# GaAs IC 3 Stage GSM Power Amplifier

**AP121-89**

## Features

- +3.5 V Operation
- Output Power of 35 dBm
- Efficiency Typically 55%
- Outstanding Efficiency vs. Supply Voltage
- High Power SSOP-16 Package with Exposed Pad
- Wide Power Control Range (70 dB)
- Designed to work with AP122-89 as a Dualband Solution

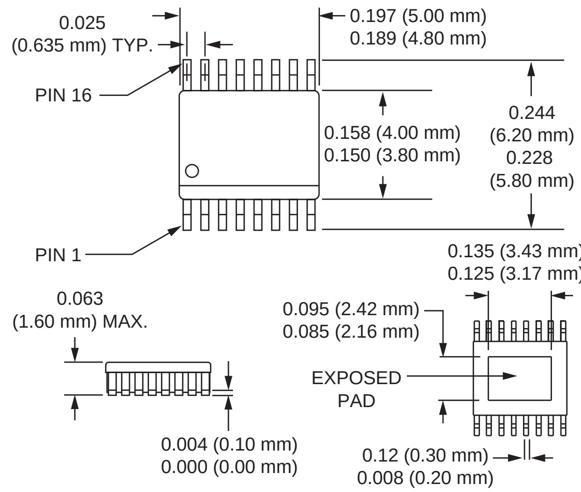
## Description

The AP121-89 is a low cost IC power amplifier designed for the 880–915 MHz frequency band. It features single supply, 3.5 V battery operation and exceptional efficiency. Drive level requirements are minimized with 3 stages of amplification, thereby reducing the cost of the VCO. The AP121-89 is designed to be stable over a temperature range of -40 to +85°C and over a 10:1 output VSWR load. External matching is used for improved performance and flexibility.

## Output Matching Circuit

The output match for the AP121-89 is provided externally in order to improve performance, reduce cost, and add flexibility. By making use of ceramic surface mount components with better Qs than GaAs matching elements, a lower loss matching network can be made. This lower loss results in higher power and efficiency for the amplifier. Also, by keeping these elements external the GaAs die size is reduced and the overall cost is less. This approach also permits the flexibility to tweak the amplifier for optimum performance at different powers, and/or frequencies.

## SSOP-16 with Exposed Pad




## Absolute Maximum Ratings

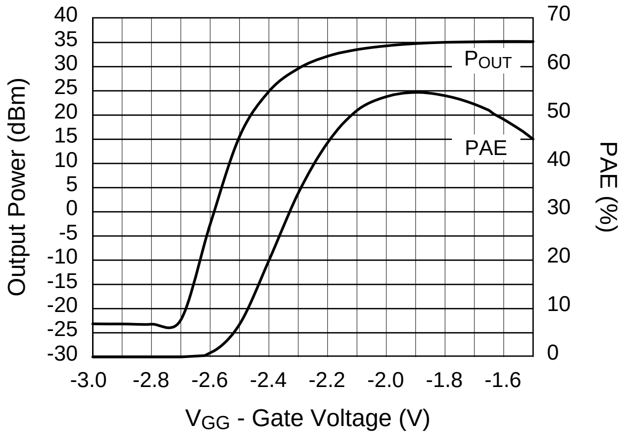
| Quantity | Value | Unit |
|---|---|---|
| Amplifier Supply Voltage ($V_{DS}$) | 10 | V |
| Input RF Power ($P_{IN}$) | 14 | dBm |
| Duty Cycle | 50 | % |
| Operating Temperature ($T_{OP}$) | -40 to +85 | °C |
| Storage Temperature ($T_{ST}$) | -65 to +150 | °C |

## Electrical Specifications at 25°C

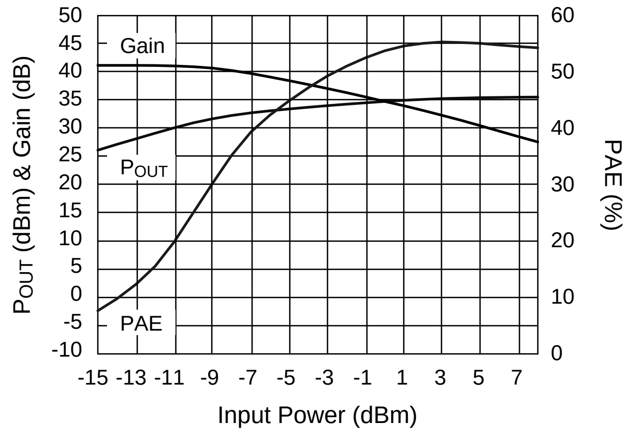
| Parameter | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Output Power | $P_{OUT}$ | $T_{OP}$ = +25°C | 34.5 | 35 | | dBm |
| | | $V_{DS}$ = 2.8 V, $T_{OP}$ = (-40 to +85°C) | 32.5 | 33 | | |
| Power Added Efficiency | $n_{PAE}$ | | 50 | 55 | | % |
| Control Voltage Range | $V_{GG}$ | | -3 | | -1 | V |
| 2nd Harmonic | $H_2$ | | | -43 | -40 | dBc |
| 3rd Harmonic | $H_3$ | | | -48 | -45 | dBc |
| Input VSWR | $VSWR_{IN}$ | $P_{OUT}$ (5–35 dBm), Controlled by $V_{GG}$ | 3:1 | 2:1 | | |
| Forward Isolation | $P_{OUT, STANDBY}$ | $P_{IN}$ = 10 dBm, $V_{GG}$ = -3.0 V | | -49 | -40 | dBm |
| Switching Time | $t_R$, $t_F$ | Time from $P_{OUT}$ = -10 dBm to $P_{OUT}$ = 34.5 dBm | | 1 | 2 | µS |
| Burn Out | BO | $V_{DS}$ = 2.8 V to 6.0 V, $P_{IN}$ = 0 dBm to 10 dBm, $Z_S$ = 50 Ω, Load VSWR = 10:1, All Phase Angles | No Module Damage or Permanent Degradation | | | |
| Stability | Stab. | All Combinations of the Following Parameters: $I_{DS}$ = 0A to xA, x = Current at $P_{OUT}$ = 34.5 dBm in 50 Ω $P_{IN}$ = 3 dBm to 10 dBm, $V_{DS}$ = 2.5 V to 4.5 V, $T_{OP}$ = -40 to +85°C, Load VSWR = 10:1, All Phase Angles | No Parasitic Oscillations Above -36 dBm | | | |
| Slope $P_{OUT}/V_{GG}$ | | $P_{OUT}$ = -15 dBm to 35 dBm | 10 | 100 | 150 | dB/V |
| Noise Power | | 100 KHz BW 925-960 MHz Band | | -90 | -85 | dBm |
| Phase Change | AM-PM | The Change in Phase When $P_{OUT}$ Changes from 33 dBm to 34 dBm | | 5 | 10 | Deg. |

