

X-band Medium Power Amplifier

GaAs Monolithic Microwave IC

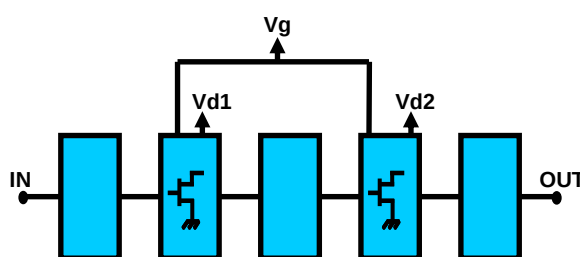
Description

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

The MPA provides typically 29dBm output power associated to 39% power added efficiency at 3dB gain compression.

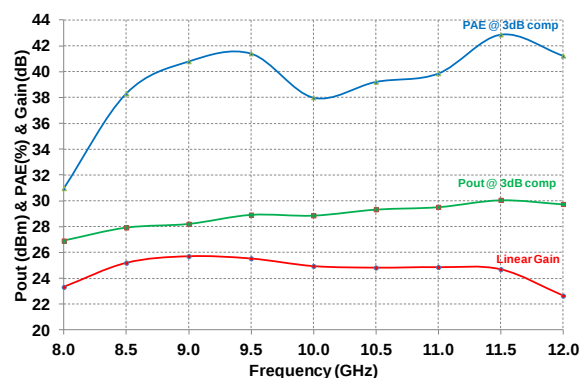
This device is manufactured using 0.25μm Power pHEMT process, including, via holes through the substrate and air bridges.

It is available in chip form.



Main Features

- 0.25μm Power pHEMT Technology
- Frequency band: 8-12GHz
- Output power: 29dBm @ 3dBcomp
- Linear gain: 25dB
- High PAE: 39% @ 3dBcomp
- Noise Factor: 5dB typ.
- Quiescent bias point: Vd=8V, Id=0.19A
- Chip size: 2.37x1.82x0.07mm



Main Characteristics

Tamb = +25°C, Vd = 8V, Id (Quiescent) = 190mA, Drain Pulse width = 100μs, Duty cycle = 20%

Symbol	Parameter	Min	Typ	Max	Unit
Fop	Operating frequency range	8		12	GHz
P _{-3dB}	Output power @ 3dB comp		29		dBm
PAE _{P-3dB}	Power added efficiency @ 3dB comp		39		%

Electrical Characteristics (Pulsed mode)

Tamb = +25°C,

Vd = 8V, Drain Pulse width = 100µs, Duty cycle = 20%

Symbol	Parameter	Min	Typ	Max	Unit
Fop	Operating frequency	8		12	GHz
G	Small signal gain		25		dB
RLin	Input Return Loss	8	10		dB
RLout	Output Return Loss	5	8		dB
P _{-1dB}	Output power @ 1dBcomp	24.5	28		dBm
P _{-3dB}	Output power @ 3dBcomp	25.5	29		dBm
PAE _{-3dB}	Power Added Efficiency @3dB comp		39		%
Id _{-3dB}	Supply drain current @3dB comp		250		mA
NF	Noise Factor		5		dB
Vd1, Vd2, Vd3	Drain supply voltage		8		V
Id	Supply quiescent current ⁽¹⁾		190		mA
Vg	Gate supply voltage		-1		V

⁽¹⁾ Parameter can be adjusted by tuning of Vg.**Electrical Characteristics (CW mode)**

Tamb = +25°C,

Vd = 8V, Idq=190mA

Symbol	Parameter	Min	Typ	Max	Unit
Fop	Operating frequency	8		12	GHz
G	Small signal gain		24		dB
RLin	Input Return Loss		10		dB
RLout	Output Return Loss		8		dB
P _{-1dB}	Output power @ 1dBcomp		28		dBm
P _{-3dB}	Output power @ 3dBcomp		29		dBm
PAE _{-3dB}	Power Added Efficiency @3dB comp		38		%
Id _{-3dB}	Supply drain current @3dB comp		250		mA
Vd1, Vd2, Vd3	Drain supply voltage		8		V
Id	Supply quiescent current ⁽¹⁾		190		mA
Vg	Gate supply voltage		-1		V

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

Absolute Maximum Ratings ⁽¹⁾

Tamb.= +25°C

Symbol	Parameter	Values	Unit
Vd	Supply voltage ⁽³⁾	9.5	V
Id	Supply current	525	mA
Pin	Maximum peak input power overdrive	+20	dBm
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.

