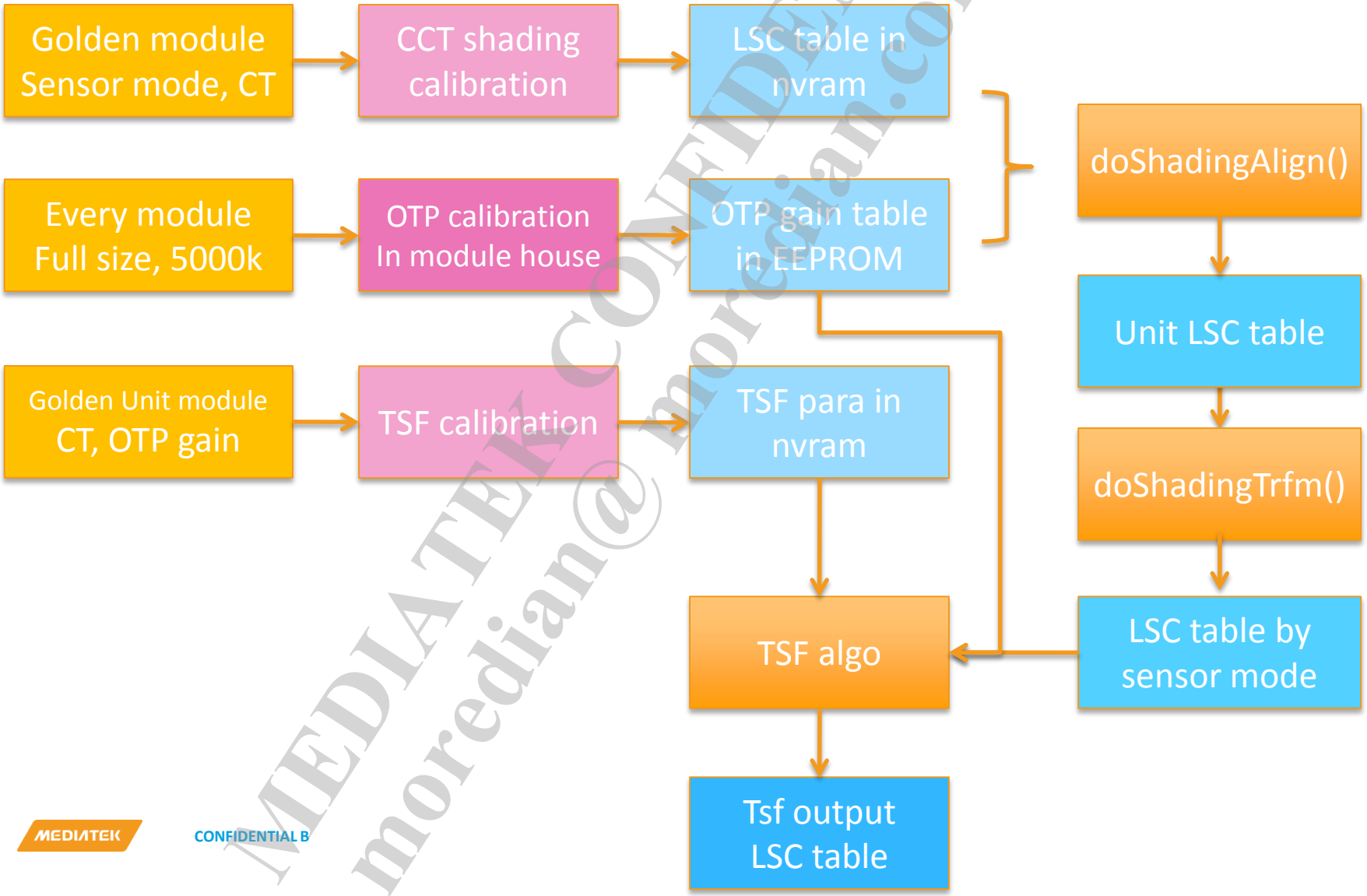
CONFIDENTIAL B

Shading

Shading flow



Platform Shading OTP calibration

- Doc & tool:
  - Old：
  - shading_calibration_flow0702.pptx
  - slim_cal&correction_v1.4_Release_version.rar
  - New：
  - Intro._to_Shading_OTP_Tool-20171205.pdf
  - OTP_Tool_RGB_051017.rar

