

# DATA SHEET



## **SAA7111A** Enhanced Video Input Processor (EVIP)

Product specification  
Supersedes data of 1997 May 26  
File under Integrated Circuits, IC22

1998 May 15

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## Enhanced Video Input Processor (EVIP)

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**1 FEATURES**

- Four analog inputs, internal analog source selectors, e.g.  $4 \times$  CVBS or  $2 \times$  Y/C or ( $1 \times$  Y/C and  $2 \times$  CVBS)
- Two analog preprocessing channels
- Fully programmable static gain for the main channels or automatic gain control for the selected CVBS or Y/C channel
- Switchable white peak control
- Two built-in analog anti-aliasing filters
- Two 8-bit video CMOS analog-to-digital converters
- On-chip clock generator
- Line-locked system clock frequencies
- Digital PLL for horizontal-sync processing and clock generation
- Requires only one crystal (24.576 MHz) for all standards
- Horizontal and vertical sync detection
- Automatic detection of 50 and 60 Hz field frequency, and automatic switching between PAL and NTSC standards
- Luminance and chrominance signal processing for PAL BGHI, PAL N, PAL M, NTSC M, NTSC N, NTSC 4.43, NTSC-Japan and SECAM
- User programmable luminance peaking or aperture correction
- Cross-colour reduction for NTSC by chrominance comb filtering
- PAL delay line for correcting PAL phase errors
- Real time status information output (RTCO)
- Brightness Contrast Saturation (BCS) control on-chip
- The YUV (CCIR-601) bus supports a data rate of:
  - $864 \times f_H = 13.5$  MHz for 625 line sources
  - $858 \times f_H = 13.5$  MHz for 525 line sources.
- Data output streams for 16, 12 or 8-bit width with the following formats:
  - YUV 4 : 1 : 1 (12-bit)
  - YUV 4 : 2 : 2 (16-bit)
  - YUV 4 : 2 : 2 (CCIR-656) (8-bit)
  - RGB (5, 6, and 5) (16-bit) with dither
  - RGB (8, 8, and 8) (24-bit) with special application.
- Odd/even field identification by a non interlace CVBS input signal
- Fix level for RGB output format during horizontal blanking
- 720 active samples per line on the YUV bus
- One user programmable general purpose switch on an output pin
- Built-in line-21 text slicer
- A 27 MHz Vertical Blanking Interval (VBI) data bypass programmable by I<sup>2</sup>C-bus for INTERCAST applications
- Power-on control
- Two via I<sup>2</sup>C-bus switchable outputs for the digitized CVBS or Y/C input signals AD1 (7 to 0) and AD2 (7 to 0)
- Chip enable function (reset for the clock generator and power save mode up from chip version 3)
- Compatible with memory-based features (line-locked clock)
- Boundary scan test circuit complies with the 'IEEE Std. 1149.1 – 1990' (ID-Code = 0 F111 02 B)
- I<sup>2</sup>C-bus controlled (full read-back ability by an external controller)
- Low power (<0.5 W), low voltage (3.3 V), small package (LQFP64)
- 5 V tolerant digital I/O ports.

**2 APPLICATIONS**

- Desktop/Notebook (PCMCIA) video
- Multimedia
- Digital television
- Image processing
- Video phone
- Intercast.

## Enhanced Video Input Processor (EVIP)

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**3 GENERAL DESCRIPTION**

The Enhanced Video Input Processor (EVIP) is a combination of a two-channel analog preprocessing circuit including source selection, anti-aliasing filter and ADC, an automatic clamp and gain control, a Clock Generation Circuit (CGC), a digital multi-standard decoder (PAL BGHI, PAL M, PAL N, NTSC M, NTSC-Japan NTSC N and SECAM), a brightness/contrast/saturation control circuit, a colour space matrix (see Fig.1) and a 27 MHz VBI-data bypass.

The pure 3.3 V CMOS circuit SAA7111A, analog front-end and digital video decoder, is a highly integrated circuit for desktop video applications. The decoder is based on the principle of line-locked clock decoding and is able to decode the colour of PAL, SECAM and NTSC signals into CCIR-601 compatible colour component values. The SAA7111A accepts as analog inputs CVBS or S-video (Y/C) from TV or VTR sources. The circuit is I<sup>2</sup>C-bus controlled. The SAA7111A then supports several text features as Line 21 data slicing and a high-speed VBI data bypass for Intercast.

**4 QUICK REFERENCE DATA**

| SYMBOL           | PARAMETER                     | MIN. | TYP. | MAX. | UNIT |
|------------------|-------------------------------|------|------|------|------|
| V <sub>DDD</sub> | digital supply voltage        | 3.0  | 3.3  | 3.6  | V    |
| V <sub>DDA</sub> | analog supply voltage         | 3.1  | 3.3  | 3.5  | V    |
| T <sub>amb</sub> | operating ambient temperature | 0    | 25   | 70   | °C   |
| P <sub>A+D</sub> | analog and digital power      | –    | 0.5  | –    | W    |

**5 ORDERING INFORMATION**

| TYPE<br>NUMBER | PACKAGE |                                                                                 |          |
|----------------|---------|---------------------------------------------------------------------------------|----------|
|                | NAME    | DESCRIPTION                                                                     | VERSION  |
| SAA7111AHZ     | LQFP64  | plastic low profile quad flat package; 64 leads; body 10 × 10 × 1.4 mm          | SOT314-2 |
| SAA7111AH      | QFP64   | plastic quad flat package; 64 leads (lead length 1.6 mm); body 14 × 14 × 2.7 mm | SOT393-1 |

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6 BLOCK DIAGRAM

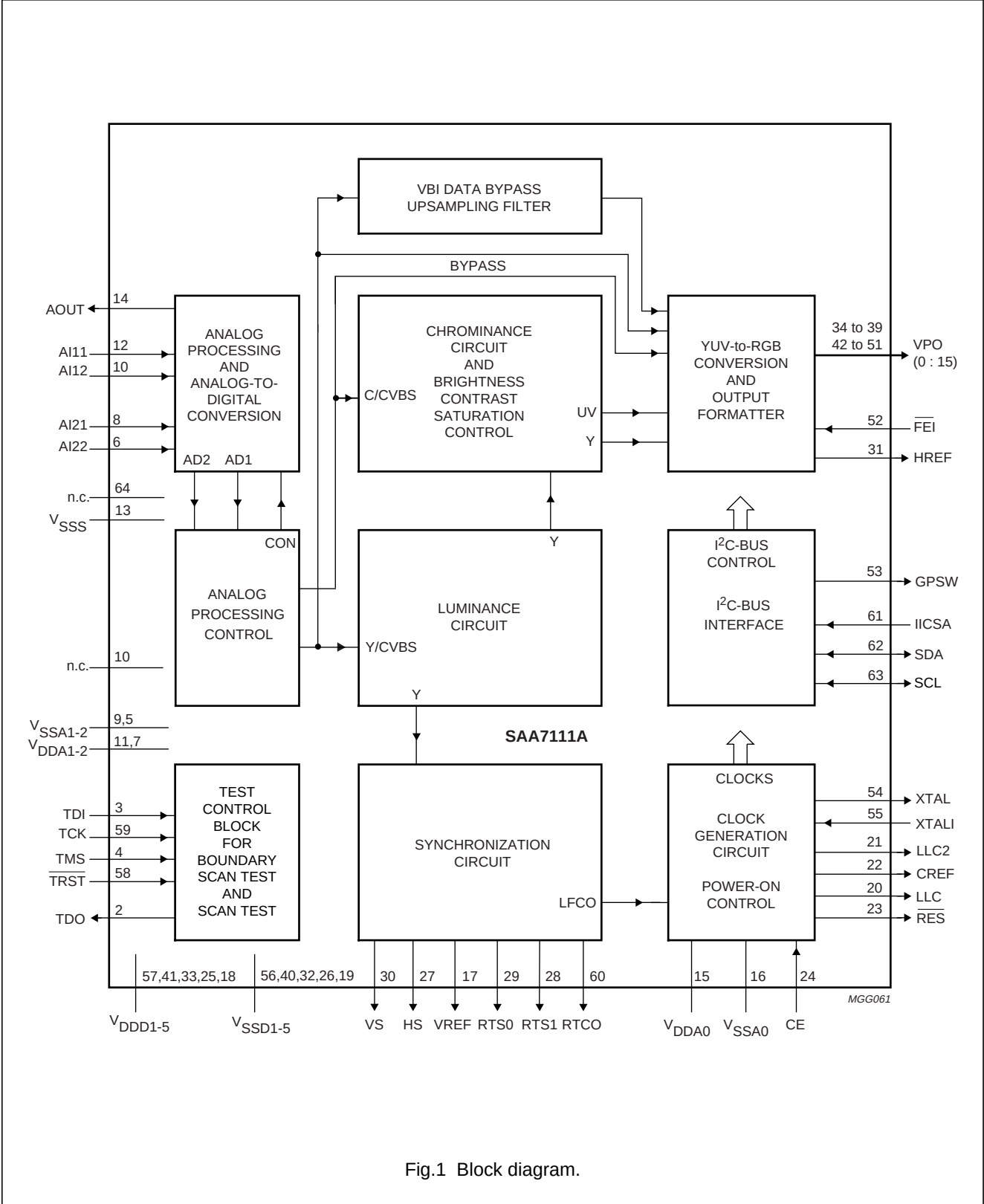


Fig.1 Block diagram.

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## 7 PINNING

| SYMBOL            | PIN      | I/O/P | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                 |
|-------------------|----------|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                   | (L)QFP64 |       |                                                                                                                                                                                                                                                                                                                                                             |
| n.c.              | 1        | –     | Do not connect.                                                                                                                                                                                                                                                                                                                                             |
| TDO               | 2        | O     | Test data output for boundary scan test; note 1.                                                                                                                                                                                                                                                                                                            |
| TDI               | 3        | I     | Test data input for boundary scan test; note 1.                                                                                                                                                                                                                                                                                                             |
| TMS               | 4        | I     | Test mode select input for boundary scan test or scan test; note 1.                                                                                                                                                                                                                                                                                         |
| V <sub>SSA2</sub> | 5        | P     | Ground for analog supply voltage channel 2.                                                                                                                                                                                                                                                                                                                 |
| AI22              | 6        | I     | Analog input 22.                                                                                                                                                                                                                                                                                                                                            |
| V <sub>DDA2</sub> | 7        | P     | Positive supply voltage for analog channel 2 (+3.3 V).                                                                                                                                                                                                                                                                                                      |
| AI21              | 8        | I     | Analog input 21.                                                                                                                                                                                                                                                                                                                                            |
| V <sub>SSA1</sub> | 9        | P     | Ground for analog supply voltage channel 1.                                                                                                                                                                                                                                                                                                                 |
| AI12              | 10       | I     | Analog input 12.                                                                                                                                                                                                                                                                                                                                            |
| V <sub>DDA1</sub> | 11       | P     | Positive supply voltage for analog channel 1 (+3.3 V).                                                                                                                                                                                                                                                                                                      |
| AI11              | 12       | I     | Analog input 11.                                                                                                                                                                                                                                                                                                                                            |
| V <sub>SSS</sub>  | 13       | P     | Substrate ground connection.                                                                                                                                                                                                                                                                                                                                |
| AOUT              | 14       | O     | Analog test output; for testing the analog input channels.                                                                                                                                                                                                                                                                                                  |
| V <sub>DDA0</sub> | 15       | P     | Positive supply voltage for internal Clock Generator Circuit (CGC) (+3.3 V).                                                                                                                                                                                                                                                                                |
| V <sub>SSA0</sub> | 16       | P     | Ground for internal CGC.                                                                                                                                                                                                                                                                                                                                    |
| VREF              | 17       | O     | Vertical reference output signal (I <sup>2</sup> C-bit COMPO = 0) or inverse composite blanking signal (I <sup>2</sup> C-bit COMPO = 1) (enabled via I <sup>2</sup> C-bus bit OEHV).                                                                                                                                                                        |
| V <sub>DD5</sub>  | 18       | P     | Digital supply voltage 5 (+3.3 V).                                                                                                                                                                                                                                                                                                                          |
| V <sub>SS5</sub>  | 19       | P     | Ground for digital supply voltage 5.                                                                                                                                                                                                                                                                                                                        |
| LLC               | 20       | O     | Line-locked system clock output (27 MHz).                                                                                                                                                                                                                                                                                                                   |
| LLC2              | 21       | O     | Line-locked clock ½ output (13.5 MHz).                                                                                                                                                                                                                                                                                                                      |
| CREF              | 22       | O     | Clock reference output: this is a clock qualifier signal distributed by the internal CGC for a data rate of LLC2. Using CREF all interfaces on the VPO bus are able to generate a bus timing with identical phase. If CCIR 656 format is selected (OFTS0 = 1 and OFTS1 = 1) an inverse composite blanking signal (pixel qualifier) is provided on this pin. |
| RES               | 23       | O     | Reset output (active LOW); sets the device into a defined state. All data outputs are in high impedance state. The I <sup>2</sup> C-bus is reset (waiting for start condition).                                                                                                                                                                             |
| CE                | 24       | I     | Chip enable; connection to ground forces a reset, up from version 3 power save function additionally available.                                                                                                                                                                                                                                             |
| V <sub>DD4</sub>  | 25       | P     | Digital supply voltage input 4 (+3.3 V).                                                                                                                                                                                                                                                                                                                    |
| V <sub>SS4</sub>  | 26       | P     | Ground for digital supply voltage input 4.                                                                                                                                                                                                                                                                                                                  |
| HS                | 27       | O     | Horizontal sync output signal (programmable); the positions of the positive and negative slopes are programmable in 8 LLC increments over a complete line (equals 64 µs) via I <sup>2</sup> C-bus bytes HSB and HSS. Fine position adjustment in 2 LLC increments can be performed via I <sup>2</sup> C-bus bits HDEL1 and HDEL0.                           |
| RTS1              | 28       | O     | Two functions output; controlled by I <sup>2</sup> C-bus bit RTSE1.<br>RTSE1 = 0: PAL line identifier (LOW = PAL line); indicates the inverted and non-inverted R – Y component for PAL signals. RTSE1 = 1: H-PLL locked indicator; a high state indicates that the internal horizontal PLL has locked.                                                     |

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| SYMBOL                   | PIN      | I/O/P | DESCRIPTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--------------------------|----------|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                          | (L)QFP64 |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| RTS0                     | 29       | O     | Two functions output; controlled by I <sup>2</sup> C-bus bit RTSE0.<br>RTSE0 = 0: odd/even field identification (HIGH = odd field). RTSE0 = 1: vertical locked indicator; a HIGH state indicates that the internal Vertical Noise Limiter (VNL) has locked.                                                                                                                                                                                                                                   |
| VS                       | 30       | O     | Vertical sync signal (enabled via I <sup>2</sup> C-bus bit OEHV); this signal indicates the vertical sync with respect to the YUV output. The HIGH period of this signal is approximately six lines if the VNL function is active. The positive slope contains the phase information for a deflection controller.                                                                                                                                                                             |
| HREF                     | 31       | O     | Horizontal reference output signal (enabled via I <sup>2</sup> C-bus bit OEHV); this signal is used to indicate data on the digital YUV bus. The positive slope marks the beginning of a new active line. The HIGH period of HREF is 720 Y samples long. HREF can be used to synchronize data multiplexer/demultiplexer. HREF is also present during the vertical blanking interval.                                                                                                          |
| V <sub>SSD3</sub>        | 32       | P     | Ground for digital supply voltage input 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| V <sub>DD3</sub>         | 33       | P     | Digital supply voltage 3 (+3.3 V).                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| VPO<br>(15 to 10)        | 34 to 39 | O     | Digital VPO-bus (Video Port Out) signal; higher bits of the 16-bit VPO-bus or the 16-bit RGB-bus output signal. The output data rate, the format and multiplexing scheme of the VPO-bus are controlled via I <sup>2</sup> C-bus bits OFTS0 and OFTS1. If I <sup>2</sup> C-bus bit VIPB = 1 the six MSBs of the digitized input signal are connected to these outputs, configured by the I <sup>2</sup> C-bus 'MODE' bits (see Figs 33 to 40):<br>LUMA → VPO15 to VPO8, CHROMA → VPO7 to VPO0. |
| V <sub>SSD2</sub>        | 40       | P     | Ground for digital supply voltage input 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| V <sub>DD2</sub>         | 41       | P     | Digital supply voltage 2 (+3.3 V).                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| VPO<br>(9 to 0)          | 42 to 51 | O     | Digital VPO-bus output signal; lower bits of the 16-bit YUV-bus or the 16-bit RGB-bus output signal. The output data rate, the format and multiplexing schema of the VPO-bus are controlled via I <sup>2</sup> C-bus bits OFTS0 and OFTS1. If I <sup>2</sup> C-bus bit VIPB = 1 the digitized input signal are connected to these outputs, configured by the I <sup>2</sup> C-bus 'MODE' bits (see Figs 33 to 40): LUMA → VPO15 to VPO8,<br>CHROMA → VPO7 to VPO0.                            |
| $\overline{\text{FEI}}$  | 52       | I     | Fast enable input signal (active LOW); this signal is used to control fast switching on the digital YUV-bus. A HIGH at this input forces the IC to set its Y and UV outputs to the high impedance state.                                                                                                                                                                                                                                                                                      |
| GPSW                     | 53       | O     | General purpose switch output; the state of this signal is set via I <sup>2</sup> C-bus control and the levels are TTL compatible.                                                                                                                                                                                                                                                                                                                                                            |
| XTAL                     | 54       | O     | Second terminal of crystal oscillator; not connected if external clock signal is used.                                                                                                                                                                                                                                                                                                                                                                                                        |
| XTALI                    | 55       | I     | Input terminal for 24.576 MHz crystal oscillator or connection of external oscillator with CMOS compatible square wave clock signal.                                                                                                                                                                                                                                                                                                                                                          |
| V <sub>SSD1</sub>        | 56       | P     | Ground for digital supply voltage input 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| V <sub>DD1</sub>         | 57       | P     | Digital supply voltage input 1 (+3.3 V).                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| $\overline{\text{TRST}}$ | 58       | I     | Test reset input not (active LOW), for boundary scan test; notes 1, 2 and 3.                                                                                                                                                                                                                                                                                                                                                                                                                  |
| TCK                      | 59       | I     | Test clock for boundary scan test; note 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| RTCO                     | 60       | O     | Real time control output: contains information about actual system clock frequency, subcarrier frequency and phase and PAL sequence.                                                                                                                                                                                                                                                                                                                                                          |

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| SYMBOL | PIN      | I/O/P | DESCRIPTION                                                                                                       |
|--------|----------|-------|-------------------------------------------------------------------------------------------------------------------|
|        | (L)QFP64 |       |                                                                                                                   |
| IICSA  | 61       | I     | I <sup>2</sup> C-bus slave address select;<br>0 = 48H for write, 49H for read<br>1 = 4AH for write, 4BH for read. |
| SDA    | 62       | I/O   | Serial data input/output (I <sup>2</sup> C-bus).                                                                  |
| SCL    | 63       | I/O   | Serial clock input/output (I <sup>2</sup> C-bus).                                                                 |
| n.c.   | 64       | –     | Not connect.                                                                                                      |

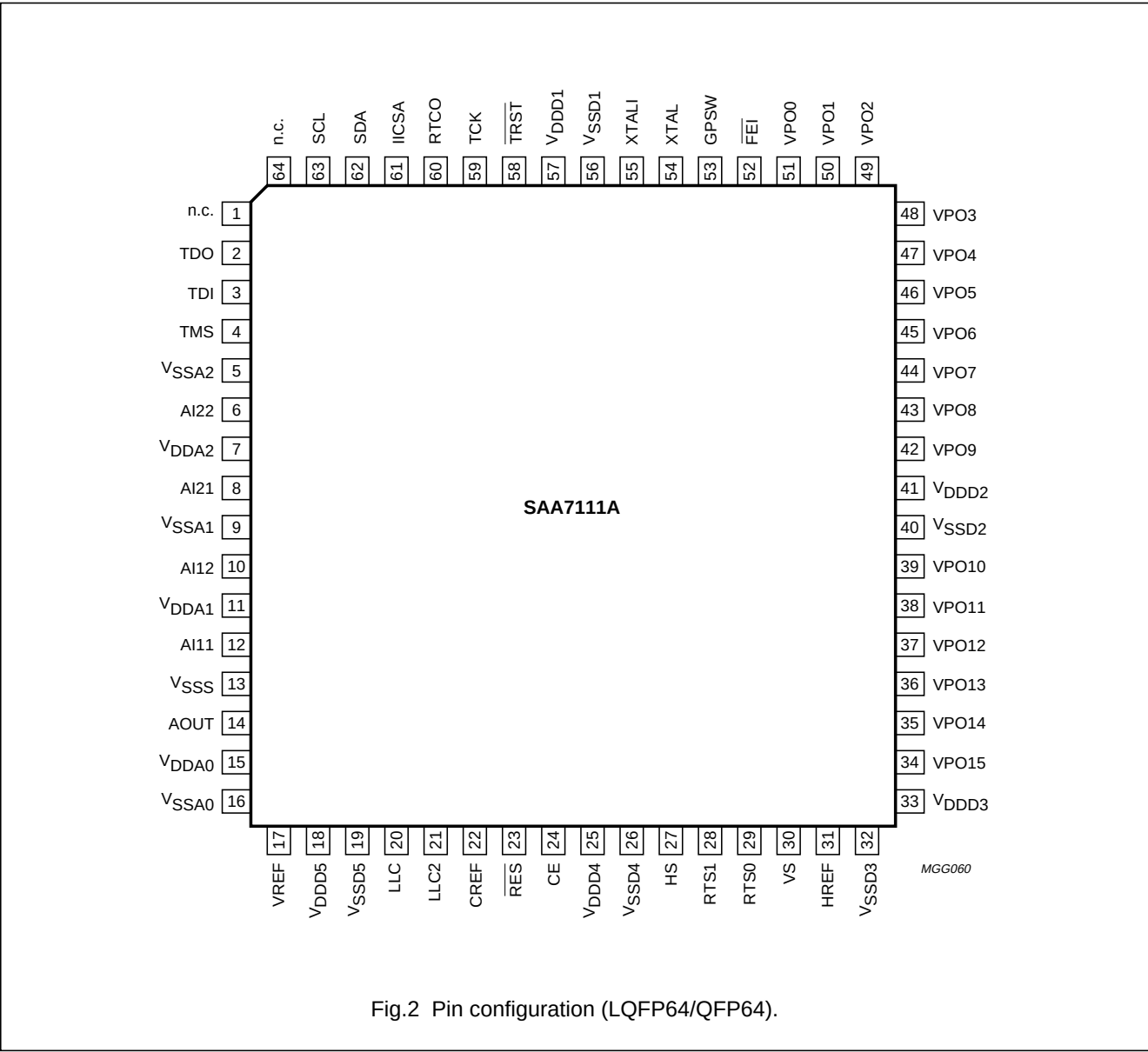
**Notes**

1. In accordance with the 'IEEE1149.1' standard the pads TCK, TDI, TMS and  $\overline{\text{TRST}}$  are input pads with an internal pull-up transistor and TDO a 3-state output pad.
2. This pin provides easy initialization of BST circuit.  $\overline{\text{TRST}}$  can be used to force the TAP (Test Access Port) controller to the Test-Logic-Reset state (normal operation) at once.
3. For board design without boundary scan implementation (pin compatibility with the SAA7110) connect the  $\overline{\text{TRST}}$  pin to ground.



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## Enhanced Video Input Processor (EVIP)

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## 8 FUNCTIONAL DESCRIPTION

## 8.1 Analog input processing

The SAA7111A offers four analog signal inputs, two analog main channels with source switch, clamp circuit, analog amplifier, anti-alias filter and video CMOS ADC (see Fig.5).

## 8.2 Analog control circuits

The anti-alias filters are adapted to the line-locked clock frequency via a filter control circuit. During the vertical blanking time, gain and clamping control are frozen.

## 8.2.1 CLAMPING

The clamp control circuit controls the correct clamping of the analog input signals. The coupling capacitor is also used to store and filter the clamping voltage. An internal digital clamp comparator generates the information with respect to clamp-up or clamp-down. The clamping levels for the two ADC channels are fixed for luminance (60) and chrominance (128). Clamping time in normal use is set with the HCL pulse at the back porch of the video signal.

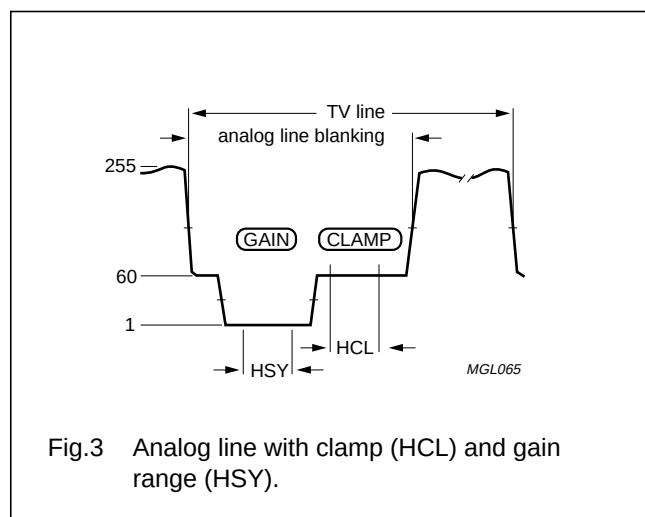


Fig.3 Analog line with clamp (HCL) and gain range (HSY).

## 8.2.2 GAIN CONTROL

Signal (white) peak control limits the gain at signal overshoots. The flow charts (see Figs 13 and 14) show more details of the AGC. The influence of supply voltage variation within the specified range is automatically eliminated by clamp and automatic gain control.

The gain control circuit receives (via the I<sup>2</sup>C-bus) the static gain levels for the two analog amplifiers or controls one of these amplifiers automatically via a built-in automatic gain control (AGC) as part of the Analog Input Control (AICO).

The AGC (automatic gain control for luminance) is used to amplify a CVBS or Y signal to the required signal amplitude, matched to the ADCs input voltage range. The AGC active time is the sync bottom of the video signal.

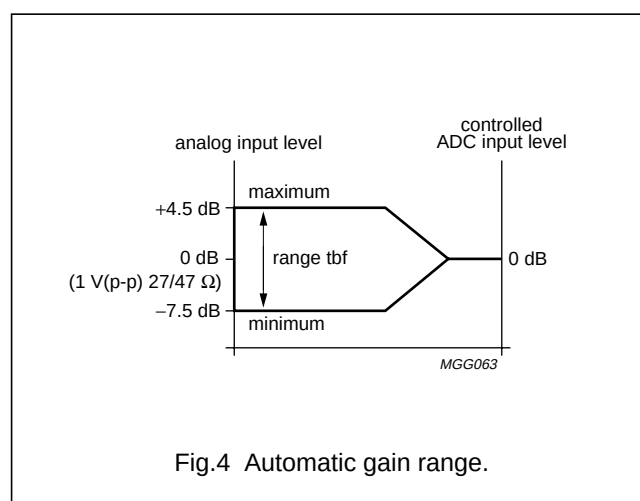


Fig.4 Automatic gain range.

## 8.3 Chrominance processing

The 8-bit chrominance signal is fed to the multiplication inputs of a quadrature demodulator, where two subcarrier signals from the local oscillator DTO1 are applied (0 and 90° phase relationship to the demodulator axis). The frequency is dependent on the present colour standard. The output signals of the multipliers are low-pass filtered (four programmable characteristics) to achieve the desired bandwidth for the colour difference signals (PAL and NTSC) or the 0 and 90° FM-signals (SECAM).

The colour difference signals are fed to the Brightness/Contrast/Saturation block (BCS), which includes the following five functions:

- AGC (Automatic Gain Control for chrominance PAL and NTSC)
- Chrominance amplitude matching (different gain factors for R – Y and B – Y to achieve CCIR-601 levels Cr and Cb for all standards)
- Chrominance saturation control
- Luminance contrast and brightness
- Limiting YUV to the values 1 (min.) and 254 (max.) to fulfil CCIR-601 requirements.

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The SECAM-processing contains the following blocks:

- Baseband 'bell' filters to reconstruct the amplitude and phase equalized 0 and 90° FM-signals
- Phase demodulator and differentiator (FM-demodulation)
- De-emphasis filter to compensate the pre-emphasised input signal, including frequency offset compensation (DB or DR white carrier values are subtracted from the signal, controlled by the SECAM-switch signal).

The burst processing block provides the feedback loop of the chroma PLL and contains;

- Burst gate accumulator
- Colour identification and killer
- Comparison nominal/actual burst amplitude (PAL/NTSC standards only)
- Loop filter chrominance gain control (PAL/NTSC standards only)
- Loop filter chrominance PLL (only active for PAL/NTSC standards)
- PAL/SECAM sequence detection, H/2-switch generation
- Increment generation for DTO1 with divider to generate stable subcarrier for non-standard signals.

The chrominance comb filter block eliminates crosstalk between the chrominance channels in accordance with the PAL standard requirements. For NTSC colour standards the chrominance comb filter can be used to eliminate crosstalk from luminance to chrominance (cross-colour) for vertical structures. The comb filter can be switched off if desired. The embedded line delay is also used for SECAM recombination (cross-over switches).

The resulting signals are fed to the variable Y-delay compensation, RGB matrix, dithering circuit and output interface, which contains the VPO output formatter and the output control logic (see Fig.6).

### 8.4 Luminance processing

The 8-bit luminance signal, a digital CVBS format or a luminance format (S-VHS, HI8), is fed through a switchable prefilter. High frequency components are emphasized to compensate for loss. The following chrominance trap filter ( $f_0 = 4.43$  or  $3.58$  MHz centre frequency selectable) eliminates most of the colour carrier signal, therefore, it must be bypassed for S-video (S-VHS and HI8) signals.

The high frequency components of the luminance signal can be peaked (control for sharpness improvement via I<sup>2</sup>C-bus) in two band-pass filters with selectable transfer characteristic. This signal is then added to the original (unpeaked) signal. A switchable amplifier achieves common DC amplification, because the DC gains are different in both chrominance trap modes. The improved luminance signal is fed to the BCS control located in the chrominance processing block (see Fig.7).

