# DATA SHEET

# CD1516; CD1516L
## Television tuner/RF loop-through for analog and digital cable applications

Preliminary specification
File under Tuners, DC03

2000 Mar 30

Philips
Components

PHILIPS

# Television tuner/RF loop-through for analog and digital cable applications

# CD1516; CD1516L

## FEATURES

- UHF/VHF tuner for analog and digital cable applications
- Systems CCIR B, G, H, I, I', L, L' and OIRT D, K
- Digitally-controlled phase-locked loop (PLL) tuning programmed via I²C-bus
- Compact size, design incorporates a single-chip synthesizer mixer-oscillator IC
- IEC and phono connector
- Active RF loop-through (CD1516L tuners)
- Single 5 V power supply
- Complies with CISPR13, CISPR20, EN55013 and EN55020
- Suitable for horizontal or vertical mounting.

## DESCRIPTION

The CD1516; CD1516L tuner is a three-band tuner specially designed to have a flat frequency response and low oscillator phase noise which is essential in digital cable applications and it is also suited to standard analog applications.

Selectivity is provided by a tuned antenna circuit and a double-tuned bandpass filter separated by a MOSFET RF amplifier. IF amplification is provided by the mixer-oscillator IC.

The built-in PLL tuning system is digitally programmable via the I²C-bus. The system has multiple addressability and a minimum tuning step size of 62.5 kHz. The frequency range is continuously covered and is divided into three bands that include a tuning margin.

The CD1516L version combines a CD1516 tuner with an active RF loop-through.

## CHANNEL COVERAGE

| BAND | FREQUENCY RANGE(1) (MHz) |
|---|---|
| Low band | 51 to 171 |
| Mid band | 178 to 450 |
| High band | 458 to 858 |

**Note**

1. Frequency data refers to the IF centre frequency (36 MHz).

## MARKING

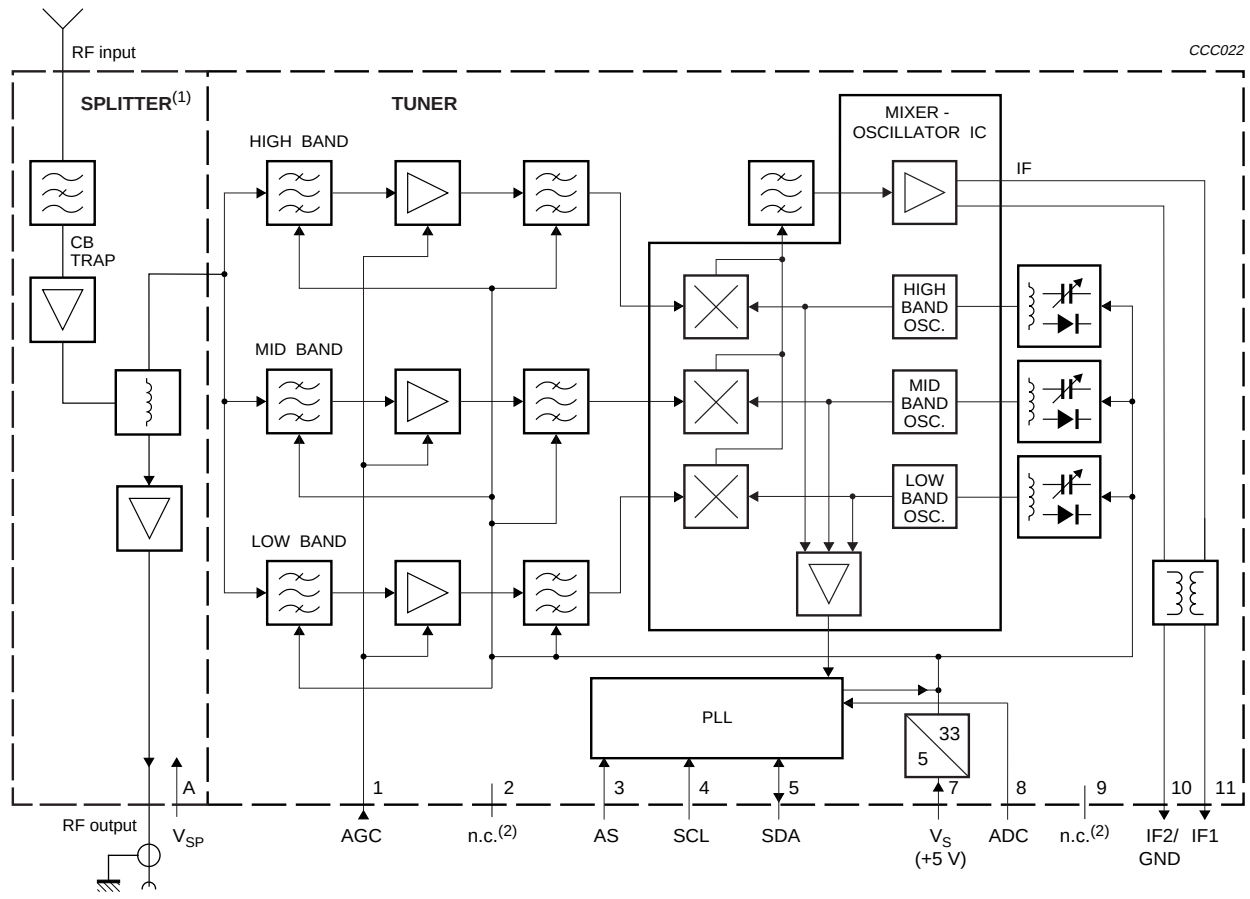
The following items of information are printed on a sticker that is on the top cover of the tuner:

- Type number
- Code number
- Origin letter of factory
- Change code
- Year and week code.

## ORDERING INFORMATION

| TYPE | CONNECTOR | MOUNTING | ORDER NUMBER |
|---|---|---|---|
| CD1516L/I | IEC | vertical | 3112 297 12201 |
| CD1516/IH | IEC | horizontal | 3112 297 12461 |
| CD1516/P | phono | vertical | 3112 297 12631 |

## BLOCK DIAGRAM




(1) Applies to CD1516L version only.

(2) For factory alignment and testing purposes only. Pin must be left open circuit in normal use.

Fig.1 Electrical block diagram.