新旧tool算法相同，差异在于个别配置项，及新tool的Criteria 更加严格。

- Config
  - slim_param_capture.txt

  :Filename, image size, bit-depth, bayer-order, x_grid_num, x_grid_num, image size offset, compensation level, ob.
  - lsv_param_capture.txt

  :Image size(half), bit-depth, bayer-order

OTP calibration config

- compensation level config

old

```
-1258667        //Pattern_distribution_coef_a
1845333         //Pattern_distribution_coef_b
-865333         //Pattern_distribution_coef_c
-71333          //Pattern_distribution_coef_d
0               //Pattern_distribution_coef_e
1000000 //Pattern_distribution_coef_f
16      //OB Value
//Parameter 1.00        = 0,0,0,0,0,1000000
//Parameter 0.95        = -391111,871111,-642222,112222,0,1000000
//Parameter 0.95 = -568889,782222,-497778,84444,0,1000000
//Parameter 0.90        = -440889,974222,-729778,96444,0,1000000
//Parameter 0.85        = -974222,1774222,-1096444,146444,0,1000000
//Parameter 0.80        = -1507556,2574222,-1463111,196444,0,1000000
//Parameter 0.75        = -1329778,2236444,-1127556,-29111,0,1000000
//Parameter 0.70        = -725333,1045333,-498667,-121333,0,1000000
//Parameter 0.65  = -1258667,1845333,-865333,-71333,0,1000000
//Parameter 0.60  = -1792000,2645333,-1232000,-21333,0,1000000
```

new

```
4               //correction_level
```

(20-4)/20 = 80%

- Grid number

Data size = 68(head)+m*n*4 (channel)*2

```
15              //m_x_grid_num
15              //n_y_grid_num
```

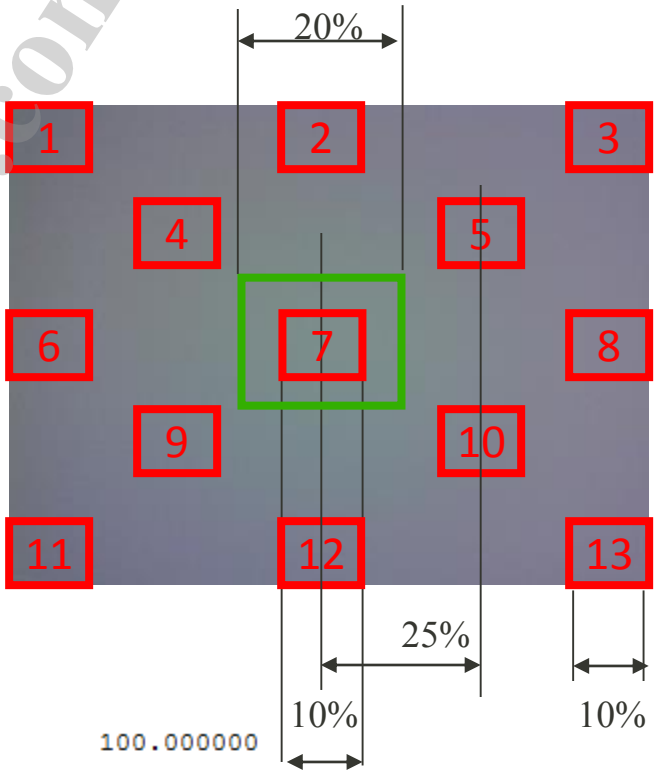
Shading verification

- Source image :Use Shading Correction image
- G mean: 140~180 (8 bit) (after OB subtraction)
- Calculation
  - G decay = 1- |(G)red-(G)green| / (G)green
  - RG color diff = (R/G)red/(R/G)green - 1
  - BG color diff = (B/G)red/(B/G)green - 1

