

INTEGRATED CIRCUITS

DATA SHEET



TDA8083 Satellite Demodulator and Decoder (SDD3)

Product specification
File under Integrated Circuits, IC02

1999 Jul 28

Satellite Demodulator and Decoder (SDD3)

TDA8083

FEATURES

- One chip Digital Video Broadcasting (DVB) (ETS300421) compliant demodulator and concatenated Viterbi and Reed-Solomon decoder with de-interleaver and de-randomizer
- 3.3 V supply voltage
- Relevant outputs are 5 V tolerant to ease interface to 5 V environment
- Few external components for full application
- On-chip crystal oscillator (4 MHz) and Phase-Locked Loop (PLL) for internal clock generation
- Power-on reset module
- QPSK/BPSK demodulator:
 - Different modulation schemes: Quadrature Phase Shift Keying (QPSK) and Binary Phase Shift Keying (BPSK)
 - Interpolator and internal anti-aliasing filter to handle variable symbol rates
 - Tuner Automatic Gain Control (AGC) control
 - Two on-chip matched 7-bit Analog-to-Digital Converters (ADCs)
 - Square-root raised-cosine Nyquist
 - Maximum symbol frequency of 30 Msymbols/s
 - Can be used at low channel Signal-to-Noise Ratio (S/R)
 - Internal full digital carrier recovery, clock recovery and AGC loops with programmable loop filters
 - Two carrier recovery loops enabling optimum phase noise suppression
 - S/R estimation.
- Viterbi decoder:
 - Rate $\frac{1}{2}$ convolutional code based
 - Constraint length $K = 7$ with $G_1 = 171_{\text{oct}}$ and $G_2 = 133_{\text{oct}}$
 - Supported puncturing code rates: $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{4}{5}$, $\frac{5}{6}$, $\frac{6}{7}$, $\frac{7}{8}$ and $\frac{8}{9}$
 - 4-bit 'soft decision' inputs for both I and Q
 - Truncation length of 144
 - Automatic synchronization to detect puncturing rate and spectral inversion
 - Channel Bit Error Rate (BER) estimation from 10^{-2} to 10^{-8}
 - Differential decoding optional.
- Reed-Solomon (RS) decoder:
 - (204, 188, T = 8) Reed-Solomon code
 - Automatic synchronization of bytes, transport packets and frames
 - Internal convolutional de-interleaving ($l = 12$; using internal memory)
 - De-randomizer based on Pseudo Random Binary Sequence (PRBS)
 - External indication of uncorrectable error (transport error indicator is set)
 - Indication of the number of lost blocks
 - Indication of the number of corrected blocks.
- Interface:
 - I²C-bus interface initializes and monitors the demodulator and Forward Error Correction (FEC) decoder; a default mode is defined
 - 6-bit I/O expander for flexible access to and from the I²C-bus
 - I²C-bus configurable interrupt input
 - Switchable I²C-bus loop-through to suppress I²C-bus crosstalk in the tuner
 - Digital Satellite Equipment Control (DiSEqC) 1.X, tone burst generation and tone mode with a 22 or 44 kHz carrier
 - Parallel or serial output mode for MPEG transport stream (3-state mode also possible)
 - Standby mode for reduced power consumption.
- Package: QFP100
- Boundary scan test.



APPLICATIONS

- Digital satellite TV: demodulation and FEC.

Satellite Demodulator and Decoder (SDD3)

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GENERAL DESCRIPTION

This document specifies a DVB compliant demodulator and forward error correction decoder IC for reception of QPSK or BPSK modulated signals for satellite applications. The Satellite Demodulator and Decoder (SDD) can handle variable symbol rates without adapting the analog filters within the tuner. Typical applications for this device are:

- **MCPC (Multi-Channel Per Carrier):** one QPSK or BPSK modulated signal in a single satellite channel (transponder)
- **Simul-cast:** QPSK or BPSK modulated signal together with a Frequency Modulated (FM) signal in a single satellite channel (transponder).

The TDA8083 can handle variable symbol rates in the range of 12 to 30 Msymbols/s with a minimum number of low cost and non-critical external components.

The TDA8083 has minimal interfaces with the tuner. It only requires the demodulated analog I and Q baseband input signals and provides a tuner AGC control signal. Analog-to-digital conversion is done internally by two matched 7-bit ADCs.

