CONFIDENTIAL B

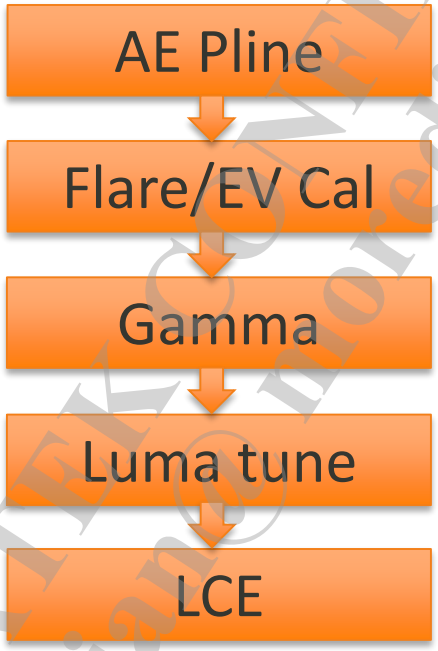
Basic Tuning Flow – AE Calibration

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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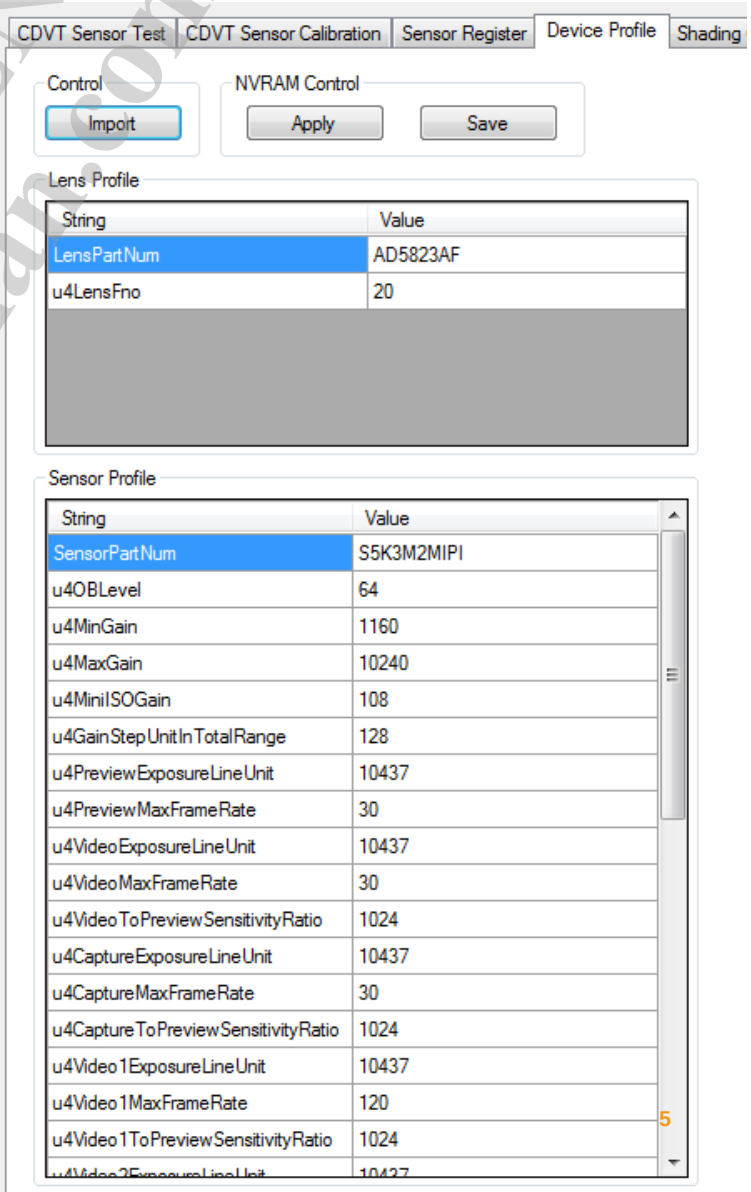
  - –Tune LCE by ImageiqSimulator
  - –LCE debug

Device Profile

- Device Profile Introduction (MTK provide)



Device Profile

- Device Profile Introduction (MTK provide)
  - u4OBLevel : OB value (useless)
  - u4MinGain : Minimum saturation gain
  - u4MaxGain : Sensor support maximum gain
  - u4MiniISOGain : 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.

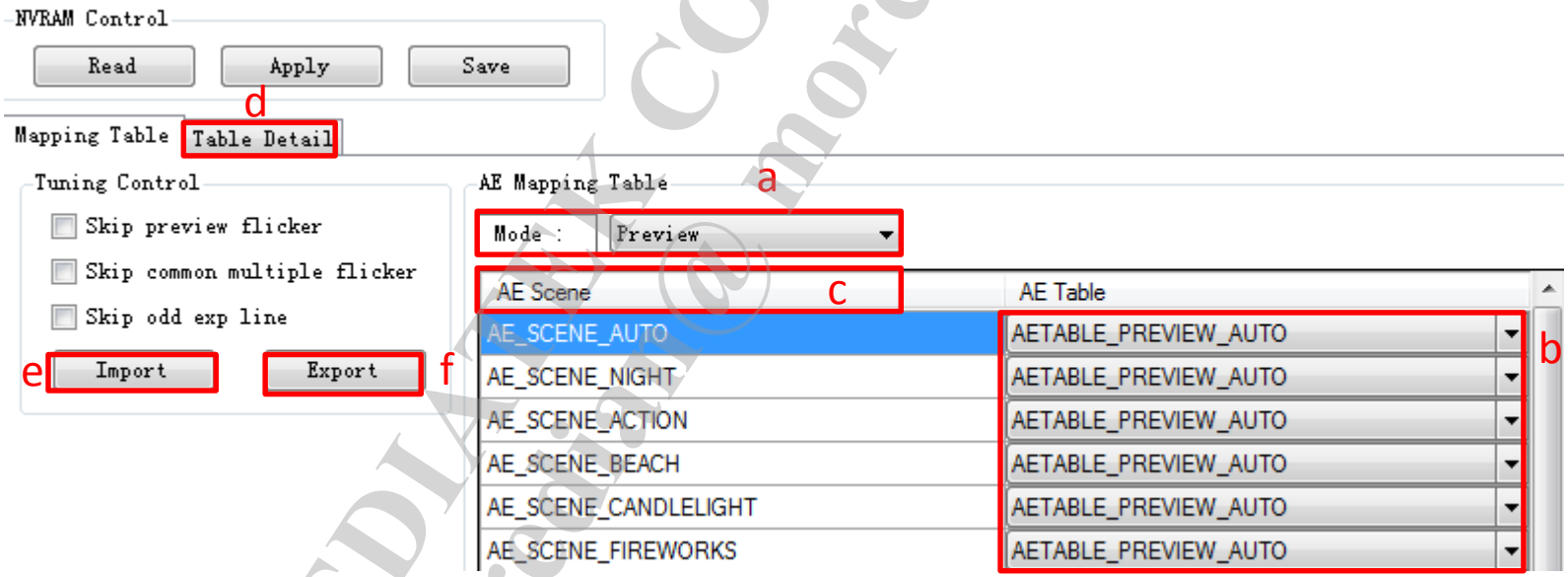


Table Mapping

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

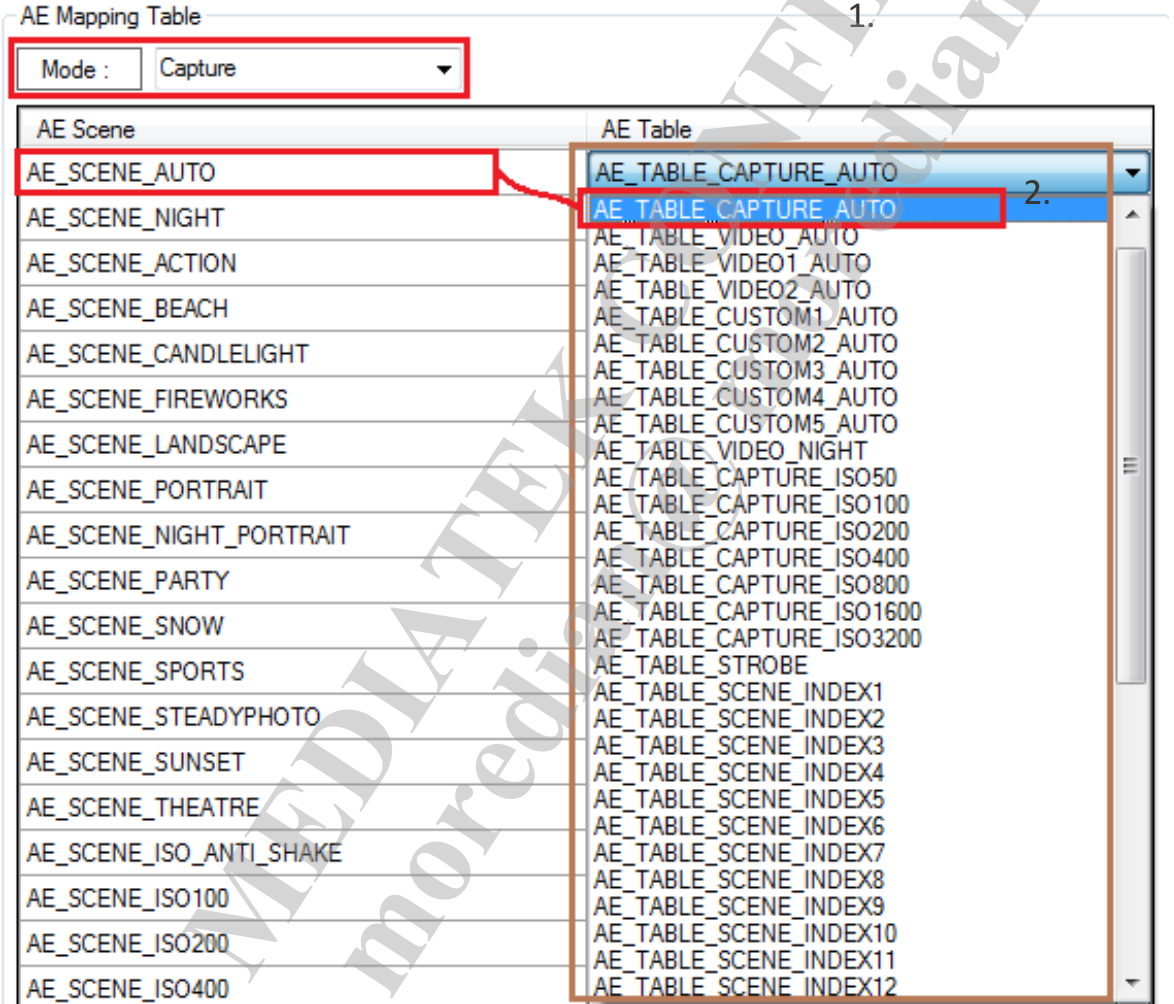
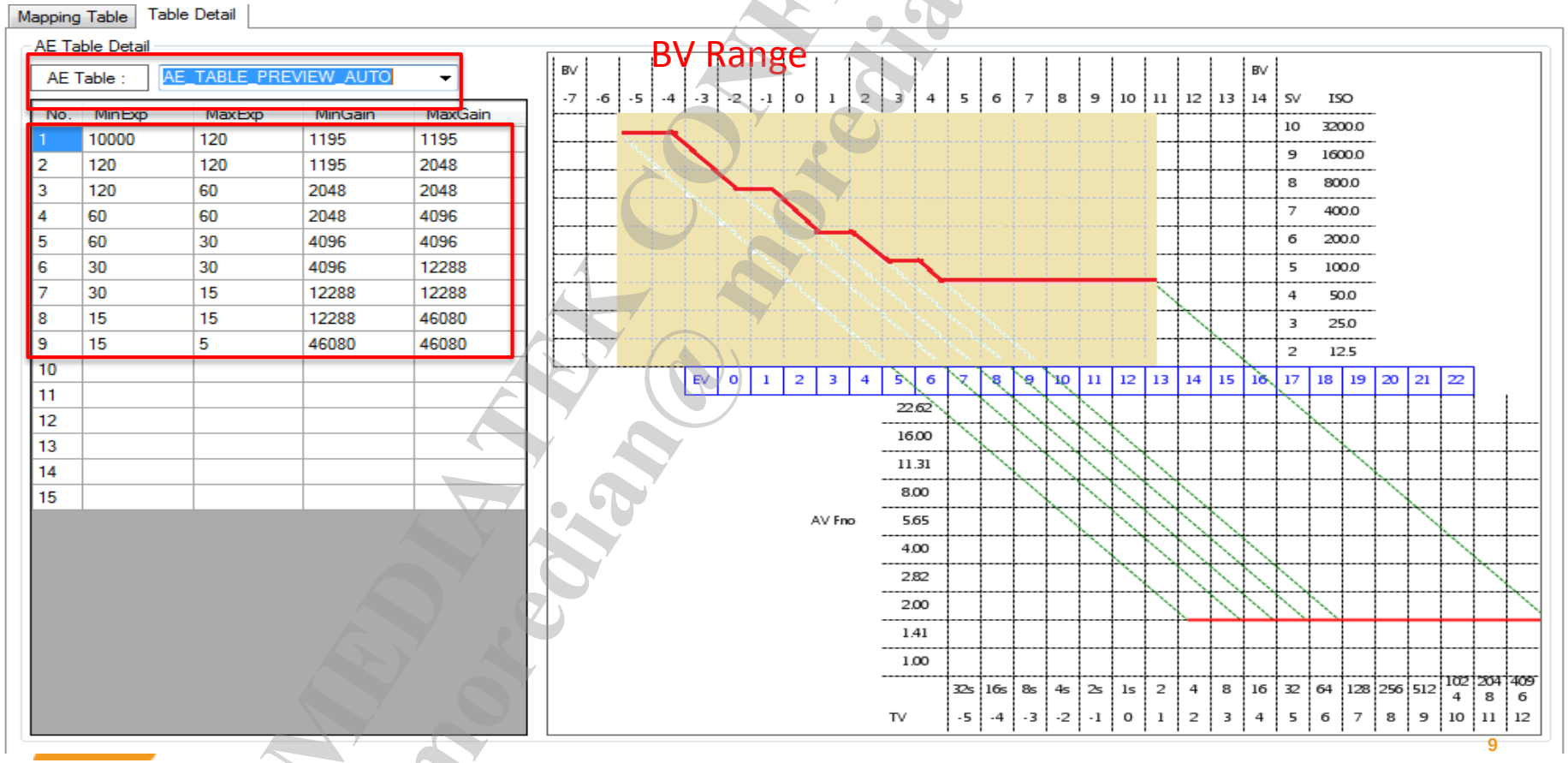


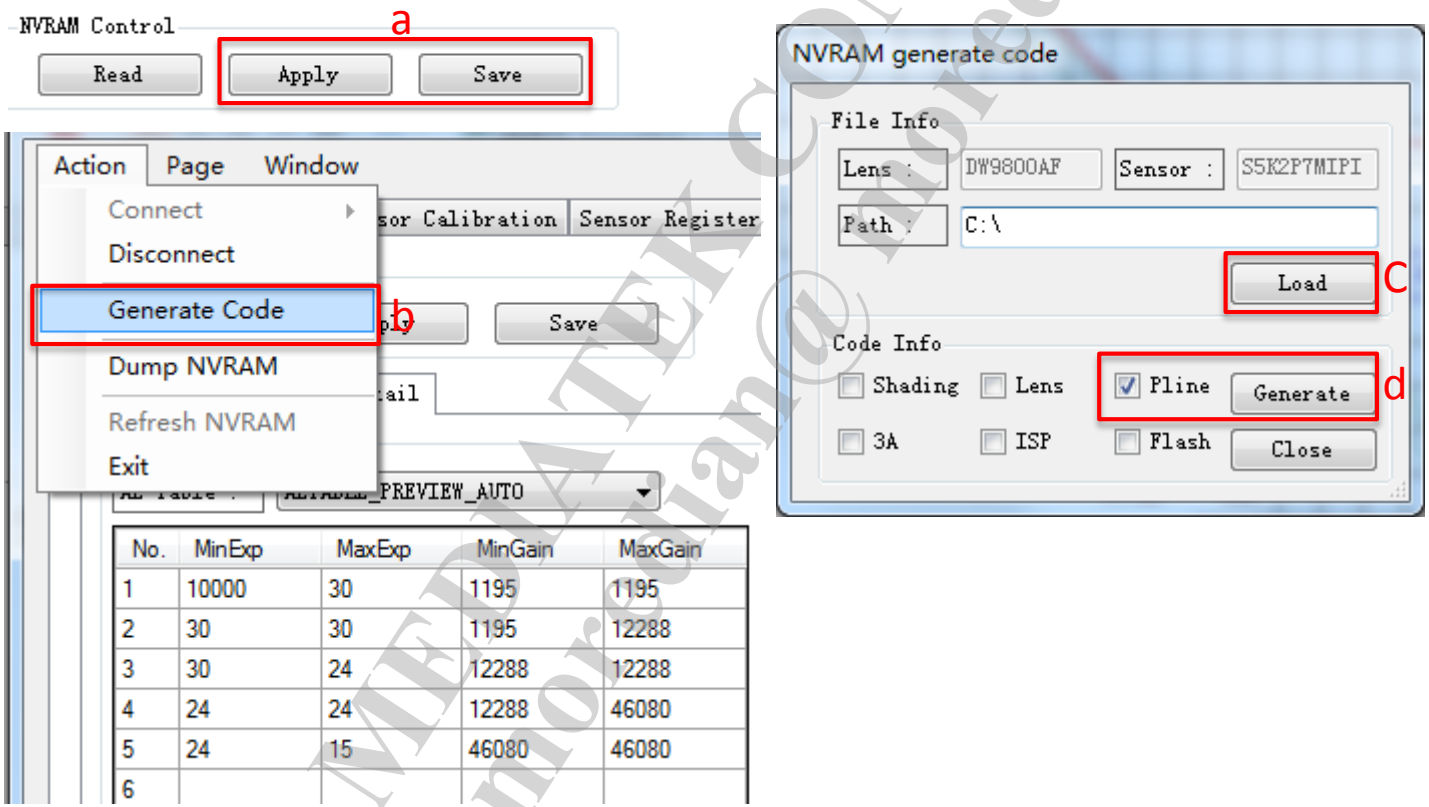
Table Mapping

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



Generate Code

- Save nvram and generate Pline
  a) Apply and save.
  b) Select Action/Generate Code.
  c) Load save path
  d) 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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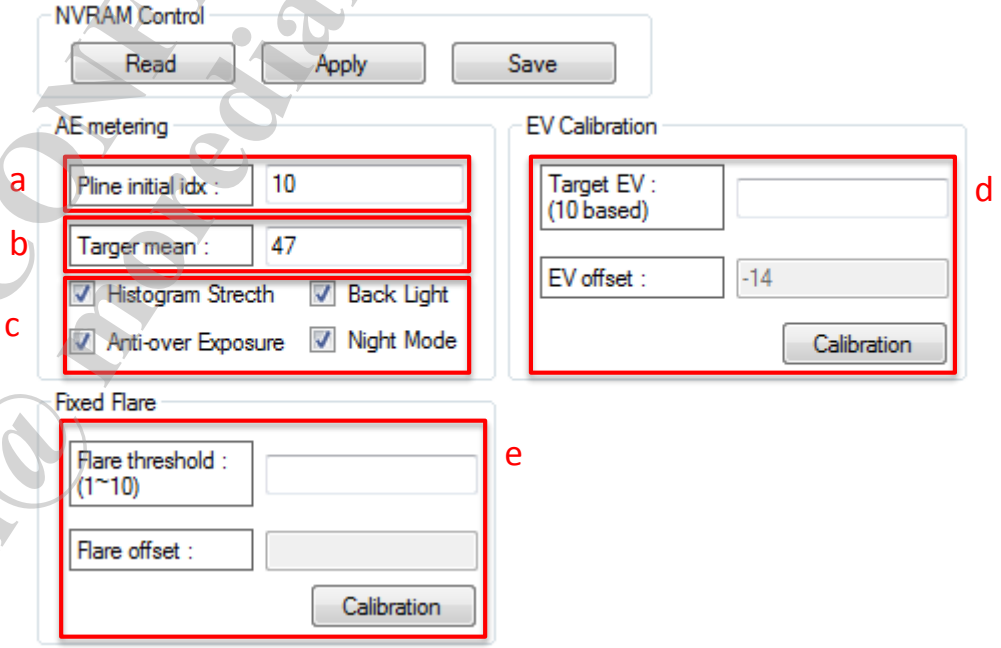
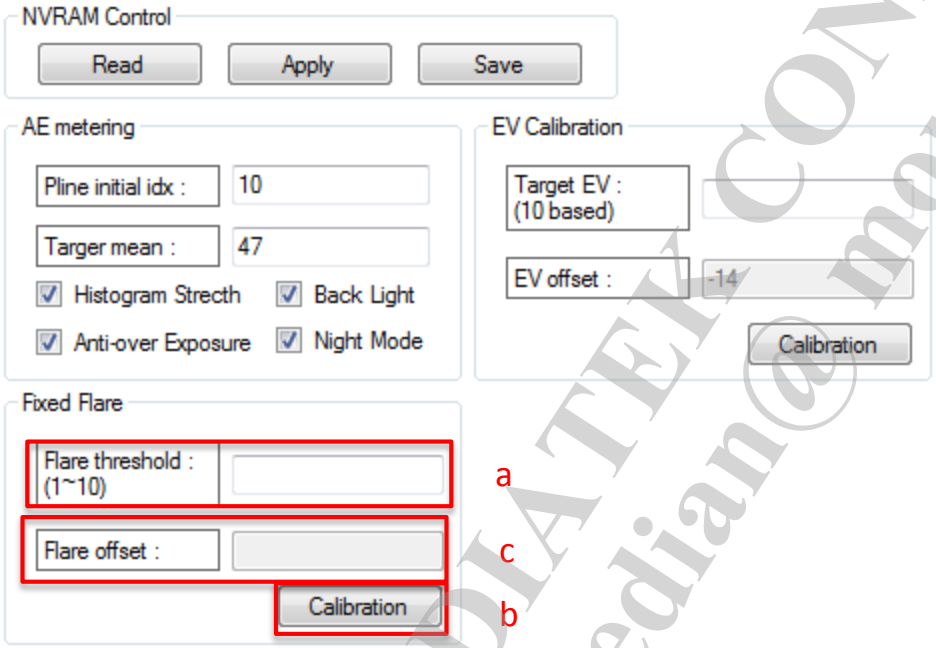
Flare/Target/EV Calibration

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



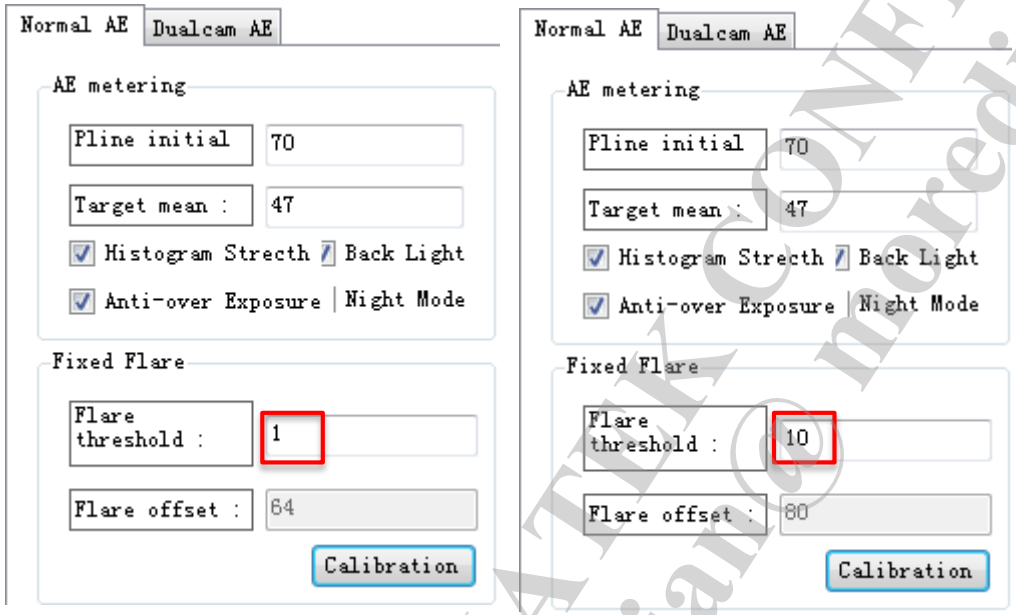
Flare/Target/EV Calibration

- Flare Offset Tuning
  a) Modify “threshold”, deduct histogram dark area percentage, 1 mean 0.1%.
  b) Click “Calibration”.
  c) Calculate flare offset.



