User's Manual

# Resizer

User's Manual

Multimedia Processor for Mobile Applications
EMMA Mobile $^{TM}$ EV2

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## General Precautions in the Handling of MPU/MCU Products

The following usage notes are applicable to all MPU/MCU products from Renesas. For detailed usage notes on the products covered by this manual, refer to the relevant sections of the manual. If the descriptions under General Precautions in the Handling of MPU/MCU Products and in the body of the manual differ from each other, the description in the body of the manual takes precedence.

1. Handling of Unused Pins

   Handle unused pins in accord with the directions given under Handling of Unused Pins in the manual.

   — The input pins of CMOS products are generally in the high-impedance state. In operation with unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible. Unused pins should be handled as described under Handling of Unused Pins in the manual.

2. Processing at Power-on

   The state of the product is undefined at the moment when power is supplied.

   — The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the moment when power is supplied.
   In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the moment when power is supplied until the reset process is completed.
   In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the moment when power is supplied until the power reaches the level at which resetting has been specified.

3. Prohibition of Access to Reserved Addresses

   Access to reserved addresses is prohibited.

   — The reserved addresses are provided for the possible future expansion of functions. Do not access these addresses; the correct operation of LSI is not guaranteed if they are accessed.

4. Clock Signals

   After applying a reset, only release the reset line after the operating clock signal has become stable. When switching the clock signal during program execution, wait until the target clock signal has stabilized.

   — When the clock signal is generated with an external resonator (or from an external oscillator) during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Moreover, when switching to a clock signal produced with an external resonator (or by an external oscillator) while program execution is in progress, wait until the target clock signal is stable.

5. Differences between Products

   Before changing from one product to another, i.e. to one with a different part number, confirm that the change will not lead to problems.

   — The characteristics of MPU/MCU in the same group but having different part numbers may differ because of the differences in internal memory capacity and layout pattern. When changing to products of different part numbers, implement a system-evaluation test for each of the products.

# How to Use This Manual

## 1. Purpose and Target Readers

This manual is designed to provide the user with an understanding of the hardware functions and electrical characteristics of the MCU. It is intended for users designing application systems incorporating the MCU. A basic knowledge of electric circuits, logical circuits, and MCUs is necessary in order to use this manual.

The manual comprises an overview of the product; descriptions of the CPU, system control functions, peripheral functions, and electrical characteristics; and usage notes.

Particular attention should be paid to the precautionary notes when using the manual. These notes occur within the body of the text, at the end of each section, and in the Usage Notes section.

The revision history summarizes the locations of revisions and additions. It does not list all revisions. Refer to the text of the manual for details.

The following documents apply to the EMMA Mobile EV2. Make sure to refer to the latest versions of these documents. The newest versions of the documents listed may be obtained from the Renesas Electronics Web site.

| Document Type | Description | Document Title | Document No. |
|---|---|---|---|
| Data Sheet | Hardware overview and electrical characteristics | EMMA Mobile EV2 Datasheet | R19DS0010EJxxxx |
| User's manual (1chip) | Hardware whole specifications (pin assignments, memory maps, peripheral function specifications, electrical characteristics, timing charts) and operation description | EMMA Mobile EV2 User's manual 1chip | R19UH0036EJxxxx |
| User's manual (module) | Hardware each macro specifications and operation description. | EMMA Mobile EV2 User's manual each module | See below |

| Document Name | Document No. | Document Name | Document No. |
|---|---|---|---|
| 1chip | R19UH0036EJxxxx | DMA Controller | R19UH0043EJxxxx |
| System Management Unit | R19UH0037EJxxxx | LP-DDR/DDR2 Controller | R19UH0039EJxxxx |
| Timer | R19UH0054EJxxxx | SD Memory Card Interface | R19UH0061EJxxxx |
| System Timer | R19UH0055EJxxxx | SDIO Interface | R19UH0042EJxxxx |
| HD Video Decoder | R19UH0056EJxxxx | CF Card Interface | R19UH0062EJxxxx |
| Rotator | R19UH0057EJxxxx | Unified Serial Interface | R19UH0047EJxxxx |
| Resizer (This manual) | R19UH0058EJxxxx | UART interface | R19UH0040EJxxxx |
| Image Composer | R19UH0038EJxxxx | USB 2.0 Host Controller | R19UH0045EJxxxx |
| LCD Interface | R19UH0044EJxxxx | USB 2.0 Function Controller | R19UH0034EJxxxx |
| ITU-R BT.656 Interface | R19UH0059EJxxxx | IIC Interface | R19UH0052EJxxxx |
| Digital Terrestrial TV Interface | R19UH0048EJxxxx | General Purpose I/O Interface | R19UH0041EJxxxx |
| Camera Interface | R19UH0060EJxxxx | Pulse Width Modulation Interface | R19UH0063EJxxxx |

4 digits of end shows the version.

## 2. Notation of Numbers and Symbols

The notation conventions for register names, bit names, numbers, and symbols used in this manual are described below.

(1) Register Names, Bit Names, and Pin Names

Registers, bits, and pins are referred to in the text by symbols. The symbol is accompanied by the word “register,” “bit,” or “pin” to distinguish the three categories.

Examples    the PM03 bit in the PM0 register
            P3_5 pin, VCC pin

(2) Notation of Numbers

The indication “b” is appended to numeric values given in binary format. However, nothing is appended to the values of single bits. The indication “h” is appended to numeric values given in hexadecimal format. Nothing is appended to numeric values given in decimal format.

Examples    Binary: 11b or 11
            Hexadecimal: EFA0h
            Decimal: 1234

## 3. Register Notation

The symbols and terms used in register diagrams are described below.

**x.x.x XXX register**

This register (XXXXXXX: xxxx_xxxxh) …..

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Reserved | | CHG_P1_LAT | LATCH_P1_SEL | Reserved | | CHG_P0_LAT | CHG_P0_LAT_SEL |

| Name | R/W | Bit No. | After Reset | Description |
|---|---|---|---|---|
| LATCH_P2_SEL | R/W | 8 | 0 | 0: Use the P2_LAT bit of the P2_POWERSW register in the SMU to latch data.<br>1: Use the CHG_P2_LAT bit to latch data. |
| Reserved | R | 7:6 | – | Reserved. If these bits are read, 0 is returned for each bit. |
| CHG_P1_LAT | R/W | 5 | 1 | 0: Output data as is. 1: Output latched data. |
| LATCH_P1_SEL | R/W | 4 | 0 | 0: Use the P1_LAT bit of the P1_POWERSW register in the SMU to latch data.<br>1: Use the CHG_P1_LAT bit to latch data. |
| Reserved | R | 3:2 | – | Reserved. If these bits are read, 0 is returned for each bit. |
| CHG_P0_LAT | R/W | 1 | 1 | 0: Output data as is. 1: Output latched data. |
| CHG_P0_LAT_SEL | R/W | 0 | 0 | 0: Use the P0_LAT bit of the P2_POWERSW register in the SMU to latch data.<br>1: Use the CHG_P0_LAT bit to latch data. |

*3

*1 *2

*1

R/W: Read and Write.

R: Read only.

W: Write only.

-: Nothing is assigned.

*2

Reserved bit.

Reserved bit. Set to specified value.

*3

・ Nothing is assigned.

Nothing is assigned to the bit. As the bit may be used for future functions, if necessary, set to 0.

・ Do not set to a value.

Operation is not guaranteed when a value is set.

・ Function varies according to the operating mode.

The function of the bit varies with the peripheral function mode. Refer to the register diagram for information on the individual modes.

## 4. List of Abbreviations and Acronyms

| Abbreviation | Full Form |
|---|---|
| ACIA | Asynchronous Communication Interface Adapter |
| bps | bits per second |
| CRC | Cyclic Redundancy Check |
| DMA | Direct Memory Access |
| DMAC | Direct Memory Access Controller |
| GSM | Global System for Mobile Communications |
| Hi-Z | High Impedance |
| IEBus | Inter Equipment Bus |
| I/O | Input/Output |
| IrDA | Infrared Data Association |
| LSB | Least Significant Bit |
| MSB | Most Significant Bit |
| NC | Non-Connect |
| PLL | Phase Locked Loop |
| PWM | Pulse Width Modulation |
| SFR | Special Function Register |
| SIM | Subscriber Identity Module |
| UART | Universal Asynchronous Receiver/Transmitter |
| VCO | Voltage Controlled Oscillator |

# Table of Contents

Resizer

EMMA Mobile EV2

R19UH0058EJ0300
Rev.3.00
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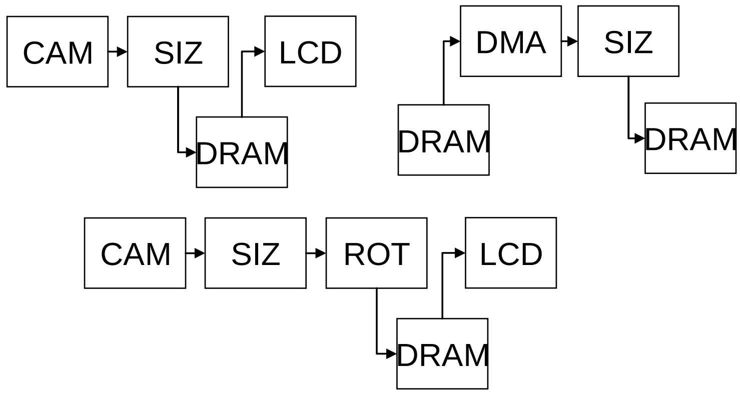
# 1. Overview

The resizer (SIZ) is a macro used to resize or rotate an image and data can be input directly from components such as the CAM and CPU.

