

8-12GHz High Power Amplifier

GaAs Monolithic Microwave IC

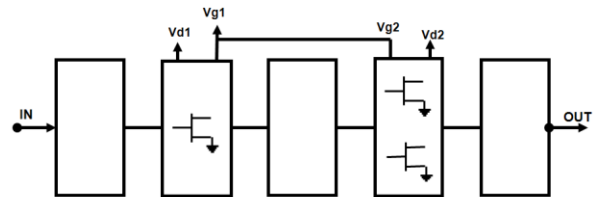
Description

The CHA6005-99F is a High Power Amplifier monolithic circuit, which integrates two stages and produces 32.5dBm output power associated to a high power added efficiency of 38%.

It is designed for a wide range of applications, from defense to commercial communication systems.

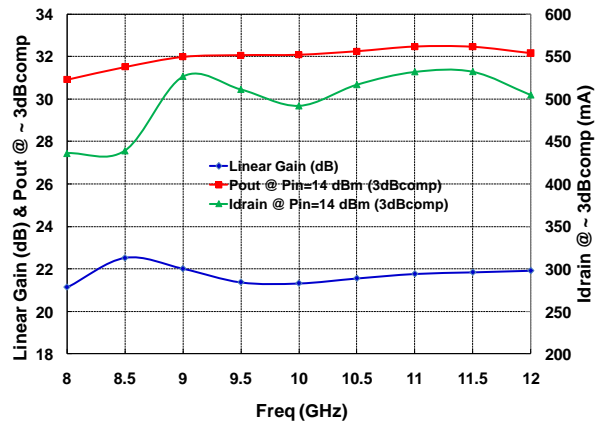
The circuit is manufactured with a pHEMT process, 0.25µm gate length, via holes through the substrate, air bridges and electron beam gate lithography.

It is available in chip form.



Main Features

- High power : 32.5dBm
- High PAE : 38%
- Frequency band : 8-12GHz
- Linear gain : 22dB
- DC bias: Vd=8Volt@Id=350mA
- Chip size 3.0x1.5x0.1mm



Main Electrical Characteristics

Tamb.= +25°C

| Symbol | Parameter | Min | Typ | Max | Unit |
|--------|------------------------------------|-----|------|-----|------|
| Freq | Frequency range | 8 | | 12 | GHz |
| G | Linear Gain | 20 | 22 | | dB |
| P3dB | Output Power @ 3dB comp. | 30 | 32.5 | | dBm |
| PAE | Power Added Efficiency @ 3dB comp. | | 38 | | % |

Electrical Characteristics

Tamb.= +25°C, Vd = +8V; Drain Pulse width = 25µs, Duty cycle = 10%

| Symbol | Parameter | Min | Typ | Max | Unit |
|---------|----------------------------------|------|------|-----|------|
| Freq | Operating frequency | 8 | | 12 | GHz |
| G | Small signal gain | 20 | 22 | | dB |
| dBS11 | Input Return Loss | | 13 | | dB |
| dBS22 | Output Return Loss | | 10 | | dB |
| P1dB | Output power @ 1dBcomp | 29 | 31.5 | | dBm |
| P3dB | Output power @ 3dBcomp | 29.5 | 32 | | dBm |
| PAE | Power Added Efficiency @ 3dBcomp | | 38 | | % |
| Id_3dBc | Supply drain current @ 3dBcomp | | 500 | 600 | mA |
| Vd1, 2 | Drain supply voltage | | 8 | | V |
| Idq | Supply quiescent current | | 350 | | mA |
| Vg | Gate supply voltage | | -1 | | V |

These values are representative of on-wafer measurements that are made without bonding wires at the RF ports.

A bonding wire of typically 0.25 to 0.3nH will improve the matching at the accesses.

