

## X-band Medium Power Amplifier

### GaAs Monolithic Microwave IC

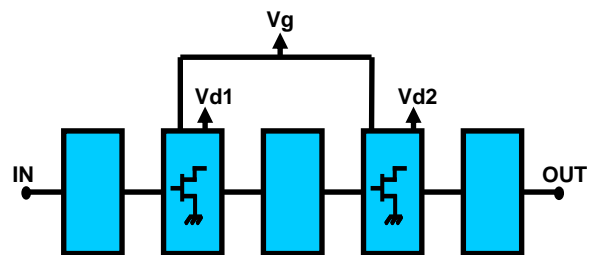
### Description

The CHA5115-99F is a monolithic two-stage GaAs medium power amplifier designed for X-band applications.

The MPA provides typically 28dBm output power associated to 37% power added efficiency at 3dB gain compression.

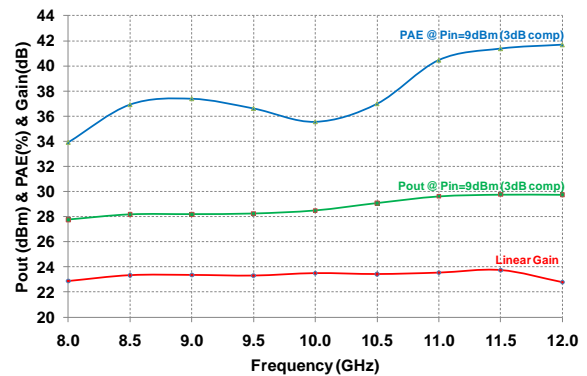
This device is manufactured using 0.25 $\mu$ m Power pHEMT process, including, via holes through the substrate and air bridges.

It is available in chip form.



### Main Features

- 0.25 $\mu$ m Power pHEMT Technology
- Frequency band: 8-12GHz
- Output power: 28dBm @ 3dBcomp
- Linear gain: 23dB
- High PAE: 37% @ 3dBcomp
- Noise Factor: 5dB typ.
- Quiescent bias point: Vd=8V, Id=0.17A
- Chip size: 2.37x1.82x0.07mm



### Main Characteristics

Tamb = +25°C, Vd = 8V, Id (Quiescent) = 170mA, Drain Pulse width = 100 $\mu$ s, Duty cycle = 20%

Symbol	Parameter	Min	Typ	Max	Unit
Fop	Operating frequency range	8		12	GHz
PAE_P <sub>-3dB</sub>	Power added efficiency @3dBcomp		37		%
P <sub>-3dB</sub>	Output power @ 3dBcomp		28		dBm

## Main Characteristics on wafer

Tamb = +25°C,

Vd = 8V, Id (Quiescent) = 170mA, Drain Pulse width = 100µs, Duty cycle = 20%

Symbol	Parameter	Min	Typ	Max	Unit
Fop	Operating frequency	8		12	GHz
G	Small signal gain		23		dB
RLin	Input Return Loss		10		dB
RLout	Output Return Loss		8		dB
P <sub>-1dB</sub>	Output power @ 1dBcomp		27		dBm
P <sub>-3dB</sub>	Output power @ 3dBcomp		28		dBm
PAE <sub>-P<sub>-3dB</sub></sub>	Power Added Efficiency @ 3dBcomp		37		%
Id <sub>-P<sub>-3dB</sub></sub>	Supply drain current @ 3dBcomp		250		mA
NF	Noise Factor		5		dB
Vd1, Vd2, Vd3	Drain supply voltage		8		V
Id	Supply quiescent current <sup>(1)</sup>		170		mA
Vg	Gate supply voltage		-1		V

<sup>(1)</sup> 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 <sup>(3)</sup>	9.5	V
Id	Supply quiescent current	240	mA
Id <sub>sat</sub>	Supply current in saturation	320	mA
Vg	Supply voltage	-0.6	V
Tj	Maximum junction temperature	175	°C
Tstg	Storage temperature range	-55 to +150	°C
Top	Operating temperature range	-40 to +85	°C

<sup>(1)</sup> Operation of this device above any one of these parameters may cause permanent damage.

