



MEDIATEK

CONFIDENTIAL B

Noise Reduction (NR1/NR2/HFG/SWNR/ SWCCR)

Index

- Support Chip
- What is Noise Reduction
- How to Do Noise Reduction
- Block Diagram
- Function
 - LPF
 - Adaptive LPF
 - Corner Noise Reduction
 - Blender
 - BPC
 - HFG
 - SWNR (Low frequency chroma noise)
- Parameter Table

Support Chip

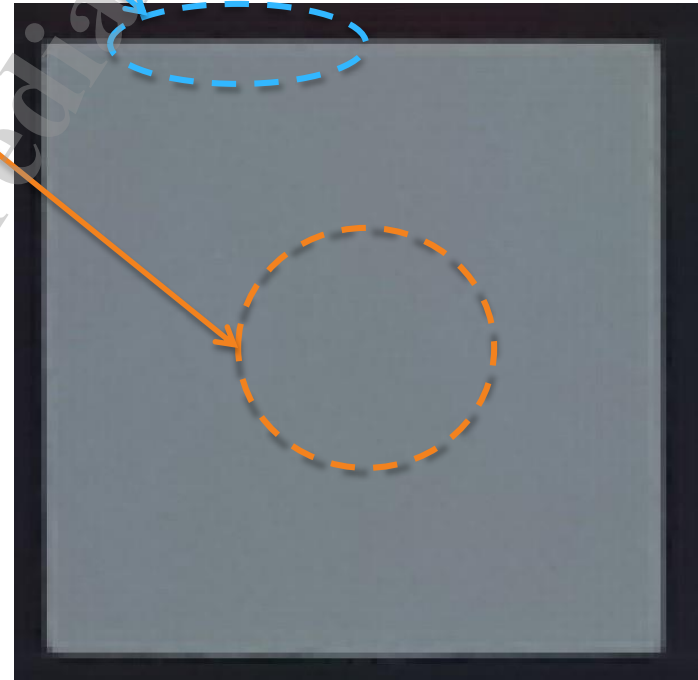
- MT6771

What is Noise Reduction

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



Before Noise Reduction

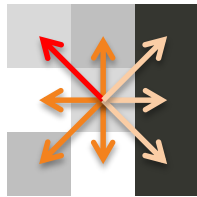


After Noise Reduction

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



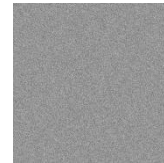
Apply weak NR strength if the brightness difference is too high.

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

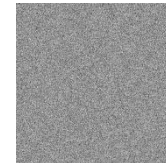
2. Standard Deviation(STD) Information

STD ↑ ⇒ Noise Level ↑ ⇒ NR strength ↑

STD = 23



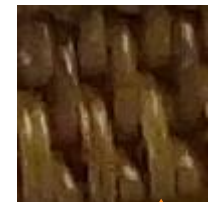
STD = 73



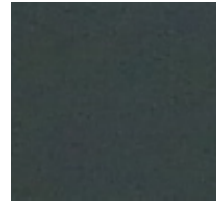
3. Activity(ACT) Information

Activity ↑ ⇒ Edge confidence ↑ ⇒ NR strength ↓

ACT = 26



ACT = 7



4. Position Information

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

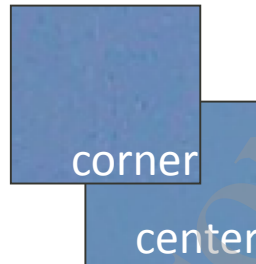
What issue might meet

Impulse Noise

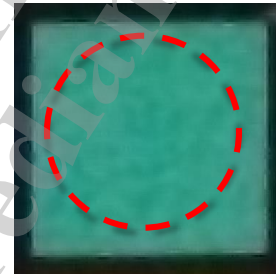


BPC

Corner Noise



Luma Noise



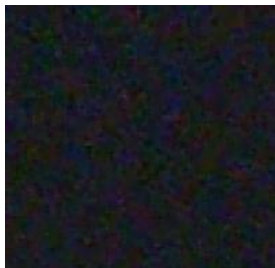
Adaptive LPF

Detail Lost



Blender

Color Noise



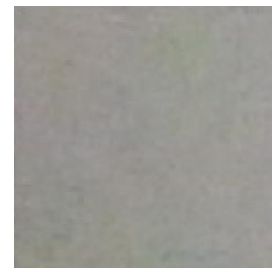
Adaptive LPF(PTC)