⁽³⁾ Without RF input power.

Device thermal information

The thermal performances of the device given below are based on UMS rules to evaluate the junction temperature.

This same procedure is the basis for junction temperature evaluation of the samples used to derive the Median lifetime and activation energy for the particular technology on which the CHA5115-99F is fabricated (AsGa Power PHEMT 0.25 μ m).

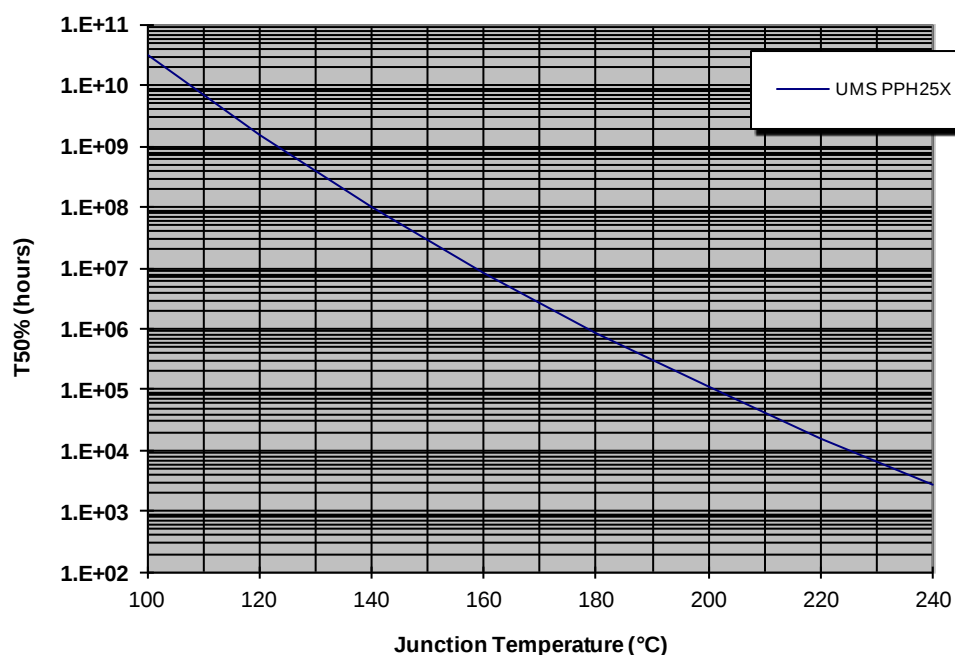
The temperature T_b is defined as the chip back side temperature

The thermal resistance (R_{th_eq}) is given for the full circuit, and assumes CW operation mode as given in the table.

Parameters	Symbol	Conditions	Value	Unit
Thermal Resistance	R_{th_eq}	$T_b=85^\circ\text{C}$, $V_d=8\text{V}$, $I_{d_drive}=0.17\text{A}$ $P_{in}=-20\text{dBm}$ $P_{out}=3.5\text{dBm}$ $P_{diss}=1.36\text{W}$ CW mode	50	$^\circ\text{C}/\text{W}$
Junction Temperature	T_j		153	$^\circ\text{C}$
Median Life	T_{50}		1.96×10^7	Hrs

Thermal Resistance	R_{th_eq}	$T_b=85^\circ\text{C}$, $V_d=8\text{V}$, $I_{d_drive}=0.155\text{A}$ $P_{in}=9\text{dBm}$ (3dB comp) $P_{out}=28\text{dBm}$ $P_{diss}=1.24\text{W}$ CW mode	57	$^\circ\text{C}/\text{W}$
Junction Temperature	T_j		157	$^\circ\text{C}$
Median Life	T_{50}		1.2×10^7	Hrs