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

<sup>(3)</sup> Without RF input power.

## Typical on-wafer Sij parameters

Tamb.= +25°C, Vd =+8V, Id =170mA

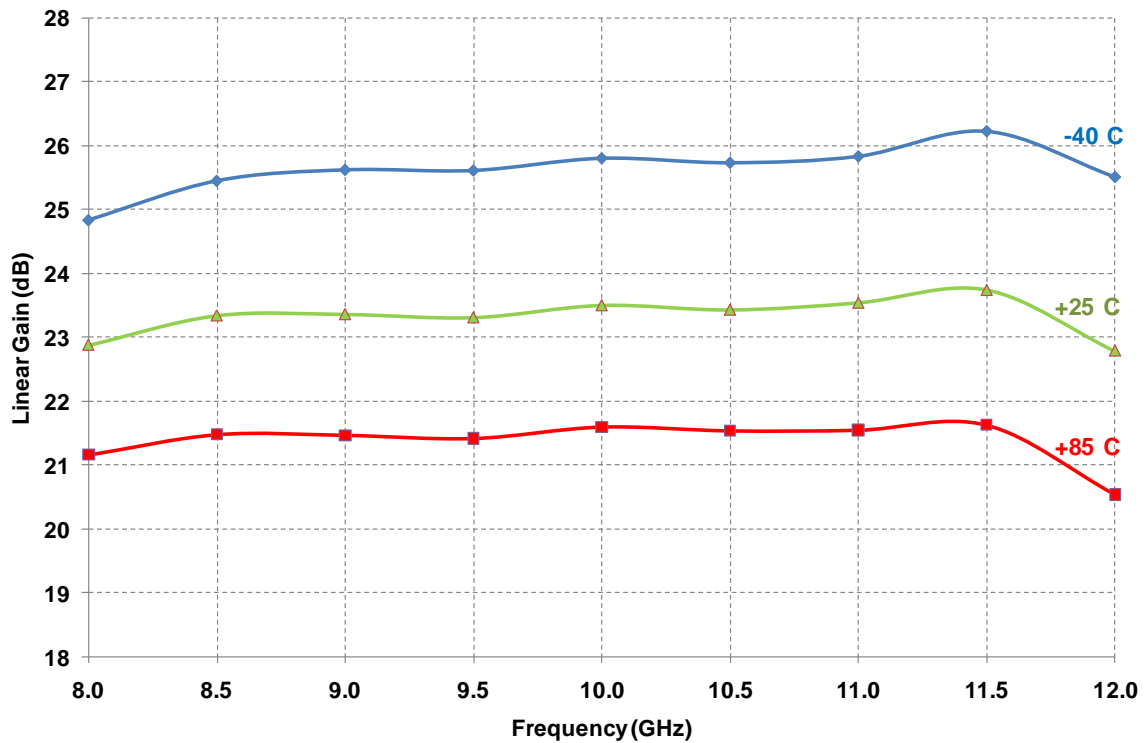
Freq (GHz)	S11 (dB)	PhS11 (°)	S12 (dB)	PhS12 (°)	S21 (dB)	PhS21 (°)	S22 (dB)	PhS22 (°)
1.00	-0.14	-17.18	-70.56	131.00	-44.86	93.40	-0.26	-51.82
2.00	-0.89	-38.60	-66.95	58.43	-15.60	140.00	-0.40	-95.81
3.00	-1.92	-36.78	-73.99	162.70	-2.90	-8.50	-0.68	-131.70
4.00	-1.22	-57.88	-66.71	-23.40	-1.76	-77.01	-1.13	-164.70
5.00	-1.62	-79.93	-68.60	-42.68	2.41	-132.20	-2.52	161.00
6.00	-2.65	-106.50	-69.42	-101.30	8.40	166.70	-5.64	118.50
7.00	-5.44	-142.00	-56.24	-167.90	15.64	86.30	-12.37	45.77
8.00	-13.17	167.30	-50.35	139.40	20.84	-22.05	-12.57	-72.91
9.00	-13.29	-2.85	-48.75	40.44	21.50	-132.90	-9.43	-116.00
10.00	-7.26	-77.96	-47.40	-32.68	20.93	130.80	-7.34	-137.20
11.00	-10.87	-133.00	-47.35	-116.50	22.08	33.31	-5.92	-170.10
12.00	-14.26	-85.45	-45.87	122.00	22.20	-88.45	-8.73	143.50
13.00	-7.25	-92.43	-47.87	-22.55	18.59	130.10	-9.89	38.02
14.00	-4.33	-141.80	-51.68	-142.90	7.69	10.25	-6.96	-56.60
15.00	-3.88	-178.60	-55.91	169.30	-1.59	-83.07	-4.89	-86.78
16.00	-3.47	148.50	-60.96	100.90	-11.16	161.30	-3.08	-104.30
17.00	-3.11	119.80	-59.85	115.40	-29.52	59.84	-2.15	-118.40
18.00	-2.73	97.19	-58.71	98.78	-55.66	27.94	-1.28	-129.10
19.00	-2.39	75.26	-59.21	102.80	-60.45	26.28	-0.80	-139.10
20.00	-1.98	57.37	-64.93	76.45	-52.10	-9.35	-0.40	-148.40
21.00	-1.62	42.54	-65.58	38.34	-64.57	-54.50	-0.08	-156.30
22.00	-1.43	28.22	-62.58	37.89	-55.29	97.29	0.15	-163.10
23.00	-1.16	15.69	-64.00	66.25	-51.78	79.43	0.20	-169.90
24.00	-0.93	5.85	-68.67	84.00	-52.42	-13.69	0.29	-177.20
25.00	-0.93	-4.28	-83.68	-105.10	-58.90	-174.90	0.51	178.20
26.00	-0.58	-13.45	-78.90	5.21	-54.56	160.70	0.16	171.70
27.00	-0.50	-21.55	-70.72	-47.68	-60.62	80.79	0.14	166.50
28.00	-0.79	-29.11	-78.47	-60.17	-57.15	-72.92	0.29	162.60
29.00	-0.46	-35.82	-61.80	-177.60	-53.85	-148.30	0.15	159.00
30.00	-0.06	-41.62	-55.89	177.40	-54.31	178.90	0.10	153.30