**PINNING**

| SYMBOL | PIN | DESCRIPTION |
|---|---|---|
| $V_{SP}$ | A | CD1516L: +5 V splitter supply voltage<br>CD1516: not connected |
| AGC | 1 | gain control voltage input |
| n.c. | 2 | do not connect; leave terminal open |
| AS | 3 | address selection input |
| SCL | 4 | $I^2C$-bus clock input |
| SDA | 5 | $I^2C$-bus data input/output |
| $V_S$ | 7 | supply voltage (+5 V) |
| ADC | 8 | analog-to-digital converter input |
| n.c. | 9 | do not connect; leave terminal open |
| IF2/GND | 10 | IF output/ground |
| IF1 | 11 | IF output |
| GND | TH1, TH2, TH3 and TH4 | mounting tags (ground) |

## LIMITING VALUES

### Limiting values under operational conditions

The tuner can be guaranteed to function properly under the following conditions.

| SYMBOL | PARAMETER | PIN | MIN. | MAX. | UNIT |
|---|---|---|---|---|---|
| **Version CD1516L only** | | | | | |
| $V_{SP}$ | splitter supply voltage | A | 4.75 | 5.25 | V |
| $I_{SP}$ | supply current | | – | 110 | mA |
| **Versions CD1516 and CD1516L** | | | | | |
| $V_{AGC}$ | AGC input voltage | 1 | – | 5.0 | V |
| $\Delta V_{AGC}$ | AGC input voltage range | | 0.6 | 4.75 | V |
| $I_{AGC}$ | AGC input current | | – | 16.0 | μA |
| $Z_{S(AGC)}$ | AGC source impedance | | – | 5.0 | kΩ |
| $V_{AS}$ | address select voltage | 3 | – | 6.0 | V |
| $V_{SCL}$ | serial clock input voltage | 4 | –0.3 | +5.5 | V |
| $V_{SDA}$ | serial data input voltage | 5 | –0.3 | +5.5 | V |
| $V_S$ | supply voltage | 7 | 4.75 | 5.25 | V |
| $I_S$ | supply current | | – | 140 | mA |

### Environmental conditions

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|---|---|---|---|---|---|
| **Non-operational conditions** | | | | | |
| $T_{amb}$ | ambient temperature | | –25 | +85 | °C |
| RH | relative humidity | | – | 100 | % |
| $g_B$ | bump acceleration | 25 g | – | 245 | $m/s^2$ |
| $g_S$ | shock acceleration | 50 g | – | 490 | $m/s^2$ |
| | vibration amplitude | 10 to 55 Hz | – | 0.35 | mm |
| **Operational conditions** | | | | | |
| $T_{amb}$ | ambient temperature | | –10 | +60 | °C |
| RH | relative humidity | | – | 95 | % |

## ELECTRICAL DATA

### Conditional data

Unless otherwise specified, all electrical values apply at the following conditions. A proper function is guaranteed within the specified operational conditions but a certain deterioration of performance parameters may occur at the limits of the operational conditions.

| SYMBOL | PARAMETER | VALUE | UNIT |
|---|---|---|---|
| $T_{amb}$ | ambient temperature | 25 ±2 | °C |
| RH | relative humidity | 60 ±10 | % |
| $V_S$ | supply voltage | 5.0 ±0.1 | V |
| $V_{SP}$ | splitter supply voltage (CD1516L only) | 5.0 ±0.1 | V |
| $V_{AGC}$ | AGC input voltage | 4.7 ±0.1 | V |
| $f_{IF}$ | IF frequency | 43.75 | MHz |

### General characteristics

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| $f_b$ | frequency range: | | | | | |
| | low band | | 51 | – | 171 | MHz |
| | mid band | | 178 | – | 450 | MHz |
| | high band | | 458 | – | 858 | MHz |
| $t_{li}$ | PLL lock-in time | charge pump HIGH | – | – | 110 | ms |
| $B_{-3dB}$ | –3 dB bandwidth: | | | | | |
| | low band | | – | 11 | – | MHz |
| | mid band | | – | 16 | – | MHz |
| | high band | | – | 18 | – | MHz |
| $G_V$ | voltage gain | $Z_{IF}$ = 1.2 kΩ; 24 pF | | | | |
| | CD1516 | | 40 | 45 | 50 | dB |
| | CD1516L | | 43 | 47 | 52 | dB |
| $\Delta G_V$ | AGC range: | | | | | |
| | low band | | 40 | – | – | dB |
| | mid band | | 40 | – | – | dB |
| | high band | | 30 | – | – | dB |
| $m_x$ | cross modulation | note 1 | – | 0.3 | 1.0 | % |
| F | noise factor | | – | 6.5 | 8.0 | dB |
| $N_{osc}$ | oscillator phase noise: | frequency distance = 10 kHz | | | | |
| | low band | | – | –94 | –88 | dBc/Hz |
| | mid band | | – | –84 | –80 | dBc/Hz |
| | high band | | – | –85 | –80 | dBc/Hz |
| | oscillator phase noise: | frequency distance = 100 kHz | | | | |
| | low band | | – | – | –106 | dBc/Hz |
| | mid band | | – | – | –100 | dBc/Hz |
| | high band | | – | – | –100 | dBc/Hz |

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| $\alpha_i$ | image rejection: | | | | | |
| | low band | | 68 | – | – | dB |
| | mid band | | 68 | – | – | dB |
| | high band | | 58 | – | – | dB |
| | return loss: | | | | | |
| | CD1516 | channel centre ±3 MHz | 5 | 8 | – | dB |
| | CD1516L | – | 8 | 10 | – | dB |
| $V_{I(max)}$ | maximum voltage at aerial input | | – | – | 100 | dBμV |
| $V_{I(osc)}$ | oscillator voltage at aerial input | $Z_I$ = 75 Ω; f ≤ 860 MHz | – | <22 | – | dBμV |
| $V_{ESD}$ | ESD protection; all pins | note 2 | 2 | – | – | kV |

**Notes**

1. Cross modulation: transfer of unwanted carrier modulation ($f_{unw}$) from an adjacent channel to the wanted carrier ($f_w$). Measurement conditions: $f_{unw} = f_w \pm 8$ MHz; level of all carriers = 70 dBμV; modulation = AM, 50%, 15 kHz; IF output load = 1.2 kΩ + 24 pF in parallel (tuned to $f_{IF}$); IF level limited to 106 dBμV (set by $V_{AGC}$).
2. All the pins of the tuner are protected against electrostatic discharge (ESD) up to 2 kV. The product is classified in category B *("MIL-STD-883C").*

