

[4EC EVT1.1] AF guide ver 4.1

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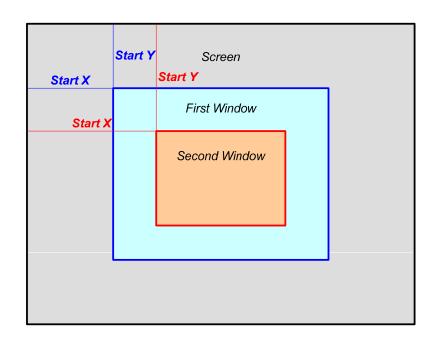
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System LSI Division Semiconductor Business Samsung Electronics Co., Ltd.



(1-1) Set AF window for Touch AF



4EC 는 2개의 AF window 로 구성됨

주의

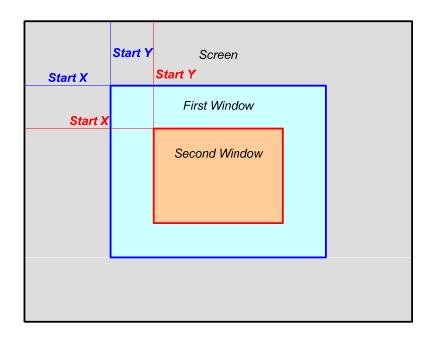
inner window, outer window위치가 바뀌지 않도록 설정함.

Second window: inner window

First window : outer window 로 반드시 설정 바람.

Parameter Name (4EC EVT1.1)	Description
FstWinStartX [0x7000 0294]	First window's start X position
FstWinStartY [0x7000 0296]	First window's start Y position
FstWinSizeX [0x7000 0298]	First window's width
FstWinSizeY [0x7000 029A]	First window's height
ScndWinStartX [0x7000 029C]	Second window's start X position
ScndWinStartY [0x7000 029E]	Second window's start Y position
ScndWinSizeX [0x7000 02A0]	Second window's width
ScndWinSizeY [0x7000 02A2]	Second window's height
WinSizesUpdated [0x7000 02A4]	If this parameter is set to 1, AF window size is updated.

(1-2) Set AF window for Touch AF



1. LSI 센서는 raw image size 가 변경되면 비율에 따라 자동적으로 AF window size 가 변경됨.

(예)

(1) 1280x960 size

Inner window : 100x100
Outer window : 400x400

(2) 2560x1920 size

Inner window: 200x200
Outer window: 800x800

위 예처럼, image size 가 1280x960 => 2560x1920 으로 변경시, 별도의 설정없이 AF window size 가 자동으로 2배로 바뀜.

2. AF window 관련 register 는,

(Start X, Start Y), width x height 로 이루어져 있음.

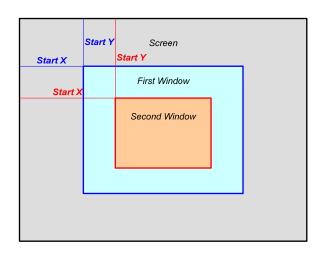
따라서,

Inner window, outer window 의 (Start X, Start Y) 좌표만을 변경하는 방식 으로 AF window 의 Position 을 움직이게 한다.

(Inner window, outer window 의 Height, Width 는 그대로 유지)



(1-3) Set AF window for Touch AF



AF window 설정법

상대비율에 따라 AF window 크기와 위치가 변경되도록 Display image size 의 (start X, start Y), (Size X x Size Y) 를 설정하는 계산수식은 아래와 같음

Inner window

ScndWinStartX(Start X Position) = (Phone Display AF start X <<10) / Phone Display H size

ScndWinStartY(Start Y Position) = (Phone Display AF start Y <<10) / Phone Display V size

ScndWinSizeX (Window Width) = (Phone Display AF size X <<10) / Phone Display H size

ScndWinSizeY (Window Height) = (Phone Display AF size Y <<10) / Phone Display V size

