DATA SHEET

SAA4951
Memory controller

Preliminary specification
File under Integrated Circuits, IC02

April 1994

Philips
Semiconductors

PHILIPS

Memory controller SAA4951

FEATURES

- Support for acquisition, display and deflection PLL
- 50/100 (or 60/120) Hz scan conversion for different input data rates: 12, 13.5, 16 and 18 MHz
- Support for 4:3 and 14:9 display on a 16:9 screen (horizontal compression)
- Support for Y:U:V data rates of 4:1:1, 4:2:2, and 4:4:4
- Horizontal zoom
- Still picture
- Support for one or two field memories
- Support for different video memory types like TMS 1050/60/70/2970
- Progressive scan
- Programmable via microcontroller port
- Golden Scart option
- Support for Multi-PIP.

GENERAL DESCRIPTION

The memory controller SAA4951 has been designed for high end TV sets using $2f_H$-technics.
The circuit provides all necessary write, read and clock pulses to control different field memory concepts. Furthermore the drive signals for the horizontal and vertical deflection power stages are generated.

The device is connected to a microcontroller via an 8-bit data bus. The controller receives commands via the I^2C-bus. Due to this fact the start and stop conditions of the main output control signals are programmable and the SAA4951 can be set in different function modes depending on the used TV-feature concept.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
V_{DD}	supply voltage	4.5	5.0	5.5	V
I_{DD}	supply current	–	50	–	mA
T_{amb}	operating ambient temperature	0	–	+70	°C

ORDERING INFORMATION

EXTENDED TYPE NUMBER	PACKAGE			
	PINS	PIN POSITION	MATERIAL	CODE
SAA4951WP	44	PLCC	plastic	SOT187(1)

Note

1. SOT187-2; 1996 December 13.

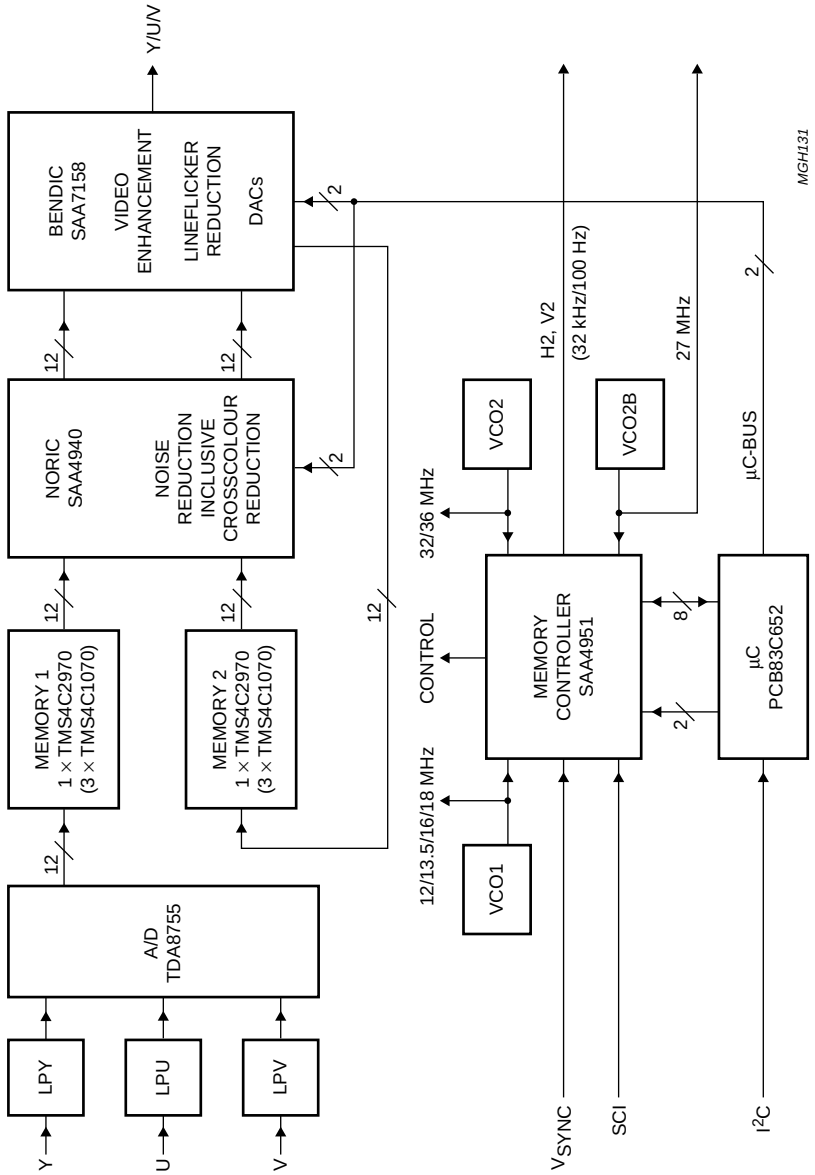


Fig.1 Improved Picture Quality (IPQ) module.

PINNING

SYMBOL	PIN	TYPE[1]	DESCRIPTION
HRD	1	O	horizontal reference signal, display part
V_{DD}	2	–	positive supply voltage
SWC1	3	O	serial write clock, memory 1
SRC	4	O	serial read clock, memory 1
SWC2	5	O	serial write clock, memory 2
WEXT	6	I	external write enable input
IE1	7	O	input enable signal, memory 1
WE1	8	O	write enable signal, memory 1
STROBE	9	I	strobe function
V_{DD}	10	–	positive supply voltage
HRA	11	O	horizontal reference signal, acquisition part
BLNA		I	horizontal blanking signal, acquisition part
V_{SS}	12	–	ground
LLA	13	I	line-locked clock signal, acquisition part
IE2	14	O	input enable signal, memory 2
WE2	15	O	write enable signal, memory 2
CLV	16	O	video clamping signal
ALDUV/VB	17	O	acquisition load signal, chrominance U, V / vertical blanking
RE1	18	O	read enable signal, memory 1
RE2	19	O	read enable signal, memory 2
BLND	20	O	horizontal blanking signal, display part
ALE	21	I	address latch enable signal
WRD	22	I	write/read data signal
V_{DD}	23	–	positive supply voltage
V_{SS}	24	–	ground
P0	25	I	data input signal, (LSB = least significant bit)
P1	26	I	data input signal
P2	27	I	data input signal
P3	28	I	data input signal
P4	29	I	data input signal
P5	30	I	data input signal
P6	31	I/O	data input/output signal
P7	32	I/O	data input/output signal, (MSB = most significant bit)
LLDFL	33	I	line-locked clock signal, deflection part
V_{SS}	34	–	ground
HRDFL	35	O	horizontal reference signal, deflection part

SYMBOL	PIN	TYPE(1)	DESCRIPTION
V_{DD}	36	–	positive supply voltage
HDFL	37	O	horizontal synchronization signal, deflection part
VDFL	38	O	vertical synchronization signal, deflection part
VACQ	39	I	vertical synchronization signal, acquisition part
TEST	40	I	test input
RSTW2	41	O	reset write signal, memory 2
RSTW1	42	O	reset write signal, memory 1
LLD	43	I	line-locked clock signal, display part
V_{SS}	44	–	ground

