

17-26GHz Medium Power Amplifier

GaAs Monolithic Microwave IC

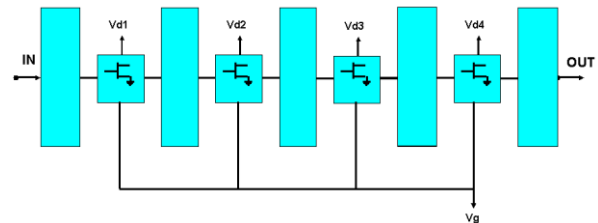
Description

The CHA5050-99F is a four stage monolithic MPA that provides typically 25.5dBm of output power associated to 20% of power added efficiency at 3dB gain compression.

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

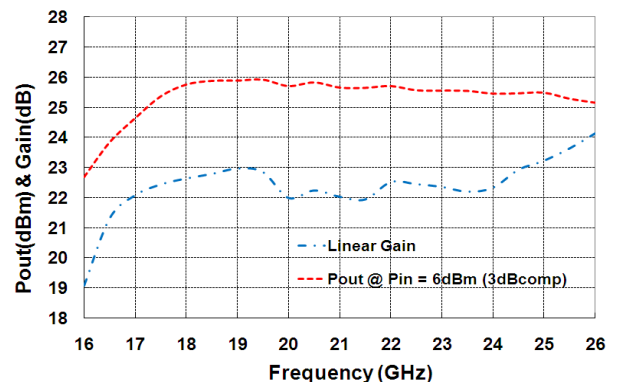
The circuit is manufactured with a pHEMT process, 0.25µm gate length, via holes through the substrate, air bridges and electron beam gate lithography.

It is available in chip form.



Main Features

- 0.25µm Power pHEMT Technology
- Frequency band: 17-26GHz
- Output power: 25.5dBm @ 3dBcomp
- Linear gain: 22dB
- Quiescent bias point: Vd=6V, Id=230 mA
- Chip size: 2.38x1.14x0.07mm



Main Electrical Characteristics

Tamb = +25°C,

Vd = 6V, Id (Quiescent) = 230 mA, CW mode.

| Symbol | Parameter | Min | Typ | Max | Unit |
|--------|-------------------------|------|------|------|------|
| Freq | Frequency range | 17.0 | | 26.0 | GHz |
| Gain | Linear Gain | | 22.0 | | dB |
| Pout | Output Power @1dB comp. | | 25.0 | | dBm |

Electrical Characteristics

Tamb = +25 °C, Vd = 6V, Id (Quiescent) = 230 mA, CW mode.

| Symbol | Parameter | Min | Typ | Max | Unit |
|----------------------------------|---|-----|------|-----|------|
| Fop | Operating frequency | 17 | | 26 | GHz |
| G | Small signal gain | | 22 | | dB |
| RLin | Input Return Loss | | 8 | | dB |
| RLout | Output Return Loss | | 10 | | dB |
| P _{-1dB} | Output power @ 1dBcomp | | 25 | | dBm |
| P _{-3dB} | Output power @ 3dBcomp | | 25.5 | | dBm |
| PAE _{-P_{-3dB}} | Power Added Efficiency @ 3dBcomp | | 20 | | % |
| Id _{-P_{-3dB}} | Supply drain current @ 3dBcomp | | 320 | | mA |
| Vd1, Vd2 | Drain supply voltage | | 6 | | V |
| Id | Supply quiescent current ⁽¹⁾ | | 230 | | mA |
| Vg | Gate supply voltage | | -0.5 | | V |

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

A bonding wire of typically 0.2 to 0.25nH will improve the matching at the accesses.

Absolute Maximum Ratings ⁽¹⁾

Tamb. = +25 °C

| Symbol | Parameter | Values | Unit |
|-------------------|----------------------------------|-------------|------|
| Cmp | Compression level ⁽²⁾ | 8 | dB |
| Vd | Supply voltage ⁽³⁾ | 8 | V |
| Id | Supply quiescent current | 400 | mA |
| Id _{sat} | Supply current in saturation | 450 | mA |
| Vg | Supply voltage | -0.2 | V |
| Tj | Maximum junction temperature | 175 | °C |
| Tstg | Storage temperature range | -55 to +150 | °C |

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

⁽²⁾ Duration < 1s.

⁽³⁾ Without RF input power.