**Splitter characteristics: RF input to RF output (CD1516L)**

| SYMBOL | PARAMETER | TYP. | UNIT |
|---|---|---|---|
| $G_P$ | power gain | 3.5 | dB |
| N | noise factor | 7.5 | dB |
| $V_{I(max)}$ | overloading 1 dB gain compression at RF output | >95 | dBμV |
| | return loss at RF output | >10 | dB |
| $IM_2$ | 2nd order intermodulation distance; note 1 | >70 | dB |
| $IM_3$ | 3rd order intermodulation distance; note 2 | >73 | dB |
| | 27 MHz citizen band suppression | >15 | dB |

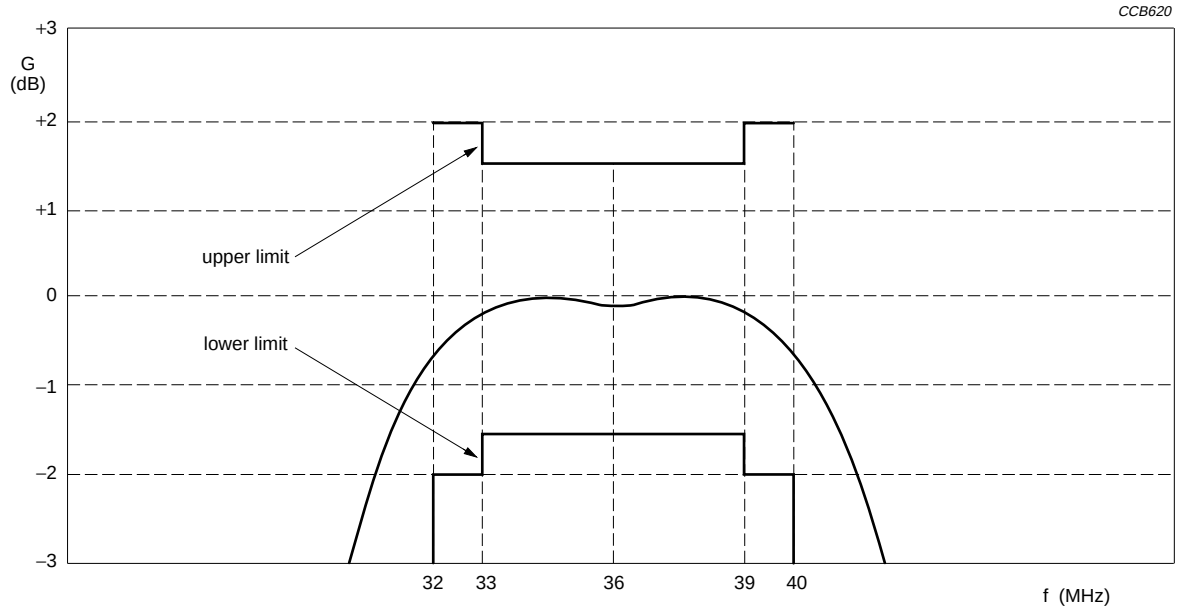
**Notes**

1. Two test signals with 80 dBμV at aerial input
2. Two test signals with 90 dBμV at aerial input

### Disturbance radiation and immunity

The tuners comply with CISPR 13 1996-09 and CISPR 20 1996-02 and with European standards EN55015 and EN55020 regarding oscillator radiation, signal handling and immunity from radiated fields.

### Amplitude response




The tilt of the overall response curve is defined as the absolute value between minimum and maximum levels within a bandwidth of 8 MHz.

Fig.2 Tilt of curve; typical values.

## APPLICATION INFORMATION

A detailed description of the I²C-bus specification, with applications, is given in brochure *"The I²C-bus and how to use it."* This brochure may be ordered using the code number 9398 393 40011.

### WRITE mode

| BYTE | BITS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **7 (MSB)** | **6** | **5** | **4** | **3** | **2** | **1** | **0 (LSB)** | **A**(1) |
| Address byte (ADB) | 1 | 1 | 0 | 0 | 0 | CA1(2) | CA0(2) | R/W = 0(3) | A |
| Programmable divider byte 1 (DB1) | 0 | n14 | n13 | n12 | n11 | n10 | n9 | n8 | A |
| Programmable divider byte 2 (DB2) | n7 | n6 | n5 | n4 | n3 | n2 | n1 | n0 | A |
| Control information byte (CB1) | 1 | CP(4) | 0 | 0 | 1 | 1 | 1 | 0 | A |
| Control information byte (CB2) | P7 | P6 | P5 | P4 | P3 | P2 | P1 | P0 | A |

**Notes**

1. A = acknowledge.
2. CA = chip address select bits.
3. R/W = 0 for WRITE mode.
4. CP = charge pump setting bit.

CHIP ADDRESS

$V_S$ = supply voltage at pin 7.

| CA1 | CA0 | VOLTAGE AT PIN 3 |
|---|---|---|
| 0 | 0 | 0 to 0.1$V_S$ |
| 0 | 1 | open or 0.2 to 0.3 $V_S$ |
| 1 | 0 | 0.4 to 0.6$V_S$ |
| 1 | 1 | 0.9 to 1.1$V_S$ |

CHARGE PUMP SETTINGS

During search tuning, the charge pump high setting should be selected. After channel selection or during fine tuning, the low charge pump setting should be selected.

CP = 1 for charge pump high

CP = 0 for charge pump low.

PROGRAMMABLE DIVIDER SETTINGS (BYTES 1 AND 2)

Divider ratio:

$$N = \frac{f_{osc}}{8 \times f_{ref}}$$

$f_{osc}$ = oscillator frequency

$f_{ref}$ = reference frequency = 7.8125 kHz

$N = (2^{14} \times n14) + (2^{13} \times n13) + (2^{12} \times n12) + (2^{11} \times n11) + (2^{10} \times n10) + (2^{9} \times n9) + (2^{8} \times n8) + (2^{7} \times n7) + (2^{6} \times n6) + (2^{5} \times n5) + (2^{4} \times n4) + (2^{3} \times n3) + (2^{2} \times n2) + (2 \times n1) + n0$

Divider ratios below 256 are not allowed.

Minimum step size is 62.5 kHz.

BAND SWITCHING

| BAND | BIT | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | P7 (MSB) | P6 | P5 | P4 | P3 | P2 | P1 | P0 (LSB) |
| Low | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| Mid | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| High | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 |

TELEGRAM EXAMPLES (WRITE MODE)

Start - ADB - Ack - DB1 - Ack - DB2 - Ack - CB1 - Ack - CB2 - Ack - Stop.

