DATA SHEET

SAA4995WP
PANorama-IC (PAN-IC)

Preliminary specification
File under Integrated Circuits, IC02

1997 Jun 10

Philips
Semiconductors

PHILIPS

PANorama-IC (PAN-IC) SAA4995WP

FEATURES

- Horizontal sample rate conversion in both zoom and compress direction, with a sample rate conversion factor between 0.5 and 2 (in 384 steps)
- Dynamic sample rate conversion for panorama mode display e.g. 4 : 3 material on a 16 : 9 display
- Dynamic sample rate conversion for amaronap mode display of e.g. 16 : 9 material on a 4 : 3 display
- Operates with $1f_h$ and $2f_h$
- Programmable via microcontroller SNERT (Synchronous No parity Eight bit Receive Transmit) bus.

GENERAL DESCRIPTION

The PAN-IC is an add-on IC to be used, for example, between analog-to-digital conversion and a serial (field) memory. The device performs the following tasks:

- Linear horizontal sample rate conversion in both zoom and compress direction, with a sample rate conversion factor between 0.5 and 2
- Dynamic sample rate conversion for panorama mode display of e.g. 4 : 3 material on a 16 : 9 display
- Dynamic sample rate conversion for amaronap mode display of e.g. 16 : 9 material on a 4 : 3 display.

The PAN-IC has the ability to increase the data rate from the ADC to a maximum of twice the data rate at the output. To achieve this a clock rate at twice the normal output clock rate is needed to write data to the memory.
All actions to generate a lower data rate, produces disable cycles in Write Enable (WE).

QUICK REFERENCE DATA

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
V_{DD}	supply voltage	4.5	5	5.5	V
I_{DD}	supply current	–	110	–	mA
f_{CLK}	operating clock frequency	–	–	33	MHz
T_{amb}	operating ambient temperature	0	–	70	°C

ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
SAA4995WP	PLCC44	plastic leaded chip carrier; 44 leads	SOT187-2

BLOCK DIAGRAM

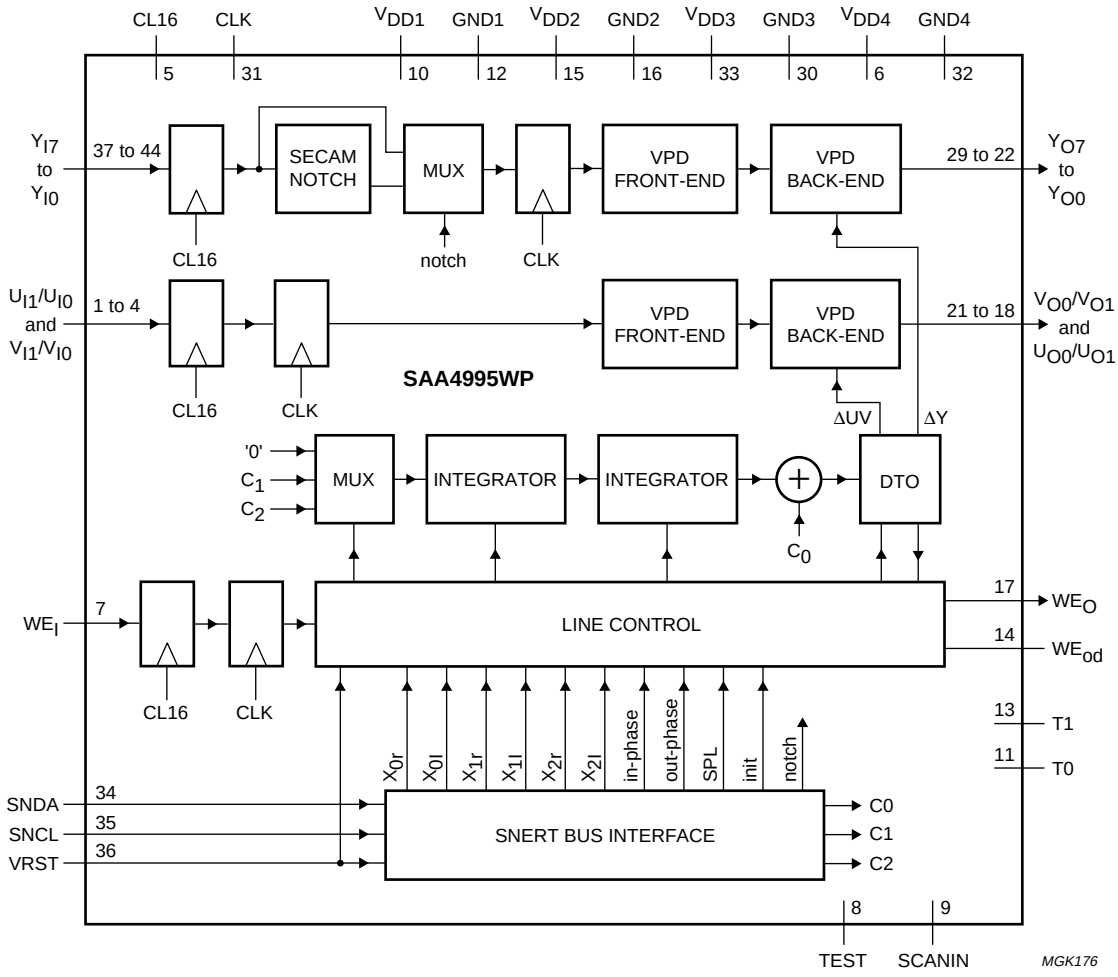


Fig.1 Block diagram.

