



## Features

- Single 3-V supply voltage
- High-power-added efficient power amplifier ( $P_{out}$  typ. 23 dBm)
- Ramp-controlled output power
- Current-saving standby mode
- Few external components
- HP-VFQFP-N16

Electrostatic sensitive device.  
Observe precautions for handling.



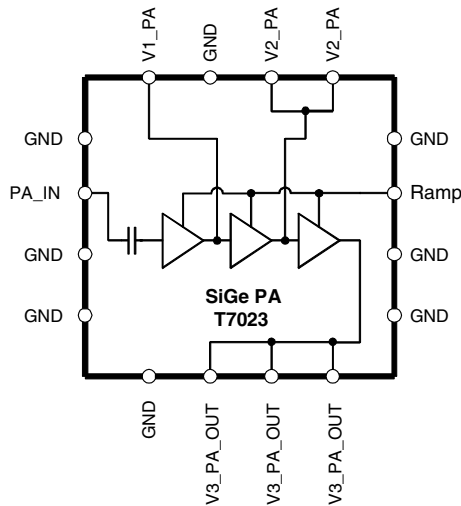
## Description

The T7023 is a monolithic SiGe power amplifier. It is especially designed for operation in TDMA systems like Bluetooth, DECT, IEEE 802.11 FHSS WLAN, home RF and ISM proprietary radios.

Due to the ramp-control feature and a very low quiescent current, an external switch transistor for  $V_S$  is not required.

## Block Diagram

Figure 1.



## Ordering Information

| Extended Type Number | Package      | Remarks          |
|----------------------|--------------|------------------|
| T7023-PES            | HP-VFQFP-N16 | Tube             |
| T7023-PEQ            | HP-VFQFP-N16 | Taped and reeled |
| T7023-DB             | Flipchip     |                  |



## ISM/Bluetooth™ 2.4-GHz Power Amplifier

### T7023

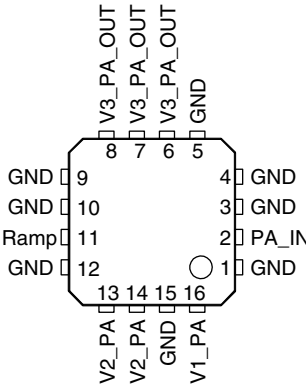
Rev. A4, 06-Dec-01





Pin Configuration

Figure 2. Pinning HP-VFQFP-N16



Pin Description

| Pin  | Symbol    | Function                                                                 |
|------|-----------|--------------------------------------------------------------------------|
| 1    | GND       | Ground                                                                   |
| 2    | PA_IN     | Power amplifier input                                                    |
| 3    | GND       | Ground                                                                   |
| 4    | GND       | Ground                                                                   |
| 5    | GND       | Ground                                                                   |
| 6    | V3_PA_OUT | Inductor to power supply and matching network for power amplifier output |
| 7    | V3_PA_OUT | Inductor to power supply and matching network for power amplifier output |
| 8    | V3_PA_OUT | Inductor to power supply and matching network for power amplifier output |
| 9    | GND       | Ground                                                                   |
| 10   | GND       | Ground                                                                   |
| 11   | RAMP      | Power ramping control input                                              |
| 12   | GND       | Ground                                                                   |
| 13   | V2_PA     | Inductor to power supply for power amplifier                             |
| 14   | V2_PA     | Inductor to power supply for power amplifier                             |
| 15   | GND       | Ground                                                                   |
| 16   | V1_PA     | Supply voltage for power amplifier                                       |
| Slug | GND       | Ground                                                                   |

## Absolute Maximum Ratings

All voltages are referred to ground (Pins GND and slug), no RF

| Parameter                                         | Symbol     | Value       | Unit |
|---------------------------------------------------|------------|-------------|------|
| Supply voltage<br>Pins V1_PA, V2_PA and V3_PA_OUT | $V_S$      | 6           | V    |
| Junction temperature                              | $T_j$      | 150         | °C   |
| Storage temperature                               | $T_{stg}$  | -40 to +125 | °C   |
| RF input power PA                                 | $P_{inPA}$ | 10 dBm      | dBm  |