Typical Bias Conditions

Tamb. = +25 °C

| Symbol | Pad N° | Parameter | Values | Unit |
|--------|-------------|-------------------------------------|-----------------------|------|
| Vd | D1,D2,D3,D4 | DC drain Voltage | 6 | V |
| Vg | G1 | DC gate Voltage | ≈ -0.5 ⁽¹⁾ | V |
| Id | | DC Drain current controlled with Vg | 230 | mA |

(1) To be adjusted until to obtain Id: 230mA

Typical on-wafer Sij parameters

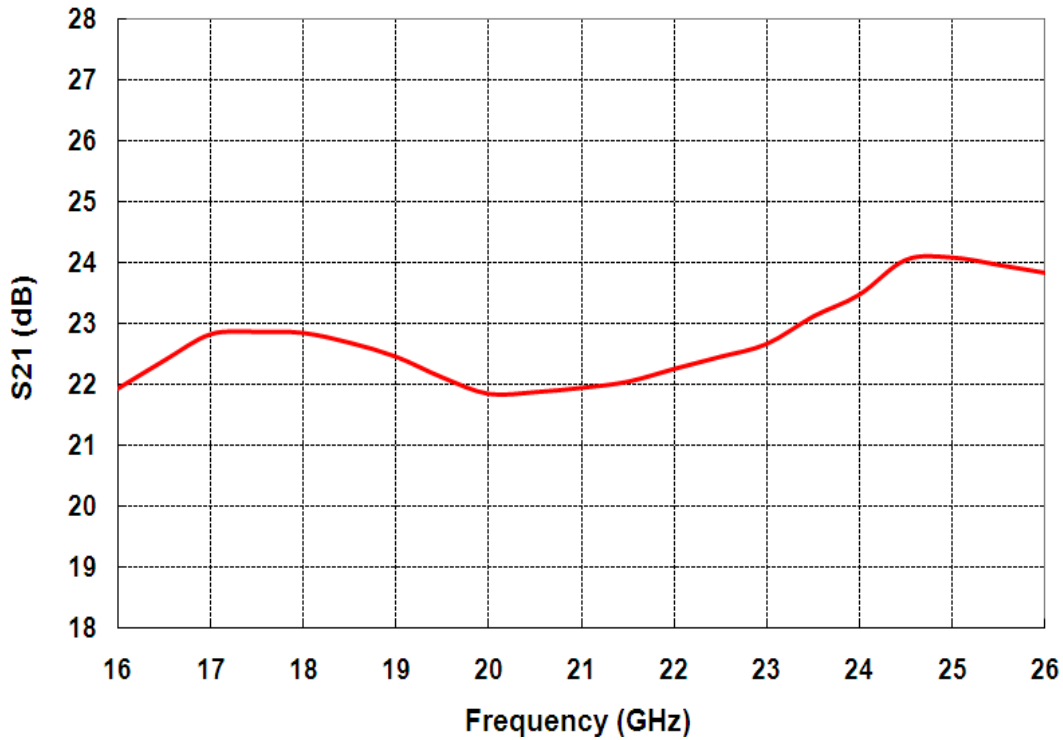
Tamb.= +25°C, Vd =+6V, Id =230 mA, CW mode.

