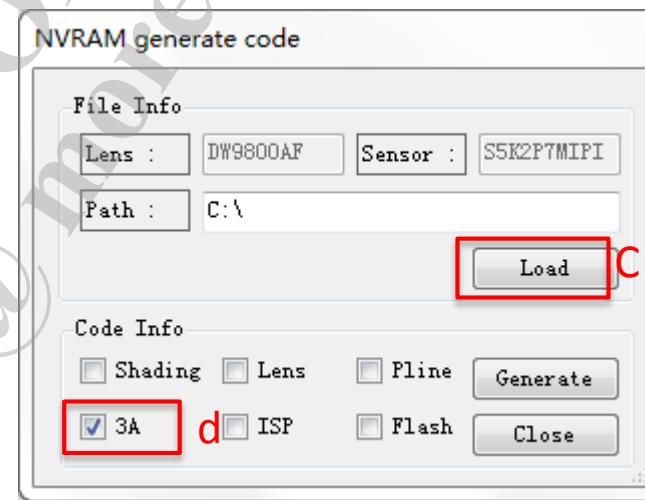
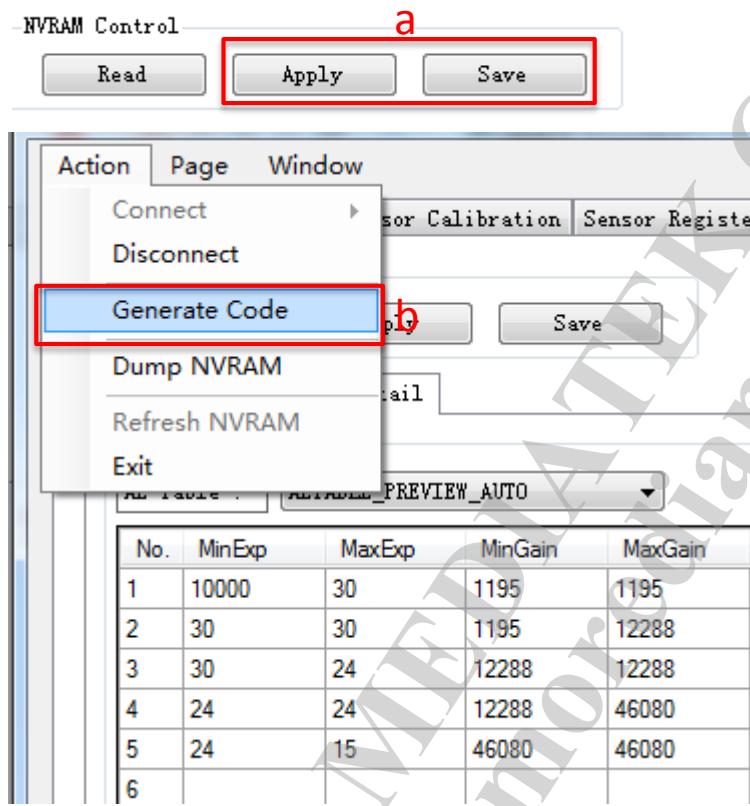
- a) Set LSB to LV10
- b) Fill 100 into “Target EV” field
- c) Click “Calibration”
- d) Apply to NVRAM
- e) Save to NVRAM



Generate Code

➤ Generate 3A code

- Apply and save.
- Select Action/Generate Code.
- Load save path
- Select “3A”, Generate



Generate Code

➤ Parameter file

- /vendor/mediatek/proprietary/custom/[Platform]/hal/imgsensor/ver1/xxx_mipi_raw/AE_Tuning_Para/
 - camera_ae_tuning_para_cap_imx386mipiraw.cpp
 - camera_ae_tuning_para_pv_imx386mipiraw.cpp
 - camera_ae_tuning_para_vdo_imx386mipiraw.cpp
 - camera_ae_tuning_para_cus1_imx386mipiraw.cpp
 - camera_ae_tuning_para_cus2_imx386mipiraw.cpp
 - camera_ae_tuning_para_cus3_imx386mipiraw.cpp
 - camera_ae_tuning_para_cus4_imx386mipiraw.cpp

Debug

➤ Validation flow

A. Setup a LSB machine



- Configure LSB machine to LV9 and capture JPG. Check EXIF parser tag “AE_TAG_LV” is close to 90 or not.
- Criterion: 90 ± 2

B. Select the AE page is the debug parser tool

AE	AF	AWB	AWBv	Strobe	Flicker	ISP	AF Table Gen	EIS	CMN	MF	N3D	SENSOR	RESVA	SHAD	SHADv	ColorSHAD	Multi Files
													AE_TAG_CAP_SHUTTER_TIME	33330			

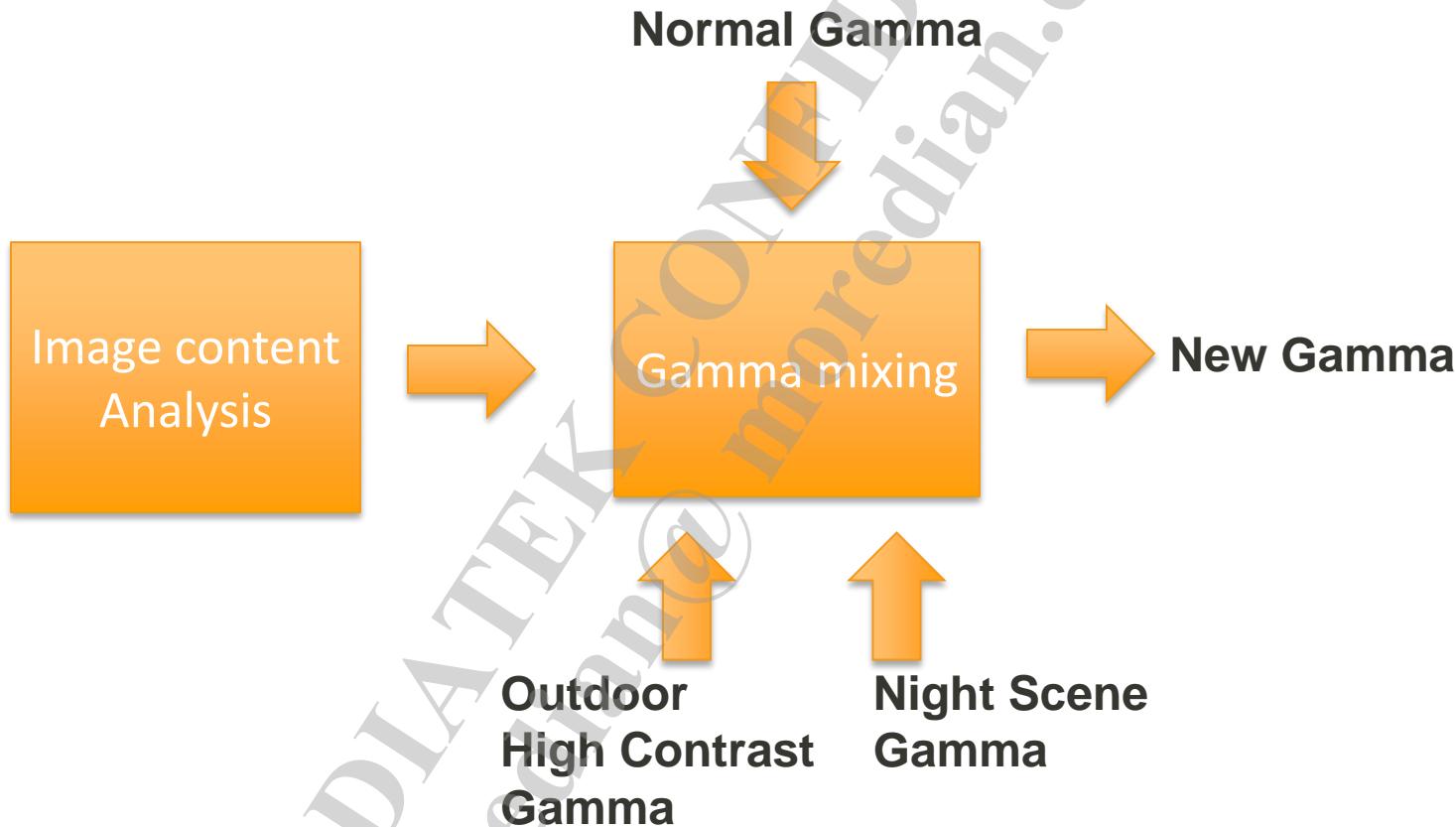
C. Check the value of AE_TAG_LV that close 90 ± 2 or not.

AE_TAG_PRV_AETABLE_ID	0
AE_TAG_CAP_AETABLE_ID	1
AE_TAG_LV	90
AE_TAG_REALBV	40
AE_TAG_REALBVX1000	4084
AE_TAG_COMPBV	40

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Dynamic Gamma tune



Dynamic Gamma tune

➤ Normal gamma

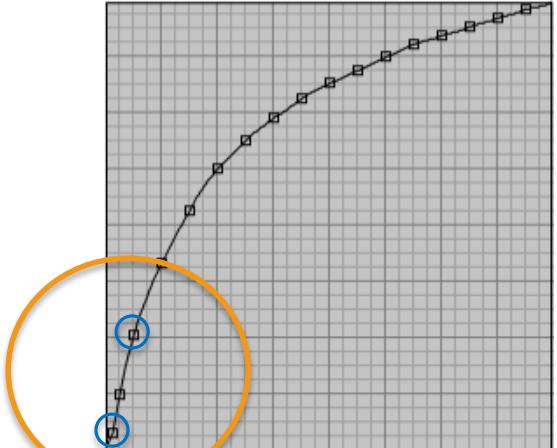
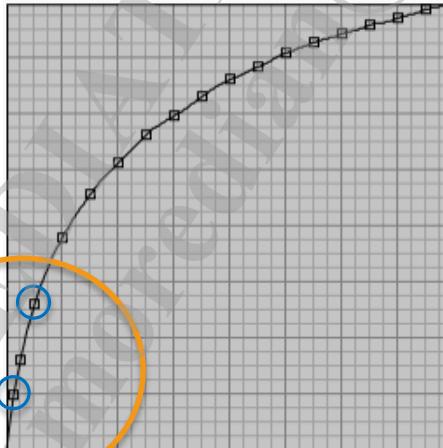
- Make sure AE is close to the target phone.
- Adjust gamma weight table make sure Lab Scene complete use normal gamma. Normal gamma should satisfy Q14 objective standard.



Dynamic Gamma tune

➤ Outdoor gamma

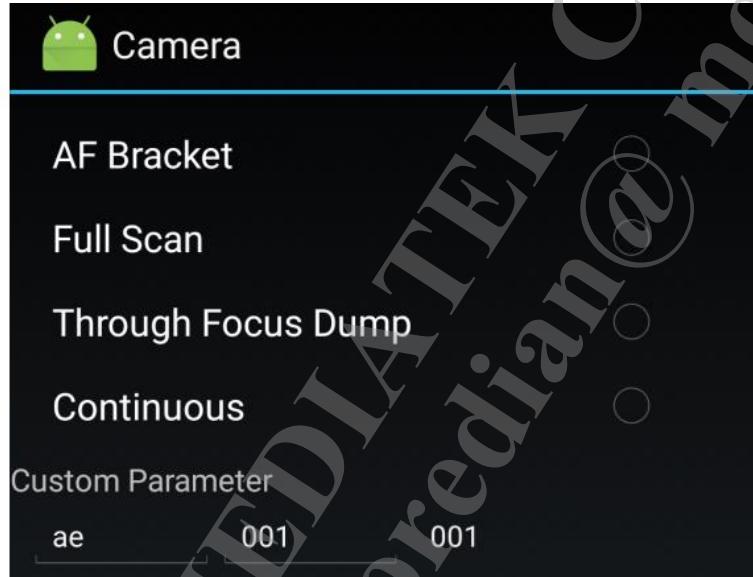
- Bypass LCE and adjust outdoor gamma make sure the DT dark enough.



Dynamic Gamma tune

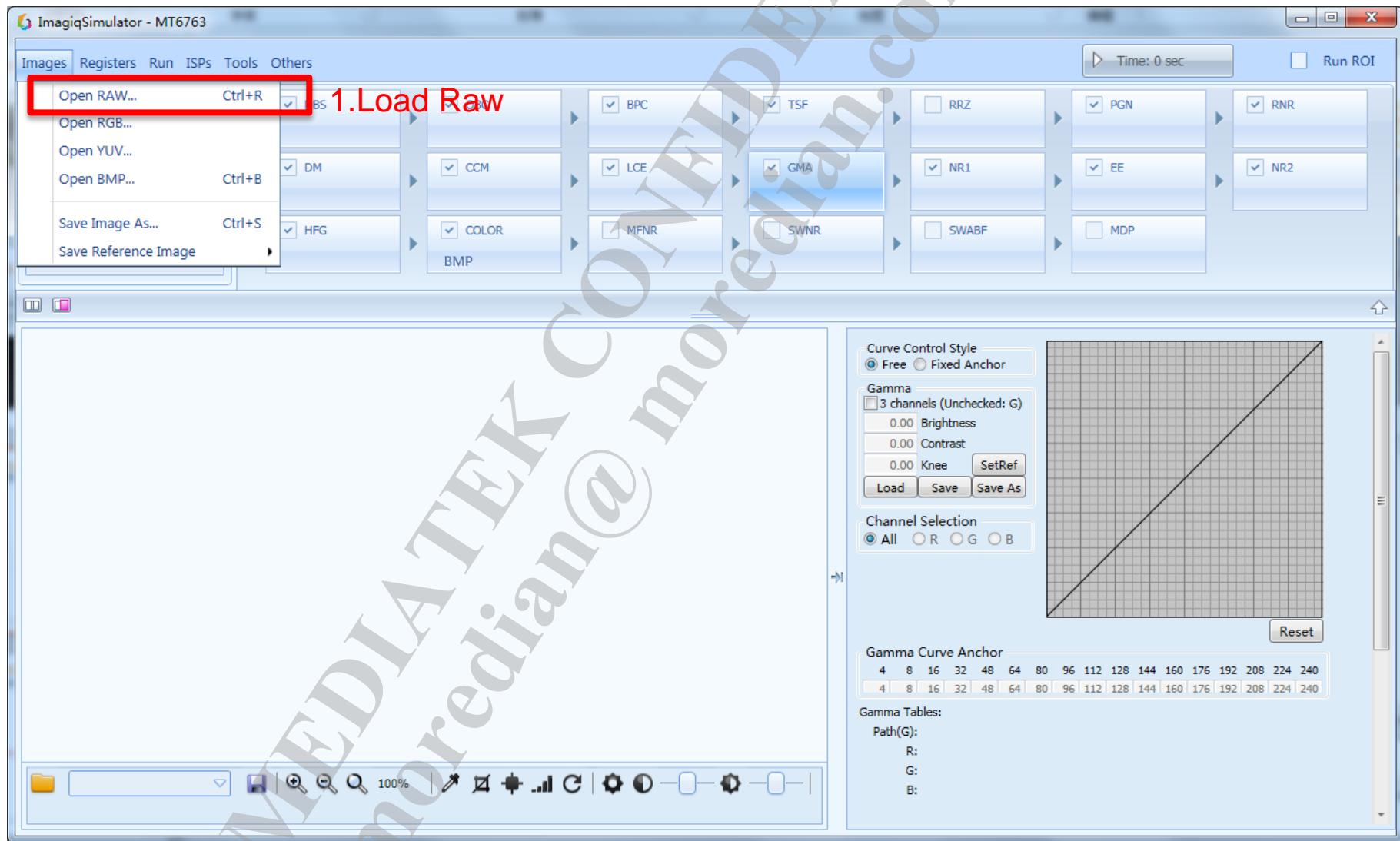
➤ Night gamma

- Select a representative scene take +/-1 EV pictures, choose a photo as the candidate which bright tone is clear.
- Brighten the DT area use isp simulator through adjusting gamma, the gamma can be used for Night scenes.
- Input “ae 001 001” in custom parameter, we take 41 raw data by interval is 0.1EV(-2EV ~ +2EV) in EM.



