

DATA SHEET

SAA7167 YUV-to-RGB Digital-to-Analog Converter (DAC)

Preliminary specification
Supersedes data of 1995 Jun 13
File under Integrated Circuits, IC22

1995 Nov 03

YUV-to-RGB Digital-to-Analog Converter (DAC)

SAA7167

FEATURES

- On-chip mixing of digital video data and analog RGB signals
- Supports video input format of YUV 4 : 2 : 2, 4 : 1 : 1, 2 : 1 : 1 and RGB 5 : 6 : 5
- Video input rate up to 50 MHz
- Allows for both binary and two's complement video input data
- Triple 8-bit DACs for video output
- Built-in voltage output amplifier
- Provide keying control with external key and internal 8-bit, 2 × 8-bit and 3 × 8-bit pixel colour key
- Programmable via the I²C-bus
- 5 V CMOS device; LQFP48 package.



voltage output amplifier, capable of converting digital video data to analog RGB video, and then mixing video and external analog RGB inputs.

The video data path contains a data re-formatter, YUV-to-RGB colour space matrix as well as triple DACs for video data processing. An analog mixer performs multiplexing between DAC outputs of the video path and external analog RGB inputs.

The final analog outputs are buffered with built-in voltage output amplifiers to provide the direct driving capability for a 150 Ω load. Figure 1 shows the overall block diagram.

The operation of SAA7167 is controlled via the I²C-bus.

GENERAL DESCRIPTION

The SAA7167 is a mixed-mode designed IC containing a video data path, keying control block, analog mixer, and a

QUICK REFERENCE DATA

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
V _{DDD}	digital supply voltage	4.75	5.25	V
V _{DDA}	analog supply voltage	4.75	5.25	V
T _{amb}	operating ambient temperature	0	70	°C

ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
SAA7167	LQFP48	plastic low profile quad flat package; 48 leads; body 7 × 7 × 1.4 mm	SOT313-2

YUV-to-RGB Digital-to-Analog Converter (DAC)

SAA7167

BLOCK DIAGRAM

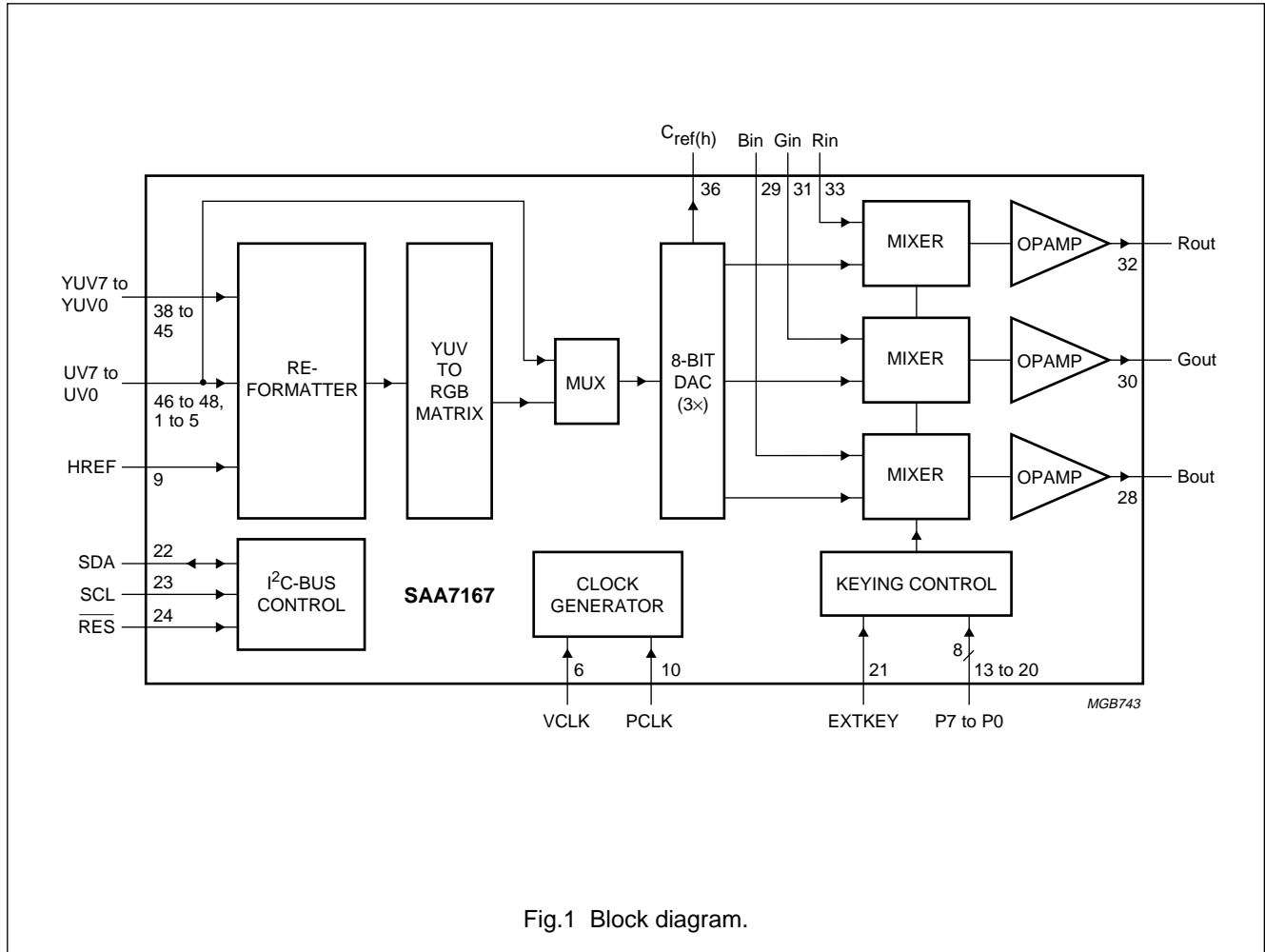


Fig.1 Block diagram.

