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RENESAS

Application Note

Multimedia Processor for Mobile Applications

Image Composer

EMMA Mobile1

Document No. S19906EJ1V0AN00
Date Published Aug. 2009

PREFACE

Purpose

The purpose of this document is to specify the usage of EMMA Mobile1 image composer (IMC).

Organization

This document includes the following:

- Introduction
- Usage of Image Composer
- Example of Image Composer Operation
- IMC Driver Function

Notation

Here explains the meaning of following words in text:

Note	Explanation of item indicated in the text
Caution	Information to which user should afford special attention
Remark	Supplementary information

Related document

The following tables list related documents.

Reference Document

Document Name	Version/date	Author	Description
S19265EJ1V0UM00_ASMUGIO.pdf	1st Edition	NECEL	SMU&GPIO user's manual
S19268EJ1V0UM00_1chip.pdf	1st Edition	NECEL	1 chip user's manual
S19263EJ1V0UM00_IMC.pdf	1st Edition	NECEL	IMC user's manual
S19907EJ1V0AN00_GD.pdf	1st Edition	NECEL	GD Spec

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Chapter 1 Introduction

1.1 Outline

This document will show users how to operate image composer (IMC) on EMMA Mobile1 evaluation board.

1.2 Development Environment

- Hardware environment of this project is listed as below.

Table 1-1 Hardware Environment

Name	Version	Maker
EMMA Mobile 1 evaluation board (PSKCH2Y-S-0016-01)	-	NEC Electronics
PARTNER-Jet ICE ARM	M20	Kyoto Microcomputer Co. Ltd

- Software used in this project is listed as below.

Table 1-2 Software Environment

Name	Version	Maker
GNUARM Toolchain	V4.3.2	GNU
WJETSET-ARM	V5.10a	Kyoto Microcomputer Co. Ltd

Chapter 2 Usage of Image Composer

The function block diagram of IMC can be show by the following figure:

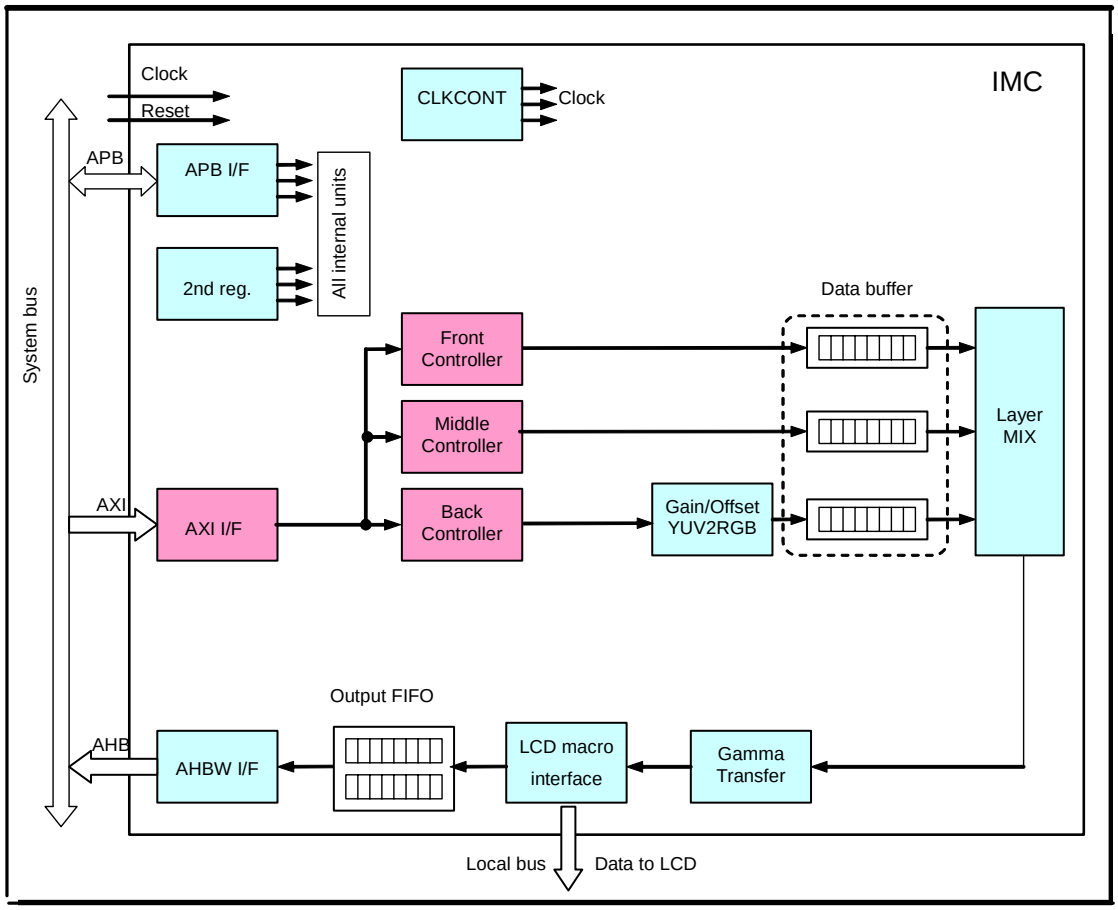

Figure 2-1 Function Block Diagram for IMC

According to the IMC feature, the EMMA Mobile 1 IMC including following function:

1. YUV-RGB conversion, dithering, gain offset
2. Overlay function
3. Gamma adjustment

The IMC operation flow chart can be shown as the following:

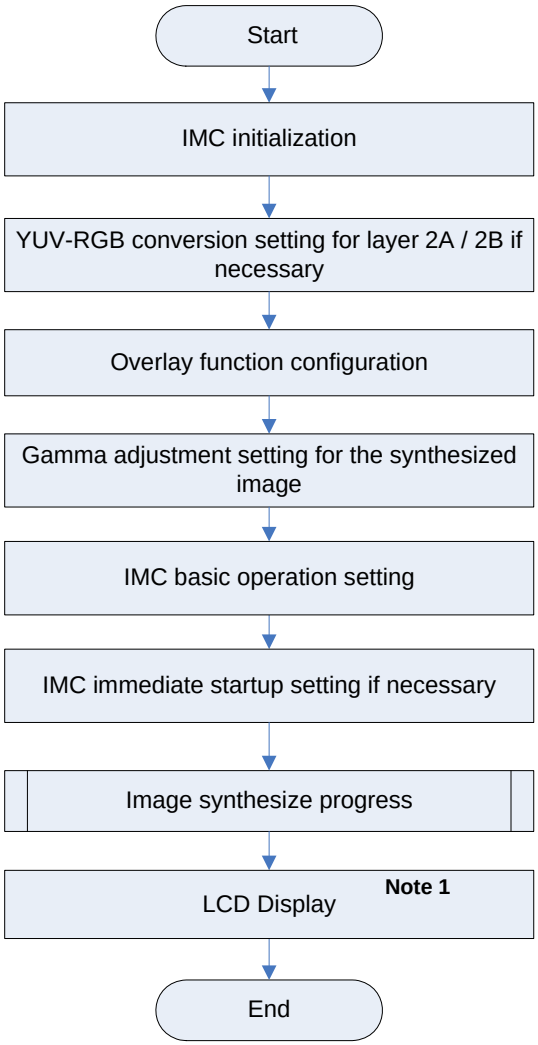

Figure 2-2 IMC Operation Flow Chart

Note:

1）LCD display mode configuration should matching with IMC startup mode, their configuration relationship is as follows:

No.	IMC	LCD
1	LCD-synchronous (IMC_CONTROL[0] = 0)	Local bus without WB (LCD_BUFSEL = 0) Local bus + WB (LCD_BUFSEL = 2 or 3)
2	Immediate startup mode (IMC_CONTROL[0] = 1)	Direct path display (LCD_BUFSEL = 1)

2) “IMC initialization” including clock setting and reset operation.

3) “IMC basic operation setting” including the IMC_CONTROL register setting and IMC update register (IMC_REFRESH) operation.

4) “IMC immediate startup setting” includes following steps:

Step1: WB function related setting

IMC_WB_AREAADR

IMC_WB_HOFFSET

IMC_WB_FORMAT

IMC_WB_SIZE

Step2: Startup register setting

IMC_START

5) Details about the YUV-RGB conversion, overlay function and gamma adjustment operation please refer to the following chapters.

More details about the IMC registers please refer to the EMMA Mobile 1 IMC user's manual.