## Typical on Jig Measurements

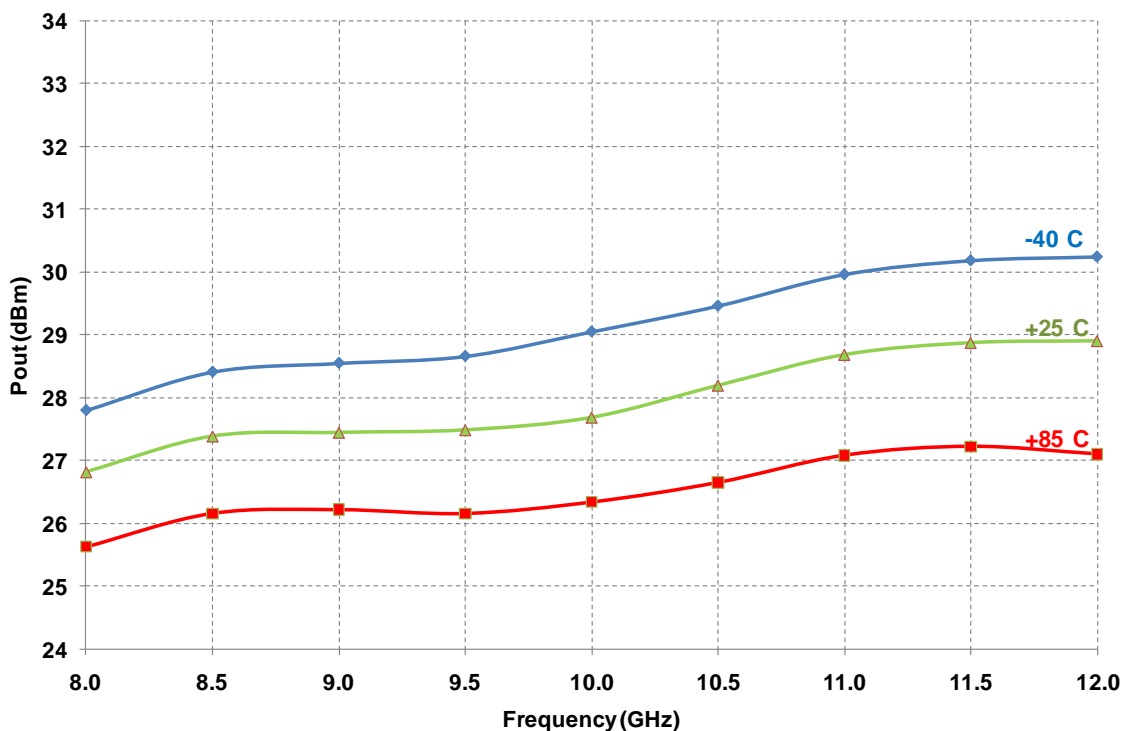
Tamb= -40°C/+25°C/+85°C;