| Freq (GHz) | S11 (dB) | PhS11 (°) | S12 (dB) | PhS12 (°) | S21 (dB) | PhS21 (°) | S22 (dB) | PhS22 (°) |
|------------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|
| Freq | dBS11 | PhS11 | dBS12 | PhS12 | dBS21 | PhS21 | dBS22 | PhS22 |
| 1.00 | -0.06 | -11.52 | -65.84 | 129.40 | -51.96 | -45.86 | -0.10 | -11.30 |
| 2.00 | -0.11 | -22.78 | -70.73 | 150.50 | -48.12 | -131.60 | -0.08 | -22.62 |
| 3.00 | -0.19 | -34.46 | -73.59 | -100.10 | -51.41 | 142.40 | -0.12 | -34.68 |
| 4.00 | -0.37 | -46.03 | -67.18 | -35.91 | -49.98 | 31.35 | -0.20 | -47.36 |
| 5.00 | -0.59 | -57.83 | -68.21 | -41.60 | -45.46 | -69.67 | -0.41 | -60.86 |
| 6.00 | -0.82 | -69.91 | -71.44 | 93.39 | -47.85 | -138.80 | -0.70 | -75.99 |
| 7.00 | -1.19 | -82.40 | -76.13 | 130.40 | -40.31 | 160.80 | -1.38 | -93.16 |
| 8.00 | -1.69 | -95.15 | -67.42 | -117.50 | -30.30 | 105.40 | -2.72 | -111.90 |
| 9.00 | -2.40 | -108.60 | -84.26 | 56.99 | -21.08 | 41.44 | -5.15 | -130.00 |
| 10.00 | -3.38 | -122.40 | -62.14 | 7.22 | -14.37 | -29.19 | -8.57 | -143.10 |
| 11.00 | -4.78 | -137.70 | -64.54 | 10.29 | -9.26 | -89.26 | -13.11 | -155.50 |
| 12.00 | -6.88 | -153.10 | -74.45 | -129.90 | -4.29 | -141.10 | -24.33 | -154.30 |
| 13.00 | -10.60 | -167.50 | -60.49 | -134.50 | 0.96 | 170.10 | -17.65 | -33.06 |
| 14.00 | -17.65 | 176.20 | -61.05 | -145.40 | 6.61 | 119.80 | -11.24 | -44.64 |
| 15.00 | -26.57 | -66.82 | -66.18 | -129.30 | 12.67 | 64.91 | -8.42 | -61.70 |
| 16.00 | -16.13 | -80.08 | -65.08 | 73.52 | 18.72 | -2.23 | -7.18 | -78.01 |
| 17.00 | -21.30 | -97.79 | -66.74 | -179.60 | 22.17 | -84.34 | -6.45 | -95.20 |
| 18.00 | -15.82 | -41.25 | -72.50 | -132.10 | 22.90 | -156.10 | -6.81 | -113.10 |
| 19.00 | -10.26 | -49.12 | -58.77 | -174.20 | 22.60 | 141.50 | -8.92 | -129.20 |
| 20.00 | -8.27 | -63.27 | -58.87 | -172.90 | 22.26 | 86.10 | -11.55 | -131.30 |
| 21.00 | -7.38 | -72.30 | -60.64 | 161.10 | 21.86 | 36.20 | -12.56 | -121.00 |
| 22.00 | -5.87 | -82.61 | -55.85 | 99.18 | 21.95 | -12.88 | -12.77 | -119.00 |
| 23.00 | -5.69 | -94.05 | -58.92 | 121.60 | 22.12 | -57.51 | -12.01 | -122.20 |
| 24.00 | -6.05 | -105.80 | -59.39 | 116.40 | 23.02 | -104.50 | -13.18 | -136.70 |
| 25.00 | -7.30 | -111.60 | -64.00 | 22.15 | 23.74 | -156.60 | -17.84 | -131.50 |
| 26.00 | -8.80 | -108.40 | -64.31 | -12.45 | 24.33 | 148.40 | -17.29 | -80.63 |
| 27.00 | -8.62 | -94.46 | -67.93 | -130.00 | 24.12 | 87.81 | -11.71 | -73.06 |
| 28.00 | -6.47 | -86.97 | -56.53 | -164.80 | 22.73 | 26.56 | -7.99 | -83.28 |
| 29.00 | -3.83 | -88.39 | -54.45 | 162.30 | 20.39 | -32.26 | -5.80 | -98.65 |
| 30.00 | -1.90 | -98.80 | -53.49 | 174.90 | 17.48 | -89.01 | -4.42 | -114.20 |
| 31.00 | -0.89 | -111.60 | -50.44 | 160.30 | 13.75 | -142.20 | -3.54 | -129.70 |
| 32.00 | -0.51 | -122.60 | -46.61 | 136.40 | 9.64 | 169.10 | -3.07 | -144.50 |
| 33.00 | -0.28 | -132.30 | -44.40 | 116.90 | 5.36 | 124.50 | -2.66 | -159.30 |
| 34.00 | -0.33 | -140.60 | -44.16 | 80.16 | 0.96 | 81.63 | -2.46 | -174.30 |
| 35.00 | -0.19 | -147.80 | -44.33 | 67.77 | -3.56 | 41.54 | -1.93 | 170.50 |
| 36.00 | -0.17 | -154.70 | -44.49 | 39.31 | -8.48 | 1.91 | -1.69 | 154.00 |
| 37.00 | -0.17 | -160.60 | -45.12 | 24.13 | -13.91 | -35.51 | -1.36 | 136.00 |
| 38.00 | -0.16 | -166.50 | -46.36 | 7.06 | -20.14 | -70.88 | -0.82 | 116.80 |