2.1 YUV-RGB Conversion, Dithering, Gain Offset

The YUV-RGB conversion function only used for the layer 2A and 2B, and the feature of “YUV-RGB conversion, dithering, gain offset” are as follows:

1. Gain and offset can be adjusted for YUV components, use following function:

$$Yout = (\frac{YGAIN}{128} * Yin) + YOFFSET$$

$$Uout = \left(\frac{UGAIN}{128} * (Uin - 80H)\right) + UOFFSET + 80H$$

$$Vout = \left(\frac{VGAIN}{128} * (Vin - 80H)\right) + VOFFSET + 80H$$

Gain (YGAIN, UGAIN, VGAIN) range: -128 to 127
Offset (YOFFSET, UOFFSET, VOFFSET) range: 0 to 255

2.When the input data format is YUV, RGB conversion can be performed with two types of standard coefficients, at the same, user can also can set the conversion coefficient if select custom coefficient converse mode.

3. Dithering by using 2 × 2 matrix upon subtracting colors for converting images into RGB666

2.1.1 Operation Flow

The conversion sequence can be show as the following steps:

Step1: Gain/offset adjustment (8-bit accuracy before and after adjustment)
Step2: YUV-to-RGB conversion (8-bit accuracy before and after adjustment)
Step3: Convert into RGB666 by dithering (Can be turned off)

Following figure shows the operation flow of YUV-RGB conversion.

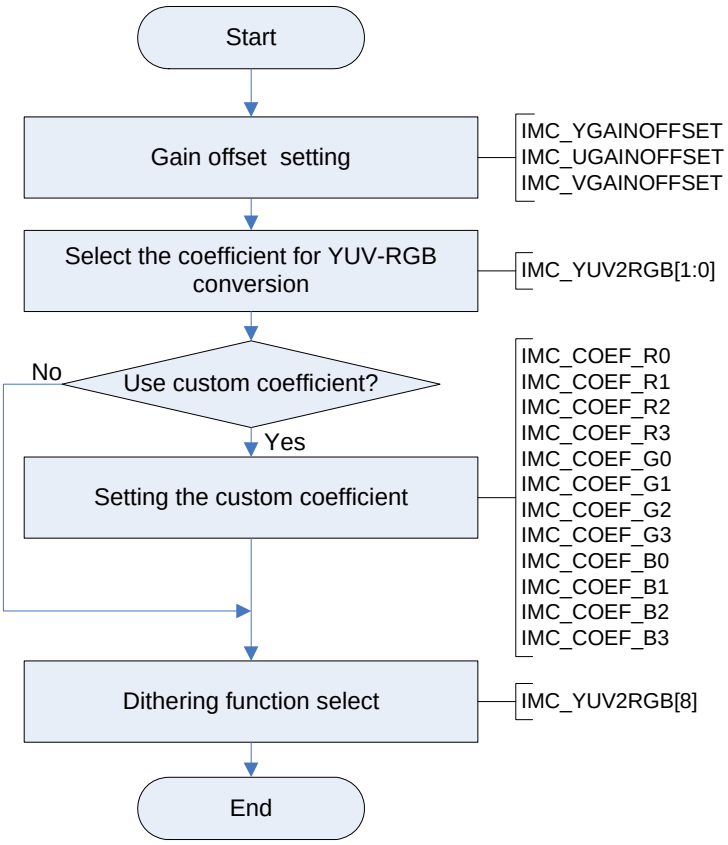

Figure 2-3 YUV-RGB Conversion Operation Flow

More details about YUV-RGB conversion rules please refer to "**3.1.2 Conversion rule**" of the EMMA Mobile 1 IMC user's manual.

2.1.2 Operation Details

(1) Gain Offset Setting

The gain and offset of YUV format data can be adjusted in the range from 0 to *255/*128. More details about gain offset adjustment please refer to "**3.1.3 Gain and offset adjustment**" of the EMMA Mobile 1 IMC user's manual.

Register list:

IMC_YGAINOFFSET
IMC_UGAINOFFSET
IMC_VGAINOFFSET

(2) Select the Coefficient for YUV-RGB Conversion

Select coefficient for YUV-RGB conversion, more details about conversion please refer to "**3.1.4 YUV-to-RGB conversion**" of the EMMA Mobile 1 IMC user's manual.

Register list:

IMC_YUV2RGB[1:0] (select the coefficient for YUV-RGB conversion)

(3) Custom Coefficient Setting

If the bit[1:0] value of IMC_YUV2RGB is 2 or 3, custom coefficient need to be set.

Register list:

IMC_COEF_R0
IMC_COEF_R1
IMC_COEF_R2
IMC_COEF_R3
IMC_COEF_G0
IMC_COEF_G1
IMC_COEF_G2
IMC_COEF_G3
IMC_COEF_B0
IMC_COEF_B1
IMC_COEF_B2
IMC_COEF_B3

(4) Dithering Function Setting

Dithering function is a method of pseudo tone processing. More details about conversion please refer to "**3.1.5 Dithering**" of the EMMA Mobile 1 IMC user's manual.

Register list:

IMC_YUV2RGB[8] (1: performs dithering; 0: does not perform dithering).

2.2 Overlay Function

The feature of “overlay function” is as follows:

1. Up to four layers can be synthesized.
2. Position and size of each plane can be set flexibly.
3. Each layer can be defined independently in formatting, mirror flipping, resizing, double buffering and gain/offset adjustment. (Whether this function is supported varies in each layer.)
4. Transparent color and alpha blending can be used for the two front layers.

2.2.1 Operation Flow

Following figure shows the flow chart of IMC overlay operation

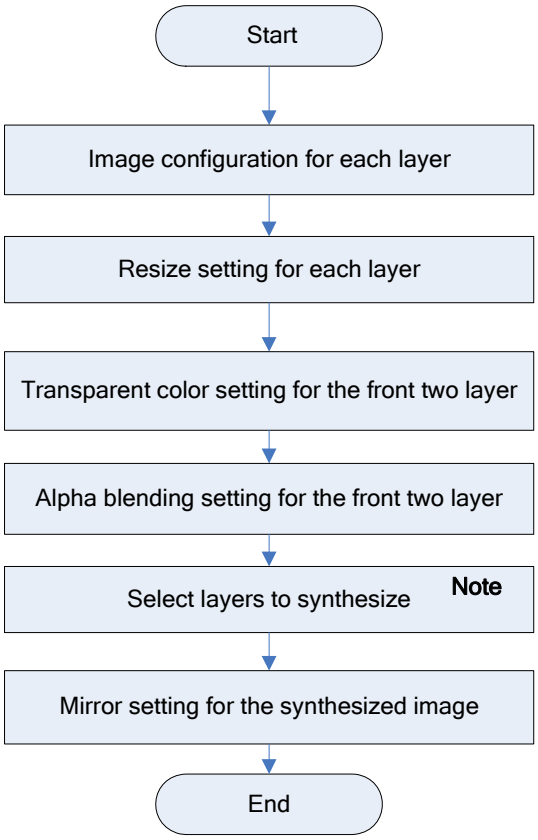

Figure 2-4 Overlay Operation

More details about the functions used in this example please refer to “**APPENDIX A IMC Driver Function**”

Note:

1) Max. four layers can be synthesized.

2.2.2 Operation Detail

(1) Image Configuration for Each Layer

Configure parameters including: image format, address addition value, buffer start address, position, size etc.

Step1: layer format registers setting.

Register list:

IMC_L0_FORMAT (support RGB565, RGB666)

IMC_L1X_FORMAT(support RGB565, RGB666)

IMC_L2A_FORMAT(support RGB565, RGB666, YUV422, YUV420)

IMC_L2B_FORMAT(support RGB565, RGB666, YUV422, YUV420)

IMC_BG_ FORMAT(support RGB565, RGB666)

Note:

YUV422 including three storage methods: pixel interleave, semi-planer, planer.

YUV420 including two storage methods: semi-planer, planer.

More details about each storage method for YUV422 and YUV420 please refer to “1.2 Feature” of EMMA Mobile 1 IMC user’s manual.

Step2: Address addition value registers setting.

Register list:

IMC_L0_OFFSET

IMC_L1X_OFFSET

IMC_L2A_OFFSET

IMC_L2B_OFFSET

IMC_BG_OFFSET

Note:

When the input format is RGB565: IMC_X_HOFFSET ≥ SIZEX *16/8

When the input format is RGB666: IMC_X_HOFFSET ≥ SIZEX*18/8

When the input format is YUV422 interleave: IMC_X_HOFFSET ≥ SIZEX*2

When the input format is Semi-planer or planer in YUV422/ YUV420 mode: IMC_X_HOFFSET ≥ SIZEX

Here SIZEX means the horizontal length of the image; IMC_X_HOFFSET means the address addition value register for each layer.