PINNING

SYMBOL	PIN	DESCRIPTION
U_{I1}	1	U input bit 1
U_{I0}	2	U input bit 0
V_{I1}	3	V input bit 1
V_{I0}	4	V input bit 0
CL16	5	half system clock
V_{DD4}	6	supply voltage 4
WE_I	7	write enable input
TEST	8	test mode switch
SCANIN	9	input for scan chain
V_{DD1}	10	supply voltage 1
T0	11	test mode switch 0
GND1	12	ground 1
T1	13	test mode switch 1
WE_{od}	14	write enable odd samples
V_{DD2}	15	supply voltage 2
GND2	16	ground 2
WE_O	17	write enable output
V_{O0}	18	V output bit 0
V_{O1}	19	V output bit 1
U_{O0}	20	U output bit 0
U_{O1}	21	U output bit 1
Y_{O0}	22	luminance output bit 0
Y_{O1}	23	luminance output bit 1

SYMBOL	PIN	DESCRIPTION
Y_{O2}	24	luminance output bit 2
Y_{O3}	25	luminance output bit 3
Y_{O4}	26	luminance output bit 4
Y_{O5}	27	luminance output bit 5
Y_{O6}	28	luminance output bit 6
Y_{O7}	29	luminance output bit 7
GND3	30	ground 3
CLK	31	system clock
GND4	32	ground 4
V_{DD3}	33	supply voltage 3
SNDA	34	data input from interface SNERT bus
SNCL	35	clock input from interface SNERT bus
VRST	36	reset input in the vertical blanking interval
Y_{I7}	37	luminance input bit 7
Y_{I6}	38	luminance input bit 6
Y_{I5}	39	luminance input bit 5
Y_{I4}	40	luminance input bit 4
Y_{I3}	41	luminance input bit 3
Y_{I2}	42	luminance input bit 2
Y_{I1}	43	luminance input bit 1
Y_{I0}	44	luminance input bit 0

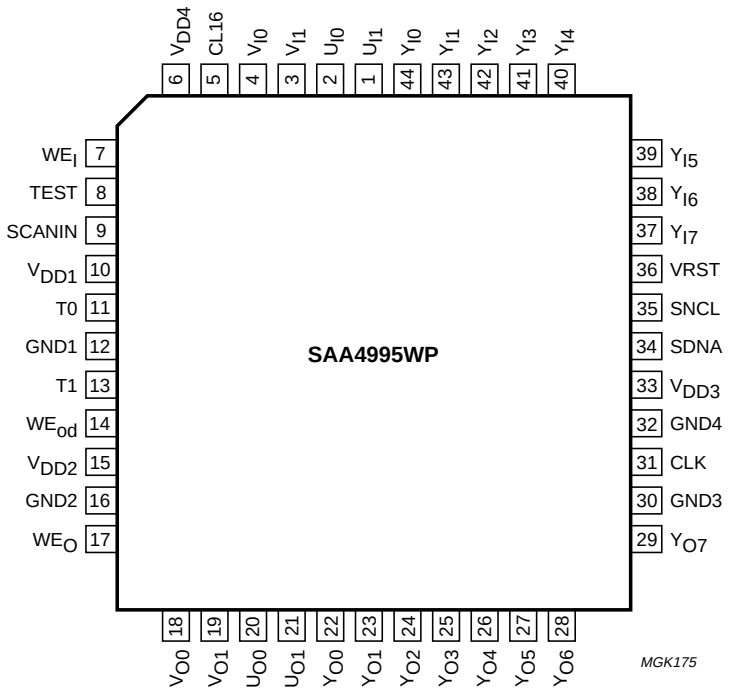


Fig.2 Pin configuration.

FUNCTIONAL DESCRIPTION

The PAN-IC is an add-on IC to be used, for example, between analog-to-digital conversion and a serial (field) memory. The device performs the following tasks:

- Linear horizontal sample rate conversion in both zoom and compress direction, with a sample rate conversion factor between 0.5 and 2
- Dynamic sample rate conversion for panorama mode display of e.g. 4 : 3 material on a 16 : 9 display
- Dynamic sample rate conversion for amaronap mode display of e.g. 16 : 9 material on a 4 : 3 display.

The PAN-IC has the ability to increase the data rate from the ADC (maximum 16 MHz in a 16/32 MHz concept) to a maximum of twice the data rate. For this, a 32 MHz clock rate is needed to write to the memory. All actions to generate a lower data rate produces disable cycles in write enable.

In panorama and amaronap modes, the sample rate conversion factor is modulated along the video line.

In the centre of the line a high quality compression (e.g. with a factor $^4/_3$) has to be made. Towards the sides of the line, more and more expansion and compression respectively is made. The sample rate conversion factor over a line will have a bathtub shape, with parameters illustrated in Fig.3:

- X_{0l} and X_{0r}, where in-between a constant data rate is maintained (area I) and starting points from where a curve can be programmed for its 2nd derivative (in areas II and V)
- X_{1l} and X_{1r}, points from where a new curve can be programmed for its 2nd derivative (for areas III and IV)
- X_{2l} corresponds to the first sample in the output data stream, defined by start of WE_I
- X_{2r} corresponds to the last sample in the output data stream, defined by the programmed number of samples
- C_1, which controls the second derivatives of the data rate in areas II and V
- C_2, which controls the second derivatives of the data rate in areas III and IV.