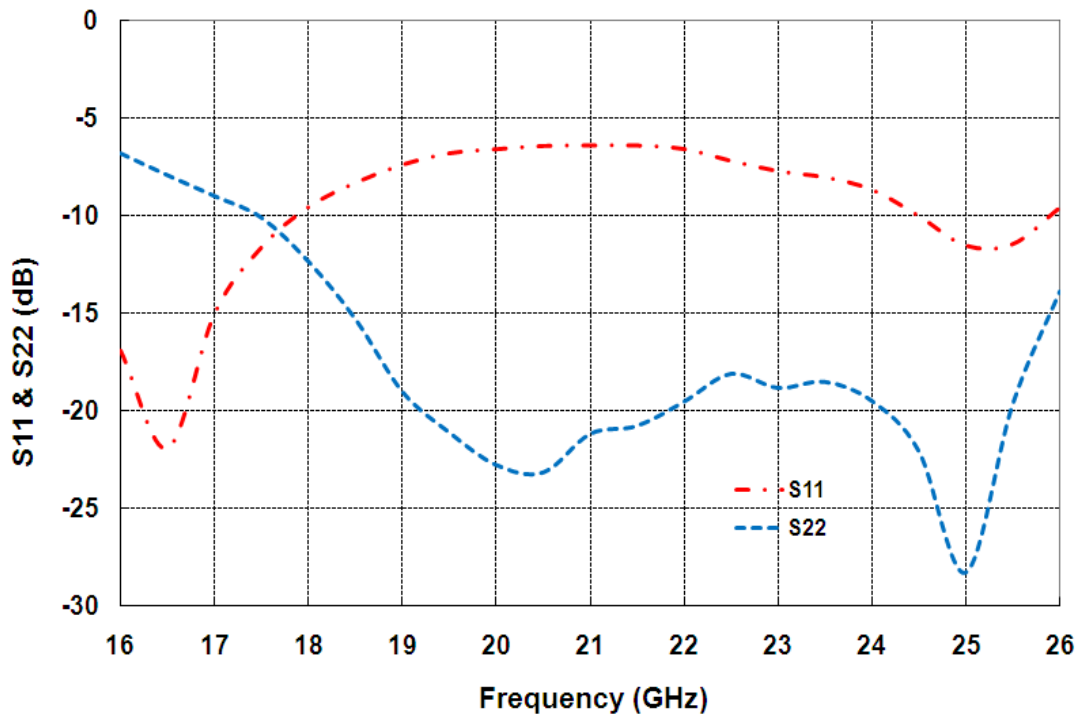
Typical on wafer Measurements

Tamb= +25°C; Vd =6V, Id (Quiescent) =230 mA, CW mode

Linear Gain versus frequency