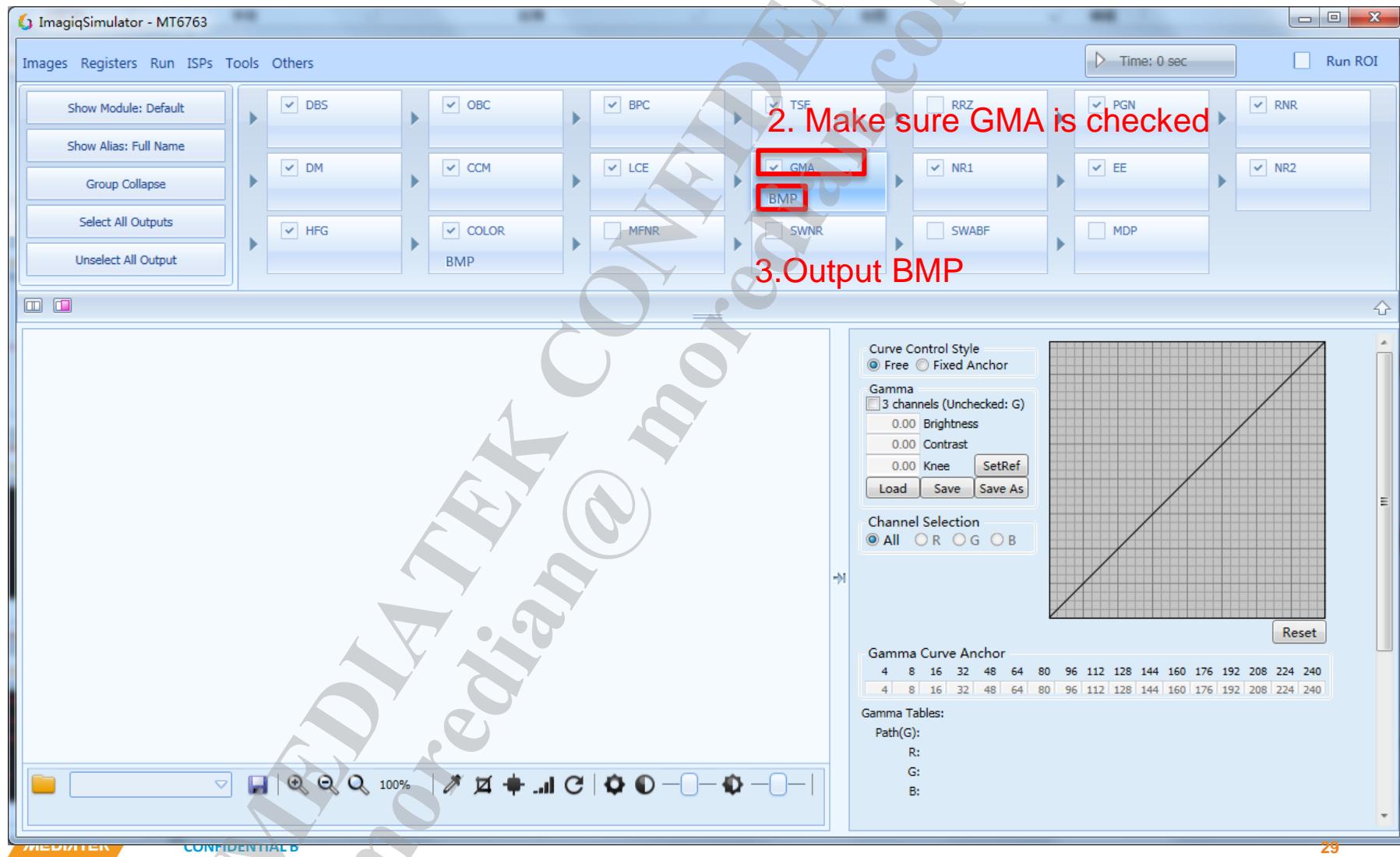
Tune gamma by ImageiqSimulator

➤ Simulation Gamma



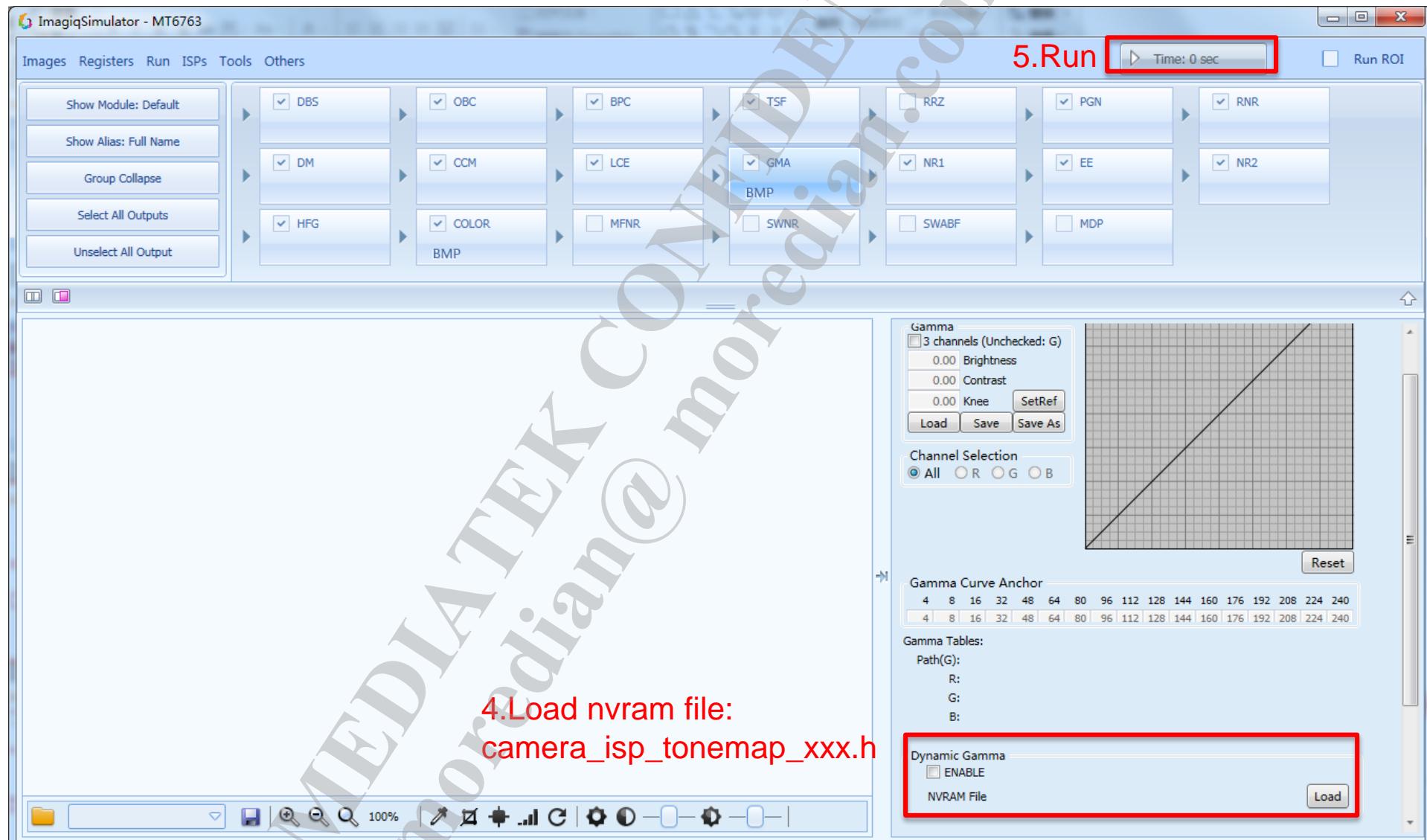
Tune gamma by ImageiqSimulator

➤ Simulation Gamma



Tune gamma by ImageiqSimulator

➤ Simulation Gamma



4.Load nvram file:
camera_isp_tonemap_xxx.h

Tune gamma by ImageiqSimulator

- In simulator folder output **JPEG_Name_dynamic_gamma_dbg_info.txt** after simulation.

```
1 ----- GM Chip/Main/Sub/System Version:6755 3 5 1 -----
2 /-C:\Simulate_GGM\Capture20150103-003547ISOAutopure_4208x3120_10_2.raw -/
3 ----- EXIF -----
4 CAM_GMA_GMAMode: = 2
5 CAM_GMA_SensorMode: = 1
6 CAM_GMA_ChipVersion: = 6755
7 CAM_GMA_MainVersion: = 3
8 CAM_GMA_SubVersion: = 5
9 CAM_GMA_SystemVersion: = 1
10 CAM_GMA_EVRatio: = 1024
11 CAM_GMA_LowContrastThr: = 8
12 CAM_GMA_LowContrastRatio: = 80
13 CAM_GMA_LowContrastSeg: = 3
14 CAM_GMA_Contrast: = 24
15 CAM_GMA_Contrast_L: = 2
16 CAM_GMA_Contrast_H: = 3
17 CAM_GMA_HdrContrastWeight: = 48
18 CAM_GMA_EVContrastY: = 310
19 CAM_GMA_ContrastY_L: = 10
20 CAM_GMA_ContrastY_H: = 10
21 CAM_GMA_NightContrastWeight: = 0
22 CAM_GMA_LV: = 115
23 CAM_GMA_LV_L: = 11
24 CAM_GMA_LV_H: = 12
25 CAM_GMA_HdrLVWeight: = 95
26 CAM_GMA_NightLVWeight: = 0
27 CAM_GMA_SmoothEnable: = 0
28 CAM_GMA_SmoothSpeed: = 4
29 CAM_GMA_SmoothWaitAE: = 1
30 CAM_GMA_GMACurveEnable: = 0
31 CAM_GMA_CenterPt: = 1024
32 CAM_GMA_LowCurve: = 450
33 CAM_GMA_SlopeL: = 100
34 CAM_GMA_FlareEnable: = 0
```

6. Version information

7. Contrast/LV value and corresponding weighting

Tune gamma by ImageiqSimulator

- In simulator folder output **JPEG_Name_dynamic_gamma_dbg_info.txt** after simulation.

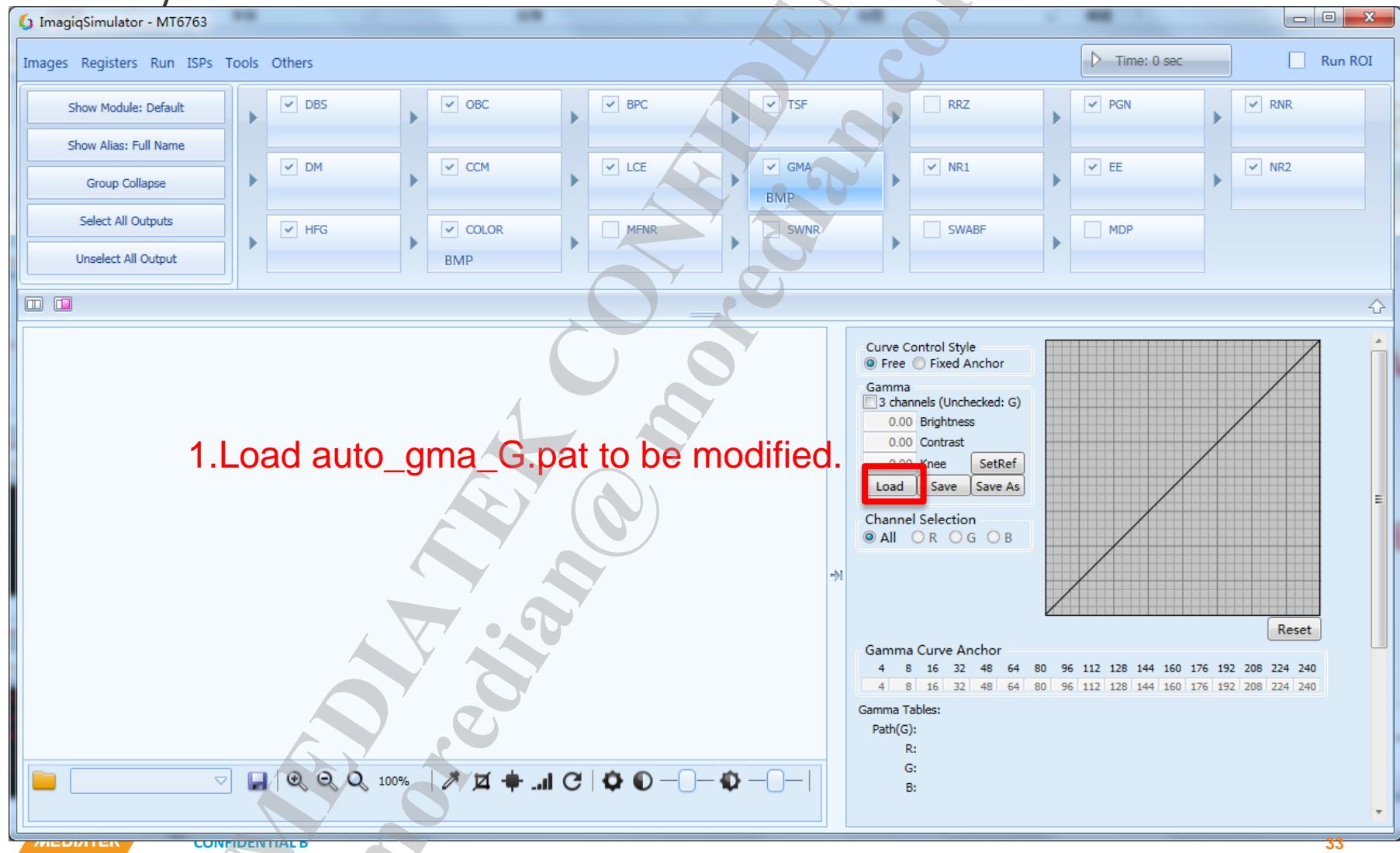
```
36 /----- GAMMA -----/
37 [0] 0 0 0 0
38 [1] 9 22 22 15
39 [2] 18 44 44 29
40 [3] 27 64 64 44
41 [4] 36 84 84 58
42 [5] 46 106 106 74
43 [6] 56 128 128 89
44 [7] 66 142 142 100
45 [8] 76 156 156 112
46 [9] 86 168 168 123
47 [10] 95 180 180 134
48 [11] 105 194 194 146
49 [12] 114 208 208 157
50 [13] 123 220 220 168
51 [14] 131 232 232 177
52 [15] 140 240 240 186
53 [16] 148 248 248 194
54 [17] 156 258 258 203
55 [18] 164 268 268 212
56 [19] 172 276 276 220
57 [20] 180 284 284 228
58 [21] 188 292 292 236
59 [22] 195 300 300 243
60 [23] 202 310 310 251
61 [24] 210 320 320 260
62 [25] 217 328 328 267
63 [26] 224 336 336 275
64 [27] 231 344 344 282
65 [28] 238 352 352 290
66 [29] 244 360 360 297
67 [30] 251 368 368 304
68 [31] 258 376 376 312
69 [32] 264 384 384 319
```

