#### [4EC] LSC and AWB Module Calibration manual

## **Technical Report**

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#### Module Cal. procedure summary







#### Setup and getting a raw data





#### **Calculating and Writing OTP data**





#### Verifying OTP data and Cal. result





#### **Appendix) 1. Setting light source**



TN recommended light source : Manufacturer : YOUTHTECH Korea. Model : MLS-290X224-4C 4channel LED light box.

Adjust 3000K(+-100K) and 5100K(+-200K) to 4000Lux(+-200Lux)



### Appendix) 2. Raw data capture condition



Condition:

Capture 5100K and 3100K.

Gr max value in image center must be 50% of full code (128code/256max)

Image format : Gr first, 10bit SOC raw 2592\*1944.

Use Raw data mode setting from S.LSI, Get 5100K and 3000K image. And save it for examples Cal01\_3000K.raw and Cal01\_5100K.raw

## Appendix) 3. Making reference AWB tuning value

This procedure is just run only 1 time for setting up Calibration system. Or you already have reference AWB value, this step can be skipped.

- 1. Prepare 5 typical module and Capture 5100K and 3000K raw data.(Refer to Appendix 1,2)
- 2. Check "Reference module", Click "Set Parameter" and Click "Run0".
- 3. Open Captured 3000K and 5100K image.
- 4. Calculated value update automatically in dialog box.
- 5. Repeat 5 module and average this value.
- 6. Use this average value for reference AWB tuning parameter.

		ExlSC(S5K4ECGX)
ExLSC(S5K4ECGX)	3.	LSC AWB DLL Program
Gr 00 H 00 B 80 Gb 80 AWB tunning 3200K R 866 3200K B 350 5100K R 627 5100K B 508 ✓ Reference module 2. Run0	▲ III → IIII → III → IIII → IIIII → IIII → IIII → IIII → IIIIII	4         B         00         00         00         00           AUR
Set Parameters Run1		

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#### Appendix) 4. Calculating calibration data.

ExLSC(S5K4ECGX)		This AWE
Image Size Width 2592 Height	1944	OTP
Channel Gain  Channel Gain  Gr  B  B  B  Channel Gain  B  Channel Gain  Channel Gain  B  Channel Gain B	80	SKA
AWB tunning 3200K R 757 3200K B 5100K R 574 5100K B Reference module	384 489	1. I 2. ( 3. /
Set Parameters		S
Open raw image (Color Temp. : 3200K)		<u> </u>
E Upto: CHL	수정한 날짜 2010-10-27 오후 5:. 2010-10-27 오후 6:. 2010-10-27 오후 6:. 2010-10-27 오후 6:. 2010-10-27 오후 5:.	유형 파일 폴더 RAW 파일 RAW 파일 RAW 파일 RAW 파일
파일 이름(N): 파일 형식(T): Raw Files(*,raw)	<b>_</b>	열기( <u>0</u> ) 취소
Save OTP SetFile		
지장 위치(!): 🔒 CAL	_ ← 🗈 🛍	* Ⅲ▼ 유형
<b>3.</b>	2010-10-27 오후 5	 파일 폴더
		TITI(-)
파일 형식( <u>T</u> ): CalULOTP 파일 형식( <u>T</u> ): Set Files(+,set)	<b>•</b>	<u>세상(S)</u> 취소

This is for getting LSC calibration data, Shading Alpha value and AWB calibration data.

OTP data would be written to module for calibration. SRAM data is Shading value for Simmian debugging.

