## INTRODUCTION

The KS7314 offers enlarged images through the zoom effect attained by horizontal and vertical interpolation of luminance and chrominance signal input supplied from the CCD digital signal processor (KS7306). The signal input is implemented by employing a 2nd generation electronic zoom IC, which electronically enlarges the image picked up by the CCD of a camcorder. In addition, it corrects the wobble of hand-held cameras, and also provides the functions of a gyro-sensor and a mosaic mirror.
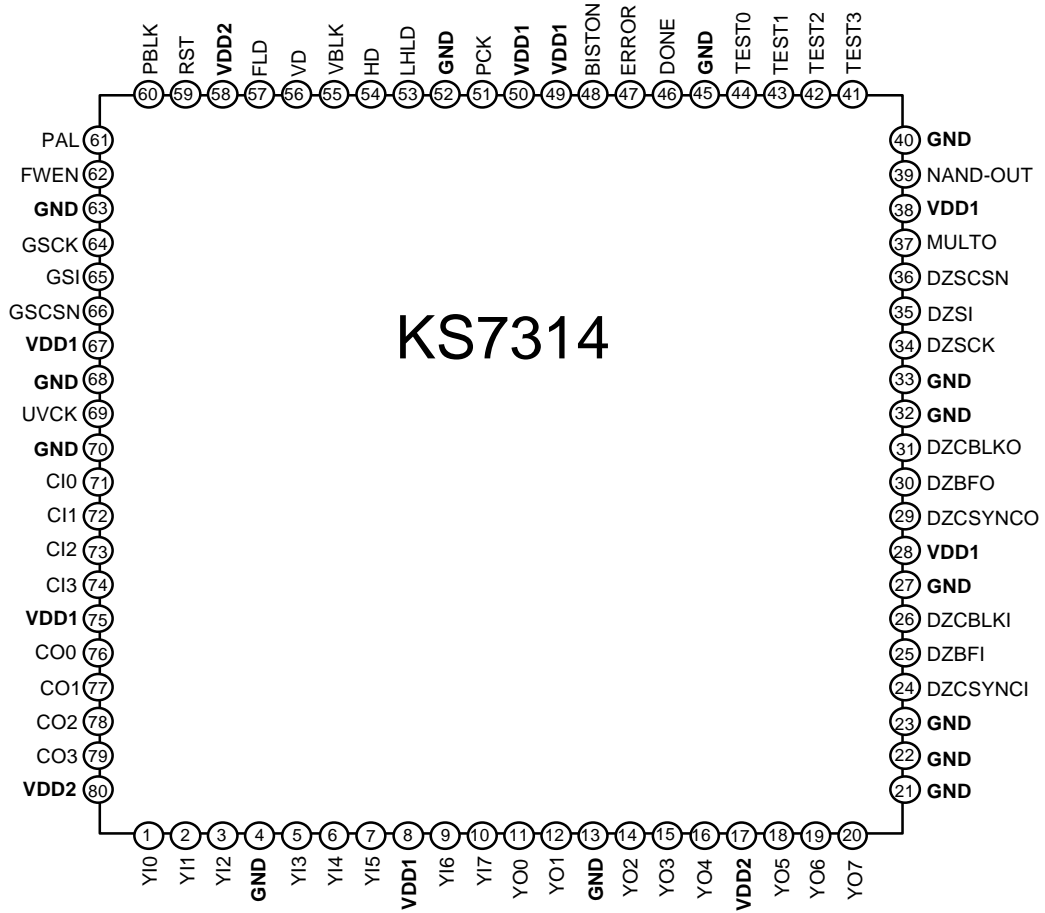
80-QFP-1212

#1
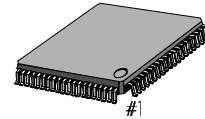
## ORDERING INFORMATION

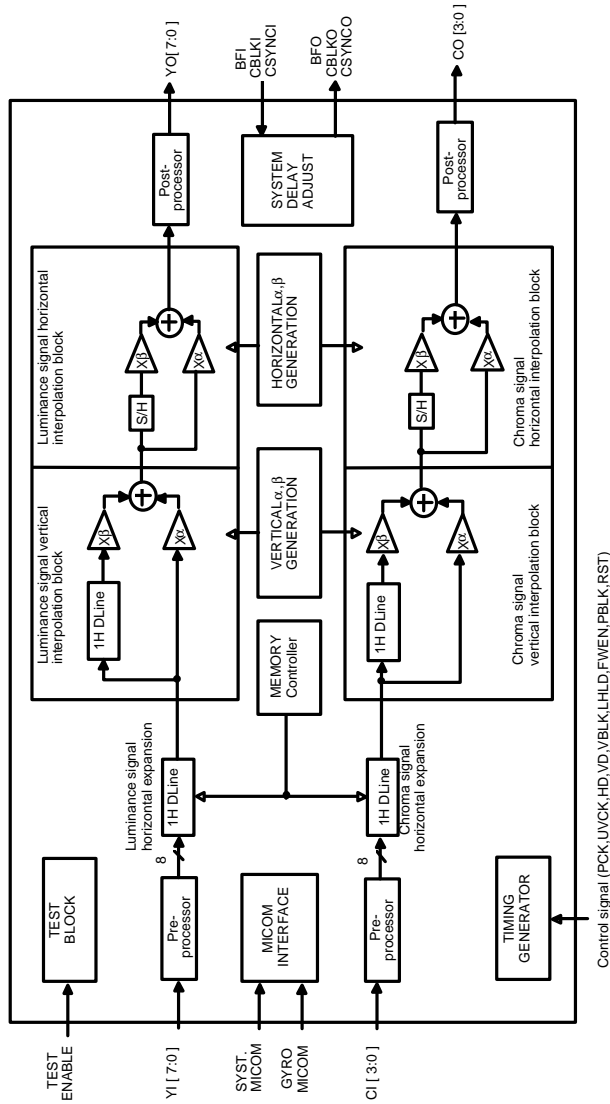| Device | Package | Operating Temperature |
|--------|---------|----------------------|
| KS7314 | 80-QFP-1212 | 0 ~ +70°C |

## FEATURES

- 256 discrete zoom steps
- Zoom operation withart using field memory
- Vertical image expansion and vertical interpolation by the control of a built-in 2H delay line
- Zoom operation dependent upon Y, R-Y, B-Y signal input (Source Format $\rightarrow$ 4:1:1)
- Variable zoom ratio technology applicable to horizontal and vertical directions (Styling Effect)
- Correction of wobbling hand by the sub-pixels in vertical direction
- Correction of wobbling hand in horizontal direction
- Provision of special effects such as:
    - Horizontal mirror technology
    - Variable 16 mode mosaic block size technology
      (Mosaic function available in EIS mode)
- Linear interpolation algorithm applied to both luminance and chroma signals in horizontal and vertical directions
- Applicable to wide TV screen with 630,000 pixels
- Applicable to world-wide models, of different systems like NTSC/PAL, HI8/NORMAL, and DVC
- Electronic zoom ratio
    Expansion available upto four times (4×) the maximum, and more in horizontal zooming
- Operable normally at 3.3V, and 5.0 V

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## PIN CONFIGURATION

Top pins (left to right): 60 PBLK, 59 RST, 58 **VDD2**, 57 FLD, 56 VD, 55 VBLK, 54 HD, 53 LHLD, 52 **GND**, 51 PCK, 50 **VDD1**, 49 **VDD1**, 48 BISTON, 47 ERROR, 46 DONE, 45 **GND**, 44 TEST0, 43 TEST1, 42 TEST2, 41 TEST3

Left pins (top to bottom): 61 PAL, 62 FWEN, 63 **GND**, 64 GSCK, 65 GSI, 66 GSCSN, 67 **VDD1**, 68 **GND**, 69 UVCK, 70 **GND**, 71 CI0, 72 CI1, 73 CI2, 74 CI3, 75 **VDD1**, 76 CO0, 77 CO1, 78 CO2, 79 CO3, 80 **VDD2**

Right pins (top to bottom): 40 **GND**, 39 NAND-OUT, 38 **VDD1**, 37 MULTO, 36 DZSCSN, 35 DZSI, 34 DZSCK, 33 **GND**, 32 **GND**, 31 DZCBLKO, 30 DZBFO, 29 DZCSYNCO, 28 **VDD1**, 27 **GND**, 26 DZCBLKI, 25 DZBFI, 24 DZCSYNCI, 23 **GND**, 22 **GND**, 21 **GND**

Bottom pins (left to right): 1 YI0, 2 YI1, 3 YI2, 4 **GND**, 5 YI3, 6 YI4, 7 YI5, 8 **VDD1**, 9 YI6, 10 YI7, 11 YO0, 12 YO1, 13 **GND**, 14 YO2, 15 YO3, 16 YO4, 17 **VDD2**, 18 YO5, 19 YO6, 20 YO7