Setp3: Buffer start address registers setting.

Register list:

IMC_L0_FRAMEADR

IMC_L1A_FRAMEADR

IMC_L1B_FRAMEADR

IMC_L1C_FRAMEADR

IMC_L2A_FRAMEADR_YP

IMC_L2A_FRAMEADR_UP

IMC_L2A_FRAMEADR_VP

IMC_L2A_FRAMEADR_YQ

IMC_L2A_FRAMEADR_UQ

IMC_L2A_FRAMEADR_VQ

IMC_L2B_FRAMEADR_YP

IMC_L2B_FRAMEADR_UP

IMC_L2B_FRAMEADR_VP

IMC_L2B_FRAMEADR_YQ

IMC_L2B_FRAMEADR_UQ

IMC_L2B_FRAMEADR_VQ

IMC_BG_FRAMEADR

Step4: Layer display position registers setting.

Register list:

IMC_L0_POSITION

IMC_L1A_POSITION

IMC_L1B_POSITION

IMC_L1C_POSITION

IMC_L2A_POSITION

IMC_L2B_POSITION

Step5: Layer display size registers setting

Register list:

IMC_L0_SIZE

IMC_L1A_SIZE

IMC_L1B_SIZE

IMC_L1C_SIZE

IMC_L2A_SIZE

IMC_L2B_SIZE

Note:

If the configure layer is layer2A or layer 2B, then the following configuration also need to be added.

1. Layer 2 double buffer control registers setting

Register list:

IMC_L2A_BUFSEL

IMC_L2B_BUFSEL

IMC_CPUBUFSEL (when layer 2A/2B not controls individually, use CPU to control

buffer selection)

2. Layer 2 byte lane registers setting

Register list:

IMC_L2A_BYTELANE

IMC_L2B_BYTELANE

3. Layer 2 horizontal/vertical flip control registers setting.

Register list:

IMC_L2A_MIRROR

IMC_L2B_MIRROR

(2) Resize Setting for Each Layer

Register list:

IMC_L0_RESIZE

IMC_L1X_ RESIZE

IMC_L2A_RESIZE

IMC_L2B_ RESIZE

IMC_BG_ RESIZE

(3) Transparent Color Setting for the Front Two Layers

Setting whether to enable the transparent color function, at the same time, define which color to be transparent, this function only used in the front and middle controller.

Register list:

IMC_L0_KEYENABLE

IMC_L1A_KEYENABLE

IMC_L1B_KEYENABLE

IMC_L1C_KEYENABLE

IMC_L0_KEYCOLOR

IMC_L1X_KEYCOLOR

(4) Alpha Blending Setting for the Front Two Layers

Register list:

IMC_L0_ALPHA

IMC_L1A_ ALPHA

IMC_L1B_ ALPHA

IMC_L1C_ ALPHA

(5) Select Layers to Synthesis

Select the layers to be synthesized.

Register list:

IMC_L0_CONTROL

IMC_L1A_CONTROL

IMC_L1B_CONTROL

IMC_L1C_CONTROL
IMC_L2A_CONTROL
IMC_L2B_CONTROL

(6) Mirror setting for the synthesized image

Register list:

IMC_MIRROR

2.3 Gamma Adjustment

Gamma adjustment used for the synthesized image, after gamma adjustment, image data can be displayed in LCD panel.

2.3.1 Operation Flow

Following figure shows the flow chart of IMC gamma operation

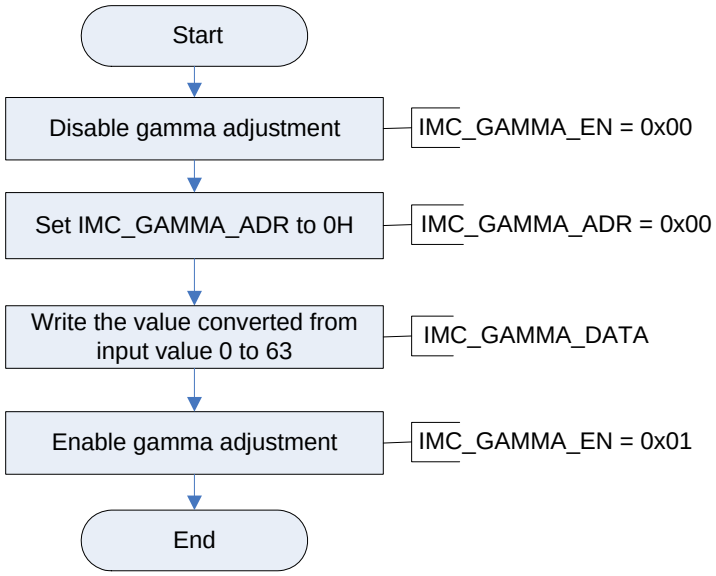

Figure 2-5 Gamma Adjustment Operation Flow

2.3.2 Operation Details

(1) Disable Gamma Adjustment

Setting gamma registers during IMC gamma adjustment operation is prohibited, so disable gamma adjustment should be execute at first.

IMC_GAMMA_EN = 0x00 (disable gamma adjustment)

(2) Setting IMC_GAMMA_ADR

Set IMC_GAMMA_ADR to 0H, and the value of IMC_GAMMA_ADR will automatically incremented when write value to IMC_GAMMA_DATA.

IMC_GAMMA_ADR = 0x00 (gamma table start address)

(3) Write Values to IMC_GAMMA_DATA

Write all the values converted from input values 0 to 63 to IMC_GAMMA_DATA.

Register list:

IMC_GAMMA_DATA

(4) Enable Gamma Adjustment

After writing value to all the gamma tables, enable the gamma adjustment by setting IMC_GAMMA_EN to 1.

IMC_GAMMA_EN = 0x01 (enable gamma adjustment)

Chapter 3 Example of Image Composer Operation

3.1 Outline of Image Composer Operation

This chapter will show users how to deal with image data via EMMA Mobile 1 image composer. After the image composer, image will be shown in the LCD panel (NL8048HL11-01B); more details about the LCD controller and LCD panel operation please refer to the LCD controller application note.

The image parameters used in this example are specified as below:

Table 3-1 Parameters of IMC Example

Parameter	Original Image						
	Layer 0	**Layer 1A**	**Layer 1B**	**Layer 1C**	**Layer 2A**	**Layer 2B**	**Layer BG**
Data format	RGB565	RGB565	RGB565	RGB565	YUV422 interleave	YUV422 interleave	Fixed color by LCDC defined
Address addition value	168*2	100*2	100*2	100*2	100*2	560*2	--
Buffer start address	0x31000000	0x31010D10	0x31015B30	0x3101A950	0x3101F770	0x31024590	--
Display position	X: 270 Y: 140	X: 40 Y: 0	X: 250 Y: 0	X: 660 Y: 0	X: 400 Y: 230	X: 100 Y: 430	--
Display size	X: 168 Y: 205	X: 100 Y: 100	X: 100 Y: 100	X: 100 Y: 100	X: 100 Y: 100	X: 560 Y: 46	--
Buffer control for L2	-	-	-	-	Control via CPU	Control via CPU	-
Byte lane for L2	-	-	-	-	0x0000E4E4	0x0000E4E4	-
Mirror control for L2	-	-	-	-	No flip	No flip	-

Following figures are original images before synthesize:

Figure 3-1 Layer 0 Image

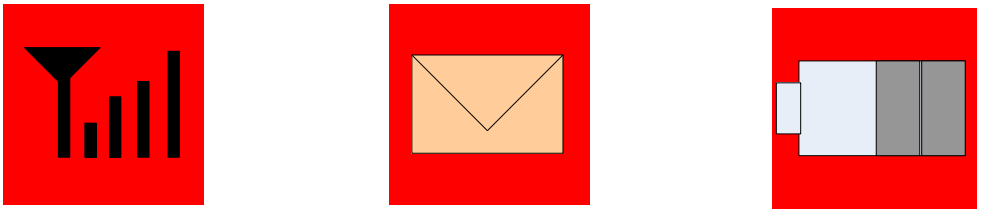

Figure 3-2 Layer 1A/1B/1C Image

Figure 3-3 Layer 2A Image

Figure 3-4 Layer 2B Image

One of synthesized image can be show as figure 3-5, the setting is as follows:

- Alpha blending (layer 0 and 1A/1B/1C are all opaque)
- Transparent color (transparent color for layer 0 is blue, for layer 1X is red)
- Resize: no
- Mirror: no
- Layer to be show: Layer 0, layer 1A, 1B and 1C, layer 2A and 2B, layer BG
- Gamma adjustment: no
- Gain offset for layer 2A and 2B: no offset, use default value for gain setting

Figure 3-5 Synthesized Image

In this example, gamma adjustment function can be used for the synthesized image, Gamma data can be shown in the table 3-2.