## Thermal Resistance

| Parameter                     | Symbol     | Value  | Unit |
|-------------------------------|------------|--------|------|
| Junction ambient HP-VFQFP-N16 | $R_{thJA}$ | t.b.d. | K/W  |

## Operating Range

All voltages are referred to ground (Pins GND and slug). Power supply points are V1\_PA, V2\_PA, V3\_PA\_OUT.  
The following table represents the sum of all supply currents depending on the TX mode.

| Parameter                                         | Symbol    | Min. | Typ. | Max. | Unit |
|---------------------------------------------------|-----------|------|------|------|------|
| Supply voltage<br>Pins V1_PA, V2_PA and V3_PA_OUT | $V_S$     | 2.7  | 3.0  | 4.6  | V    |
| Supply current                                    | $I_S$     |      | 165  |      | mA   |
| Standby current                                   | $I_S$     |      | 10   |      | μA   |
| Ambient temperature                               | $T_{amb}$ | -25  | +25  | +70  | °C   |

## Electrical Characteristics

Test conditions (unless otherwise specified):  $V_S = 3.0\text{ V}$ ,  $T_{\text{amb}} = 25^\circ\text{C}$

| No.                                                                                                                                                                                                                                                                                                                                                         | Parameters                    | Test Conditions                                     | Pin | Symbol                | Min. | Typ.   | Max.    | Unit          | Type* |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|-----------------------------------------------------|-----|-----------------------|------|--------|---------|---------------|-------|
| <b>Power Amplifier <sup>1)</sup></b>                                                                                                                                                                                                                                                                                                                        |                               |                                                     |     |                       |      |        |         |               |       |
|                                                                                                                                                                                                                                                                                                                                                             | Supply voltage                | Pins V1_PA, V2_PA and V3_PA_OUT                     |     | $V_S$                 | 2.7  | 3.0    | 4.6     | V             |       |
|                                                                                                                                                                                                                                                                                                                                                             | Supply current                | TX                                                  |     | $I_{S\_TX}$           |      | 165    |         | mA            |       |
|                                                                                                                                                                                                                                                                                                                                                             |                               | RX (PA off),<br>$V_{\text{RAMP}} \geq 0.1\text{ V}$ |     | $I_{S\_RX}$           |      |        | 10      | $\mu\text{A}$ |       |
|                                                                                                                                                                                                                                                                                                                                                             |                               | Standby                                             |     | $I_{S\_standby}$      |      |        | 10      | $\mu\text{A}$ |       |
|                                                                                                                                                                                                                                                                                                                                                             | Frequency range               | TX                                                  |     | f                     | 2.4  |        | 2.5     | GHz           |       |
|                                                                                                                                                                                                                                                                                                                                                             | Gain-control range            | TX                                                  |     | $\Delta G_p$          | 60   | 42     |         | dB            |       |
|                                                                                                                                                                                                                                                                                                                                                             | Power gain max.               | TX<br>Pin PA_IN to<br>V3_PA_OUT                     |     | $G_p$                 | 28   | 30     | 33      | dB            |       |
|                                                                                                                                                                                                                                                                                                                                                             | Power gain min.               | TX<br>Pin PA_IN to<br>V3_PA_OUT                     |     | $G_p$                 | -40  |        | -17     | dB            |       |
|                                                                                                                                                                                                                                                                                                                                                             | Ramping voltage max.          | TX, power gain (max)<br>Pin RAMP                    |     | $V_{\text{RAMP max}}$ | 1.7  | 1.75   | 1.83    | V             |       |
|                                                                                                                                                                                                                                                                                                                                                             | Ramping voltage min.          | TX, power gain (min)<br>Pin RAMP                    |     | $V_{\text{RAMP min}}$ |      | 0.1    |         | V             |       |
|                                                                                                                                                                                                                                                                                                                                                             | Ramping current max.          | $V = 1.75\text{ V}$                                 |     |                       |      |        | 0.5     | mA            |       |
|                                                                                                                                                                                                                                                                                                                                                             | Power-added efficiency        | TX                                                  |     | PAE                   | 35   | 40     |         | %             |       |
|                                                                                                                                                                                                                                                                                                                                                             | Saturated output power        | TX, input power = 0 dBm referred to Pins V3_PA_OUT  |     | $P_{\text{sat}}$      | 22.5 | 23     | 23.5    | dBm           |       |
|                                                                                                                                                                                                                                                                                                                                                             | Input matching <sup>2)</sup>  | TX, Pin PA_IN                                       |     | Load VSWR             |      | <1.5:1 | 1.5 : 1 |               |       |
|                                                                                                                                                                                                                                                                                                                                                             | Output matching <sup>2)</sup> | TX, Pin V3_PA_OUT                                   |     | Load VSWR             |      | <1.5:1 | 1.5 : 1 |               |       |
|                                                                                                                                                                                                                                                                                                                                                             | Harmonics @P 1dBCP            | TX, Pin V3_PA_OUT                                   |     | 2 fo                  |      |        | -30     | dBc           |       |
|                                                                                                                                                                                                                                                                                                                                                             | Harmonics @P 1dBCP            | TX, Pin V3_PA_OUT                                   |     | 3 fo                  |      |        | -30     | dBc           |       |
| <p>*) Type means: A =100% tested, B = 100% correlation tested, C = Characterized on samples, D = Design parameter</p> <p>Notes: 1) Power amplifier shall be unconditional stable, maximum duty cycle 100%, true cw operation, maximum load mismatch and duration t.b.d.</p> <p>2) With external matching network, load impedance 50 <math>\Omega</math></p> |                               |                                                     |     |                       |      |        |         |               |       |