Center label: **KS7314**

## BLOCK DIAGRAM

## PIN DESCRIPTION

| No | Symbol | I/O | From / To | Description |
|----|--------|-----|-----------|-------------|
| 1 | YI0 | I | DCP / | Luminance signal input |
| 2 | YI1 | I | DCP / | Luminance signal input |
| 3 | YI2 | I | DCP / | Luminance signal input |
| 4 | **GND** | **G** | **-** | **Ground** |
| 5 | YI3 | I | DCP/ | Luminance signal input |
| 6 | YI4 | I | DCP / | Luminance signal input |
| 7 | YI5 | I | DCP / | Luminance signal input |
| 8 | **VDD1** | **P** | **-** | **Power(3.3 V)** |
| 9 | YI6 | I | DCP/ | Luminance signal input |
| 10 | YI7 | I | DCP / | Luminance signal input |
| 11 | YO0 | O | DCP / | Luminance signal output |
| 12 | YO1 | O | DCP / | Luminance signal output |
| 13 | **GND** | **G** | **-** | **Ground** |
| 14 | YO2 | O | DCP/ | Luminance signal output |
| 15 | YO3 | O | DCP / | Luminance signal output |
| 16 | YO4 | O | DCP / | Luminance signal output |
| 17 | **VDD2** | **P** | **-** | **Power(5.0 V)** |
| 18 | YO5 | O | DCP/ | Luminance signal output |
| 19 | YO6 | O | DCP / | Luminance signal output |
| 20 | YO7 | O | DCP / | Luminance signal output |
| 21 | **GND** | **G** | **-** | **Ground** |
| 22 | **GND** | **G** | **-** | **Ground** |
| 23 | **GND** | **G** | **-** | **Ground** |
| 24 | DZCSYNC1 | I | DCP/ | CSYNC input for delay adjust |
| 25 | DZBFI | I | DCP / | Burst Flag input for delay adjust |
| 26 | DZCBLKI | I | DCP / | CBLK input for delay adjust |
| 27 | **GND** | **G** | **-** | **Ground** |
| 28 | **VDD1** | **P** | **-** | **Power(3.3 V)** |
| 29 | DZCSYNCO | O | / DCP | Delayed CSYNC output |
| 30 | DZBFO | O | / DCP | Delayed BURST FLAG output |
| 31 | DZCBLKO | O | / DCP | Delayed CBLK output |

(Continued)

| No | Symbol | I/O | FROM / TO | Description |
|----|--------|-----|-----------|-------------|
| 32 | **GND** | **G** | **-** | **Ground** |
| 33 | **GND** | **G** | **-** | **Ground** |
| 34 | DZSCK | I | S.MICOM / | System micom data sampling clock |
| 35 | DZSI | I | S.MICOM / | System micom data serial input |
| 36 | DZSCSN | I | S.MICOM / | System micom data enable Signal input |
| 37 | MUL-TO | O | - | Multiplier test output |
| 38 | **VDD1** | **P** | **-** | **Power(3.3 V)** |
| 39 | NAND-OUT | O | - | NAND TREE TEST output |
| 40 | **GND** | **G** | **-** | **Ground** |
| 41 | TEST3 | I | - | Test signal input |
| 42 | TEST2 | I | - | Test signal input |
| 43 | TEST1 | I | - | Test signal input |
| 44 | TEST0 | I | - | Test signal input |
| 45 | **GND** | **G** | **-** | **Ground** |
| 46 | DONE | O | - | Memory bist end signal output |
| 47 | ERROR | O | - | Memory bist error signal input |
| 48 | BISTON | I | - | Memory bist enable signal input |
| 49 | **VDD1** | **P** | **-** | **Power(3.3 V)** |
| 50 | **VDD1** | **P** | **-** | **Power(3.3 V)** |
| 51 | PCK | I | TGM / | System clock |
| 52 | **GND** | **G** | **-** | **Ground** |
| 53 | LHLD | I | L | Linememory hold signal input |
| 54 | HD | I | TGM / | Horizontal drive pulse input |
| 55 | VBLK | I | TGM / | Vertical blank signal input |
| 56 | VD | I | TGM / | Vertical drive pulse input |
| 57 | FLD | I | TGM / | Field selection signal input |
| 58 | **VDD2** | **P** | **-** | **Power(5.0 V)** |
| 59 | RST | I | SYSTEM / | System reset signal input |
| 60 | PBLK | I | TGM / | Pre-blank Signal input for Linememory Reset |
| 61 | PAL | I | - | NTSC/PAL Signal input (PAL : High) |
| 62 | FWEN | I | TGM / | Linememory hold signal 1 |

(Continued)

| No | Symbol | I/O | FROM / TO | Description |
|----|--------|-----|-----------|-------------|
| 63 | **GND** | **G** | **-** | **Ground** |
| 64 | GSCK | I | G.MICOM / | Gyro micom data sampling clock |
| 65 | GSI | I | G.MICOM / | Gyro micom data serial input |
| 66 | GSCSN | I | G.MICOM / | Gyro micom data enable signal input |
| 67 | **VDD1** | **P** | **-** | Power(3.3 V) |
| 68 | **GND** | **G** | **-** | **Ground** |
| 69 | UVCK | I | DCP / | Clock input for (R.Y)/(B-Y) judgement |
| 70 | **GND** | **G** | **-** | **Ground** |
| 71 | CI0 | I | DCP / | Chroma signal input |
| 72 | CI1 | I | DCP / | Chroma signal input |
| 73 | CI2 | I | DCP / | Chroma signal input |
| 74 | CI3 | I | DCP / | Chroma signal input |
| 75 | **VDD1** | **P** | **-** | **Power(3.3 V)** |
| 76 | CO0 | O | DCP / | Chroma signal output |
| 77 | CO1 | O | DCP / | Chroma signal output |
| 78 | CO2 | O | DCP / | Chroma signal output |
| 79 | CO3 | O | DCP / | Chroma signal output |
| 80 | **VDD2** | **P** | **-** | **Power(5.0 V)** |

## FUNCTIONS OF BLOCKS

| Function Block | Function Performed |
| --- | --- |
| LUMINANCE HORIZONTAL INTERPOLATION | Interpolates linearly of luminance signal in horizontal direction |
| LUMINANCE VERTICAL INTERPOLATION | Interpolates linearly of luminance signal in vertical direction |
| CHROMA HORIZONTAL INTERPOLATION | Interpolates linearly of chroma signal in horizontal direction |
| CHROMA VERTICAL INTERPOLATION | Interpolates linearly of chroma signal in vertical direction |
| HORIZONTAL COEFFICIENT GENERATION | Generates the horizontal interpolation coefficient for luminance and chroma signals |
| VERTICAL COEFFICIENT GENERATION | Generates EVEN/ODD field vertical interpolation coefficient for luminance and chroma signals |
| LINE MEMORY CONTROLLER | Generates READ/WRITE ADDRESS for 1H DELAY LINE for horizontal image expansion and 1H delay line for vertical interpolation |
| TIMING GENERATION | Generates time signals for controls |
| MICOM INTERFACE | Decodes zoom/DVC/Special Effect mode |
| GYRO MICOM INTERFACE | Decodes wobbling hand correction level signal |

## ABSOLUTE MAXIMUM RATINGS

| Characteristics | Symbol | Value | Unit |
|---|---|---|---|
| Supply voltage | $V_{DD}$ | -0.3 ~ +7.0 | V |
| Input voltage | $V_I$ | -0.3 ~ VDD+0.3 | V |
| Output voltage | $V_O$ | -0.3 ~ VDD+0.3 | V |
| Storage temperature | $T_{STG}$ | -40 ~ +125 | °C |
| Operating temperature | $T_{OPR}$ | 0 ~ +70 | °C |
| Latch-up current | $I_{LU}$ | 100 | mA |

## ELECTRICAL CHARACTERISTICS

### DC

$(T_{OPR} = 0 \sim +70°C)$

| Characteristics | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Operating voltage for Internal | $V_{DD1}$ | 3.1 | 3.3 | 3.5 | V |
| Operating voltage for I/O cell | $V_{DD2}$ | 4.75 | 5.0 | 5.25 | V |
| Ground | $V_{SS}$ | 0 | 0 | 0 | V |
| Input high voltage | $V_{IH}$ | $0.7V_{DD2}$ | - | - | V |
| Input low voltage | $V_{IL}$ | - | | $0.3V_{DD2}$ | V |
| Operating current | $I_{DD}$ | - | - | 100 | mA |
| Standby current | $I_{DS}$ | - | - | 1 | mA |
| Output high voltage (IOH = -1mA) | $V_{OH}$ | 2.4 | - | - | V |
| Output low voltage (IOL = 1mA) | $V_{OL}$ | - | - | 0.4 | V |
| Input high leakage current($V_I = 0 \sim V_{DD}$) | $I_{IH}$ | -10 | - | +10 | μA |
| Input low leakage current($V_I = 0 \sim V_{DD}$) | $I_{IL}$ | -10 | - | +10 | μA |