Note

1. I = Input
   O = Output

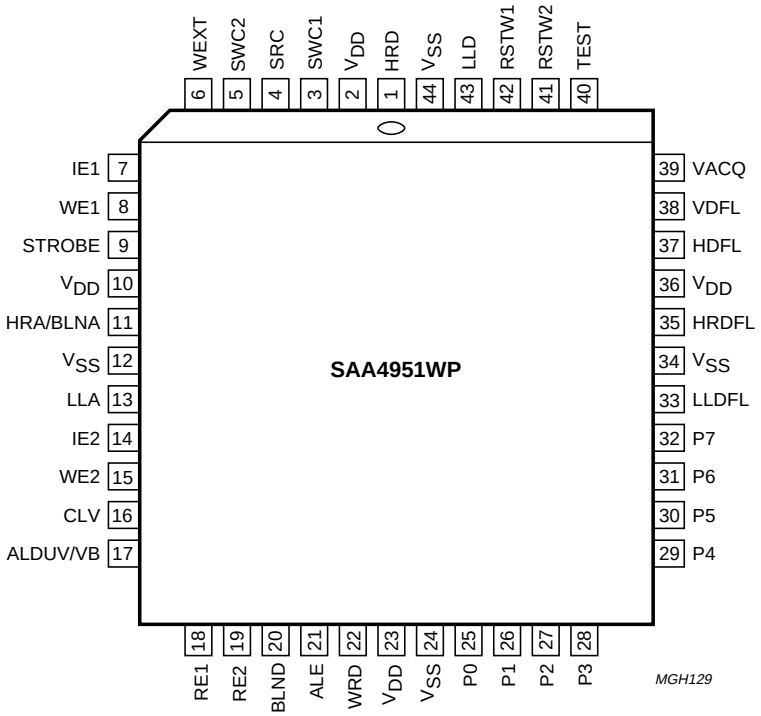


Fig.2 Pin configuration.

FUNCTIONAL DESCRIPTION

Block diagram and short description

The SAA4951 is a memory controller intended to be used for scan conversion in TV receivers. This conversion is done from 50 to 100 Hz or from 60 to 120 Hz. The device supports three separate PLL circuits: the acquisition PLL can run on 12, 13.5, 16 or 18 MHz, the display PLL on 27, 32 or 36 MHz, and the deflection PLL on 27 MHz. This allows frequency doubling for input data rates of 13.5, 16 and 18 MHz. For displaying a 4:3 picture on a 16:9 screen additional horizontal compression is possible when using the clock configuration 12/32 MHz and 13.5/36 MHz. The VCO and loop filter are peripheral parts of each PLL, the clock divider and generation of the reference pulse for the phase detector are internally provided.

The device generates all write, read and clock pulses to operate a field memory in a desired mode. The required signals are programmable via an 8-bit parallel microcontroller port.

The block diagram of the SAA4951 is shown in Fig.3. The clock signal from the VCO is fed in at pin 13, a horizontal reference pulse for the phase discriminator is fed out at pin 11.

By setting the clock divider to different values the PLL can be forced to run on different clock frequencies.

Besides this the acquisition part can also be configured to run on a fixed input clock. Then pin 11 is an input pin, so the horizontal reference pulse can be supplied from the outside. This mode is intended to be used together with a digital decoder which is providing clock and reference pulses.

In the horizontal processing part the signals WE1, WE2 and CLV are generated. The vertical processing block supplies the signals RSTW1 and RSTW2 as well as enable signals for the horizontal part. The start and stop position of the pulses are programmable, the increment being 4 clock cycles in the horizontal part and 1 line in the vertical part. For WE1 and WE2 an additional 2-bit fine delay is available.

Display related control signals are derived from the display PLL. The functions are similar to the acquisition part. The PLL can be switched to 32 or 36 MHz, in case of 27 MHz this clock is taken from the deflection PLL which always runs on 27 MHz. In the horizontal part the pulse WE2, RE1, RE2 and BLN are programmable in increments of 4 clock cycles, each one adjustable by an additional 2-bit fine delay. The vertical processing block generates VDFL, RSTW2 and enable signals for the horizontal part.

The deflection PLL runs on 27 MHz. From this clock the 16 kHz PLL reference pulse HRDFL is generated as well as the 32 kHz deflection pulse HDFL.

In the vertical acquisition part the distance between the incoming 50 Hz vertical synchronization pulse VACQ and the horizontal synchronization pulse CLV generated by the horizontal deflection circuit is measured. In addition the field length is calculated by the acquisition counter, which is enabled by CLV.

A fixed vertical reset pulse RSTW1 and a programmable vertical control of the write enable pulse WE1 for memory 1 defining the vertical write window are generated.

In the display section the programmable 100 Hz write enable pulse WE2 for the memory 2 and the programmable 100 Hz read enable pulses RE1 and RE2 are provided. The 100 Hz vertical synchronizing signal VDFL is corrected by the calculated values of the acquisition part. The position of this pulse can also be chosen by the microcontroller. Furthermore two field identification signals for 50 Hz and for 100 Hz are generated internally to mark the corresponding fields by the microcontroller.

