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## Features

- **35 dBm Output Power in CW Mode**
- **High Power Added Efficiency (PAE)**
- **Single Supply Operation (No Negative Rail)**
- **Simple Analog Power Ramp Control**
- **Low Current Consumption in Power-down Mode (Typically ≤ 15 µA)**
- **Small SMD Package (PSSOP28 with Heat Slug)**

## Applications

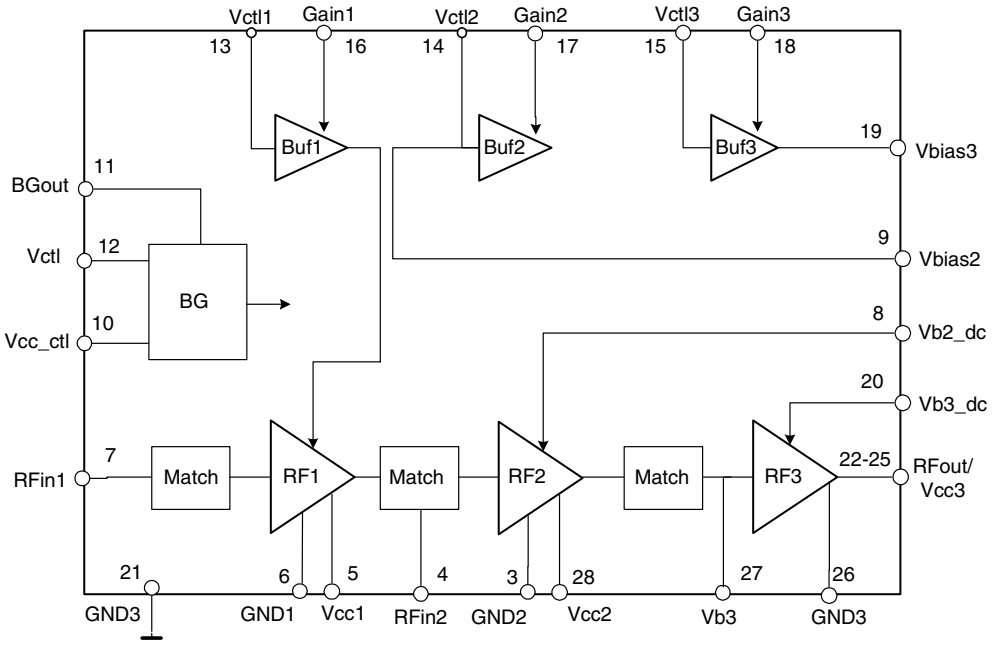
- **Professional Phones**
- **Hands-free Sets**
- **ISM Band Application**
- **Wireless Infrastructure Preamplifiers**

## Description

The T0905 is a monolithic integrated power amplifier IC manufactured with Atmel's Silicon-Germanium (SiGe) process. Due to its open architecture, the device can be used either as a two or three-stage amplifier. Every stage can be matched individually, thus allowing applications in a wide frequency range. The T0905 can be used from 135 MHz up to 600 MHz in both linear and non-linear (saturated) mode. The power gain can be set dynamically by means of an analog control input optionally for each single stage or for the entire power amplifier. Constant gain mode is also possible. The T0905 is suited for CW mode up to 35 dBm. These features, including wide power ramp control, make the T0905 a very flexible power amplifier for many different applications.

Apart from telephone applications, the T0905 can also be used for car identification systems and several other wireless communication systems. The single supply voltage operation at +3.5 V and a negligible leakage current in power-down mode enable a remarkable simplification of the application's power management.