### 8.5 RGB matrix

Y, Cr and Cb data are converted after interpolation into RGB data in accordance with CCIR-601 recommendations. The realized matrix equations consider the digital quantization:

$$R = Y + 1.371 Cr$$

$$G = Y - 0.336 Cb - 0.698 Cr$$

$$B = Y + 1.732 Cb.$$

After dithering (noise shaping) the RGB data is fed to the output interface within the VPO-bus output formatter.

### 8.6 VBI-data bypass

For a 27 MHz VBI-data bypass the offset binary CVBS signal is upsampled behind the ADCs. Upsampling of the CVBS signal from 13.5 to 27 MHz is possible, because the ADCs deliver high performance at 13.5 MHz sample clock. Suppressing of the back folded CVBS frequency components after upsampling is achieved by an interpolation filter (see Fig.42).

The TUF block on the digital top level performs the upsampling and interpolation for the bypassed CVBS signal (see Fig.6).

For bypass details see Figs 8 to 10.

### 8.7 VPO-bus (digital outputs)

The 16-bit VPO-bus transfers digital data from the output interfaces to a feature box or a field memory, a digital colour space converter (SAA7192 DCSC), a video enhancement and digital-to-analog processor (SAA7165 VEDA2) or a colour graphics board (Targa-format) as a graphical user interface.

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The output data formats are controlled via the I<sup>2</sup>C-bus bits OFTS0, OFTS1 and RGB888. Timing for the data stream formats, YUV (4 : 1 : 1) (12-bit), YUV (4 : 2 : 2) (16-bit), RGB (5, 6 and 5) (16-bit) and RGB (8, 8 and 8) (24-bit) with an LLC2 data rate, is achieved by marking each second positive rising edge of the clock LLC in conjunction with CREF (clock reference) (except RGB (8, 8 and 8), see special application in Fig.32). The higher output signals VPO15 to VPO8 in the YUV format perform the digital luminance signal. The lower output signals VPO7 to VPO0 in the YUV format are the bits of the multiplexed colour difference signals (B – Y) and (R – Y). The arrangement of the RGB (5, 6 and 5) and RGB (8, 8 and 8) data stream bits on the VPO-bus is given in Table 6.

The data stream format YUV 4 : 2 : 2 (the 8 higher output signals VPO15 to VPO8) in LLC data rate fulfils the CCIR-656 standard with its own timing reference code at the start and end of each video data block.

A pixel in the format tables is the time required to transfer a full set of samples. If 16-bit 4 : 2 : 2 format is selected two luminance samples are transmitted in comparison to one (B – Y) and one (R – Y) sample within a pixel. The time frames are controlled by the HREF signal.

Fast enable is achieved by setting input  $\overline{FEI}$  to LOW. The signal is used to control fast switching on the digital VPO-bus. HIGH on this pin forces the VPO outputs to a high-impedance state (see Figs 18 and 19). The I<sup>2</sup>C-bus bit OEYC has to be set HIGH to use this function.

The digitized PAL, SECAM or NTSC signals AD1 (7 to 0) and AD2 (7 to 0) are connected directly to the VPO-bus via I<sup>2</sup>C-bus bit VIPB = 1 and MODE = 4, 5, 6 or 7.

AD1 (7 to 0) → VPO (15 to 8) and  
AD2 (7 to 0) → VPO (7 to 0).

The selection of the analog input channels is controlled via I<sup>2</sup>C-bus subaddress 02 MODE select.

The upsampled 8-bit offset binary CVBS signal (VBI-data bypass) is multiplexed under control of the I<sup>2</sup>C-bus to the digital VPO-bus (see Fig.8).

### 8.8 Reference signals HREF, VREF and CREF

- HREF: The positive slope of the HREF output signal indicates the beginning of a new active video line. The high period is 720 luminance samples long and is also present during the vertical blanking. The description of timing and position from HREF is illustrated in Figs 15, 16, 21 and 23.

- VREF: The VREF output delivers a vertical reference signal or an inverse composite blank signal controlled via the I<sup>2</sup>C-bus [subaddress 11, inverse composite blank (COMPO)]. Furthermore four different modes of vertical reference signals are selectable via the I<sup>2</sup>C-bus [subaddress 13, vertical reference output control (VCTR1 and VCTR0)]. The description of VREF timing and position is illustrated in Figs 15, 16, 24 and 25.
- CREF: The CREF output delivers a clock/pixel qualifier signal for external interfaces to synchronize to the VPO-bus data stream.

Four different modes for the clock qualifier signal are selectable via the I<sup>2</sup>C-bus [subaddress 13, clock reference output control (CCTR1 and CCTR0)]. The description of CREF timing and position is illustrated in Figs 16, 18, 20 and 21.

### 8.9 Synchronization

The prefiltered luminance signal is fed to the synchronization stage. Its bandwidth is reduced to 1 MHz in a low-pass filter. The sync pulses are sliced and fed to the phase detectors where they are compared with the sub-divided clock frequency. The resulting output signal is applied to the loop filter to accumulate all phase deviations. Internal signals (e. g. HCL and HSY) are generated in accordance with analog front-end requirements. The output signals HS, VS, and PLIN are locked to the timing reference, guaranteed between the input signal and the HREF signal, as further improvements to the circuit may change the total processing delay. It is therefore not recommended to use them for applications which require absolute timing accuracy on the input signals. The loop filter signal drives an oscillator to generate the line frequency control signal LFCO (see Fig.7).

### 8.10 Clock generation circuit

The internal CGC generates all clock signals required for the video input processor. The internal signal LFCO is a digital-to-analog converted signal provided by the horizontal PLL. It is the multiple of the line frequency

$$6.75\text{MHz} = \frac{429}{432} \times f_H$$

Internally the LFCO signal is multiplied by a factor of 2 or 4 in the PLL circuit (including phase detector, loop filtering, VCO and frequency divider) to obtain the LLC and LLC2 output clock signals. The rectangular output clocks have a 50% duty factor (see Fig.26).

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### 8.11 Power-on reset and CE input

A missing clock, insufficient digital or analog  $V_{DDA0}$  supply voltages (below 2.7 V) will initiate the reset sequence; all outputs are forced to 3-state. The indicator output  $\overline{RES}$  is LOW for approximately 128LLC after the internal reset and can be applied to reset other circuits of the digital TV system.

It is possible to force a reset by pulling the chip enable (CE) to ground. After the rising edge of CE and sufficient power supply voltage, the outputs LLC, LLC2, CREF, RTCO, RTS0, RTS1, GPSW and SDA return from 3-state to active, while HREF, VREF, HS and VS remain in 3-state and have to be activated via I<sup>2</sup>C-bus programming (see Table 5).

### 8.12 RTCO output

The real time control and status output signal contains serial information about the actual system clock (increment of the HPLL), subcarrier frequency [increment and phase (via reset) of the FSC-PLL] and PAL sequence bit. The signal can be used for various applications in external circuits, e.g. in a digital encoder to achieve clean encoding (see Fig.20).

### 8.13 The Line-21 text slicer

The text slicer block detects and acquires Line-21 Closed Captioning data from a 525-line CVBS signal. Extended data services on Line-21 Field 2 are also supported. If valid data is detected the two data bytes are stored in two I<sup>2</sup>C-bus registers. A parity check is also performed and the result is stored in the MSB of the corresponding byte. A third I<sup>2</sup>C-bus register is provided for data valid and data ready flags. The two bits F1VAL and F2VAL indicate that the input signal carries valid Closed Captioning data in the corresponding fields. The data ready bits F1RDY and F2RDY have to be evaluated if asynchronous I<sup>2</sup>C-bus reading is used.

#### 8.13.1 SUGGESTIONS FOR I<sup>2</sup>C-BUS INTERFACE OF THE DISPLAY SOFTWARE READING LINE-21 DATA

There are two methods by which the software can acquire the data:

1. Synchronous reading once per frame (or once per field); It can use either the rising edge (Line-21 Field 1) or both edges (Line-21 Field 1 or 2) of the ODD signal (pin RTS0) to initiate an I<sup>2</sup>C-bus read transfer of the three registers 1A, 1B and 1C.
2. Asynchronous reading; It can poll either the F1RDY bit (Line-21 Field 1) or both F1RDY/F2RDY bits (Line-21 Field 1 or 2). After valid data has been read the corresponding F\*RDY bit is set to LOW until new data has arrived. The polling frequency has to be slightly higher than the frame or field frequency, respectively.

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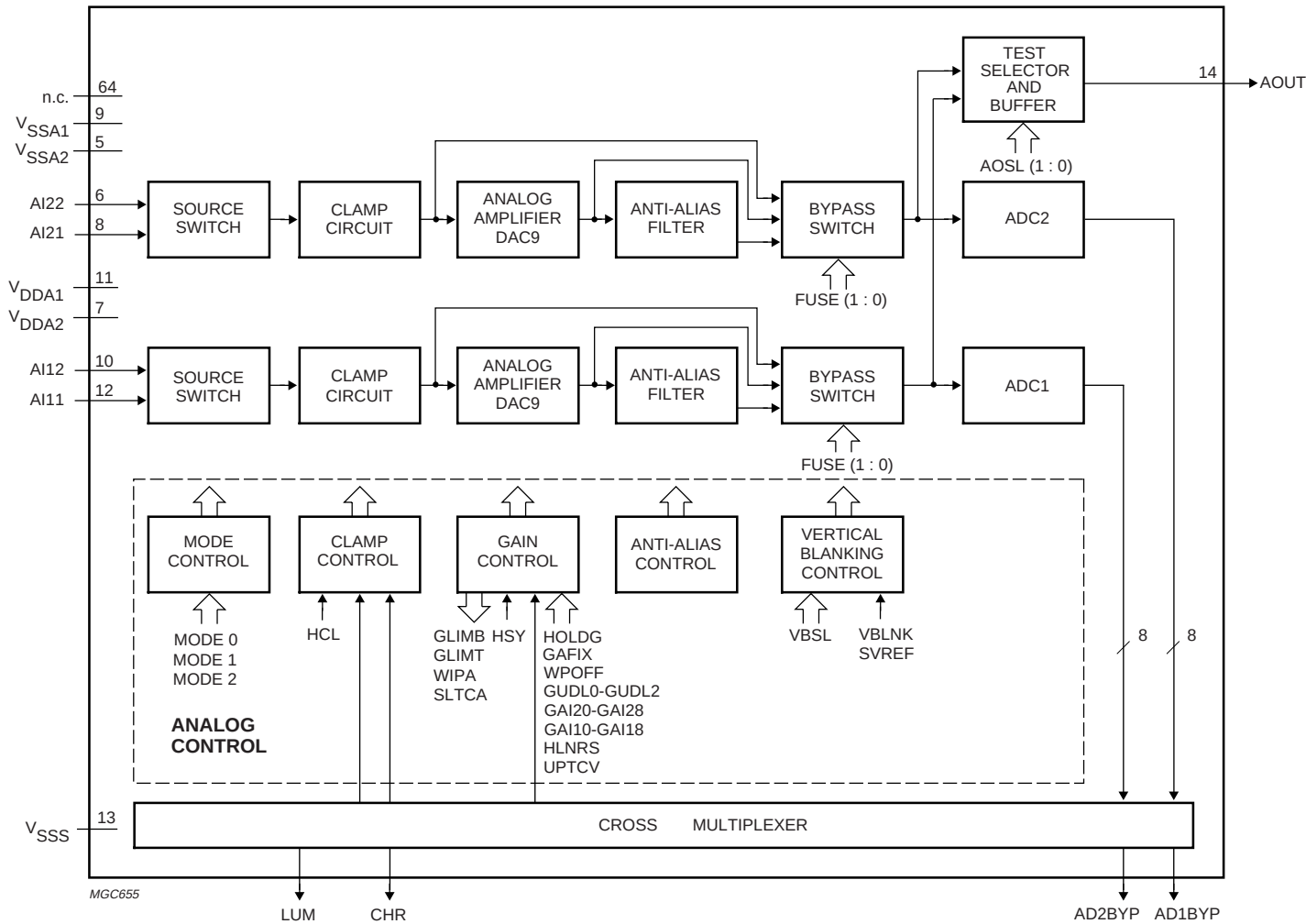


Fig.5 Analog input processing.

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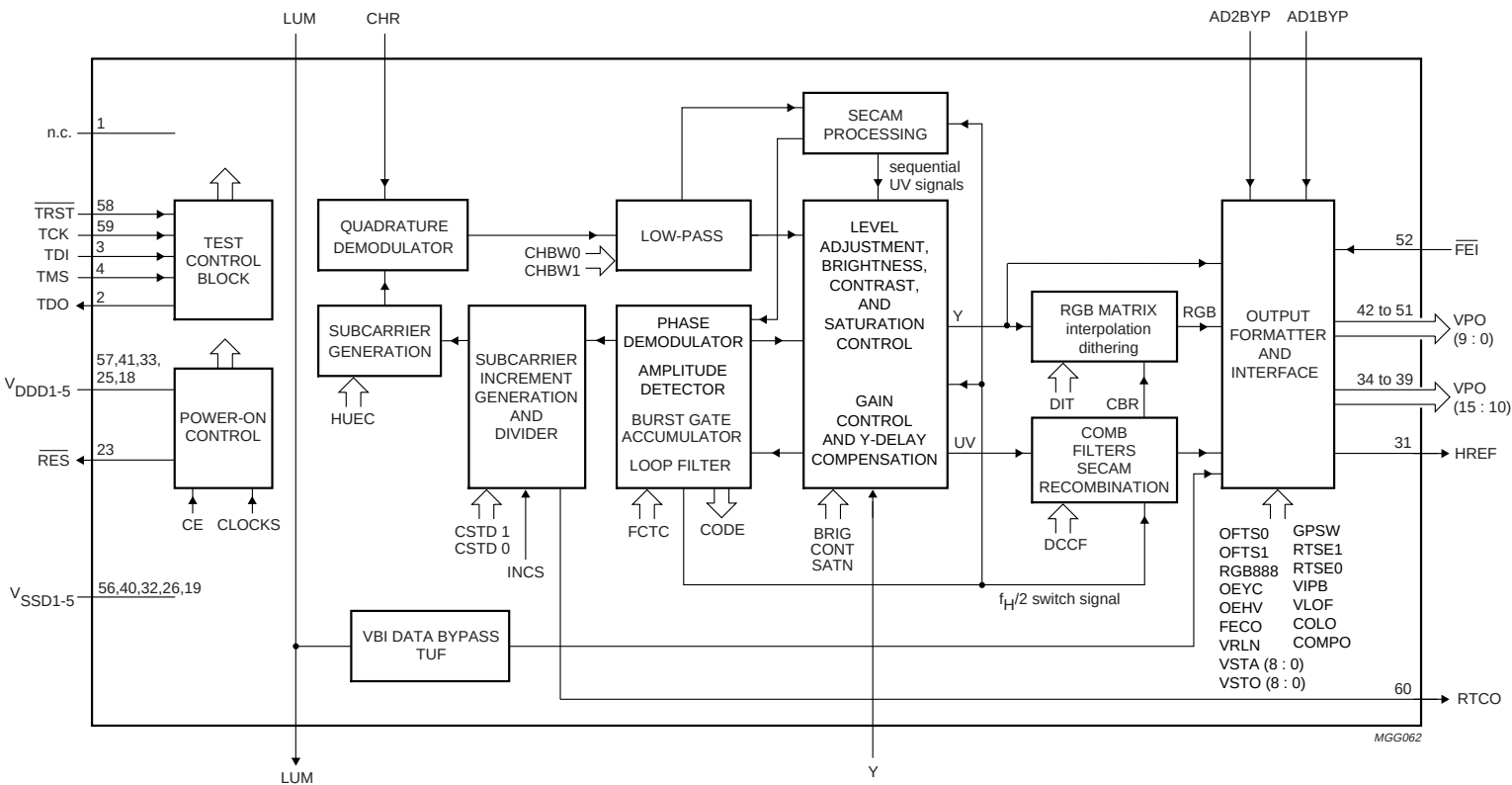


Fig.6 Chrominance circuit.

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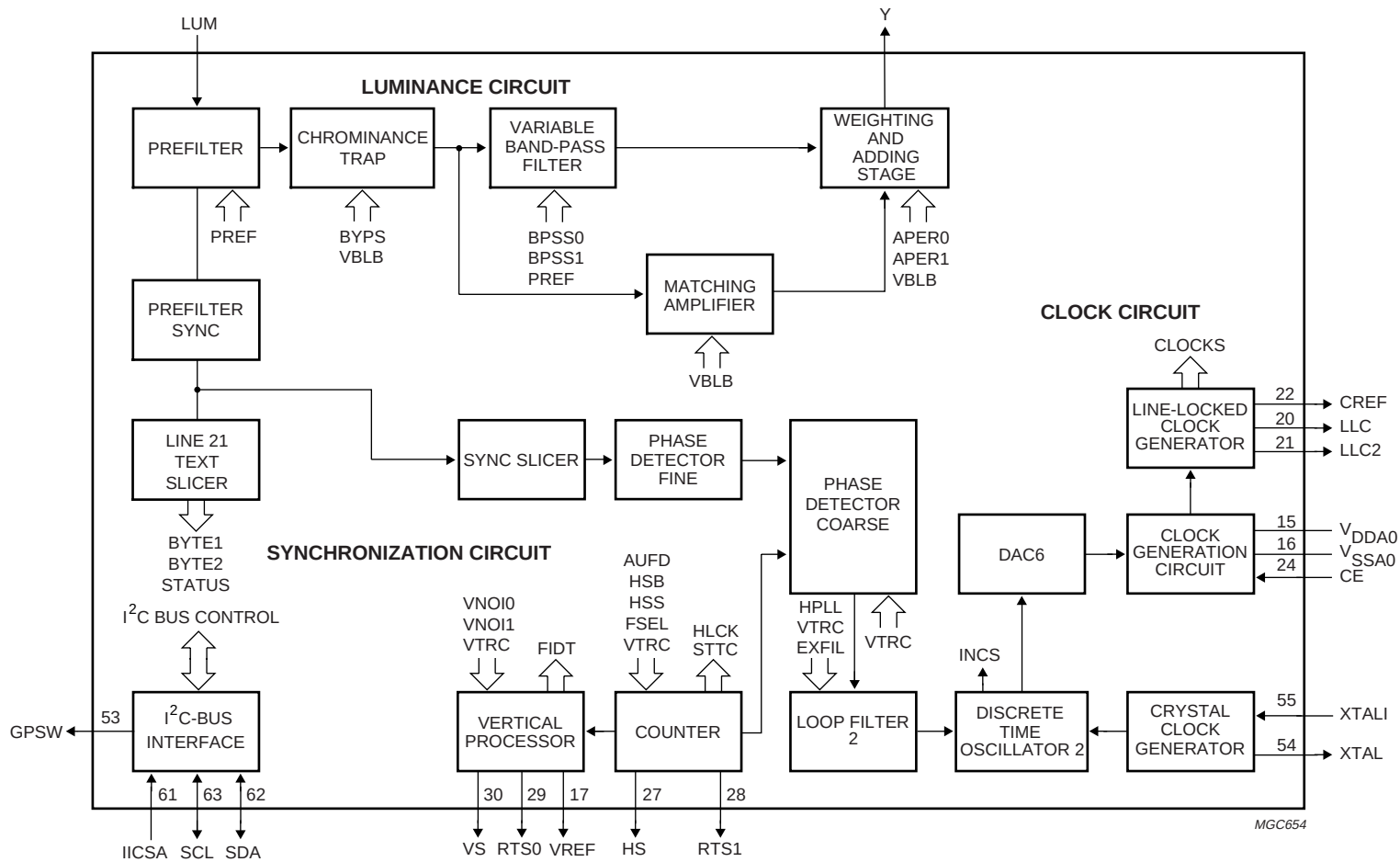
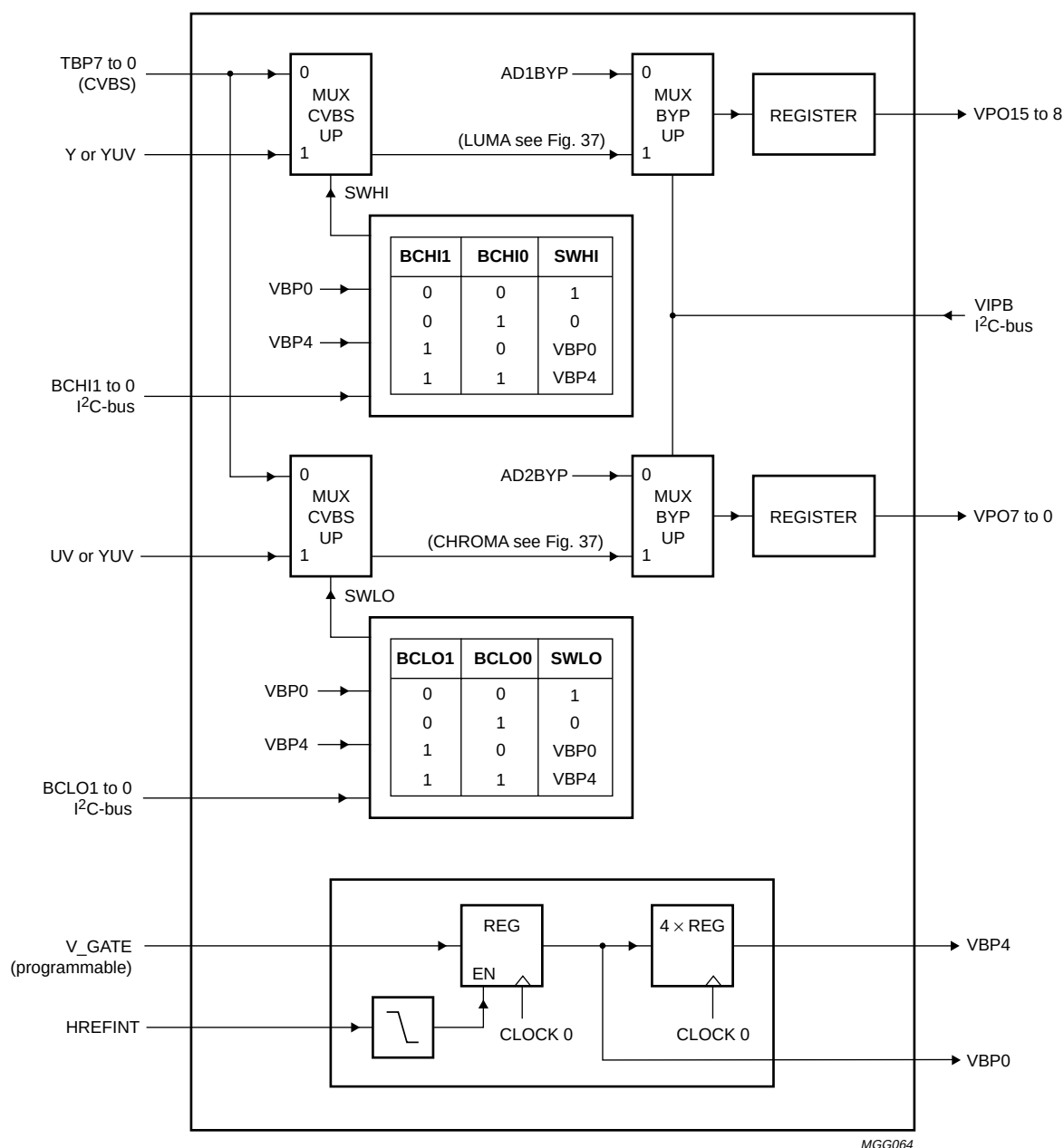


Fig.7 Luminance and sync processing.



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HREFINT = internal horizontal reference.

TBP = upsampled CVBS input data (27 MHz).

AD1BYP/AD2BYP = digitized CVBS input data and Y/C input data (13.5 MHz).

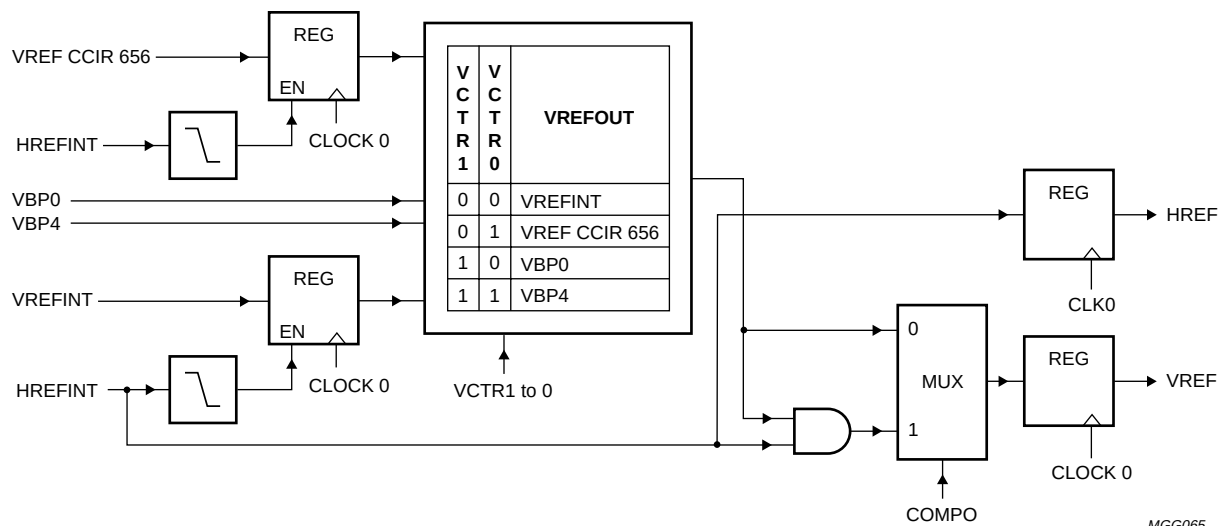
VBP0 = programmable vertical reference signal.

VBP4 = delayed programmable vertical reference signal (4LLC clocks delay).

Fig.8 Multiplexing of the CVBS signal to the VPO-bus.

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VREF\_CCIR 656 = vertical reference signal referring to the field interval definitions of CCIR656.

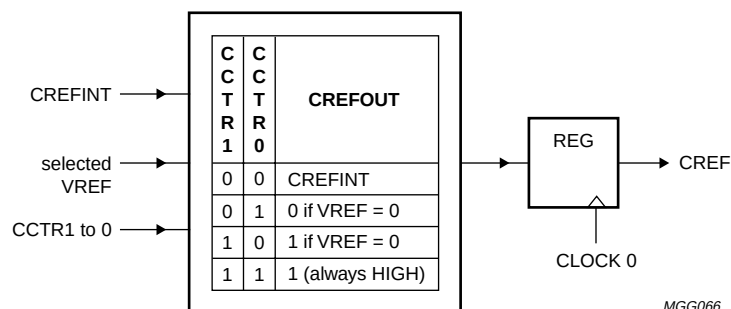
HREFINT = internal horizontal reference signal.

VREFINT = internal vertical reference signal.

VBP0 = programmable vertical reference signal.

VBP4 = delayed programmable vertical reference signal (4LLC clocks delay).

Fig.9 VREF output signal generation.



CREFINT = internal clock qualifier signal.

Fig.10 CREF output signal generation.

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**9 BOUNDARY-SCAN TEST**

The SAA7111A has built in logic and 5 dedicated pins to support boundary-scan testing which allows board testing without special hardware (nails). The SAA7111A follows the '*IEEE Std. 1149.1 - Standard Test Access Port and Boundary-Scan Architecture*' set by the Joint Test Action Group (JTAG) chaired by Philips.

The 5 special pins are Test Mode Select (TMS), Test Clock (TCK), Test Reset (TRST), Test Data Input (TDI) and Test Data Output (TDO).

The BST functions BYPASS, EXTEST, INTEST, SAMPLE, CLAMP and IDCODE are all supported (see Table 1). Details about the JTAG BST-TEST can be found in the specification "*IEEE Std. 1149.1*". A file containing the detailed Boundary-Scan Description Language (BSDL) description of the SAA7111A is available on request.

**9.1 Initialization of boundary-scan circuit**

The Test Access Port (TAP) controller of an IC should be in the reset state (TEST\_LOGIC\_RESET) when the IC is in functional mode. This reset state also forces the instruction register into a functional instruction such as IDCODE or BYPASS.

To solve the power-up reset, the standard specifies that the TAP controller will be forced asynchronously to the TEST\_LOGIC\_RESET state by setting the TRST pin LOW.

**9.2 Device identification codes**

A Device Identification Register (DIR) is specified in '*IEEE Std. 1149.1-1990 - IEEE Standard Test Access Port and Boundary-Scan Architecture*' (IEEE Std. 1149.1b-1994). It is a 32-bit register which contains fields for the specification of the IC manufacturer, the IC part number and the IC version number. Its biggest advantage is the possibility to check for the correct ICs mounted after production and determination of the version number of ICs during field service.

When the IDCODE instruction is loaded into the BST instruction register, the identification register will be connected between TDI and TDO of the IC.

The identification register will load a component specific code during the CAPTURE\_DATA\_REGISTER state of the TAP controller and this code can subsequently be shifted out. At board level this code can be used to verify component manufacturer, type and version number. The device identification register contains 32-bits, numbered 31 to 0, where bit 31 is the Most Significant Bit (MSB) (nearest to TDI) and bit 0 is the Least Significant Bit (LSB) (nearest to TDO); see Fig.11.

**Table 1** BST instructions supported by the SAA7111A

| INSTRUCTION | DESCRIPTION                                                                                                                                                                                                        |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| BYPASS      | This mandatory instruction provides a minimum length serial path (1 bit) between TDI and TDO when no test operation of the component is required.                                                                  |
| EXTEST      | This mandatory instruction allows testing of off-chip circuitry and board level interconnections.                                                                                                                  |
| SAMPLE      | This mandatory instruction can be used to take a sample of the inputs during normal operation of the component. It can also be used to preload data values into the latched outputs of the boundary-scan register. |
| CLAMP       | This optional instruction is useful for testing when not all ICs have BST. This instruction addresses the bypass register while the boundary-scan register is in external test mode.                               |
| IDCODE      | This optional instruction will provide information on the components manufacturer, part number and version number.                                                                                                 |
| INTEST      | This optional instruction allows testing of the internal logic (no support for customers available).                                                                                                               |
| USER1       | This private instruction allows testing by the manufacturer (no support for customers available).                                                                                                                  |

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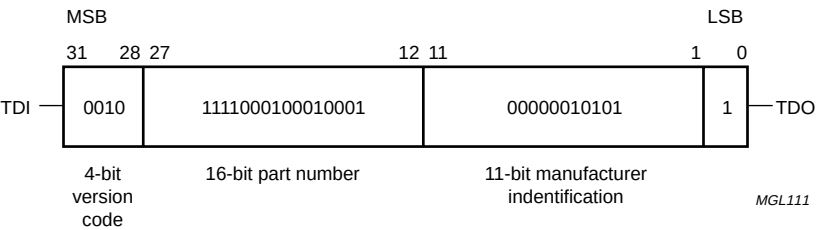


Fig.11 32 bits of identification code.

