Application Note

Video Input of MB86295

History

10-12-02	MMi	V1.0	First version

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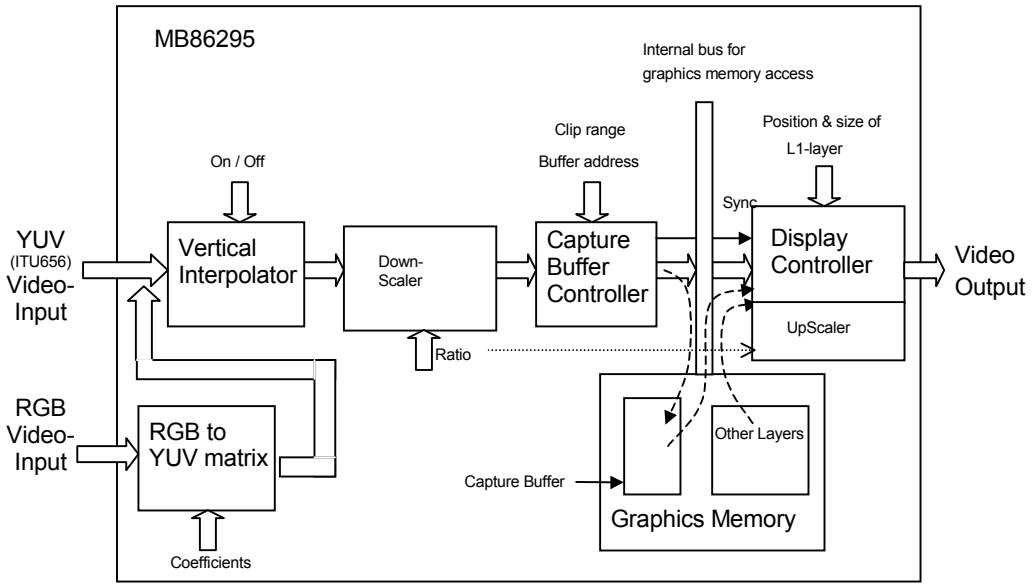
1. Overview

The video capture unit of MB86295 works as shown in figure below :



MB86295 accepts YUV422 (ITU656) or RGB666 video input streams. The ITU656 **video input stream** corresponds to the „CCIR International Radio Consultative Committee Recommendation 656 – Interfaces for digital component video signals in 525-line and 625-line television systems“. MB86295 is able to capture video stream data from the 8-bit VI pin in synchronization with the CCLK clock. In this mode, only a digital video stream conforming to ITU-RBT656 can be processed. For this reason, a Y,Cb,Cr 4:2:2 format to which timing reference codes are added is used. The video stream is captured according to the timing reference codes.

Incoming RGB666-data is internally converted to YUV422 using a programmable matrix which also allows contrast and brightness control by modifiing the matrix coefficients. Instead of the embedded sync code method used in ITU656 mode, the capture range in RGB mode must be specified by register parameters.

The **vertical interpolater** can be used for non-interlace convertion in BOB mode and adds rasters between even or odd field. The algorithm which is used is :

Generation of even rasters for odd fields :

```
pix[x,2n] = (pix[x,2n-1]+pix[x,2n+1])/2  (n=1,2,3, ... )
```

Generation of odd rasters for even fields :

```
pix[x,1]      = pix[x,2];
pix[x,2n-1] = (pix[x,2n]+pix[x,2+1])/2  (n=2,3,4, ... )
```

The down-**scaler** unit shrinks the input image with any given ratio. Bi-linear interplation is used for rational image size modification. The upscaling process takes the pictures from the Capture Buffer and works together with the Display Controller. Note that simultanous up- and downscaling is not possible.

The **capture buffer controller** stores image data into graphics memory after clipping. A circular buffer management is applied for writing data into the capture buffer. Image data is stored in YCbCr format in graphics memory in this format :

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Y0								Cb							

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Y1								Cr							

The **display controller** reads image data in video capture synchronously with capture operation and displays it on screen as L1-layer with other layers. Non-interlace conversion in WEAVE mode as well as the upscaling process is controlled by the display controller.

