

DATA SHEET



SAA8115HL Digital camera USB interface IC

Preliminary specification
File under Integrated Circuits, IC22

1999 Jun 28

Digital camera USB interface IC

SAA8115HL



FEATURES

- VGA (progressive mode), CIF and medium resolution (PAL non-interlaced mode) CCD sensors compliant
- D1 digital video input (8 bits YUV 4 : 2 : 2, time multiplexed)
- Internal Pulse Pattern Generator (PPG) dedicated for VGA Panasonic, CIF and medium resolution Sharp sensors or compatibles, and frame rate selection
- Frame rate converter
- SDRAM interface for high quality VGA snapshot (uncompressed 4 : 2 : 2)
- Downsampler and scaler (programmable formatter for CIF, QCIF, sub-QCIF, SIF and QSIF) controlled via SNERT (UART) interface
- Flexible compression engine controlled via SNERT (UART) interface
- Selectable output frame rate (up to 15 fps in VGA, up to 30 fps in CIF and QCIF)
- Video packetizer FIFO
- I²C-bus interface for communication between the USB protocol hardware and the external microcontroller
- Microphone/audio input to USB (microphone supply, controllable gain and ADC)

- Integrated analog bus driver (ATX)
- Integrated main oscillator
- Integrated 5 V power and reset circuit including functions for bus-powered USB device
- Miscellaneous functions e.g. power management, PLL for audio frequencies.

APPLICATIONS

Low-cost desktop video applications with USB interface.

GENERAL DESCRIPTION

The SAA8115HL is the second generation of an integrated circuit applicable in PC video cameras to convert D1 video signals and analog audio signals to properly formatted USB packets.

This powerful successor of the SAA8117HL can handle up to 15 fps in VGA format or 30 fps in CIF format. High snapshot quality is achieved by using the SDRAM interface to an external memory.

It is designed as a back-end of the SAA8112HL (general camera digital processing IC) and is optimized for use with the TDA8784 to TDA8787 (camera pre-processing ICs).

ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
SAA8115HL	LQFP144	plastic low profile quad flat package; 144 leads; body 20 × 20 × 1.4 mm	SOT486-1

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QUICK REFERENCE DATA

Measured over full voltage and temperature range.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{DDD}	digital supply voltage		3.0	3.3	3.6	V
V_{DDA}	analog supply voltage		3.0	3.3	3.6	V
$V_{DDA(USB)}$	analog supply voltage from USB	note 1	4.0	5.0	5.5	V
$I_{DD(tot)}$	total supply current	$V_{DDD} = 3.3\text{ V}$	–	tbf	–	mA
V_I	input signal levels	$3.0\text{ V} < V_{DDD} < 3.6\text{ V}$	low voltage TTL compatible			V
V_O	output signal levels	$3.0\text{ V} < V_{DDD} < 3.6\text{ V}$	low voltage TTL compatible			V
f_{clk}	clock frequency		–	48	–	MHz
P_{tot}	total power dissipation	$T_{amb} = 25\text{ °C}$	–	tbf	–	mW
T_{stg}	storage temperature		–55	–	+150	°C
T_{amb}	ambient temperature		0	25	70	°C
T_j	junction temperature	$T_{amb} = 70\text{ °C}$	–40	–	+125	°C