# Typical Operating Characteristics

Figure 3. Output power and PAE vs. supply voltage

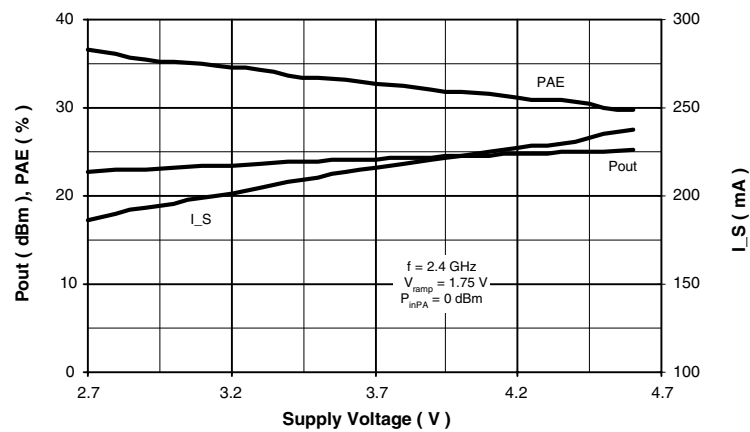


Figure 4. Output power and PAE vs. frequency

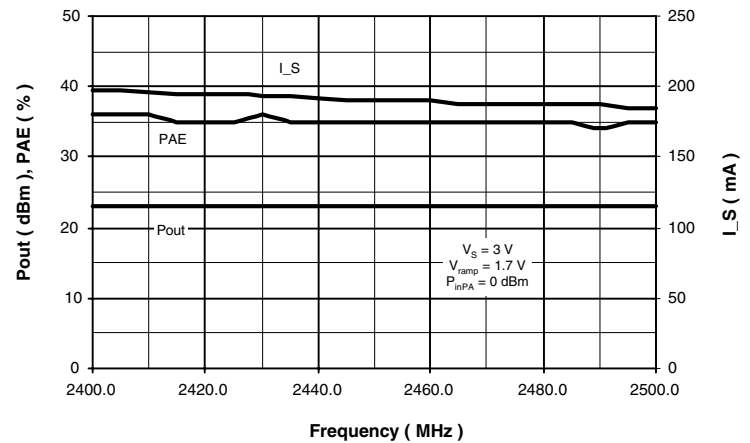


Figure 5. Output power and PAE vs. ramp voltage

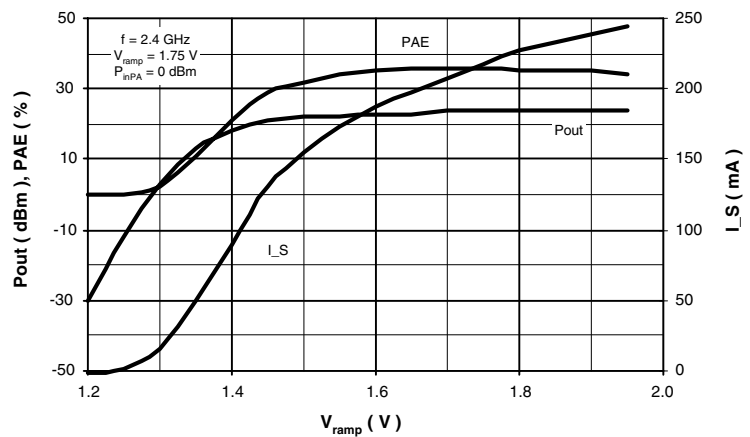


Figure 6. Output power and PAE vs. input power

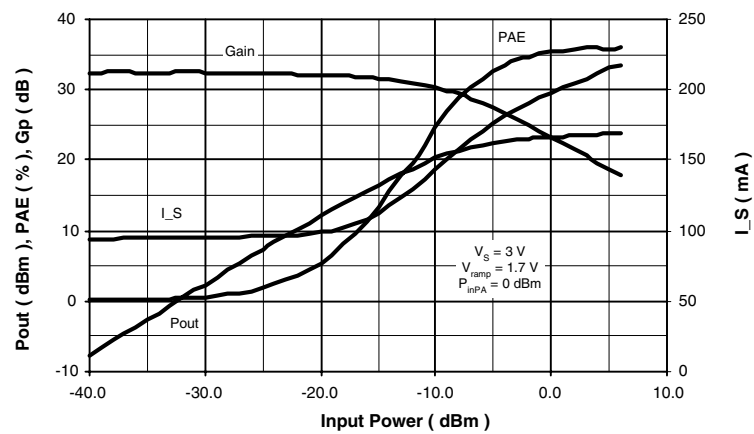


Figure 7. P<sub>out</sub> vs. V<sub>ramp</sub> and temperature

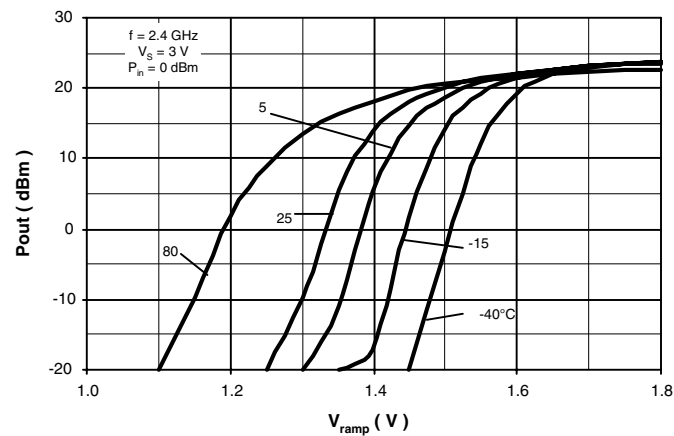


Figure 8.