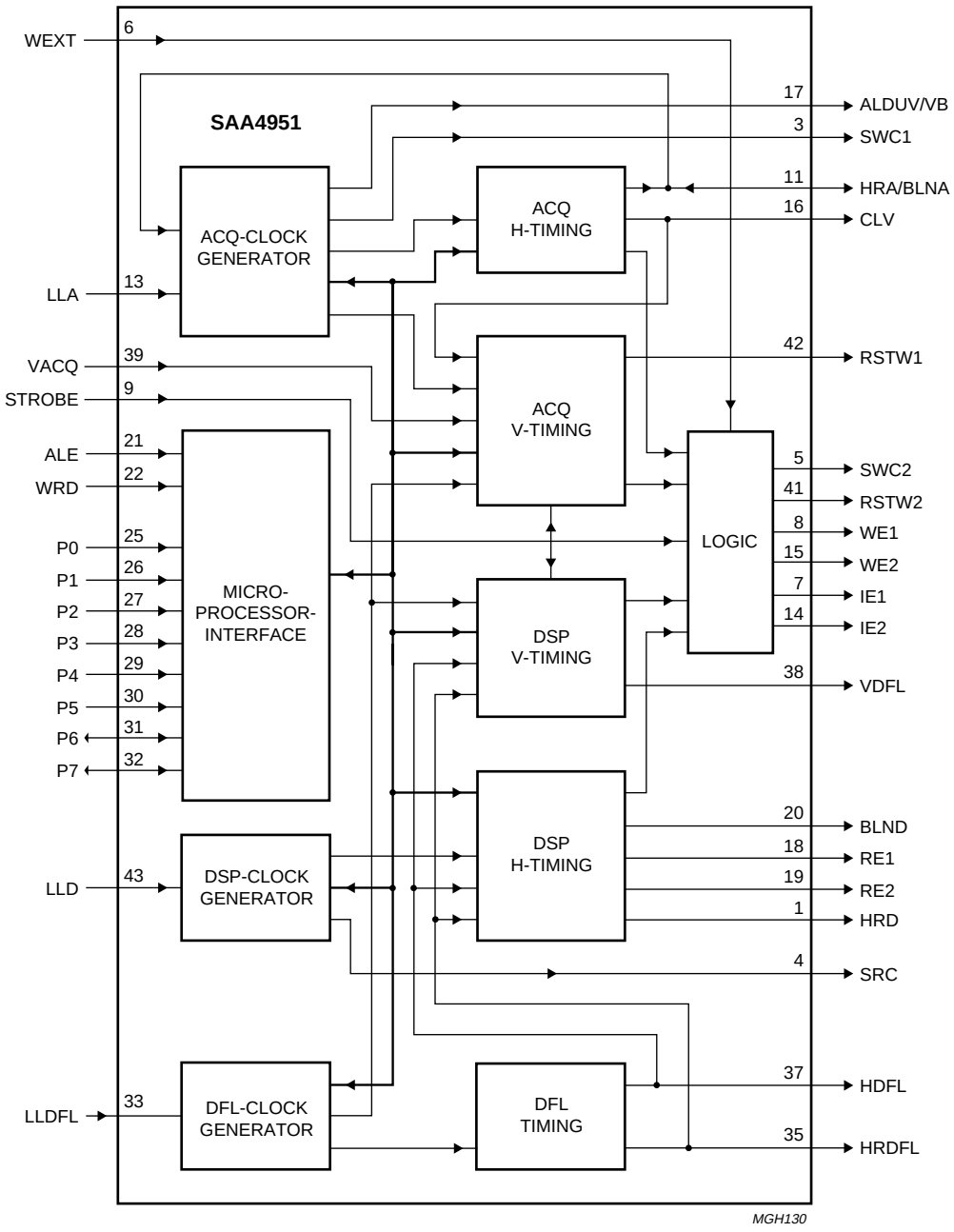


Fig.3 Block diagram.

Microcontroller interface

The SAA4951 is connected to a microcontroller via pins P0 to P7, ALE and WRD. This controller receives commands from the I²C-bus and sets the registers of the SAA4951 accordingly. Fig.4 shows the timing of these signals. Address and data are transmitted sequentially on the bus with the falling edge of ALE denoting a valid address and the falling edge of WRD indicating valid data. The individual registers, their address and their function are listed in Table 1. Various start and stop registers are 9 bits wide, in this case the MSB is combined with other MSBs or fine delay control bits in an extra register which has to be addressed and loaded separately.
In order to load the proper values to the vertical write enable registers in case of median filtering, information about the current 100 Hz field is necessary. To obtain these data, the microcontroller sends the address 80Hex (READ mode) which puts the SAA4951 in output mode for the next address / data cycle. For this one cycle the WRD pin works as a RDN pin.

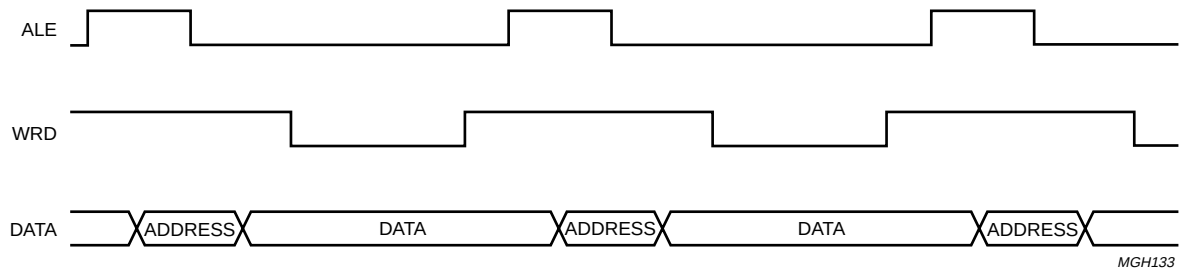


Fig.4 μP-interface timing.

Table 1 Internal registers.

ADDRESS (HEX)	REGISTER	FUNCTION
Vertical pulses generated from the display clock		
40	VDFLSTA	start of VDFL pulse (lower 8 of 9 bits)
41	VDFLSTO	end of VDFL pulse (lower 8 of 9 bits)
42	VWE2STA	start of vertical write enable (lower 8 of 9 bits)
43	VWE2STO	end of vertical write enable (lower 8 of 9 bits)
44	VRE2STA	start of vertical read enable (lower 8 of 9 bits)
45	VRE2STO	end of vertical write enable (lower 8 of 9 bits)
46	VDMSB	bit 0: MSB of VDFLSTA
		bit 1: MSB of VDFLSTO
		bit 2: MSB of VWE2STA
		bit 3: MSB of VWE2STO
		bit 4: MSB of VRE1STA
		bit 5: MSB of VRE1STO

ADDRESS (HEX)	REGISTER	FUNCTION
Horizontal pulses generated from the display clock		
48	BLNDSTA	start of horizontal blanking pulse (lower 8 of 9 bits)
49	BLNDSTO	end of horizontal blanking pulse (lower 8 of 9 bits)
4A	HWE2STA	start of horizontal write enable (lower 8 of 9 bits)
4B	HWE2STO	end of horizontal write enable (lower 8 of 9 bits)
4C	HRESTA	start of horizontal read enable (lower 8 of 9 bits)
4D	HRESTO	end of horizontal read enable (lower 8 of 9 bits)
4E	HDMSB	bit 0: MSB of BLNDSTA
		bit 1: MSB of BLNDSTO
		bit 2: MSB of HWE2STA
		bit 3: MSB of HWE2STO
		bit 4: MSB of HRESTA
		bit 5: MSB of HRESTO
4F	HDDEL	bit 0: fine delay of BLND (LSB)
		bit 1: fine delay of BLND (MSB)
		bit 2: fine delay of HWE2 (LSB)
		bit 3: fine delay of HWE2 (MSB)
		bit 4: fine delay of HRE (LSB)
		bit 5: fine delay of HRE (MSB)
Vertical pulses generated from the acquisition clock		
50	VWE1STA	start of vertical write enable (lower 8 of 9 bits)
51	VWE1STO	end of vertical write enable (lower 8 of 9 bits)
52	VAMSB	bit 0: MSB of VWE1STA
		bit 1: MSB of VWE1STO
Horizontal pulses generated from the acquisition clock		
58	CLVSTA	start of CLV pulse
59	CLVSTO	end of CLV pulse
5A	HWE1STA	start of horizontal write enable (lower 8 of 9 bits)
5B	HWE1STO	end of horizontal write enable (lower 8 of 9 bits)
5C	HAMSBDEL	bit 0: MSB of HWE1STA
		bit 1: MSB of HWE1STO
		bit 2: fine delay of HWE1 (LSB)
		bit 3: fine delay of HWE1 (MSB)
		bit 4: memory configuration bit 2 (MC2): 0 = 1050/60; 1 = 1070/2970
		bit 5: WEXT (external WE)
		bit 6: SFR (select field recognition)

ADDRESS (HEX)	REGISTER	FUNCTION
Registers to turn on different modes		
60	MODE0	mode register 0
61	MODE1	mode register 1
		the bits of the two mode registers define the operating mode of the SAA4951
80	READ	read mode
		by sending this address the SAA4951 is switched to output mode for the next address/data cycle, i. e. the microcontroller reads data from the SAA4951

As it can be seen from the above table the registers form groups which are reflected in the addressing scheme according to Table 2.

Table 2 Internal register addressing scheme.