Color Bleeding



Adaptive LPF(C DIFF)

Low Frequency Color Noise



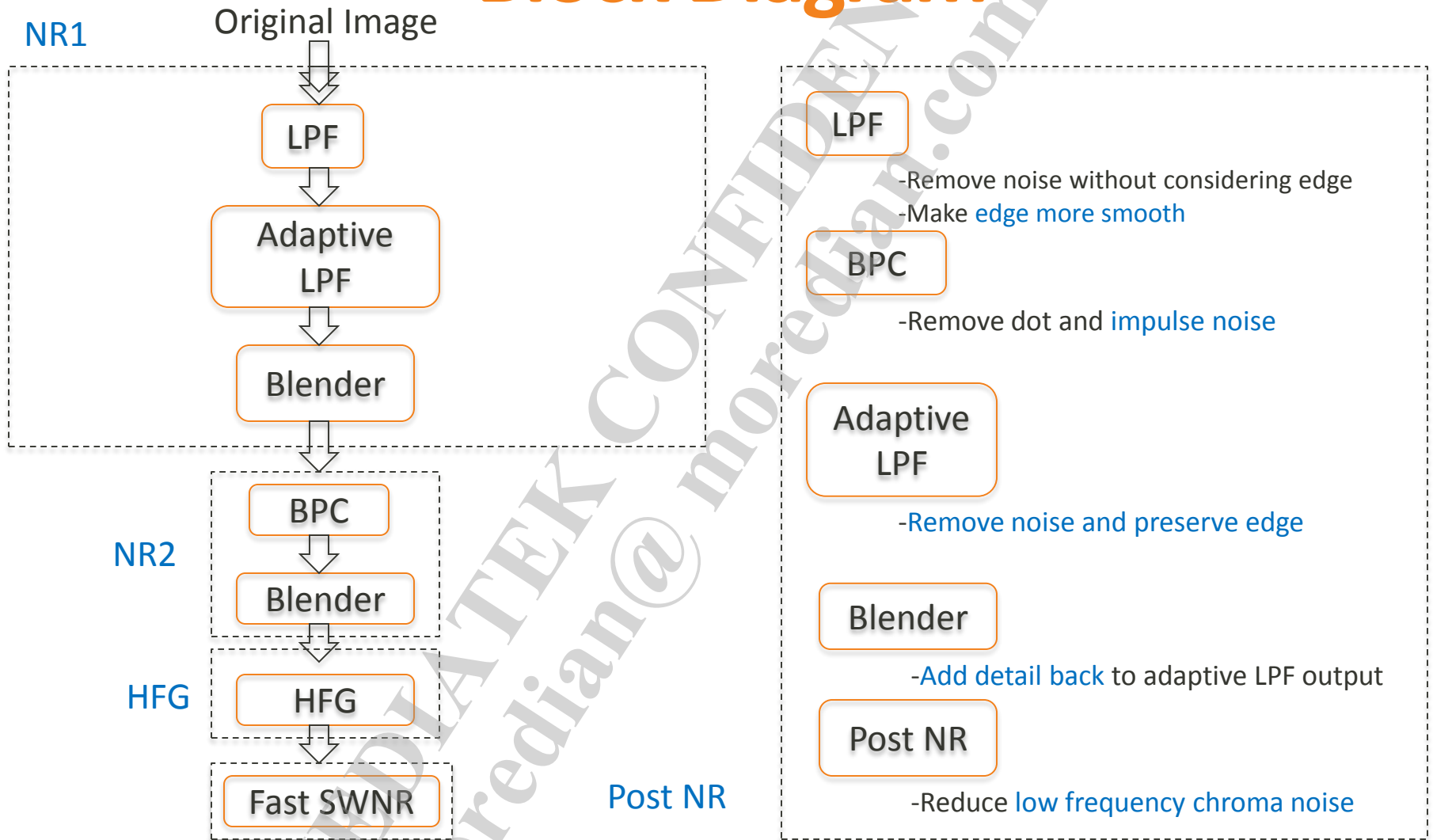
Fast SWNR

Dirty Edge



LPF

Block Diagram



NR1 UI Introduction

NBC

NBCBlend

FW NBC Link

Global

LTM LINK

☒

ANR ENY

☒

ANR ENC

☒

Range Filters

PTC GAIN TH

0

YNR Strength

L0 std

16

L1 std

16

L2 std

16

L3 std

8

Y SLOPE H TH

4

Y SLOPE V TH

5

CNR Strength

PTC1

2

PTC2

4

PTC3

6

PTC4

8

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

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

CANR Mods

C L DIFF TH

24

C SM EDGE

1

YANR Mods

CEN GAIN HI TH

0

CEN GAIN LO TH

0

CEN GAIN HI TH LF

0

CEN GAIN LO TH LF

0

NBC

NBCBlend

FW NBC Link

Act Blend [Y 0/64 BLF/Ori]

Y HF ACT X1

16

Y HF ACT X2

24

Y HF ACT X3

32

Y HF ACT X4

40

Y HF ACT Y0

32

Y HF ACT Y1

32

Y HF ACT Y2

32

Y HF ACT Y3

32

Y HF ACT Y4

32

Y HF ACT SP4

0

Blending Control

