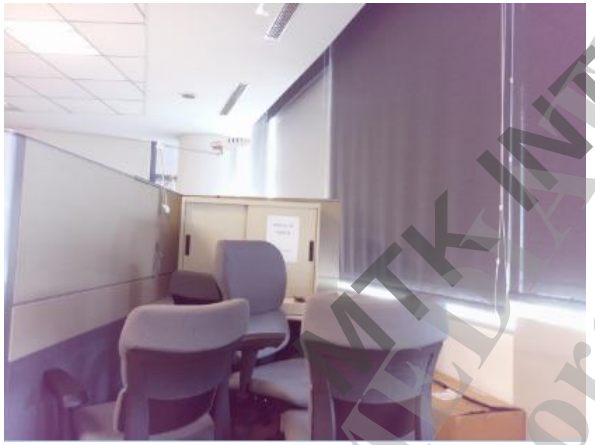
INTERNAL USE

Basic Tuning Flow – Basic Info Calibration

Introduction to Optical Black (OB)

- Optical Black (OB)
  - There may have offset in image raw data, caused by sensor dark current, would lead to incorrect color. As a result, the offset, named OB, should be calibrated and reduced through ISP

OB taken off not enough



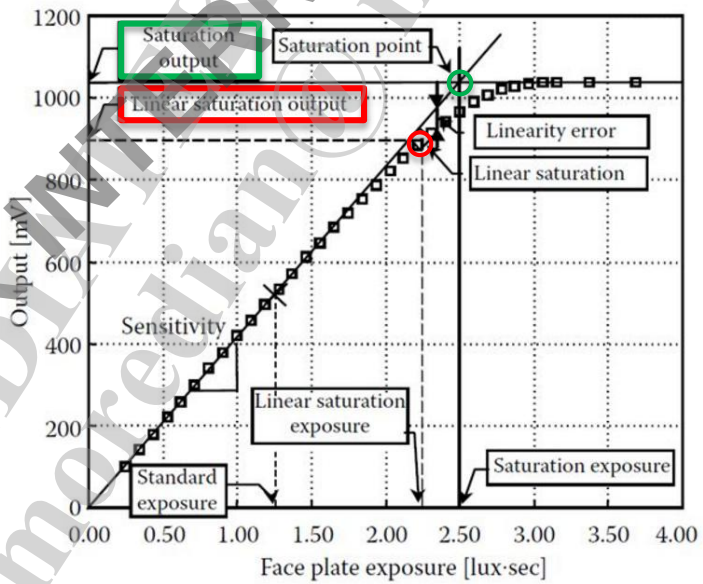
OB taken off correctly

OB taken off too much

Introduction to Minimum Saturation Gain

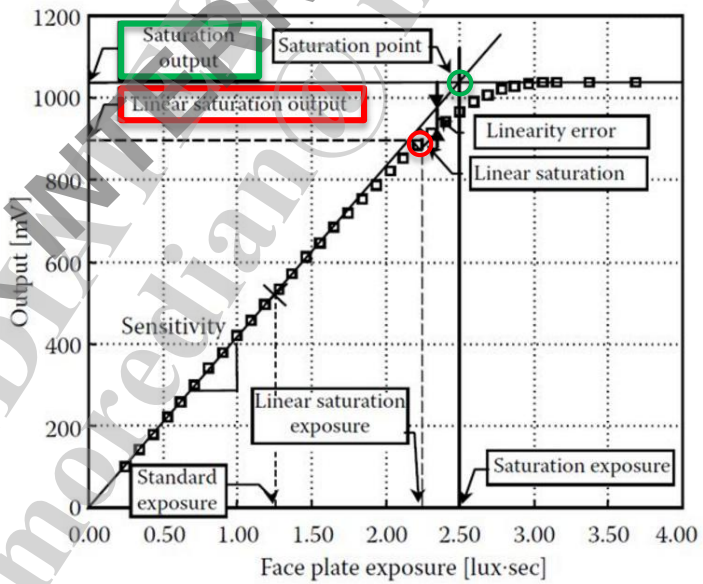
- Minimum Saturation Gain
  - Minimum gain value can make sensor output saturated with enough exposure (R/G/B reach max.)
  - To check relation between exposure and sensor output is linear before saturation

