# DATA SHEET

## CGY2015
GSM/DCS/PCS power amplifier

Preliminary specification 2002 Mar 12

Philips Semiconductors

PHILIPS

## FEATURES

- 3.5 V nominal supply voltage
- Efficiency: 55% in GSM band and 42% in DCS band
- Wide operating temperature range −20 to +85 °C
- HVQFN16 exposed die pad package.

## APPLICATIONS

- Dual band system:
  - Low Band (LB) from 880 to 915 MHz hand held transceivers for Extended GSM (E-GSM)
  - High Band (HB) from 1710 to 1785 MHz for DCS and from 1710 to 1910 MHz for DCS/PCS.
- Multi-mode systems: General Packet Radio Service (GPRS) class 1 up to GPRS class 12.

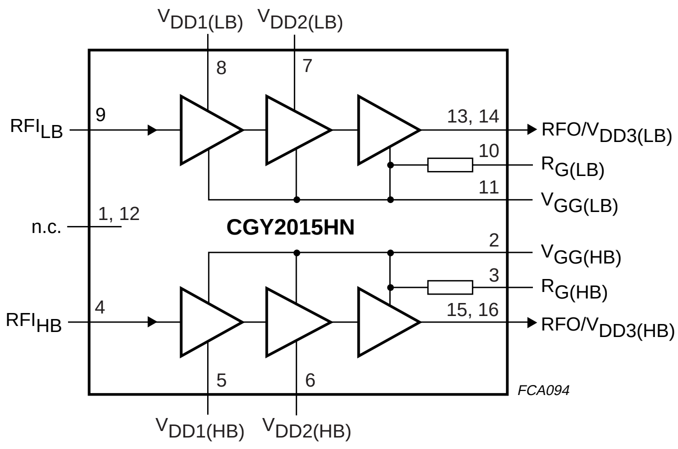
## GENERAL DESCRIPTION

The CGY2015 is a dual GaAs Monolithic Microwave Integrated Circuit (MMIC) Power Amplifier (PA). On the same die, one PA is intended for Global System for Mobile communication (GSM), the second PA is intended for Digital Cellular System (DCS) and for Personal Communications Services (PCS).

## ORDERING INFORMATION

| TYPE NUMBER | PACKAGE | | |
|---|---|---|---|
| | NAME | DESCRIPTION | VERSION |
| CGY2015HN | HVQFN16 | plastic, thermal enhanced very thin quad flat package; no leads; 16 terminals; body 4 × 4 × 0.85 mm | SOT629-1 |

## BLOCK DIAGRAM




The die pad must be connected to ground.

Fig.1 Block diagram.

## PINNING

| SYMBOL | PIN | DESCRIPTION |
|---|---|---|
| n.c. | 1 | not connected |
| $V_{GG(HB)}$ | 2 | DCS/PCS power amplifier gates |
| $R_{G(HB)}$ | 3 | DCS/PCS power amplifier gates through a resistor |
| $RFI_{HB}$ | 4 | DCS/PCS power amplifier input |
| $V_{DD1(HB)}$ | 5 | DCS/PCS first stage supply voltage |
| $V_{DD2(HB)}$ | 6 | DCS/PCS second stage supply voltage |
| $V_{DD2(LB)}$ | 7 | GSM second stage supply voltage |
| $V_{DD1(LB)}$ | 8 | GSM first stage supply voltage |
| $RFI_{LB}$ | 9 | GSM power amplifier input |
| $R_{G(LB)}$ | 10 | GSM power amplifier gates through a resistor |
| $V_{GG(LB)}$ | 11 | GSM power amplifier gates |
| n.c. | 12 | not connected |
| $RFO/V_{DD3(LB)}$ | 13 | GSM PA output and third stage supply voltage |
| $RFO/V_{DD3(LB)}$ | 14 | GSM PA output and third stage supply voltage |
| $RFO/V_{DD3(HB)}$ | 15 | DCS/PCS PA output and third stage supply voltage |
| $RFO/V_{DD3(HB)}$ | 16 | DCS/PCS PA output and third stage supply voltage |
| | die pad | ground |

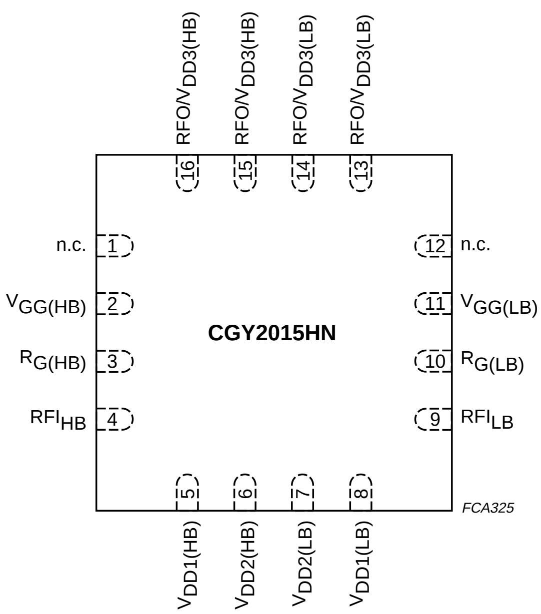



Fig.2 Pin configuration (top view).

## FUNCTIONAL DESCRIPTION

### Operating conditions

The CGY2015 is designed to meet the European Telecommunication Standards Institute (ETSI) specification *"ETS 300 577"*.

### Power amplifier

The GSM and DCS/PCS power amplifiers consist of three cascaded gain stages with an open-drain configuration. Each drain has to be DC supplied through an adequate reactive circuit.