Table 3-2 Gamma Table

Input value	Output value			Input value	Output value		
	R	G	B		R	G	B
0	0	1	20	**32**	32	33	52
1	1	2	21	**33**	33	34	53
2	2	3	22	**34**	34	35	54
3	3	4	23	**35**	35	36	55
4	4	5	24	**36**	36	37	56
5	5	6	25	**37**	37	38	57
6	6	7	26	**38**	38	39	58
7	7	8	27	**39**	39	40	59
8	8	9	28	**40**	40	41	60
9	9	10	29	**41**	41	42	61
10	10	11	30	**42**	42	43	62
11	11	12	31	**43**	43	44	63
12	12	13	32	**44**	44	45	0
13	13	14	33	**45**	45	46	1
14	14	15	34	**46**	46	47	2
15	15	16	35	**47**	47	48	3
16	16	17	36	**48**	48	49	4
17	17	18	37	**49**	49	50	5
18	18	19	38	**50**	50	51	6
19	19	20	39	**51**	51	52	7
20	20	21	40	**52**	52	53	8
21	21	22	41	**53**	53	54	9
22	22	23	42	**54**	54	55	10
23	23	24	43	**55**	55	56	11
24	24	25	44	**56**	56	57	12
25	25	26	45	**57**	57	58	13
26	26	27	46	**58**	58	59	14
27	27	28	47	**59**	59	60	15
28	28	29	48	**60**	60	61	16
29	29	30	49	**61**	61	62	17
30	30	31	50	**62**	62	63	18
31	31	32	51	**63**	63	0	19

The image (figure 3-5) after gamma adjustment is as following figure shows:

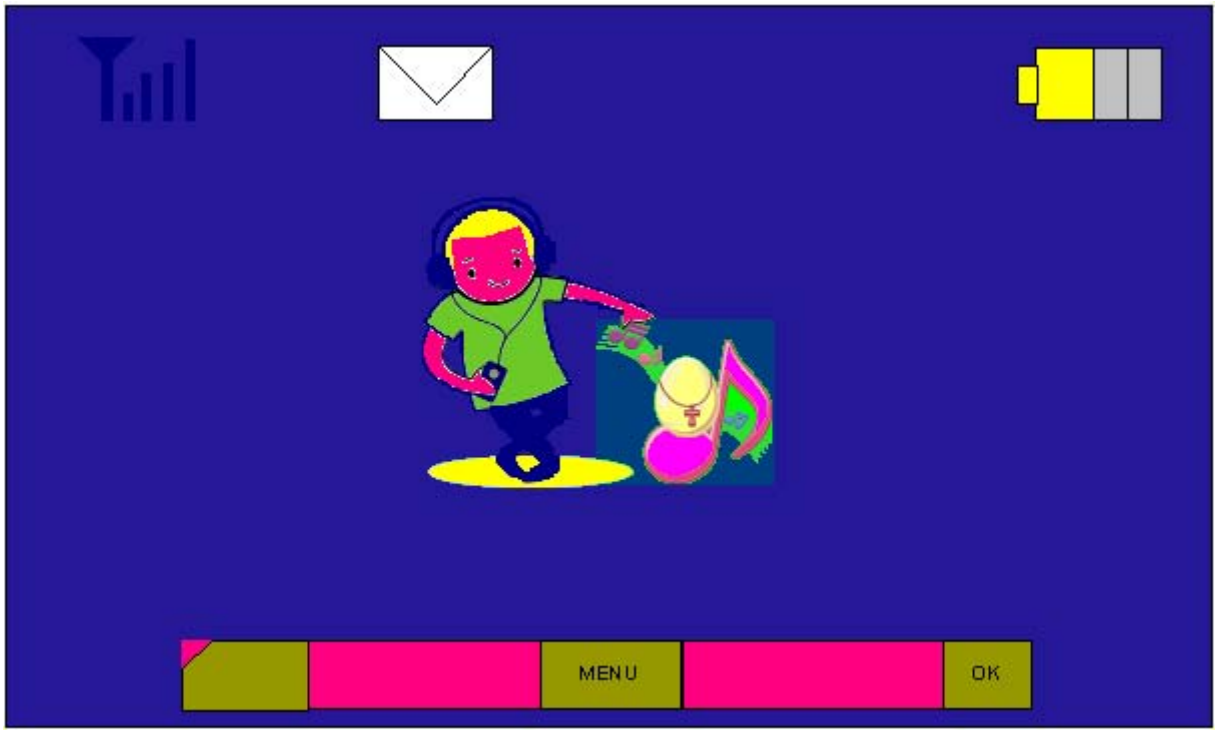

Figure 3-6 Synthesized Images after Gamma Adjustment

3.2 Operation Flow

Following figure shows the operation flow of the IMC example.

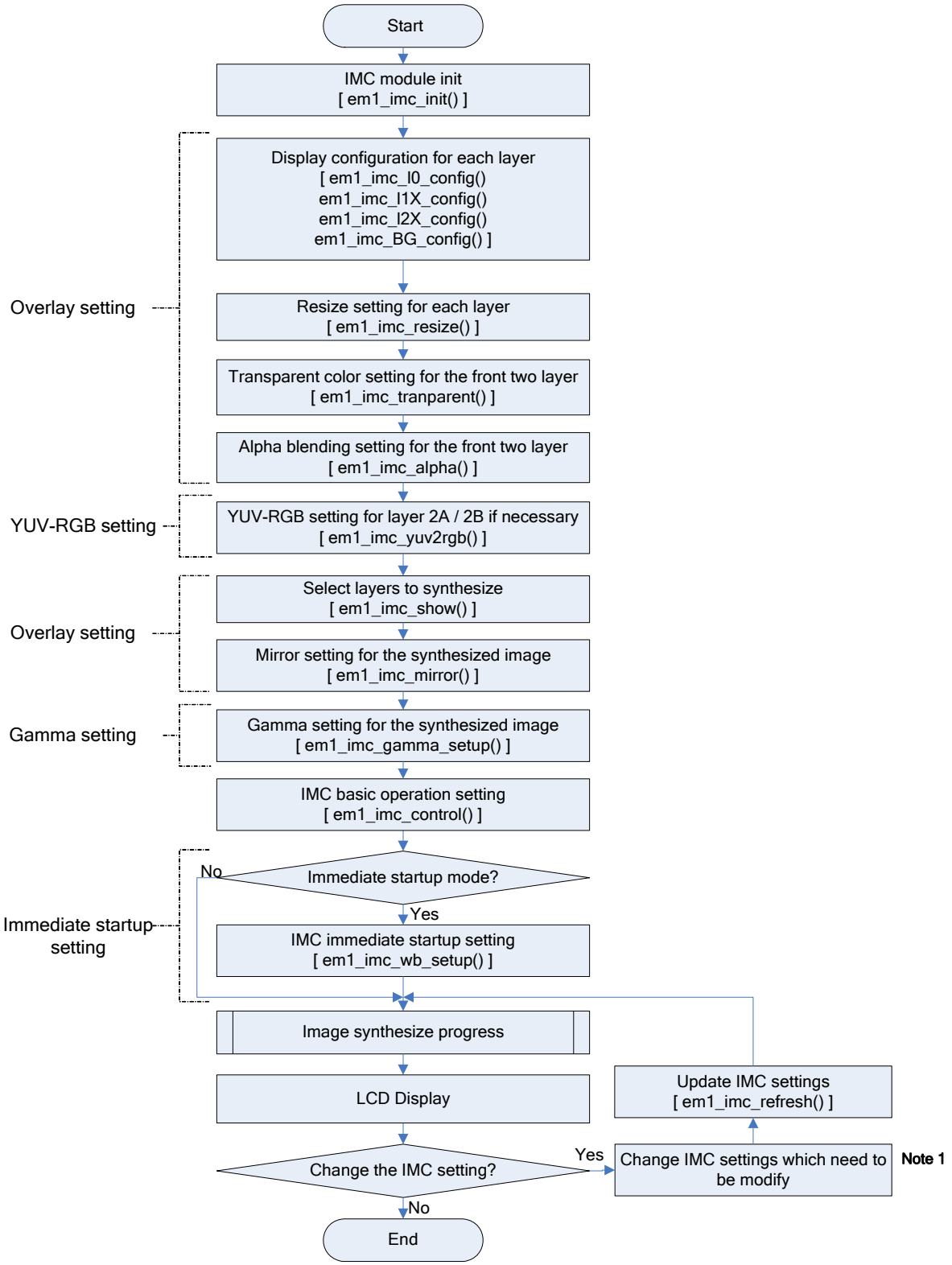

Figure 3-7 IMC example Operation Flow

Note:

1) User can update the IMC setting; more details please refer to chapter 3.3.12.