Interpolation function

The interpolation for phase positions between the original samples, is achieved with a variable phase delay filter with 10 taps for luminance signals and 4 taps for chrominance signals. For luminance the PAN-IC supplies samples up to 32 MHz. For chrominance the PAN-IC supplies each U and V samples with a data rate of 8 MHz (max).

Processing control in the PAN-IC

The compress factor (see Fig.4) at any position in the lines is a function of the dynamically changing DTO-increment. When DTO_{incr} = 255, the sample rate is divided by 2; when DTO_{incr} = 0, the sample rate in the PAN-IC remains unchanged; when DTO_{incr} = –128, the sample rate is doubled.

Control of number of samples per line

Three possibilities exist for the relationship between the end of WE_I and the required number of samples per line for storage in the field memory:

- WE_I negative edge coincides with the required last sample in the line; standard operation.
- WE_I negative edge is reached before the present last sample in the line was required; extra dummy WE cycles will be generated at the maximum rate (zoom factor 2) to arrive at the required number of samples per line.
- The required number of samples per line is reached before WE_I negative edge; the DTO calculations will continue until the required number of samples is reached, but without generation of WE cycles.

The programmed number of samples per line is thus always realized, independent of all other controls (unless the line period becomes insufficient to store up to the last sample in a line). When using odd/even sample distribution, the programmed number of samples refers to the number of samples in each data stream. Consequently, the total number of samples is twice as many.

There is an offset in the programmed number of samples compared to the effective number of samples per line.

- Effective number of Y samples = 4 × (programmed number of samples + 1)
- Effective number of UV samples = 1 × (programmed number of samples + 1)

SECAM Y notch

A notch filter at the Y input of the PAN-IC can be switched on. The purpose of this filter is to prevent artefacts from scan velocity modulation with SECAM inputs. The notch filter is an FIR filter with coefficients (–1 0 3 0 3 0 –1). When f_s = 16 MHz, the notch frequency is 4 MHz; the maximum gain of the filter is +3 dB at 2 and 6 MHz.

Timing

The inputs are related to CL16 (half system clock). This clock is used for reference in the PAN-IC from the CL16 pin. The system clock must have a fixed phase relationship to the CL16 enable signal (one clock system).

Relationship of WE to video data

WE inputs and outputs may be used with either coincident or advanced WE to video timing (see Fig.5). The advanced WE to video timing is applicable to field memories, such as the SAA4955TJ. The input and output WEs of the PAN-IC can be programmed separately to either timing by the in-phase and out-phase bits.

Odd/even sample distribution

The PAN-IC usually delivers a complete YUV data stream to one receiving device, e.g. a field memory. Optionally, a data stream can be split into odd and even samples, to be received by two receiving devices.

The relationship between Y and UV samples is then non-trivial (see Tables 1 to 4).

NO SPLITTING INTO ODD AND EVEN SAMPLE STREAM

Table 1 Normal output YUV data stream

E	**O**	**E**	**O**	**E**	**O**	**E**	**O**	**E**	**O**	**E**	**O**	**E**
Y^0	Y^1	Y^2	Y^3	Y^4	Y^5	Y^6	Y^7	Y^8	Y^9	Y^{10}	Y^{11}	Y^{12}
$UV_{76}{}^0$	$UV_{54}{}^0$	$UV_{32}{}^0$	$UV_{10}{}^0$	$UV_{76}{}^4$	$UV_{54}{}^4$	$UV_{32}{}^4$	$UV_{10}{}^4$	$UV_{76}{}^8$	$UV_{54}{}^8$	$UV_{32}{}^8$	$UV_{10}{}^8$	$UV_{76}{}^{12}$

SPLITTING INTO ODD AND EVEN SAMPLE STREAM

Keeps corresponding parts of the UV samples in one stream (UV^0, UV^8, etc. in even stream and UV^4, UV^{12}, etc. in odd stream): The odd data stream misses two samples at the start of a line and has two dummy samples at the end of the line, to keep the UV format correct and maintain the same line length as for the even stream (In the odd stream, the last two Y samples and the last U and V samples of a line are not valid).

Table 2 Even YUV data stream

E	–	**E**	–	**E**	–	**E**	–	**E**	–	**E**	–	**E**
Y^0	–	Y^2	–	Y^4	–	Y^6	–	Y^8	–	Y^{10}	–	Y^{12}
$UV_{76}{}^0$	–	$UV_{54}{}^0$	–	$UV_{32}{}^0$	–	$UV_{10}{}^0$	–	$UV_{76}{}^8$	–	$UV_{54}{}^8$	–	$UV_{32}{}^{12}$

Table 3 Odd YUV data stream

–	–	–	–	–	**O**	–	**O**	–	**O**	–	**O**	–
–	–	–	–	–	Y^5	–	Y^7	–	Y^9	–	Y^{11}	–
–	–	–	–	–	$UV_{76}{}^4$	–	$UV_{54}{}^4$	–	$UV_{32}{}^4$	–	$UV_{10}{}^4$	–

The even and odd data streams given in Tables 2 and 3 can be distributed to two receiving devices with input enable facilities. A separate input signal for each of the receiving devices must then be applied while the even YUV data stream and odd YUV data stream are again combined.