Vd =8V, Id (Quiescent) =170mA, Drain Pulse width =100µs, Duty cycle =20%

Linear Gain versus frequency



Output Power @ Pin=6dBm (1dB comp) versus frequency

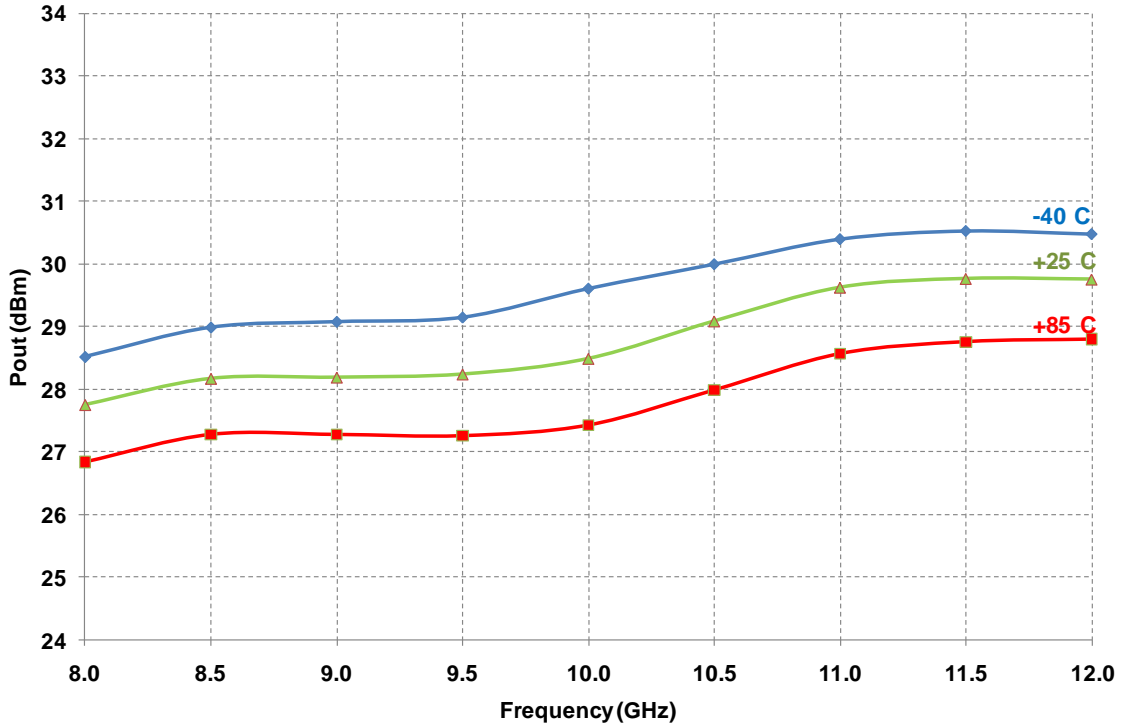


**Typical on Jig Measurements**

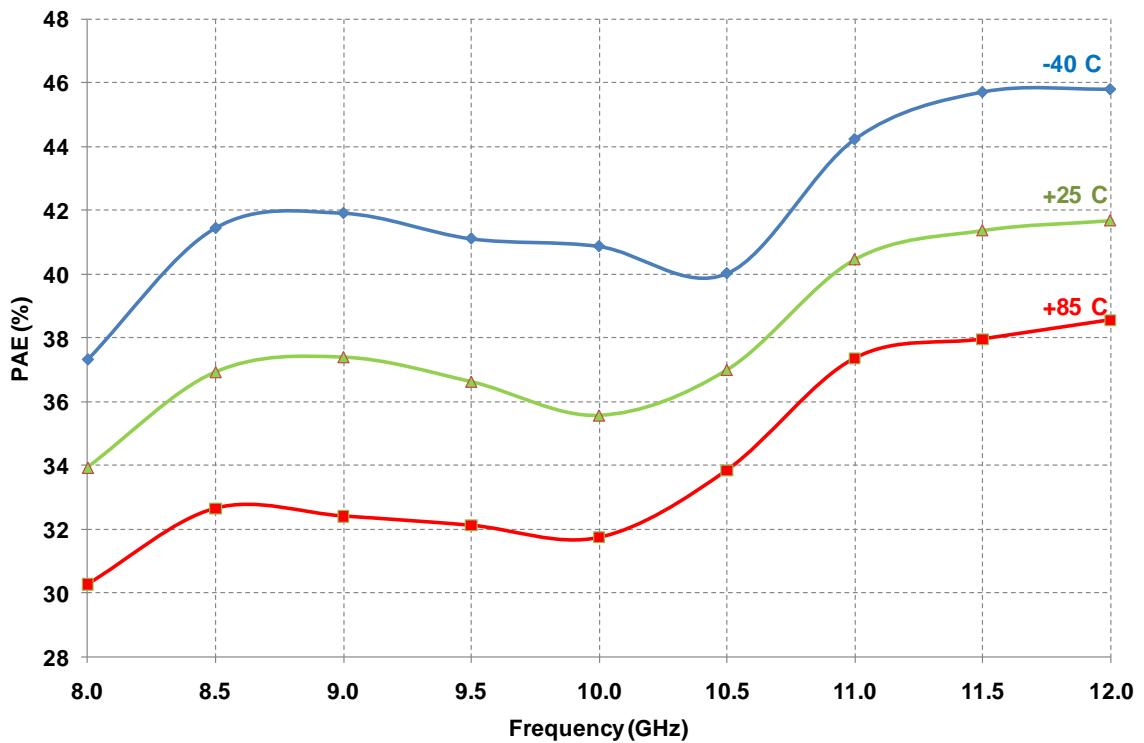
Tamb= -40°C/+25°C/+85°C;