Minimum Saturation Gain = saturation output / linear saturation output



Introduction to Minimum Saturation Gain

- Decline Rate
  - Used to determine the linear saturation point. Larger decline rate gets larger linear saturation point
- Gain Buffer
  - Considering module difference, use a larger Saturation Gain to make sure every module can reach saturation
    - FinalMinSatGain = MinSatGain * (1+GainBuffer)



Introduction to Minimum ISO

- Minimum ISO
  - The ISO value when gain is 1x (1024)
    - To test sensitivity of sensor

Use 1st Version Parameters

- Before tuning, merge 3A default setting to initial parameters

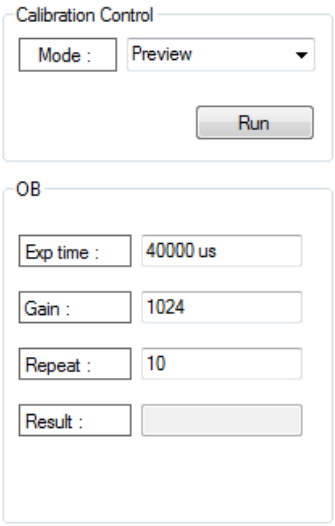
CDVT Sensor Test PreCheck

- To avoid brightness change led by Auto Focus, it's necessary to disable AF before calibration

- Adb command
  - setprop debug.af_motor.disable 1
  - setprop debug.af_motor.position 1000

CDVT sensor calibration

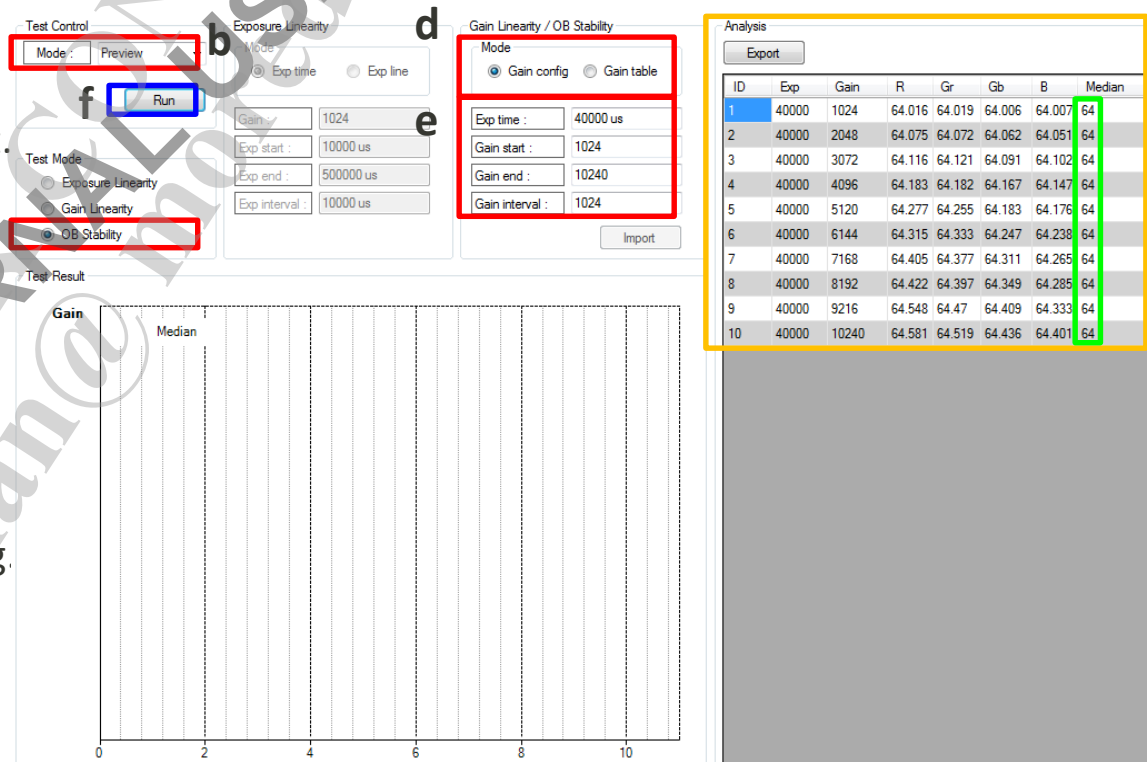
- Goal
  - OB
    - Get mean value of OB of multiple test with the same sensitivity setting.
  - Minimum ISO
    - Get ISO value with minimum sensor gain (1024)
  - Minimum Saturation Gain
    - To find the minimum gain for sensor saturation (G channel)
- Use ISP_calibration_check_lists.xlsx to check result