More details about the functions used in the figure 3-4 please refer to the "**APPENDIX A IMC Driver Function**".

3.3 Operation Details

3.3.1 Init Image Composer

Before use the image composer, initialization should be executed at first. EMMA Mobile 1 image composer initialization including following steps:

Step1: reset setting

ASMU_ RESETREQ0 [17]; (0: reset; 1: cancel reset)

ASMU_ RESETREQ0ENA[17]; (0: disable setting; 1: enable setting)

Step2: clock setting

ASMU_GCLKCTRL0ENA[19:18] (0: disable setting; 1: enable setting)

ASMU_GCLKCTRL0[19:18] (0: close clock; 1: open clock)

ASMU_AHBCLKCTRL0[22] (0: Disables automatic control ; 1: Enables automatic control)

ASMU_APBCLKCTRL0[15] (0: Disables automatic control ; 1: Enables automatic control)

3.3.2 Display Configuration

As the table 3-1 shows, display parameter registers and value can be set as follows:

Step1: layer format registers setting.

Register list:

IMC_L0_FORMAT = 1 (RGB565)

IMC_L1X_FORMAT = 1 (RGB565)

IMC_L2A_FORMAT = 2 (YUV422 interleave)

IMC_L2B_FORMAT = 2 (YUV422 interleave)

IMC_BG_ FORMAT = 3 (fixed background color which set by LCD_BACKCOLOR)

Step2: Address addition value registers setting.

Register list:

IMC_L0_OFFSET = 168*2

IMC_L1X_OFFSET = 100*2

IMC_L2A_OFFSET = 100*2

IMC_L2B_OFFSET = 560*2

IMC_BG_OFFSET ignored

Setp3: Buffer start address registers setting. Because layer 2A/2B use YUV422 interleave mode to store data, so only need to configure the IMC_L2A_FRAMEADR_YP and IMC_L2B_FRAMEADR_YP for the start address

Register list:

IMC_L0_FRAMEADR = 0x31000000

IMC_L1A_FRAMEADR = 0x31010D10

IMC_L1B_FRAMEADR = 0x31015B30

IMC_L1C_FRAMEADR = 0x3101A950

IMC_L2A_FRAMEADR_YP = 0x3101F770

IMC_L2B_FRAMEADR_YP = 0x31024590

IMC_L2A_FRAMEADR_UP ignored

IMC_L2A_FRAMEADR_VP ignored

IMC_L2A_FRAMEADR_YQ ignored

IMC_L2A_FRAMEADR_UQ ignored

IMC_L2A_FRAMEADR_VQ ignored

IMC_L2B_FRAMEADR_UP ignored

IMC_L2B_FRAMEADR_VP ignored

IMC_L2B_FRAMEADR_YQ ignored

IMC_L2B_FRAMEADR_UQ ignored

IMC_L2B_FRAMEADR_VQ ignored

IMC_BG_FRAMEADR ignored

Step4: Layer display position registers setting.

Register list:

IMC_L0_POSITION = (140 << 16) | 270

IMC_L1A_POSITION = (0 << 16) | 40

IMC_L1B_POSITION = (0 << 16) | 250

IMC_L1C_POSITION = (0 << 16) | 660

IMC_L2A_POSITION = (230 << 16) | 400

IMC_L2B_POSITION = (430 << 16) | 100

Step5: Layer display size registers setting

Register list:

IMC_L0_SIZE = (205 << 16) | 100

IMC_L1A_SIZE = (100 << 16) | 100

IMC_L1B_SIZE = (100 << 16) | 100

IMC_L1C_SIZE = (100 << 16) | 100

IMC_L2A_SIZE = (100 << 16) | 100

IMC_L2B_SIZE = (46 << 16) | 560

Step6: Layer 2 double buffer control registers setting

Register list:

IMC_L2A_BUFSEL = 2 (control via CPU)

IMC_L2B_BUFSEL = 2 (control via CPU)

IMC_CPUBUFSEL = 0 (use P buffer)

Step7: Layer 2 byte lane registers setting

Register list:

IMC_L2A_BYTELANE = 0x0000E4E4

IMC_L2B_BYTELANE = 0x0000E4E4

Step8: Layer 2 horizontal/vertical flip control registers setting.

Register list:

IMC_L2A_MIRROR = 0

IMC_L2B_MIRROR = 0

3.3.3 Resize Setting for Each Layer

Resize setting only can double the image, all the resize register setting has the same meaning:

- 0: does not resize image;
- 1: resize image

After change the register value, please update the setting by set IMC_REFREASH register to be 1.

Register list:

IMC_L0_RESIZE

IMC_L1X_ RESIZE

IMC_L2A_RESIZE

IMC_L2B_ RESIZE

IMC_BG_ RESIZE

3.3.4 Transparent Color Setting for the Front Two Layer

When enable the transparent color function, at the same time, define which color to be transparent, this function only used in the front and middle controller. Transparent color enable register setting value can be as follows:

- 0: enable transparent color;
- 1: disable

After change the register value, please update the setting by set IMC_REFREASH register to be 1.

Register list:

IMC_L0_KEYENABLE

IMC_L1A_KEYENABLE

IMC_L1B_KEYENABLE

IMC_L1C_KEYENABLE

IMC_L0_KEYCOLOR = 0x0000003F (blue)

IMC_L1X_KEYCOLOR = 0x003F0000 (red)

3.3.5 Alpha Blending Setting for the Front Two Layer

After change the register value, please update the setting by set IMC_REFREASH register to be 1.

Register list:

IMC_L0_ALPHA (from 0 to 63)
IMC_L1A_ ALPHA (from 0 to 63)
IMC_L1B_ ALPHA (from 0 to 63)
IMC_L1C_ ALPHA (from 0 to 63)

3.3.6 YUV-RGB Conversion Setting

YUV-RGB conversion including following steps:

Step1: Gain Offset Setting

User can change the gain and offset configuration value in the example.

Register list:

IMC_YGAINOFFSET
IMC_UGAINOFFSET
IMC_VGAINOFFSET

Step2: Select the Coefficient for YUV-RGB Conversion. In this example, user can choose ITU-R BT.601-compliant or ITU-R BT.709-compliant as the coefficient.

Register list:

IMC_YUV2RGB [1:0] = 0 or 1 (select the coefficient for YUV-RGB conversion)

Step3: Dithering Function Setting

Register list:

IMC_YUV2RGB [8] (1: performs dithering; 0: does not perform dithering).

Note:

The example not use custom YUV-RGB coefficient, so there is no need to configure the custom coefficient registers.

More details about conversion please refer to chapter 2.1.

3.3.7 Select Layers to Synthesis

Select the layers to be synthesized. Register value can be set as follows:

- 0: disable layer
- 1: enable layer

After change the register value, please update the setting by set IMC_REFREASH register to be 1.

Register list:

IMC_L0_CONTROL
IMC_L1A_CONTROL
IMC_L1B_CONTROL
IMC_L1C_CONTROL
IMC_L2A_CONTROL
IMC_L2B_CONTROL

3.3.8 Mirror Setting for Synthesized Image

Mirror setting register value can be set as follows:

- 0: No flip
- 1: Horizontal flip
- 2: Vertical flip
- 3: Horizontal and vertical flip

Register list:

IMC_MIRROR

3.3.9 Gamma Adjustment Setting for Synthesized Image

Following steps shows the gamma adjustment operation

Step1: Disable Gamma Adjustment

IMC_GAMMA_EN = 0x00 (disable gamma adjustment)

Step2: Setting IMC_GAMMA_ADR

IMC_GAMMA_ADR = 0x00 (gamma table start address)

Step3: Write Values to IMC_GAMMA_DATA as the table 3-2 shows.

IMC_GAMMA_DATA

Step4: Enable Gamma Adjustment

IMC_GAMMA_EN = 0x01 (enable gamma adjustment)

3.3.10 IMC Basic Operation Setting

In this example, use the LCD-synchronous startup mode.
Basic operation setting,

IMC_CONTROL = 0

3.3.11 IMC Immediate Startup Setting if Necessary

In this example, use the LCD-synchronous startup mode, so there is no need to configure the write back operation. When use the immediate startup mode, please configure the following

registers.