Note

1. This concerns pins VBUS1 and VBUS2 (pins 90 and 91).

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BLOCK DIAGRAM

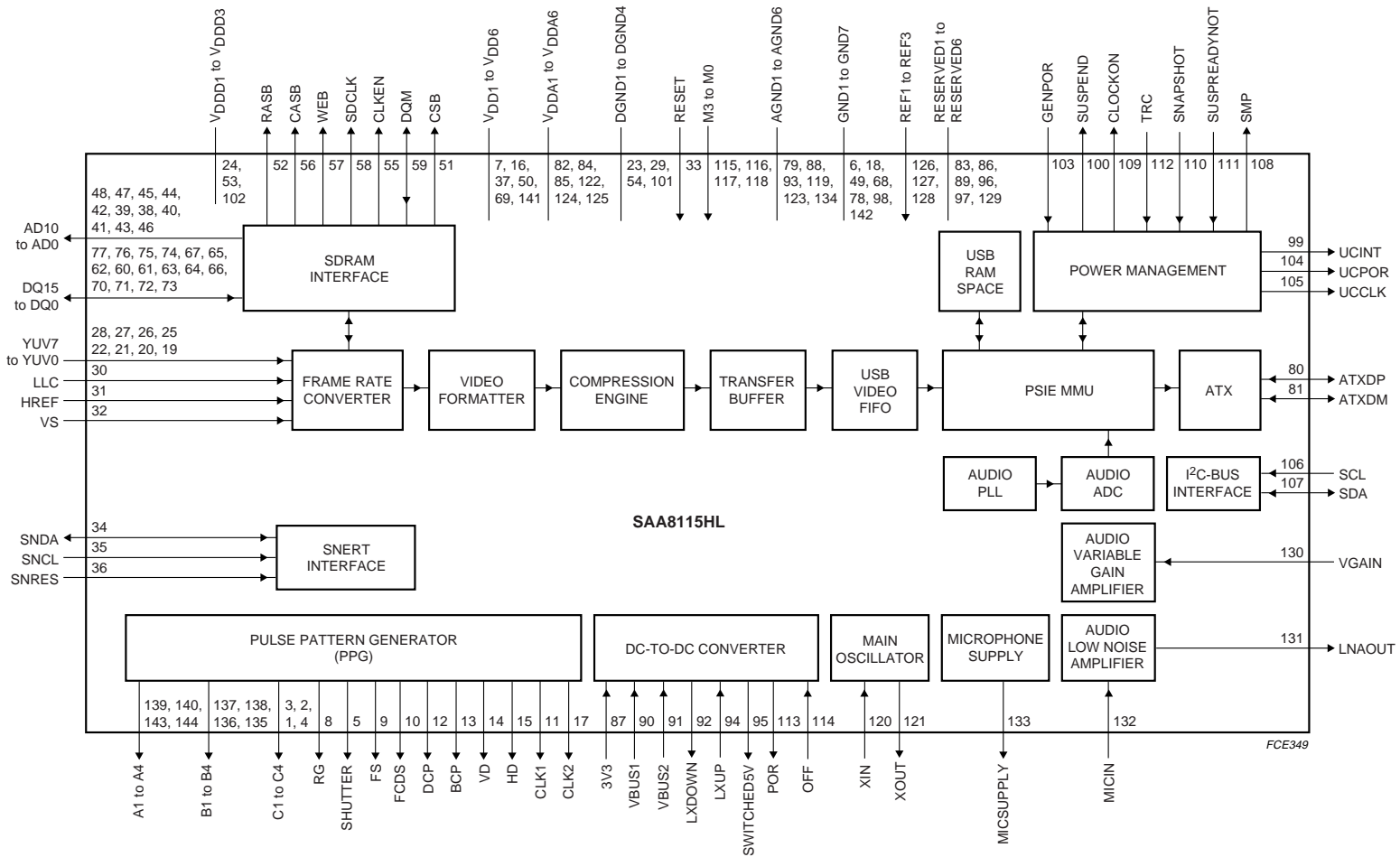


Fig.1 Block diagram.