CDVT sensor test – OB Stability

Test flow

a) Dark environment or cover lens with cloth.
b) Select “Preview” mode.
c) Select “OB Stability”.
d) Set “Exp Time/Gain Start/Gain End/Gain Interval”.
e) Click “Run” for testing.
f) Result will be shown in “Analysis”.
g) Click “Export” for output detail result.
h) Repeat d,e,f,g for other modes.

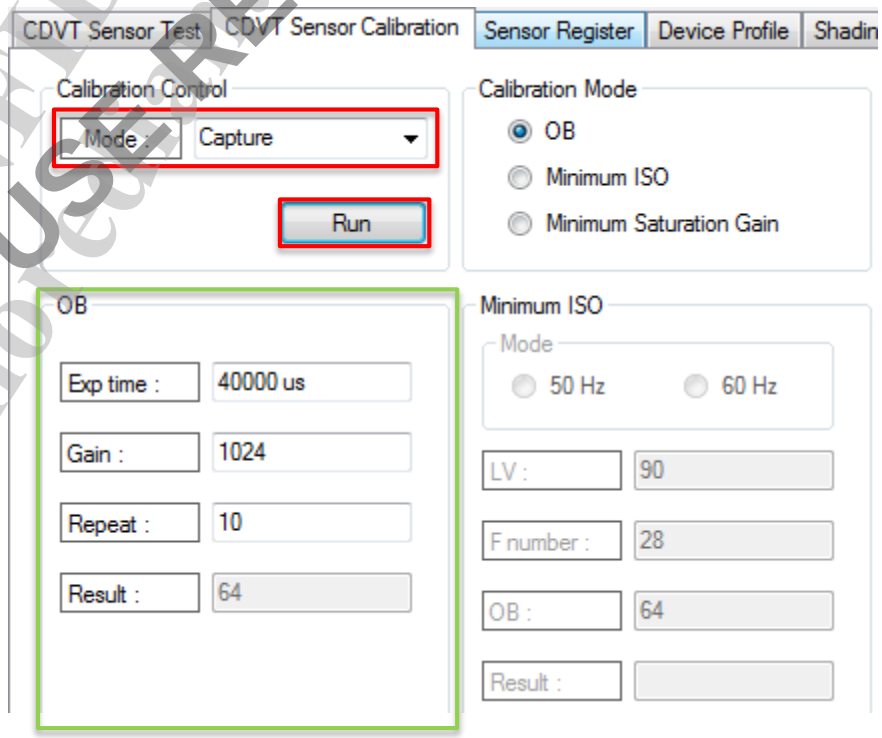


Expected result

- OB values of 4 channels can be different, but the difference can’t be much within the same gain setting.

OB Calibration

- Calibration condition
  - Dark environment and cover lens.
- Flow
  a) Set ‘Expo time/Gain/Repeat times’.
  b) Click ‘Run’ for testing.
  c) Results as shown in test box.



Check Calibration Results

- Expected result
  - OB values@10-bit of 4 channels should be same.
    - A little difference is acceptable(1~2 @10-bit)
  - OB values@10-bit of different ISO should be same.
- If something goes wrong,
  - Highlight to customer and vendor.