8. Gamma table: from left to right are base, outdoor, night and final.

9. Simulation result: folder/result/JPEG_Name__GGM_A.bmp

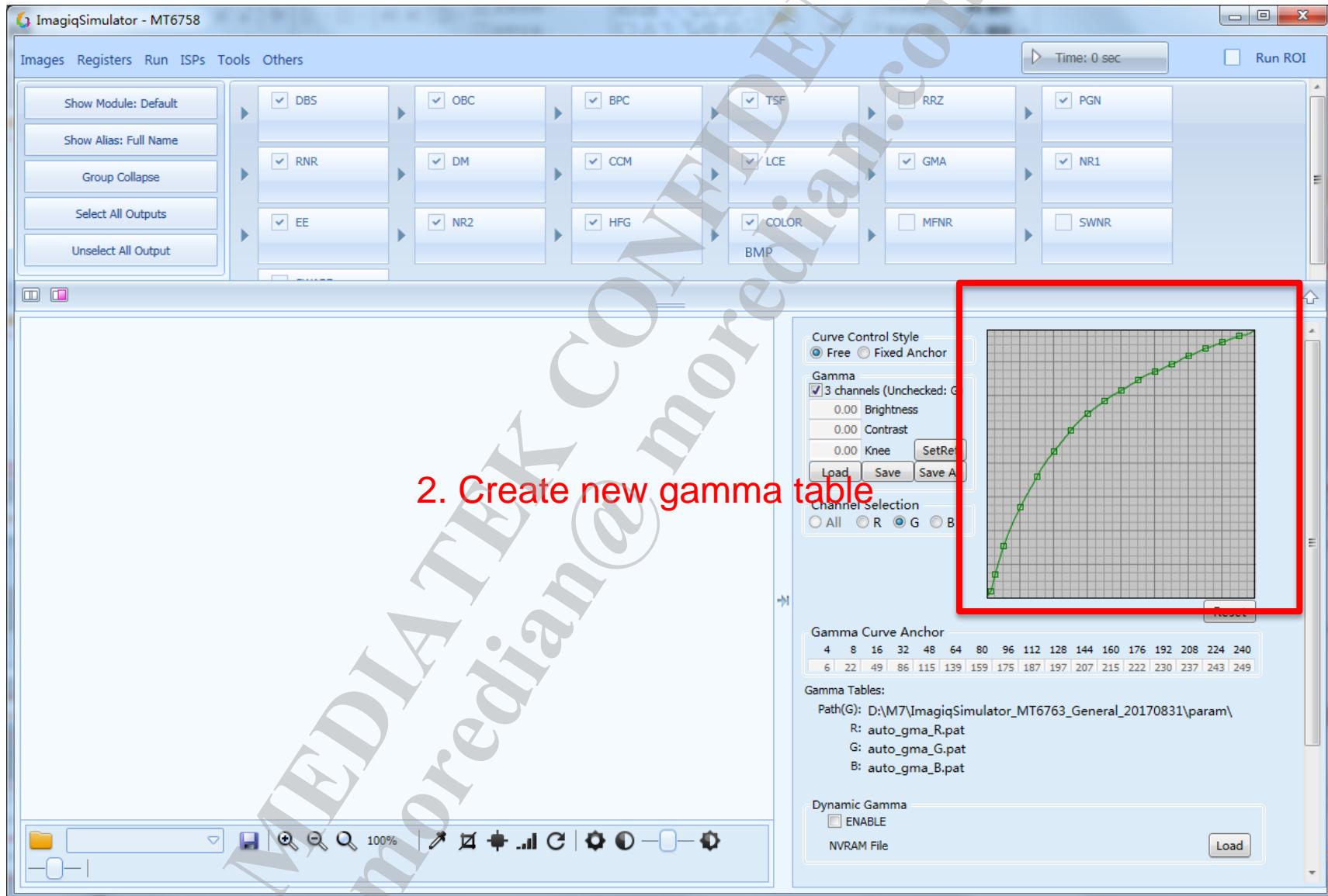
Tune gamma by ImageiqSimulator

➤ Modify Gamma



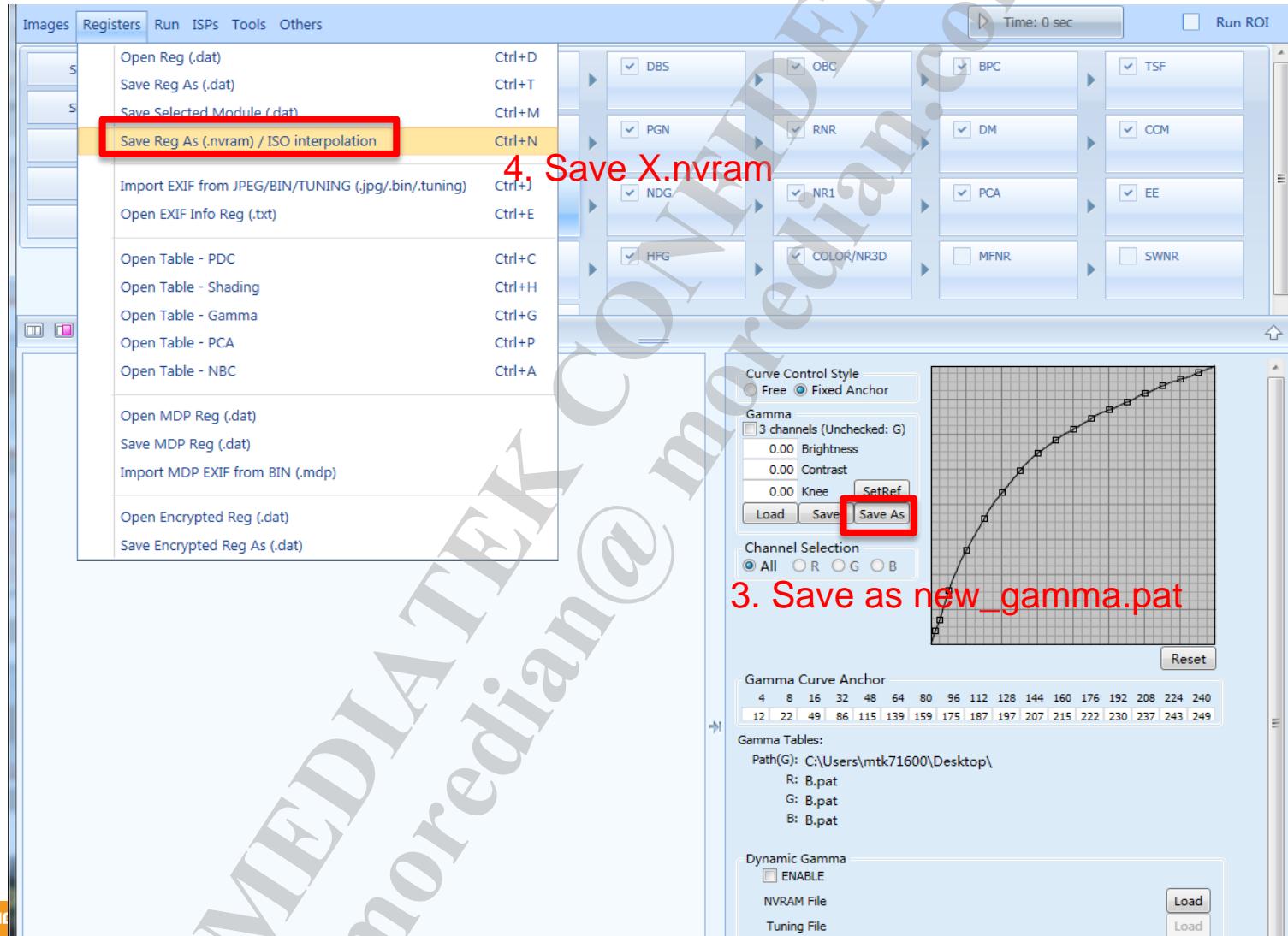
Tune gamma by ImageiqSimulator

➤ Modify Gamma



Tune gamma by ImageiqSimulator

➤ Modify Gamma



Tune gamma by ImageiqSimulator

4.Copy x.nvram [GGM] to reg file

```
[GGM]
{
lut_rb:{set:{

0x00001000, 0x00041004, 0x00080808, 0x000A080A, 0x000C100C, 0x00101010, 0x00140814, 0x00160816, 0x00182018, 0x00202020,
0x00282028, 0x00302030, 0x00382038, 0x00402040, 0x00482048, 0x00502050, 0x00582058, 0x00602060, 0x00681868, 0x006E186E,
0x00742074, 0x007C207C, 0x00841884, 0x008A188A, 0x00901890, 0x00961896, 0x009C209C, 0x00A420A4, 0x00AC18AC, 0x00B218B2,
0x00B818B8, 0x00BE18BE, 0x00C418CA, 0x00CA18CA, 0x00D010D0, 0x00D410D4, 0x00D818D8, 0x00DE18DE, 0x00E418E4, 0x00EA18EA,
0x00F010F0, 0x00F410F4, 0x00FE81F8, 0x00FE18FE, 0x01041104, 0x01081108, 0x010C110C, 0x01101110, 0x01141914, 0x011A191A,
0x01201120, 0x01241124, 0x01281128, 0x012C112C, 0x01301130, 0x01341134, 0x01381138, 0x013C113C, 0x01401140, 0x01441144,
0x01481148, 0x014C114C, 0x01501150, 0x01541154, 0x01582158, 0x01602160, 0x01682168, 0x01702170, 0x01782178, 0x01802180,
0x01881188, 0x018C218C, 0x01942194, 0x019C219C, 0x01A411A4, 0x01A821A8, 0x01B021B0, 0x01B821B8, 0x01C011C0, 0x01C421C4,
0x01CC21CC, 0x01D421D4, 0x01DC21DC, 0x01E421E4, 0x01EC11EC, 0x01F021F0, 0x01F811F8, 0x01FC21FC, 0x02041204, 0x02082208,
0x02101210, 0x02141214, 0x02181218, 0x021C221C, 0x02241224, 0x02281228, 0x022C322C, 0x02382238, 0x02403240, 0x024C224C,
0x02543254, 0x02602260, 0x02683268, 0x02742274, 0x027C327C, 0x02882288, 0x02902290, 0x02982298, 0x02A022A0, 0x02A822A8,
0x02B012B0, 0x02B422B4, 0x02BC22BC, 0x02C412C4, 0x02C822C8, 0x02D012D0, 0x02D422D4, 0x02DC12DC, 0x02E022E0, 0x02E812E8,
0x02EC12EC, 0x02F022F0, 0x02F812F8, 0x02FC22FC, 0x03041304, 0x03081308, 0x030C130C, 0x03101310, 0x03145314, 0x03285328,
0x033C533C, 0x03503350, 0x035C335C, 0x03684368, 0x03784378, 0x03884388, 0x03983398, 0x03A443A4, 0x03B433B4, 0x03C033C0,
0x03CC33CC, 0x03D433D8, 0x03E423E4, 0x03F04FEC
}}},  

lut_g:{set:{

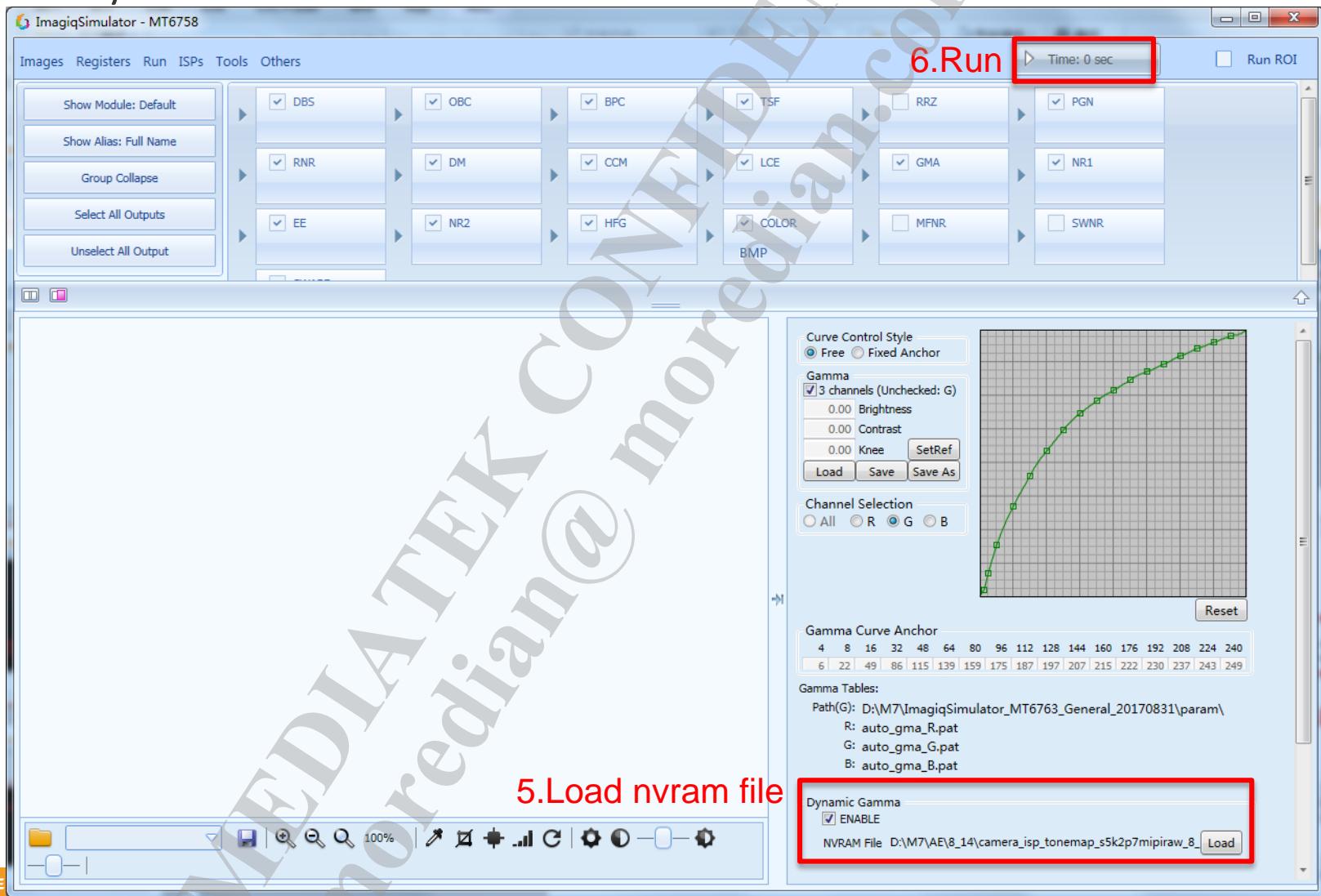
0x00001000, 0x00000104, 0x000000808, 0x00000080A, 0x00000100C, 0x000001010, 0x000000814, 0x000000816, 0x000002018, 0x000002020,
0x000002028, 0x000002030, 0x000002038, 0x000002040, 0x000002048, 0x000002050, 0x000002058, 0x000002060, 0x000001868, 0x00000186E,
0x000002074, 0x00000207C, 0x000001884, 0x00000188A, 0x000001890, 0x000001896, 0x00000209C, 0x0000020A4, 0x0000018AC, 0x0000018B2,
0x0000018B8, 0x0000018BE, 0x0000018C4, 0x0000018CA, 0x0000010D0, 0x0000010D4, 0x0000018D8, 0x0000018DE, 0x0000018E4, 0x0000018EA,
0x0000010F0, 0x0000010F4, 0x0000018F8, 0x0000018FE, 0x000001104, 0x000001108, 0x00000110C, 0x000001110, 0x000001914, 0x00000191A,
0x000001120, 0x000001124, 0x000001128, 0x00000112C, 0x000001130, 0x000001134, 0x000001138, 0x00000113C, 0x000001140, 0x000001144,
0x000001148, 0x00000114C, 0x000001150, 0x000001154, 0x000002158, 0x000002160, 0x000002168, 0x000002170, 0x000002178, 0x000002180,
0x000001188, 0x00000218C, 0x000002194, 0x00000219C, 0x0000011A4, 0x0000021A8, 0x0000021B0, 0x0000021B8, 0x0000011C0, 0x0000021C4,
0x0000021CC, 0x0000021D4, 0x0000021DC, 0x0000021E4, 0x0000011EC, 0x0000021F0, 0x0000011F8, 0x0000021FC, 0x000001204, 0x000002208,
0x000001210, 0x000001214, 0x000001218, 0x00000221C, 0x000001224, 0x000001228, 0x00000322C, 0x000002238, 0x000003240, 0x00000224C,
0x000003254, 0x000002260, 0x000003268, 0x000002274, 0x00000327C, 0x000002288, 0x000002290, 0x000002298, 0x0000022A0, 0x0000022A8,
0x0000012B0, 0x0000022B4, 0x0000022BC, 0x0000012C4, 0x0000022C8, 0x0000012D0, 0x0000022D4, 0x0000012DC, 0x0000022E0, 0x0000012E8,
0x0000012EC, 0x0000022F0, 0x0000012F8, 0x0000022FC, 0x000001304, 0x000001308, 0x00000130C, 0x000001310, 0x000005314, 0x000005328,
0x00000533C, 0x000003350, 0x00000335C, 0x000004368, 0x000004378, 0x000004388, 0x000003398, 0x0000043A4, 0x0000033B4, 0x0000033C0,
0x0000033CC, 0x0000033D8, 0x0000023E4, 0x000004FEC
}}},  

}
```

camera_isp_tonemap_xxx.h

Tune gamma by ImageiqSimulator

➤ Modify Gamma



Debug

- If you consider some issue are caused by gamma, such as Luma noise
 - A. Disable gamma:
adb shell setprop isp.ggm.disable 1
 - B. If work, weaken gamma strength.
 - C. If not work, prepare mtklog and raw data to mtk confirm.

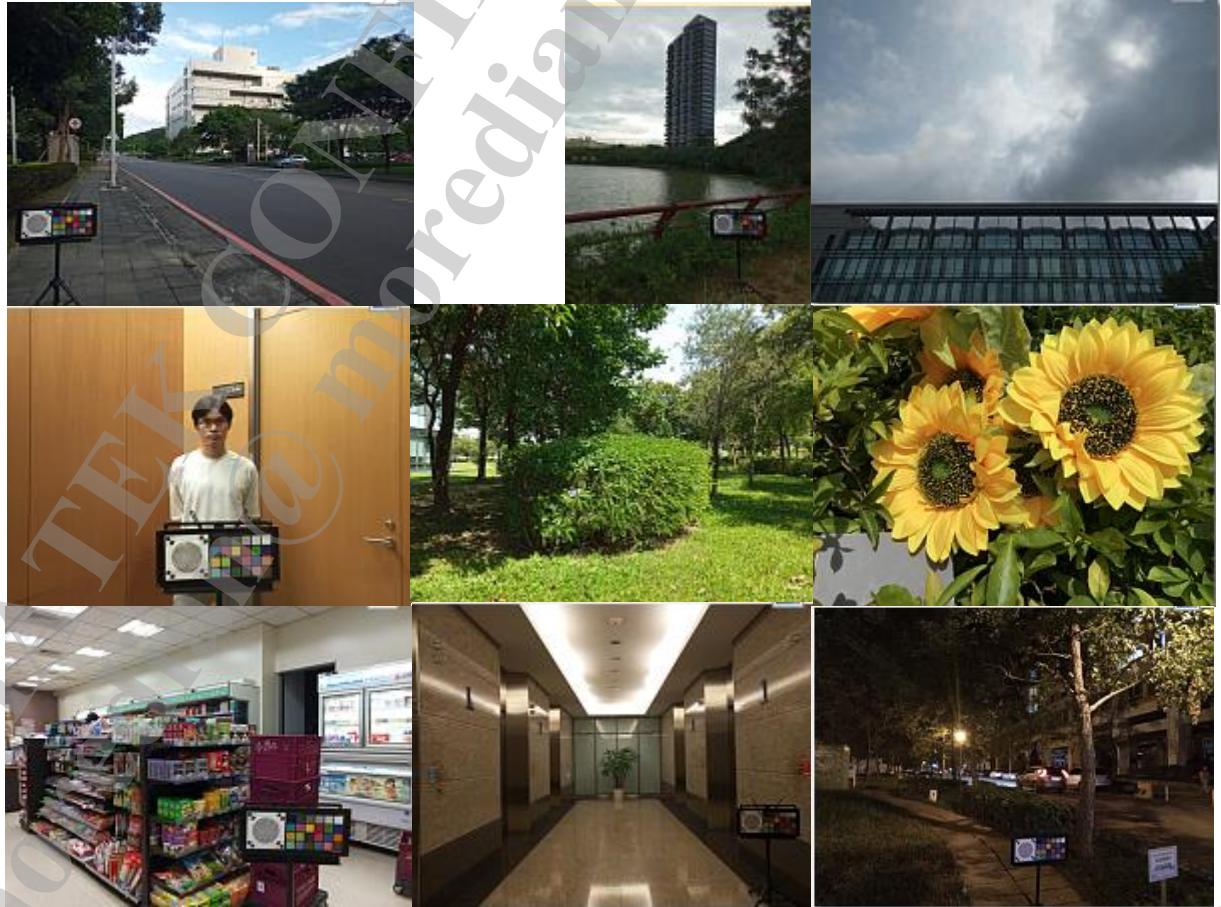
AE Contents

- AE Pline
 - Device Profile
 - Table Mapping
 - Generate code
 - Debug
- Flare/Target/EV calibration
 - Calibration
 - Generate code
 - Debug
- Gamma
 - Dynamic gamma tune
 - Tune gamma by ImageiqSimulator
 - Debug
- AE tuning tool SOP
- LCE
 - LCE theory
 - Tune LCE by ImageiqSimulator
 - LCE debug

Real Scene tune

- Real Scene Database

- The environment should include the following scenarios
 - (1) indoor
 - (2) outdoor
 - (3) Sunny
 - (4) Cloudy
 - (5) Night
 - (6) Face



Old AE Tune Method

- Modify parameters directly, side effects are not easy to predict.
- Low efficiency, maybe need to adjust many times to align target.
- **Now this method has become the past, out of use!!!**

```
{    // TargetBVRatioTbl
-2000,
64,
4000,
66
},           ↓
                    // TargetBVRatioTbl.i4X1 :BV
                    // TargetBVRatioTbl.i4Y1 :Target
// TargetBVRatioTbl.i4X2 :BV
// TargetBVRatioTbl.i4Y2 :Target

static strHSv4p0CFG g_HSv4p0CFG =
{
    TRUE,
    1024,
    5,
    5,
    {1000, 2000, 4000, 8200, 10000}, ,
    {80,    75,    60,    20,    15},
    {1000, 2200, 3500, 5100, 6800},   //
    {
        //BV0-THD
        {125, 135, 148, 162, 175},
        //BV1-THD
        {135, 145, 168, 180, 190},
        //BV2-THD
        {145, 160, 175, 185, 200},
        //BV3-THD
        {155, 165, 180, 192, 210},
        //BV4-THD
        {155, 165, 182, 200, 212}
    },
    ↓
},           CONFIDENTIAL
```

