

## 4.5-6.5GHz Medium Power Amplifier

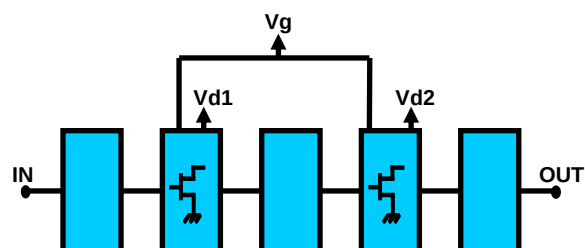
### GaAs Monolithic Microwave IC

#### Description

The CHA4107-99F is a monolithic two stage power amplifier designed for C-Band applications.

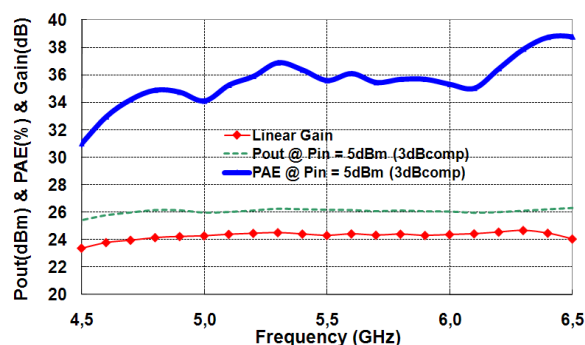
The MPA provides typically 26dBm output power associated to 35% power added efficiency at 3dBcomp.

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

- Frequency band: 4.5-6.5GHz
- 26dBm @ 3dBcomp
- 24.5 dB Linear Gain
- High PAE: 35% for +5dBm input power
- DC bias: Vd=8V@Id=115mA
- Chip size 2.37x1.5x0.07mm



#### Main Characteristics

Vd = 8V, Id (Quiescent) = 115 mA, Drain Pulse width = 45μs, Duty cycle = 12%

| Symbol | Parameter                | Min | Typ  | Max | Unit |
|--------|--------------------------|-----|------|-----|------|
| Freq   | Frequency range          | 4.5 |      | 6.5 | GHz  |
| Gain   | Linear Gain              |     | 24.5 |     | dB   |
| NF     | Noise Figure             |     | 5    |     | dB   |
| Pout   | Output Power @ 3dB comp. |     | 26   |     | dBm  |

**Electrical Characteristics**

Vd = 8V, Id (Quiescent) = 115 mA, Drain Pulse width = 45µs, Duty cycle = 12%

| Symbol   | Parameter                     | Min | Typ  | Max | Unit |
|----------|-------------------------------|-----|------|-----|------|
| Freq     | Frequency range               | 4.5 |      | 6.5 | GHz  |
| Gain     | Linear Gain                   |     | 24.5 |     | dB   |
| NF       | Noise Figure                  |     | 5    |     | dB   |
| RLin     | Input Return Loss             |     | 13   |     | dB   |
| RLout    | Output Return Loss            |     | 8    |     | dB   |
| P_1dBc   | Output power @ 1dBcomp        |     | 25   |     | dBm  |
| P_3dBc   | Output power @ 3dBcomp        |     | 26   |     | dBm  |
| PAE_3dBc | Power Added Efficiency @ 3dBc |     | 35   |     | %    |
| Id_3dBc  | Supply drain current @ 3dBc   |     | 130  |     | mA   |
| Vd1, Vd2 | Drain supply voltage          |     | 8    |     | V    |
| Id       | Supply quiescent current (1)  |     | 115  |     | mA   |
| Vg       | Gate supply voltage           |     | -0.8 |     | V    |

These values are representative of on-Jig measurements.

(1) Parameter can be adjusted by tuning of Vg.

**Absolute Maximum Ratings <sup>(1)</sup>**

Tamb.= +25°C

| Symbol | Parameter                        | Values       | Unit |
|--------|----------------------------------|--------------|------|
| Cmp    | Compression level <sup>(2)</sup> | 6            | dB   |
| Vd     | Supply voltage                   | 9.5          | V    |
| Id     | Supply quiescent current         | 250          | mA   |
| Id_sat | Supply current in saturation     | 350          | mA   |
| Vg     | Supply voltage                   | [-3.0; -0.4] | V    |
| Tj     | Maximum junction temperature     | 175          | °C   |
| Tstg   | Storage temperature range        | -55 to +150  | °C   |
| Top    | Operating temperature range      | -40 to +85   | °C   |

(1) Operation of this device above anyone of these parameters may cause permanent damage.