The TDA8083 runs on a low frequency crystal which is upconverted to a clock frequency by means of an internal PLL. Furthermore, the TDA8083 has an internal anti-alias filter, which can cover the range of symbol frequencies without the need to switch external (SAW) filters.

The TDA8083 has a double carrier loop configuration which has excellent capabilities of tracking phase noise. Synchronization of the FEC unit is done completely internally, thereby minimizing I²C-bus communication. The output of the TDA8083 allows different output modes (parallel or serial) to interface to a demultiplexer, descrambler or MPEG-2 decoder including a 3-state mode. For evaluation of the TDA8083, demodulator and Viterbi decoder outputs can be made available externally.

The SDD can be controlled and monitored by the I²C-bus. A 5-bit bidirectional I/O expander and an interrupt line are available. By sending an interrupt signal, the SDD can inform the microcontroller of its internal status. Separate resets are available for logic only, logic plus the I²C-bus and carrier loops. A switchable I²C-bus loop-through to the tuner is implemented to switch off the I²C-bus connection to the tuner. This reduces phase noise in the tuner in case of I²C-bus crosstalk.

Furthermore, for dish control applications hardware supports DiSEqC 1.X and tone burst generation via I²C-bus control. A 22 or a 44 kHz carrier can be generated (tone mode).

Satellite Demodulator and Decoder (SDD3)

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QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V _{DDA}	analog supply voltage		3.0	3.3	3.6	V
V _{DDD}	digital supply voltage		3.0	3.3	3.6	V
I _{DD(tot)}	total supply current	note 1	–	270	340	mA
f _{clk(int)}	internal clock frequency		–	–	64	MHz
r _s	symbol rate		12	–	30	Msymbols/s
α _{ro}	Nyquist roll-off		–	35	–	%
IL	implementation loss	note 2	–	0.3	–	dB
S/R	signal-to-noise ratio	locking the SDD in QPSK mode; note 2	2	–	–	dB
P _{tot}	total power dissipation	T _{amb} = 70 °C; note 1	–	890	1220	mW
T _{stg}	storage temperature		–55	–	+150	°C
T _{amb}	ambient temperature		0	–	70	°C
T _j	junction temperature	T _{amb} = 70 °C	–	–	125	°C