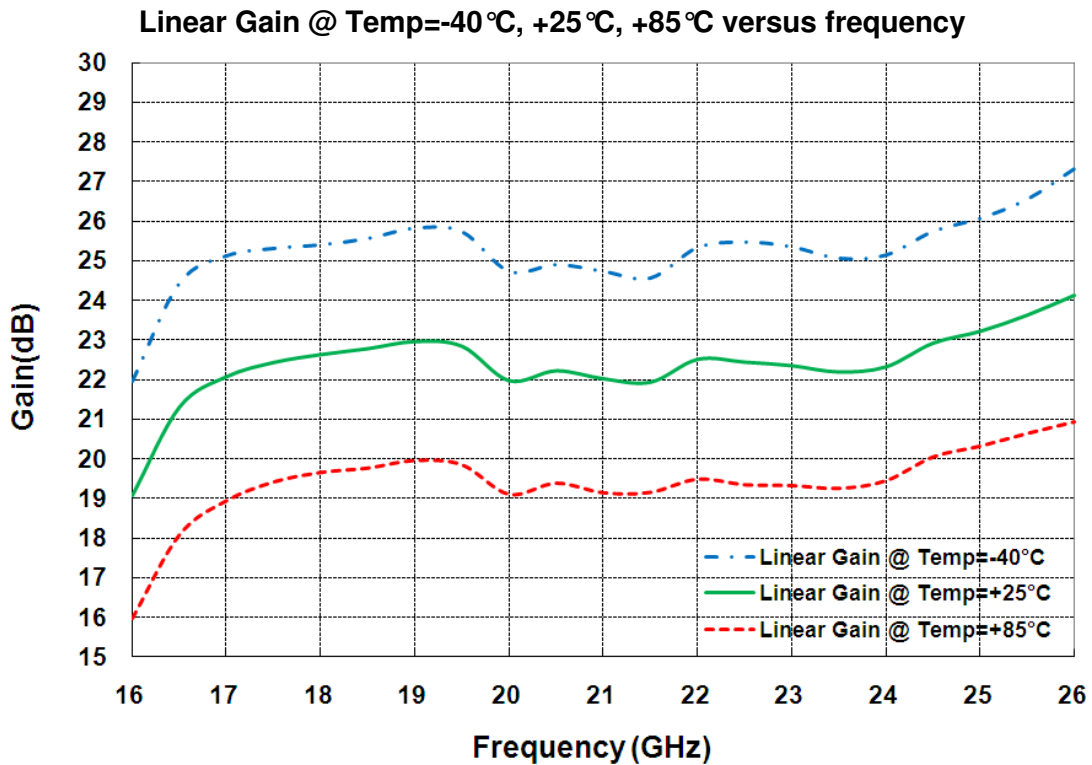


Return losses versus frequency

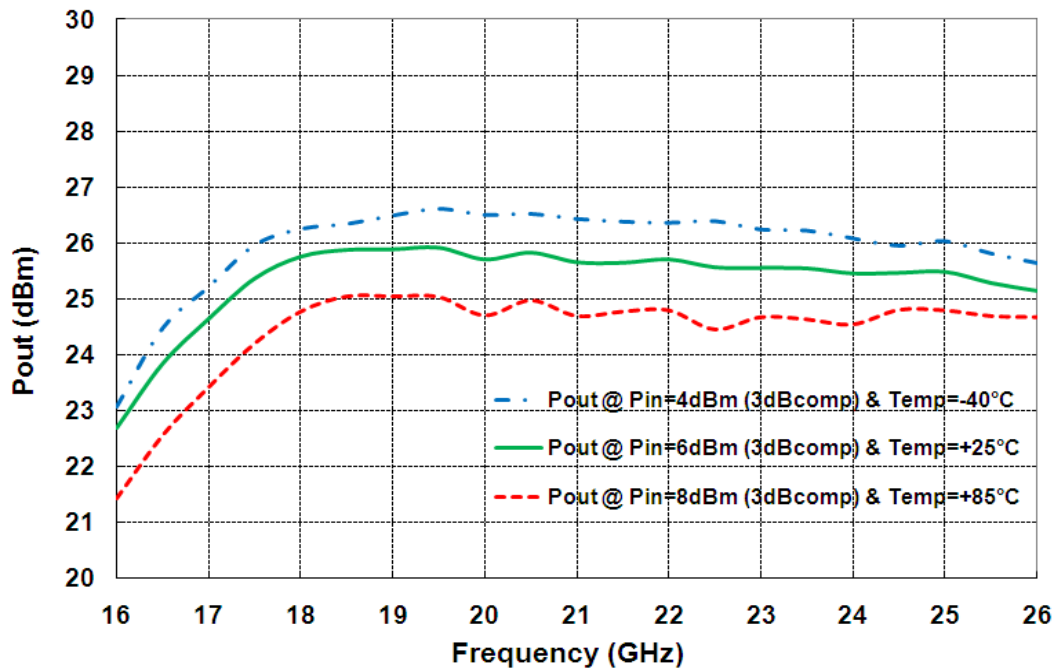


Typical Test Fixture Measurements