Coral supposes that YCbCr data is converted from RGB by following equations :

```
R' = (219/256)R+16, G'= (219/256)G+16, B'= (219/256)B+16
Y =  (77/256)R'+(150/256)G'+(29/256)B'
Cr = (131/256)R'-(110/256)G'-(21/256)B'+128
Cb = -(44/256)R'-(87/256)G' +(131/256)B'+128
```

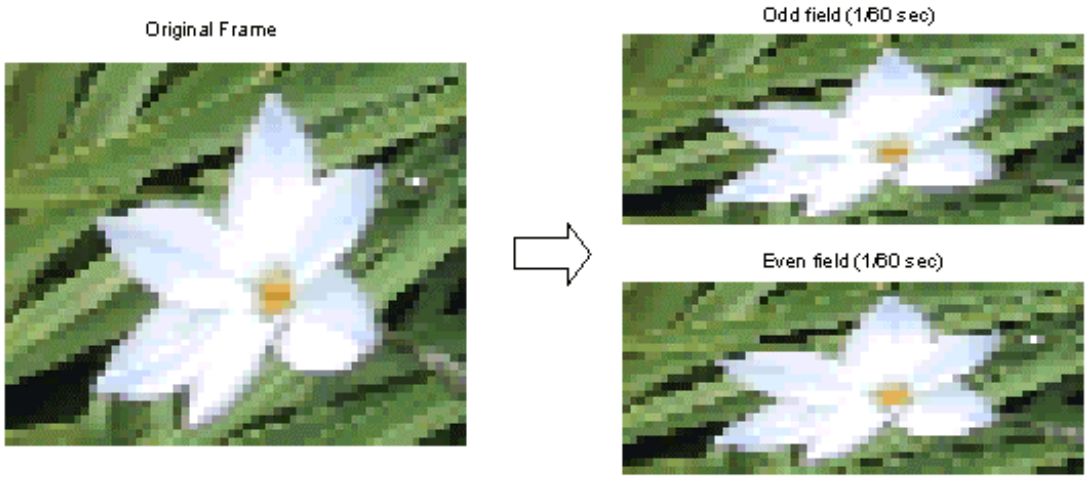
The inverse conversion of this is used for YCbCr data to display output.

Note :
- Each coefficient can be defined by registers.
- Cb and Cr components are reduced to half after the RGB→YCbCr operation to form in 4:2:2 format.

2. Modes of non-interlace convertion

Captured video graphics can be displayed in non-interlaced format. Two modes (BOB and WEAVE) can be selected at non-interlace transformation.

If an interlaced video stream is given as input :

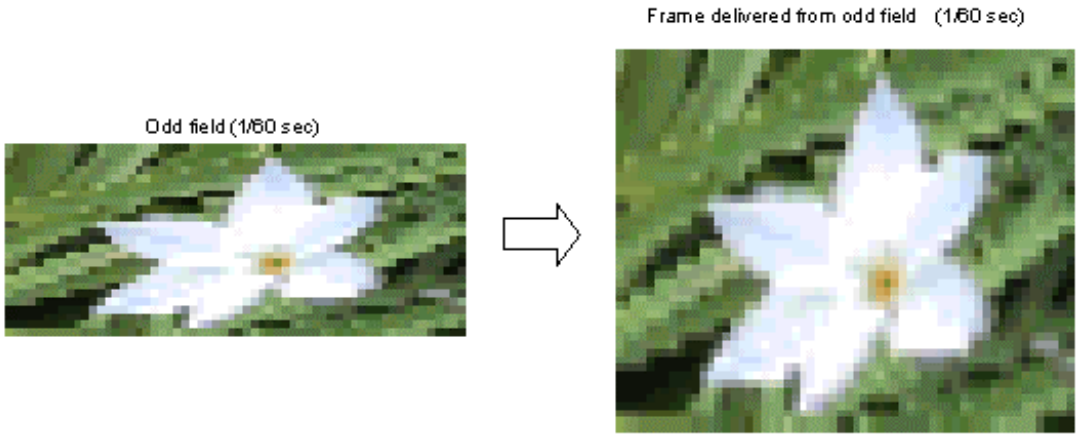


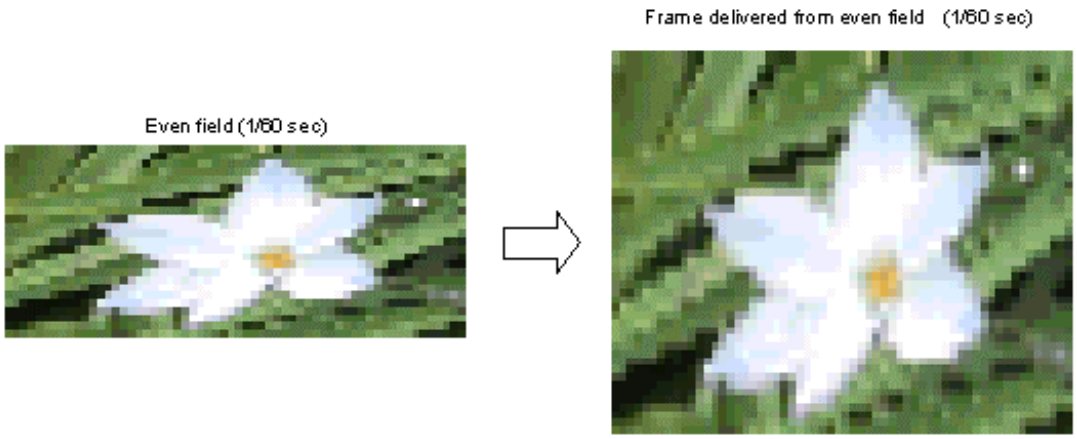
odd fields are transferred in the first 1/60 second and even fields are transferred in the next 1/60 second, so half number of rasters are included in each field. Note that 1/60 second is taken for one field in NTSC while 1/50 second is taken in PAL.