Outter window

FstWinStartX(Start X Position) = (Phone Display AF start X <<10) / Phone Display H size

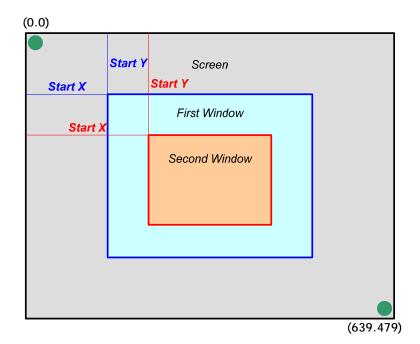
FstWinStartY(Start Y Position) = (Phone Display AF start Y <<10) / Phone Display V size

FstWinSizeX (Window Width) = (Phone Display AF size X <<10) / Phone Display H size

FstWinSizeY (Window Height) = (Phone Display AF size Y <<10) / Phone Display V size



(1-4) Set AF window for Touch AF



AF window setting (ex : 640x480 display, set AF window in center)

- -Inner window 시작위치 (247,167), (640x480 display)
- -Inner window width x height 143x143, (640x480 display)

ScndWinStartX(Start X Position) [0x7000 029C] = 247 x 1024(2^10) / 640 = 395(18B h)

ScndWinStartY(Start Y Position) [0x7000 029E] = 167 x 1024(2^10) / 480 = 356(164 h)

ScndWinSizeX (Window Width) $[0x7000\ 02A0] = 143\ x\ 1024(2^10) / 640 = 228(0E4\ h)$

ScndWinSizeY (Window Height) [0x7000 02A2] = 143 x 1024(2^10) / 480 = 305(131 h)

- -Outer window 시작위치 (160,106), (640x480 display)
- -Outer window width x height 320x266, (640x480 display)

FstWinStartX(Start X Position) $[0x7000\ 0294] = 160\ x\ 1024(2^{10}) / 640 = 256(100\ h)$

FstWinStartY(Start Y Position) [0x7000 0296] = 106 x 1024(2^10) / 480 = 226(0E2 h)

FstWinSizeX (Window Width) [0x7000 0298] = 320 x 1024(2^10) / 640 = 512(200 h)

FstWinSizeY (Window Height) [0x7000 029A] = 266 x 1024(2^10) / 480 = 567(237 h)

위 설정을 마친뒤,

WinSizesUpdated [0x7000 02A4] = 0001 을 실행하면, AF window updated 됨.

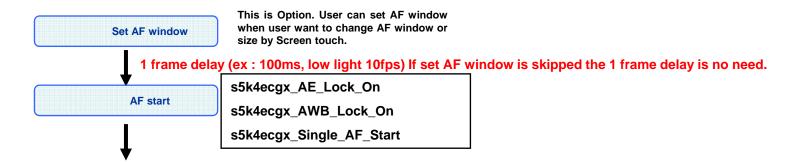
Parameter Name (4EC EVT1.1)	Description
FstWinStartX [0x7000 0294]	First window's start X position
FstWinStartY [0x7000 0296]	First window's start Y position
FstWinSizeX [0x7000 0298]	First window's width
FstWinSizeY [0x7000 029A]	First window's height
ScndWinStartX [0x7000 029C]	Second window's start X position
ScndWinStartY [0x7000 029E]	Second window's start Y position
ScndWinSizeX [0x7000 02A0]	Second window's width
ScndWinSizeY [0x7000 02A2]	Second window's height
WinSizesUpdated [0x7000 02A4]	If this parameter is set to 1, AF window size is updated.

(1-5) Set AF window for Touch AF

AF window 변경시 update 를 위해 0 ~ 1 frame 의 시간이 필요하므로 AF start 명령전, 반드시 1frame 의 Delay time 을 가진뒤, AF start 명령을 내릴것. 1frame delay 없이 AF start 명령을 내리게 되면, 변경된 AF window 가 Iens 이동도중에 반영되므로 AF 동작에 문제 있을 수 있음.