Temp= -40 °C, +25 °C, +85 °C; Vd =6V, Id (Quiescent) =230 mA, CW mode

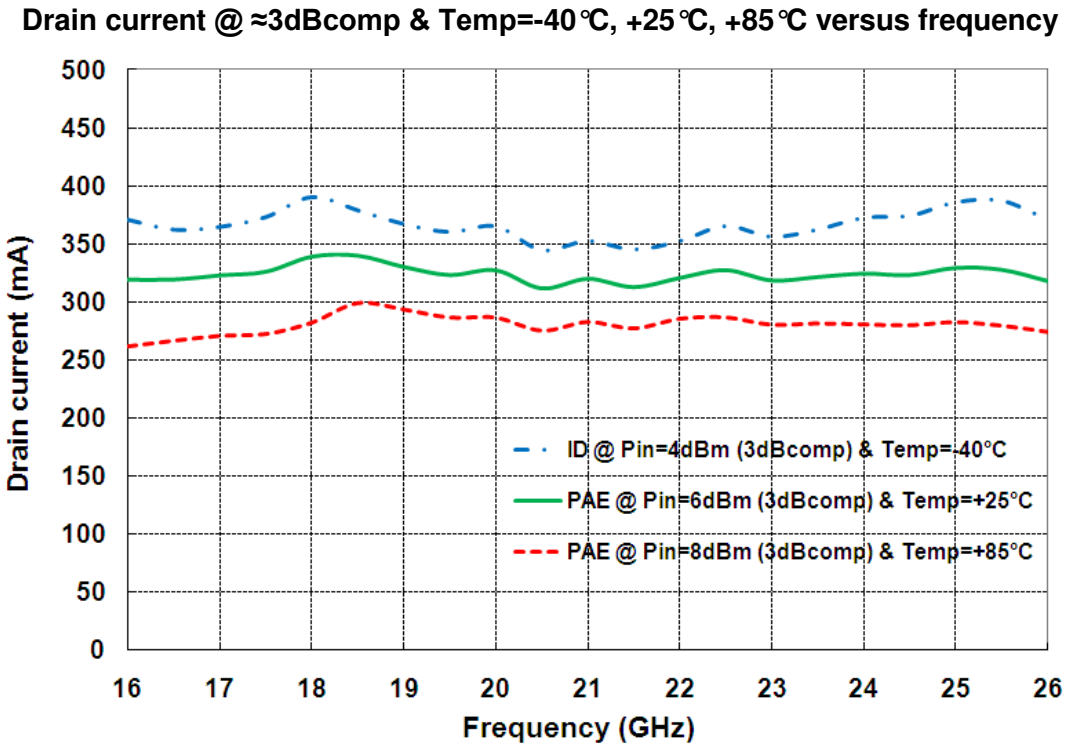
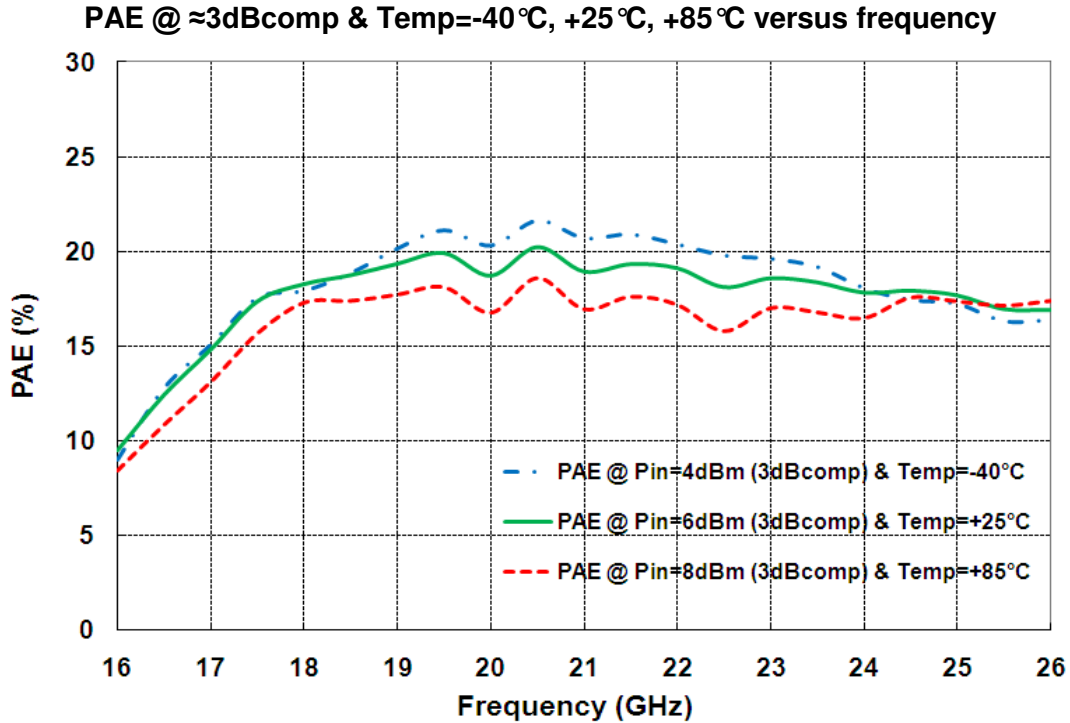