INTERNAL REGISTER ADDRESS								
RW	**OP**	**MO**	**AD**	**HV**	**D2**	**D1**	**D0**	
7	**6**	**5**	**4**	**3**	**2**	**1**	**0**	
1	X	X	X	X	X	X	X	microcontroller reads data
0	0	X	X	X	X	X	X	all registers off
0	1	1	X	X	X	X	D	select mode 1 / mode 2
0	1	0	1	1	D	D	D	select hor. ACQ registers
0	1	0	1	0	D	D	D	select vert. ACQ registers
0	1	0	0	1	D	D	D	select hor. DSP registers
0	1	0	0	0	D	D	D	select vert. DSP registers

Note

1. X = don’t care, D = data bit

bit names:	RW	read/write bit: 1 = read, 0 = write
	OP	operate bit, must be 1 to address any register
	MO	mode bit, select mode registers
	AD	select acquisition (= 1) or display (= 0) registers
	HV	select horizontal (= 1) or vertical (= 0) registers
	D2	data bit 2
	D1	data bit 1
	D0	data bit 0

The bits of the two mode registers control the operation modes.

Table 3 Mode registers.

REGISTER	BIT	NAME	REMARKS		
MODE0	0 (LSB)	FSA0	frequency select acquisition bit 0		
	1	FSA1	frequency select acquisition bit 1		
	2	FSD0	frequency select display bit 0		
	3	FSD1	frequency select display bit 1		
			FSA1	**FSA0**	**acquisition frequency**
			0	0	12.0 MHz
			0	1	13.5 MHz
			1	0	16.0 MHz
			1	1	18.0 MHz
			FSD1	**FSD0**	**display frequency**
			0	0	27.0 MHz
			0	1	27.0 MHz
			1	0	32.0 MHz
			1	1	36.0 MHz
	4	FORMAT0	control bit 0 for data format		
MODE0	5	FORMAT1	control bit 1 for data format		
			FORMAT1	**FORMAT0**	**Y:U:V data rate**
			0	0	4: 1: 1
			0	1	4: 2: 2
			1	0	4: 4: 4
			1	1	4: 4: 4
	6	HDEL0	horizontal delay control bit 0		
	7 (MSB)	HDEL1	horizontal delay control bit 1		
			the bits HDEL0, HDEL1 control the position of the internal vertical read enable signals for RE1		
			HDEL1	**HDEL0**	
			0	0	2 lines earlier
			0	1	1 line earlier
			1	0	normal
			1	1	1 line later

REGISTER	BIT	NAME	REMARKS		
MODE1	0 (LSB)	DR	display raster		
	1	STPWM1	stop writing to memory 1: still picture mode		
	2	STPWM2	stop writing to memory 2: still picture mode		
	3	MC1	memory configuration bit 1		
			0: two field memories; 1: one field memory		
	4	GSC	golden scart		
			0: normal IPQ mode; 1: golden scart input		
	5	CCIR60	for external mode (13.5 MHz input clock) only:		
			0 = 50 Hz, 864 clock cycles per line; 1 = 60 Hz, 858 clock cycles per line		
	6	EXTLLA	horizontal reference pulse BLNA and clock LLA from external source		
			0: internal (PLL); 1: external		
	7	VFS	vertical frequency select		
			VFS	**DR**	**display mode**
			0	0	100 Hz (312.5 lines) ABAB raster
			0	1	100 Hz (313/312.5/312/312.5 lines) AABB raster
			1	0	50 Hz (625 lines) 1:1, non-interlaced
			1	1	50 Hz (1250 lines) 2:1, interlaced

Description of acquisition part

LLA

This is the main input clock pulse for the acquisition side of the memory controller generated by an external PLL circuit. Depending on the chosen system application LLA runs on the different frequencies of 12/13.5/16/18 MHz. The PLL circuit is controlled by the analog burst key pulse ABK provided by an inserted synchronization circuit (i. e. TDA2579) and the horizontal reference signal HRA supplied by the SAA4951 circuit.

WEXT

External write enable input for digital colour decoder applications, where the write enable signal is generated by the digital colour decoder. This signal is simply sampled by LLA and fed out at WE1.

SWC1

The acquisition clock input signal LLA is connected through the memory controller circuit. LLA is internally buffered and put out as serial write clock SWC1 for the memory 1. Additionally SWC1 is used as a clock signal for the three AD-converters and for the formatter function.

ALDUV/VB

The output signal ALDUV (analog load for the chrominance signals U and V) controls the formation of the 8-bit digital data information of the chrominance signals U and V.

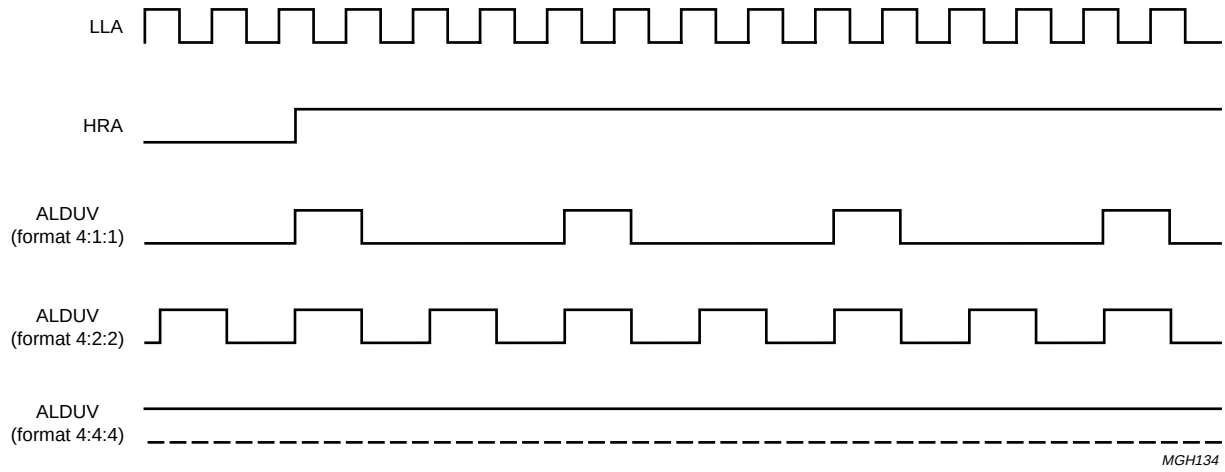


Fig.5 Timing of the signal ALDUV.

In case of an external write enable signal WEXT this output provides a vertical blanking signal, which can be used to generate a sandcastle pulse. The settings for the blanking signal are done with the registers VWE1STA (falling edge) and VWE1STO (rising edge).

CLV

The horizontal video clamping output pulse is generated by the acquisition clock signal LLA and is used as clamp pulse for the incoming luminance and chrominance signals Y, U, V of the three analog to digital converters. The time reference of CLV is the LOW-to-HIGH transition of the HRA signal.

HRA/BLNA

The horizontal reference output pulse HRA operates on the two standards PAL and NTSC.
In the PAL standard HRA has a frequency of 15.625 kHz and in the NTSC standard the frequency is 15.734 kHz. In both cases the duty cycle of this signal is 50%.
When the memory controller circuit is operating in a digital environment, a horizontal reference signal BLNA and a suitable acquisition clock pulse have to be supplied from the external used circuits (i. e. SAA7151A, DMSD and SAA7157, CGC).

WE1

A HIGH level on this output pin enables picture data to be written to field memory 1. WE1 is a composite signal, which includes the horizontal write enable signal as well as the vertical one.
It is possible to delay the horizontal timing of WE1 up to three LLA clock cycles. In case of an external write enable signal WEXT the horizontal and vertical settings and the delay control have no influence on WE1.
WE1 operates at a vertical frequency of 50 Hz. When the progressive scan mode is activated, WE1 is disabled every second field. In still picture mode this signal is set to LOW level.