### Control

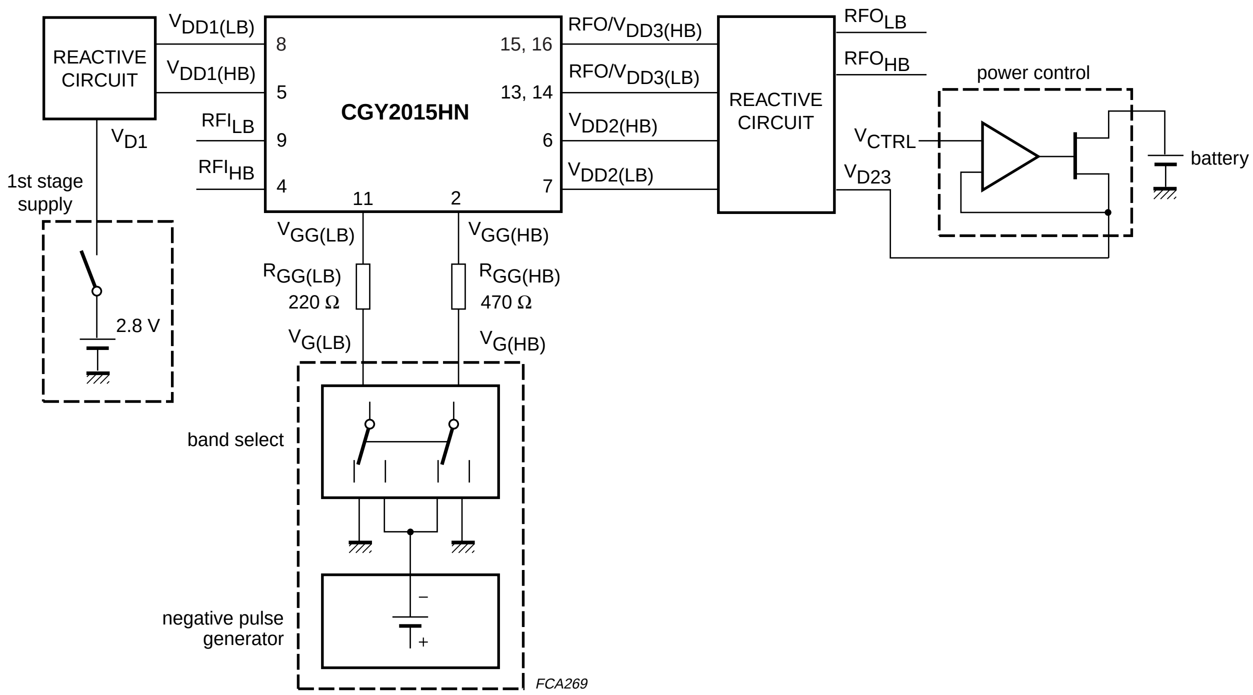



Fig.3 Control principle.

**Table 1** Operating mode

| VOLTAGE | STANDBY | GSM | DCS/PCS |
|---|---|---|---|
| $V_{D1}$ | 0 V | 2.8 V | 2.8 V |
| $V_{D23}$ | 0 V | 0 V to $V_{BAT}$ | 0 V to $V_{BAT}$ |
| $V_{G(LB)}$ | 0 V | 0 V | ≤–1.5 V |
| $V_{G(HB)}$ | 0 V | ≤–1.5 V | 0 V |

The output power is controlled by $V_{D23}$.

The band select switches off the non active PA.

The value of $R_{GG(LB)}$ and $R_{GG(HB)}$ have been optimized for the low power efficiency.

This principle can be implemented with the Philips companion chip UBA1711 or with a discrete control circuit (see Fig.19).

## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 60134).

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|---|---|---|---|---|---|
| $V_D$ | supply voltage pins 5 to 8 and 13 to 16 | | – | 5.2 | V |
| $T_{j(max)}$ | maximum operating junction temperature | | – | 150 | °C |
| $P_{tot}$ | total continuous power dissipation | | – | 2 | W |
| $P_i$ | input power | note 1 | – | 10 | dBm |
| $T_{stg}$ | storage temperature | | –55 | +150 | °C |

**Note**

1. For GSM PA or for DCS/PCS PA.

## HANDLING

Do not operate or store near strong electrostatic fields.

Mets class 0 ESD test requirements Human Body Model (HBM), in accordance with *“EIA/JESD22-A114-A”* (October 1997) and class A ESD test requirements Machine Model (MM), in accordance with *“EIA/JESD22-A115-A”* (October 1997).

## THERMAL CHARACTERISTICS

| SYMBOL | PARAMETER | CONDITIONS | VALUE | UNIT |
|---|---|---|---|---|
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | note 1 | 30 | K/W |

**Note**

1. In free air, under operating conditions, on Philips evaluation board (see Fig.16).

### DC CHARACTERISTICS

$V_{D1}$ = 2.8 V; $T_{amb}$ = 25 °C; peak current value during burst; measured and guaranteed on Philips evaluation board (see Fig.16); unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|
| $I_{DD(LB)}$ | GSM positive peak supply current | $P_{i(LB)}$ = 5 dBm; $V_{D23}$ = 3.5 V; $V_{G(LB)}$ = 0 V; $V_{G(HB)} \leq -1.5$ V | 1.6 | – | A |
| $I_{DD(HB)}$ | DCS/PCS positive peak supply current | $P_{i(HB)}$ = 5 dBm; $V_{D23}$ = 3.5 V; $V_{G(HB)}$ = 0 V; $V_{G(LB)} \leq -1.5$ V | 1.2 | – | A |
| $I_{DD(lp)(LB)}$ | GSM low power positive supply current | $P_{i(LB)}$ = 5 dBm; $V_{D23}$ adjusted for $P_{o(LB)}$ = 15 dBm; $V_{G(LB)}$ = 0 V; $V_{G(HB)} \leq -1.5$ V | 200 | 300 | mA |
| $I_{DD(lp)(HB)}$ | DCS/PCS low power positive supply current | $P_{i(HB)}$ = 5 dBm; $V_{D23}$ adjusted for $P_{o(HB)}$ = 15 dBm; $V_{G(HB)}$ = 0 V; $V_{G(LB)} \leq -1.5$ V | 200 | 300 | mA |
| $I_{GG(LB)}$ | GSM negative gate current | $P_{i(HB)}$ = 5 dBm; $V_{D23}$ = 2.8 V; $V_{G(HB)}$ = 0 V; $V_{G(LB)}$ = –2.1 V; note 1 | 0.8 | 2 | mA |
| $I_{GG(HB)}$ | DCS/PCS negative gate current | $P_{i(LB)}$ = 5 dBm; $V_{D23}$ = 2.8 V; $V_{G(LB)}$ = 0 V; $V_{G(HB)}$ = –2.1 V; note 1 | 0.8 | 2 | mA |

**Note**

1. See Section “Power control” for more details.

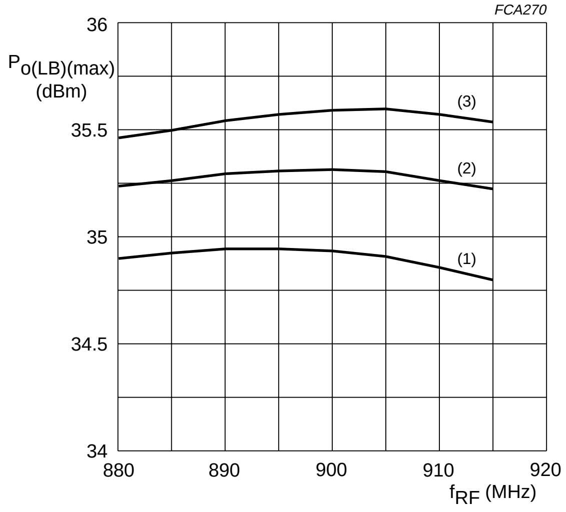
### AC CHARACTERISTICS (LOW BAND PA)