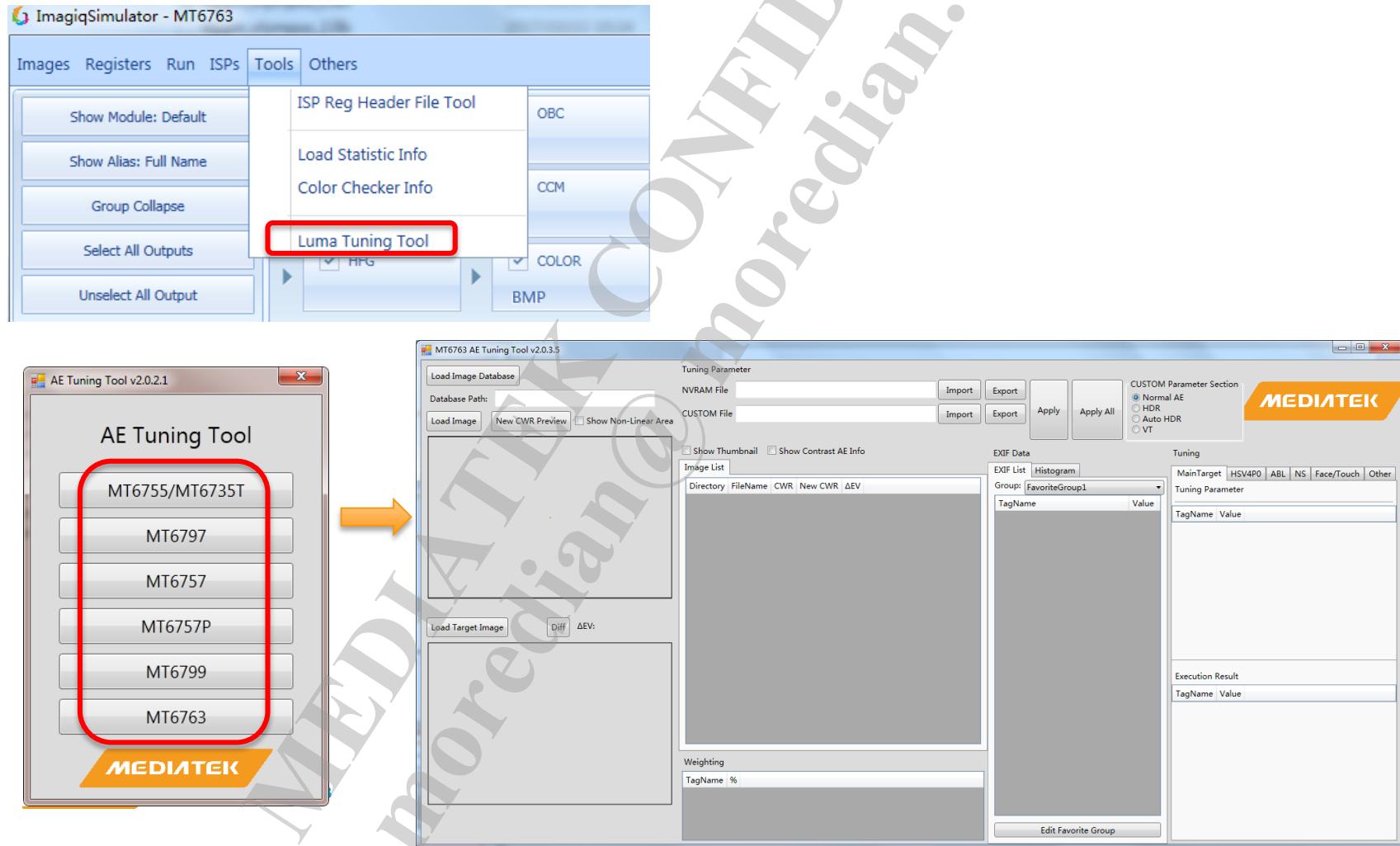


AE Advanced Tuning tool

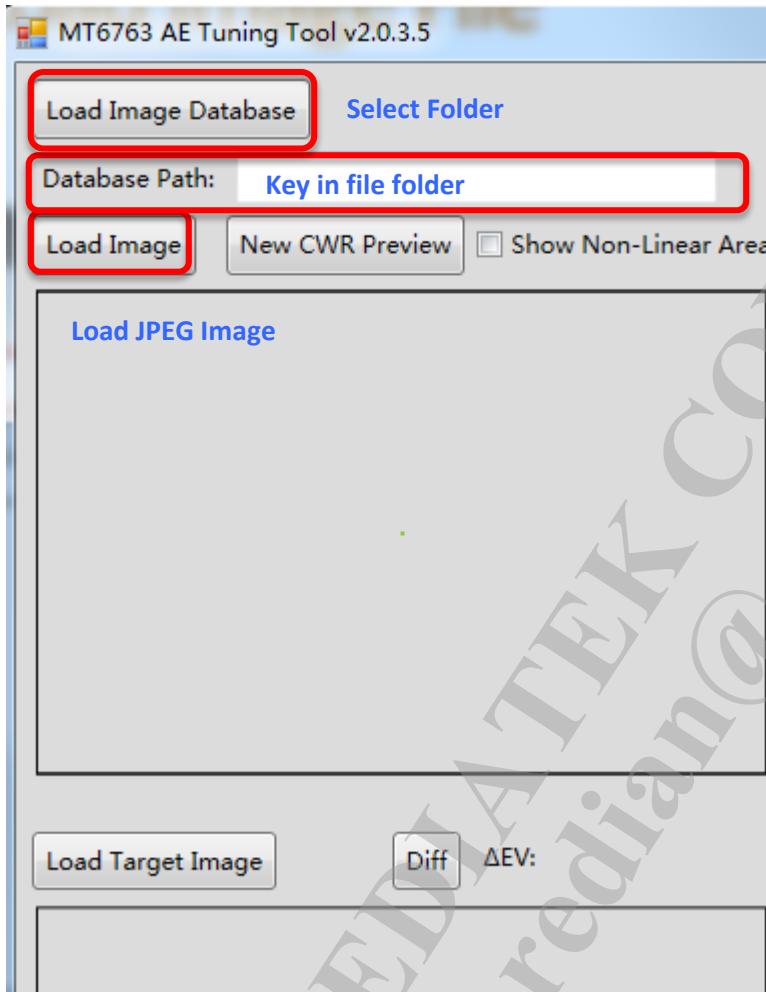
- AE tuning tool can be use for advanced tuning.
 - Histogram.
 - New CWR preview
 - Show Non-Linear Area.
 - Luminance, R, G, B Mean.
 - Selected area EV diff.
 - Show Contrast AE Info.

Startup Screen

- Click on imageiqSimulator “Luma Tuning Tool” can start support projects interface, select project name to enter tuning tool.



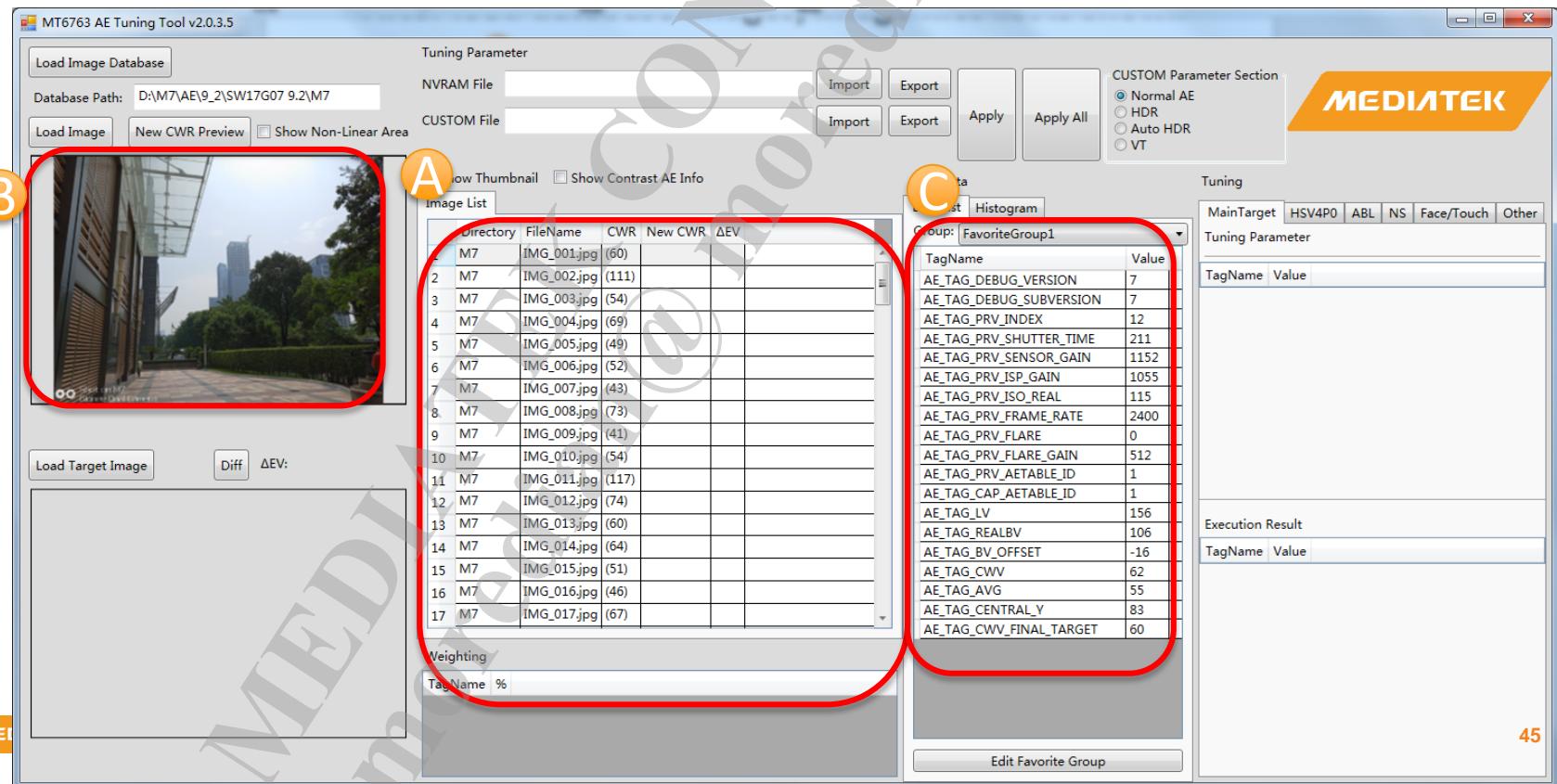
Load Image File



- Load Image Database – User can load a list of images by click the “Load Image Database” button, a dialog will shown to let user select the image files folder.
- Database Path – This textbox will show the folder path which the user select. User can also can direct key in the folder path to load the image database.
- Load Image – For loading single image only.

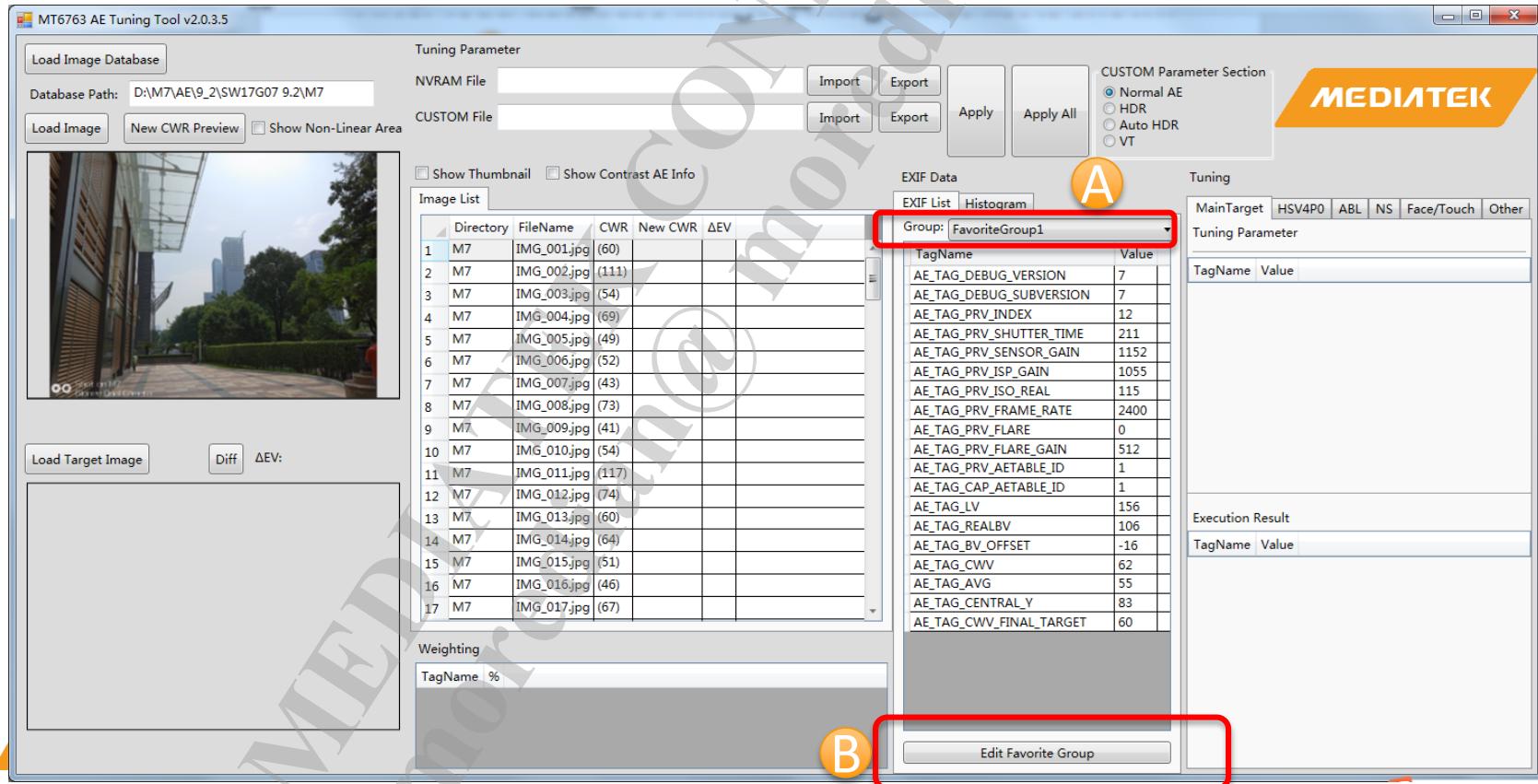
Load Image File

- After load database images, image files list is shown at area A.
- when user click on the image list to select an image, a preview of the selected image will be shown at area B.
- Area C will list the image's EXIF data.



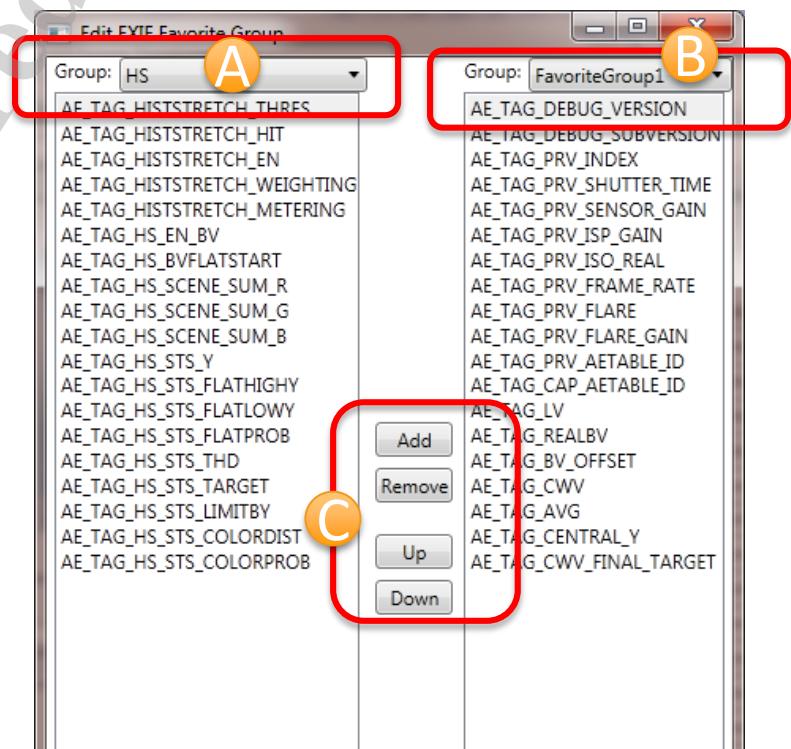
Load Image File EXIF List (1/2)

- EXIF data are show at “EXIF List page”, please use combo box A to select EXIF data wish to view.
- There are 8 EXIF Favorite group, please press button B to customize EXIF Favorite group.



Load Image File EXIF List (2/2)

- After press “Edit EXIF group” button, a dialog box will be show, please use A to change EXIF data group, use B to change Favorite group.
- Use “Add” or “Remove” button at area C to add/remove EXIF tag to favorite group.



Load Image File Image list Thumbnail

- When select A “Show Thumbnail” checkbox, image thumbnail will be shown at area B .

The screenshot shows the MT6763 AE Tuning Tool interface. In the center, there is a table titled "Image List" with columns: Thumbnail, Directory, FileName, CWR, New CWR, and ΔEV. The "Thumbnail" column contains small preview images of the corresponding jpg files. A red oval labeled "A" points to the "Show Thumbnail" checkbox located above the table. A red oval labeled "B" points to the "Image List" table where the thumbnails are displayed. The "Thumbnail" column is highlighted with a red border.

	Thumbnail	Directory	FileName	CWR	New CWR	ΔEV
1		M7	IMG_001.jpg	(60)		
2		M7	IMG_002.jpg	(111)		
3		M7	IMG_003.jpg	(54)		
4		M7	IMG_004.jpg	(69)		
5		M7	IMG_005.jpg	(49)		
6		M7	IMG_006.jpg	(52)		
7		M7	IMG_007.jpg	(43)		
8		M7	IMG_008.jpg	(73)		
9		M7	IMG_009.jpg	(41)		
10		M7	IMG_010.jpg	(54)		
11		M7	IMG_011.jpg	(117)		

Tuning Parameter

EXIF Data

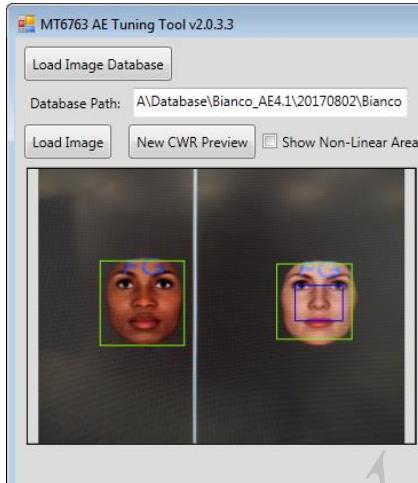
Tuning

Execution Result

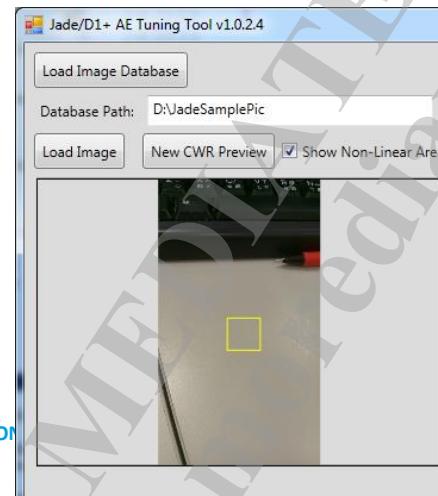
CONFIDENTIAL B

Load Image File Face and Touch Rectangle

- Face rectangle is **Green** Color

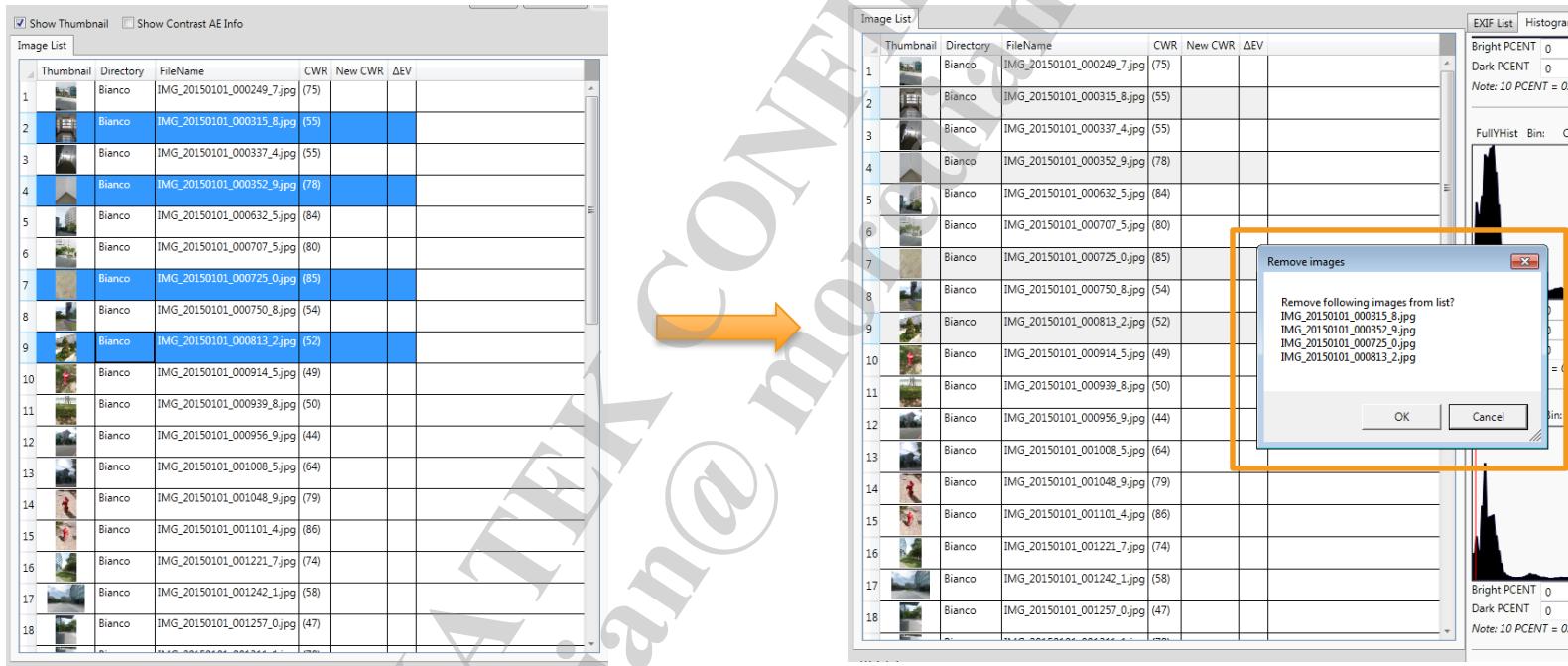


- Touch rectangle is **Yellow** Color.