Absolute Maximum Ratings ⁽¹⁾T_{amb.} = +25°C

| Symbol | Parameter | Values | Unit |
|------------------|---|-------------|------|
| V _d | Drain bias voltage | 9.5 | V |
| I _{dq} | Quiescent drain bias current | 450 | mA |
| I _d | Drain bias current | 800 | mA |
| P _{in} | Maximum peak input power overdrive ⁽²⁾ | +20 | dBm |
| T _j | Junction temperature | 175 | °C |
| T _a | Operating temperature range | -40 to +85 | °C |
| T _{stg} | Storage temperature range | -55 to +150 | °C |

⁽¹⁾ Operation of this device above any one of these parameters may cause permanent damage.⁽²⁾ Duration < 1s.**Typical Bias Conditions**T_{amb.} = +25°C

| Symbol | Pad N° | Parameter | Values | Unit |
|--------|--------|----------------------|--------|------|
| V1 | V1 | Drain supply voltage | 8 | V |
| V2 | V2 | Gate supply voltage | -1 | V |

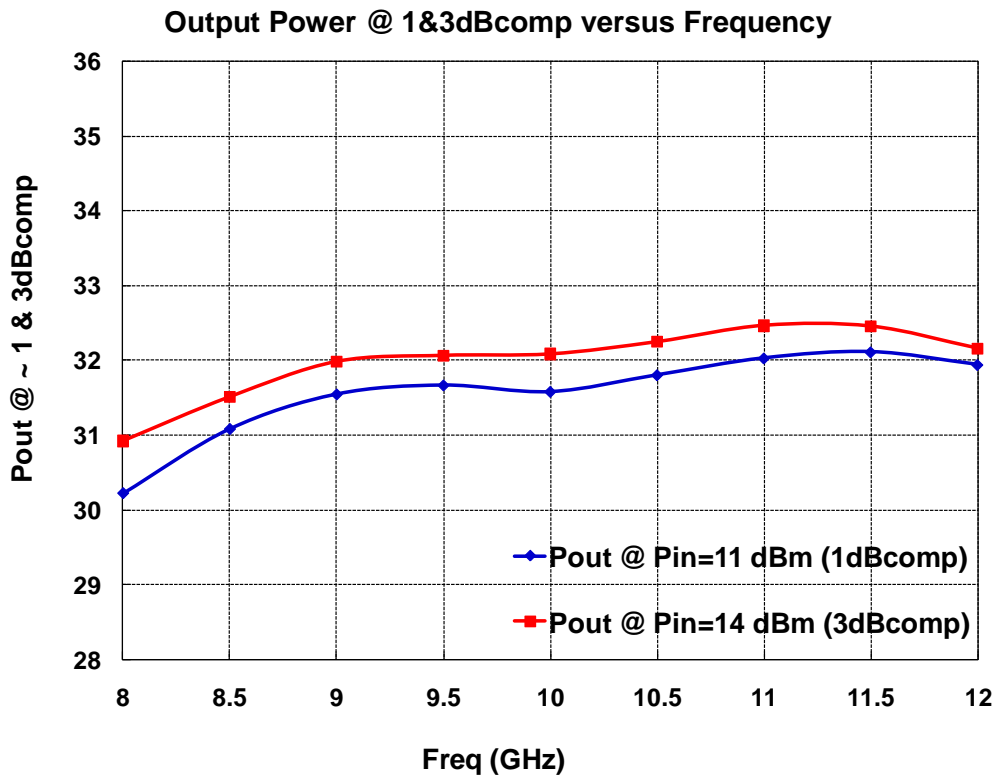
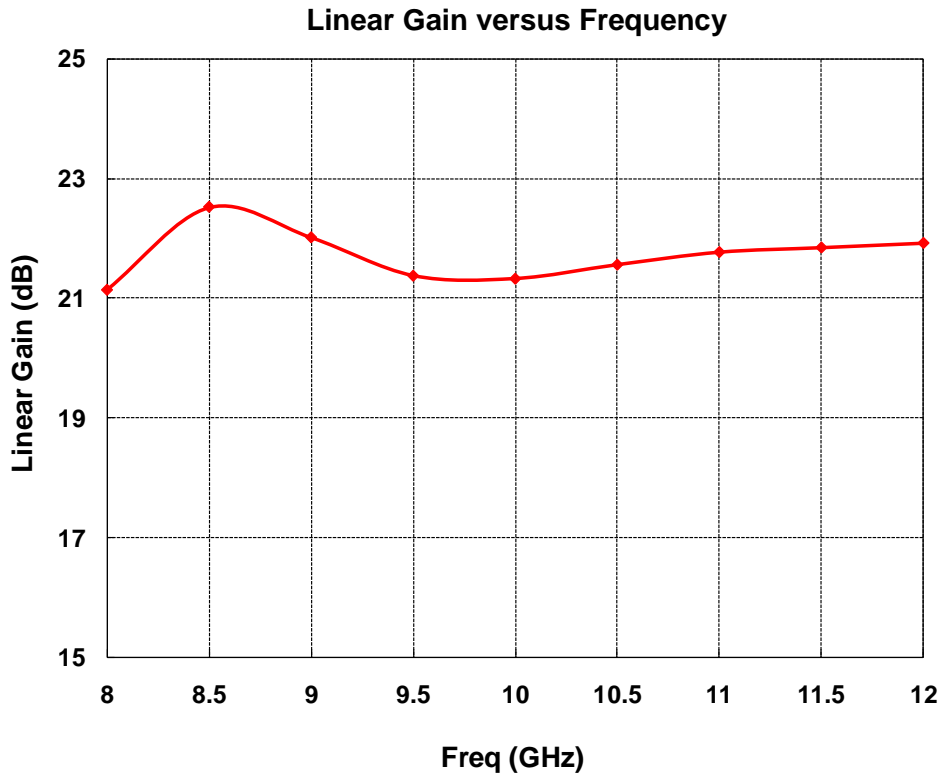
Typical on-wafer Sij parameters

