CONFIDENTIAL B

MT6771 ISP Tuning Introduction

有奖问答

- Q1： ISP tuning的pipeline？
- Q2： 哪些模块会影响到noise的表现？

有奖问答

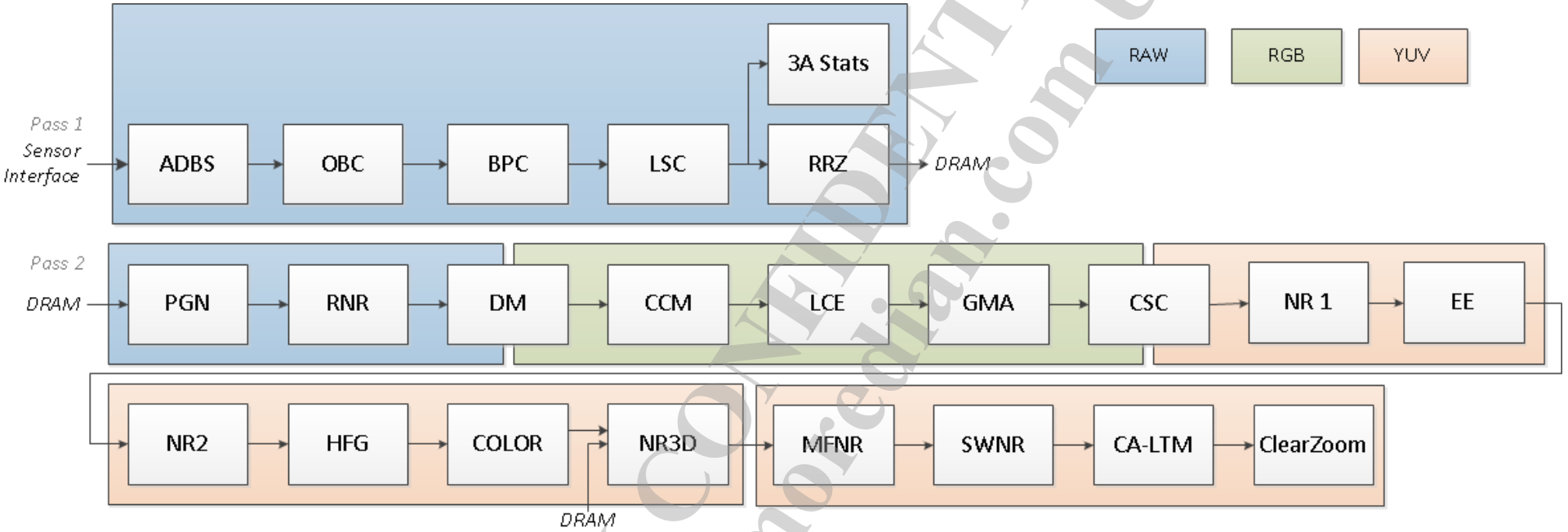
- Q1:ISP tuning的pipeline

  DBS->OB->BPC->SHADING->DM->CCM->LCE->GAMMA->NR->EE

- Q2:哪些模块会影响到noise的表现

  DBS->OB->BPC->SHADING->DM->CCM->LCE->GAMMA->NR->EE

MT6771 Block Diagram



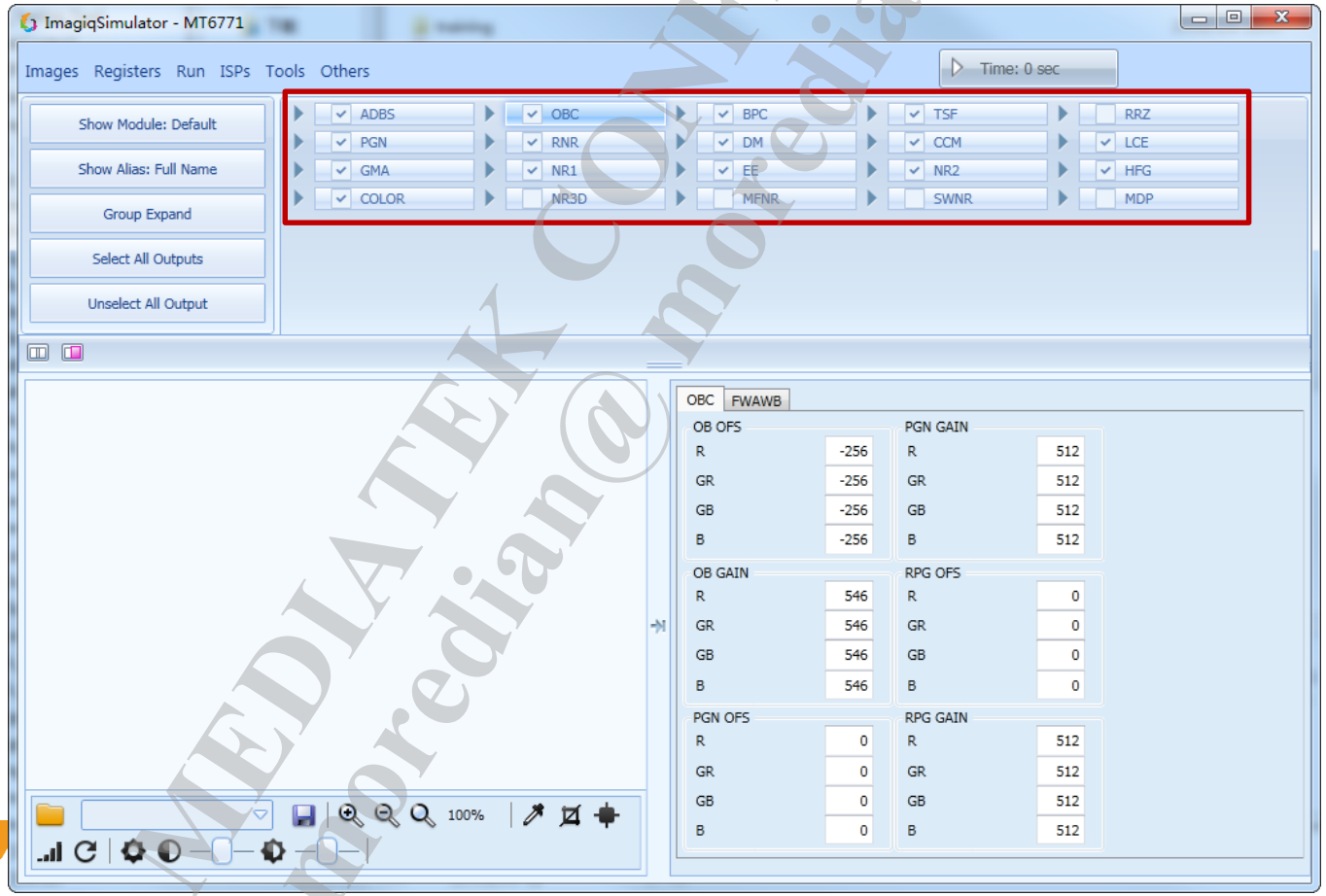
Noise	
BPC	Bad Pixel Correction & G imbalance
NR 1	Noise Reduction 1
NR 2	Noise Reduction 2
NR2 - ABF	Anti-Blooming Filter
NR2 - CCR	Chroma Coring
RNR	Raw Noise Reduction
HFG	High Frequency Generator
NR3D	Temporal Noise Reduction
MFNR	Multi-Frame Noise Reduction
SWNR	SW-based Noise Reduction

Tone	
ADBS	Advanced De-Bias
OBC	Optical Black Correction
LSC	Lens Shading Correction
LCE	Local Contrast Enhancement
GMA	Gamma Correction
CA-LTM	Content-Aware Local Tone Mapping
Others	
3A Stats	3A Statistics
CSC	Color Space Conversion

Color	
PGN	Pre-gain (WB gain)
CCM	Color Correction Matrix
COLOR	Color Engine
Morphing	
RRZ	Raw Resizer
Texture	
DM	Demosaic
EE	Edge Enhancement
ClearZoom	Clear Zoom

ImagiqSimulator5

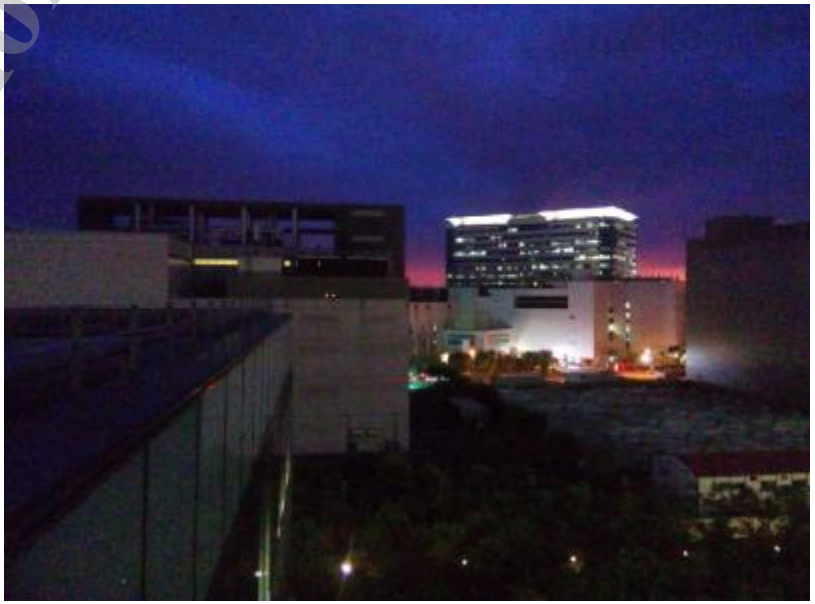
- ImagiqSimulator_MT6771_General_20180403
  - ISP simulation tool for mt6771
- ImagiqSimulator5_UserManual_GeneralCustomer.pdf



ADBS: Advanced De-Bias

- Purpose
  - Improve sensor linearity for low-light region
- Usage
  - Automatic self-calibration, Just enable it, no need to do parameter calibration.

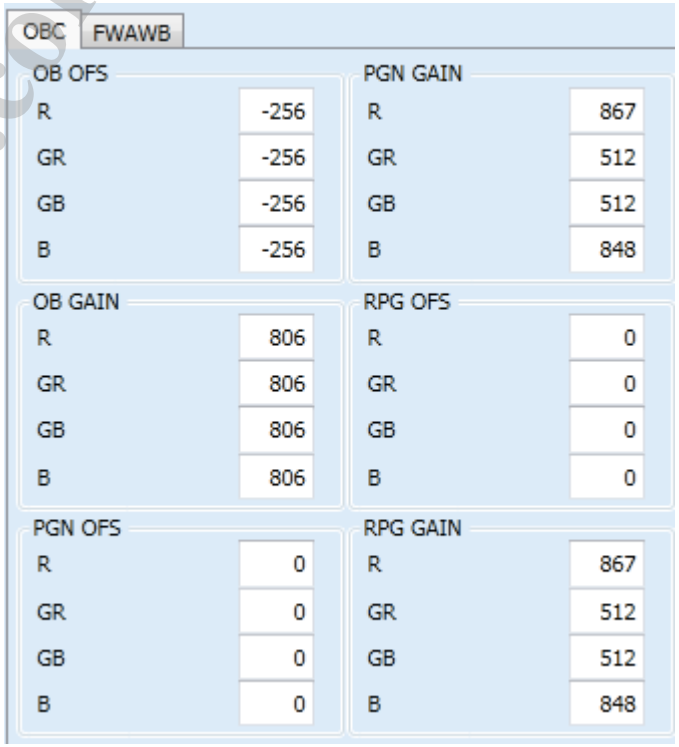
w/o ADBS



w/ ADBS

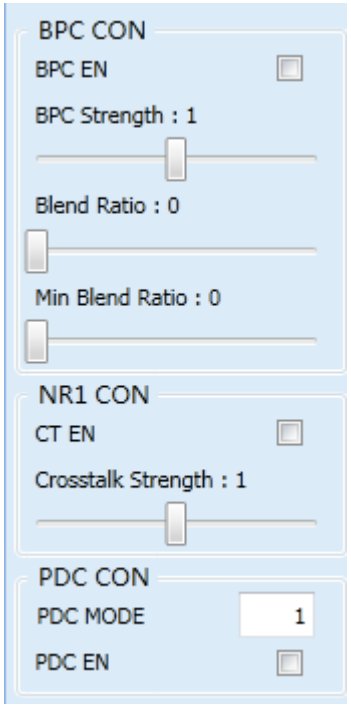
OBC

- OBC, PGN
  - OB offset 12bit
  - OB gain = OB gain * isp gain
  - PGN/RPG gain = awb gain*flare gain



BPC

- BPC
  - BPC
  - NR1 = crosstalk
  - PDC, raw type PDAF sensor，需要通过PDC来补偿pd点。导通PDAF驱动时候需要PDC Table，ISP模拟的时候需要将PDC table导入。

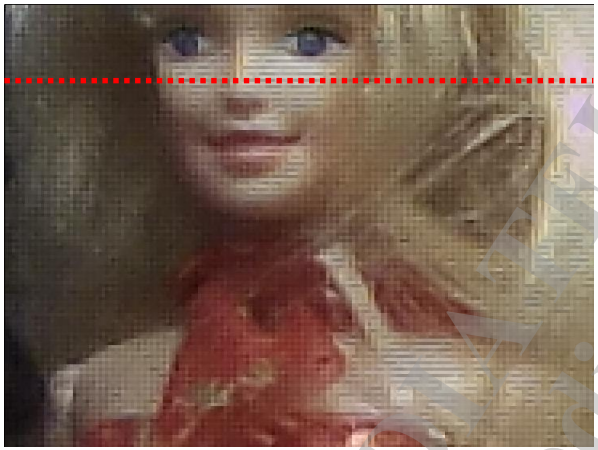


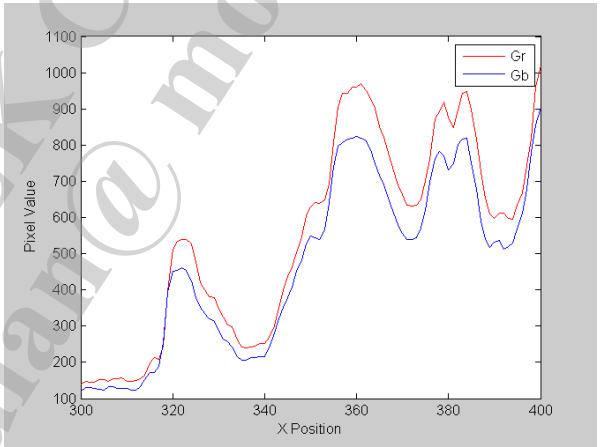
BPC: Bad Pixel Correction

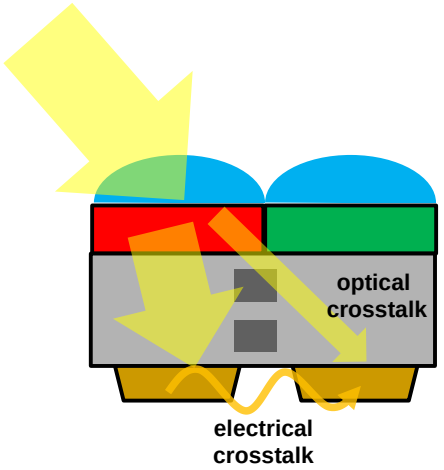
- Purpose
  - Remove bad pixels while keeping most details
- Usage
  - Tuning for different BPC pattern

BPC-CT: Gr/Gb Crosstalk

- Purpose
  - Remove maze-like pattern from Gr/Gb difference
- Usage
  - Tuning depends on crosstalk level



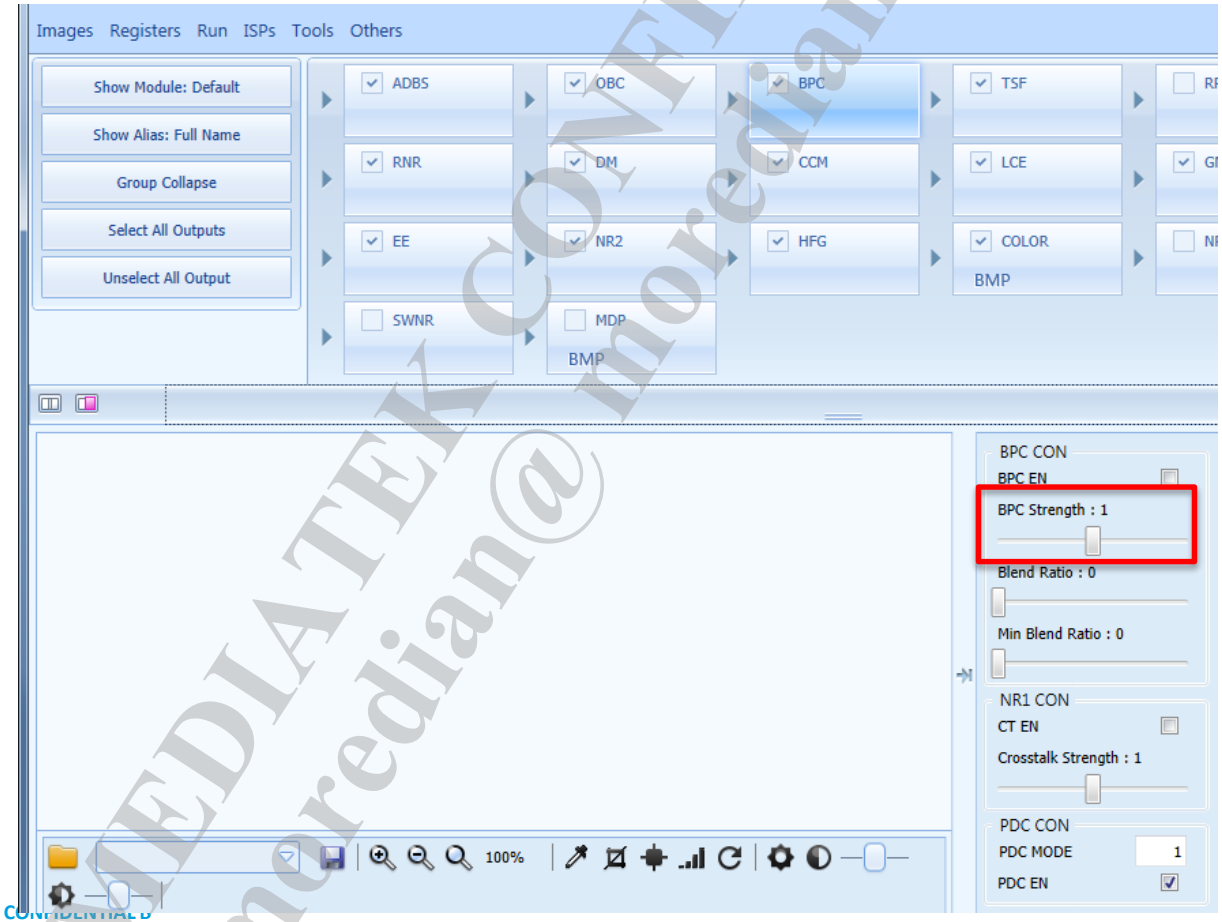




Tuning Slider (ImagiqSimulator)

1. Strength

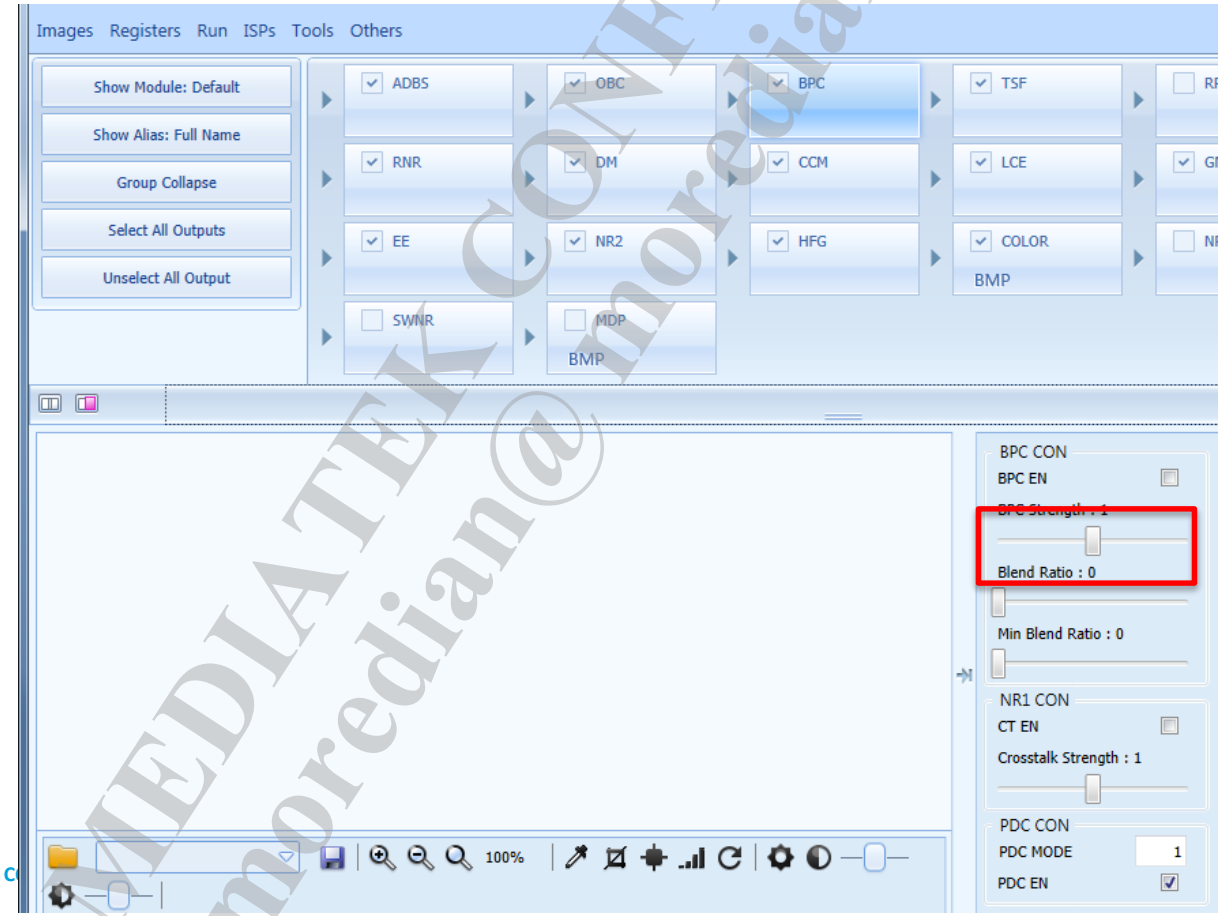
- There are three levels for BPC strength, Low, Mid, and High
- The High strength is recommended to high ISO only.