(2) For higher compression the level limit can be increased by decreasing the voltage Vd using the rate 0.5V/dBcomp.

**Typical on-wafer Sij parameters**

Tamb.= +25°C, Vd = +8V, Id = 115mA

| Freq<br>(GHz) | S11<br>(dB) | PhS11<br>(°) | S12<br>(dB) | PhS12<br>(°) | S21<br>(dB) | PhS21<br>(°) | S22<br>(dB) | PhS22<br>(°) |
|---------------|-------------|--------------|-------------|--------------|-------------|--------------|-------------|--------------|
| 2.00          | -3.71       | -43.44       | -63.21      | -139.00      | 5.79        | 166.00       | -8.39       | 31.33        |
| 2.40          | -3.85       | -49.94       | -63.68      | -72.72       | 10.38       | 95.99        | -7.92       | -25.37       |
| 2.80          | -4.02       | -57.93       | -63.92      | 164.50       | 12.30       | 48.66        | -10.56      | -34.55       |
| 3.20          | -4.46       | -69.48       | -48.25      | 120.80       | 14.21       | 11.12        | -10.62      | -29.96       |
| 3.60          | -5.24       | -83.39       | -60.90      | 170.80       | 16.68       | -23.41       | -9.14       | -30.55       |
| 4.00          | -7.12       | -97.66       | -70.26      | -57.20       | 19.36       | -59.84       | -8.22       | -43.06       |
| 4.40          | -10.98      | -106.30      | -52.87      | -7.31        | 21.91       | -103.70      | -8.02       | -56.73       |
| 4.80          | -13.83      | -90.00       | -48.62      | 22.44        | 23.30       | -150.90      | -8.67       | -68.98       |
| 5.20          | -12.93      | -82.05       | -49.80      | -23.29       | 23.52       | 163.50       | -9.11       | -79.47       |
| 5.60          | -13.52      | -85.54       | -57.81      | -65.50       | 23.52       | 121.40       | -8.78       | -92.08       |
| 6.00          | -14.21      | -73.76       | -49.52      | -124.40      | 23.65       | 77.11        | -8.20       | -113.30      |
| 6.40          | -11.03      | -69.98       | -51.47      | -177.10      | 23.16       | 28.73        | -8.47       | -141.30      |
| 6.80          | -8.33       | -89.16       | -52.36      | 159.00       | 21.03       | -21.97       | -10.46      | -173.00      |
| 7.20          | -7.75       | -112.90      | -63.26      | 142.80       | 17.81       | -66.68       | -12.94      | 164.30       |
| 7.60          | -7.77       | -130.30      | -69.48      | 2.62         | 14.02       | -103.70      | -14.57      | 143.70       |
| 8.00          | -7.68       | -148.30      | -53.55      | 121.40       | 10.28       | -136.90      | -15.74      | 130.80       |
| 8.40          | -7.21       | -166.40      | -59.68      | 8.18         | 6.56        | -166.10      | -14.85      | 120.40       |
| 8.80          | -6.84       | 175.30       | -51.19      | 138.20       | 2.62        | 166.90       | -14.71      | 114.80       |
| 9.20          | -6.19       | 159.50       | -50.78      | -51.15       | -1.14       | 143.70       | -13.35      | 106.30       |
| 9.60          | -5.86       | 143.80       | -55.03      | -47.20       | -4.96       | 122.70       | -12.13      | 98.57        |
| 10.00         | -5.46       | 128.60       | -52.40      | -146.90      | -8.67       | 103.10       | -10.43      | 91.47        |
| 10.40         | -4.84       | 116.20       | -62.55      | -176.60      | -12.02      | 85.93        | -9.05       | 85.73        |
| 10.80         | -4.77       | 104.70       | -48.22      | -131.80      | -15.66      | 70.81        | -8.17       | 78.93        |
| 11.20         | -3.96       | 93.63        | -48.09      | -93.38       | -18.84      | 54.85        | -7.21       | 71.07        |
| 11.60         | -3.67       | 87.22        | -48.28      | 55.47        | -21.78      | 41.57        | -6.18       | 62.82        |
| 12.00         | -3.37       | 75.38        | -59.40      | 173.70       | -25.54      | 29.73        | -5.44       | 60.08        |
| 12.40         | -3.35       | 70.02        | -52.11      | -103.20      | -28.37      | 20.69        | -4.30       | 52.83        |
| 12.80         | -3.11       | 57.48        | -43.51      | 175.10       | -31.95      | 0.60         | -3.94       | 47.00        |
| 13.20         | -1.64       | 56.46        | -44.50      | 55.48        | -32.32      | -8.66        | -3.00       | 35.69        |
| 13.60         | -1.74       | 48.11        | -45.37      | 141.30       | -37.42      | -26.74       | -3.14       | 26.64        |
| 14.00         | -1.83       | 43.10        | -53.12      | 119.10       | -39.44      | -40.94       | -2.82       | 24.77        |