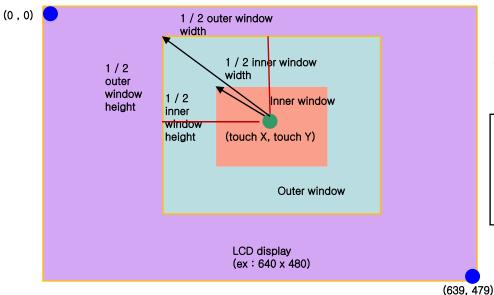
To update changed AF window (WinSizesUpdated = 0001), sensor consumes 0~1 frame. So, BE chip should command "single AF" after 1frame delay.

If BE chip neglects 1frame delay, sensor can update AF window during AF convergence.





(1-6) Set AF window for Touch AF



- 1. BE chip receives touched position user(touch X, touch Y) by cellular phone user.
- 2. Then, BE chip can detect AF window (Start X, Start Y) position.

If user touch center position in LCD display, formula is below.

```
inner_window_start_X = touch_X - inner_window_width/2;
inner_window_start_Y = touch_Y - inner_window_height/2;
outer_window_start_X = touch X - outer_window_width/2;
```

User touches center position in LCD display. Inner window is placed in center of outer window.

outer_window_start_Y = touch Y - outer_window_height/2;

(0,0)
(touch X, touch Y)
Inner window

Outer window

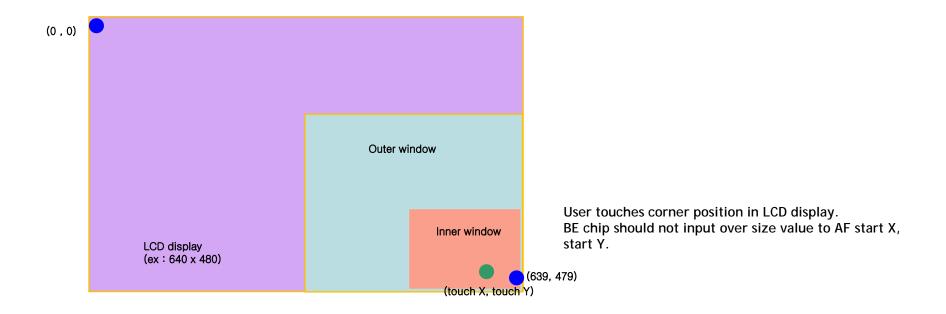
LCD display
(ex: 640 x 480)

User touches corner position in LCD display. BE chip should not input negative value to AF start X, start Y.

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(639, 479)

(1-7) Set AF window for Touch AF





(1-8) Set AF window for Touch AF (set X axis)