  red = red window

  green = green window
- Criteria : (old)
  - RAW min (G decate) >65%
  - RAW max(color_diff) < 5%
- result.txt - old

```
pass        Total time    3.634000
R_Center          110.000000 G_Center          186.000000 B_Center
RG   0.025608        BG   -0.450704        Y_Decay -23.376623
RG   0.488312        BG   -0.091429        Y_Decay -5.844156
RG   -0.464217       BG   -1.063830        Y_Decay -24.025974
RG   -0.255363       BG   -0.730337        Y_Decay -3.896104
RG   0.308166        BG   -0.169492        Y_Decay -4.545455
RG   0.429752        BG   0.327273         Y_Decay -11.038961
RG   0.369470        BG   -0.534759        Y_Decay 0.649351
RG   0.429752        BG   -0.800000        Y_Decay -11.038961
RG   0.308166        BG   -0.169492        Y_Decay -4.545455
RG   0.878099        BG   -0.659091        Y_Decay -5.194805
RG   0.246753        BG   -0.357143        Y_Decay -24.675325
RG   0.672622        BG   -0.011561        Y_Decay -6.493506
RG   0.246753        BG   -0.357143        Y_Decay -24.675325
```



ROI Layout

Criteria - new

Before Calibration	MONO Sensor	Bayer Sensor	RWB Sensor	Error Code
G mean of □ : (8bit) (After OB subtraction)	140 ~ 180	140 ~ 180	140 ~ 180	LUM_TEST_FAIL
min (R/G) / max (R/G)	> 95%	> 70%	> 70%	PRECOR_TEST_FAIL
min (B/G) / max (B/G)	> 95%	> 70%	> 70%	PRECOR_TEST_FAIL
max(G)/min(G)	< 4	<4	<4	OVERFLOW_HARDWARE_BITS
After Calibration	**MONO Sensor**	**Bayer Sensor**	**RWB Sensor**	**Error Code**
G mean of □ : (8bit) (After OB subtraction)	140 ~ 180	140 ~ 180	140 ~ 180	LUM_TEST_FAIL
Min (G decay)	> 70%	> 70%	> 70%	FALLOFF_TEST_FAIL
Max (Color diff)	< 5%	< 5%	< (5% / color_gain)	COLOR_TEST_FAIL

Result.txt - new

```
pass    Fail          after_ob.raw  Total time    1.546000  R_Center        101.000000 G_Center        177.000000 B_Ce
RG_Pre  0.583212        BG_Pre  0.374922        RG  -1.050717       BG  -9.355652        Y_Decay -17.931034
RG_Pre  0.603717        BG_Pre  0.462221        RG  0.605061        BG  -1.789430        Y_Decay -8.965517
RG_Pre  0.571312        BG_Pre  0.387676        RG  -1.050717       BG  -8.002752        Y_Decay -17.931034
RG_Pre  0.592868        BG_Pre  0.460136        RG  -0.162016       BG  -1.164454        Y_Decay -6.896552
RG_Pre  0.599948        BG_Pre  0.469524        RG  0.292258        BG  -1.759848        Y_Decay -6.896552
RG_Pre  0.594861        BG_Pre  0.417669        RG  -0.655862       BG  -2.461891        Y_Decay -11.724138
RG_Pre  0.573002        BG_Pre  0.505590        RG  -0.138282       BG  -0.006277        Y_Decay 0.689655
RG_Pre  0.599925        BG_Pre  0.437445        RG  -0.655862       BG  -2.461891        Y_Decay -11.724138
RG_Pre  0.586156        BG_Pre  0.456857        RG  0.292258        BG  -1.759848        Y_Decay -6.896552
RG_Pre  0.588186        BG_Pre  0.470549        RG  0.292258        BG  -0.561798        Y_Decay -6.206897
RG_Pre  0.565931        BG_Pre  0.377287        RG  -0.535189       BG  -4.593076        Y_Decay -17.241379
RG_Pre  0.589233        BG_Pre  0.464244        RG  -0.012148       BG  -1.171848        Y_Decay -8.275862
RG_Pre  0.576812        BG_Pre  0.403769        RG  0.141443        BG  -5.296950        Y_Decay -17.241379

Center_Lum  177.000000      RG_Pre_RTO  0.937412        BG_Pre_RTO  0.741554        Max_Color_Diff  9.355652        Max_
RTO 1.000000        Color_Pre   0.700000        RG  5.000000        BG  5.000000        Y_Decay 70
```

Before Calibration	After Calibration	Input Filename			Green ROI					
pass	pass	after_ob.raw	Total time	0.254	R_Center	36	G_Center	56	B_Center	32