$V_{D23}$ = 3.5 V; $V_{D1}$ = 2.8 V; $T_{amb}$ = 25 °C; $f_{RF}$ = 880 to 915 MHz (GSM operation); $P_{i(LB)}$ = 5 dBm; $V_{G(LB)}$ = 0 V; $V_{G(HB)} \leq -1.5$ V; measured and guaranteed on Philips evaluation board (see Fig.16); unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| $P_{o(LB)(max)}$ | maximum output power | | 34.5 | 35 | – | dBm |
| $\eta_{LB}$ | efficiency | | 50 | 55 | – | % |
| $P_{o(LB)(off)}$ | output power in standby mode | $V_{D1} = V_{D23}$ = 0 V; $V_{G(LB)}$ and $V_{G(HB)}$ in high-impedance | – | –30 | – | dBm |
| $P_{o(LB)(min)}$ | minimum output power | $V_{D23}$ = 0 V; | – | –5 | – | dBm |
| $N_{RX(LB)}$ | output noise in RX band | $f_{RF}$ = 925 to 935 MHz | – | – | –117 | dBm/Hz |
| | | $f_{RF}$ = 935 to 960 MHz | – | – | –129 | dBm/Hz |
| $H2_{LB}$ | second harmonic level | | – | –45 | –40 | dBc |
| $H3_{LB}$ | third harmonic level | | – | –45 | –40 | dBc |
| $Stab_{LB}$ | stability | note 1 | – | – | –60 | dBc |
| | ruggedness | output VSWR = 10 : 1 for all phases angles | – | note 2 | – | |

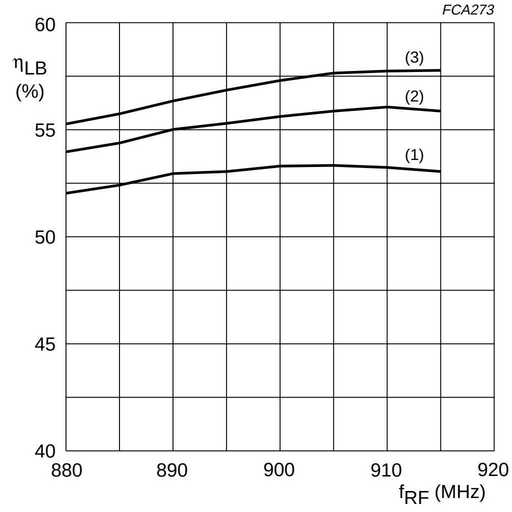
**Notes**

1. The device is adjusted to provide nominal load power into a 50 Ω load. The device is switched off and a 3 : 1 load replaces the 50 Ω load. The device is switched on and the phase of the 3 : 1 load is varied 360 electrical degrees during a 60 seconds test period.
2. No circuit damage or performance degradation.



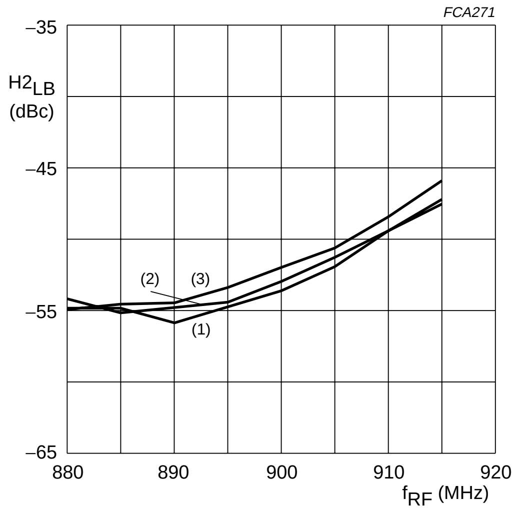

(1) $T_{amb}$ = 85 °C.
(2) $T_{amb}$ = 25 °C.
(3) $T_{amb}$ = −20 °C.

Fig.4 Maximum output power as a function of frequency.



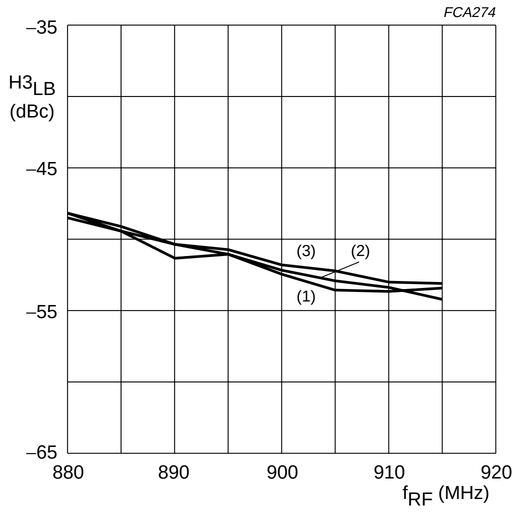

(1) $T_{amb}$ = 85 °C.
(2) $T_{amb}$ = 25 °C.
(3) $T_{amb}$ = −20 °C.

Fig.5 Efficiency as a function of frequency.



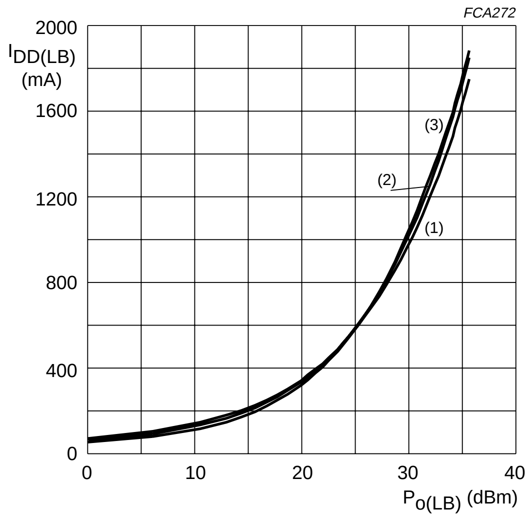

(1) $T_{amb}$ = 85 °C.
(2) $T_{amb}$ = 25 °C.
(3) $T_{amb}$ = −20 °C.

Fig.6 Second harmonic level as a function of frequency.