Code Setting

- Path
  - vendor\mediatek\proprietary\custom*$project*\hal\imgsensor\ver2*$sensor*\
- File
  - Camera_isp_regs_video_$sensor.h
  - Camera_isp_regs_preview_$sensor.h
  - Camera_isp_regs_capture_$sensor.h
  - Camera_isp_regs_feature_$sensor.h

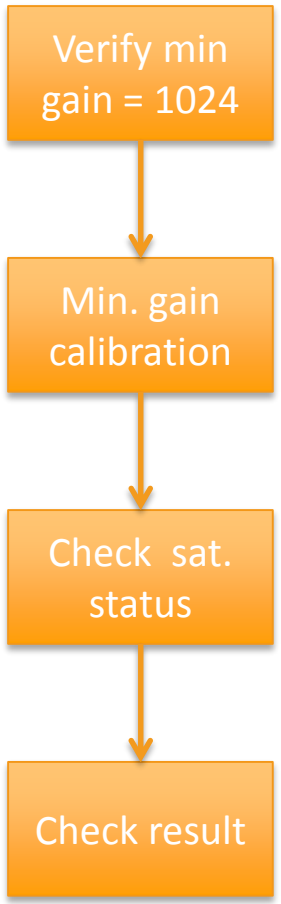
camera_isp_regs_$scenario_$sensor.h

```
#define OBC_0125 /*profile = N3D_Preview, ISO_3*/{{\
        .offst0     ={.bits={.OBC_OFST_B=7936, .rsv_13=0}},\
        .offst1     ={.bits={.OBC_OFST_GR=7936, .rsv_13=0}},\
        .offst2     ={.bits={.OBC_OFST_GB=7936, .rsv_13=0}},\
        .offst3     ={.bits={.OBC_OFST_R=7936, .rsv_13=0}},\
        .gain0      ={.bits={.OBC_GAIN_B=546, .rsv_13=0}},\
        .gain1      ={.bits={.OBC_GAIN_GR=546, .rsv_13=0}},\
        .gain2      ={.bits={.OBC_GAIN_GB=546, .rsv_13=0}},\
        .gain3      ={.bits={.OBC_GAIN_R=546, .rsv_13=0}}\
    }}
#define OBC_0126 /*profile = N3D_Preview, ISO_10*/{{\
        .offst0     ={.bits={.OBC_OFST_B=7938, .rsv_13=0}},\
        .offst1     ={.bits={.OBC_OFST_GR=7938, .rsv_13=0}},\
        .offst2     ={.bits={.OBC_OFST_GB=7938, .rsv_13=0}},\
        .offst3     ={.bits={.OBC_OFST_R=7938, .rsv_13=0}},\
        .gain0      ={.bits={.OBC_GAIN_B=546, .rsv_13=0}},\
        .gain1      ={.bits={.OBC_GAIN_GR=546, .rsv_13=0}},\
        .gain2      ={.bits={.OBC_GAIN_GB=546, .rsv_13=0}},\
        .gain3      ={.bits={.OBC_GAIN_R=546, .rsv_13=0}}\
    }}
```

we suggest use **CCT** to fill in OB value, then tool would transform OB value to Gain & Offset