**Figure 1-1. SIZ Data Flow**




## 1.1 Features

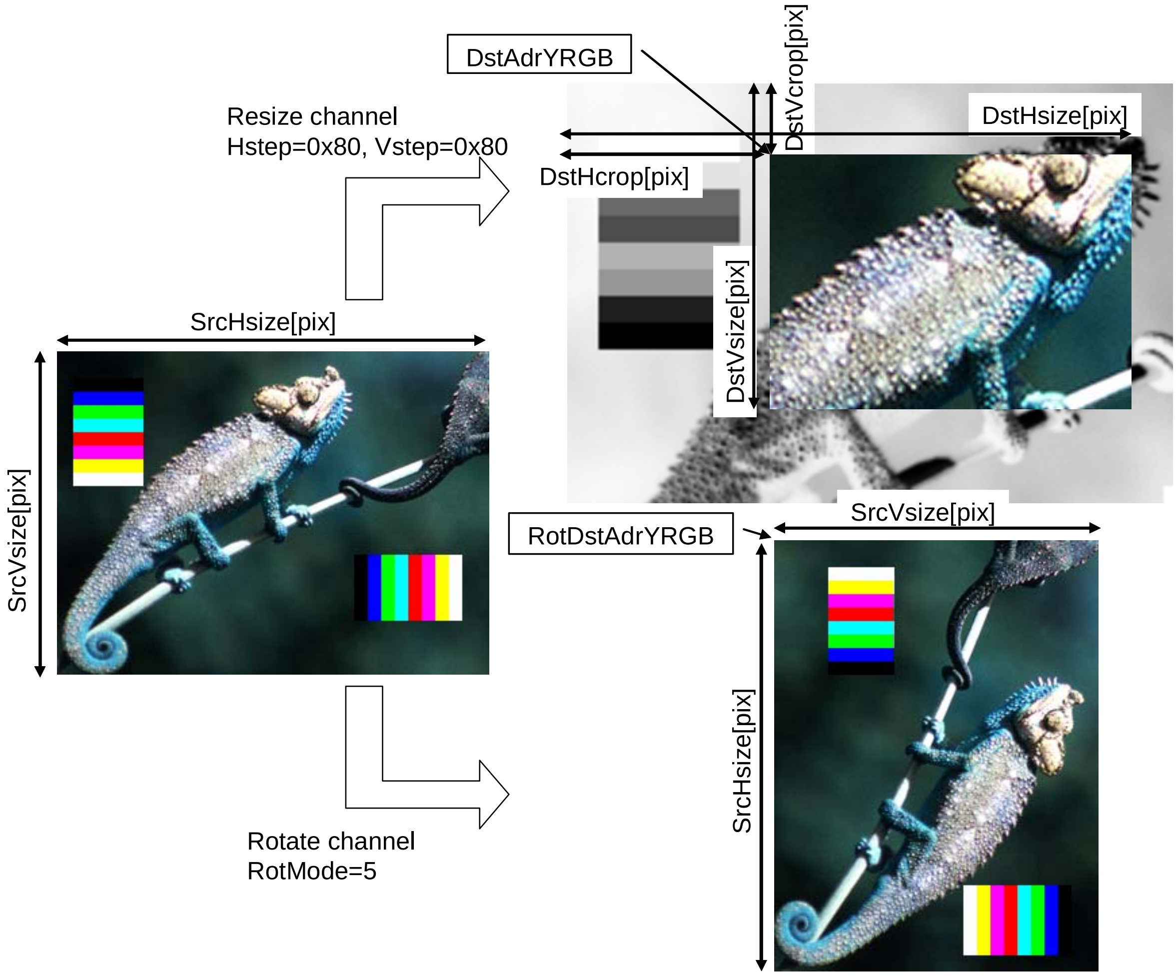
### 1.1.1 Resizing channel

- Resizing (×256 to 1/64) with 2 × 2 or 4 × 4 filtering
- Configurable filter
- Formats: RGB888/565, YUV422 interleaved/semi-planar/planar, YUV420 semi-planar/planar
- Format conversion: RGB to RGB or YUV to YUV
- Cropping: By setting the number of pixels in the horizontal and vertical directions for a destination image to a value smaller than the resized image, the right and lower edges can be cropped, and by setting this number to a value other than 0, the left and top edges can be cropped.
- Line skip: The output area can be specified as an arbitrary rectangle and can be made to overlay an existing image.
- Color conversion: Half of the SRAM (12 KB) in the SIZ macro can be used as a table, and the output data and table values can be switched.

### 1.1.2 Rotation channel

- Rotation or flipping in the X or Y direction
- Input format: YUV422 interleaved
- Output formats: YUV422 interleaved, YUV422 semi-planar, YUV420 semi-planar

**Figure 1-2. Overview of Resizing and Rotating**



## 1.2 Restrictions

### 1.2.1 Input interface (slave interface)

Pixels must be input in raster scan order
Writing in bytes or half words is not supported.

### 1.2.2 Input address for source images

| | | |
|---|---|---|
| RGB888/565, YUV422 interleaved: | | F800_0000H to FFFF_FFFFH |
| YUV422/420 semi-planar: | Y: | F800_0000H to FBFF_FFFFH |
| | UV: | FC00_0000H to FFFF_FFFFH |
| YUV422/420 planar: | Y: | F800_0000H to FBFF_FFFFH |
| | U: | FC00_0000H to FDFF_FFFFH |
| | V: | FE00_0000H to FFFF_FFFFH |

### 1.2.3 Horizontal size (image width)

| | |
|---|---|
| Up scale: | 1,024 pixels (for 4 × 4 filtering) or 2,048 pixels (for 2 × 2 filtering) |
| Down scale (1/1 to 1/4): | 1,024 pixels (for 4 × 4 filtering) or 2,048 pixels (for 2 × 2 filtering) |
| Down scale (1/4 to 1/8): | 2,048 pixels (for 4 × 4 filtering) or 4,096 pixels (for 2 × 2 filtering) |
| Down scale (1/8 to 1/16): | 4,096 pixels (for 4 × 4 filtering) or 8,191 pixels (for 2 × 2 filtering) |
| Down scale (1/16 or smaller): | 8,191 pixels |

If the number of pixels in the horizontal direction of a source image exceeds this restriction, cut the input image into rectangular slices.

### 1.2.4 Output (destination) address

No restriction

### 1.2.5 Input (source) address

4-byte alignment (8-byte alignment is recommended for better performance.)

### 1.2.6 Output (destination) pixel boundary

| | |
|---|---|
| RGB | 1 × 1 pixel |
| YUV | 2 × 1 pixels |

### 1.2.7 Input (source) pixel boundary

| | |
|---|---|
| RGB888 | 4 × 1 pixels |
| RGB565 | 2 × 1 pixels |
| YUV422 interleaved | 2 × 1 pixels |
| YUV420/422 semi-planar | 4 × 1 pixels |
| YUV420/422 planar | 8 × 1 pixels |

(Smaller boundaries than those shown above are possible if dummy pixels are used to ensure that 4 bytes are written.)

### 1.2.8 Restrictions on rotation channel

The following restrictions apply when the rotation channel is enabled:

- Up- or down- (1/1 to 1/4) scaling (HSTEP < 400H and VSTEP < 400H)
- When using 4 × 4 filtering, bits 2 to 0 of the FILTOPT register must be cleared to 0.
- The format can only be converted from YUV422 interleaved to 422 interleaved, 422 semi-planar, or 420 semi-planar.
- Input (source) address: 8-byte aligned
- Output (destination) address for the rotation channel: 8-byte aligned
- Input pixel boundary: 4 × 4 pixels

### 1.2.9 RGB to YUV and the YUV to RGB color conversion

It's possible to be to do setting appropriate to 9 registers of the color conversion coefficient and do the color change in RGB from YUV and YUV from RGB.

A setting example of a YUV to RGB conversion

$R = (298\times(Y-16) + 517\times U + 0\times V + 0) / 256$

$G = (298\times (Y-16) - 100\times U - 208\times V + 0) / 256$

$B = (298\times (Y-16) + 0\times U + 409\times V + 0) / 256$

SIZ_FILTOPT = 5<<8

SIZ_COEF_R0 = 0x12A
SIZ_COEF_R1 = 0x205
SIZ_COEF_R2 = 0x000
SIZ_COEF_R3 = 0x000
SIZ_COEF_G0 = 0x12A
SIZ_COEF_G1 = 0x79C
SIZ_COEF_G2 = 0x730
SIZ_COEF_G3 = 0x000
SIZ_COEF_B0 = 0x12A
SIZ_COEF_B1 = 0x000
SIZ_COEF_B2 = 0x199

SIZ_COEF_B3 = 0x000

2-7 (the YUV format) is designated in SIZ_SRCFMT.
0 or 1 (the RGB format) is designated in SIZ_DSTFMT.

The writing in address when inputting YUV data to a SIZ module, is as follows.
Y data 0xF8000000
UV or U data 0xFC000000
(When it's YUVsemi-planar, UV data is written in this address. When it's YUVplanar, U data is written in this address.).
V data 0xFE000000

A setting example of a RGB to YUV conversion

$$Y = (B0 \times R + B2 \times G + B1 \times B + 4096) / 256$$
$$U = (R0 \times R + R2 \times G + R1 \times B + 32768) / 256$$
$$V = (G0 \times R + G2 \times G + G1 \times B + 32768) / 256$$

SIZ_FILTOPT = 7<<8

SIZ_COEF_R0 = 0x7DA
SIZ_COEF_R1 = 0x070
SIZ_COEF_R2 = 0x7B6
SIZ_COEF_R3 = 0x000
SIZ_COEF_G0 = 0x070
SIZ_COEF_G1 = 0x7EE
SIZ_COEF_G2 = 0x7A2
SIZ_COEF_G3 = 0x000
SIZ_COEF_B0 = 0x042
SIZ_COEF_B1 = 0x019
SIZ_COEF_B2 = 0x081
SIZ_COEF_B3 = 0x000

0 or 1 (the RGB format) is designated in SIZ_SRCFMT.
2 to 6 (the YUV format) is designated in SIZ_DSTFMT.