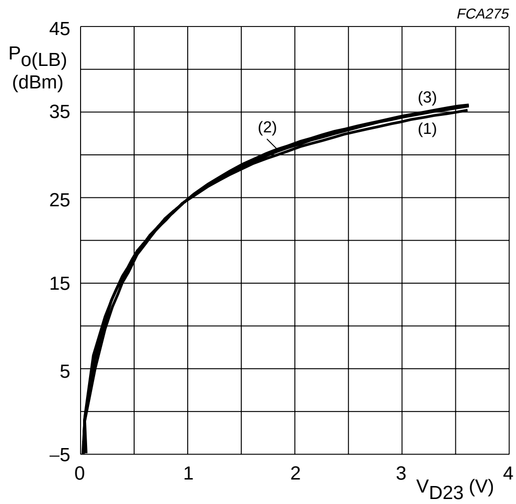

(1) $T_{amb}$ = 85 °C.
(2) $T_{amb}$ = 25 °C.
(3) $T_{amb}$ = −20 °C.

Fig.7 Third harmonic level as a function of frequency.




(1) $T_{amb}$ = 85 °C.
(2) $T_{amb}$ = 25 °C.
(3) $T_{amb}$ = −20 °C.

Fig.8 Positive peak supply current as a function of output power.




(1) $T_{amb}$ = 85 °C.
(2) $T_{amb}$ = 25 °C.
(3) $T_{amb}$ = −20 °C.

Fig.9 Output power as a function of supply voltage.

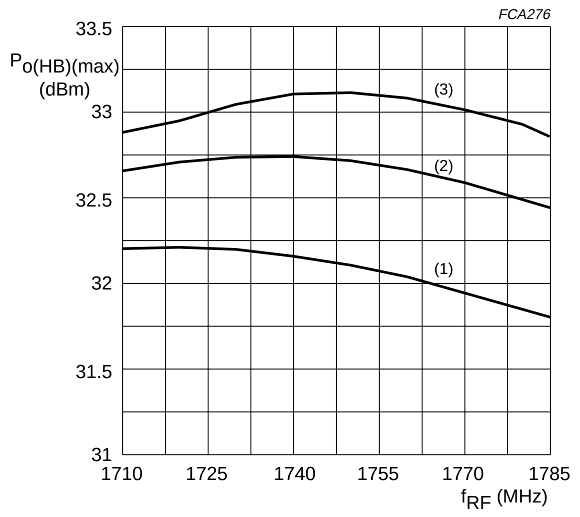
### AC CHARACTERISTICS (HIGH BAND PA)

$V_{D23}$ = 3.5 V; $V_{D1}$ = 2.8 V; $T_{amb}$ = 25 °C; $P_{i(HB)}$ = 5 dBm; $V_{GHB}$ = 0 V; $V_{GLB}$ ≤ –1.5 V; $f_{RF}$ = 1710 to 1785 MHz (for DCS operation) or $f_{RF}$ = 1710 to 1910 MHz (for DCS/PCS operation); measured and guaranteed on Philips evaluation board (see Fig.16); unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| $P_{o(HB)(max)}$ | maximum output power | $f_{RF}$ = 1710 to 1785 MHz | 32 | 32.5 | – | dBm |
| | | $f_{RF}$ = 1710 to 1910 MHz | – | 32 | – | dBm |
| $\eta_{(HB)}$ | efficiency | $f_{RF}$ = 1710 to 1785 MHz | 38 | 42 | – | % |
| | | $f_{RF}$ = 1710 to 1910 MHz | – | 38 | – | % |
| $P_{o(HB)(off)}$ | output power in standby mode | $V_{D1}$ = $V_{D23}$ = 0 V; $V_{GLB}$ and $V_{GHB}$ in high impedance | – | –30 | – | dBm |
| $P_{o(HB)(min)}$ | minimum output power | $V_{D23}$ = 0 V | – | –5 | – | dBm |
| $N_{RX(HB)}$ | output noise in RX band | | – | – | –121 | dBm/Hz |
| $\alpha_{HB}$ | HB isolation when LB is operating | note 1 | – | 5 | – | dBm |
| $H2_{HB}$ | second harmonic level | $f_{RF}$ = 1710 to 1785 MHz | – | –45 | –40 | dBc |
| | | $f_{RF}$ = 1710 to 1910 MHz | – | – | –35 | dBc |
| $H3_{HB}$ | third harmonic level | $f_{RF}$ = 1710 to 1785 MHz | – | –45 | –40 | dBc |
| | | $f_{RF}$ = 1710 to 1910 MHz | – | – | –35 | dBc |
| $Stab_{HB}$ | stability | note 2 | – | – | –60 | dBc |
| | ruggedness | $f_{RF}$ = 1710 to 1910 MHz; output VSWR = 10 : 1 for all phases angles | – | note 3 | – | |

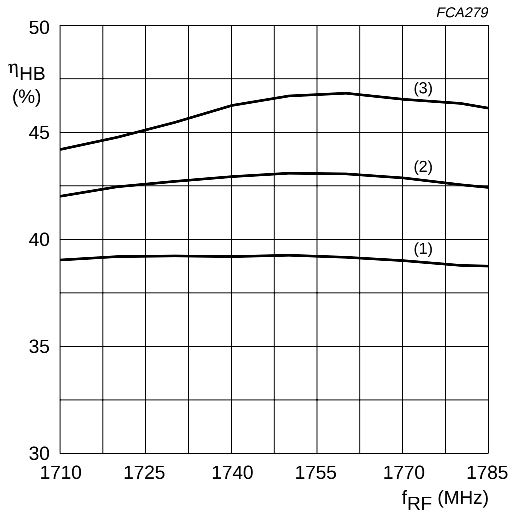
**Notes**

1. Isolation can be improved to –15 dBm (typical value) with a pin diode switched in the HB output matching.
2. The device is adjusted to provide nominal load power into a 50 Ω load. The device is switched off and a 3 : 1 load replaces the 50 Ω load. The device is switched on and the phase of the 3 : 1 load is varied 360 electrical degrees during a 60 seconds test period.
3. No circuit damage or performance degradation.



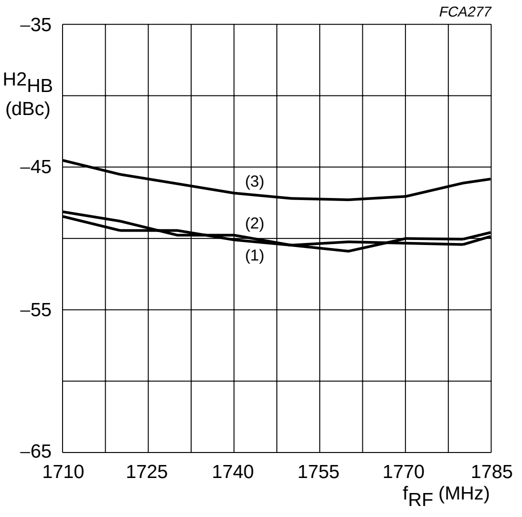

(1) $T_{amb}$ = 85 °C.
(2) $T_{amb}$ = 25 °C.
(3) $T_{amb}$ = −20 °C.