**Figure 1.** Block Diagram




# General-purpose VHF/UHF Power Amplifier (135 to 600 MHz)

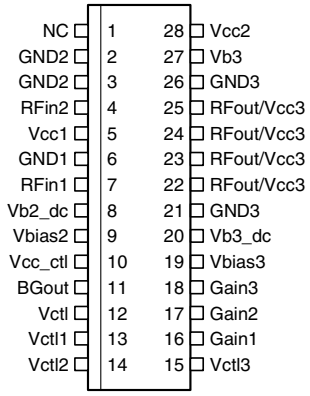
# T0905

# Preliminary

Rev. 4751A–SIGE–09/03

## Pin Configuration

**Figure 2.** Pinning PSSOP28




## Pin Description

| Pin | Symbol | Function |
|---|---|---|
| 1 | NC | Not connected |
| 2 | GND2 | Ground |
| 3 | GND2 | Ground |
| 4 | RFin2 | RF input (2-stage operation) |
| 5 | Vcc1 | Supply voltage, first stage |
| 6 | GND1 | Ground |
| 7 | RFin1 | RF input (3-stage operation) |
| 8 | Vb2_dc | Input for gain setting, second stage |
| 9 | Vbias2 | Output Buf2 |
| 10 | Vcc_ctl | Supply voltage control block |
| 11 | BGout | Output band gap |
| 12 | Vctl | Control voltage input |
| 13 | Vctl1 | Control voltage input, first stage |
| 14 | Vctl2 | Control voltage input, second stage |
| 15 | Vctl3 | Control voltage input, third stage |
| 16 | Gain1 | Gain setting Buf1 |
| 17 | Gain2 | Gain setting Buf2 |
| 18 | Gain3 | Gain setting Buf3 |
| 19 | Vbias3 | Output Buf3 |
| 20 | Vb3_dc | Input for gain setting, third stage |
| 21 | GND3 | Ground |
| 22 | RFout/Vcc3 | RF output/supply voltage, third stage |
| 23 | RFout/Vcc3 | RF output/supply voltage, third stage |
| 24 | RFout/Vcc3 | RF output/supply voltage, third stage |
| 25 | RFout/Vcc3 | RF output/supply voltage, third stage |
| 26 | GND3 | Ground |
| 27 | Vb3 | Pin to extend the input capacity of stage 3 |
| 28 | Vcc2 | Supply voltage second stage |

## Absolute Maximum Ratings

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

| Parameters | Symbol | Value | Unit |
|---|---|---|---|
| Supply voltage $V_{CC,}$ no RF | $V_{CC1}$, $V_{CC2,}$ $V_{CC3}$ | 0 to +5.5 | V |
| Input power | $P_{RFin}$ | 10 | dBm |
| Gain control voltage(1) | $V_{ctl}$ | 0 to +2.5 | V |
| Operating case temperature | $T_c$ | -30 to +100 | °C |
| Storage temperature | $T_{stg}$ | -40 to +150 | °C |
| Maximum output power | $P_{RFout}$ | 36 | dBm |

Note: 1. The part may not survive all maximums applied simultaneously

## Thermal Resistance

| Parameters | Symbol | Value | Unit |
|---|---|---|---|
| Junction case | $R_{thJC}$ | 19 | K/W |

## Operating Range

All voltages are referred to GND

| Parameters | Symbol | Value | Unit |
|---|---|---|---|
| Supply voltage | $V_{CC}$ | 2.4 to 5.0 | V |
| Ambient temperature | $T_{amb}$ | -30 to +85 | °C |
| Input frequency | $f_{Rfin}$ | 135 to 600 | MHz |

## Electrical Characteristics

Test conditions (if not otherwise specified): $V_{CC}$ = +3.5 V, $T_{amb}$ = +25°C, 50 Ω input and 50 Ω output match

| No. | Parameters | Test Conditions | Pin | Symbol | Min. | Typ. | Max. | Unit | Type* |
|---|---|---|---|---|---|---|---|---|---|
| **1** | **Power Supply** | | | | | | | | |
| 1.1 | Current consumption power down mode (leakage current) | $V_{ctlx} \leq 0.2$ V | 10, 22 - 25, 28 | I | | 15 | 25 | µA | A |
| **2** | **150-MHz Amplifier Mode** | | | | | | | | |
| 2.1 | Frequency range | | | $f_{Rfin150}$ | 135 | | 178 | MHz | C |
| 2.2 | Output power normal conditions | $V_{CC}$ = 3.5 V<br>$T_{amb}$ = +25°C<br>$P_{RFin}$ = 3 dBm<br>$R_L = R_G$ = 50 Ω | 22 - 25 | $P_{RFout150}$ | 34.0 | 35.0 | | dBm | C |
| 2.3 | Extreme conditions | $V_{CC}$ = 2.4 V<br>$T_{amb}$ = +85°C<br>$P_{RFin}$ = 3 dBm<br>$R_L = R_G$ = 50 Ω | 22 - 25 | $P_{RFout150}$ | 32.0 | 33.0 | | dBm | C |
| 2.4 | Input power | | 4 | $P_{RFin150}$ | | 3 | 10 | dBm | C |

*) Type means: A = 100% tested, B = 100% correlation tested, C = Characterized on samples, D = Design parameter