Flare/Target/EV Calibration

- Flare Offset Tuning
  a) Flare threshold=1 vs =10:



Offset=64

Offset=80

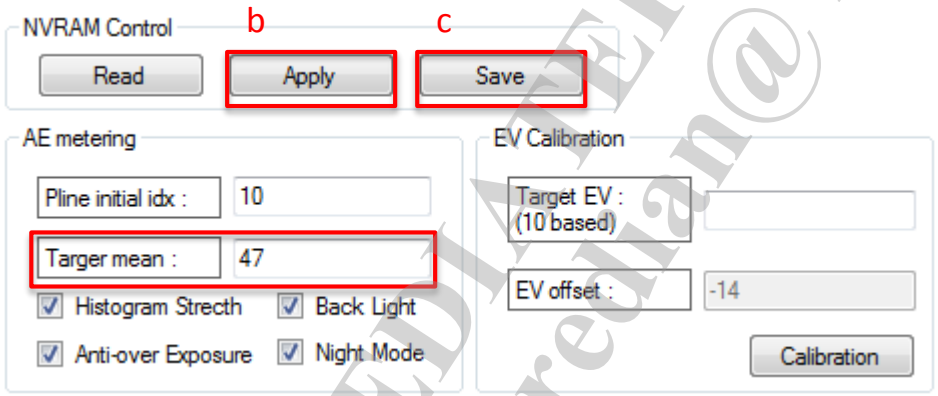
Flare/Target/EV Calibration

- Flare Offset Tuning
  - b) Recommended initial value:

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

Flare/Target/EV Calibration

- AE Target Tuning
  a) Modify “Target mean”
  b) Click “Apply”
  c) Click ”Save”



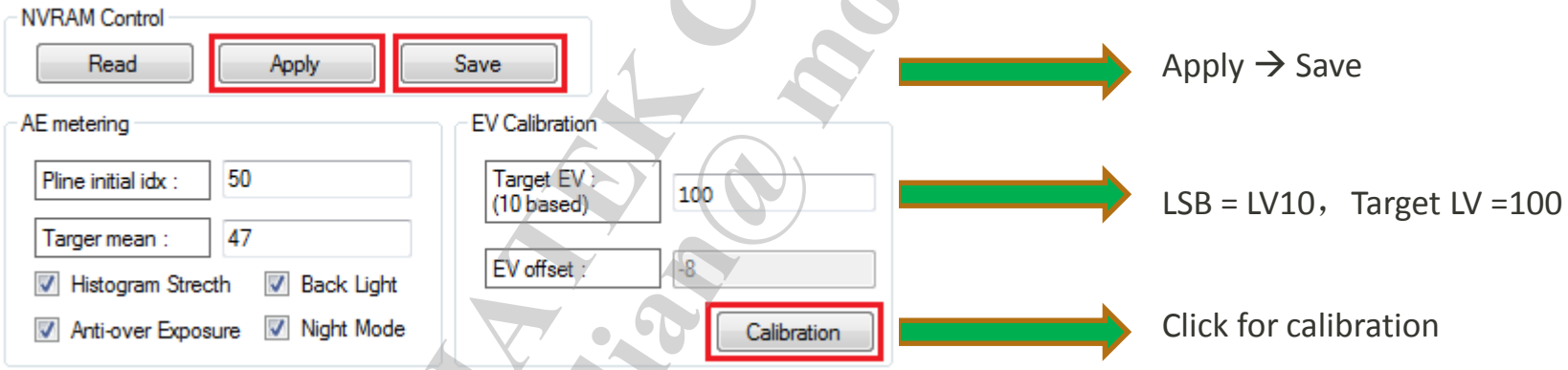
Target Mean:120

Target Mean:60

Target Mean:20

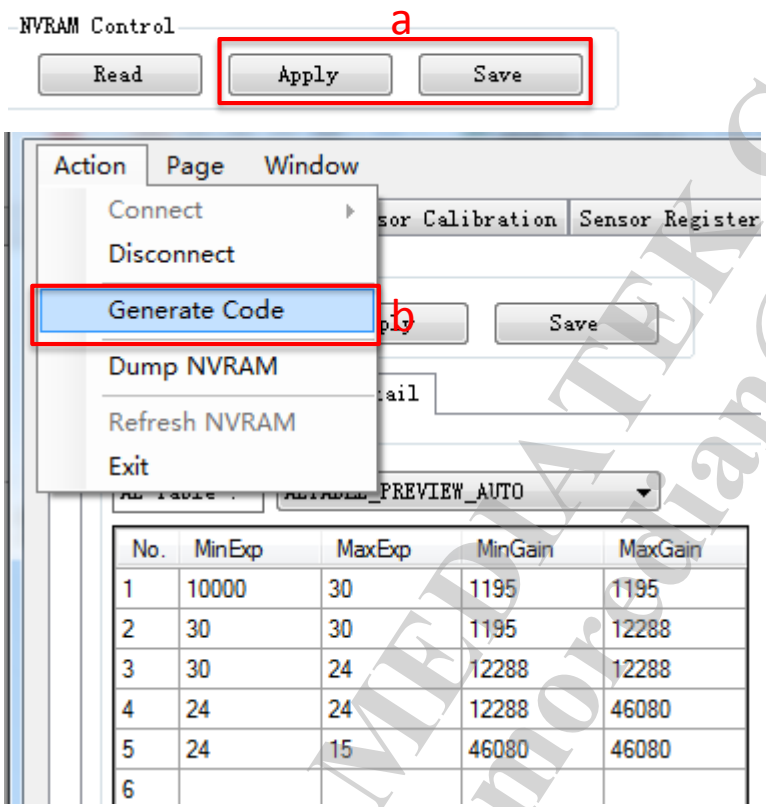
Flare/Target/EV Calibration

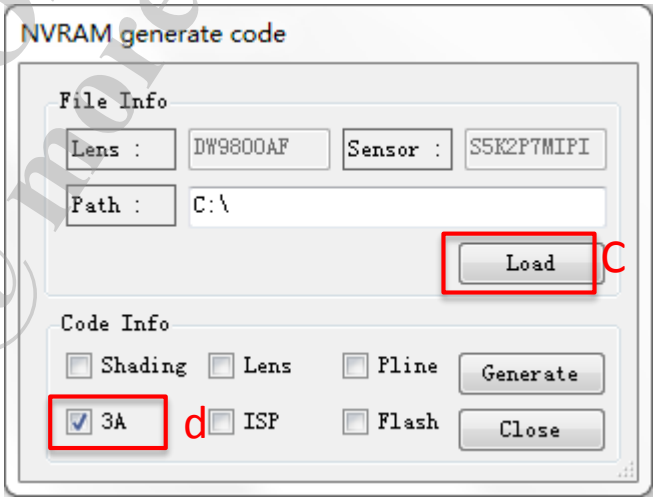
- EV offset (AE calibration page)
  a) Set LSB to LV10
  b) Fill 100 into “Target EV” filed
  c) Click “Calibration”
  d) Apply to NVRAM
  e) Save to NVRAM



Generate Code

- Generate 3A code
  a) Apply and save.
  b) Select Action/Generate Code.
  c) Load save path
  d) 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

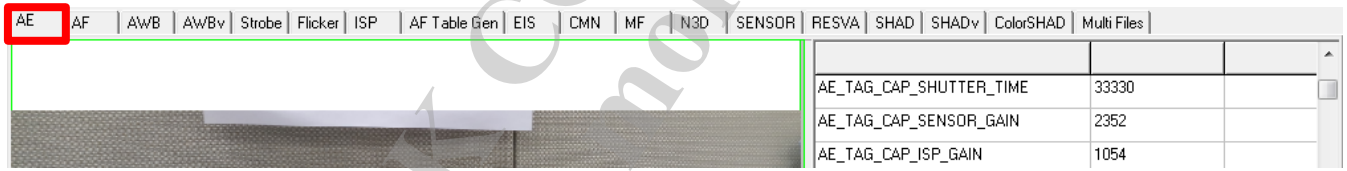
camera_ae_tuning_para_cus3_imx386mipiraw.cpp

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



  - 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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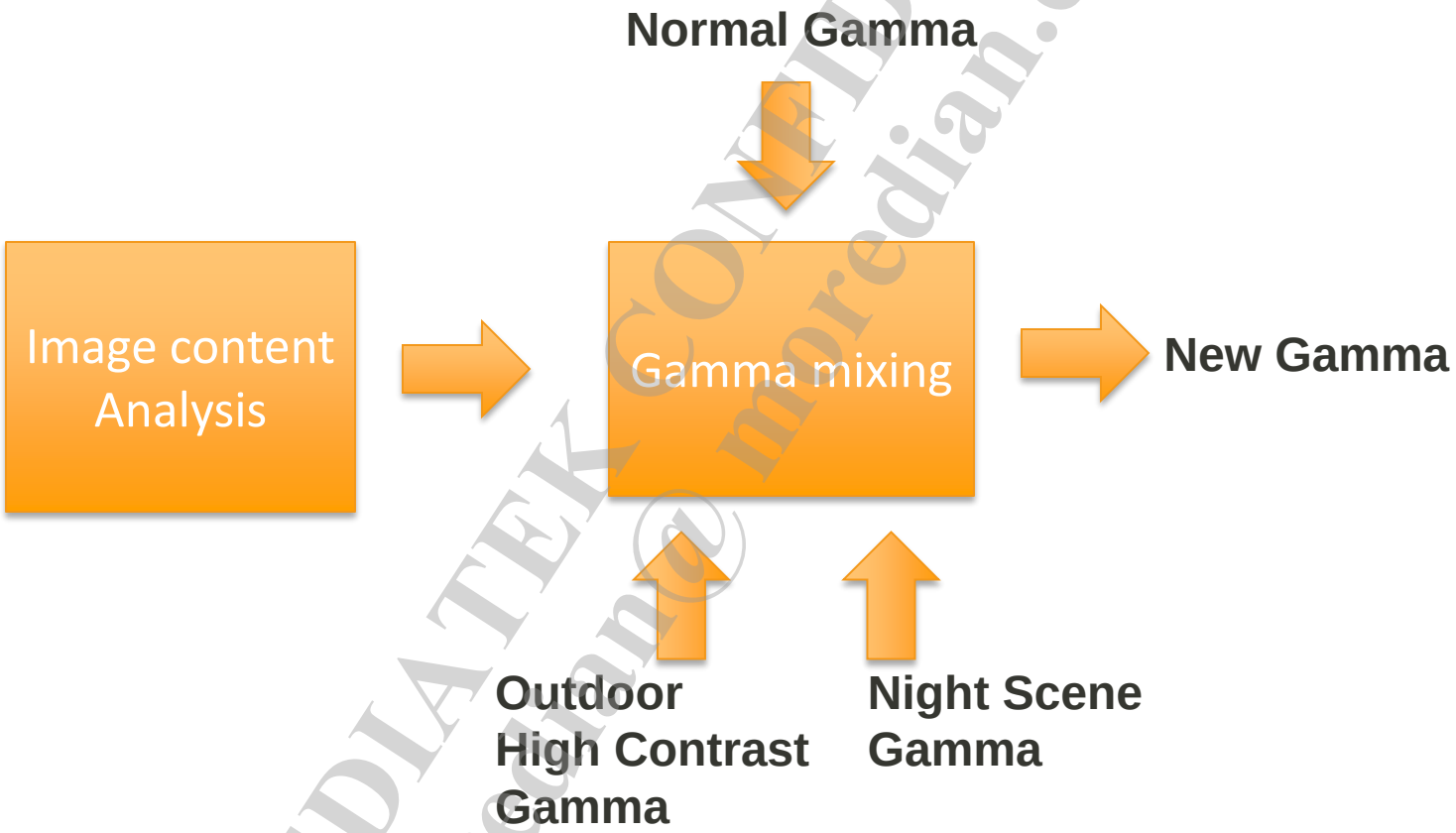
Dynamic Gamma tune

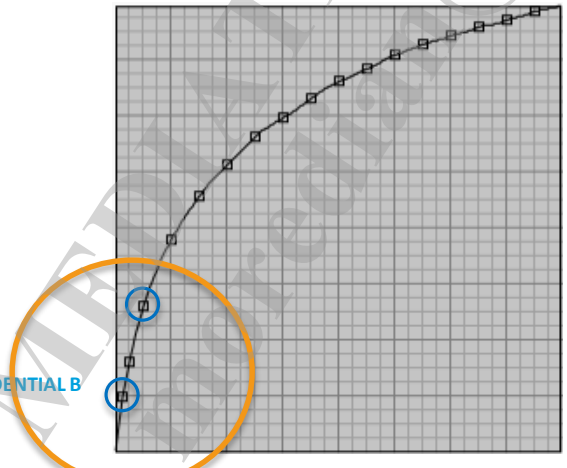


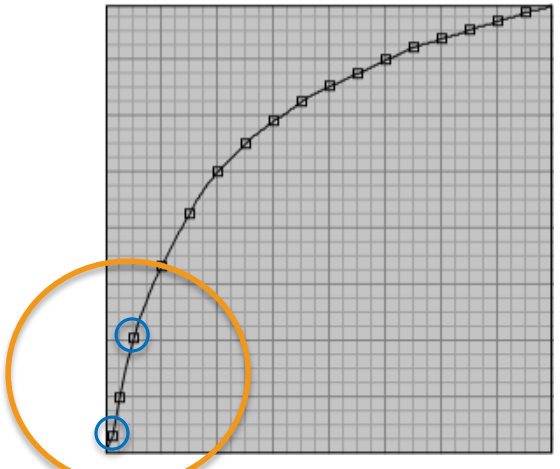
Dynamic Gamma tune

- 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

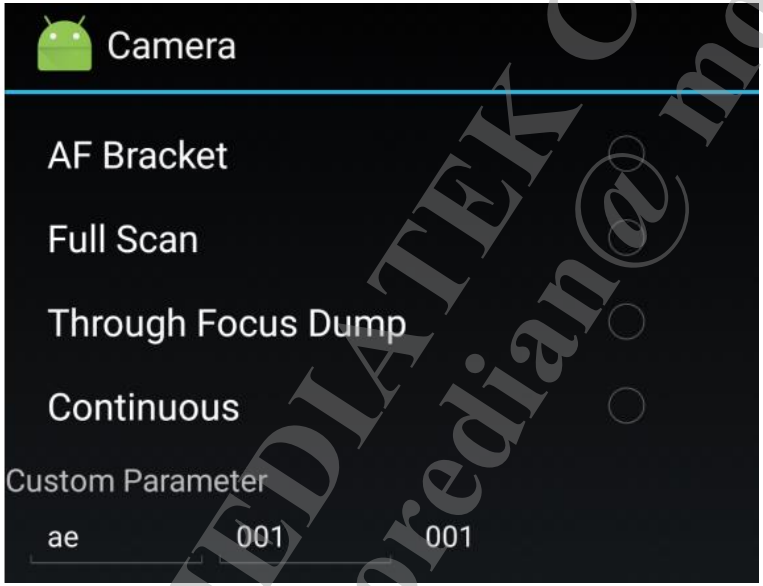
- Outdoor gamma
  - Bypass LCE and adjust outdoor gamma make sure the DT dark enough.





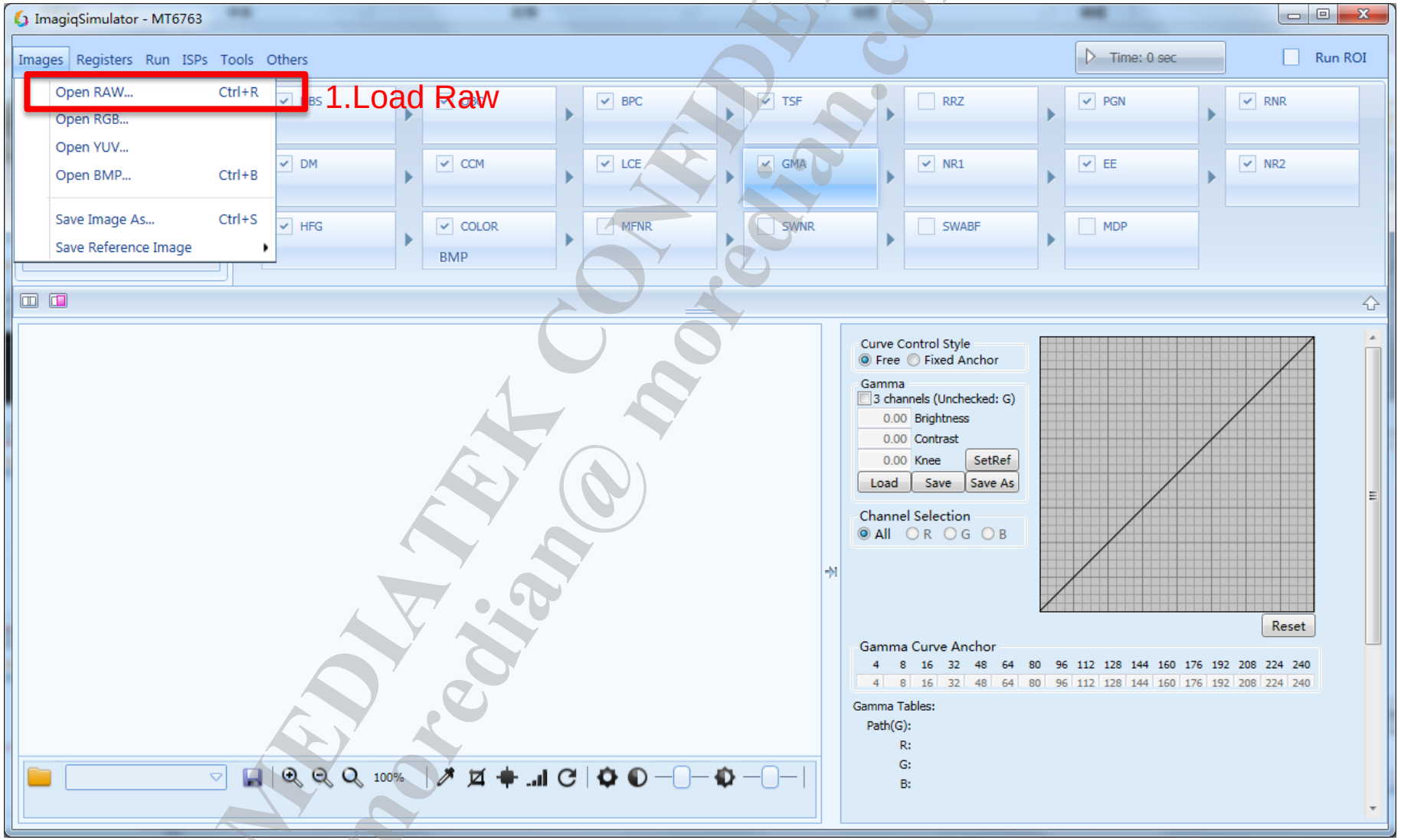
Dynamic Gamma tune

- 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.