\* VDD1 : Pin No  8, 28, 38, 49, 50, 67, 75
  VDD2 : Pin No  17, 58, 80

## AC

$(T_{OPR} = 0 \sim +70°C, ts = 100\ ns)$

| Characteristics | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| YI Data setup time | $t_{YST}$ | 25 | - | - | |
| YI Data hold time | $t_{YHT}$ | 10 | - | - | |
| CI Data setup time | $t_{CST}$ | 25 | - | - | ns |
| CI Data hold time | $t_{CHT}$ | 10 | - | - | |
| UVCK clock delay time | $t_D$ | 10 | - | 35 | |
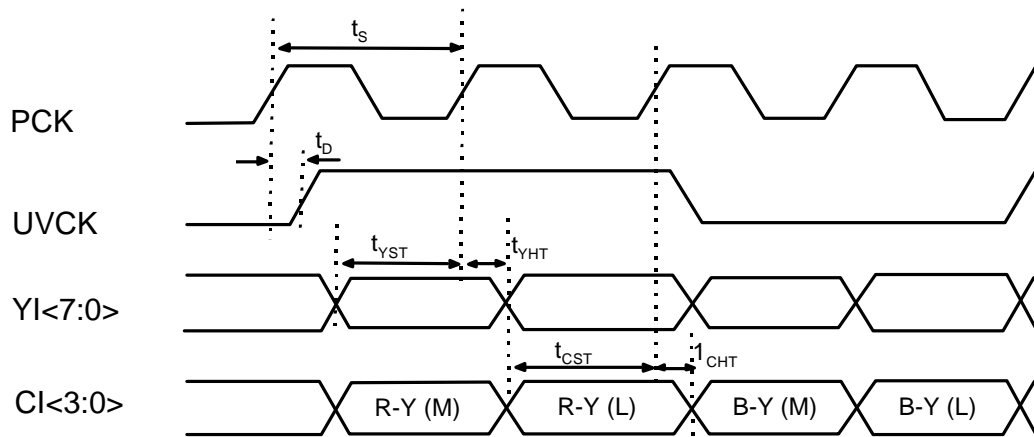
**MICOM INTERFACE**

## 1. NEC SYSTEM MICOM INTERFACE (mPD78014)

Serial Port Timing Characteristics ($f_{CLK}$ = 12 MH$_Z$)

| Characteristics | Symbol | Min | Typ | Max | Unit |
|-----------------|--------|-----|-----|-----|------|
| Serial port clock cycle time | $t_{SCK}$ | 1300 | - | - | |
| Serial port clock high, low width | $t_{WH}$, $t_{WL}$ | 556 | - | - | |
| Input data setup to clock rising edge | $t_S$ | 30 | - | - | ns |
| Input data hold after clock rising edge | $t_H$ | 30 | - | - | |
| SCSN setup time | $t_{SCN}$ | 30 | | | |
| SCSN hold time | $t_{SHD}$ | 30 | | | |



&lt;Serial I/O Timing Diagram&gt;
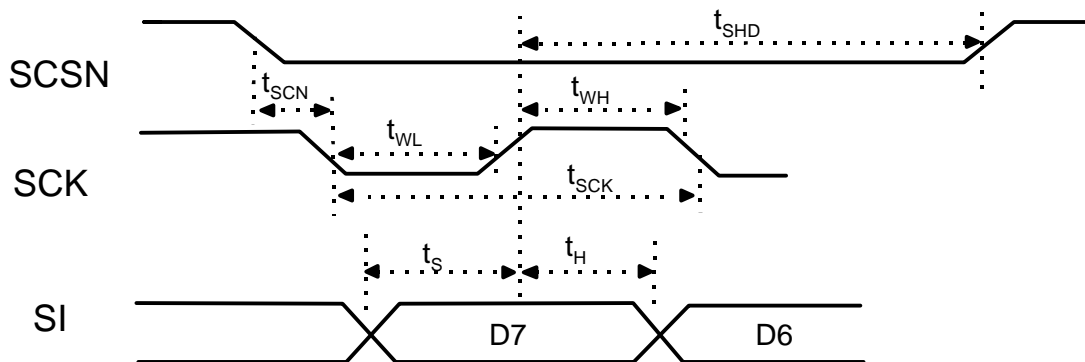
## 2.GYRO MICOM INTERFACE(CXD81120)

| Characteristics | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Serial port clock cycle time | $t_{SCK}$ | 2000 | - | - | |
| Input data setup to clock rising edge | $t_S$ | 30 | - | - | |
| Input data hold after clock rising edge | $t$ | 30 | - | - | |
| Serial port clock high, low width | $t_{WH}$, $t_{WL}$ | 700 | - | - | ns |
| SCSN Setup Time | $t_{SCN}$ | 30 | - | - | |
| SCSN Hold Time | $t_{SHD}$ | 30 | - | - | |



&lt;Serial I/O Timing Diagram&gt;
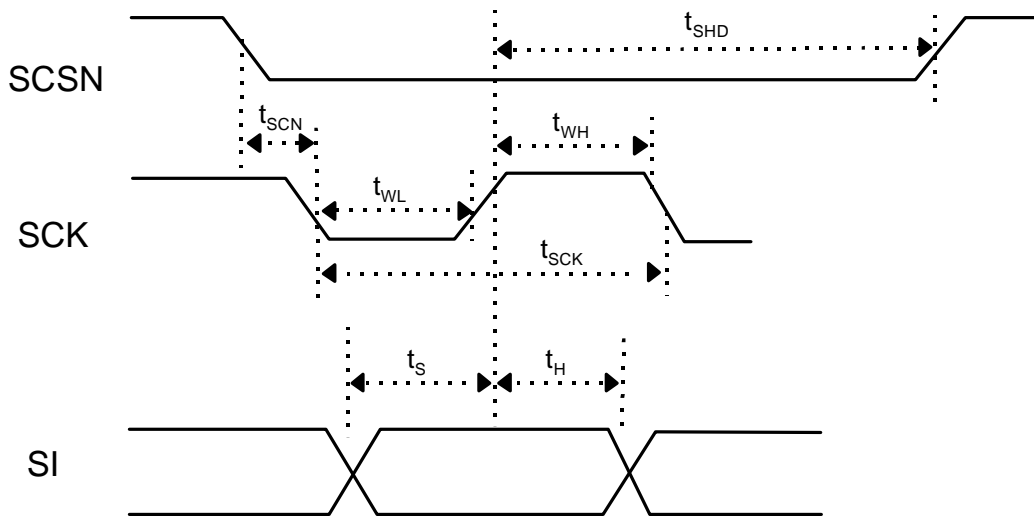
## SYSTEM CONFIGURATION AND OPERATION
 (Implementation of 2nd generation electronic zoom)

## 1. System block configuration I ( EIS+D.Zoom + Spec. Effect )
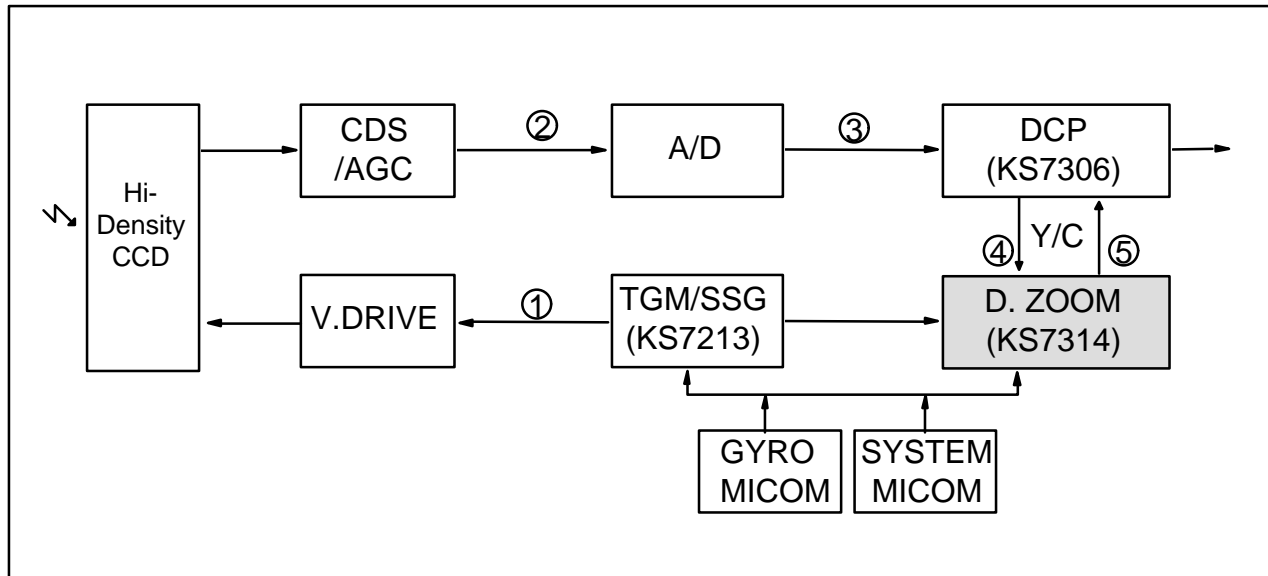


Fig.1  2nd  generation EIS/Electronic zoom applied camcorder camera system

The 2nd generation electronic zoom which enlarges images without using field memory, performs the electronic zooming process by means of image extension first, and then by signal interpolation.