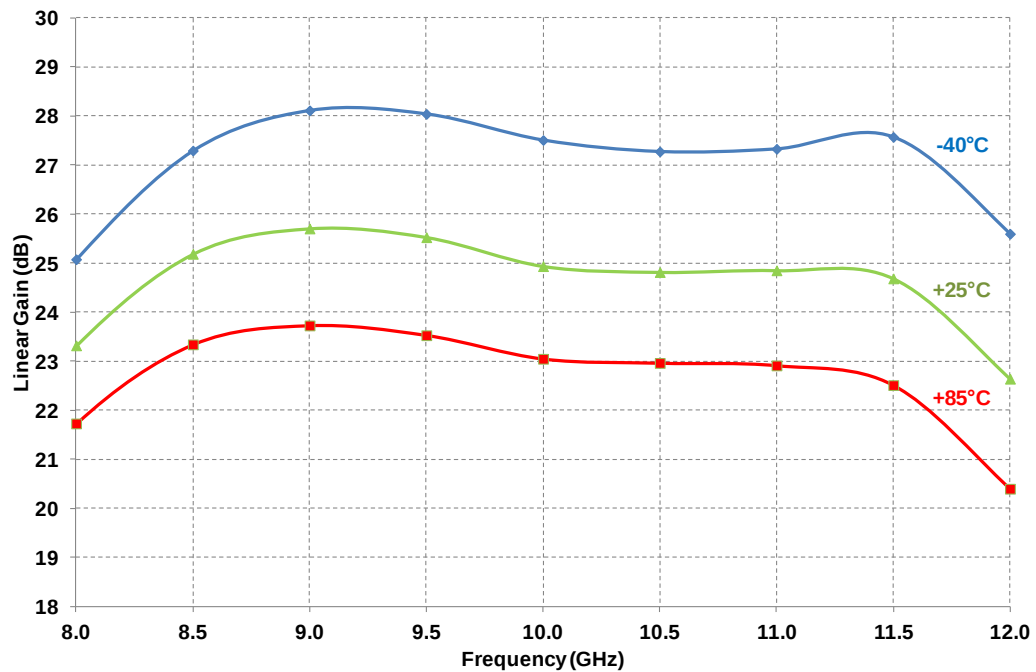
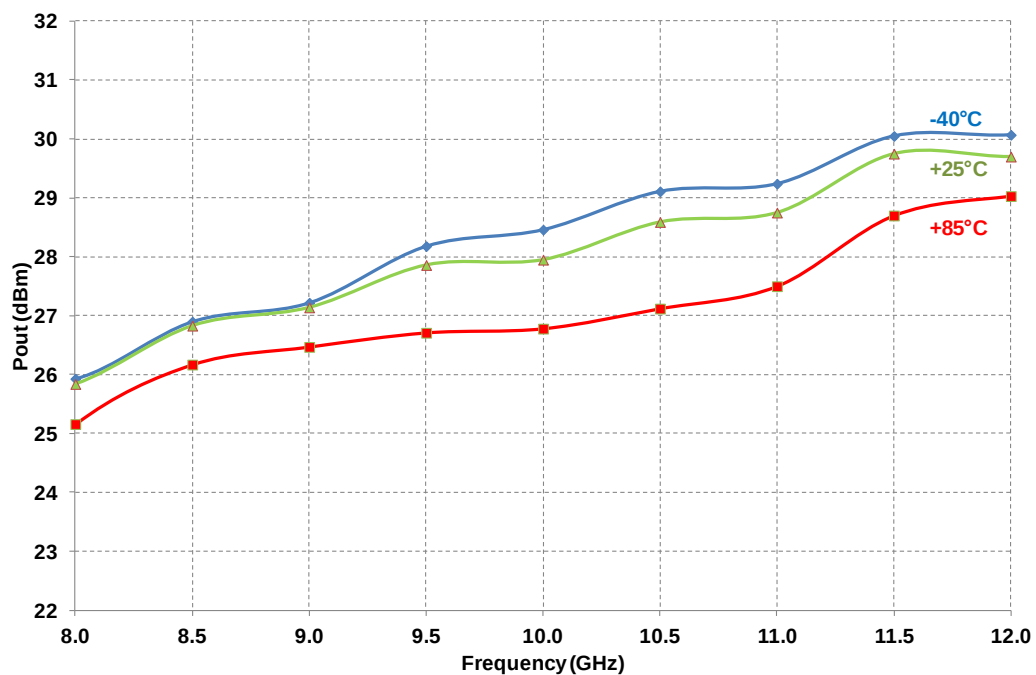
Median Life Time versus Junction Temperature



Typical on Jig Measurements (Pulse mode)

Tamb= -40°C/+25°C/+85°C;