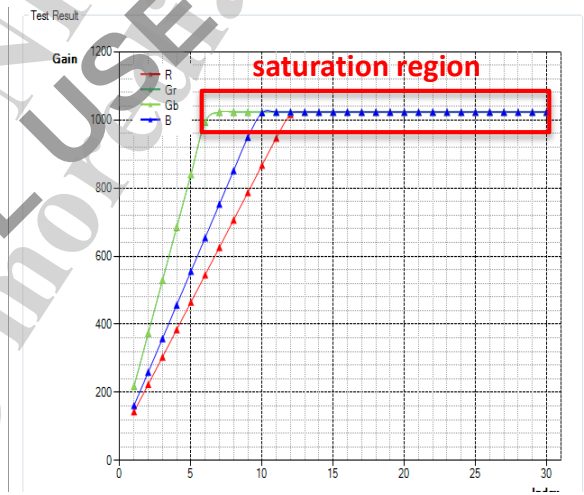
Min Gain Calibration Flow

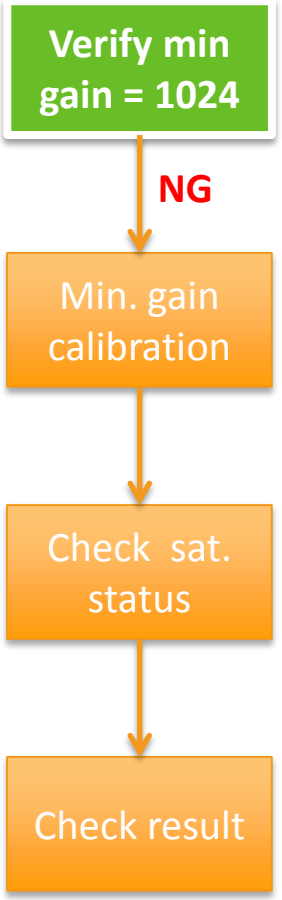
- Calibration condition
  - Camera face to a uniform light source.
  - Connect to CCT Tool.
  - Set maximum exposure time to 300 msec.
- Calibration Flow
  a) Verify min gain = 1024.
  b) Min gain calibration.
  c) Check saturation status.
  d) Check result



Verify Min Gain = 1024

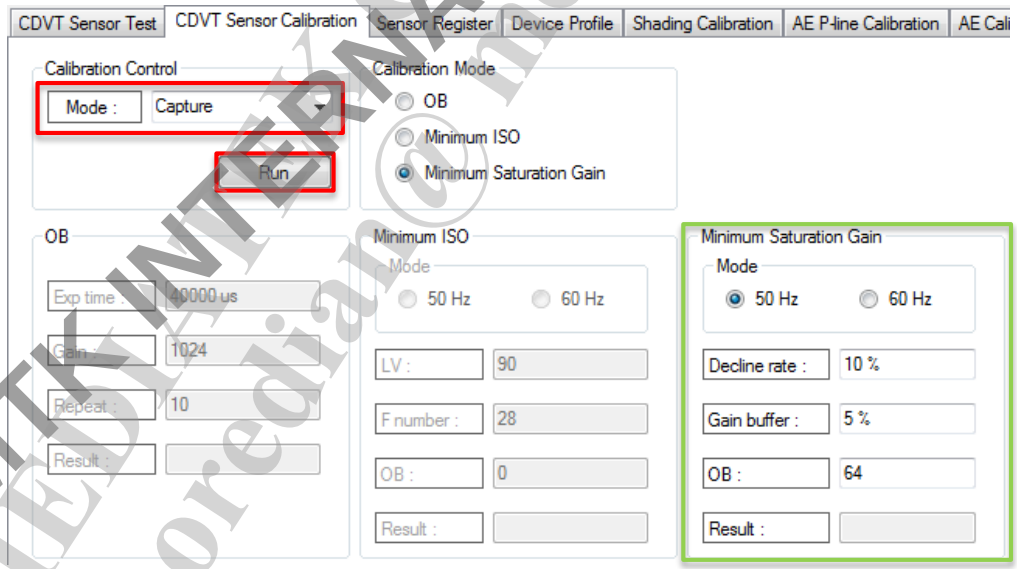
- Capture condition
  - Uniform light source.
- Test flow
  - same with Exposure Linearity.
- Check point
  - R/G/B can exceed 1024.
- If result is fail, highlight to customer in advance.