In the 1st  process of image zooming, the vertical zooming is accomplished by the control of image data read-out pulse from CCD. The generation of CCD read-out  pulse  is  accomplished at TGM(KS7213) with the input of electronic zooming ratio data supplied from the System Micom.

The image being vertically extended for the electronic zooming is fed to DCP(KS7306) in its form of an image extended only vertically.

At the DCP(KS7306), image interpolation for the vertically zoomed image by NNI is first performed according to the line hold signal.

This is the process of removing blank data existing in between lines of a vertically zoomed image.

The image data is first interpolated at the fed to the electronic zoom (KS7314).

The image input separated in luminance and chroma signals snaped in a 4:1:1 formation from the fed to the DCP is then processed for horizontal extension within the electronic zoom for the horizontal zooming. Horizontal extension is accomplished through the address control of line memory self-contained in the electronic zoom processor.

The image data of the horizontally extended is interpolated in vertical and horizontal directions by the inner-interpolation function of the electronic zoom processor.  The discussion so far relates the functional process of the electronic zoom. The hand wobble correction is accomplished in the following manner. The hand wobble data of the camcorder detected by the gyro-sensor and the gyro-micom are fed to TGM for vertical compensation by lines. The vertical compensation is performed by the control of CCD read out pulse supplied by TGM. The image data compensated for vertical agitation by lines is then fed to the electronic zoom through DCP to perform horizontal correction of hand wobble through the use of the line memories for horizontal extension within the electronic zoom.  In other words, the correction of horizontal hand wobble is implemented by pixels with the use of read address of the line memories.  The correction of hand wobble in vertical and horizontal detailed to sub-pixels is reflected in the creation of interpolation coefficient with which the interpolation is implemented.

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For horizontal wobble correction, a fixed ratio of electronic zooming needs to be maintained in the electronic zoom, and for vertical wobble correction, employment of a high density CCD is required. The threshold for the correction of hand wobble is dependent upon the number of effective lines of the high density CCD and the horizontal zoom ratio of the electronic zoom.

## 2. System block configuration II (electronic zoom and special effect blocks)
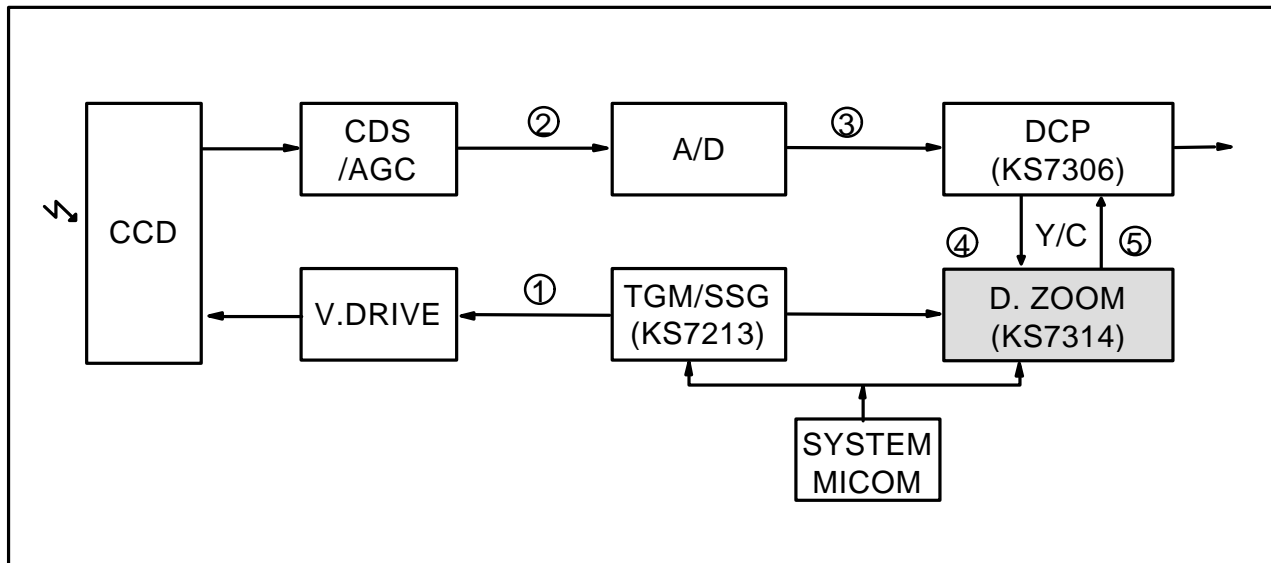
Fig. 2  Camcorder camera system of electronic zoom 2nd  generation application

Fig. 2  above illustrates a camcorder a camera system with an electronic zoom function.  The difference between the above system to the camcorder camera system with electronic zoom and hand wobble correction function is that, the former does not, for the attainment of image stability, employ high density CCD intended for the vertical correction of hand wobble.  The signal process system explained below and electronic zoom signal process system are identical to the one illustrated in Fig.1. As for this camcorder camera system, it is important that all aspects of signal procesing must go through the electronic zoom process (KS7314) since the repetition of the KS7314 chip enable/disable occuring every time the electronic zoom turns to on/off would entail screen shift of the image.  So to speak, the screen shift occurs just as much as the electronic zoom processing is delayed develops.  In order to compensate for the electronic zoom system, the video data is delayed to match, the processing delay of electronic zoom, using the synchronizing signal (burst flag, CBLK or CSYNC), and is then passed to the signal processor (KS7306). The special effect is implemented in the following manner.  The special effects data in serial format, supplied from the system micom, is first converted to parallel format. The mirror effect in horizontal direction and the mosaic effect in vertical direction are implemented, controlled by the read address of line memories for horizontal expansion. The read/write enable signal while the mosaic effect in horizontal direction is achieved by the conversion of sampling frequency against the fully interpolated image data.  In particular, the mosaic effect can also be achieved in EIS mode.

## 3. EIS / System micom interface

| EIS  MICOM   INTERFACE | | TO | Remarks |
|---|---|---|---|
| Level of horizontal hand whole | INTEGER | Digital Zoom (KS7314) | 2′s Complement |
| | SUB-PIXEL OFFSET | Digital Zoom (KS7314) | 2′s Complement |
| Level of vertical hand whole | INTEGER | TGM (KS7213) | 2′s Complement |
| | SUB-PIXEL | TGM (KS7213) | 2′s Complement |
| | SUB-PIXEL OFSET | Digital Zoom (KS7314) | Positive only |

Table 1.  EIS micom interface

| SYSTEM   MICOM   INTERFACE | | TO | Remarks |
|---|---|---|---|
| Horizontal   zoom Start Point | INTEGER | Digital Zoom (KS7314) | LINEMEMORY READ ADDRESS to decide |
| | SUB-PIXEL OFFSET | Digital Zoom (KS7314) | Entered into horizontal interpolation coefficient part |
| Horizontal    electronic    zoom | | Digital Zoom (KS7314) | Entered into horizontal interpolation coefficient part |
| Vertical    zoom Start   Point | INTEGER | TGM (KS7213) | CCD LINE SKIP to decide |
| | SUB-PIXEL OFFSET | TGM (KS7213) Digital ZOOM(KS7314) | Entered into vertical interpolation coefficient part |
| Vertical    electronic    zoom  RATIO  INVERSE | | TGM (KS7213) Digital Zoom(KS7314) | Generate line hold signal Vertical coefficient part |

Table 2. SYSTEM MICOM INTERFACE

Tables 1 and 2 summarize the interfacing data formats of the EIS micom (Gyro micom) and the system micom respectively.  In the EIS micom interfacing of Table 1, the data for horizontal hand tremble is supplied to KS7314.  The default line skip level and vertical hand tremble level are not computed by EIS micom, but the line skip is determined finally by KS7213 after the operation of vertical hand tremble level data entries taken in the form of 2′s complement.  The vertical sub-pixel hand tremble level data are, however, converted to positive value before they are entered.  In the system micom interfacing of Table 2, the start point data of horizontal/vertical electronic zooming are computed by the following formulae and then transmitted to KS7314 and KS7213.