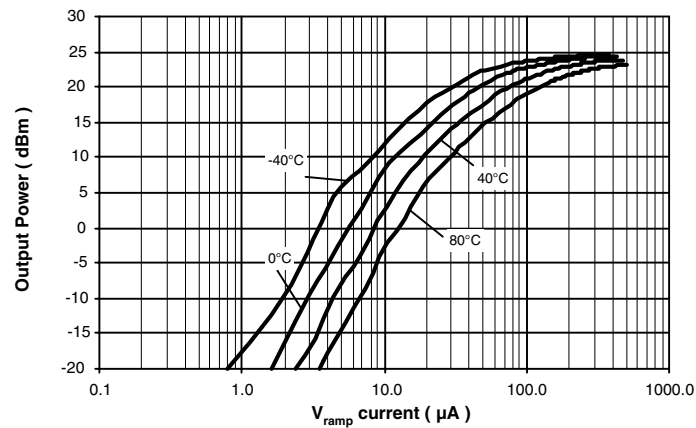
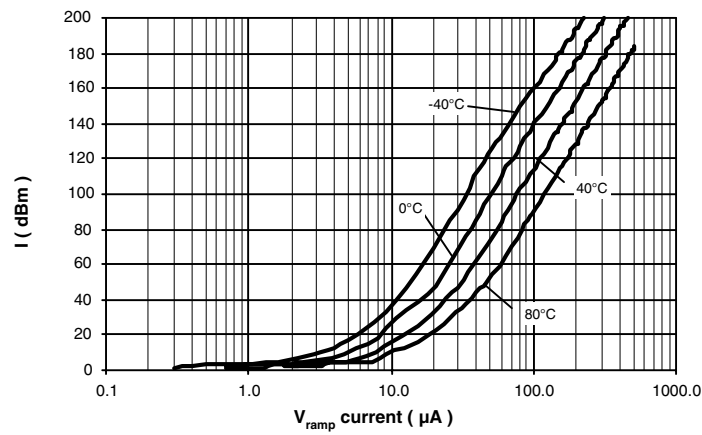


Figure 9.



Input / Output Circuits

Figure 10.

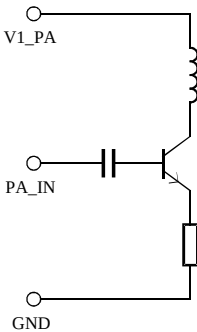


Figure 11.