Tuning Slider (ImagiqSimulator)

2. Blend ratio

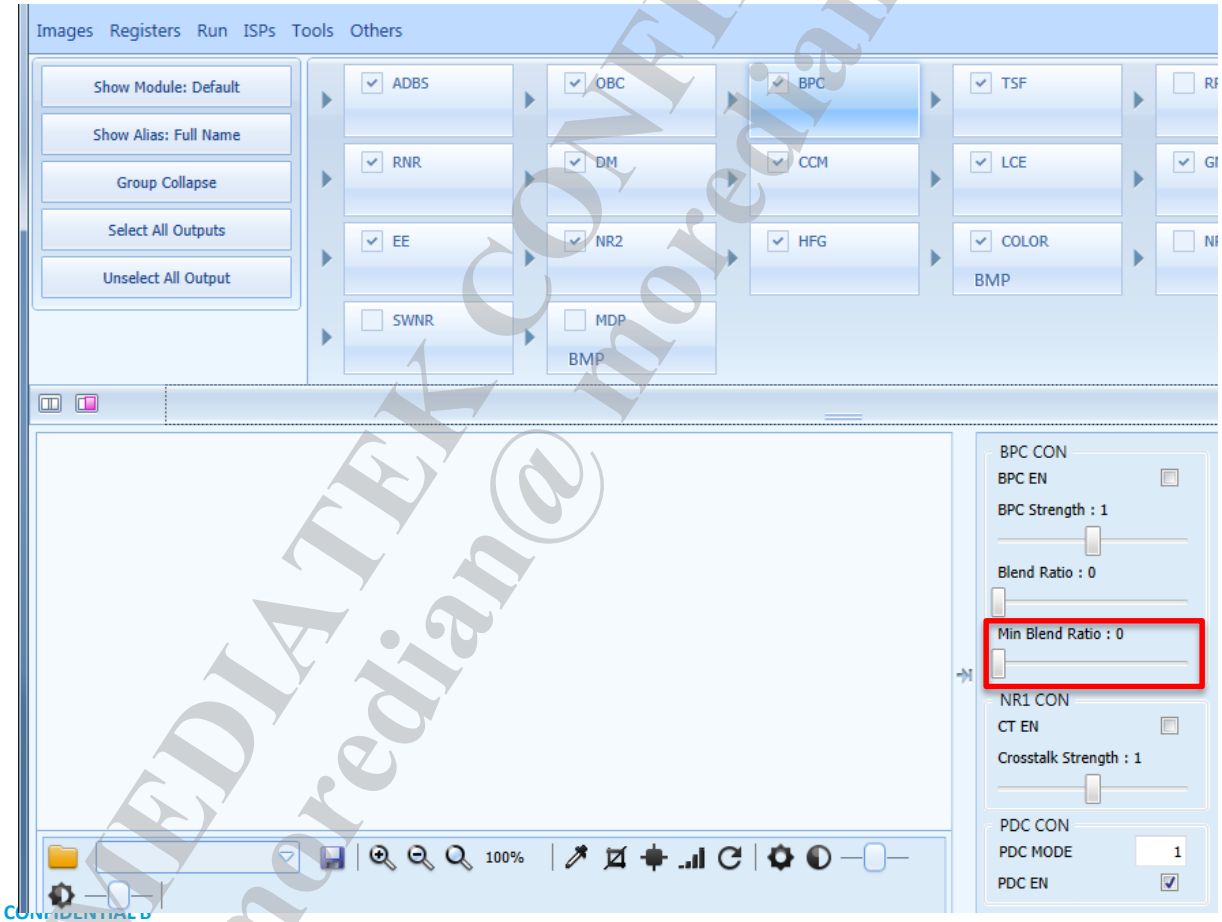
- 256 levels for Blend ratio, from 0 (min blending) to 255 (max blending)
- The higher difference between original and BPC-modified frame is observed, the larger blending ratio(255) is recommended



Tuning Slider (ImagiqSimulator)

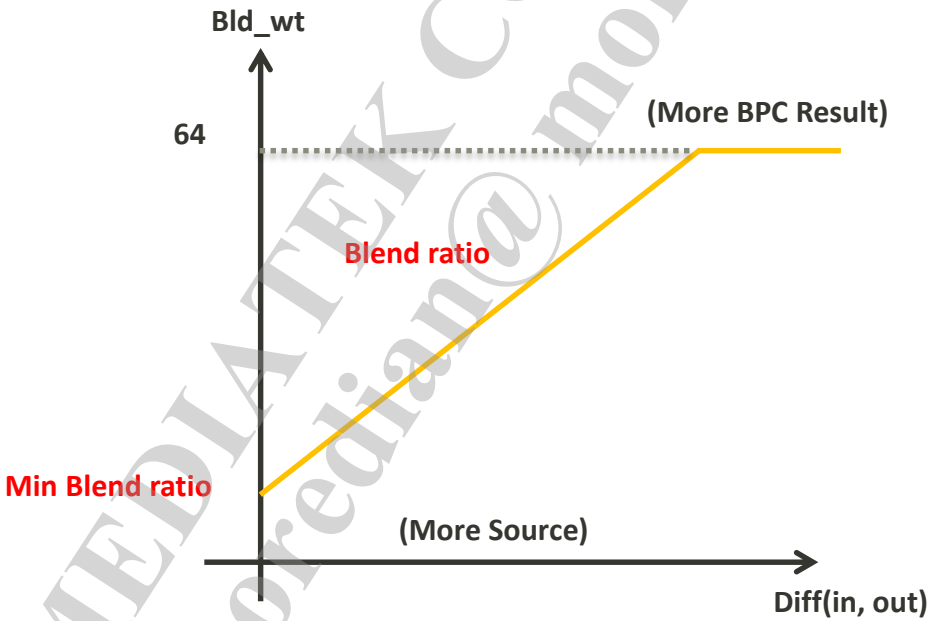
3. Min Blend ratio

- There are 65 levels for Min Blend ratio, from 0 (no blending) to 64 (full blending)
- The min Blending level at least would be applied



BPC Tuning

- In ISP tuning tool, We also have three items as slider for tuning.
  - 1. Strength
  - 2. Blend ratio
  - 3. Min Blend ratio

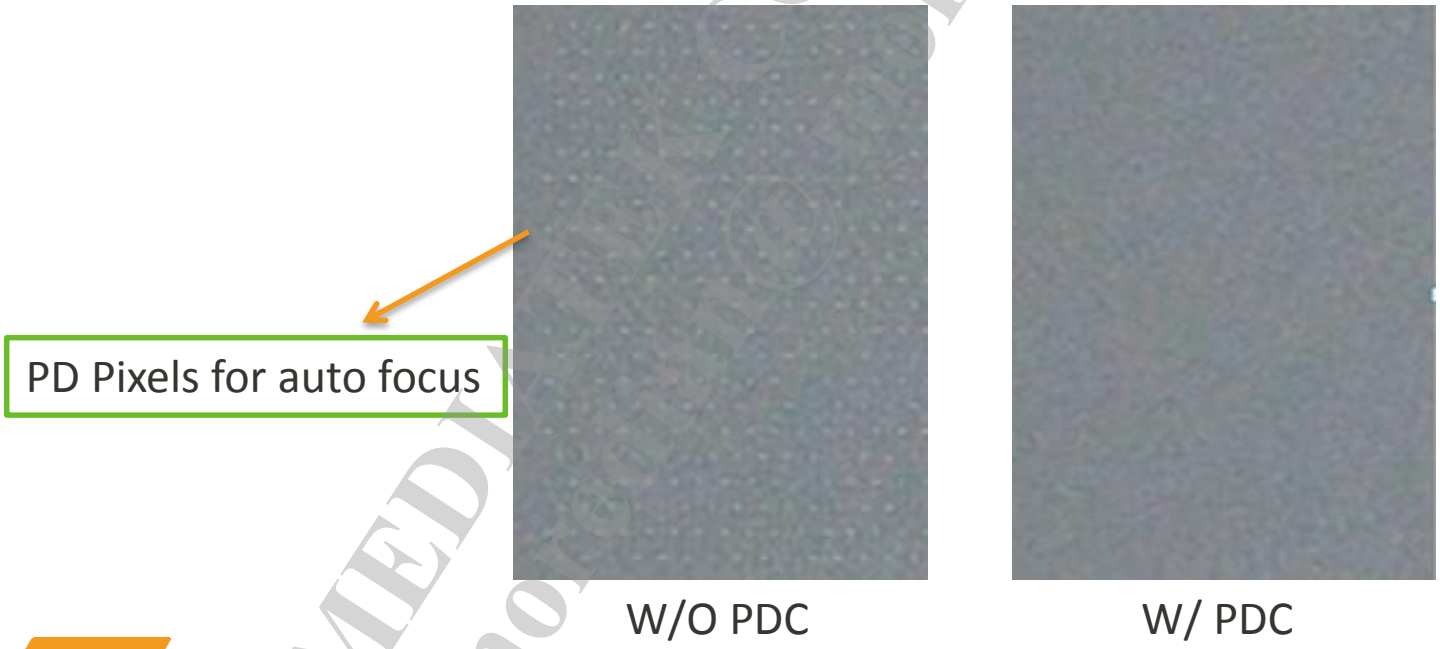


Method to do PDC

- ISP PDC (Phase Difference pixel Correction)
  - Advanced Static Bad Pixel Correction
  - Phase Difference Pixels corrected by ISP
- Sensor SPC (Shield Pixel Correction)
  - A shielded pixel requires to have some gain such that the signal level of each shield pixel will be equivalent to a normal pixel.
  - This SPC gain map values should be written by the module vendor within the module calibration process.
  - e.g. IMX298

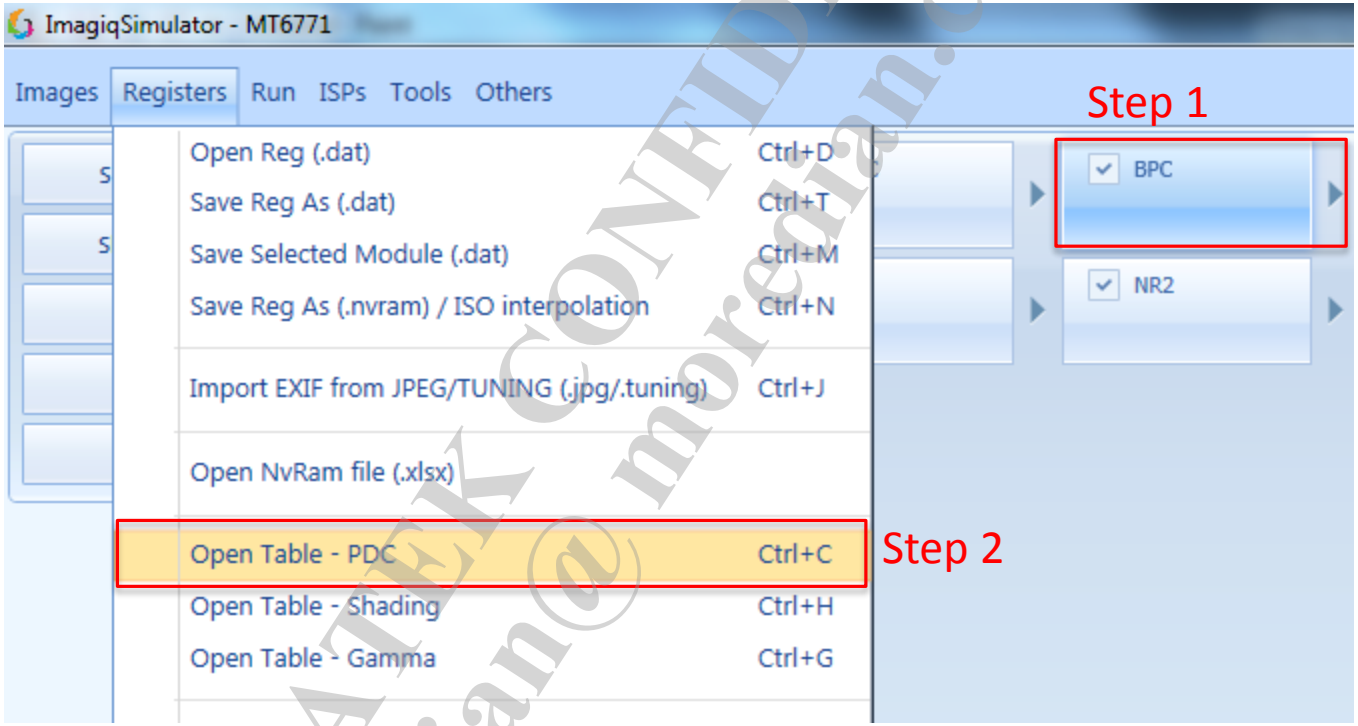
BPC-PDC: Phase Difference Pixel Correction

- Purpose
  - Remove PD pixels naturally
- Usage
  - Based on specific PD table to do correction



ISP PDC Functional Steps

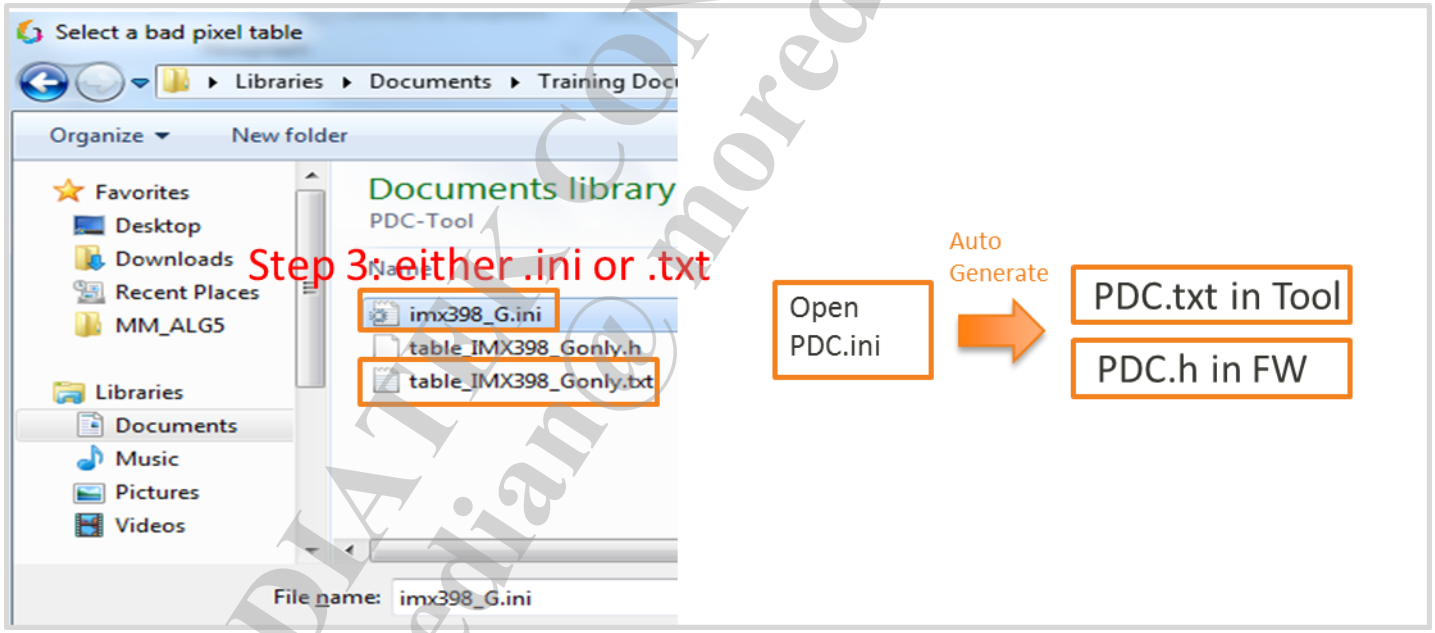
- Step 1: Active BPC module
- Step 2: Open PDC description file in PDC.ini or PDC.txt file type.



Note: A PD Pixel Description File in .ini file type should request to sensor vendor, see also: page 14.

ISP PDC Functional Steps

- Step 3:
  - Opening PDC.ini file is required at the first time, tool would generate a PDC.txt file which could comply with ImadiqSimulator.
  - Next you could open .txt been stored into the same folder as PDC.ini once PDC Table in .txt file type is generated automatically.



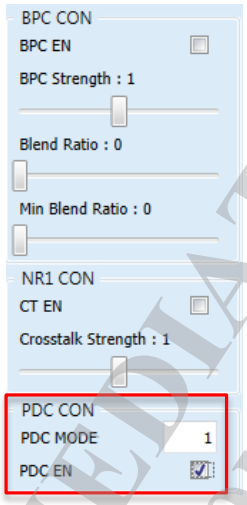
ISP PDC Functional Steps

- Step 4(optional): TO ACTIVE FW, MUST Copy PDC.h content to FW file

  vendor\mediatek\proprietary\custom\mtxxxx\hal\imgsensor\verx\xxxxxx_mipi_raw**camera_bpci_tbl**_xxxxxxmipiraw.h

```
const unsigned int bpci_xsize=9983;
const unsigned int bpci_ysize=0;
const unsigned int pdo_xsize=2239;
const unsigned int pdo_ysize=415;
const unsigned char bpci_array[]={
0x49,0xC0,0x5A,0x00,0x7A,0x11,0x07,0x00,0x01,0x00,0x07,0x40,0x01,0x00,0x07,0x40,
0x01,0x00,0x07,0x40,0x01,0x00,0x07,0x40,0x51,0xC0,0x5E,0x00,0x7A,0x11,0x07,0x00,
0x01,0x00,0x07,0x40,0x01,0x00,0x07,0x40,0x01,0x00,0x07,0x40,0x01,0x00,0x07,0x40,
0x59,0xC0,0x5A,0x00,0x7A,0x11,0x07,0x00,0x01,0x00,0x07,0x40,0x01,0x00,0x07,0x40,
0x01,0x00,0x07,0x40,0x01,0x00,0x07,0x40,0x61,0xC0,0x5E,0x00,0x7A,0x11,0x07,0x00,
0x01,0x00,0x07,0x40,0x01,0x00,0x07,0x40,0x01,0x00,0x07,0x40,0x01,0x00,0x07,0x40,
0x69,0xC0,0x5A,0x00,0x7A,0x11,0x07,0x00,0x01,0x00,0x07,0x40,0x01,0x00,0x07,0x40,
```

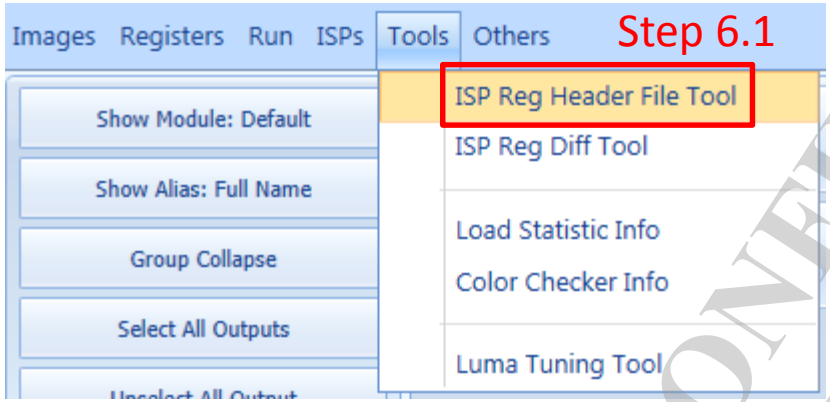
- Step 5: Atviate PDC Enable and select Mode as requirement by following below info.