**Typical on-wafer Sij parameters**

Tamb.= +25°C, Vd = +8V, Id = 115mA

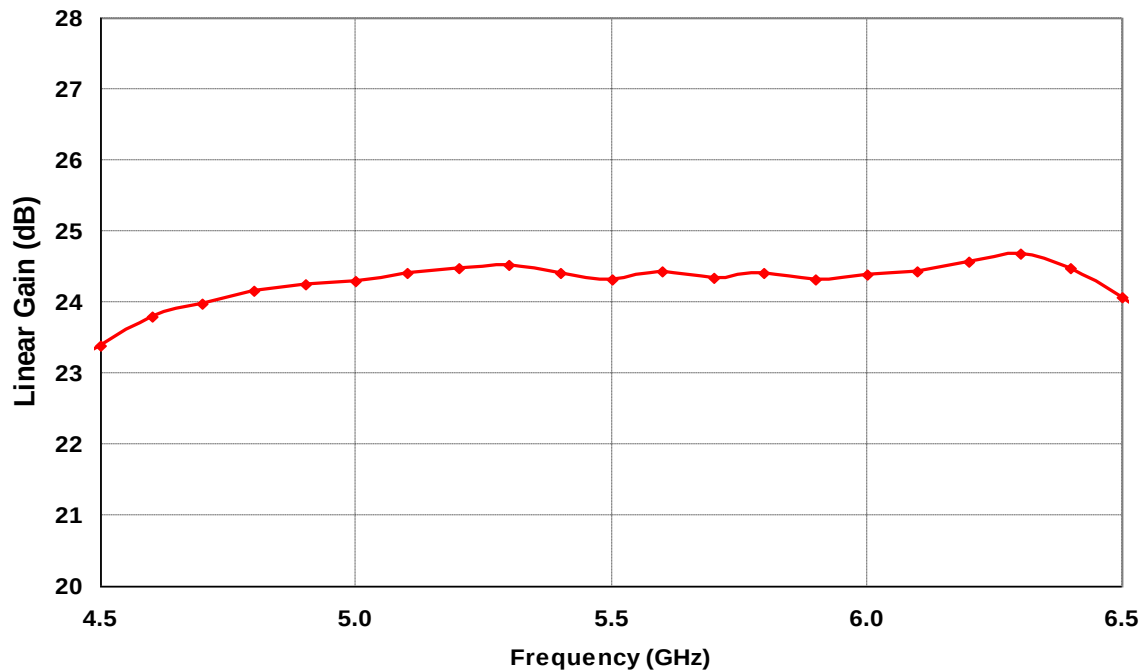
| Freq<br>(GHz) | S11<br>(dB) | PhS11<br>(°) | S12<br>(dB) | PhS12<br>(°) | S21<br>(dB) | PhS21<br>(°) | S22<br>(dB) | PhS22<br>(°) |
|---------------|-------------|--------------|-------------|--------------|-------------|--------------|-------------|--------------|
| 14.40         | -1.57       | 41.82        | -56.19      | 59.72        | -46.09      | -48.43       | -1.59       | 19.73        |
| 14.80         | -1.17       | 32.98        | -40.02      | -169.00      | -51.16      | -127.00      | -1.49       | 15.50        |
| 15.20         | -1.84       | 24.26        | -40.17      | -71.68       | -47.88      | -59.04       | -2.12       | 11.99        |
| 15.60         | -0.89       | 19.12        | -51.96      | -16.02       | -49.10      | -76.69       | -1.77       | 4.34         |
| 16.00         | -1.09       | 26.33        | -54.17      | -178.80      | -42.14      | -83.60       | -0.50       | 2.88         |
| 16.40         | -1.09       | 9.86         | -51.44      | 174.50       | -50.02      | 157.60       | -1.75       | -3.97        |
| 16.80         | -0.36       | 8.65         | -44.47      | -19.29       | -45.84      | -16.49       | -0.61       | -10.70       |
| 17.20         | -0.85       | 6.22         | -44.09      | 60.04        | -53.59      | 50.86        | -0.66       | -9.31        |
| 17.60         | -0.31       | -2.44        | -46.94      | 8.43         | -48.01      | 97.35        | -1.29       | -18.54       |
| 18.00         | -0.86       | -0.40        | -47.33      | -162.90      | -48.23      | 69.86        | -0.66       | -20.51       |