There are two modes of non-interlace convertion or BOB mode and WEAVE mode.

(1) BOB mode

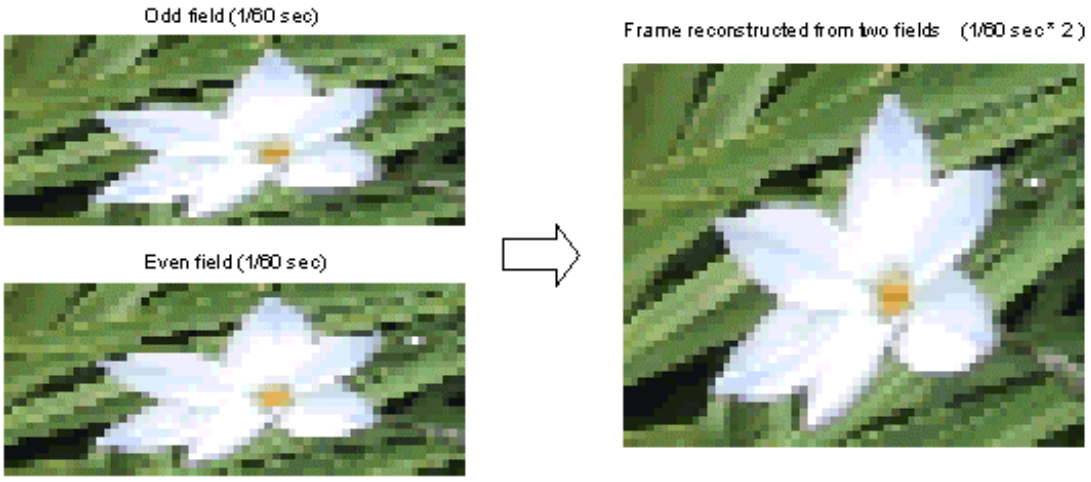
In BOB mode, odd fields are converted into a frame with interpolated rasters in 1/60 second. Even fields are converted in the next frame with interpolated rasters in 1/60 second. This operation is done by the vertical interpolator :





(2) WEAVE mode

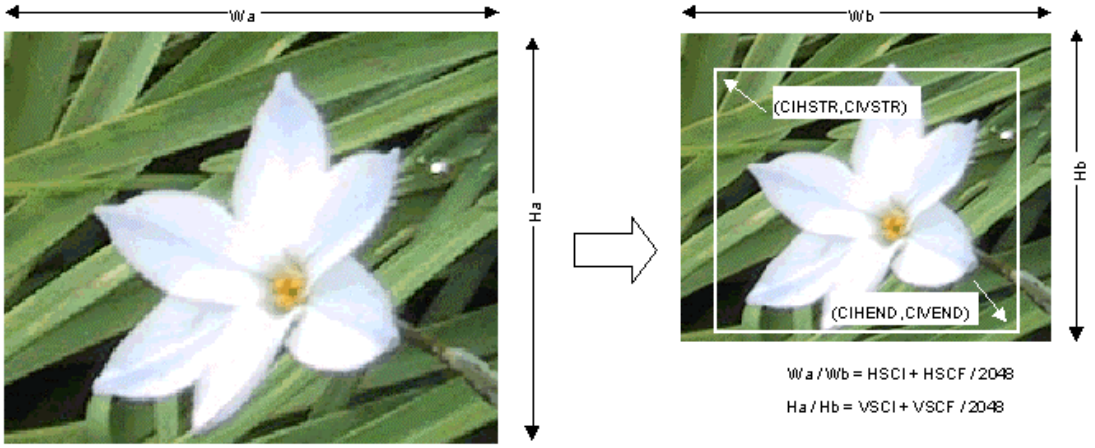
In weave mode, a frame is reconstructed from both the odd fields and even fields every 1/30 second and is displayed twice on screen in non-interlaced scanning in 1/30 second. This operation is done by the display controller. The vertical interpolator is not used for WEAVE mode.