Red ROI #1~13									
RG_Pre	0.618974	BG_Pre	0.654684	RG	-0.20964	BG	-0.9434	Y_Decay	-5.35714

Color_Gain		Criteria for RG_Pre, BG_Pre		Criteria for RG, BG				Criteria for Y_Decay	
RTO	1	Color_Pre	0.85	RG	5	BG	5	Y_Decay	70

Golden OTP reg config in NVRAM

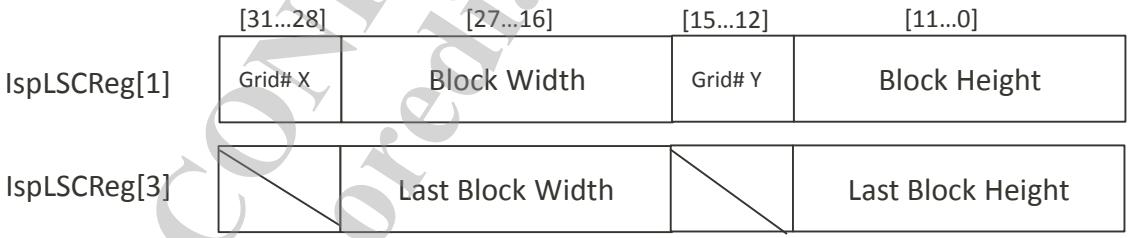
- Fill in register config value

```
SensorGoldenCalTable: {
   PixId:          0,
   SlimLscType:    0,
   Width:          0x90,
   Height:         0x6B,
   OffsetX:        0,
   OffsetY:        0,
   TblSize:        1800,
   IspLSCReg:
   {               0x00000000,
                   0xd090d06B,
                   0x00000000,
                   0x00900075,
                   0x20202020},
                   ....},
```

// bayer order for golden table

// block width
// block height
// gain table X offset
// gain table Y offset
// table size in bytes (gird_x * grid_y * 2 * 4)

不要参考1_unit_13x9_3_goldenFmt.txt中的PixId
根据驱动设定来配置



IspLSCReg[4] = Ratio

- Must
  - PixId: 0:B 1:Gb 2:Gr 3:R (fill in first pixel channel of sensor Bayer older)
  - Width: block width (sensor raw width/2/(gird_x -1))
  - Height : block height (sensor raw height/2/(gird_y-1))
  - TblSize: gird_x * gird_y * 2 *4
  - Grid# X : gird_x - 2 Grid# Y: gird_y - 2
  - ex : if shading OTP table is 15*15, sensor size: 4032*3016,
  - Grid# X = 15 – 2 = 13 = 0xd; Grid# Y= 15 – 2 = 13 = 0xd;
  - block width: 2016/(15-1) = 144 = 0x90, last block width = 2016 – 144*(15-2)= 144 = 0x90
  - block height: 1508/(15-1) = 107 = 0x6B, last block width = 1508 – 107*(15-2)= 117 = 0x75

OTP width block， height block对应配置文件中的m_x_grid_num，n_x_grid_num Grid 15*15，对应14*14个block，13*13个等宽block。

Shading Issue Check List

1. 问题场景下用adb命令开关tsf，看是shading表现否有差异，确认是否tsf问题。
2. 用debug parse查看tsf、lsc参数是否生效。
3. 关闭smooth shading，固定ratio为32，看是否有影响。
4. 在问题场景盖diffuser拍pure data加入到tsf calibration data中。如果有平台shading otp补偿，calibration时也开启此功能。
5. 确认Sensor Driver中imgsensor_winsize_info是否正确。
6. 如果有平台端shading calibration，确定OTP Driver有无问题，data format，width height，unit gain table和golden gain table等是否正确，log中是否有shadingalign error。

Shading Issue Check List

1. 关闭tsf，lsc可以如下命令：
   - adb shell setprop debug.lsc_mgr.enable 0 //关闭lsc
   - adb shell setprop debug.lsc_mgr.manual_tsf 0 //关闭tsf

2. 检查tsf参数是否生效
   - 查看Debug parse的SHAD page，
   - SHAD_TAG_TSF_EN 1
   - SHAD_TAG_ALGO_VER开始的值和camera_tsf_para_xxx.h中的是否保持一致。