Tamb.= +25°C, Vd = +8V, Id = 350mA

| Freq (GHz) | S11 (dB) | PhS11 (°) | S12 (dB) | PhS12 (°) | S21 (dB) | PhS21 (°) | S22 (dB) | PhS22 (°) |
|------------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|
| 1.0 | -0.13 | -24.56 | -41.65 | 94.28 | -41.00 | 5.33 | -0.14 | -31.59 |
| 1.5 | -0.41 | -36.99 | -73.73 | -169.07 | -33.87 | 124.41 | -0.25 | -46.43 |
| 2.0 | -0.91 | -49.02 | -69.95 | 74.68 | -23.74 | 83.31 | -0.36 | -60.62 |
| 2.5 | -1.58 | -59.45 | -63.20 | 3.88 | -18.60 | 78.66 | -0.45 | -76.49 |
| 3.0 | -2.38 | -68.02 | -56.66 | 157.15 | -10.90 | 48.69 | -0.33 | -92.84 |
| 3.5 | -2.84 | -74.73 | -63.04 | 94.69 | -6.27 | 4.33 | -0.30 | -108.37 |
| 4.0 | -3.31 | -82.38 | -57.85 | -114.80 | -3.73 | -33.50 | -0.46 | -125.86 |
| 4.5 | -3.93 | -90.68 | -60.34 | 158.64 | -1.35 | -66.01 | -0.48 | -144.00 |
| 5.0 | -4.31 | -97.82 | -60.03 | 24.56 | 1.15 | -94.43 | -1.12 | -163.74 |
| 5.5 | -4.83 | -106.35 | -50.57 | -80.01 | 4.11 | -123.24 | -1.84 | 175.57 |
| 6.0 | -5.46 | -116.08 | -70.50 | 131.94 | 7.63 | -154.66 | -2.81 | 149.75 |
| 6.5 | -6.62 | -124.18 | -55.54 | -157.24 | 11.36 | 170.68 | -4.14 | 117.44 |
| 7.0 | -8.19 | -132.30 | -53.46 | -7.29 | 15.47 | 129.40 | -6.12 | 71.13 |
| 7.5 | -9.90 | -137.14 | -55.00 | -29.83 | 19.90 | 79.16 | -7.72 | 6.74 |
| 8.0 | -11.75 | -139.76 | -57.16 | -149.65 | 22.91 | 14.32 | -8.43 | -68.64 |
| 8.5 | -14.25 | -147.90 | -51.44 | 49.02 | 23.09 | -50.26 | -10.58 | -110.20 |
| 9.0 | -22.50 | -149.89 | -61.08 | 68.48 | 22.44 | -104.62 | -12.35 | -122.40 |
| 9.5 | -19.68 | -36.57 | -61.46 | 37.28 | 22.18 | -154.83 | -11.34 | -131.10 |
| 10.0 | -11.97 | -46.88 | -49.78 | -37.51 | 22.25 | 154.10 | -10.95 | -144.80 |
| 10.5 | -9.48 | -66.85 | -54.09 | 43.84 | 22.31 | 99.85 | -11.30 | -158.95 |
| 11.0 | -9.03 | -76.06 | -45.08 | -123.49 | 22.21 | 43.81 | -12.08 | -174.53 |
| 11.5 | -8.28 | -75.50 | -45.12 | -167.53 | 22.20 | -18.84 | -14.05 | 168.12 |
| 12.0 | -7.24 | -77.36 | -46.53 | 178.36 | 21.59 | -93.01 | -19.54 | 110.78 |
| 12.5 | -6.28 | -73.12 | -50.56 | 143.28 | 17.68 | -177.82 | -16.12 | -41.18 |
| 13.0 | -4.14 | -77.38 | -45.11 | -73.10 | 10.97 | 108.88 | -11.80 | -75.70 |
| 13.5 | -2.77 | -86.29 | -40.75 | -41.28 | 3.20 | 49.97 | -10.40 | -90.23 |
| 14.0 | -2.03 | -97.24 | -43.07 | 39.37 | -4.83 | -0.77 | -8.93 | -101.41 |
| 14.5 | -1.55 | -108.80 | -46.25 | -168.74 | -12.75 | -42.90 | -7.39 | -116.10 |
| 15.0 | -1.57 | -118.06 | -61.73 | -65.61 | -20.85 | -80.03 | -6.32 | -123.79 |
| 15.5 | -1.81 | -127.31 | -40.65 | 56.06 | -28.30 | -106.29 | -5.11 | -131.17 |
| 16.0 | -1.92 | -138.32 | -51.69 | -38.56 | -36.54 | -126.10 | -4.24 | -145.42 |
| 16.5 | -2.40 | -143.30 | -37.13 | 17.09 | -40.98 | 170.77 | -5.04 | -150.20 |
| 17.0 | -1.78 | -155.35 | -53.00 | -31.01 | -52.02 | 96.09 | -3.40 | -156.88 |
| 17.5 | -2.71 | -171.55 | -30.56 | -18.51 | -34.16 | 104.30 | -2.95 | -165.99 |
| 18.0 | -4.54 | 169.63 | -37.57 | -134.74 | -41.04 | -142.48 | -3.18 | -173.70 |

Typical on Test Fixture Measurements

Tamb.= +25°C,
 Vd = 8V, Id (Quiescent) = 350mA, Drain Pulse width = 25µs, Duty cycle = 10%