IMC_START
IMC_WB_AREAADR
IMC_WB_HOFFSET
IMC_WB_FORMAT
IMC_WB_SIZE

3.3.12 LCD Configuration and Display

In this example, IMC work in LCD-synchronous mode, so LCD should work in local bus between IMC and LCD mode, details about configuration can be show as follows:

Register list and value:

LCD_CONTROL = 0x10
LCD_BUFSEL = 0
LCD_HAREA = 800
LCD_HEDGE1 = 6
LCD_HEDGE2 = 7
LCD_HTOTAL = 811
LCD_VAREA = 480
LCD_VEDGE1 = 3
LCD_VEDGE2 = 4
LCD_VTOTAL = 488
LCD_IFORMAT = 1
LCD_BACKCOLOR = 0x00003F3F
LCD_LCDOUT = 1

Note:

More details about LCD setting please refer to the LCDC application note.

3.3.13 Change IMC Setting

When there is necessary to change the IMC setting (such as resize, transparent color, alpha, mirror configurations), please note that the immediately-reflect register can not be changed during macro operation, the update target registers should be refreshed after change the setting.

3.3.14 Refresh Updated Registers

After change the update target registers, please make sure to execute update operation.

IMC_REFRESH = 1

APPENDIX A IMC Driver Function

A.1 Function List

The following table shows the IMC driver interface functions:

Table A-1 IMC Driver Function List

Class	Function Name	Function Detail
External function	em1_imc_init	Image composor macro initialization
	em1_imc_l0_config	Display parameters setting for layer 0
	em1_imc_l1X_config	Display parameters setting for layer 1A/1B/1C
	em1_imc_l2X_config	Display parameters setting for layer 2A/2B
	em1_imc_bg_config	Display parameters setting for layer BG
	em1_imc_resize	Resize setting for the appointed layer
	em1_imc_transparent	Transparent color setting for the appointed layer
	em1_imc_alpha	Alpha blending setting for the appointed layer
	em1_imc_mirror	Mirror setting for the synthesized image or layer 2A / 2B
	em1_imc_yuv2rgb	YUV-RGB conversion setting
	em1_imc_hide	Hide the layer appointed
	em1_imc_show	Show the layer appointed
	em1_imc_gamma_enable	Enable the gamma adjustment function
	em1_imc_gamma_disable	Disable the gamma adjustment function
	em1_imc_gamma_setup	Gamma table setting
	em1_imc_control	Setting for the IMC basic operation
	em1_imc_wb_setup	Setting up the WB function
	em1_imc_refresh	Refresh the updated registers
	em1_imc_start	Start IMC in immediate startup mode
	em1_imc_stop	Stop IMC in immediate startup mode
	em1_imc_get_status	Get the image composor status
	em1_imc_change_buf	Change buffer for layer 2A/2B

A.2 Global Variable Define

None.

A.3 Structure Define

Table A-2 Structure Define

Structure Name	Detail
IMC_L0_CONF	Layer 0 configuration structure
IMC_L1X_CONF	Layer 1A/1B/1C configuration structure
IMC_L2X_CONF	Layer 2A/2B configuration structure
IMC_BG_CONF	Layer BG configuration structure
IMC_TRANS_COLOR	Transparent color setting structure
IMC_ALPHA	Alpha setting structure
IMC_YUV2RGB_ST	YUV-RGB conversion configuration structure
IMC_GAMMA_SETUP	Gamma adjustment configuration structure
IMC_WB_SETUP	Write back configuration structure

A.3.1 IMC_L0_CONF

Table A-3 Structure of IMC_L0_CONF

Member	Detail
uint format	Image format setting
uint offset	address addition value
uint frame_addr	buffer start address
uint position	display position
uint size	display size

A.3.2 IMC_L1X_CONF

Table A-4 Structure of IMC_L1X_CONF

Member	Detail
IMC_LAYER	Enum type, layer to be set
uint format	Image format setting
uint offset	address addition value
uint frame_addr	buffer start address
uint position	display position
uint size	display size

A.3.3 IMC_L2X_CONF

Table A-5 Structure of IMC_L2X_CONF

Member	Detail
IMC_LAYER	Enum type, layer to be set
uint format	Image format setting
uint offset	address addition value
uint frame_addr_yp	buffer start address yp

uint frame_addr_up	buffer start address up
uint frame_addr_vp	buffer start address vp
uint frame_addr_yq	buffer start address yq
uint frame_addr_uq	buffer start address uq
uint frame_addr_vq	buffer start address vq
uint position	display position
uint size	display size
uint bufsel	double buffer control
uint bytelane	bytelane setting
uint mirror	horizontal/vertical flip
uint cpu_bufsel	cpu buffer selection

A.3.4 IMC_BG_CONF

Table A-6 Structure of IMC_BG_CONF

Member	Detail
uint format	Image format setting
uint offset	address addition value
uint frame_addr	buffer start address

A.3.5 IMC_TRANS_COLOR

Table A-7 Structure of IMC_TRANS_COLOR

Member	Detail
IMC_LAYER layer	Enum type, layer to be set
uint reverse	whether to enable the reverse setting
uint alpha_data	alpha data

A.3.6 IMC_YUV2RGB_ST

Table A-8 Structure of IMC_YUV2RGB_ST

Member	Detail
uchar y_gain	Y gain value
uchar u_gain	U gain value
uchar v_gain	V gain value
char y_offset	Y offset value
char u_offset	u offset value
char v_offset	v offset value
uint dither	whether to enable the dithering setting
uint trans_mode	select the coeffiecent
uint coef_r0	custom coefficient r0
uint coef_r1	custom coefficient r1
uint coef_r2	custom coefficient r2
uint coef_r3	custom coefficient r3

uint coef_g0	custom coefficient g0
uint coef_g1	custom coefficient g1
uint coef_g2	custom coefficient g2
uint coef_g3	custom coefficient g3
uint coef_b0	custom coefficient b0
uint coef_b1	custom coefficient b1
uint coef_b2	custom coefficient b2
uint coef_b3	custom coefficient b3

A.3.7 IMC_GAMMA_SETUP

Table A-9 Structure of IMC_GAMMA_SETUP

Member	Detail
uint addr	Display area address
char d_red[64]	red value
char d_green[64]	green value
char d_blue[64]	blue value

A.3.8 IMC_WB_SETUP

Table A-10Structure of IMC_WB_SETUP

Member	Detail
uint area_addr	display area address
uint hoffset	address addition value
uint format	image format
uint size	image size

A.4 Function Details

A.4.1 IMC Initialization Function

[Function Name]

em1_imc _init

[Format]

void em1_imc _init (void);

[Argument]

None

[Function Return]

None

[Flow Chart]

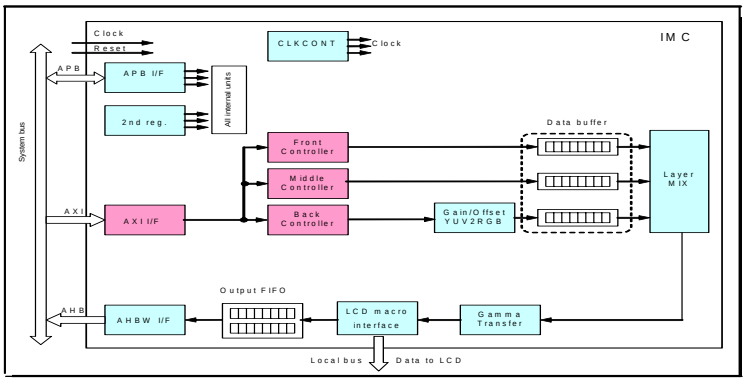

Figure A-1 IMC Macro Initialization

[Note]

None

A.4.2 Display Configuration for Layer 0

[Function Name]

em1_imc_l0_config

[Format]

void em1_imc_l0_config (IMC_L0_CONF* l0_conf);

[Argument]

Parameter	Type	I/O	Detail
l0_conf	IMC_L0_CONF*	I	Layer 0 display configuration sturcture

[Function Return]

None

[Flow Chart]

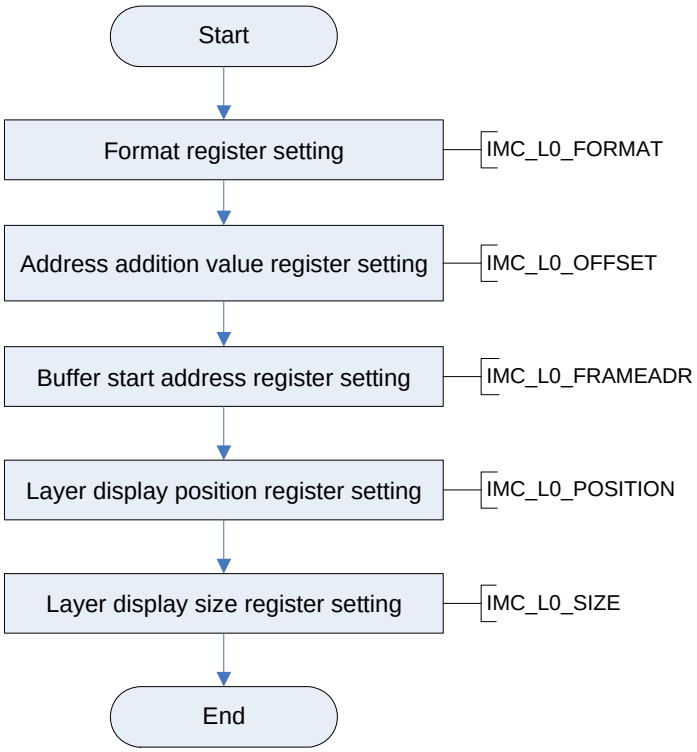

Figure A-2 IMC Layer 0 Display Configuration

[Note]

None.