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10 GAIN CHARTS

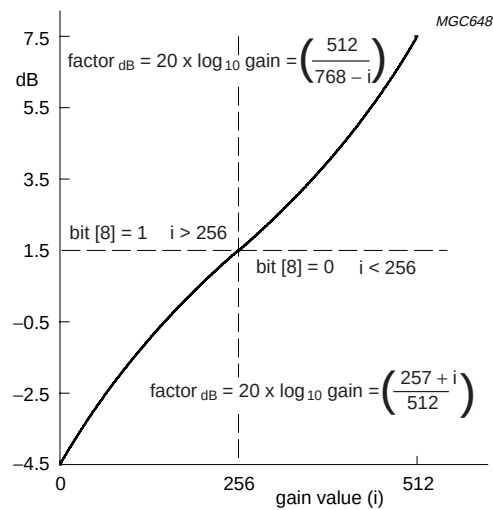
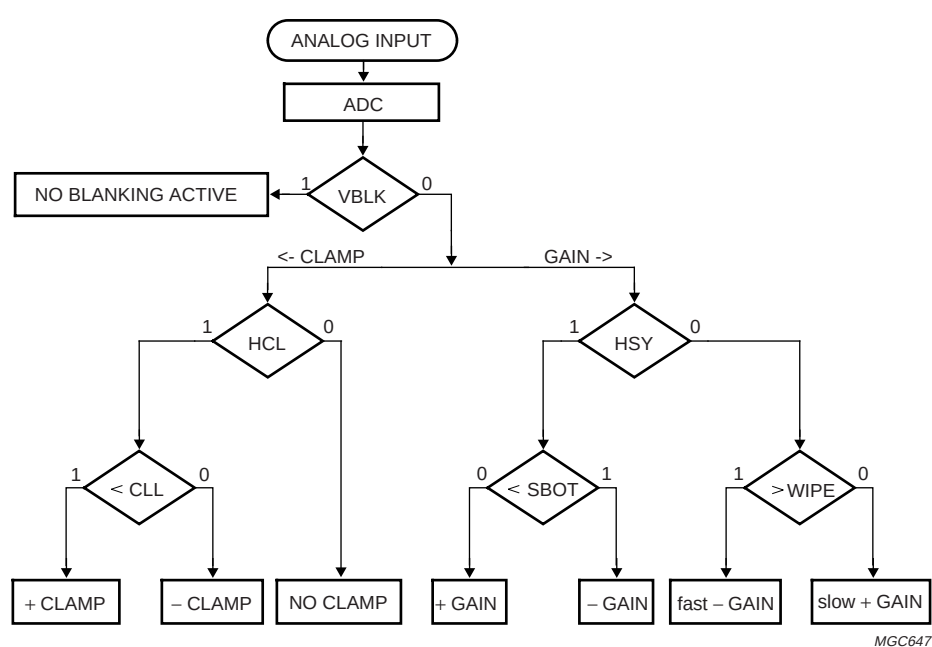


Fig.12 Amplifier curve.

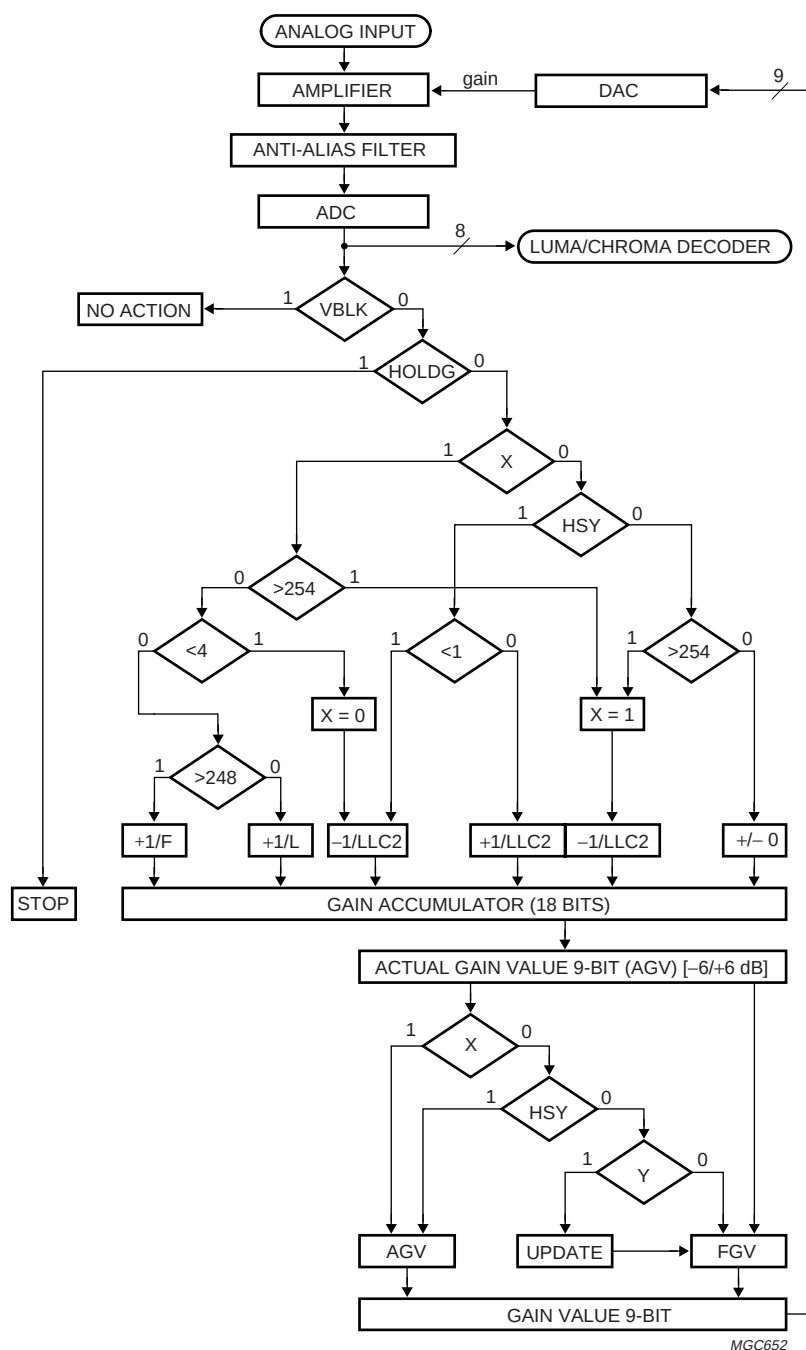


WIPE = white peak level (254); SBOT = sync bottom level (1); CLL = clamp level [60 Y (128 C)];  
HSY = horizontal sync pulse; HCL = horizontal clamp pulse.

Fig.13 Clamp and gain flow.

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X = system variable; Y = IAGV – FGVI > GUDL; VBLK = vertical blanking pulse; HSY = horizontal sync pulse; AGV = actual gain value; FGV = frozen gain value.

Fig.14 Gain flow chart.

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**11 LIMITING VALUES**

In accordance with the Absolute Maximum Rating System (IEC 134); all ground pins connected together and all supply pins connected together.

| SYMBOL          | PARAMETER                                               | CONDITIONS         | MIN.  | MAX.                          | UNIT |
|-----------------|---------------------------------------------------------|--------------------|-------|-------------------------------|------|
| $V_{DDD}$       | digital supply voltage                                  |                    | −0.5  | +4.6                          | V    |
| $V_{DDA}$       | analog supply voltage                                   |                    | −0.5  | +4.6                          | V    |
| $V_{i(A)}$      | input voltage at analog inputs                          |                    | −0.5  | $V_{DDA} + 0.5$<br>(4.6 max.) | V    |
| $V_{o(A)}$      | output voltage at analog output                         |                    | −0.5  | $V_{DDA} + 0.5$               | V    |
| $V_{i(D)}$      | input voltage at digital inputs and outputs             | outputs in 3-state | −0.5  | +5.5                          | V    |
| $V_{o(D)}$      | output voltage at digital outputs                       | outputs active     | −0.5  | $V_{DDD} + 0.5$               | V    |
| $\Delta V_{SS}$ | voltage difference between $V_{SSAall}$ and $V_{SSall}$ |                    | −     | 100                           | mV   |
| $T_{stg}$       | storage temperature                                     |                    | −65   | +150                          | °C   |
| $T_{amb}$       | operating ambient temperature                           |                    | 0     | 70                            | °C   |
| $T_{amb(bias)}$ | operating ambient temperature under bias                |                    | −10   | +80                           | °C   |
| $V_{esd}$       | electrostatic discharge all pins                        | note 1             | −2000 | +2000                         | V    |

**Note**

- Human body model: equivalent to discharging a 100 pF capacitor through a 1.5 kΩ resistor.

**12 CHARACTERISTICS**

$V_{DDD} = 3.0$  to  $3.6$  V;  $V_{DDA} = 3.1$  to  $3.5$  V;  $T_{amb} = 25$  °C; unless otherwise specified.

| SYMBOL             | PARAMETER                                   | CONDITIONS                                                                                                                      | MIN. | TYP. | MAX. | UNIT |
|--------------------|---------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| <b>Supplies</b>    |                                             |                                                                                                                                 |      |      |      |      |
| $V_{DDD}$          | digital supply voltage                      |                                                                                                                                 | 3.0  | 3.3  | 3.6  | V    |
| $I_{DDD}$          | digital supply current                      |                                                                                                                                 | −    | 63   | 70   | mA   |
| $P_D$              | digital power                               |                                                                                                                                 | −    | 0.21 | −    | W    |
| $V_{DDA}$          | analog supply voltage                       |                                                                                                                                 | 3.1  | 3.3  | 3.5  | V    |
| $I_{DDA}$          | analog supply current                       | AOSL = [1:0] = 00b;<br>AOUT not connected                                                                                       | −    | 52   | −    | mA   |
| $P_A$              | analog power                                |                                                                                                                                 | −    | 0.17 | −    | W    |
| $P_{A+D}$          | analog and digital power                    |                                                                                                                                 | −    | 0.38 | −    | W    |
| $P_{pd}$           | analog and digital power in power-down mode | CE connected to ground<br>(since version 3)                                                                                     | −    | 0.02 | −    | W    |
| <b>Analog part</b> |                                             |                                                                                                                                 |      |      |      |      |
| $I_{clamp}$        | clamping current                            | $V_I = 0.9$ V DC                                                                                                                | −    | ±3.5 | −    | μA   |
| $V_{i(p-p)}$       | input voltage<br>(peak-to-peak value)       | for normal video levels<br>[1 V (p-p)]; −3 dB<br>termination 27/47 Ω and<br>AC coupling required;<br>coupling capacitor = 22 nF | 0.3  | 0.7  | 1.2  | V    |
| $ Z_i $            | input impedance                             | clamping current off                                                                                                            | 200  | −    | −    | kΩ   |
| $C_i$              | input capacitance                           |                                                                                                                                 | −    | −    | 10   | pF   |

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| SYMBOL                              | PARAMETER                                                            | CONDITIONS                                      | MIN.                | TYP. | MAX.                   | UNIT |
|-------------------------------------|----------------------------------------------------------------------|-------------------------------------------------|---------------------|------|------------------------|------|
| $\alpha_{cs}$                       | channel crosstalk                                                    | $f_i = 5 \text{ MHz}$                           | –                   | –    | –50                    | dB   |
| <b>Analog-to-digital converters</b> |                                                                      |                                                 |                     |      |                        |      |
| B                                   | bandwidth                                                            | at –3 dB                                        | –                   | 7    | –                      | MHz  |
| $\phi_{diff}$                       | differential phase<br>(amplifier plus anti-alias<br>filter = bypass) |                                                 | –                   | 2    | –                      | deg  |
| $G_{diff}$                          | differential gain<br>(amplifier plus anti-alias<br>filter = bypass)  |                                                 | –                   | 2    | –                      | %    |
| $f_{clkADC}$                        | ADC clock frequency                                                  |                                                 | 12.8                | –    | 14.3                   | MHz  |
| DLE                                 | DC differential linearity<br>error                                   |                                                 | –                   | 0.7  | –                      | LSB  |
| ILE                                 | DC integral linearity error                                          |                                                 | –                   | 1    | –                      | LSB  |
| <b>Digital inputs</b>               |                                                                      |                                                 |                     |      |                        |      |
| $V_{IL(SCL,SDA)}$                   | LOW level input voltage<br>pins SDA and SCL                          |                                                 | –0.5                | –    | +0.3V <sub>DDD</sub>   | V    |
| $V_{IH}$                            | HIGH level input voltage<br>pins SDA and SCL                         |                                                 | 0.7V <sub>DDD</sub> | –    | V <sub>DDD</sub> + 0.5 | V    |
| $V_{IL(xtal)}$                      | LOW level CMOS input<br>voltage pin XTALI                            |                                                 | –0.3                | –    | +0.8                   | V    |
| $V_{IH(xtal)}$                      | HIGH level CMOS input<br>voltage pin XTALI                           |                                                 | 2.0                 | –    | V <sub>DDD</sub> + 0.3 | V    |
| $V_{ILn}$                           | LOW level input voltage all<br>other inputs                          |                                                 | –0.3                | –    | +0.8                   | V    |
| $V_{IHn}$                           | HIGH level input voltage<br>all other inputs                         |                                                 | 2.0                 | –    | 5.5                    | V    |
| $I_{LI}$                            | input leakage current                                                |                                                 | –                   | –    | 1                      | μA   |
| $C_i$                               | input capacitance                                                    | outputs at 3-state                              | –                   | –    | 8                      | pF   |
| $C_{i(n)}$                          | input capacitance all other<br>inputs                                |                                                 | –                   | –    | 5                      | pF   |
| <b>Digital outputs</b>              |                                                                      |                                                 |                     |      |                        |      |
| $V_{OL(SCL,SDA)}$                   | LOW level output voltage<br>pins SDA and SCL                         | SDA/SCL at 3 mA (6 mA)<br>sink current          | –                   | –    | 0.4 (0.6)              | V    |
| $V_{OL}$                            | LOW level output voltage                                             | V <sub>DDD</sub> = max; I <sub>OL</sub> = 2 mA  | 0                   | –    | 0.4                    | V    |
| $V_{OH}$                            | HIGH level output voltage                                            | V <sub>DDD</sub> = min, I <sub>OH</sub> = –2 mA | 2.4                 | –    | V <sub>DDD</sub> + 0.5 | V    |
| $V_{OL(clk)}$                       | LOW level output voltage<br>for clocks                               |                                                 | –0.5                | –    | +0.6                   | V    |
| $V_{OH(clk)}$                       | HIGH level output voltage<br>for clocks                              |                                                 | 2.4                 | –    | V <sub>DDD</sub> + 0.5 | V    |
| $I_{LO}$                            | output leakage current                                               | at 3-state mode                                 | –                   | –    | 10                     | μA   |
| <b>FEI input timing</b>             |                                                                      |                                                 |                     |      |                        |      |
| $t_{SU;DAT}$                        | input data set-up time                                               |                                                 | 13                  | –    | –                      | ns   |
| $t_{HD;DAT}$                        | input data hold time                                                 |                                                 | 3                   | –    | –                      | ns   |



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| SYMBOL                                            | PARAMETER                                                    | CONDITIONS                    | MIN.      | TYP.    | MAX.     | UNIT      |
|---------------------------------------------------|--------------------------------------------------------------|-------------------------------|-----------|---------|----------|-----------|
| <b>Data and control output timing; note 1</b>     |                                                              |                               |           |         |          |           |
| $C_L$                                             | output load capacitance                                      |                               | 15        | –       | 40       | pF        |
| $t_{OHD;DAT}$                                     | output hold time                                             | $C_L = 15 \text{ pF}$         | 4         | –       | –        | ns        |
| $t_{PD}$                                          | propagation delay                                            | $C_L = 25 \text{ pF}$         | –         | –       | 20       | ns        |
| $t_{PDZ}$                                         | propagation delay to 3-state                                 |                               | –         | –       | 20       | ns        |
| <b>Clock output timing (LLC and LLC2); note 2</b> |                                                              |                               |           |         |          |           |
| $C_{L(LLC)}$                                      | output load capacitance                                      |                               | 15        | –       | 40       | pF        |
| $T_{cy}$                                          | cycle time                                                   | LLC                           | 35        | –       | 39       | ns        |
|                                                   |                                                              | LLC2                          | 70        | –       | 78       | ns        |
| $\delta_{LLC}$                                    | duty factors for $t_{LLCH}/t_{LLC}$ and $t_{LLC2H}/t_{LLC2}$ | $C_L = 25 \text{ pF}$         | 40        | –       | 60       | %         |
| $t_r$                                             | rise time LLC, LLC2                                          |                               | –         | –       | 5        | ns        |
| $t_f$                                             | fall time LLC, LLC2                                          |                               | –         | –       | 5        | ns        |
| $t_d$                                             | delay time LLC output to LLC2 output                         | at 1.5 V;<br>LLC/LLC2 = 25 pF | –4        | –       | +8       | ns        |
| <b>Data qualifier output timing (CREF)</b>        |                                                              |                               |           |         |          |           |
| $t_{OHD;CREF}$                                    | output hold time                                             | $C_L = 15 \text{ pF}$         | 4         | –       | –        | ns        |
| $t_{PD;CREF}$                                     | propagation delay from positive edge of LLC                  | $C_L = 25 \text{ pF}$         | –         | –       | 20       | ns        |
| <b>Clock input timing (XTALI)</b>                 |                                                              |                               |           |         |          |           |
| $\delta_{XTALI}$                                  | duty factor for $t_{XTALIH}/t_{XTALI}$                       | nominal frequency             | 40        | –       | 60       | %         |
| <b>Horizontal PLL</b>                             |                                                              |                               |           |         |          |           |
| $f_{Hn}$                                          | nominal line frequency                                       | 50 Hz field                   | –         | 15625   | –        | Hz        |
|                                                   |                                                              | 60 Hz field                   | –         | 15734   | –        | Hz        |
| $\Delta f_H/f_{Hn}$                               | permissible static deviation                                 |                               | –         | –       | 5.7      | %         |
| <b>Subcarrier PLL</b>                             |                                                              |                               |           |         |          |           |
| $f_{SCn}$                                         | nominal subcarrier frequency                                 | PAL BGHI                      | –         | 4433619 | –        | Hz        |
|                                                   |                                                              | NTSC M; NTSC-Japan            | –         | 3579545 | –        | Hz        |
|                                                   |                                                              | PAL M                         | –         | 3575612 | –        | Hz        |
|                                                   |                                                              | PAL N                         | –         | 3582056 | –        | Hz        |
| $\Delta f_{SC}$                                   | lock-in range                                                |                               | $\pm 400$ | –       | –        | Hz        |
| <b>Crystal oscillator</b>                         |                                                              |                               |           |         |          |           |
| $f_n$                                             | nominal frequency                                            | 3rd harmonic; note 3          | –         | 24.576  | –        | MHz       |
| $\Delta f/f_n$                                    | permissible nominal frequency deviation                      |                               | –         | –       | $\pm 50$ | $10^{-6}$ |

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| SYMBOL                            | PARAMETER                                                | CONDITIONS           | MIN. | TYP.           | MAX.     | UNIT               |
|-----------------------------------|----------------------------------------------------------|----------------------|------|----------------|----------|--------------------|
| <b>Crystal oscillator</b>         |                                                          |                      |      |                |          |                    |
| $f_n$                             | nominal frequency                                        | 3rd harmonic; note 3 | –    | 24.576         | –        | MHz                |
| $\Delta f/f_n$                    | permissible nominal frequency deviation                  |                      | –    | –              | $\pm 50$ | $10^{-6}$          |
| $\Delta T/f_n$                    | permissible nominal frequency deviation with temperature |                      | –    | –              | $\pm 20$ | $10^{-6}$          |
| <b>CRYSTAL SPECIFICATION (X1)</b> |                                                          |                      |      |                |          |                    |
| $T_{amb(X1)}$                     | operating ambient temperature                            |                      | 0    | –              | 70       | $^{\circ}\text{C}$ |
| $C_L$                             | load capacitance                                         |                      | 8    | –              | –        | pF                 |
| $R_s$                             | series resonance resistor                                |                      | –    | 40             | 80       | $\Omega$           |
| $C_1$                             | motional capacitance                                     |                      | –    | $1.5 \pm 20\%$ | –        | fF                 |
| $C_0$                             | parallel capacitance                                     |                      | –    | $3.5 \pm 20\%$ | –        | pF                 |

**Notes**

1. The levels must be measured with load circuits; 1.2 k $\Omega$  at 3 V (TTL load);  $C_L = 50$  pF.
2. The effects of rise and fall times are included in the calculation of  $t_{OHD,DAT}$ ,  $t_{PD}$  and  $t_{PDZ}$ . Timings and levels refer to drawings and conditions illustrated in Figs 15 and 16.
3. Order number: Philips 4322 143 05291.

**Table 2** Processing delay

| FUNCTION                                  | TYPICAL ANALOG DELAY<br>AI22 $\rightarrow$ ADCIN (AOUT) (ns) | DIGITAL DELAY<br>ADCIN $\rightarrow$ VPO (LLC CLOCKS)<br>[YDEL(2 to 0) = 000]; note 1 |
|-------------------------------------------|--------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Without amplifier or anti-alias filter    | 15                                                           | 179                                                                                   |
| With amplifier, without anti-alias filter | 25                                                           |                                                                                       |
| With amplifier and anti-alias filter      | 75                                                           |                                                                                       |

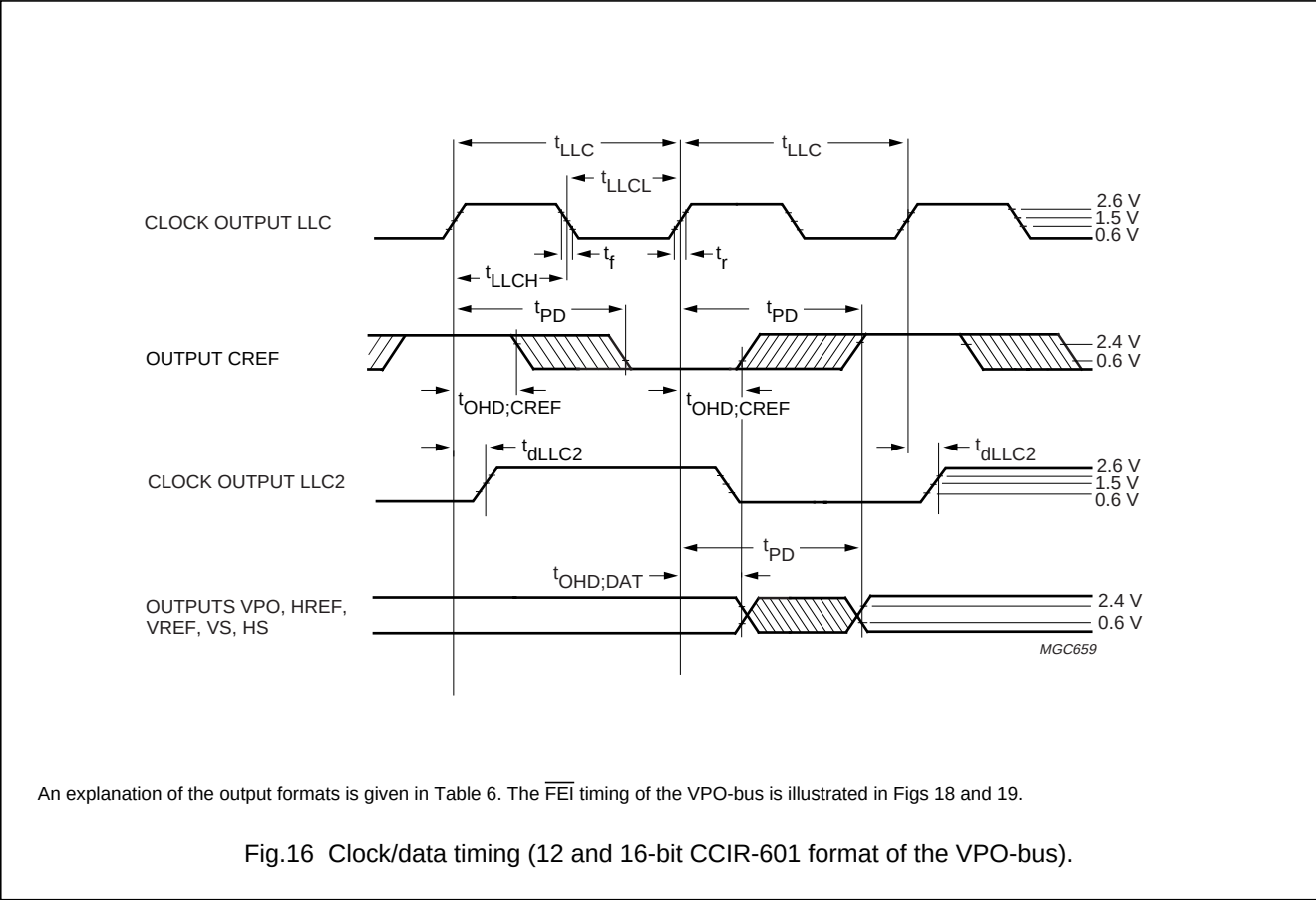
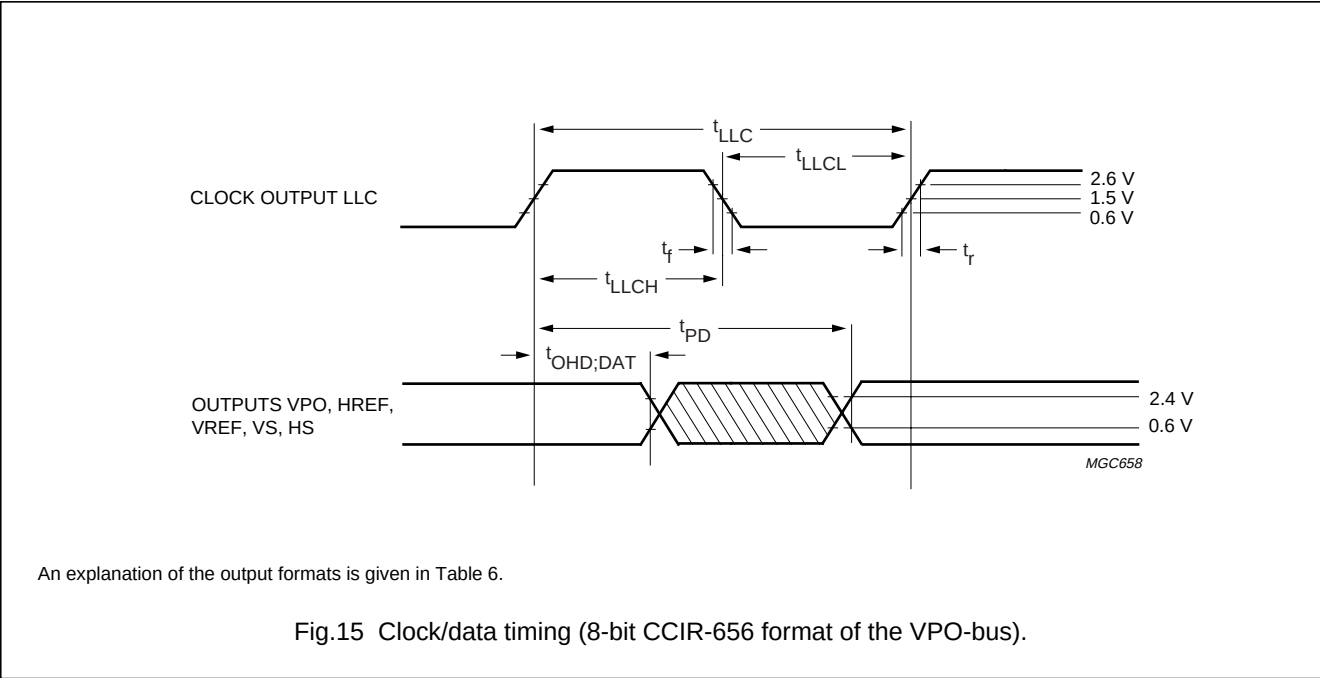
**Note**