- 1. Input AWB reference value that gotten in Appendix 3.
- 2. Open Captured 3000K and 5100K image.
- 3. Automatically calculated, Save OTP value ex) Cal01\_OTP.set and save SRAM data ex) Cal01\_SRAM.set

#### Calculated OTP data detail @ Appendix 5 Calculated SRAM data

	and the second se					EVICO		×
A.	WRITE D0000012 0001 WRITE D000007A 0000					EXLOC		
	WRITE DODGADAC 00FC WRITE DODGAD52 0145 WRITE DODGAD58 0108							
	WRITE DODCAGOD 0004 WRITE DODCAGE2 4000 WRITE DODCAGE2 0000 WRITE DODCAGE2 0000					1 🔺	// TVAR_ash_p s00287000	GAS_high
	WRITE DOODADO6 BEDAECHIFEF datu) p100 //waiting time	F90220246A1FC1380F98DDF6C25	0F60648C9F00CE802A55227C032F40F	HSEO91294E9302ACFFFC640F8055D635068DEFFC	80701874410A050240 /// (64byte		s002A0D26	
	WRITE DOODAD02 0001 WRITE DOODAD06 FE21809A8C0 data	0402FF2AE0FCC05073161CE2FC33	3001256FCD968F020CDC4FFF0850818	N28D4FEF03FF83CAF56AFE8A303CWFFF6CE05E5	2906032550P966204D /// (64byte		s0F120F00	
	p100 //waiting time						s0F12000F	
	WRITE DODGADG2 0002 WRITE DODGADG6 FC582401864 data)	WHECODISDESE16D06ABHHE1EI0	C0FA31D40292DFFE97E09E920BF0FF26	R0FDEB80A8/A2886/C3310011EDF48/CA5750821	#1393006803F1AFC /// (64byte		s0F12000F	
	ptoo //waeing time						SUFIZUFUF	
	WRITE DOOGAOO6 2200F8381F0	0EA4F03103C40F01CC002AC70A6F	041270FBC9505815461501C96FF83D3	FFDE4F82404D08FFC8CFDCBA8450805E84FFFELD	5185F66C02F85FFC50 /// _ (64byte		SOF120F00	
	p100 //waiting time						s0F120000	
	WRITE D000A002 0004 WRITE D000A006 5088E518079 data)	1E2680006A8F3080C81708E57FFE	EBOAS354080FC1810FB284FBFD9E77C	03C46F0067808173159F032190FA5F8008004D81	00CATVFDDESF271DED /// _ (64byte		s0F120000	
	p100 //waiting time						s0F12000F	
	WRITE DODGA002 0005 WRITE DODGA006 F4048EBFFEE	63087302DE1030770FE869080660	6FDFF1870FDF2F0315D0FC3FD2C2000	5E0FC2A18C000000000000000000000000000000000000	00000000000000000000000000000000000000		s0F120F00	
	WRITE DODGADD2 0007						s0F120F0F	
	WHITE DODDADDG G41A6762555 //coef_R_//coef_B_/	s779ecococococococococococococococococococo	00000000000000000000000000000000000000	000000000000000000000000000000000000000	000000000000000000000000000000000000000		s0F120F00	
	p100 //waiting time						s0F12000F	
	WRITE DOOGADOO DOOA	//interface enable off					s0F120000	
	WRITE D000A062 0100 1207k 8	//write mode disable					s0F12000F	
					- R2			SAMSU
_		0				-		

#### Appendix) 5. Calibration data (OTP,SRAM)

OTP data would be written directly to OTP area in module. SRAM data is Shading value for Simmian debugging.