Remove Image File

- If images list has unwanted images, user can remove it from images list.

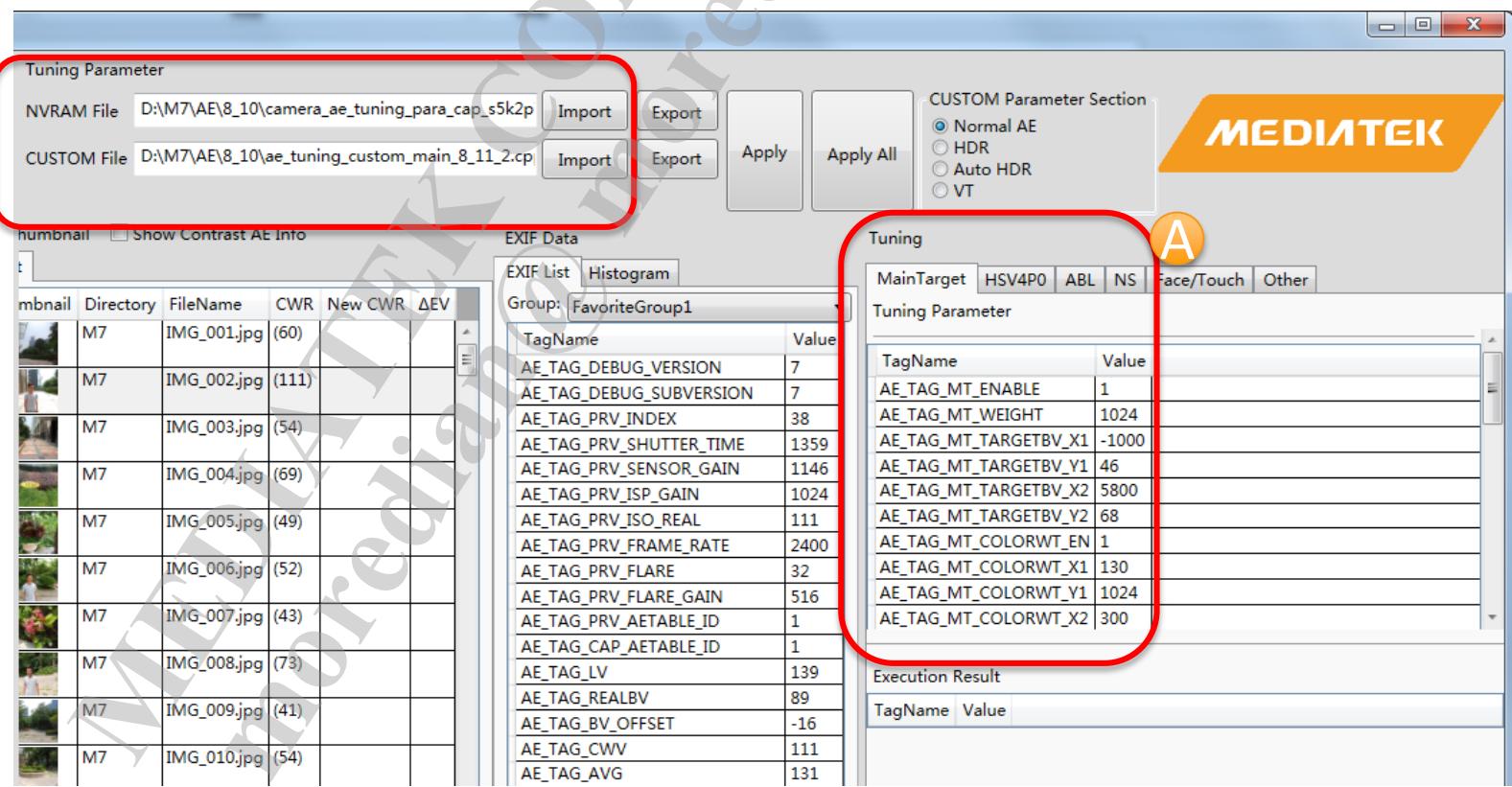


1 Select pictures to remove and then press delete key.

2 A dialog will pop up to confirm remove pictures.

Import/Export Tuning Parameter

- Import/Export tuning parameter from cpp file
 - NVRAM file
 - alps\vendor\mediatek\proprietary\custom\[chip id]\imgsensor\[Sensor]\camera_tuning_para_[sensor].cpp
 - CUSTOM file
 - alps\vendor\mediatek\proprietary\custom\[chip id]\hal\camera_3a\ae_tuning_custom_*.cpp
- Tuning parameter will be show at area A.



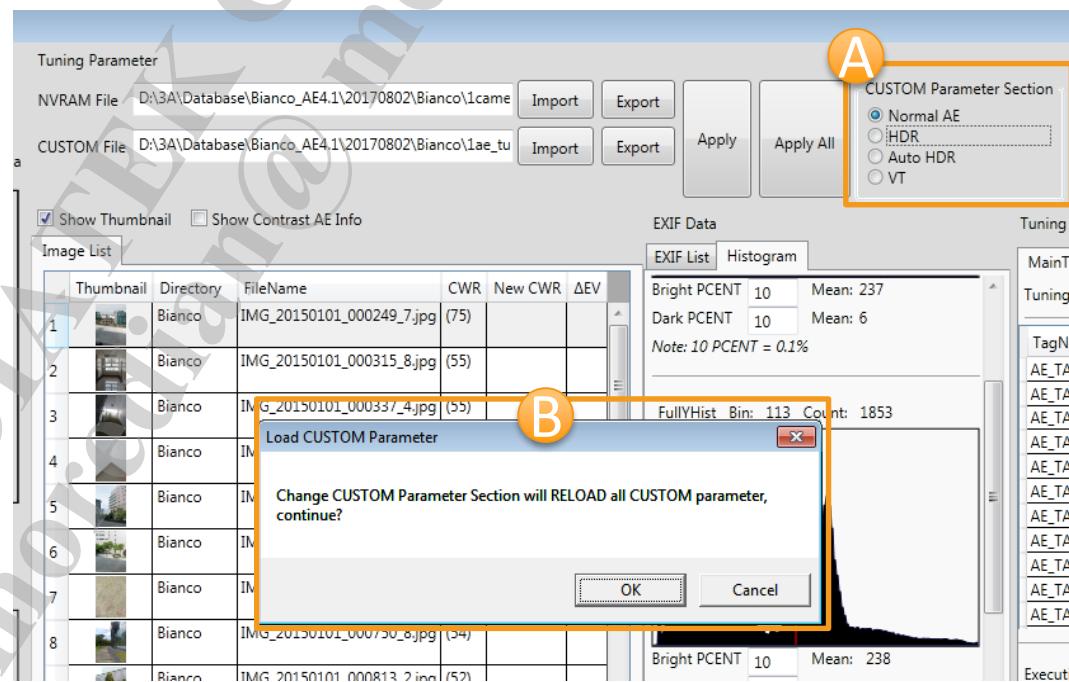
Import Tuning Parameter

- **Important Note About Tuning Parameter**
 - AE Tuning Tool read tuning parameter from cpp files only, it will **NOT** read tuning parameter from EXIF.
 - Please remember to **SAVE** a copy of the tuning parameter cpp files before you go to take picture.
 - When use this tool, please put original tuning parameter cpp files (ae_tuning_custom_*.cpp and camera_tuning_para_*.cpp) into Image directory.
 - Not support “#if”, “#ifdef”, and “#endif” to select tuning parameter at cpp file. Please manual remove these keyword at cpp file before import tuning parameter.
 - Do not change tuning parameter cpp file code structure format.

Import/Export Tuning Parameter

Multi mode AE parameter support

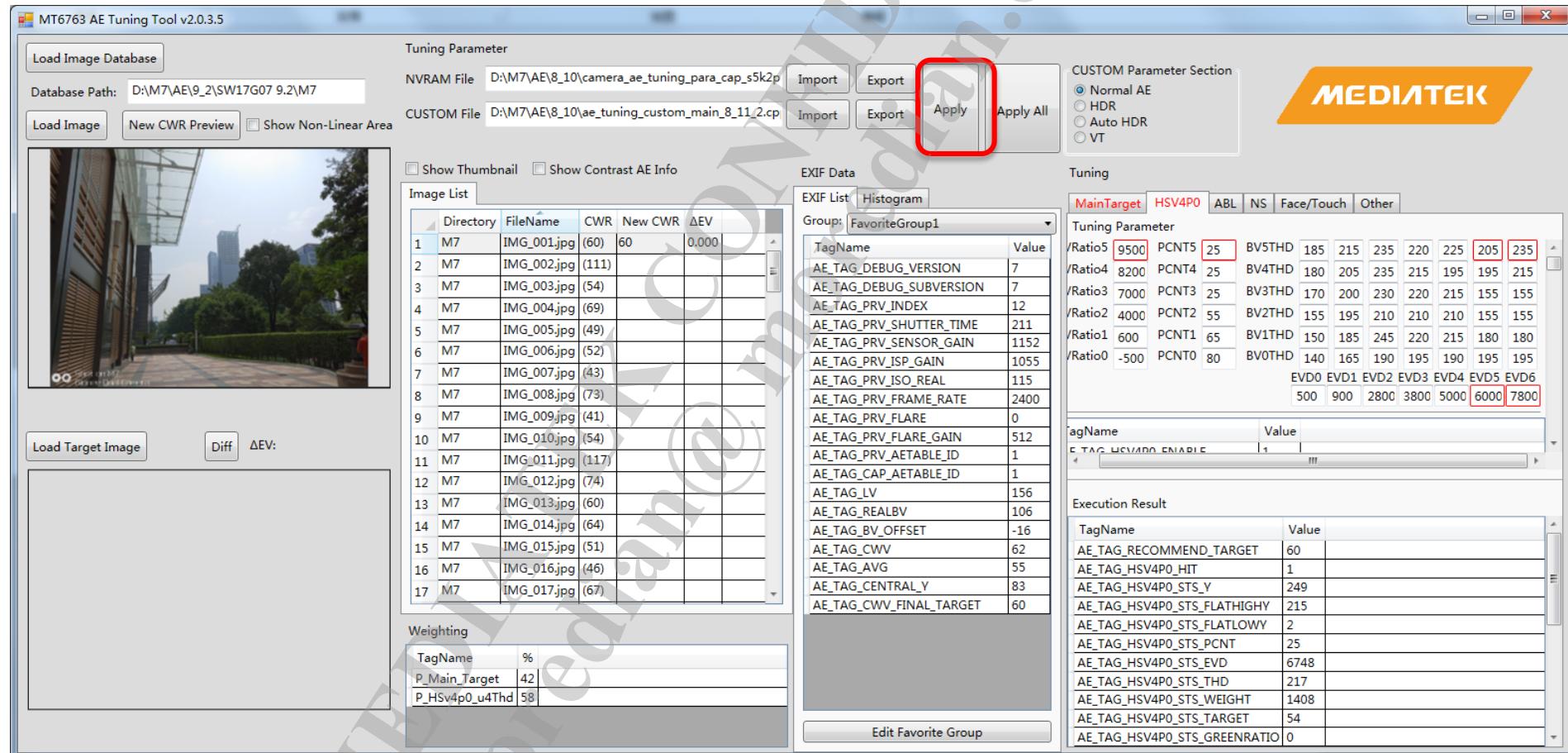
- Area A can select load CUSTOM parameters from ae_tuning_custom_xxx.cpp different mode.
 - Normal AE – Load from getAEParam() section.
 - HDR – Load from getHDRAEParam() section.
 - Auto HDR – Load from getAUTOHDRAEParam() section.
 - VT – Load from getVTAEParam() section.
- If change selection after import CUSTOM cpp file, a dialog box B will ask user to confirm reload CUSTOM parameters.



Basic tuning

Select Image for tuning

- Select an Image at Image list for tuning.
- Press Apply Button to calculate CWR and New CWR.



Basic tuning New CWR

	Before press Apply button	After Press Apply button
CWR	Show EXIF AE_TAG_CWV_FINAL_TARGET Show with parentheses "()"	Show Recommend_Target Calculate by using original tuning parameter from cpp file. Show without parentheses.
New CWR	Blank	Show Recommend_Target Calculate by using user modify tuning parameter . If value is different from previous value, it is show as red color.

MT6763 AE Tuning Tool v2.0.3.5

Load Image Database
Database Path: D:\M7\AE\9_2\SW17G07 9.2\M7
Load Image
New CWR Preview
Show Non-Linear Area

Tuning Parameter
NVRAM File: D:\M7\AE\8_10\camera_ae_tuning_para_cap_s5k2p
CUSTOM File: D:\M7\AE\8_10\ae_tuning_custom_main_8_11_2.cpp
Import
Export
Apply
Apply All
CUSTOM Parameter Section
 Normal AE
 HDR
 Auto HDR
 VT

MEDIATEK

Show Thumbnail
Show Contrast AE Info

Image List
Directory FileName CWR New CWR ΔEV
 1 M7 IMG_001.jpg 60 60 0.000
 2 M7 IMG_002.jpg 111 111 0.000
 3 M7 IMG_003.jpg 54 54 0.000
 4 M7 IMG_004.jpg 69 69 0.000
 5 M7 IMG_005.jpg 49 49 0.000
 6 M7 IMG_006.jpg 52 52 0.000
 7 M7 IMG_007.jpg 43 43 0.000
 8 M7 IMG_008.jpg 73 73 0.000
 9 M7 IMG_009.jpg 41 41 0.000
 10 M7 IMG_010.jpg 54 54 0.000
 11 M7 IMG_011.jpg 117 117 0.000
 12 M7 IMG_012.jpg 74 74 0.000
 13 M7 IMG_013.jpg 60 60 0.000
 14 M7 IMG_014.jpg 64 64 0.000
 15 M7 IMG_015.jpg 51 51 0.000
 16 M7 IMG_016.jpg 46 46 0.000
 17 M7 IMG_017.jpg 67 67 0.000

Diff
ΔEV:

EXIF Data
EXIF List Histogram
Group: FavoriteGroup1

TagName	Value
AE_TAG_DEBUG_VERSION	7
AE_TAG_DEBUG_SUBVERSION	7
AE_TAG_PRV_INDEX	12
AE_TAG_PRV_SHUTTER_TIME	211
AE_TAG_PRV_SENSOR_GAIN	1152
AE_TAG_PRV_ISP_GAIN	1055
AE_TAG_PRV_ISO_REAL	115
AE_TAG_PRV_FRAME_RATE	2400
AE_TAG_PRV_FLARE	0
AE_TAG_PRV_FLARE_GAIN	512
AE_TAG_PRV_AETABLE_ID	1
AE_TAG_CAP_AETABLE_ID	1
AE_TAG_LV	156
AE_TAG_REALBV	106
AE_TAG_BV_OFFSET	-16
AE_TAG_CWV	62
AE_TAG_AVG	55
AE_TAG_CENTRAL_Y	83
AE_TAG_CWV_FINAL_TARGET	60

Tuning Parameter
 /Ratio5 9500 PCNT5 25 BV5THD 185 215 235 220 225 205 235
 /Ratio4 8200 PCNT4 25 BV4THD 180 205 235 215 195 195 215
 /Ratio3 7000 PCNT3 25 BV3THD 170 200 230 220 215 155 155
 /Ratio2 4000 PCNT2 55 BV2THD 155 195 210 210 210 155 155
 /Ratio1 600 PCNT1 65 BV1THD 150 185 245 220 215 180 180
 /Ratio0 -500 PCNT0 80 BV0THD 140 165 190 195 190 195 195

EVDO EVD1 EVD2 EVD3 EVD4 EVD5 EVD6
500 900 2800 3800 5000 6000 7800

TagName Value
AE_TAG_HSV4PO_ENABLE 1 1 !!!

Execution Result
 TagName Value
 AE_TAG_RECOMMEND_TARGET 60
 AE_TAG_HSV4PO_HIT 1
 AE_TAG_HSV4PO_STS_Y 249
 AE_TAG_HSV4PO_STS_FLATHIGHY 215
 AE_TAG_HSV4PO_STS_FLATLOWY 2
 AE_TAG_HSV4PO_STS_PCNT 25
 AE_TAG_HSV4PO_STS_EVD 6748
 AE_TAG_HSV4PO_STS_THD 217
 AE_TAG_HSV4PO_STS_WEIGHT 1408
 AE_TAG_HSV4PO_STS_TARGET 54
 AE_TAG_HSV4PO_STS_GREENRATIO 0

Weighting
TagName %
P_Main_Target 42
P_Hsv4p0_u4Thd 58

Edit Favorite Group

Basic tuning

Execution result

- After press Apply button, the results execution are show at area A .
- If the metering target is HIT, it is show as Red color at area B .
- Area C show the weighting percentage of metering targets that sum up to be Recommend_Target.

The screenshot shows the MT6763 AE Tuning Tool interface. Key areas highlighted with orange circles are:

- A**: The "Execution Result" panel on the right, which displays tuning parameters and their values. It includes sections for MainTarget, HSV4P0, ABL, NS, Face/Touch, and Other. A red box highlights the MainTarget section.
- B**: The "Tuning" panel on the right, specifically the "MainTarget" tab. A red box highlights the "Value" column for the /Ratio5 parameter, which is set to 9500. The value 9500 is also circled in orange.
- C**: The "Weighting" table in the bottom-left corner, which lists TagName and % values. A red box highlights the row for P_Main_Target (42%) and P_Hsv4p0_u4Thd (58%).