COMBINED ODD/EVEN OUTPUT YUV DATA STREAM

Table 4 Distribution with odd/even input enable signals

E	–	**E**	–	**E**	–	**E**	**O**	**E**	**O**	**E**	**O**	**E**
Y^0	–	Y^2	–	Y^4	Y^5	Y^6	Y^7	Y^8	Y^9	Y^{10}	Y^{11}	Y^{12}
$UV_{76}{}^0$	–	$UV_{54}{}^0$	–	$UV_{32}{}^0$	$UV_{76}{}^4$	$UV_{10}{}^0$	$UV_{54}{}^4$	$UV_{75}{}^8$	$UV_{32}{}^4$	$UV_{54}{}^8$	$UV_{10}{}^4$	$UV_{32}{}^8$

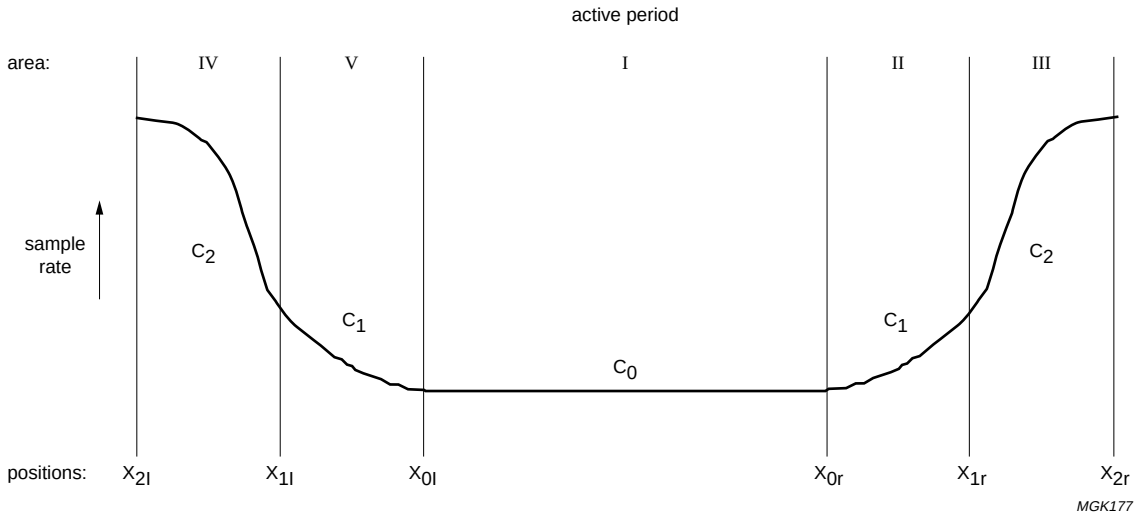


Fig.3 Panorama mode.

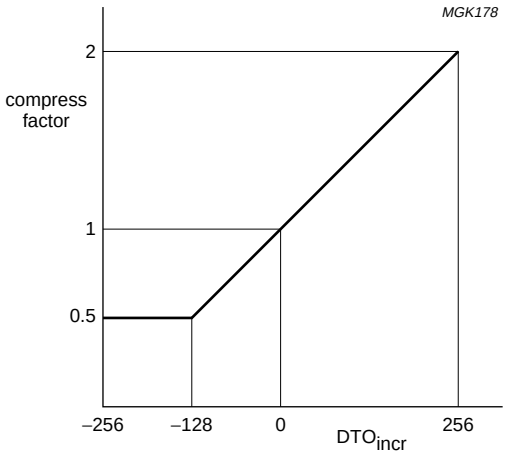


Fig.4 Compress factor.

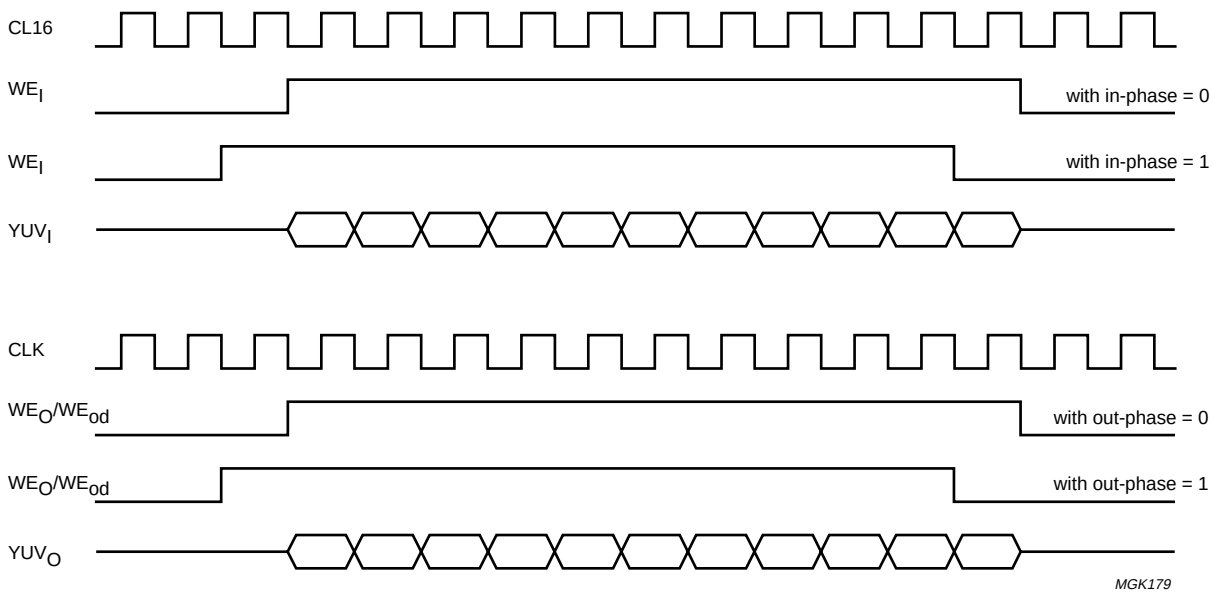


Fig.5 WE timing.