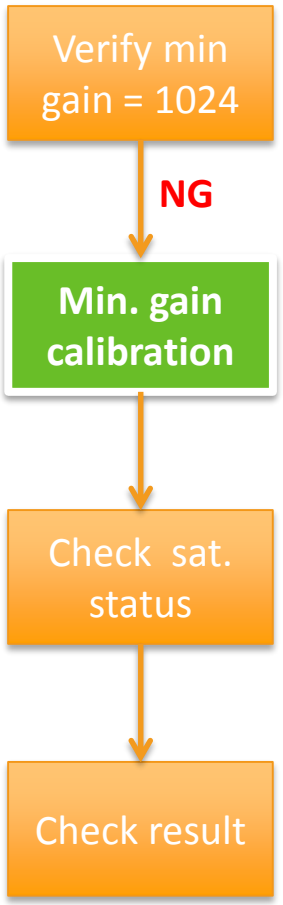




Min. Gain Calibration

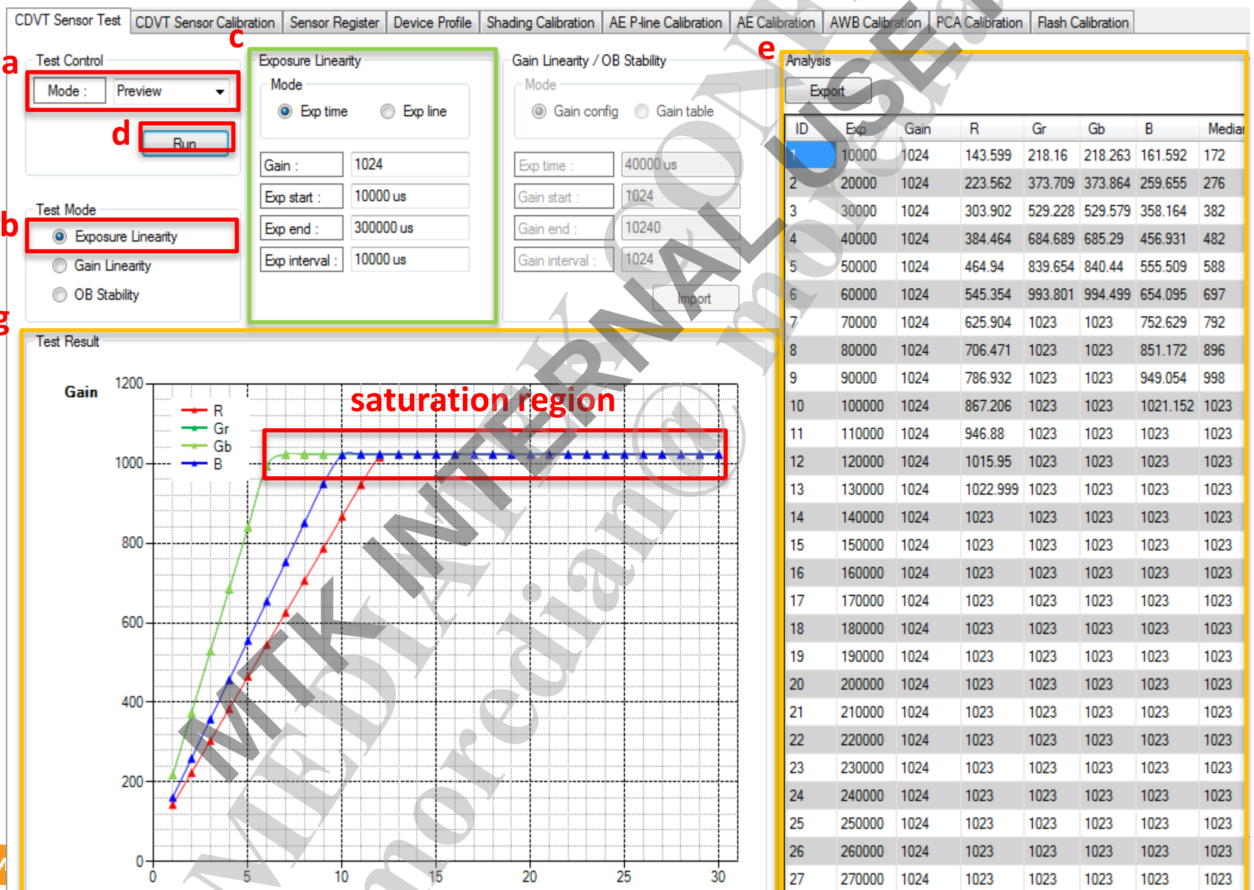
- Test flow
  a) Average light source.
  b) Set ‘Decline Rate/Gain Buffer/OB’.
  c) Click ‘Run’ to testing.
  d) Result as shown in text box.