The writing in address when inputting RGB data to a SIZ module, is as follows.
RGB data 0xF8000000

# 2. Registers

The SIZ registers can only be accessed in 32-bit units.
Do not access reserved registers. When a reserved register is read, the value 0000_0000H is returned.
Do not write any value other than 0 to reserved bits in each register.

## 2.1 Register List

Base address: E118_0000H

(1/2)

| Address | Register Name | Symbol | R/W | After Reset |
|---|---|---|---|---|
| 0000H | Horizontal pixel count setting register | SRCHSIZE | R/W | 0000_0000H |
| 0004H | Vertical pixel count setting register | SRCVSIZE | R/W | 0000_0000H |
| 0008H | Pixel format setting register | SRCFMT | R/W | 0000_0000H |
| 000CH | Horizontal destination setting register 1 | DSTHSIZE | R/W | 0000_0000H |
| 0010H | Vertical destination setting register 1 | DSTVSIZE | R/W | 0000_0000H |
| 0014H | Destination skip setting register | DSTHSKIP | R/W | 0000_0000H |
| 0018H | Destination address (YRGB) setting register | DSTADRYRGB | R/W | 0000_0000H |
| 001CH | Destination address (UV) setting register | DSTADRUV | R/W | 0000_0000H |
| 0020H | Destination address (V) setting register | DSTADRV | R/W | 0000_0000H |
| 0024H | Destination format setting register | DSTFMT | R/W | 0000_0000H |
| 0028H | Destination byte lane setting register | DSTBL | R/W | 0000_00E4H |
| 002CH | Horizontal magnification setting register | DSTHSTEP | R/W | 0000_0100H |
| 0030H | Vertical magnification setting register | DSTVSTEP | R/W | 0000_0100H |
| 0034H | Filtering option setting register | FILTOPT | R/W | 0000_0000H |
| 0038H | Horizontal destination setting register 2 | DSTHCROP | R/W | 0000_0000H |
| 003CH | Vertical destination setting register 2 | DSTVCROP | R/W | 0000_0000H |
| 0040H | Rotation channel destination address (YRGB) setting register | ROTDSTADRYRGB | R/W | 0000_0000H |
| 0044H | Rotation channel destination address (UV) setting register | ROTDSTADRUV | R/W | 0000_0000H |
| 0048H | Rotation channel function setting register | ROTMODE | R/W | 0000_0000H |
| 004CH | Rotation channel destination format setting register | ROTDSTFMT | R/W | 0000_0000H |
| 0050H | Status register | STAT | R | 0000_0000H |
| 0054H | Filtering coefficient setting register 0 | FILT0 | R/W | 00f8_0008H |
| 0058H | Filtering coefficient setting register 1 | FILT1 | R/W | 00e8_0018H |
| 005CH | Filtering coefficient setting register 2 | FILT2 | R/W | 00d8_0028H |
| 0060H | Filtering coefficient setting register 3 | FILT3 | R/W | 00c8_0038H |
| 0064H | Filtering coefficient setting register 4 | FILT4 | R/W | 00b8_0048H |
| 0068H | Filtering coefficient setting register 5 | FILT5 | R/W | 00a8_0058H |
| 006CH | Filtering coefficient setting register 6 | FILT6 | R/W | 0098_0068H |
| 0070H | Filtering coefficient setting register 7 | FILT7 | R/W | 0088_0078H |

(2/2)

| Address | Register Name | Symbol | R/W | After Reset |
|---|---|---|---|---|
| 0074H | Color conversion coefficient | COEF_R0 | R/W | 0000_03FBH |
| 0078H | Color conversion coefficient | COEF_R1 | R/W | 0000_05D1H |
| 007CH | Color conversion coefficient | COEF_R2 | R/W | 0000_05DBH |
| 0080H | Color conversion coefficient | COEF_R3 | R/W | 0000_027CH |
| 0084H | Color conversion coefficient | COEF_G0 | R/W | 0000_028FH |
| 0088H | Color conversion coefficient | COEF_G1 | R/W | 0000_063FH |
| 008CH | Color conversion coefficient | COEF_G2 | R/W | 0000_077FH |
| 0090H | Color conversion coefficient | COEF_G3 | R/W | 0000_07CFH |
| 0094H | Color conversion coefficient | COEF_B0 | R/W | 0000_05FCH |
| 0098H | Color conversion coefficient | COEF_B1 | R/W | 0000_05DAH |
| 009CH | Color conversion coefficient | COEF_B2 | R/W | 0000_0193H |
| 00A0H | Color conversion coefficient | COEF_B3 | R/W | 0000_03D3H |

## 2.2 Register Details

### 2.2.1 Horizontal pixel count setting register and vertical pixel count setting register

These registers (SRCHSIZE: 0000H and SRCVSIZE: 0004H) specify the number of pixels in a source image.

| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

| 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|---|---|---|---|---|---|---|---|
| Reserved | | | SRCHSIZE/SRCVSIZE | | | | |

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| SRCHSIZE/SRCVSIZE | | | | | | | |

| Name | R/W | Bit No. | After Reset | Description |
|---|---|---|---|---|
| Reserved | R | 31:13 | 0_0000H | Reserved. If these bits are read, 0 is returned for each bit. |
| SRCHSIZE | R/W | 12:0 | 0000H | Specify the number of pixels in the horizontal direction for images.<br>Specifiable range: 2 to 8,190 pixels |

| Name | R/W | Bit No. | After Reset | Description |
|---|---|---|---|---|
| Reserved | R | 31:13 | 0_0000H | Reserved. If these bits are read, 0 is returned for each bit. |
| SRCVSIZE | R/W | 12:0 | 0000H | Specify the number of pixels in the vertical direction for images.<br>Specifiable range: 2 to 8,190 pixels |

### 2.2.2 Pixel format setting register

This register (SRCFMT: 0008H) specifies the source image format.

| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

| 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | SRCFMT | | |

| Name | R/W | Bit No. | After Reset | Description |
|---|---|---|---|---|
| Reserved | R | 31:3 | 0000_0000H | Reserved. If these bits are read, 0 is returned for each bit. |
| SRCFMT | R/W | 2:0 | 0H | Specify the source image format.<br>0: RGB888<br>1: RGB565<br>2: YUV422 interleaved<br>3: YUV422 semi-planar<br>4: YUV422 planar<br>5: YUV420 semi-planar<br>6: YUV420 planar |

### 2.2.3 Horizontal destination setting register 1 and vertical destination setting register 1

These registers (DSTHSIZE: 00CH and DSTVSIZE: 0010H) specify the number of pixels in a destination image. By setting the number of pixels in the horizontal and vertical directions to a value smaller than the resized image, the right and lower edges can be cropped.

| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

| 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|---|---|---|---|---|---|---|---|
| Reserved | | | DSTHSIZE/DSTVSIZE | | | | |

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| DSTHSIZE/DSTVSIZE | | | | | | | |

| Name | R/W | Bit No. | After Reset | Description |
|---|---|---|---|---|
| Reserved | R | 31:13 | 0_0000H | Reserved. If these bits are read, 0 is returned for each bit. |
| DSTHSIZE | R/W | 12:0 | 0000H | Specify the number of pixels in the horizontal direction for images.<br>Specifiable range: 2 to 8,190 pixels |

| Name | R/W | Bit No. | After Reset | Description |
|---|---|---|---|---|
| Reserved | R | 31:13 | 0_0000H | Reserved. If these bits are read, 0 is returned for each bit. |
| DSTVSIZE | R/W | 12:0 | 0000H | Specify the number of pixels in the vertical direction for images.<br>Specifiable range: 2 to 8,190 pixels |

### 2.2.4 Destination skip setting register

This register (DSTHSKIP: 0014H) enables destination-address line skipping and input to the rotator (ROT). After the number of pixels specified for the DSTHSIZE register are output, DSTHSKIP address bytes are skipped to reach the next line. However, for U and V pixel values in the planar format, (DSTHSKIP/2) bytes are skipped.

| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

| 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|---|---|---|---|---|---|---|---|
| DSTHSKIP | | | | | | | |

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| DSTHSKIP | | | | | | | |

| Name | R/W | Bit No. | After Reset | Description |
|---|---|---|---|---|
| Reserved | R | 31:16 | 0000H | Reserved. If these bits are read, 0 is returned for each bit. |
| DSTHSKIP | R/W | 15:0 | 0000H | Specify the number of address bytes to skip. |

Input picture 800 × 480 pixel RGB565

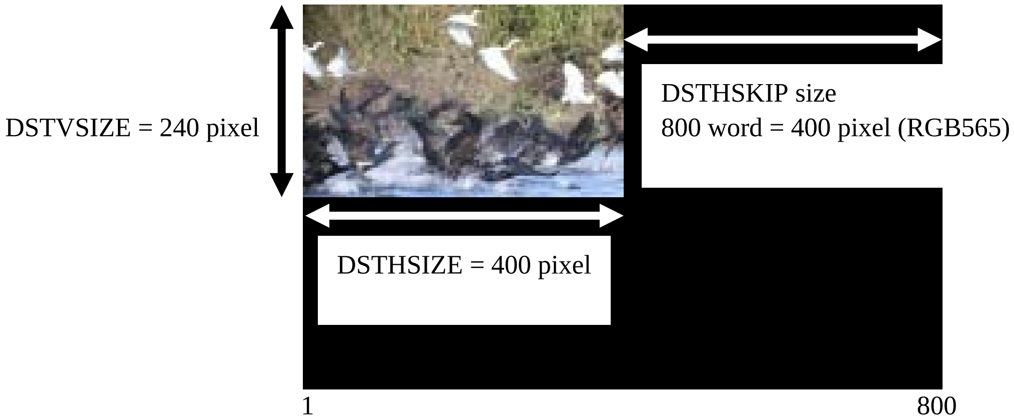
When combining with a RANDOM mode of ROT and using it, DSTHSKIP in SIZ is set appropriately. ROT-RANDOM mode has to write an input data in the address according to the setting of the MODE register BOUNDARY bit of ROT in the linear unit.