Notes

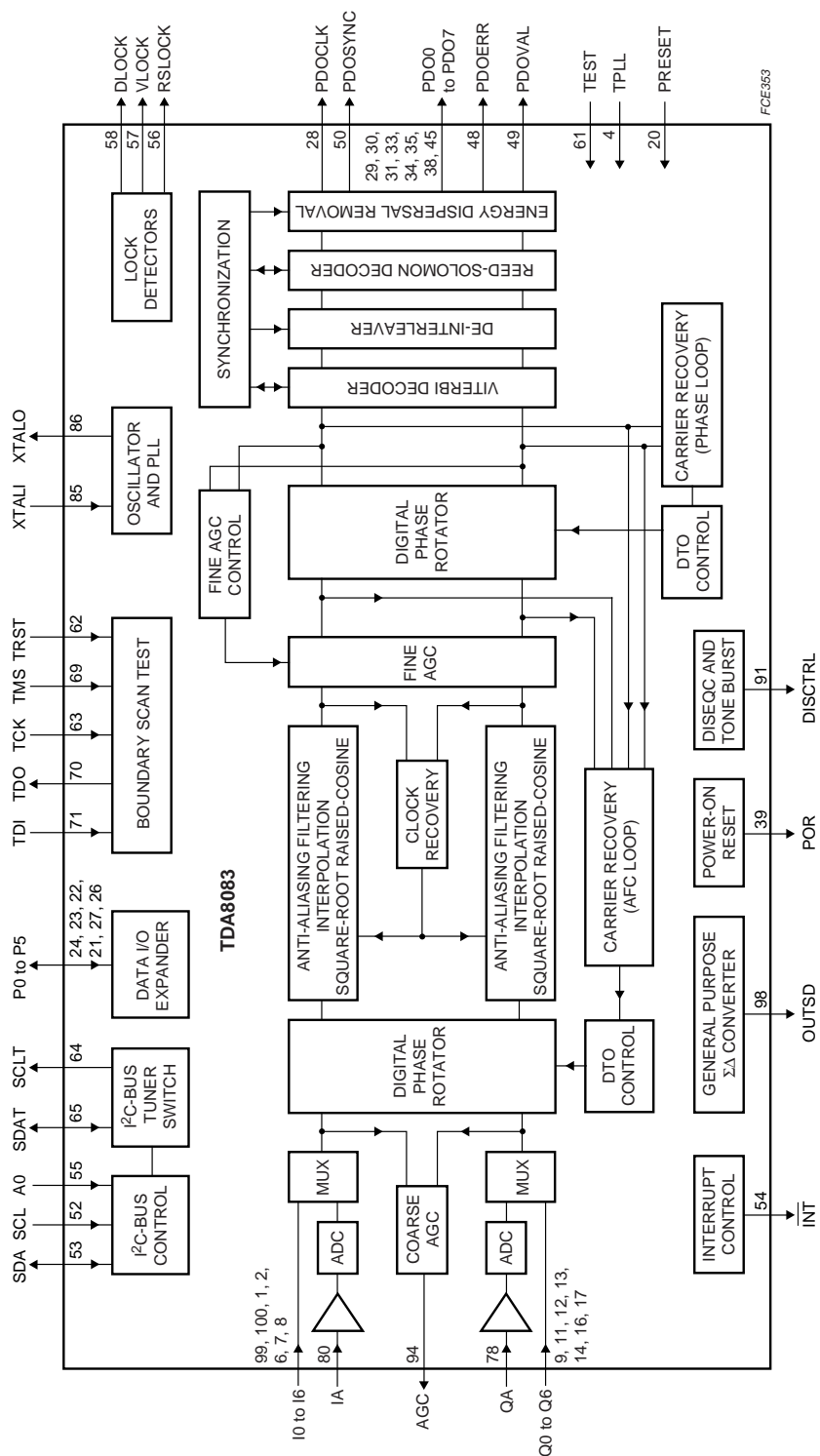
1. Typical value is specified for a symbol rate of 27.5 Msymbols/s, a puncture rate of $\frac{3}{4}$ and a supply voltage of 3.3 V. Maximum value is specified for a symbol rate of 30 Msymbols/s, a puncture rate of $\frac{7}{8}$, a supply voltage of 3.6 V and using a 4 MHz crystal.
2. Implementation loss at the demodulator output and minimum SNR to lock the TDA8083 are measured including tuner in a laboratory environment at a symbol rate of 27.5 MS/s.

ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
TDA8083H	QFP100	plastic quad flat package; 100 leads (lead length 1.95 mm); body 14 × 20 × 2.8 mm	SOT317-2

TDA8083

Fig.1 Block diagram.



Satellite Demodulator and Decoder (SDD3)

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PINNING

SYMBOL	PIN	I/O	DESCRIPTION
I2	1	I	digital I-input bit 2 (ADC bypass); note 1
I3	2	I	digital I-input bit 3 (ADC bypass); note 1
V _{SSD1}	3	–	digital ground 1 (core and input periphery)
TPLL	4	I	test pin (normally connected to ground)
V _{SSD2}	5	–	digital ground 2 (core and input periphery)
I4	6	I	digital I-input bit 4 (ADC bypass); note 1
I5	7	I	digital I-input bit 5 (ADC bypass); note 1
I6	8	I	digital I-input bit 6 (ADC bypass; MSB); note 1
Q0	9	I	digital Q-input bit 0 (ADC bypass; LSB); note 1
V _{DDD1}	10	–	digital supply voltage 1 (core and input periphery)
Q1	11	I	digital Q-input bit 1 (ADC bypass); note 1
Q2	12	I	digital Q-input bit 2 (ADC bypass); note 1
Q3	13	I	digital Q-input bit 3 (ADC bypass); note 1
Q4	14	I	digital Q-input bit 4 (ADC bypass); note 1
V _{SSD3}	15	–	digital ground 3 (core and input periphery)
Q5	16	I	digital Q-input bit 5 (ADC bypass); note 1
Q6	17	I	digital Q-input bit 6 (ADC bypass; MSB); note 1
V _{SSD4}	18	–	digital ground 4 (output periphery)
V _{DDD2}	19	–	digital supply voltage 2 (core and input periphery)
PRESET	20	I	input for default mode setting
P3	21	I/O	quasi-bidirectional I/O port (bit 3)
P2	22	I/O	quasi-bidirectional I/O port (bit 2)
P1	23	I/O	quasi-bidirectional I/O port (bit 1)
P0	24	I/O	quasi-bidirectional I/O port (bit 0)
V _{DDD3}	25	–	digital supply voltage 3 (output periphery)
P5	26	I/O	quasi-bidirectional I/O port (bit 5)
P4	27	I/O	quasi-bidirectional I/O port (bit 4)
PDOCLK	28	O	clock output for transport stream bytes
PDO0	29	O	parallel data output (bit 0) or serial data output
PDO1	30	O	parallel data output (bit 1)
PDO2	31	O	parallel data output (bit 2)
V _{SSD5}	32	–	digital ground 5 (output periphery)
PDO3	33	O	parallel data output (bit 3)
PDO4	34	O	parallel data output (bit 4)
PDO5	35	O	parallel data output (bit 5)
V _{SSD6}	36	–	digital ground 6 (core and input periphery)
V _{SSD7}	37	–	digital ground 7 (core and input periphery)
PDO6	38	O	parallel data output (bit 6)
POR	39	O	Power-on reset output
V _{DDD4}	40	–	digital supply voltage 4 (output periphery)