Start - ADB - Ack - CB1 - Ack - CB2 - Ack - DB1 - Ack - DB2 - Ack - Stop.

Start - ADB - Ack - DB1 - Ack - DB2 - Ack - CB1 - Ack - Stop.

Start - ADB - Ack - DB1 - Ack - DB2 - Ack - Stop.

Where:

Start = start condition

ADB = address byte

Ack = acknowledge

DB1 = divider byte 1

DB2 = divider byte 2

CB1 = control byte 1

CB2 = control byte 2

Stop = stop condition.

**READ mode**

The in-lock flag and the analog-to-digital converter value can be read out by setting the R/W bit to 1.

| BYTE | BITS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **7 (MSB)** | **6** | **5** | **4** | **3** | **2** | **1** | **0 (LSB)** | **A**[1] |
| Address byte | 1 | 1 | 0 | 0 | 0 | CA1[2] | CA0[2] | R/W = 1[3] | A |
| Status byte | 0 | LB[4] | X[5] | X[5] | X[5] | AD2 | AD1 | AD0 | – |

**Notes**

1. A = acknowledge.
2. CA = chip address select bits (see “WRITE mode”).
3. R/W bit = 1 for READ mode.
4. LB = 1 indicates loop is phase locked.
5. X = don’t care.

ANALOG-TO-DIGITAL CONVERTER INFORMATION (AD BITS)

$V_S$ = supply voltage at pin 7.

| ADC INPUT VOLTAGE (PIN 8) | AD2 | AD1 | AD0 |
|---|---|---|---|
| 0.00 to 0.15$V_S$ | 0 | 0 | 0 |
| 0.15 to 0.30$V_S$ | 0 | 0 | 1 |
| 0.30 to 0.45$V_S$ | 0 | 1 | 0 |
| 0.45 to 0.60$V_S$ | 0 | 1 | 1 |
| 0.60 to 1.00$V_S$ | 1 | 0 | 0 |

**IF output**

IF OUTPUT LEVEL

To avoid driving the tuner into extreme signal handling conditions, adjust the RF gain control loop to obtain an IF output level of 105 dBμV ≤ $V_{IF}$ ≤ 107 dBμV.

IF LOAD

The maximum permissible load at the IF output (pins 10 and 11): $Z_{IF(max)}$ = 1 kΩ (min.); 30 pF (max.).

Signal handling is optimized by tuning-out the reactive part of the IF load ($C_{ext}$) to the IF centre frequency using coil (L) connected in parallel to pins 10 and 11.

$$L = \frac{1}{(2\pi f_{IF})^2 \times (C_{ext} + C_{int})}$$

$C_{int}$ = 5 pF

The IF amplifier output circuit is shown in Fig.3. This can be approximated to a floating source due to the coupling inductors and small capacitance to ground.

The tuner load can be symmetrical, or asymmetrical if the unused IF output pin is connected to ground.

Three load configurations are shown in Fig.4. Tracks on the main PCB to the tuner output pins should be as short as possible to prevent oscillator radiation and provide immunity from radiated fields.

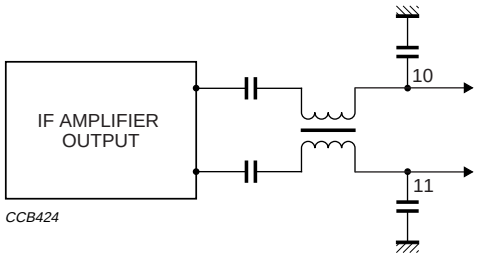
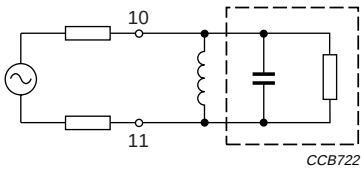
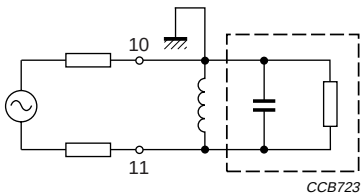


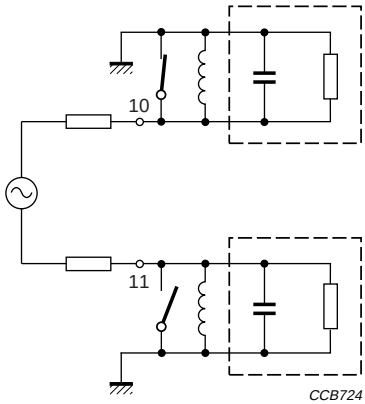

Fig.3 IF amplifier output circuit.




a. Symmetrical.




b. Asymmetrical.




c. Asymmetrical with switchable polarity.

Fig.4 IF loading using SAW filters.

**TYPICAL AGC CURVES**

The gain control voltage applied to the AGC input (pin 1) should not exceed the supply voltage Vs (pin 7).

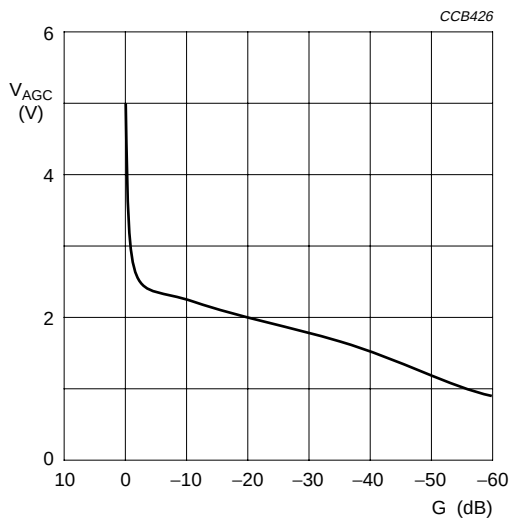



Fig.5 Low band AGC characteristic at 51 MHz.

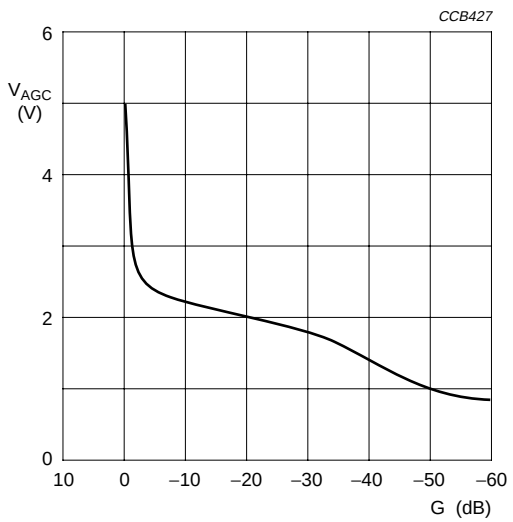



Fig.6 Low band AGC characteristic at 171 MHz.