IE1

This output signal is used as a data input enable for memory 1. A logic HIGH level on this output pin enables the data information to be written into field memory 1. Via signal IE1 the still picture function is controlled. When this mode is selected, IE1 is switched to LOW level. It is possible to disable the still picture mode with externally supplied STROBE pulses.

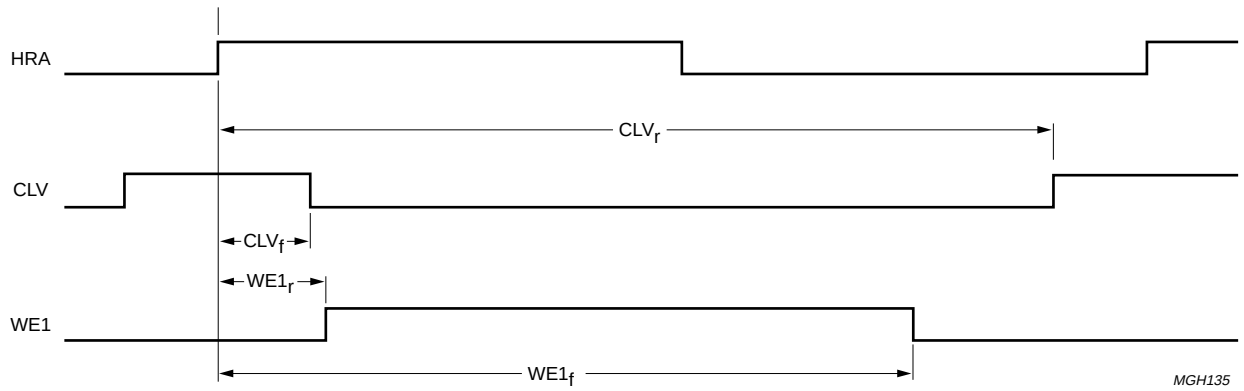


Fig.6 Programmable horizontal acquisition signals.

Table 4 Horizontal programming range of CLV and WE1 (see also Fig.6).

13.5 MHz, 50 Hz	$CLV_r = (4Nr + 2) \times LLA$	$0 \leq Nr < 215$
	$CLV_f = (4Nf + 2) \times LLA$	$0 < Nf \leq 215$
	$WE1_r = (2Nr + 2) \times LLA$	$0 \leq Nr < 431$
	$WE1_f = (2Nf + 2) \times LLA$	$0 < Nf \leq 431$
13.5 MHz, 60 Hz	$CLV_r = (4Nr + 2) \times LLA$	$0 \leq Nr < 213$
	$CLV_f = (4Nf + 2) \times LLA$	$0 < Nf \leq 213$
	$WE1_r = (2Nr + 2) \times LLA$	$0 \leq Nr < 428$
	$WE1_f = (2Nf + 2) \times LLA$	$0 < Nf \leq 428$
18 MHz	$CLV_r = (8Nr + 4) \times LLA$	$0 \leq Nr < 143$
	$CLV_f = (8Nf + 4) \times LLA$	$0 < Nf \leq 143$
	$WE1_r = (4Nr + 4) \times LLA$	$0 \leq Nr < 287$
	$WE1_f = (4Nf + 4) \times LLA$	$0 < Nf \leq 287$
16 MHz	$CLV_r = (4Nr + 2) \times LLA$	$0 \leq Nr < 255$
	$CLV_f = (4Nf + 2) \times LLA$	$0 < Nf \leq 255$
	$WE1_r = (2Nr + 2) \times LLA$	$0 \leq Nr < 511$
	$WE1_f = (2Nf + 2) \times LLA$	$0 < Nf \leq 511$
12 MHz	$CLV_r = (4Nr + 2) \times LLA$	$0 \leq Nr < 191$
	$CLV_f = (4Nf + 2) \times LLA$	$0 < Nf \leq 191$
	$WE1_r = (2Nr + 2) \times LLA$	$0 \leq Nr < 383$
	$WE1_f = (2Nf + 2) \times LLA$	$0 < Nf \leq 383$

$Nr \neq Nf$

VACQ

This is the 50 Hz vertical synchronization input signal derived from a suitable vertical synchronization circuit (i. e. TDA2579). The LOW-to-HIGH transition of this pulse is the timing reference of all vertical control signals of the SAA4951.

RSTW1

The reset write output pulse 1 starts the write address pointer of field memory 1. The RSTW1 signal is derived from the 50 Hz vertical acquisition pulse VACQ and has a pulse width of 64 μs (PAL) (see Fig.7).

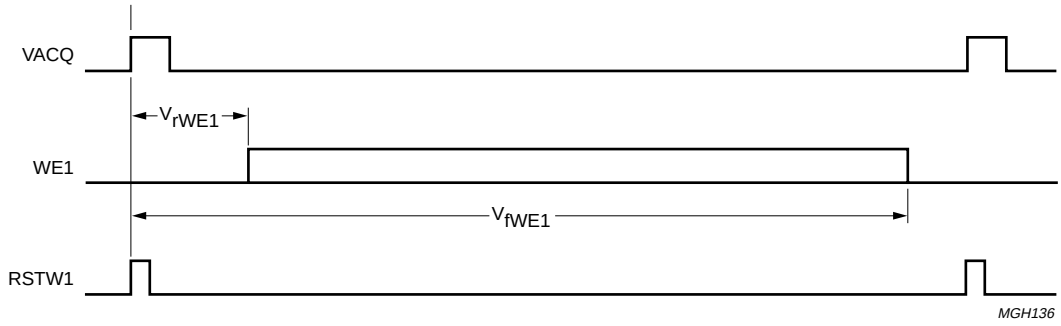


Fig.7 Vertical acquisition timing.

Table 5 Vertical programming range of WE1 (see also Fig.7).

50 Hz	$V_{rWE1} = Nr \times Line$	$1 \leq Nr < 311$
	$V_{fWE1} = Nf \times Line$	$1 < Nf \leq 311$
60 Hz	$V_{rWE1} = Nr \times Line$	$1 \leq Nr < 261$
	$V_{fWE1} = Nf \times Line$	$1 < Nf \leq 261$

$Nr \neq Nf$

STROBE

The asynchronous active HIGH STROBE input controls the input enable signals IE1 and IE2 of the memory block in the still picture mode.

Description of display part

LLD

The input signal LLD is the main line-locked clock for the display side of SAA4951 generated by an external PLL circuit. Depending on the chosen application, LLD runs on three different frequencies 12/32/36 MHz. The PLL circuit is controlled by the horizontal deflection drive output pulse HDFL and the horizontal reference output signal HRD supplied by the memory controller.

SWC2

Depending on the chosen system mode the output pin SWC2 delivers either the serial acquisition clock signal LLA (PSC mode, 50 Hz) or the serial display clock pulse LLD (two field memories, 100 Hz) to write the data information into memory 2.

SRC

The display clock input signal LLD is connected through the memory controller. LLD is internally buffered and put out as serial read clock SRC for field memory 1. Additionally SRC is used as clock pulse for the noise reduction circuit NORIC and the backend circuit BENDIC.