3. 关闭smooth shading确认效果是否有改善
   - isp_tuning_custom.cpp文件evaluate_Shading_Ratio函数直接返回32或者 adb shell setprop debug.lsc_mgr.ratio 32

Shading Issue Check List

4. 在问题场景该diffuser拍raw加入到tsf training data中，用平台支持的最高版本工具生成tsf参数。
5. 如果有平台端shading otp，需要检查填写的data format，width，height等配置是否正确。注意：从6755开始已经将data format{B,Gb,Gr,R}的enum定义改成0,1,2,3(6755之前平台是0,2,4,8)。
6. 检查sensor drive中win size info设定是否正确，crop时中心对齐，resize时长宽等比例。
7. MT6755后，isp_lsc中仅保存capture的shading table，其他mode的shading table会依据crop info来计算，所以要求crop info信息需严格按照要求来。

Sensor crop information

- Describe how the sensor mode is cropped from full size.

Only save capture(max fov) shading table in nvram.

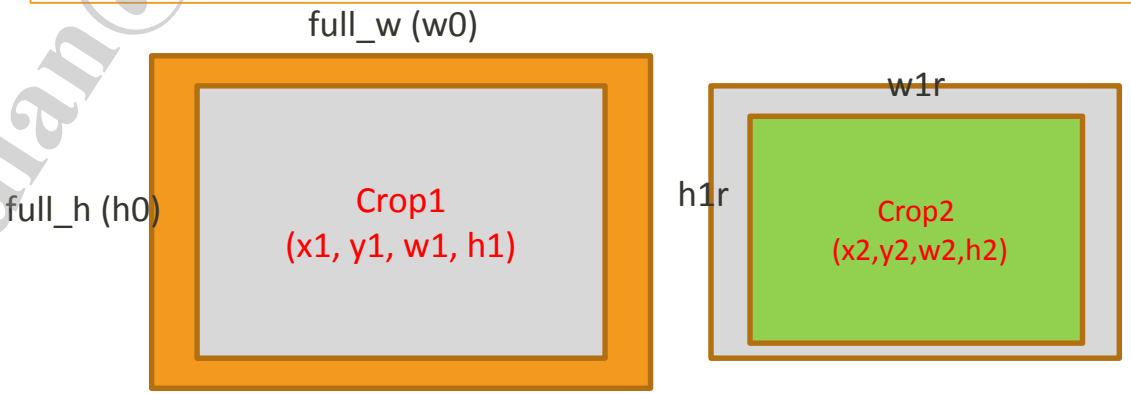
Other sensor mode shading table was generated via shading transformation function with sensor crop info which is provided by kernel drier.

Crop at center, resize width and height with the same ratio.

lsc_mgr2.h
(mediatek\platform\mt6595\hardware\mtkcam\core\featureio\pipe\aaa\lsc_mgr)

```
struct SensorCropInfo_T
{
    // TBD
    MUINT32  w0;    // original full width
    MUINT32  h0;    // original full height
    MUINT32  x1;    // crop_1 x offset from full_0
    MUINT32  y1;    // crop_1 y offset from full_0
    MUINT32  w1;    // crop_1 width from full_0
    MUINT32  h1;    // crop_1 height from full_0
    MUINT32  w1r;   // scaled width from crop_1, w1 * r
    MUINT32  h1r;   // scaled height from crop_1, h1 * r
    MUINT32  x2;    // crop_2 x offset from scaled crop_1
    MUINT32  y2;    // crop_2 y offset from scaled crop_1
    MUINT32  w2;    // crop_2 width from scaled crop_1
    MUINT32  h2;    // crop_2 height from scaled crop_1

    MUINT32  u4W;   // input size of LSC, w2*r2, r2 must be 1
    MUINT32  u4H;   // input size of LSC, h2*r2, r2 must be 1
};
```