YUV-to-RGB Digital-to-Analog Converter (DAC)

SAA7167

PINNING

SYMBOL	PIN	DESCRIPTION	I/O
UV4	1	digital video UV (of YUV format 4 : 1 : 1 and 4 : 2 : 2) input data, or digital G and R input data	I
UV3	2	digital video UV (of YUV format 4 : 1 : 1 and 4 : 2 : 2) input data, or digital G and R input data	I
UV2	3	digital video UV (of YUV format 4 : 1 : 1 and 4 : 2 : 2) input data, or digital G and R input data	I
UV1	4	digital video UV (of YUV format 4 : 1 : 1 and 4 : 2 : 2) input data, or digital G and R input data	I
UV0	5	digital video UV (of YUV format 4 : 1 : 1 and 4 : 2 : 2) input data, or digital G and R input data	I
VCLK	6	video clock input	I
V _{DD}	7	digital supply voltage	I/O
V _{SS}	8	digital ground	I/O
HREF	9	horizontal reference input signal	I
PCLK	10	pixel clock input	I
AP	11	test pins, normally connected to ground	I
SP	12	test pins, normally connected to ground	I
P7	13	pixel bus input 7 (for keying control)	I
P6	14	pixel bus input 6 (for keying control)	I
P5	15	pixel bus input 5 (for keying control)	I
P4	16	pixel bus input 4 (for keying control)	I
P3	17	pixel bus input 3 (for keying control)	I
P2	18	pixel bus input 2 (for keying control)	I
P1	19	pixel bus input 1 (for keying control)	I
P0	20	pixel bus input 0 (for keying control)	I
EXTKEY	21	external key signal input	I
SDA	22	I ² C-bus data line	I/O
SCL	23	I ² C-bus clock line	I
RES	24	set to LOW to reset the I ² C-bus	I
n.c.	25	not connected	–
V _{SSA2}	26	analog ground 2	I/O
V _{DDA2}	27	analog supply voltage 2	I/O
Bout	28	analog Blue signal output	O
Bin	29	analog Blue signal input	I
Gout	30	analog Green signal output	O
Gin	31	analog Green signal input	I
Rout	32	analog Red signal output	O
Rin	33	analog Red signal input	I
V _{SSA1}	34	analog ground 1	I/O
V _{DDA1}	35	analog supply voltage 1	I/O
C _{ref(h)}	36	capacitor for reference high voltage output (2.25 V)	I/O

YUV-to-RGB Digital-to-Analog Converter (DAC)

SAA7167

SYMBOL	PIN	DESCRIPTION	I/O
n.c.	37	not connected	-
YUV7	38	digital video Y or UV (of YUV format 2 : 1 : 1) input data, or digital G and B input data	I
YUV6	39	digital video Y or UV (of YUV format 2 : 1 : 1) input data, or digital G and B input data	I
YUV5	40	digital video Y or UV (of YUV format 2 : 1 : 1) input data, or digital G and B input data	I
YUV4	41	digital video Y or UV (of YUV format 2 : 1 : 1) input data, or digital G and B input data	I
YUV3	42	digital video Y or UV (of YUV format 2 : 1 : 1) input data, or digital G and B input data	I
YUV2	43	digital video Y or UV (of YUV format 2 : 1 : 1) input data, or digital G and B input data	I
YUV1	44	digital video Y or UV (of YUV format 2 : 1 : 1) input data, or digital G and B input data	I
YUV0	45	digital video Y or UV (of YUV format 2 : 1 : 1) input data, or digital G and B input data	I
UV7	46	digital video UV (of YUV format 4 : 1 : 1 and 4 : 2 : 2) input data, or digital G and R input data	I
UV6	47	digital video UV (of YUV format 4 : 1 : 1 and 4 : 2 : 2) input data, or digital G and R input data	I
UV5	48	digital video UV (of YUV format 4 : 1 : 1 and 4 : 2 : 2) input data, or digital G and R input data	I

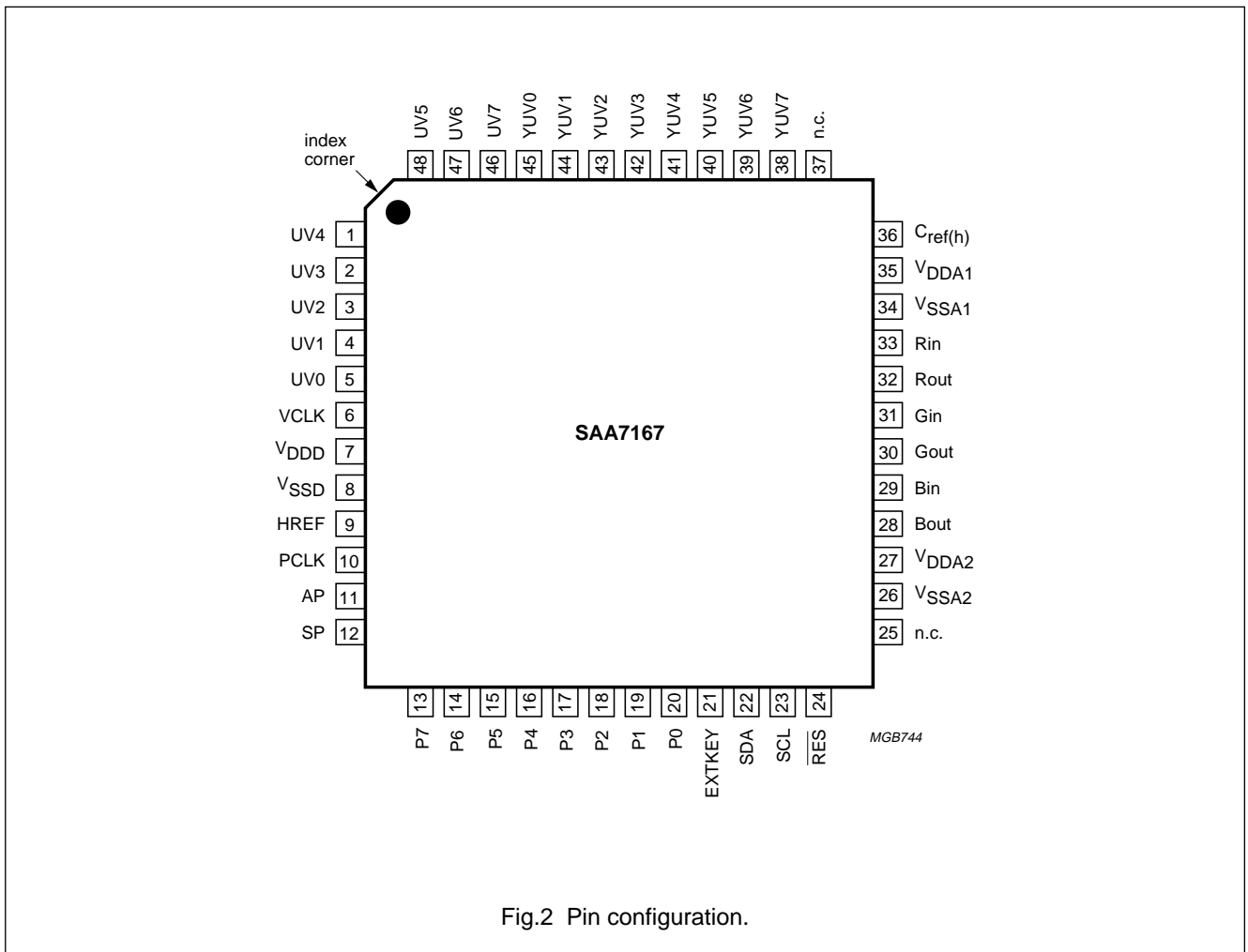


Fig.2 Pin configuration.