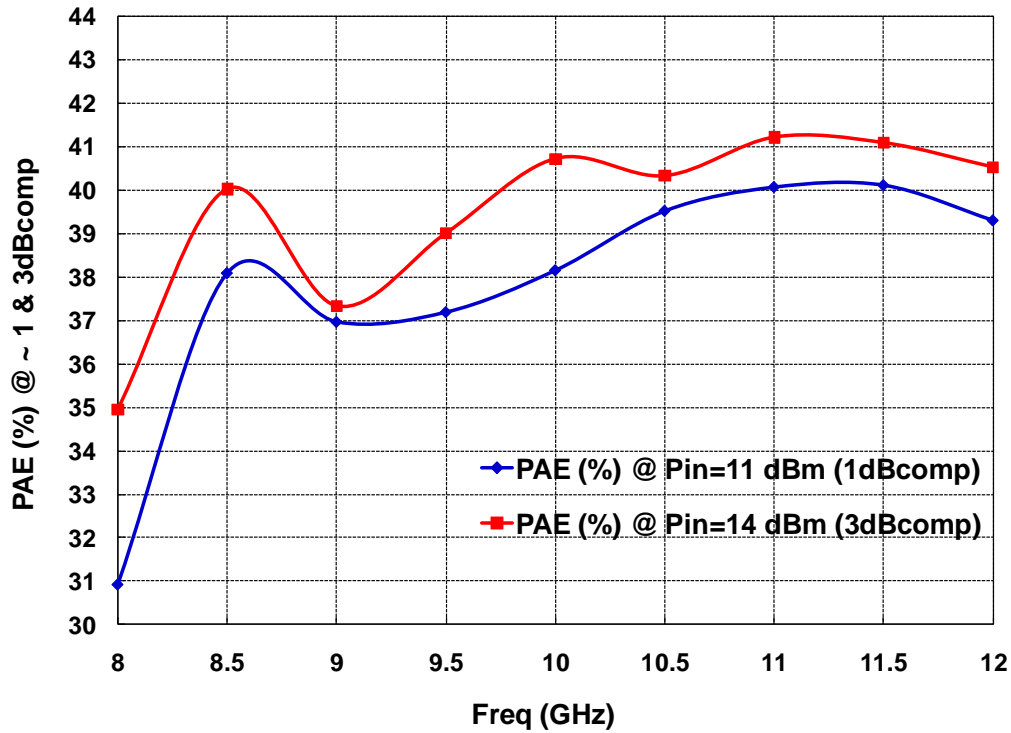


Typical Test Fixture Measurements

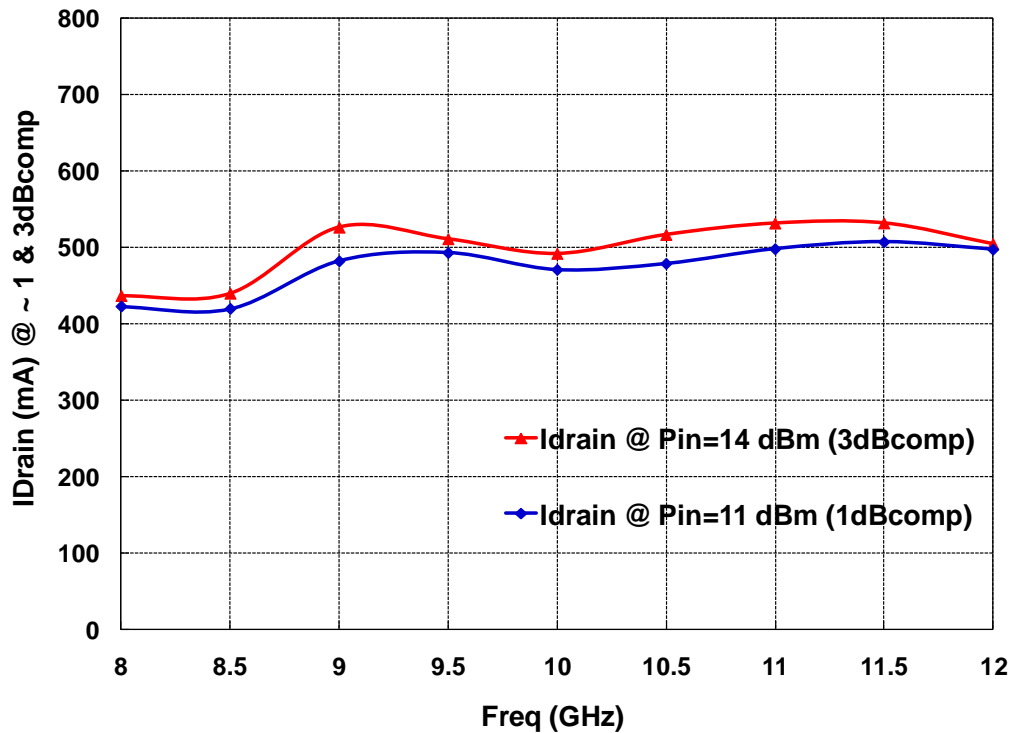
Tamb.= +25°C,