HRD

The horizontal reference display pulse HRD has a duty cycle of 50% and a frequency of 32 kHz. HRD is the reference pulse for the horizontal timing of the control signals RE1, RE2, WE2 and BLND generated by the display circuit of SAA4951.

BLND

The output signal BLND is a horizontal blanking pulse and is used for the peripheral circuits NORIC and BENDIC. A LOW level indicates the blanking interval, a HIGH level indicates valid data from the memories. It is possible to delay the horizontal timing of BLND up to three steps of LLD clock pulses.

WE2

A HIGH level on this output pin enables picture data to be written to field memory 2. WE2 is a composite signal, which includes the horizontal write enable signal as well as the vertical one.
The horizontal timing of WE2 can be delayed up to three steps of LLD clock pulses.
The WE2 output signal is used in different modes. When two field memories are implemented in a serial structure, WE2 operates at a vertical frequency of 100 Hz. In case two field memories are connected in parallel, WE2 has a vertical frequency of 50 Hz. In the progressive scan mode the WE2 signal is disabled every second field.

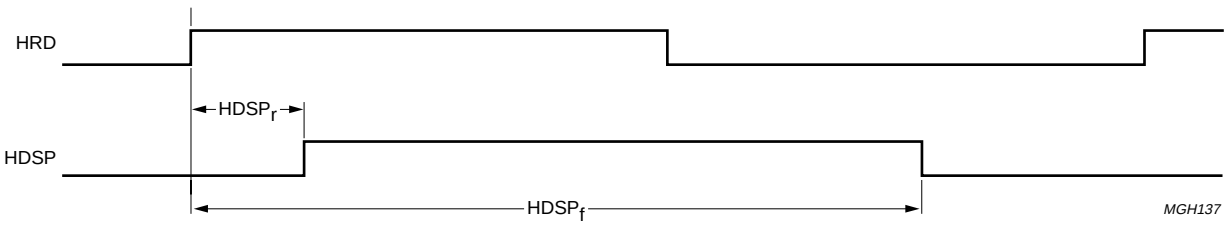


Fig.8 Programmable horizontal display signals (HDSP = BLN, WE2, RE1 or RE2).

Table 6 Horizontal programming range for display signals (HDSP = BLN, WE2, RE1 or RE2; see also Fig.8).

27 MHz, 50 Hz	$HDSP_r = (2Nr + 2) \times LLD$	$0 \leq Nr < 431$
	$HDSP_f = (2Nf + 2) \times LLD$	$0 < Nf \leq 431$
27 MHz, 60 Hz	$HDSP_r = (2Nr + 2) \times LLD$	$0 \leq Nr < 428$
	$HDSP_f = (2Nf + 2) \times LLD$	$0 < Nf \leq 428$
32 MHz	$HDSP_r = (2Nr + 2) \times LLD$	$0 \leq Nr < 511$
	$HDSP_f = (2Nf + 2) \times LLD$	$0 < Nf \leq 511$
36 MHz, 50 Hz	$HDSP_r = (4Nr + 4) \times LLD$	$0 \leq Nr < 287$
	$HDSP_f = (4Nf + 4) \times LLD$	$0 < Nf \leq 287$
36 MHz, 60 Hz	$HDSP_r = (4Nr + 4) \times LLD$	$0 \leq Nr < 285$
	$HDSP_f = (4Nf + 4) \times LLD$	$0 < Nf \leq 285$

$Nr \neq Nf$

IE2

This output signal is used as data input enable for memory 2. A logic HIGH level on this output pin enables the data information to be written to field memory 2.

RE1

The output RE1 is the read enable signal for field memory 1. A HIGH level enables the picture data to be read from the memory. RE1 is a composite signal and includes the horizontal read enable timing as well as the vertical timing. It is possible to delay the horizontal timing of RE1 up to three steps of LLD clock pulses.

Furthermore the vertical timing can be set one or two lines before RE2 respectively one line after RE2 (median filtering, noise reduction mode).

RE2

The output RE2 is the read enable signal for field memory 2. A HIGH level enables the picture data to be read from memory 2. RE2 is a composite signal and includes the horizontal read enable timing as well as the vertical timing. The horizontal timing of RE2 can be delayed up to three steps of LLD clock pulses.

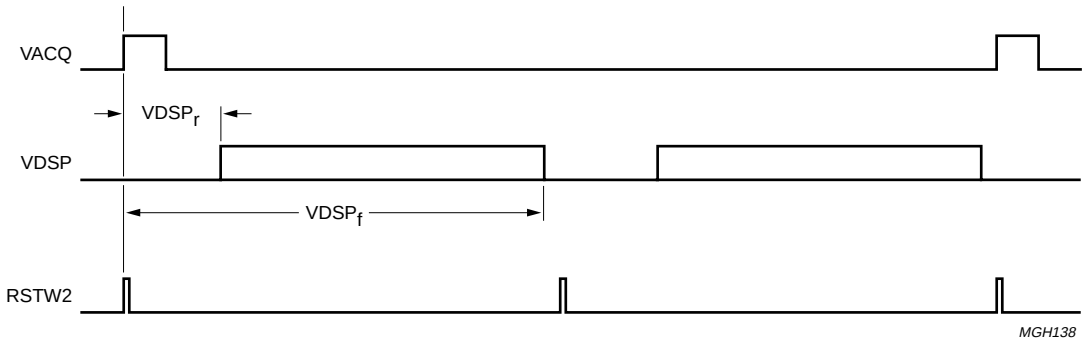


Fig.9 Vertical display timing (VDSP = V_{WE2}, $V_{RE1/2}$ or VDFL).

Table 7 Vertical programming range for display signals (VDSP = WE2, RE1 or RE2; see also Fig.9).

50 Hz	$VDSP_r = Nr \times Line$	$1 \leq Nr < 311$
	$VDSP_f = Nf \times Line$	$1 < Nf \leq 311$
60 Hz	$VDSP_r = Nr \times Line$	$1 \leq Nr < 261$
	$VDSP_f = Nf \times Line$	$1 < Nf \leq 261$

$Nr \neq Nf$

RSTW2

The reset write output pulse 2 starts the write address pointer of field memory 2. There are two functions possible for this pin. If a serial structure of the memories is implemented, RSTW2 is a 100 Hz pulse; in progressive scan mode and with one field memory, RSTW2 is a 50 Hz pulse. The pulse duration of RSTW2 is 32 μs (PAL).

Description of deflection part

LLDFL

The input signal LLDFL is the main line-locked clock pulse for the deflection side of the memory controller generated by an external PLL circuit. The frequency of LLDFL is always 27 MHz and is independent of the chosen feature modes. The PLL circuit operates on the video clamping pulse CLV of the acquisition part and the horizontal reference signal HRDFL generated by the deflection side of SAA4951.

HRDFL

This horizontal output signal is the reference pulse for the horizontal deflection drive signal HDFL. The duty cycle of HRDFL is 50% and the cycle time is 64 μs (PAL). In case of golden scart mode the cycle time is reduced to 32 μs.