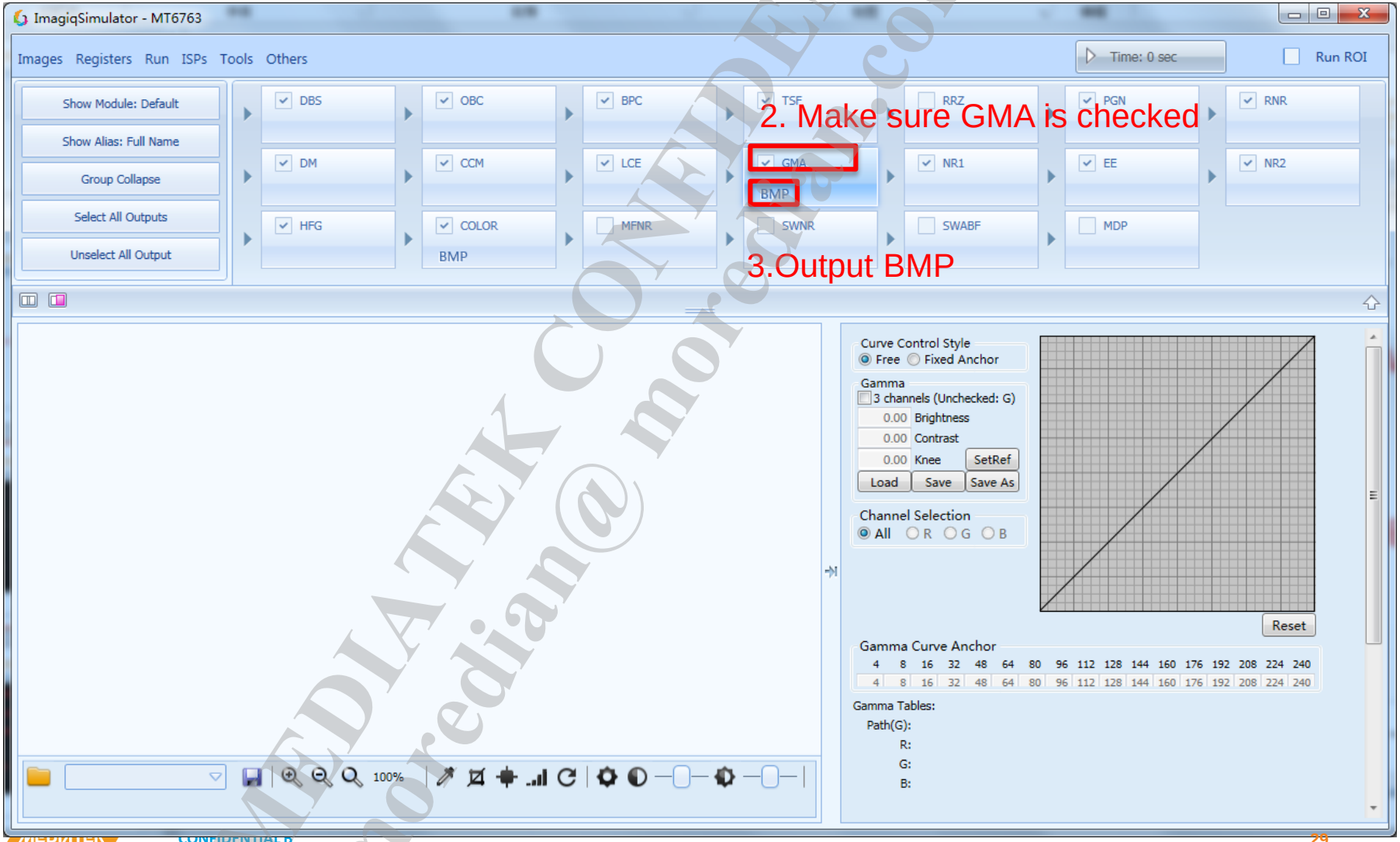
Tune gamma by ImageiqSimulator

- Simulation Gamma



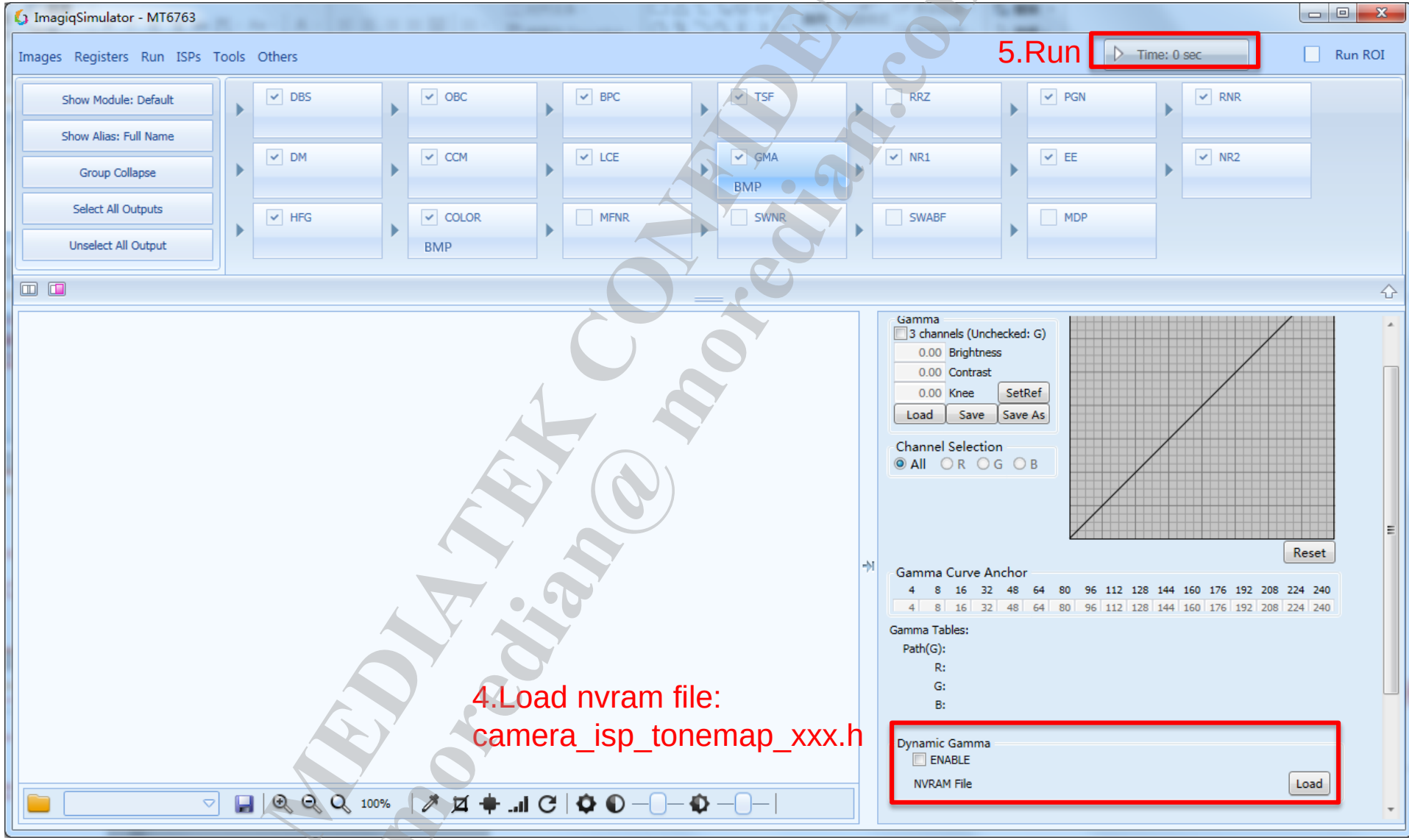
Tune gamma by ImageiqSimulator

- Simulation Gamma



Tune gamma by ImageiqSimulator

- Simulation Gamma



Tune gamma by ImageiqSimulator

- In simulator folder output JPEG_Name_*dynamic_gamma_dbg_info.txt* after simulation.

```
/------ GM Chip/Main/Sub/System Version:6755 3 5 1 -----/
/-C:\Simulate_GGM\Capture20150103-003547ISOAutopure__4208x3120_10_2.raw -/
/----- EXIF -----/
CAM_GMA_GMAMode: = 2
CAM_GMA_SensorMode: = 1
CAM_GMA_ChipVersion: = 6755
CAM_GMA_MainVersion: = 3
CAM_GMA_SubVersion: = 5
CAM_GMA_SystemVersion: = 1
CAM_GMA_EVRatio: = 1024
CAM_GMA_LowContrastThr: = 8
CAM_GMA_LowContrastRatio: = 80
CAM_GMA_LowContrastSeg: = 3
CAM_GMA_Contrast: = 24
CAM_GMA_Contrast_L: = 2
CAM_GMA_Contrast_H: = 3
CAM_GMA_HdrContrastWeight: = 48
CAM_GMA_EVContrastY: = 310
CAM_GMA_ContrastY_L: = 10
CAM_GMA_ContrastY_H: = 10
CAM_GMA_NightContrastWeight: = 0
CAM_GMA_LV: = 115
CAM_GMA_LV_L: = 11
CAM_GMA_LV_H: = 12
CAM_GMA_HdrLVWeight: = 95
CAM_GMA_NightLVWeight: = 0
CAM_GMA_SmoothEnable: = 0
CAM_GMA_SmoothSpeed: = 4
CAM_GMA_SmoothWaitAE: = 1
CAM_GMA_GMACurveEnable: = 0
CAM_GMA_CenterPt: = 1024
CAM_GMA_LowCurve: = 450
CAM_GMA_SlopeL: = 100
CAM_GMA_FlareEnable: = 0
```

6.Version information

7. Contrast/LV value and corresponding weighting

Tune gamma by ImageioSimulator

- In simulator folder output JPEG_Name_*dynamic_gamma_dbg_info.txt* after simulation.

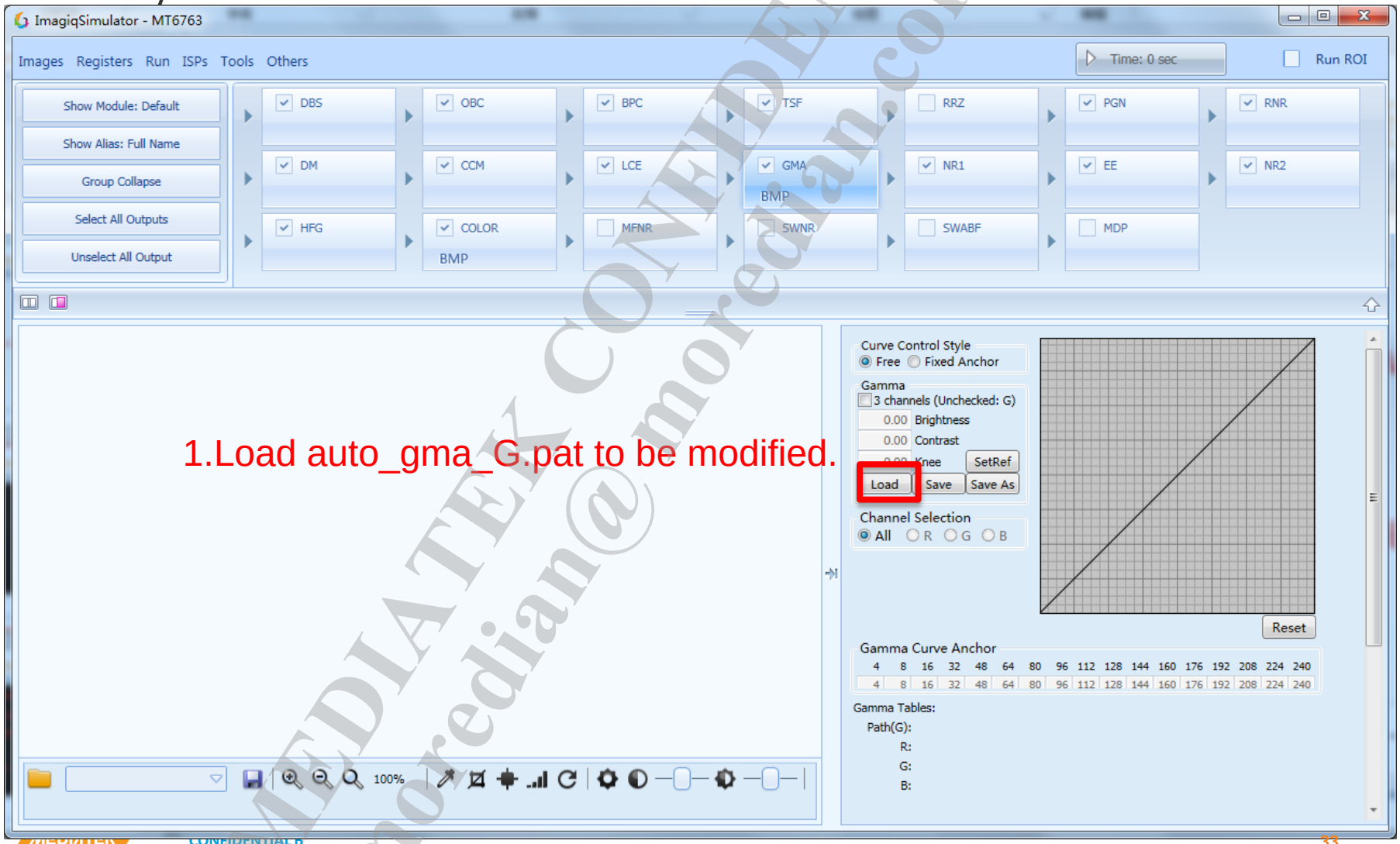
```
/----- GAMMA -----/
[0]   0      0      0      0
[1]   9      22     22     15
[2]   18     44     44     29
[3]   27     64     64     44
[4]   36     84     84     58
[5]   46     106    106    74
[6]   56     128    128    89
[7]   66     142    142    100
[8]   76     156    156    112
[9]   86     168    168    123
[10]  95     180    180    134
[11]  105    194    194    146
[12]  114    208    208    157
[13]  123    220    220    168
[14]  131    232    232    177
[15]  140    240    240    186
[16]  148    248    248    194
[17]  156    258    258    203
[18]  164    268    268    212
[19]  172    276    276    220
[20]  180    284    284    228
[21]  188    292    292    236
[22]  195    300    300    243
[23]  202    310    310    251
[24]  210    320    320    260
[25]  217    328    328    267
[26]  224    336    336    275
[27]  231    344    344    282
[28]  238    352    352    290
[29]  244    360    360    297
[30]  251    368    368    304
[31]  258    376    376    312
[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

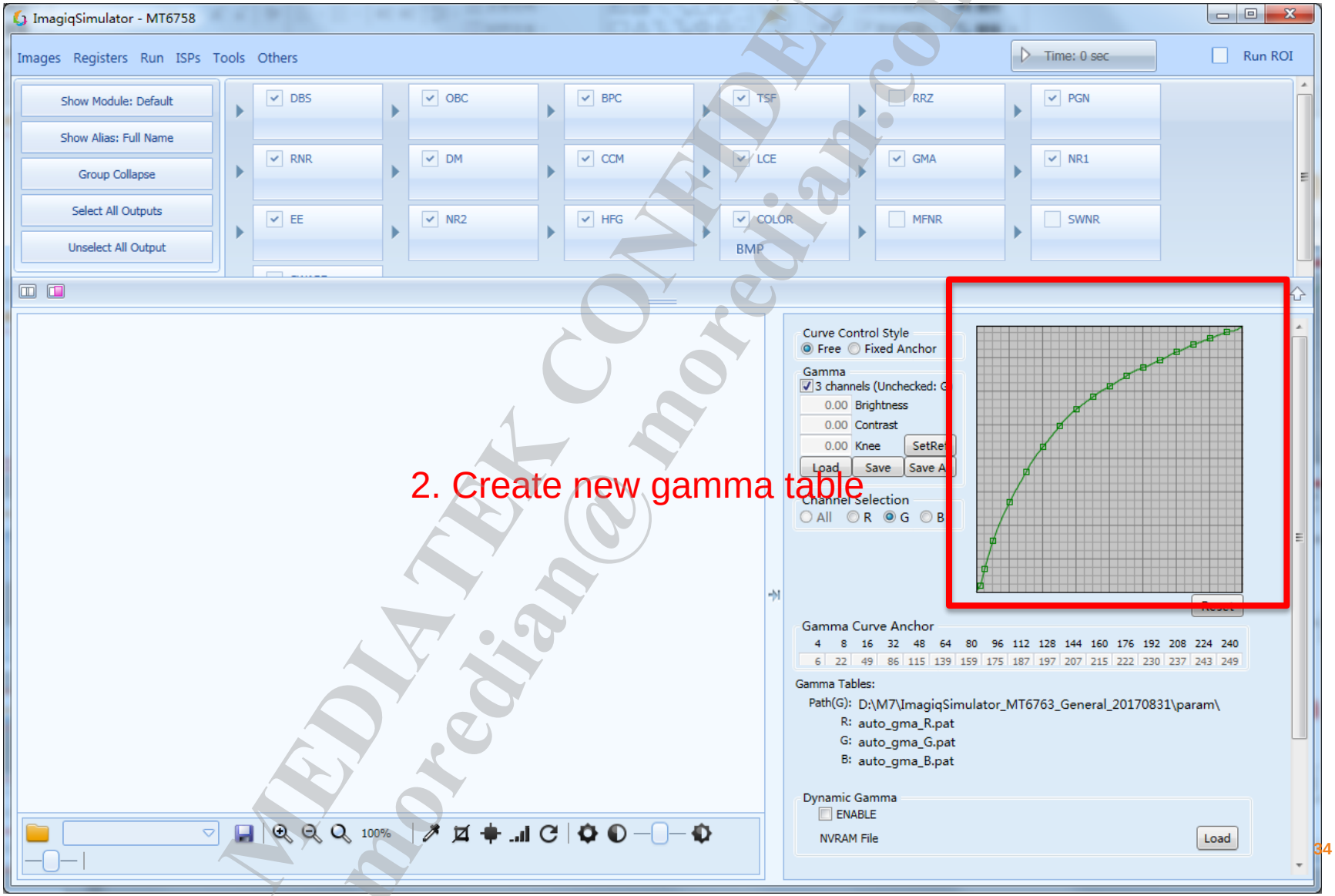
Tune gamma by ImageiqSimulator

- Modify Gamma



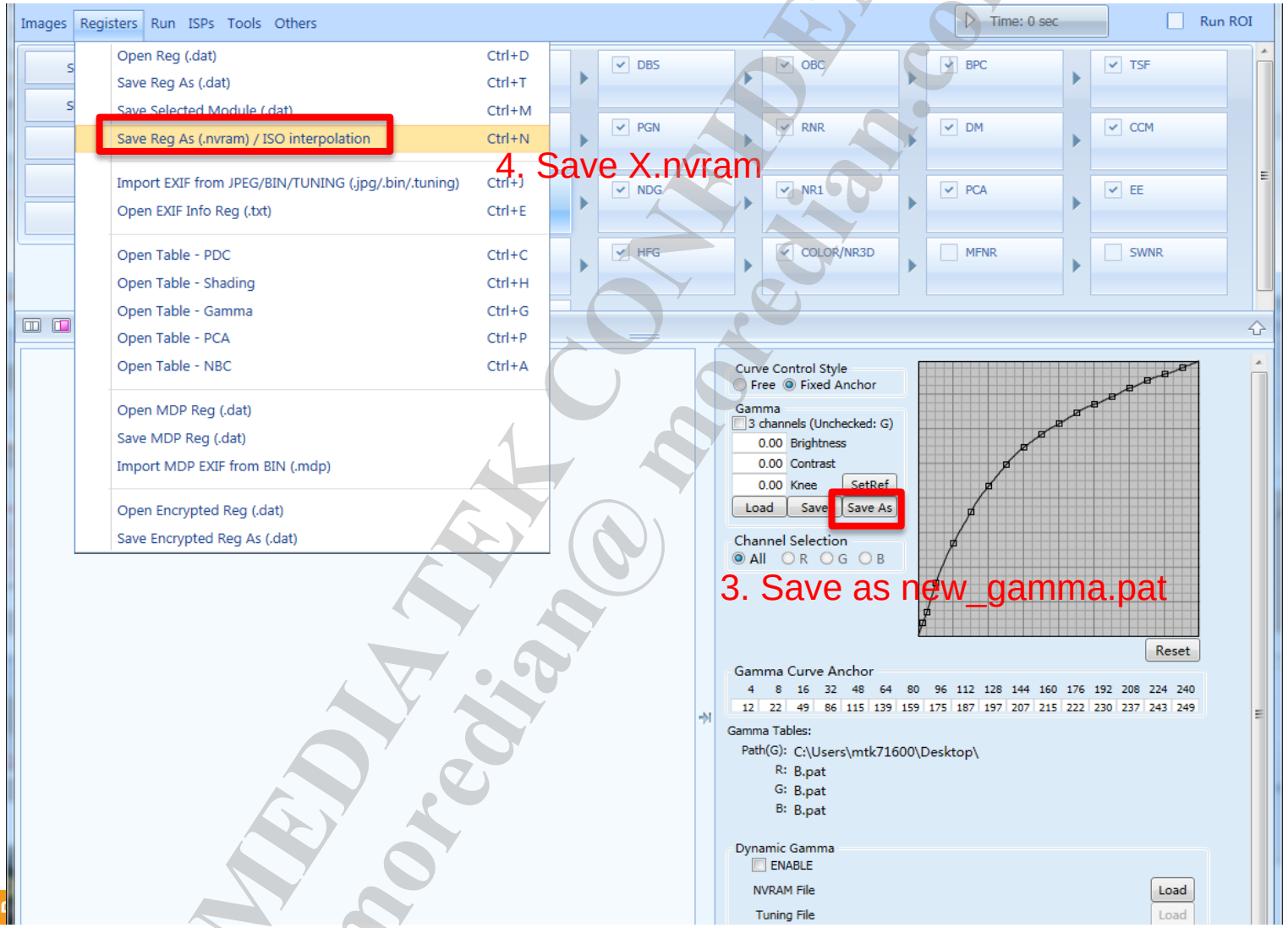
Tune gamma by ImageiqSimulator

- Modify Gamma



Tune gamma by ImageiqSimulator

- Modify Gamma



Tune gamma by ImageiqSimulator

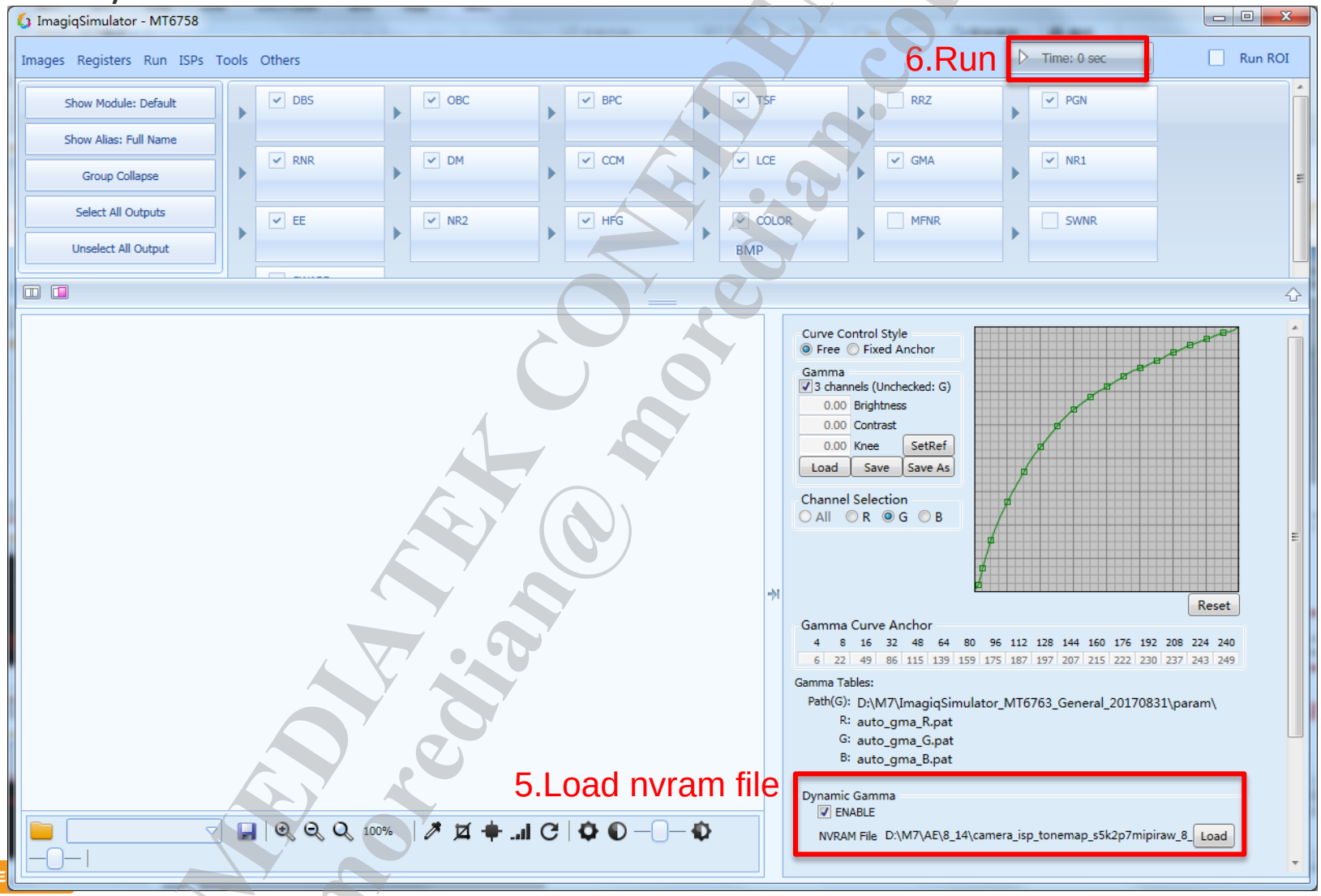
4.Copy x.nvram [GGM] to reg file