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DD}	supply voltage		–0.5	+6.5	V
V_i, V_o	input and output voltages		–0.5	V_{DD} + 0.5	V
$I_{o/out}$	output current per output pin		–	20	mA
P/out	power dissipation per output pin		–	100	mW
T_{stg}	storage temperature		–55	+140	°C
T_{amb}	operating ambient temperature		–40	+85	°C
V_{ESD}	electrostatic handling for all pins	note 1	–	±2000	V
		note 2	–	±300	V

Notes

1. Human body model: C = 100 pF, R = 1.5 kΩ, V = 2 kV.
2. Machine model: C = 200 pF, R = 0 Ω, V = 300 V.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient in free air	50	K/W

CHARACTERISTICS

V_{DD} = 5.0 V; T_{amb} = 25 °C; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{DD}	supply voltage		4.5	5	5.5	V
I_{DD}	supply current		–	110	–	mA
f_{CLK}	operating frequency (CLK)		–	–	33	MHz
f_{CL16}	operating frequency (CL16)		–	$\frac{1}{2}f_{CLK}$	–	MHz
V_{IL}	LOW level input voltage		–	–	0.8	V
V_{IH}	HIGH level input voltage		2.0	–	V_{DD}	V
C_i	input capacitance		–	10	15	pF
V_{OL}	LOW level output voltage	I_o = 4 mA	–	–	0.4	V
V_{OH}	HIGH level output voltage	I_o = –4 mA	2.6	3.4	–	V
$t_{su(i)(D)}$	input set-up time with respect to CL16 rising edge	except pins SNDA, SNCL, VRST and CLK; see Fig.6	8	–	–	ns
$t_{h(i)(CL16)}$	input hold time with respect to CL16 rising edge	except pins SNDA, SNCL, VRST and CLK; see Fig.6	0	–	–	ns
$t_{su(i)(CL16)}$	input set-up time with respect to CLK rising edge	see Fig.6	7	–	–	ns
$t_{h(i)(CL16)}$	input hold time with respect to CLK rising edge	see Fig.6	3	–	–	ns
$t_{h(o)}$	output hold time with respect to CLK	C_L = 7 pF	5	–	–	ns
t_d	output delay time with respect to CLK	C_L = 15 pF	–	–	19	ns
T_{amb}	operating ambient temperature		0	–	70	°C
T_j	junction temperature		–	–	125	°C

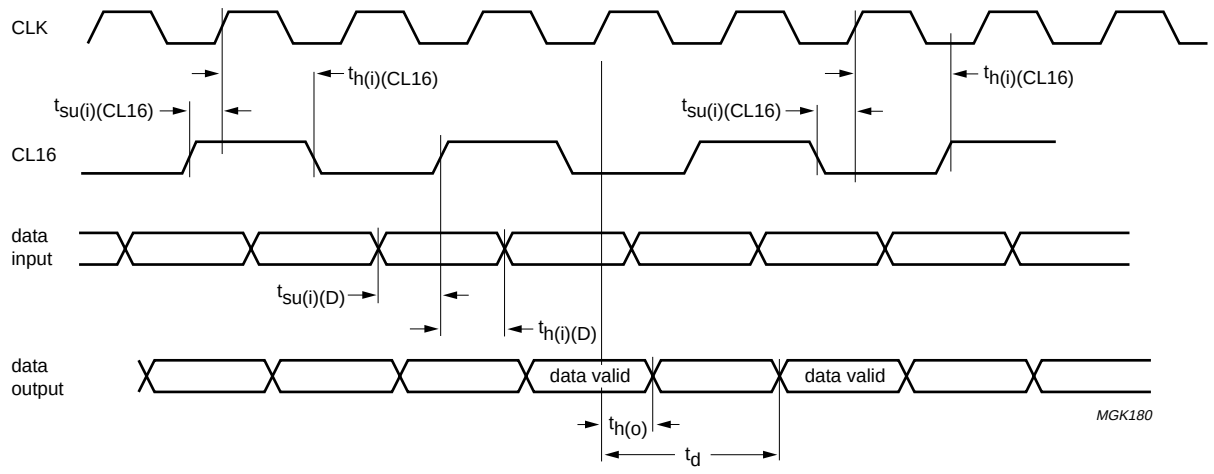


Fig.6 Clock timing.

MICROCONTROLLER BUS TIMING (SNERT BUS)

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$T_{cy(SNCL)}$	SNCL cycle time	see Fig.7	1	–	µs
$t_{su(i)}$	input data set-up time	see Fig.7	90	–	ns
$t_{h(i)}$	input data hold time	see Fig.7	50	–	ns
$t_{h(o)(D)}$	output data hold time	see Fig.7	0	–	ns
t_d	output data delay time	see Fig.7	–	700	ns