Output Power @ ≈3dBcomp & Temp=-40 °C, +25 °C, +85 °C versus frequency

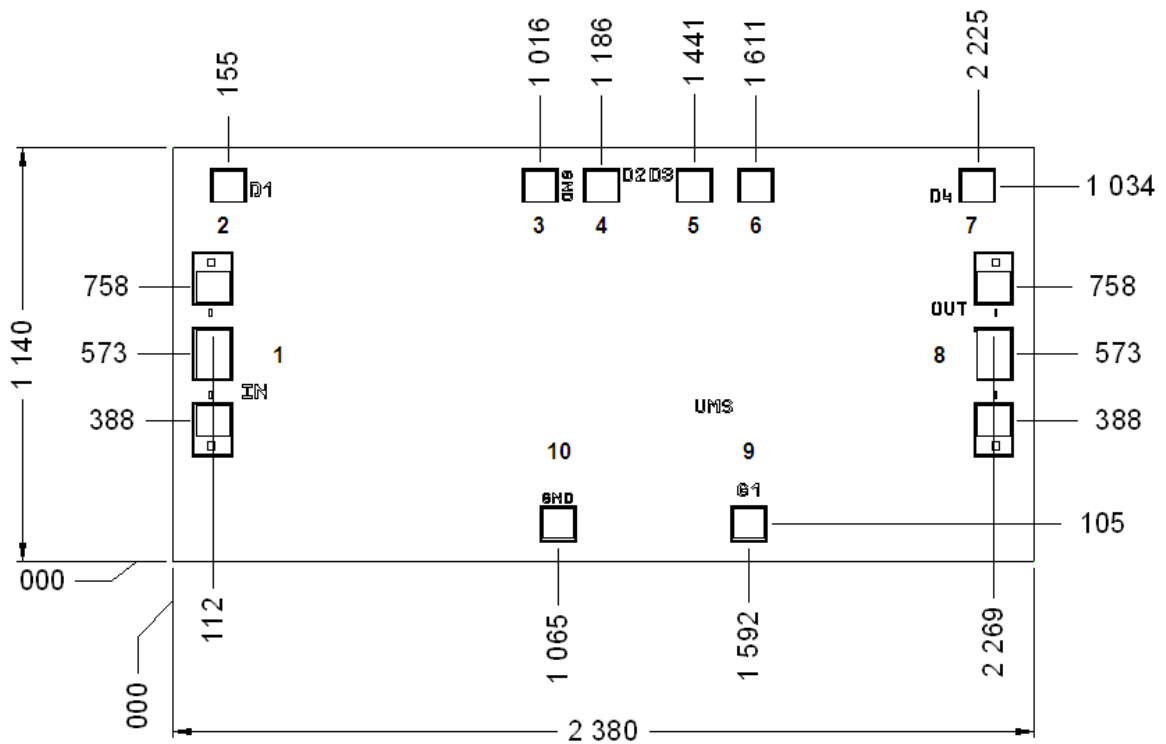


Typical Test Fixture Measurements

Temp= -40°C, +25°C, +85°C; Vd =6V, Id (Quiescent) =230 mA, CW mode



Mechanical data



All dimensions are in micrometers

Chip size = 2380x1140 ±35µm

Chip thickness = 70µm ±10µm

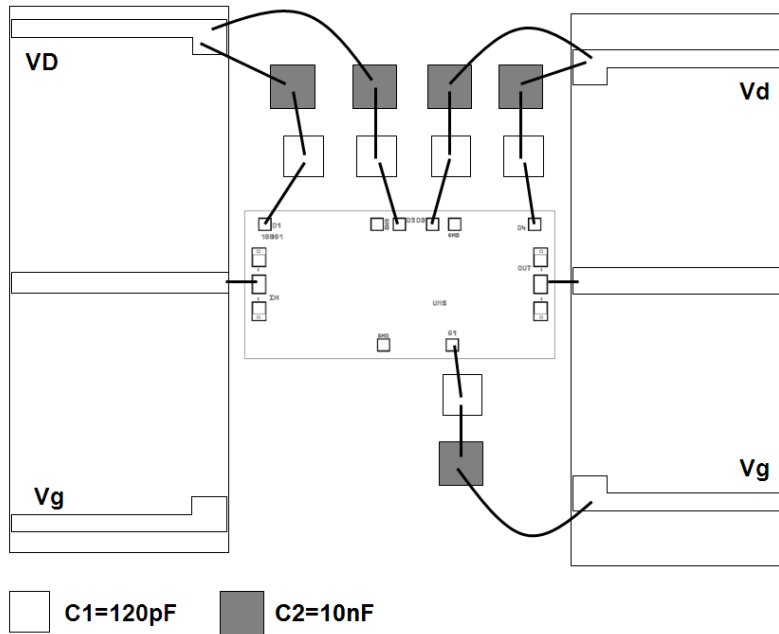
RF pads (1, 8) = 110 x 150µm²

DC pads (2, 4, 5, 7, 9) = 100 x 100µm²

Chip width and length are given with a tolerance of ±35µm

| Pin number | Pin name | Description |
|------------|----------|-------------|
| 1 | IN | Input RF |
| 2 | D1 | Vd1 |
| 3, 6, 10 | GND | NC |
| 4 | D2 | Vd2 |
| 5 | D3 | Vd3 |