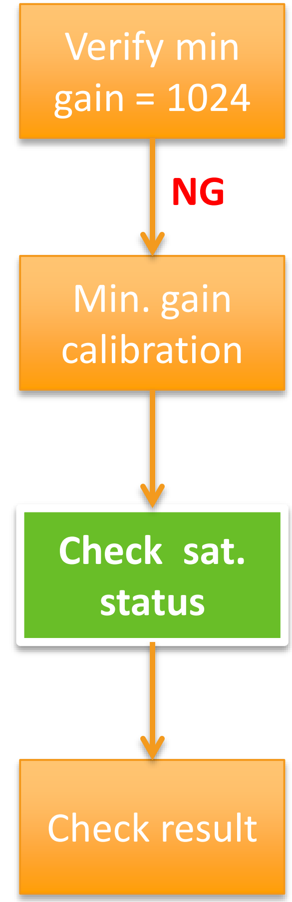
Check Saturation Status

- Check if R/G/B can exceed 1024.



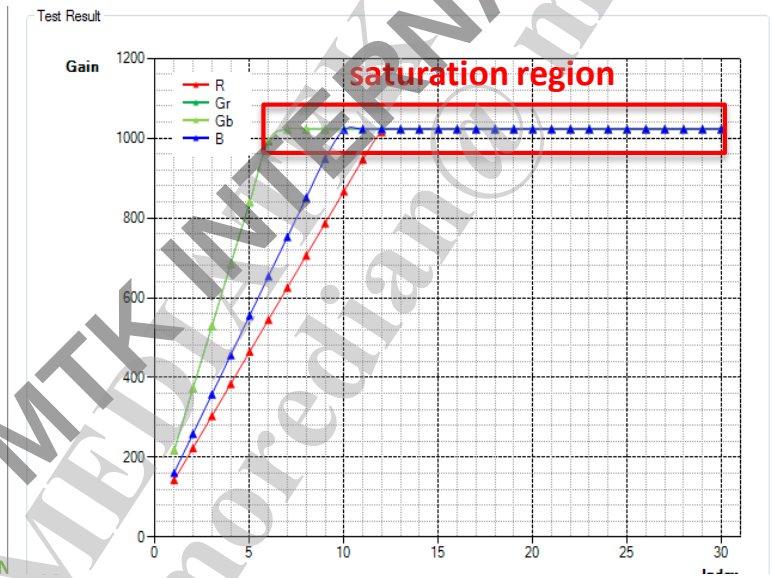
CDVT Sensor Test
CDVT Sensor Calibration
Sensor Register
Device Profile
Shading Calibration
AE P-line Calibration
AE Calibration
AWB Calibration
PCA Calibration
Flash Calibration
a
Test Control
Mode :
Preview
d
Run
b
Test Mode
Exposure Linearity
Gain Linearity
OB Stability
c
Exposure Linearity
Mode
Exp time
Exp line
Gain :
1024
Exp start :
10000 us
Exp end :
300000 us
Exp interval :
10000 us
Gain Linearity / OB Stability
Mode
Gain config
Gain table
Exp time :
40000 us
Gain start :
1024
Gain end :
10240
Gain interval :
1024
Import
e
Analysis
Export
g
Test Result
Gain
saturation region
R
Gr
Gb
B