Vd =8V, Id (Quiescent) =190mA, Drain Pulse width =100μs, Duty cycle =20%

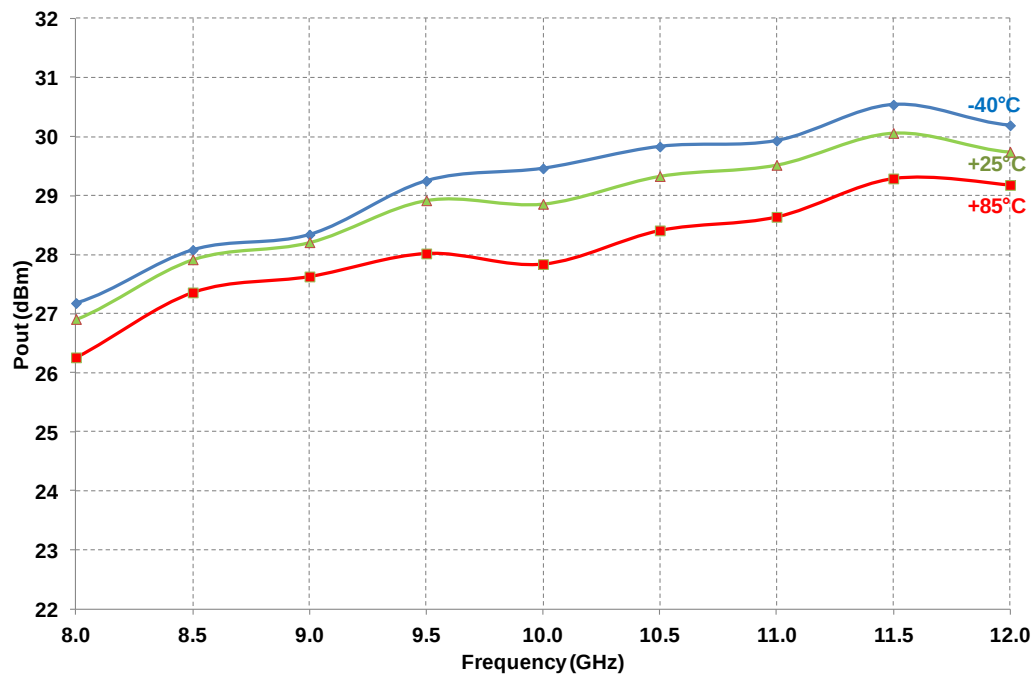
Linear Gain versus frequency**Output Power @ 1dB comp versus frequency**

Typical on Jig Measurements (Pulse mode)

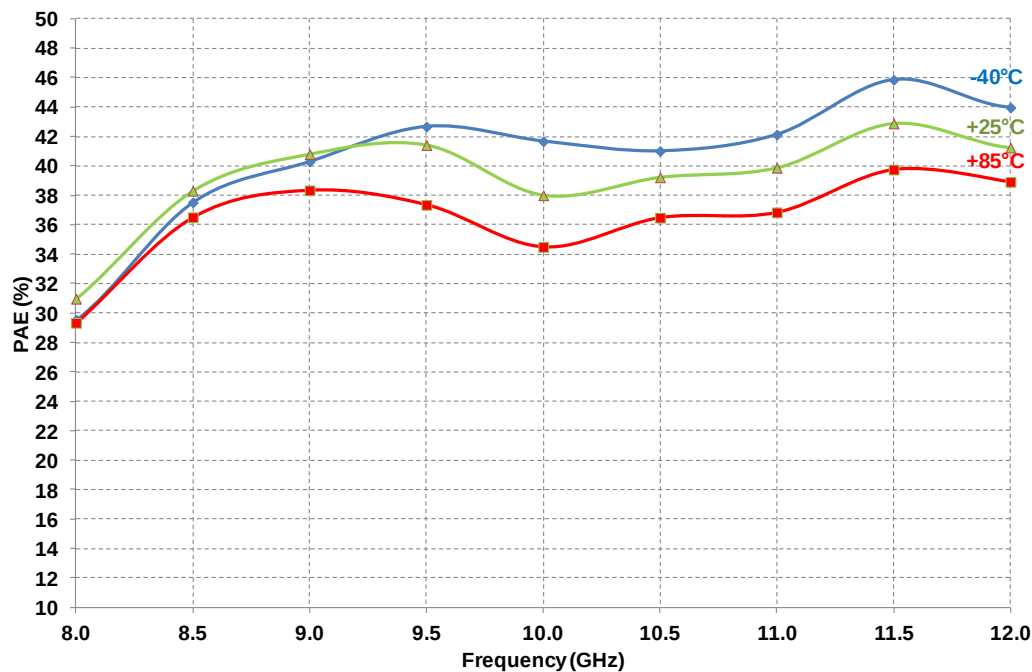
Tamb= -40°C/+25°C/+85°C;