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PINNING

SYMBOL	PIN	TYPE	DESCRIPTION
C3	1	O	horizontal CCD transfer pulse output
C2	2	O	horizontal CCD transfer pulse output (FH1)
C1	3	O	horizontal CCD transfer pulse output (FH2)
C4	4	O	horizontal CCD transfer pulse output
SHUTTER	5	O	shutter control output for CCD charge reset
GND1	6	P	ground 1 for output buffers
V _{DD1}	7	P	supply voltage 1 for output buffers
RG	8	O	reset output for CCD output amplifier gate
FS	9	O	data sample-and-hold pulse output to TDA8784/87 (SHD)
FCDS	10	O	preset sample-and-hold pulse output to TDA8784/87 (SHP)
CLK1	11	O	pixel clock output to TDA8784/87 and SAA8112HL
DCP	12	O	dummy clamp pulse output to TDA8784/86
BCP	13	O	optical black clamp pulse output to TDA8784/86
VD	14	O	vertical definition pulse output to SAA8112HL
HD	15	O	horizontal definition pulse output to SAA8112HL
V _{DD2}	16	P	supply voltage 2 for output buffers
CLK2	17	O	double pixel clock output to SAA8112HL
GND2	18	P	ground 2 for output buffers
YUV0	19	I	multiplexed input YUV bit 0
YUV1	20	I	multiplexed input YUV bit 1
YUV2	21	I	multiplexed input YUV bit 2
YUV3	22	I	multiplexed input YUV bit 3
DGND1	23	P	digital ground 1 for input buffers, predrivers and for the digital core
V _{DD1}	24	P	digital supply voltage 1 for input buffers, predrivers and one part of the digital core
YUV4	25	I	multiplexed input YUV bit 4
YUV5	26	I	multiplexed input YUV bit 5
YUV6	27	I	multiplexed input YUV bit 6
YUV7	28	I	multiplexed input YUV bit 7
DGND2	29	P	digital ground 2 for input buffers, predrivers and for the digital core
LLC	30	I	line-locked clock input (delayed CLK2) for YUV-port from SAA8112HL
HREF	31	I	horizontal reference input for YUV-port from SAA8112HL
VS	32	I	vertical synchronization input for YUV-port from SAA8112HL
RESET	33	I	Power-on reset input (for video processing and PPG)
SNDA	34	I/O	data input/output for SNERT-interface (communication between SAA8115HL and SAA8112HL)
SNCL	35	I	clock input for SNERT-interface (communication between SAA8115HL and SAA8112HL)
SNRES	36	I	reset input for SNERT-interface (communication between SAA8115HL and SAA8112HL)
V _{DD3}	37	P	supply voltage 3 for output buffers

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SYMBOL	PIN	TYPE	DESCRIPTION
AD4	38	O	SDRAM output address bit 4
AD5	39	O	SDRAM output address bit 5
AD3	40	O	SDRAM output address bit 3
AD2	41	O	SDRAM output address bit 2
AD6	42	O	SDRAM output address bit 6
AD1	43	O	SDRAM output address bit 1
AD7	44	O	SDRAM output address bit 7
AD8	45	O	SDRAM output address bit 8
AD0	46	O	SDRAM output address bit 0
AD9	47	O	SDRAM output address bit 9
AD10	48	O	SDRAM output address bit 10
GND3	49	P	ground 3 for output buffers
V _{DD4}	50	P	supply voltage 4 for output buffers
CSB	51	O	SDRAM chip select output
RASB	52	O	SDRAM row address strobe output
V _{DDD2}	53	P	digital supply voltage 2 for the switchable digital core
DGND3	54	P	digital ground 3 for input buffers, predrivers and for the digital core
CLKEN	55	O	SDRAM clock enable output
CASB	56	O	SDRAM column address strobe output
WEB	57	O	SDRAM write enable output
SDCLK	58	O	SDRAM clock output
DQM	59	I/O	SDRAM data input/output mask enable
DQ8	60	I/O	SDRAM data I/O bit 8
DQ7	61	I/O	SDRAM data I/O bit 7
DQ9	62	I/O	SDRAM data I/O bit 9
DQ6	63	I/O	SDRAM data I/O bit 6
DQ5	64	I/O	SDRAM data I/O bit 5
DQ10	65	I/O	SDRAM data I/O bit 10
DQ4	66	I/O	SDRAM data I/O bit 4
DQ11	67	I/O	SDRAM data I/O bit 11
GND4	68	P	ground 4 for output buffers
V _{DD5}	69	P	supply voltage 5 for output buffers
DQ3	70	I/O	SDRAM data I/O bit 3
DQ2	71	I/O	SDRAM data I/O bit 2
DQ1	72	I/O	SDRAM data I/O bit 1
DQ0	73	I/O	SDRAM data I/O bit 0
DQ12	74	I/O	SDRAM data I/O bit 12
DQ13	75	I/O	SDRAM data I/O bit 13
DQ14	76	I/O	SDRAM data I/O bit 14
DQ15	77	I/O	SDRAM data I/O bit 15
GND5	78	P	ground 5 for output buffers