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SYMBOL	PIN	I/O	DESCRIPTION
V _{DDD5}	41	–	digital supply voltage 5 (core and input periphery)
V _{SSD8}	42	–	digital ground 8 (core and input periphery)
V _{DDD6}	43	–	digital supply voltage 6 (core and input periphery)
V _{DDD7}	44	–	digital supply voltage 7 (output periphery)
PDO7	45	O	parallel data output (bit 7)
n.c.	46	–	not connected
V _{SSD9}	47	–	digital ground 9 (core and input periphery)
PDOERR	48	O	transport error indicator output
PDOVAL	49	O	data valid indicator output
PDOSYNC	50	O	transport packet synchronization pulse output
V _{SSD10}	51	–	digital ground 10 (output periphery)
SCL	52	I	serial clock of I ² C-bus input; note 1
SDA	53	I/O	serial data of I ² C-bus input or output; note 1
INT	54	O	interrupt output (active LOW); note 1
A0	55	I	I ² C-bus hardware address input
RSLOCK	56	O	Reed-Solomon lock indicator output
VLOCK	57	O	Viterbi lock indicator output
DLOCK	58	O	demodulator lock indicator output
V _{DDD8}	59	–	digital supply voltage 8 (core and input periphery)
V _{DDD9}	60	–	digital supply voltage 9 (core and input periphery)
TEST	61	I	test pin (normally connected to ground)
TRST	62	I	BST optional asynchronous reset input (normally connected to ground)
TCK	63	I	BST dedicated test clock input (normally connected to ground)
SCLT	64	O	serial clock of I ² C-bus loop-through output; note 1
SDAT	65	I/O	serial data of I ² C-bus loop-through input or output; note 1
V _{DDD10}	66	–	digital supply voltage 10 (core and input periphery)
V _{SSD11}	67	–	digital ground 11 (output periphery)
V _{SSD12}	68	–	digital ground 12 (core and input periphery)
TMS	69	I	BST control signal input (normally connected to ground)
TDO	70	O	BST serial test data output
TDI	71	I	BST serial test data input (normally connected to ground)
V _{DDD11}	72	–	digital supply voltage 11 (core and input periphery)
V _{SSD13}	73	–	digital ground 13 (core and input periphery)
V _{SSD(AD)}	74	–	digital ground ADC
V _{DDD(AD)}	75	–	digital supply ADC
V _{ref(B)}	76	O	bottom reference voltage output for ADC
V _{SSA1}	77	–	analog ground 1
QA	78	I	analog input Q
V _{ref(Q)}	79	O	AGC decoupling output (Q path)
IA	80	I	analog input I
V _{SSA2}	81	–	analog ground 2

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SYMBOL	PIN	I/O	DESCRIPTION
$V_{\text{ref(I)}}$	82	O	AGC decoupling output (I path)
V_{DDA}	83	–	analog supply voltage
$V_{\text{DD(XTAL)}}$	84	–	supply voltage for crystal oscillator
XTALI	85	I	crystal oscillator input
XTALO	86	O	crystal oscillator output
$V_{\text{SS(XTAL)}}$	87	–	ground for crystal oscillator
V_{DDD12}	88	–	digital supply voltage 12 (core and input periphery)
V_{DDD13}	89	–	digital supply voltage 13 (core and input periphery)
V_{SSD14}	90	–	digital ground 14 (core and input periphery)
DISCTRL	91	O	22 or 44 kHz output for dish control applications
V_{SSD15}	92	–	digital ground 15 (output periphery)
V_{SSD16}	93	–	digital ground 16 (core and input periphery)
AGC	94	O	tuner AGC output; note 1
n.c.	95	–	not connected
V_{DDD14}	96	–	digital supply voltage 14 (output periphery)
V_{DDD15}	97	–	digital supply voltage 15 (core and input periphery)
OUTSD	98	O	sigma delta output; note 1
I0	99	I	digital I-input bit 0 (ADC bypass; LSB); note 1
I1	100	I	digital I-input bit 1 (ADC bypass); note 1