Vd =8V, Id (Quiescent) =170mA, Drain Pulse width =100µs, Duty cycle =20%

**Output Power @ Pin=9dBm (3dB comp) versus frequency**



**Power added efficiency @ Pin=9dBm (3dBcomp) versus frequency**

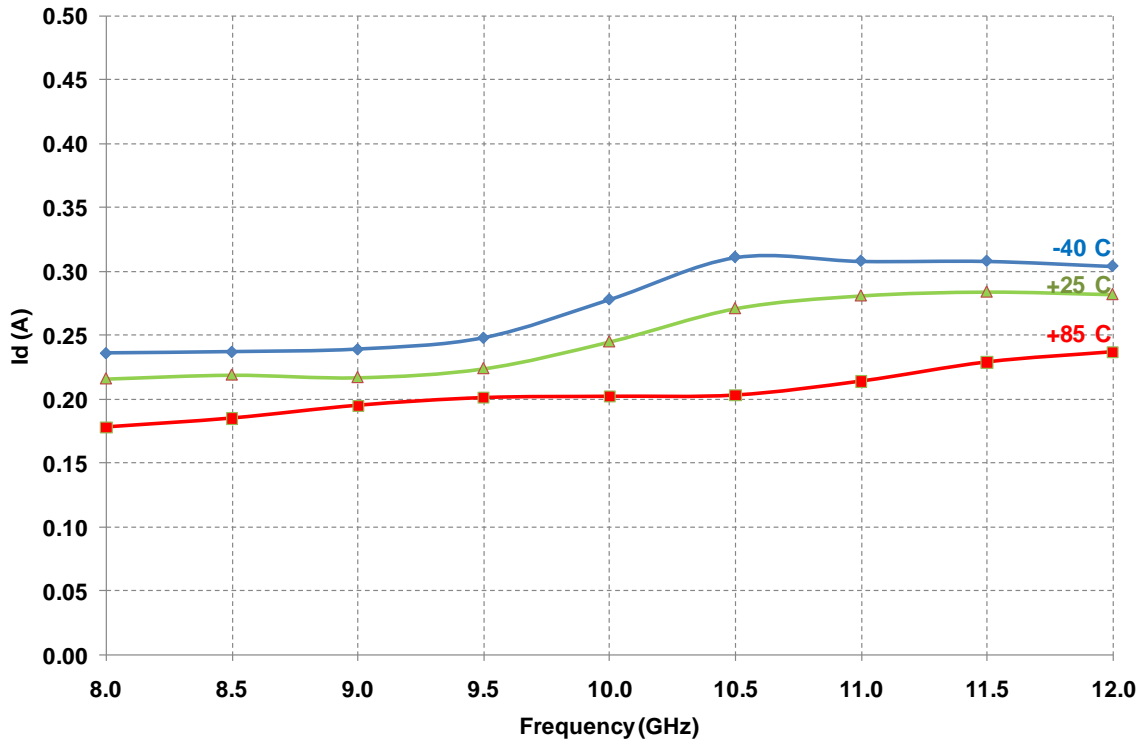


## Typical on Jig Measurements

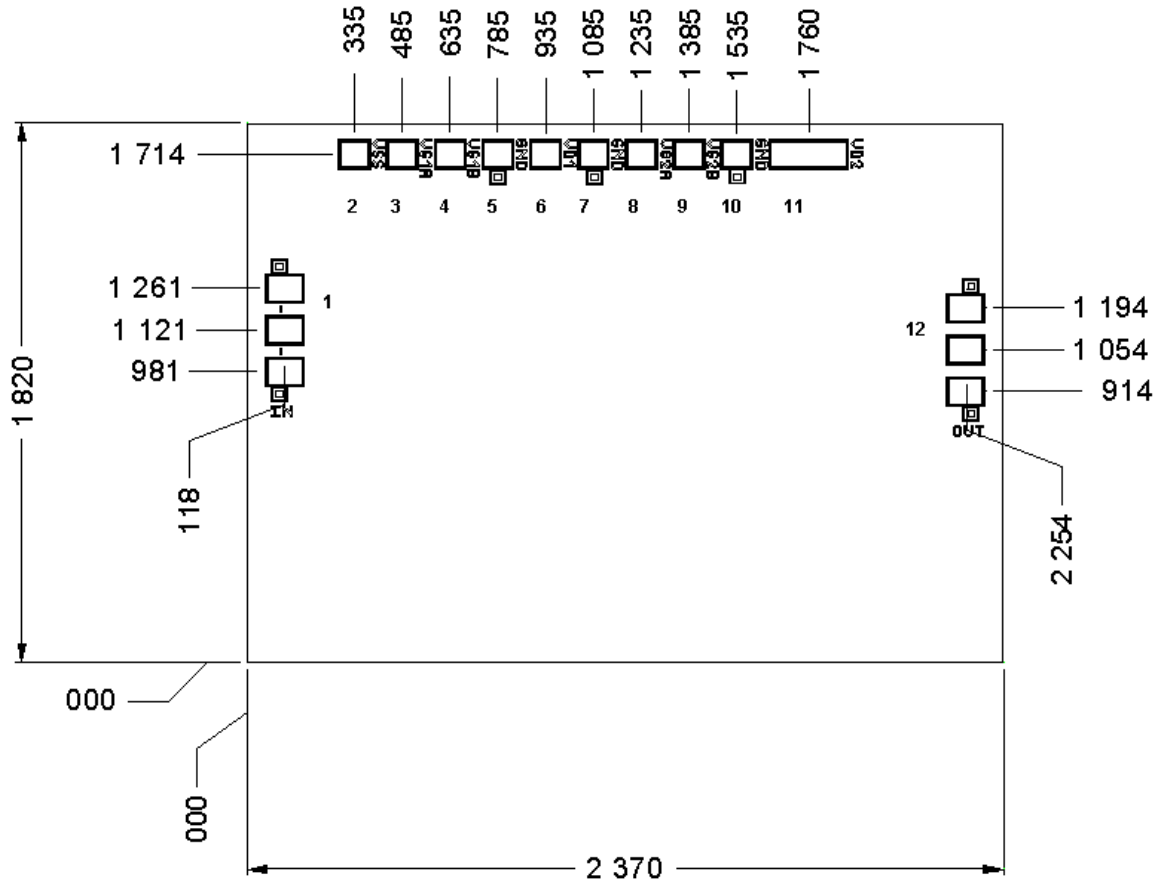
Tamb= -40°C/+25°C/+85°C;