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SYMBOL	PIN	TYPE	DESCRIPTION
AGND1	79	P	analog ground 1 for ATX (transceiver)
ATXDP	80	I/O	positive driver of the differential data pair input/output (ATX)
ATXDM	81	I/O	negative driver of the differential data pair input/output (ATX)
V _{DDA1}	82	P	analog supply voltage 1 for ATX
RESERVED1	83	–	test pin 1 (should not be used)
V _{DDA2}	84	P	analog supply voltage 2 for band gap (reference)
V _{DDA3}	85	P	analog supply voltage 3 for band gap, comparator and ring oscillator
RESERVED2	86	–	test pin 2 (should not be used)
3V3	87	I	3V3 detector input signal
AGND2	88	P	analog ground 2 for N-switch
RESERVED3	89	–	test pin 3 (should not be used)
VBUS1	90	I	supply voltage input 1 from the USB
VBUS2	91	I	supply voltage input 2 from the USB
LXDOWN	92	O	LX coil node output (5 V downconverter)
AGND3	93	P	analog ground 3 for N-switch
LXUP	94	I	LX coil node input (5 V upconverter)
SWITCHED5V	95	O	5 V switched power supply
RESERVED4	96	–	test pin 4 (should not be used)
RESERVED5	97	–	test pin 5 (should not be used)
GND6	98	P	ground 6 for output buffers
UCINT	99	O	interrupt output from USB to microcontroller
SUSPEND	100	O	control output from USB protocol hardware to microcontroller
DGND4	101	P	digital ground 4 for input buffers, predrivers and for the digital core
V _{DD3}	102	P	digital supply voltage 3 for input buffers, predrivers and one part of the digital core
GENPOR	103	I	Power-on reset input (for USB protocol hardware)
UCPOR	104	O	control output from USB protocol hardware to microcontroller
UCCLK	105	O	clock output from USB protocol hardware to microcontroller
SCL	106	I	slave I ² C-bus clock input
SDA	107	I/O	slave I ² C-bus data input/output
SMP	108	O	switch mode pulse output for CCD supplies
CLOCKON	109	O	control output for main oscillator switched on
SNAPSHOT	110	I	input for remote wake-up (snapshot)
SUSREADYNOT	111	I	input from microcontroller for SUSPEND mode
TRC	112	I	threshold control input for enabling clock
POR	113	O	3.3 V supply domain ready indicator output
OFF	114	I	disable 5 V switchable supply domain input
M3	115	I	test mode control input signal bit 3
M2	116	I	test mode control input signal bit 2
M1	117	I	test mode control input signal bit 1
M0	118	I	test mode control input signal bit 0
AGND4	119	P	analog ground 4 for crystal oscillator (48 MHz, 3rd overtone)

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SYMBOL	PIN	TYPE	DESCRIPTION
XIN	120	I	oscillator input
XOUT	121	O	oscillator output
V _{DDA4}	122	P	analog supply voltage 4 for crystal oscillator (48 MHz, 3rd overtone)
AGND5	123	P	analog ground 5 for PLL
V _{DDA5}	124	P	analog supply voltage 5 for PLL
V _{DDA6}	125	P	analog supply voltage 6 for amplifier and ADC
REF1	126	I	reference voltage 1 (used in the ADC)
REF2	127	I	reference voltage 2 (used in the ADC)
REF3	128	I	reference voltage 3 (used in the amplifier and the ADC)
RESERVED6	129	–	test pin 6 (should not be used)
VGAIN	130	I	variable gain amplifier input
LNAOUT	131	O	low noise amplifier output
MICIN	132	I	microphone input
MICSUPPLY	133	O	microphone supply output
AGND6	134	P	analog ground 6 for amplifier and ADC
B4	135	O	vertical CCD load pulse output (VH1X)
B3	136	O	vertical CCD load pulse output (VH3X)
B1	137	O	vertical CCD load pulse output
B2	138	O	vertical CCD load pulse output
A1	139	O	vertical CCD transfer pulse output (V1X)
A2	140	O	vertical CCD transfer pulse output (V2X)
V _{DD6}	141	P	supply voltage 6 for output buffers
GND7	142	P	ground 7 for output buffers
A3	143	O	vertical CCD transfer pulse output (V3X)
A4	144	O	vertical CCD transfer pulse output (V4X)