## Typical on Jig Measurements

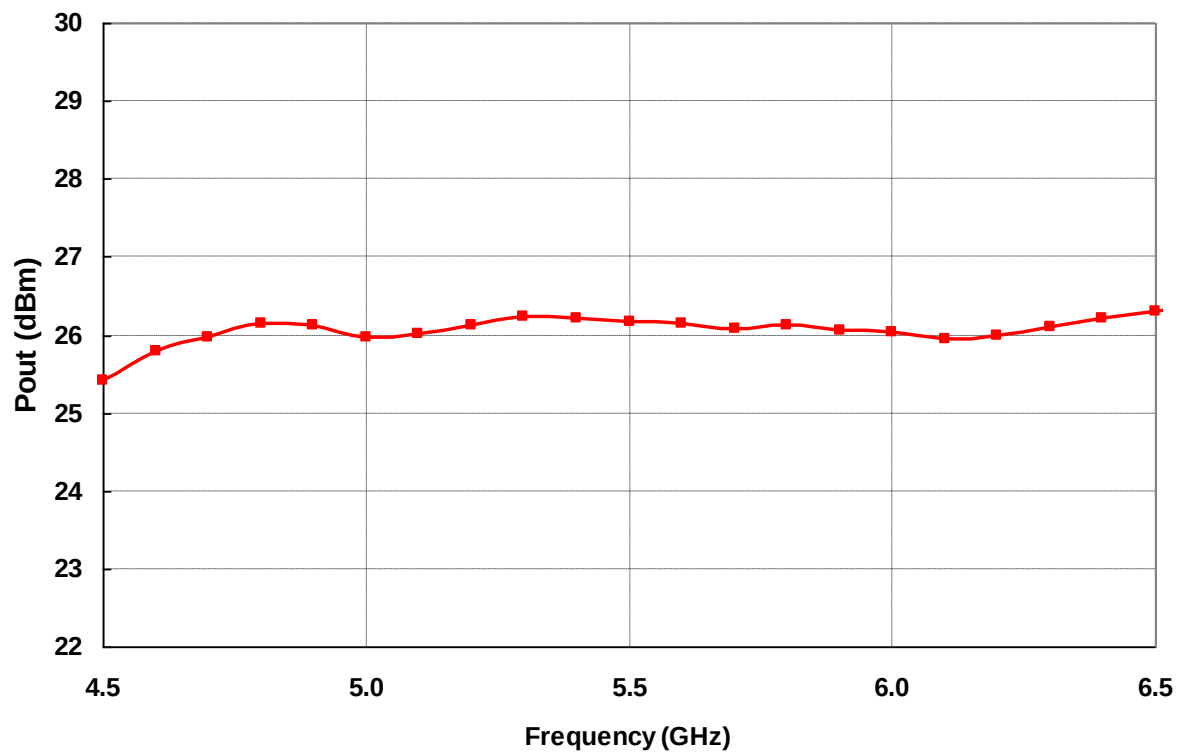
Tamb.= +25°C,

Vd = 8V, Id (Quiescent) = 115mA, Drain Pulse width = 45μs, Duty cycle = 12%