1. Digital processing delay (LLC CLOCKS) for VBI data is defined in Fig.23 'Horizontal timing diagram'.

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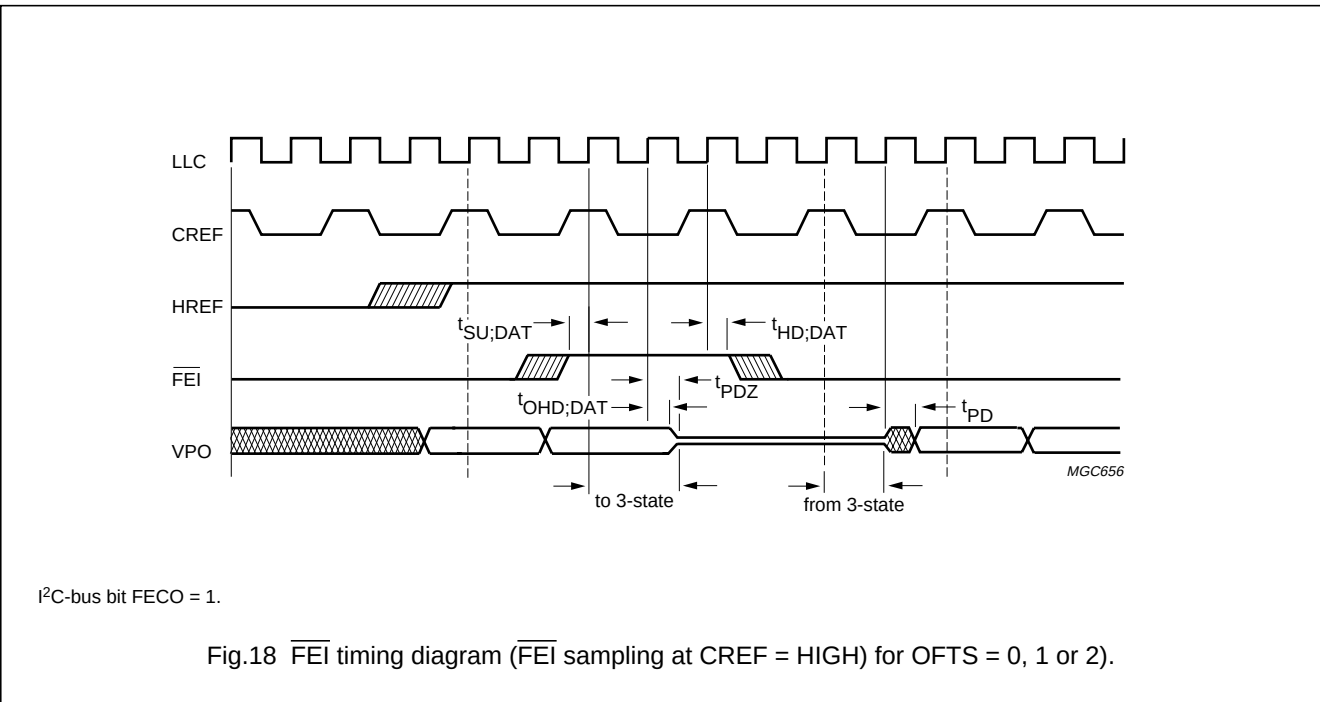
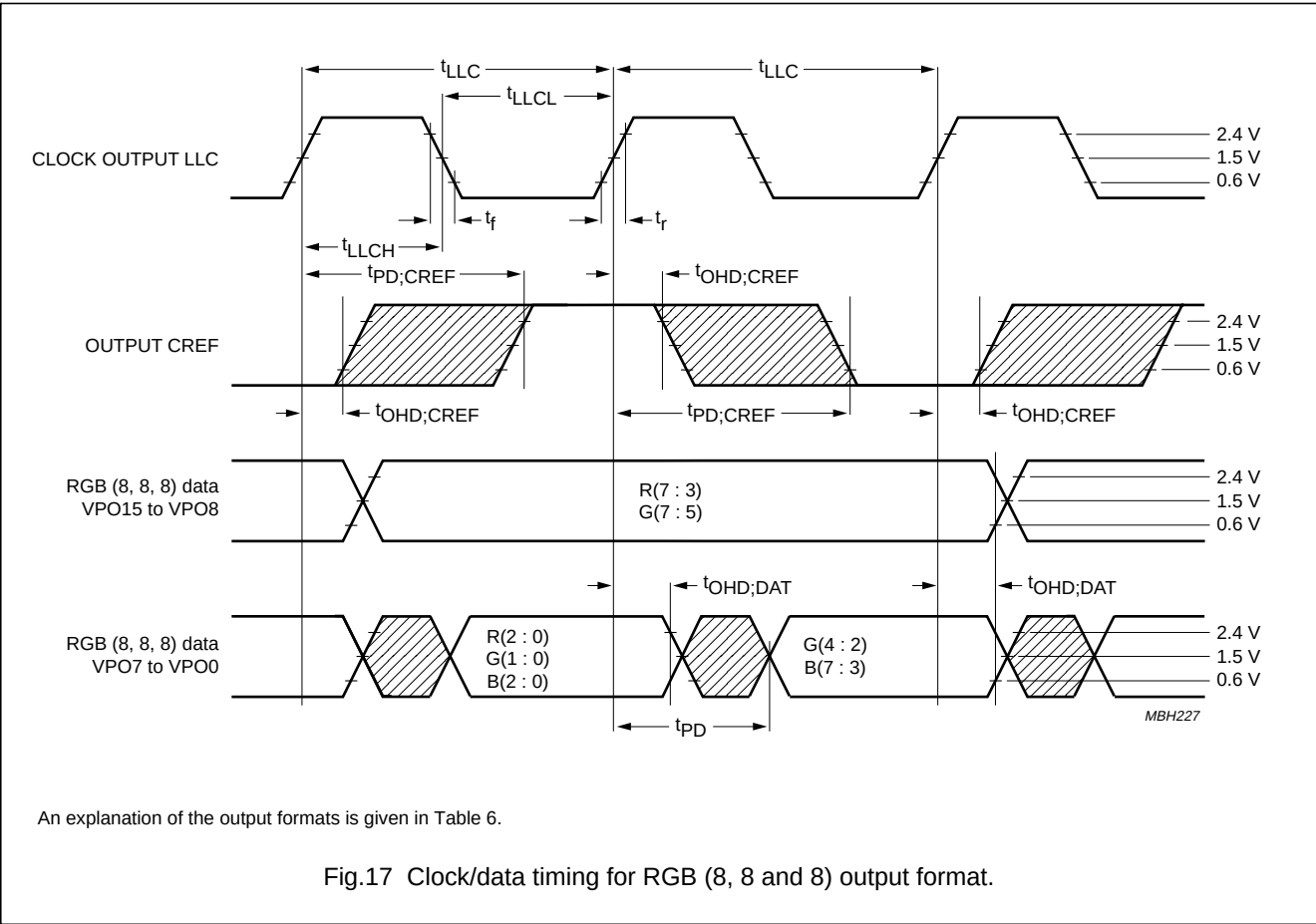
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13 TIMING DIAGRAMS



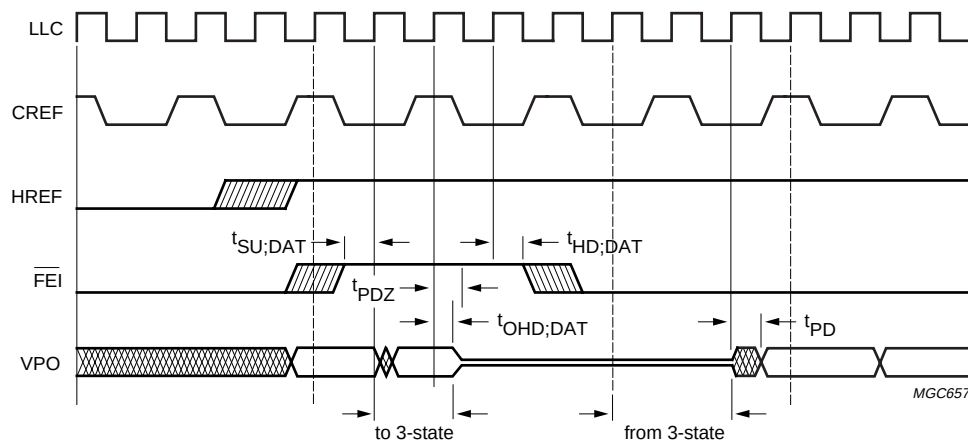
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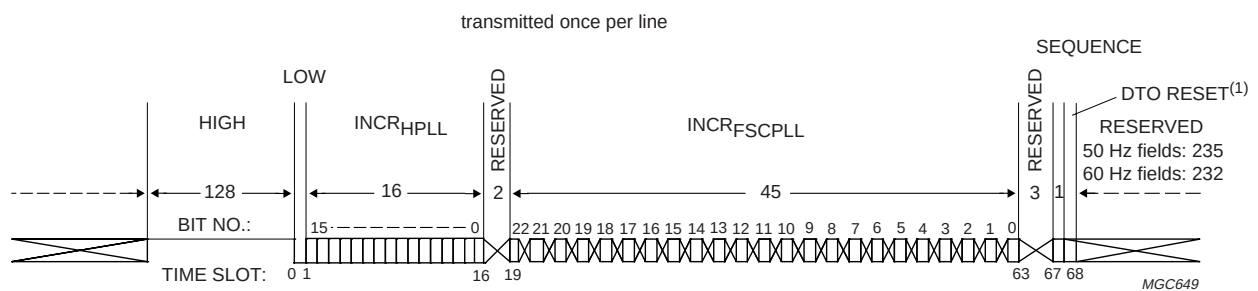
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Timing is compatible with SAA7110; I<sup>2</sup>C-bus bit FECO = 0.

Fig.19  $\overline{\text{FEI}}$  timing diagram ( $\overline{\text{FEI}}$  sampling at CREF = LOW) for OFTS = 0, 1 or 2).



- (1) Set to zero for one transmission, if a phase reset of the  $f_{sc}$  - DTO is applied via I<sup>2</sup>C-bus bit CDTO. RTCO sequence is generated in LLC/4. The HPLL increment represents the actual LFCO frequency ( $f_{LFCO} \times 4 = f_{LLC}$ ); 16 LSB from 20, upper four bits are fixed to 0100b.

$$f_{LFCO} = \frac{\text{INCR}_{HPLL} \times f_{XTAL}}{2^{\text{word length DTO2}}}$$

Where:  $f_{XTAL} = 24.576 \text{ MHz}$ , word length DTO2 = 20 bits.

The  $f_{sc}$  increment represents the actual subcarrier frequency (related to the actual clock); 23 LSB from 24, MSB is 0b.

$$f_{sc} = \frac{\text{INCR}_{FSCPLL} \times f_{XTAL}}{2^{\text{word length DTO1}}} \times \frac{\text{INCR}_{HPLL}}{2^{19}}$$

Where: word length DTO1 = 24 bits.

Fig.20 Real time control output.

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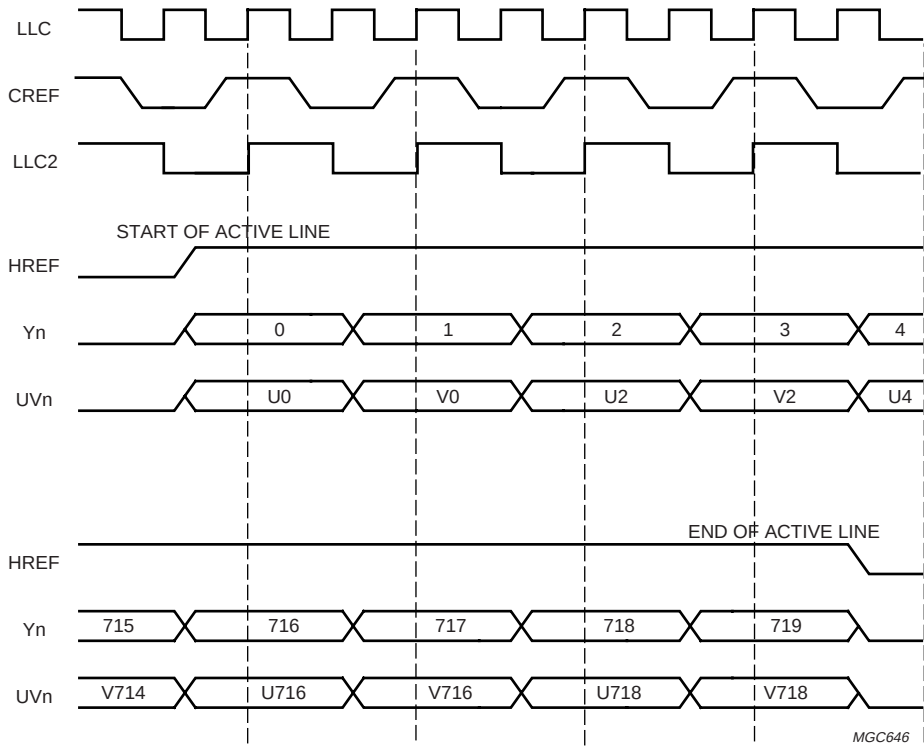


Fig.21 HREF timing diagram.

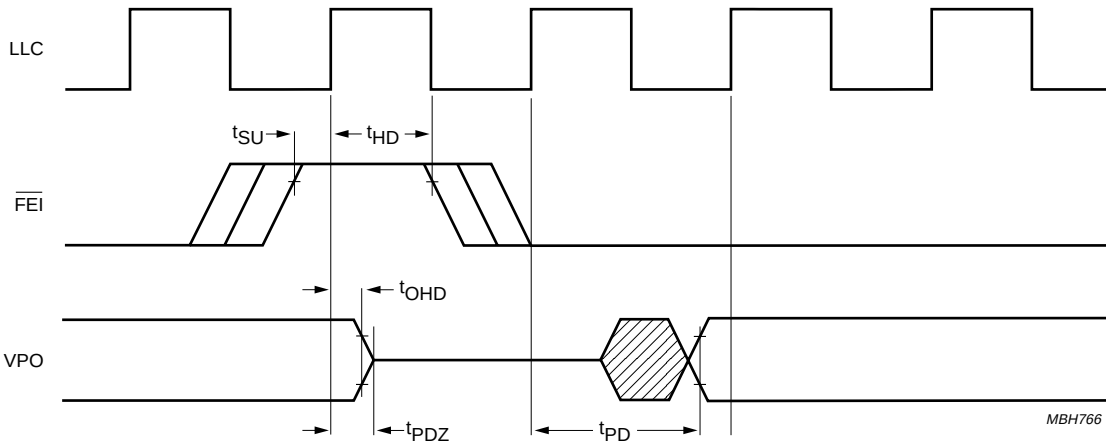
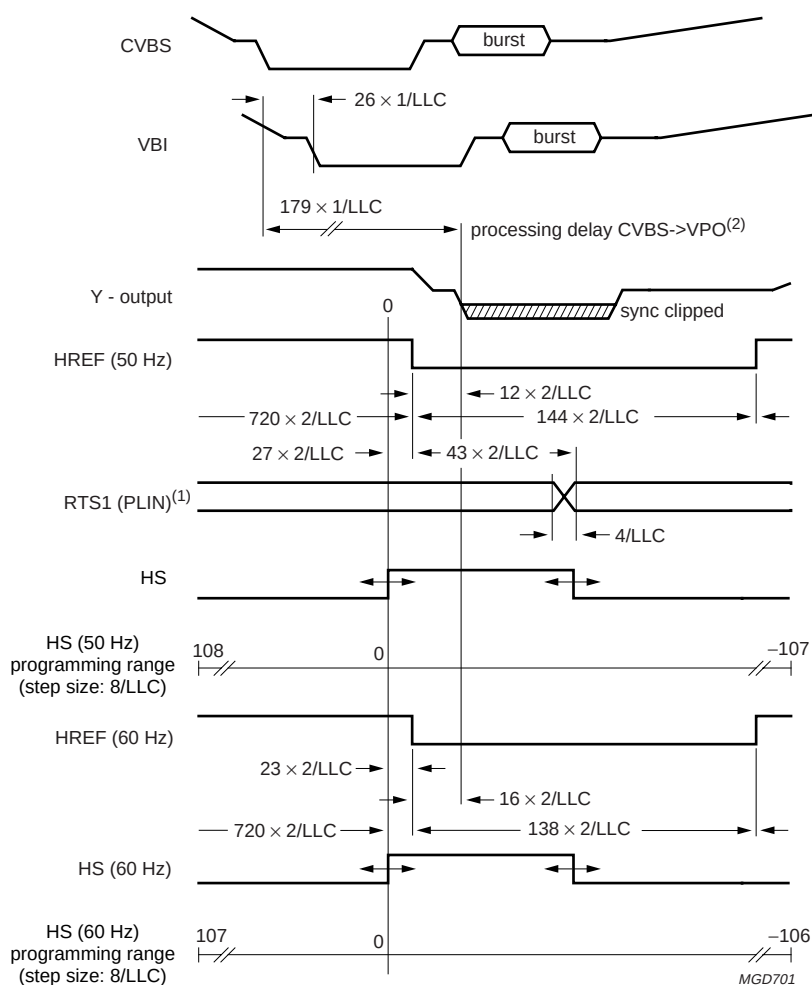


Fig.22  $\overline{FEI}$  timing in CCIR 656 mode [OFTS (1 : 0) = 3].

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(1) PLIN is switched to output RTS1 via I<sup>2</sup>C-bus bit RTSE1 = 0.

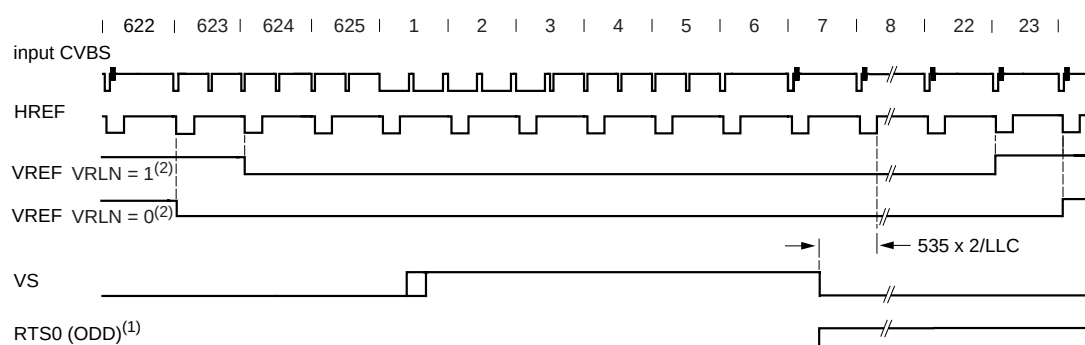
(2) See Table 2.

(3) HDEL (1 : 0) = 0 0, YDEL (2 : 0) = 0 0 0.

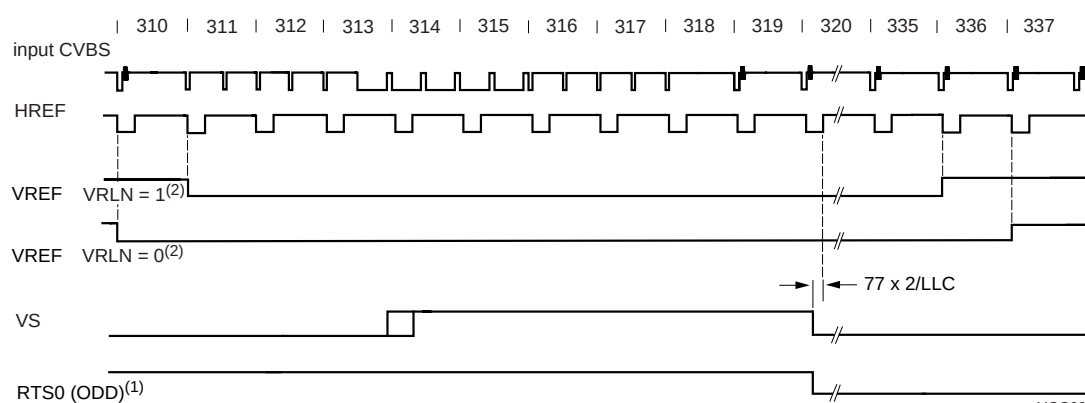
Fig.23 Horizontal timing diagram.

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(a) 1st field



(b) 2nd field

MGG069

(1) ODD is switched to output RTS0 via I<sup>2</sup>C-bus bit RTSE0 = 0.

(2) Additional VREF positions can be achieved via I<sup>2</sup>C-bits VCTR1 and VCTR0 (see Fig.9).

The luminance peaking and the chrominance trap are bypassed during VREF = 0 if I<sup>2</sup>C-bus bit VBLB is set to logic 1.

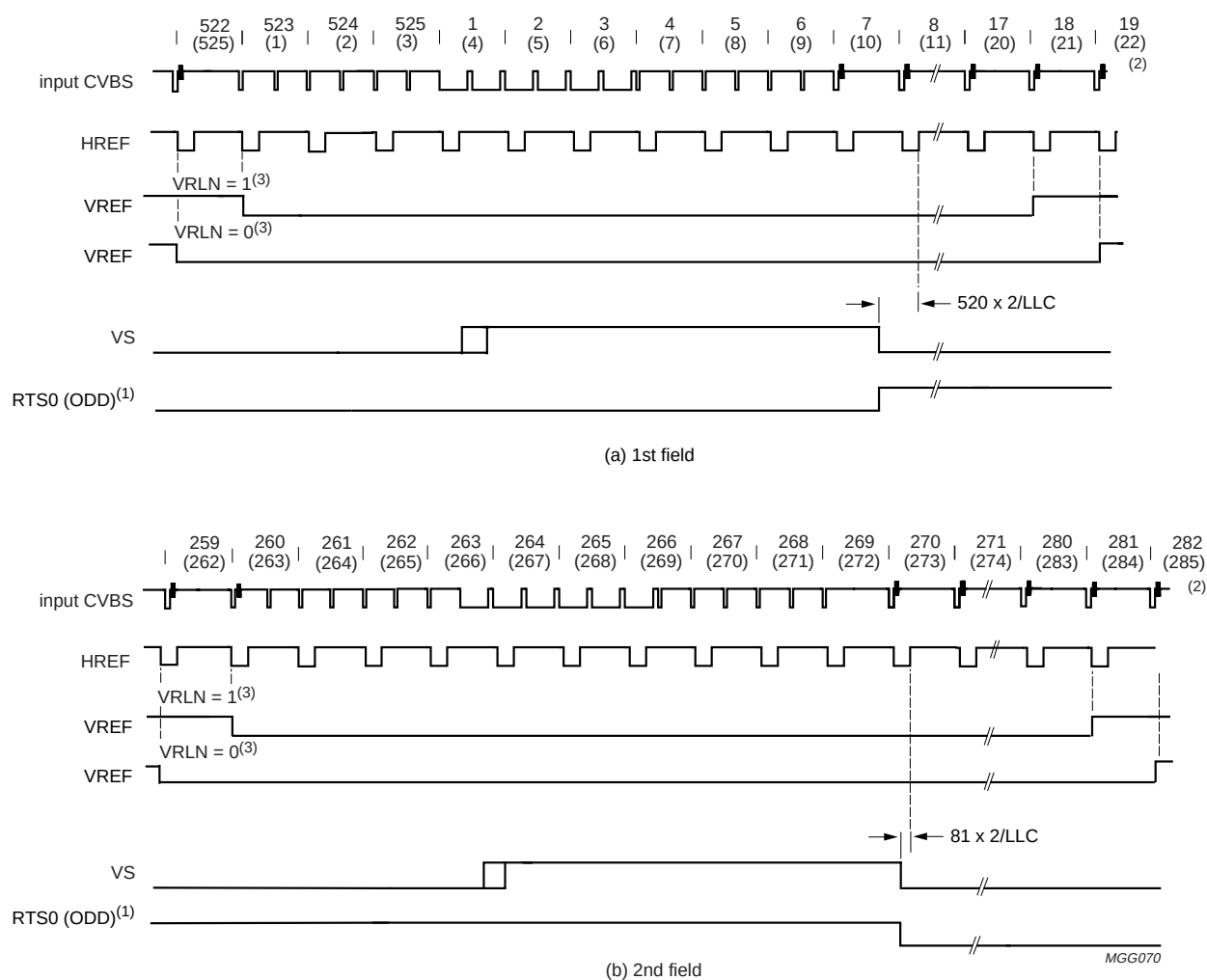
The chrominance delay line (chrominance-comb filter for NTSC, phase error correcting for PAL) is disabled during VREF = 0.

Fig.24 Vertical timing diagram for 50 Hz [nominal input signal VNL in normal mode (VNOI = 00b)].



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(1) ODD is switched to output RTS0 via I<sup>2</sup>C-bus bit RTSE0 = 0.

(2) Line numbers in parenthesis refer to CCIR line counting.

(3) Additional VREF positions can be achieved via I<sup>2</sup>C-bus bits VCTR1 and VCTR0 (see Fig.9).

The luminance peaking and the chrominance trap are bypassed during VREF = 0 if I<sup>2</sup>C-bus bit VBLB is set to logic 1.

The chrominance delay line (chrominance-comb filter for NTSC, phase error correcting for PAL) is disabled during VREF = 0.

Fig.25 Vertical timing diagram for 60 Hz [nominal input signal VNL in normal mode (VNOI = 00b)].

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Table 3 Digital output control

| OEYC | $\overline{\text{FEI}}$ | TCLO <sup>(1)</sup> | VPO<br>15 to 8 | VPO<br>7 to 0 |
|------|-------------------------|---------------------|----------------|---------------|
| 0    | 0                       | 0                   | Z              |               |
| 1    | 0                       | 0                   | active         |               |
| 0    | 1                       | 0                   | Z              |               |
| 1    | 1                       | 0                   | Z              |               |
| 0    | 0                       | 1                   | Z              | Z             |
| 1    | 0                       | 1                   | active         | Z             |
| 0    | 1                       | 1                   | Z              | Z             |
| 1    | 1                       | 1                   | Z              | Z             |

Note

1. Only active in 656-format (OFTS = 3).

14 CLOCK SYSTEM

14.1 Clock generation circuit

The internal CGC generates the system clocks LLC, LLC2 and the clock reference signal CREF. The internally generated LFCO (triangular waveform) is multiplied by 4 via the analog PLL (including phase detector, loop filter, VCO and frequency divider). The rectangular output signals have a 50% duty factor.

Table 4 Clock frequencies

| CLOCK | FREQUENCY (MHz) |
|-------|-----------------|
| XTAL  | 24.576          |
| LLC   | 27              |
| LLC2  | 13.5            |
| LLC4  | 6.75            |
| LLC8  | 3.375           |

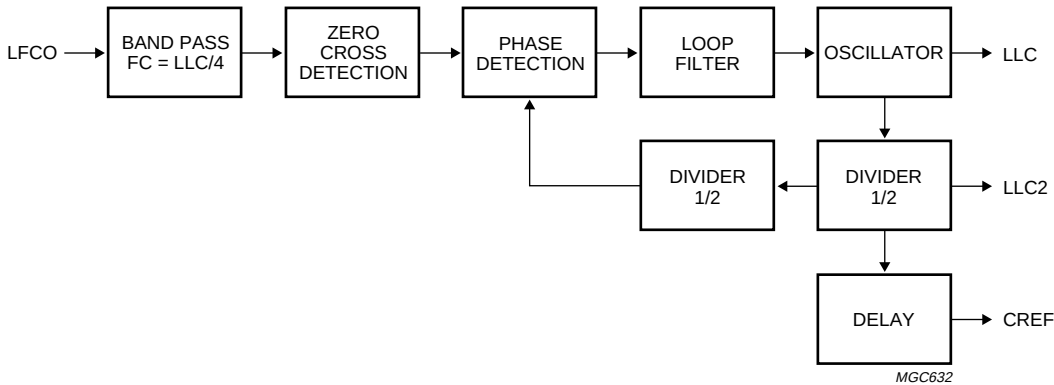


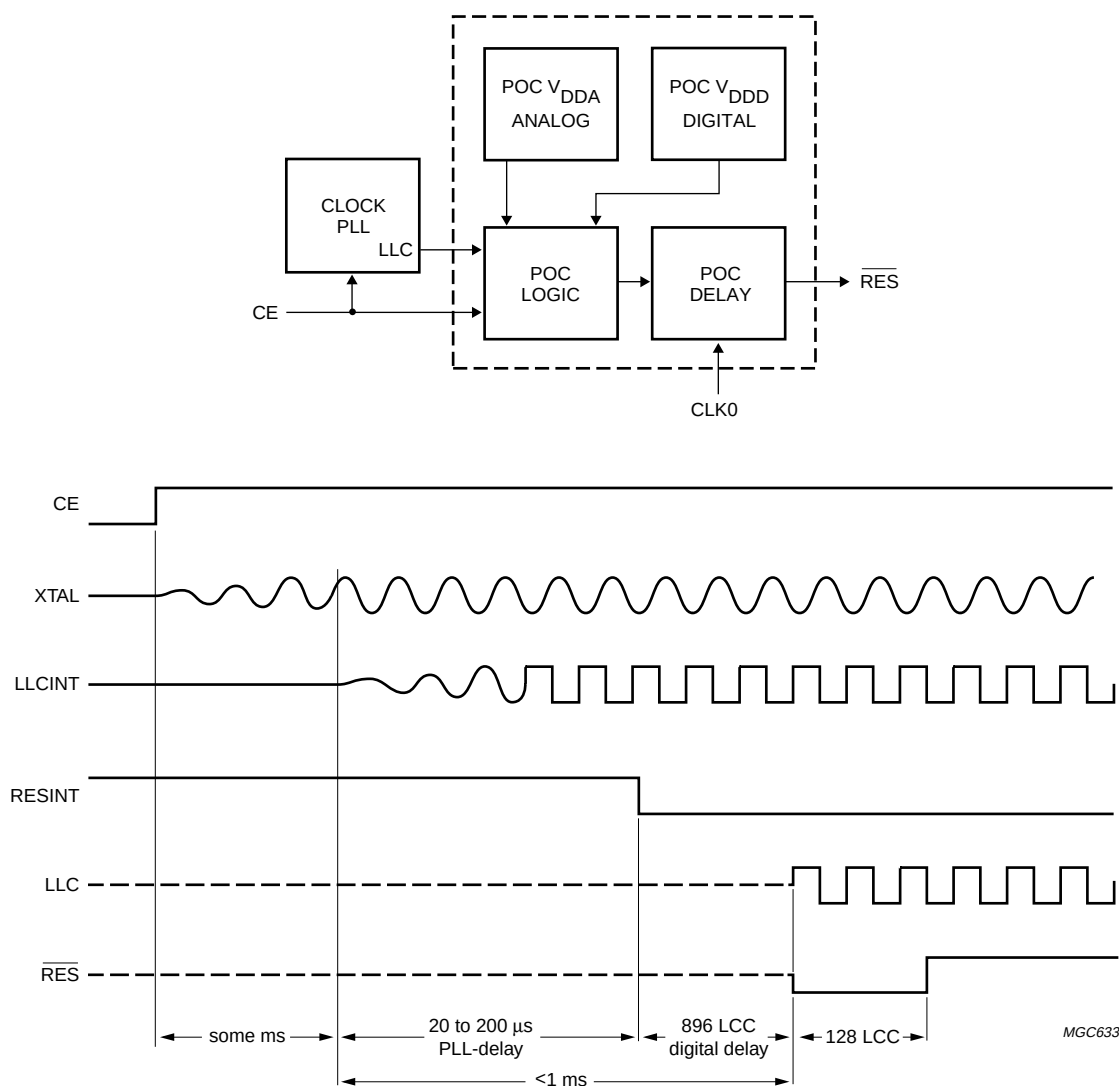
Fig.26 Block diagram of clock generation circuit.