Y L0 HF W

16

Y L1 HF W

16

Y L2 HF W

16

Y L3 HF W

16

Chroma Blend

ACT BLD BASE C

48

NBC

NBCBlend

FW NBC Link

Control

ENABLE

☐

LCE Link Strength

LCE LINK STR

16

LCE LINK LUMA STI

16

NR2 UI Introduction

NBC2 ABF

Global		SL2 Link	
ANR2 ENY	<input checked="" type="checkbox"/>	SL2 X1	64
ANR2 ENC	<input checked="" type="checkbox"/>	SL2 X2	128
SCALE MODE	0	SL2 X3	192
PTC Strength [U+V]		SL2 GAIN0	16
PTC1	2	SL2 GAIN1	20
PTC2	3	SL2 GAIN2	24
PTC3	4	SL2 GAIN3	32
PTC4	6	SL2 SP3	16
Median Filter		CANR Mods	
LCL TH	32	C L DIFF TH	24
LCL LV	16	C SM EDGE	1
NCL TH	48	Activity Map	
NCL LV	16	ACT BLD BASE C	48

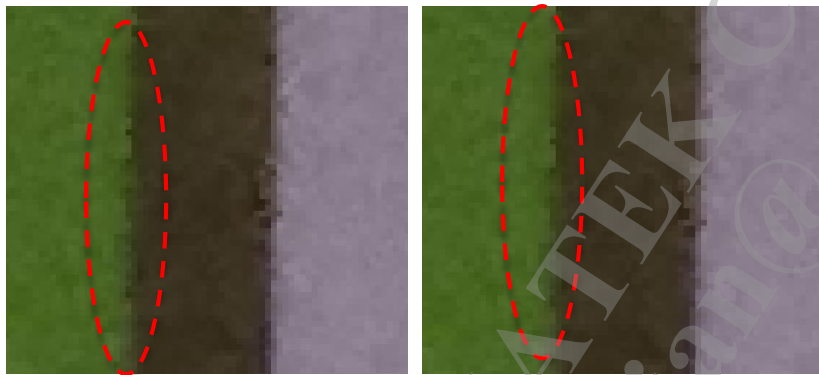
HFG UI Introduction

HFC Luma	
Noise STD	6

NR1 LPF(Low Pass Filter)

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

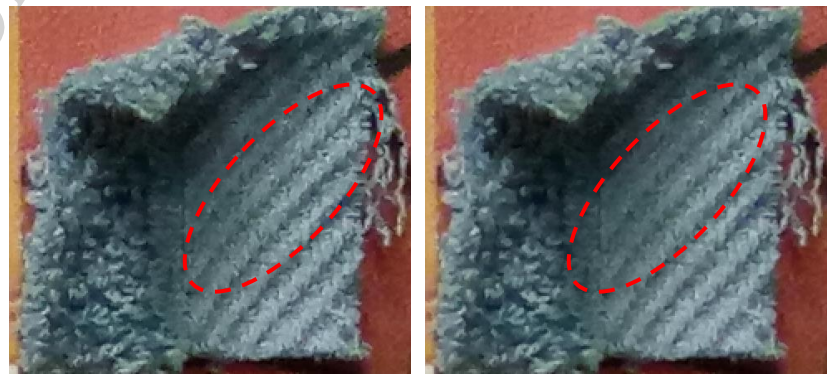
Effect



Before

After

Side Effect



Before

After

NR1 LPF(Low Pass Filter)