Linear Gain versus frequency



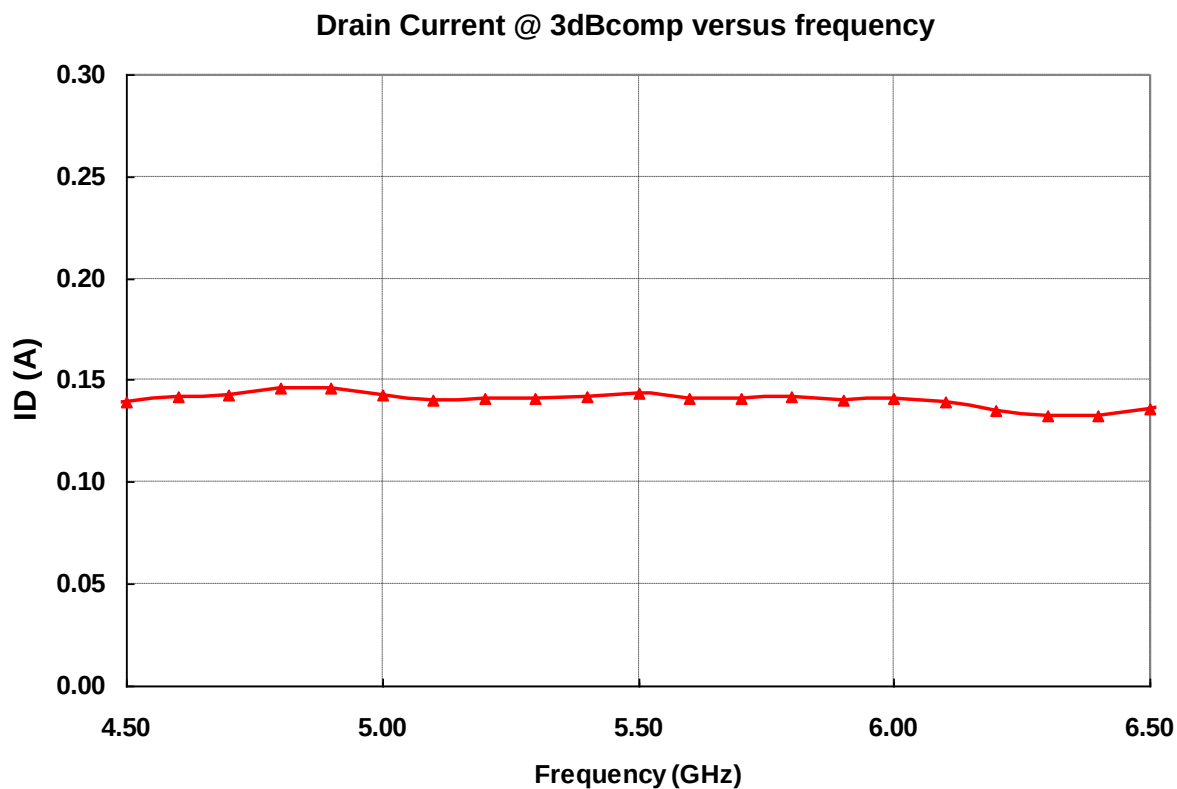
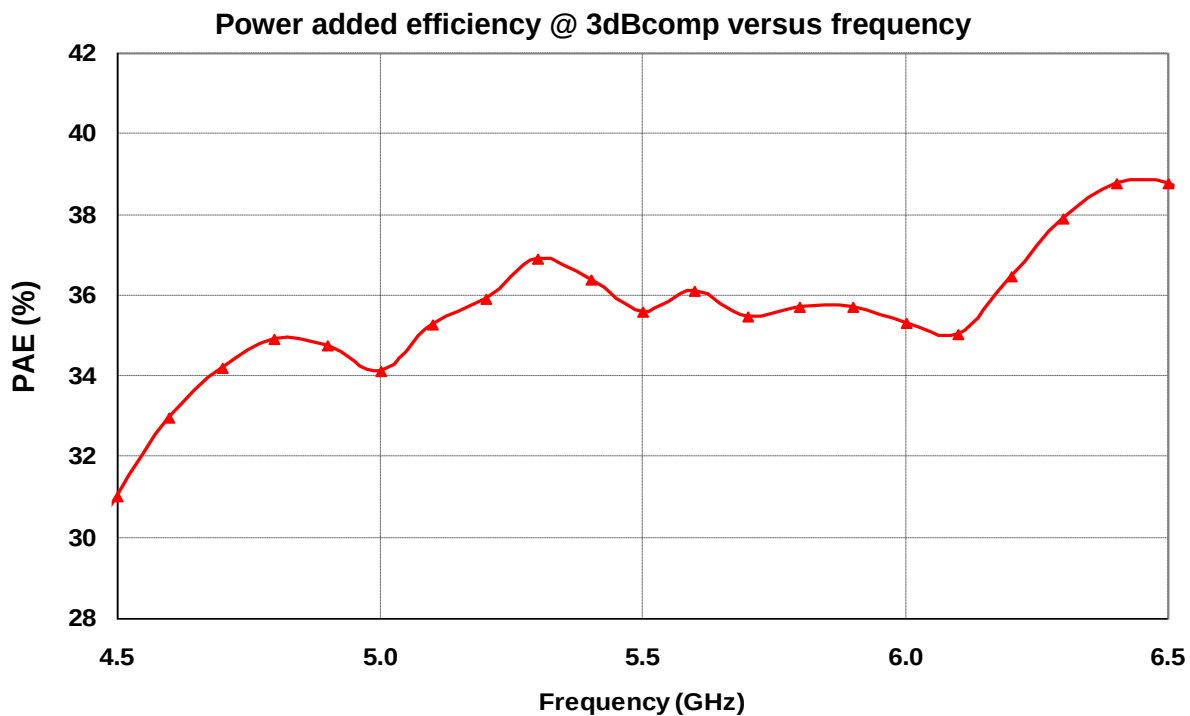
Output Power @ 3dBcomp versus frequency