Vd =8V, Id (Quiescent) =170mA, Drain Pulse width =100µs, Duty cycle =20%

Drain Current @ Pin=9dBm (3dBcomp) versus frequency



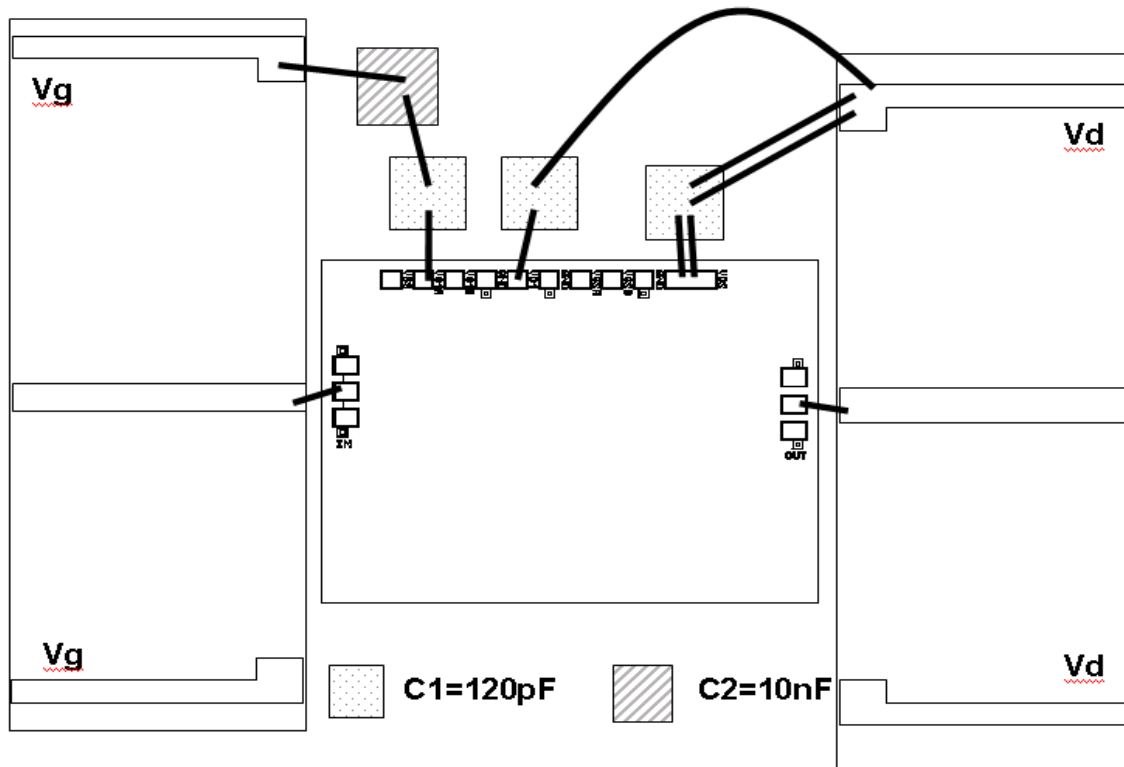
**Mechanical data**



All dimensions are in micrometers  
 Chip size = 1820x2370 ±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	Input RF
2, 4	G	NC
3	VG1A	Vg
5, 7, 10	GND	Ground
6, 11	VD1, VD2	Vd
12	OUT	Output RF

## Recommended assembly plan



Pads VG1A (pin 3) & VG2A (pin 8) are connected inside the chip, so the CHA5115 can be used without VG2A bias.

Equivalent RF Wire Bonding: 0.2nH (typical length of 200µm for a 25µm diameter wire).