```
[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, 0x00C418C4, 0x00CA18CA, 0x00D010D0, 0x00D410D4, 0x00D818D8, 0x00DE18DE, 0x00E418E4, 0x00EA18EA,
0x00F010F0, 0x00F410F4, 0x00F818F8, 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, 0x00001004, 0x00000808, 0x0000080A, 0x0000100C, 0x00001010, 0x00000814, 0x00000816, 0x00002018, 0x00002020,
0x00002028, 0x00002030, 0x00002038, 0x00002040, 0x00002048, 0x00002050, 0x00002058, 0x00002060, 0x00001868, 0x0000186E,
0x00002074, 0x0000207C, 0x00001884, 0x0000188A, 0x00001890, 0x00001896, 0x0000209C, 0x000020A4, 0x000018AC, 0x000018B2,
0x000018B8, 0x000018BE, 0x000018C4, 0x000018CA, 0x000010D0, 0x000010D4, 0x000018D8, 0x000018DE, 0x000018E4, 0x000018EA,
0x000010F0, 0x000010F4, 0x000018F8, 0x000018FE, 0x00001104, 0x00001108, 0x0000110C, 0x00001110, 0x00001914, 0x0000191A,
0x00001120, 0x00001124, 0x00001128, 0x0000112C, 0x00001130, 0x00001134, 0x00001138, 0x0000113C, 0x00001140, 0x00001144,
0x00001148, 0x0000114C, 0x00001150, 0x00001154, 0x00002158, 0x00002160, 0x00002168, 0x00002170, 0x00002178, 0x00002180,
0x00001188, 0x0000218C, 0x00002194, 0x0000219C, 0x000011A4, 0x000021A8, 0x000021B0, 0x000021B8, 0x000011C0, 0x000021C4,
0x000021CC, 0x000021D4, 0x000021DC, 0x000021E4, 0x000011EC, 0x000021F0, 0x000011F8, 0x000021FC, 0x00001204, 0x00002208,
0x00001210, 0x00001214, 0x00001218, 0x0000221C, 0x00001224, 0x00001228, 0x0000322C, 0x00002238, 0x00003240, 0x0000224C,
0x00003254, 0x00002260, 0x00003268, 0x00002274, 0x0000327C, 0x00002288, 0x00002290, 0x00002298, 0x000022A0, 0x000022A8,
0x000012B0, 0x000022B4, 0x000022BC, 0x000012C4, 0x000022C8, 0x000012D0, 0x000022D4, 0x000012DC, 0x000022E0, 0x000012E8,
0x000012EC, 0x000022F0, 0x000012F8, 0x000022FC, 0x00001304, 0x00001308, 0x0000130C, 0x00001310, 0x00005314, 0x00005328,
0x0000533C, 0x00003350, 0x0000335C, 0x00004368, 0x00004378, 0x00004388, 0x00003398, 0x000043A4, 0x000033B4, 0x000033C0,
0x000033CC, 0x000033D8, 0x000023E4, 0x00004FEC
}}},
```

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

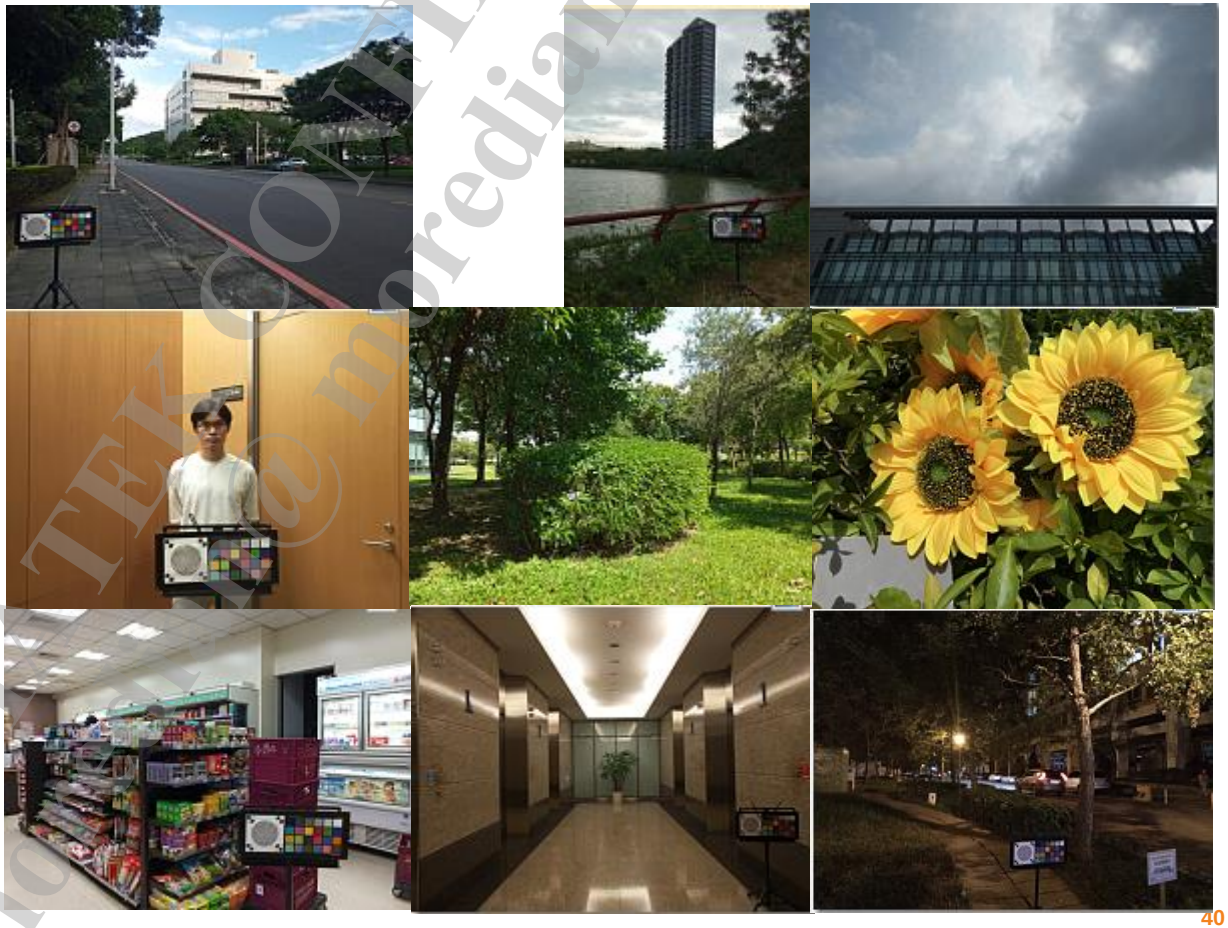
(2)outdoor

(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,                      // TargetBVRatioTbl.i4X1 :BV
    64,                           // TargetBVRatioTbl.i4Y1 :Target
    4000,                       // TargetBVRatioTbl.i4X2  :BV
    66                           // TargetBVRatioTbl.i4Y2 :Target
},
```

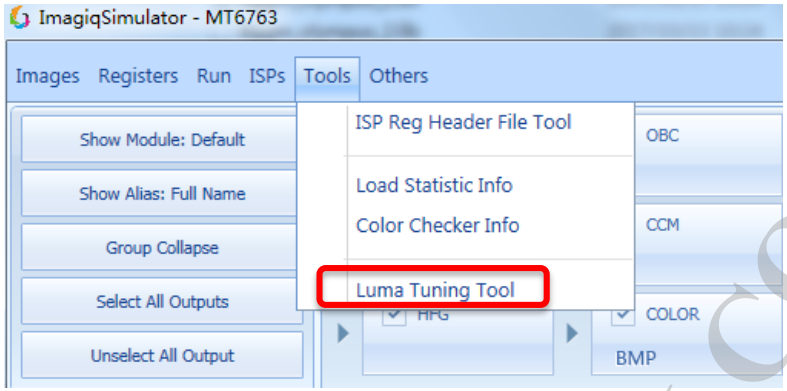
```
static strHSv4p0CFG g_HSv4p0CFG =
{
    TRUE,                       //bEnableHSv4p0
    1024,                       //u4HSv4p0Weight
    5,                          //u4BVSize
    5,                          //u4EVDSize
    {1000, 2000, 4000, 8200, 10000},
    {80,     75,    60,     20,    15},
    {1000, 2200, 3500, 5100, 6800},    //u
    {
        //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},
    },
```

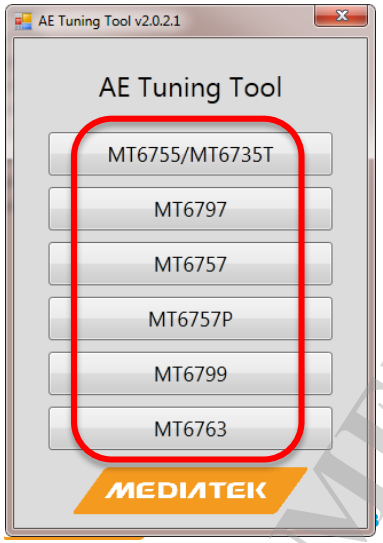
AE Advanced Tuning tool

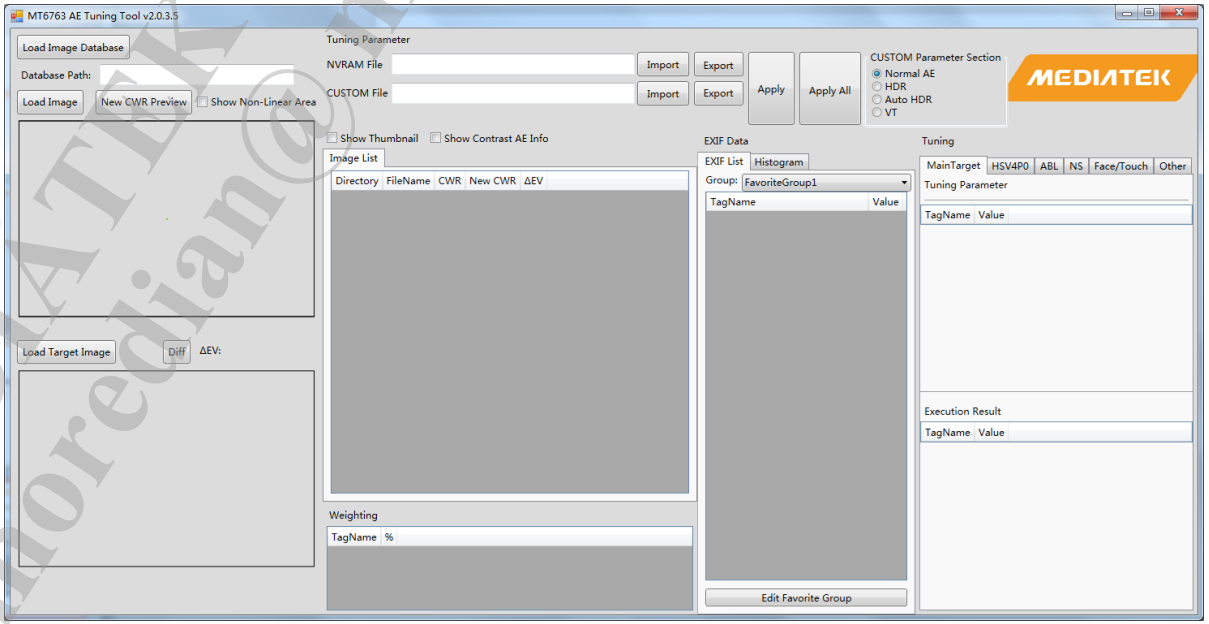
- AE tuning tool can be use for advanced tuning.
  - Histogram.
  - New CWR preview
  - Show Non-Linear Area.
  - Luminance, R, G, B Mean.
  - Selected area EV diff.
  - Show Contrast AE Info.

Startup Screen

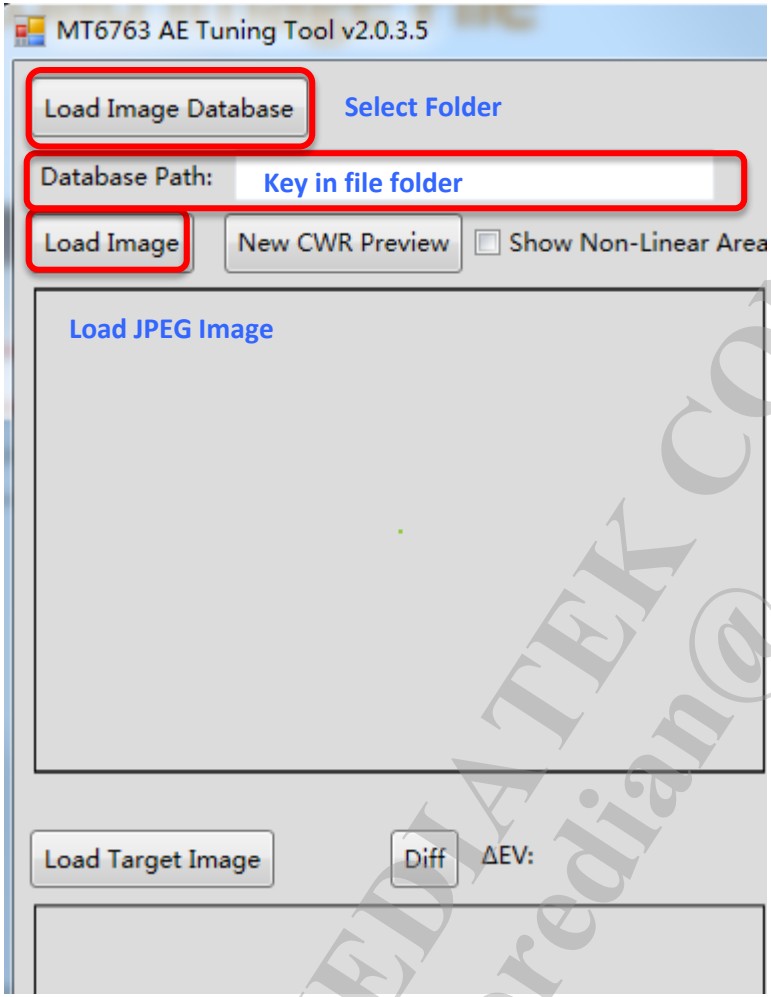
- Click on imageiqSimulator “Luma Tuning Tool” can start support projects interface, select project name to enter tuning tool.







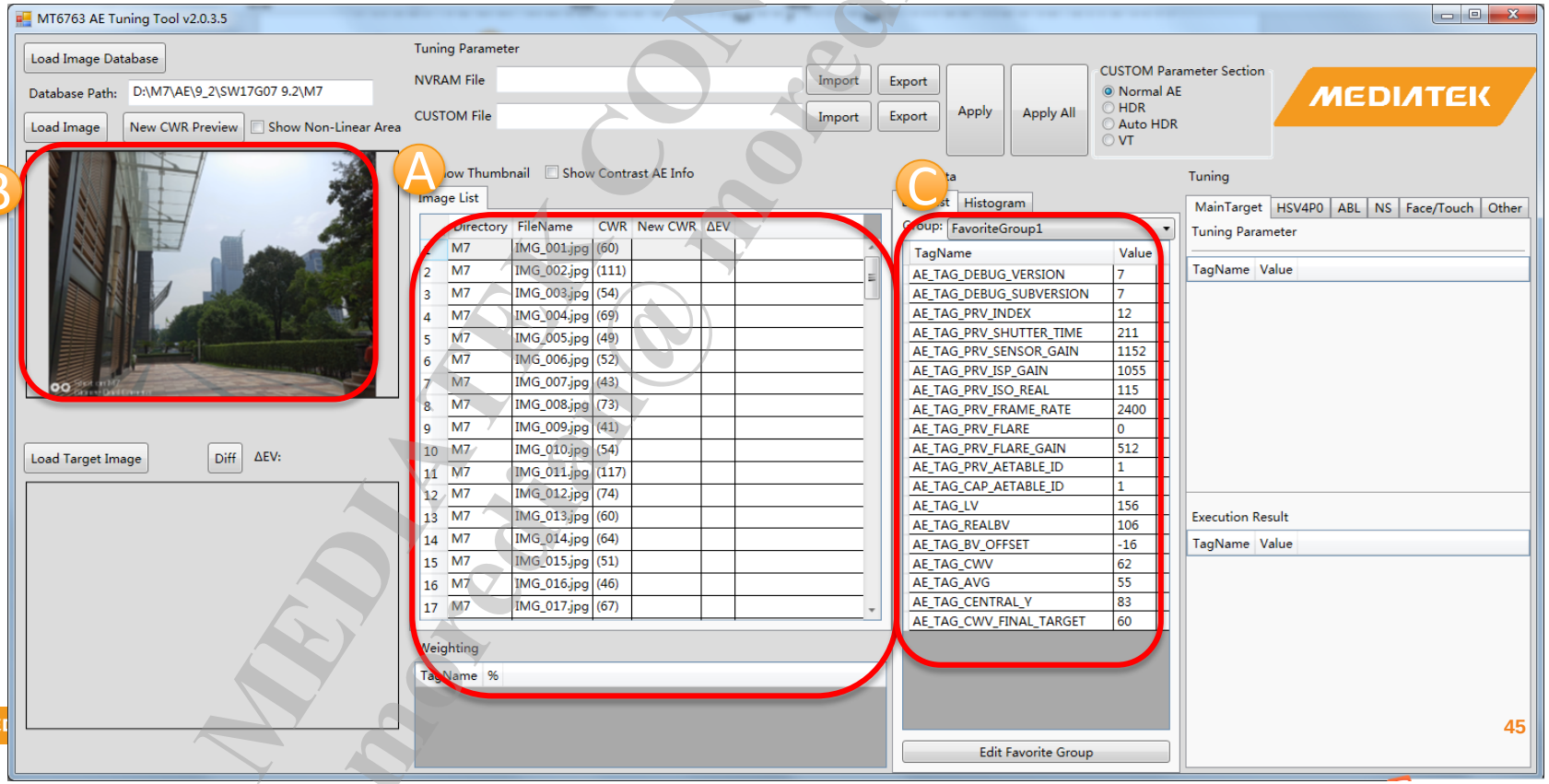
Load Image File



- 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.

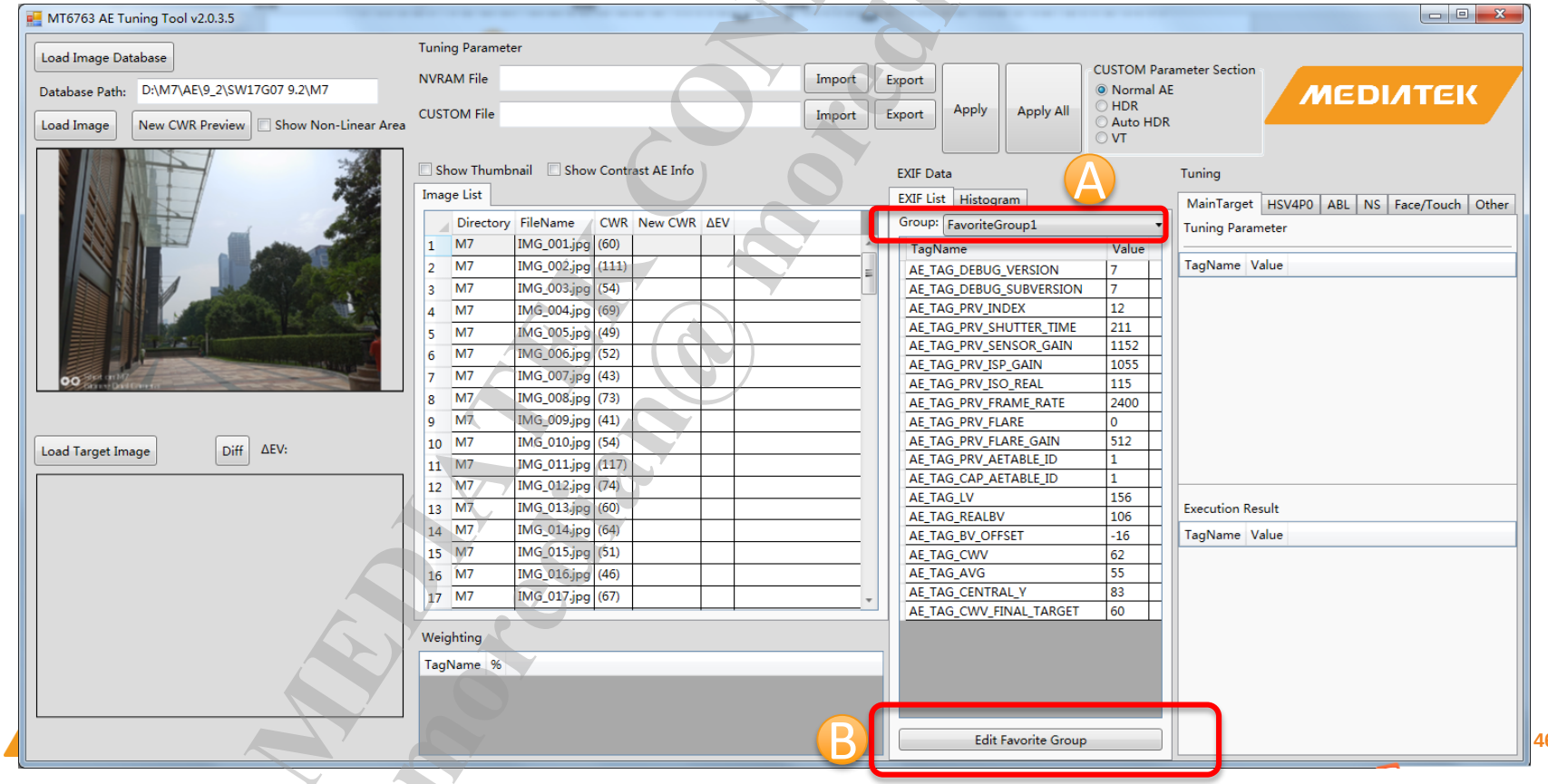
Load Image File

- 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.



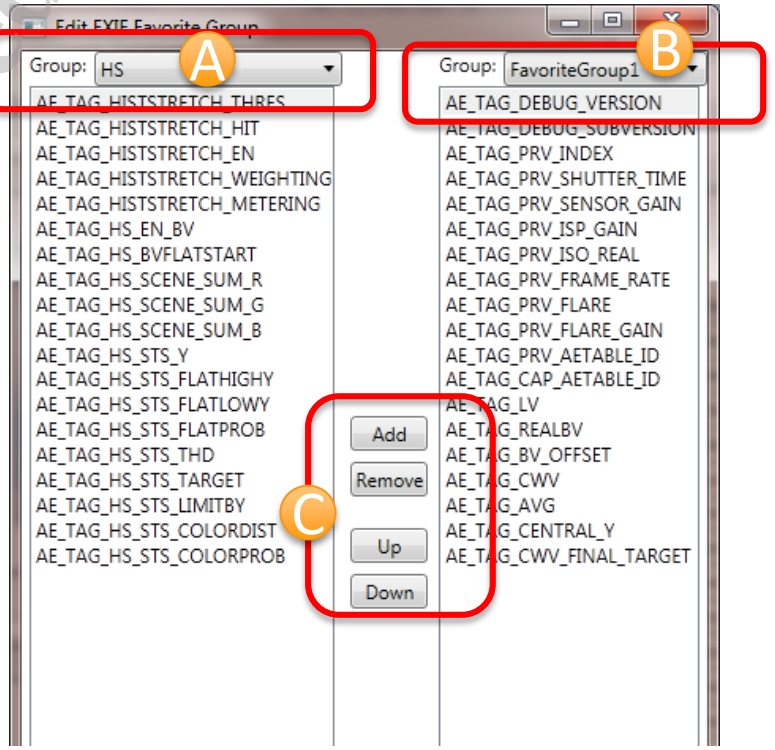
Load Image File
EXIF List (1/2)

- 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.



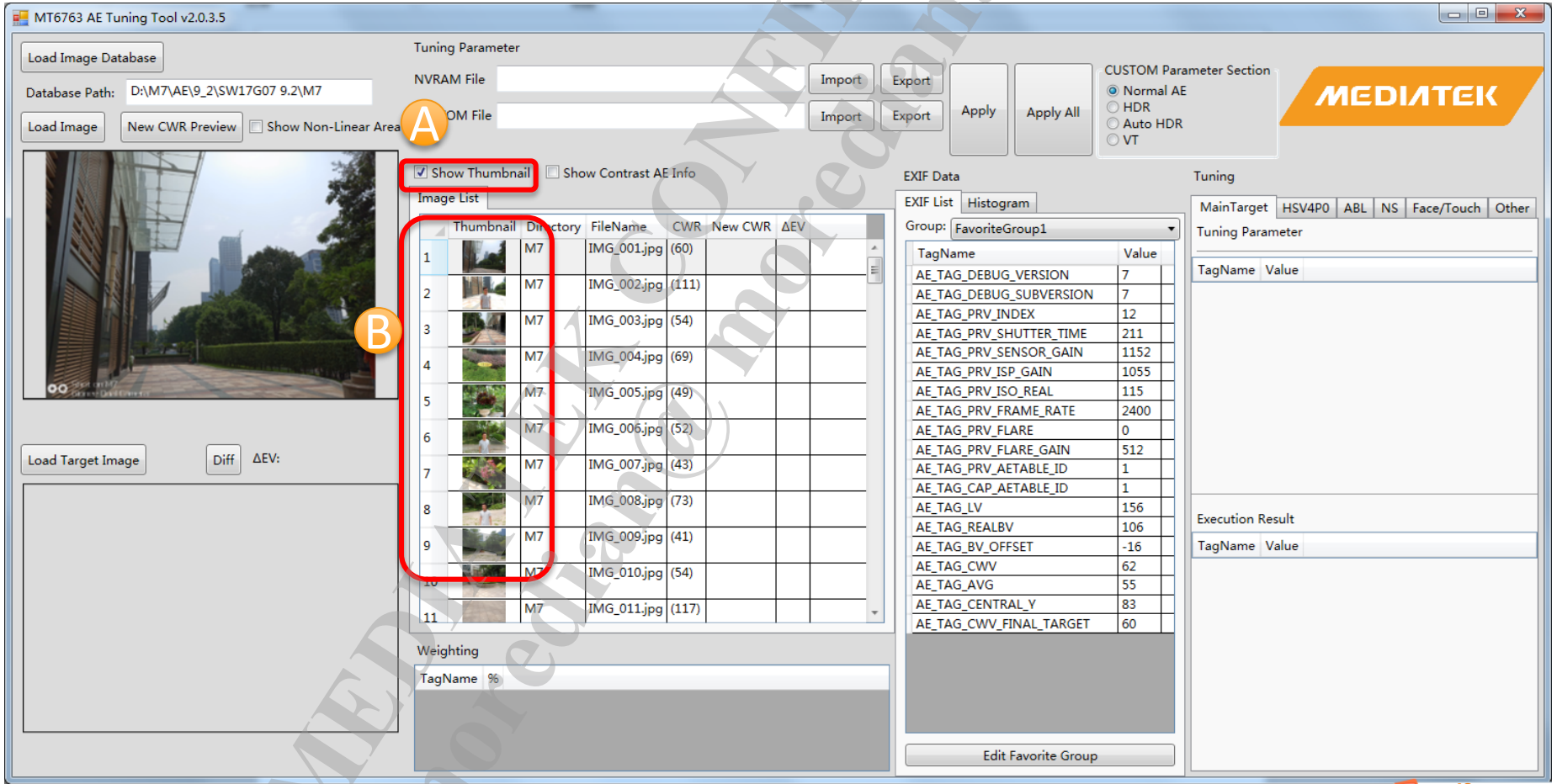
Load Image File
EXIF List (2/2)

- 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.