- **전제조건
- mirror/ flip 을 사용하지 않았다.(mirror/ flip 사용시 좌표 바꿔줘야 함. 뒷 page 참고)
- phone 사용자가 LCD의 center 영역을 touch 했을때, touch 지점은 inner window 와 outer window 의 center 에 있다. (inner window 가 outer window 의 center 에 있다.)
- -phone 사용자가 LCD의 corner 를 touch 했을때, inner window 는 touch 지점에 최대한 가까이 가되, start X, start Y 좌표가 음수가 되지 않도록 한다. 또한, width, 와 height 은 LCD 의 크기를 벗어나지 않도록 한다.
- Phone 사용자의 touch 지점에 따라 start X, start Y 를 변경하고, width, height 는 변경하지 않는다.
- -640x480 LCD display 로 가정한다
- AF window size 는 아래 size 를 사용한다고 가정한다. (아래 AF window size 는 LSI recommend 값이며 모듈업체에 따라 달라질 수 있음)
- -Inner window: 143x143 size (640x480 display 기준)
- -Outer window: 320x266 size (640x480 display 기준)

```
int touch_X // phone 사용자가 touch 한 지점 X 좌표
int touch_Y // phone 사용자가 touch 한 지점 Y 좌표

int inner_window_start_X
int inner_window_start_Y
int inner_window_width = ( (Read (ScndWinSizeX [0x7000 02A0]) x 640 ) /1024 )
int inner_window_height = ( (Read (ScndWinSizeY [0x7000 02A2]) x 480 ) /1024 )

int outer_window_start_X
int outer_window_start_Y
int outer_window_width = ( (Read (FstWinSizeX [0x7000 0298]) x 640 ) /1024 )
int outer_window_height = ( (Read (FstWinSizeY [0x7000 029A]) x 480 ) /1024 )
```

```
If (touch_X =< inner_window_width/2)</pre>
{ //inner window, outer window 가 음수가 되는 것을 방어
 inner window start X = 0;
 outer_window_start_X = 0;
else if (touch_X =< outer_window_width/2)
{ //outer window only 가 음수가 되는 것을 방어
 inner window start X = touch X - inner window width/2
 outer window start X = 0:
else if (touch_X >= (639 - inner_window_width/2) //639 : H size
{ // inner window, outer window 가 LCD display size 넘는 것을 방어
 inner window start X = 639 - inner window width ;
 outer_window_start_X = 639 - outer_window_width;
else if (touch_X >= (639 - outer_window_width/2) //639 : H size
{ //outer window only 가 LCD diaply size 넘는 것을 방어
 inner_window_start_X = touch_X - inner_window_width/2;
 outer_window_start_X = 639 - outer_window_width;
else
{ // corner 가 아니므로 그대로 inner window, outer window 설정
 inner window start X = touch X - inner window width/2;
 outer_window_start_X = touch X - outer_window_width/2;
```



(1-9) Set AF window for Touch AF (set Y axis)

- **전제조건
- mirror/ flip 을 사용하지 않았다.(mirror/ flip 사용시 좌표 바꿔줘야 함. 뒷 page 참고)
- phone 사용자가 LCD의 center 영역을 touch 했을때, touch 지점은 inner window 와 outer window 의 center 에 있다. (inner window 가 outer window 의 center 에 있다.)
- -phone 사용자가 LCD의 corner 를 touch 했을때, inner window 는 touch 지점에 최대한 가까이 가되, start X, start Y 좌표가 음수가 되지 않도록 한다. 또한, width, 와 height 은 LCD 의 크기를 벗어나지 않도록 한다.
- Phone 사용자의 touch 지점에 따라 start X, start Y 를 변경하고, width, height 는 변경하지 않는다.
- -640x480 LCD display 로 가정한다
- AF window size 는 아래 size 를 사용한다고 가정한다. (아래 AF window size 는 LSI recommend 값이며 모듈업체에 따라 달라질 수 있음)
- -Inner window: 143x143 size (640x480 display 기준)
- -Outer window: 320x266 size (640x480 display 기준)

```
int touch_X // phone 사용자가 touch 한 지점 X 좌표
int touch_Y // phone 사용자가 touch 한 지점 Y 좌표

int inner_window_start_X
int inner_window_start_Y
int inner_window_width = ( (Read (ScndWinSizeX [0x7000 02A0]) x 640 ) /1024 )
int inner_window_height = ( (Read (ScndWinSizeY [0x7000 02A2]) x 480 ) /1024 )

int outer_window_start_X
int outer_window_start_Y
int outer_window_width = ( (Read (FstWinSizeX [0x7000 0298]) x 640 ) /1024 )
int outer_window_height = ( (Read (FstWinSizeY [0x7000 029A]) x 480 ) /1024 )
```

```
If (touch_Y =< inner_window_height/2)</pre>
{ //inner window, outer window 가 음수가 되는 것을 방어
 inner window start Y = 0;
 outer_window_start_Y = 0;
else if (touch_Y =< outer_window_height/2)
{ //outer window only 가 음수가 되는 것을 방어
 inner window start Y = touch Y - inner window height/2
 outer window start Y = 0:
else if (touch_Y >= (479 - inner_window_height/2) //479 : V size
{ // inner window, outer window 가 LCD display size 넘는 것을 방어
 inner_window_start_Y = 479 - inner_window_height;
 outer_window_start_Y = 479 - outer_window_height;
else if (touch_Y >= (479 - outer_window_width/2) //479 : V size
{ //outer window only 가 LCD diaply size 넘는 것을 방어
 inner_window_start_Y = touch_Y - inner_window_height/2;
 outer_window_start_Y = 479 - outer_window_height;
else
{ // corner 가 아니므로 그대로 inner window, outer window 설정
 inner window start Y = touch Y - inner window height/2;
 outer_window_start_Y = touch Y - outer_window_height/2;
```