Electronic zoom start point = Width(or Height) * (1-(1/Zoom Ratio))/2
= Width(or Height) * (Elec. Zoom Step)/(2*256)

where width or height represent the value of effective pixels of CCD and in case the high density CCD and FCM of the EIS application are used, they then represent effective line output of high density CCD and effective pixel number respectively.  The figure 256 standing in above formulae explains that each of pixel is devided in 256 parts for the electronic zooming.  The electronic zoom ratio data are generated in the form of electronic zoom step for the horizontal element and electronic zoom ratio inverse for the vertical element.

## 4. KS7314 input video data format
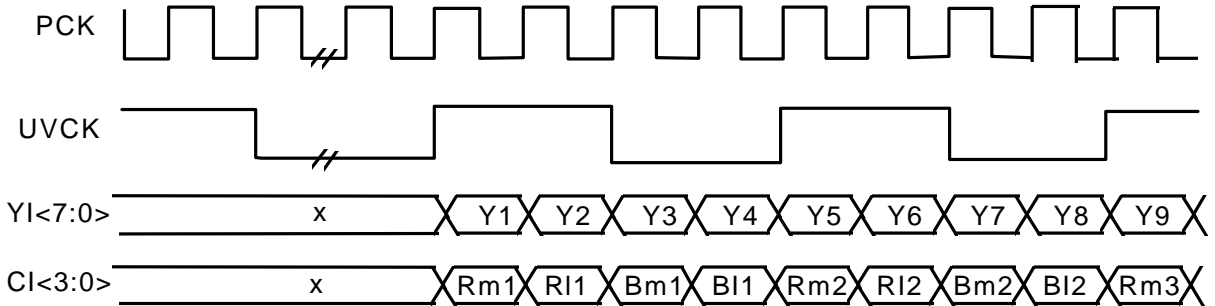


Fig. 3  Electronic zoom input video data format(4:1:1)

Fig. 3 illustrates the video data format input to KS7314, fed from KS7306.  The Luminance and chroma D  Data are in the 4:1:1 format, and the chroma data is entered in sequence of (R-Y) LSB, (B-Y) MSB, and (B-Y) LSB.  The UVCH signal distinguishs R-Y from B-Y.  The LBLKO is the signal used to reset the counter during the process of generating the READ/WRITE address of the line memory.  The duration in which LBKO is at high level is the effective pixel section.  KS7314 generates LBLK signal that is used as the counter reset signal of line memory address self-contained in the line memory address of KS7314.  Considering that 28CK is developed while processing the effective data of KS7306, LBLK is delayed to create LBLKD for use as a reset signal of the line memory counter.

The chroma input of 4 formation is restructered to 8 bit signal before the application to the interpolation.

## 5. Line memory reset signal (LBLK) generation
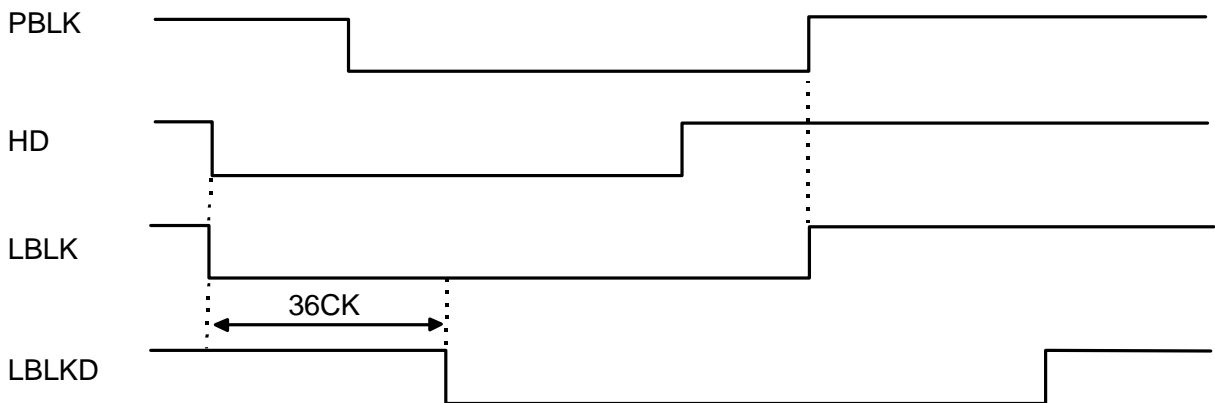
## 6. Vertical interpolation
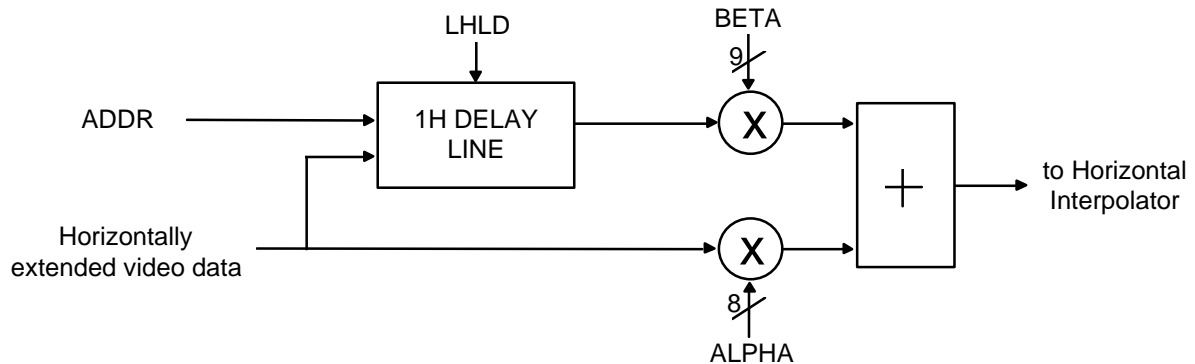


Fig. 4-1 Vertical interpolation circuit
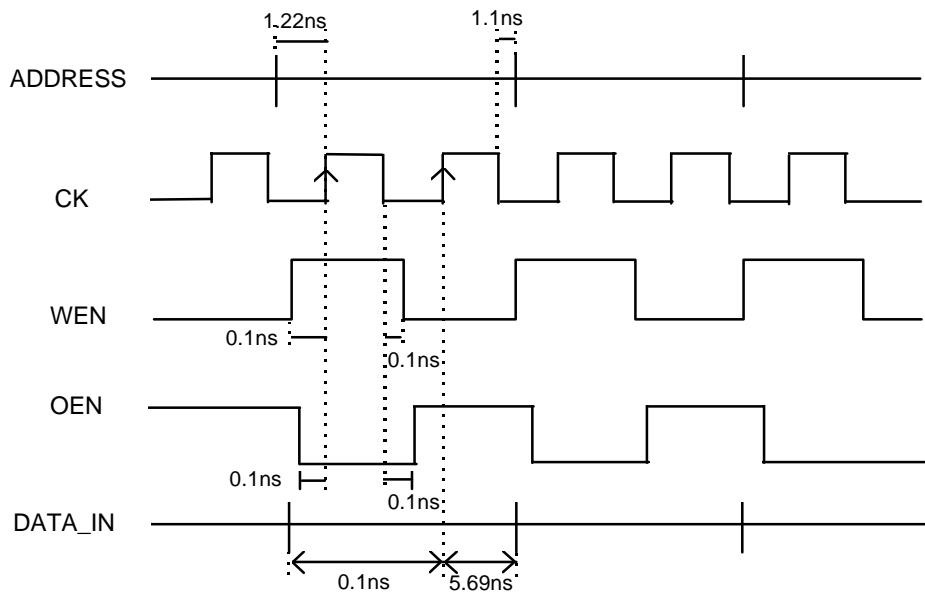


Fig. 4-2 H delay line timing specification for
vertical interpolation application

Fig. 4-1 is the vertical interpolating circuit applicable to both luminance and chroma signals. The vertical video input data for the vertical interpolator is readily processed for horizontal video extension, using the linememory at the former stage of luminance and the chroma signal horizontal extender. In the vertical interpolation block, the interpolation coefficients Alpha and Beta, generated by the vertical interpolating coefficient generator, are applied in the interpolation operation.

Fig. 4-2 dipicts 1H delay line timing specification applied to vertical interpolation. The function of READ and WRITE is performed in the method of READ first and WRITE second, in 2 cycles of the linememory clock. The AC timing above should be regarded as the minimum.