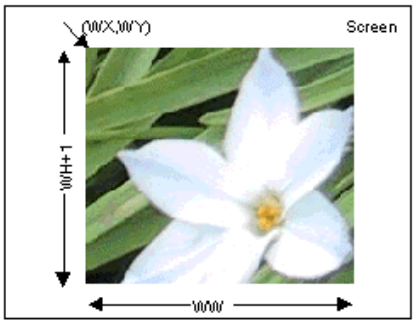


NOTE : The WEAVE mode is the appropriate mode for still pictures since the picture quality is higher compared to the BOB mode. Moving pictures in WEAVE mode will have some distortions due to the frame reconstruction from different fields. For moving pictures, the BOB mode is more appriopriate.

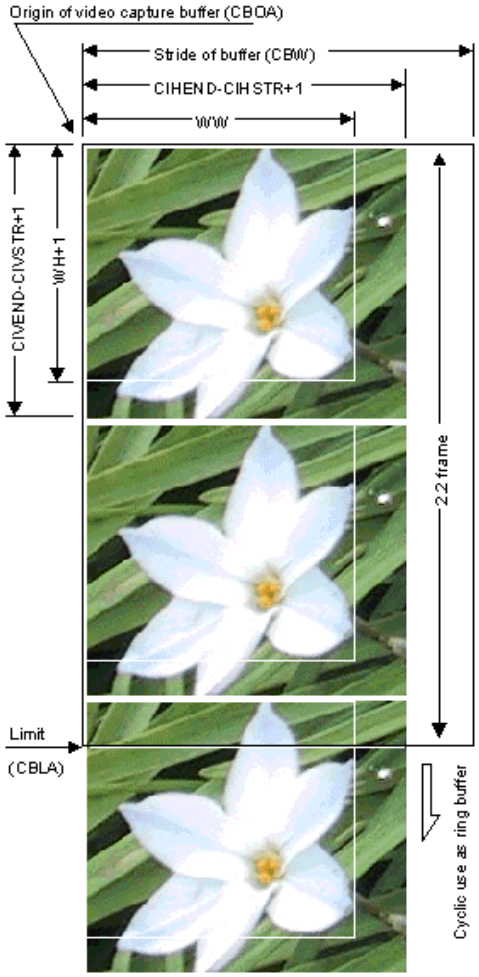
3. Applied parameters

The following parameters are applied during scaler operation :
(See explanations on next page)





(d) Displayed on screen



(c) Stored into video capture buffer

The original picture size is Wa, Ha. The size after scaling should be Wb, Hb.

(1) Scaler parameters

The scaler shrinks or enlarges input image with given ratios defined by the scaling registers. The input image size is defined by input data stream since input data stream includes HSYNC and VSYNC code.

Note : In BOB mode, only one field is passed to the scaler unit. This means if the input image is an 720*480 pixel interlaced frame, the parameters are : Ha = 480 in BOB mode, Ha = 240 in WEAVE mode and Wa = 720 in both modes.

The reduction scale is set by 5bit integer and 11bit fraction values for horizontal and vertical direction. So a setting of VSC=1.0 and HSC=1.0 would be represented by a value of 08000800_H in the CSC register. Valid settings for VSC and HSC are from 0800_H to $FFFF_H$. Set the vertical direction at bits 31 to 16 of the capture scale register (CSC) and the horizontal direction at bits 15 to 00. An example of the expressions for setting a reduction in the vertical and horizontal directions is shown below.
Reduction in vertical direction 576→ 490 lines 576/490 = 1.176
1.176 x 2048=2408→ 0968_H
Reduction in horizontal direction 720 → 648 pixels 720/648 = 1.111
1.111 x 2048=2275 → $08E3_H$
Therefore, $096808E3_H$ is set in CSC.

In order to use magnify (up-scaling) mode, the horizontal and vertical factor must be less than one. Do not specify different scaling ways (reduction/enlargement) for horizontal and vertical factors ! Also initialize the following registers as follows :
Set the magnify flag in the L1-layer mode register of the display controller.
Set the picture source size (before magnification) into CMSHP and CMSVL.
Set the final picture size (after magnification) into CMDHP and CMDVL.
An example of the expressions for setting an enlargement in the vertical and horizontal directions is shown below :