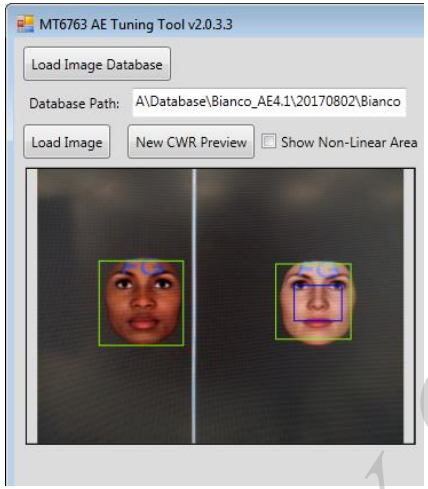
Load Image File
Image list Thumbnail

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

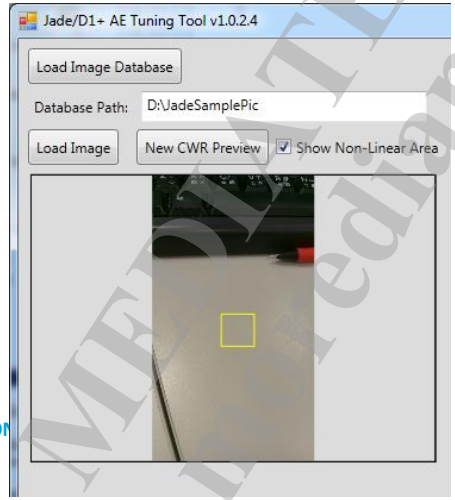


Load Image File
Face and Touch Rectangle

- Face rectangle is Green Color

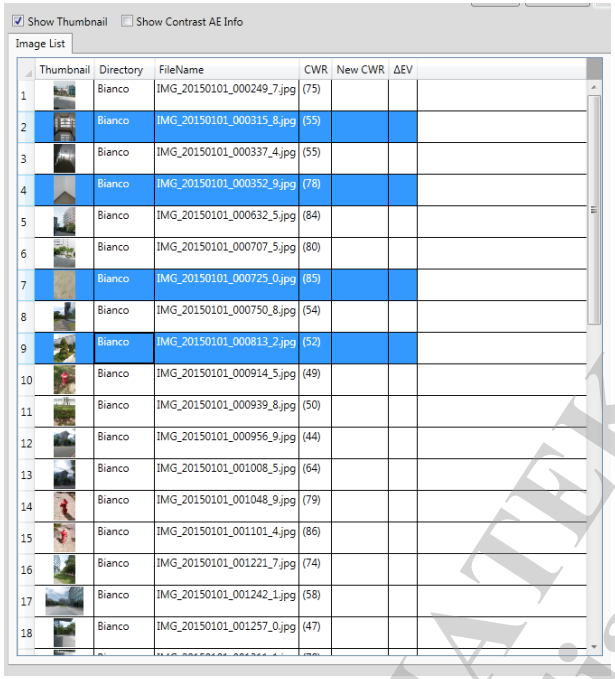


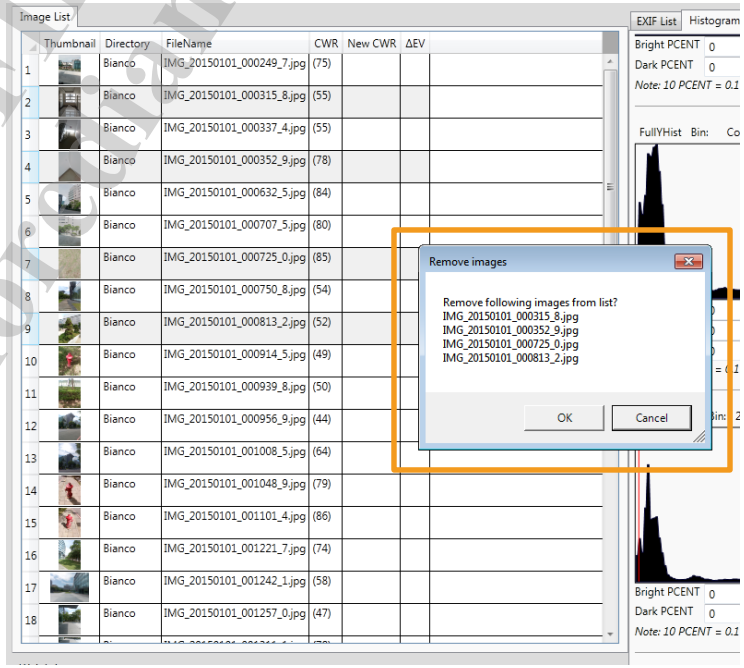
- Touch rectangle is Yellow Color.



Remove Image File

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



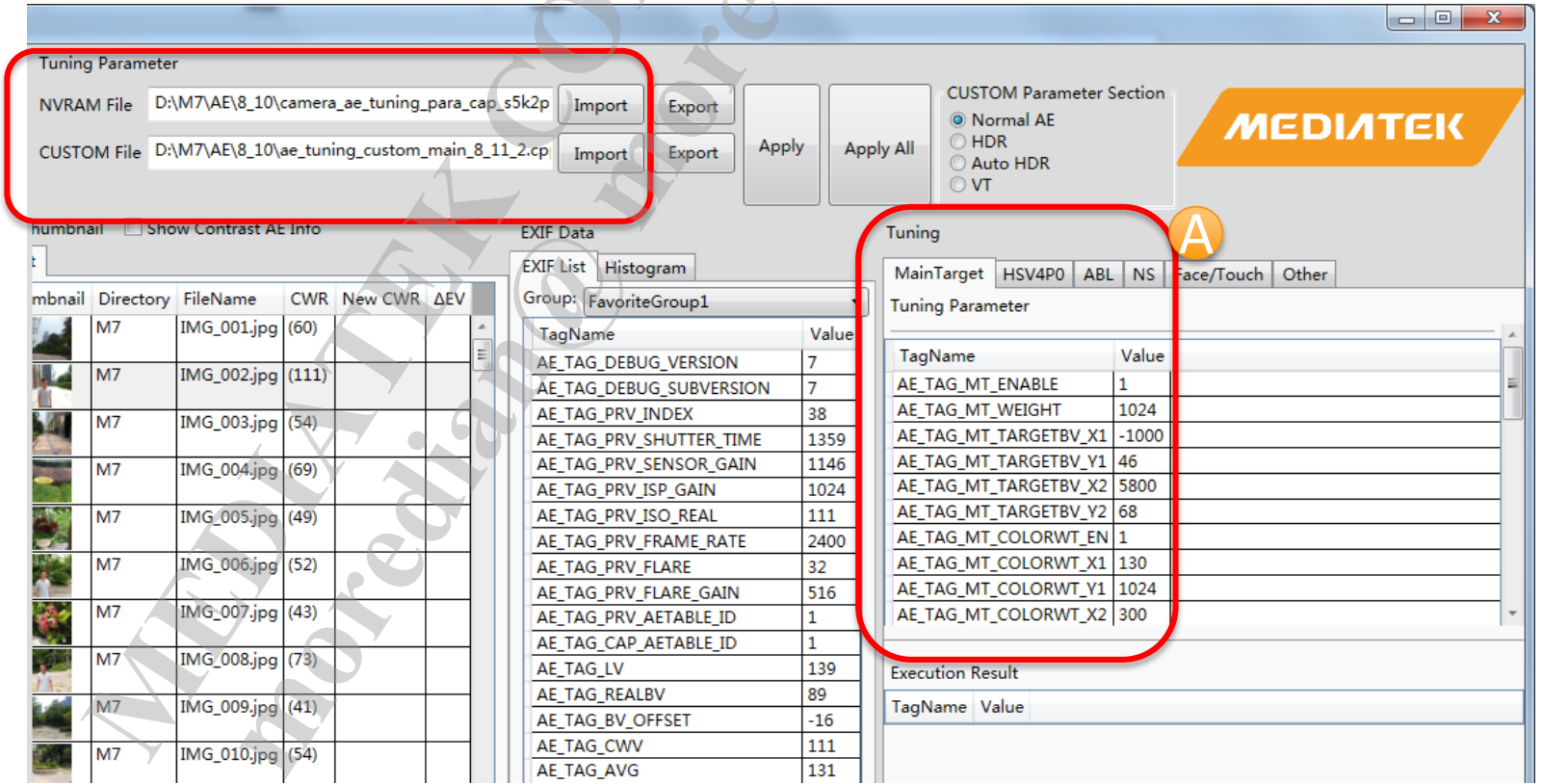


1. Select pictures to remove and then press delete key.

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.

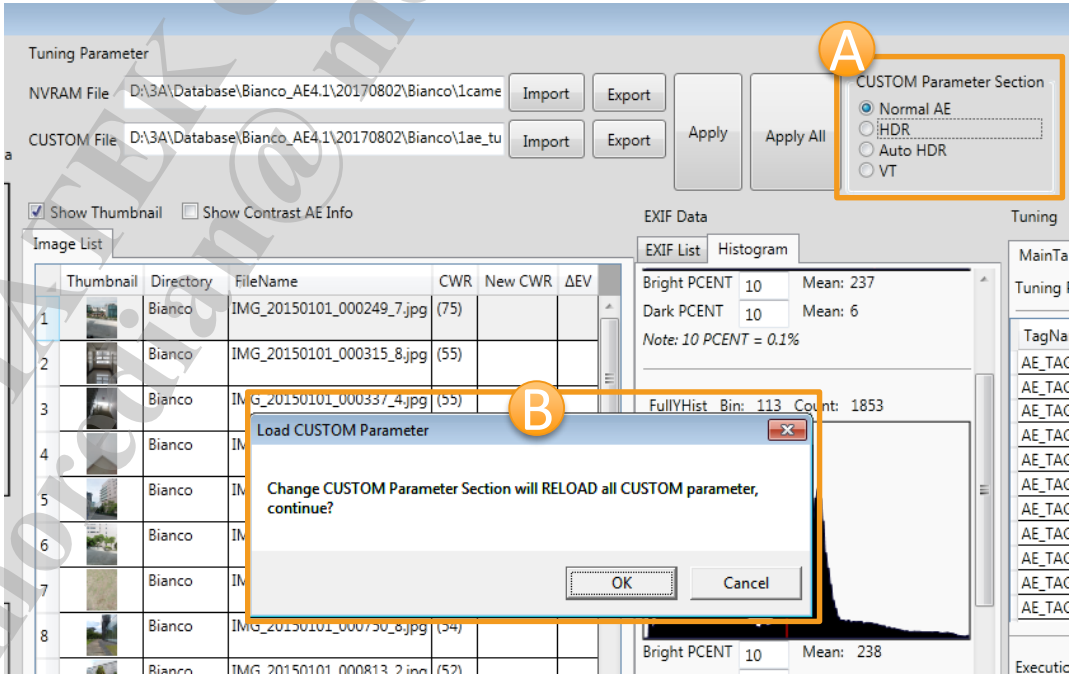


Import Tuning Parameter

- 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.

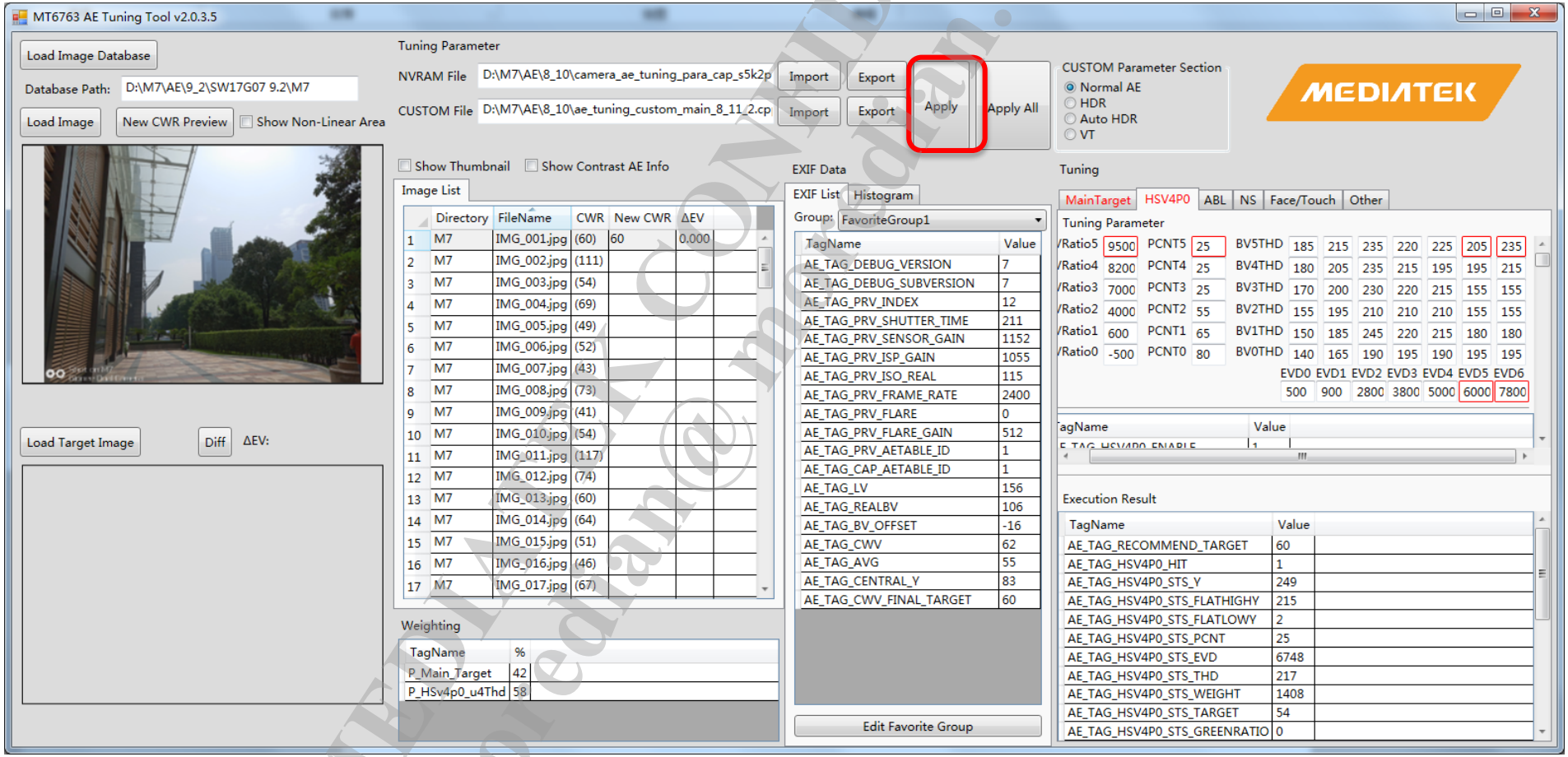
Import/Export Tuning Parameter
Multi mode AE parameter support

- 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.



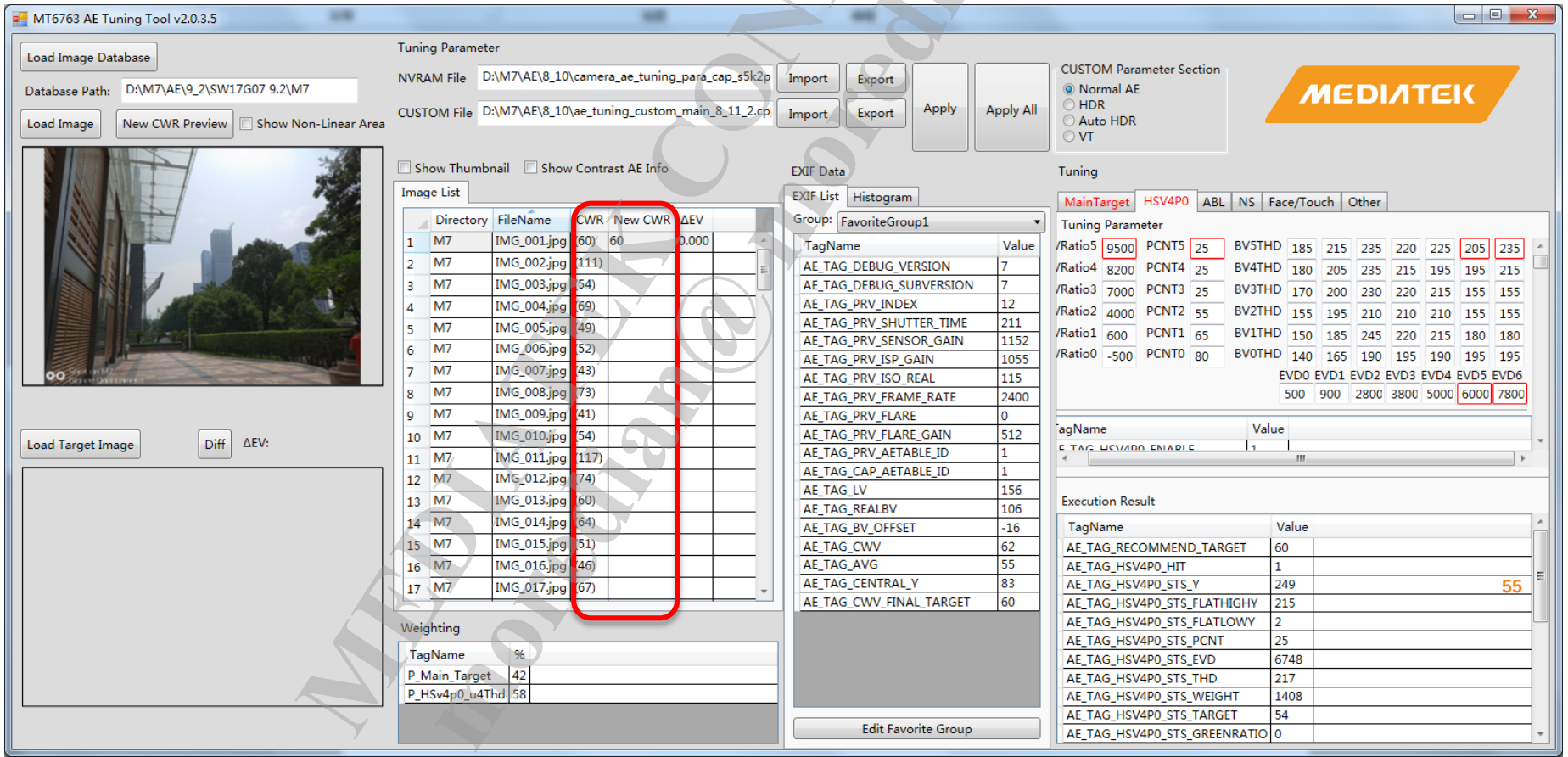
Basic tuning
Select Image for tuning

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



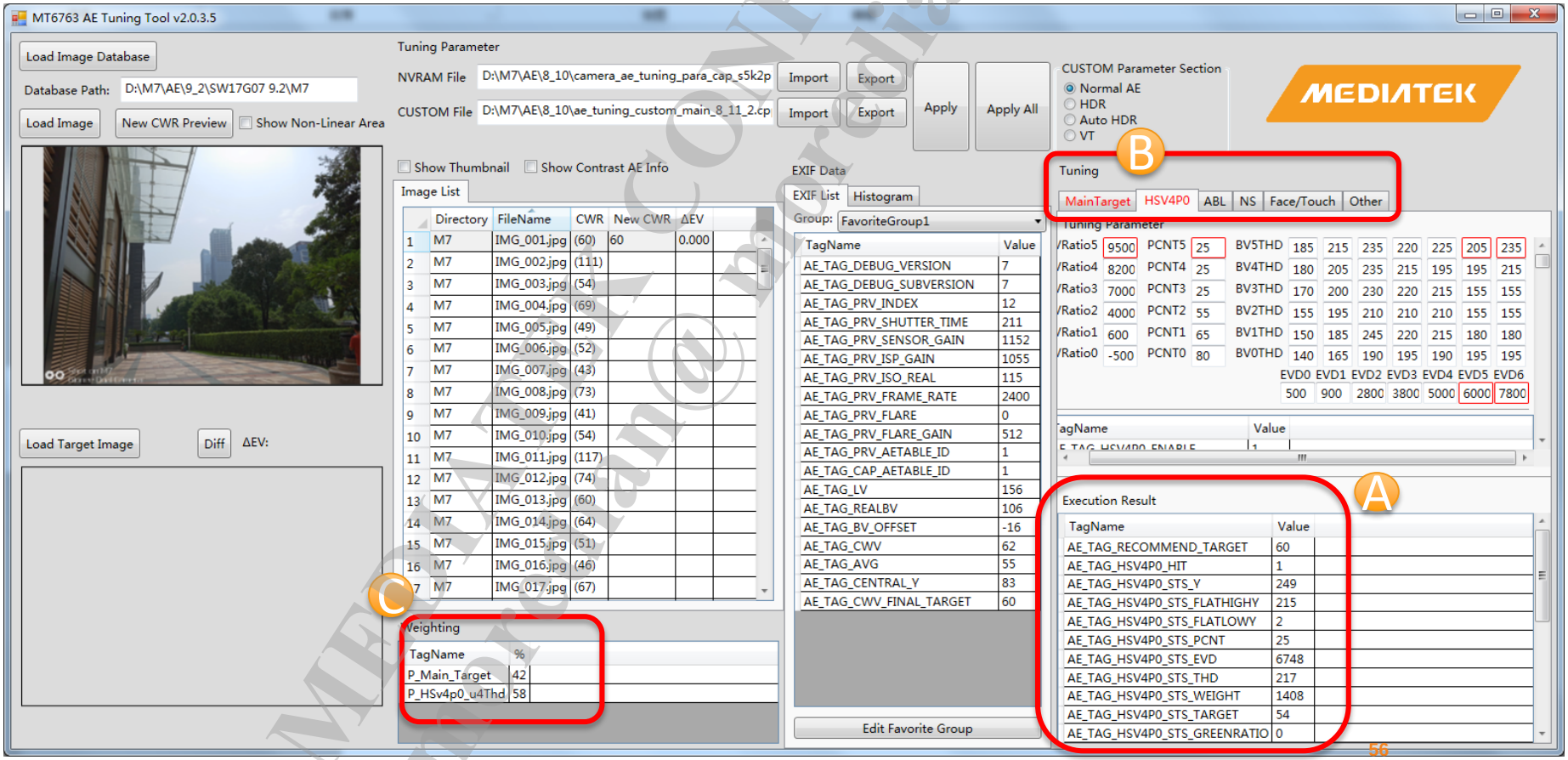
Basic tuning New CWR

	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.