## Enhanced Video Input Processor (EVIP)

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## 14.2 Power-on control

Power-on reset is activated at power-on, chip enable, PLL clock generation failure and if the supply voltage falls below 2.7 V. The  $\overline{\text{RES}}$  signal can be applied to reset other circuits of the digital picture processing system.



CE = chip enable input; XTAL = crystal oscillator output; LLCINT = internal system clock;  
RESINT = internal reset; LLC = line-locked clock output;  $\overline{\text{RES}}$  = reset output (active LOW).

Fig.27 Power-on control circuit.

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**Table 5** Power-on control sequence

| INTERNAL POWER-ON CONTROL SEQUENCE         | PIN OUTPUT STATUS                                                                                                                    | FUNCTION                                                                                 |
|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| Directly after power-on asynchronous reset | VPO15 to VPO0, RTCO, RTS0, RTS1, GPSW, HREF, VREF, HS, VS, LLC, LLC2 and CREF are in high-impedance state                            | direct switching to high impedance for 20 to 200 ms                                      |
| Synchronous reset sequence                 | LLC, LLC2, CREF, RTCO, RTS0, RTS1, GPSW and SDA become active; VPO15 to VPO0, HREF, VREF, HS and VS are held in high-impedance state | internal reset sequence                                                                  |
| Status after power-on control sequence     | VPO15 to VPO0, HREF, VREF, HS and VS are held in high-impedance state                                                                | after power-on (reset sequence) a complete I <sup>2</sup> C-bus transmission is required |

**15 OUTPUT FORMATS****Table 6** Output formats of the VPO bus (note 1)

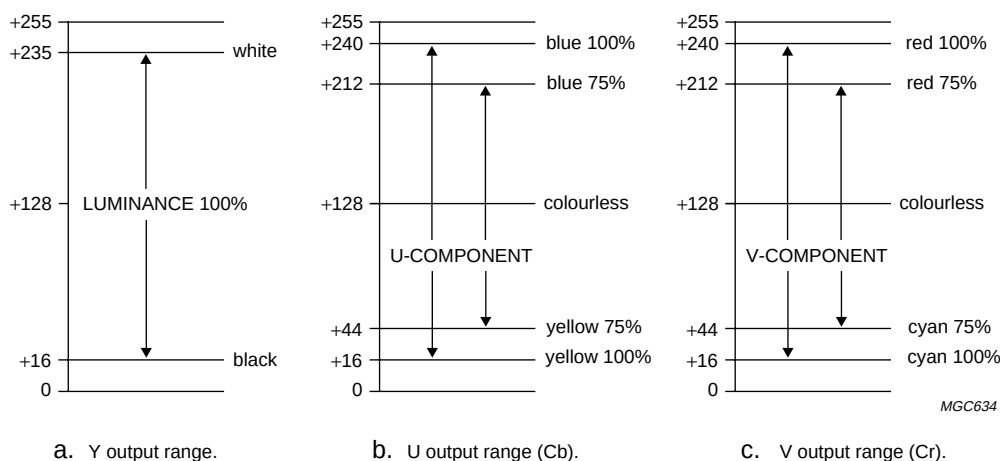
| BUS SIGNAL                           | 411 (12-BIT)    |                 |                 |                 | 422 (16-BIT) <sup>(2)</sup> |                 | CCIR-656 (8-BIT) <sup>(3)</sup> |                 |                 |                 | RGB (16-BIT) <sup>(4)</sup> | RGB (24-BIT) <sup>(4)</sup> |        |
|--------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------------------|-----------------|---------------------------------|-----------------|-----------------|-----------------|-----------------------------|-----------------------------|--------|
| VPO15                                | Y <sub>07</sub> | Y <sub>17</sub> | Y <sub>27</sub> | Y <sub>37</sub> | Y <sub>07</sub>             | Y <sub>17</sub> | U <sub>07</sub>                 | Y <sub>07</sub> | V <sub>07</sub> | Y <sub>17</sub> | R4                          | R7                          | R7     |
| VPO14                                | Y <sub>06</sub> | Y <sub>16</sub> | Y <sub>26</sub> | Y <sub>36</sub> | Y <sub>06</sub>             | Y <sub>16</sub> | U <sub>06</sub>                 | Y <sub>06</sub> | V <sub>06</sub> | Y <sub>16</sub> | R3                          | R6                          | R6     |
| VPO13                                | Y <sub>05</sub> | Y <sub>15</sub> | Y <sub>25</sub> | Y <sub>35</sub> | Y <sub>05</sub>             | Y <sub>15</sub> | U <sub>05</sub>                 | Y <sub>05</sub> | V <sub>05</sub> | Y <sub>15</sub> | R2                          | R5                          | R5     |
| VPO12                                | Y <sub>04</sub> | Y <sub>14</sub> | Y <sub>24</sub> | Y <sub>34</sub> | Y <sub>04</sub>             | Y <sub>14</sub> | U <sub>04</sub>                 | Y <sub>04</sub> | V <sub>04</sub> | Y <sub>14</sub> | R1                          | R4                          | R4     |
| VPO11                                | Y <sub>03</sub> | Y <sub>13</sub> | Y <sub>23</sub> | Y <sub>33</sub> | Y <sub>03</sub>             | Y <sub>13</sub> | U <sub>03</sub>                 | Y <sub>03</sub> | V <sub>03</sub> | Y <sub>13</sub> | R0                          | R3                          | R3     |
| VPO10                                | Y <sub>02</sub> | Y <sub>12</sub> | Y <sub>22</sub> | Y <sub>32</sub> | Y <sub>02</sub>             | Y <sub>12</sub> | U <sub>02</sub>                 | Y <sub>02</sub> | V <sub>02</sub> | Y <sub>12</sub> | G5                          | G7                          | G7     |
| VPO9                                 | Y <sub>01</sub> | Y <sub>11</sub> | Y <sub>21</sub> | Y <sub>31</sub> | Y <sub>01</sub>             | Y <sub>11</sub> | U <sub>01</sub>                 | Y <sub>01</sub> | V <sub>01</sub> | Y <sub>11</sub> | G4                          | G6                          | G6     |
| VPO8                                 | Y <sub>00</sub> | Y <sub>10</sub> | Y <sub>20</sub> | Y <sub>30</sub> | Y <sub>00</sub>             | Y <sub>10</sub> | U <sub>00</sub>                 | Y <sub>00</sub> | V <sub>00</sub> | Y <sub>10</sub> | G3                          | G5                          | G5     |
| VPO7                                 | U <sub>07</sub> | U <sub>05</sub> | U <sub>03</sub> | U <sub>01</sub> | U <sub>07</sub>             | V <sub>07</sub> | X                               | X               | X               | X               | G2                          | G4                          | R2     |
| VPO6                                 | U <sub>06</sub> | U <sub>04</sub> | U <sub>02</sub> | U <sub>00</sub> | U <sub>06</sub>             | V <sub>06</sub> | X                               | X               | X               | X               | G1                          | G3                          | R1     |
| VPO5                                 | V <sub>07</sub> | V <sub>05</sub> | V <sub>03</sub> | V <sub>01</sub> | U <sub>05</sub>             | V <sub>05</sub> | X                               | X               | X               | X               | G0                          | G2                          | R0     |
| VPO4                                 | V <sub>06</sub> | V <sub>04</sub> | V <sub>02</sub> | V <sub>00</sub> | U <sub>04</sub>             | V <sub>04</sub> | X                               | X               | X               | X               | B4                          | B7                          | G1     |
| VPO3                                 | X               | X               | X               | X               | U <sub>03</sub>             | V <sub>03</sub> | X                               | X               | X               | X               | B3                          | B6                          | G0     |
| VPO2                                 | X               | X               | X               | X               | U <sub>02</sub>             | V <sub>02</sub> | X                               | X               | X               | X               | B2                          | B5                          | B2     |
| VPO1                                 | X               | X               | X               | X               | U <sub>01</sub>             | V <sub>01</sub> | X                               | X               | X               | X               | B1                          | B4                          | B1     |
| VPO0                                 | X               | X               | X               | X               | U <sub>00</sub>             | V <sub>00</sub> | X                               | X               | X               | X               | B0                          | B3                          | B0     |
| Pixel order Y                        | 0               | 1               | 2               | 3               | 0                           | 1               | 0                               |                 | 1               |                 | –                           | note 5                      | note 6 |
| Pixel order UV                       | 0               |                 |                 |                 | 0                           |                 | 0                               |                 |                 |                 | –                           | –                           |        |
| Data rates                           | LLC2            |                 |                 |                 | LLC2                        |                 | LLC                             |                 |                 |                 | LLC2                        | –                           |        |
| I <sup>2</sup> C-bus control signals | OFTS0 = 0       |                 |                 |                 | OFTS0 = 1                   |                 | OFTS0 = 1                       |                 |                 |                 | OFTS0 = 0                   | OFTS0 = 0                   |        |
|                                      | OFTS1 = 1       |                 |                 |                 | OFTS1 = 0                   |                 | OFTS1 = 1                       |                 |                 |                 | OFTS1 = 0                   | OFTS1 = 0                   |        |
|                                      | RGB888 = X      |                 |                 |                 | RGB888 = X                  |                 | RGB888 = X                      |                 |                 |                 | RGB888 = 0                  | RGB888 = 1                  |        |

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## Notes to Table 5

1. VPO bus allows connection to 5 V video data bus systems.
2. Values in accordance with CCIR 601.
3. Before and after the video data, video timing codes are inserted in accordance with CCIR 656.
  - a) VPO15 to VPO8 = VPO7 to VPO0 = CCIR 656 data if I<sup>2</sup>C-bus bit TCLO = 0
  - b) VPO15 to VPO8 = CCIR 656 data, VPO7 to VPO0 = 3-state if I<sup>2</sup>C-bus bit TCLO = 1.
4. During HREF = LOW RGB levels are set to 16 (10 hex). RGB 16-bit is achieved by dropping the LSBs of the 8-bit signals (after dithering if desired).
5. CREF = 0 (see Fig.17).
6. CREF = 1 (see Fig.17).



CCIR Rec. 602 digital levels.

Equations for modification to the YUV levels via BCS control I<sup>2</sup>C-bus bytes BRIG, CONT and SATN.

Luminance:

$$Y_{OUT} = \text{Int} \left[ \frac{\text{CONT}}{71} \times (Y - 128) \right] + \text{BRIG}$$

Chrominance:

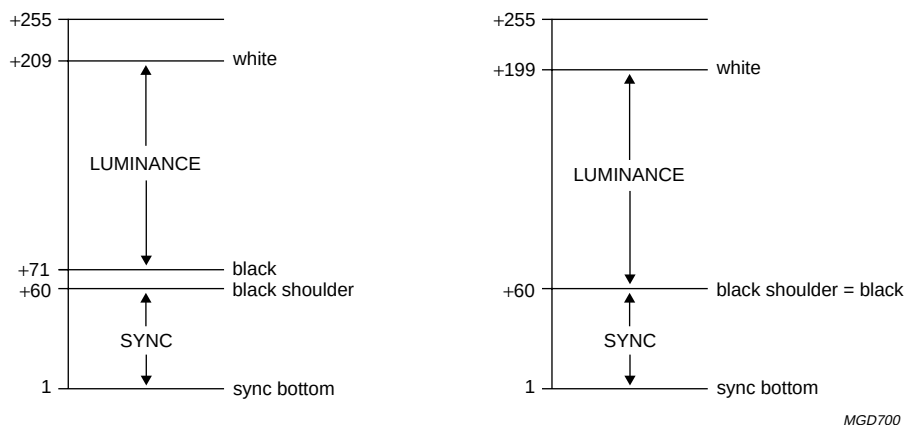
$$UV_{OUT} = \text{Int} \left[ \frac{\text{SATN}}{64} \times (Cr, Cb - 128) \right] + 128$$

It should be noted that the resulting levels are limited to 1 to 254 in accordance with CCIR-601/656 standard.

Fig.28 VPO output signal range with default BCS settings.

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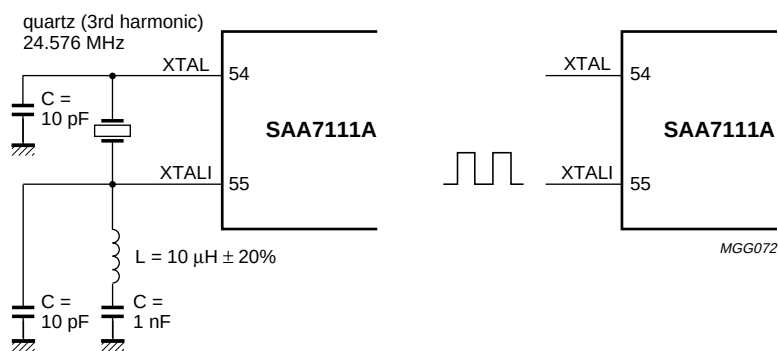
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a. For sources containing 7.5 IRE black level offset (e.g. NTSC-M).      b. For sources not containing black level offset.

VBI data levels are **not** dependent on BCS settings.

Fig.29 VBI data bypass output range.



a. With quartz crystal.      b. With external clock.

Order number: Philips 4322 143 05291.

Fig.30 Oscillator application.

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16 APPLICATION INFORMATION

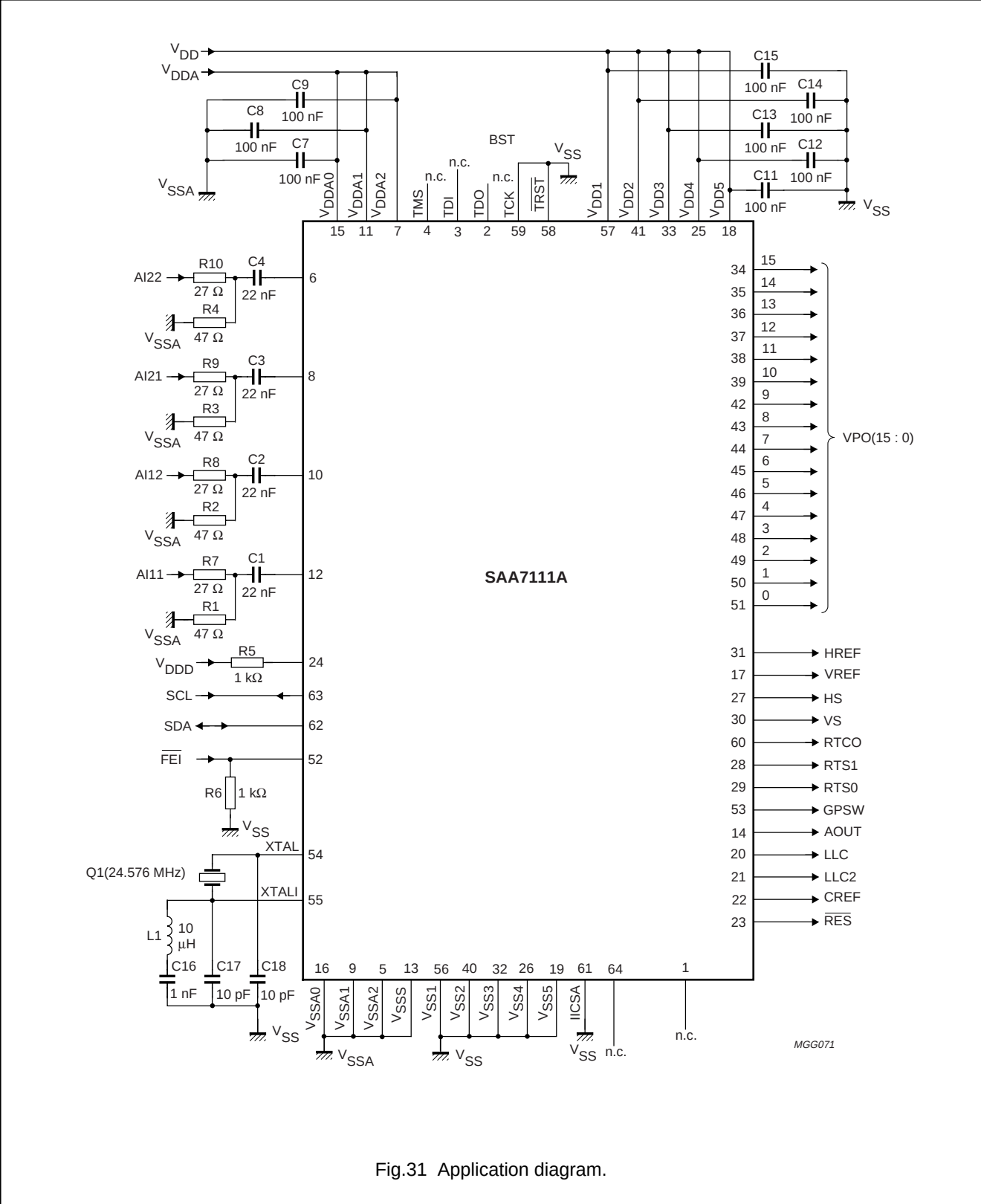
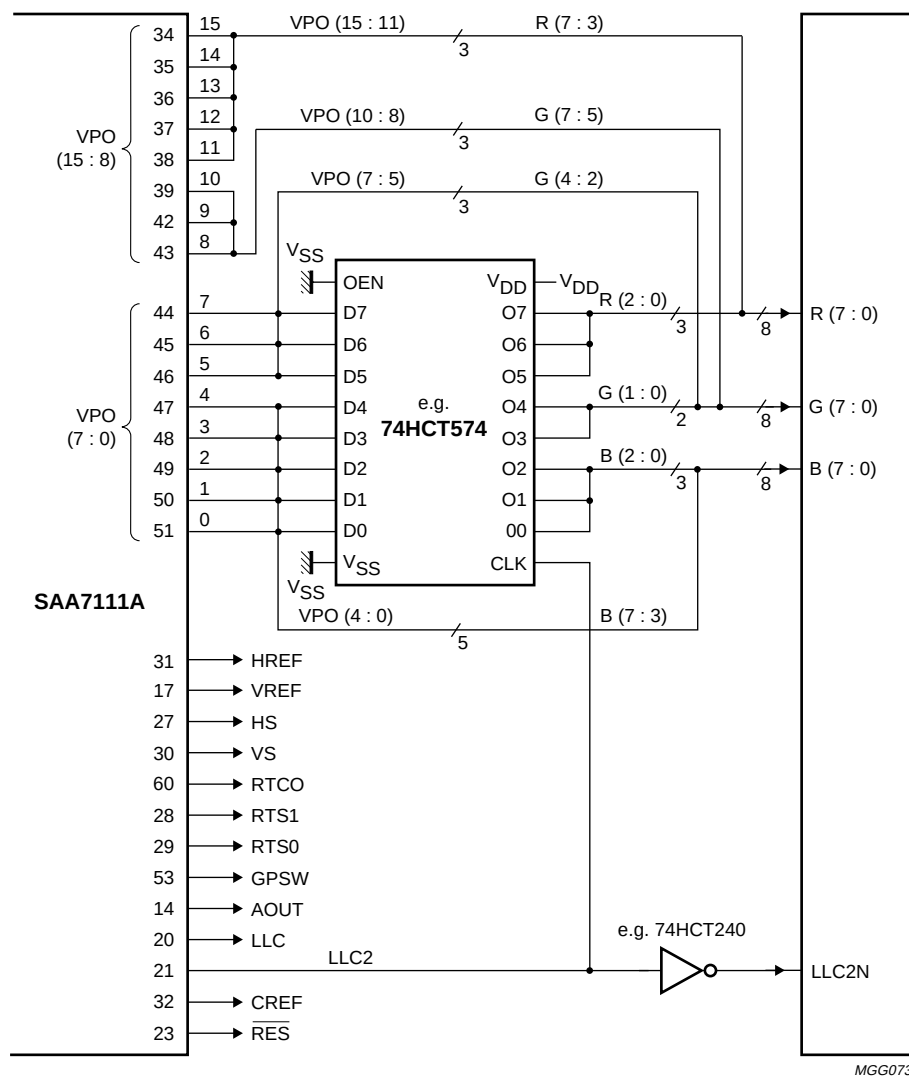


Fig.31 Application diagram.

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I<sup>2</sup>C-bus control bits:

OFTS(1 : 0) = 00 (subaddress 10H, bits D7 and D6).

RGB888 = 1 (subaddress 12H, bit D3).

Fig.32 Application diagram for RGB 24-bit output format.

## 16.1 Layout hints

Use separate ground planes for analog and digital ground. Connect these planes at one point directly under the device, by using a zero  $\Omega$  resistor. Use separate supply lines for analog and digital supply. Place the supply decoupling capacitors close to the supply pins.

Place the coupling (clamp) capacitors close to the analog input pins. Place the termination resistors close to the coupling capacitors. Care should be exercised concerning the hidden layout capacitors around the crystal application. To avoid reflection effects use serial resistors in the clock, sync and data lines.



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17 I<sup>2</sup>C-BUS DESCRIPTION17.1 I<sup>2</sup>C-bus format

Table 7 Write procedure

|   |                 |       |            |       |                |       |   |
|---|-----------------|-------|------------|-------|----------------|-------|---|
| S | SLAVE ADDRESS W | ACK-s | SUBADDRESS | ACK-s | DATA (N BYTES) | ACK-s | P |
|---|-----------------|-------|------------|-------|----------------|-------|---|

Table 8 Read procedure (combined format)

|    |                 |       |                |         |
|----|-----------------|-------|----------------|---------|
| S  | SLAVE ADDRESS W | ACK-s | SUBADDRESS     | ACK-s   |
| Sr | SLAVE ADDRESS R | ACK-s | DATA (N BYTES) | ACK-m P |

Table 9 Description of I<sup>2</sup>C-bus format

| CODE                  | DESCRIPTION                                                                                                                            |                        |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| S                     | START condition                                                                                                                        |                        |
| Sr                    | repeated START condition                                                                                                               |                        |
| Slave address W       | 0100 1000b (IICSA = LOW) or 0100 1010b (IICSA = HIGH)                                                                                  |                        |
| Slave address R       | 0100 1001b (IICSA = LOW) or 0100 1011b (IICSA = HIGH)                                                                                  |                        |
| ACK-s                 | acknowledge generated by the slave                                                                                                     |                        |
| ACK-m                 | acknowledge generated by the master                                                                                                    |                        |
| Subaddress            | subaddress byte; see Table 10                                                                                                          |                        |
| Data                  | data byte; see Table 10; note 1                                                                                                        |                        |
| P                     | STOP condition                                                                                                                         |                        |
| X = LSB slave address | read/write control bit; X = 0, order to write (the circuit is slave receiver); X = 1, order to read (the circuit is slave transmitter) |                        |
| Slave address         | read = 49H or 4BH; note 2                                                                                                              |                        |
|                       | write = 48H or 4AH                                                                                                                     |                        |
|                       | IICSA = 0 or 1                                                                                                                         |                        |
| Subaddresses          | 00H chip version                                                                                                                       | read and write; note 3 |
|                       | 01H reserved                                                                                                                           | –                      |
|                       | 02h to 05H front-end part                                                                                                              | read and write         |
|                       | 06H to 13H decoder part                                                                                                                | read and write         |
|                       | 14H reserved                                                                                                                           | –                      |
|                       | 15H to 17H decoder part                                                                                                                | read and write         |
|                       | 18H to 19H reserved                                                                                                                    | –                      |
|                       | 1AH to 1CH Line-21 text slicer part                                                                                                    | read only              |
|                       | 1DH to 1EH reserved                                                                                                                    | –                      |
|                       | 1FH status byte                                                                                                                        | read only              |

## Notes

1. If more than one byte DATA is transmitted then the auto-increment of the subaddress is performed.
2. During slave transmitter mode the SCL-LOW period may be extended by pulling SCL to LOW (in accordance with the I<sup>2</sup>C-bus specification).
3. The I<sup>2</sup>C-bus subaddress 00 has to be initialized with 0 before being read.

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**Table 10** I<sup>2</sup>C-bus receiver/transmitter overview

| SLAVE ADDRESS                       |              | READ       |        | WRITE      |        | IICSA  |        |        |        |
|-------------------------------------|--------------|------------|--------|------------|--------|--------|--------|--------|--------|
|                                     |              | 49H<br>4BH |        | 48H<br>4AH |        | 0<br>1 |        |        |        |
| REGISTER<br>FUNCTION                | SUB-<br>ADDR | D7         | D6     | D5         | D4     | D3     | D2     | D1     | D0     |
| Chip version                        | 00           | ID07       | ID06   | ID05       | ID04   | ID03   | ID02   | ID01   | ID00   |
| Reserved                            | 01           | (1)        | (1)    | (1)        | (1)    | (1)    | (1)    | (1)    | (1)    |
| Analog input contr 1                | 02           | FUSE1      | FUSE0  | GUDL2      | GUDL1  | GUDL0  | MODE2  | MODE1  | MODE0  |
| Analog input contr 2                | 03           | (1)        | HLNRS  | VBSL       | WPOFF  | HOLDG  | GAFIX  | GAI28  | GAI18  |
| Analog input contr 3                | 04           | GAI17      | GAI16  | GAI15      | GAI14  | GAI13  | GAI12  | GAI11  | GAI10  |
| Analog input contr 4                | 05           | GAI27      | GAI26  | GAI25      | GAI24  | GAI23  | GAI22  | GAI21  | GAI20  |
| Horizontal sync start               | 06           | HSB7       | HSB6   | HSB5       | HSB4   | HSB3   | HSB2   | HSB1   | HSB0   |
| Horizontal sync stop                | 07           | HSS7       | HSS6   | HSS5       | HSS4   | HSS3   | HSS2   | HSS1   | HSS0   |
| Sync control                        | 08           | AUFD       | FSEL   | EXFIL      | (1)    | VTRC   | HPLL   | VNOI1  | VNOI0  |
| Luminance control                   | 09           | BYPS       | PREF   | BPSS1      | BPSS0  | VLB    | UPTCV  | APER1  | APER0  |
| Luminance<br>brightness             | 0A           | BRIG7      | BRIG6  | BRIG5      | BRIG4  | BRIG3  | BRIG2  | BRIG1  | BRIG0  |
| Luminance contrast                  | 0B           | CONT7      | CONT6  | CONT5      | CONT4  | CONT3  | CONT2  | CONT1  | CONT0  |
| Chroma saturation                   | 0C           | SATN7      | SATN6  | SATN5      | SATN4  | SATN3  | SATN2  | SATN1  | SATN0  |
| Chroma Hue control                  | 0D           | HUEC7      | HUEC6  | HUEC5      | HUEC4  | HUEC3  | HUEC2  | HUEC1  | HUEC0  |
| Chroma control                      | 0E           | CDTO       | CSTD2  | CSTD1      | CSTD0  | DCCF   | FCTC   | CHBW1  | CHBW0  |
| Reserved                            | 0F           | (1)        | (1)    | (1)        | (1)    | (1)    | (1)    | (1)    | (1)    |
| Format/delay control                | 10           | OFTS1      | OFTS0  | HDEL1      | HDEL0  | VRLN   | YDEL2  | YDEL1  | YDEL0  |
| Output control 1                    | 11           | GPSW       | CM99   | FECO       | COMPO  | OEYC   | OEHV   | VIPB   | COLO   |
| Output control 2                    | 12           | RTSE1      | RTSE0  | TCLO       | CBR    | RGB888 | DIT    | AOSL1  | AOSL0  |
| Output control 3                    | 13           | VCTR1      | VCTR0  | CCTR1      | CCTR0  | BCHI1  | BCHI0  | BCLO1  | BCLO0  |
| Reserved                            | 14           | (1)        | (1)    | (1)        | (1)    | (1)    | (1)    | (1)    | (1)    |
| V_GATE1_START                       | 15           | VSTA7      | VSTA6  | VSTA5      | VSTA4  | VSTA3  | VSTA2  | VSTA1  | VSTA0  |
| V_GATE1_STOP                        | 16           | VSTO7      | VSTO6  | VSTO5      | VSTO4  | VSTO3  | VSTO2  | VSTO1  | VSTO0  |
| V_GATE1_MSB                         | 17           | (1)        | (1)    | (1)        | (1)    | (1)    | (1)    | VSTO8  | VSTA8  |
| Reserved                            | 18-19        | (1)        | (1)    | (1)        | (1)    | (1)    | (1)    | (1)    | (1)    |
| Text slicer status                  | 1A           | (1)        | (1)    | (1)        | (1)    | F2VAL  | F2RDY  | F1VAL  | F1RDY  |
| Decoded bytes of<br>the text slicer | 1B           | P1         | BYTE16 | BYTE15     | BYTE14 | BYTE13 | BYTE12 | BYTE11 | BYTE10 |
|                                     | 1C           | P2         | BYTE26 | BYTE25     | BYTE24 | BYTE23 | BYTE22 | BYTE21 | BYTE20 |
| Reserved                            | 1D-1E        | (1)        | (1)    | (1)        | (1)    | (1)    | (1)    | (1)    | (1)    |
| Status byte                         | 1F           | STTC       | HLCK   | FIDT       | GLIMT  | GLIMB  | WIPA   | SLTCA  | CODE   |

**Note**

1. All unused control bits must be programmed with logic 0.

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17.2 I<sup>2</sup>C-bus detail

The I<sup>2</sup>C-bus receiver slave address is 48H/49H. Subaddresses 0F, 14, 18, 19, 1D and 1E are reserved; subaddress 01 is reserved for chip version.

## 17.2.1 SUBADDRESS 00

**Table 11** Chip version SA00; note 1

| FUNCTION     |    | LOGIC LEVELS |      |      |      |      |      |      |      |
|--------------|----|--------------|------|------|------|------|------|------|------|
|              |    | ID07         | ID06 | ID05 | ID04 | ID03 | ID02 | ID01 | ID00 |
| Chip version | V1 | 0            | 0    | 0    | 1    | X    | X    | X    | X    |
|              | V2 | 0            | 0    | 1    | 0    | X    | X    | X    | X    |

**Note**

1. X = reserved.

## 17.2.2 SUBADDRESS 02

**Table 12** Analog control 1 SA02; note 1

| FUNCTION <sup>(2)</sup>                                              | CONTROL BITS D2 TO D0 |        |        |
|----------------------------------------------------------------------|-----------------------|--------|--------|
|                                                                      | MODE 2                | MODE 1 | MODE 0 |
| Mode 0 : CVBS (automatic gain)                                       | 0                     | 0      | 0      |
| Mode 1 : CVBS (automatic gain)                                       | 0                     | 0      | 1      |
| Mode 2 : CVBS (automatic gain)                                       | 0                     | 1      | 0      |
| Mode 3 : CVBS (automatic gain)                                       | 0                     | 1      | 1      |
| Mode 4 : Y (automatic gain) + C (gain channel 2 fixed to GAI2 level) | 1                     | 0      | 0      |
| Mode 5 : Y (automatic gain) + C (gain channel 2 fixed to GAI2 level) | 1                     | 0      | 1      |
| Mode 6 : Y (automatic gain) + C (gain channel 2 adapted to Y gain)   | 1                     | 1      | 0      |
| Mode 7 : Y (automatic gain) + C (gain channel 2 adapted to Y gain)   | 1                     | 1      | 1      |

**Notes**

1. Mode select (see Figs 33 to 40).
2. For modes 0 to 3 use BYPS(SA09,D7) = 0 (chrominance trap active), for modes 4 to 7 use BYPS = 1 (chrominance trap bypassed).