YUV-to-RGB Digital-to-Analog Converter (DAC)

SAA7167

FUNCTIONAL DESCRIPTION

The SAA7167 contains a video data path, 3 analog mixers and voltage output amplifiers for the RGB channels respectively, a keying control block as well as an I²C-bus control block.

Video data path

The video data path includes a video data re-formatter, a YUV-to-RGB colour space conversion matrix, and triple 8-bit DACs.

RE-FORMATTER

The re-formatter de-multiplexes the different video formats YUV 4 : 1 : 1, 4 : 2 : 2 or 2 : 1 : 1 to internal YUV 4 : 4 : 4, which can then be processed by the RGB matrix. The pixel byte sequences of those video input formats are shown in Tables 1 to 4.

Table 1 Pixel byte sequence of 4 : 2 : 2

INPUT	PIXEL BYTE SEQUENCE OF 4 : 2 : 2					
	YUV0 (LSB)	Y0	Y0	Y0	Y0	Y0
YUV1	Y1	Y1	Y1	Y1	Y1	Y1
YUV2	Y2	Y2	Y2	Y2	Y2	Y2
YUV3	Y3	Y3	Y3	Y3	Y3	Y3
YUV4	Y4	Y4	Y4	Y4	Y4	Y4
YUV5	Y5	Y5	Y5	Y5	Y5	Y5
YUV6	Y6	Y6	Y6	Y6	Y6	Y6
YUV7 (MSB)	Y7	Y7	Y7	Y7	Y7	Y7
UV0 (LSB)	U0	V0	U0	V0	U0	V0
UV1	U1	V1	U1	V1	U1	V1
UV2	U2	V2	U2	V2	U2	V2
UV3	U3	V3	U3	V3	U3	V3
UV4	U4	V4	U4	V4	U4	V4
UV5	U5	V5	U5	V5	U5	V5
UV6	U6	V6	U6	V6	U6	V6
UV7 (MSB)	U7	V7	U7	V7	U7	V7
Y data	0	1	2	3	4	5
UV data	0		2		4	

Table 2 Pixel byte sequence of 4 : 1 : 1

INPUT	PIXEL BYTE SEQUENCE OF 4 : 1 : 1							
	YUV0	Y0	Y0	Y0	Y0	Y0	Y0	Y0
YUV1	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
YUV2	Y2	Y2	Y2	Y2	Y2	Y2	Y2	Y2
YUV3	Y3	Y3	Y3	Y3	Y3	Y3	Y3	Y3
YUV4	Y4	Y4	Y4	Y4	Y4	Y4	Y4	Y4
YUV5	Y5	Y5	Y5	Y5	Y5	Y5	Y5	Y5
YUV6	Y6	Y6	Y6	Y6	Y6	Y6	Y6	Y6
YUV7	Y7	Y7	Y7	Y7	Y7	Y7	Y7	Y7
UV0	X	X	X	X	X	X	X	X
UV1	X	X	X	X	X	X	X	X
UV2	X	X	X	X	X	X	X	X
UV3	X	X	X	X	X	X	X	X
UV4	V6	V4	V2	V0	V6	V4	V2	V0
UV5	V7	V5	V3	V1	V7	V5	V3	V1
UV6	U6	U4	U2	U0	U6	U4	U2	U0
UV7	U7	U5	U3	U1	U7	U5	U3	U1
Y data	0	1	2	3	4	5	6	7
UV data	0				4			

Table 3 Pixel byte sequence of 2 : 1 : 1

INPUT	PIXEL BYTE SEQUENCE OF 2 : 1 : 1							
	YUV0	U0	Y0	V0	Y0	U0	Y0	V0
YUV1	U1	Y1	V1	Y1	U1	Y1	V1	Y1
YUV2	U2	Y2	V2	Y2	U2	Y2	V2	Y2
YUV3	U3	Y3	V3	Y3	U3	Y3	V3	Y3
YUV4	U4	Y4	V4	Y4	U4	Y4	V4	Y4
YUV5	U5	Y5	V5	Y5	U5	Y5	V5	Y5
YUV6	U6	Y6	V6	Y6	U6	Y6	V6	Y6
YUV7	U7	Y7	V7	Y7	U7	Y7	V7	Y7
Y data	X	0	X	2	X	4	X	6
UV data	0	X	0	X	4	X	4	X

YUV-to-RGB Digital-to-Analog Converter (DAC)

SAA7167

Table 4 Pixel byte sequence of 5 : 6 : 5

INPUT	PIXEL BYTE SEQUENCE OF RGB			
	5 : 6 : 5			
UV7	G0	G0	G0	G0
UV6	R4	R4	R4	R4
UV5	R3	R3	R3	R3
UV4	R2	R2	R2	R2
UV3	R1	R1	R1	R1
UV2	R0	R0	R0	R0
UV1	G5	G5	G5	G5
UV0	G4	G4	G4	G4
YUV7	G3	G3	G3	G3
YUV6	G2	G2	G2	G2
YUV5	G1	G1	G1	G1
YUV4	B4	B4	B4	B4
YUV3	B3	B3	B3	B3
YUV2	B2	B2	B2	B2
YUV1	B1	B1	B1	B1
YUV0	B0	B0	B0	B0
RGB data	0	1	2	3

For RGB 5 : 6 : 5 video inputs, the video data are just directly bypassed to triple DACs.

The input video data can be selected to either two's complement (I²C-bus DRP-bit = 0) or binary offset (DRP-bit = 1). The video input format is selected by I²C-bus bits FMTC1 and FMTC0.

The rising edge of HREF input defines the start of active video data. When HREF is inactive, the video output will be blanked.

YUV-TO-RGB MATRIX

The matrix converts YUV data, in accordance with CCIR-601, to RGB data with approximately 1.5 LSB deviation to the theoretical values for 8-bit resolution.

TRIPLE 8-BIT DACS

Three identical DACs for R, G and B video outputs are designed with voltage-drive architecture to provide high-speed operation of up to 50 MHz conversion data rate. A C_{ref(h)} pin is provided to allow for one external de-coupling capacitor to be connected between the internal reference voltage source and ground.

Analog mixers and keying control

The analog mixers are controlled to switch between the outputs from the video DACs and analog RGB inputs by a keying signal. The analog RGB inputs need to interface with analog mixers in the way of DC-coupling, also these RGB inputs are limited to RGB signals without a sync level pedestal. The keying control can be enabled by setting I²C bit KEN = 1. Two kinds of keying are possible to generate: one is external key (from EXTKEY pin when KMOD2 to KMOD0 are logic 0), and the other is the internal pixel colour key (when KMOD2 to KMOD0 are not logic 0) generated by comparing the input pixel data with the internal I²C-bus register value KD7 to KD0. Controlled by KMOD2 to KMOD0 bits, there are 4 ways to compare the pixel data (see Table 5).