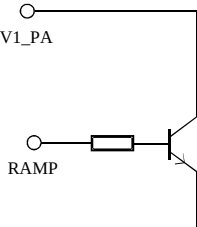




Figure 12.

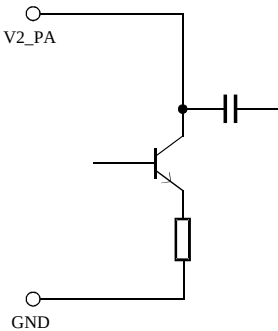
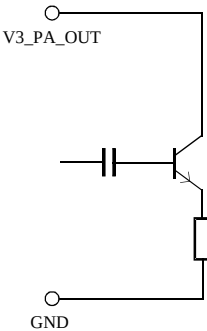


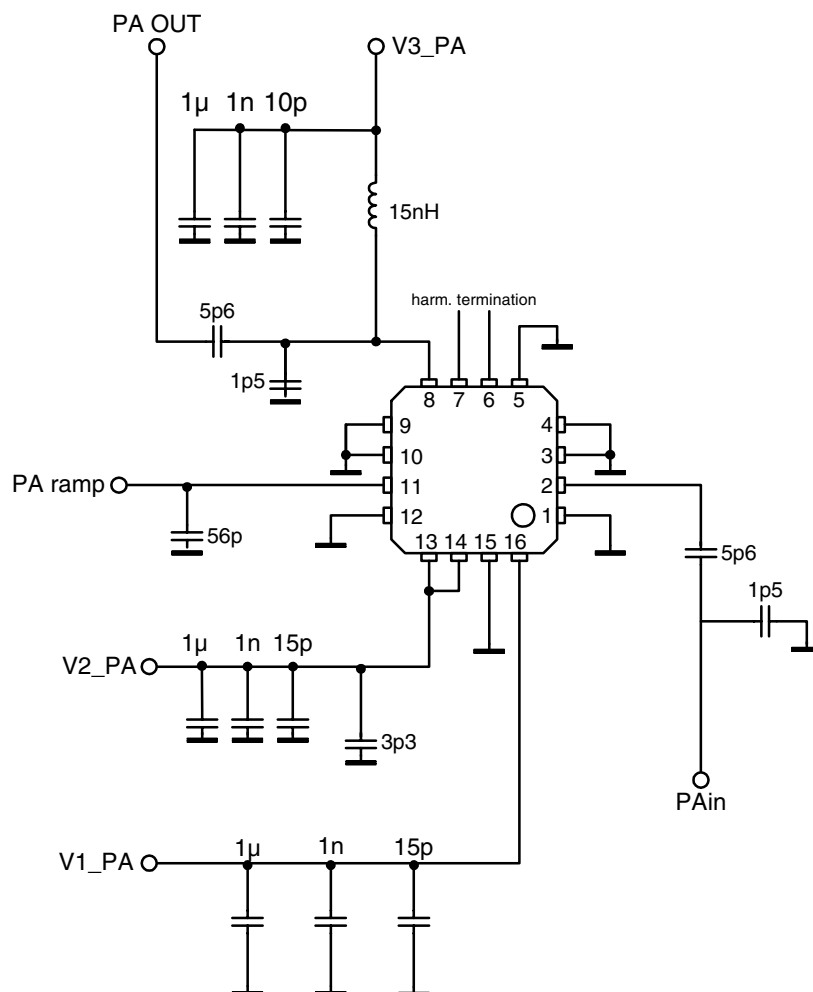
Figure 13.