## 7. Horizontal interpolation procedure
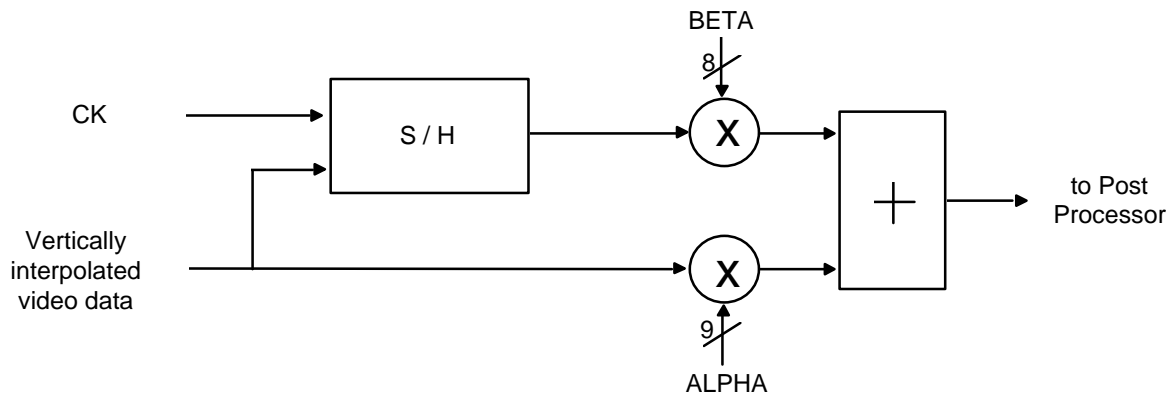


Fig. 5  Luminance signal horizontal interpolation circuit

Prior to the horizontal interpolation process, the video data are extended at the horizontal extension and passed to the vertical interpolation part for the vertical process and then entered into the horizontal interpolation part.  The horizontal interpolation part is configured of the luminance data horizontal interpolation part and the the chroma data horizontal interpolation part.

The chroma data and are entered R-Y and B-Y components alternatively, so that the data are interpolated separately by the components before they are put to liner interpolation process.

## 8. Generation of interpolating coefficient

1) Generation of horizontal interpolating coefficient

| Data (zrd) supplied by micom | Interpol. Coeff.($\alpha$) | Interpol. Coeff.($\beta$) | Zooming ratio(256/(256-ZRD)) | Zoom Step. |
|---|---|---|---|---|
| 00000000 | 1 | 0 | x1 | 0 |
| 00000001 | 255/256 | 1/256 | 256/255 | 1 |
| : | : | : | : | : |
| 10000000 | 128/256 | 128/256 | x2 | 128 |
| : | : | : | : | : |
| 11000000 | 64/256 | 192/256 | x4 | 192 |

Table 3. Zoom ratio data(horizontal) supplied by the system micom

| Motion vector decimal | Interpolation coeff. ($\alpha$) | Interpolation coeff. ($\beta$) |
|---|---|---|
| 0.75 (11000000) | 192/256 | 64/256 |
| 0.5 (10000000) | 128/256 | 128/256 |
| 0.25 (01000000) | 64/256 | 192/256 |
| 0 (00000000) | 1 | 0 |

Table 4. Relation of EIS micom output decimals of horizontal hand
tremble level to interpolation coefficient

Table 3 Illustrates the system micom transmission data(ZRD) for generating the horizontal interpolating coefficient for electronic zooming.

Table 4 Illustrates the EIS micom transmission data for generating the interpolating coefficient for decimal level correction of hand trembles.

2) Generation of vertical interpolation coefficient

Table 5. Zoom ratio inverse data(vertical) transmitted by system micom

| Micom supplied data(ZMIV) | Interpolating coefficient($\alpha$) | Interpolating coefficient($\beta$) | Zoom ratio (256/ZMIV) | ZOOM STEP |
|---|---|---|---|---|
| 00000000 | 0 | 1 | X1 | 0 |
| 11111111 | 255/256 | 1/256 | 256/255 | 1 |
| : | : | : | : | : |
| 10000000 | 128/256 | 128/256 | X2 | 128 |
| : | : | : | : | : |
| 01000000 | 64/256 | 192/256 | X4 | 192 |

Table 6. An example of generating vertical interpolating coefficient
based on zoom ratio data

| Zoom ratio data(ZMIV) | Interpolating coefficient($\alpha$) | Interpolating coefficient($\beta$) |
|---|---|---|
| 0 | 0, 0, 0, 0, 0, . . . | 1, 1, 1, 1, 1, . . . |
| 255 | 0, 255/256, 254/256, 253/256, 252/256, . . | 1, 1/256, 2/256, 3/256, 4/256, . . |
| 254 | 0, 254/256, 252/256, 250/256, 248/256,. . | 1, 2/256, 4/256, 6/256, 8/256, . . |
| : | : | : |
| 128 | 0, 128/256, 0, 128/256, 0, . . . | 1, 128/256, 1, 128/256, 1, . . |
| : | : | : |
| 64 | 0, 64/256, 128/256, 192/256, 0, . . | 1, 192/256, 128/256, 64/256, 1, . . |

The data entered to the vertical interpolating coefficient generation part consist of zoom ratio inverse data, and vertical sub-pixel hand tremble data, supplied from the EIS micom. The vertical interpolating coefficient is generated, based on the above data.

The vertical sub-pixel hand tremble data supplied by the EIS micom would look identical to that shown in Table 4 above. The vertical interpolating coefficient applies equally to luminance and chroma.

The vertical interpolating coefficients $\alpha$ and $\beta$ responding to specific zoom ratio are tabulated in Table 6 above. Upon the entry of zoom ratio data, interpolation coefficient $\alpha$, interpolation coefficient $\beta$ are generated.

The interpolation coefficients shown on Table 3 are generated continuously, and then the zooming process is implemented after a separate operation of the coefficient and the pixel data, entered in the zoom processor.

## 9. Special effect I (Horizontal mirror effect)

Horizontal mirror effect is termed after the fact that the function offers symmetrical images siding by the upright axis in the center of screen, just like a mirror reflection. The effect is achieved by the control of the Read Address of 1H delay line, used in the horizontal expansion of luminance and hue signals inside the zoom processor. The function is implemented by means of counting the number of effective pixels in the image input to KS7314, assigning half the count as the horizontal mirror point, and then performing control up/down of the read address counter when read address is generated.
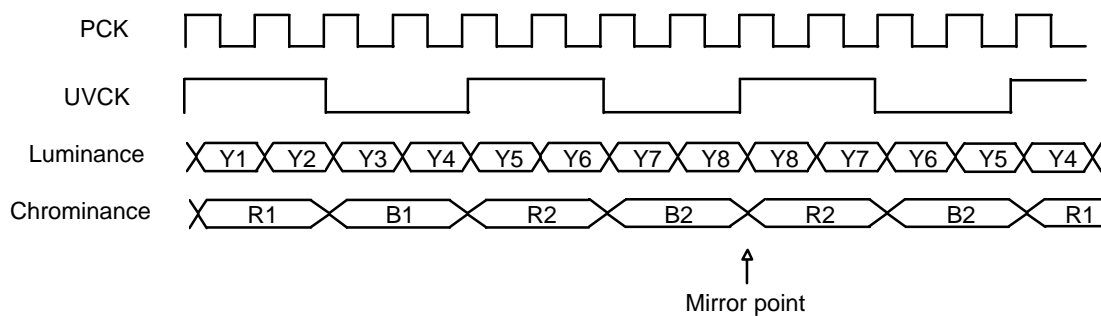


Fig. 6 Mirror read address timing diagram

## 10. Special effect II (Style)

The function allows image expansion in horizontal or vertical direction, independently from each other. The supply of zoom ratio data from the micom, separated in horizontal and vertical directions, enables to stage such effect of an image.

In case the zoom ratio data from the micom specify 2 power in horizontal, and single power in vertical direction, the zoom processor needs to perform interpolation only in horizontal direction. In this way, an image of different magnification, either in the horizontal or the vertical, independently from each other, is obtainable. The application of zoom ratio data, separated in directions supplied by the micom to the circuit of the zoom processor where the horizontal and vertical interpolating coefficients are gernerated, can implement the special effect function easily.