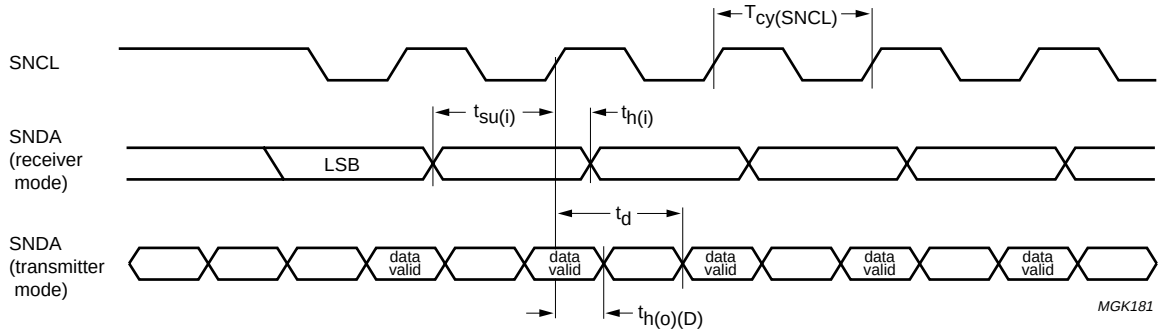


Fig.7 SNERT bus interface timing.

MICROCONTROLLER BUS CONTROL (SNERT BUS)

The following control table applies (Table 5), for control via the microcontroller bus (SNERT bus, consisting of SNCL, SNDA and VRST signals). Data communication is by writing to the PAN-IC (address 40H to 48H) and reading from it (address 49H)

Table 5 SNERT-bus control

ADDRESS (HEX)	FUNCTION	# OF BITS	BIT POSITION	REMARKS
40	X_{1l}	8	7 : 0	definition of X_{1l} with a resolution of 4 samples; see Fig.3 and note 1
41	X_{0l}	8	7 : 0	definition of X_{0l} with a resolution of 4 samples; see Fig.3 and note 1
42	X_{0r}	8	7 : 0	definition of X_{0r} with a resolution of 4 samples; see Fig.3 and note 1
43	X_{1r}	8	7 : 0	definition of X_{1r} with a resolution of 4 samples; see Fig.3 and note 1
44	output samples per line	8	7 : 0	resolution of 4 luminance samples; actual # samples = (programmed # samples + 1) × 4; note 2

ADDRESS (HEX)	FUNCTION	# OF BITS	BIT POSITION	REMARKS
45	C_0	8	7 : 0	constant DTO_{incr} value for area I, MSB extended by zoom bit at address 48 (twos complement value); see Figs 3 and 4
46	C_1	6	5 : 0	2nd derivatives for DTO_{incr} for areas II and V (twos complement value); see Figs 3 and 4
	distribution	1	6	enables odd/even sample distribution; see Tables 1 to 4
47	C_2	6	5 : 0	2nd derivatives for DTO_{incr} for areas III and IV (twos complement value)
	test 1	1	6	test bit, must be logic 0 in normal operation
	notch	1	7	SECAM Y notch on/off (logic 1 = on, logic 0 = off)
48	zoom bit	1	0	logic 1 = zoom, logic 0 = compress in area I
	in-phase	1	1	logic 1 = shifted relation WE_IN to input data; see Fig.5
	out-phase	1	2	logic 1 = shifted relation WE_O/WE_{od} to output data; see Fig.5
	init	1	3	circuitry is initialized at VRST pulse
	vrst_xfer	1	4	new settings are activated at VRST pulse
	keep	1	5	compression curve is kept from last active line in field
	test 2	1	6	test bit, must be logic 0 in normal operation
	adapt	1	7	adapt bit, must be logic 0 in normal operation
49	identify read	8 read bits	7 : 0	PAN-IC identifies by pulling all bits LOW (hardware cluck)

Notes

1. For a symmetrical bathtub curve $X_{nl} + X_{nr}$ = output samples per line + 1.
2. WE_I falling edge delay to the WE_O latest sample should not be equal to the pipeline delay. This can be controlled with the WE_I length via the microcontroller.

TEST

The test mode can be chosen via pins TEST, T0 and T1.