Case 1 LSC参数设定不正确导致NE

```
D lsc_mgr2_rto_thread: [tsfPostCmd] TSF(On), eCmd(E_TSF_CMD_BATCH)
D lsc_mgr2_rto_thread: [tsfBatch +]
D AppTsf  : [TsfFeatureCtrl][Error] Lsc config incorrect!
E lsc_mgr2_rto_thread: [tsfBatch()] Err:921:, [tsfBatch] Error(0x80000005):
MTKTSF_FEATURE_SET_TBL_CHANGE
D AppTsf  : [TsfReset] TsfReset
D lsc_mgr2_rto_thread: [tsfBatch -](0x80000005)
D lsc_mgr2_rto: [updateLsc] User: BADDR(0x02600000), CTL1(0x00000000), CTL2(0x00000000),
          CTL3(0x00000000), LBLOCK(0x00000000), RTO(0x20202020)-------这个地方全传的0
E isp_mgr : [apply()] Err:   612:, apply Invalid parameter
D lsc_mgr2_rto_thread: [tsfPostCmd] SensorDev(2) TSF ON, eCmd(E_TSF_CMD_RUN)
D lsc_mgr2_rto_thread: [tsfRun +] Rto(8) step(0)
D lsc_mgr2_rto_thread: [tsfSetProcInfo] ForceAwb(0), L(50), C(6500), F(83), DF(100), R(981),
G(512), B(685)
D lsc_mgr2_rto_thread: [tsfSetProcInfo] m_prAwbStat(0xf75ff8b0), tmpBuf(0xf757c028), size(43200)
D AppTsf  : [TsfFeatureCtrl] LV 50, CCT 6500, R 981, G 512, B 685, Fluo 83, Day Fluo 100, LscRA
32
```

Error 5说明
参数错误

CTL0,1,2都为0,CTL定义部分请参考ispif.h文件中
ISP_NVRAM_LSC_T。特别注意6755开始此struct定义有变化。

Case 2 crop info不正确导致概率性NE

D AppTsf : [TsfExit] TsfExit
D AppTsf : [TsfInit][Error] Cropped + offset is larger than full size!
D AppTsf : [TsfInit][Error] full_width(4208), full_height(3120), resize_width(2100), resize_height(1557), crop_width(2100), crop_height(1560)
D AppTsf : [TsfReset] TsfReset

```
static SENSOR_WINSIZE_INFO_STRUCT imgsensor_winsize_info[10] =
        {{ 4208, 3120,     0,       0, 4208, 3120, 2100,  1560, 0000, 0000, 2100,  1560,          0,       0, 2100, 1560}, // Preview
        { 4208, 3120,      0,       0, 4208, 3120, 4208,  3120, 0000, 0000, 4208,  3120,          0,       0, 4208, 3120}, // capture
        { 4208, 3120,      0,       0, 4208, 3120, 4208,  3120, 0000, 0000, 4208,  3120,          0,       0, 4208, 3120}, // video
#if 0
        { 4208, 3120,      0,       0, 4208, 3120, 4208,  3120, 0000, 0000, 4208,  3120,          0,       0, 4208, 3120}, // capture2
#endif
        //{ 4208, 3120,    0,       0, 4208, 3120, 4208,  3120, 0000, 0000, 4208,  3120,          0,       0, 4208, 3120}, // video
        { 4208, 3120,      8,   0, 4192, 3120, 1048,  780 , 0000, 0000, 1048,   780,      0,   0, 1048,  780}, //hight speed video
        //{ 4208, 2688,    0,  432, 4208, 2256, 1400,  752 , 0000, 0000, 1400,           752,       0,       0, 1400,  752}, //hight speed video
        { 4208, 3120,      4,       0, 4200, 3120, 2100,  1560, 0000, 0000, 2100,  1560,          0,       0, 2100, 1560}};// slim video
        //{ 4208, 2688,    0,  432, 4208, 2256, 1400,  752 , 0000, 0000, 1400,           752,       0,       0, 1400,  752}};// slim video
```

, 4208x3120 resize后应该是1/2 or ¼, 但4208 / 2100 并不是exactly 2.这一组应该要改成:

{ 4208, 3120, 0, 0, 4208, 3120, 2104, 1560, 0000, 0000, 2100, 1560, 0, 0, 2100, 1560}, // Preview

crop中心对齐，resize等比例

Case 3 Shading导致Pre Cap颜色表现不一致

- capture和preview的fov保持一致，如果不一致，preview切换到capture的时候tsf会reset，导致preview和capture的shading表现不同。