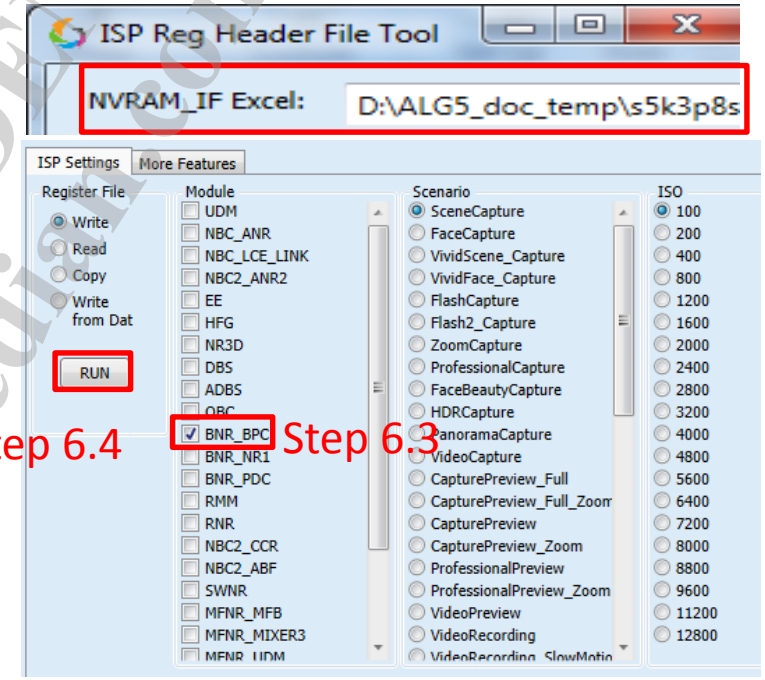
PDC Enable
Mode 1

ISP PDC Functional Steps

- Step 6: Update ISP PDC Parameter.



Step 6.2



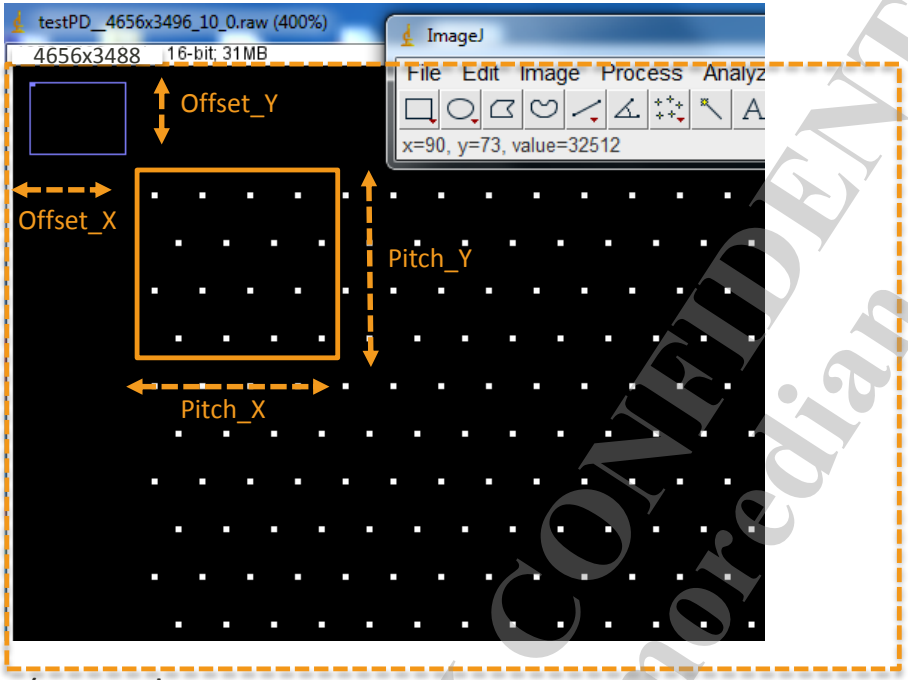
- Ensure it's correct in Reg Header File

```
#define BNR_PDC_0420 /*profile = Capture, sensor mode = Capture, ISO_0;profile = Capture_Capture_ZOOM1, ISO_0;profile =
        .con     ={.bits={.PDC_EN=1, .rsv_1=0, .PDC_CT=0, .rsv_5=0, .PDC_MODE=1, .rsv_10=0, .PDC_OUT=0, .rsv_17=0}},\
```

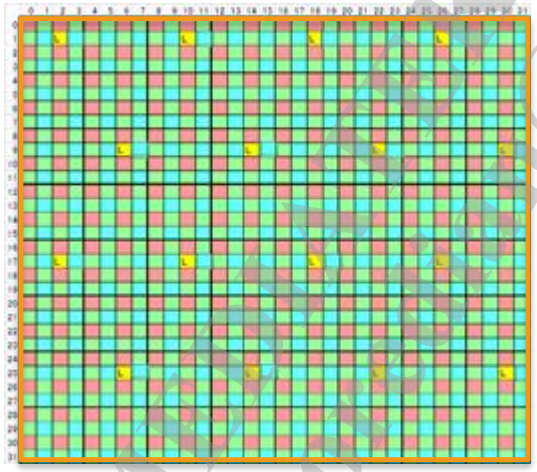
Step 6.5

(Param content Example)

Verify PD Pixel Position



(Example: PD Pixels been specified with white in RAW image)



(Example: PD Pixels on both Gb and B channel in a Block)

```
RAW_WIDTH=4656;
RAW_HEIGHT=3488;
RAW_BITS=10;
RAW_BYTE_ORDER=0;
PD_OFFSET_X=88;
PD_OFFSET_Y=72;
PD_PITCH_X=32;
PD_PITCH_Y=32;
PD_DENSITY_X=8;
PD_DENSITY_Y=16;
PD_BLOCK_NUM_X=140;
PD_BLOCK_NUM_Y=104;
PD_BINNING_TYPE=0;
CALI_PARAM1=20;
CALI_PARAM2=4;
CALI_PARAM3=8;
CALI_PARAM4=8;
CALI_CAPTURE_NUM=10;

PD_POS_L=
[90 73]
[98 73]
[106 73]
[114 73]
[94 81]
[102 81]
[110 81]
[118 81]
[90 89]
[98 89]
[106 89]
[114 89]
[94 97]
[102 97]
[110 97]
[118 97];
```

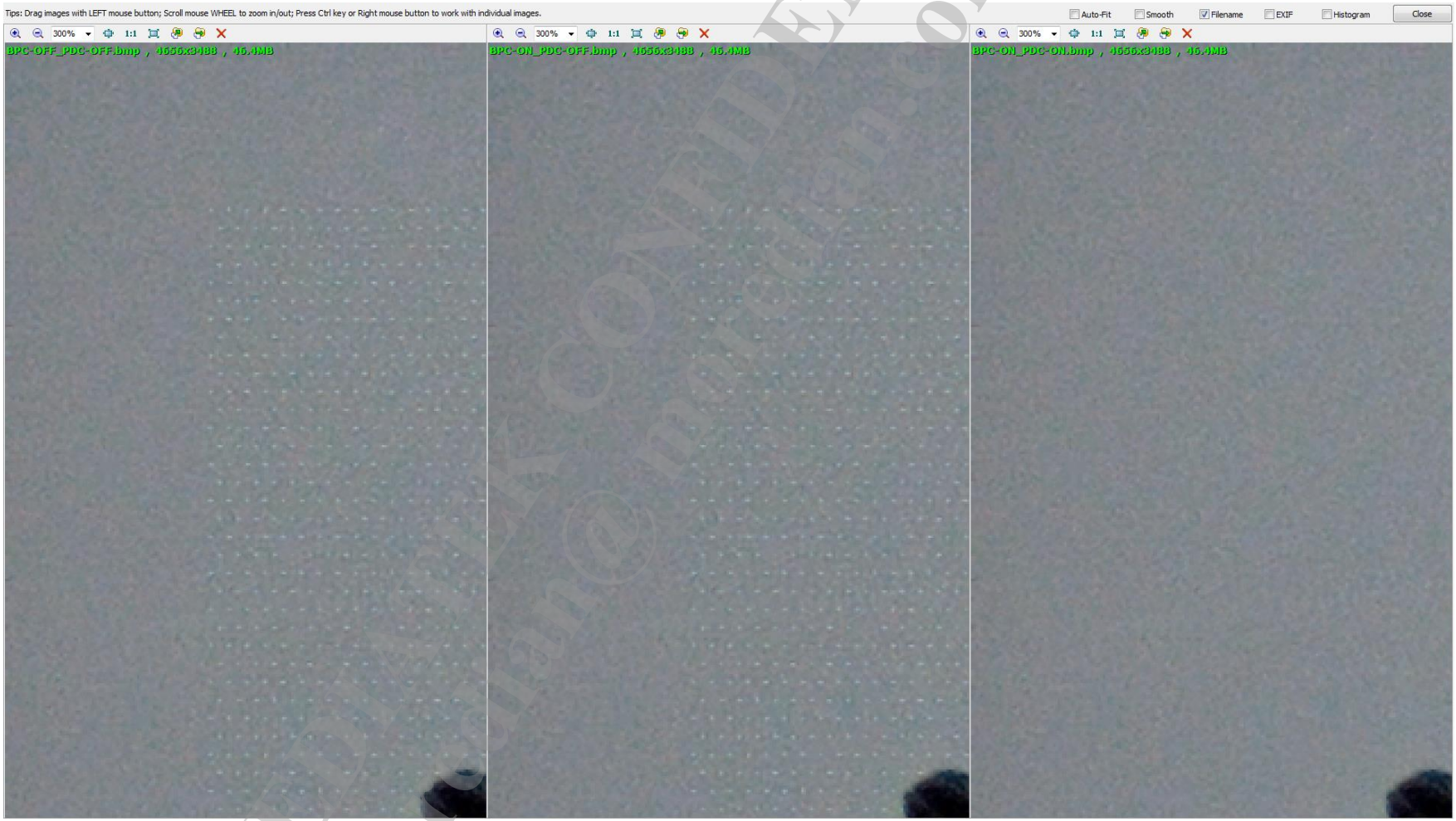
Sensor PD Info

Include all PD Pixel Coordinator of the first Block

(PDC.h Example)

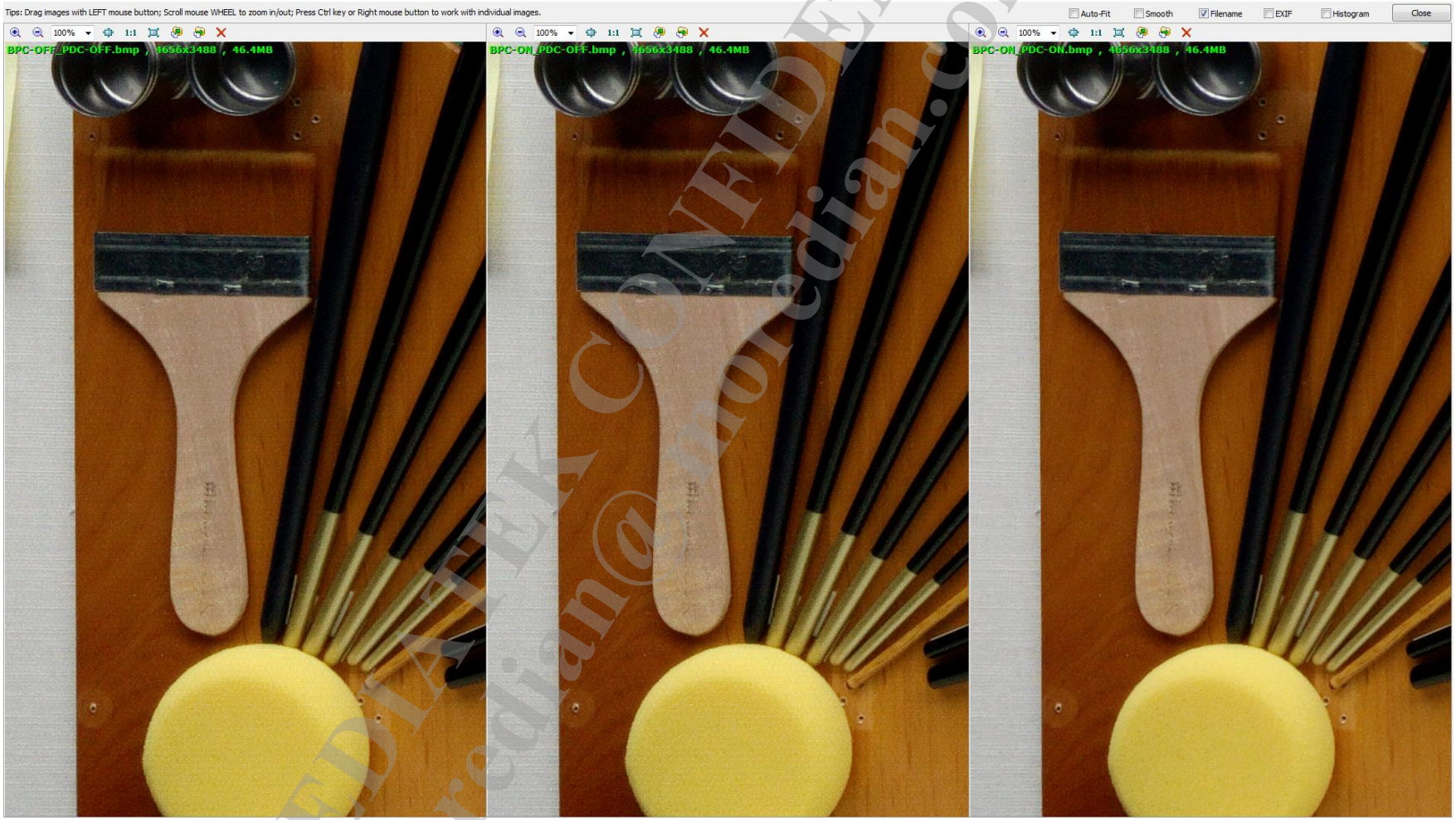
Sample Image

- W/O BPC, W/O PDC
- W/ BPC, W/O PDC
- W/ BPC, W/ PDC



Sample Image

- W/O BPC, W/O PDC
- W/ BPC, W/O PDC
- W/ BPC, W/ PDC



Notes

1. The PDC configuration forbids checking PDC_Enable alone without opening PDC Table.

2. Sensor BIN or ISP BIN would break phase difference information, the Sensor SPC (Shield Pixel Correction) is preferred for the BIN case than ISP PDC.

3. Scenario Tracking Table:

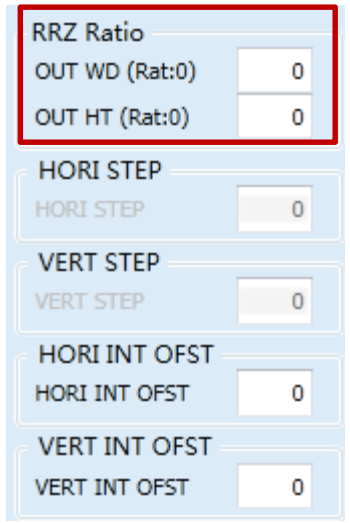
Notes

Scenario Tracking Table:

Tracking Scenario	Preview Crash w/PDC Enable	PDC Not Functional	PDAF Not Functional	Instruction
PDC Table is not loaded	■	■		Step 1~3
PDC Enable is not selected		■	■	Step 5
PDC header in FW is not update		■		Step 4
Improper PDC Table Description		■		Page 14
BIN is activated		■		Note 2 on page 19
ISP Param is not update		■		Step 6

RRZ

- RRZ
  - Need to turn on when isp profile is video or preview, turn off when capture.
  - Because of rrzo, the image quality is different between pre and cap when using the same parameter.

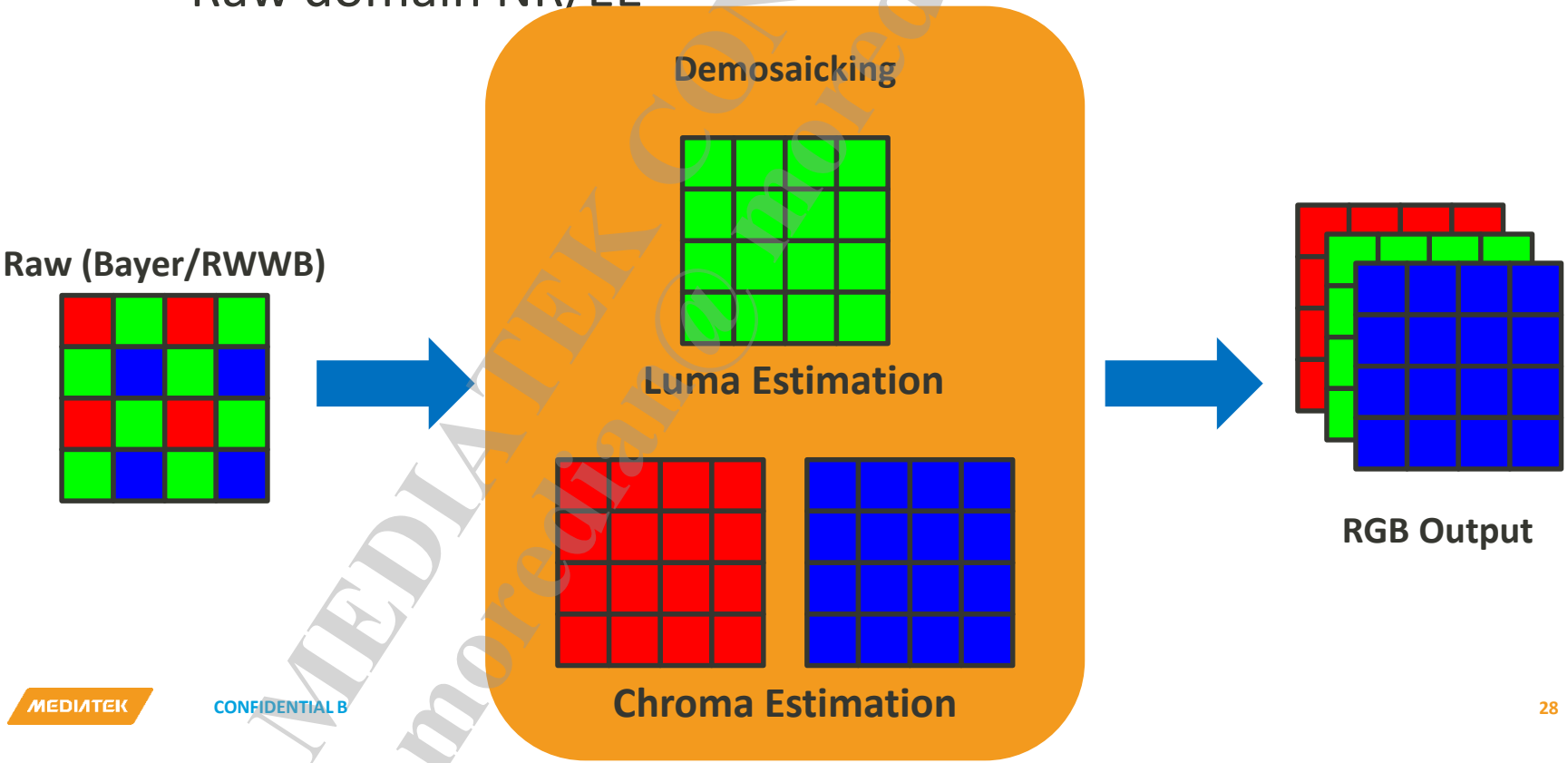



```
x1,rrz_in_w/h(4032/3024),rrz_crop_x/y/fx/fy/w/h(2/2/0/0/4028/3020),rrz_out_w/h(1440/1080),rlb_offset(6752),rrz_h/v_step(
```

DM

DM: Demosaic

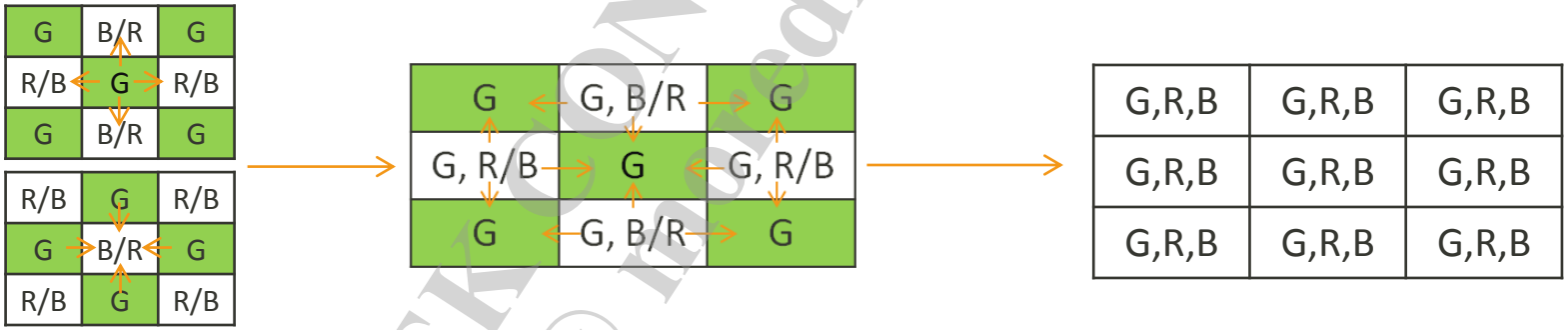
- Purpose
  - Converts raw pattern into three (R/G/B) images with full resolution
  - Raw domain NR/EE



How to do Demosaic

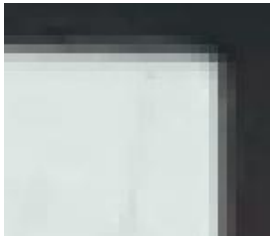
Interpolate the other two colors from neighborhood.
Use Direction filter to keep edge.
Use Low-pass Filter(LPF) to reduce noise
Use High Pass Filter(HPF) to enhance edge

1. Interpolation

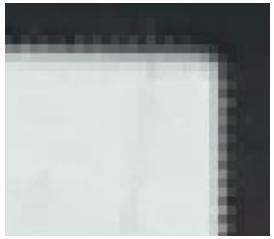


2. Edge Keeping

Preserve Edge



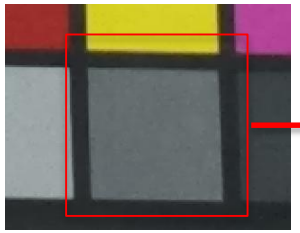
Without Preserve Edge



How to do Demosaic

Interpolate the other two colors from neighborhood.
Use Direction filter to keep edge.
Use Low-pass Filter(LPF) to reduce noise
Use High Pass Filter(HPF) to enhance edge