Fig.10 Maximum output power as a function of frequency.



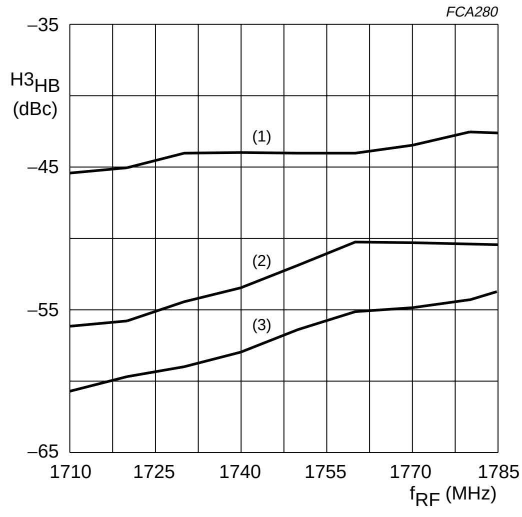

(1) $T_{amb}$ = 85 °C.
(2) $T_{amb}$ = 25 °C.
(3) $T_{amb}$ = −20 °C.

Fig.11 Efficiency as a function of frequency.



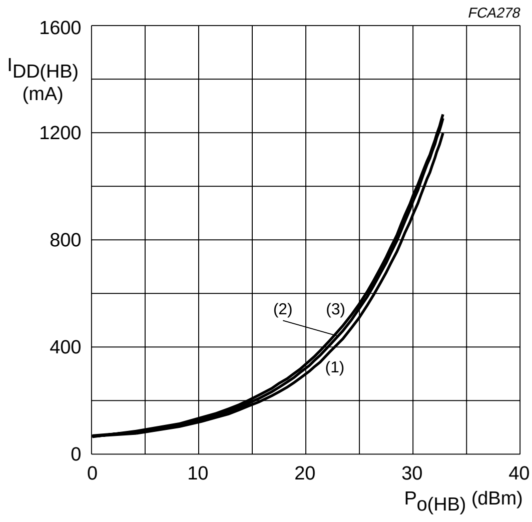

(1) $T_{amb}$ = 85 °C.
(2) $T_{amb}$ = 25 °C.
(3) $T_{amb}$ = −20 °C.

Fig.12 Second harmonic level as a function of frequency.



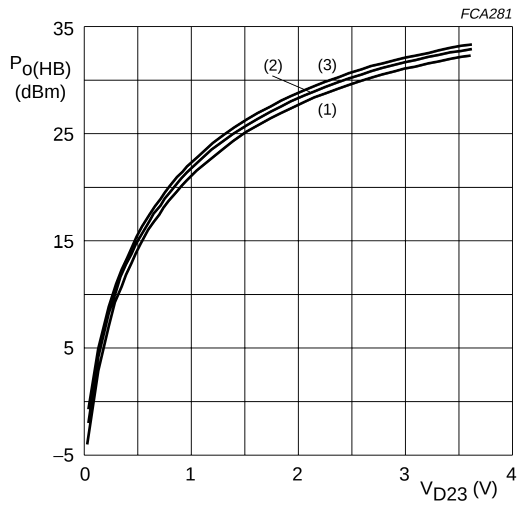

(1) $T_{amb}$ = 85 °C.
(2) $T_{amb}$ = 25 °C.
(3) $T_{amb}$ = −20 °C.

Fig.13 Third harmonic level as a function of frequency.




(1) $T_{amb}$ = 85 °C.
(2) $T_{amb}$ = 25 °C.
(3) $T_{amb}$ = −20 °C.

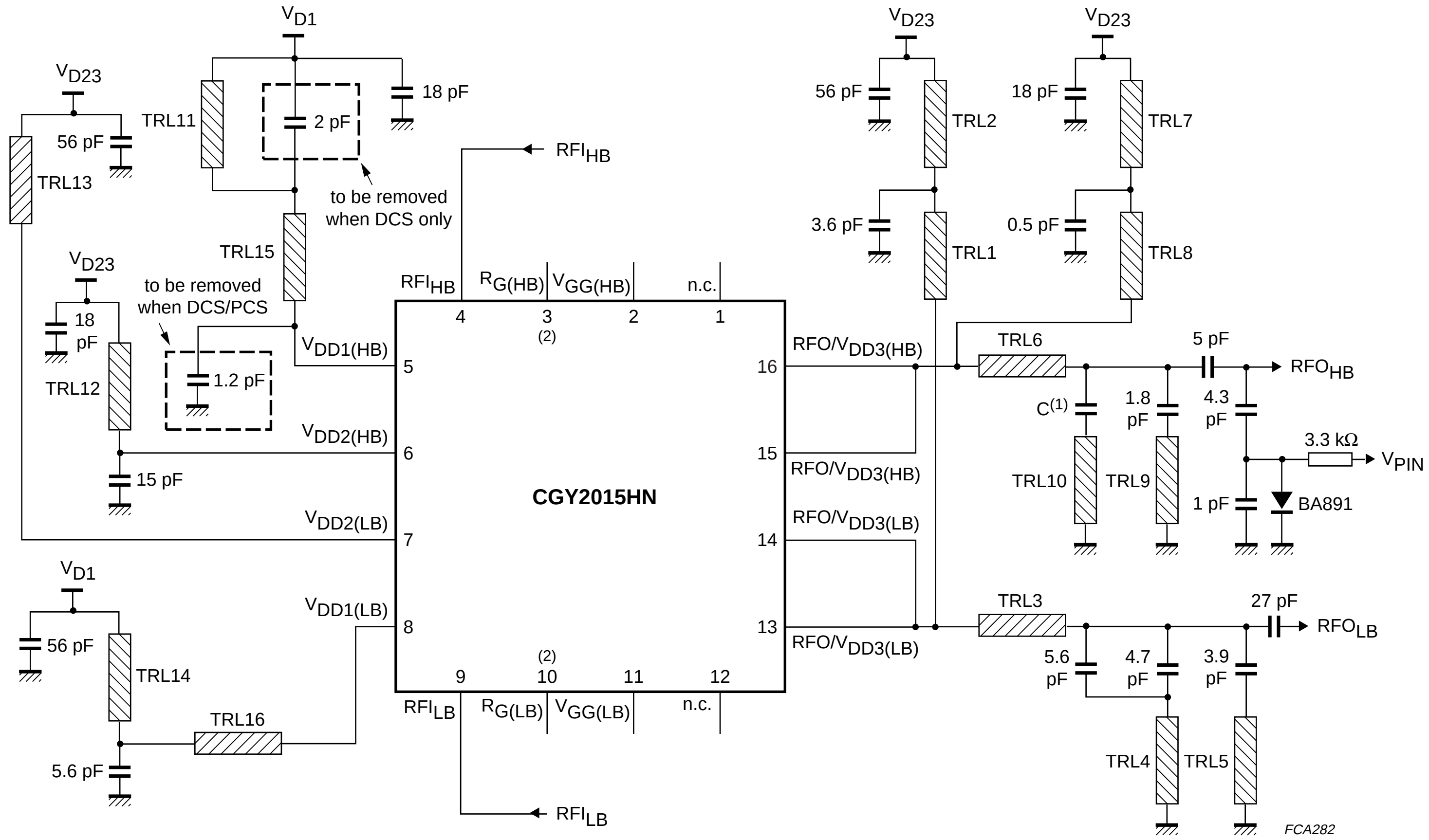
Fig.14 Positive peak supply current as a function of output power.