| 7 | D4 | Vd4 |
| 8 | OUT | Output RF |
| 9 | G1 | Vg |

Recommended assembly plan

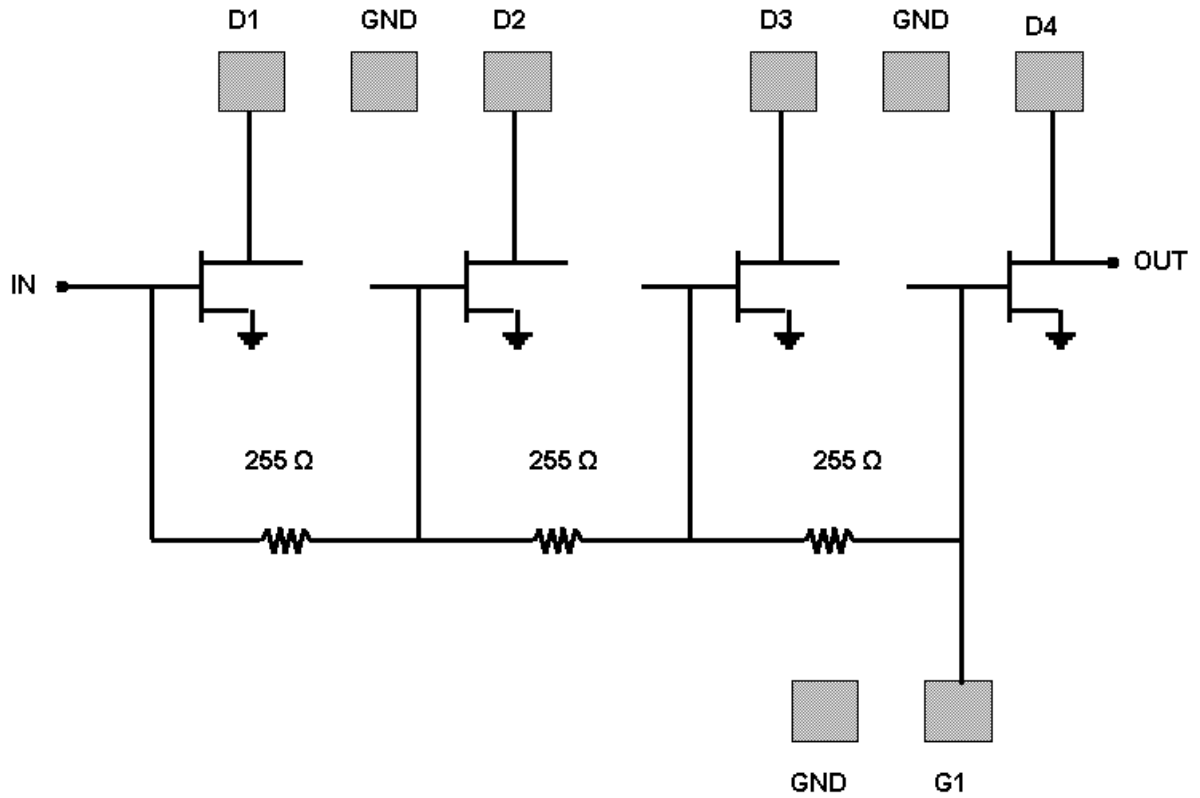


Bonding recommendations

| Port | Connection | External capacitor |
|------|--|-----------------------|
| IN | Inductance (L_{bonding}) = 0.3nH 400 μm length with a wire diameter of 25 μm | |
| OUT | Inductance (L_{bonding}) = 0.3nH 400 μm length with a wire diameter of 25 μm | |
| Vg | Inductance \leq 1nH | C1 ~ 120pF, C2 ~ 10nF |
| Vd | Inductance \leq 1nH | C1 ~ 120pF |

DC Schematic

Medium Power Amplifier: 6V, 230mA



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:

CHA5050-99F/00

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