Example

Vertical direction 1/2 reduces 1/2 times of horizontal direction by the following setting.

SIZ_SRCHSIZE = 800 [pixel]
SIZ_SRCVSIZE = 480 [pixel]
SIZ_SRCFMT = 1 (RGB565)
SIZ_DSTHSIZE = 400 [pixel]
SIZ_DSTVSIZE = 240 [pixel]
SIZ_DSTHSKIP = 800 400pixel = 800word (At RGB565)
SIZ_HSTEP = 0x200 (Horizontal direction 1/2)
SIZ_VSTEP = 0x200 (Vertical direction 1/2)
SIZ_DSTHCROP = 0
SIZ_DSTVCROP = 0

The image which made a picture in 1/2 times of horizontal direction and 1/2 times of vertical direction in picture territory of 800×480.



### 2.2.5 Destination address (YRGB/UV/V) setting register and destination address setting registers

These registers (DSTADRYRGB: 0018H, DSTADRUV: 001CH, and DSTADRV: 0020H) specify the destination address in bytes.

| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 |
|---|---|---|---|---|---|---|---|
| DSTADR | | | | | | | |

| 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
|---|---|---|---|---|---|---|---|
| DSTADR | | | | | | | |

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|---|---|---|---|---|---|---|---|
| DSTADR | | | | | | | |

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| DSTADR | | | | | | | |

| Name | R/W | Bit No. | After Reset | Description |
|---|---|---|---|---|
| DSTADR | R/W | 31:0 | 0000_0000H | Destination address |

### 2.2.6 Destination format setting register

This register (DSTFMT: 0024H) specifies the destination image format.

| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

| 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | DSTFMT | | |

| Name | R/W | Bit No. | After Reset | Description |
|---|---|---|---|---|
| Reserved | R | 31:3 | 0000_0000H | Reserved. If these bits are read, 0 is returned for each bit. |
| DSTFMT | R/W | 2:0 | 0H | Specify the destination image format.<br>0: RGB888<br>1: RGB565<br>2: YUV422 interleaved<br>3: YUV422 semi-planar<br>4: YUV422 planar<br>5: YUV420 semi-planar<br>6: YUV420 planar |

### 2.2.7 Destination byte lane setting register

This register (DSTBL: 0028H) specifies the byte lane for a destination image.

| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

| 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

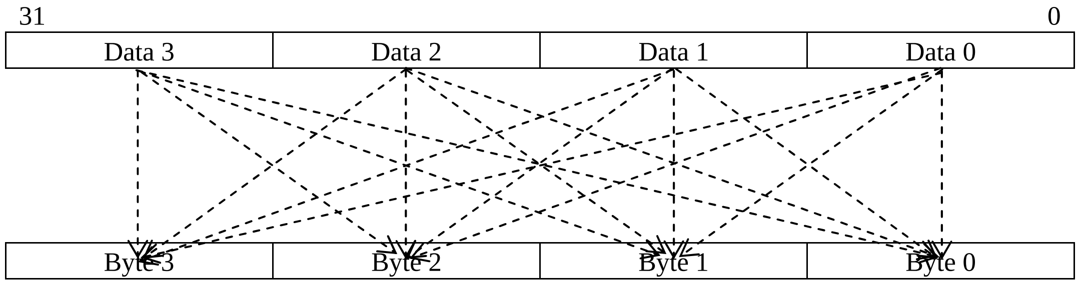
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| DSTBL | | | | | | | |

| Name | R/W | Bit No. | After Reset | Description |
|---|---|---|---|---|
| Reserved | R | 31:8 | 00_0000H | Reserved. If these bits are read, 0 is returned for each bit. |
| DSTBL | R/W | 7:0 | E4H | Specify the data to be written to exchange in bytes. For example, if these bits are set to 6CH, data bits 31 to 24 and 15 to 8 are exchanged.<br>DSTBL[7:6]: WDATA[31:24]<br>DSTBL[5:4]: WDATA[23:16]<br>DSTBL[2:3]: WDATA[15:8]<br>DSTBL[1:0]: WDATA[7:0] |

The relationships among data 3 to data 0 and byte 3 to byte 0 are as follows:

**Figure 2-1. Relationship Among Data and Bytes**




Data 3 to data 0 cannot be set to the same value.

The table below shows the combinations of values that can be specified. If other values are specified, data becomes undefined.

**Table 2-1. Combinations of Values That Can Be Specified**

| Data 3 | Data 2 | Data 1 | Data 0 | Value Specified for Register |
|---|---|---|---|---|
| 3 | 2 | 1 | 0 | E4 |
| 3 | 2 | 0 | 1 | E1 |
| 3 | 1 | 2 | 0 | D8 |
| 3 | 1 | 0 | 2 | D2 |
| 3 | 0 | 2 | 1 | C9 |
| 3 | 0 | 1 | 2 | C6 |
| 2 | 3 | 1 | 0 | B4 |
| 2 | 3 | 0 | 1 | B1 |
| 2 | 1 | 3 | 0 | 9C |
| 2 | 1 | 0 | 3 | 93 |
| 2 | 0 | 3 | 1 | 8D |
| 2 | 0 | 1 | 3 | 87 |
| 1 | 3 | 2 | 0 | 78 |
| 1 | 3 | 0 | 2 | 72 |
| 1 | 2 | 3 | 0 | 6C |
| 1 | 2 | 0 | 3 | 63 |
| 1 | 0 | 3 | 2 | 4E |
| 1 | 0 | 2 | 3 | 4B |
| 0 | 3 | 2 | 1 | 39 |
| 0 | 3 | 1 | 2 | 36 |
| 0 | 2 | 3 | 1 | 2D |
| 0 | 2 | 1 | 3 | 27 |
| 0 | 1 | 3 | 2 | 1E |
| 0 | 1 | 2 | 3 | 1B |

### 2.2.8 Horizontal magnification setting register and vertical magnification setting register

These registers (DSTHSTEP: 002CH and DSTVSTEP: 0030H) specify the magnification rate for resizing in 256 steps.

| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

| 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|---|---|---|---|---|---|---|---|
| Reserved | | DSTHSTEP/DSTVSTEP | | | | | |

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| DSTHSTEP/DSTVSTEP | | | | | | | |

| Name | R/W | Bit No. | After Reset | Description |
|---|---|---|---|---|
| Reserved | R | 31:14 | 0_0000H | Reserved. If these bits are read, 0 is returned for each bit. |
| DSTHSTEP | R/W | 13:0 | 100H | Specify the magnification rate for resizing in the horizontal direction in 256 steps. (256/step)<br>0 is setting prohibited. |

| Name | R/W | Bit No. | After Reset | Description |
|---|---|---|---|---|
| Reserved | R | 31:14 | 0_0000H | Reserved. If these bits are read, 0 is returned for each bit. |
| DSTVSTEP | R/W | 13:0 | 100H | Specify the magnification rate for resizing in the vertical direction in 256 steps. (256/step)<br>0 is setting prohibited. |

### 2.2.9 Filtering option setting register

This register (FILTOPT: 0034H) specifies the filtering options.

| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

| 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|---|---|---|---|---|---|---|---|
| Reserved | COLCONV | | | | | | |

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | MODE | | |

(1/2)

| Name | R/W | Bit No. | After Reset | Description |
|---|---|---|---|---|
| Reserved | R | 31:15 | 0_0000H | Reserved. If these bits are read, 0 is returned for each bit. |
| COLCONV | R/W | 14:8 | 00H | Specify how to convert colors for the output resized image.<br>0: Do not convert colors.<br>1: Replace the higher 4 bits ([7:4]) of each RGB888 (RGB565) or YUV420 (YUV422) color component with the SRAM values.<br>R[7:4] = SRAM (B[7:4], G[7:4], R[7:4]) [3:0];<br>G[7:4] = SRAM (B[7:4], G[7:4], R[7:4]) [7:4];<br>B[7:4] = SRAM (B[7:4], G[7:4], R[7:4]) [11:8];<br>(For YUV, R = U, G = V, and B = Y)<br>8H to FH: If the highest bits of each color component (a total of 3 bits) match bits 2 to 0 of COLCONV, replace bits 6 to 3.<br>If R7 = COLCONV0, G7 = COLCONV1, and B7 = COLCONV2,<br>R[6:3] = SRAM (B[6:3], G[6:3], R[6:3]) [3:0];<br>G[6:3] = SRAM (B[6:3], G[6:3], R[6:3]) [7:4];<br>B[6:3] = SRAM (B[6:3], G[6:3], R[6:3]) [11:8]<br>40H to 7FH: If the higher 2 bits of each color component (a total of 6 bits) match bits 5 to 0 of COLCONV, replace bits 5 to 2.<br>If R[7:6] = COLCONV[1:0], G[7:6] = COLCONV[3:2], and B[7:6] = COLCONV[5:4],<br>R[5:2] = SRAM (B[5:2], G[5:2], R[5:2]) [3:0];<br>G[5:2] = SRAM (B[5:2], G[5:2], R[5:2]) [7:4];<br>B[5:2] = SRAM (B[5:2], G[5:2], R[5:2]) [11:8]<br>0x4 : Refer to the following<br>0x5 : At the time of a YUV-> RGB conversion.<br>0x6 : Refer to the following<br>0x7 : At the time of a RGB-> YUV conversion. |
| Reserved | R | 7:3 | 00H | Reserved. If these bits are read, 0 is returned for each bit. |