**Table 13** Analog control 1 SA 02, D5 to D3 (see Fig.14)

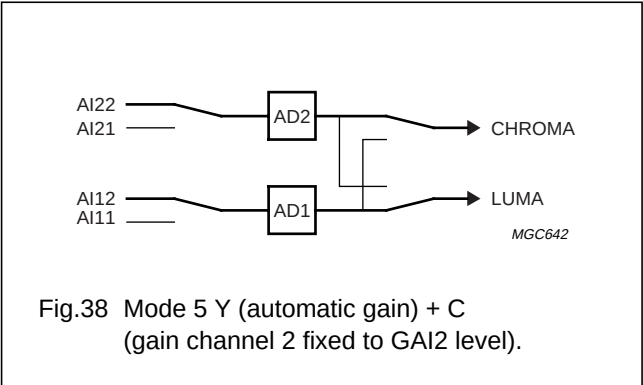
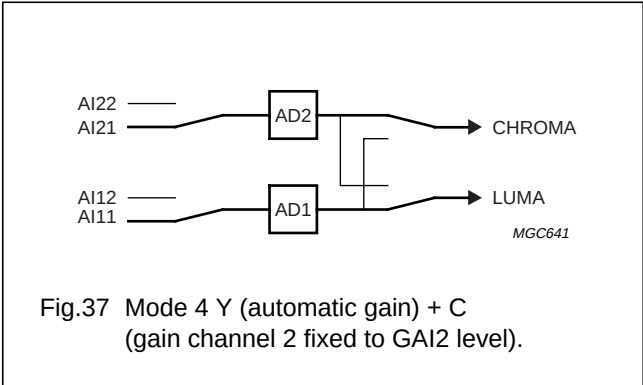
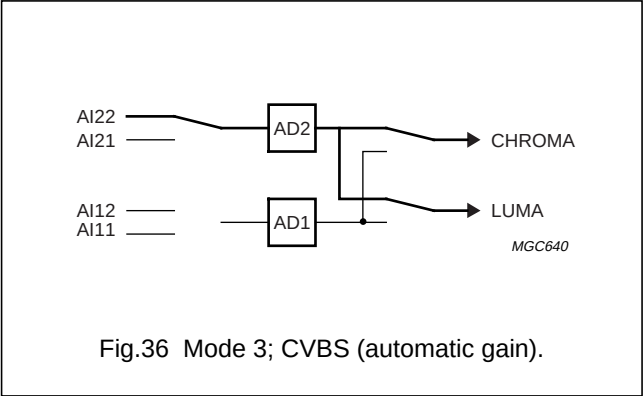
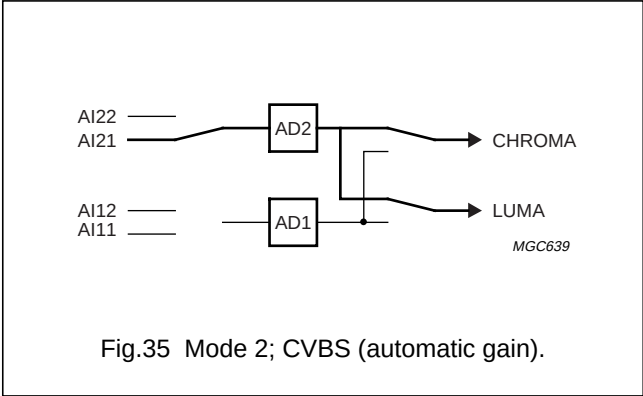
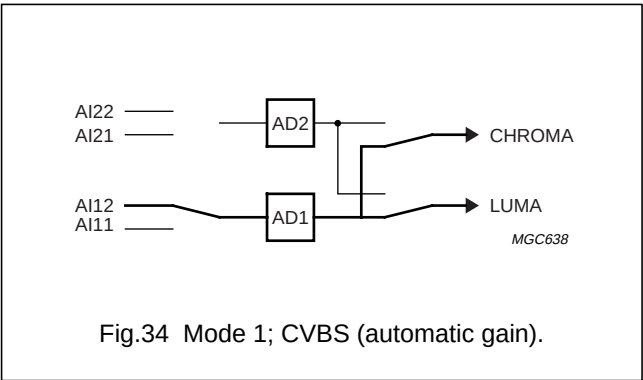
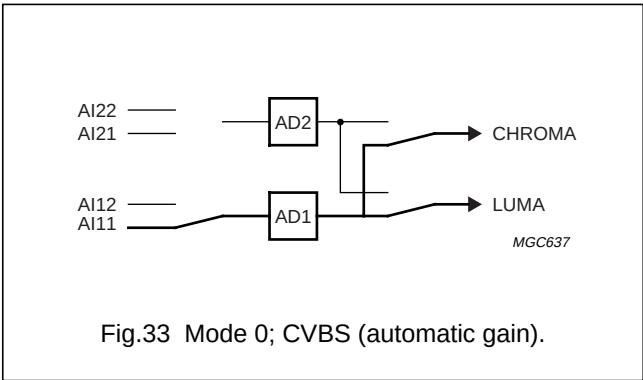
| DECIMAL VALUE | UPDATE HYSTERESIS FOR 9-BIT GAIN | CONTROL BITS D5 TO D3 |        |        |
|---------------|----------------------------------|-----------------------|--------|--------|
|               |                                  | GUDL 2                | GUDL 1 | GUDL 0 |
| 0....         | off                              | 0                     | 0      | 0      |
| ....7         | ±7 LSB                           | 1                     | 1      | 1      |

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Table 14 Analog control

| ANALOG FUNCTION SELECT FUSE               | CONTROL BITS D7 AND D6 |        |
|-------------------------------------------|------------------------|--------|
|                                           | FUSE 1                 | FUSE 0 |
| Amplifier plus anti-alias filter bypassed | 0                      | 0      |
|                                           | 0                      | 1      |
| Amplifier active                          | 1                      | 0      |
| Amplifier plus anti-alias filter active   | 1                      | 1      |



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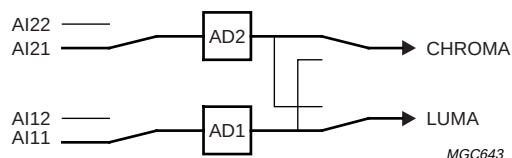


Fig.39 Mode 6 Y (automatic gain) + C  
(gain channel 2 adapted to Y gain).

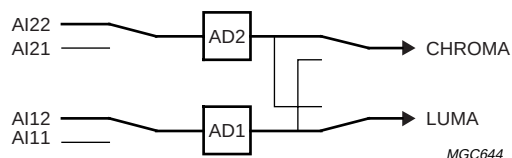


Fig.40 Mode 7 Y (automatic gain) + C  
(gain channel 2 adapted to Y gain).

## 17.2.3 SUBADDRESS 03

**Table 15** Analog control 2 (AICO2) SA03

| FUNCTION                                                | BIT NAME | LOGIC LEVEL  | CONTROL BIT |
|---------------------------------------------------------|----------|--------------|-------------|
| <b>Static gain control channel 1 (GAI18) (see SA04)</b> |          |              |             |
| Sign bit of gain control                                | GAI18    | see Table 16 | D0          |
| <b>Static gain control channel 2 (GAI28) (see SA05)</b> |          |              |             |
| Sign bit of gain control                                | GAI28    | see Table 17 | D1          |
| <b>Gain control fix (GAFIX)</b>                         |          |              |             |
| Automatic gain controlled by MODE 1 and MODE 0          | GAFIX    | 0            | D2          |
| Gain control is user programmable via GAI1 + GAI2       | GAFIX    | 1            | D2          |
| <b>Automatic gain control integration (HOLDG)</b>       |          |              |             |
| AGC active                                              | HOLDG    | 0            | D3          |
| AGC integration hold (freeze)                           | HOLDG    | 1            | D3          |
| <b>White peak off (WPOFF)</b>                           |          |              |             |
| White peak control active                               | WPOFF    | 0            | D4          |
| White peak off                                          | WPOFF    | 1            | D4          |
| <b>Vertical blanking select (VBSL)</b>                  |          |              |             |
| Long vertical blanking                                  | VBSL     | 0            | D5          |
| Short vertical blanking                                 | VBSL     | 1            | D5          |
| <b>HL not reference select (HLNRS)</b>                  |          |              |             |
| Normal clamping by HL not                               | HLNRS    | 0            | D6          |
| Reference select by HL not                              | HLNRS    | 1            | D6          |

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## 17.2.4 SUBADDRESS 04

**Table 16** Gain control analog (AIC03); static gain control channel 1 GAI1 SA 04, D7 to D0

| DECIMAL VALUE | GAIN (dB) | SIGN BIT | CONTROL BITS D7 TO D0 |       |       |       |       |       |       |       |
|---------------|-----------|----------|-----------------------|-------|-------|-------|-------|-------|-------|-------|
|               |           | GAI18    | GAI17                 | GAI16 | GAI15 | GAI14 | GAI13 | GAI12 | GAI11 | GAI10 |
| 0....         | −5.98     | 0        | 0                     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| ...255        | 0         | 0        | 1                     | 1     | 1     | 1     | 1     | 1     | 1     | 1     |
| 256....       | 0         | 1        | 0                     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| ...511        | 5.98      | 1        | 1                     | 1     | 1     | 1     | 1     | 1     | 1     | 1     |

## 17.2.5 SUBADDRESS 05

**Table 17** Gain control analog (AIC04); static gain control channel 2 GAI2 SA 05, D7 to D0

| DECIMAL VALUE | GAIN (dB) | SIGN BIT (SA 03, D1) | CONTROL BITS D7 to D0 |       |       |       |       |       |       |       |
|---------------|-----------|----------------------|-----------------------|-------|-------|-------|-------|-------|-------|-------|
|               |           | GAI28                | GAI27                 | GAI26 | GAI25 | GAI24 | GAI23 | GAI22 | GAI21 | GAI20 |
| 0....         | −5.98     | 0                    | 0                     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| ...255        | 0         | 0                    | 1                     | 1     | 1     | 1     | 1     | 1     | 1     | 1     |
| 256....       | 0         | 1                    | 0                     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| ...511        | 5.98      | 1                    | 1                     | 1     | 1     | 1     | 1     | 1     | 1     | 1     |

## 17.2.6 SUBADDRESS 06

**Table 18** Horizontal sync begin SA 06, D7 to D0

| DELAY TIME (STEP SIZE = 8/LLC)       | CONTROL BITS D7 to D0                               |      |      |      |      |      |      |      |
|--------------------------------------|-----------------------------------------------------|------|------|------|------|------|------|------|
|                                      | HSB7                                                | HSB6 | HSB5 | HSB4 | HSB3 | HSB2 | HSB1 | HSB0 |
| −128...−108                          | forbidden (outside available central counter range) |      |      |      |      |      |      |      |
| −107...                              | 1                                                   | 0    | 0    | 1    | 0    | 1    | 0    | 1    |
| ...108 (50Hz)                        | 0                                                   | 1    | 1    | 0    | 1    | 1    | 0    | 0    |
| ...107 (60Hz)                        | 0                                                   | 1    | 1    | 0    | 1    | 0    | 1    | 1    |
| 109...127 (50Hz)<br>108...127 (60Hz) | forbidden (outside available central counter range) |      |      |      |      |      |      |      |

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## 17.2.7 SUBADDRESS 07

**Table 19** Horizontal sync stop SA 07, D7 to D0

| DELAY TIME<br>(STEP SIZE = 8/LLC)    | CONTROL BITS D7 to D0                               |      |      |      |      |      |      |      |
|--------------------------------------|-----------------------------------------------------|------|------|------|------|------|------|------|
|                                      | HSS7                                                | HSS6 | HSS5 | HSS4 | HSS3 | HSS2 | HSS1 | HSS0 |
| –128...–108                          | forbidden (outside available central counter range) |      |      |      |      |      |      |      |
| –107...                              | 1                                                   | 0    | 0    | 1    | 0    | 1    | 0    | 1    |
| ...108 (50Hz)                        | 0                                                   | 1    | 1    | 0    | 1    | 1    | 0    | 0    |
| ...107 (60Hz)                        | 0                                                   | 1    | 1    | 0    | 1    | 0    | 1    | 1    |
| 109...127 (50Hz)<br>108...127 (60Hz) | forbidden (outside available central counter range) |      |      |      |      |      |      |      |

## 17.2.8 SUBADDRESS 08

**Table 20** Sync control SA 08, D7 to D5, D3 to D0

| FUNCTION                                                   | BIT NAME | LOGIC LEVEL | CONTROL BIT |
|------------------------------------------------------------|----------|-------------|-------------|
| <b>Vertical noise reduction (VNOI)</b>                     |          |             |             |
| Normal mode                                                | VNOI1    | 0           | D1          |
|                                                            | VNOI0    | 0           | D0          |
| Searching mode                                             | VNOI1    | 0           | D1          |
|                                                            | VNOI0    | 1           | D0          |
| Free running mode                                          | VNOI1    | 1           | D1          |
|                                                            | VNOI0    | 0           | D0          |
| Vertical noise reduction bypassed                          | VNOI1    | 1           | D1          |
|                                                            | VNOI0    | 1           | D0          |
| <b>Horizontal PLL (HPLL)</b>                               |          |             |             |
| PLL closed                                                 | HPLL     | 0           | D2          |
| PLL open, horizontal frequency fixed                       | HPLL     | 1           | D2          |
| <b>TV/VTR mode select (VTRC)</b>                           |          |             |             |
| TV mode<br>(recommended for poor quality TV signals only)  | VTRC     | 0           | D3          |
| VTR mode (recommended as default setting)                  | VTRC     | 1           | D3          |
| <b>Extended loop filter (EXFIL)</b>                        |          |             |             |
| Word width of the loop filter (LF2) amplification = 16-bit | EXFIL    | 0           | D5          |
| Word width of the loop filter (LF2) amplification = 14-bit | EXFIL    | 1           | D5          |
| <b>Field selection (FSEL)</b>                              |          |             |             |
| 50 Hz, 625 lines                                           | FSEL     | 0           | D6          |
| 60 Hz, 525 lines                                           | FSEL     | 1           | D6          |
| <b>Automatic field detection (AUFD)</b>                    |          |             |             |
| Field state directly controlled via FSEL                   | AUFD     | 0           | D7          |
| Automatic field detection                                  | AUFD     | 1           | D7          |

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## 17.2.9 SUBADDRESS 09

**Table 21** Luminance control SA 09, D7 to D0

| FUNCTION                                            | BIT NAME | LOGIC LEVEL | CONTROL BIT |
|-----------------------------------------------------|----------|-------------|-------------|
| <b>Aperture factor (APER)</b>                       |          |             |             |
| Aperture factor = 0                                 | APER1    | 0           | D1          |
|                                                     | APER0    | 0           | D0          |
| Aperture factor = 0.25                              | APER1    | 0           | D1          |
|                                                     | APER0    | 1           | D0          |
| Aperture factor = 0.5                               | APER1    | 1           | D1          |
|                                                     | APER0    | 0           | D0          |
| Aperture factor = 1.0                               | APER1    | 1           | D1          |
|                                                     | APER0    | 1           | D0          |
| <b>Update time interval for AGC value (UPTCV)</b>   |          |             |             |
| Horizontal update (once per line)                   | UPTCV    | 0           | D2          |
| Vertical update (once per field)                    | UPTCV    | 1           | D2          |
| <b>Vertical blanking luminance bypass (VBLB)</b>    |          |             |             |
| Active luminance processing                         | VBLB     | 0           | D3          |
| Luminance bypass during vertical blanking           | VBLB     | 1           | D3          |
| <b>Aperture band pass (centre frequency) (BPSS)</b> |          |             |             |
| Centre frequency = 4.1 MHz                          | BPSS1    | 0           | D5          |
|                                                     | BPSS0    | 0           | D4          |
| Centre frequency = 3.8 MHz; note 1                  | BPSS1    | 0           | D5          |
|                                                     | BPSS0    | 1           | D4          |
| Centre frequency = 2.6 MHz; note 1                  | BPSS1    | 1           | D5          |
|                                                     | BPSS0    | 0           | D4          |
| Centre frequency = 2.9 MHz; note 1                  | BPSS1    | 1           | D5          |
|                                                     | BPSS0    | 1           | D4          |
| <b>Prefilter active (PREF)</b>                      |          |             |             |
| Bypassed                                            | PREF     | 0           | D6          |
| Active                                              | PREF     | 1           | D6          |
| <b>Chrominance trap bypass (BYPS)</b>               |          |             |             |
| Chrominance trap active; default for CVBS mode      | BYPS     | 0           | D7          |
| Chrominance trap bypassed; default for S-Video mode | BYPS     | 1           | D7          |

**Note**

1. Not to be used with bypassed chrominance trap.



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## 17.2.10 SUBADDRESS 0A

**Table 22** Luminance brightness control BRIG7 to BRIG0 SA 0A

| OFFSET           | CONTROL BITS D7 to D0 |       |       |       |       |       |       |       |
|------------------|-----------------------|-------|-------|-------|-------|-------|-------|-------|
|                  | BRIG7                 | BRIG6 | BRIG5 | BRIG4 | BRIG3 | BRIG2 | BRIG1 | BRIG0 |
| 255 (bright)     | 1                     | 1     | 1     | 1     | 1     | 1     | 1     | 1     |
| 128 (CCIR level) | 1                     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| 0 (dark)         | 0                     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |

## 17.2.11 SUBADDRESS 0B

**Table 23** Luminance contrast control CONT7 to CONT0 SA 0B

| GAIN                   | CONTROL BITS D7 to D0 |       |       |       |       |       |       |       |
|------------------------|-----------------------|-------|-------|-------|-------|-------|-------|-------|
|                        | CONT7                 | CONT6 | CONT5 | CONT4 | CONT3 | CONT2 | CONT1 | CONT0 |
| 1.999 (maximum)        | 0                     | 1     | 1     | 1     | 1     | 1     | 1     | 1     |
| 1.109 (CCIR level)     | 0                     | 1     | 0     | 0     | 0     | 1     | 1     | 1     |
| 1.0                    | 0                     | 1     | 0     | 0     | 0     | 0     | 0     | 0     |
| 0 (luminance off)      | 0                     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| –1 (inverse luminance) | 1                     | 1     | 0     | 0     | 0     | 0     | 0     | 0     |
| –2 (inverse luminance) | 1                     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |

## 17.2.12 SUBADDRESS 0C

**Table 24** Chrominance saturation control SATN7 to SATN0 SA 0C

| GAIN                     | CONTROL BITS D7 to D0 |       |       |       |       |       |       |       |
|--------------------------|-----------------------|-------|-------|-------|-------|-------|-------|-------|
|                          | SATN7                 | SATN6 | SATN5 | SATN4 | SATN3 | SATN2 | SATN1 | SATN0 |
| 1.999 (maximum)          | 0                     | 1     | 1     | 1     | 1     | 1     | 1     | 1     |
| 1.0 (CCIR level)         | 0                     | 1     | 0     | 0     | 0     | 0     | 0     | 0     |
| 0 (colour off)           | 0                     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| –1 (inverse chrominance) | 1                     | 1     | 0     | 0     | 0     | 0     | 0     | 0     |
| –2 (inverse chrominance) | 1                     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |

## 17.2.13 SUBADDRESS 0D

**Table 25** Chrominance hue control HUEC7 to HUEC0 SA 0D

| HUE PHASE (DEG) | CONTROL BITS D7 to D0 |       |       |       |       |       |       |       |
|-----------------|-----------------------|-------|-------|-------|-------|-------|-------|-------|
|                 | HUEC7                 | HUEC6 | HUEC5 | HUEC4 | HUEC3 | HUEC2 | HUEC1 | HUEC0 |
| +178.6....      | 0                     | 1     | 1     | 1     | 1     | 1     | 1     | 1     |
| ....0....       | 0                     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| ....–180        | 1                     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |

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## 17.2.14 SUBADDRESS 0E

**Table 26** Chrominance control SA 0E

| FUNCTION                                                                                                                                                                                                                                                   | BIT NAME | LOGIC LEVEL | CONTROL BIT |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-------------|-------------|
| <b>Chroma bandwidth (CHBW0 and CHBW1)</b>                                                                                                                                                                                                                  |          |             |             |
| Small bandwidth ( $\approx 620$ kHz)                                                                                                                                                                                                                       | CHBW1    | 0           | D1          |
|                                                                                                                                                                                                                                                            | CHBW0    | 0           | D0          |
| Nominal bandwidth ( $\approx 800$ kHz)                                                                                                                                                                                                                     | CHBW1    | 0           | D1          |
|                                                                                                                                                                                                                                                            | CHBW0    | 1           | D0          |
| Medium bandwidth ( $\approx 920$ kHz)                                                                                                                                                                                                                      | CHBW1    | 1           | D1          |
|                                                                                                                                                                                                                                                            | CHBW0    | 0           | D0          |
| Wide bandwidth ( $\approx 1000$ kHz)                                                                                                                                                                                                                       | CHBW1    | 1           | D1          |
|                                                                                                                                                                                                                                                            | CHBW0    | 1           | D0          |
| <b>Fast colour time constant (FCTC)</b>                                                                                                                                                                                                                    |          |             |             |
| Nominal time constant                                                                                                                                                                                                                                      | FCTC     | 0           | D2          |
| Fast time constant                                                                                                                                                                                                                                         | FCTC     | 1           | D2          |
| <b>Disable chrominance comb filter (DCCF)</b>                                                                                                                                                                                                              |          |             |             |
| Chrominance comb filter on (during VREF = 1) (see Figs 24 and 25)                                                                                                                                                                                          | DCCF     | 0           | D3          |
| Chrominance comb filter off                                                                                                                                                                                                                                | DCCF     | 1           | D3          |
| <b>Colour standard (CSTD0 to CSTD2); logic levels 100, 110 and 111 are reserved, do not use</b>                                                                                                                                                            |          |             |             |
| Colour standard control automatic switching between PAL BGHI and NTSC M (NTSC-Japan with special level adjustment; luminance brightness subaddress 0A = 95H, luminance contrast subaddress 0BH = 48H)                                                      | CSTD2    | 0           | D6          |
|                                                                                                                                                                                                                                                            | CSTD1    | 0           | D5          |
|                                                                                                                                                                                                                                                            | CSTD0    | 0           | D4          |
| Colour standard control automatic switching between NTSC 4.43 (50 Hz) and PAL 4.43 (60 Hz)                                                                                                                                                                 | CSTD2    | 0           | D6          |
|                                                                                                                                                                                                                                                            | CSTD1    | 0           | D5          |
|                                                                                                                                                                                                                                                            | CSTD0    | 1           | D4          |
| Colour standard control automatic switching between PAL N and NTSC 4.43 (60 Hz)                                                                                                                                                                            | CSTD2    | 0           | D6          |
|                                                                                                                                                                                                                                                            | CSTD1    | 1           | D5          |
|                                                                                                                                                                                                                                                            | CSTD0    | 0           | D4          |
| Colour standard control automatic switching between NTSC N and PAL M                                                                                                                                                                                       | CSTD2    | 0           | D6          |
|                                                                                                                                                                                                                                                            | CSTD1    | 1           | D5          |
|                                                                                                                                                                                                                                                            | CSTD0    | 1           | D4          |
| Colour standard control automatic switching between SECAM and PAL 4.43 (60 Hz)                                                                                                                                                                             | CSTD2    | 1           | D6          |
|                                                                                                                                                                                                                                                            | CSTD1    | 0           | D5          |
|                                                                                                                                                                                                                                                            | CSTD0    | 1           | D4          |
| <b>Clear DTO (CDTO)</b>                                                                                                                                                                                                                                    |          |             |             |
| Disabled                                                                                                                                                                                                                                                   | CDTO     | 0           | D7          |
| Every time CDTO is set, the internal subcarrier DTO phase is reset to 0° and the RTCO output generates a logic 0 at time slot 68 (see RTCO description Fig.20). So an identical subcarrier phase can be generated by an external device (e.g. an encoder). | CDTO     | 1           | D7          |

## Enhanced Video Input Processor (EVIP)

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## 17.2.15 SUBADDRESS 10

**Table 27** Format/delay control SA 10

| LUMINANCE DELAY COMPENSATION<br>(STEPS IN 2/LLC) | CONTROL BITS D2 to D0 |       |       |
|--------------------------------------------------|-----------------------|-------|-------|
|                                                  | YDEL2                 | YDEL1 | YDEL0 |
| –4...                                            | 1                     | 0     | 0     |
| ...0...                                          | 0                     | 0     | 0     |
| ...3                                             | 0                     | 1     | 1     |

**Table 28** VREF pulse position and length VRLN SA 10 (D3)

| VRLN                   | VREF at 60 Hz 525 LINES <sup>(1)</sup> |           |           |           | VREF at 50 Hz 625 LINES <sup>(1)</sup> |      |       |      |
|------------------------|----------------------------------------|-----------|-----------|-----------|----------------------------------------|------|-------|------|
|                        | 0                                      |           | 1         |           | 0                                      |      | 1     |      |
| Length                 | 240                                    |           | 242       |           | 286                                    |      | 288   |      |
| Line number            | first                                  | last      | first     | last      | first                                  | last | first | last |
| Field 1 <sup>(2)</sup> | 19 (22)                                | 258 (261) | 18 (21)   | 259 (262) | 24                                     | 309  | 23    | 310  |
| Field 2 <sup>(2)</sup> | 282 (285)                              | 521 (524) | 281 (284) | 522 (525) | 337                                    | 622  | 336   | 623  |

**Notes**

1. Additional VREF positions can be achieved via I<sup>2</sup>C-bus bits VCTR1 and VCTR0 (see Fig.9).
2. The numbers given in parenthesis refer to CCIR line counting.