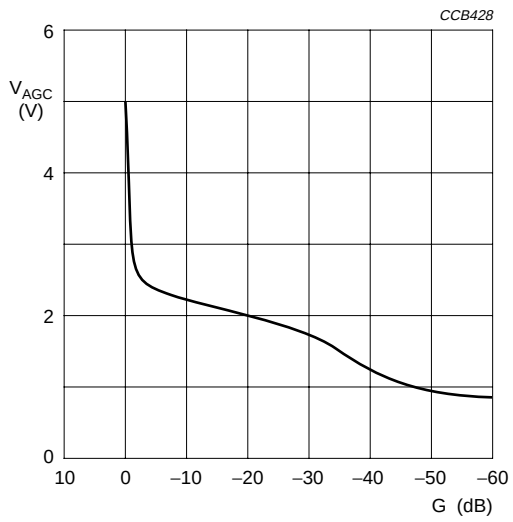



Fig.7 Mid band AGC characteristic at 178 MHz.

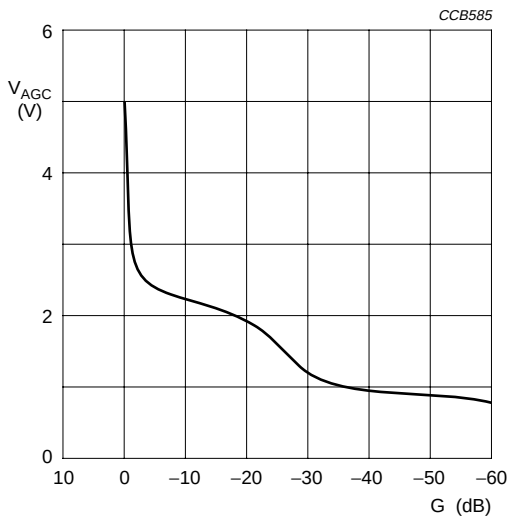



Fig.8 Mid band AGC characteristic at 450 MHz.

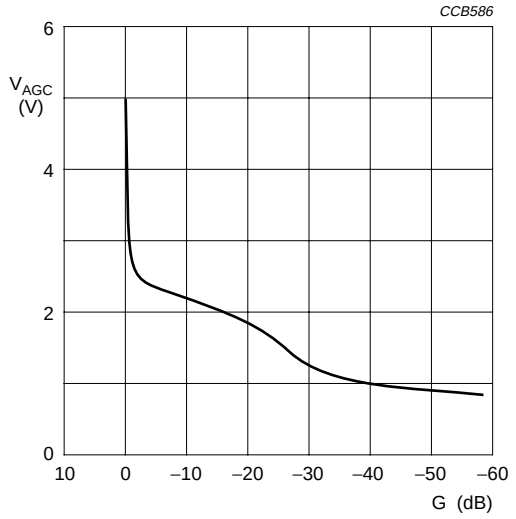



Fig.9 High band AGC characteristic at 458 MHz.

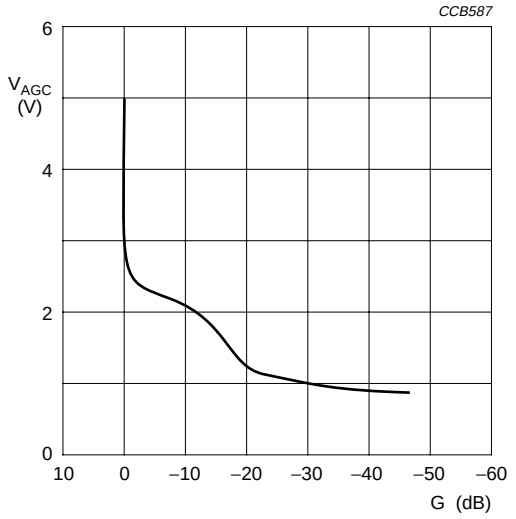
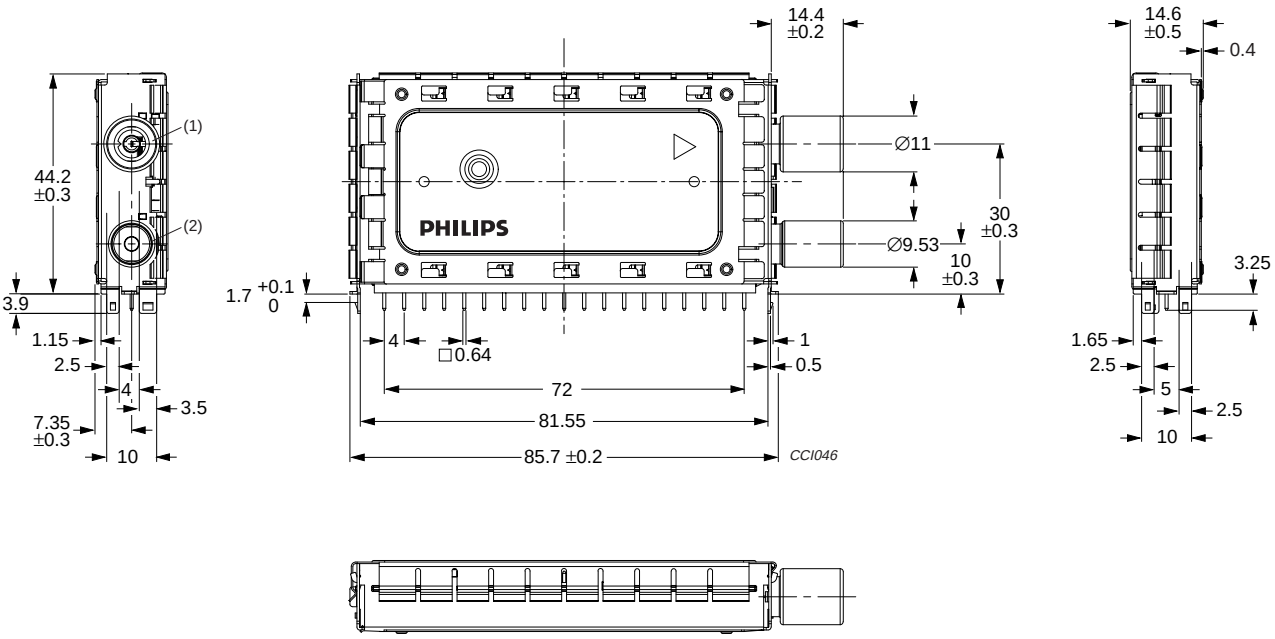



Fig.10 High band AGC characteristic at 858 MHz.