(1) $T_{amb}$ = 85 °C.
(2) $T_{amb}$ = 25 °C.
(3) $T_{amb}$ = −20 °C.

Fig.15 Output power as a function of supply voltage.

APPLICATION INFORMATION (RF PART)




Die pad is connected to ground.

Component type: R are 0402 Philips, C are 0402 Philips.

Transmission lines; see Table 2.

(1) C = 2.2 pF for DCS/PCS; C = 2.7 pF for DCS only.

(2) Not to be connected.

Fig.16 Schematic of Philips evaluation board (RF part).

**Table 2** Transmission lines (substrate thickness is 400 μm)

| TRANSMISSION LINE | WIDTH (μm) | LENGTH (mm) |
|---|---|---|
| TRL1 | 400 | 1.6 |
| TRL2 | 400 | 16.5 |
| TRL3 | 400 | 1.7 |
| TRL4 | 700 | 1.9 |
| TRL5 | 700 | 1.1 |
| TRL6 | 800 | 0.8 |
| TRL7 | 400 | 16.5 |
| TRL8 | 400 | 1.6 |
| TRL9 | 400 | 2.0 |
| TRL10 | 400 | 1.6 |
| TRL11 | 150 | 6.4 |
| TRL12 | 200 | 3.2 |
| TRL13 | 300 | 1.9 |
| TRL14 | 150 | 10.8 |
| TRL15 | 150 | 3.5 |
| TRL16 | 150 | 3.8 |

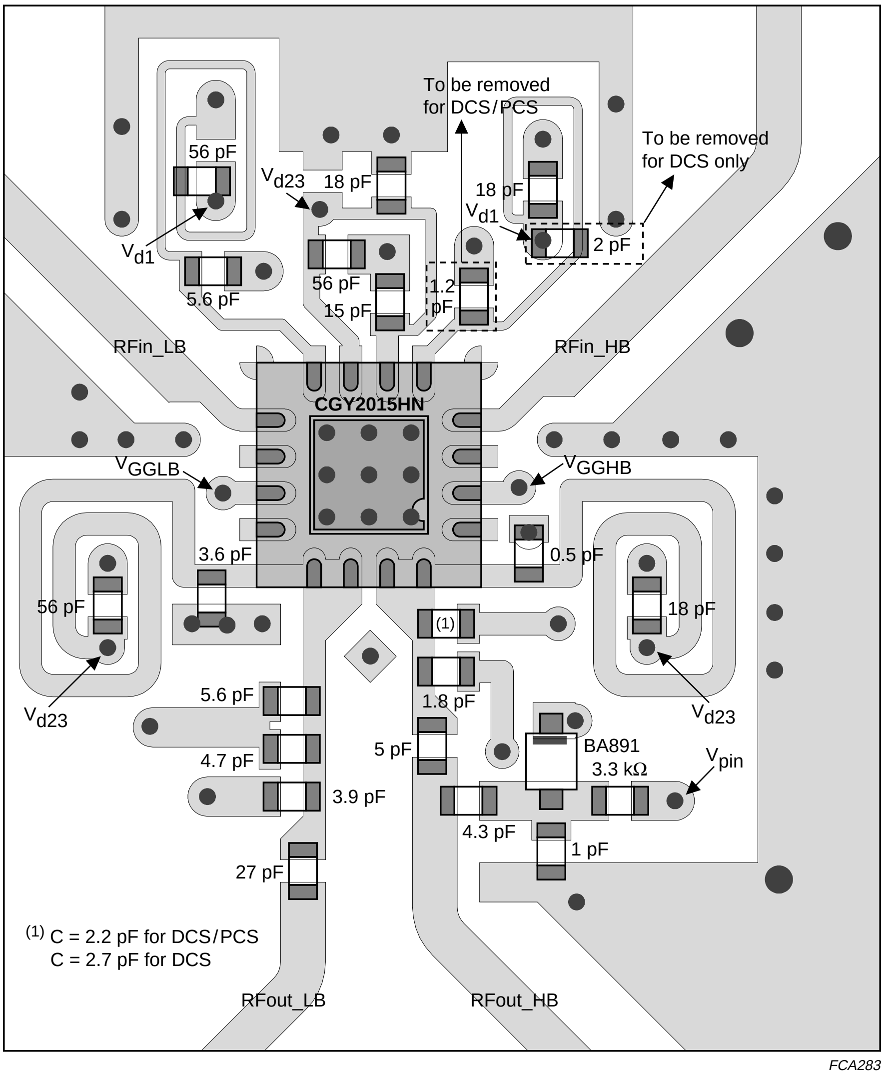



Fig.17 PCB layout of Philips evaluation board (RF part).

**Power control**

One solution for power control of the CGY2015 implements the Philips companion chip UBA1711. This device is designed to operate with dual band GaAs FET PA, especially when 50% duty cycle is applied because of:

- Its optimal thermal resistance (typical 30 K/W)
- Its optimized negative voltage generator which ensures 4 TX operation. The maximum value for $I_G$ (see Chapter "DC characteristics") is low enough to guarantee a negative voltage (≤–1.5 V) in these conditions.

Another solution for power control of the CGY2015 uses discrete components (see Fig.19). This solution has been designed to meet 1 TX operation.

These solutions need external signals:

- $V_{BAT}$: power supply voltage (3.6 V)
- DCS/$\overline{GSM}$: selects the band: DCS operation if the level is HIGH and GSM operation if the level is LOW (TLL levels)
- $V_{ref}$: 2.8 V reference voltage (only needed for the solution with discrete components)
- $V_{on/off}$: enables PA supply (TTL levels)
- $V_{ctrl}$: controls the voltage on second and third stages and then the output power.