3. Low-Pass Filter



Without LPF

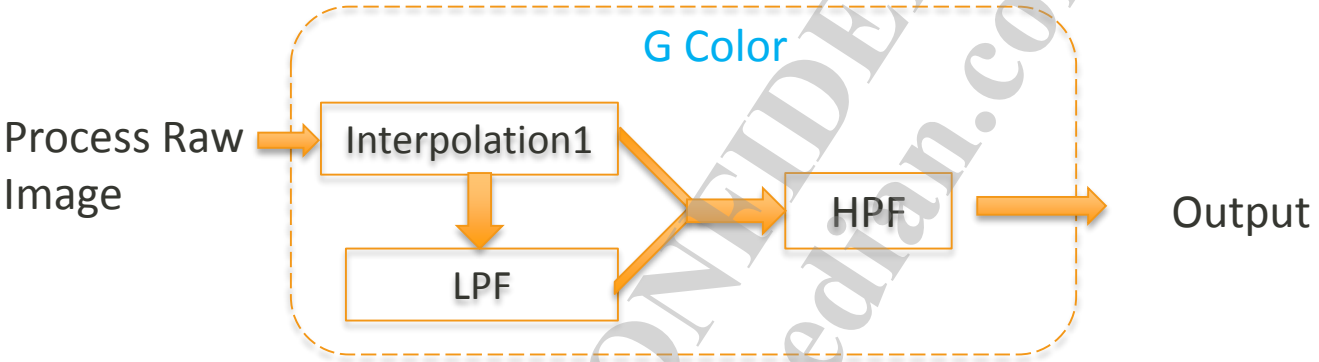
With strong LPF

4. High Pass Filter

Without HPF

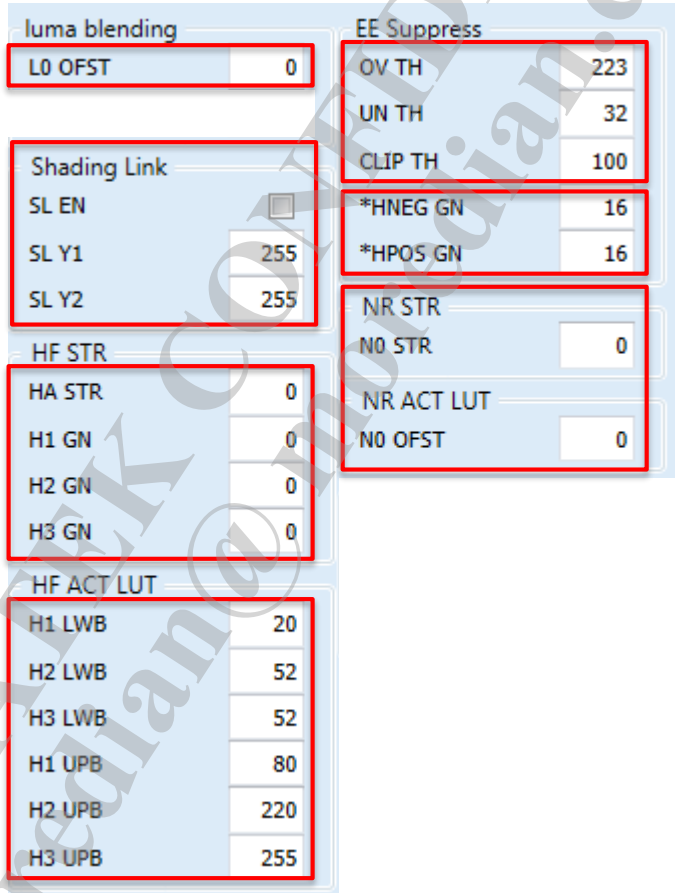
With strong HPF

DM Block Diagram



Interpolation1	-Interpolation G channel -Keep edge
LPF	-Denoise at flatness region -Edge recognition
HPF	-Edge enhancement
Interpolation2	-Interpolation R/B color to get R/G/B for every pixel.

MT6771 DM UI



Connectivity, Detail

Corner NR, Enable signal

Corner NR, Strength

Overall EE Strength
EE Strength, Detail
EE Strength, Edge
EE Strength, Strong Edge

EE Noise Level, Detail
EE Noise Level, Edge
EE Noise Level, Strong Edge

Edge Suppression, White
Edge Suppression, Dark
Edge Suppression, Threshold

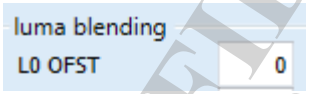
Positive/Negative EE Response

NR, Strength

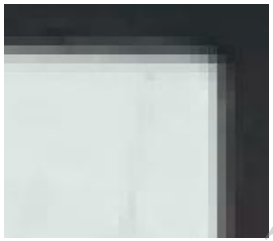
NR, Noise Level

Interpolation1

Connectivity, Detail, 0~255



edge



0

255

Trade off

flatness

High pass Filter – EE Strength

HA STR	0

Overall EE strength control. 0: No EE

H1 GN	0
H2 GN	0
H3 GN	0

EE Strength, Detail, 0~31
EE Strength, Edge, 0~31
EE Strength, Strong Edge, 0~31

EE Strength ↑ → Detail & Edge ↑

H1 GN	0
H2 GN	0
H3 GN	0

H1 GN	8
H2 GN	8
H3 GN	8

High pass Filter – Noise Level

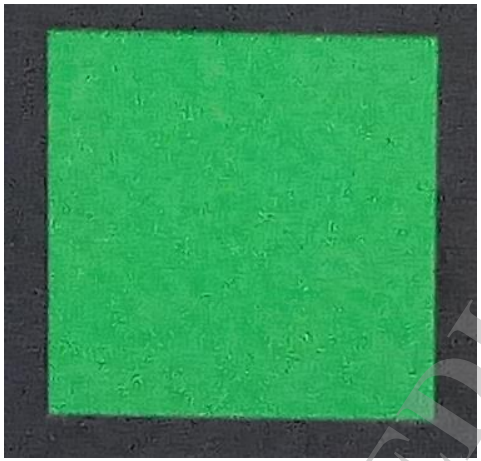
EE Noise Level, Detail, 0~255
EE Noise Level, Edge, 0~255
EE Noise Level, Strong Edge, 0~255
EE Edge Level, Detail, 0~255
EE Edge Level, Edge, 0~255
EE Edge Level, Strong Edge, 0~255

HF ACT LUT	
H1 LWB	20
H2 LWB	52
H3 LWB	52
H1 UPB	80
H2 UPB	220
H3 UPB	255

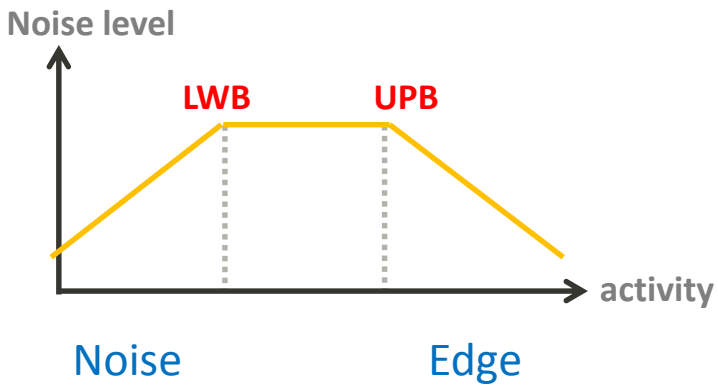
Noise LV ↑ → Noise ↓ , Blur ↑

Edge LV ↑ → Edge ↑ , Blur ↓

LWB Small value



LWB Large value

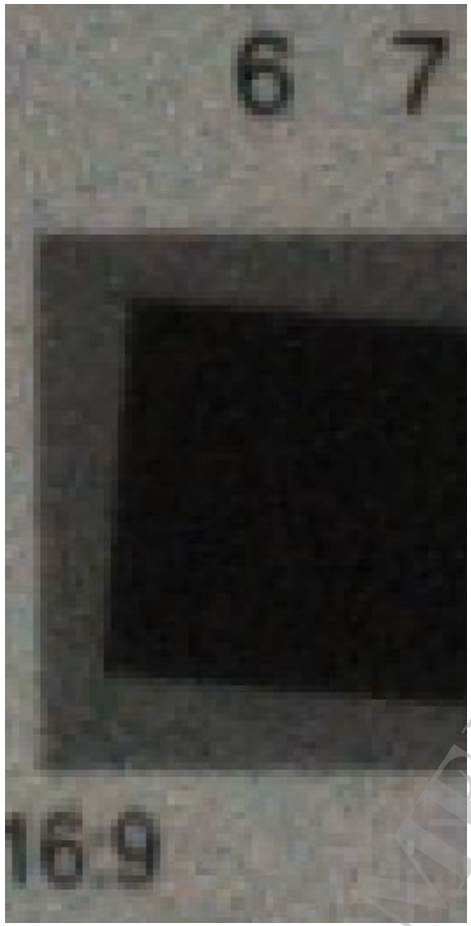


*HNEG GN	16
*HPOS GN	16

Positive/Negative EE Response

(※ Default)

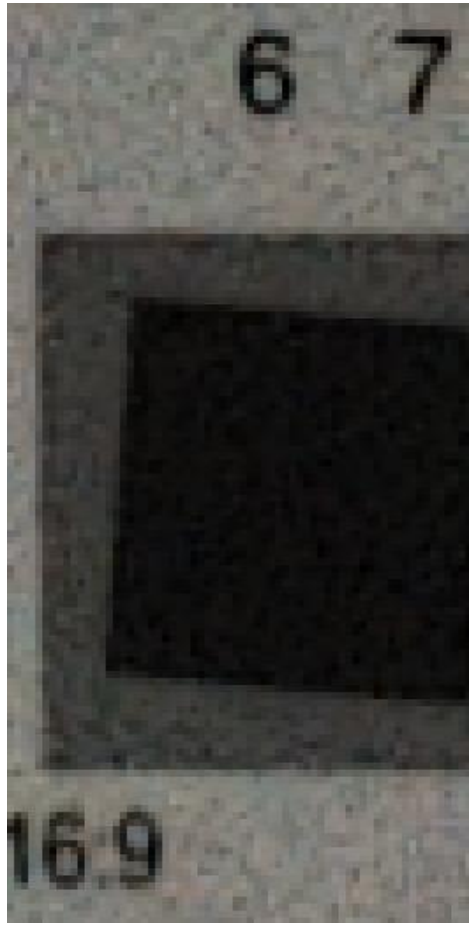
HNEG_GN = 0
HPOS_GN = 0



HNEG_GN = 16
HPOS_GN = 16

HNEG_GN = 0
HPOS_GN = 16

HNEG_GN = 16
HPOS_GN = 0



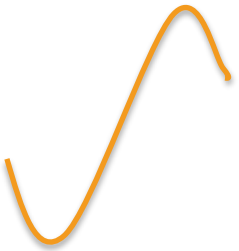
Over/Under Shoot

Edge Suppression, White, 255~0
Edge Suppression, Dark , 0~255
Edge Suppression, Threshold , 0~255

EE Suppress	
OV TH	223
UN TH	32
CLIP TH	100

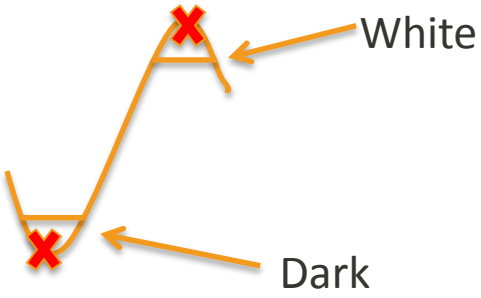
Used when HPF enhance too much

Too sharp



OVTH ↓
or
UN TH ↑
or
CLIP TH ↓

smoother



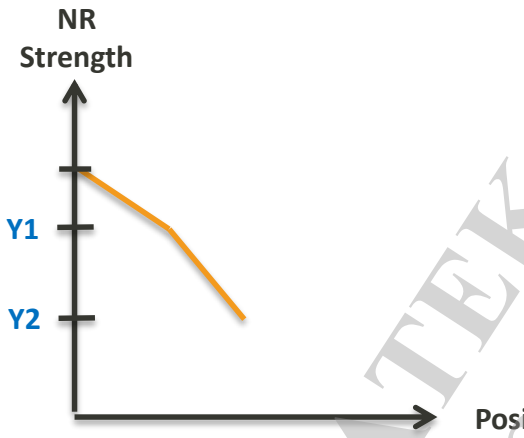
Corner Noise

Corner NR, Enable signal

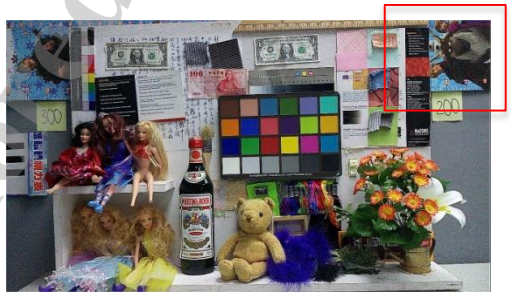
Corner NR, Strength

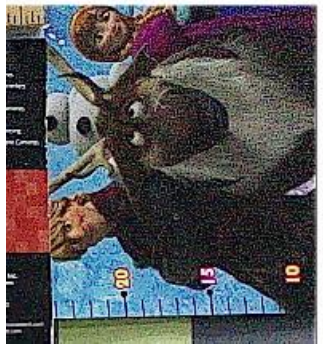
SL EN		
SL Y1	255	255~0
SL Y2	255	255~0

Used if Corner is too much noise caused by HPF , especially at high ISO

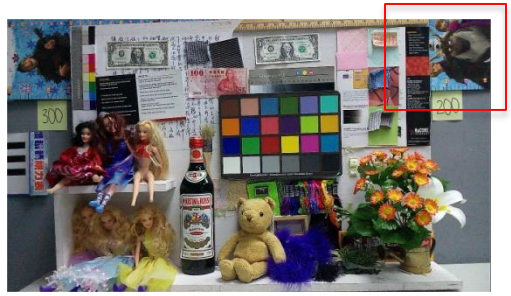


Large value





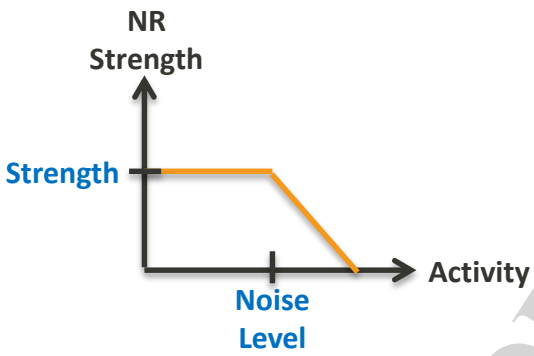
Small value



Low Pass Filter

NR, Strength, 0~16

NR, Noise Level, 0~255



	Large STR	Small STR
Large OFST		
Small OFST		

NBC

NBC/NR1: YUV Noise Reduction 1

- Purpose
  - Reduce luma and chroma noise

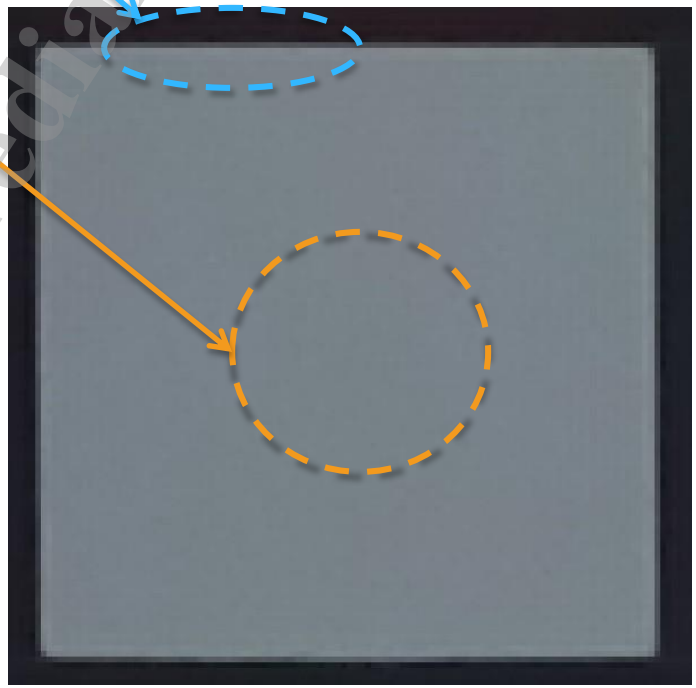
Before NR

After NR

What is Noise Reduction

A function to remove noise and preserve edge while removing noise.

Before Noise Reduction

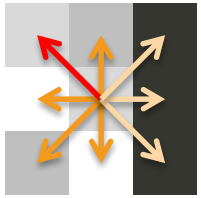


After Noise Reduction

How to do Noise Reduction(NR)

Use Low-pass Filter(LPF) to reduce noise.
Adjust LPF strength according to content of image to keep edge.
We use the information listed below to keep edge.

1. Brightness Difference Information



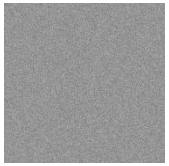
Apply weak NR strength if the brightness difference is too high.

- Strong NR strength
- Middle NR strength
- Weak NR strength

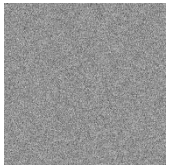
2. Standard Deviation(STD) Information

STD ↑ ⇨ Noise Level ↑ ⇨ NR strength ↑

STD = 23



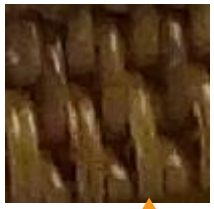
STD = 73



3. Activity(ACT) Information

Activity ↑ ⇨ Edge confidence ↑ ⇨ NR strength ↓

ACT = 26



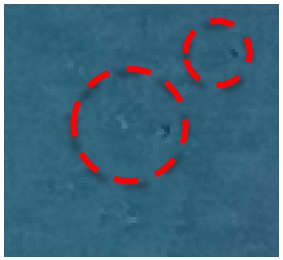
ACT = 7

4. Position Information

Distance from center ↑ ⇨ Noise Level ↑ ⇨ NR strength ↑

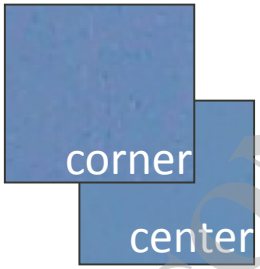
What issue might meet

Impulse Noise

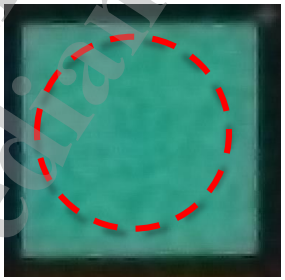


BPC

Corner Noise



Luma Noise



Adaptive LPF

Detail Lost

Blender

Color Noise

Adaptive LPF(PTC)

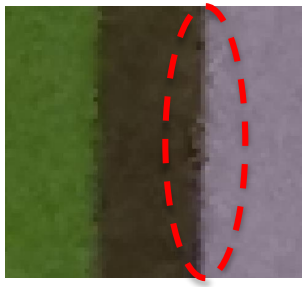
Color Bleeding

Adaptive LPF(C DIFF)