Note

1. This pin is 5 V tolerant.

Satellite Demodulator and Decoder
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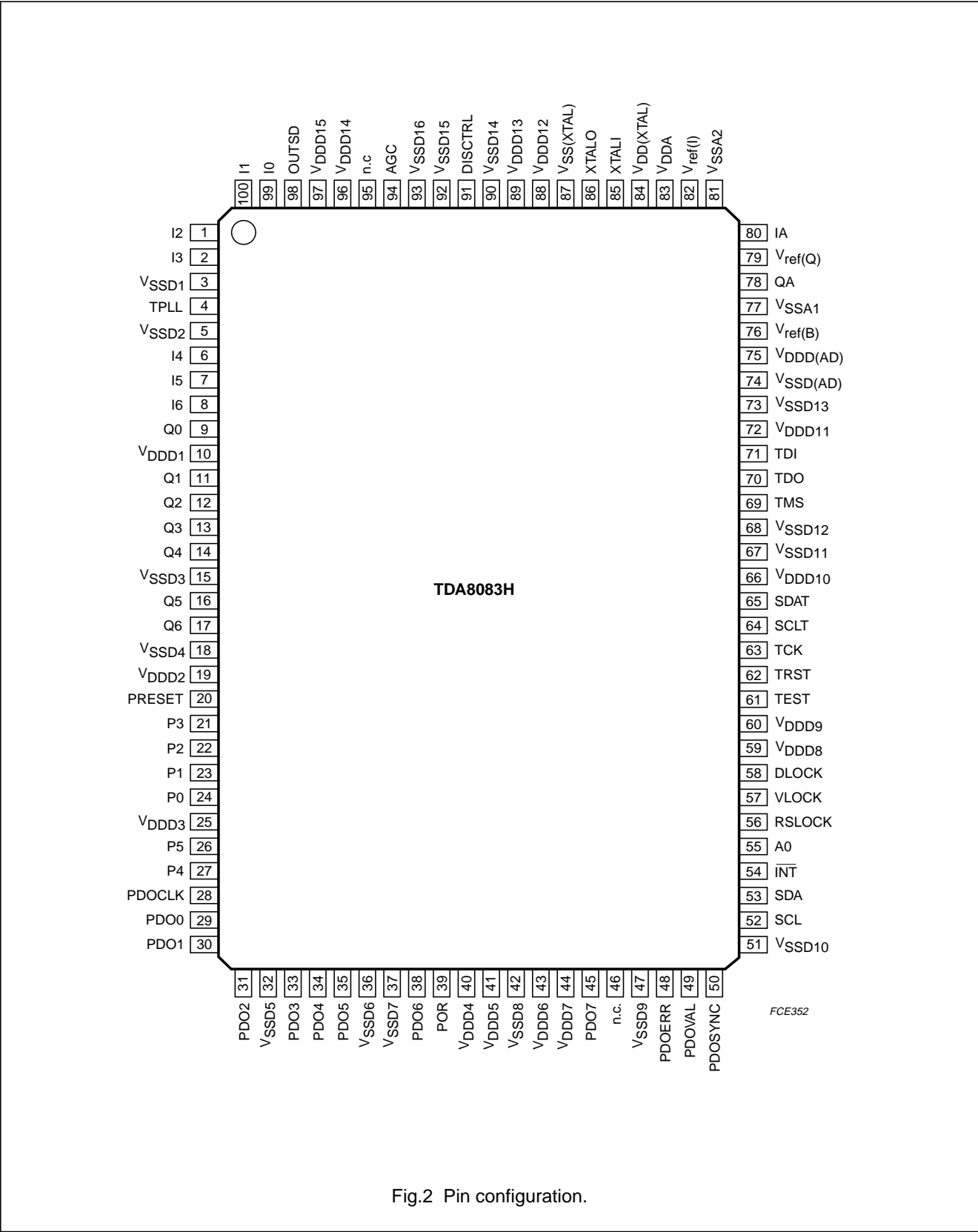
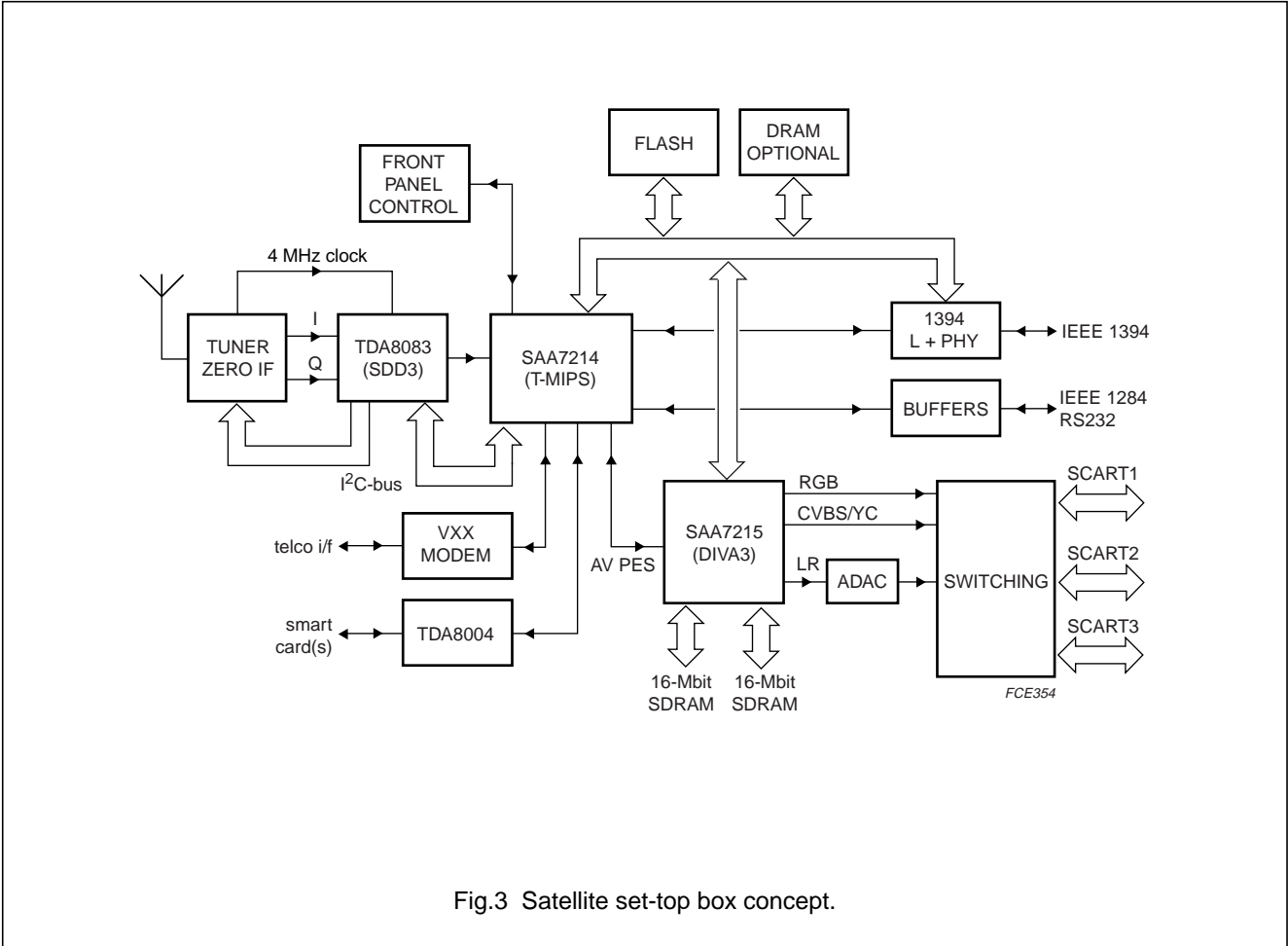


Fig.2 Pin configuration.