(1-10) Set AF window for Touch AF

//앞 page 에서 계속

//Write value to sensor register

//write inner window start X, outer window start X

ScndWinStartX [0x7000 029C] = inner_window_start_X x 1024(2^10) / 640

FstWinStartX [0x7000 0294] = outer_window_start_X x 1024(2^10) / 640

//write inner window start Y, outer window start Y

ScndWinStartY [0x7000 029E] = inner_window_start_Y x 1024(2^10) / 480

FstWinStartY [0x7000 0296] = outer_window_start_Y x 1024(2^10) / 480

WinSizesUpdated [0x7000 02A4] = 0001 //update AF window

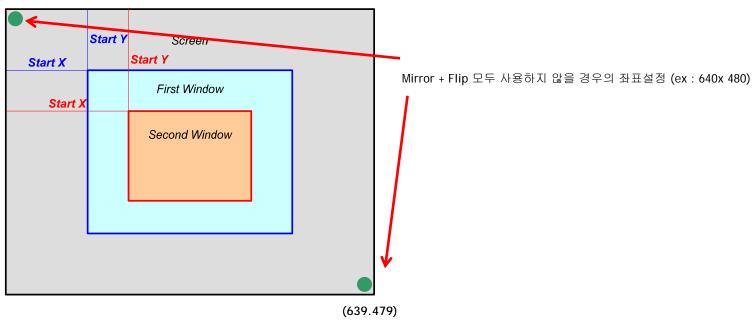
Delay (100ms) // 1frame delay

AF start [0x7000 028C] = 0005 //single AF

Parameter Name (4EC EVT1.1)	Description
FstWinStartX [0x7000 0294]	First window's start X position
FstWinStartY [0x7000 0296]	First window's start Y position
FstWinSizeX [0x7000 0298]	First window's width
FstWinSizeY [0x7000 029A]	First window's height
ScndWinStartX [0x7000 029C]	Second window's start X position
ScndWinStartY [0x7000 029E]	Second window's start Y position
ScndWinSizeX [0x7000 02A0]	Second window's width
ScndWinSizeY [0x7000 02A2]	Second window's height
WinSizesUpdated [0x7000 02A4]	If this parameter is set to 1, AF window size is updated.

(1-11) Set AF window for Touch AF

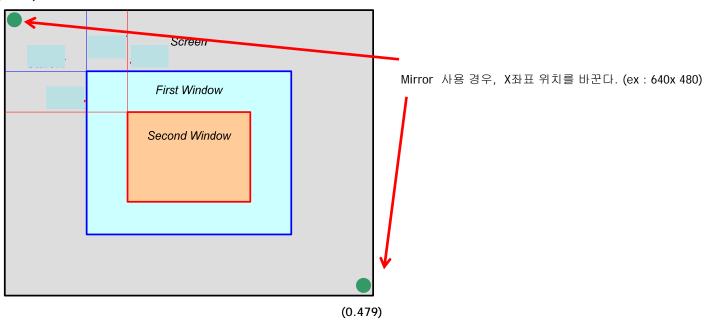
(0.0)