Table 5 KMOD2 to KMOD0

KMOD2 to KMOD0	PIXEL TYPE	REMARK
100	8-bit pixel	pseudo colour mode
101	2 × 8-bit pixel	high colour mode 1 with pixels given at both rising and falling edges of PCLK
110	2 × 8-bit pixel	high colour mode 2 with pixels given only at rising edges of PCLK
111	3 × 8-bit pixel	true colour mode

Since only one control register KD7 to KD0 provides the data value for pixel data comparison, when at 2 × 8-bit or 3 × 8-bit pixel input modes, it is presumed that all input bytes (lower, middle, or higher) of each pixel must be same as KD7 to KD0 in order to make graphics colour key active.

The polarity of EXTKEY can be selected with KINV. With KINV = 0, EXTKEY = HIGH switches analog mixers to select DAC outputs. Before the internal keying signal switches the analog multiplexers, it can be further delayed up to 7 PCLK cycles with the control bits KDLY2 to KDLY0.

YUV-to-RGB Digital-to-Analog Converter (DAC)

SAA7167

Voltage output amplifiers

Before the analog input enters the analog mixers, it passes through voltage output amplifiers. Level shifters are used internally to provide an offset of 0.2 V and an amplifier gain of 2 for analog inputs to match with the output levels from DACs. After buffering with voltage output amplifiers, the final RGB outputs can drive a 150 Ω load directly (25 Ω internal resistor, 50 Ω external serial resistor, and 75 Ω load resistor at monitor side (see Fig.9).

The output voltage level of DAC ranges from the lowest level 0.2 V (zero code) to the highest level 1.82 V (all one code).

With the digital input YUV video data in accordance with CCIR-601, the RGB output of 8-bit DAC actually ranges from the 16th step (black) to the 235th step (white). Therefore, after the voltage divider with external serial resistor and monitor load resistor, the output voltage range to monitor is approximately 0.7 V (peak-to-peak).

I²C-bus control

Only one control byte is needed for the SAA7167. The I²C-bus format is shown in Table 6.

Table 6 I²C-bus format

S	slave address	A	subaddress	A	data	A	P
---	---------------	---	------------	---	------	---	---

Notes

1. S = START condition.
2. Slave address = 1011 111X; this slave address is identical to the one for the SAA9065; X = $\overline{R/W}$ control bit:
 - a) X = 0; order to write.
 - b) X = 1; order to read (not used for SAA7167).
3. A = acknowledge; generated by the slave.
4. Subaddress = subaddress byte.
5. Data = data byte.
6. P = STOP condition.

Table 7 Control data byte

SUBADDRESS	D7	D6	D5	D4	D3	D2	D1	D0
00	KMOD2	KMOD1	KMOD0	DRP	KEN	KINV	FMTC1	FMTC0
01	0	0	0	0	0	KDLY2	KDLY1	KDLY0
02	KD7	KD6	KD5	KD4	KD3	KD2	KD1	KD0

YUV-to-RGB Digital-to-Analog Converter (DAC)

SAA7167

Table 8 Bit functions in data byte; notes 1 and 2

BIT	DESCRIPTION
FMTC1 and FMTC0	video format control: 00; YUV 4 : 2 : 2 01; YUV 4 : 1 : 1 10; YUV 2:1:1/CCIR 656 11; RGB 5 : 6 : 5
KINV	key polarity: KINV = 0: EXTKEY = HIGH for analog mixer to select DAC outputs KINV = 1: EXTKEY = HIGH for analog mixer to select analog RGB inputs
KEN	key enable: 0 = disable 1 = enable
DRP	UV input data code: 0 = two's complement; 1 = binary offset
KMOD2 to KMOD0	keying mode: 000; external key 100; 8-bit pixel colour key 101; 2 × 8-bit pixel colour key (with two-edge clock latching for pixel input) 110; 2 × 8-bit pixel colour key (with one-edge clock latching for pixel input) 111; 3 × 8-bit pixel colour key (with one-edge clock latching for pixel input) all other combinations are reserved
KDLY2 to KDLY0	added keying delay cycles (from 0 to 7 PCLK)
KD7 to KD0	the data value compared for 8, 16 or 24-bit pixel colour key

Notes

- All I²C-bus control bits are initialized to logic 0 after $\overline{\text{RES}}$ is activated.
- PCLK should be active in any event to allow for correct operation of I²C-bus programming.

DC CHARACTERISTICST_{amb} = 0 to 70 °C.

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
V _{DDD}	digital supply voltage	4.75	5.0	5.25	V
V _{DDA}	analog supply voltage	4.75	5.0	5.25	V
I _{DDtot}	total supply current (f _{clk} = 50 MHz)	–	100	–	mA
V _{IH}	HIGH level input voltage (pin SDA)	3	–	V _{DDD} + 0.5	V
V _{IL}	LOW level input voltage (pin SDA)	–0.5	–	+1.5	V
V _{IH}	HIGH level digital input voltage	2	–	–	V
V _{IL}	LOW level digital input voltage	–	–	0.8	V
V _{in}	full-scale analog RGB inputs	–	0.7	–	V
V _{out}	full scale analog RGB outputs (for 150 Ω load)	–	1.4	–	V
DNL	differential non-linearity error of video output	–	–	1	LSB
INL	integral non-linearity error of video output	–	–	1	LSB

YUV-to-RGB Digital-to-Analog Converter (DAC)

SAA7167

AC CHARACTERISTICS

 $T_{amb} = 0 \text{ to } 70 \text{ }^{\circ}\text{C}$.

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
f_{clk}	video clock rate	–	–	50	MHz
δ	duty factor of VCLK	–	50	–	%
PCLK	pixel clock rate (8-bit pixel colour key); see Fig.4	–	–	50	MHz
	pixel clock rate (2×8 -bit pixel colour key; mode 1); see Fig.5	–	–	40	MHz
	pixel clock rate (2×8 -bit pixel colour key; mode 2); see Fig.6	–	–	80	MHz
	pixel clock rate (3×8 -bit pixel colour key); see Fig.7	–	–	75	MHz
	duty factor of PCLK	40	50	60	%
t_{su1}	digital input set-up time to VCLK rising edge	3	–	–	ns
t_{h1}	digital input hold time to VCLK rising edge	3	–	–	ns
t_{su2}	digital input set-up time to PCLK rising edge	3	–	–	ns
t_{h2}	digital input hold time to PCLK rising edge	3	–	–	ns
t_{su3}	digital input set-up time to PCLK falling edge	3	–	–	ns
t_{h3}	digital input hold time to PCLK falling edge	3	–	–	ns
t_{sw}	switching time between video DAC/analog inputs; note 1	–	–	15	ns
T_{group}	overall group delay from digital video inputs to analog outputs (see Fig.8): YUV video input mode	–	$20T_{VCLK} + t_{PD}$	–	ns
	RGB video input mode	–	$12T_{VCLK} + t_{PD}$	–	ns
t_r	DAC analog output rise time (see Fig.8); note 2	–	5	–	ns
t_f	DAC analog output fall time (see Fig.8); note 2	–	5	–	ns
t_s	DAC analog output settling time (see Fig.8); note 3	–	–	15	ns
t_{PD}	DAC analog output propagation delay (see Fig.8); note 4	–	15	–	ns
Analog outputs from analog inputs					
G_v	voltage gain	–	2.0	–	
B	bandwidth (–3 dB)	–	75	–	MHz
SR	slew rate	–	90	–	V/ μ s