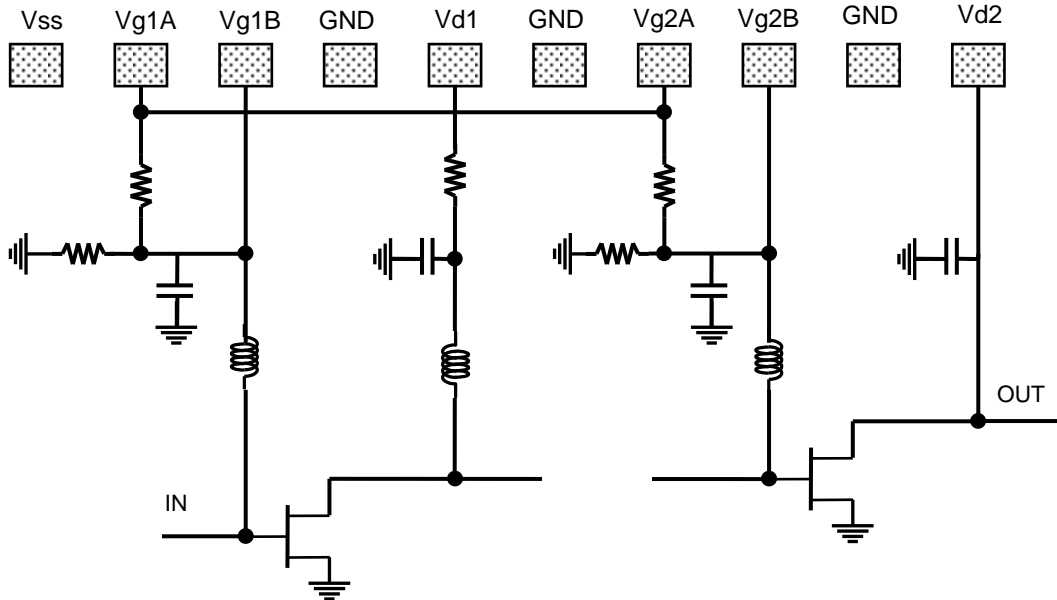
## Bonding recommendations

Port	Connection	External capacitor
IN	Inductance (L <sub>bonding</sub> ) = 0.3nH 1 gold wire with diameter of 25µm	
OUT	Inductance (L <sub>bonding</sub> ) = 0.3nH 1 gold wire with diameter of 25µm	
Vg	Inductance ≤ 1nH	C1 ~ 120pF, C2 ~ 10nF
Vd	Inductance ≤ 1nH	C1 ~ 120pF



**DC Schematic**

**Medium Power Amplifier: 8V, 170mA**



## 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.

## Ordering Information

Chip form: CHA5115-99F/00

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