Table 6 Test modes

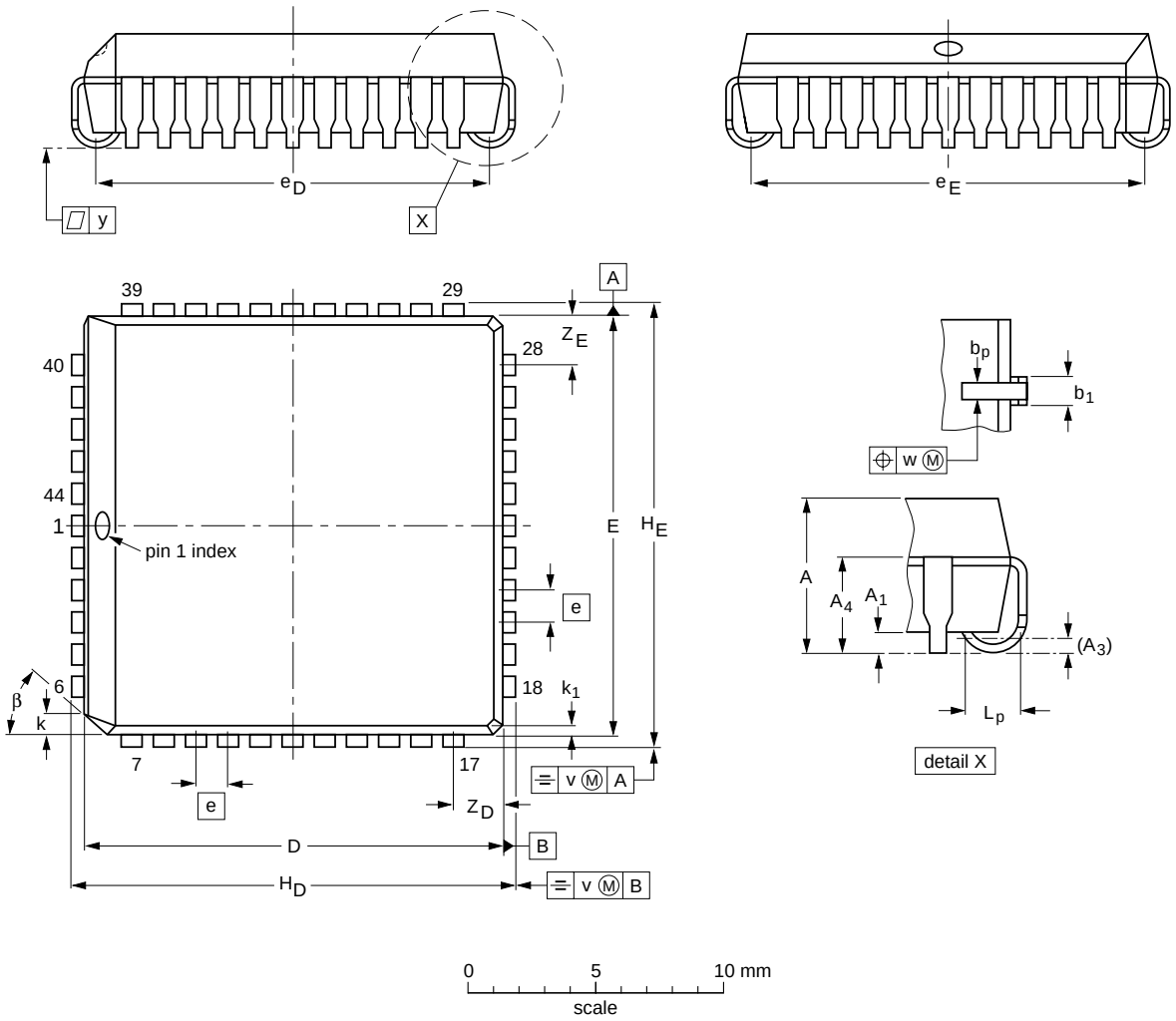
MODE	PIN NAME		
	TEST	T1	T0
Functional test	0	X(1)	X(1)
Test mode on	1	X(1)	X(1)

Note

1. X = don’t care.

PACKAGE OUTLINE

PLCC44: plastic leaded chip carrier; 44 leads **SOT187-2**



DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)

UNIT	A	A_1 min.	A_3	A_4 max.	b_p	b_1	$D^{(1)}$	$E^{(1)}$	e	e_D	e_E	H_D	H_E	k	k_1 max.	L_p	v	w	y	$Z_D^{(1)}$ max.	$Z_E^{(1)}$ max.	β
mm	4.57 4.19	0.51	0.25	3.05	0.53 0.33	0.81 0.66	16.66 16.51	16.66 16.51	1.27	16.00 14.99	16.00 14.99	17.65 17.40	17.65 17.40	1.22 1.07	0.51	1.44 1.02	0.18	0.18	0.10	2.16	2.16	45°
inches	0.180 0.165	0.020	0.01	0.12	0.021 0.013	0.032 0.026	0.656 0.650	0.656 0.650	0.05	0.630 0.590	0.630 0.590	0.695 0.685	0.695 0.685	0.048 0.042	0.020	0.057 0.040	0.007	0.007	0.004	0.085	0.085	

Note

1. Plastic or metal protrusions of 0.01 inches maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT187-2	112E10	MO-047AC				~~92-11-17~~ 95-02-25

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 PLCC packages.

The choice of heating method may be influenced by larger PLCC 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 9398 510 63011).

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 techniques can be used for all PLCC packages if the following conditions are observed:

- A double-wave (a turbulent wave with high upward pressure followed by a smooth laminar wave) soldering technique should be used.
- The longitudinal axis of the package footprint must be parallel to the solder flow.
- The package footprint must incorporate solder thieves at the downstream 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.

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.

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 this 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.

Philips Semiconductors – a worldwide company

Argentina: see South America

Australia: 34 Waterloo Road, NORTH RYDE, NSW 2113,
Tel. +61 2 9805 4455, Fax. +61 2 9805 4466

Austria: Computerstr. 6, A-1101 WIEN, P.O. Box 213,
Tel. +43 1 60 101, Fax. +43 1 60 101 1210

Belarus: Hotel Minsk Business Center, Bld. 3, r. 1211, Volodarski Str. 6,
220050 MINSK, Tel. +375 172 200 733, Fax. +375 172 200 773

Belgium: see The Netherlands

Brazil: see South America

Bulgaria: Philips Bulgaria Ltd., Energoproject, 15th floor,
51 James Bourchier Blvd., 1407 SOFIA,
Tel. +359 2 689 211, Fax. +359 2 689 102

Canada: PHILIPS SEMICONDUCTORS/COMPONENTS,
Tel. +1 800 234 7381

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: see South America

Czech Republic: see Austria

Denmark: Prags Boulevard 80, PB 1919, DK-2300 COPENHAGEN S,
Tel. +45 32 88 2636, Fax. +45 31 57 0044

Finland: Sinikalliontie 3, FIN-02630 ESPOO,
Tel. +358 9 615800, Fax. +358 9 61580920