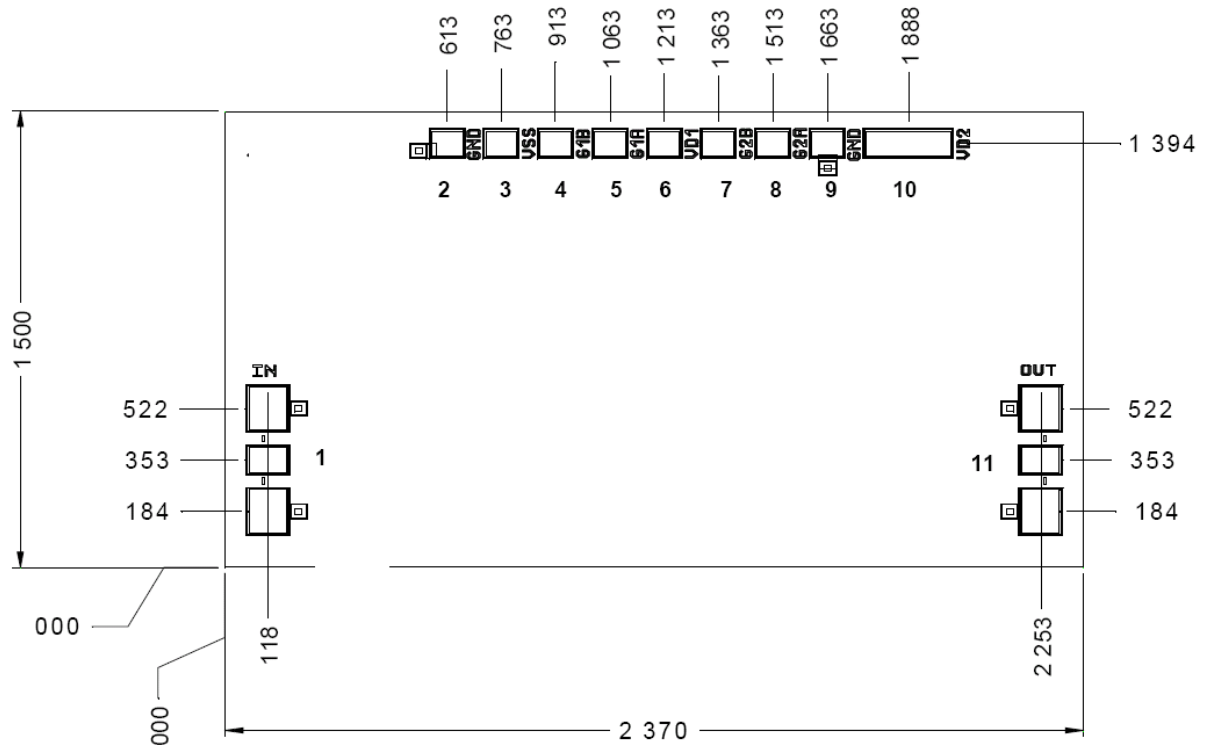


**Typical on Jig Measurements**

Tamb.= +25°C,

Vd = 8V, Id (Quiescent) = 115mA, Drain Pulse width = 45µs, Duty cycle = 12%



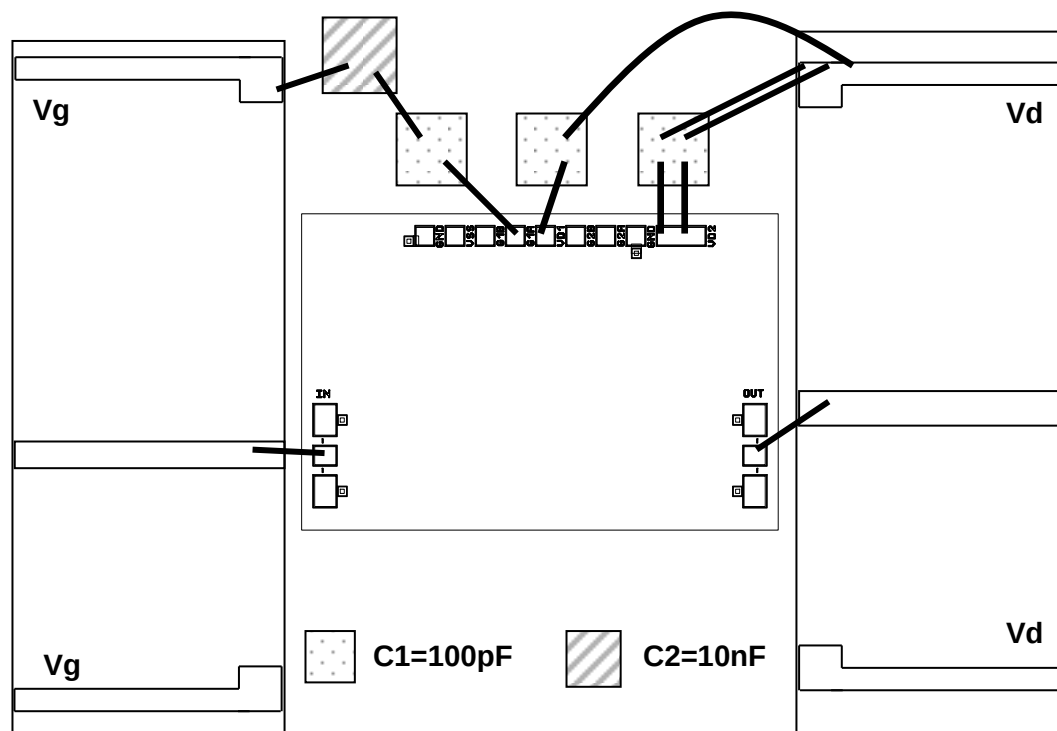
**Mechanical data**

UNITS : μm  
Tol : ± 35μm

All dimensions are in micrometers  
 Chip size = 1500x2370 ± 35μm  
 Chip thickness = 70μm ± 10μm  
 RF pads (1, 12) = 100 x 122μm<sup>2</sup>  
 DC pads (3, 6, 8, 11) = 100 x 100μm<sup>2</sup>  
 Chip width and length are given with a tolerance of ± 35μm

| Pin number | Pin name           | Description |
|------------|--------------------|-------------|
| 1          | IN                 | RF Input    |
| 3, 4, 7, 8 | Vss, G1B, G2B, G2A | NC          |
| 5          | G1A                | Vg          |
| 2, 9       | GND                | NC          |
| 6, 10      | VD1, VD2           | Vd          |
| 11         | OUT                | RF Output   |