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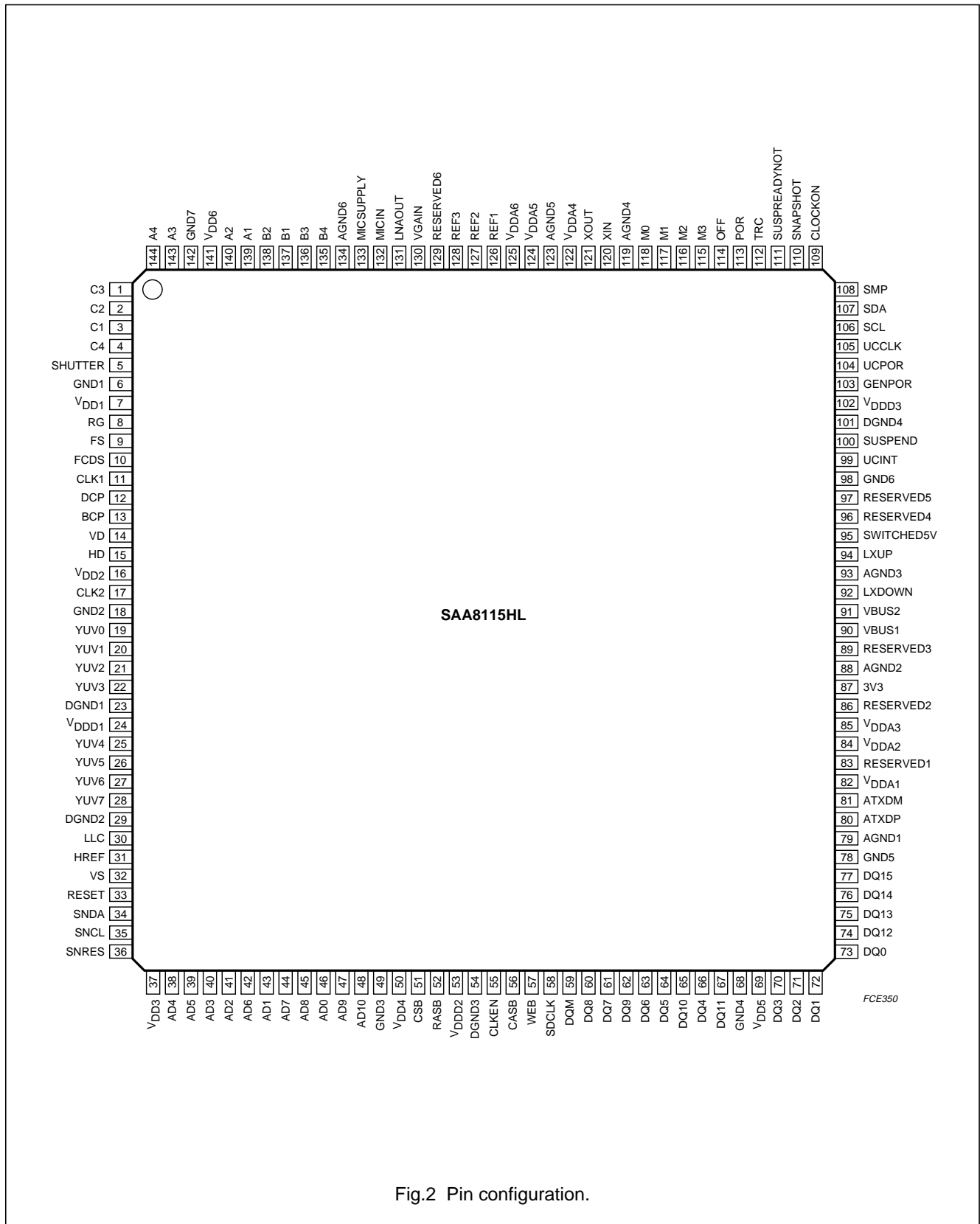


Fig.2 Pin configuration.