France: 4 Rue du Port-aux-Vins, BP317, 92156 SURESNES Cedex,
Tel. +33 1 40 99 6161, Fax. +33 1 40 99 6427

Germany: Hammerbrookstraße 69, D-20097 HAMBURG,
Tel. +49 40 23 53 60, Fax. +49 40 23 536 300

Greece: No. 15, 25th March Street, GR 17778 TAVROS/ATHENS,
Tel. +30 1 4894 339/239, Fax. +30 1 4814 240

Hungary: see Austria

India: Philips INDIA Ltd, Shivsagar Estate, A Block, Dr. Annie Besant Rd.
Worli, MUMBAI 400 018, Tel. +91 22 4938 541, Fax. +91 22 4938 722

Indonesia: see Singapore

Ireland: Newstead, Clonskeagh, DUBLIN 14,
Tel. +353 1 7640 000, Fax. +353 1 7640 200

Israel: RAPAC Electronics, 7 Kehilat Saloniki St, PO Box 18053,
TEL AVIV 61180, Tel. +972 3 645 0444, Fax. +972 3 649 1007

Italy: PHILIPS SEMICONDUCTORS, Piazza IV Novembre 3,
20124 MILANO, Tel. +39 2 6752 2531, Fax. +39 2 6752 2557

Japan: Philips Bldg 13-37, Kohnan 2-chome, Minato-ku, TOKYO 108,
Tel. +81 3 3740 5130, Fax. +81 3 3740 5077

Korea: Philips House, 260-199 Itaewon-dong, Yongsan-ku, SEOUL,
Tel. +82 2 709 1412, Fax. +82 2 709 1415

Malaysia: No. 76 Jalan Universiti, 46200 PETALING JAYA, SELANGOR,
Tel. +60 3 750 5214, Fax. +60 3 757 4880

Mexico: 5900 Gateway East, Suite 200, EL PASO, TEXAS 79905,
Tel. +9-5 800 234 7381

Middle East: see Italy

Netherlands: Postbus 90050, 5600 PB EINDHOVEN, Bldg. VB,
Tel. +31 40 27 82785, Fax. +31 40 27 88399

New Zealand: 2 Wagener Place, C.P.O. Box 1041, AUCKLAND,
Tel. +64 9 849 4160, Fax. +64 9 849 7811

Norway: Box 1, Manglerud 0612, OSLO,
Tel. +47 22 74 8000, Fax. +47 22 74 8341

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

Poland: Ul. Lukiska 10, PL 04-123 WARSZAWA,
Tel. +48 22 612 2831, Fax. +48 22 612 2327

Portugal: see Spain

Romania: see Italy

Russia: Philips Russia, Ul. Usatcheva 35A, 119048 MOSCOW,
Tel. +7 095 755 6918, Fax. +7 095 755 6919

Singapore: Lorong 1, Toa Payoh, SINGAPORE 1231,
Tel. +65 350 2538, Fax. +65 251 6500

Slovakia: see Austria

Slovenia: see Italy

South Africa: S.A. PHILIPS Pty Ltd., 195-215 Main Road Martindale,
2092 JOHANNESBURG, P.O. Box 7430 Johannesburg 2000,
Tel. +27 11 470 5911, Fax. +27 11 470 5494

South America: Rua do Rocio 220, 5th floor, Suite 51,
04552-903 São Paulo, SÃO PAULO - SP, Brazil,
Tel. +55 11 821 2333, Fax. +55 11 829 1849

Spain: Balmes 22, 08007 BARCELONA,
Tel. +34 3 301 6312, Fax. +34 3 301 4107

Sweden: Kottbygatan 7, Akalla, S-16485 STOCKHOLM,
Tel. +46 8 632 2000, Fax. +46 8 632 2745

Switzerland: Allmendstrasse 140, CH-8027 ZÜRICH,
Tel. +41 1 488 2686, Fax. +41 1 481 7730

Taiwan: Philips Semiconductors, 6F, No. 96, Chien Kuo N. Rd., Sec. 1,
TAIPEI, Taiwan Tel. +886 2 2134 2865, Fax. +886 2 2134 2874

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

Turkey: Talatpasa Cad. No. 5, 80640 GÜLTEPE/ISTANBUL,
Tel. +90 212 279 2770, Fax. +90 212 282 6707

Ukraine: PHILIPS UKRAINE, 4 Patrice Lumumba str., Building B, Floor 7,
252042 KIEV, Tel. +380 44 264 2776, Fax. +380 44 268 0461

United Kingdom: Philips Semiconductors Ltd., 276 Bath Road, Hayes,
MIDDLESEX UB3 5BX, Tel. +44 181 730 5000, Fax. +44 181 754 8421

United States: 811 East Arques Avenue, SUNNYVALE, CA 94088-3409,
Tel. +1 800 234 7381

Uruguay: see South America

Vietnam: see Singapore

Yugoslavia: PHILIPS, Trg N. Pasica 5/v, 11000 BEOGRAD,
Tel. +381 11 625 344, Fax.+381 11 635 777

For all other countries apply to: Philips Semiconductors, Marketing & Sales Communications,
Building BE-p, P.O. Box 218, 5600 MD EINDHOVEN, The Netherlands, Fax. +31 40 27 24825

Internet: http://www.semiconductors.philips.com

Printed in The Netherlands 547047/20/01/pp16 Date of release: 1997 Jun 10 Document order number: 9397 750 01609

Let's make things better.

Philips Semiconductors

PHILIPS