(2/2)

| Name | R/W | Bit No. | After Reset | Description |
|---|---|---|---|---|
| MODE | R/W | 2:0 | 0H | 0: 4 × 4 filtering with COEF0 and COEF3 handled as negative values<br>(When using the rotation channel, clear these bits to 0.)<br>1: 4 × 4 filtering with COEF0 and COEF3 handled as positive values<br>2: 2 × 2 filtering but 4-line buffering (overrun tolerant)<br>3: Reserved<br>4: 2 × 2 filtering<br>5: Reserved<br>6: Table write mode<br>7: Reserved |

### 2.2.10 Horizontal destination setting register 2 and vertical destination setting register 2

These registers (DSTHCROP: 0038H and DSTVCROP: 003CH) specify the number of pixels to crop for a destination image. By setting the number of pixels in the horizontal and vertical directions for a destination image to a value other than 0, the left and top edges can be cropped.

| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

| 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|---|---|---|---|---|---|---|---|
| Reserved | | | DSTHCROP/DSTVCROP | | | | |

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| DSTHCROP/DSTVCROP | | | | | | | |

| Name | R/W | Bit No. | After Reset | Description |
|---|---|---|---|---|
| Reserved | R | 31:13 | 0_0000H | Reserved. If these bits are read, 0 is returned for each bit. |
| DSTHCROP | R/W | 12:0 | 0000H | Specify the number of pixels in the horizontal direction for images.<br>Specifiable range: 2 to 8,190 pixels |

| Name | R/W | Bit No. | After Reset | Description |
|---|---|---|---|---|
| Reserved | R | 31:13 | 0_0000H | Reserved. If these bits are read, 0 is returned for each bit. |
| DSTVCROP | R/W | 12:0 | 0000H | Specify the number of pixels in the vertical direction for images.<br>Specifiable range: 2 to 8,190 pixels |

Input picture 800 × 480 pixel RGB565

Example 1)

Horizontal direction is magnified with the following setting 2 times and horizontal direction left side 400pixel is cropped.

SIZ_SRCHSIZE = 800 [pixel]
SIZ_SRCVSIZE = 480 [pixel]
SIZ_SRCFMT = 1 (RGB565)
SIZ_DSTHSIZE = 1200 [pixel]
SIZ_DSTVSIZE = 480 [pixel]
SIZ_DSTHSKIP = 0
SIZ_DSTFMT = 1 (RGB565)
SIZ_HSTEP = 0x80 (Horizontal direction 2 times)
SIZ_VSTEP = 0x100 (Vertical direction 1 time)
SIZ_DSTHCROP = 400 [pixel]
SIZ_DSTVCROP = 0
M2M_LCH0_AADD = 0x40000000 (Start address of an input picture of RGB565)
M2M_LCH0_BADD = 0xF8000000 (The writing in address to SIZ）
M2M_LCH0_LENG = 768000 [Byte] (800pixel × 480pixel = 384000pixel = 768000Byte at RGB565 )
M2M_LCH0_SIZE = 768000 [Byte]
M2M_LCH0_AOFF = 0 [Byte]
M2M_LCH0_MODE = 0xE4E40000
M2M_CONT = 1 (DMA start)

Horizontal direction two times and picture of DSTHSIZE=1200pixel

1 400 800 1200

The picture cut down in DSTHCROP=400

DSTHCROP = 400 pixel

1 800

Example 2)

A vertical direction magnifies horizontal direction quadruple expansion with the following setting 4 times, and horizontal direction left side 1200pixel is cropped.

SIZ_SRCHSIZE = 800 [pixel]
SIZ_SRCVSIZE = 480 [pixel]
SIZ_SRCFMT = 1 (RGB565)
SIZ_DSTHSIZE = 2000 [pixel] Horizontal direction is cropped in 2000pixel.
SIZ_DSTVSIZE = 480 [pixel] Vertical direction is cropped in 480pixel.
SIZ_DSTHSKIP = 0
SIZ_DSTFMT = 1 (RGB565)
SIZ_HSTEP = 0x40 (Horizontal direction 4times)
SIZ_VSTEP = 0x40 (Vertical direction 4 times)
SIZ_DSTHCROP = 1200 [pixel]
SIZ_DSTVCROP = 0
M2M_LCH0_AADD = 0x40000000 (Start address of an input picture of RGB565)
M2M_LCH0_BADD = 0xF8000000 (The writing in address to SIZ)
M2M_LCH0_LENG = 768000 [Byte] (800pixel × 480pixel = 384000pixel = 768000Byte at RGB565)
M2M_LCH0_SIZE = 768000 [Byte]
M2M_LCH0_AOFF = 0 [Byte]
M2M_LCH0_MODE = 0xE4E40000
M2M_CONT = 1 (DMA start)

Input picture 800 × 480 pixel RGB565

480 pixel

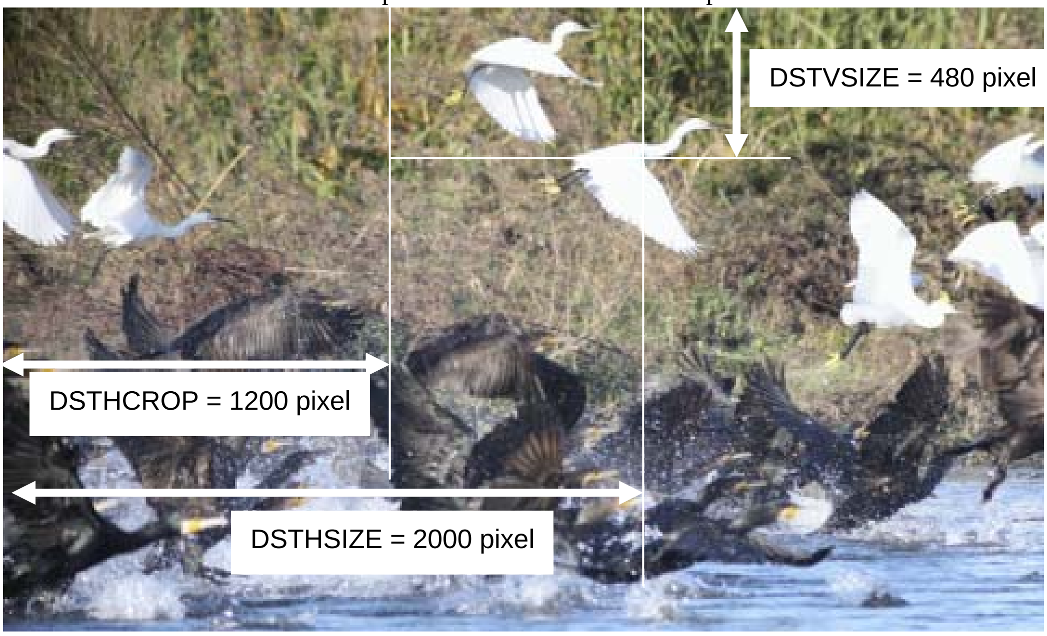
800 pixel

The picture cut down in DSTHCROP=1200

480 pixel

800 pixel

Horizontal direction two times and picture of DSTHSIZE = 2000 pixel




It's also possible to get the same result as the above by the following setting.

SIZ writes only necessary data in SIZ using M2M-DMA, and outputs the result each level verticalness did 4 times.

SIZ_SRCHSIZE = 200 [pixel]

SIZ_SRCVSIZE = 120 [pixel]

SIZ_SRCFMT = 1 (RGB565)

SIZ_DSTHSIZE = 800 [pixel]

SIZ_DSTVSIZE = 480 [pixel]

SIZ_DSTHSKIP = 0

SIZ_DSTFMT = 1 (RGB565)

SIZ_HSTEP = 0x40 (Horizontal 4 times))

SIZ_VSTEP = 0x40 (Vertical 4 times)

SIZ_DSTHCROP = 0

SIZ_DSTVCROP = 0

M2M_LCH0_AADD = 0x40000256 (Start address of an input picture of RGB565. Location =600Byte=0x258 of 300pixel)

M2M_LCH0_BADD = 0xF8000000 (The writing in address to SIZ)

M2M_LCH0_LENG = 48000 [Byte] (200pixel × 120pixel = 24000pixel = 48000Byte at RGB565)

M2M_LCH0_SIZE = 400 [Byte] (200pixel = 400Byte at RGB565)

M2M_LCH0_AOFF = 1200 [Byte] (800pixel - 200pixel = 600pixel = 1200Byte at RGB565)

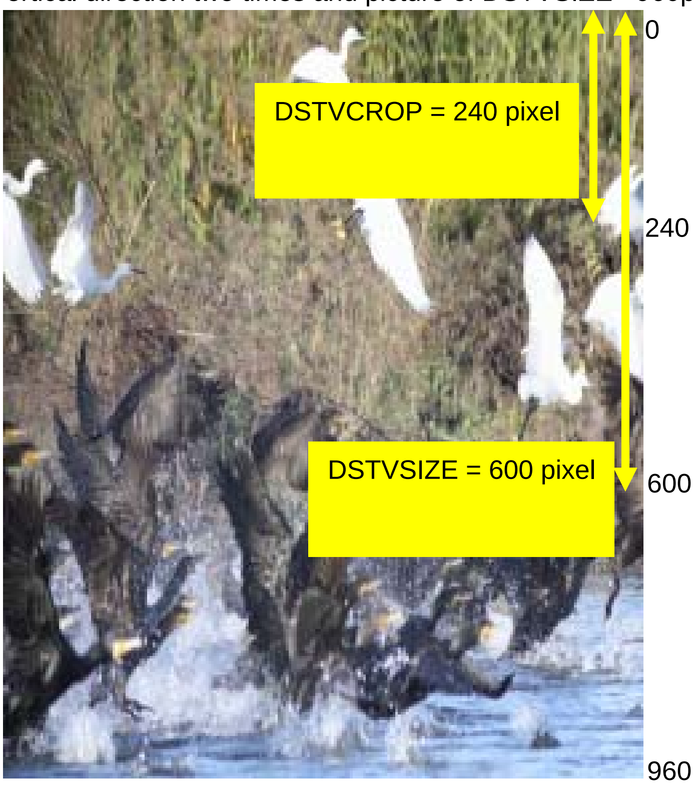
M2M_LCH0_MODE = 0xE4E40000
M2M_CONT = 1 (DMA start)

Example 3)

A vertical direction is magnified with the following setting 2 times and vertical direction upper side 240pixel is cropped.