Satellite Demodulator and Decoder
(SDD3)

TDA8083

APPLICATION INFORMATION



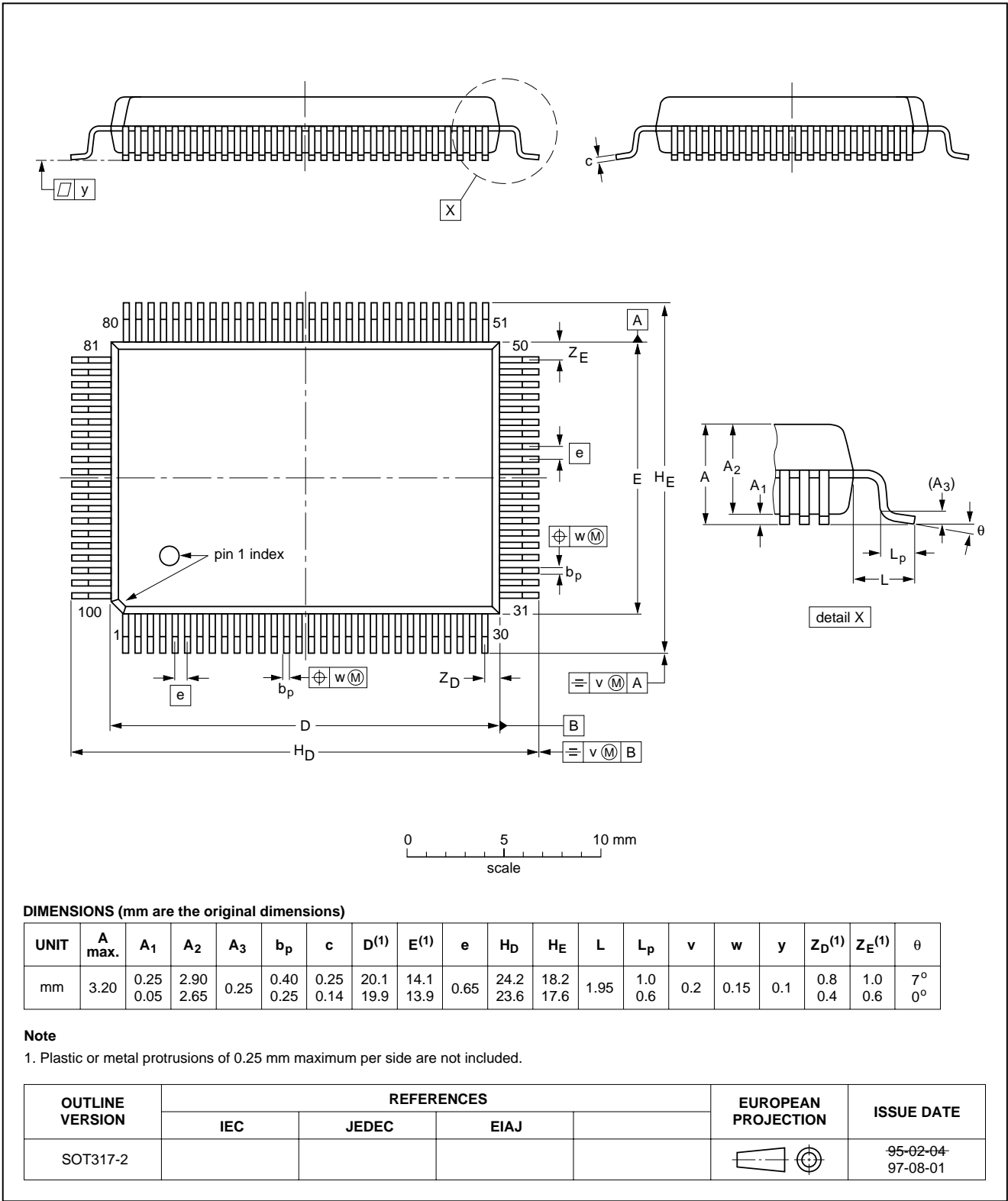
Satellite Demodulator and Decoder
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PACKAGE OUTLINE

QFP100: plastic quad flat package; 100 leads (lead length 1.95 mm); body 14 x 20 x 2.8 mm

SOT317-2



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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.

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.

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NOTES

Philips Semiconductors – a worldwide company

Argentina: see South America

Australia: 3 Figtree Drive, HOMEBUSH, NSW 2140,
Tel. +61 2 9704 8141, Fax. +61 2 9704 8139

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, Via Casati, 23 - 20052 MONZA (MI),
Tel. +39 039 203 6838, Fax +39 039 203 6800

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,
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