Notes

1. Switching time measured from the 50% point of the EXTKEY transition edge to the 50% point of the selected analog output transition.
2. DAC output rise/fall time measured between the 10% and 90% points of full scale transition.
3. DAC settling time measured from the 50% point of full-scale transition to the output remaining within ± 1 LSB.
4. DAC analog output propagation delay measured from the 50% point of the rising edge of VCLK to the 50% point of full-scale transition.

YUV-to-RGB Digital-to-Analog Converter (DAC)

SAA7167

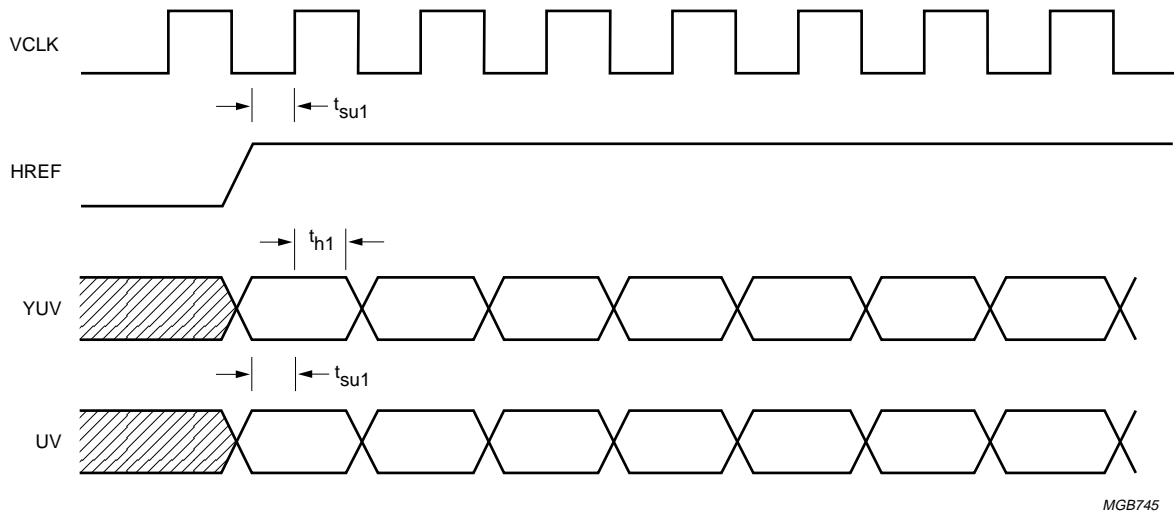


Fig.3 Video data input timing.

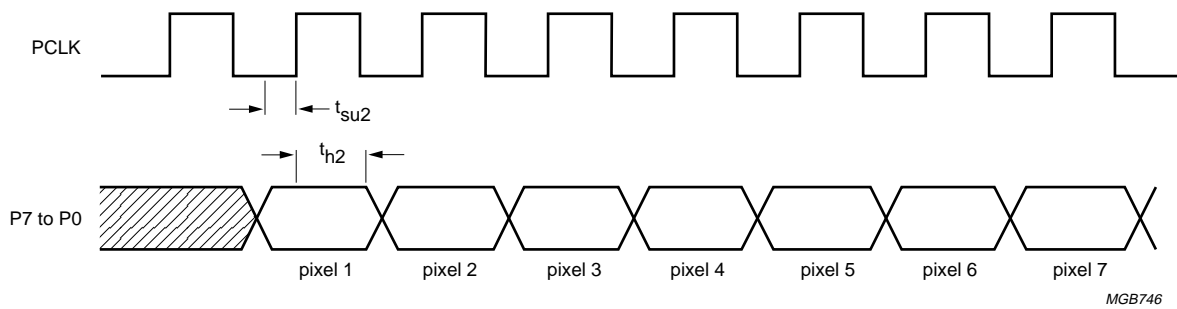


Fig.4 Pixel data timing; 8-bit pixel colour key.

YUV-to-RGB Digital-to-Analog Converter (DAC)

SAA7167

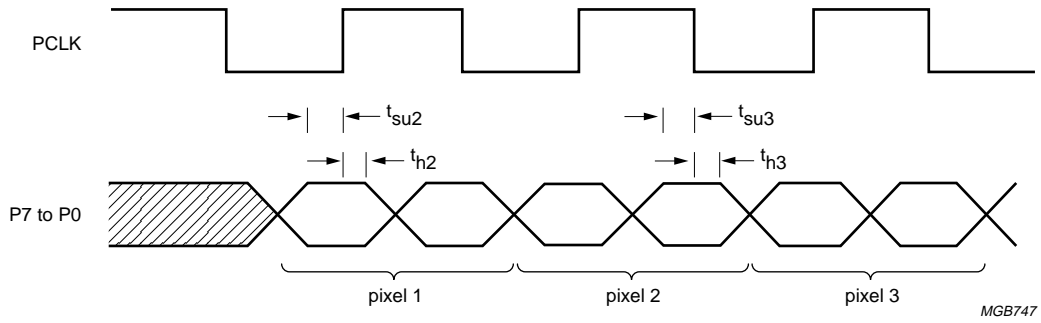


Fig.5 Pixel data input timing; 2 × 8-bit pixel colour key; mode 1.

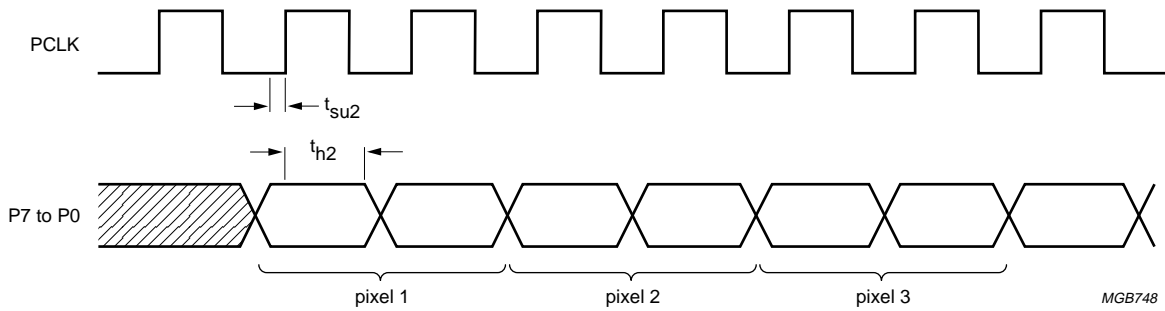


Fig.6 Pixel data input timing; 2 × 8-bit pixel colour key; mode 2.