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THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	45	K/W

CHARACTERISTICS

$V_{DDD} = V_{DDA} = 3.3 \text{ V} \pm 10\%$; $T_{amb} = 0 \text{ to } 70 \text{ }^\circ\text{C}$.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supplies						
V_{DDD}	digital supply voltage		3.0	3.3	3.6	V
V_{DDA}	analog supply voltage		3.0	3.3	3.6	V
V_{DGND}	digital ground supply		-0.3	0.0	+0.3	V
V_{AGND}	analog ground supply		-0.3	0.0	+0.3	V
I_{DDD}	digital supply current	$T_{amb} = 25 \text{ }^\circ\text{C}$	-	tbf	-	mA
I_{DDA}	analog supply current	$T_{amb} = 25 \text{ }^\circ\text{C}$	-	tbf	-	mA
T_{amb}	temperature range		0	25	70	$^\circ\text{C}$
Data and control inputs						
V_{IL}	LOW-level input voltage		-	-	0.8	V
V_{IH}	HIGH-level input voltage		2.0	-	-	V
Data and control outputs						
V_{OL}	LOW-level output voltage		-	-	0.8	V
V_{OH}	HIGH-level output voltage		2.0	-	-	V

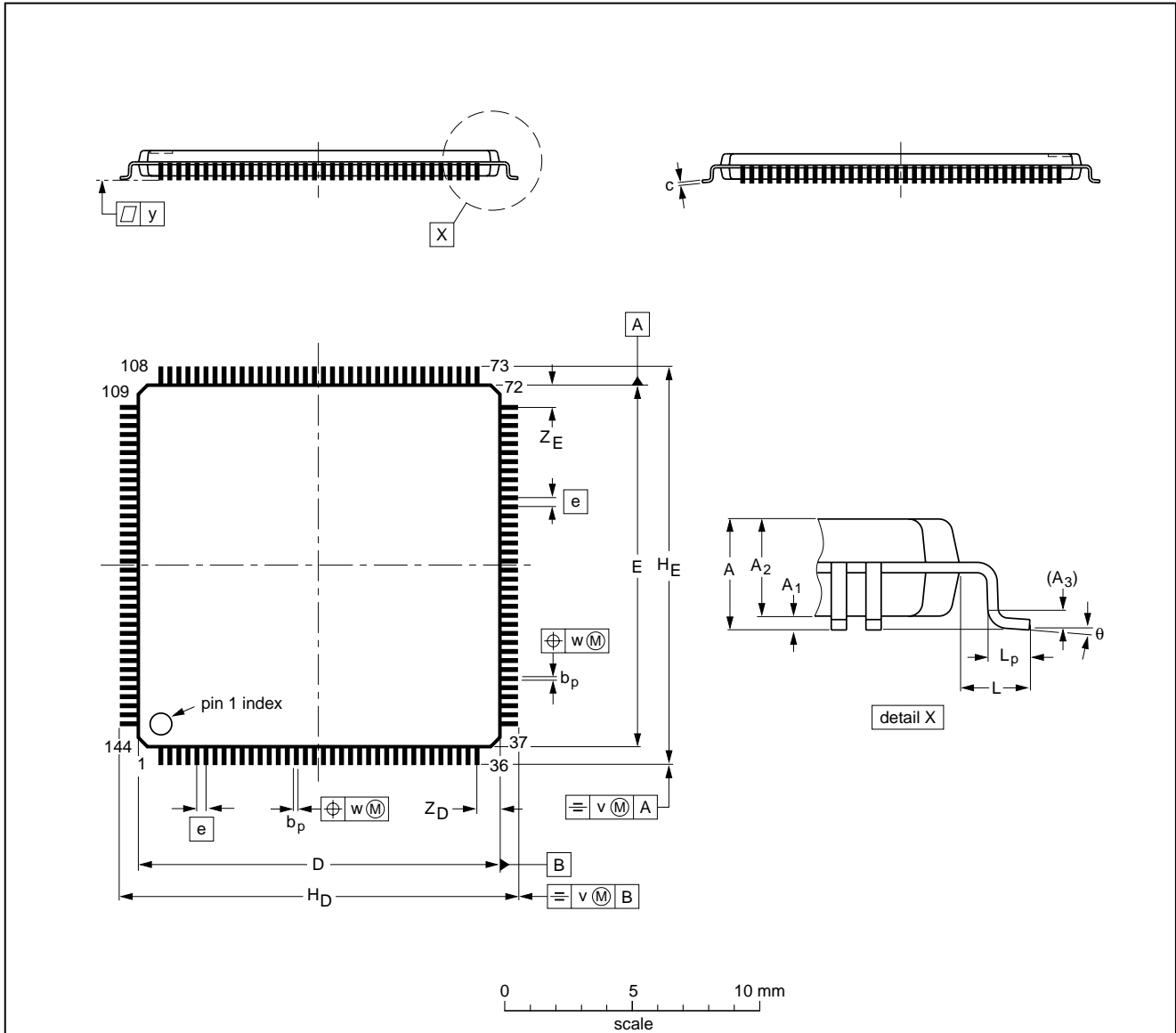
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PACKAGE OUTLINE