D lsc_mgr2: [showResolutionInfo] SensorMode(0), full_0(4192,3104)
crop1(0,0,4192,3104) resize(2096,1552) crop2(0,0,2096,1552) final size(2104,1560)
D lsc_mgr2: [showResolutionInfo] SensorMode(1), full_0(4192,3104)
crop1(0,0,4192,3104) resize(4192,3104) crop2(0,0,4192,3104) final size(4192,3104)
D lsc_mgr2: [showResolutionInfo] SensorMode(2), full_0(4192,3104)
crop1(0,0,4192,3104) resize(4192,3104) crop2(0,0,4192,3104) final size(2104,1560)
D lsc_mgr2: [showResolutionInfo] SensorMode(3), full_0(4192,3104)
crop1(0,0,4192,3104) resize(688,512) crop2(0,0,688,512) final size(800,480)
=> 请确定resize是能被crop1 width/height整除.
D lsc_mgr2: [showResolutionInfo] SensorMode(4), full_0(4192,3104)
crop1(0,485,4192,2328) resize(1280,720) crop2(0,0,1280,720) final size(1280,720)
=> 请确定resize能够被crop1 width/height整除

拍tsf pure raw基本要求

1. 必须是pure raw，不能是process raw，而且ob设定要正确
2. 拍的raw data不能有flick。
3. raw图片四角亮度要保证基本相同，不能有明显的暗角。
   |Max(Y_corner)-Min(Y_cornor)/Max(Y_corner)-1|<10%。
4. 个别模组lens停在不同的位置，shading效果表现有差异，需考虑拍raw时是否要将镜头固定在近焦和远焦中间的位置。
5. 详细操作请参考 User Manual - TSF.pdf：
   https://online.mediatek.com/Lists/SDE_Service/Attachments/20/User%20Manual%20-%20TSF.pdf
6. 生成TSF参数的链接：
   https://online.mediatek.com/_layouts/15/mol/sde/ext/sdehome.aspx

tsf debug sop

1. Trouble scene images
   - 提供 Engineer mode Pure raw + jpeg + sdblk
   - 在问题景 + diffuser
   - 此module在灯箱各色温下拍摄 (如此状况表现不好，请将此module加入tuning)
2. Custom tuning/calibration data
   - camera_tsf_data_xxx.h
   - camera_tsf_para_xxx.h
   - camera_isp_lsc_xxx.h
   - camera_tuning_para_.cpp
3. Full tuning folders

   放置Raw File的Folder, 档名请统一 “Sensor_Customer_OB_Appendix”

   Ex : OV8825_Apple_OB17_1
   - Tuning 时的完整影像
   - Tuning commend
   - TSF_golden_config.txt (TSF 2.0 only)

tsf debug sop

4. MTKLog

   请先用adb command打开log后录制.

   - adb shell setprop debug.tsfcore_exifdbg.enable 1

   - adb shell setprop debug.tsfcore.enable 1

5. Dump AWB Stat

   请先用adb command打开log后按下capture录制.

   - adb shell setprop debug.lsc_mgr.log 2047

   档案会分别存在以下path, 由于档名是固定的, 所以若要存多笔capture的awb stat, 请先pull出来再拍下一次.

   - Sdblk => /sdcard/tsfInput /sdcard/tsf

   - awb stat => /sdcard/tsfAwbStat.bin

TSF Tuning相关FAQ

- [FAQ17412]
  [Camera Tuning] TSF On_line tools 使用说明
- FAQ09396
  [camera Tuning]TSF(改善Color Shading问题)功能的调试和开启
- [FAQ11301]
  [Camera Tuning] TSF(改善Color Shading的问题)进阶客制化
- FAQ11138
  [Camera Tuning] 提供TSF PureRawData时注意事项
- FAQ11142
  [Camera Tuning] 如何确认TSF参数有无正确生效
- [FAQ11709]
  [camera Tuning] Golden Sample模组的挑选

Lsc debug command

- adb shell setprop debug.lsc_mgr.enable 0 //关闭lsc
  adb shell setprop debug.lsc_mgr.manual_tsf 0 //关闭tsf
  adb shell setprop debug.lsc_mgr.ratio 32 //关闭smooth shading ratio

- //开启shading log
  adb shell setprop debug.tsfcore_exifdbg.enable 1
  adb shell setprop debug.tsfcore.enable 1
  adb shell setprop debug.lsc_mgr.log 2047
  adb shell setprop mkdir /sdcard/tsf

everyday genius