Parameter Name (4EC EVT1.1)	Description	
FstWinStartX [0x7000 0294]	First window's start X position	
FstWinStartY [0x7000 0296]	First window's start Y position	
FstWinSizeX [0x7000 0298]	First window's width	
FstWinSizeY [0x7000 029A]	First window's height	
ScndWinStartX [0x7000 029C]	Second window's start X position	
ScndWinStartY [0x7000 029E]	Second window's start Y position	
ScndWinSizeX [0x7000 02A0]	Second window's width	
ScndWinSizeY [0x7000 02A2]	Second window's height	
WinSizesUpdated [0x7000 02A4]	If this parameter is set to 1, AF window size is updated.	
		SAM

(1-12) Set AF window for Touch AF

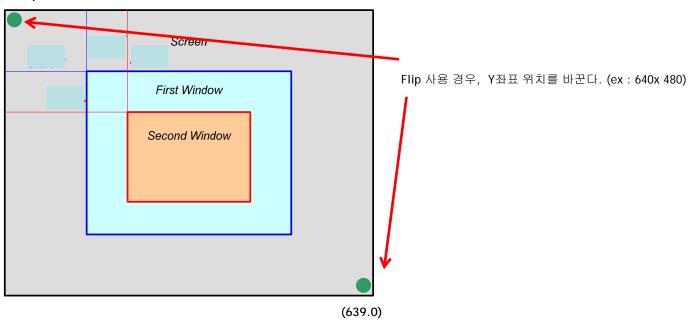
(639.0)



Description	
First window's start X position	
First window's start Y position	
First window's width	
First window's height	
Second window's start X position	
Second window's start Y position	
Second window's width	
Second window's height	
If this parameter is set to 1, AF window size is updated.	
	First window's start X position First window's start Y position First window's width First window's height Second window's start X position Second window's start Y position Second window's width Second window's height

(1-13) Set AF window for Touch AF

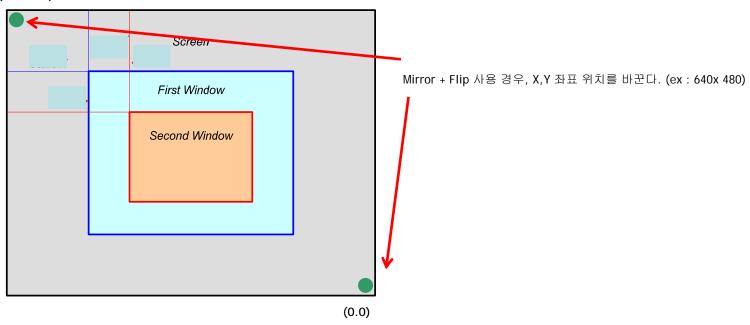
(0.479)



Parameter Name (4EC EVT1.1)	Description
FstWinStartX [0x7000 0294]	First window's start X position
FstWinStartY [0x7000 0296]	First window's start Y position
FstWinSizeX [0x7000 0298]	First window's width
FstWinSizeY [0x7000 029A]	First window's height
ScndWinStartX [0x7000 029C]	Second window's start X position
ScndWinStartY [0x7000 029E]	Second window's start Y position
ScndWinSizeX [0x7000 02A0]	Second window's width
ScndWinSizeY [0x7000 02A2]	Second window's height
WinSizesUpdated [0x7000 02A4]	If this parameter is set to 1, AF window size is updated.

(1-14) Set AF window for Touch AF

(639.479)



Parameter Name (4EC EVT1.1)	Description
FstWinStartX [0x7000 0294]	First window's start X position
FstWinStartY [0x7000 0296]	First window's start Y position
FstWinSizeX [0x7000 0298]	First window's width
FstWinSizeY [0x7000 029A]	First window's height
ScndWinStartX [0x7000 029C]	Second window's start X position
ScndWinStartY [0x7000 029E]	Second window's start Y position
ScndWinSizeX [0x7000 02A0]	Second window's width
ScndWinSizeY [0x7000 02A2]	Second window's height
WinSizesUpdated [0x7000 02A4]	If this parameter is set to 1, AF window size is updated.