**MECHANICAL DATA**

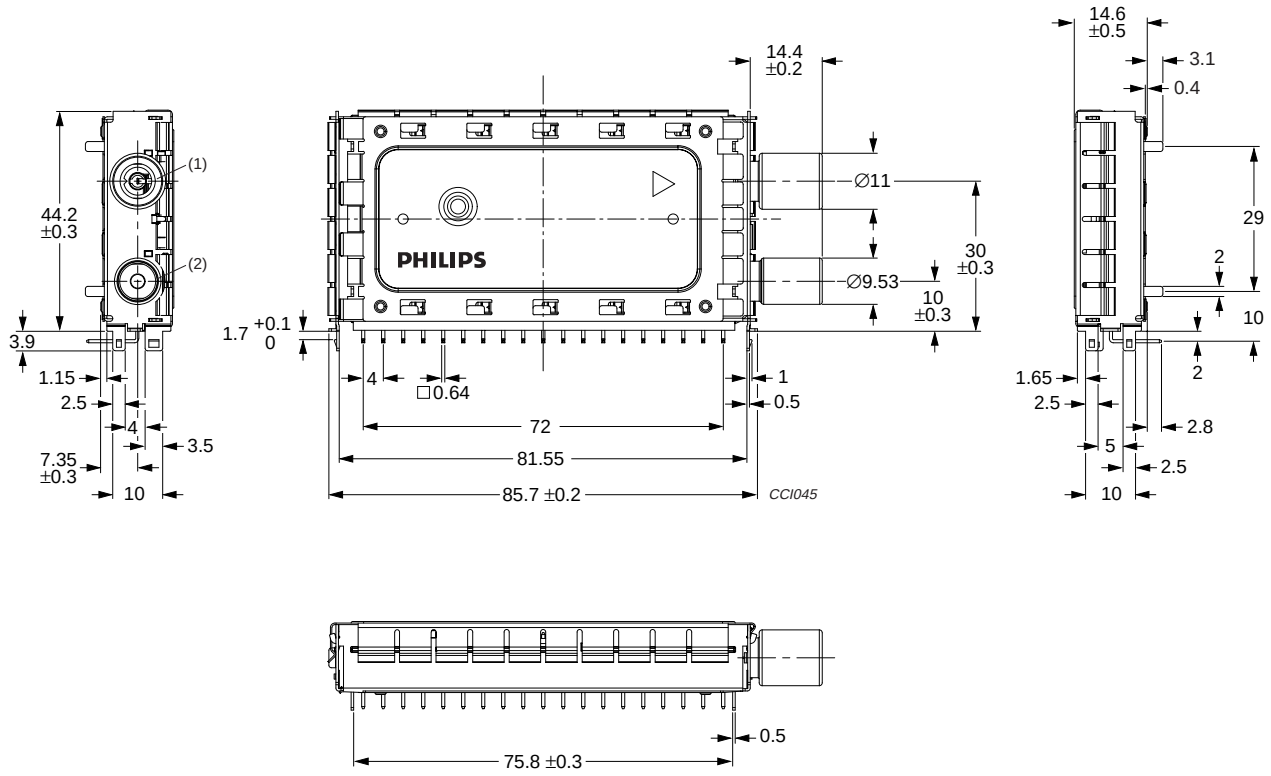



Dimensions in mm.

(1) RF input.

(2) RF output (CD1516L only)

Fig.11 Mechanical outline, vertical mounting version with IEC connectors.

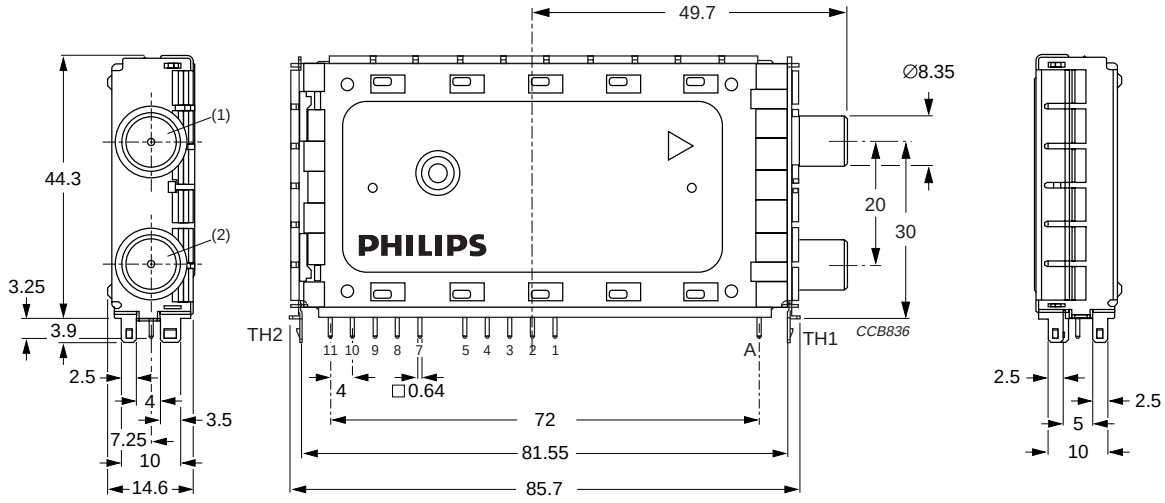



Dimensions in mm.

(1) RF input.

(2) RF output (CD1516L only)

Fig.12 Mechanical outline, horizontal mounting version with IEC connectors.