Vd = 8V, Id (Quiescent) = 350mA, Drain Pulse width = 25µs, Duty cycle = 10%

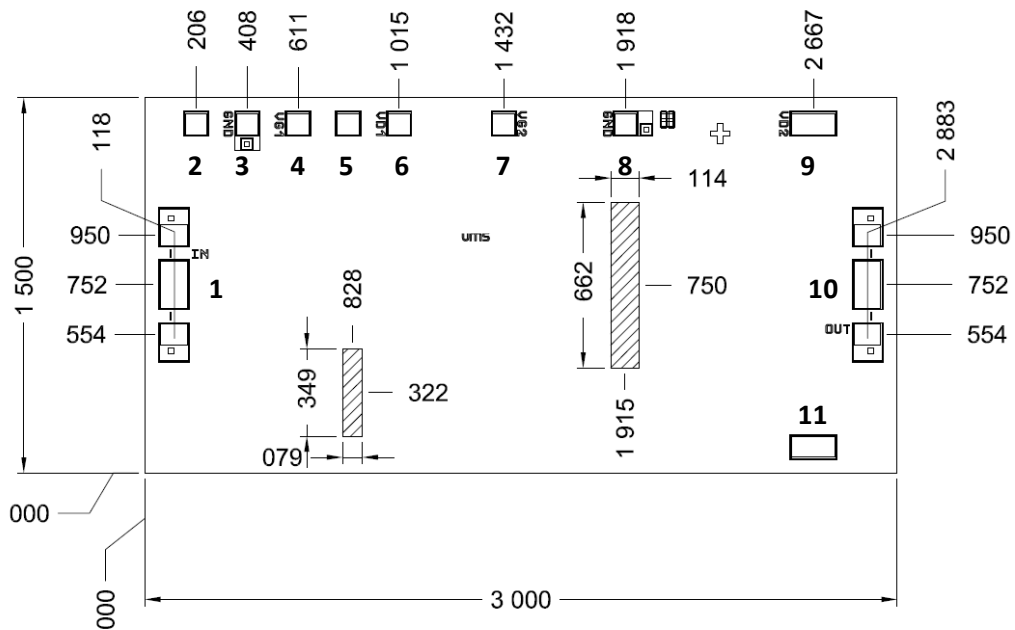
Power added efficiency @ 1 & 3dBcomp versus Frequency