SIZ_SRCHSIZE = 800 [pixel]
SIZ_SRCVSIZE = 480 [pixel]
SIZ_SRCFMT = 1 (RGB565)
SIZ_DSTHSIZE = 800 [pixel]
SIZ_DSTVSIZE = 600 [pixel]    A vertical direction is cropped in 600pixel.
SIZ_DSTHSKIP = 0
SIZ_DSTFMT = 1 (RGB565)
SIZ_HSTEP = 0x100 (Horizontal 1 time))
SIZ_VSTEP = 0x80 (Vertical 2 times)
SIZ_DSTHCROP = 0 [pixel]
SIZ_DSTVCROP = 240 [pixel]
M2M_LCH0_AADD = 0x40000000 (Start address of an input picture of RGB565)
M2M_LCH0_BADD = 0xF8000000(The writing in address to SIZ )
M2M_LCH0_LENG = 768000 [Byte] (800pixel × 480pixel = 384000pixel = 768000Byte at RGB565)
M2M_LCH0_SIZE = 768000 [Byte]
M2M_LCH0_AOFF = 0 [Byte]
M2M_LCH0_MODE = 0xE4E40000
M2M_CONT = 1 (DMA start)

Vertical direction two times and picture of DSTVSIZE =960pixel



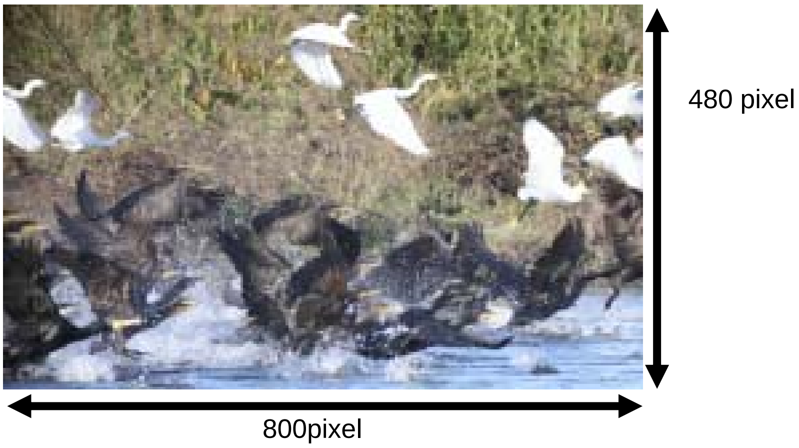

The picture cut down in DSTVCROP=240

Example 4)

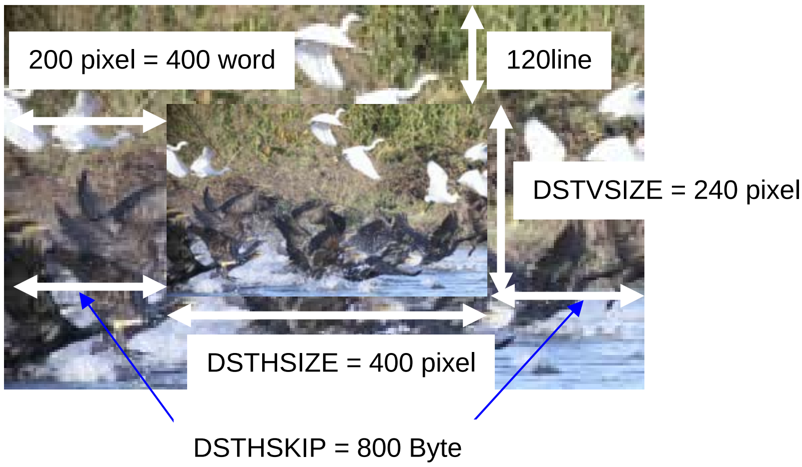
1/2 times of vertical direction reduces horizontal direction 1/2 and arranges in the center of the former picture by the following setting.

SIZ_SRCHSIZE = 800 [pixel]
SIZ_SRCVSIZE = 480 [pixel]
SIZ_SRCFMT = 1 (RGB565)
SIZ_DSTHSIZE = 400 [pixel]
SIZ_DSTVSIZE = 240 [pixel]
SIZ_DSTHSKIP = 800
SIZ_DSTFMT = 1 (RGB565)
SIZ_HSTEP = 0x200 (Horizontal 1/2)
SIZ_VSTEP = 0x200 (Vertical 1/2)
SIZ_DSTHCROP = 0
SIZ_DSTVCROP = 0
SIZ_DSTADRYRGB ＝ 0x4002EF90
0x40000000 (The upper left of a original picture）+ (800pixel × 2[word] ) × 120line + 200pixel × 2 [word] = 0x4002EF90
M2M_LCH0_AADD = 0x40000000 (Start address of an input picture of RGB565)
M2M_LCH0_BADD = 0xF8000000 (The writing in address to SIZ )
M2M_LCH0_LENG = 768000 [Byte] (800pixel × 480pixel = 384000pixel = 768000Byte at RGB565)
M2M_LCH0_SIZE = 768000 [Byte]
M2M_LCH0_AOFF = 0 [Byte]
M2M_LCH0_MODE = 0xE4E40000
M2M_CONT = 1 (DMA start)

Input picture 800×480pixel RGB565




The picture reduced in 1/2 or horizontal direction vertical direction 1/2 in a central part in the input picture part is overwritten.



### 2.2.11 Rotation channel destination address (YRGB/UV) setting registers

These registers (ROTDSTADRYRGB: 0040H and ROTDSTADRUV: 0044H) specify the destination address on the rotation channel in bytes.

| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 |
|---|---|---|---|---|---|---|---|
| DSTADR | | | | | | | |

| 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
|---|---|---|---|---|---|---|---|
| DSTADR | | | | | | | |

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|---|---|---|---|---|---|---|---|
| DSTADR | | | | | | | |

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| DSTADR | | | | | 0 | | |

| Name | R/W | Bit No. | After Reset | Description |
|---|---|---|---|---|
| DSTADR | R/W | 31:0 | 0000_0000H | Destination address |

### 2.2.12 Rotation channel function setting register

This register (ROTMODE: 0048H) sets up the features used on the rotation channel. Flipping in the X or Y direction is executed followed by rotating to output an image.

| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

| 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | YMIRROR | XMIRROR | MODE | |

| Name | R/W | Bit No. | After Reset | Description |
|---|---|---|---|---|
| Reserved | R | 31:4 | 000_0000H | Reserved. If these bits are read, 0 is returned for each bit. |
| YMIRROR | R/W | 3 | 0 | Specify whether to flip images in the Y direction.<br>0: Do not flip 1: Flip |
| XMIRROR | R/W | 2 | 0 | Specify whether to flip images in the X direction.<br>0: Do not flip 1: Flip |
| MODE | R/W | 1:0 | 00b | Specify the rotation direction.<br>00: Do not rotate<br>01: 90°<br>10: 180°<br>11: 270° |

### 2.2.13 Rotation channel destination format setting register

This register (ROTDSTFMT: 004CH) specifies the destination format on the rotation channel.

| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

| 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | DSTFMT | | |

| Name | R/W | Bit No. | After Reset | Description |
|---|---|---|---|---|
| Reserved | R | 31:3 | 0000_0000H | Reserved. If these bits are read, 0 is returned for each bit. |
| DSTFMT | R/W | 2:0 | 0H | Specify the destination image format.<br>0: Disable the rotation channel.<br>2: YUV422 interleaved<br>3: YUV422 semi-planar<br>5: YUV420 semi-planar |

### 2.2.14 Status register

This register (STAT: 0050H) indicates whether the SIZ module is running. When inputting a source image starts, this register is set to 1. When one frame is input and the resized (and rotated) image is output, this register is cleared to 0. It takes about 200 $\mu$s (1,000 pixels × 4 lines × magnification rate × 6 ns) at most from when one frame is input (an interrupt from another component such as the CAM occurs) until the resized image is output.

| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

| 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | STAT |

| Name | R/W | Bit No. | After Reset | Description |
|---|---|---|---|---|
| Reserved | R | 31:2 | 0000_0000H | Reserved. If these bits are read, 0 is returned for each bit. |
| STAT | R | 0 | 0 | Indicates the SIZ module running status.<br>0: Inactive<br>1: Active |

### 2.2.15 Filtering coefficient setting registers 0 to 7

FILT0: 0054H
FILT1: 0058H
FILT2: 005CH
FILT3: 0060H
FILT4: 0064H
FILT5: 0068H
FILT6: 006CH
FILT7: 0070H

These registers specify filtering coefficients.

| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 |
|---|---|---|---|---|---|---|---|
| COEF0 | | | | | | | COEF1 |

| 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
|---|---|---|---|---|---|---|---|
| COEF1 | | | | | | | |

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|---|---|---|---|---|---|---|---|
| COEF3 | | | | | | | COEF2 |