**Table 29** Fine position of HS HDEL0 and HDEL1 SA 10

| FINE POSITION OF HS WITH A STEP SIZE<br>OF 2/LLC | CONTROL BITS D5 and D4 |       |
|--------------------------------------------------|------------------------|-------|
|                                                  | HDEL1                  | HDEL0 |
| 0                                                | 0                      | 0     |
| 1                                                | 0                      | 1     |
| 2                                                | 1                      | 0     |
| 3                                                | 1                      | 1     |

**Table 30** Output format selection OFTS0 and OFTS1 SA 10

| FORMATS                                                                                  | CONTROL BITS D7 and D6 |       |
|------------------------------------------------------------------------------------------|------------------------|-------|
|                                                                                          | OFTS1                  | OFTS0 |
| RGB (5, 6 and 5), RGB (8, 8 and 8)<br>(dependent on control bit RGB888); see<br>Table 32 | 0                      | 0     |
| YUV 422 16 bits                                                                          | 0                      | 1     |
| YUV 411 12 bits                                                                          | 1                      | 0     |
| YUV CCIR-656 8 bits                                                                      | 1                      | 1     |

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## 17.2.16 SUBADDRESS 11

**Table 31** Output control 1 SA 11

| FUNCTION                                                                                   | BIT NAME | LOGIC LEVEL | CONTROL BIT |
|--------------------------------------------------------------------------------------------|----------|-------------|-------------|
| <b>Colour on (COLO)</b>                                                                    |          |             |             |
| Automatic colour killer                                                                    | COLO     | 0           | D0          |
| Colour forced on                                                                           | COLO     | 1           | D0          |
| <b>Decoder VIP bypassed (VIPB)</b>                                                         |          |             |             |
| DMSD data to YUV output                                                                    | VIPB     | 0           | D1          |
| ADC data to YUV output; dependent on mode settings                                         | VIPB     | 1           | D1          |
| <b>Output enable horizontal/vertical sync (OEHV)</b>                                       |          |             |             |
| HS, HREF, VREF and VS high-impedance inputs                                                | OEHV     | 0           | D2          |
| Outputs HS, HREF, VREF and VS active                                                       | OEHV     | 1           | D2          |
| <b>Output enable YUV data (OEYC)</b>                                                       |          |             |             |
| VPO-bus high-impedance inputs                                                              | OEYC     | 0           | D3          |
| Output VPO-bus active                                                                      | OEYC     | 1           | D3          |
| <b>Inverse composite blank (COMPO)</b>                                                     |          |             |             |
| VREF is vertical reference                                                                 | COMPO    | 0           | D4          |
| VREF is inverse composite blank                                                            | COMPO    | 1           | D4          |
| <b>FEI control (FECO)</b>                                                                  |          |             |             |
| $\overline{\text{FEI}}$ sampling at CREF = LOW<br>(SAA7110 compatible); (see Fig.19)       | FECO     | 0           | D5          |
| $\overline{\text{FEI}}$ sampling at CREF = HIGH                                            | FECO     | 1           | D5          |
| <b>Compatibility to SAA7199 (CM99)</b>                                                     |          |             |             |
| Default value                                                                              | CM99     | 0           | D6          |
| To be set if SAA7199 (digital encoder) is used for<br>re-encoding in conjunction with RTCO | CM99     | 1           | D6          |
| <b>General purpose switch (GPSW)</b>                                                       |          |             |             |
| Switches directly pin 64 GPSW                                                              | GPSW     | 0           | D7          |
|                                                                                            | GPSW     | 1           | D7          |

## Enhanced Video Input Processor (EVIP)

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## 17.2.17 SUBADDRESS 12

**Table 32** Output control 2 SA 12, D7 to D6, D4 to D0

| FUNCTION                                                                                         | BIT NAME | LOGIC LEVEL | CONTROL BIT |
|--------------------------------------------------------------------------------------------------|----------|-------------|-------------|
| <b>Analog test select (AOSL)</b>                                                                 |          |             |             |
| AOUT connected to internal test point 1                                                          | AOSL1    | 0           | D1          |
|                                                                                                  | AOSL0    | 0           | D0          |
| AOUT connected to input AD1                                                                      | AOSL1    | 0           | D1          |
|                                                                                                  | AOSL0    | 1           | D0          |
| AOUT connected to input AD2                                                                      | AOSL1    | 1           | D1          |
|                                                                                                  | AOSL0    | 0           | D0          |
| AOUT connected to internal test point 2                                                          | AOSL1    | 1           | D1          |
|                                                                                                  | AOSL0    | 1           | D0          |
| <b>Dithering (noise shaping) control (DIT)</b>                                                   |          |             |             |
| Dithering off                                                                                    | DIT      | 0           | D2          |
| Dithering on                                                                                     | DIT      | 1           | D2          |
| <b>RGB output format selection (RGB888)</b>                                                      |          |             |             |
| RGB (5, 6 and 5)                                                                                 | RGB888   | 0           | D3          |
| RGB (8, 8 and 8)                                                                                 | RGB888   | 1           | D3          |
| <b>Chrominance interpolation filter function (CBR)</b>                                           |          |             |             |
| Cubic interpolation (default)                                                                    | CBR      | 0           | D4          |
| Linear interpolation (lower bandwidth)                                                           | CBR      | 1           | D4          |
| <b>3-state control VPO7 to VPO0 (TCLO)</b>                                                       |          |             |             |
| VPO7 to VPO0 depends on OEYC, $\overline{\text{FEI}}$ only (default)<br>(see Figs 18, 19 and 22) | TCLO     | 0           | D5          |
| VPO7 to VPO0 in 3-state [and OFTS (1 : 0) = 3]<br>(see Tables 3 and 6)                           | TCLO     | 1           | D5          |
| <b>Real time outputs mode select (RTSE0)</b>                                                     |          |             |             |
| ODD switched to output pin 40                                                                    | RTSE0    | 0           | D6          |
| VL switched to output pin 40                                                                     | RTSE0    | 1           | D6          |
| <b>Real time outputs mode select (RTSE1)</b>                                                     |          |             |             |
| PLIN switched to output pin 39                                                                   | RTSE1    | 0           | D7          |
| HL switched to output pin 39                                                                     | RTSE1    | 1           | D7          |

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## 17.2.18 SUBADDRESS 13

**Table 33** Output control 3 SA 13

| FUNCTION                                        | BIT NAME | LOGIC LEVEL | CONTROL BIT |
|-------------------------------------------------|----------|-------------|-------------|
| <b>Bypass control LOW for VPO7 to VPO0</b>      |          |             |             |
| No bypass                                       | BCLO1    | 0           | D1          |
|                                                 | BCLO0    | 0           | D0          |
| Permanent bypass                                | BCLO1    | 0           | D1          |
|                                                 | BCLO0    | 1           | D0          |
| Bypass controlled by V_GATE                     | BCLO1    | 1           | D1          |
|                                                 | BCLO0    | 0           | D0          |
| Bypass controlled by delayed V_GATE             | BCLO1    | 1           | D1          |
|                                                 | BCLO0    | 1           | D0          |
| <b>Bypass control HIGH for VPO15 to VPO8</b>    |          |             |             |
| No bypass                                       | BCHI1    | 0           | D3          |
|                                                 | BCHI0    | 0           | D2          |
| Permanent bypass                                | BCHI1    | 0           | D3          |
|                                                 | BCHI0    | 1           | D2          |
| Bypass controlled by V_GATE                     | BCHI1    | 1           | D3          |
|                                                 | BCHI0    | 0           | D2          |
| Bypass controlled by delayed V_GATE             | BCHI1    | 1           | D3          |
|                                                 | BCHI0    | 1           | D2          |
| <b>Clock Reference Output Control</b>           |          |             |             |
| CREF is independent of VREF                     | CCTR1    | 0           | D5          |
|                                                 | CCTR0    | 0           | D4          |
| CREF is LOW if VREF = 0                         | CCTR1    | 0           | D5          |
|                                                 | CCTR0    | 1           | D4          |
| CREF is HIGH if VREF = 0                        | CCTR1    | 1           | D5          |
|                                                 | CCTR0    | 0           | D4          |
| CREF always = 1                                 | CCTR1    | 1           | D5          |
|                                                 | CCTR0    | 1           | D4          |
| <b>Vertical Reference Output Control (VREF)</b> |          |             |             |
| Internal VREF                                   | VCTR1    | 0           | D7          |
|                                                 | VCTR0    | 0           | D6          |
| VREF_CCIR                                       | VCTR1    | 0           | D7          |
|                                                 | VCTR0    | 1           | D6          |
| Programmable V_GATE                             | VCTR1    | 1           | D7          |
|                                                 | VCTR0    | 0           | D6          |
| Delayed programmable V_GATE                     | VCTR1    | 1           | D7          |
|                                                 | VCTR0    | 1           | D6          |

## Enhanced Video Input Processor (EVIP)

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## 17.2.19 SUBADDRESS 15

**Table 34** Start of decoded data on VPO-port SA 15; note 1

| FIELD |     | FRAME<br>LINE <sup>(2)</sup><br>COUNTING | DECIMA<br>L VALUE | MSB<br>(SA 17,<br>D0) | CONTROL BITS D7 to D0 |       |       |       |       |       |       |       |
|-------|-----|------------------------------------------|-------------------|-----------------------|-----------------------|-------|-------|-------|-------|-------|-------|-------|
|       |     |                                          |                   | VSTA8                 | VSTA7                 | VSTA6 | VSTA5 | VSTA4 | VSTA3 | VSTA2 | VSTA1 | VSTA0 |
| 50 Hz | 1st | 1                                        | 312               | 1                     | 0                     | 0     | 1     | 1     | 1     | 0     | 0     | 0     |
|       | 2nd | 314                                      |                   |                       |                       |       |       |       |       |       |       |       |
|       | 1st | 2                                        | 0....             | 0                     | 0                     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
|       | 2nd | 315                                      |                   |                       |                       |       |       |       |       |       |       |       |
|       | 1st | 312                                      | ....310           | 1                     | 0                     | 0     | 1     | 1     | 0     | 1     | 1     | 1     |
|       | 2nd | 625                                      |                   |                       |                       |       |       |       |       |       |       |       |
| 60 Hz | 1st | 1 (4)                                    | 262               | 1                     | 0                     | 0     | 0     | 0     | 0     | 1     | 1     | 0     |
|       | 2nd | 264 (267)                                |                   |                       |                       |       |       |       |       |       |       |       |
|       | 1st | 2 (5)                                    | 0....             | 0                     | 0                     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
|       | 2nd | 265 (268)                                |                   |                       |                       |       |       |       |       |       |       |       |
|       | 1st | 262 (265)                                | ....260           | 1                     | 0                     | 0     | 0     | 0     | 0     | 1     | 0     | 1     |
|       | 2nd | 525 (3)                                  |                   |                       |                       |       |       |       |       |       |       |       |

**Notes**

1. Start of decoded data on VPO-port (end of bypassed region; start of VREF if selected by VCTR1 and VCTR0; see Figs 8 and 10).
2. Line numbers in brackets refer to CCIR line counting.

# Enhanced Video Input Processor (EVIP)

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## 17.2.20 SUBADDRESS 16

**TABLE 35** STOP OF DECODED DATA ON VPO-PORT SA 16; NOTE 1

| FIELD |     | FRAME LINE <sup>(2)</sup><br>COUNTING | DECIMAL<br>VALUE | MSB<br>(SA 17, D0) | CONTROL BITS D7 to D0 |       |       |       |       |       |       |       |
|-------|-----|---------------------------------------|------------------|--------------------|-----------------------|-------|-------|-------|-------|-------|-------|-------|
|       |     |                                       |                  | VSTO8              | VSTO7                 | VSTO6 | VSTO5 | VSTO4 | VSTO3 | VSTO2 | VSTO1 | VSTO0 |
| 50 Hz | 1st | 1                                     | 312              | 1                  | 0                     | 0     | 1     | 1     | 1     | 0     | 0     | 0     |
|       | 2nd | 314                                   |                  |                    |                       |       |       |       |       |       |       |       |
|       | 1st | 2                                     | 0....            | 0                  | 0                     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
|       | 2nd | 315                                   |                  |                    |                       |       |       |       |       |       |       |       |
|       | 1st | 312                                   | ....310          | 1                  | 0                     | 0     | 1     | 1     | 0     | 1     | 1     | 1     |
|       | 2nd | 625                                   |                  |                    |                       |       |       |       |       |       |       |       |
| 60 Hz | 1st | 1 (4)                                 | 262              | 1                  | 0                     | 0     | 0     | 0     | 0     | 1     | 1     | 0     |
|       | 2nd | 264 (267)                             |                  |                    |                       |       |       |       |       |       |       |       |
|       | 1st | 2 (5)                                 | 0....            | 0                  | 0                     | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
|       | 2nd | 265 (268)                             |                  |                    |                       |       |       |       |       |       |       |       |
|       | 1st | 262 (265)                             | ....260          | 1                  | 0                     | 0     | 0     | 0     | 0     | 1     | 0     | 1     |
|       | 2nd | 525 (3)                               |                  |                    |                       |       |       |       |       |       |       |       |

### NOTES

1. STOP OF DECODED DATA ON VPO-PORT (BEGIN OF BYPASSED REGION; STOP OF VREF IF SELECTED BY VCTR1 AND VCTR0; SEE FIGS 8 AND 10).
2. LINE NUMBERS IN BRACKETS REFER TO CCIR LINE COUNTING.

## 17.2.21 SUBADDRESS 17

**Table 36** Sign bits of the VBI-data stream control

| FUNCTION                                        | BIT NAME | LOGIC LEVEL  | CONTROL BIT |
|-------------------------------------------------|----------|--------------|-------------|
| <b>VBI-data stream start (VSTA8); see SA 15</b> |          |              |             |
| Sign bit VBI-data stream start                  | VSTA8    | see Table 34 | D0          |
| <b>VBI-data stream stop (VSTO8); see SA 16</b>  |          |              |             |
| Sign bit VBI-data stream stop                   | VSTO8    | see Table 35 | D1          |



## Enhanced Video Input Processor (EVIP)

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## 17.2.22 SUBADDRESS 1A (READ-ONLY REGISTER)

**Table 37** Line-21 text slicer status SA 1A, D3 to D0

| I <sup>2</sup> C-BUS<br>STATUS BIT<br>NAME | FUNCTION                                                                      | STATUS BIT |
|--------------------------------------------|-------------------------------------------------------------------------------|------------|
| F1RDY                                      | new data on field 1 has been acquired (for asynchronous reading); active HIGH | D0         |
| F1VAL                                      | line-21 of field 1 carries valid data; active HIGH                            | D1         |
| F2RDY                                      | new data on field 2 has been acquired (for asynchronous reading); active HIGH | D2         |
| F2VAL                                      | line-21 of field 2 carries valid data; active HIGH                            | D3         |

## 17.2.23 SUBADDRESS 1B (READ-ONLY REGISTER)

**Table 38** First decoded data byte of the text slicer SA 1B

| I <sup>2</sup> C-BUS<br>TEXT DATA<br>BITS | FUNCTION                                                              | DATA BITS |
|-------------------------------------------|-----------------------------------------------------------------------|-----------|
| BYTE1 (6 to 0)                            | data bit 6 to 0 of first data byte                                    | D6 to D0  |
| P1                                        | parity error flag bit; bit goes HIGH when a parity error has occurred | D7        |

## 17.2.24 SUBADDRESS 1C (READ-ONLY REGISTER)

**Table 39** Second decoded data byte of the text slicer SA 1C

| I <sup>2</sup> C-BUS<br>TEXT DATA<br>BITS | FUNCTION                                                              | DATA BITS |
|-------------------------------------------|-----------------------------------------------------------------------|-----------|
| BYTE2 (6 to 0)                            | data bit 6 to 0 of second data byte                                   | D6 to D0  |
| P2                                        | parity error flag bit; bit goes HIGH when a parity error has occurred | D7        |

## 17.2.25 SUBADDRESS 1F (READ-ONLY REGISTER)

**Table 40** Status byte SA 1F

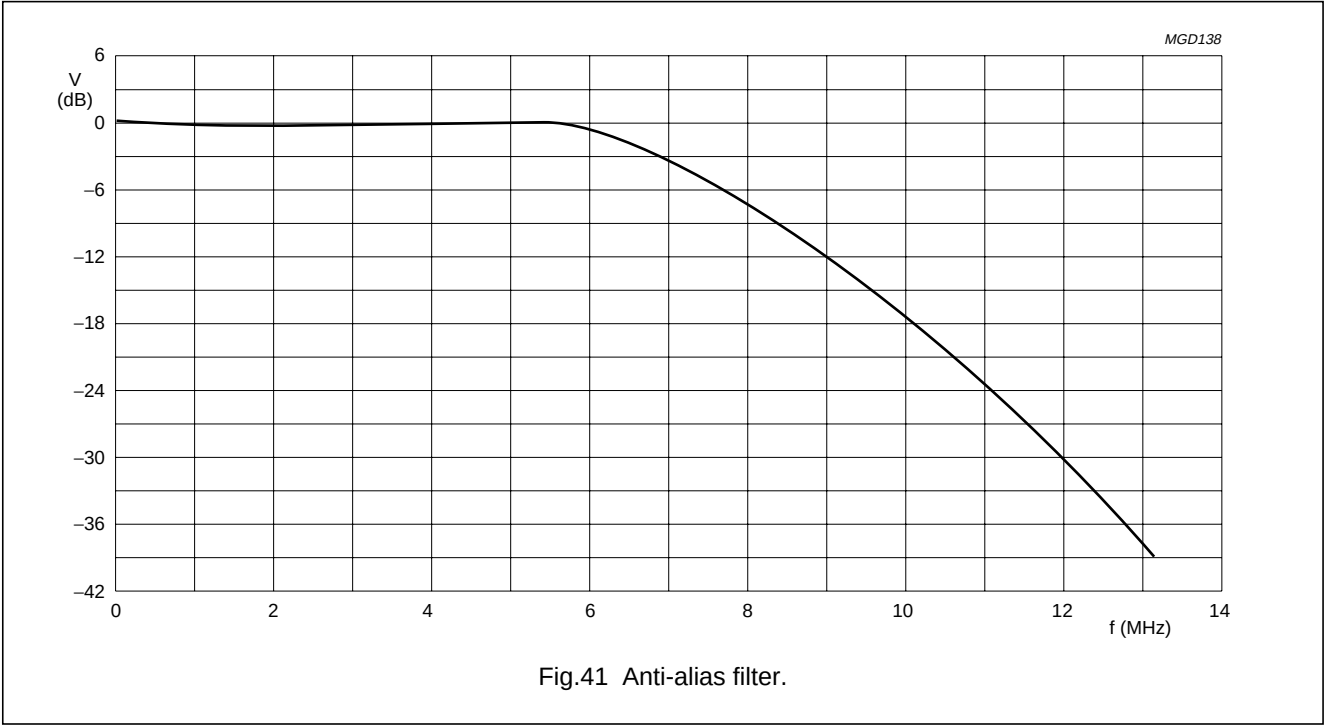
| I <sup>2</sup> C-BUS<br>STATUS BIT<br>NAME | FUNCTION                                                                               | STATUS BIT |
|--------------------------------------------|----------------------------------------------------------------------------------------|------------|
| CODE                                       | colour signal in accordance with selected standard has been detected; active HIGH      | D0         |
| SLTCA                                      | slow time constant active in WIPA-mode; active HIGH                                    | D1         |
| WIPA                                       | white peak loop is activated; active HIGH                                              | D2         |
| GLIMB                                      | gain value for active luminance channel is limited [min (bottom)]; active HIGH         | D3         |
| GLIMT                                      | gain value for active luminance channel is limited [max (top)]; active HIGH            | D4         |
| FIDT                                       | identification bit for detected field frequency; LOW = 50 Hz, HIGH = 60 Hz             | D5         |
| HLCK                                       | status bit for locked horizontal frequency; LOW = locked, HIGH = unlocked              | D6         |
| STTC                                       | status bit for horizontal phase loop; LOW = TV time-constant, HIGH = VTR time-constant | D7         |

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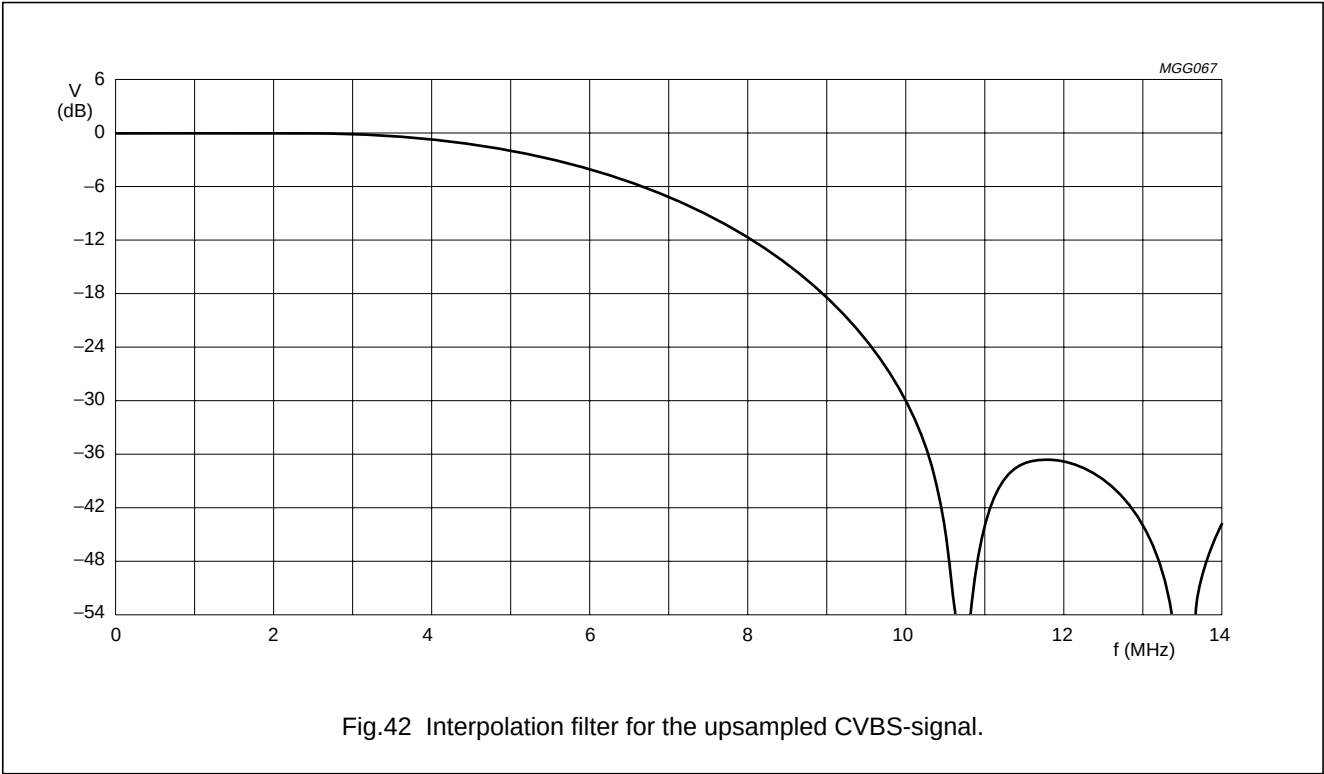
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18 FILTER CURVES

18.1 Anti-alias filter curve



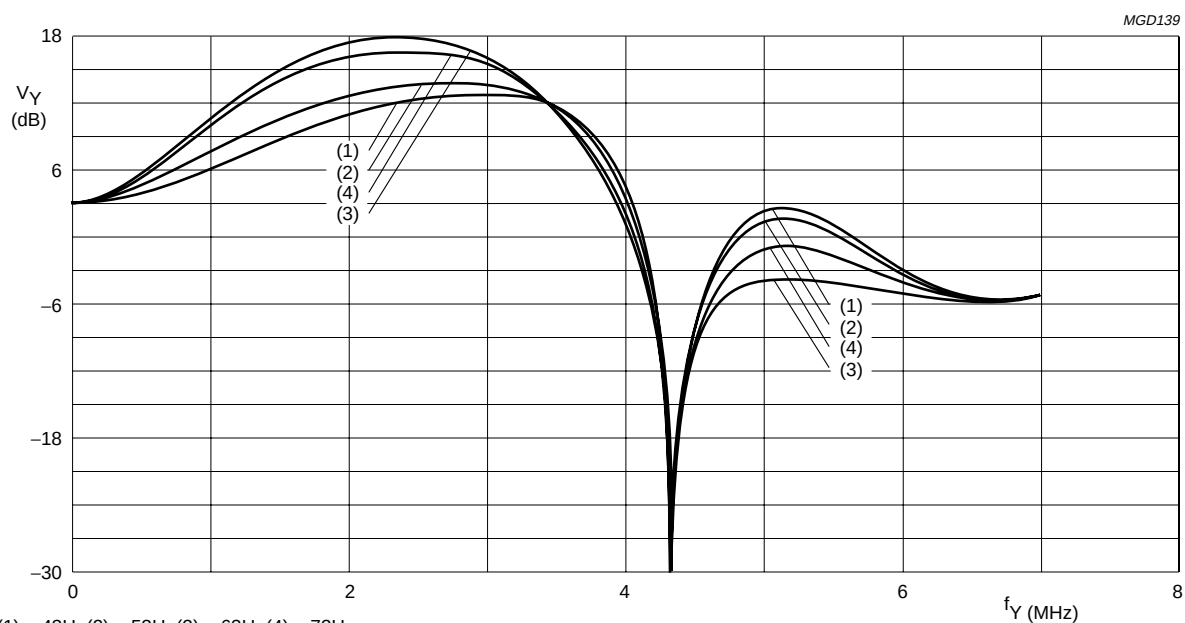
18.2 TUF-block filter curve



## Enhanced Video Input Processor (EVIP)

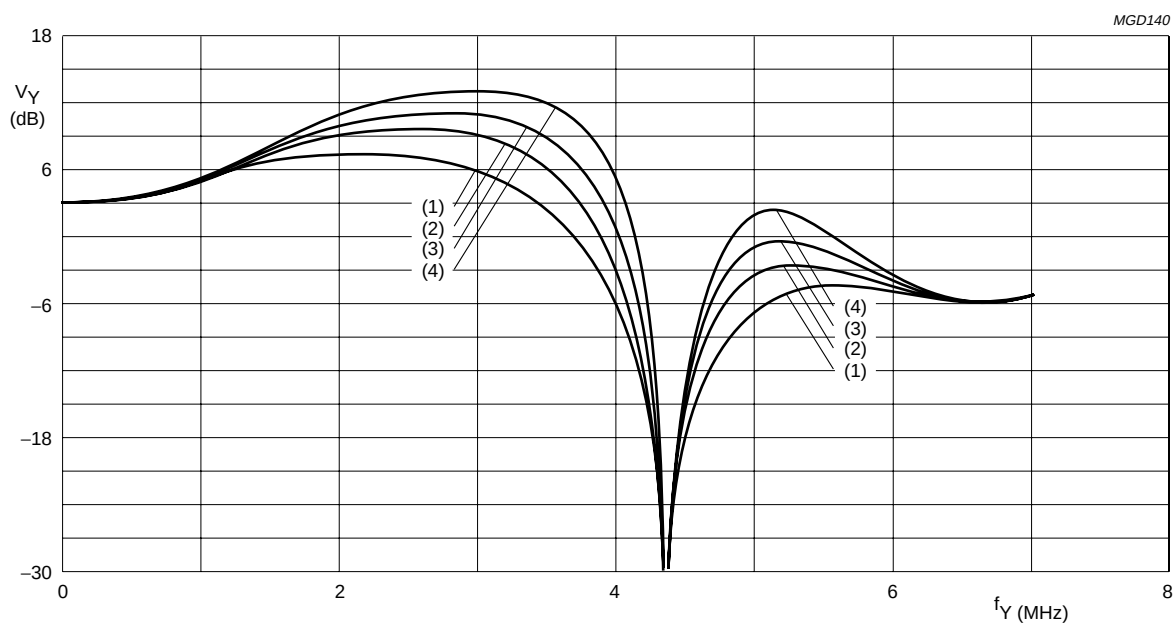
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## 18.3 Luminance filter curves



(1) = 43H; (2) = 53H; (3) = 63H; (4) = 73H.

Fig.43 Luminance control SA 09H, 4.43 MHz Trap/CVBS mode, prefilter on, different aperture bandpass centre frequencies.



(1) = 40H; (2) = 41H; (3) = 42H; (4) = 43H.

Fig.44 Luminance control SA 09H, 4.43 MHz Trap/CVBS mode, prefilter on, different aperture factors.

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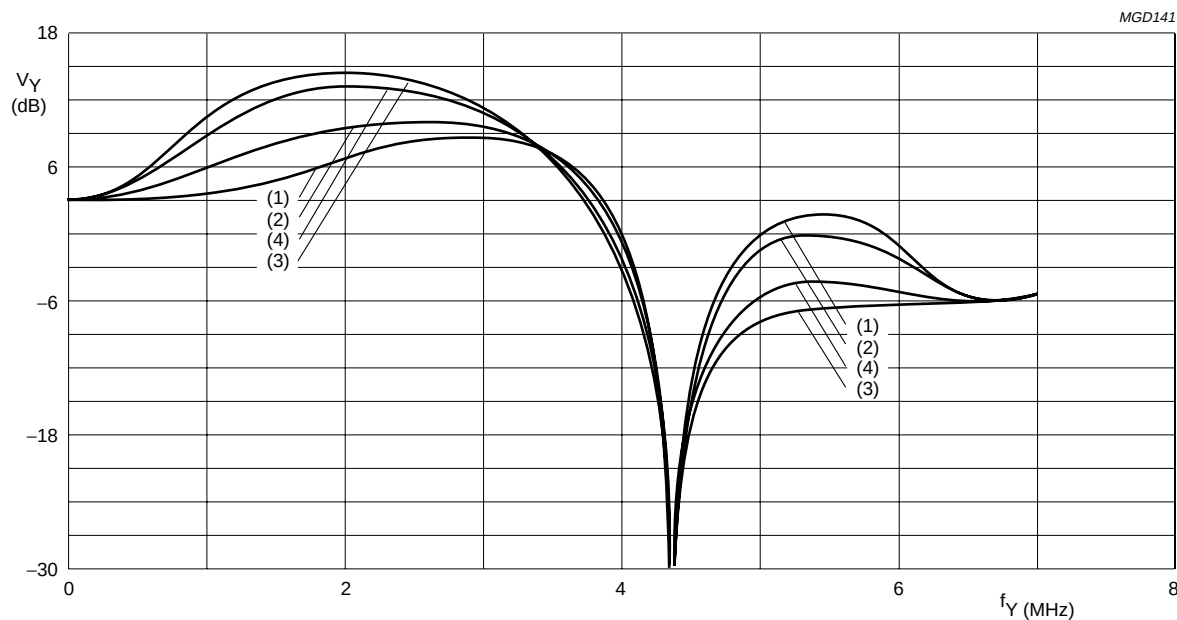


Fig.45 Luminance control SA 09H, 4.43 MHz Trap/CVBS mode, prefilter off, different aperture band-pass centre frequencies.

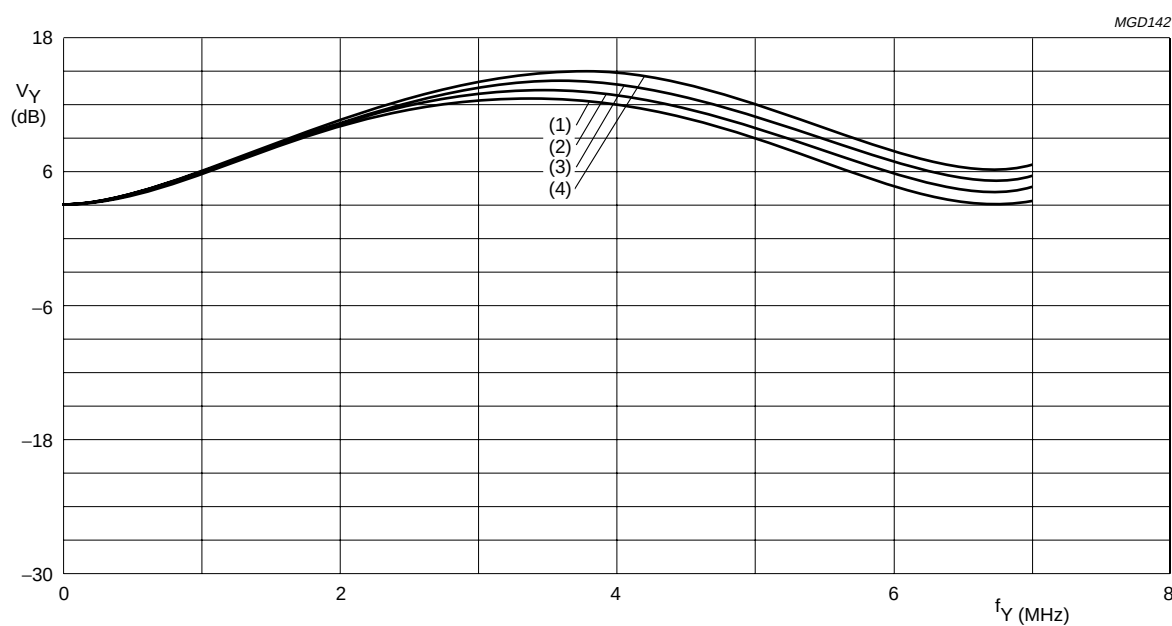
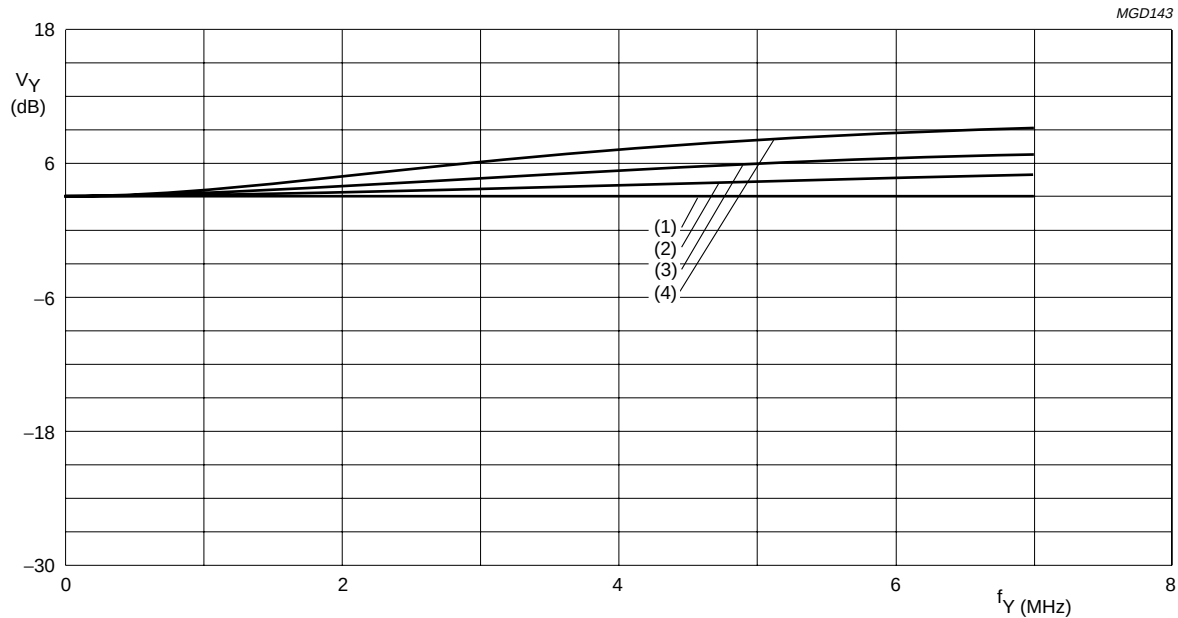


Fig.46 Luminance control SA 09H, Y/C mode, prefilter on, different aperture factors.