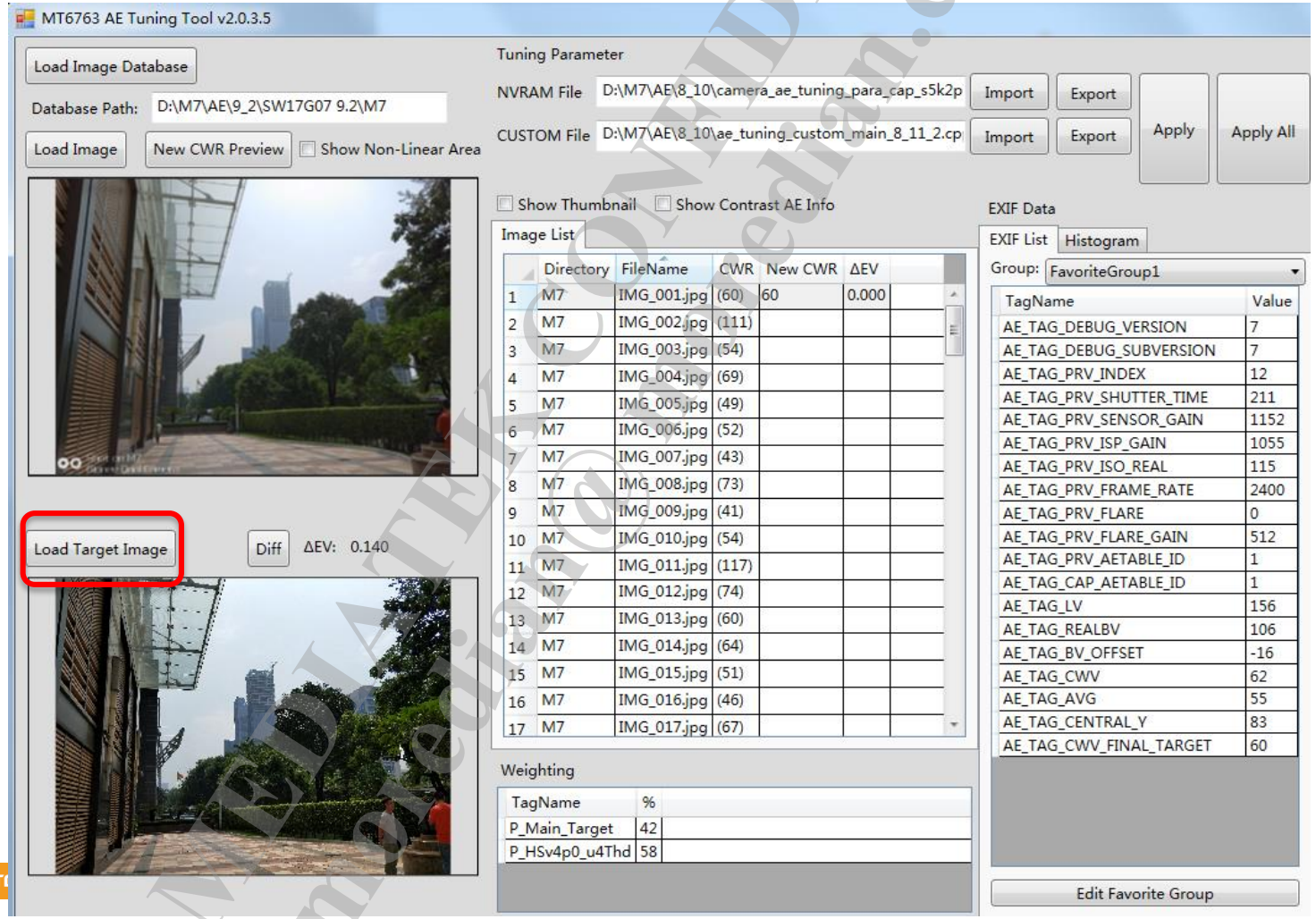
Basic tuning
Execution result

- 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.



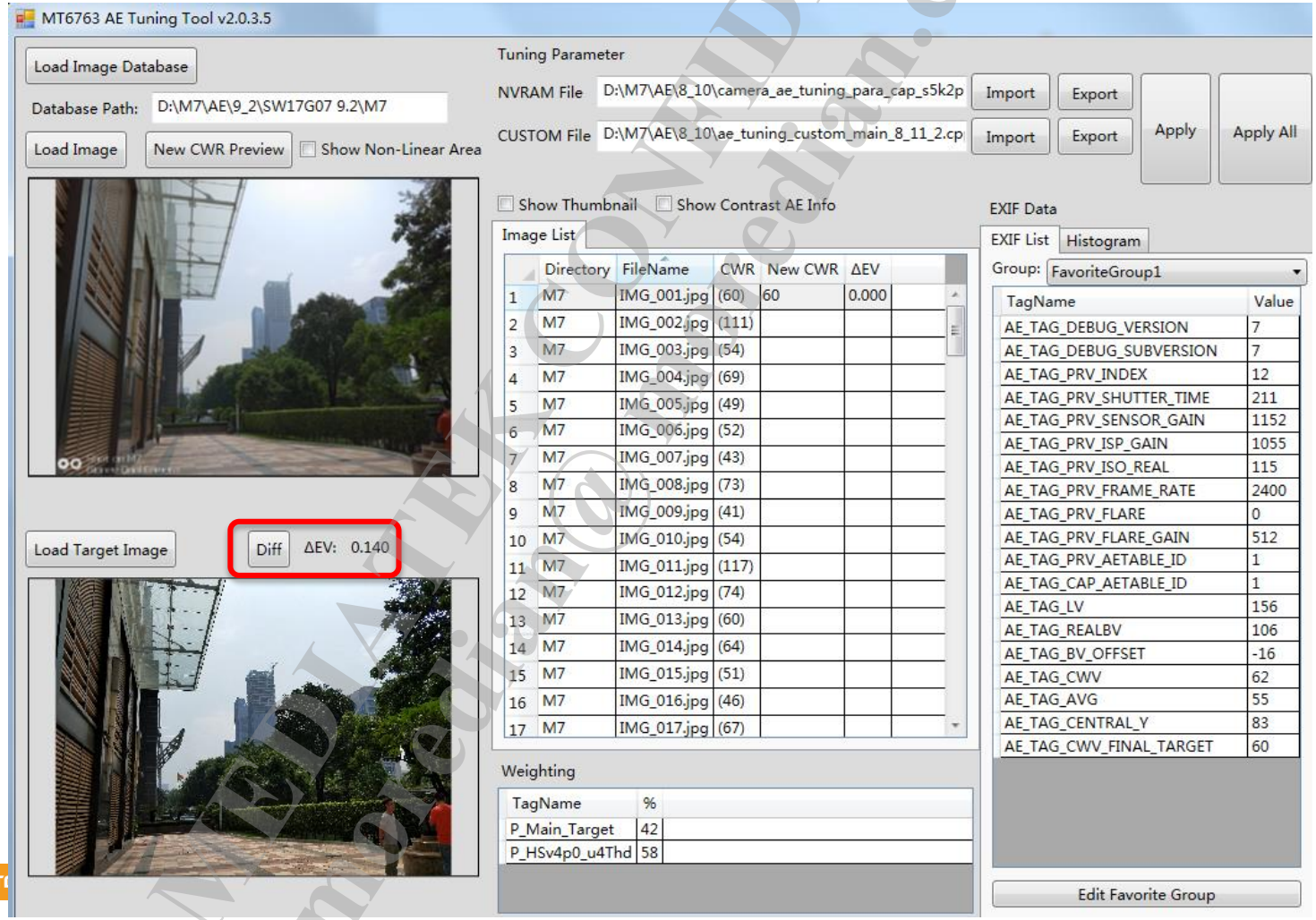
Basic tuning
Load Target Image

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



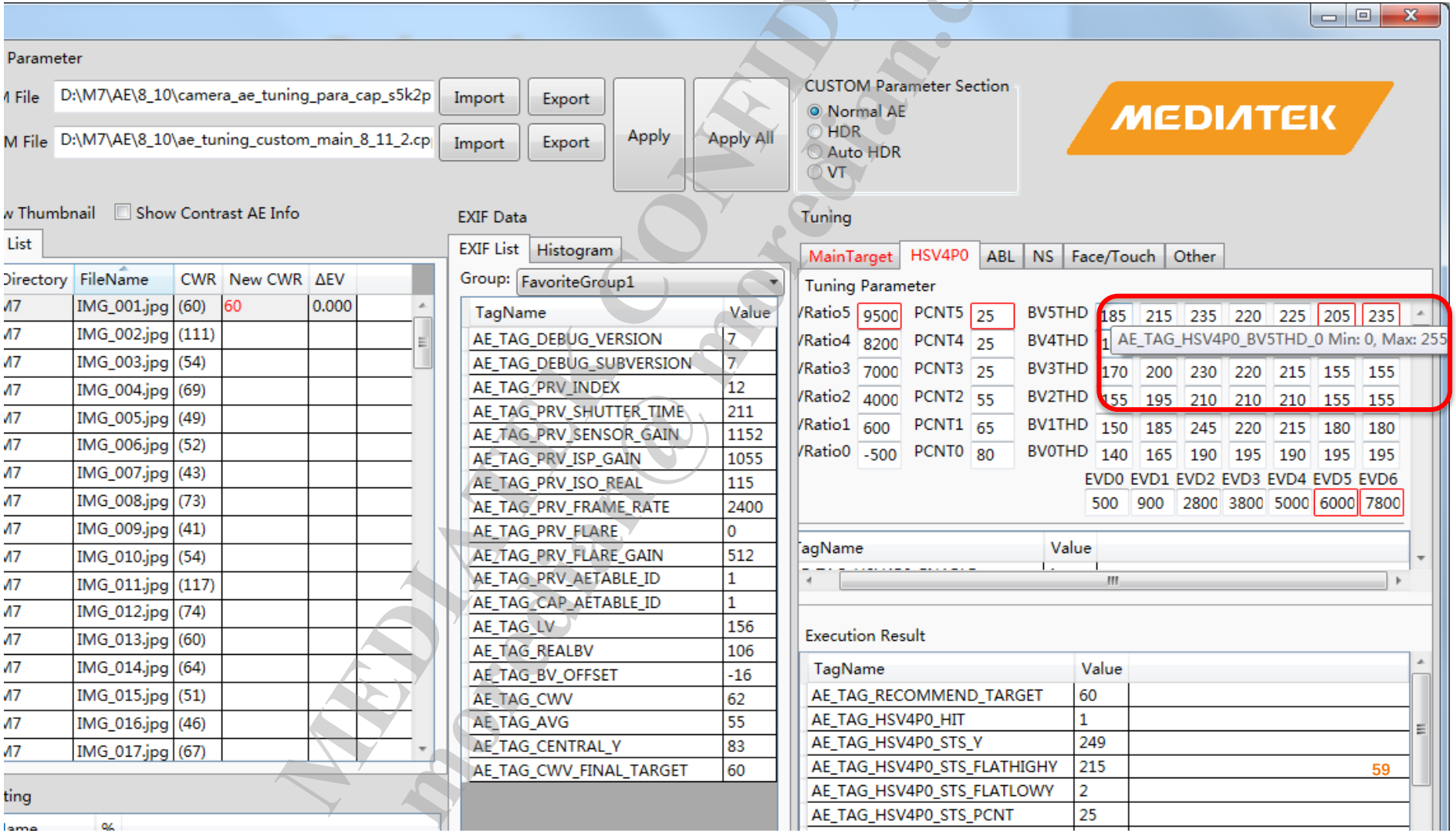
Basic tuning
EV Diff

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



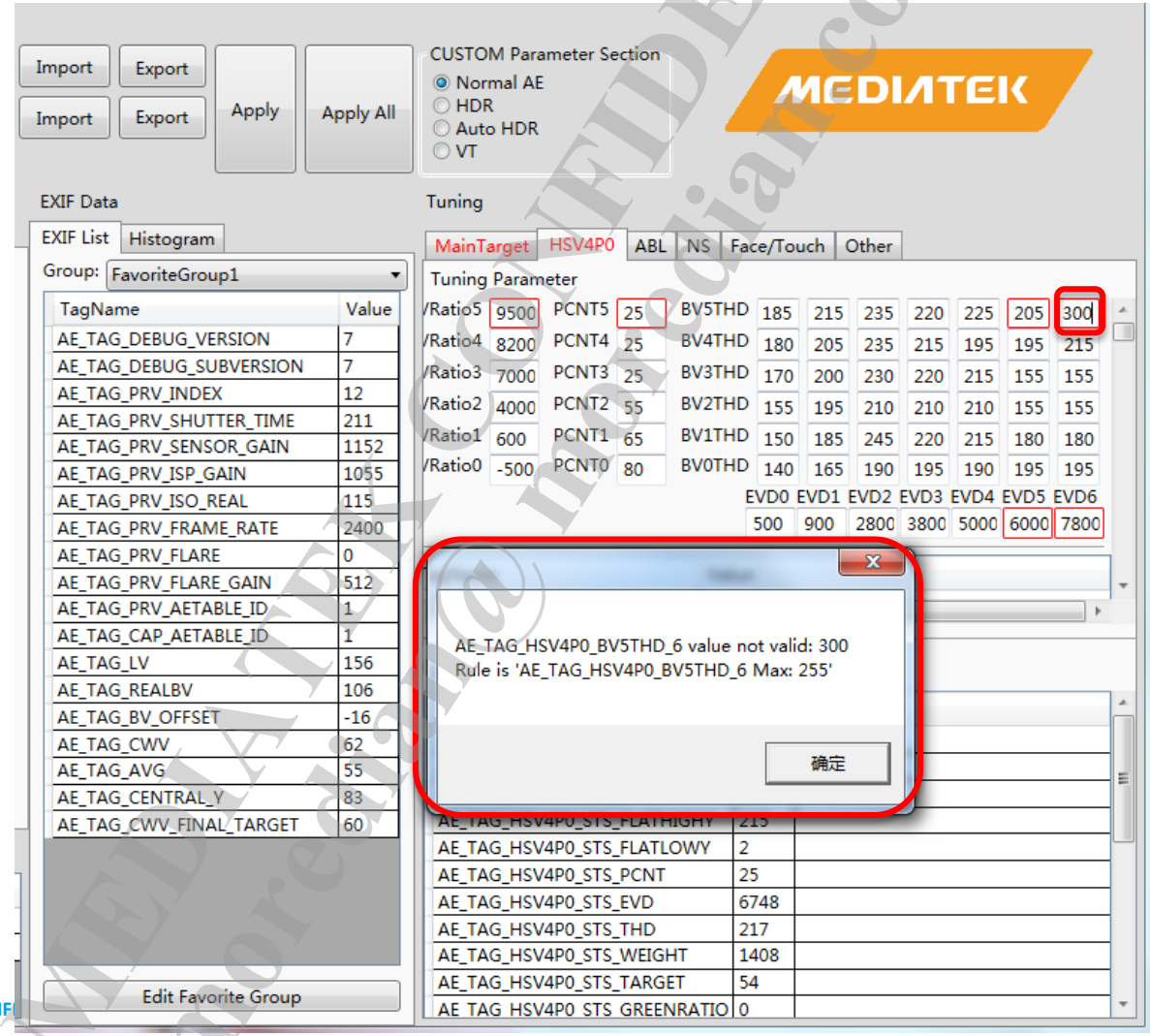
Basic tuning
Tuning parameter tool tips

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



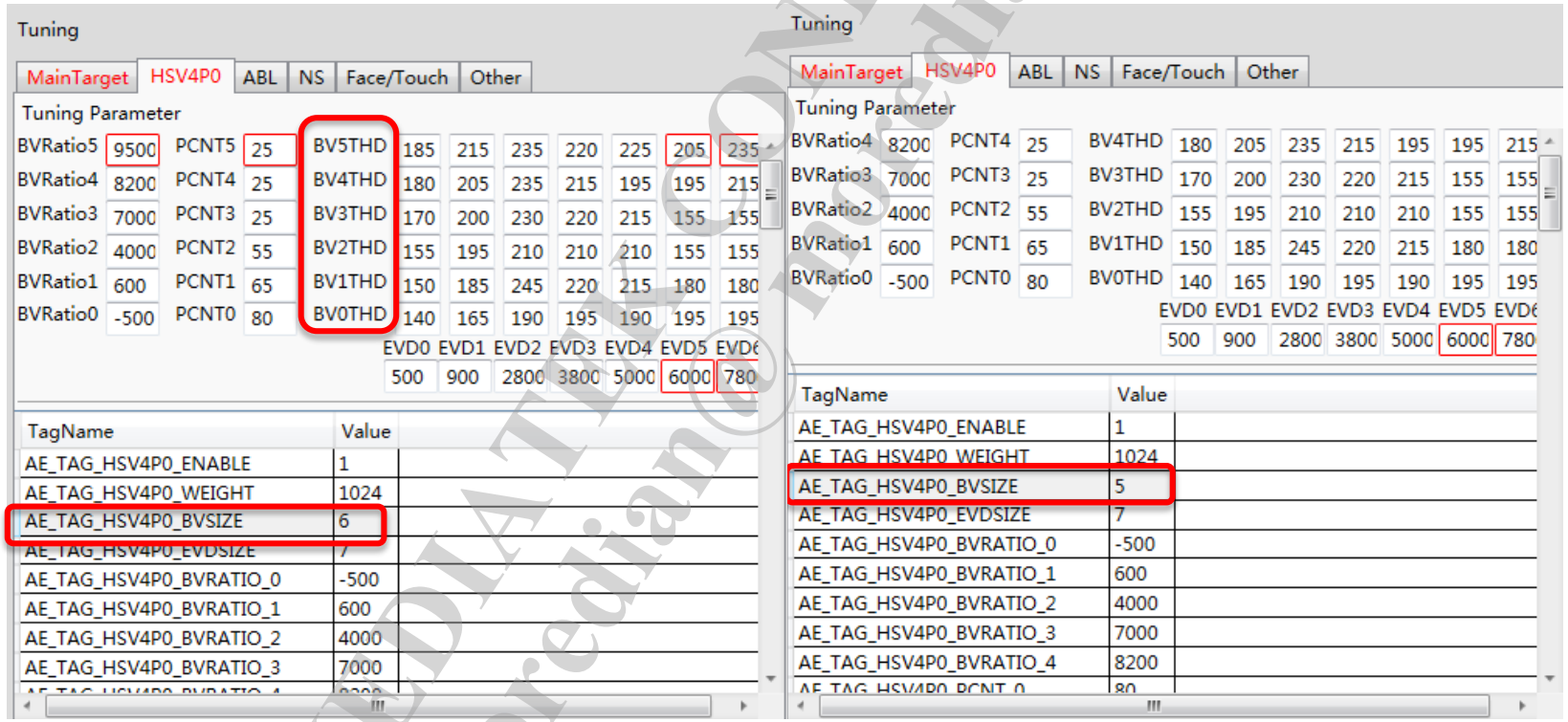
Basic tuning
Warning Message

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



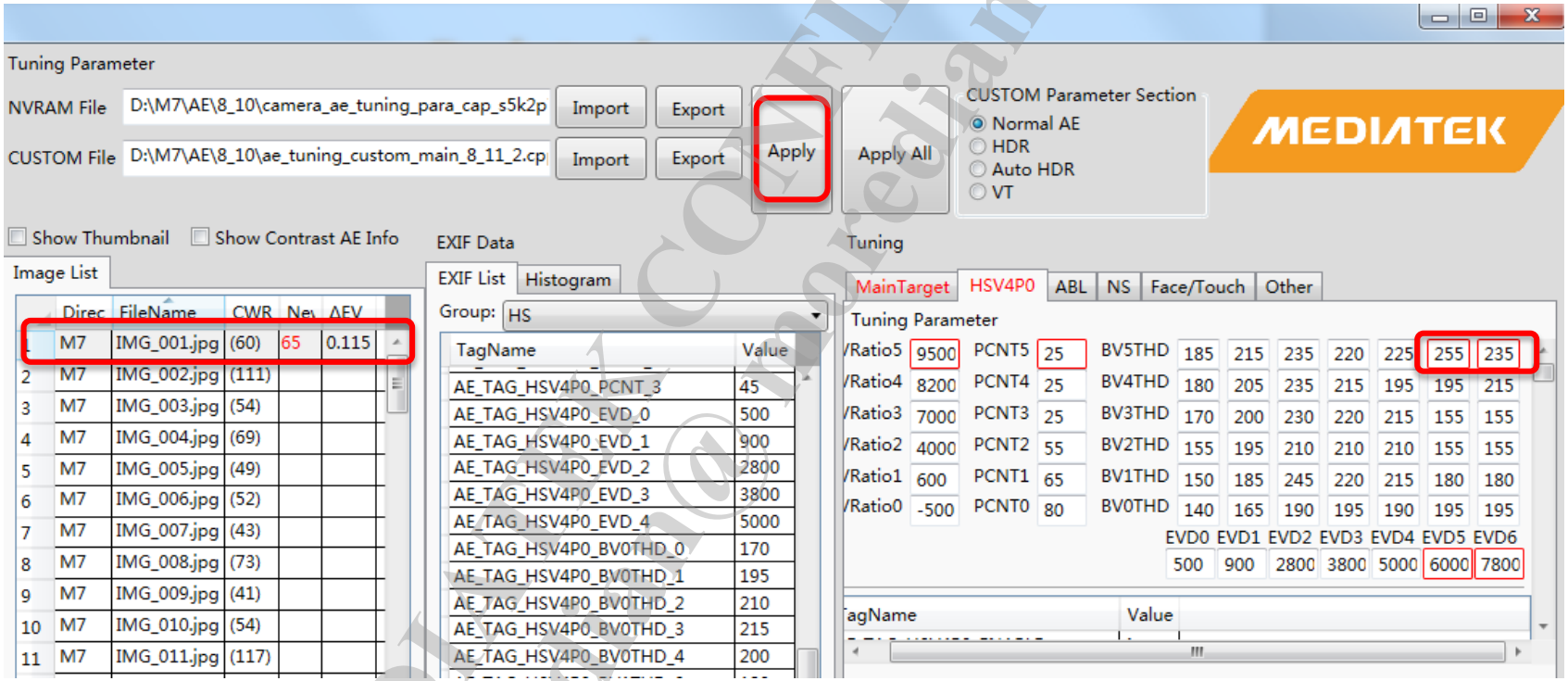
Basic tuning
Dynamic length parameter

- 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 .