A.4.3 Display Configuration for Layer 1

[Function Name]

em1_imc_l1x_config

[Format]

int em1_imc_l1x_config (IMC_L1X_CONF* l1x_conf);

[Argument]

Parameter	Type	I/O	Detail
L1x_conf	IMC_L1X_CONF*	I	Layer 1A/1B/1C display configuration sturcture

[Function Return]

DRV_OK

DRV_ERR_PARAM

[Flow Chart]

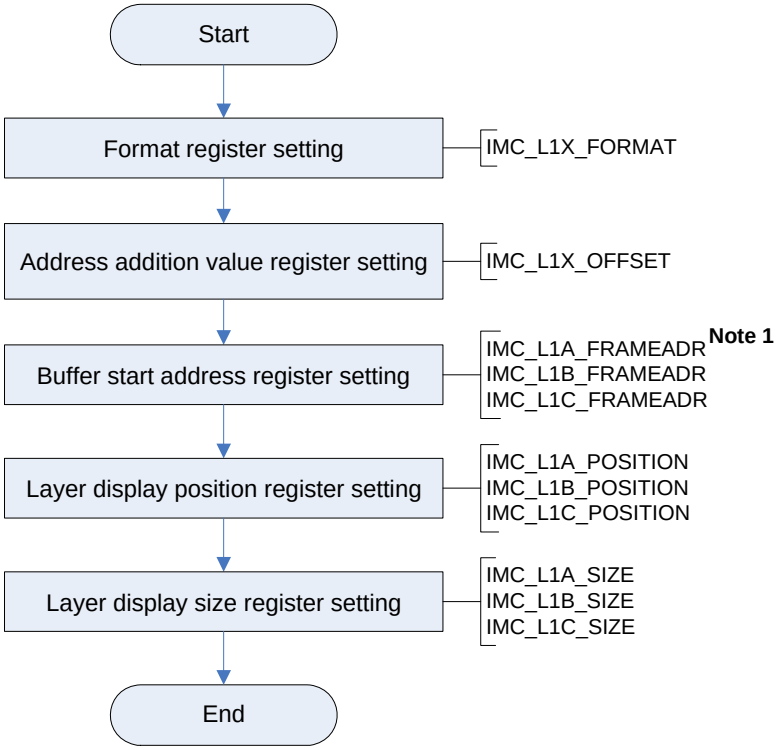

Figure A-3 IMC Layer 1A/1B/1C Display Configuration

[Note]

1) According the appointed layer plane to configure.

A.4.4 Display Configuration for Layer 2

[Function Name]

em1_imc_l2x_config

[Format]

int em1_imc_l2x_config (IMC_L2X_CONF* l2x_conf);

[Argument]

Parameter	Type	I/O	Detail
L2x_conf	IMC_L2X_CONF*	I	Layer 2A/2B display configuration sturcture

[Function Return]

DRV_OK

DRV_ERR_PARAM

[Flow Chart]

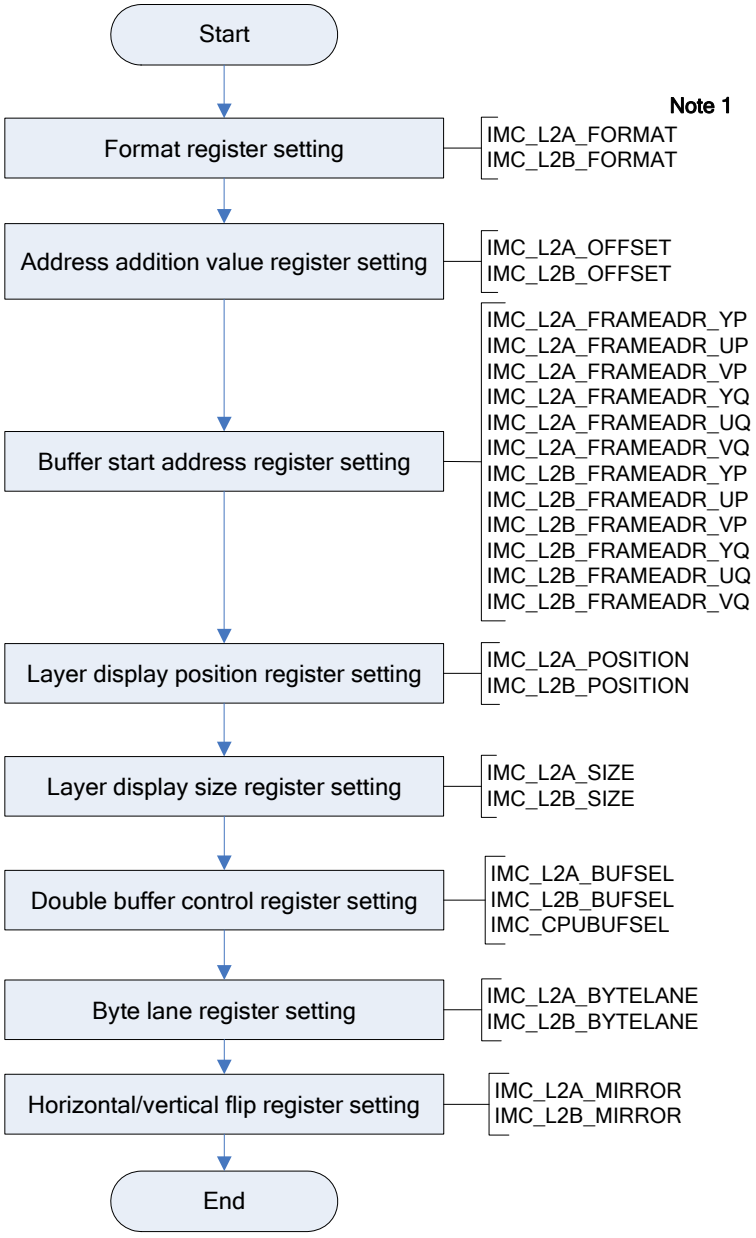

Figure A-4 IMC Layer 2A/2B Display Configuration

[Note]

1) According the appointed layer plane to configure the related register.

A.4.5 Display Configuration for Layer BG

[Function Name]

em1_imc_bg_config

[Format]

void em1_imc_bg_config (IMC_BG_CONF* bg_conf);

[Argument]

Parameter	Type	I/O	Detail
bg_conf	IMC_BG_CONF*	I	Layer BG display configuration sturcture

[Function Return]

None

[Flow Chart]

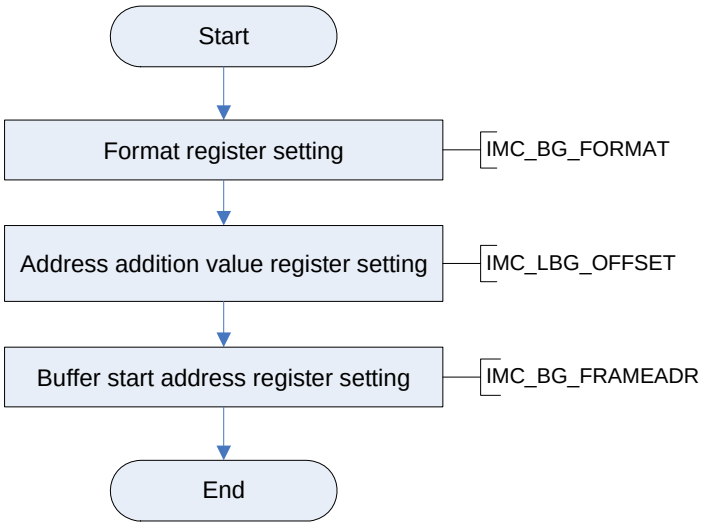

Figure A-5 IMC Layer BG Display Configuration

[Note]

None.