## 11. Special effect III (Mosaic)

The mosaic function offers the user an ability to form a blocked area of a set size on screen, to display the image with an obscure outline.  The room processor supports a mosic effect implemented in block sizes of 4×4, 8×8, 12×12, 16×16, . . . 60×60, 64×64, making 16 sizes altogether.  To obtain the mosaic effect, first decide on the mosaic size and then fill out the block with uniform pixel value for every pixel in the block. The process should be performed according to luminance and chroma signals separately.  As for the process of luminance signal, in order to maintain uniform brightness of pixels, take the value of the uppermost-left pixel of the block as the representative value, and then replace all the rest of the pixel values in the block.  For the process of replacing all the pixel values with the representative value, first adapt the system clock to conform to the selected mosaic mode by means of demultiplying the clock by 4, 8, . . . 64,  and use this demultiplied clock as the mosaic clock.  The case of chroma signal is fairly complicated.  Since the chroma signal alternates R-Y to B-Y by the clock, the luminance method can not be directly applied and that the adjustment of the mosaic clock is necessary to maintain R-Y and B-Y chroma components.  The replacement of a vertical pixel value with the representative value can be achieved by the read/write enable control of 1H delay line, applied in horizontal expansion.  In the vertical signal process for a mosaic, attention is invited to the fact that the standard TV screen comes separated in even and odd fields by interlaced scanning. Signal process only in a half of that required in the horizontal process would be sufficient.

For example, in an 8×8 mosaic mode, only 4 lines of mosaic video process vertical will display a square mosaic block on screen.

In the same manner, the mosaic process of luminance and chroma signals in vertical direction can be performed.  In case of a vertical mosaic, the system delay in vertical direction may vary, depending on the type of camcorder usage.  That user may, in case of a vertical mosaic operation, take the dummy data of black level appearing on the top side of the screen for the initial mosaic start line, and a symptom, in which the black level on the top side would grow as the mosaic block size grows, may develop.  The system micom is, therefore, designed to be capable of controlling the vertical mosaic start line in order to avoid such symptoms. The mosaic function is enabled in EIS electronic image stabilizer mode of operation.
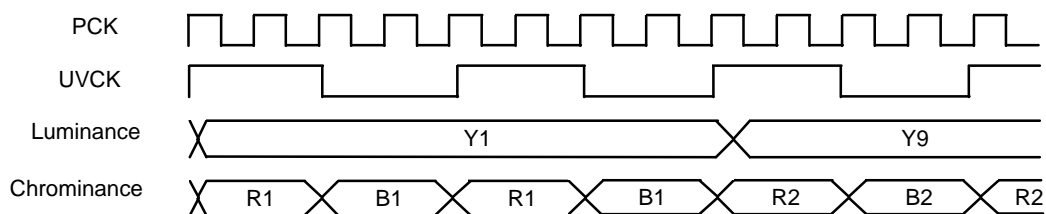


Fig. 7 Horizontal mosaic timing diagram (8×8 mosaic)

| VBLK | | | | | | | | | | | | | | |
|------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| HD | | | | | | | | | | | | | | |
| CCD OUTPUT | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| KS7314 INPUT | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| MOSAIC OUTPUT | | 1 | 1 | 1 | 1 | 5 | 5 | 5 | 5 | 9 | 9 | | |

Vertical mosaic initial line of execution
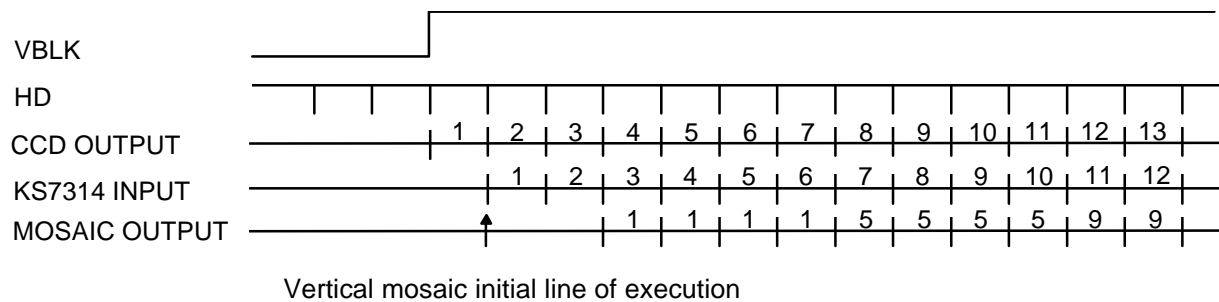
Fig. 8  Vertical mosaic timing diagram (8×8 mosaic)

## 12.  Digital video interface

KS7314 has a built-in DVC interface for application to digital video camcorders.  In other words, the luminance and chroma signal output of KS7314 can be used as an input to DVC encorder, without the need of transmitting the output to KS7306, which is the signal processor.  For this purpose, it is able to adjust chroma signal timing in DVC mode against luminance signal and synchronization signal $\pm$ 8CK by the system clock unit.  KS7314 takes the input of the DVC mode recognition signal and the delay adjustment value for the chroma signal from the micom.

## 13.  Delay adjust

The processing delay developed in the process of electronic zooming should be compensated, and the compensation can be achieved by delaying the signals related to active display of image, equal to the electronic zoom processing delay.  Namely, the input of signals CBLK, CSYNC, and CBF from the digital camera processor(DCP) is taken to process and then entered back to DCP.  The vertical delay is not adjusted particulary in the electronic zoom process, now that PBLK is used in DCP as the line memory reset. The signal gets readily processed before the image effective pixel process and thus vertical delay is not considered.  The electronic zoom processing delay lasts 20 system clock in total and it develops to 28 system clock for KS7314 in DVC mode.

## REGISTER TABLE

### 1. Micom command register

| REG. Name | REGISTER DESCRIPTION |
|---|---|
| COMMAND (HEADER) | COMMAND REGISTER (HEADER)<br><br>7                                0<br>See tables below. |

COMMAND REGISTER (HEADER)

7                                  0

| DZ | EIS | EFCT | VADJ | HADJ | DVC |
|---|---|---|---|---|---|

MODE)

| DZ | MODE | EIS | MODE | EFCT | MODE |
|---|---|---|---|---|---|
| 0 | DZ OFF | 0 | EIS OFF | 0 | EFFECT OFF |
| 1 | D.ZOOM | 1 | EIS ON | 1 | EFFECET ON |

| VADJ | MODE | HADJ | MODE |
|---|---|---|---|
| 0 0 | 2 H DELAY | 0 0 | 32 CK DELAY |
| 0 1 | 3 H DELAY | 0 1 | 36 CK DELAY |
| 1 0 | 4 H DELAY | 1 0 | 40 CK DELAY |
| 1 1 | 5 H DELAY | 1 1 | 44 CK DELAY |

| DVC | MODE |
|---|---|
| 0 | NORMAL ZOOM |
| 1 | ZOOM for DVC |

notes) VADJ : VBLK DELAY ADJUST
       HADJ : LBLK DEALY ADJUST
       Possible synchronous realization of Mosaic and EIS
       Impossible synchronous realization of Mirror and D.Zoom

Note ) System micom interface timing
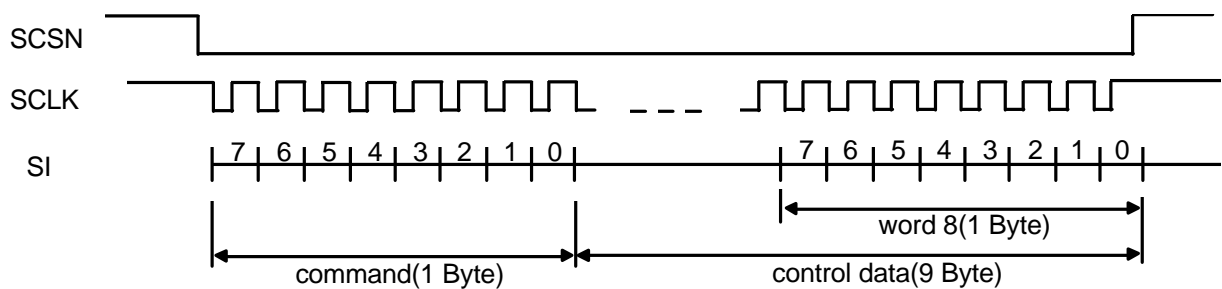
## 2.  System Micom Register Table

1) Zoom register table

|  | REG. Name | REGISTER DESCRIPTION |
|---|---|---|
| WORD 0 | HZOOM (ZRD) | HORIZONTAL ZOOM STEP. ( 0 ~ 192 : X 1 ~ X 4 ) |
| WORD 1 | VZOOM (ZMIV) | VERTICAL ZOOM STEP. (256 ~ 64 : X 1 ~ X 4 ) |
| WORD 2<br>WORD 3 | HSP | HORIZONTAL START READ ADDRESS.(16 BIT)<br>15　　　　9 8　　　　0<br>\| 0 \| 0 ~ 511 \| |
| WORD 4 | HSUB | HORIZONTAL ZOOM START SUB PIXEL. ( 0 ~ 255 ) |
| WORD 5 | VOFFO | VERTICAL ZOOM START SUB PIXEL ODD FIELD (0~255) |
| WORD 6 | VOFFE | VERTICAL ZOOM START SUB PIXEL EVEN FIELD (0~255) |
| WORD 7 | DVC_DLY | DELAY ADJUST(2's COMPLEMENT) for DVC |