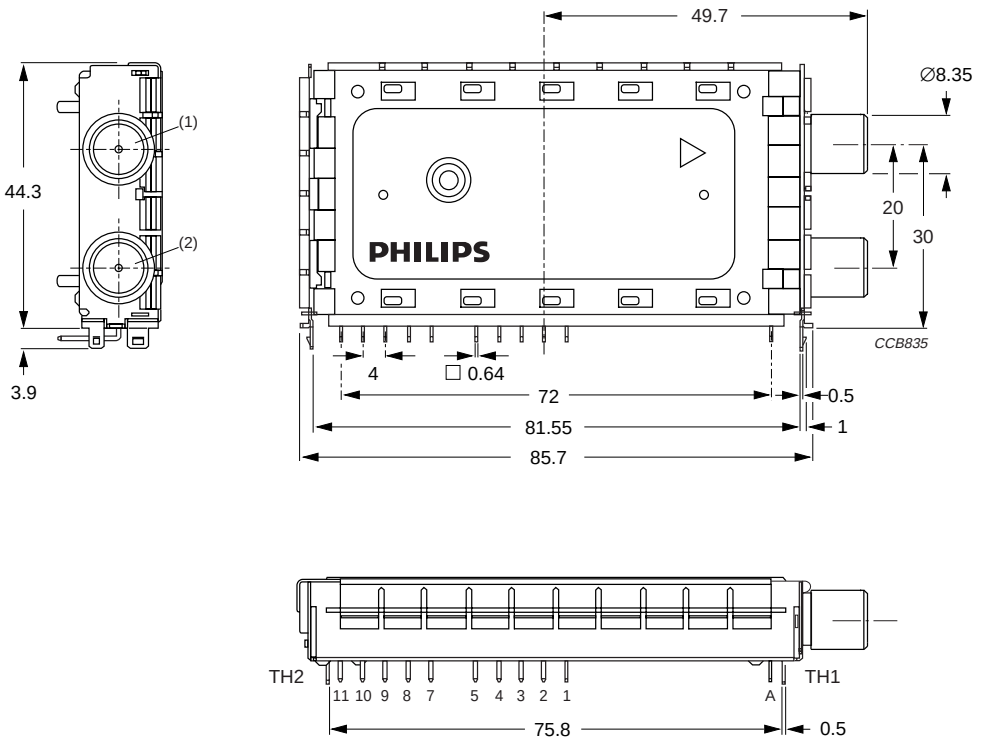



Dimensions in mm.

(1) RF input.

(2) RF output (CD1516L only)

Fig.13 Mechanical outline, vertical mounting version with phono connectors.




Dimensions in mm.

(1) RF input.

(2) RF output (CD1516L only)

Fig.14 Mechanical outline, horizontal mounting version with phono connectors.

**Aerial connection**

IEC or phono connector, depending on version. For phono connectors, the total length of the inner conductor must not exceed 12 mm.

**Robustness of pins**

The pins will not be damaged when tested in accordance with *"IEC 60068-2-21"* of which the following tests are applied:

- Test $Ua_1$, tensile of 10 N in axial direction
- Test $Ua_2$, thrust of 4 N in axial direction.

**Mass**

CD1516: approximately 52 g.

CD1516L: approximately 58 g

**Solderability**

The solderability of pins and mounting tags when tested initially and after 16 hours steam ageing in accordance with *"IEC 60068-2-20"*, test Ta, method 1 (solder bath 235 °C for 2 s), results in a wetted area of 95%. No de-wetting will occur when soldered at 260 °C for 5 s.

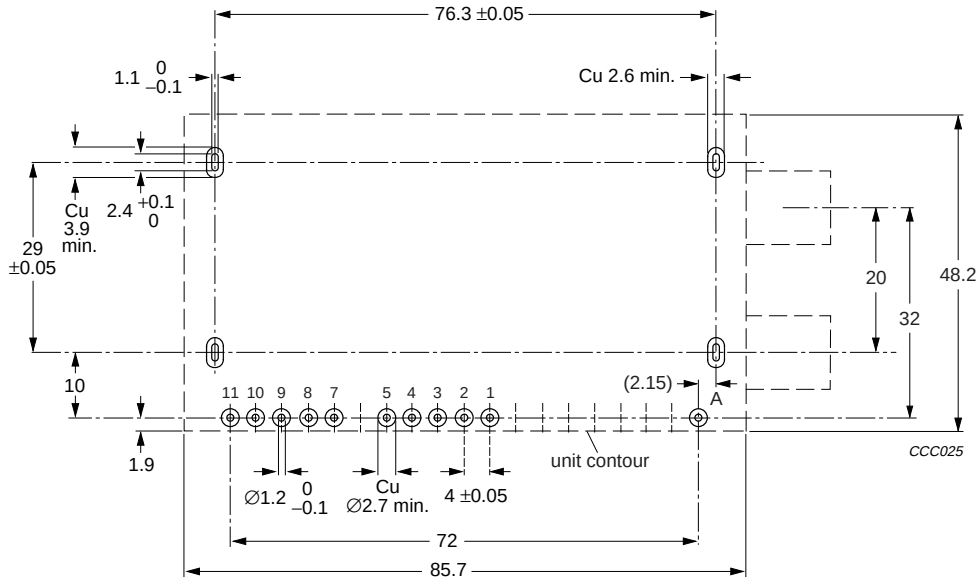
**Resistance to soldering heat**

The product will not be damaged when tested in accordance with *"IEC 60068-2-20"*, test Tb, method 1A (solder bath 260 °C for 10 ±1 s).

**Punching pattern of chassis PCB**

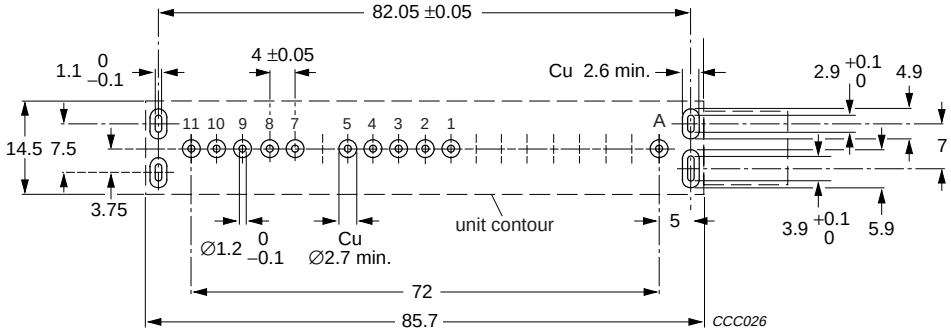
For mounting the tuner on a printed-circuit board (PCB), the recommended punching patterns are shown in Fig.15 for the horizontal version and Fig.16 for the vertical version.

The tuner must be mounted without clearance between the tuner supporting surface and the PCB. When mounted in this way, the tuner must be soldered to the PCB. This can be achieved by pressing the unit vertically on the PCB during soldering.




Dimensions in mm.

Fig.15 Punching pattern seen from solder side, horizontal version.