YANR Mods	
CEN GAIN HI TH	0
CEN GAIN LO TH	0
CEN GAIN HI TH LF	0
CEN GAIN LO TH LF	0

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



Adaptive LPF – Edge Preserve NR

YNR Strength	
L0 std	16
L1 std	16
L2 std	16
L3 std	8
Y SLOPE H TH	4
Y SLOPE V TH	5
CNR Strength	
PTC1	2
PTC2	4
PTC3	6
PTC4	8

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

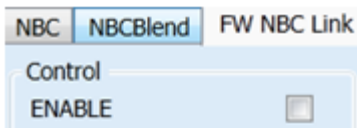
Adaptive LPF – LCE NR LINK

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

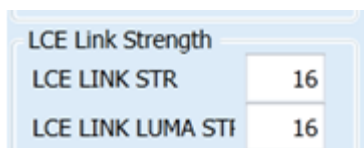
LTM LINK



Enable bit



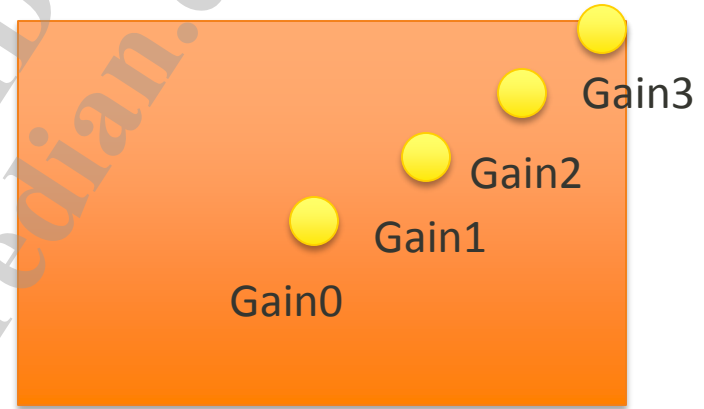
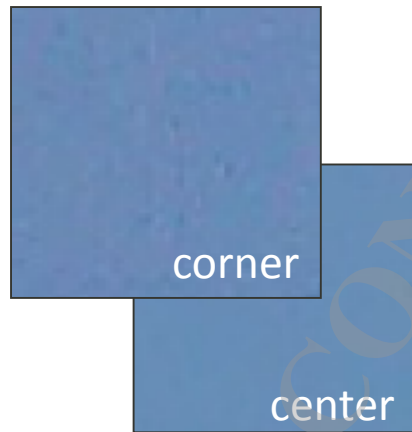
Enable: Enable FW simulation (should read NVRAM)



The larger value is, the stronger the NR strength is

Registers	Run	ISPs	Tools	Others
	Open Reg (.dat)			Ctrl+D
	Save Reg As (.dat)			Ctrl+T
	Save Selected Module (.dat)			Ctrl+M
	Save Reg As (.nvram) / ISO interpolation			Ctrl+N
	Import EXIF from JPEG/TUNING (.jpg/.tuning)			Ctrl+J
	Open NvRam file (.xlsx)			
	Open Table - PDC			Ctrl+C
	Open Table - Shading			Ctrl+H
	Open Table - Gamma			Ctrl+G
	Open MDP Reg (.dat)			
	Save MDP Reg (.dat)			
	Save MDP Sub Module (.dat)			
	Import MDP EXIF from BIN (.mdp)			

Corner Noise Reduction



SL2 Link	
SL2 LINK	<input checked="" type="checkbox"/>
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 bleeding



C L DIFF TH	24
C SM EDGE	1

C L DIFF TH = 0: No bleeding, almost no chroma NR

C L DIFF TH = 255: More bleeding, stronger NR

Suggestion: its range from 24 (low ISO) to 100 (highest ISO)