Tuning Parameter

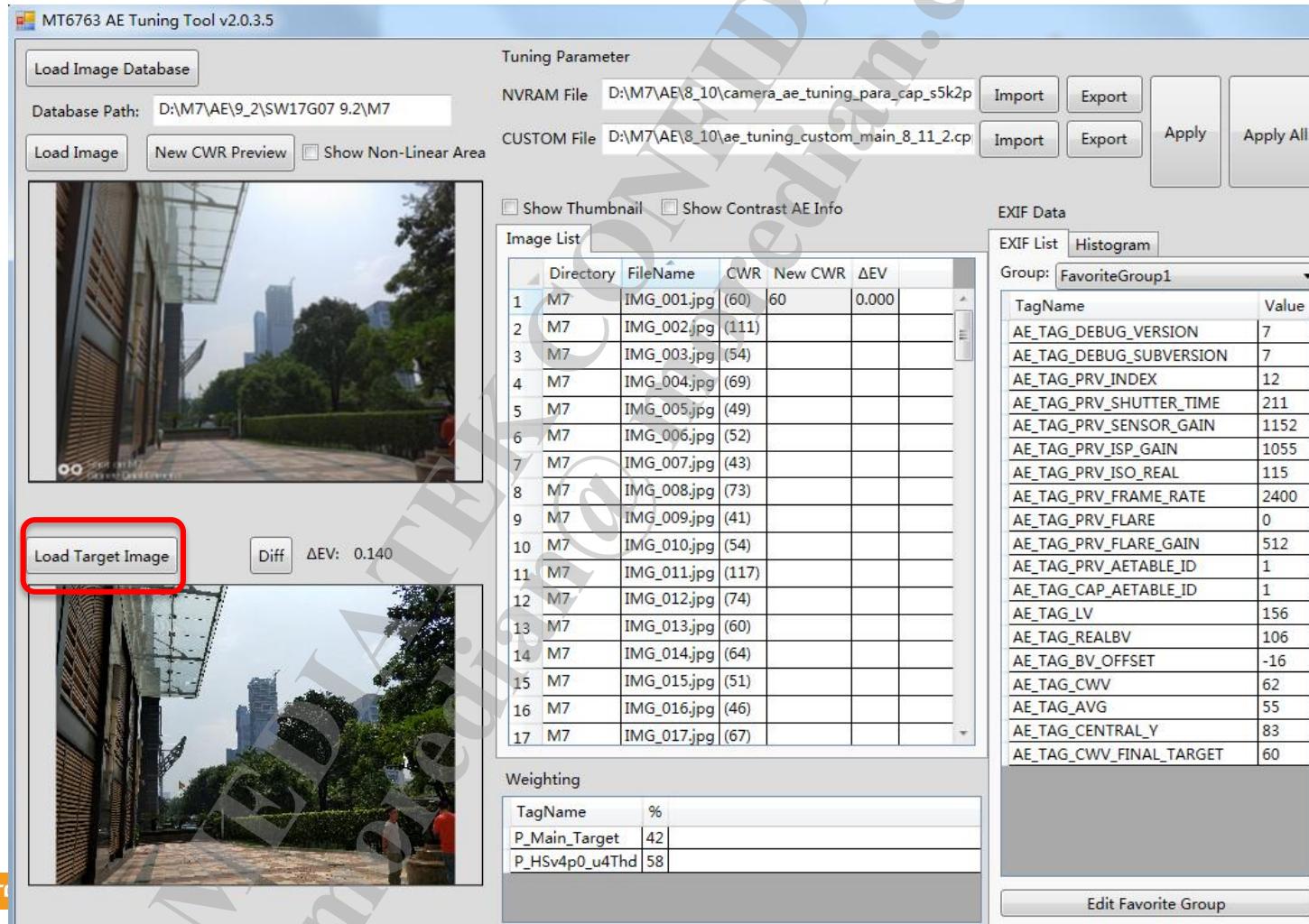
	Value	PCNT5	25	BV5THD	185	215	235	220	225	205	235
/Ratio5	9500	PCNT5	25	BV5THD	185	215	235	220	225	205	235
/Ratio4	8200	PCNT4	25	BV4THD	180	205	235	215	195	195	215
/Ratio3	7000	PCNT3	25	BV3THD	170	200	230	220	215	155	155
/Ratio2	4000	PCNT2	55	BV2THD	155	195	210	210	155	155	155
/Ratio1	600	PCNT1	65	BV1THD	150	185	245	220	215	180	180
/Ratio0	-500	PCNT0	80	BVOTHD	140	165	190	195	190	195	195

Execution Result

TagName	Value
AE_TAG_RECOMMEND_TARGET	60
AE_TAG_HSV4P0_HIT	1
AE_TAG_HSV4P0_STS_Y	249
AE_TAG_HSV4P0_STS_FLATHIGHY	215
AE_TAG_HSV4P0_STS_FLATLOWY	2
AE_TAG_HSV4P0_STS_PCNT	25
AE_TAG_HSV4P0_STS_EVD	6748
AE_TAG_HSV4P0_STS_THD	217
AE_TAG_HSV4P0_STS_WEIGHT	1408
AE_TAG_HSV4P0_STS_TARGET	54
AE_TAG_HSV4P0_STS_GREENRATIO	0

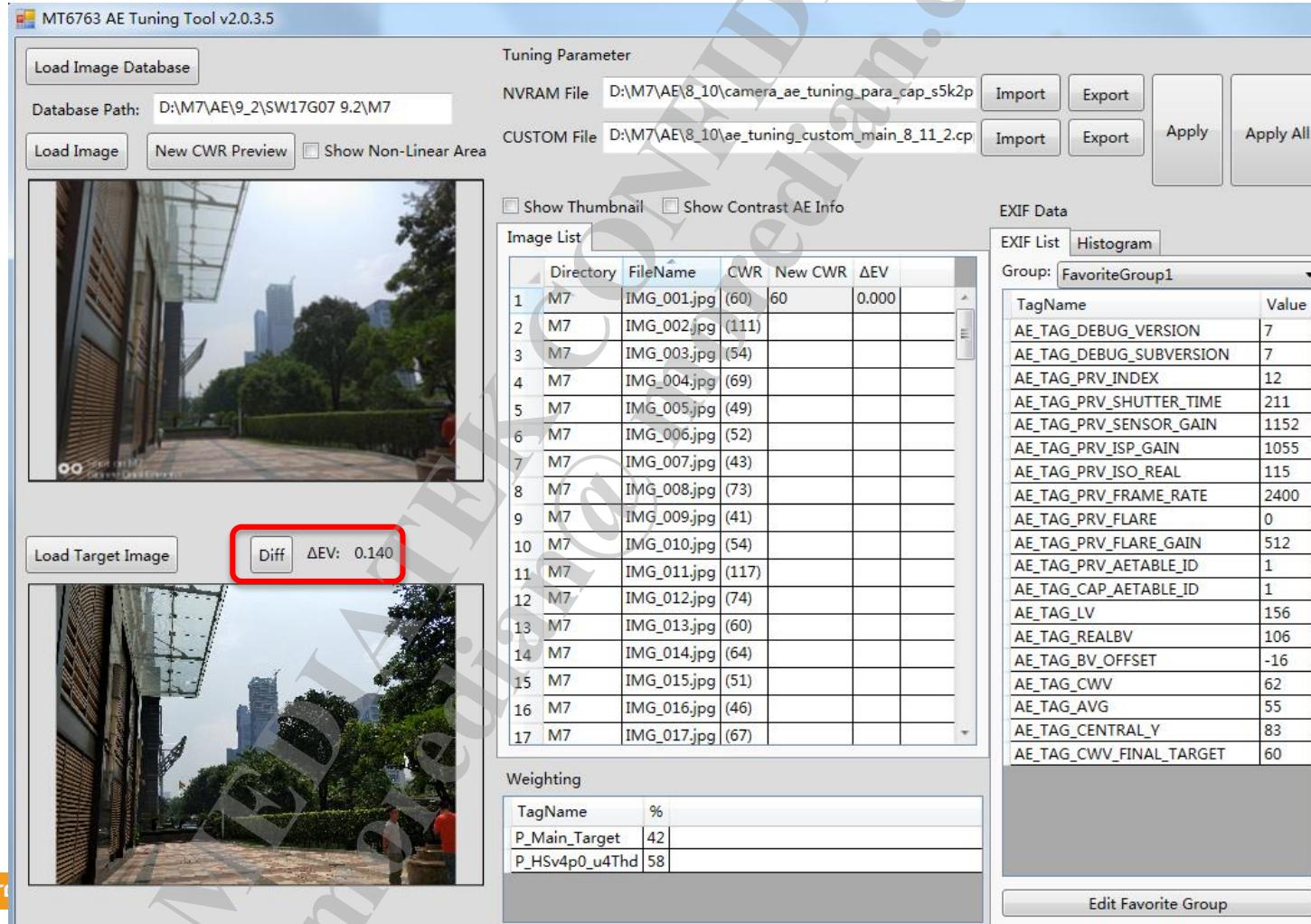
Basic tuning Load Target Image

- Use “Load Target Image” button to load target Image for compare.



Basic tuning EV Diff

- Use “Diff” button to calculate EV diff with target Image.
- The EV diff value is calculated by “source image EV - target image EV.”



Basic tuning

Tuning parameter tool tips

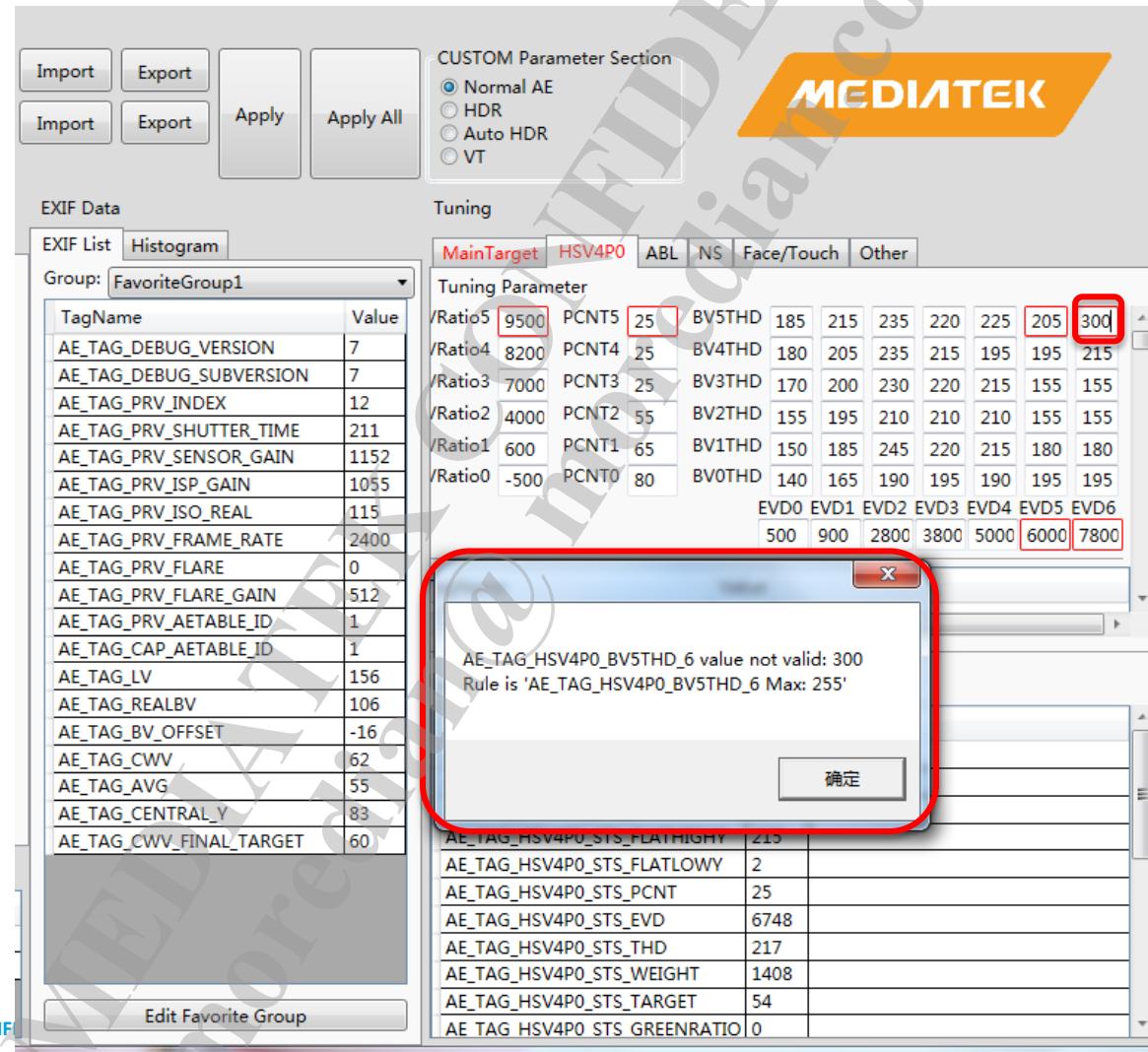
- If mouse is over a parameter, a tool tips will display the parameter rules.

The screenshot displays the MEDIATEK Camera AE Tuning Parameter Editor software. The main window has several sections:

- Parameter**: Shows paths for D:\M7\AE\8_10\camera_ae_tuning_para_cap_s5k2p and D:\M7\AE\8_10\ae_tuning_custom_main_8_11_2.cp, with buttons for Import, Export, Apply, and Apply All.
- CUSTOM Parameter Section**: Contains radio buttons for Normal AE, HDR, Auto HDR, and VT.
- Thumbnail**: Shows a preview of the images.
- Show Contrast AE Info**: A checkbox.
- List**: A tab selection.
- EXIF Data**: A table showing EXIF data for multiple images (IMG_001.jpg to IMG_017.jpg) across columns CWR, New CWR, and ΔEV.
- Tuning**: A large grid for tuning parameters. The grid has rows labeled /Ratio5 to /Ratio0 and columns grouped by MainTarget (PCNT5, PCNT4, PCNT3, PCNT2, PCNT1, PCNT0), HSV4PO (BV5THD, BV4THD, BV3THD, BV2THD, BV1THD, BV0THD), and various EV values (EVD0 to EVD6). A red box highlights the /Ratio0 row and the first few columns.
- Execution Result**: A table showing the final values for various tags.

Basic tuning Warning Message

- If enter invalid value, a warning message will be shown.



Basic tuning

Dynamic length parameter

- Support tuning parameter items dynamic add/remove.
 - Example : If AE_TAG_AOE_BV_TBL_LENGTH change, the table will immediate add/remove number of AE_TAG_BV_THD_X and AE_TAG_BV_THD_Y .

MainTarget	HSV4PO	ABL	NS	Face/Touch	Other	Tuning																	
Tuning Parameter						Tuning Parameter																	
BVRatio5	9500	PCNT5	25	BV5THD	185	215	235	220	225	205	235	BVRatio4	8200	PCNT4	25	BV4THD	180	205	235	215	195	195	215
BVRatio4	8200	PCNT4	25	BV4THD	180	205	235	215	195	195	215	BVRatio3	7000	PCNT3	25	BV3THD	170	200	230	220	215	155	155
BVRatio3	7000	PCNT3	25	BV3THD	170	200	230	220	215	155	155	BVRatio2	4000	PCNT2	55	BV2THD	155	195	210	210	210	155	155
BVRatio2	4000	PCNT2	55	BV2THD	155	195	210	210	210	155	155	BVRatio1	600	PCNT1	65	BV1THD	150	185	245	220	215	180	180
BVRatio1	600	PCNT1	65	BV1THD	150	185	245	220	215	180	180	BVRatio0	-500	PCNT0	80	BV0THD	140	165	190	195	190	195	195
BVRatio0	-500	PCNT0	80	BV0THD	140	165	190	195	190	195	195					EVD0	EVD1	EVD2	EVD3	EVD4	EVD5	EVD6	
					EVDO	EVD1	EVD2	EVD3	EVD4	EVD5	EVD6					500	900	2800	3800	5000	6000	7800	
					500	900	2800	3800	5000	6000	7800												
TagName	Value	Tag Name														Value	Value						
AE_TAG_HSV4PO_ENABLE	1	AE_TAG_HSV4PO_ENABLE														1	Value						
AE_TAG_HSV4PO_WEIGHT	1024	AE_TAG_HSV4PO_WEIGHT														1024	Value						
AE_TAG_HSV4PO_BVSIZE	6	AE_TAG_HSV4PO_BVSIZE														5	Value						
AE_TAG_HSV4PO_EVDSIZE	7	AE_TAG_HSV4PO_EVDSIZE														7	Value						
AE_TAG_HSV4PO_BVRATIO_0	-500	AE_TAG_HSV4PO_BVRATIO_0														-500	Value						
AE_TAG_HSV4PO_BVRATIO_1	600	AE_TAG_HSV4PO_BVRATIO_1														600	Value						
AE_TAG_HSV4PO_BVRATIO_2	4000	AE_TAG_HSV4PO_BVRATIO_2														4000	Value						
AE_TAG_HSV4PO_BVRATIO_3	7000	AE_TAG_HSV4PO_BVRATIO_3														7000	Value						
AE_TAG_HSV4PO_BVRATIO_4	8200	AE_TAG_HSV4PO_BVRATIO_4														8200	Value						
AE_TAG_HSV4PO_PCNT_0	80	AE_TAG_HSV4PO_PCNT_0														80	Value						

Basic tuning

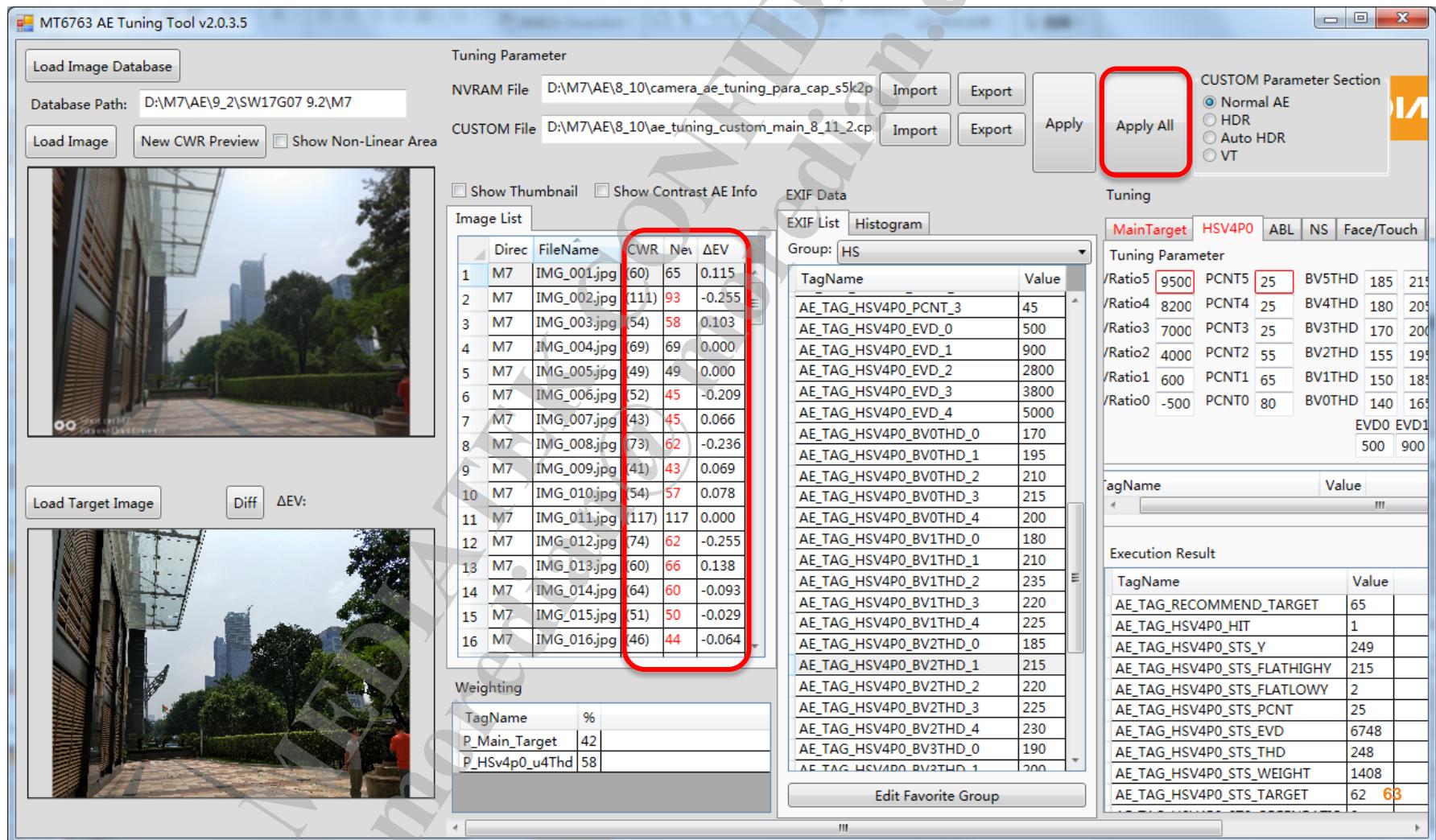
Apply new tuning parameter

- Modify tuning parameter and then press “Apply” button.
- EV diff with original tuning parameter will be show.