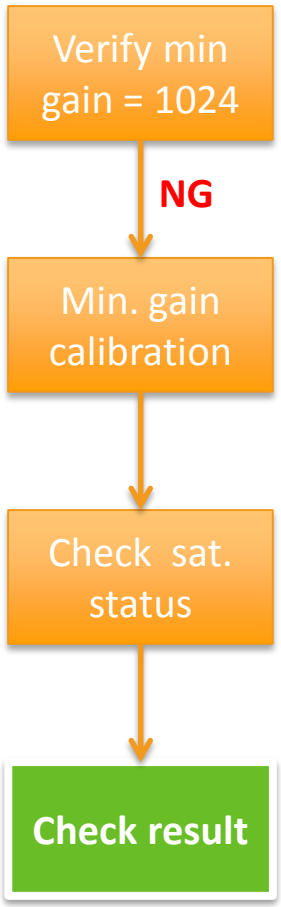
ID	Exp	Gain	R	Gr	Gb	B	Median
1	10000	1024	143.599	218.16	218.263	161.592	172
2	20000	1024	223.562	373.709	373.864	259.655	276
3	30000	1024	303.902	529.228	529.579	358.164	382
4	40000	1024	384.464	684.689	685.29	456.931	482
5	50000	1024	464.94	839.654	840.44	555.509	588
6	60000	1024	545.354	993.801	994.499	654.095	697
7	70000	1024	625.904	1023	1023	752.629	792
8	80000	1024	706.471	1023	1023	851.172	896
9	90000	1024	786.932	1023	1023	949.054	998
10	100000	1024	867.206	1023	1023	1021.152	1023
11	110000	1024	946.88	1023	1023	1023	1023
12	120000	1024	1015.95	1023	1023	1023	1023
13	130000	1024	1022.999	1023	1023	1023	1023
14	140000	1024	1023	1023	1023	1023	1023
15	150000	1024	1023	1023	1023	1023	1023
16	160000	1024	1023	1023	1023	1023	1023
17	170000	1024	1023	1023	1023	1023	1023
18	180000	1024	1023	1023	1023	1023	1023
19	190000	1024	1023	1023	1023	1023	1023
20	200000	1024	1023	1023	1023	1023	1023
21	210000	1024	1023	1023	1023	1023	1023
22	220000	1024	1023	1023	1023	1023	1023
23	230000	1024	1023	1023	1023	1023	1023
24	240000	1024	1023	1023	1023	1023	1023
25	250000	1024	1023	1023	1023	1023	1023
26	260000	1024	1023	1023	1023	1023	1023
27	270000	1024	1023	1023	1023	1023	1023



Check Result

- If R/G/B can not exceed saturation region
  - Increase Gain margin.
  - Re-do min gain calibration.
  - Feedback to customer/sensor vendor





Code Setting

- Path
  - vendor\mediatek\proprietary\custom*$project*\hal\imgsensor\ver2\$sensor\AE_Tuning_Para
  - Writing setting into following file

    $camera_ae_tuning_para_$sensor.cpp
    $camera_ae_tuning_para_cus1_$sensor.cpp
    $camera_ae_tuning_para_cus2_$sensor.cpp
    $camera_ae_tuning_para_cus4_$sensor.cpp
    $camera_ae_tuning_para_vdo_$sensor.cpp
    $camera_ae_tuning_para_pv_$sensor.cpp
    $camera_ae_tuning_para_cap_$sensor.cpp

camera_AE_tuning_para_$scenario_*$sensor*.cpp

```
#include "camera_custom_nvram.h"

#include "camera_ae_tuning_para_imx338mipiraw.h"

template <>
AE_NVRAM_T const&
getAENVRAM_imx338mipiraw<CAM_SCENARIO_CAPTURE>()
{
   // rDevicesInfo
   static AE_DEVICES_INFO_T   g_rDevicesInfo =
   {
     1136,   // u4MinGain
     8192,   // u4MaxGain
     100,   // u4MiniISOGain
     16,   // u4GainStepUnit
     13701,   // u4PreExpUnit
     31,   // u4PreMaxFrameRate
     10045,   // u4VideoExpUnit
     30,   // u4VideoMaxFrameRate
     1024,   // u4Video2PreRatio
```

➢ Fill the result into "DeviceInfo"

LensPartNum	FM50AFAF
u4LensFno	22
SensorPartNum	IMX135MIPIR
u4OBLevel	64
u4MinGain	1136

Minimum ISO

- Test flow
  a) Check whether F numver(LensFno) is correct
  b) Average light source , select correct light mode
  c) Set “Mode/LV(80~100)/F number/OB”.
  d) Click “Run” for testing.
  e) Result as shown in text box.

- Fill the result into “DeviceInfo”

u4MiniISOGain	51