## Recommended assembly plan



Pads G1A (pin 5) & G2A (pin 8) are connected inside the chip, The CHA4107 could be used without G2A bias. There is a resistor bridge inside the chip. This one generates the correct value of G1A Bias. Equivalent RF Wire Bonding: 0.2nH (typical length of 200 $\mu$ m for a 25 $\mu$ m diameter wire).

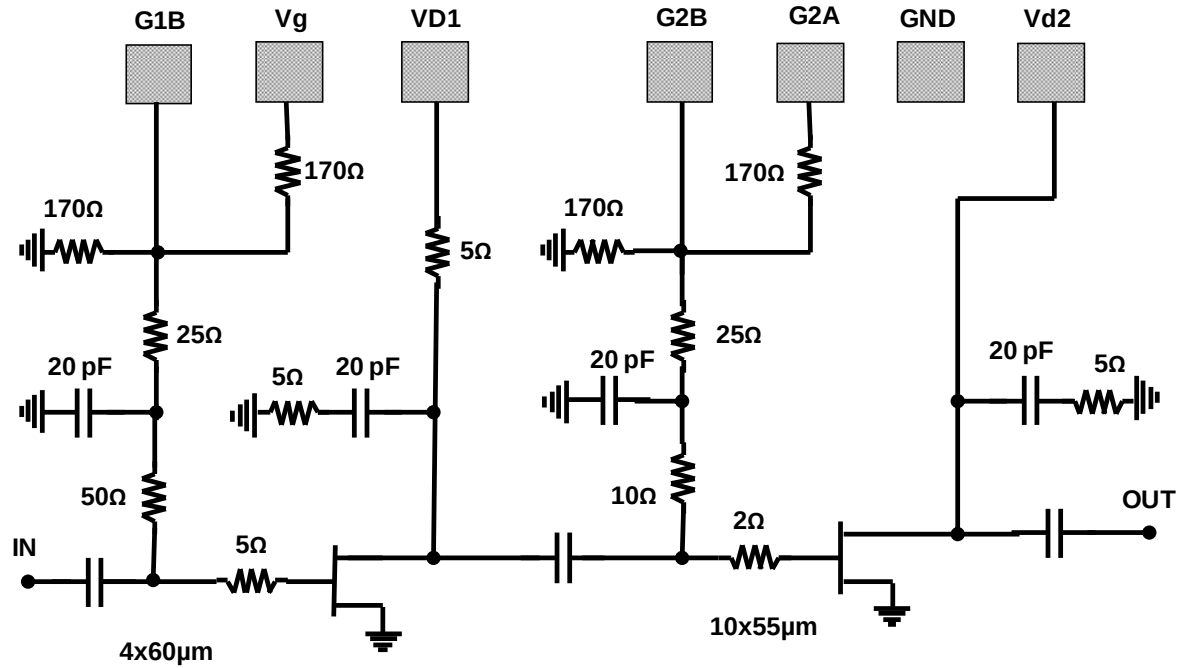
## Bonding recommendations

| Port | Connection                                                                             | External capacitor    |
|------|----------------------------------------------------------------------------------------|-----------------------|
| IN   | Inductance ( $L_{\text{bonding}}$ ) = 0.2nH<br>1 gold wire with diameter of 25 $\mu$ m |                       |
| OUT  | Inductance ( $L_{\text{bonding}}$ ) = 0.2nH<br>1 gold wire with diameter of 25 $\mu$ m |                       |
| Vg   | Inductance $\leq$ 1nH                                                                  | C1 ~ 100pF, C2 ~ 10nF |
| Vd   | Inductance $\leq$ 1nH                                                                  | C1 ~ 100pF            |



## DC Schematic

Medium Power Amplifier: 8V, 115mA



### Recommended ESD management

Refer to the application note AN0020 available at <https://www.ums-rf.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 <https://www.ums-rf.com>.

### Ordering Information

Chip form:

CHA4107-99F/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.**