Drain current @ 1 & 3dBcomp versus Frequency



Mechanical data



 Active device

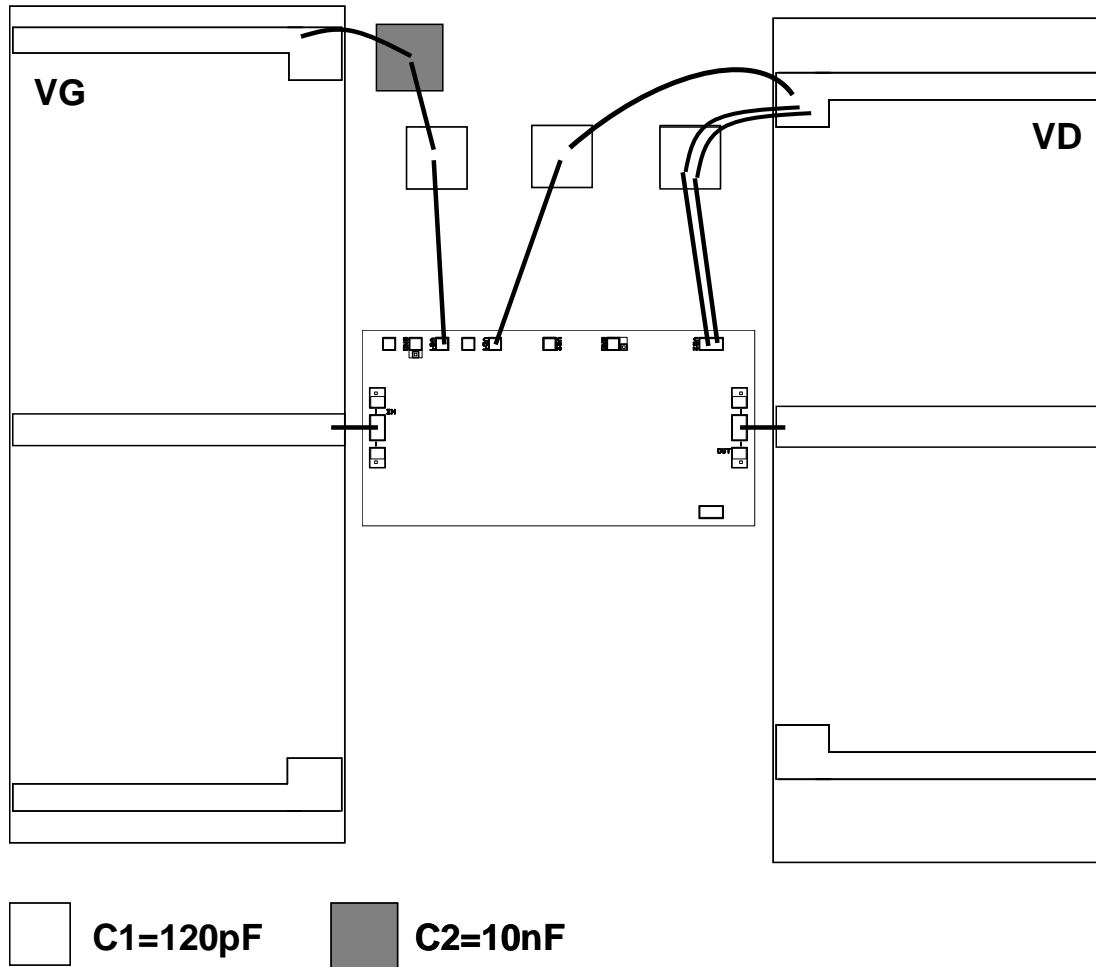
UNITS : μm
Tol : $\pm 35\mu\text{m}$

Chip thickness: $70\mu\text{m} \pm 10\mu\text{m}$
Chip size: $3000 \times 1500 \pm 35\mu\text{m}$
All dimensions are in micrometers

RF pads (1, 10) = $122 \times 100\mu\text{m}^2$
DC pads (4, 6, 7, 8, 9) = $100 \times 100\mu\text{m}^2$

| Pin number | Pin name | Description |
|------------|----------|---------------|
| 1 | IN | Input RF |
| 2; 5; 11 | - | Not Connected |
| 4 | VG1 | Vg1 |
| 6 | VD1 | Vd1 |
| 7 | VG2 | Not Connected |
| 3; 8 | GND | Not Connected |
| 9 | VD2 | Vd2 |
| 10 | OUT | Output RF |