Dimensions in mm.

Fig.16 Punching pattern seen from solder side, vertical version.

## 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. |
| **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.

**NOTES**

**NOTES**

# *Philips Components – a worldwide company*

**Australia:** Philips Components Pty Ltd., HOMEBUSH,
Tel. +61 2 9704 8141, Fax. +61 2 9704 8139

**Austria:** Österreichische Philips Industrie GmbH, WIEN,
Tel. +43 1 60 101 12 41, Fax. +43 1 60 101 12 11

**Belarus:** Philips Office Belarus, MINSK,
Tel. +375 172 200 924/733, Fax. +375 172 200 773

**Benelux:** Philips Components B.V., EINDHOVEN, NL,
Tel. +31 40 25 90 772, Fax. +31 40 25 90 777

**Brazil:** Philips Components, SÃO PAULO,
Tel. +55 11 3841 2338, Fax. +55 11 829 1849

**Canada:** Philips Electronics Ltd., SCARBOROUGH,
Tel. +1 416 292 5161, Fax. +1 416 754 6248

**China:** Philips Company, SHANGHAI,
Tel. +86 21 6354 1088, Fax. +86 21 6354 1060

**Denmark:** Philips Components A/S, COPENHAGEN V,
Tel. +45 3329 3333, Fax. +45 3329 3905

**Finland:** Philips Components, ESPOO,
Tel. +358 9 615 800, Fax. +358 9 615 80510

**France:** Philips Composants, SURESNES,
Tel. +33 1 4099 6161, Fax. +33 1 4099 6493

**Germany:** Philips Components GmbH, HAMBURG,
Tel. +49 40 2489-0, Fax. +49 40 2489 1400

**Hong Kong:** Philips Hong Kong, KOWLOON,
Tel. +852 2784 3000, Fax. +852 2784 3003

**India:** Philips India Ltd., MUMBAI,
Tel. +91 22 4930 311, Fax. +91 22 4930 966/4950 304

**Indonesia:** P.T. Philips Development Corp., JAKARTA,
Tel. +62 21 794 0040, Fax. +62 21 794 0080

**Ireland:** Philips Electronics (Ireland) Ltd., DUBLIN,
Tel. +353 1 7640 203, Fax. +353 1 7640 210

**Israel:** Rapac Electronics Ltd., TEL AVIV,
Tel. +972 3 6450 444, Fax. +972 3 6491 007

**Italy:** Philips Components S.r.l., MILANO,
Tel. +39 2 6752 2531, Fax. +39 2 6752 2557

**Japan:** Philips Japan Ltd., TOKYO,
Tel. +81 3 3740 5135, Fax. +81 3 3740 5035

**Korea** (Republic of): Philips Electronics (Korea) Ltd., SEOUL,
Tel. +82 2 709 1472, Fax. +82 2 709 1480

**Malaysia:** Philips Malaysia SDN Berhad,
Components Division, PULAU PINANG,
Tel. +60 3 750 5213, Fax. +60 3 757 4880

**Mexico:** Philips Components, EL PASO, U.S.A.,
Tel. +52 915 772 4020, Fax. +52 915 772 4332

**New Zealand:** Philips New Zealand Ltd., AUCKLAND,
Tel. +64 9 815 4000, Fax. +64 9 849 7811

**Norway:** Philips Components, STOCKHOLM,
Tel. +46 8 5985 2000, Fax. +46 8 5985 2745

**Pakistan:** Philips Electrical Industries of Pakistan Ltd., KARACHI,
Tel. +92 21 587 4641-49, Fax. +92 21 577 035/+92 21 587 4546

**Philippines:** Philips Semiconductors Philippines Inc.,
METRO MANILA, Tel. +63 2 816 6345, Fax. +63 2 817 3474

**Poland:** Philips Poland Sp. z.o.o., WARSZAWA,
Tel. +48 22 5710 000, Fax. +48 22 5710 001

**Portugal:** Philips Portuguesa S.A.,
Philips Components: LINDA-A-VELHA,
Tel. +351 1 416 3160/416 3333, Fax. +351 1 416 3174/416 3366

**Russia:** Philips Russia, MOSCOW,
Tel. +7 95 755 6918, Fax. +7 95 755 6919

**Singapore:** Philips Singapore Pte Ltd., SINGAPORE,
Tel. +65 350 2000, Fax. +65 355 1758

**South Africa:** S.A. Philips Pty Ltd., JOHANNESBURG,
Tel. +27 11 470 5911, Fax. +27 11 470 5494

**Spain:** Philips Components, BARCELONA,
Tel. +34 93 301 63 12, Fax. +34 93 301 42 43

**Sweden:** Philips Components, STOCKHOLM,
Tel. +46 8 5985 2000, Fax. +46 8 5985 2745

**Switzerland:** Philips Components AG, ZÜRICH,
Tel. +41 1 488 22 11, Fax. +41 1 481 7730

**Taiwan:** Philips Taiwan Ltd., TAIPEI,
Tel. +886 2 2134 2900, Fax. +886 2 2134 2929

**Turkey:** Türk Philips Ticaret A.S., UMRABIYE/ISTANBUL,
Tel. +90 216 522 18 00, Fax. +90 216 522 18 14

**United Kingdom:** Philips Components Ltd., DORKING,
Tel. +44 1306 512 000, Fax. +44 1306 512 345

**United States:**

- Philips Components, SAN JOSE, CA,
  Tel. +1 408 570 5600, Fax. +1 408 570 5700
- Philips Display Components, ANN ARBOR, MI,
  Tel. +1 734 996 9400, Fax. +1 734 761 2776
- Philips Discrete Ceramics, EL PASO, TX,
  Tel. +1 877 250 5996 / +1 915 860 3267, Fax. +1 915 860 3270
- Philips Ferrite Ceramics, ROSWELL, GA,
  Tel. +1 877 433 77483, Fax. +1 770 992 0725

**Yugoslavia** (Federal Republic of): Philips Components, BELGRADE,
Tel. +381 11 3341 299, Fax. +381 11 3342 553

**Internet:**

- Discrete and Ferrite Ceramics: www.acm.components.philips.com
- Display Components: www.philipsdisplay.com

**For all other countries apply to:**
Philips Components, Building BAE-1, P.O. Box 218, 5600 MD EINDHOVEN,
The Netherlands, Fax. +31 40 27 22 599

COD34


Printed in The Netherlands

*Let's make things better.*

**Philips Components**

PHILIPS