The screenshot shows the 'Tuning Parameter' application window. At the top, there are fields for 'NVRAM File' (D:\M7\AE\8_10\camera_ae_tuning_para_cap_s5k2p) and 'CUSTOM File' (D:\M7\AE\8_10\ae_tuning_custom_main_8_11_2.cp), each with 'Import' and 'Export' buttons. A large red box highlights the 'Apply' button, which is also surrounded by a red border. To the right of the 'Apply' button is a 'CUSTOM Parameter Section' with radio buttons for 'Normal AE', 'HDR', 'Auto HDR', and 'VT'. The 'Normal AE' option is selected. On the far right, the Mediatek logo is visible. Below the top bar, there are checkboxes for 'Show Thumbnail' and 'Show Contrast AE Info'. The main area is divided into 'Image List' and 'EXIF Data' sections. The 'Image List' table has columns: Direct, FileName, CWR, Nev, ΔEV. A row for file IMG_001.jpg is selected, with values 60, 65, and 0.115 highlighted in red. The 'EXIF Data' section shows a table of EXIF tags grouped under 'HS'. The 'Tuning' section contains a grid of tuning parameters categorized by MainTarget (HSV4P0, ABL, NS, Face/Touch, Other). A red box highlights the 'Ratio5' row in the 'HSV4P0' category, specifically the PCNT5 and Value columns (25 and 9500 respectively). Another red box highlights the EVD6 row in the 'EVD6' column of the same category.

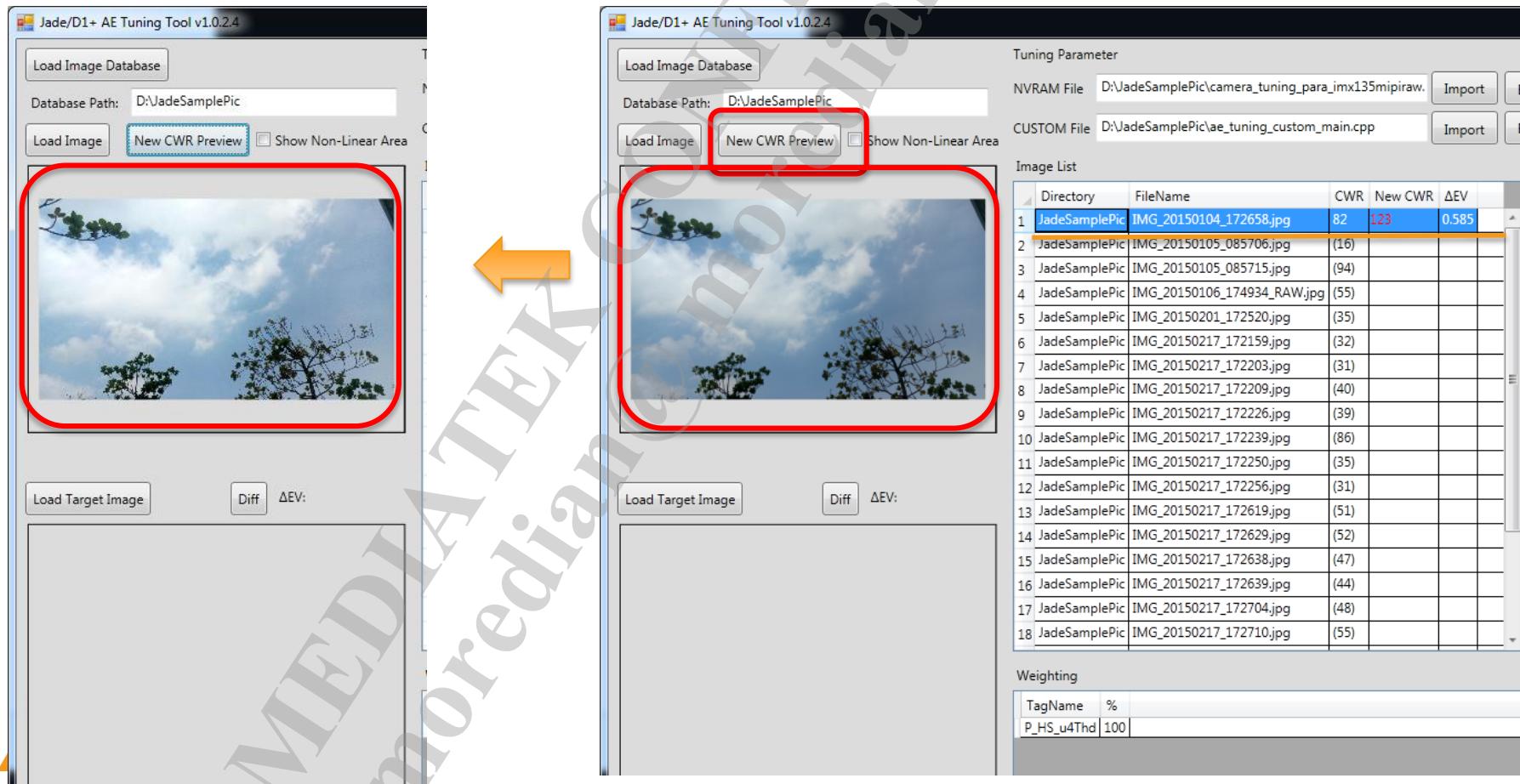
Basic tuning Apply All

- User can press “Apply All” button to apply tuning parameter to all image.



Advanced Tuning New CWR preview

- New CWR preview can let user preview the effect of new cwr gain.



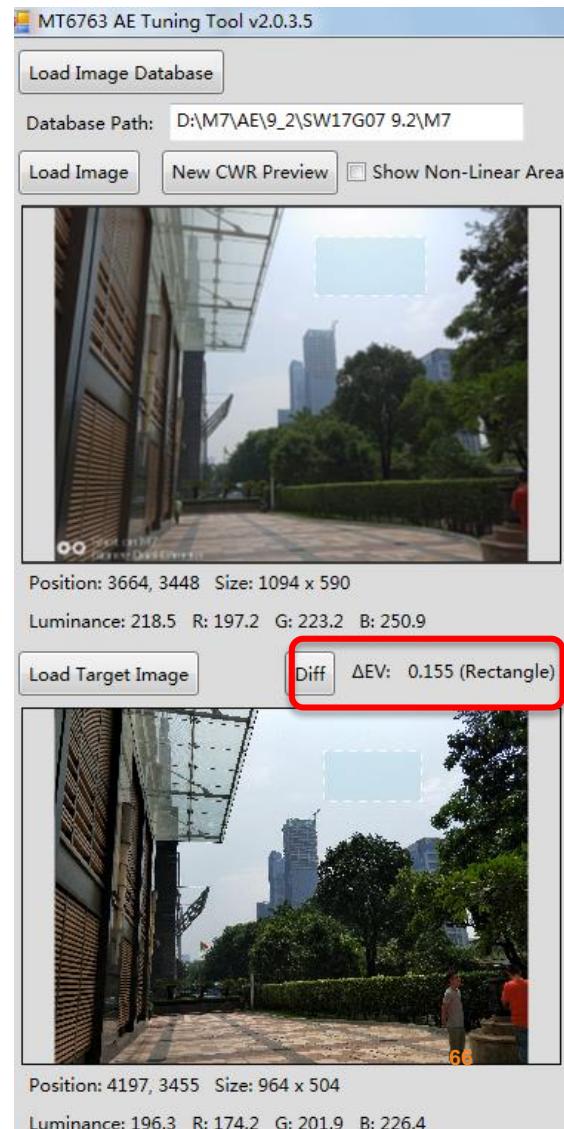
Advanced Tuning Mean of Luminance, R, G, B Mean.

- User can get mean of luminance, R, G, and B information by using mouse to select an area on the image.



Advanced Tuning Selected area EV diff

- When user select an area at both source and target image, tool will automatic calculate the selected area EV diff, **no need to press the “Diff” button.**
- A keyword “**(Rectangle)**” will show after the EV diff value, mean this value is selected area EV diff, **it is not whole image EV diff.**



Advanced Tuning

Show Contrast AE Info

- When select **A** “Show Contrast AE Info” checkbox, LCE info will be shown at area **B**.

Load Image Database

Database Path: D:\ShareTmp\mtksctwt22\Data\oppo_demo

Load Image New CWR Preview Show Non-Linear Area

Show Thumbnail Show Contrast AE Info **A**

Image List **B**

	Directory	FileName	CWR	New CWR	ΔEV	LCE_LIdx_L	LCE_LIdx_H	LCE_ContrastIdx_L	LCE_ContrastIdx_H
16	camera	IMG_20150101_055931_2.jpg	(35)			6	7	5	6
17	camera	IMG_20150101_060528_7.jpg	(39)			6	7	5	6
18	camera	IMG_20150101_060534_4.jpg	(35)			6	7	5	6
19	camera	IMG_20150101_060538_7.jpg	(35)			6	7	5	6
20	camera	IMG_20150101_061512_4.jpg	(28)			6	7	5	6
21	camera	IMG_20150101_061516_3.jpg	(29)			6	7	5	6
22	camera	IMG_20150101_061520_8.jpg	(27)			6	7	5	6
23	camera	IMG_20150101_055926_4.jpg	(35)			6	7	6	7
24	camera	IMG_20150101_061158_7.jpg	(55)			6	7	6	7
25	camera	IMG_20150101_055922_0.jpg	(54)			6	7	7	8
26	camera	IMG_20150101_061202_9.jpg	(56)			6	7	7	8
27	camera	IMG_20150101_061207_3.jpg	(56)			6	7	7	8
28	camera	IMG_20150101_045631_0.jpg	(47)			6	7	8	9
29	camera	IMG_20150101_045636_6.jpg	(46)			6	7	8	9
30	camera	IMG_20150101_045642_4.jpg	(47)			6	7	8	9
31	camera	IMG_20150101_061448_2.jpg	(65)			6	7	9	10
32	camera	IMG_20150101_061452_6.jpg	(64)			6	7	9	10
33	camera	IMG_20150101_061456_9.jpg	(65)			6	7	9	10
34	camera	IMG_20150101_060441_0.jpg	(64)			6	7	10	10
35	camera	IMG_20150101_060446_5.jpg	(64)			6	7	10	10
36	camera	IMG_20150101_052828_3.jpg	(66)			7	8	3	4

AE Contents

- AE Pline
 - Device Profile
 - Table Mapping
 - Generate code
 - Debug
- Flare/Target/EV calibration
 - Calibration
 - Generate code
 - Debug
- Gamma
 - Dynamic gamma tune
 - Tune gamma by ImageiqSimulator
 - Debug
- AE tuning tool SOP
- LCE
 - LCE theory
 - Tune LCE by ImageiqSimulator
 - LCE debug

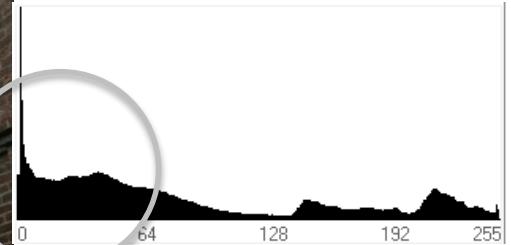
LCE Theory

- After AE tuning DT Keeping



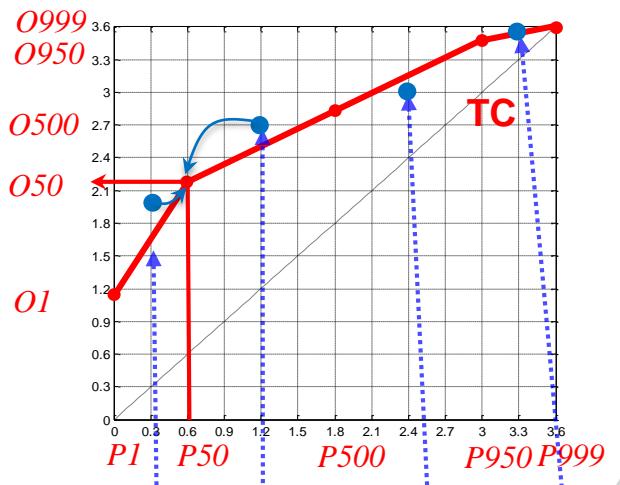
LCE Theory

- LCE(Location Contrast Enhance) tone mapping includes :
 - Tone curve generation
 - Image **contrast** analysis from AE
 - **Brightness** of environment from AE
 - Mid-frequency contrast enhancement



LCE Theory

➤ Tone Curve Decide



User decide

```
1700, //i4vFixedPt1  
2200, //i4vFixedPt2  
2800, //i4vFixedPt3  
3450. //i4vFixedPt4
```

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CONFIDENTIAL B

Contrast

LCE Theory

➤ Image Contrast Analysis--Contrast Y

DIP_X_LCE_EVContrastY10	0x00000005C	ContrastY = 92
DIP_X_LCE_SegDiv	0x00000001E	31
DIP_X_LCE_ContrastIdx_L	0x000000003	(L,H) = (3,4)
DIP_X_LCE_ContrastIdx_H	0x000000004	

ContrastIdx_L = EVContrastY10 / SegDiv
ContrastIdx_H = ContrastIdx_L + 1

```
{ //i4vTbl1 (for i4vFixedPt1)
//   LV0   LV1   LV2   LV3   LV4   LV5   LV6   LV7   LV8   LV9   LV10  LV11  LV12  LV13  LV14  LV15  LV16  LV17  LV18
{2150, 2150, 2200, 2200, 2200, 2200, 2250, 2250, 2250, 2250, 2200, 2150, 2150, 2150, 2150, 2150, 2150, 2150}, // 0 * N
{2150, 2150, 2150, 2200, 2200, 2200, 2250, 2250, 2250, 2250, 2200, 2150, 2150, 2150, 2150, 2150, 2150, 2150}, // 1
{2150, 2150, 2150, 2150, 2150, 2150, 2200, 2200, 2250, 2250, 2200, 2150, 2150, 2150, 2150, 2150, 2150, 2150}, // 2
{2150, 2150, 2150, 2150, 2150, 2150, 2200, 2200, 2250, 2250, 2200, 2150, 2150, 2150, 2150, 2150, 2150, 2150}, // 3
{2100, 2100, 2100, 2100, 2100, 2100, 2150, 2150, 2150, 2150, 2200, 2100, 2100, 2100, 2100, 2100, 2100, 2100}, // 4
{2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2150, 2150, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100}, // 5
{2050, 2050, 2050, 2050, 2050, 2050, 2050, 2050, 2050, 2050, 2050, 2100, 2100, 2100, 2100, 2100, 2100, 2100}, // 6
{1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950}, // 7
{1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950}, // 8
{1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950}, // 9
{1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950} // 10
```

LCE Theory

➤ Brightness of Environment-LV

$$LVidx_L = LV / 10$$

$$LVidx_H = LVidx_L + 1$$

DIP_X_LCE_LV	0x0000007A	LV = 122
DIP_X_LCE_LVIdx_L	0x0000000C	(L,H) = (12,13)
DIP_X_LCE_LVIdx_H	0x0000000D	


```
{ //i4vTbl1 (for i4vFixedPt1)
//  LV0   LV1   LV2   LV3   LV4   LV5   LV6   LV7   LV8   LV9   LV10  LV11  LV12  LV13  LV14  LV15  LV16  LV17  LV18
{2150, 2150, 2200, 2200, 2200, 2200, 2200, 2250, 2250, 2250, 2250, 2200, 2150, 2150, 2150, 2150, 2150, 2150, 2150}, // 0 * N
{2150, 2150, 2150, 2200, 2200, 2200, 2200, 2250, 2250, 2250, 2250, 2200, 2150, 2150, 2150, 2150, 2150, 2150, 2150}, // 1
{2150, 2150, 2150, 2150, 2150, 2150, 2150, 2200, 2200, 2250, 2250, 2200, 2150, 2150, 2150, 2150, 2150, 2150, 2150}, // 2
{2150, 2150, 2150, 2150, 2150, 2150, 2150, 2200, 2200, 2250, 2250, 2200, 2150, 2150, 2150, 2150, 2150, 2150, 2150}, // 3
{2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100}, // 4
{2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100}, // 5
{2050, 2050, 2050, 2050, 2050, 2050, 2050, 2050, 2050, 2050, 2050, 2050, 2050, 2050, 2050, 2050, 2050, 2050, 2050}, // 6
{1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950}, // 7
{1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950}, // 8
{1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950}, // 9
{1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950} // 10
},
```

LCE Theory

➤ Control Points Calculation



LCS Y = 1803

The LCS value indicates
which control point to adjust.