Low Frequency Color Noise

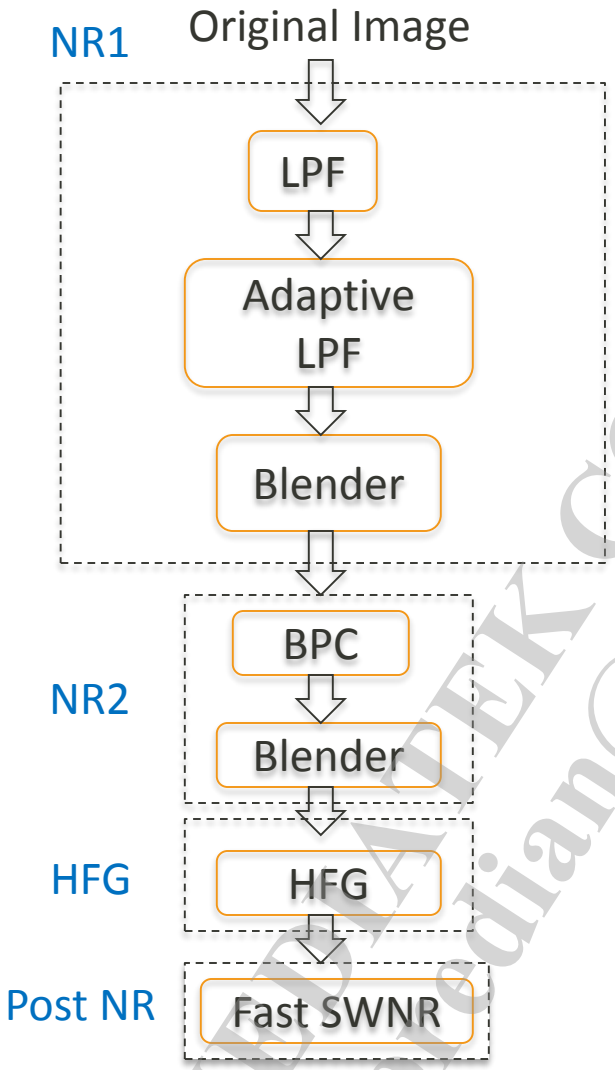
Fast SWNR

Dirty Edge



LPF

Block Diagram



LPF

-Remove noise without considering edge
-Make edge more smooth

BPC

-Remove dot and impulse noise

Adaptive LPF

-Remove noise and preserve edge

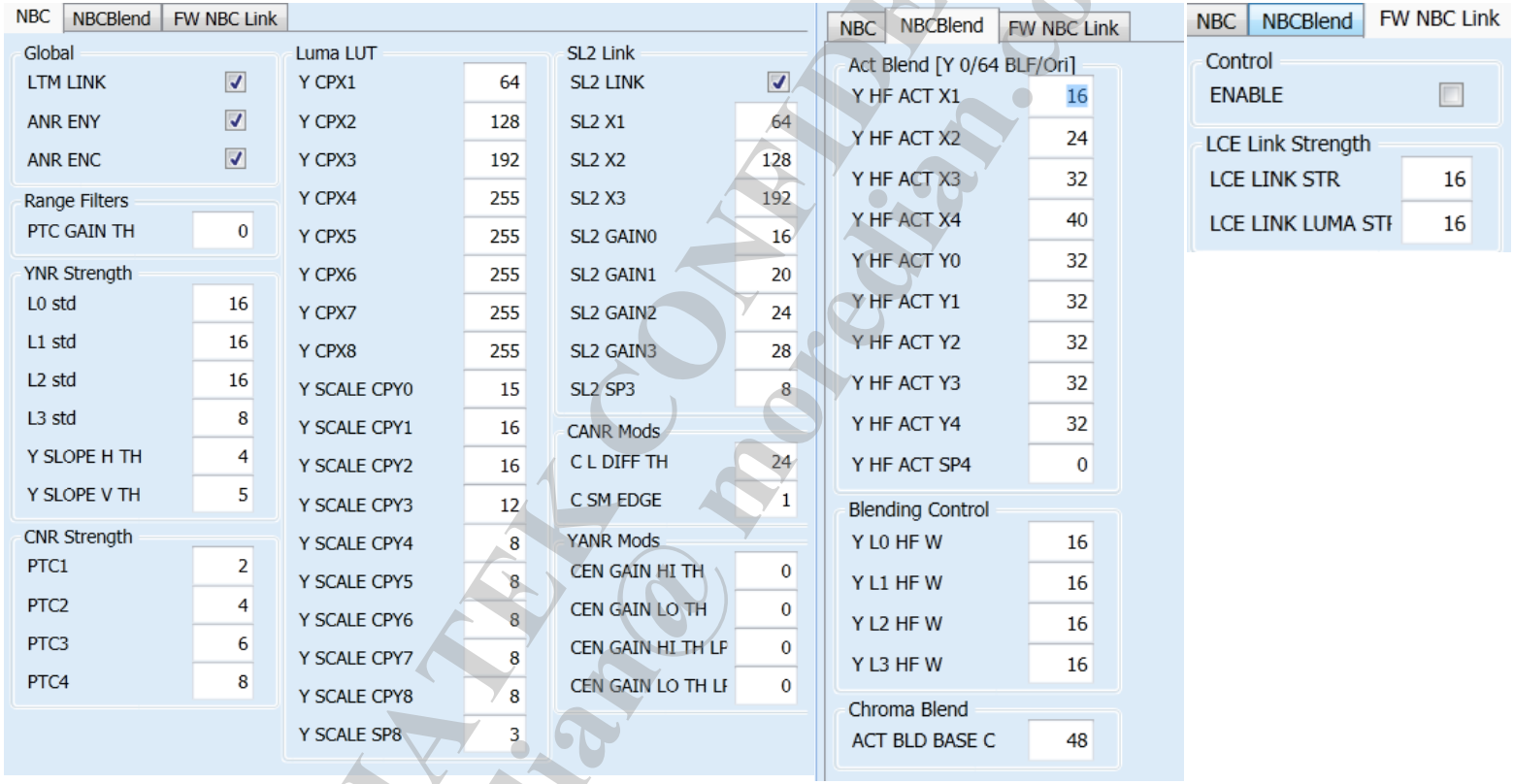
Blender

-Add detail back to adaptive LPF output

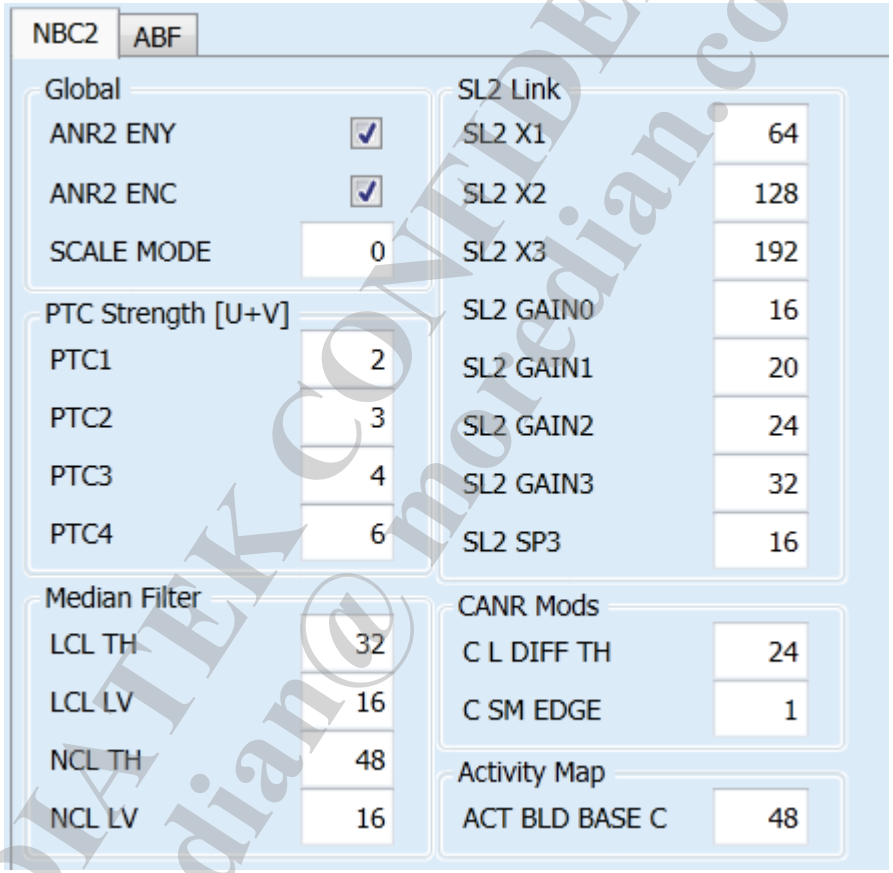
Post NR

-Reduce low frequency chroma noise

NBC UI Introduction



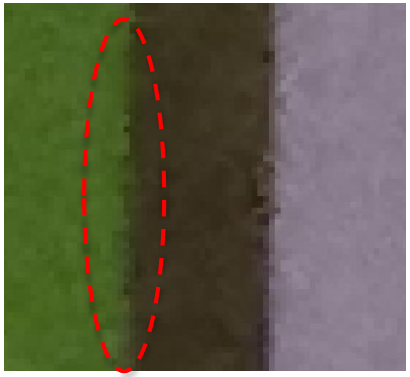
NBC2 UI Introduction



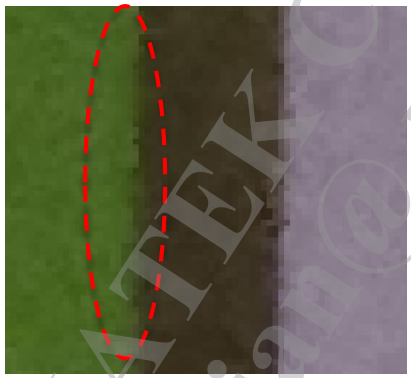
NR1 LPF(Low Pass Filter)

- Target
  - Remove noise without considering edge
  - Make edge more smooth

Effect

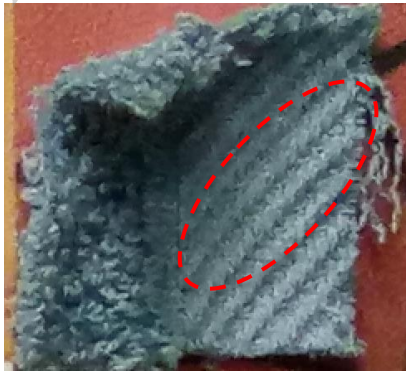


Before

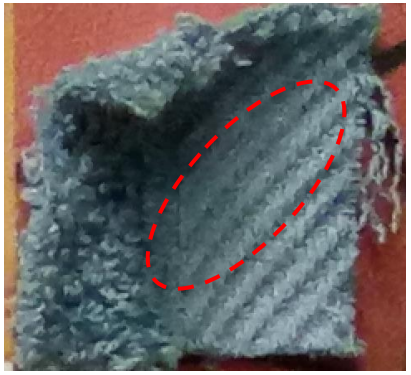


After

Side Effect

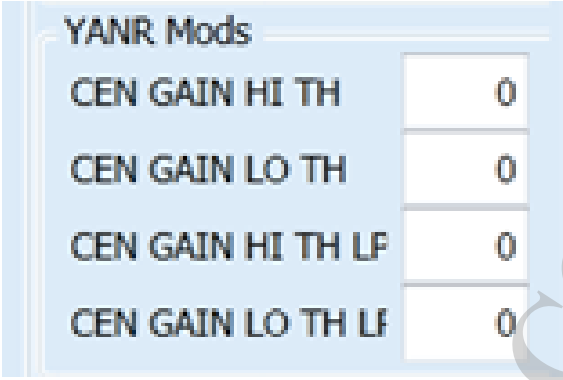


Before



After

NR1 LPF(Low Pass Filter)



Range is from 0~16
16 → Edge would be more smooth
0 → Edge would be less smooth

Suggestion: Four registers are usually the same. At least HI TH should be larger than LO TH.

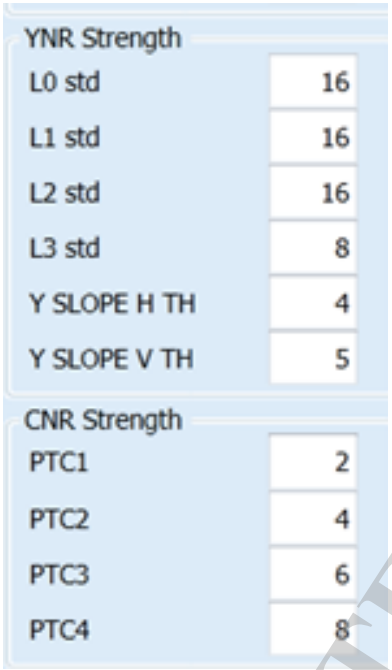
Adaptive LPF

- Remove noise and preserve edge

Before

After

Adaptive LPF – Edge Preserve NR



- ↑L0 std → Less high-f detail
- ↑L1 std → Less middle high-f detail
- ↑L2 std → Less middle-f detail
- ↑L3 std → Less low-f detail
- ↑Y SLOPE H TH → More smooth edge
  Y SLOPE V TH = Y SLOPE H TH * 1.25
- ↑PTC → Less chroma noise
  PTC1 = PTC2/2 = PTC3/3 = PTC4/4

Adaptive LPF – Luma Preserve NR

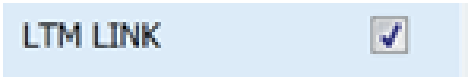
Luma LUT	
Y CPX1	64
Y CPX2	128
Y CPX3	192
Y CPX4	255
Y CPX5	255
Y CPX6	255
Y CPX7	255
Y CPX8	255
Y SCALE CPY0	15
Y SCALE CPY1	16
Y SCALE CPY2	16
Y SCALE CPY3	12
Y SCALE CPY4	8
Y SCALE CPY5	8
Y SCALE CPY6	8
Y SCALE CPY7	8
Y SCALE CPY8	8
Y SCALE SP8	3

Y CPX1~8: X axis of luma dependent NR
0: Pure dark value
255: Pure white value

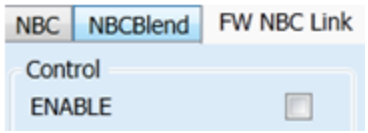
Y SCALE CPY0~8: Y axis of luma dependent NR
16: Strongest NR
0: Weakest NR
Y SCALE CPY0 is the NR strength corresponding to X = 0
Y SCALE CPY1 is the NR strength corresponding to X = Y CPX1
…
Y SCALE CPY8 is the NR strength corresponding to X = Y CPX8

Adaptive LPF – LCE NR LINK

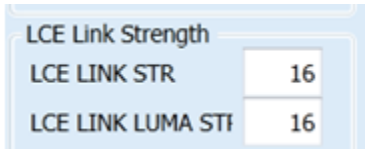
Goal: Increase the NR strength of the region with large LCE gain



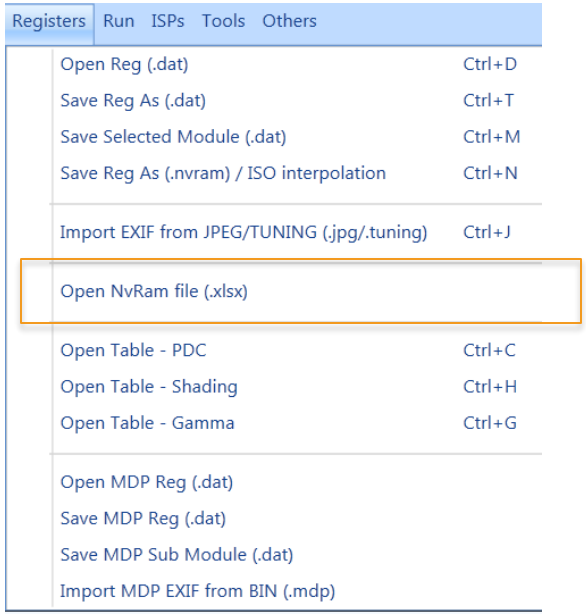
Enable bit



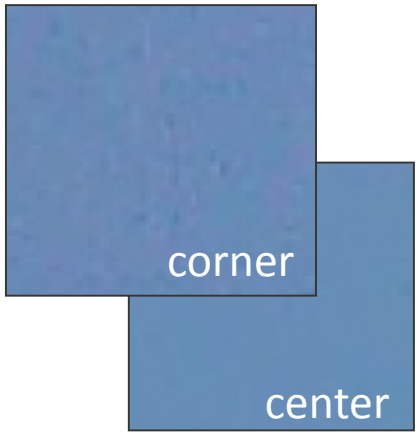
Enable: Enable FW simulation (should read NVRAM)

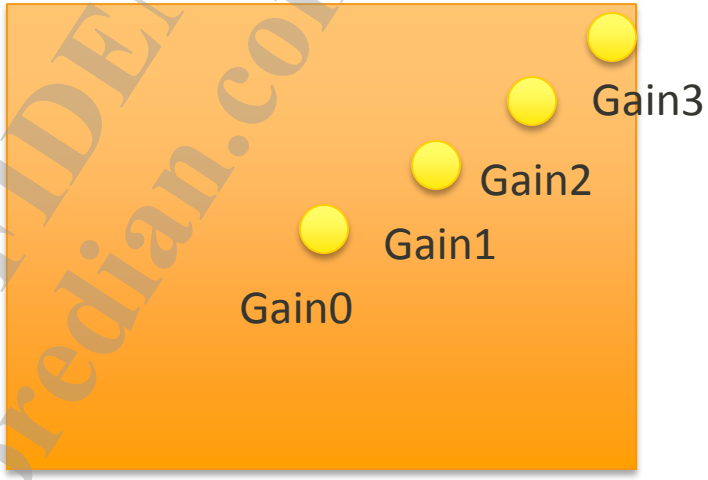


The larger value is, the stronger the NR strength is



Corner Noise Reduction

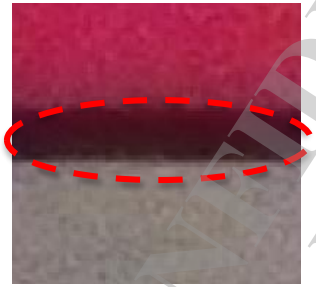




SL2 Link	
SL2 LINK	☑
SL2 X1	64
SL2 X2	128
SL2 X3	192
SL2 GAIN0	16
SL2 GAIN1	20
SL2 GAIN2	24
SL2 GAIN3	28
SL2 SP3	8

SL2 GAIN0~3: NR strength from center to boundary
1x NR strength = 16
2x NR strength = 32

Color blending

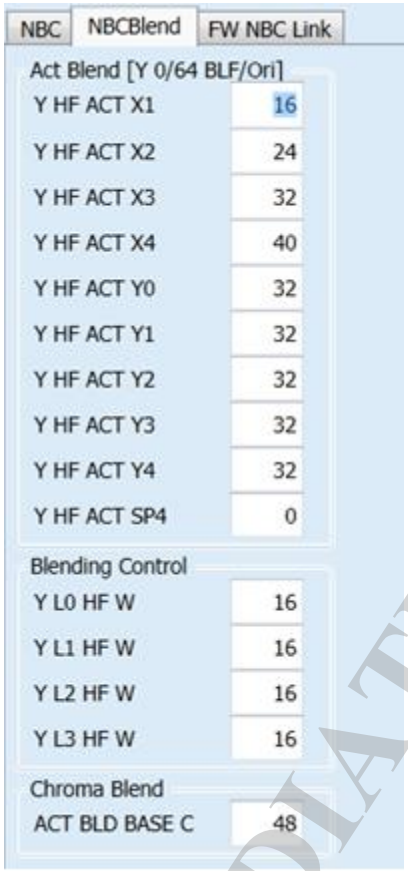


C L DIFF TH	24
C SM EDGE	1

C L DIFF TH = 0: No blending, almost no chroma NR
C L DIFF TH = 255: More blending, stronger NR
Suggestion: its range from 24 (low ISO) to 100 (highest ISO)

C SM EDGE = 0, less blending
C SM EDGE = 1, more blending
Suggestion: its range from 0 or 1 (low ISO) to 1 (middle/high ISO)

Blender



Y HF ACT X1~4: X axis of activity dependent blender
0: Smooth region
255: Strong edge

Y HF ACT Y1~4: Y axis of activity dependent blender
(Blending ratio between adaptive LPF output and original NR1 input)
0 to 64: Clean to dirty

Y L0 HF W ⬆: Increase high-f detail
Y L1 HF W ⬆: Increase middle high-f detail
Y L2 HF W ⬆: Increase middle-f detail
Y L3 HF W ⬆: Increase low-f detail

ACT BLD BASE ⬆: Reduce chroma noise
0 to 64: Dirty to clean

EE

EE: Edge Enhancement

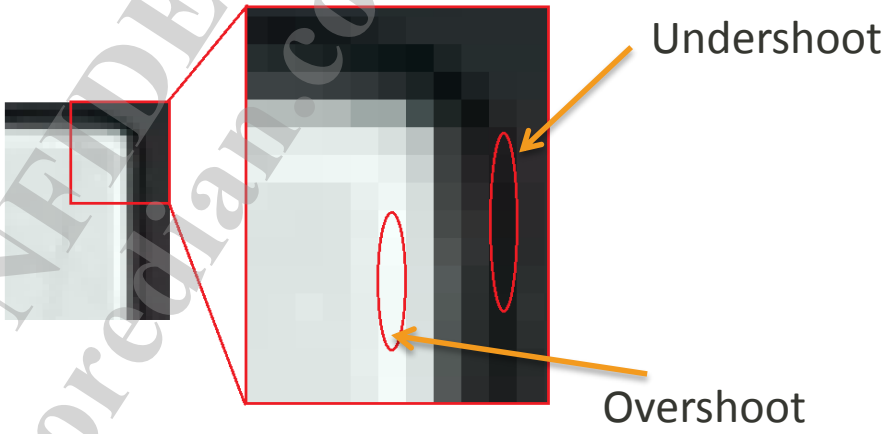
- Purpose
  - Boost sharpness level of images