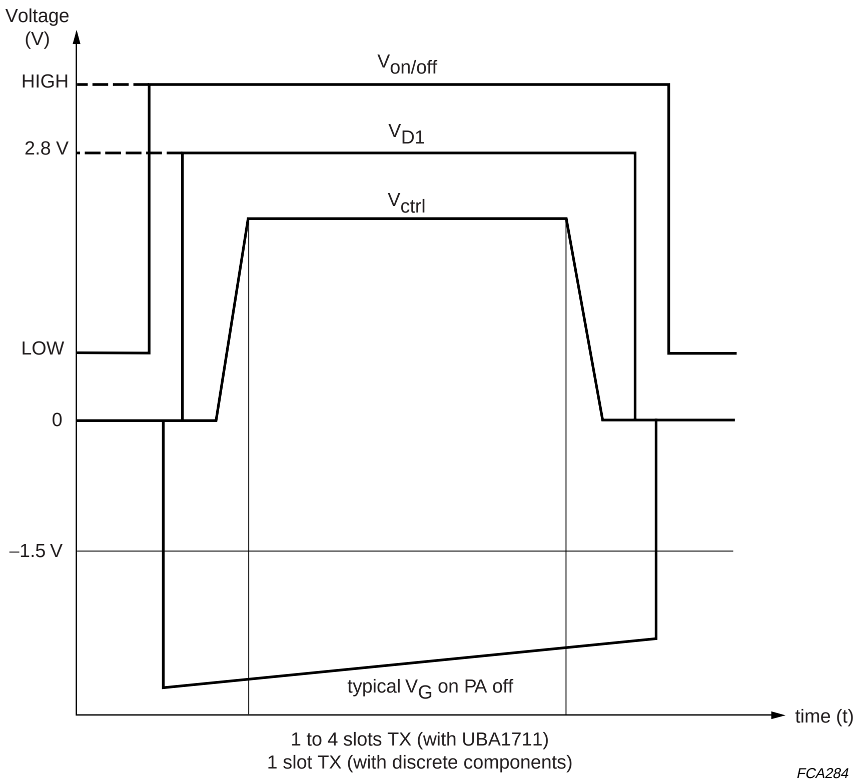



Fig.18 Timing diagram.

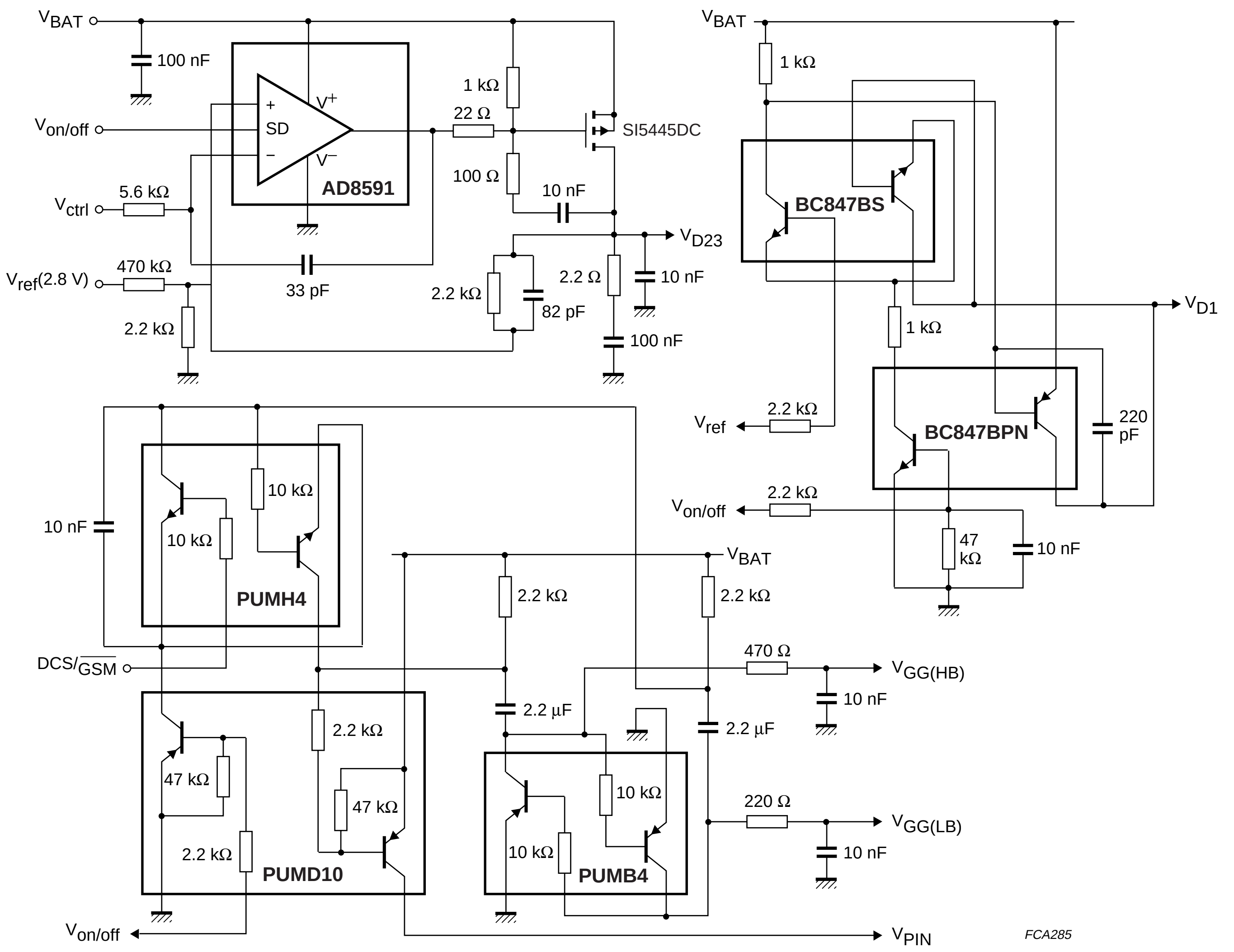
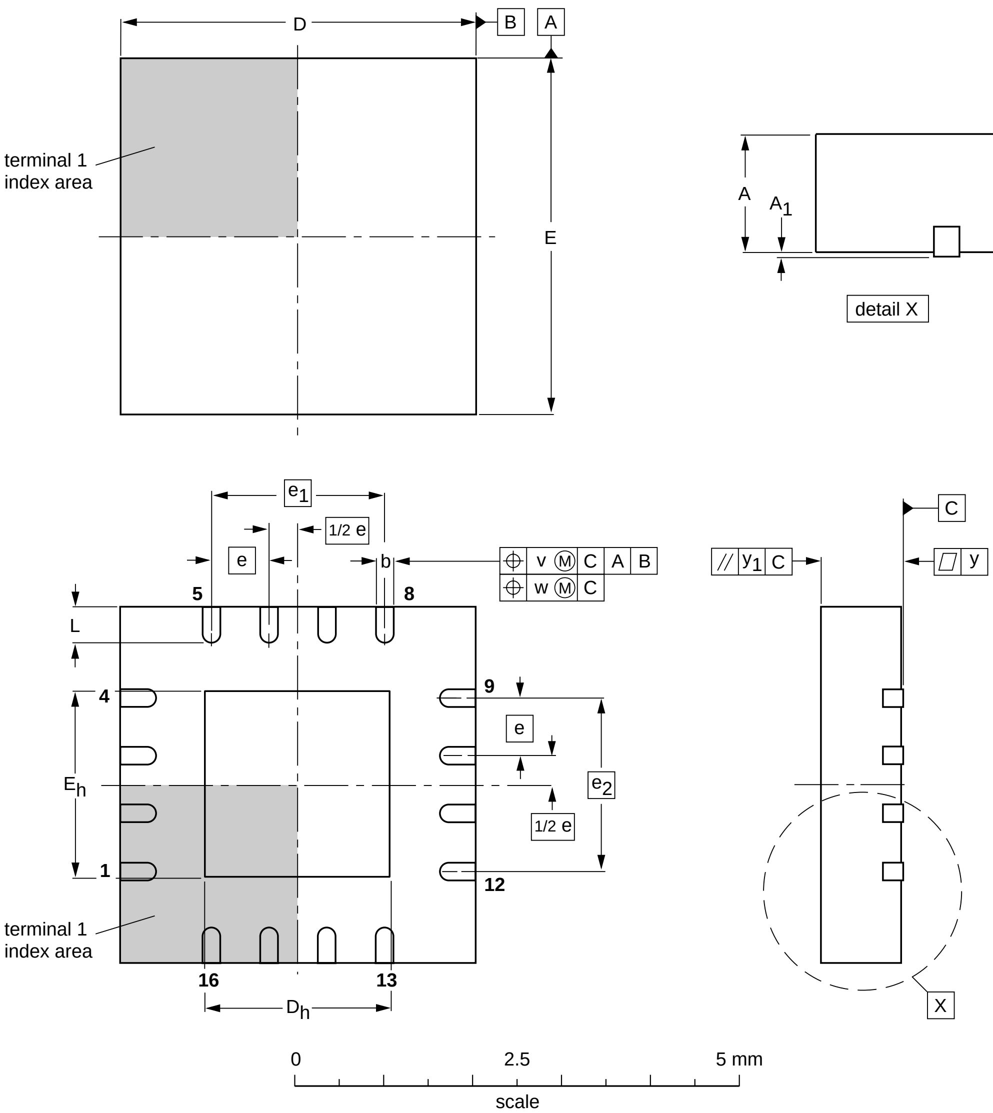