XX OTP.set YM CELER YM CELER CYM CELER CYM CELER CYM CELER CHYFR A HYC CLER CHYFr Hyn Chyfrae h yr fryn celer Chyfrae hyfr WRITE D0000012 0001 WRITE D000007A 0000 WRITE D000A04C 00FC WRITE D000A052 0145 WRITE D000A058 0108 WRITE D000A000 0004 LSC data WRITE D000A062 4000 WRITE D000A002 0000 WRITE D000A000 0003 WRITE D000A006 320709D0FD0210A5973B54FD0710FF5E6F6BDFD85F03CA5F017B4043D311F1FE2C30FC47605427316F00CB2F013EDFF829DB4102E82FFEFDE0F4DA3516FF12A0 /// .... (64byte data) p100 //waiting time WRITE D000A002 0001 WRITE D000A006 0015CF77DEF3B2FFF8BFF8B80DF44004CFE1700017ECF1E9FE7FB070880FDB8307E5B3D7CFD03A0FFF7DF69B1CEF403C5FF015B60206E1982FE3220FCFE8019>/// .... (64byte data) p100 //waiting time WRITE D000A002 0002 WRITE D000A006 EC360D00C80F029D3FE349DCDE01E1FF00F60007733230FE0A900155A01911000BFE004000D4E04AF207DEFD0F70021F1F1977E32B0707D0FD2B20988F3B86FD>/// .... (64byte data) pl00 //waiting time WRITE D000A002 0003 WRITE D000A006 0450FF148F0E70DA9203C4DF013FA098480F01002790FCCD20C98F27DF00C81F00324FA548E13901FB6FFE0C9028F73E13000BD001E91F281CEFEAFFED3FFF60>/// .... (64byte data) p100 //waiting time WRITE D000A002 0004 WRITE D000A006 F07926034AFE10E001FBFF4186F065070570FD2EC0E8E534D8FD0230FF42EF5546DDD402D69F000C60B99A1361FF2270FD7BC0474E238100D3EF01C2AFCA7DE3>/// .... (64byte data) p100 //waiting time WRITE D000A002 0005 p100 //waiting time WRITE D000A002 0007 //coef R> //coef B> //const R>//const B>//const R H>//const B H p100 //waiting time

WRITE\_D000A000\_0004>> //interface\_enable\_off
WRITE\_D000A000\_0000>> //interface\_enable\_off
WRITE\_D000A062\_0100>> //write\_mode\_disable

AWB data





#### Appendix) 6. OTP related setting in Init set file.

Each OTP function(Shading, AWB, Alpha) can be on and off.

This is example for module calibration. All OTP function is off.

This is example for real project. Use OTP function(Shading, AWB, not Alpha function).

// OTP setting				
s002A0722 s0F120100	//skl OTP usWaitTime This reg should be in fornt of D0001000			
s002A0726				
s0F120001	//skl_bUseOTPfunc OTP shading is used,this reg should be 1 //			
s002A08D8 s0F120001	//ash bUseOTPData OTP shading is used, this reg should be 1 //			
s002A146E	_			
s0F120000	//awbb_otp_disable OTP AWB (0: use AWB Cal.) //			
s0F120000	//ash_bUseGasAlphaOTP OTP alpha is used, this reg should be 1			



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#### Appendix) 7. OTP Write and Read method

This is example that you want to Write 64 byte data to Page 0 of OTP

WRITE D0000012 0001 WRITE D000007A 0000

// S/W core reset // Clock enable to control block

// make initial state

WRITE D000A04C 00FC	// set EXTCLK 24Mhz
WRITE D000A052 0145	// set EXTCLK 24Mhz
WRITE D000A058 0108	// set EXTCLK 24Mhz

WRITE D000A000 0004 WRITE D000A062 4000 bit) WRITE D000A002 0000 WRITE D000A000 0003

// set PAGE 0 of OTP ( 0<=PAGE<=F)
// set write mode</pre>

// repeat write enable (main & redundancy



WRITE D000A006 8E0AEC....(max 64 byte) p100 //waiting time

WRITE D000A000 0004// interface enable offWRITE D000A000 0000// interface enable offWRITE D000A062 0100// write mode disable

#### This is example that you want to Read data to Page 0 of OTP

WRITE D0000012 0001 WRITE D000007A 0000 // S/W core reset // Clock enable to control block

WRITE D000A000 0004 WRITE D000A002 0000 WRITE D000A000 0001 p100 //waiting time // make initial state
// set PAGE 0 of OTP ( 0<=PAGE<=F)
// set Read mode</pre>

READ D000A006 READ D000A008

••••

WRITE D000A000 0004 WRITE D000A000 0000 SAMSUNG ELECTRONICS //interface enable off //interface enable off



#### Appendix) 8. OTP MAP

This is OTP Map. Page 6,A,B,C,D can use freely user site.





# LSC and AWB Module Calibration manual for Alternative Supplier.

#### Module Cal. procedure summary







## **Getting reference AWB data**

If you have first vendor's module (OTP written), you can estimated reference AWB value and can match your new light source box without difference from original module.