YUV-to-RGB Digital-to-Analog Converter (DAC)

SAA7167

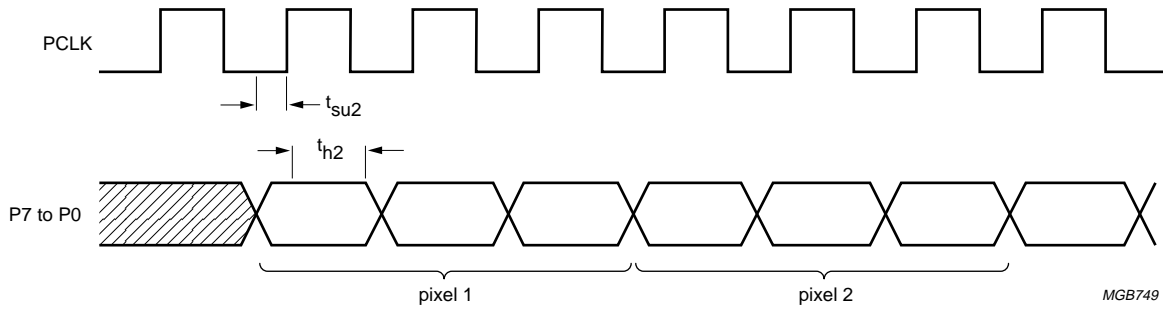


Fig.7 Pixel data input timing; 3 × 8-bit pixel colour key.

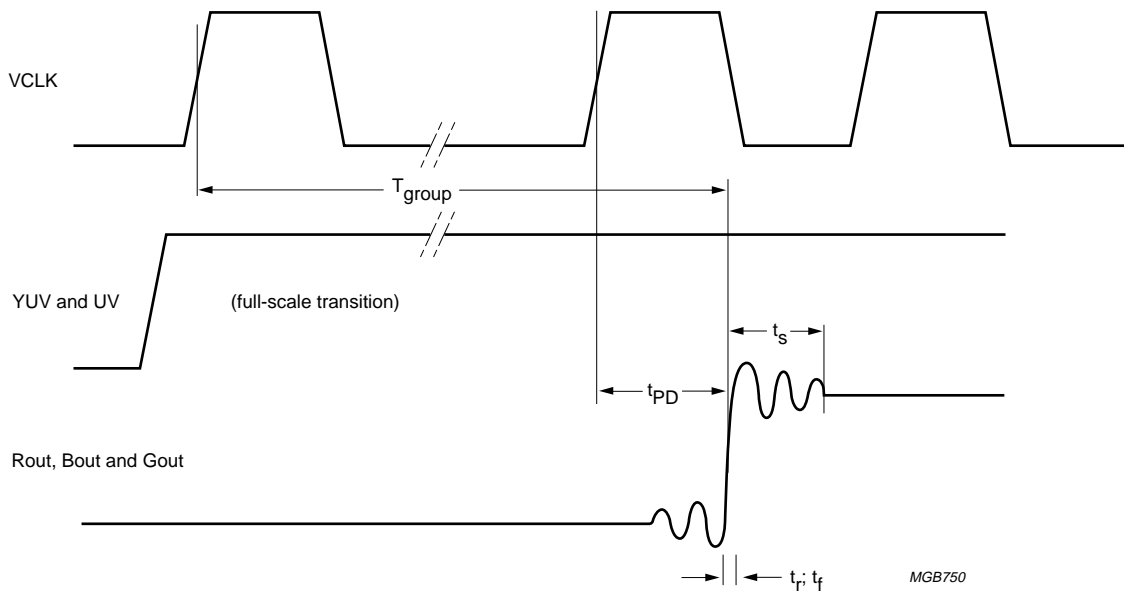


Fig.8 DAC output timing.

YUV-to-RGB Digital-to-Analog Converter (DAC)

SAA7167

APPLICATION INFORMATION

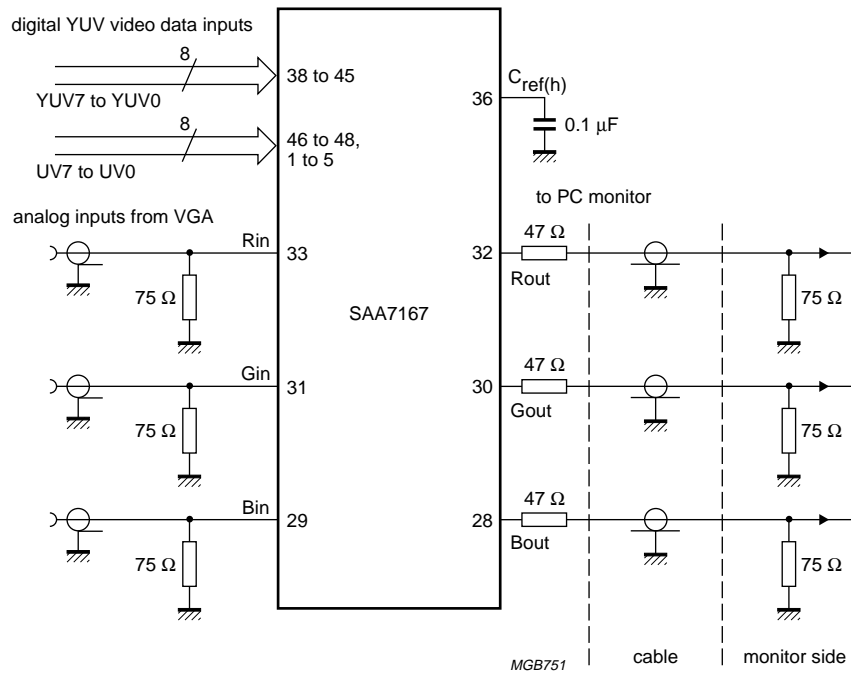


Fig.9 Typical application diagram for analog circuits.