(2) AF status sequence (1st + 2nd searching)

Example Frame rate base: 10 fps This is Option. User can set AF window **Set AF window** when user want to change AF window or size by Screen touch. 1 frame delay (ex: 100ms, low light 10fps) If set AF window is skipped the 1 frame delay is no need. **Polling** s5k4ecgx_AE_Lock_On AF start (Recheck) s5k4ecgx Single AF Start Read [70002EEE, usStatus] 2frame delay(ex: 200ms, low light 10fps) to check 1st search finish. Read [7000 2EEE, usStatus] to check 1st search finish or not. [7000 2EEE]: 0001h, 1st AF 1st AF [7000 2EEE]: 0000h, 0003h, 0004h, 0006h, 0008h low conf after 1st search Fail & Finish progress searching Host should be read AF Success? status register after 1frame delay when host Success: 1st Search Finish recheck AF status register [7000 2EEE]: 0002h, AF success 1frame delay(ex: 100ms, low light 10fps) Polling (Recheck) [7000 2207]: 01xxh, Not search finish finish? Host should be read AF status register after **Success & Finish** 1frame delay when host Host: AF fail [7000 2207]: 00xxh, finish (Lower byte is garbage) recheck AF 2nd search message status register 4EC F/W move lens to 2nd search Max log position Host: AF success message



(3) AF Functions

```
s5k4ecgx_Single_AF_Start

* Start AF searching (Command for lens moving)
{
  s00287000
  s002A028C
  s0F120005 //REG_TC_AF_AfCmd = 5, single AF
}
```

AE lock on

```
s5k4ecgx_AE_Lock_On

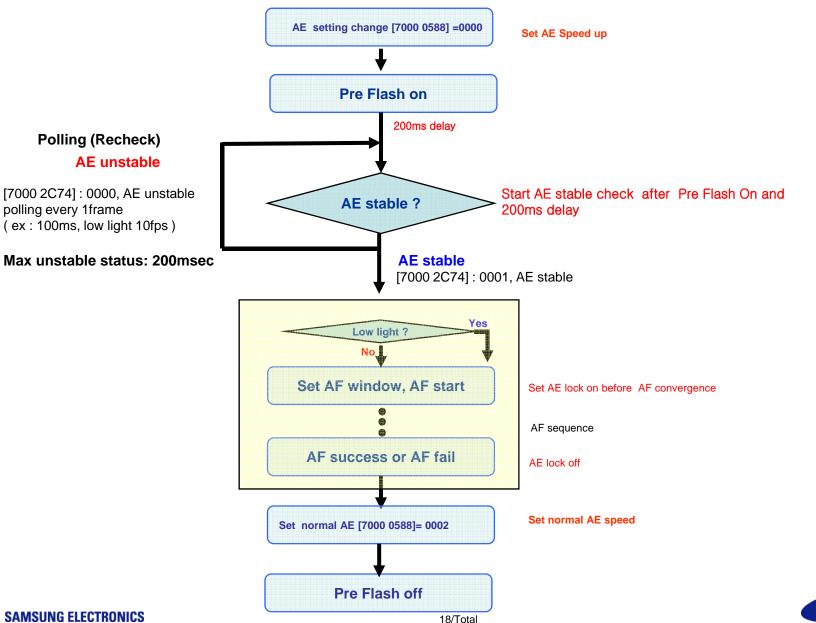
•AE lock on should be done before AF commands

• Remove AWB lock on/off
{
    s00287000
    s002A2C5E // /* AE Lock On */
    s0F120000
}
```

AE lock off



(4) AF sequence under flash on case





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