## Electrical Characteristics (Continued)

Test conditions (if not otherwise specified): $V_{CC}$ = +3.5 V, $T_{amb}$ = +25°C, 50 Ω input and 50 Ω output match

| No. | Parameters | Test Conditions | Pin | Symbol | Min. | Typ. | Max. | Unit | Type* |
|---|---|---|---|---|---|---|---|---|---|
| 2.5 | Power added efficiency | $V_{CC}$ = 3.5 V<br>$P_{RFout}$ = 35.0 dBm | 10, 22 - 25, 28 | $PAE_{150}$ | 50 | 55 | | % | C |
| 2.6 | Current consumption active mode | $P_{RFout}$ = 35 dBm | 10, 22 - 25, 28 | $I_{150}$ | | 1.64 | | A | C |
| 2.7 | Input VSWR | $P_{RFin}$ = 0 to 8 dBm<br>$P_{RFout}$ = 31.0 dBm | 4 | $VSWR_{150}$ | | | 2:1 | | C |
| 2.8 | Stability/load mismatch | $P_{RFout}$ = 31.0 dBm<br>$V_{CC}$ = 4.6 V | 22 - 25 | $VSWR_{150}$ | | | 8:1 | | C |
| 2.9 | 2nd harmonic distortion | | 22 - 25 | $2fo_{150}$ | | | -35 | dBc | C |
| 2.10 | 3rd harmonic distortion | | 22 - 25 | $3fo_{150}$ | | | -35 | dBc | C |
| 2.11 | 4th to 8th harmonic distortion | | 22 - 25 | $4fo..8fo_{150}$ | | | -35 | dBc | C |
| 2.12 | Isolation between input and output | $P_{Rfin150}$ = 8 dBm<br>$V_{ctl} \leq$ 0.2 V<br>(power down) | 4,<br>22 - 25 | $P_{RFout150}$ | | | -30 | dBm | C |
| **3** | **450-MHz Amplifier Mode** | | | | | | | | |
| 3.1 | Frequency range | | | $f_{Rfin450}$ | 380 | | 520 | MHz | A |
| 3.2 | Output power normal conditions | $V_{CC}$ = 3.5 V<br>$T_{amb}$ = +25°C<br>$P_{RFin}$ = 3 dBm<br>$R_L = R_G$ = 50 Ω | 22 - 25 | $P_{RFout450}$ | 34.0 | 35.0 | | dBm | A |
| 3.3 | Extreme conditions | $V_{CC}$ = 2.4 V<br>$T_{amb}$ = +85°C<br>$P_{RFin}$ = 3 dBm<br>$R_L = R_G$ = 50 Ω | 22 - 25 | $P_{RFout450}$ | 32.0 | 33.0 | | dBm | C |
| 3.4 | Input power | | 4 | $P_{RFin450}$ | | 3 | 10 | dBm | A |
| 3.5 | Power added efficiency | $V_{CC}$ = 3.5 V<br>$P_{RFout}$ = 35.0 dBm | 10, 22 - 25, 28 | $PAE_{450}$ | 50 | 55 | | % | A |
| 3.6 | Current consumption active mode | $P_{RFout}$ = 35 dBm<br>PAE = 55% | 10, 22 - 25, 28 | $I_{450}$ | | 1.64 | | A | A |
| 3.7 | Input VSWR | $P_{Rfin450}$ = 0 to 8 dBm<br>$P_{RFout}$ = 31.0 dBm | 4 | $VSWR_{450}$ | | | 2:1 | | C |
| 3.8 | Stability/load mismatch | $P_{RFout450}$ = 31.0 dBm<br>$V_{CC}$ = 4.6 V | 22 - 25 | $VSWR_{450}$ | | | 8:1 | | C |
| 3.9 | 2nd harmonic distortion | | 22 - 25 | $2fo_{450}$ | | | -35 | dBc | A |
| 3.10 | 3rd harmonic distortion | | 22 - 25 | $3fo_{450}$ | | | -35 | dBc | A |
| 3.11 | 4th to 8th harmonic distortion | | 22 - 25 | $4fo..8fo_{450}$ | | | -35 | dBc | C |
| 3.12 | Isolation between input and output | $P_{Rfin150}$ = 8 dBm<br>$V_{ctl} \leq$ 0.2 V<br>(power down) | 4,<br>22 - 25 | $P_{RFout450}$ | | | -30 | dBm | A |

*) Type means: A = 100% tested, B = 100% correlation tested, C = Characterized on samples, D = Design parameter