Vd =8V, Id (Quiescent) =190mA, Drain Pulse width =100μs, Duty cycle =20%

Output Power @ 3dB comp versus frequency



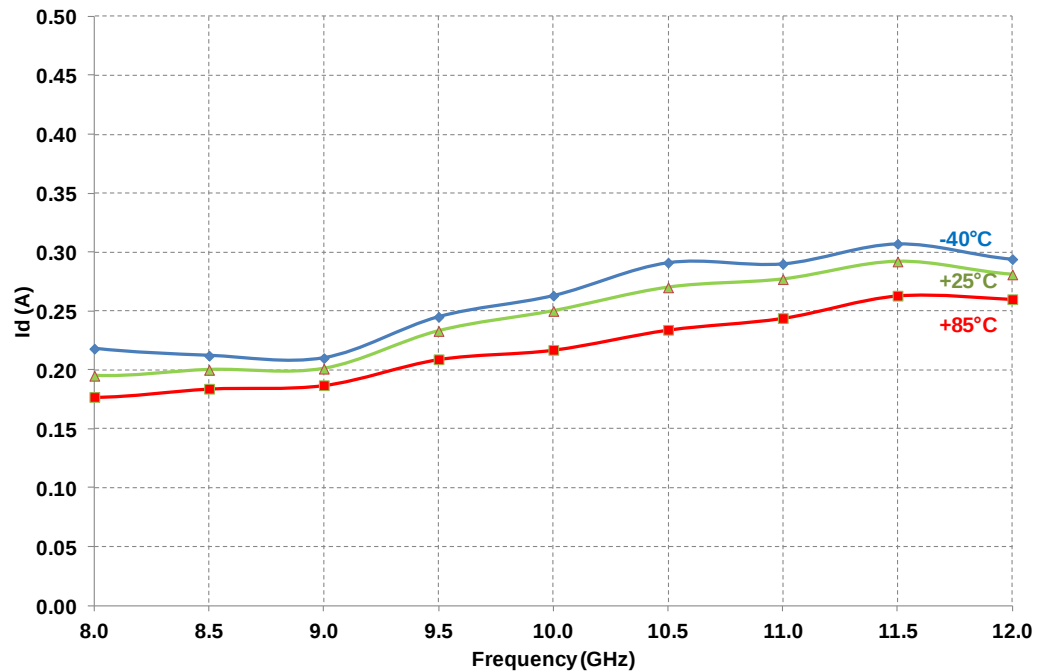
Power added efficiency @ 3dBcomp versus frequency



Typical on Jig Measurements (Pulse mode)

Tamb= -40°C/+25°C/+85°C;