Recommended assembly plan



25µm wedge bonding is preferred

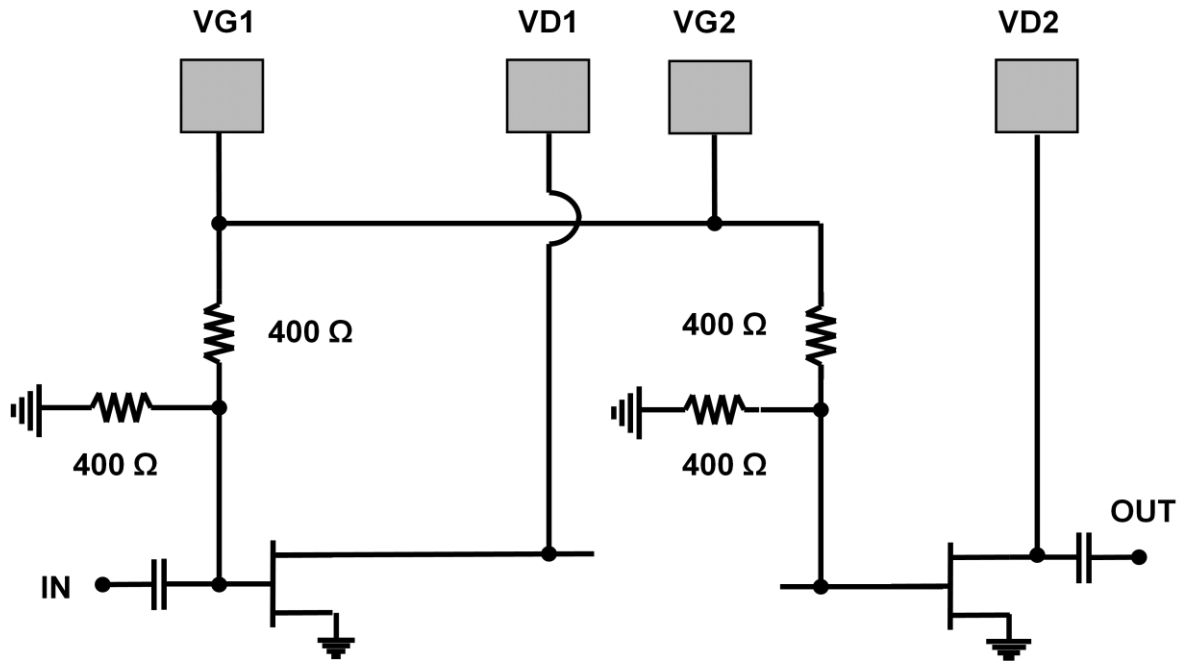
Note: Equivalent RF Wire Bonding: 0.25nH (typical length of 200µm for a 25µm diameter wire).

Recommended circuit bonding table

| Port | Connection | External capacitor |
|------|---|-----------------------|
| IN | Inductance (Lbonding) = 0.3nH 400µm length with a wire diameter of 25 µm | |
| OUT | Inductance (Lbonding) = 0.3nH 400µm length with a wire diameter of 25 µm | |
| VG | Inductance ≤ 1nH | C1 ~ 120pF, C2 ~ 10nF |
| VD | Inductance ≤ 1nH | C1 ~ 120pF |

DC Schematic

Medium Power Amplifier: 8V, 350mA



Recommended ESD management

Refer to the application note AN0020 available at <http://www.ums-gaas.com> for ESD sensitivity and handling recommendations for the UMS products.

Recommended environmental management

UMS products are compliant with the regulation in particular with the directives RoHS N°2011/65 and REACH N°1907/2006. More environmental data are available in the application note AN0019 also available at <http://www.ums-gaas.com>.

Ordering Information

Chip form:

CHA6005-99F/00

Information furnished is believed to be accurate and reliable. However **United Monolithic Semiconductors S.A.S.** assumes no responsibility for the consequences of use of such information nor for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of **United Monolithic Semiconductors S.A.S.** Specifications mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. **United Monolithic Semiconductors S.A.S.** products are not authorised for use as critical components in life support devices or systems without express written approval from **United Monolithic Semiconductors S.A.S.**