C SM EDGE = 0, less bleeding

C SM EDGE = 1, more bleeding

Suggestion: its range from 0 or 1 (low ISO) to 1 (middle/high ISO)

Blender

NBC	NBCBlend	FW NBC Link
Act Blend [Y 0/64 BLF/Ori]		
Y HF ACT X1		16
Y HF ACT X2		24
Y HF ACT X3		32
Y HF ACT X4		40
Y HF ACT Y0		32
Y HF ACT Y1		32
Y HF ACT Y2		32
Y HF ACT Y3		32
Y HF ACT Y4		32
Y HF ACT SP4		0
Blending Control		
Y L0 HF W		16
Y L1 HF W		16
Y L2 HF W		16
Y L3 HF W		16
Chroma Blend		
ACT BLD BASE C		48

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

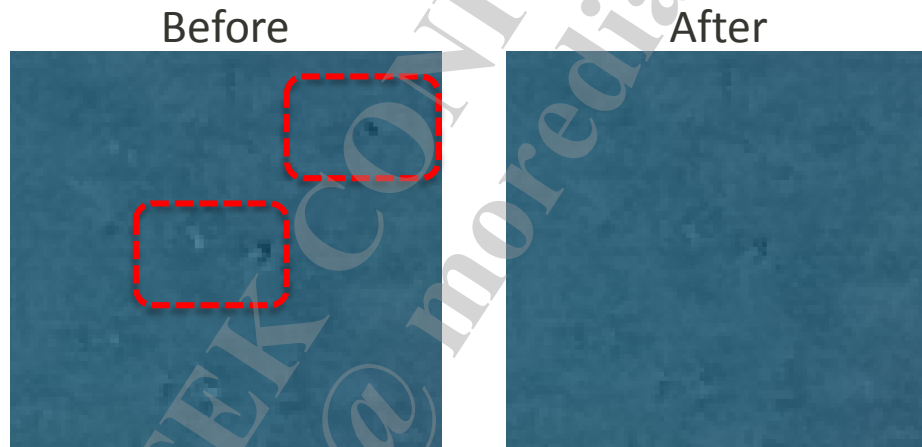
Y HF ACT Y1~4: Y axis of activity dependent blender
(Blending ratio between adaptive LPF output and original NR1 input)
0 to 64: Clean to dirty

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

BPC (Bad Pixel Correction)

- Target
 - Remove dot and impulse noise

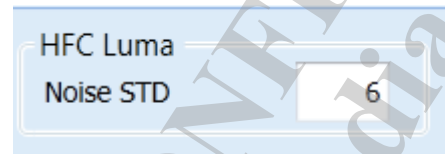


BPC (Bad Pixel Correction)

Median Filter	
LCL TH	32
LCL LV	16
NCL TH	48
NCL LV	16

- 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.

HFG – Add High-Freq Detail



0

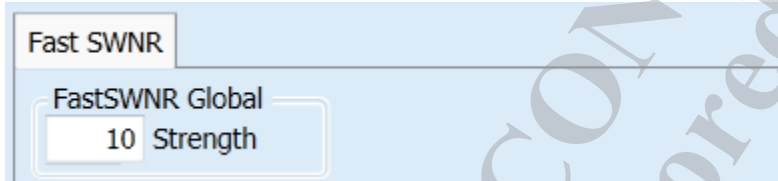



16



SWNR/SWCCR

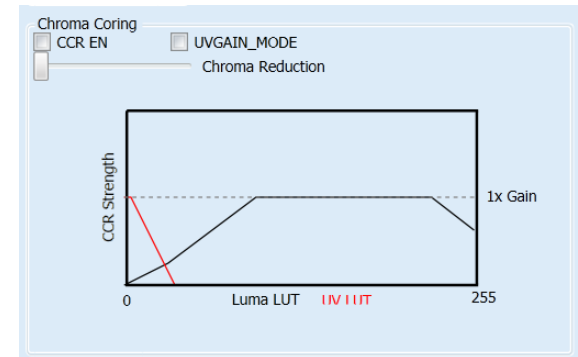
- SWNR: Remove low-f noise



Strength  : Less chroma noise

- SW CCR

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



MEDIATEK

everyday genius