Characteristic Values:
$P_{IN}$ = 3 dBm
fc = 880–915 MHz
$V_{DS}$ = 3.5 V
$T_{OP}$ = +25°C
$V_{GG}$ = Switched at 217 Hz with Duty Cycle of 12.5%

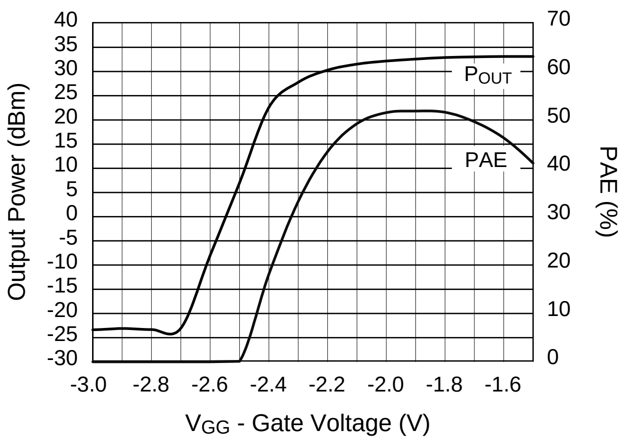
# Typical Performance Data



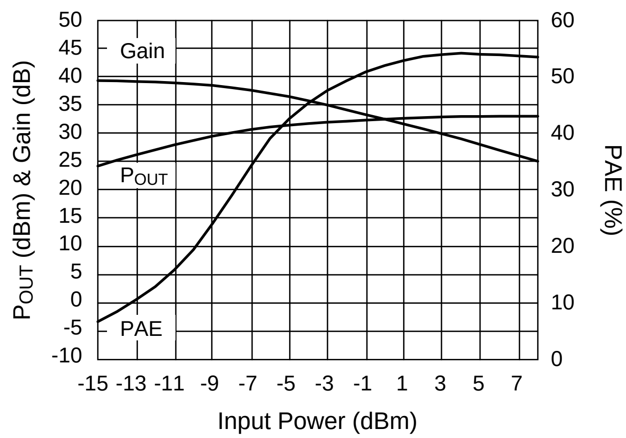

**GSM PA - Gate Sweep**
**$P_{IN}$ = 3 dBm, $V_{DD}$ = 3.5 V,**
**Frequency = 902 MHz**




**GSM PA - Power Sweep**
**$V_G$ = -1.9 V, $V_{DD}$ = 3.5 V,**
**Frequency = 902 MHz**

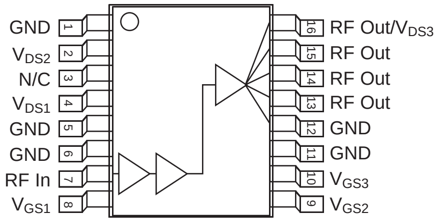



**GSM PA - Gate Sweep**
**$P_{IN}$ = 3 dBm, $V_{DD}$ = 2.8 V,**
**Frequency = 902 MHz**




**GSM PA - Power Sweep**
**$V_G$ = -1.9 V, $V_{DD}$ = 2.8 V,**
**Frequency = 902 MHz**

## Pin Out




## Pin Configuration

| Terminal | Symbol | Function |
|---|---|---|
| 1 | GND | Ground |
| 2 | $V_{DS2}$ | Stage 2 Drain Voltage |
| 3 | N/C | No Connect |
| 4 | $V_{DS1}$ | Stage 1 Drain Voltage |
| 5 | GND | Ground |
| 6 | GND | Ground |
| 7 | RF IN | RF Input |
| 8 | $V_{GS1}$ | Stage 1 Gate Voltage |
| 9 | $V_{GS2}$ | Stage 2 Gate Voltage |
| 10 | $V_{GS3}$ | Stage 3 Gate Voltage |
| 11 | GND | Ground |
| 12 | GND | Ground |
| 13 | RF Out | RF Output |
| 14 | RF Out | RF Output |
| 15 | RF Out | RF Output |
| 16 | RF Out/$V_{DS3}$ | RF Output/Stage 3 Drain Voltage |