- 1. Prepare original module and Capture 5100K and 3000K raw data.(Refer to Appendix 1,2)
- 2. Using Image analysis tools, get center 100x100 's R,G,B average code.
- 3. Input RGB codes in attached excel sheet.
- 4. Read OTP's AWB coefficient data. 7Page D000.A006~A010. Refer to Appendix 7.
- 5. Input coefficient data to excel sheet.
- 6. Use calculated value, input to LSC tool.



ExLSC(S5K4ECGX)	X			
LSC AWB DLL Program				
☐ Simulated Results	Pedestal 0			
Width 2592	Height 1944			
Channel Gain				
Gr 80	R 80			
<b>6.</b> в 80	Gb 80			
- AWB tunning				
3200K R 757	3200K B 384			
5100K R 574	5100K B 489			
Set Parameters	Run0			



ESTIMATION

#### **Setting AWB set file**

You can change Sensor AWB point with OTP's AWB data.

- 1. Copy OTP.set's AWB data to attached excel sheet.
- 2. Copy #2's data to attached AWB\_Reset.nset



			-1 -			
	Const_H 2	값이 0000 인	경우			
						2 //> AWB_module_variation_parameter>
		OTP value			최종값	UDITE 20002553 9646 //#War AWR MadulaWar Cooff
	Const_R	DFA9	-8279	FFFFFFBF6	FBF6	WRITE 7000255C FBF6 //#Mon AWB ModuleVar ConstR
	Const B	F689	-6519	FFFFFFCD2	FCD2	WRITE 7000255E 868A //#Mon_AWB_ModuleVar_CoefB
	001101_0	2000				WRITE 70002560 FCD2 //#Mon_AWB_ModuleVar_ConstB
1	8C46868A	DFA9E68900	000000			//> AWB Reset sequence>
	8C46		8C46		//coef_R	
	868A		868A		//coef_B	WRITE_7000145A_00F4>//AWB_Reset_mode_on>> > //#awbb_Use_Filters
	DFA9		FBF6		//const_R	p100> > //_after_1_frame
	E689		FCD2		//const_B	WRITE 700004E6 07775//AWB disabless s s //#REG TC DBG AutoAlgEnBits
	0000				//const_R_H	
	0000				//const_B_H	p100> > //_after_1_frame
$\bigcirc$						WRITE_700004E6_077F>//AWB_enable> > > > > //#REG_TC_DBG_AutoAlgEnBits
4	WRITE 7000255A 8C46 //#Mon_AWB_ModuleVar_CoetR			Ion_AWB_Module\	/ar_CoefR	-100
	WRITE 7000255C FBF6 //#Mon_AWB_ModuleVar_ConstR			lon_AWB_ModuleV	/ar_ConstR	pioo
	WRITE 7000255E 868A //#Mon_AWB_ModuleVar_CoefB				/ar_CoefB	WRITE 7000145A 0074>//AWB Reset mode off> > //#awbb Use Filters
	WRITE 700	002560 FCD2	? //#N	1on_AWB_Module\	/ar_ConstB	
		1	1	1		



### **Check AWB/MWB and Modify AWB value**

Check AWB and MWB test, verify that reference AWB data is proper or not.

- 1. Upload Initial setting and AWB\_Reset.net
- 2. Check AWB is proper or not.
- 3. Upload MWB setting.
- 4. Check MWB is proper or not.
- 5. If all test is OK, you can use this reference AWB value for OTP calibration.

If you have AWB and MWB Spec out. You must change reference AWB point.

- 1. If D65 light spec out.(MWB Daylight, Cloudy) First, Check R,B code and adjust 5100K's R,B AWB points.
- 2. If CW light spec out. (MWB Tungsten, Flourescent) First, Check R,B code and adjust 3000K's R,B AWB points.
- 3. Set new AWB\_Reset.nset with adjusted reference AWB value.
- 4. Repeat check sequence until you get a good data.