Before EE

After EE

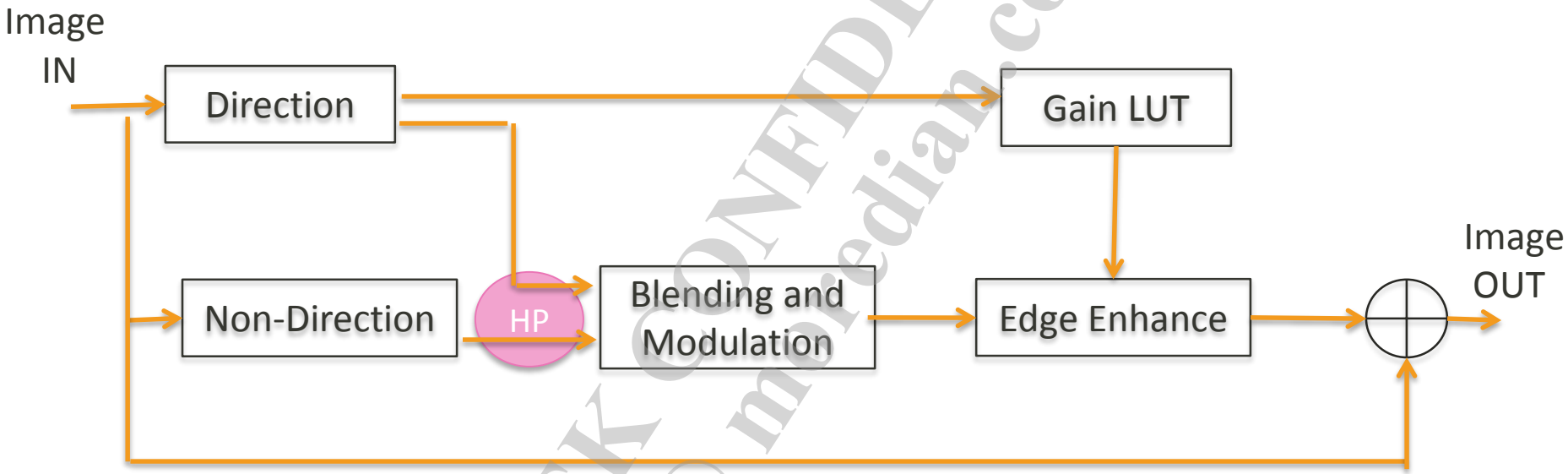
What issue might meet

- Overshoot/Undershoot

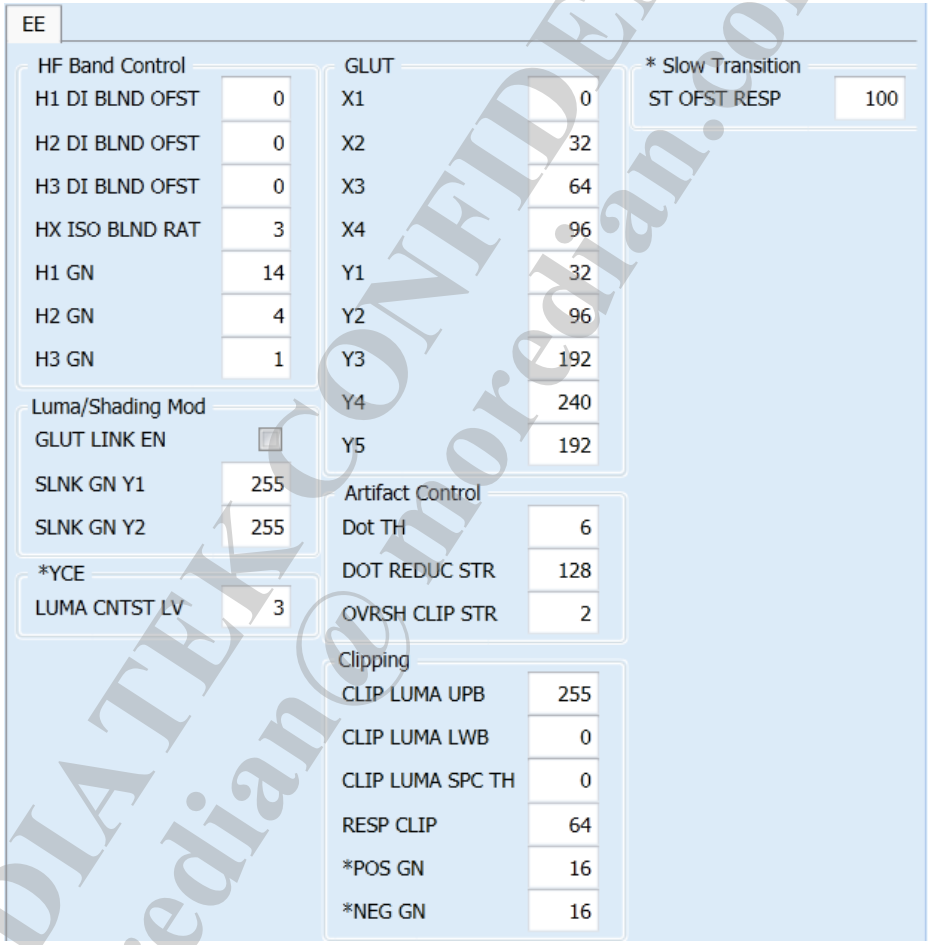


- Edge Enhance (include Detail & Texture)

Block Diagram



UI



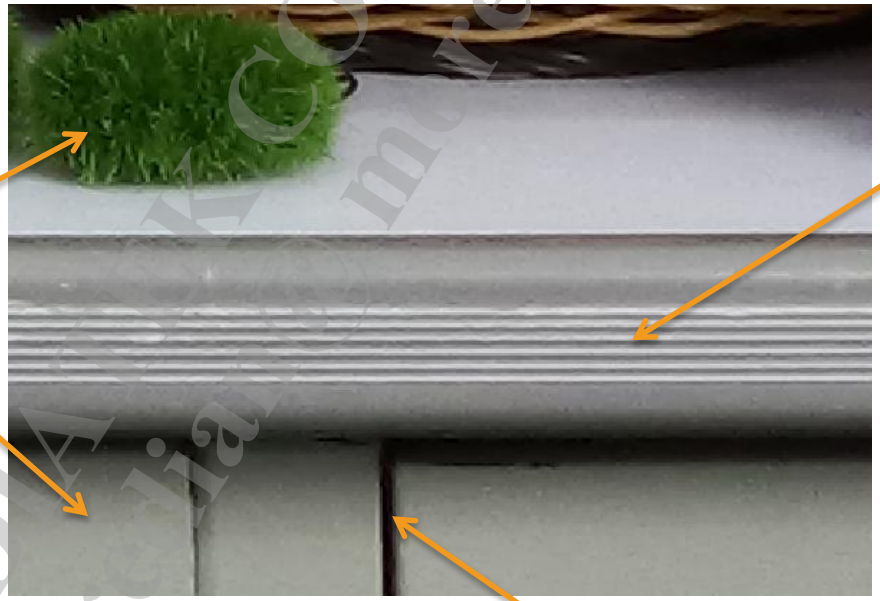
Frequence Division EE

- Parameters
  - H1 GN
    - Means Signal level. Fine Detail ↑ , Signal ↑ , more Noisy
  - H2 GN
    - Means Signal level. Fine Texture ↑ , Signal ↑ , more Noisy
  - H3 GN
    - Means Signal level. Fine Edge ↑ , Signal ↑ , more Noisy
  - Suggestion
    - Sharpness is the combination of three parameters
    - If not satisfied the Sharpness result, fine tune Detail and fine Texture and fine tune Edge

H1 GN	14
H2 GN	4
H3 GN	1

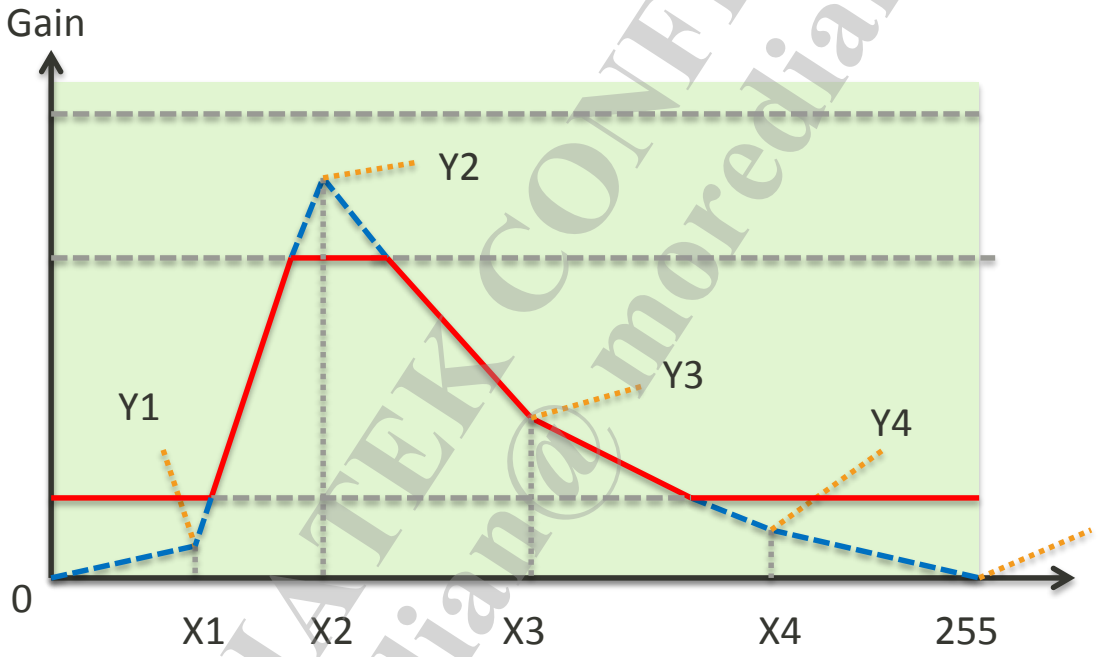
Edge Response

- We will enhance edge by High Pass Filter
- Use edge response to judge which to enhance or not



LUT

- Use Look Up Table to add edge strength of different scales
- Use Edge Response to decide enhance region

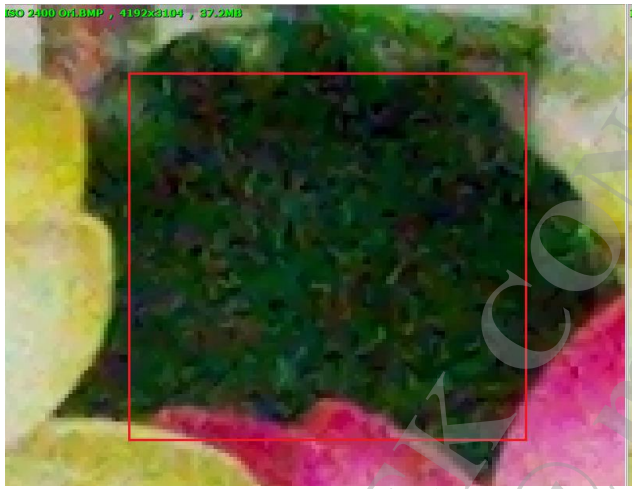


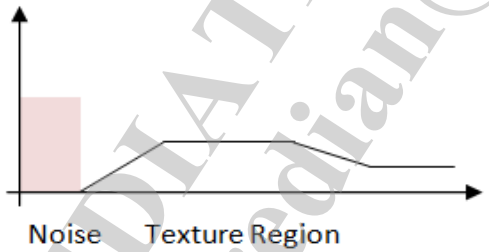
GLUT	
X1	0
X2	32
X3	64
X4	96
Y1	32
Y2	96
Y3	192
Y4	240
Y5	192

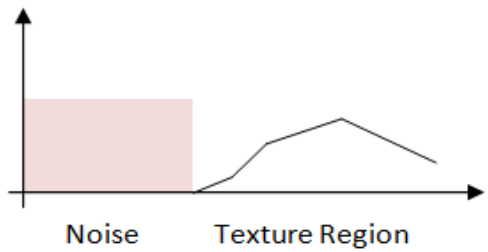
LUT Example

Small Noise Region

Large Noise Region

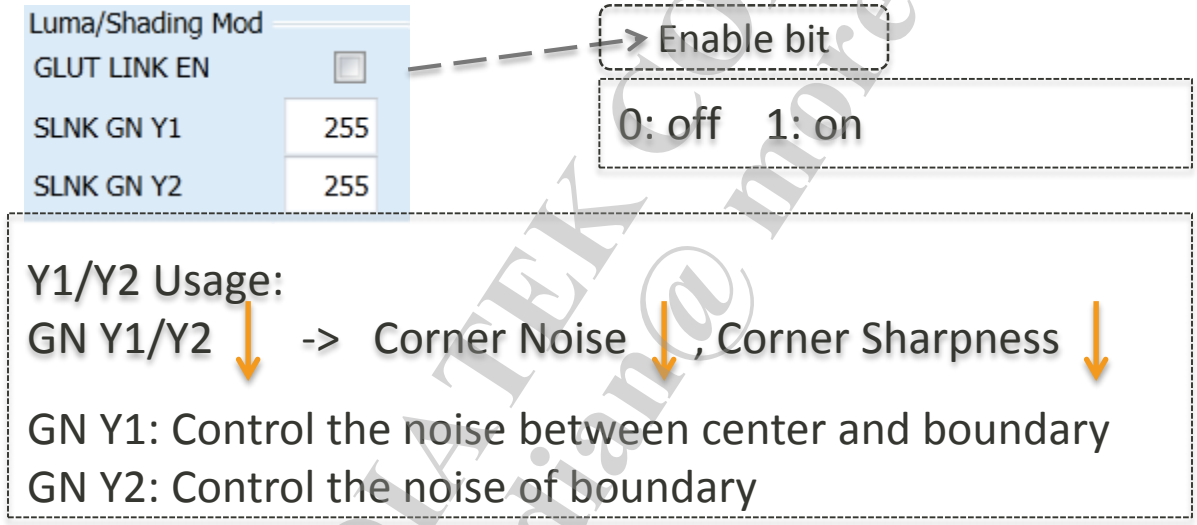






Corner Noise

- Some noise will be enhance than center, by control strength to decrease corner noise

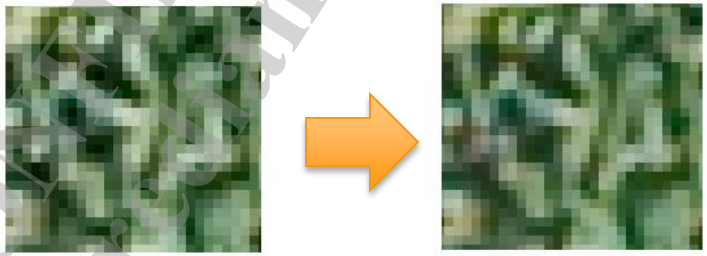


White/Dark Edge Suppression (1)

- Overshoot/Undershoot Clipping

- Default Value

Clipping	
CLIP LUMA UPB	255
CLIP LUMA LWB	0
CLIP LUMA SPC TH	0
RESP CLIP	64
*POS GN	16
*NEG GN	16



Method 1 (Locally adjusted by luma value and edge response)
CLIP LUMA UPB: To suppress overshoot
CLIP LUMA UPB → Overshoot
CLIP LUMA LWB : To suppress undershoot
CLIP LUMA LWB → Undershoot
CLIP LUMA SPC TH: Select suppression signal
Only the edge response > CLIP LUMA SPC TH would be suppressed
(0: flat region; 255: strong edge)

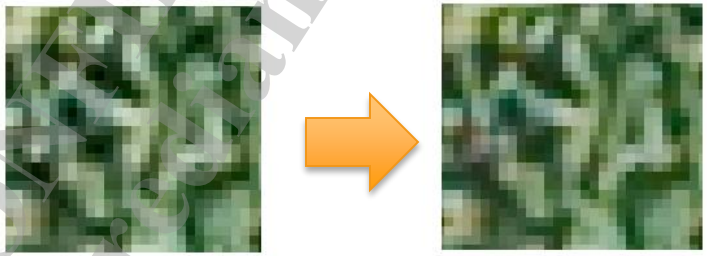
White/Dark Edge Suppression (2)

- Overshoot/Undershoot Clipping

- Default Value

Clipping

CLIP LUMA UPB	255
CLIP LUMA LWB	0
CLIP LUMA SPC TH	0
RESP CLIP	64
*POS GN	16
*NEG GN	16



Method 2 (Global clipping)

- RESP CLIP: Overall edge enhancement would not exceed this limit (0: no EE)

Method 3 (Only depends on overshoot or undershoot response)

- POS GN: Adjust overshoot level (base = 16; 0 = no overshoot)
- NEG GN: Adjust undershoot level (base = 16; 0 = no undershoot)

Line Pattern Reduction

- Use for reducing line pattern

Default Value

HF Band Control	
H1 DI BLND OFST	0
H2 DI BLND OFST	0
H3 DI BLND OFST	0
HX ISO BLND RAT	3

Step:
1.Use default value as initial
2.First fine tune H1~3 DI BLND OFST
3.Then fine tune HX ISO BLND RAT

H1 DI BLND OFST ↓ → Detail line pattern ↓
H2 DI BLND OFST ↓ → Texture line pattern ↓
H3 DI BLND OFST ↓ → Edge line pattern ↓
HX ISO BLND RAT ↓ → Line Pattern ↓

YCE

- Speed up edge transition speed by drawing pixels close to local max/min ones.

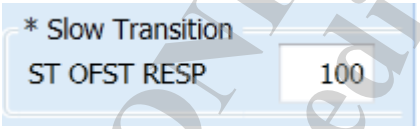
- No overshoot/undershoot introduced

*YCE	
LUMA CNTST LV	3

LUMA CNTST LV ↑ → Stronger EE

Slow Transition

- Avoid applying EE in gradient region for preventing **contour** artifact



- Range suggestion: 96~128
  - Lower means less contour (but the edge may become smoother)

NBC2

NR2: YUV Noise Reduction 2

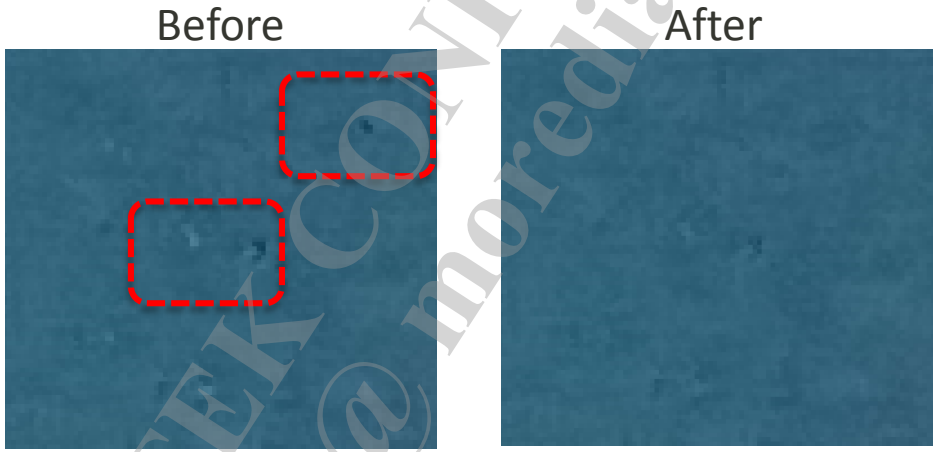
- Purpose
  - Reduce luma impulse noise and more chroma noise (especially low-f chroma noise)

Before ANR2

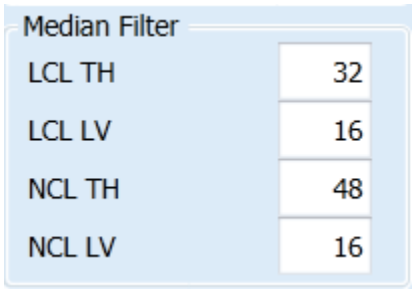
After ANR2

NR2-BPC (Bad Pixel Correction)

- Target
  - Remove dot and impulse noise



NR2-BPC (Bad Pixel Correction)



① Set “LCL LV/NCL LV” to maximum 16.

② Increase “LCL TH”, until all impulse noise are disappear. (Set NCL TH = LCL TH + 16)

③ Decrease “LCL LV/NCL LV” to make impulse noise and detail balance.

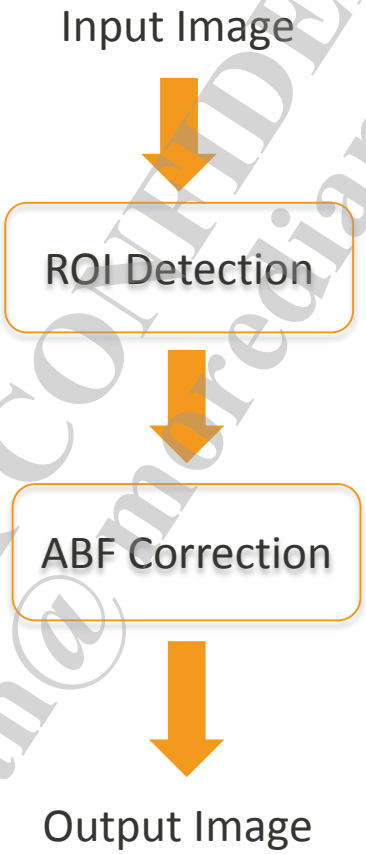
NR2-ABF: Anti-Blooming Filter

- Purpose
  - Remove blooming effect caused by sensor or lens refraction.