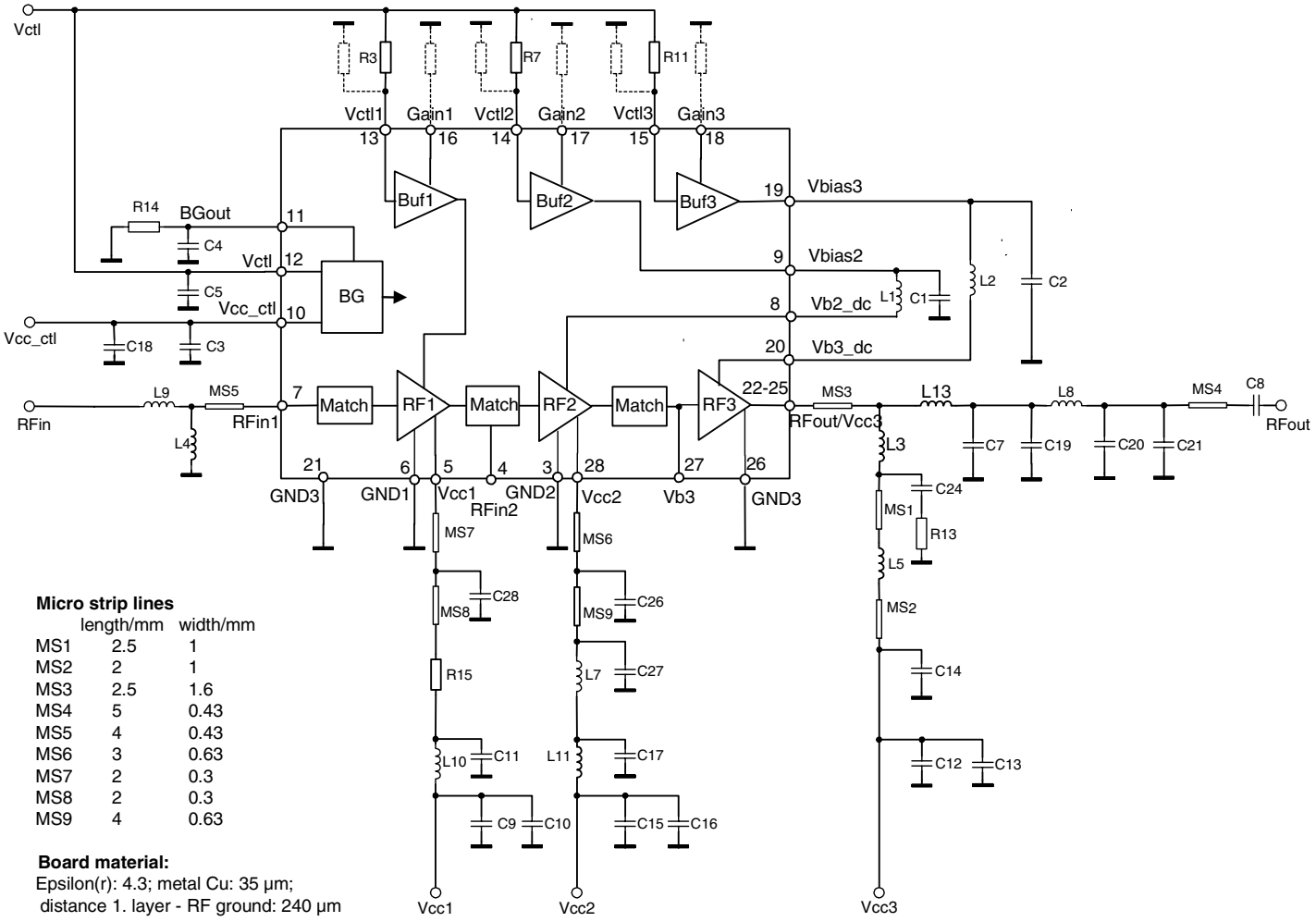
## Electrical Characteristics (Continued)

Test conditions (if not otherwise specified): $V_{CC}$ = +3.5 V, $T_{amb}$ = +25°C, 50 Ω input and 50 Ω output match

| No. | Parameters | Test Conditions | Pin | Symbol | Min. | Typ. | Max. | Unit | Type* |
|---|---|---|---|---|---|---|---|---|---|
| **4** | **Power Control** | | | | | | | | |
| 4.1 | Control curve slope | $P_{RFout} \geq 5$ dBm<br>$P_{RFout} \geq 25$ dBm | 22 - 25 | $S_{ctl}$ | | 300<br>120 | 350<br>150 | dB/V<br>dB/V | C |
| 4.2 | Power control range | $V_{ctl}$ = 0 to 2.5 V | 22 - 25 | $G_{ctl}$ | 60 | | | dB | C |
| 4.3 | Control voltage range | | 12 - 14 | $V_{ctl}$ | 0.5 | | 2.0 | V | C |
| 4.4 | Control current | $P_{RFin}$ = 0 to 8 dBm<br>$V_{ct}$l = 0 to 2.0 V | 12 - 14 | $I_{ctll}$ | | | 200 | µA | A |