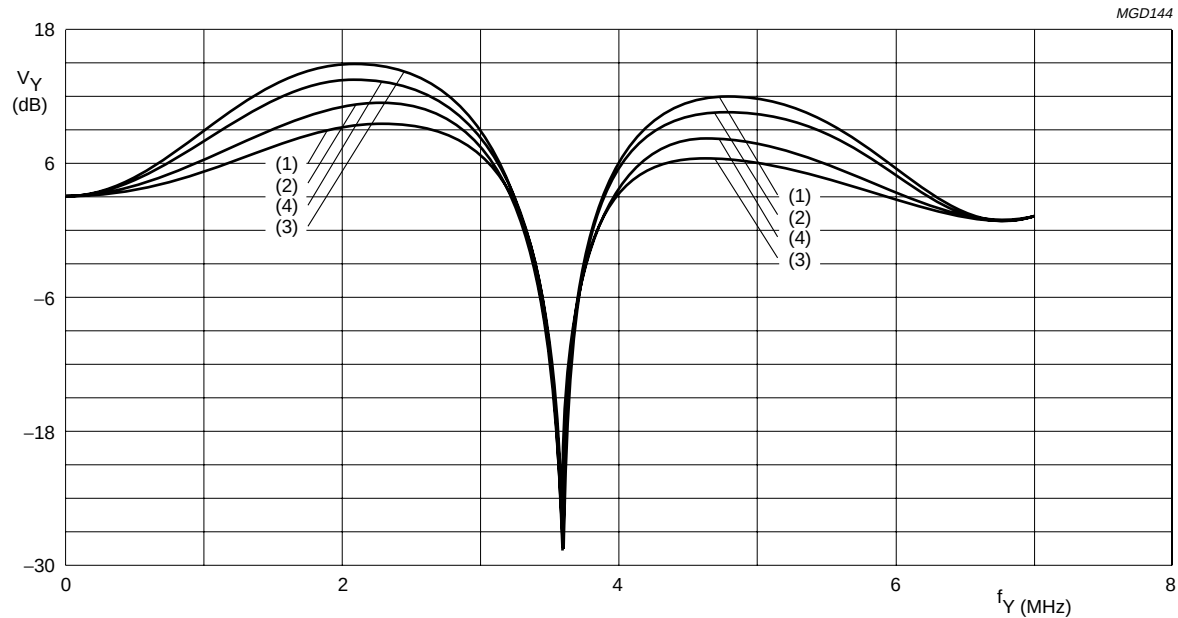
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(1) = 80H; (2) = 81H; (3) = 82H; (4) = 83H.

Fig.47 Luminance control SA 09H, Y/C mode, prefilter off, different aperture factors.

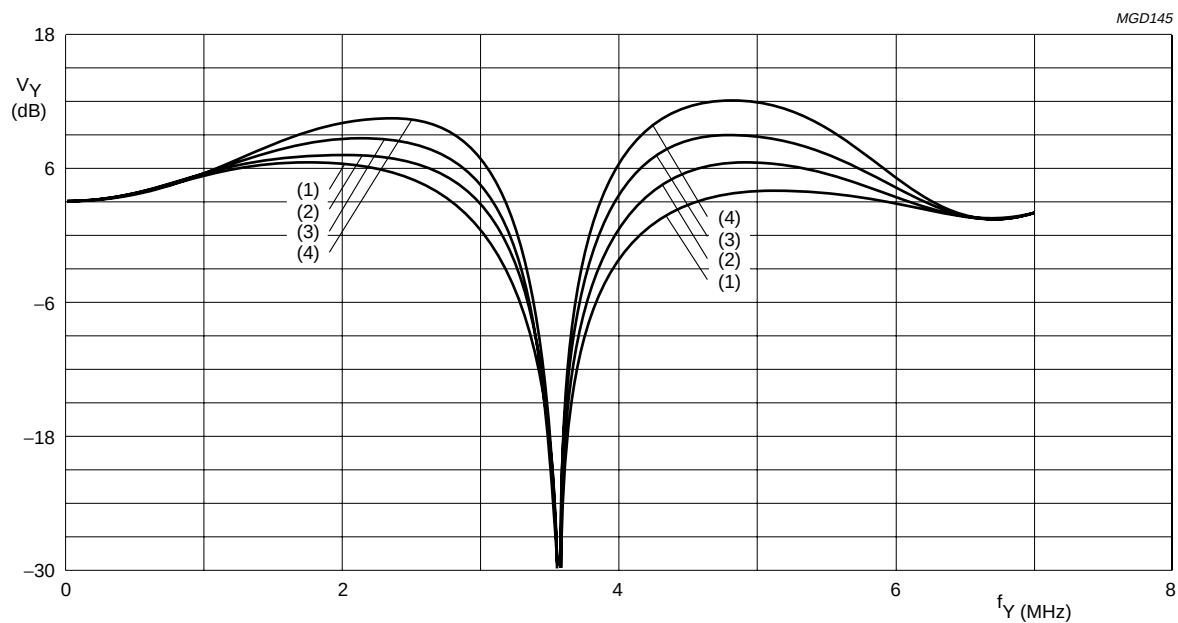


(1) = 43H; (2) = 53H; (3) = 63H; (4) = 73H.

Fig.48 Luminance control SA 09H, 3.58 MHz Trap/CVBS mode, prefilter on, different aperture band-pass centre frequencies.

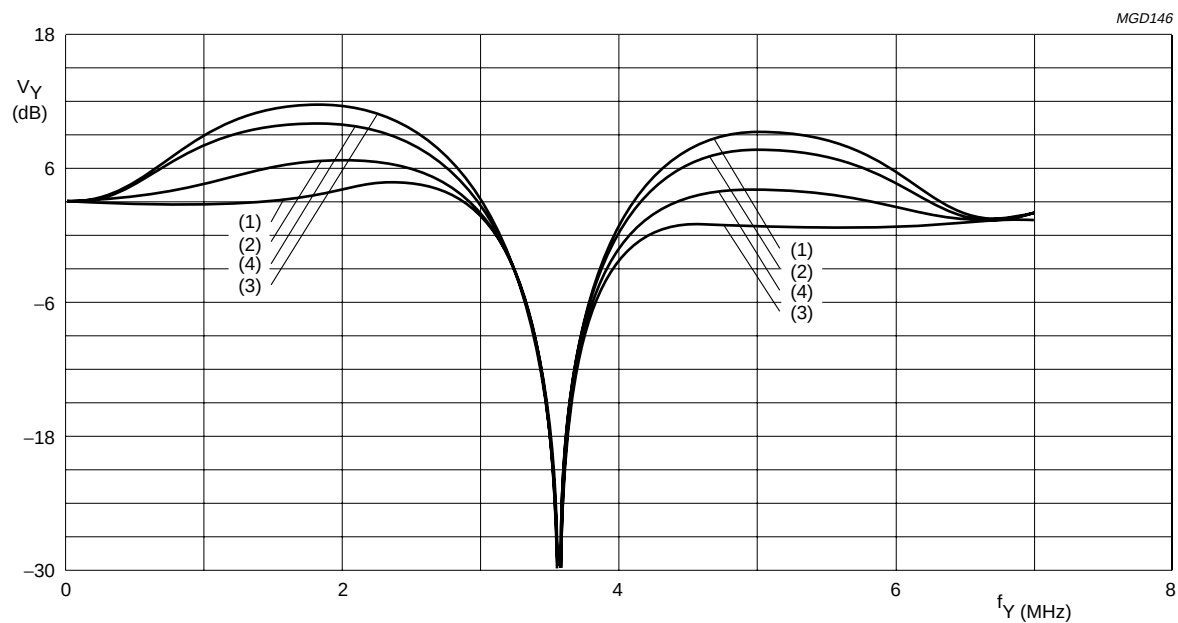
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(1) = 40H; (2) = 41H; (3) = 42H; (4) = 43H.

Fig.49 Luminance control SA 09H, 3.58 MHz Trap/CVBS mode, prefilter on, different aperture factors.



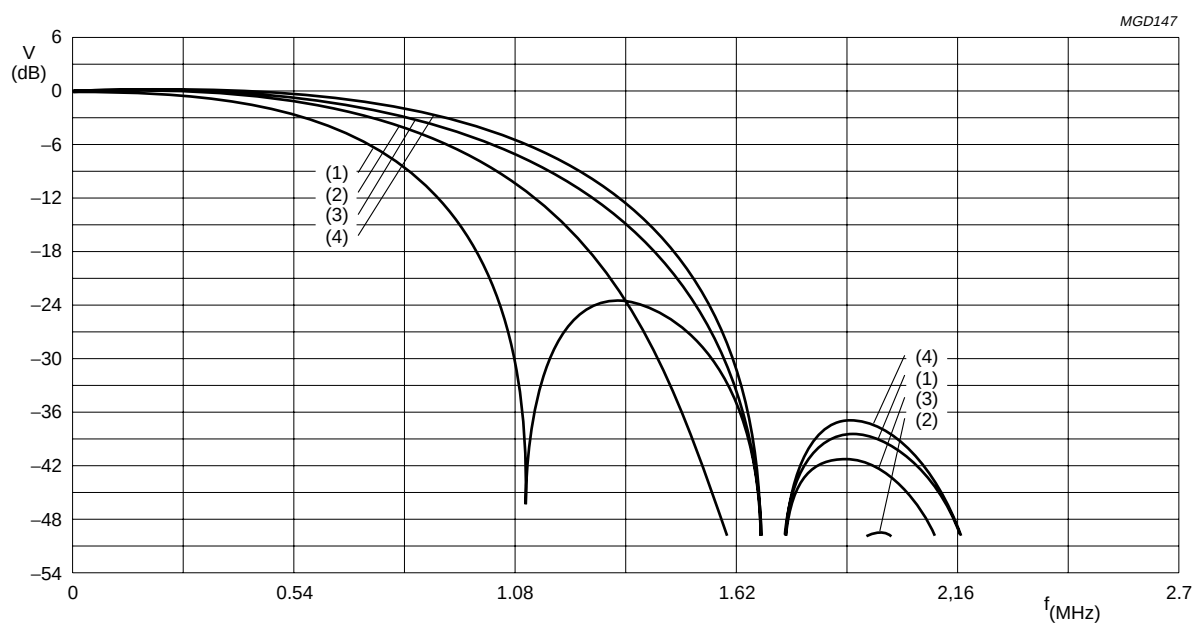
(1) = 03H; (2) = 13H; (3) = 23H; (4) = 33H.

Fig.50 Luminance control SA 09H, 3.58 MHz Trap/CVBS mode, prefilter off, different aperture band-pass centre frequencies.

## Enhanced Video Input Processor (EVIP)

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## 18.4 Chrominance filter curves



- (1) Transfer characteristics of the chrominance low-pass dependent on CHBW[1 : 0] settings. CHBW [1 : 0] = 00; (2) CHBW [1 : 0] = 01; (3) CHBW [1 : 0] = 10; (4) CHBW [1 : 0] = 11.

Fig.51 Chrominance filter.

19 I<sup>2</sup>C-BUS START SET-UP

- The given values force the following behaviour of the SAA7111A:
  - The analog input AI11 expects a signal in CVBS format; analog anti-alias filter active
  - Automatic field detection
  - YUV 4 : 2 : 2 16-bit output format enabled
  - Outputs HS, HREF, VREF and VS active
  - Contrast, brightness and saturation control in accordance with CCIR standards
  - Chrominance processing with nominal bandwidth (800 kHz).

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**Table 41** I<sup>2</sup>C-bus start set-up values

| SUB<br>(HEX) | FUNCTION               | NAME <sup>(1)</sup>                                                | VALUES (BIN)       |   |   |   |   |   |   |   | (HEX) |
|--------------|------------------------|--------------------------------------------------------------------|--------------------|---|---|---|---|---|---|---|-------|
|              |                        |                                                                    | 7                  | 6 | 5 | 4 | 3 | 2 | 1 | 0 | START |
| 00           | chip version           | ID07 to ID00; see Table 9                                          | read only          |   |   |   |   |   |   |   |       |
| 01           | reserved               |                                                                    | 0                  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 00    |
| 02           | analog input control 1 | FUSE1 and FUSE0, GUDL2 to GUDL0, MODE2 to MODE0                    | 1                  | 1 | 0 | 0 | 0 | 0 | 0 | 0 | C0    |
| 03           | analog input control 2 | X, HLNRS, VBSL, WPOFF, HOLDG, GAFIX, GAI28 and GAI18               | 0                  | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 33    |
| 04           | analog input control 3 | GAI17 to GAI10                                                     | 0                  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 00    |
| 05           | analog input control 4 | GAI27 to GAI20                                                     | 0                  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 00    |
| 06           | horizontal sync start  | HSB7 to HSB0                                                       | 1                  | 1 | 1 | 0 | 1 | 0 | 1 | 1 | EB    |
| 07           | horizontal sync stop   | HSS7 to HSS0                                                       | 1                  | 1 | 1 | 0 | 0 | 0 | 0 | 0 | E0    |
| 08           | sync control           | AUFD, FSEL, EXFIL, X, VTRC, HPLL, VNOI1 and VNOI0                  | 1                  | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 88    |
| 09           | luminance control      | BYPS, PREF, BPSS1 and BPSS0, VBLB, UPTCV, APER1 and APER0          | 0                  | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 01    |
| 0A           | luminance brightness   | BRIG7 to BRIG0                                                     | 1                  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 80    |
| 0B           | luminance contrast     | CONT7 to CONT0                                                     | 0                  | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 47    |
| 0C           | chrominance saturation | SATN7 to SATN0                                                     | 0                  | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 40    |
| 0D           | chroma hue control     | HUEC7 to HUEC0                                                     | 0                  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 00    |
| 0E           | chrominance control    | CDTO, CSTD2 to CSTD0, DCCF, FCTC, CHBW1 and CHBW0                  | 0                  | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 01    |
| 0F           | reserved               |                                                                    | 0                  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 00    |
| 10           | format/delay control   | OFTS1 and OFTS0, HDEL1 and HDEL0, VRLN, YDEL2 to YDEL0             | 0                  | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 40    |
| 11           | output control 1       | GPSW, CM99, FECO, COMPO, OEYC, OEHV, VIPB, and COLO                | 0                  | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1C    |
| 12           | output control 2       | RTSE1 and RTSE0, TCLO, CBR, RGB888 DIT, AOSL1 and AOSL0            | 0                  | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 00    |
| 13           | output control 3       | CCTR1 and CCTR0, BCHI1 and BCHI0, BCLO1 and BCLO0, VCTR1 and VCTR0 | 0                  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 00    |
| 14           | reserved               |                                                                    | 0                  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 00    |
| 15           | VBI-data stream start  | VSTA7 to VSTA0                                                     | 0                  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 00    |
| 16           | VBI-data stream stop   | VSTO7 to VSTO0                                                     | 0                  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 00    |
| 17           | MSBs for VBI control   | X, X, X, X, X, X, VSTO8, and VSTA8                                 | 0                  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 00    |
| 18-19        | reserved               |                                                                    | 0                  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 00    |
| 1A           | text slicer status     | 0, 0, 0, 0, F2VAL, F2RDY, F1VAL, and F1RDY                         | read only register |   |   |   |   |   |   |   |       |
| 1B           | decoded bytes of the   | P1, BYTE1 (6 to 0)                                                 |                    |   |   |   |   |   |   |   |       |
| 1C           | text slicer            | P2, BYTE2 (6 to 0)                                                 |                    |   |   |   |   |   |   |   |       |
| 1D-1E        | reserved               |                                                                    | 0                  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 00    |
| 1F           | status byte            | STTC, HLCK, FIDT, GLIMT, GLIMB, WIPA, SLTCA and CODE               | read only register |   |   |   |   |   |   |   |       |

**Note**

1. All X values must be set to LOW.



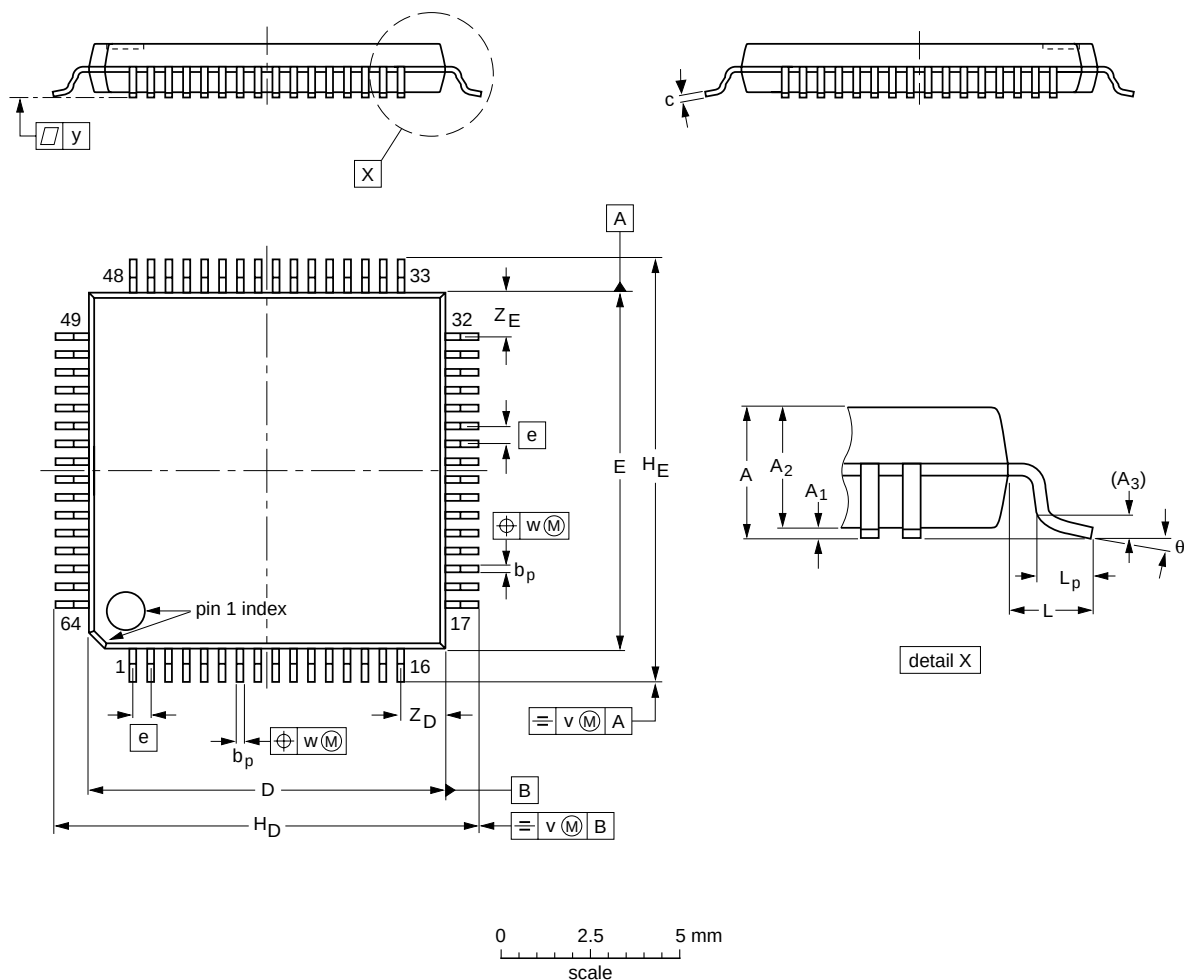
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20 PACKAGE OUTLINES

LQFP64: plastic low profile quad flat package; 64 leads; body 10 x 10 x 1.4 mm

SOT314-2

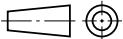


DIMENSIONS (mm are the original dimensions)

| UNIT | A<br>max. | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | b <sub>p</sub> | c            | D <sup>(1)</sup> | E <sup>(1)</sup> | e   | H <sub>D</sub> | H <sub>E</sub> | L   | L <sub>p</sub> | v   | w    | y   | Z <sub>D</sub> <sup>(1)</sup> | Z <sub>E</sub> <sup>(1)</sup> | θ        |
|------|-----------|----------------|----------------|----------------|----------------|--------------|------------------|------------------|-----|----------------|----------------|-----|----------------|-----|------|-----|-------------------------------|-------------------------------|----------|
| mm   | 1.60      | 0.20<br>0.05   | 1.45<br>1.35   | 0.25           | 0.27<br>0.17   | 0.18<br>0.12 | 10.1<br>9.9      | 10.1<br>9.9      | 0.5 | 12.15<br>11.85 | 12.15<br>11.85 | 1.0 | 0.75<br>0.45   | 0.2 | 0.12 | 0.1 | 1.45<br>1.05                  | 1.45<br>1.05                  | 7°<br>0° |

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

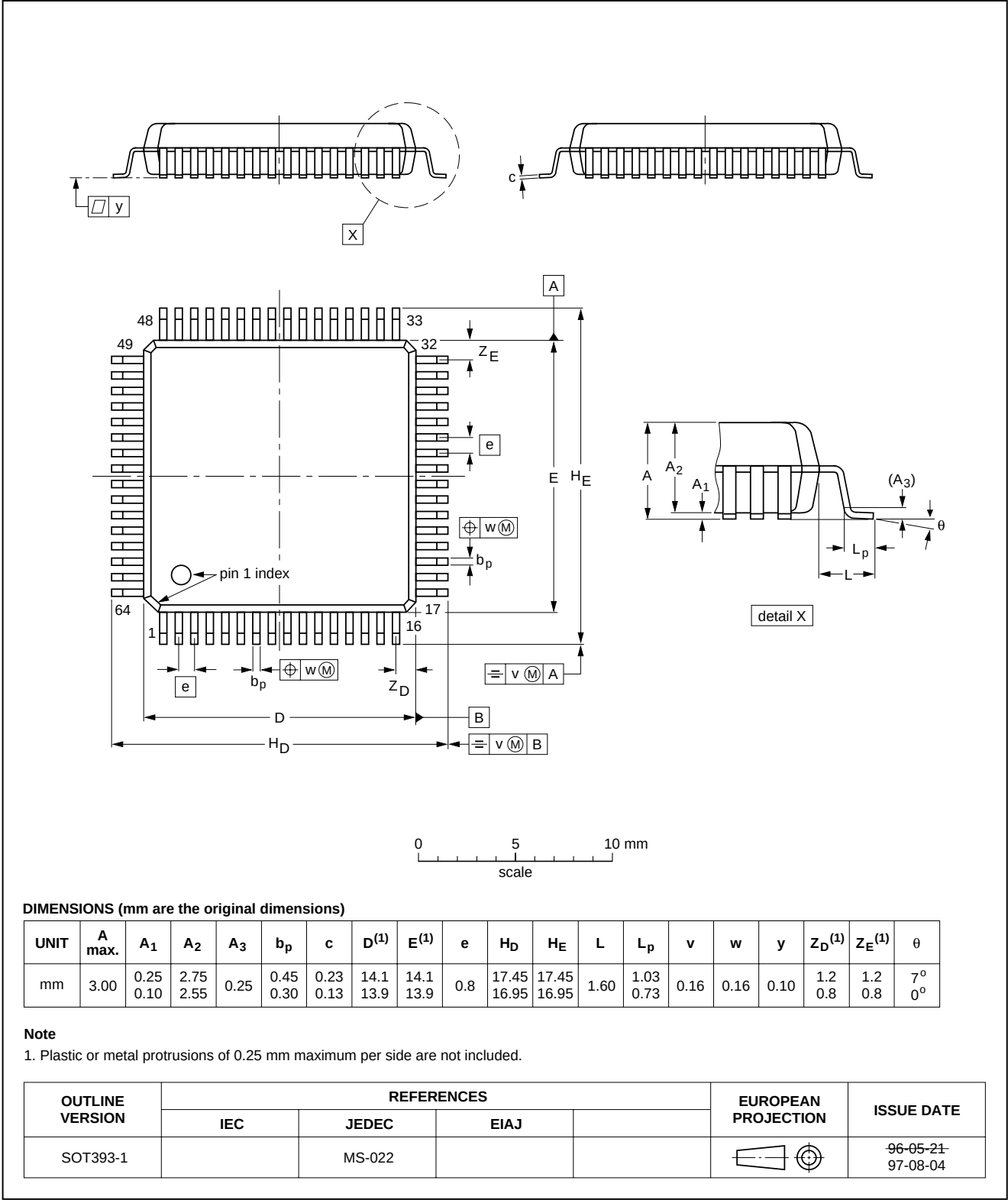
| OUTLINE<br>VERSION | REFERENCES |       |      |  | EUROPEAN<br>PROJECTION                                                                | ISSUE DATE           |
|--------------------|------------|-------|------|--|---------------------------------------------------------------------------------------|----------------------|
|                    | IEC        | JEDEC | EIAJ |  |                                                                                       |                      |
| SOT314-2           |            |       |      |  |  | 95-12-19<br>97-08-01 |

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QFP64: plastic quad flat package; 64 leads (lead length 1.6 mm); body 14 x 14 x 2.7 mm

SOT393-1



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21 SOLDERING

21.1 Introduction

There is no soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and surface mounted components are mixed on one printed-circuit board. However, wave soldering is not always suitable for surface mounted ICs, or for printed-circuits with high population densities. In these situations reflow soldering is often used.

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our “IC Package Databook” (order code 9398 652 90011).

21.2 Reflow soldering

Reflow soldering techniques are suitable for all LQFP and QFP packages.

The choice of heating method may be influenced by larger plastic QFP packages (44 leads, or more). If infrared or vapour phase heating is used and the large packages are not absolutely dry (less than 0.1% moisture content by weight), vaporization of the small amount of moisture in them can cause cracking of the plastic body. For more information, refer to the Drypack chapter in our “Quality Reference Handbook” (order code 9397 750 00192).

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement.

Several methods exist for reflowing; for example, infrared/convection heating in a conveyor type oven. Throughput times (preheating, soldering and cooling) vary between 50 and 300 seconds depending on heating method. Typical reflow peak temperatures range from 215 to 250 °C.

21.3 Wave soldering

Wave soldering is **not** recommended for LQFP and QFP packages. This is because of the likelihood of solder bridging due to closely-spaced leads and the possibility of incomplete solder penetration in multi-lead devices.

|                                                                                                            |
|------------------------------------------------------------------------------------------------------------|
| CAUTION                                                                                                    |
| Wave soldering is NOT applicable for all LQFP and QFP packages with a pitch (e) equal or less than 0.5 mm. |

If wave soldering cannot be avoided, for LQFP and QFP packages with a pitch (e) larger than 0.5 mm, the following conditions must be observed:

- A double-wave (a turbulent wave with high upward pressure followed by a smooth laminar wave) soldering technique should be used.
- The footprint must be at an angle of 45° to the board direction and must incorporate solder thieves downstream and at the side corners.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

Maximum permissible solder temperature is 260 °C, and maximum duration of package immersion in solder is 10 seconds, if cooled to less than 150 °C within 6 seconds. Typical dwell time is 4 seconds at 250 °C.

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

21.4 Repairing soldered joints

Fix the component by first soldering two diagonally-opposite end leads. Use only a low voltage soldering iron (less than 24 V) applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C. When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.

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**22 DEFINITIONS**

| <b>Data sheet status</b>                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Objective specification                                                                                                                                                                                                                                                                                                                                                                                                                                   | This data sheet contains target or goal specifications for product development.       |
| Preliminary specification                                                                                                                                                                                                                                                                                                                                                                                                                                 | This data sheet contains preliminary data; supplementary data may be published later. |
| Product specification                                                                                                                                                                                                                                                                                                                                                                                                                                     | This data sheet contains final product specifications.                                |
| <b>Limiting values</b>                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                       |
| Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability. |                                                                                       |
| <b>Application information</b>                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                       |
| Where application information is given, it is advisory and does not form part of the specification.                                                                                                                                                                                                                                                                                                                                                       |                                                                                       |

**23 LIFE SUPPORT APPLICATIONS**

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.

**24 PURCHASE OF PHILIPS I<sup>2</sup>C COMPONENTS**

Purchase of Philips I<sup>2</sup>C components conveys a license under the Philips' I<sup>2</sup>C patent to use the components in the I<sup>2</sup>C system provided the system conforms to the I<sup>2</sup>C specification defined by Philips. This specification can be ordered using the code 9398 393 40011.

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## Enhanced Video Input Processor (EVIP)

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### NOTES

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### NOTES

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