W/O ABF

W/ ABF

Block Diagram

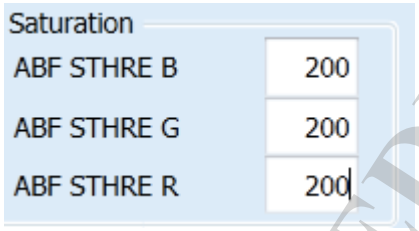


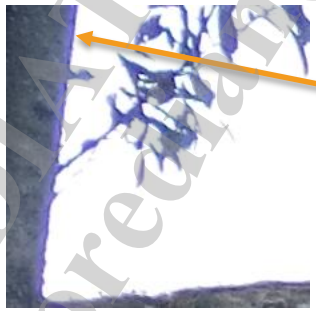
Function

- Control

Checked: on, Unchecked: off

- Saturation Threshold
  - Blooming effect happens near Saturation Region most of the time
  - When all of the R/G/B value exceed the given threshold value (STHRE R/ STHRE G/ STHRE B) are defined as the saturation region





Saturation Region:
R: 255 G: 255 B: 255

Saturation Region:
R: 174 G: 222 B: 255

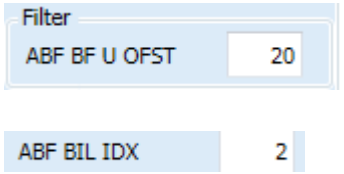
Filter Tuning

- Filter Strength: BF_U_OFST (0~63)

  BF_U_OFST ↑, Strength ↑

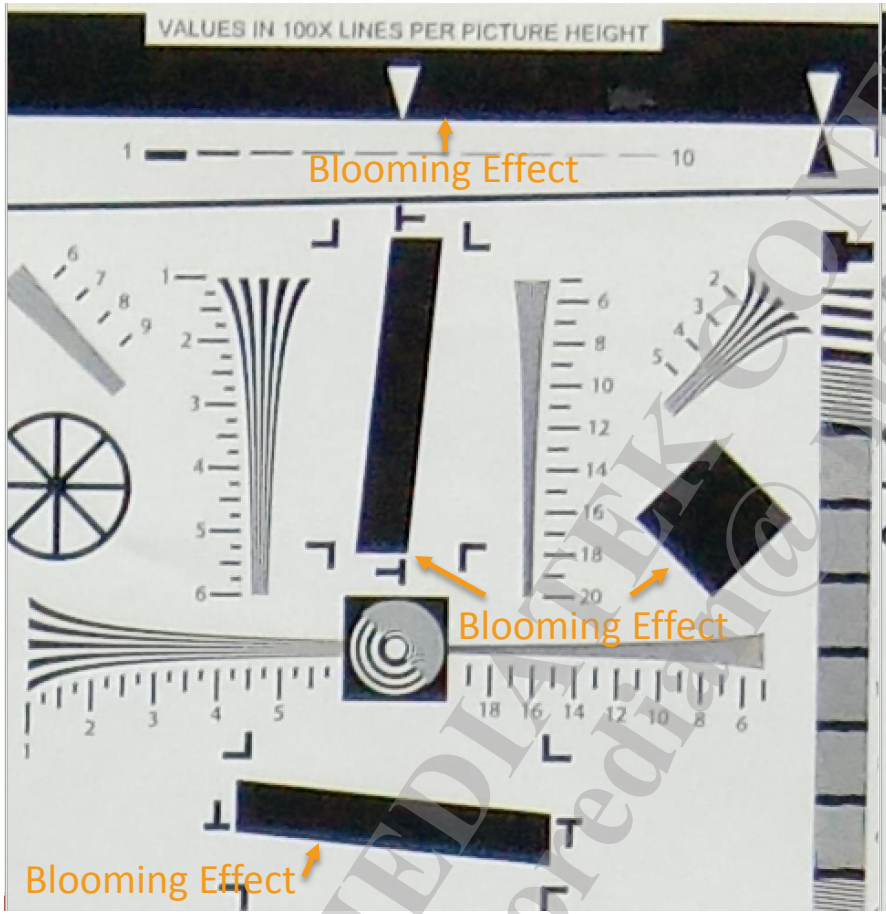
- Filter Size: BIL_IDX (0~2)

  BIL_IDX ↑, Filter Size ↑

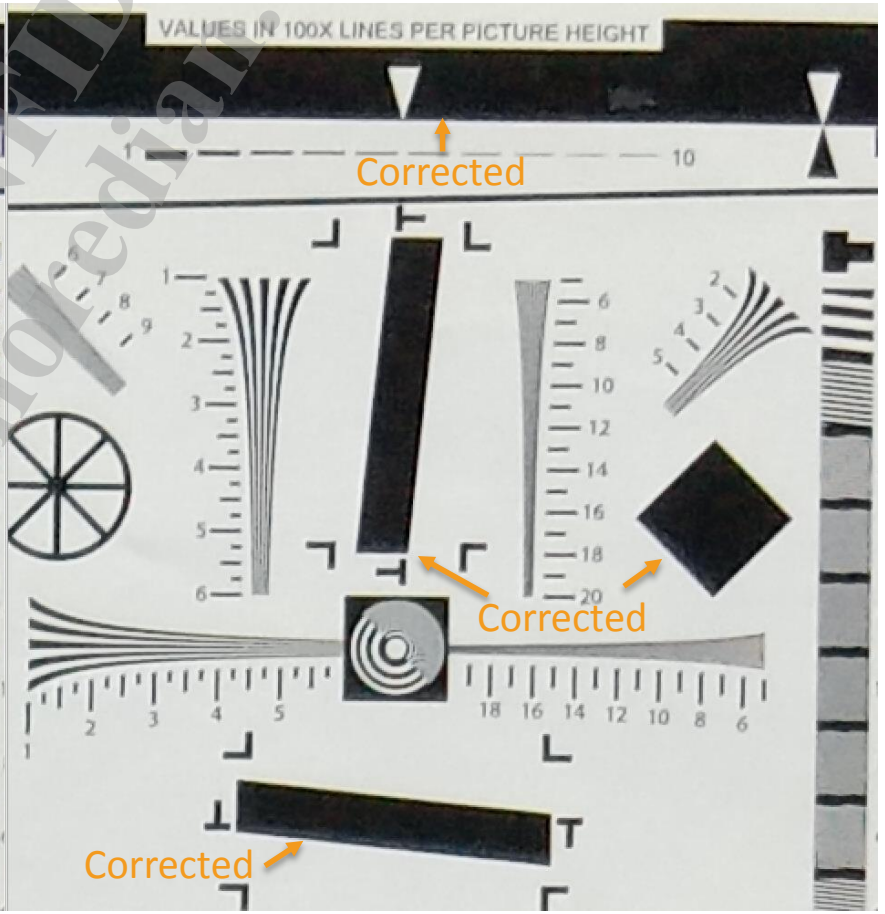


Sample Image

W/O ABF



W/ ABF



NR2-CCR: Chroma Coring

- Purpose
  - Reduce chroma noise depends on pixels' luminance, saturation value, and hue angle

Original

After CCR

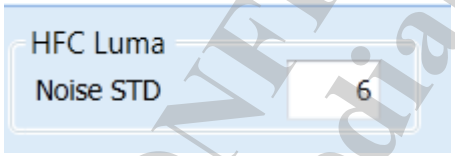
HFG: High Frequency Generator

- Purpose
  - Add high-f luma noise to generate uniform noise pattern

w/o HFC

w/ HFC

HFG – Add High-Freq Detail



0

16

SWNR: SW-based Noise Reduction

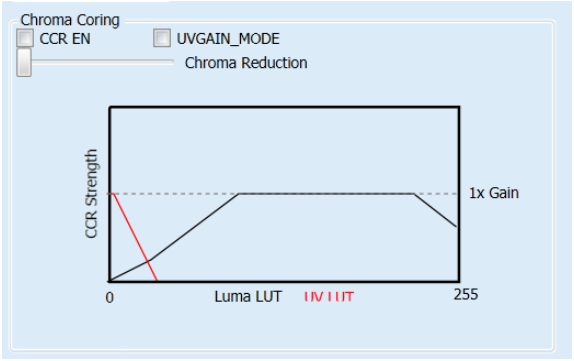
- Purpose
  - Reduce very low-f chroma noise
  - Also provide CCR function as NR2-CCR

SWNR/SWCCR

- SWNR: Remove low-f noise

Strength ↑ : Less chroma noise

- SW CCR
  - Step 1: Enable CCR/UVGAIN_MODE
  - Step 2: Set the chroma reduction bar to appropriate value
    - Weak → strong



Swnr debug

- adb shell setprop mkdir /sdcard/camera_dump
- adb shell setprop debug.camera.dump.nr 1

- Dump data in folder /sdcard/camer_dump:
  - nr-swnr-in-0-4640x3488.yuv
  - nr-swnr-out-0-4640x3488.yuv

Swnr debug

- adb shell setprop debug.swnr.enable 1

```
11-15 10:41:28.689903   507 23642 D NRvendorImp: [decideNrMode] nrMode: 0x3, nrType: 2, iso: 4000, threshold(H/S)(800/800)

11-15 10:41:28.690207   507 23622 D capturenr: [doSwNR] idx 0: iso 4000 perf 0, buf 0xb29d3c80
11-15 10:41:28.690625   507 23622 D capturenr: [getSensorDevice] sensorDev(1), u4SensorID(8455)
11-15 10:41:28.690655   507 23622 D capturenr: [getTuningInfo] 0: iso=4000 (4000~4800), isMfll=0
11-15 10:41:28.690782   507 23622 D capturenr: [dumpParams] NR_K:100
11-15 10:41:28.690794   507 23622 D capturenr: [dumpParams] NR_S:22
11-15 10:41:28.690807   507 23622 D capturenr: [dumpParams] NR_SD:-1004194448
11-15 10:41:28.690818   507 23622 D capturenr: [dumpParams] NR_BLD_W:64
11-15 10:41:28.690829   507 23622 D capturenr: [dumpParams] NR_BLD_TH:5
11-15 10:41:28.690843   507 23622 D capturenr: [dumpParams] NR_SMTH:256
11-15 10:41:28.690856   507 23622 D capturenr: [dumpParams] NR_NTRL_TH_1_Y:255
11-15 10:41:28.690869   507 23622 D capturenr: [dumpParams] NR_NTRL_TH_2_Y:255
11-15 10:41:28.690881   507 23622 D capturenr: [dumpParams] NR_NTRL_TH_1_UV:255
11-15 10:41:28.690893   507 23622 D capturenr: [dumpParams] NR_NTRL_TH_2_UV:0
11-15 10:41:28.690906   507 23622 D capturenr: [dumpParams] HFG_ENABLE:0
11-15 10:41:28.690919   507 23622 D capturenr: [dumpParams] HFG_GSD:-1004193679
11-15 10:41:28.690934   507 23622 D capturenr: [dumpParams] HFG_SD0:55552
11-15 10:41:28.690948   507 23622 D capturenr: [dumpParams] HFG_SD1:56905
11-15 10:41:28.690962   507 23622 D capturenr: [dumpParams] HFG_SD2:46189
11-15 10:41:28.690974   507 23622 D capturenr: [dumpParams] HFG_TX_S:16
11-15 10:41:28.690986   507 23622 D capturenr: [dumpParams] HFG_LCE_LINK_EN:0

11-15 10:41:28.691595   507 23622 D capturenr: [dumpParams] CCR_HUE_GAIN2:64
11-15 10:41:28.691679   507 23622 D capturenr: [doSwNR] SwNR type: Fast SwNR
11-15 10:41:28.691912   507 23622 D capturenr: [allocWorkingBuf] working buffer: normal heap
11-15 10:41:28.734810   507 23622 D capturenr: [enablePerformanceService] [capturenr] PerfServiceNative_userRegScn succeed! handle = 25
11-15 10:41:28.742699   507 23622 D capturenr: [doSwNR] start+
11-15 10:41:28.816682   507 23622 D capturenr: [doSwNR] start-
11-15 10:41:28.830062   507 23622 D NRvendorImp: [doSwnr] no need to process Abf
11-15 10:41:28.830735   507 23622 D NRvendorImp: [doSwnr] -
```

Hwth &swth

Swnr para

Nr strength

Swnr type

Basic ISP Tuning Debug Guide

- Color issue:
  - First, confirm it's not an AWB issue (global color, check gray to distinguish awb and ccm)
  - CCM: color saturation
  - Color engine: color saturation, hue, brightness
  - OBC: magenta (purple, pink) when set less or off; green when set over;
  - UDM: De-mosaic config (rrzo, imgo format)
  - LSC: shading is not uniform, check corner/central
- Brightness issue:
  - First, confirm it's not an AE issue (pass1 processed-raw dump)
  - OBC: dark is not black enough when set less; brightness drop when set over
  - PGN: flare offset from AE algo
  - GGM: gamma correction (enable: bright; disable: dark)
  - LCE: disable lce to check
  - G2C: offset when set Hue/Sat/Brightness/Contrast/EffectMode on user menu
- General rule:
  - Check pure-raw (sensor), processed-raw (pass1), JPEG (pass1+pass2+mdp)
  - Isp tuning tool simulation, check the output of each isp module