DELAY ADJUST bit layout (bit 7 ... 0): SIGN, X, X, X, DL3, DL2, DL1, DL0

| SIGN | DL3 DL2 DL1 DL0 | MODE |
|---|---|---|
| 0 | 0000 | 0 PCK DELAY |
| 0 | 0001 | +1 PCK DELAY |
| 0 | 0010 | +2 PCK DELAY |
| 0 | 0011 | +3 PCK DELAY |
| 0 | 0100 | +4 PCK DELAY |
| 0 | 0101 | +5 PCK DELAY |
| 0 | 0110 | +6 PCK DELAY |
| 0 | 0111 | +7 PCK DELAY |
| 0 | 1000 | +8 PCK DELAY |
| 1 | 1000 | -8 PCK DELAY |
| 1 | 1001 | -7 PCK DELAY |
| 1 | 1010 | -6 PCK DELAY |
| 1 | 1011 | -5 PCK DELAY |
| 1 | 1100 | -4 PCK DELAY |
| 1 | 1101 | -3 PCK DELAY |
| 1 | 1110 | -2 PCK DELAY |
| 1 | 1111 | -1 PCK DELAY |

2) Effect register table

| | REG. Name | REGISTER DESCRIPTION | | |
|---|---|---|---|---|
| WORD 8 | EFFECT | 7     6        0 <br> MIRROR    MOSAIC <br><br> MODE) | | |

| VALUE | MODE |
|---|---|
| 0 | MOSAIC OFF |
| 4 | 4 X 4 MOSAIC |
| 8 | 8 X 8 MOSAIC |
| 12 | 12 X 12 MOSAIC |
| 16 | 16 X 16 MOSAIC |
| . . . | . . . |
| 60 | 60 X 60 MOSAIC |
| 64 | 64 X 64 MOSAIC |
| 128 | Horizontal MIRROR |

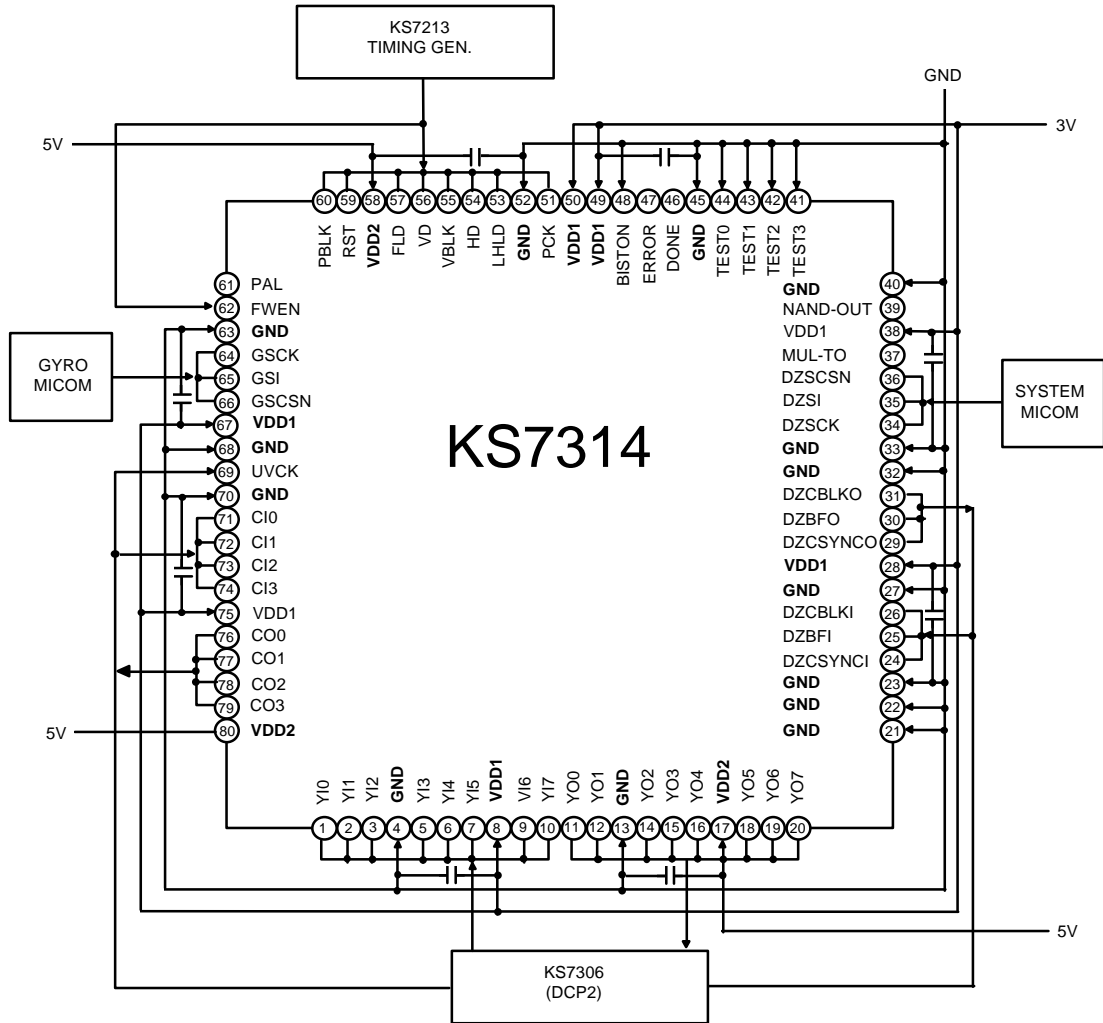| COMMAND REGISTER | CONTROL DATA REGISTER |
|---|---|
| 1 1 1 X X X X 0 | D.ZOOM / EIS / MOSAIC ON (Non-DVC Mode) |
| 0 0 1 X X X X 0 | EFFECT ON (MIRROR /MOSAIC) (Non-DVC Mode) |
| 0 1 0 X X X X 0 | EIS ON (Non-DVC Mode) |
| 1 0 0 X X X X 0 | D.ZOOM ON (Non-DVC Mode) |
| 1 1 0 X X X X 0 | D.ZOOM / EIS ON (Non-DVC Mode) |
| 1 1 1 X X X X 1 | D.ZOOM / EIS / MOSAIC ON (DVC Mode) |
| 0 0 1 X X X X 1 | EFFECT ON (MIRROR / MOSAIC) (DVC Mode) |
| 0 1 0 X X X X 1 | EIS ON (DVC Mode) |
| 1 0 0 X X X X 1 | D.ZOOM ON (DVC Mode) |
| 1 1 0 X X X X 1 | D.ZOOM / EIS ON (DVC Mode) |

### 3. **Gyro micom register table (2's complement)**

| | REG. Name | REGISTER DESCRIPTION |
|---|---|---|
| WORD1<br>WORD2 | HINT | HINT(9BIT) :<br>HORIZONTAL MOTION VECTOR(2's COMPLEMENT INTEGER)<br><br>HMV(8BIT) : HORIZONTAL MOTION VECTOR(2's COMPLEMENT SUB-PIXEL) |
| WORD3 | HMV | (see bit diagram below) |
| WORD 4 | VMV | VERTICAL MOTION VECTIO SUB-PIXEL. ( 0 ~ 255 ) |

Bit diagram (WORD1/WORD2/WORD3):

```
        23      22    17 16          8 7           0
       +------+------+-------------+-------------+
       | SIGN |  X   |  -511 ~ +511 | -255 ~ +255 |
       +------+------+-------------+-------------+
          ^                 |<-- HINT -->|<-- HMV -->|
       SIGN BIT
```

MSB 1 bit is the sign bit and relates to the integrals and the decimals both.

Note) Gyro micom interface timing

```
SCSN  ‾‾_____/‾‾

SCLK  ___|‖‖‖‖‖‖‖‖|_ _ _|‖‖‖‖‖‖‖‖|___

SI     | 7 6 5 4 3 2 1 0 |      | 7 6 5 4 3 2 1 0 |
       |                 |      |<-- word 3(1 Byte) -->|
       |<-- command(1 Byte) -->|<-- control data(4 Byte) -->|
```

## APPLICATION CIRCUIT

## PACKAGE DIMENSIONS

**80 - QFP - 1212**

unit: mm



14.00 ±0.30

12.00 ±0.20

14.00 ±0.30

12.00 ±0.20

#80

#1

0.18 +0.10 -0.05

0.50

⊕ 0.10MAX

(1.25)

0~8°

0.15 +0.10 -0.05

◠ 0.10MAX

0.50 ±0.10

0.05MIN

1.35 ±0.10

1.90MAX