## Application Board Schematic

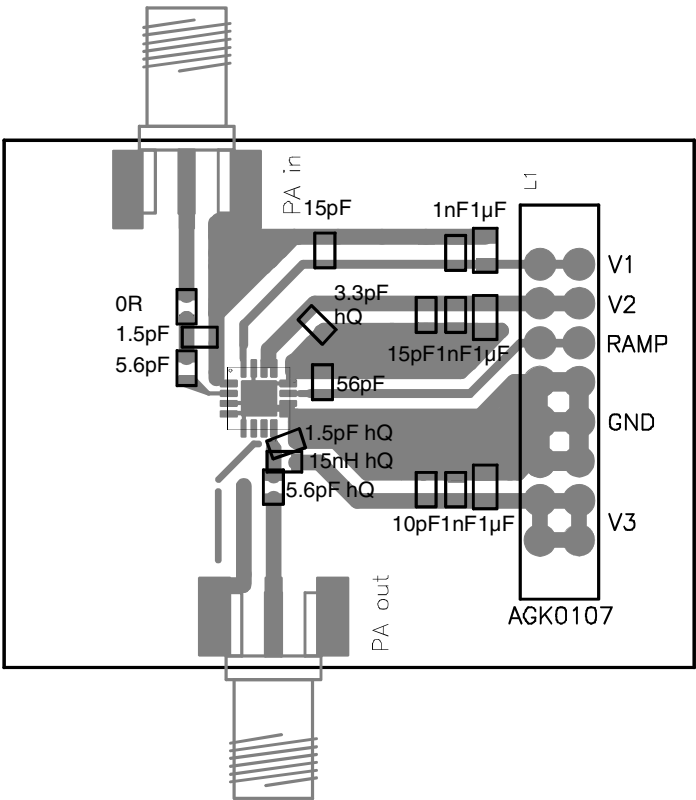
Figure 14.





Application Board Layout

Figure 15.





## Ozone Depleting Substances Policy Statement

It is the policy of **Atmel Germany GmbH** to

1. Meet all present and future national and international statutory requirements.
2. Regularly and continuously improve the performance of our products, processes, distribution and operating systems with respect to their impact on the health and safety of our employees and the public, as well as their impact on the environment.

It is particular concern to control or eliminate releases of those substances into the atmosphere which are known as ozone depleting substances (ODSs).

The Montreal Protocol (1987) and its London Amendments (1990) intend to severely restrict the use of ODSs and forbid their use within the next ten years. Various national and international initiatives are pressing for an earlier ban on these substances.

**Atmel Germany GmbH** has been able to use its policy of continuous improvements to eliminate the use of ODSs listed in the following documents.

1. Annex A, B and list of transitional substances of the Montreal Protocol and the London Amendments respectively
2. Class I and II ozone depleting substances in the Clean Air Act Amendments of 1990 by the Environmental Protection Agency (EPA) in the USA
3. Council Decision 88/540/EEC and 91/690/EEC Annex A, B and C (transitional substances) respectively.

**Atmel Germany GmbH** can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.



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