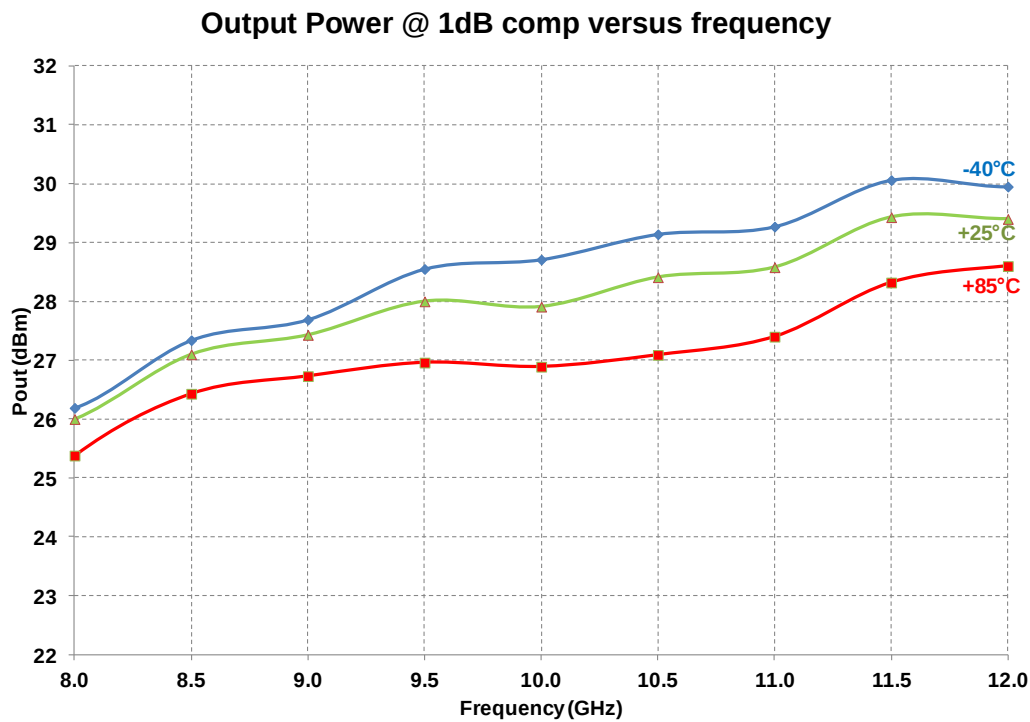
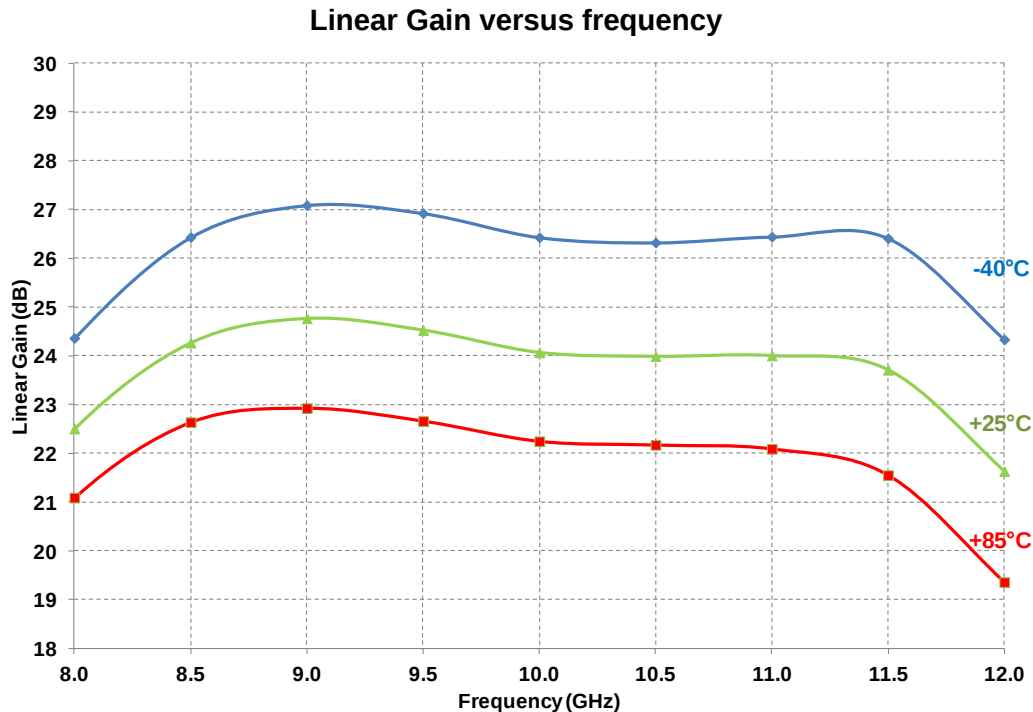
Vd =8V, Id (Quiescent) =190mA, Drain Pulse width =100µs, Duty cycle =20%

Drain Current @ 3dBcomp versus frequency

Typical on Jig Measurements (CW mode)

Tamb= -40°C/+25°C/+85°C;