LQFP144: plastic low profile quad flat package; 144 leads; body 20 x 20 x 1.4 mm

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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	v	w	y	Z _D ⁽¹⁾	Z _E ⁽¹⁾	θ
mm	1.6	0.15 0.05	1.45 1.35	0.25	0.27 0.17	0.20 0.09	20.1 19.9	20.1 19.9	0.50	22.15 21.85	22.15 21.85	1.0	0.75 0.45	0.2	0.1	0.1	1.40 1.10	1.40 1.10	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			
SOT486-1						97-08-04

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SOLDERING

Introduction to soldering surface mount packages

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our *"Data Handbook IC26; Integrated Circuit Packages"* (document order number 9398 652 90011).

There is no soldering method that is ideal for all surface mount IC packages. Wave soldering is not always suitable for surface mount ICs, or for printed-circuit boards with high population densities. In these situations reflow soldering is often used.

Reflow soldering

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

Several methods exist for reflowing; for example, infrared/convection heating in a conveyor type oven. Throughput times (preheating, soldering and cooling) vary between 100 and 200 seconds depending on heating method.

Typical reflow peak temperatures range from 215 to 250 °C. The top-surface temperature of the packages should preferably be kept below 230 °C.

Wave soldering

Conventional single wave soldering is not recommended for surface mount devices (SMDs) or printed-circuit boards with a high component density, as solder bridging and non-wetting can present major problems.

To overcome these problems the double-wave soldering method was specifically developed.

If wave soldering is used the following conditions must be observed for optimal results:

- Use a double-wave soldering method comprising a turbulent wave with high upward pressure followed by a smooth laminar wave.
- For packages with leads on two sides and a pitch (e):
 - larger than or equal to 1.27 mm, the footprint longitudinal axis is **preferred** to be parallel to the transport direction of the printed-circuit board;
 - smaller than 1.27 mm, the footprint longitudinal axis **must** be parallel to the transport direction of the printed-circuit board.

The footprint must incorporate solder thieves at the downstream end.

- For packages with leads on four sides, the footprint must be placed at a 45° angle to the transport direction of the printed-circuit board. The footprint must incorporate solder thieves downstream and at the side corners.

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

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.

Manual soldering

Fix the component by first soldering two diagonally-opposite end leads. Use a low voltage (24 V or less) soldering iron applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C.

When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.

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Suitability of surface mount IC packages for wave and reflow soldering methods

PACKAGE	SOLDERING METHOD	
	WAVE	REFLOW ⁽¹⁾
BGA, SQFP	not suitable	suitable
HLQFP, HSQFP, HSOP, HTSSOP, SMS	not suitable ⁽²⁾	suitable
PLCC ⁽³⁾ , SO, SOJ	suitable	suitable
LQFP, QFP, TQFP	not recommended ⁽³⁾⁽⁴⁾	suitable
SSOP, TSSOP, VSO	not recommended ⁽⁵⁾	suitable

Notes

1. All surface mount (SMD) packages are moisture sensitive. Depending upon the moisture content, the maximum temperature (with respect to time) and body size of the package, there is a risk that internal or external package cracks may occur due to vaporization of the moisture in them (the so called popcorn effect). For details, refer to the Drypack information in the “Data Handbook IC26; Integrated Circuit Packages; Section: Packing Methods”.
2. These packages are not suitable for wave soldering as a solder joint between the printed-circuit board and heatsink (at bottom version) can not be achieved, and as solder may stick to the heatsink (on top version).
3. If wave soldering is considered, then the package must be placed at a 45° angle to the solder wave direction. The package footprint must incorporate solder thieves downstream and at the side corners.
4. Wave soldering is only suitable for LQFP, TQFP and QFP packages with a pitch (e) equal to or larger than 0.8 mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.65 mm.
5. Wave soldering is only suitable for SSOP and TSSOP packages with a pitch (e) equal to or larger than 0.65 mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.5 mm.