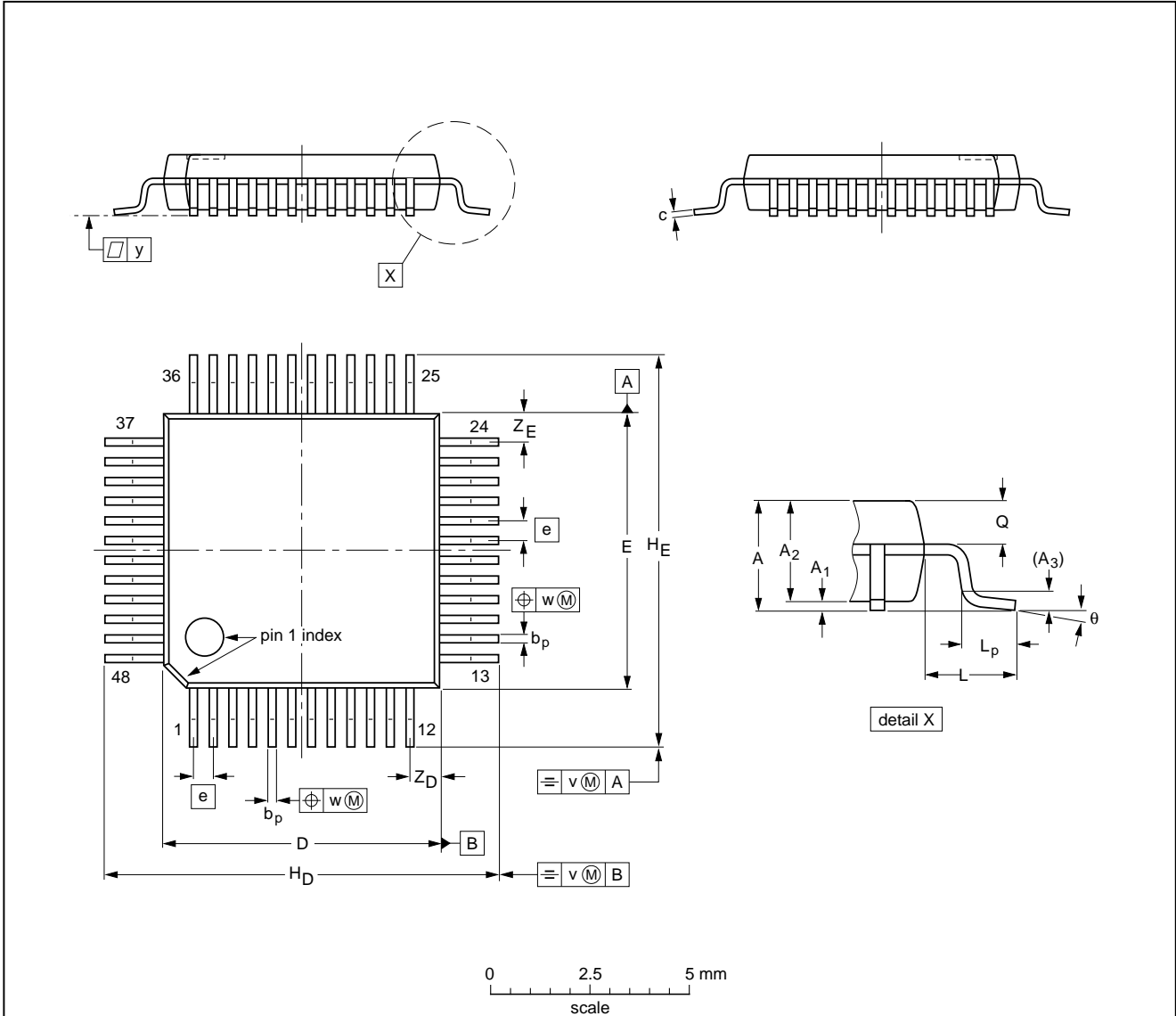
YUV-to-RGB Digital-to-Analog Converter (DAC)

SAA7167

PACKAGE OUTLINE

LQFP48: plastic low profile quad flat package; 48 leads; body 7 x 7 x 1.4 mm

SOT313-2



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _D	H _E	L	L _p	Q	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	1.60	0.20 0.05	1.45 1.35	0.25	0.27 0.17	0.18 0.12	7.1 6.9	7.1 6.9	0.5	9.15 8.85	9.15 8.85	1.0	0.75 0.45	0.69 0.59	0.2	0.12	0.1	0.95 0.55	0.95 0.55	7° 0°

Note

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

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT313-2						93-06-15 94-12-19

YUV-to-RGB Digital-to-Analog Converter (DAC)

SAA7167

SOLDERING

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).

Reflow soldering

Reflow soldering techniques are suitable for all LQFP packages.

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 techniques exist for reflowing; for example, thermal conduction by heated belt. Dwell times vary between 50 and 300 seconds depending on heating method. Typical reflow temperatures range from 215 to 250 °C.

Preheating is necessary to dry the paste and evaporate the binding agent. Preheating duration: 45 minutes at 45 °C.

Wave soldering

Wave soldering is **not** recommended for LQFP 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.

If wave soldering cannot be avoided, 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.**

Even with these conditions, do not consider wave soldering LQFP packages LQFP48 (SOT313-2), LQFP64 (SOT314-2) or LQFP80 (SOT315-1).

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.

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.

YUV-to-RGB Digital-to-Analog Converter (DAC)

SAA7167

DEFINITIONS

Data sheet status	
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.
Limiting values	
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.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

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.

PURCHASE OF PHILIPS I²C COMPONENTS



Purchase of Philips I²C components conveys a license under the Philips' I²C patent to use the components in the I²C system provided the system conforms to the I²C specification defined by Philips. This specification can be ordered using the code 9398 393 40011.

YUV-to-RGB Digital-to-Analog
Converter (DAC)

SAA7167

NOTES

YUV-to-RGB Digital-to-Analog
Converter (DAC)

SAA7167

NOTES

Philips Semiconductors – a worldwide company

Argentina: IEROD, Av. Juramento 1992 - 14.b, (1428)
BUENOS AIRES, Tel. (541)786 7633, Fax. (541)786 9367

Australia: 34 Waterloo Road, NORTH RYDE, NSW 2113,
Tel. (02)805 4455, Fax. (02)805 4466

Austria: Triester Str. 64, A-1101 WIEN, P.O. Box 213,
Tel. (01)60 101-1236, Fax. (01)60 101-1211

Belgium: Postbus 90050, 5600 PB EINDHOVEN, The Netherlands,
Tel. (31)40-2783749, Fax. (31)40-2788399

Brazil: Rua do Rocio 220 - 5th floor, Suite 51,
CEP: 04552-903-SÃO PAULO-SP, Brazil.
P.O. Box 7383 (01064-970),
Tel. (011)821-2333, Fax. (011)829-1849

Canada: PHILIPS SEMICONDUCTORS/COMPONENTS:
Tel. (800) 234-7381, Fax. (708) 296-8556