HDFL

The output signal HDFL is aimed for driving the connected horizontal deflection circuit. HDFL has a cycle time of 32 μs and a pulse width of 64 x LLDFL = 2.37 μs

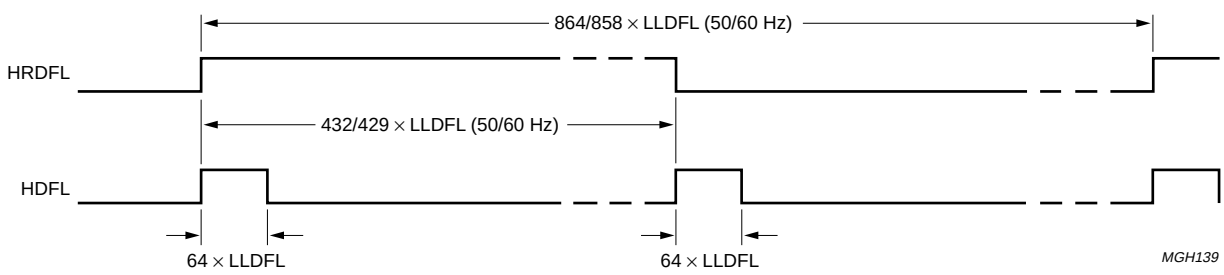


Fig.10 Horizontal deflection timing.

VDFL

This is the vertical synchronization output signal generated by the acquisition side of SAA4951. The timing reference of VDFL is the LOW-to HIGH transition of the vertical acquisition input pulse VACQ. Normally VDFL has a pulse width of 2.5 x HDFL = 80 μs and a cycle time of 100 Hz.

In normal mode the memory controller operates with two field memories and 100 Hz interlace picture reproduction. When the system includes only one field memory it is necessary to activate the AABB mode. In the simple field repetition mode the first two and the last two 100 Hz fields are out one upon another

Description of control inputs/outputs

ALE

The address latch enable input signal ALE is provided by the microcontroller. A falling edge of ALE denotes a valid address.

WRD

This is the write/read enable control signal supplied by the microcontroller. The HIGH-to-LOW transition of WRD indicates valid data.

P0 to P7

The SAA4951 is controlled by the bidirectional port bus P0.0 to P0.7 of a microcontroller. Address and data are transmitted sequentially on the bus.

TEST

The TEST input pin has to be connected to ground.

Timing specification

The internal delays of the output signals referred to the respective clock are given in Table 8.

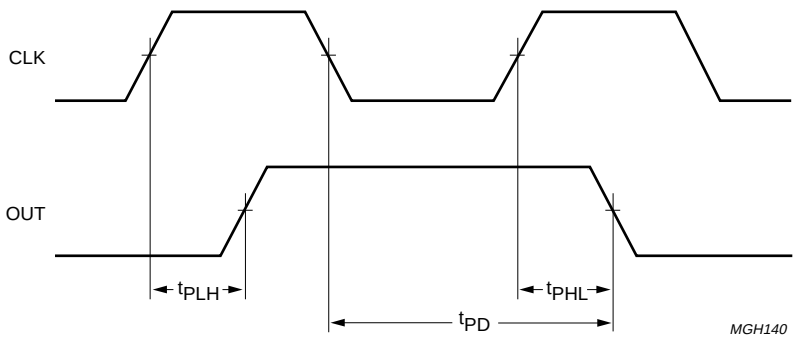


Fig.11 Timing diagram.

Table 8 Delay table.
Conditions: V_{DD} = +4.5 V; T_j =+70 °C (worst case).

CLK	OUT	LOAD (pF)	t_{PLH} (ns)	t_{PHL} (ns)	t_{PD} (ns)
LLA	SWC1	15	6.4	–	6.5
LLD	SRC	45	11.2	–	13.7
LLDFL	SRC	45	11.9	–	13.9
SRC	SWC2	25	3.2	–	2.6
SWC1	WE1	15	15.9	18.9	–
SWC2	WE2	10	8.0	10.9	–
SRC	RE1	10	7.0	8.6	–
SRC	RE2	10	7.2	8.7	–
LLDFL	HDFL	25	12.8	15.8	–
LLDFL	HRDFL	10	11.9	13.9	–
SWC1	HRA	10	6.5	8.4	–
SRC	HRD	10	5.6	7.6	–
SRC	BLND	25	7.4	10.3	–
SWC1	ALDUV	25	11.5	14.0	–
LLDFL	VB	25	28.2	30.3	–
SWC1	CLV	25	8.3	11.3	–
LLDFL	VDFL	25	24.6	27.6	–
LLA	WE1(EXT)	25	18.1	21.1	–

LIMITING VALUES

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

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
V_{DD}	supply voltage	–0.5	+6.0	V
V_I	input voltage	–0.5	V_{DD} + 0.5	V
T_{amb}	operating ambient temperature	0	+70	°C
T_{stg}	storage temperature	–40	+125	°C

CHARACTERISTICS

Recommended operating conditions

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
V_{DD}	DC supply voltage	4.5	5.0	5.5	V
V_I	DC input voltage	–0.5	–	V_{DD}+0.5	V
V_O	DC output voltage	–0.5	–	V_{DD}+0.5	V
I_{DD}	supply current	–	50	–	mA
T_{amb}	operating ambient temperature	0	–	70	°C
T_j	junction temperature	0	–	140	°C