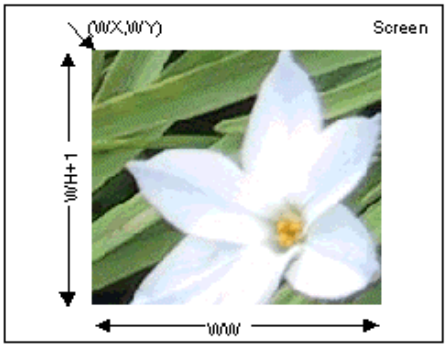
if the input picture size is 480x360 and the display picture size is 640x480, then the parameters for each register are as follows.
HSCALE=(480/640)*2048=0x0600
VSCALE=(360/480)*2048=0x0600
CMSHP=0x00f0
CMSVL=0x0168
CMDHP=0x0140
CMDVL=0x01e0
L1WW=0x0280
L1WH=0x01df

(2) Capture buffer controller

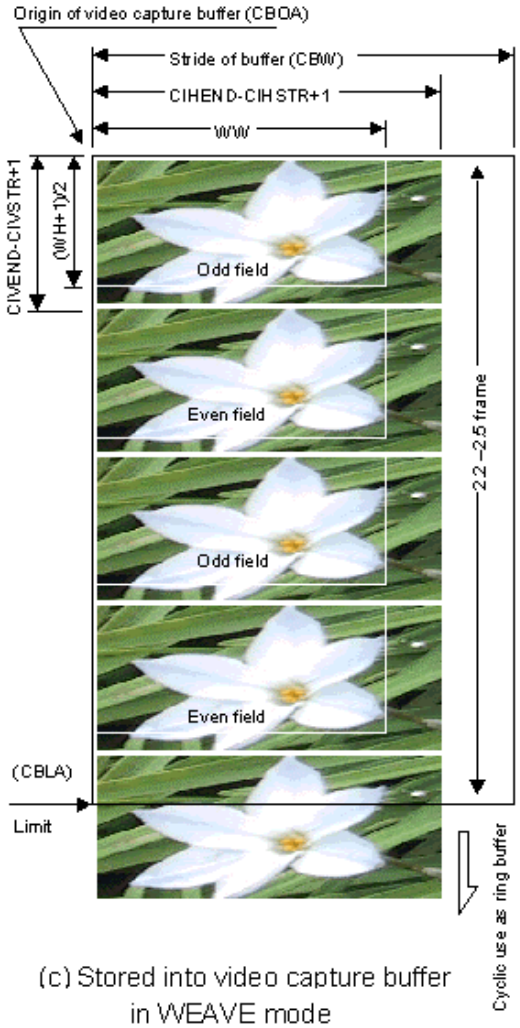
From the scaled image, a rectangular area is clipped out before the final picture is written to the memory. The cature buffer controller applies clip range defied by CIHSTR/ CIVSTR / CIHEND / CIVEND registers and stores data into capture buffer area in graphics memory defined by CBOA / CBLA / CBW registers. Capture buffer is managed as ring buffer (if read or write pointer location crosses the limit, it returns to the origin).

(3) Display controller

The display controller displays image data in capture buffer as W-layer with other layes. It follows latest available frame in capture buffer. In WEAVE, the display controller reconstructs a frame from odd field and even field stored in capture buffer. In WEAVE mode, a buffer size of 2.2 frames is the minimum, a safe recommendation is a 2.5 frame buffer.



(d) Displayed on screen



(c) Stored into video capture buffer in WEAVE mode

RGB Parameters

Instead of embedded sync code method used in ITU656 mode, the capture range in RGB mode must be specified by the following register parameters :

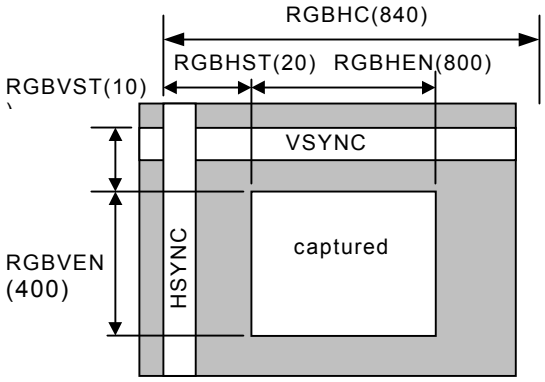
1) RGB input mode of capture : Set RGB666 input flag in VCM.

2) HSYNC Cycle : Set the number of HSYNC Cycles in RGBHC.

3) Horizontal Enable area : Set enable area start position and enable picture size into RGBHST and RGBHEN.

4) Vertical Enable area : Set enable area start position and enable picture size into RGBVST and RGBVEN.

For example, if input picture size is 800x400, then parameters for each register are decided as follow :



5)Convert Matrix Coefficient
In order to change the color conversion matrix, set up RGBCMY,RGBCb,RGBCr and RGBCMb.