Fig.19 Power control part for Philips evaluation board.

## PACKAGE OUTLINE

**HVQFN16: plastic thermal enhanced very thin quad flat package; no leads; 16 terminals; body 4 x 4 x 0.85 mm** **SOT629-1**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | A(1) max. | $A_1$ | b | c | D(1) | $D_h$ | E(1) | $E_h$ | e | $e_1$ | $e_2$ | L | v | w | y | $y_1$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1 | 0.05<br>0.00 | 0.40<br>0.23 | 0.2 | 4.05<br>3.95 | 2.25<br>1.95 | 4.05<br>3.95 | 2.25<br>1.95 | 0.65 | 1.95 | 1.95 | 0.75<br>0.35 | 0.1 | 0.05 | 0.05 | 0.1 |

**Note**

1. Plastic or metal protrusions of 0.075 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT629-1 | - - - | MO-220 | - - - | | | ~~01-08-08~~<br>02-01-22 |

## 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 can still be used for certain surface mount ICs, but it is not suitable for fine pitch SMDs. In these situations reflow soldering is recommended.

### 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, convection or convection/infrared 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 preferable be kept below 220 °C for thick/large packages, and below 235 °C for small/thin packages.

### 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.

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

| PACKAGE | SOLDERING METHOD | |
|---|---|---|
| | WAVE | REFLOW[1] |
| BGA, HBGA, LFBGA, SQFP, TFBGA | not suitable | suitable |
| HBCC, HLQFP, HSQFP, HSOP, HTQFP, HTSSOP, HVQFN, 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. On versions with the heatsink on the bottom side, the solder cannot penetrate between the printed-circuit board and the heatsink. On versions with the heatsink on the top side, the solder might be deposited on the heatsink surface.
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.

## DATA SHEET STATUS

| DATA SHEET STATUS(1) | PRODUCT STATUS(2) | DEFINITIONS |
|---|---|---|
| Objective data | Development | This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice. |
| Preliminary data | Qualification | This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product. |
| Product data | Production | This data sheet contains data from the product specification. Philips Semiconductors reserves the right to make changes at any time in order to improve the design, manufacturing and supply. Changes will be communicated according to the Customer Product/Process Change Notification (CPCN) procedure SNW-SQ-650A. |

**Notes**

1. Please consult the most recently issued data sheet before initiating or completing a design.
2. The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL http://www.semiconductors.philips.com.

## DEFINITIONS

**Short-form specification** — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

**Limiting values definition** — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). 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** — Applications that are described herein for any of these products are for illustrative purposes only. Philips Semiconductors make no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

## DISCLAIMERS

**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 Semiconductors customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips Semiconductors for any damages resulting from such application.

**Right to make changes** — Philips Semiconductors reserves the right to make changes, without notice, in the products, including circuits, standard cells, and/or software, described or contained herein in order to improve design and/or performance. Philips Semiconductors assumes no responsibility or liability for the use of any of these products, conveys no licence or title under any patent, copyright, or mask work right to these products, and makes no representations or warranties that these products are free from patent, copyright, or mask work right infringement, unless otherwise specified.

**NOTES**

## NOTES

## NOTES

# *Philips Semiconductors – a worldwide company*

**Contact information**

For additional information please visit **http://www.semiconductors.philips.com**. Fax: **+31 40 27 24825**
For sales offices addresses send e-mail to: **sales.addresses@www.semiconductors.philips.com**.



SCA74



Printed in The Netherlands 403506/01/pp24 Date of release: 2002 Mar 12 Document order number: 9397 750 09143