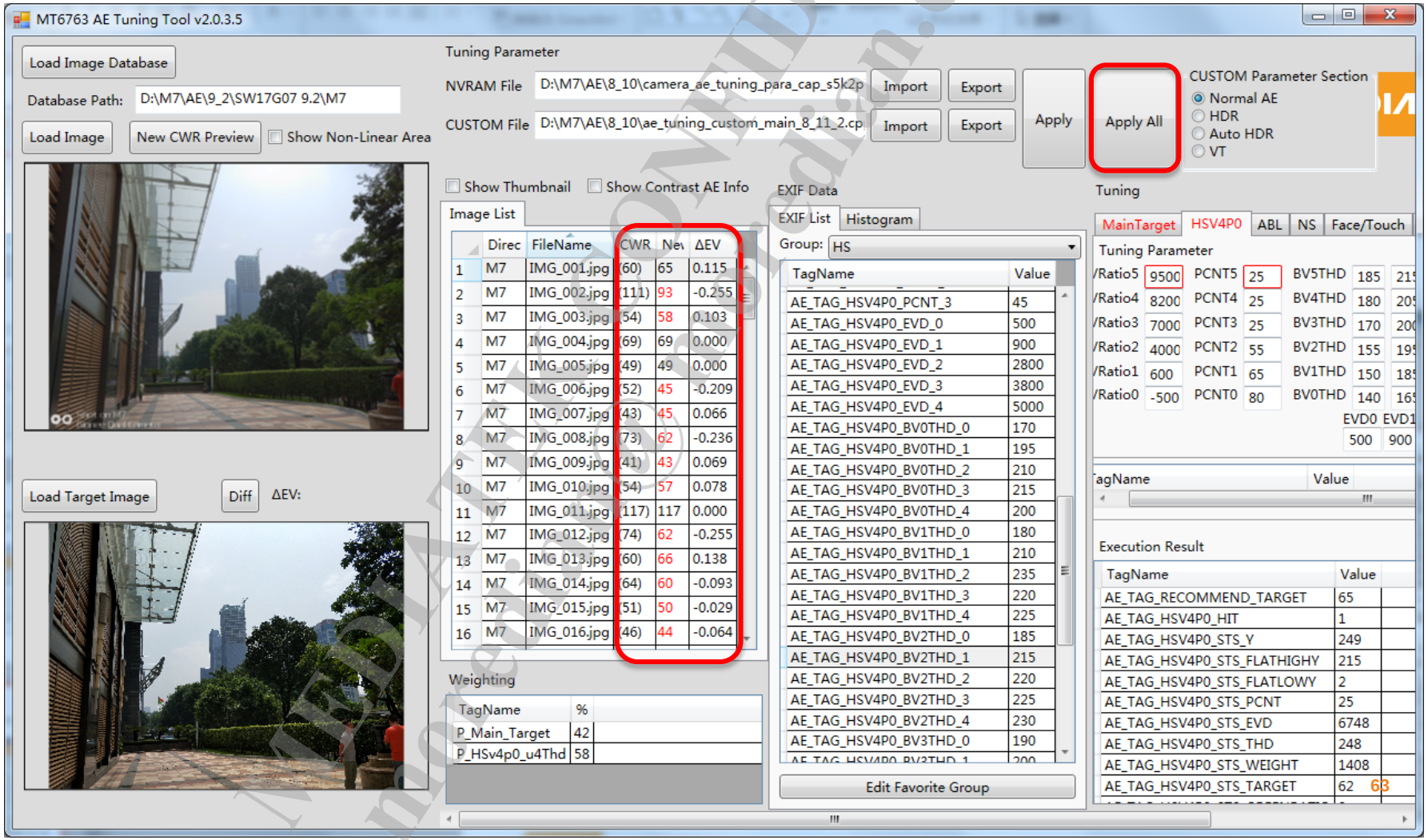
Basic tuning
Apply new tuning parameter

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



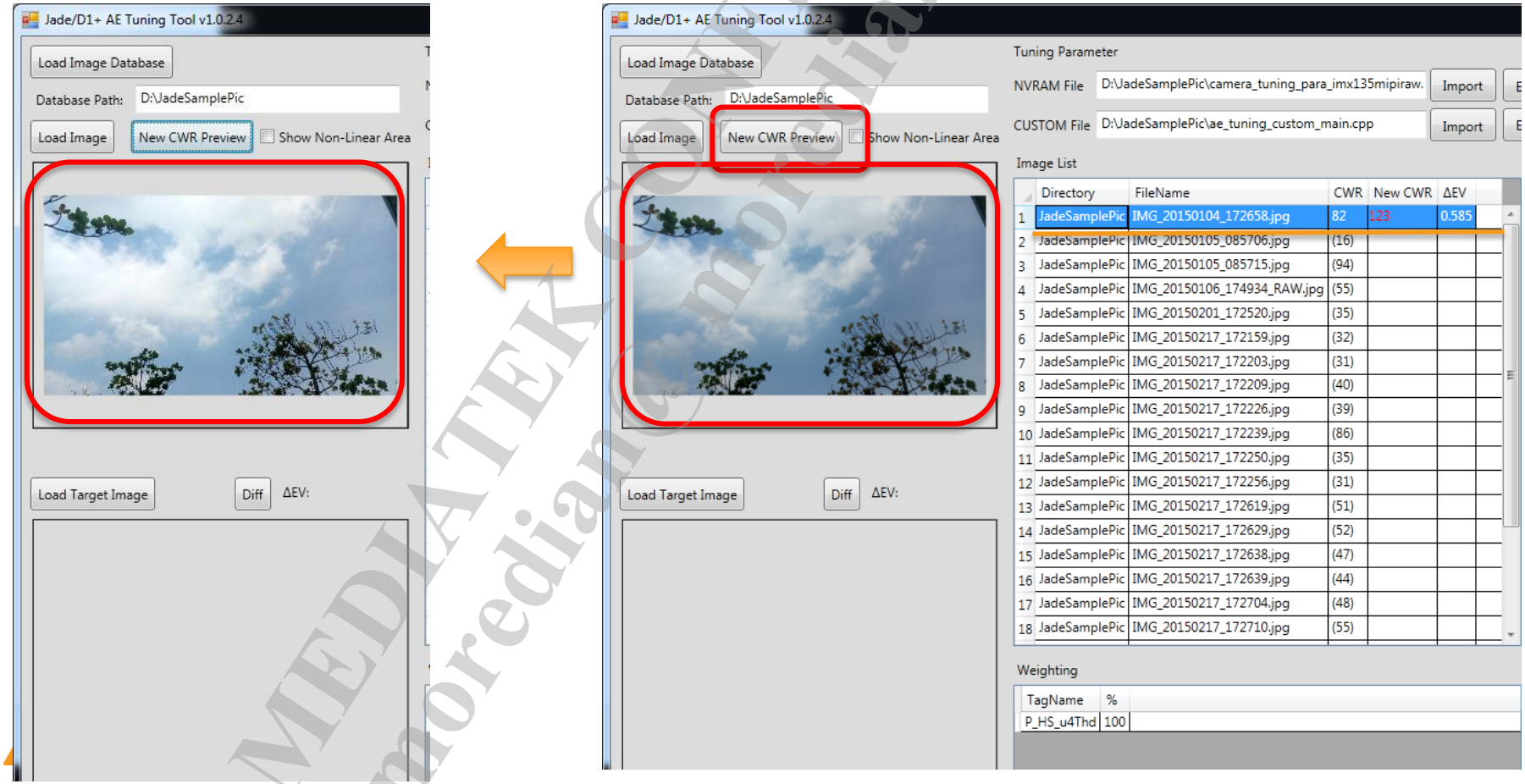
Basic tuning
Apply All

- 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.

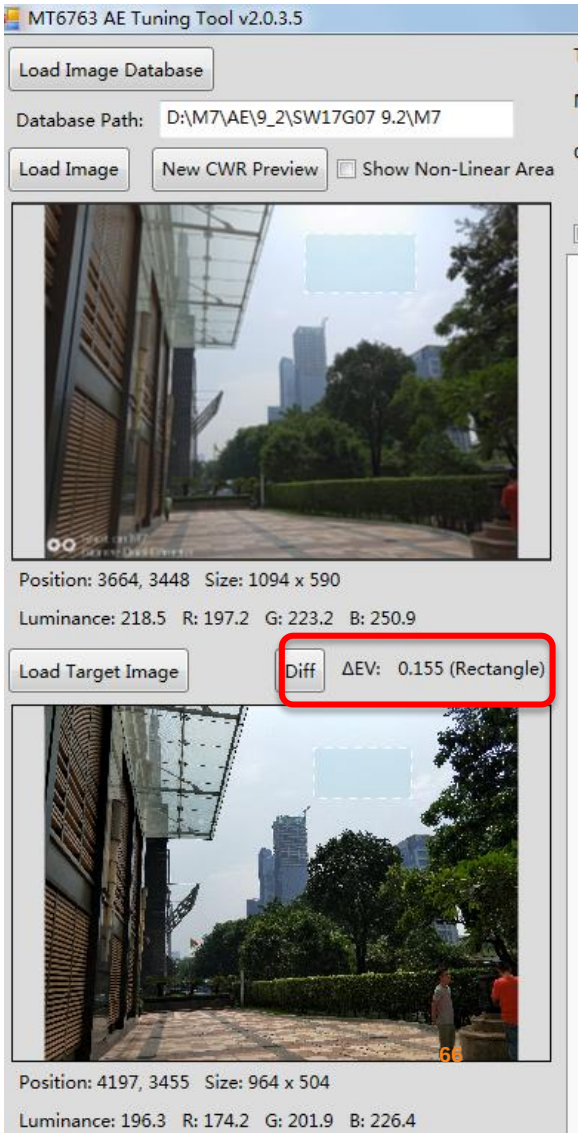


Advanced Tuning
Mean of Luminance, R, G, B Mean.

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

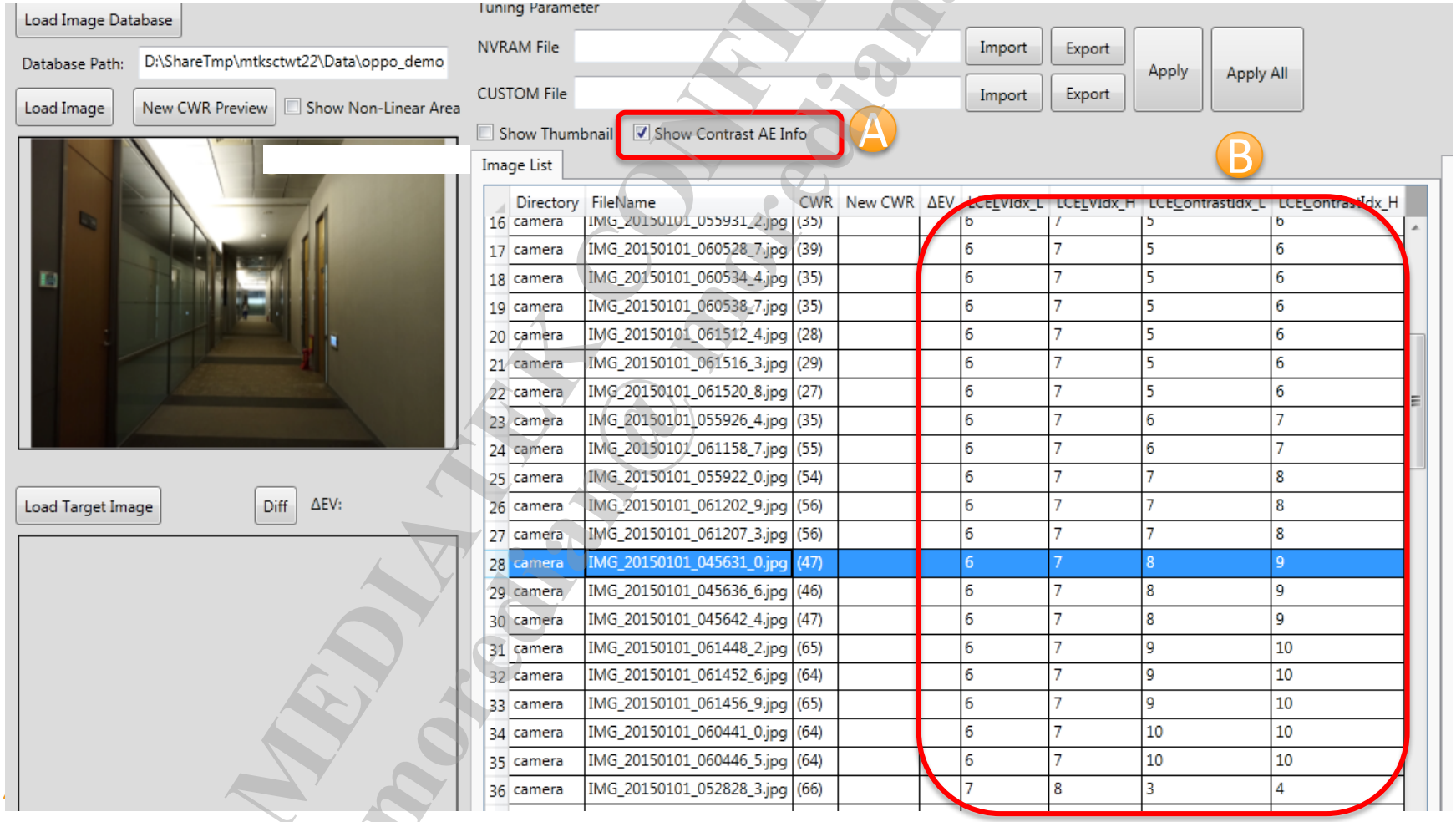
Advanced Tuning
Selected area EV diff

- 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.



	Directory	FileName	CWR	New CWR	ΔEV	LCELVIdx_L	LCELVIdx_H	LCEContrastIdx_L	LCEContrastIdx_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

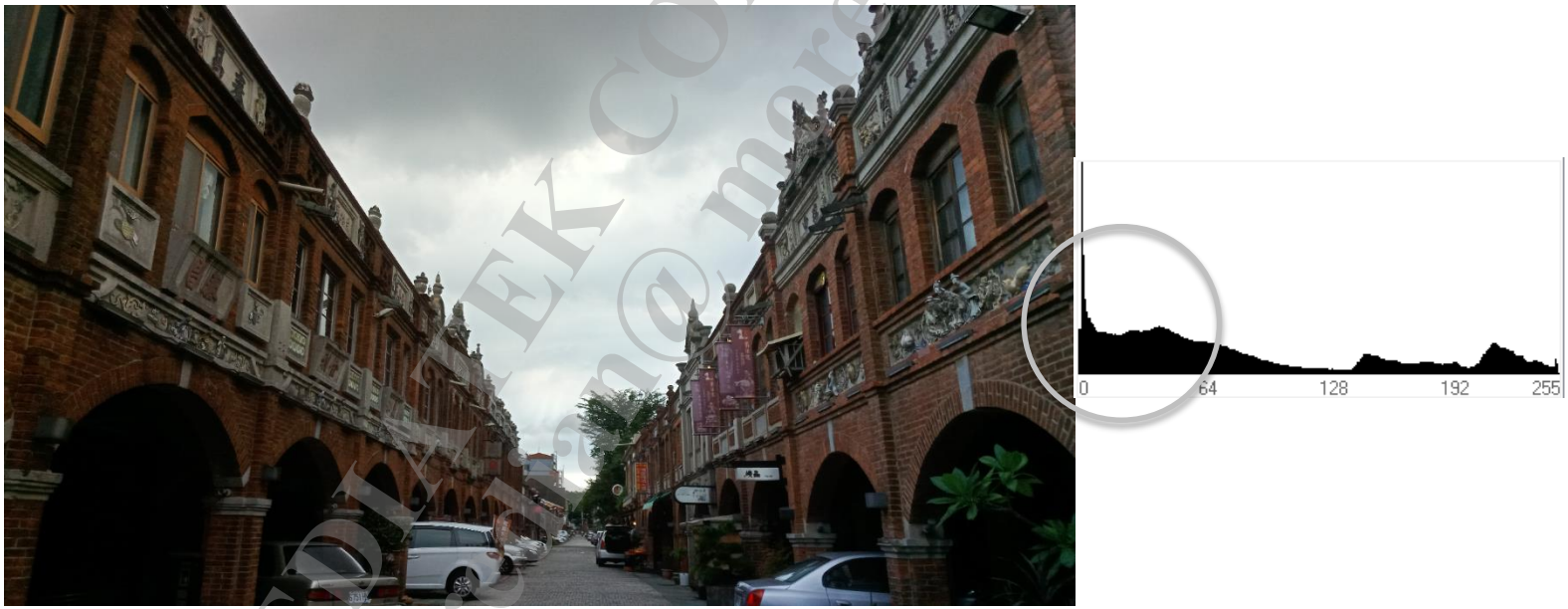
- AE Pline
  - –Device Profile
  - –Table Mapping
  - –Generate code
  - –Debug
- Flare/Target/EV calibration
  - –Calibration
  - –Generate code
  - –Debug
- Gamma
  - –Dynamic gamma tune
  - –Tune gamma by ImageiqSimulator
  - –Debug
- AE tuning tool SOP
- LCE
  - –LCE theory
  - –Tune LCE by ImageiqSimulator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

LCE Theory

- After AE tuning DT Keeping

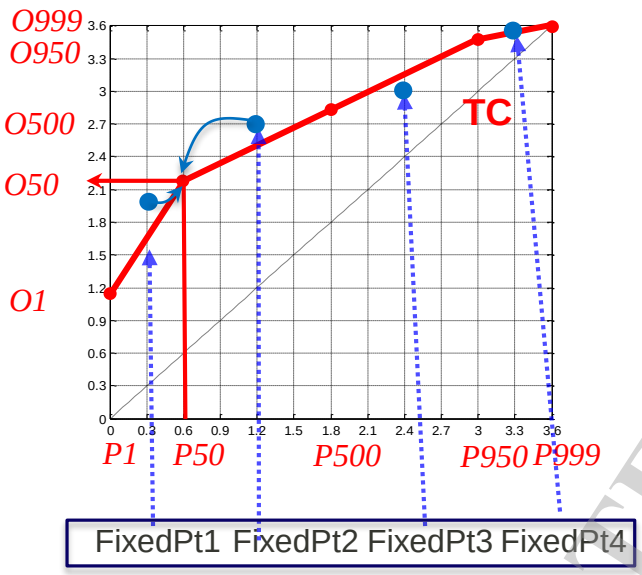
LCE Theory

- 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

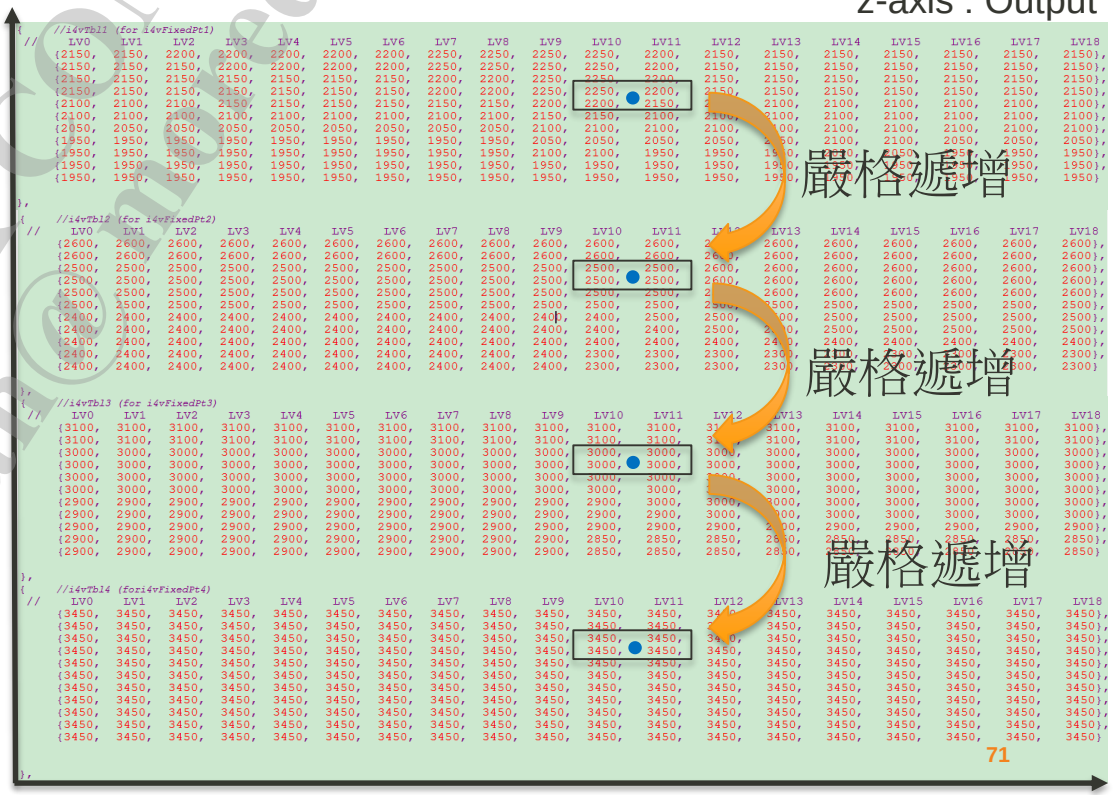
- Tone Curve Decide



User decide

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

x-axis : Contrast
y-axis : LV
z-axis : Output



LCE Theory

- Image Contrast Analysis--Contrast Y

ContrastIdx_L = EVContrastY10 / SegDiv
ContrastIdx_H = ContrastIdx_L + 1

DIP_X_LCE_EVContrastY10	0x0000005C
DIP_X_LCE_SegDiv	0x0000001E
DIP_X_LCE_ContrastIdx_L	0x00000003
DIP_X_LCE_ContrastIdx_H	0x00000004

ContrastY = 92

31

(L,H) = (3,4)

```
{    //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,  2150,  2150,  2150,  2150,  2150,  2150,  2200,  2200,  2150,  2100,  2100,  2100,  2100,  2100,  2100,  2100},  //  4
     {2100,  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,  2100,  2100,  2100,  2100,  2100,  2100,  2100,  2100,  2100,  2100},  //  6
     {1950,  1950,  1950,  1950,  1950,  1950,  1950,  1950,  1950,  2050,  2050,  2050,  2050,  2050,  2100,  2100,  2050,  2050,  2050},  //  7
     {1950,  1950,  1950,  1950,  1950,  1950,  1950,  1950,  1950,  2100,  2100,  1950,  1950,  1950,  2050,  2050,  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

- Brightness of Environment-LV

LVIdx_L = LV/ 10
LVIdx_H = LVIdx_L + 1

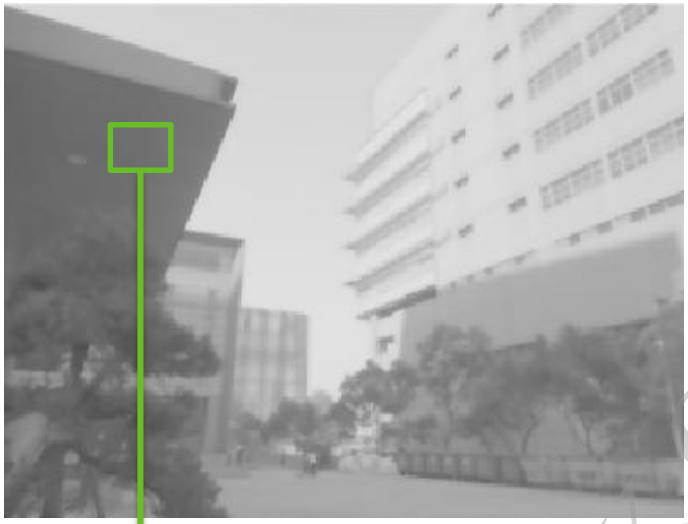
DIP_X_LCE_LV	0x0000007A ← LV = 122
DIP_X_LCE_LVIdx_L	0x0000000C ← (L,H) = (12,13)
DIP_X_LCE_LVIdx_H	0x0000000D

```
{    //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, 2150, 2150, 2150, 2150, 2150, 2150, 2200, 2200, 2150, 2100, 2100, 2100, 2100, 2100, 2100, 2100},  //  4
     {2100, 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, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100},  //  6
     {1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 2050, 2050, 2050, 2050, 2050, 2100, 2100, 2050, 2050, 2050},  //  7
     {1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 2100, 2100, 1950, 1950, 1950, 2050, 2050, 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



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.

LCS Y = 1803

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

The LCS value indicates which control point to adjust.