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| COEF2 | | | | | | | |

| Name | R/W | Bit No. | After Reset | Description |
|---|---|---|---|---|
| COEF0 | R/W | 31:25 | 00H | Coefficient 0 |
| COEF1 | R/W | 24:16 | 000H | Coefficient 1 |
| COEF3 | R/W | 15:9 | 00H | Coefficient 3 |
| COEF2 | R/W | 8:0 | 000H | Coefficient 2 |

FILT configuration examples

| | **Sharpness** | **lanczos2** | **Smoothing** |
|---|---|---|---|
| FILTOPT[0] | 0 | 0 | 1 |
| FILT0 | 1105_0A08H | 0AFF_0205H | 8872_0249H |
| FILT1 | 2D08_1A1BH | 1AFB_0212H | 7E70_0A4CH |
| FILT2 | 4507_2A30H | 24F3_0421H | 746D_1250H |
| FILT3 | 5701_3C48H | 2AE7_0832H | 6A6C_1853H |
| FILT4 | 64F7_4A60H | 2ED8_0C46H | 606A_2056H |
| FILT5 | 6CE9_5879H | 2CC7_125BH | 5668_2859H |
| FILT6 | 70D6_6293H | 2AB3_1871H | 4C65_325CH |
| FILT7 | 70C2_6AABH | 249D_1E87H | 4463_3A5EH |

### 2.2.16 The color conversion coefficient

COEF_R0: 0074H
COEF_R1: 0078H
COEF_R2: 007CH
COEF_R3: 0080H
COEF_G0: 0084H
COEF_G1: 0088H
COEF_G2: 008CH
COEF_G3: 0090H
COEF_B0: 0094H
COEF_B1: 0098H
COEF_B2: 009CH
COEF_B3: 00A0H

These registers specify color conversion coefficients.

| 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

| 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | | | |

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|---|---|---|---|---|---|---|---|
| Reserved | | | | | C_COEF | | |

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|
| C_COEF | | | | | | | |

| Name | R/W | Bit No. | After Reset | Description |
|---|---|---|---|---|
| Reserved | R | 31:11 | 00_0000H | Reserved. If these bits are read, 0 is returned for each bit. |
| C_COEF | R/W | 10:0 | 000H | The color conversion coefficient. Bit [10] is a sign bit. |

The value of RGB is calculated by the following arithmetic expression.

$R = (R0\times(Y-16) + R1\times U + R2\times V + 0) / 256$

$G = (G0\times(Y-16) + G1\times U + G2\times V + 0) / 256$

$B = (B0\times(Y-16) + B1\times U + B2\times V + 0) / 256$

A register of COEF_R3, COEF_G3, COEF_B3 doesn't use.

# 3. Description of Functions

## 3.1 Input from M2M-DMA

Resize and/or Rotate is possible to designate Destination address of M2M-DMA as the SIZ range. But, there is necessity to establish M2M-DMA so that below may be filled.

1. Input to SIZ sets it as the M2M_LCH*_SIZE=line byte amount because there is needing burst can stop every line.
2. When inputting semi - planar or planar, it's set as "M2M_LCH*_MODE[7:6]=0" and logical channel is started at the same time using logical channel of 2 or 3. To make the entry sequence Y⇒ U⇒ V, one of procedures are used in the following.
   A) M2M-DMA, once, reset, (A DMA start from channel 0.)
   B) One of channel 0 or 3~7 is started once. (A possibility that a DMA is started from channel 1 or 2 is excluded.)
   C) It's set as SIZ_FILTOPT [25:24 ]= 3. (Consideration of channel ordering becomes unnecessary, but, throughput falls about 18 %.)
3. To have to input UV:1line to Y:2line in case of YUV420, logical channel used by the UV is set as M2M_LCH*_MODE [7:6]= 1.

The setting example which inputs YUV420semi-planar to SIZ by M2M-DMA is indicated in the following.

```
M2M_LCH0_AADD=0x40001234;// src address of Y
M2M_LCH0_BADD=0xF8000000;// dst address of Y
M2M_LCH0_LENG=640*480;              // total size of Y
M2M_LCH0_SIZE      =640;                       // horizontal size of Y
M2M_LCH0_MODE=0xE4E40000;           // [7:6]=0
M2M_LCH1_AADD=0x40001234+640*480;           // src address of UV
M2M_LCH1_BADD=0xFC000000;           // dst address of UV
M2M_LCH1_LENG=640*480/2;            // total size of UV
M2M_LCH1_SIZE      =640;                       // horizontal size of UV
M2M_LCH1_MODE=0xE4E40040;           // [7:6]=1
// scenario B)
M2M_LCH7_AADD=0x70000000;// tmp address
M2M_LCH7_BADD=0x70000000;// tmp address
M2M_LCH7_LENG=1;                    //
M2M_LCH7_SIZE      =1;                         //
M2M_CONT    =0x80;                  // start LCH7 to set channel ordering
M2M_CONT    =3;                     // start LCH0 and LCH1 simultaneously
```

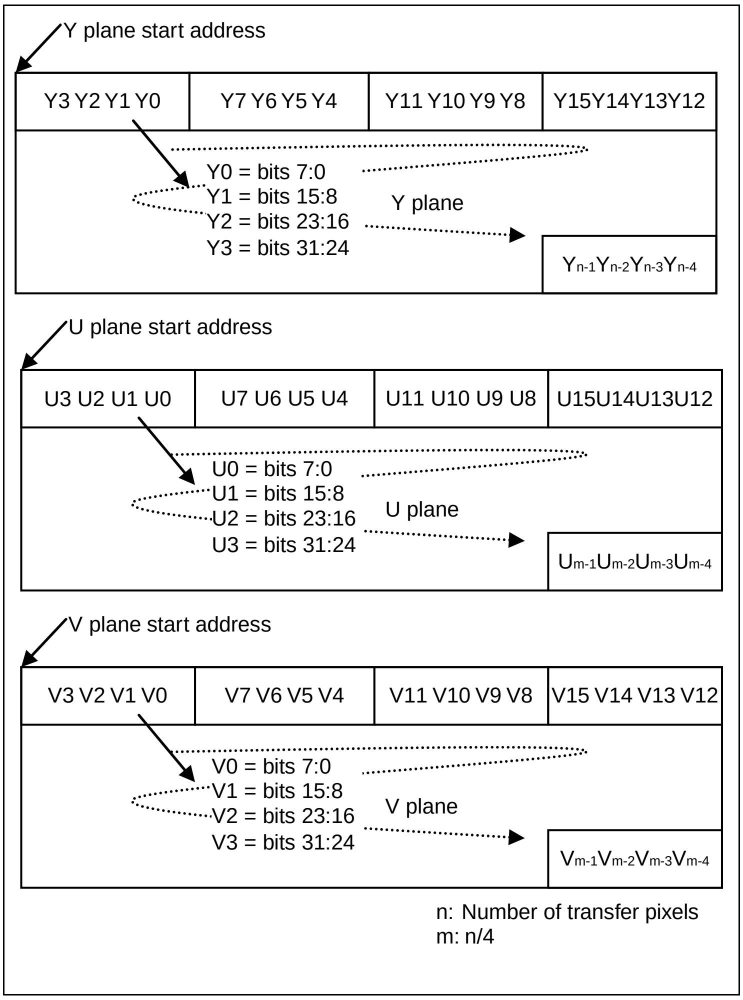
## 3.2 YUV Format

### 3.2.1 YUV420 format

YUV420 planar

Image data is transferred to the separate areas Y, U, and V in memory. (These areas are respectively referred to as the Y plane, U plane, and V plane in the figure below.) In each plane, any bytes can be replaced in 32-bit units. Figure 3-1 shows the format when little endian is specified.

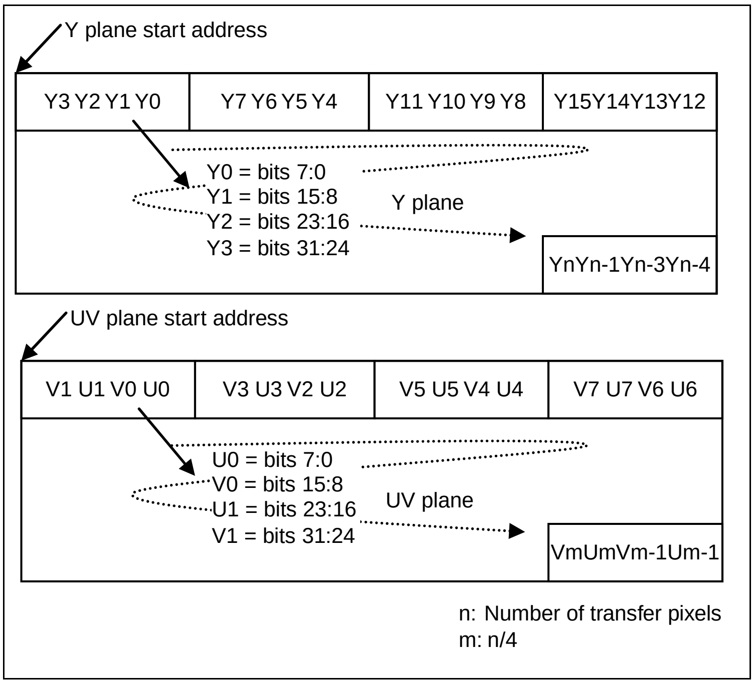
**Figure 3-1. YUV420 Planar Format**



YUV420 semi-planar

Image data is transferred to separate areas Y and UV in memory. (These areas are respectively referred to as Y plane and UV plane in the figure below.) In each plane, any bytes can be replaced in 32-bit units. Figure 3-2 shows the format when little endian is specified.