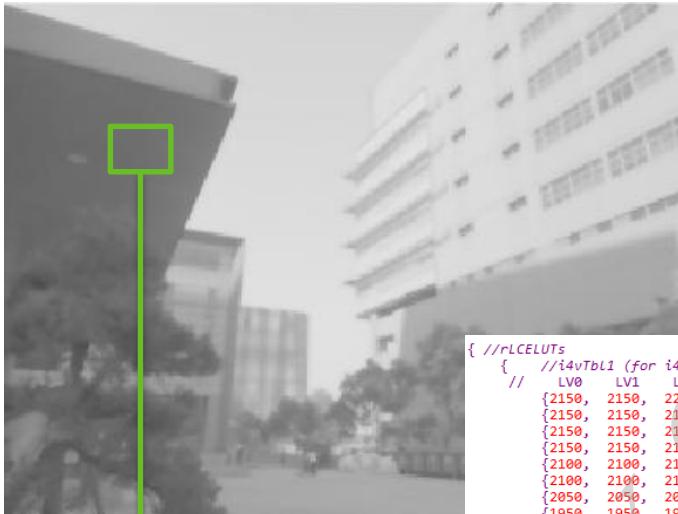
DIP_X_LCE_P1	0x00000520
DIP_X_LCE_P50	0x0000060E
DIP_X_LCE_P500	0x0000091E
DIP_X_LCE_P950	0x00000D78
DIP_X_LCE_P999	0x00000E18

This determines the control
points of tone curve.

TC_P1 = 1312
TC_P50 = 1550
TC_P500 = 2334
TC_P950 = 3451
TC_P999 = 3608

LCE Theory

➤ Control Points Calculation



LCE LightMap = 1803

TC_{P1} = 1312

TC P50 = 1550

TC P500 = 2334

TC_P950 = 3451

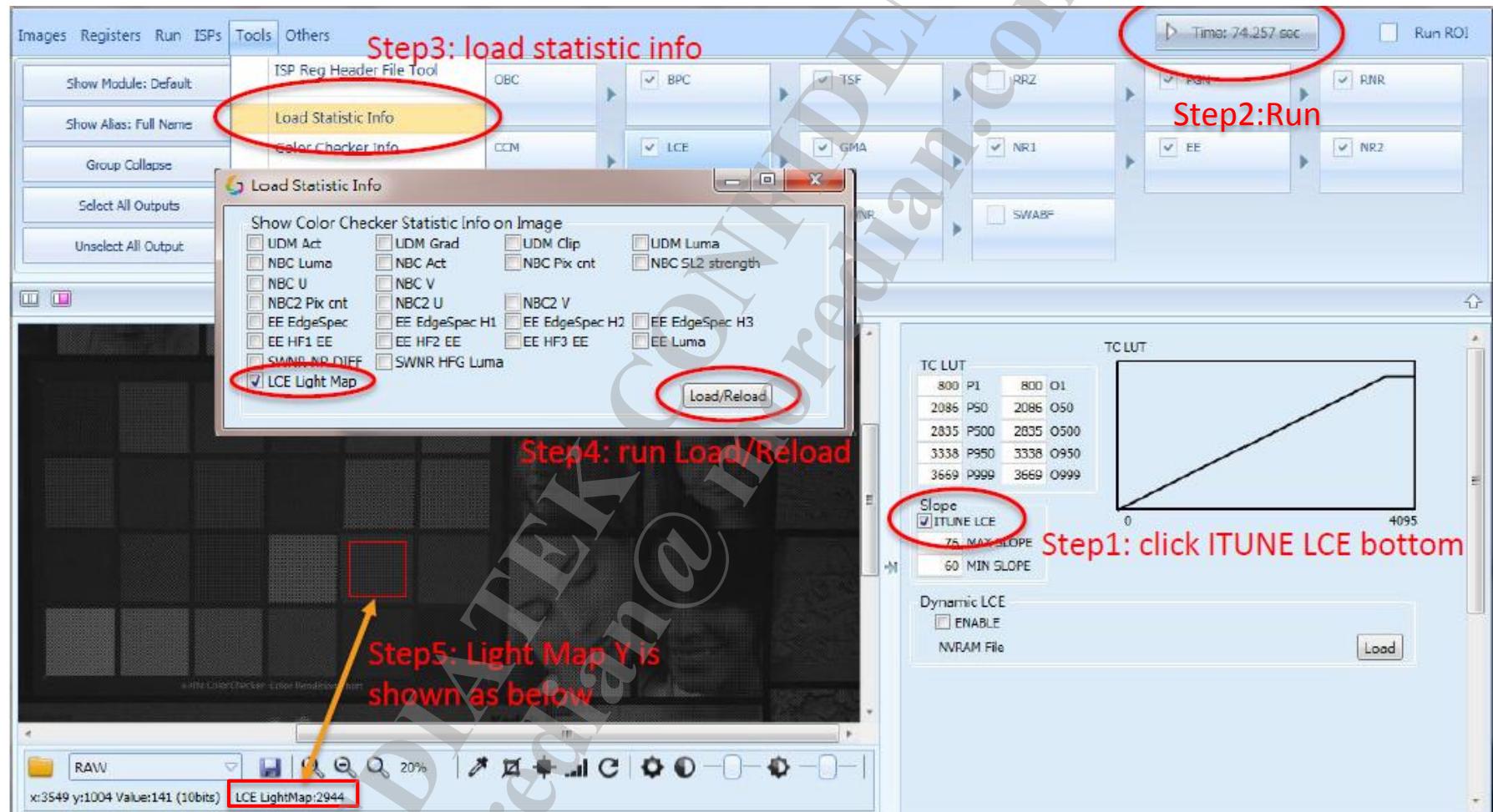
TC_P999 = 3608

```
1700, //i4vFixedPt1  
2200, //i4vFixedPt2  
2800, //i4vFixedPt3  
3450, //i4vFixedPt4
```

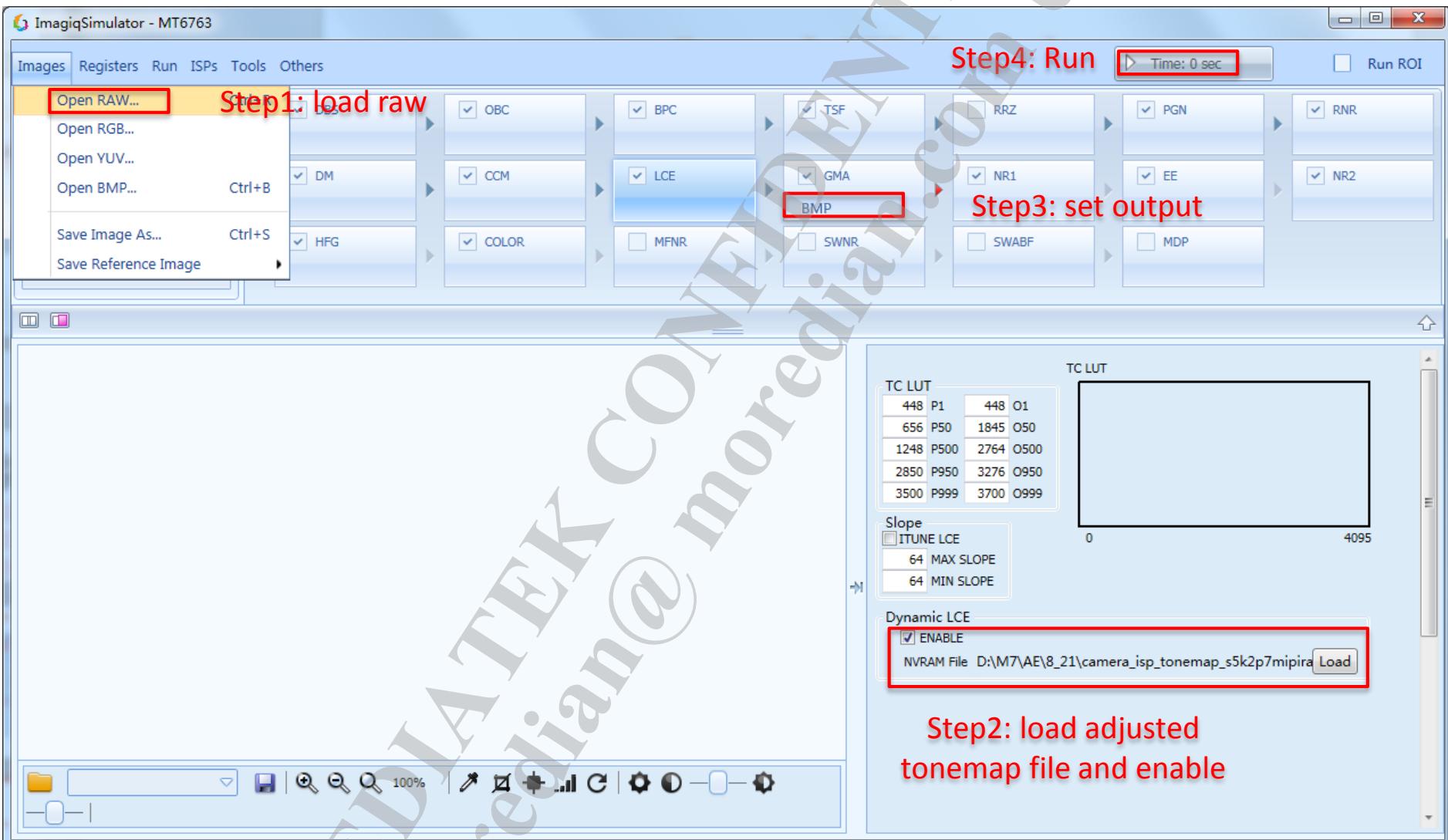
1550 < 1700
so to change O50 we
need to modify i4vTbl1

$2200 \leq 2334 < 2800$
so to change O500 we
need to modify i4vTbl2
and i4vTbl3

Get Light Map Y from ImageiqSimulator



Tune LCE by ImageiqSimulator



Debug

Tag

AE	AF	AWB	Sensor	Shading	Strobe	ISP	MFNR	N3D	SWNR	Common	Detail
ISP_SW	ISP_HW_P1	ISP_HW_P2									
:											
^ v											
Alias						Value					
DIP_X_LCE_LceProfile						2					0
DIP_X_LCE_LCECamMode						2					0
DIP_X_LCE_AutoHDEReable						0					0
DIP_X_LCE_ChipVersion						6763					0
DIP_X_LCE_MainVersion						30					0
DIP_X_LCE_SubVersion						2					0
DIP_X_LCE_SystemVersion						1					0
DIP_X_LCE_LV						0					0
DIP_X_LCE_ContrastY10						21					0
DIP_X_LCE_EVRatio						1024					0
DIP_X_LCE_EVContrastY10						21					0
DIP_X_LCE_SegDiv						20					0
DIP_X_LCE_ContrastIdx_L						1					0
DIP_X_LCE_ContrastIdx_H						2					0
DIP_X_LCE_LVIdx_L						0					0
DIP_X_LCE_LVIdx_H						1					0
DIP_X_LCE_DetailRatio1						8					0
DIP_X_LCE_DetailRatio50						19					0
DIP_X_LCE_DetailRatio500						60					0
DIP_X_LCE_DetailRatio950						69					0
DIP_X_LCE_DetailRatio999						2					0
DIP_X_LCE_IntpDiffRangex128						471					0
DIP_X_LCE_DiffRangeIdx_L						3					0
DIP_X_LCE_DiffRangeIdx_H						4					0
DIP_X_LCE_P1						2448					0
DIP_X_LCE_P50						2527					0
DIP_X_LCE_P500						2724					0
DIP_X_LCE_P950						2897					0
DIP_X_LCE_P999						2942					0
DIP_X_LCE_01						2579					0
DIP_X_LCE_050						2628					0
DIP_X_LCE_0500						2752					0
DIP_X_LCE_0950						2897					0
DIP_X_LCE_0999						2942					0

Debug

➤ DT is too Dark:

- 1. Check whether BT align the target phone.
- 2. Check LCE:

If P1~P999=O1~O999, it means LCE has been turned off.

DIP_X_LCE_P1	1536
DIP_X_LCE_P50	2005
DIP_X_LCE_P500	2935
DIP_X_LCE_P950	3394
DIP_X_LCE_P999	3672
DIP_X_LCE_O1	1536
DIP_X_LCE_O50	2005
DIP_X_LCE_O500	2935
DIP_X_LCE_O950	3394
DIP_X_LCE_O999	3672

Please check LCE para:

Debug

- LCE can work should be: i4bTbl >i4vFixedPt

```
1600, //i4vFixedPt1
2100, //i4vFixedPt2
2800, //i4vFixedPt3
3450, //i4vFixedPt4
1000, //I4TCPBLB
20000, //I4TCPUB

0, //i4Reserved0
0, //i4Reserved1
0, //i4Reserved2
0, //i4Reserved3
0, //i4Reserved4

{ //rlCEIJUTS
    { //i4vTbl1 (for i4vFixedPt1)-1600
        // LV0   LV1   LV2   LV3   LV4   LV5   LV6   LV7   LV8   LV9   LV10  LV11  LV12  LV13  LV14  LV15  LV16  LV17  LV18
        {1900, 1900, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 2450, 2400, 2450, 2450, 2450, 2450, 2450, 2450, 2450}, // 0 * N
        {1900, 1900, 1950, 1950, 1950, 1950, 1850, 2150, 2300, 2300, 2300, 2300, 2400, 2450, 2450, 2450, 2450}, // 1
        {1900, 1900, 1950, 1950, 1950, 1950, 1950, 1950, 2150, 2250, 2300, 2300, 2350, 2250, 2400, 2400, 2400}, // 2
        {1850, 1850, 1850, 1850, 1850, 1850, 1950, 2050, 2150, 2150, 2200, 2250, 2250, 2250, 2250, 2350, 2350}, // 3
        {1850, 1850, 1850, 1800, 1800, 1700, 1850, 2000, 2150, 2100, 2200, 2200, 2250, 2150, 2250, 2250}, // 4
        {1850, 1850, 1850, 1800, 1750, 1600, 1750, 1950, 2000, 2100, 2200, 2100, 2100, 2150, 2200, 2200, 2000}, // 5
        {1750, 1750, 1750, 1650, 1650, 1600, 1600, 1650, 1650, 1850, 2200, 2150, 2100, 1850, 2000, 2000, 2000}, // 6
        {1650, 1650, 1650, 1650, 1650, 1600, 1600, 1600, 1600, 1700, 1950, 1900, 1850, 1850, 2000, 2000, 2000}, // 7
        {1600, 1600, 1600, 1600, 1600, 1600, 1600, 1600, 1600, 1600, 1600, 1600, 1700, 1750, 1750, 2000, 2000}, // 8
        {1600, 1600, 1600, 1600, 1600, 1600, 1600, 1600, 1600, 1600, 1600, 1600, 1600, 1600, 1600, 1600, 1600}, // 9
        {1600, 1600, 1600, 1600, 1600, 1600, 1600, 1600, 1600, 1600, 1600, 1600, 1600, 1600, 1600, 1600, 1600} // 10
    },
    { //i4vTbl2 (for i4vFixedPt2)-2100
        // LV0   LV1   LV2   LV3   LV4   LV5   LV6   LV7   LV8   LV9   LV10  LV11  LV12  LV13  LV14  LV15  LV16  LV17  LV18
        {2450, 2450, 2450, 2450, 2500, 2550, 2500, 2600, 2500, 2700, 2650, 2650, 2650, 2650, 2650, 2500, 2500, 2500}, // 10 * N
        {2450, 2450, 2450, 2450, 2500, 2550, 2400, 2350, 2350, 2700, 2650, 2650, 2650, 2650, 2650, 2500, 2500, 2500}, // 1
        {2450, 2450, 2450, 2450, 2450, 2450, 2450, 2350, 2350, 2700, 2500, 2550, 2600, 2600, 2650, 2400, 2400, 2400}, // 2
        {2400, 2450, 2400, 2400, 2350, 2400, 2400, 2350, 2350, 2450, 2500, 2550, 2600, 2600, 2650, 2400, 2400, 2400}, // 3
        {2400, 2400, 2400, 2400, 2400, 2300, 2300, 2250, 2350, 2350, 2450, 2500, 2550, 2600, 2600, 2650, 2400, 2400, 2400}, // 4
        {2400, 2400, 2400, 2350, 2350, 2200, 2300, 2300, 2450, 2450, 2500, 2400, 2400, 2400, 2450, 2500, 2300, 2300}, // 5
        {2400, 2400, 2400, 2250, 2250, 2150, 2200, 2150, 2150, 2200, 2400, 2400, 2300, 2320, 2400, 2400, 2300, 2300}, // 6
        {2300, 2300, 2250, 2250, 2150, 2100, 2100, 2100, 2100, 2200, 2350, 2250, 2200, 2200, 2400, 2400, 2300, 2300}, // 7
        {2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2150, 2150, 2200, 2200, 2200, 2400, 2400, 2300, 2300}, // 8
        {2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2150, 2150, 2100, 2100, 2300, 2300, 2150, 2150}, // 9
        {2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100} // 10
    },
}
```

Debug

- DT is too Dark:
 - 3. Enhance the i4bTbl value which can be located by Contrast and LV. Adjacent parameters need to be smoothed.

DIP_X_LCE_ContrastIdx_L	6
DIP_X_LCE_ContrastIdx_H	7
DIP_X_LCE_LVLidx_L	9
DIP_X_LCE_LVLidx_H	10

Debug

➤ Bypass LCE:

- 1.adb command: adb shell setprop isp.lce.disable 1
- 2.set i4bTbl =i4vFixedPt

```
1650, //i4vFixedPt1
2100, //i4vFixedPt2
2800, //i4vFixedPt3
3450, //i4vFixedPt4
1000, //i4TCPBL
20000, //i4TCPBU

{ //rLCELLUTS
    { //i4vTbl1 (for i4vFixedPt1)-1600
        //   LV0   LV1   LV2   LV3   LV4   LV5   LV6   LV7   LV8   LV9   LV10  LV11  LV12  LV13  LV14  LV15  LV16  LV17  LV18
        {1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650}, // 0 * N
        {1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650}, // 1
        {1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650}, // 2
        {1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650}, // 3
        {1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650}, // 4
        {1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650}, // 5
        {1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650}, // 6
        {1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650}, // 7
        {1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650}, // 8
        {1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650}, // 9
        {1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650, 1650} // 10
    },
    { //i4vTbl2 (for i4vFixedPt2)-2100
        //   LV0   LV1   LV2   LV3   LV4   LV5   LV6   LV7   LV8   LV9   LV10  LV11  LV12  LV13  LV14  LV15  LV16  LV17  LV18
        {2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100}, // 10 * N
        {2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100}, // 1
        {2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100}, // 2
        {2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100}, // 3
        {2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100}, // 4
        {2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100}, // 5
        {2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100}, // 6
        {2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100}, // 7
        {2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100}, // 8
        {2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100}, // 9
        {2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100} // 10
    },
},
MEDIATEK CONFIDENTIAL B
```

Debug

- If the debug method cannot resolve the issue, please collect data to MTK:
- Print log
 - Enable LCE & normal ae log
 - adb shell setprop debug.ae.enable 9
 - adb shell setprop debug.dynamic_lce.log 1
 - adb shell setprop debug.lce.core.enable 1
- Capture EM mode pure raw
 - Get JPG and pure raw files

Any Question

THANKS