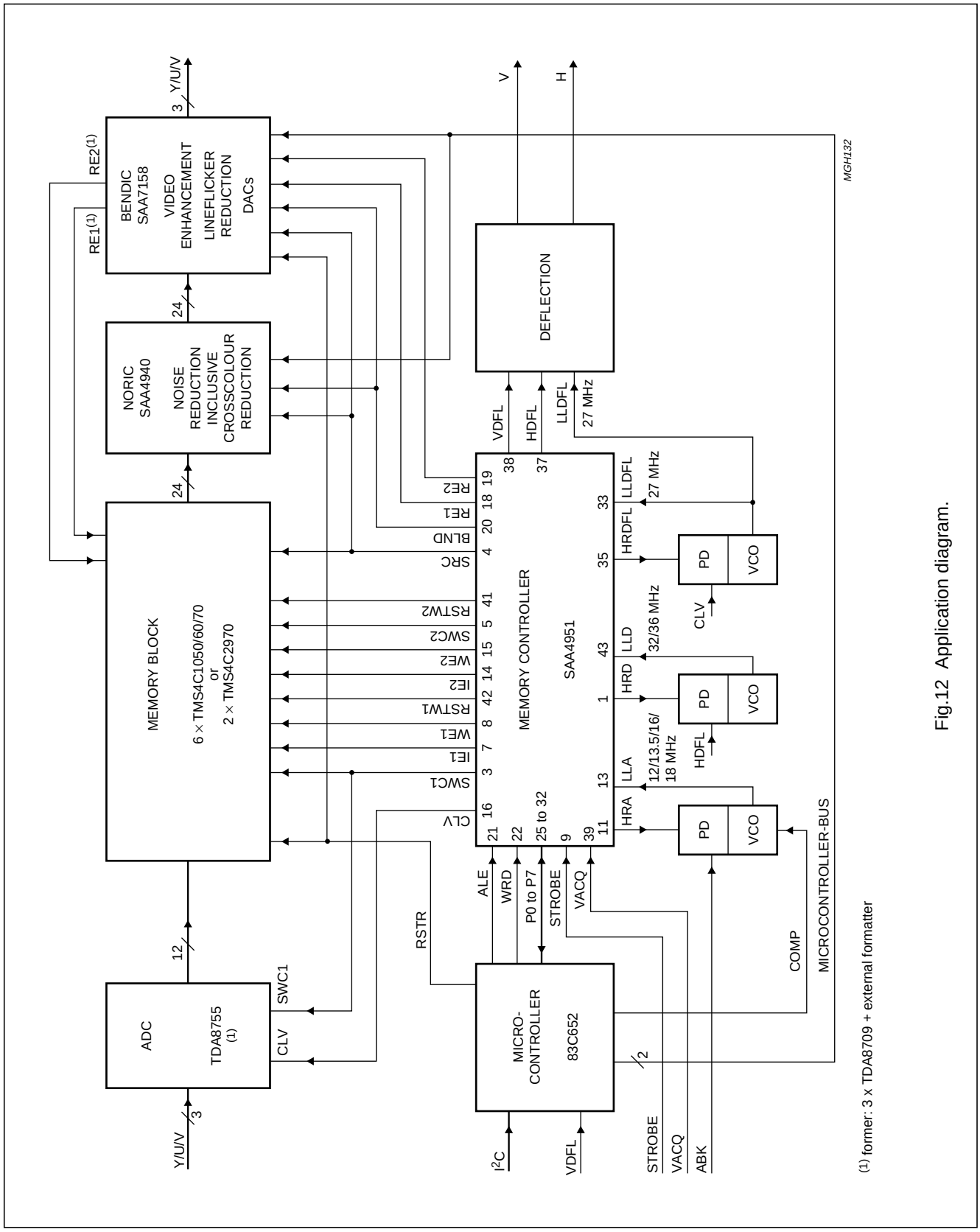
DC Characteristics

SYMBOL	PARAMETER	T_{amb} = +25 °C		UNIT	TEST CONDITIONS		
		MIN.	MAX.		V_{DD} (V)	V_I (V)	OTHER
v_{IH}	TTL-input	2.0	–	V	4.5	–	–
	HIGH level input voltage	2.0			5.5		
V_{IL}	TTL-input	–	0.8	V	4.5	–	–
	LOW level input voltage		0.8		5.5		
V_{OH}	HIGH level output voltage	4.4	–	V	4.5	V_{IH} or V_{IL}	I_0 = –2 µA
		5.4			5.5		I_0 = –2 µA
		3.1			4.5		I_0 = –4.0 mA/ 8.0 mA (SRC)
V_{OL}	LOW level output voltage	–	0.1	V	4.5	V_{IH} or V_{IL}	I_0 = +2 µA
			0.1		5.5		I_0 = +2 µA
			0.27		4.5		I_0 = –4.0 mA/ 8.0 mA (SRC)
I_{LI}	input leakage current	–	±1.0	µA	5.5	V_{DD} or V_{SS}	–
R_{pull}	internal pull-up resistor for I/O cells	42	150	kΩ	4.5	–	–
		35	105		5.5		

APPLICATION INFORMATION

Fig.12 shows a block diagram of the application environment of the memory controller SAA4951. The full option chip set of the new TV-feature system (third generation) controlled by the I^2C-bus includes the following circuits:

TDA8709	3 × ADC (8-bit) with clamp and gain setting, 30 MHz or
TDA8755	1 × ADC
TMS4C10XX	1 Mbit video RAM, (optional TMS4C1050/60/70) or
TMS4C2970	2.9 Mbit video RAM
SAA7158	BENDIC (Back END IC) with LFR, CTI, Y-Peaking, DAC
SAA4940	NORIC (NOise Reduction IC) with Noise Reduction (NR) and Cross Colour Reduction (CCR)
SAA4951	Memory controller
83C652	μC software control of activated features

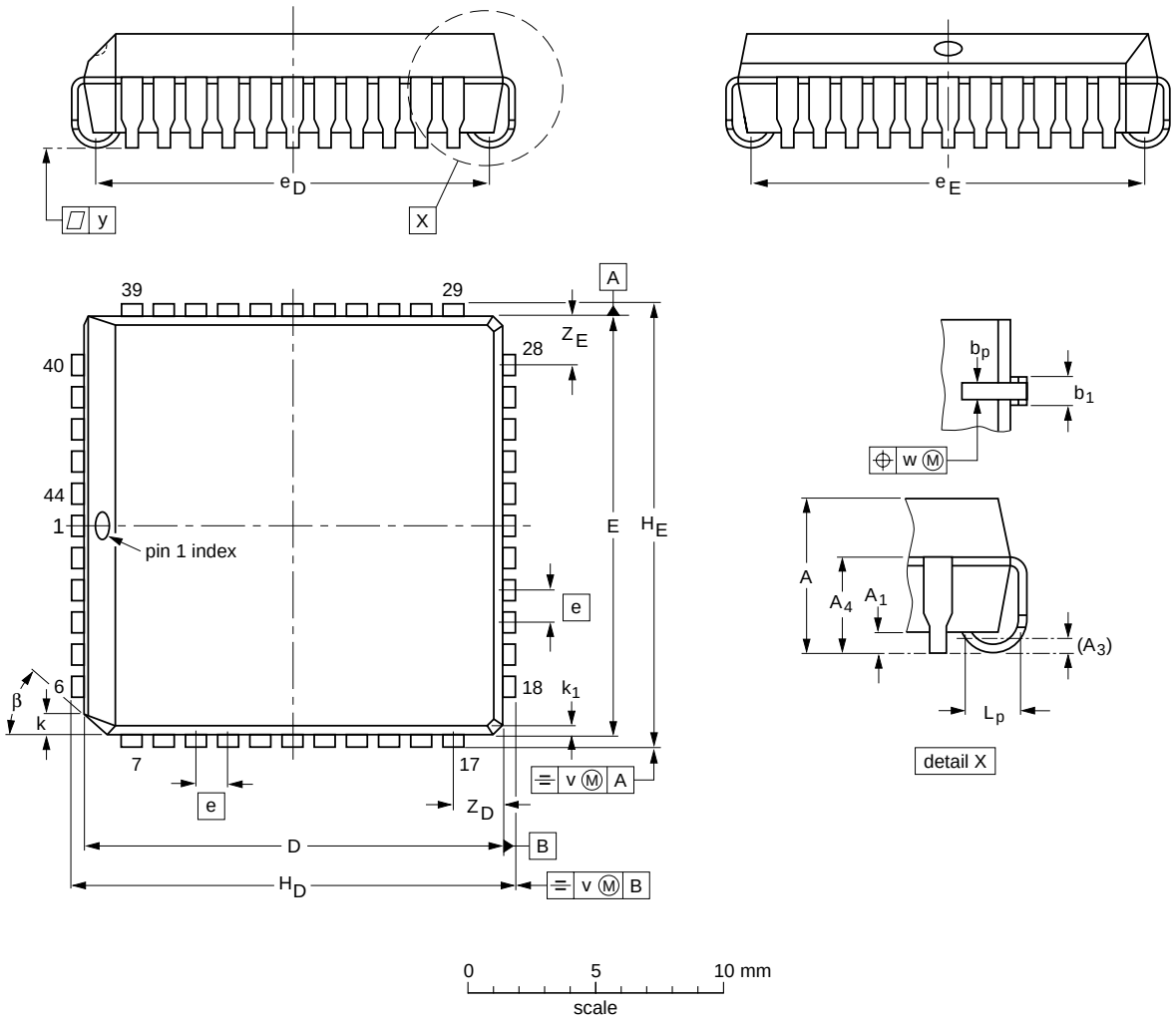


(1) former: 3 x TDA8709 + external formatter

Fig.12 Application diagram.

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 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 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 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.