MEDIATEK

附录

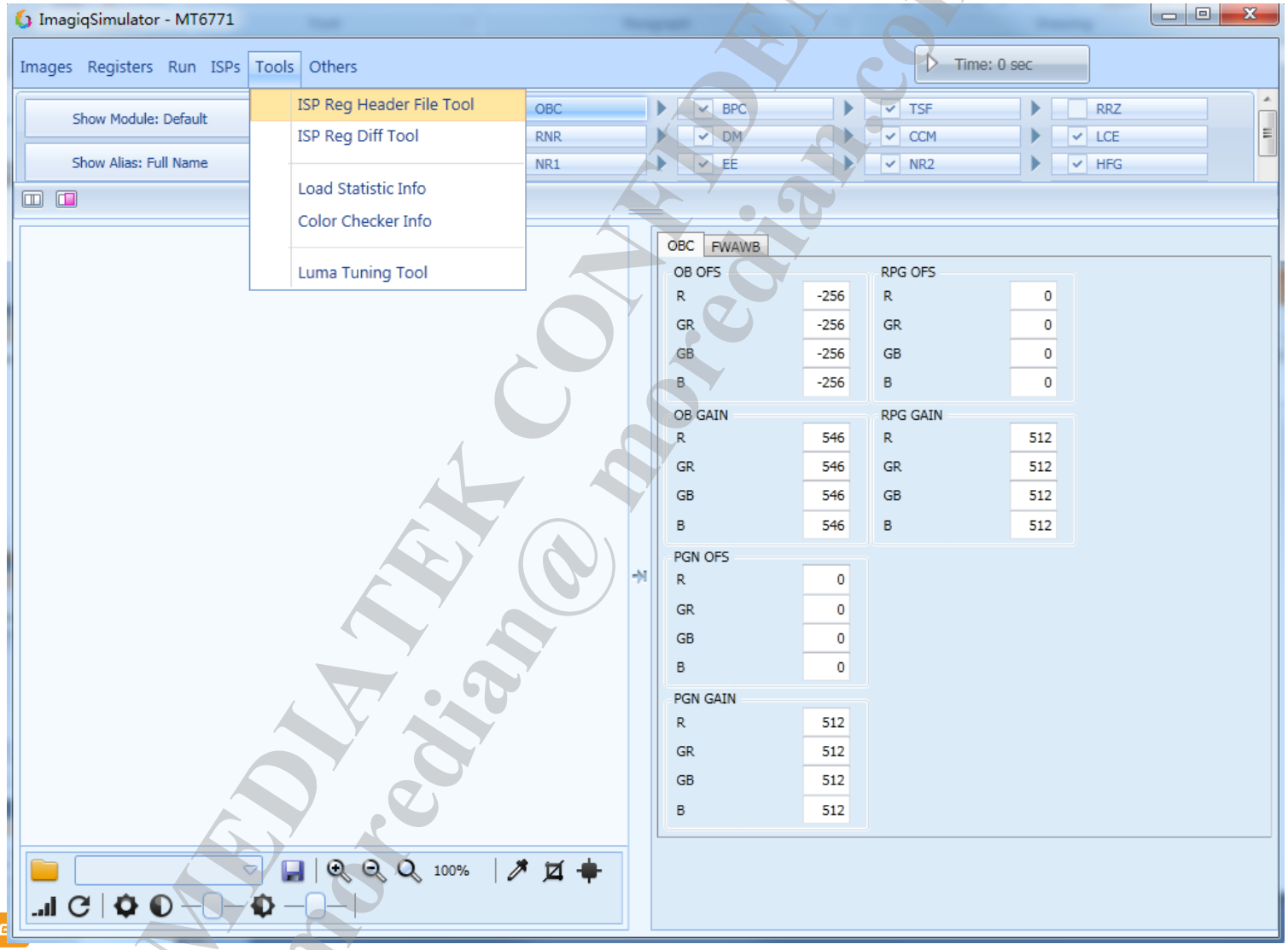
MEDIATEK

6771 ISP Reg Head File Tool

201803

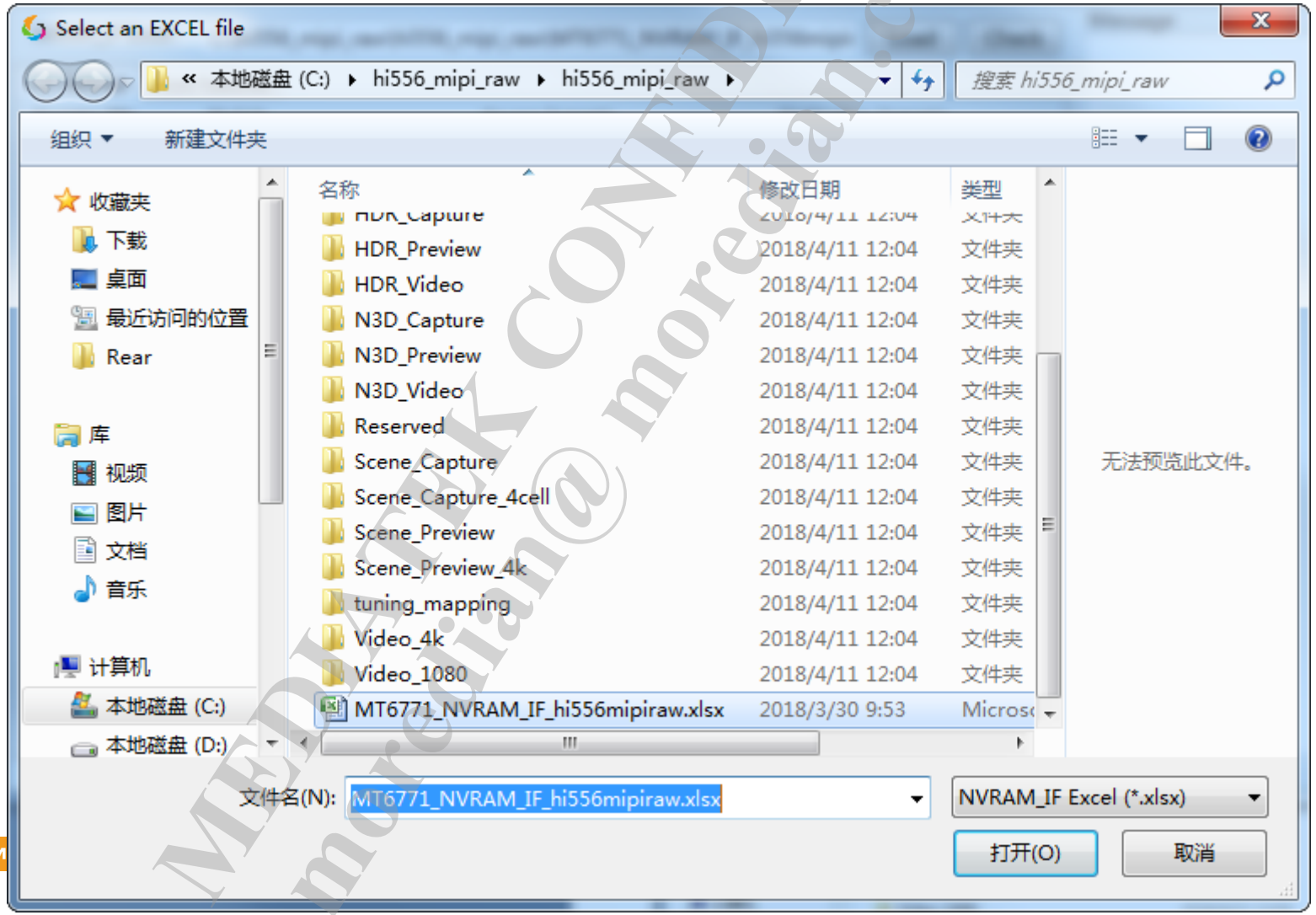
如何合参数

- 一、菜单Tools →ISP Reg Header File Tool



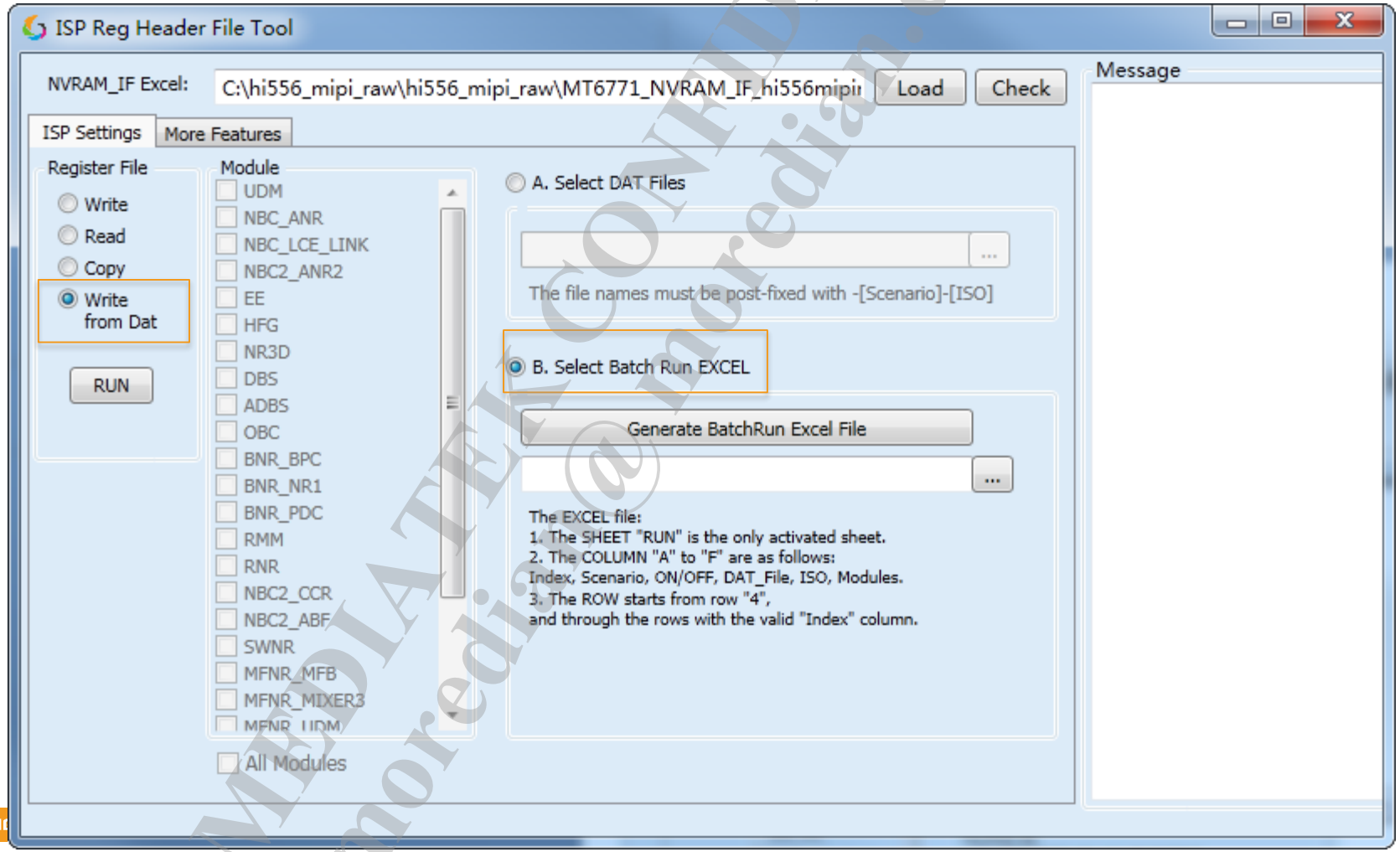
如何合参数

- 二、选择参数目录下的MT6771_NVRAM_IF_{sensorname}mipiraw.xlsx，打开



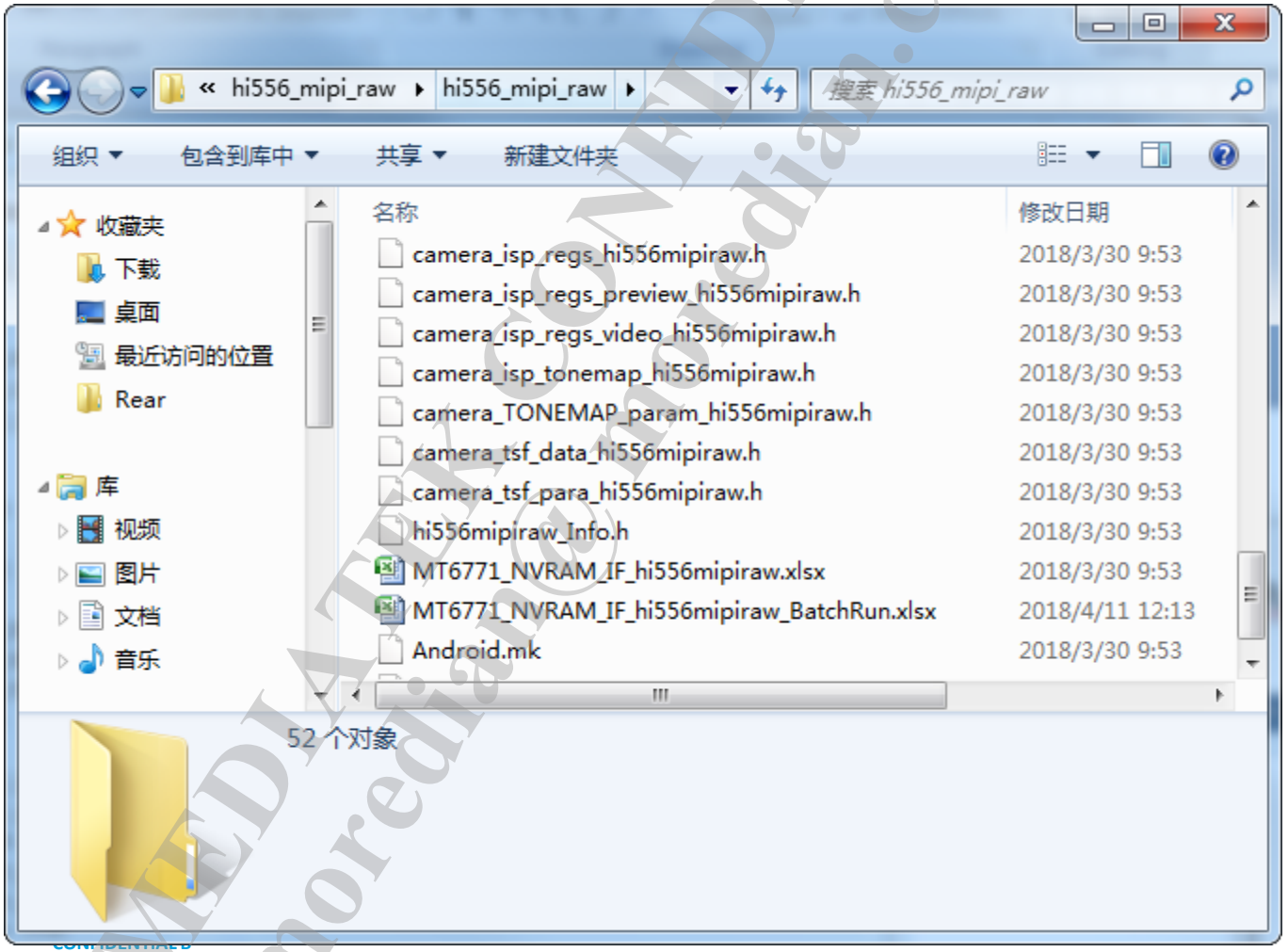
如何合参数

- 三、选中Write from Dat后，选择B Select Batch Run Excel，点Generate BatchRun Excel File。



如何合参数

- 四、在参数目录下看到生成文件：
MT6771_NVRAM_IF_{sensorname}mipiraw_BatchRun.xlsx



如何合参数

- 五、编辑 MT6771_NVRAM_IF_{sensorname}mipiraw_BatchRun.xlsx

将参数dat的路径写入对应的file里，ON/OFF设置为ON。

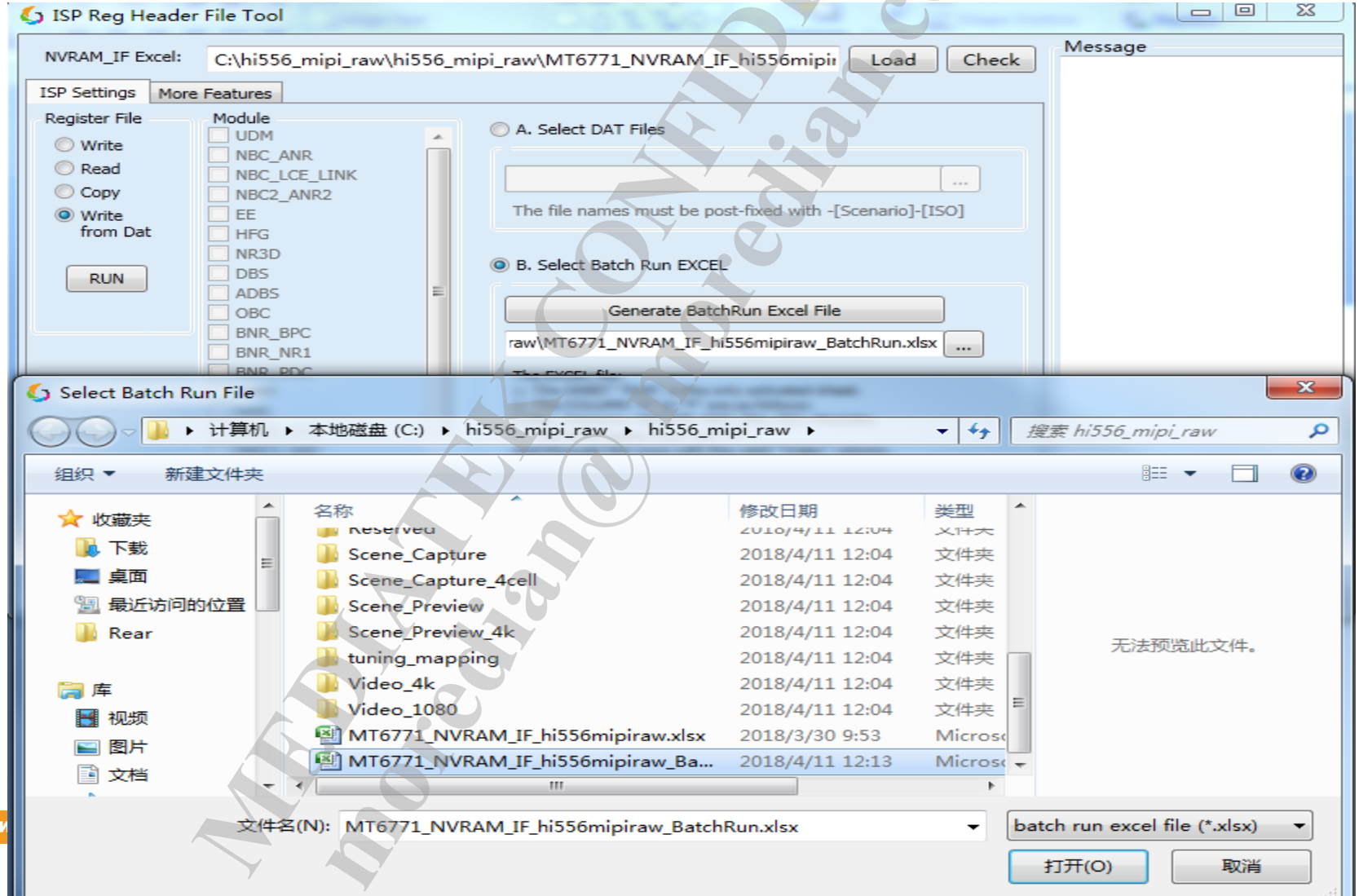
D8 | E:\DAT\0308\Singal\ISO1200.dat

Read Me:
1. This excel is the input file of "ISP Reg Header File Tool" -> "Register" -> "Write From DAT" -> "B. Select Batch Run EXCEL".

short name	user defined scenar	{ON, OFF}	full path	code name	code names
Index	Scenario	ON/OFF	DAT_File	ISO	Modules
1	Scene_Capture	ON	E:\DAT\0308\Singal\ISO100.dat	IDX_00	UDM,NBC_ANR,NBC_LCE_LINK,NBC2_ANR2,EE,HFG,NR3D
2	Scene_Capture	ON	E:\DAT\0308\Singal\ISO200.dat	IDX_01	UDM,NBC_ANR,NBC_LCE_LINK,NBC2_ANR2,EE,HFG,NR3D
3	Scene_Capture	ON	E:\DAT\0308\Singal\ISO400.dat	IDX_02	UDM,NBC_ANR,NBC_LCE_LINK,NBC2_ANR2,EE,HFG,NR3D
4	Scene_Capture	ON	E:\DAT\0308\Singal\ISO800.dat	IDX_03	UDM,NBC_ANR,NBC_LCE_LINK,NBC2_ANR2,EE,HFG,NR3D
5	Scene_Capture	ON	E:\DAT\0308\Singal\ISO1200.dat	IDX_04	UDM,NBC_ANR,NBC_LCE_LINK,NBC2_ANR2,EE,HFG,NR3D
6	Scene_Capture	ON	E:\DAT\0308\Singal\ISO1600.dat	IDX_05	UDM,NBC_ANR,NBC_LCE_LINK,NBC2_ANR2,EE,HFG,NR3D
7	Scene_Capture	ON	E:\DAT\0308\Singal\ISO2000.dat	IDX_06	UDM,NBC_ANR,NBC_LCE_LINK,NBC2_ANR2,EE,HFG,NR3D
8	Scene_Capture	ON	E:\DAT\0308\Singal\ISO2400.dat	IDX_07	UDM,NBC_ANR,NBC_LCE_LINK,NBC2_ANR2,EE,HFG,NR3D
9	Scene_Capture	ON	E:\DAT\0308\Singal\ISO2800.dat	IDX_08	UDM,NBC_ANR,NBC_LCE_LINK,NBC2_ANR2,EE,HFG,NR3D
10	Scene_Capture	ON	E:\DAT\0308\Singal\ISO3200.dat	IDX_09	UDM,NBC_ANR,NBC_LCE_LINK,NBC2_ANR2,EE,HFG,NR3D
11	Scene_Capture	ON	E:\DAT\0308\Singal\ISO4000.dat	IDX_10	UDM,NBC_ANR,NBC_LCE_LINK,NBC2_ANR2,EE,HFG,NR3D
12	Scene_Capture	OFF		IDX_11	UDM,NBC_ANR,NBC_LCE_LINK,NBC2_ANR2,EE,HFG,NR3D
13	Scene_Capture	OFF		IDX_12	UDM,NBC_ANR,NBC_LCE_LINK,NBC2_ANR2,EE,HFG,NR3D
14	Scene_Capture	OFF		IDX_13	UDM,NBC_ANR,NBC_LCE_LINK,NBC2_ANR2,EE,HFG,NR3D
15	Scene_Capture	OFF		IDX_14	UDM,NBC_ANR,NBC_LCE_LINK,NBC2_ANR2,EE,HFG,NR3D
16	Scene_Capture	OFF		IDX_15	UDM,NBC_ANR,NBC_LCE_LINK,NBC2_ANR2,EE,HFG,NR3D
17	Scene_Capture	OFF		IDX_16	UDM,NBC_ANR,NBC_LCE_LINK,NBC2_ANR2,EE,HFG,NR3D
18	Scene_Capture	OFF		IDX_17	UDM,NBC_ANR,NBC_LCE_LINK,NBC2_ANR2,EE,HFG,NR3D

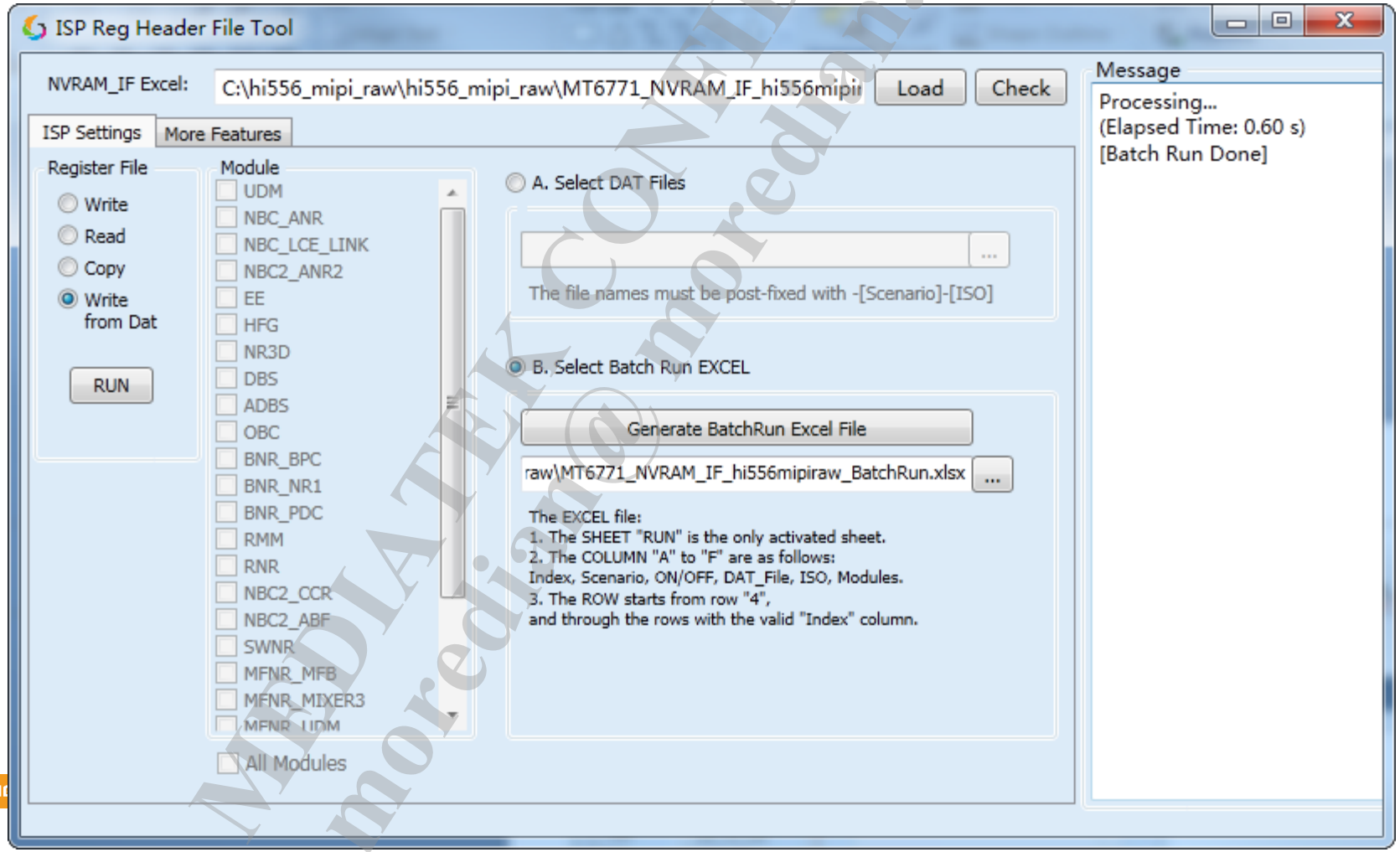
如何合参数

- 六、在tool的合参数界面：打开MT6771_NVRAM_IF_{sensorname}mipiraw_BatchRun.xlsx

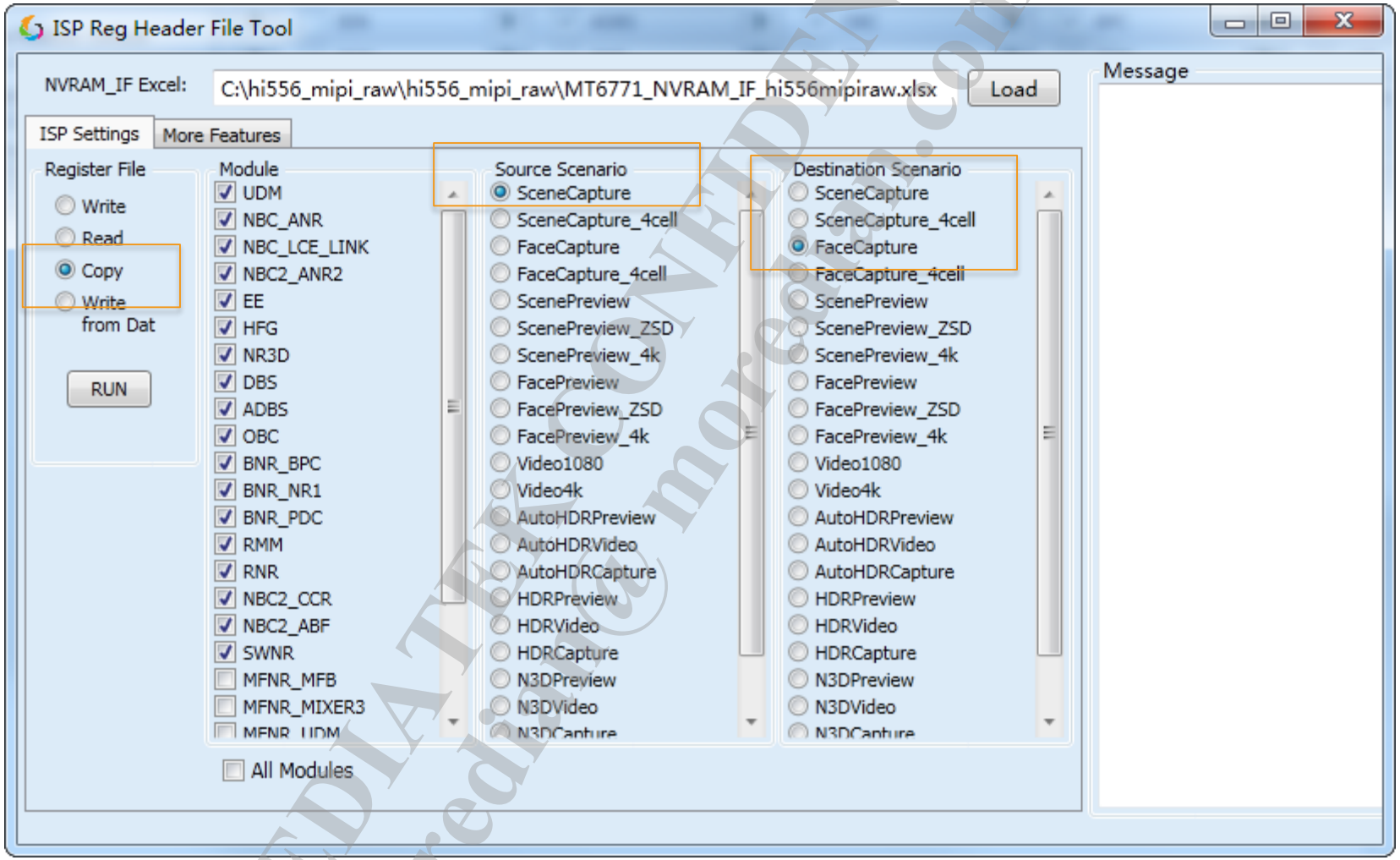


如何合参数

- 六、在进入tool的合参数界面：选择MT6771_NVRAM_IF_{sensorname}mipiraw_BatchRun， 点RUN，完成。



如何copy参数



注意

- 1，建议用ISP Reg Head File Tool合参数。
- 2，修改mapping后，index可能会变化，不要修改，只需修改参数。
- 3，软件版本升级，NVRAM结构可能会变化，需要同步修改。

everyday genius