LCE Theory

- Control Points Calculation

LCE LightMap = 1803

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

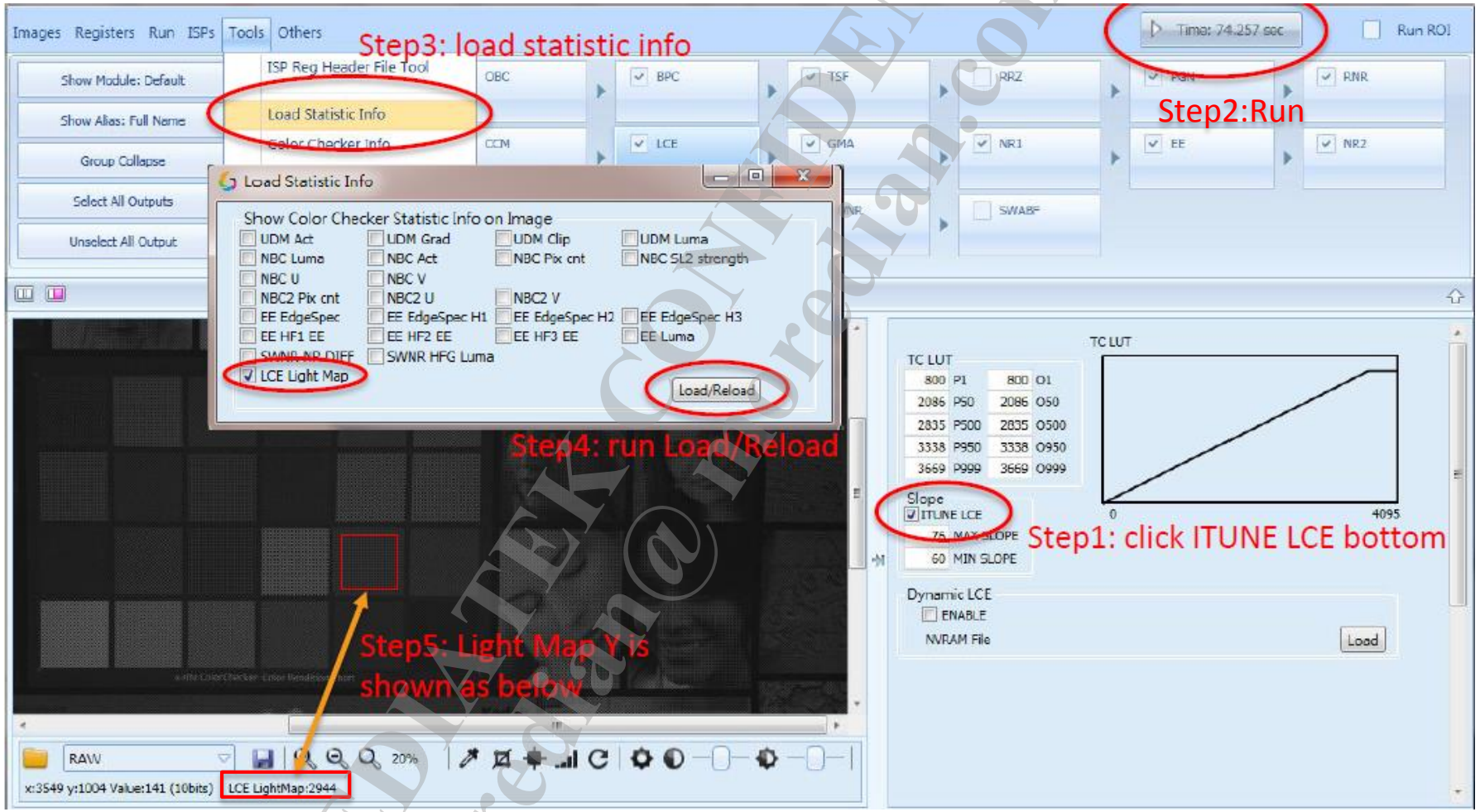
```
1700, //i4vFixedPt1
2200, //i4vFixedPt2
2800, //i4vFixedPt3
3450, //i4vFixedPt4
```

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

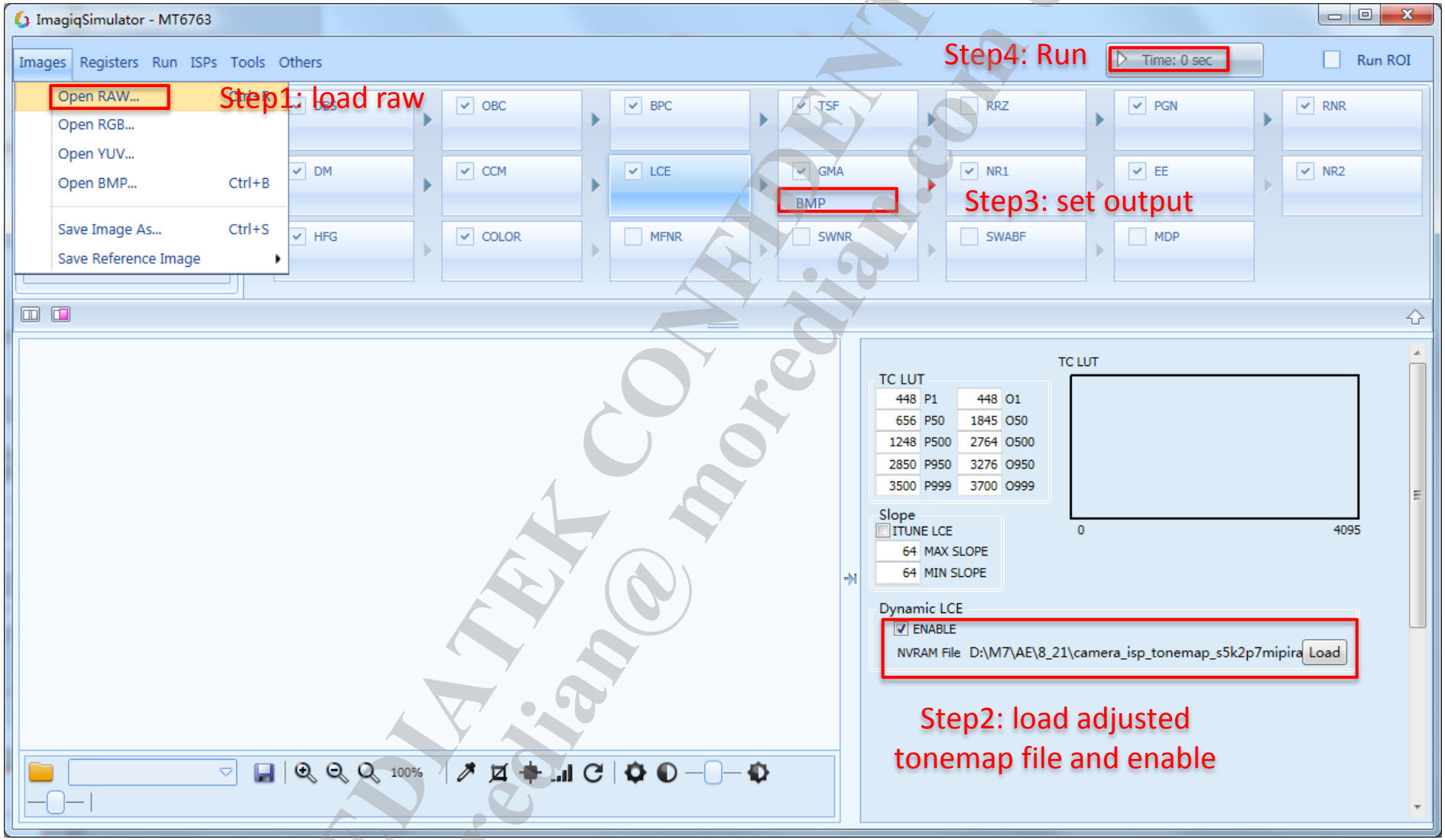
2200 <= **2334** < 2800
so to change O500 we need to modify i4vTbl2 and i4vTbl3

```
{ //rLCELUTs
    {    //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, 2150, 2150, 2150, 2150, 2150, 2150, 2200, 2200, 2150, 2100, 2100, 2100, 2100, 2100, 2100, 2100},  //  4
         {2100, 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, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100, 2100},  //  6
         {1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 2050, 2050, 2050, 2050, 2050, 2100, 2100, 2050, 2050, 2050},  //  7
         {1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 1950, 2100, 2100, 1950, 1950, 1950, 2050, 2050, 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
    },
    {    //i4vTbl2 (for i4vFixedPt2)
     //    LV0   LV1   LV2   LV3   LV4   LV5   LV6   LV7   LV8   LV9   LV10  LV11  LV12  LV13  LV14  LV15  LV16  LV17  LV18
         {2600, 2600, 2600, 2600, 2600, 2600, 2600, 2600, 2600, 2600, 2600, 2600, 2600, 2600, 2600, 2600, 2600, 2600, 2600},  //  10 * N
         {2600, 2600, 2600, 2600, 2600, 2600, 2600, 2600, 2600, 2600, 2600, 2600, 2600, 2600, 2600, 2600, 2600, 2600, 2600},  //  1
         {2500, 2500, 2500, 2500, 2500, 2500, 2500, 2500, 2500, 2500, 2500, 2500, 2500, 2600, 2600, 2600, 2600, 2600, 2600},  //  2
         {2500, 2500, 2500, 2500, 2500, 2500, 2500, 2500, 2500, 2500, 2500, 2500, 2500, 2600, 2600, 2600, 2600, 2600, 2600},  //  3
         {2500, 2500, 2500, 2500, 2500, 2500, 2500, 2500, 2500, 2500, 2500, 2500, 2500, 2600, 2600, 2600, 2600, 2600, 2600},  //  4
         {2500, 2500, 2500, 2500, 2500, 2500, 2500, 2500, 2500, 2500, 2500, 2500, 2500, 2500, 2500, 2500, 2500, 2500, 2500},  //  5
         {2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2500, 2500, 2500, 2500, 2500, 2500, 2500},  //  6
         {2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2500, 2500, 2500, 2500, 2500, 2500},  //  7
         {2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400},  //  8
         {2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2300, 2300, 2300, 2300, 2300, 2300, 2300, 2300},  //  9
         {2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2400, 2300, 2300, 2300, 2300, 2300, 2300, 2300, 2300}   // 10
    },
    {    //i4vTbl3 (for i4vFixedPt3)
     //    LV0   LV1   LV2   LV3   LV4   LV5   LV6   LV7   LV8   LV9   LV10  LV11  LV12  LV13  LV14  LV15  LV16  LV17  LV18
         {3100, 3100, 3100, 3100, 3100, 3100, 3100, 3100, 3100, 3100, 3100, 3100, 3100, 3100, 3100, 3100, 3100, 3100, 3100},  //  10 * N
         {3100, 3100, 3100, 3100, 3100, 3100, 3100, 3100, 3100, 3100, 3100, 3100, 3100, 3100, 3100, 3100, 3100, 3100, 3100},  //  1
         {3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000},  //  2
         {3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000},  //  3
         {3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000},  //  4
         {3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000},  //  5
         {2900, 2900, 2900, 2900, 2900, 2900, 2900, 2900, 2900, 2900, 2900, 3000, 3000, 3000, 3000, 3000, 3000, 3000, 3000},  //  6
         {2900, 2900, 2900, 2900, 2900, 2900, 2900, 2900, 2900, 2900, 2900, 2900, 3000, 3000, 3000, 3000, 3000, 3000, 3000},  //  7
         {2900, 2900, 2900, 2900, 2900, 2900, 2900, 2900, 2900, 2900, 2900, 2900, 2900, 2900, 2900, 2900, 2900, 2900, 2900},  //  8
         {2900, 2900, 2900, 2900, 2900, 2900, 2900, 2900, 2900, 2900, 2900, 2850, 2850, 2850, 2850, 2850, 2850, 2850, 2850},  //  9
         {2900, 2900, 2900, 2900, 2900, 2900, 2900, 2900, 2900, 2900, 2900, 2850, 2850, 2850, 2850, 2850, 2850, 2850, 2850}   // 10
    },
```

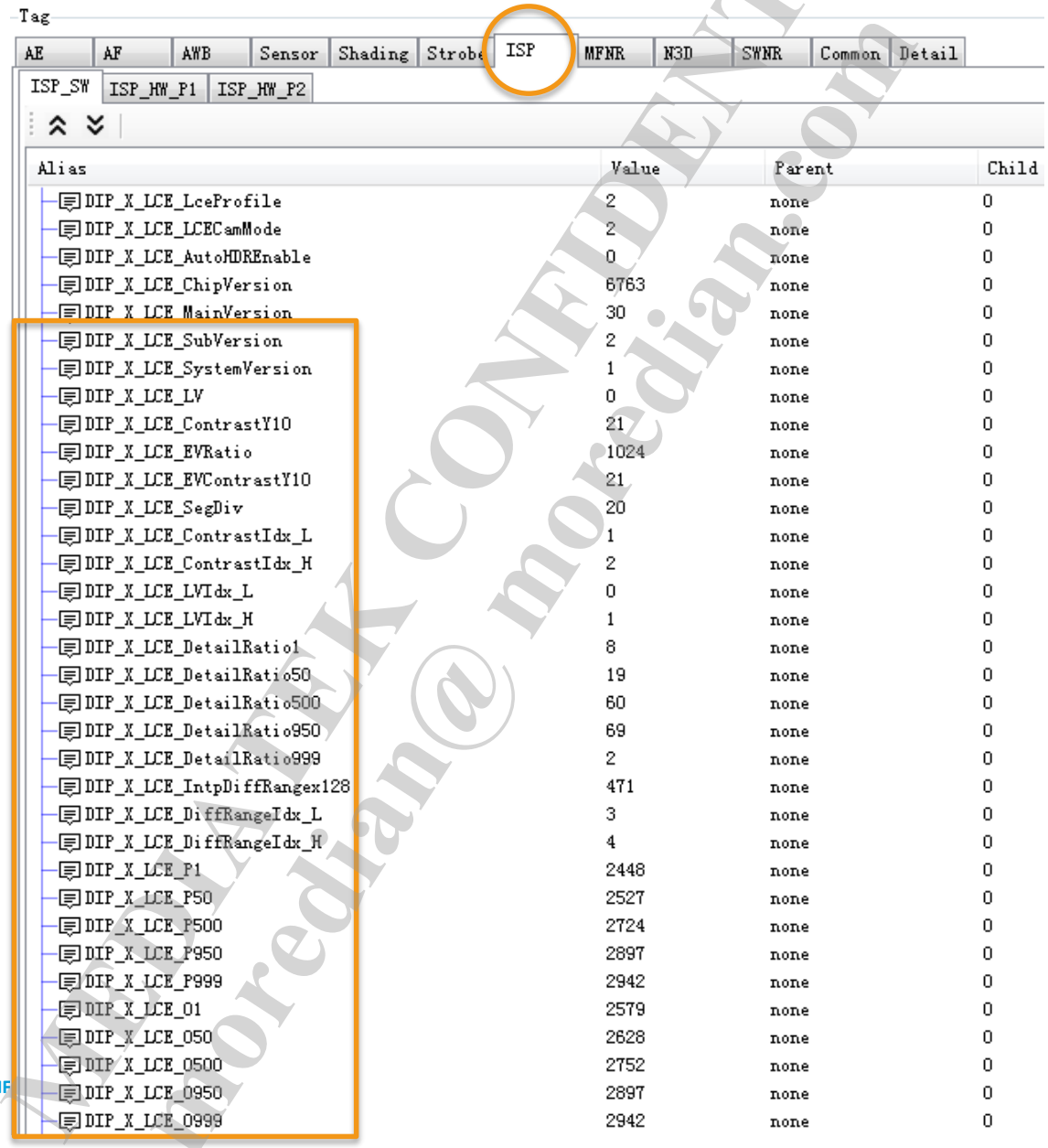
Get Light Map Y from ImageiqSimulator



Tune LCE by ImageiqSimulator



Debug



Alias	Value	Parent	Child
DIP_X_LCE_LceProfile	2	none	0
DIP_X_LCE_LCECamMode	2	none	0
DIP_X_LCE_AutoHDREnable	0	none	0
DIP_X_LCE_ChipVersion	6763	none	0
DIP_X_LCE_MainVersion	30	none	0
DIP_X_LCE_SubVersion	2	none	0
DIP_X_LCE_SystemVersion	1	none	0
DIP_X_LCE_LV	0	none	0
DIP_X_LCE_ContrastY10	21	none	0
DIP_X_LCE_EVRatio	1024	none	0
DIP_X_LCE_EVContrastY10	21	none	0
DIP_X_LCE_SegDiv	20	none	0
DIP_X_LCE_ContrastIdx_L	1	none	0
DIP_X_LCE_ContrastIdx_H	2	none	0
DIP_X_LCE_LVIdx_L	0	none	0
DIP_X_LCE_LVIdx_H	1	none	0
DIP_X_LCE_DetailRatio1	8	none	0
DIP_X_LCE_DetailRatio50	19	none	0
DIP_X_LCE_DetailRatio500	60	none	0
DIP_X_LCE_DetailRatio950	69	none	0
DIP_X_LCE_DetailRatio999	2	none	0
DIP_X_LCE_IntpDiffRangex128	471	none	0
DIP_X_LCE_DiffRangeIdx_L	3	none	0
DIP_X_LCE_DiffRangeIdx_H	4	none	0
DIP_X_LCE_P1	2448	none	0
DIP_X_LCE_P50	2527	none	0
DIP_X_LCE_P500	2724	none	0
DIP_X_LCE_P950	2897	none	0
DIP_X_LCE_P999	2942	none	0
DIP_X_LCE_O1	2579	none	0
DIP_X_LCE_O50	2628	none	0
DIP_X_LCE_O500	2752	none	0
DIP_X_LCE_O950	2897	none	0
DIP_X_LCE_O999	2942	none	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, //i4TCPLB
20000,//I4TCPUB

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

{ //rLCELUTs
    {    //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,  2150,  2450,  2400,  2400,  2450,  2450,  2450,  2450,  2450,  2450,  2450},  //  0 * N
         {1900,  1900,  1950,  1950,  1950,  1950,  1850,  1850,  2150,  2300,  2300,  2300,  2300,  2400,  2400,  2450,  2450,  2450,  2450},  //  1
         {1900,  1900,  1950,  1950,  1950,  1950,  1950,  1950,  2150,  2250,  2250,  2300,  2300,  2350,  2250,  2400,  2400,  2400,  2400},  //  2
         {1850,  1850,  1850,  1850,  1850,  1850,  1950,  2050,  2150,  2150,  2200,  2250,  2250,  2250,  2250,  2250,  2350,  2350,  2350},  //  3
         {1850,  1850,  1850,  1800,  1800,  1700,  1850,  2000,  2150,  2100,  2200,  2200,  2200,  2200,  2150,  2250,  2350,  2200,  2200},  //  4
         {1650,  1850,  1850,  1800,  1750,  1600,  1750,  1950,  2000,  2100,  2200,  2200,  2100,  2100,  2150,  2200,  2200,  2000,  2000},  //  5
         {1750,  1750,  1750,  1650,  1650,  1600,  1600,  1650,  1650,  1850,  2200,  2150,  2100,  1850,  2000,  2000,  2000,  2000,  2000},  //  6
         {1650,  1650,  1650,  1650,  1650,  1600,  1600,  1600,  1600,  1700,  1950,  1900,  1850,  1850,  2000,  2000,  2000,  2000,  2000},  //  7
         {1600,  1600,  1600,  1600,  1600,  1600,  1600,  1600,  1600,  1600,  1600,  1700,  1750,  1750,  2000,  2000,  2000,  2000,  2000},  //  8
         {1600,  1600,  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,  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,  2650,  2500,  2500,  2500},  //  10 * N
         {2450,  2450,  2450,  2450,  2500,  2550,  2400,  2350,  2350,  2700,  2650,  2650,  2650,  2650,  2650,  2650,  2500,  2500,  2500},  //  1
         {2450,  2450,  2450,  2450,  2450,  2450,  2450,  2450,  2350,  2700,  2500,  2550,  2600,  2600,  2600,  2650,  2400,  2400,  2400},  //  2
         {2400,  2450,  2400,  2400,  2400,  2350,  2400,  2400,  2350,  2450,  2500,  2550,  2600,  2600,  2600,  2650,  2400,  2400,  2400},  //  3
         {2400,  2400,  2400,  2400,  2400,  2400,  2300,  2250,  2350,  2350,  2450,  2500,  2550,  2600,  2550,  2600,  2600,  2400,  2400},  //  4
         {2400,  2400,  2400,  2350,  2350,  2200,  2200,  2300,  2300,  2450,  2450,  2500,  2400,  2400,  2450,  2550,  2400,  2300,  2300},  //  5
         {2400,  2400,  2400,  2250,  2150,  2200,  2150,  2150,  2150,  2200,  2400,  2400,  2300,  2320,  2400,  2400,  2400,  2300,  2300},  //  6
         {2300,  2300,  2250,  2250,  2150,  2100,  2100,  2100,  2100,  2200,  2350,  2250,  2200,  2200,  2400,  2400,  2400,  2300,  2300},  //  7
         {2100,  2100,  2100,  2100,  2100,  2100,  2100,  2100,  2100,  2150,  2150,  2200,  2200,  2200,  2400,  2400,  2400,  2300,  2300},  //  8
         {2100,  2100,  2100,  2100,  2100,  2100,  2100,  2100,  2100,  2100,  2150,  2150,  2100,  2150,  2300,  2300,  2300,  2150,  2150},  //  9
         {2100,  2100,  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_LVIdx_L	9
DIP_X_LCE_LVIdx_H	10

```
{    //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,  2150,  2450,  2400,  2400,  2450,  2450,  2450,  2450,  2450,  2450,  2450},  //  0 * N
      {1900,  1900,  1950,  1950,  1950,  1950,  1850,  1850,  2150,  2300,  2300,  2300,  2300,  2400,  2400,  2450,  2450,  2450,  2450},  //  1
      {1900,  1900,  1950,  1950,  1950,  1950,  1950,  1950,  2150,  2250,  2250,  2300,  2300,  2350,  2250,  2400,  2400,  2400,  2400},  //  2
      {1850,  1850,  1850,  1850,  1850,  1850,  1950,  2050,  2150,  2150,  2200,  2250,  2250,  2250,  2250,  2250,  2350,  2350,  2350},  //  3
      {1850,  1850,  1850,  1800,  1800,  1700,  1850,  2000,  2150,  2100,  2200,  2200,  2200,  2200,  2150,  2250,  2350,  2200,  2200},  //  4
      {1650,  1850,  1850,  1800,  1750,  1600,  1750,  1950,  2000,  2100,  2200,  2200,  2100,  2100,  2150,  2200,  2200,  2000,  2000},  //  5
      {1750,  1750,  1750,  1650,  1650,  1600,  1600,  1650,  1650,  1850,  2200,  2150,  2100,  1850,  2000,  2000,  2000,  2000,  2000},  //  6
      {1650,  1650,  1650,  1650,  1650,  1600,  1600,  1600,  1600,  1700,  1950,  1900,  1850,  1850,  2000,  2000,  2000,  2000,  2000},  //  7
      {1600,  1600,  1600,  1600,  1600,  1600,  1600,  1600,  1600,  1600,  1600,  1700,  1750,  1750,  2000,  2000,  2000,  2000,  2000},  //  8
      {1600,  1600,  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,  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,  2650,  2500,  2500,  2500},  //  10 * N
      {2450,  2450,  2450,  2450,  2500,  2550,  2400,  2350,  2350,  2700,  2650,  2650,  2650,  2650,  2650,  2650,  2500,  2500,  2500},  //  1
      {2450,  2450,  2450,  2450,  2450,  2450,  2450,  2450,  2350,  2700,  2500,  2550,  2600,  2600,  2600,  2650,  2400,  2400,  2400},  //  2
      {2400,  2450,  2400,  2400,  2400,  2350,  2400,  2400,  2350,  2450,  2500,  2550,  2600,  2600,  2600,  2650,  2400,  2400,  2400},  //  3
      {2400,  2400,  2400,  2400,  2400,  2300,  2250,  2350,  2350,  2450,  2500,  2550,  2600,  2550,  2600,  2600,  2400,  2400,  2400},  //  4
      {2400,  2400,  2400,  2350,  2350,  2200,  2200,  2300,  2300,  2450,  2450,  2500,  2400,  2400,  2450,  2550,  2400,  2300,  2300},  //  5
      {2400,  2400,  2400,  2250,  2150,  2200,  2150,  2150,  2150,  2200,  2400,  2400,  2300,  2320,  2400,  2400,  2400,  2300,  2300},  //  6
      {2300,  2300,  2250,  2250,  2150,  2100,  2100,  2100,  2100,  2200,  2350,  2250,  2200,  2200,  2400,  2400,  2400,  2300,  2300},  //  7
      {2100,  2100,  2100,  2100,  2100,  2100,  2100,  2100,  2100,  2150,  2150,  2200,  2200,  2200,  2400,  2400,  2400,  2300,  2300},  //  8
      {2100,  2100,  2100,  2100,  2100,  2100,  2100,  2100,  2100,  2100,  2150,  2150,  2100,  2150,  2300,  2300,  2300,  2150,  2150},  //  9
      {2100,  2100,  2100,  2100,  2100,  2100,  2100,  2100,  2100,  2100,  2100,  2100,  2100,  2100,  2100,  2100,  2100,  2100,  2100}   // 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, //i4TCPLB
20000,//I4TCPUB

{ //rLCELUTs
    {    //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,  1600,  1600,  1650,  1650,  1650,  1650},   //  0 * N
         {1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1600,  1600,  1650,  1650,  1650,  1650},   //  1
         {1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1600,  1600,  1650,  1650,  1650,  1650},   //  2
         {1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1600,  1600,  1650,  1650,  1650,  1650},   //  3
         {1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1600,  1600,  1650,  1650,  1650,  1650},   //  4
         {1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1600,  1600,  1650,  1650,  1650,  1650},   //  5
         {1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1600,  1600,  1650,  1650,  1650,  1650},   //  6
         {1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1600,  1600,  1650,  1650,  1650,  1650},   //  7
         {1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1600,  1600,  1650,  1650,  1650,  1650},   //  8
         {1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1600,  1600,  1650,  1650,  1650,  1650},   //  9
         {1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1650,  1600,  1600,  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,  2100},   //  10 * N
         {2100,  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,  2100},   //  2
         {2100,  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,  2100},   //  4
         {2100,  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,  2100},   //  6
         {2100,  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,  2100},   //  8
         {2100,  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,  2100}    // 10

    },
```

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