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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.

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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.

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NOTES

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 1248, Fax. +43 1 60 101 1210

Belarus: Hotel Minsk Business Center, Bld. 3, r. 1211, Volodarski Str. 6,
220050 MINSK, Tel. +375 172 20 0733, Fax. +375 172 20 0773

Belgium: see The Netherlands

Brazil: see South America

Bulgaria: Philips Bulgaria Ltd., Energoproject, 15th floor,
51 James Bourchier Blvd., 1407 SOFIA,
Tel. +359 2 68 9211, Fax. +359 2 68 9102

Canada: PHILIPS SEMICONDUCTORS/COMPONENTS,
Tel. +1 800 234 7381, Fax. +1 800 943 0087

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: Sydhavnsgade 23, 1780 COPENHAGEN V,
Tel. +45 33 29 3333, Fax. +45 33 29 3905

Finland: Sinikalliontie 3, FIN-02630 ESPOO,
Tel. +358 9 615 800, Fax. +358 9 6158 0920

France: 51 Rue Carnot, BP317, 92156 SURESNES Cedex,
Tel. +33 1 4099 6161, Fax. +33 1 4099 6427

Germany: Hammerbrookstraße 69, D-20097 HAMBURG,
Tel. +49 40 2353 60, Fax. +49 40 2353 6300

Hungary: see Austria

India: Philips INDIA Ltd, Band Box Building, 2nd floor,
254-D, Dr. Annie Besant Road, Worli, MUMBAI 400 025,
Tel. +91 22 493 8541, Fax. +91 22 493 0966

Indonesia: PT Philips Development Corporation, Semiconductors Division,
Gedung Philips, Jl. Buncit Raya Kav.99-100, JAKARTA 12510,
Tel. +62 21 794 0040 ext. 2501, Fax. +62 21 794 0080

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 02 67 52 2531, Fax. +39 02 67 52 2557

Japan: Philips Bldg 13-37, Kohnan 2-chome, Minato-ku,
TOKYO 108-8507, Tel. +81 3 3740 5130, Fax. +81 3 3740 5057

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, Fax +9-5 800 943 0087

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

Pakistan: see Singapore

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 319762,
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 58088 Newville 2114,
Tel. +27 11 471 5401, Fax. +27 11 471 5398

South America: Al. Vicente Pinzon, 173, 6th floor,
04547-130 SÃO PAULO, SP, Brazil,
Tel. +55 11 821 2333, Fax. +55 11 821 2382

Spain: Balmes 22, 08007 BARCELONA,
Tel. +34 93 301 6312, Fax. +34 93 301 4107

Sweden: Kottbygatan 7, Akalla, S-16485 STOCKHOLM,
Tel. +46 8 5985 2000, Fax. +46 8 5985 2745

Switzerland: Allmendstrasse 140, CH-8027 ZÜRICH,
Tel. +41 1 488 2741 Fax. +41 1 488 3263

Taiwan: Philips Semiconductors, 6F, No. 96, Chien Kuo N. Rd., Sec. 1,
TAIPEI, Taiwan Tel. +886 2 2134 2886, 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: Yukari Dudullu, Org. San. Blg., 2.Cad. Nr. 28 81260 Umraniye,
ISTANBUL, Tel. +90 216 522 1500, Fax. +90 216 522 1813

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. +44 208 730 5000, Fax. +44 208 754 8421

United States: 811 East Arques Avenue, SUNNYVALE, CA 94088-3409,
Tel. +1 800 234 7381, Fax. +1 800 943 0087

Uruguay: see South America

Vietnam: see Singapore

Yugoslavia: PHILIPS, Trg N. Pasica 5/v, 11000 BEOGRAD,
Tel. +381 11 62 5344, Fax. +381 11 63 5777

For all other countries apply to: Philips Semiconductors,
International 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>

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Printed in The Netherlands

545006/25/01/pp16

Date of release: 1999 Jun 28

Document order number: 9397 750 05846

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