A.4.6 Resize Setting

[Function Name]

em1_imc_resize

[Format]

int em1_imc_resize (IMC_LAYER layer_n, char resize_en);

[Argument]

Parameter	Type	I/O	Detail
layer_n	IMC_LAYER	I	Layer enum
resize_en	char	I	Enable /disable resize

[Function Return]

DRV_OK

DRV_ERR_PARAM

[Flow Chart]

None

[Note]

If enable the resize function, set the IMC_Lx_RESIZE to be 1, otherwise,

set the IMC_Lx_RESIZE to be 0. Here the “Lx” means the appointed layer.

A.4.7 Transparent Color Setting

[Function Name]

em1_imc_transparent

[Format]

int em1_imc_transparent (IMC_TRANS_COLOR* trans_col);

[Argument]

Parameter	Type	I/O	Detail
trans_col	IMC_TRANS_COLOR*	I	Transparent color setting structure

[Function Return]

DRV_OK

DRV_ERR_PARAM

[Flow Chart]

None

[Note]

Setting whether enables transparent color, if enable, set the color value which need to be transparent.

A.4.8 Alpha Blending Setting

[Function Name]

em1_imc_alpha

[Format]

int em1_imc_alpha (IMC_ALPHA* s_alpha);

[Argument]

Parameter	Type	I/O	Detail
s_alpha	IMC_ALPHA*	I	Alpha setting structure

[Function Return]

DRV_OK

DRV_ERR_PARAM

[Flow Chart]

None

[Note]

Set the IMC_Lx_ALPHA, the “Lx” means the appointed layer.

A.4.9 Mirror Setting

[Function Name]

em1_imc_mirror

[Format]

int em1_imc_mirror (uint degree, IMC_LAYER layer_n);

[Argument]

Parameter	Type	I/O	Detail
degree	uint	I	Flip degree value
layer_n	IMC_LAYER	I	Layer to be filped

[Function Return]

DRV_OK

DRV_ERR_PARAM

[Flow Chart]

None

[Note]

Set the IMC_MIRROR/IMC_L2A_MIRROR/ IMC_L2B_MIRROR to be “degrees” that need to be flipped.

A.4.10 YUV-RGB Conversion

[Function Name]

em1_imc_yuv2rgb

[Format]

int em1_imc_yuv2rgb (IMC_YUV2RGB_ST* s_yuv2rgb);

[Argument]

Parameter	Type	I/O	Detail
s_yuv2rgb	IMC_YUV2RGB_ST*	I	YUV-RGB conversion configuration sturcture

[Function Return]

DRV_OK

DRV_ERR_PARAM

[Flow Chart]

Please refer to figure 2-3.

[Note]

None.

A.4.11 Layer Hide

[Function Name]

em1_imc_hide

[Format]

int em1_imc_hide (IMC_LAYER layer_n);

[Argument]

Parameter	Type	I/O	Detail
Layer_n	IMC_LAYER	I	Layer enum

[Function Return]

DRV_OK

DRV_ERR_PARAM

[Flow Chart]

None

[Note]

Set the IMC_Lx_CONTROL to be 0, the “Lx” means the appointed layer.

A.4.12 Layer Show

[Function Name]

em1_imc_show

[Format]

int em1_imc_show (IMC_LAYER layer_n);

[Argument]

Parameter	Type	I/O	Detail
Layer_n	IMC_LAYER	I	Layer enum

[Function Return]

DRV_OK

DRV_ERR_PARAM

[Flow Chart]

None

[Note]

Set the IMC_Lx_CONTROL to be 1, the “Lx” means the appointed layer.

A.4.13 Gamma Enable

[Function Name]

em1_imc_gamma_enable

[Format]

void em1_imc_ gamma_enable (void);

[Argument]

None

[Function Return]

None

[Flow Chart]

None

[Note]

Set the IMC_GAMMA_EN[0] to be 1.

A.4.14 Gamma Disable

[Function Name]

em1_imc_gamma_disable

[Format]

void em1_imc_ gamma_disable (void);

[Argument]

None

[Function Return]

None

[Flow Chart]

None

[Note]

Set the IMC_GAMMA_EN[0] to be 0.

A.4.15 Gamma Table Setting

[Function Name]

em1_imc_gamma_setup

[Format]

int em1_imc_gamma_setup (IMC_GAMMA_SETUP *imc_gamma);

[Argument]

Parameter	Type	I/O	Detail
imc_gamma	IMC_GAMMA_SETUP *	I	Gamma configuration structure

[Function Return]

DRV_OK

DRV_ERR_PARAM

[Flow Chart]

None

[Note]

Write gamma adjustment data to gamma table.

A.4.16 Basic Control

[Function Name]

em1_imc_control

[Format]

void em1_imc_control (int imc_contrl);

[Argument]

Parameter	Type	I/O	Detail
Imc_contrl	int	I	Basic control setting value

[Function Return]

None

[Flow Chart]

None

[Note]

Setting the startup mode and basic operation configuration, more detail about the setting, please refer to the IMC_CONTROL register description in EMMA Mobile 1 IMC user's manual.

A.4.17 WB Function Setting

[Function Name]

em1_imc_wb_setup

[Format]

void em1_imc_wb_setup (IMC_WB_SETUP* wb_set);

[Argument]

Parameter	Type	I/O	Detail
wb_set	IMC_WB_SETUP*	I	Write back configuration sturcture

[Function Return]

None

[Flow Chart]

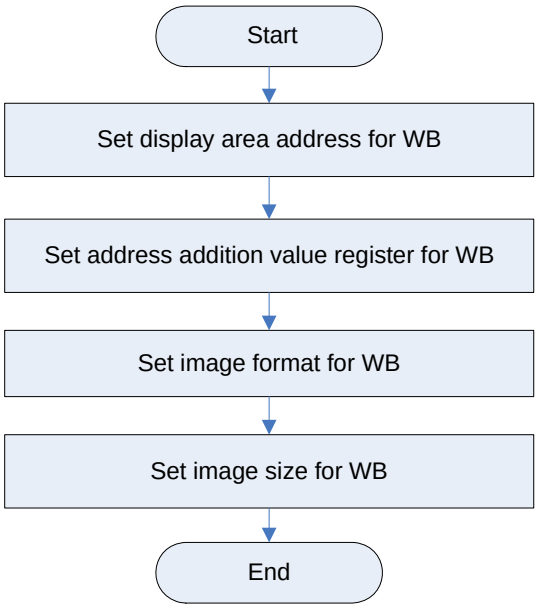

Figure A-6 IMC WB Function Configuration

[Note]

None.

A.4.18 IMC Settings Update

[Function Name]

em1_imc_refresh

[Format]

void em1_imc_refresh (void);

[Argument]

None

[Function Return]

None

[Flow Chart]

None

[Note]

Set the IMC_REFRESH[0] to be 1.

A.4.19 IMC Start Work

[Function Name]

em1_imc_start

[Format]

void em1_imc_start (void);

[Argument]

None

[Function Return]

None

[Flow Chart]

None

[Note]

Start IMC in immediate startup mode.

A.4.20 IMC Stop Work

[Function Name]

em1_imc_stop

[Format]

void em1_imc_stop (void);

[Argument]

None

[Function Return]

None

[Flow Chart]

None

[Note]

Stop IMC in immediate startup mode.

A.4.21 Read IMC Status

[Function Name]

em1_ imc_get_status

[Format]

int em1_imc_get_status(void);

[Argument]

None.

[Function Return]

IMC status

[Flow Chart]

None.

[Note]

Read status register: IMC_STATUS. This register is only valid when IMC in immediate startup mode.

A.4.22 Change Buffer for Layer2A/2B

[Function Name]

em1_imc_change_buf

[Format]

int int em1_imc_change_buf(IMC_LAYER layer_n);

[Argument]

Parameter	Type	I/O	Detail
layer_n	IMC_LAYER	I	Layer to be changed buffer

[Function Return]

DRV_OK

DRV_ERR_PARAM

[Flow Chart]

None.

[Note]

Layer 2A/2B can select buffer P or Q as the image data buffer individually, at the same time, layer 2A/2B can also use the CPU control mode to select buffer.

ANNEX Modification History

Number	Modification Contents	Author	Date
Ver 1.00	New version		Aug, 4, 2009