Chile: Av. Santa Maria 0760, SANTIAGO,
Tel. (02)773 816, Fax. (02)777 6730

China/Hong Kong: 501 Hong Kong Industrial Technology Centre,
72 Tat Chee Avenue, Kowloon Tong, HONG KONG,
Tel. (852)2319 7888, Fax. (852)2319 7700

Colombia: IPRELENZO LTDA, Carrera 21 No. 56-17,
77621 BOGOTA, Tel. (571)249 7624/(571)217 4609,
Fax. (571)217 4549

Denmark: Prags Boulevard 80, PB 1919, DK-2300
COPENHAGEN S, Tel. (032)88 2636, Fax. (031)57 1949

Finland: Sinikalliontie 3, FIN-02630 ESPOO,
Tel. (358)0-615 800, Fax. (358)0-61580 920

France: 4 Rue du Port-aux-Vins, BP317,
92156 SURESNES Cedex,
Tel. (01)4099 6161, Fax. (01)4099 6427

Germany: P.O. Box 10 63 23, 20043 HAMBURG,
Tel. (040)3296-0, Fax. (040)3296 213.

Greece: No. 15, 25th March Street, GR 17778 TAVROS,
Tel. (01)4894 339/4894 911, Fax. (01)4814 240

India: Philips INDIA Ltd, Shivsagar Estate, A Block,
Dr. Annie Besant Rd. Worli, Bombay 400 018
Tel. (022)4938 541, Fax. (022)4938 722

Indonesia: Philips House, Jalan H.R. Rasuna Said Kav. 3-4,
P.O. Box 4252, JAKARTA 12950,
Tel. (021)5201 122, Fax. (021)5205 189

Ireland: Newstead, Clonskeagh, DUBLIN 14,
Tel. (01)7640 000, Fax. (01)7640 200

Italy: PHILIPS SEMICONDUCTORS S.r.l.,
Piazza IV Novembre 3, 20124 MILANO,
Tel. (0039)2 6752 2531, Fax. (0039)2 6752 2557

Japan: Philips Bldg 13-37, Kohnan 2-chome, Minato-ku, TOKYO 108,
Tel. (03)3740 5130, Fax. (03)3740 5077

Korea: Philips House, 260-199 Itaewon-dong,
Yongsan-ku, SEOUL, Tel. (02)709-1412, Fax. (02)709-1415

Malaysia: No. 76 Jalan Universiti, 46200 PETALING JAYA,
SELANGOR, Tel. (03)750 5214, Fax. (03)757 4880

Mexico: 5900 Gateway East, Suite 200, EL PASO, TX 79905,
Tel. 9-5(800)234-7381, Fax. (708)296-8556

Netherlands: Postbus 90050, 5600 PB EINDHOVEN, Bldg. VB,
Tel. (040)2783749, Fax. (040)2788399

New Zealand: 2 Wagener Place, C.P.O. Box 1041, AUCKLAND,
Tel. (09)849-4160, Fax. (09)849-7811

Norway: Box 1, Manglerud 0612, OSLO,
Tel. (022)74 8000, Fax. (022)74 8341

Pakistan: Philips Electrical Industries of Pakistan Ltd.,
Exchange Bldg. ST-2/A, Block 9, KDA Scheme 5, Clifton,
KARACHI 75600, Tel. (021)587 4641-49,
Fax. (021)577035/5874546

Philippines: PHILIPS SEMICONDUCTORS PHILIPPINES Inc.,
106 Valero St. Salcedo Village, P.O. Box 2108 MCC, MAKATI,
Metro MANILA, Tel. (63) 2 816 6380, Fax. (63) 2 817 3474

Portugal: PHILIPS PORTUGUESA, S.A.,
Rua dr. António Loureiro Borges 5, Arquiparque - Miraflores,
Apartado 300, 2795 LINDA-A-VELHA,
Tel. (01)4163160/4163333, Fax. (01)4163174/4163366

Singapore: Lorong 1, Toa Payoh, SINGAPORE 1231,
Tel. (65)350 2000, Fax. (65)251 6500

South Africa: S.A. PHILIPS Pty Ltd.,
195-215 Main Road Martindale, 2092 JOHANNESBURG,
P.O. Box 7430, Johannesburg 2000,
Tel. (011)470-5911, Fax. (011)470-5494

Spain: Balmes 22, 08007 BARCELONA,
Tel. (03)301 6312, Fax. (03)301 42 43

Sweden: Kottbygatan 7, Akalla. S-164 85 STOCKHOLM,
Tel. (0)8-632 2000, Fax. (0)8-632 2745

Switzerland: Allmendstrasse 140, CH-8027 ZÜRICH,
Tel. (01)488 2211, Fax. (01)481 77 30

Taiwan: PHILIPS TAIWAN Ltd., 23-30F, 66, Chung Hsiao West
Road, Sec. 1. Taipeh, Taiwan ROC, P.O. Box 22978,
TAIPEI 100, Tel. (886) 2 382 4443, Fax. (886) 2 382 4444

Thailand: PHILIPS ELECTRONICS (THAILAND) Ltd.,
209/2 Sanpavuth-Bangna Road Prakanong,
Bangkok 10260, THAILAND,
Tel. (66) 2 745-4090, Fax. (66) 2 398-0793

Turkey: Talatpasa Cad. No. 5, 80640 GÜLTEPE/ISTANBUL,
Tel. (0212)279 27 70, Fax. (0212)282 67 07

Ukraine: Philips UKRAINE, 2A Akademika Koroleva str., Office 165,
252148 KIEV, Tel. 380-44-4760297, Fax. 380-44-4766991

United Kingdom: Philips Semiconductors LTD.,
276 Bath Road, Hayes, MIDDLESEX UB3 5BX,
Tel. (0181)730-5000, Fax. (0181)754-8421

United States: 811 East Arques Avenue, SUNNYVALE,
CA 94088-3409, Tel. (800)234-7381, Fax. (708)296-8556

Uruguay: Coronel Mora 433, MONTEVIDEO,
Tel. (02)70-4044, Fax. (02)92 0601

Internet: <http://www.semiconductors.philips.com/ps/>

For all other countries apply to: Philips Semiconductors,
International Marketing and Sales, Building BE-p,
P.O. Box 218, 5600 MD EINDHOVEN, The Netherlands,
Telex 35000 phtcnl, Fax. +31-40-2724825

SCD45

© Philips Electronics N.V. 1995

All rights are reserved. Reproduction in whole or in part is prohibited without the prior written consent of the copyright owner.

The information presented in this document does not form part of any quotation or contract, is believed to be accurate and reliable and may be changed without notice. No liability will be accepted by the publisher for any consequence of its use. Publication thereof does not convey nor imply any license under patent- or other industrial or intellectual property rights.

Printed in The Netherlands

483061/1100/01/pp20
Document order number:

Date of release: 1995 Nov 03
9397 750 00416