**Figure 3-2. YUV420 Semi-Planar Format**

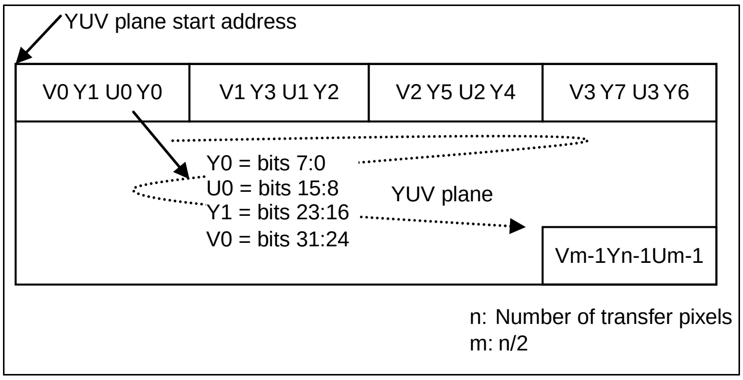


### 3.2.2 YUV422 format

YUV422 interleaved

Image data is transferred from the memory area where YUV is interleaved. (This area is referred to as the YUV plane in the figure below.) In the plane, any bytes can be replaced in 32-bit units. Figure 3-3 shows the format when a VYUY data sequence is specified.

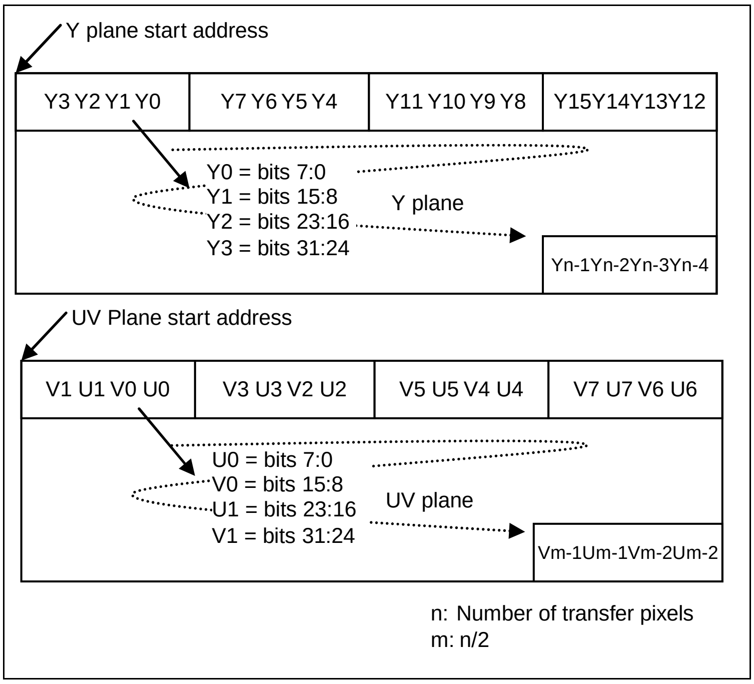
**Figure 3-3. YUV422 Interleaved Format**




YUV422 semi-planar

Image data Y and UV are transferred from separate memory areas. (These areas are referred to as the Y plane and UV plane in the figure below.) In each plane, any bytes can be replaced in 32-bit units. Figure 3-4 shows the format when little endian is specified.

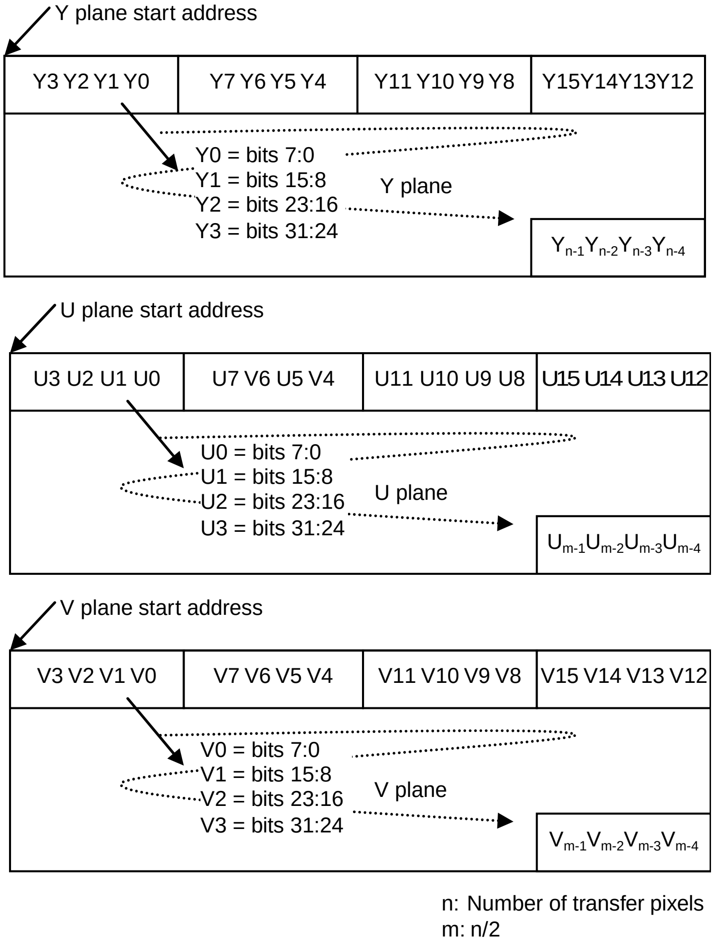
**Figure 3-4. YUV422 Semi-Planar Format**



YUV422 planar

Image data Y, U and V are transferred from separate memory areas. (These areas are referred to as the Y plane, U plane, and V plane in the figure below.) In each plane, any bytes can be replaced in 32-bit units. Figure 3-5 shows the format when little endian is specified.

**Figure 3-5. YUV422 Planar Format**

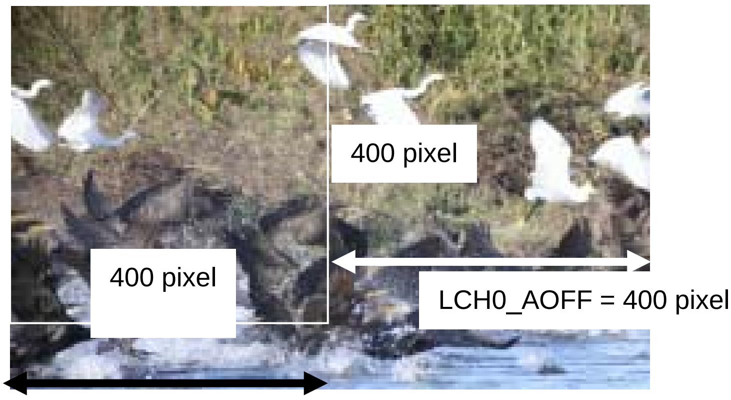



### 3.2.3 RGB format

<table>
<tr><td>Plane</td><td>Address</td><td>31</td><td>30</td><td>29</td><td>28</td><td>27</td><td>26</td><td>25</td><td>24</td><td>23</td><td>22</td><td>21</td><td>20</td><td>19</td><td>18</td><td>17</td><td>16</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td rowspan="3">RGB</td><td>00</td><td colspan="8">B1</td><td colspan="8">R0</td><td colspan="8">G0</td><td colspan="8">B0</td></tr>
<tr><td>04</td><td colspan="8">G2</td><td colspan="8">B2</td><td colspan="8">R1</td><td colspan="8">G1</td></tr>
<tr><td>08</td><td colspan="8">R3</td><td colspan="8">G3</td><td colspan="8">B3</td><td colspan="8">R2</td></tr>
<tr><td colspan="34">Data storage image of RGB888</td></tr>
<tr><td>RGB</td><td>00</td><td colspan="5">R1</td><td colspan="6">G1</td><td colspan="5">B1</td><td colspan="5">R0</td><td colspan="6">G0</td><td colspan="5">B0</td></tr>
<tr><td colspan="34">Data storage image of RGB565</td></tr>
</table>

# 4. Usage

Input picture 800*400 YUV422IL




It rotate a part in input picture upper left 400×400pixel 90 deg by level vertical standard mode by the following setting.

SIZ_SRCHSIZE = 400 [pixel]
SIZ_SRCVSIZE = 400 [pixel]
SIZ_SRCFMT = 2 (YUV422IL)The format of the input picture of ROT is supporting only YUV422IL.
SIZ_DSTHSIZE = 200 [pixel] This parameter doesn't influence ROT output.
SIZ_DSTVSIZE = 200 [pixel] This parameter doesn't influence ROT output.
SIZ_DSTHSKIP = 0 This parameter doesn't influence ROT output.
SIZ_HSTEP = 0x200 (Horizontal 1 time) This parameter doesn't influence ROT output.
SIZ_VSTEP = 0x200 (Vertical 1 time) This parameter doesn't influence ROT output.
SIZ_DSTHCROP = 0 This parameter doesn't influence ROT output.
SIZ_DSTVCROP = 0 This parameter doesn't influence ROT output.
SIZ_ROTMODE = 1 (90 deg)
SIZ_ROTDSTFMT = 2 (YUV422IL)
M2M_LCH0_AADD = 0x40000000 (Start address of an input picture of the YUV422IL format)
M2M_LCH0_BADD = 0xF8000000 (The writing in address to SIZ)
M2M_LCH0_LENG = 320000 [Byte] (400pixel × 400pixel = 160000pixel = 320000Byte at YUV422IL)
M2M_LCH0_SIZE = 800 [Byte] (400pixel = 800Byte at YUV422IL)
M2M_LCH0_AOFF = 800 [Byte] (800pixel - 400pixel = 400pixel = 800Byte at YUV422IL)
M2M_LCH0_MODE = 0xE4E40000
M2M_CONT = 1 (DMA start)

Picture of horizontal, vertical, standard mode and 90 deg.

A ROT mode of SIZ outputs data in the address which continued. Line up and please change output data of a ROT mode as the need arises.

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