*) Type means: A = 100% tested, B = 100% correlation tested, C = Characterized on samples, D = Design parameter

**Figure 3.** Application Example for 450-MHz PA with Variable Gain

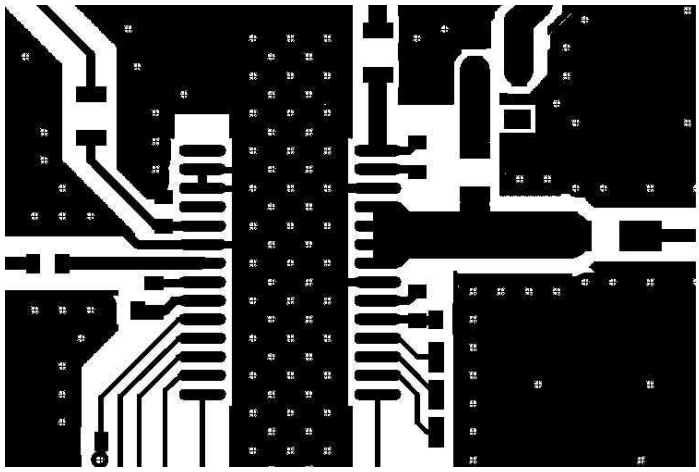



**Micro strip lines**

| | length/mm | width/mm |
|---|---|---|
| MS1 | 2.5 | 1 |
| MS2 | 2 | 1 |
| MS3 | 2.5 | 1.6 |
| MS4 | 5 | 0.43 |
| MS5 | 4 | 0.43 |
| MS6 | 3 | 0.63 |
| MS7 | 2 | 0.3 |
| MS8 | 2 | 0.3 |
| MS9 | 4 | 0.63 |

**Board material:**
Epsilon(r): 4.3; metal Cu: 35 µm;
distance 1. layer - RF ground: 240 µm

**Figure 4.** Recommended Package Footprint Extract from the PCB Showing a Part of the Core Application (Without Components)



- Only ground signal traces are recommended directly under the package.
- Maximum density of ground vias guarantees an optimum connection of the ground layers and the best diversion of the heat.
- Heat slug must be soldered to GND.
- Plugging of the ground vias under the heat slug is recommended to avoid soldering problems.

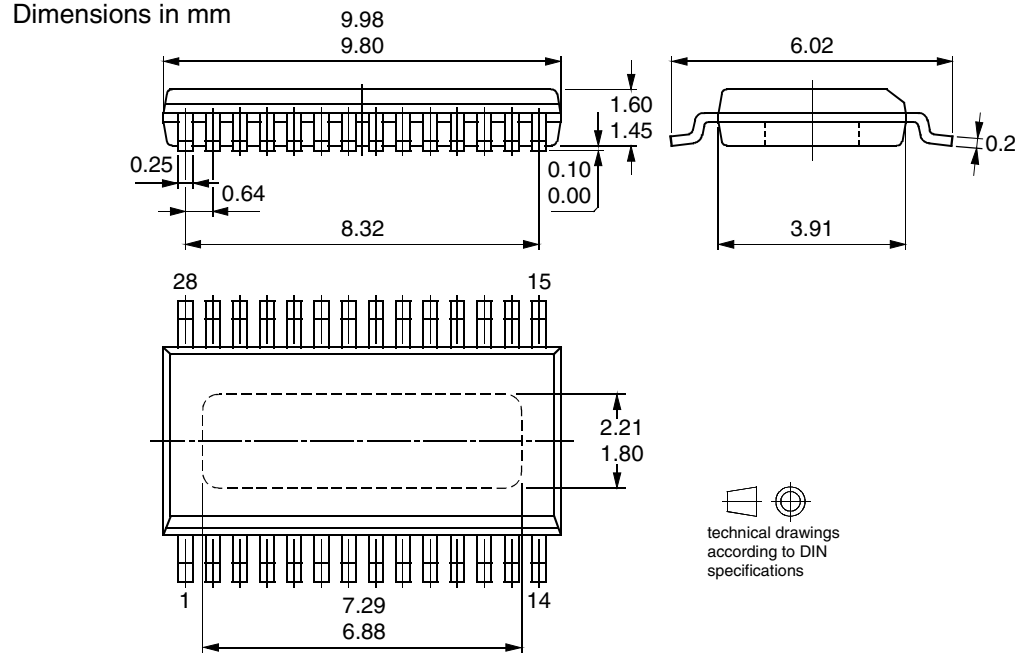
## Ordering Information

| Extended Type Number | Package | Remarks |
|---|---|---|
| T0905 | PSSOP28 | – |

## Package Information

Package PSSOP28

Dimensions in mm



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