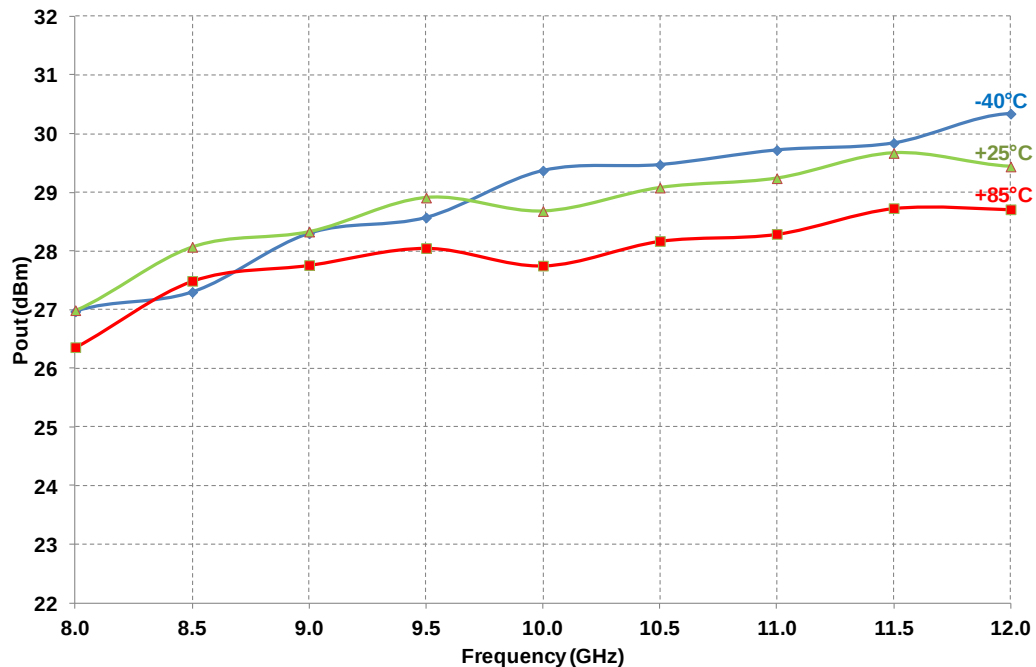
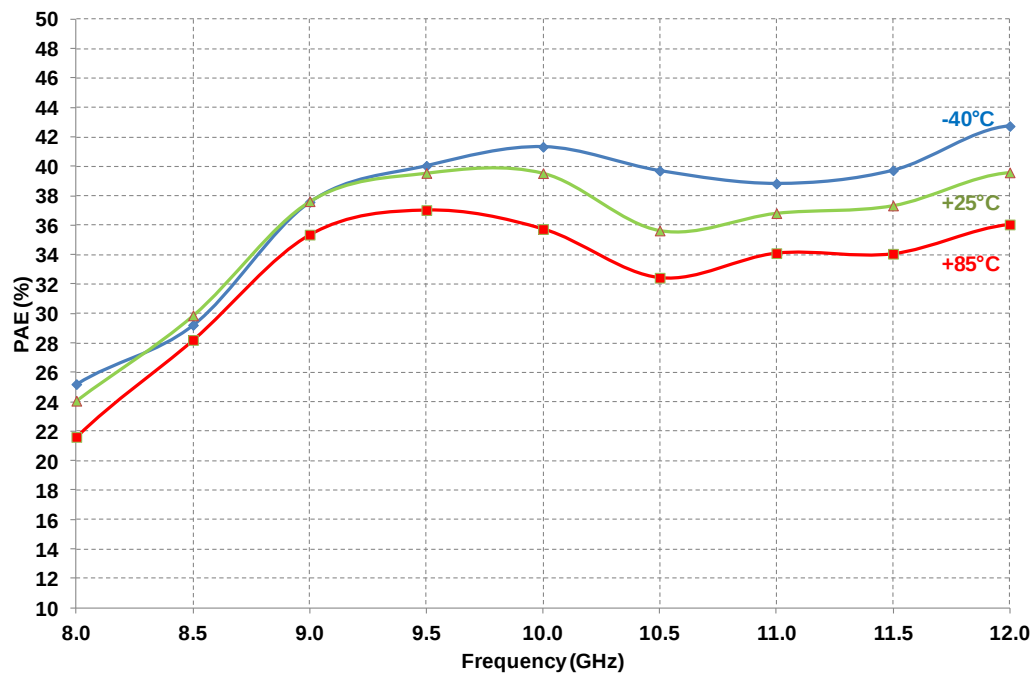
Vd =8V, Id (Quiescent) =190mA



Typical on Jig Measurements (CW mode)

Tamb= -40°C/+25°C/+85°C;

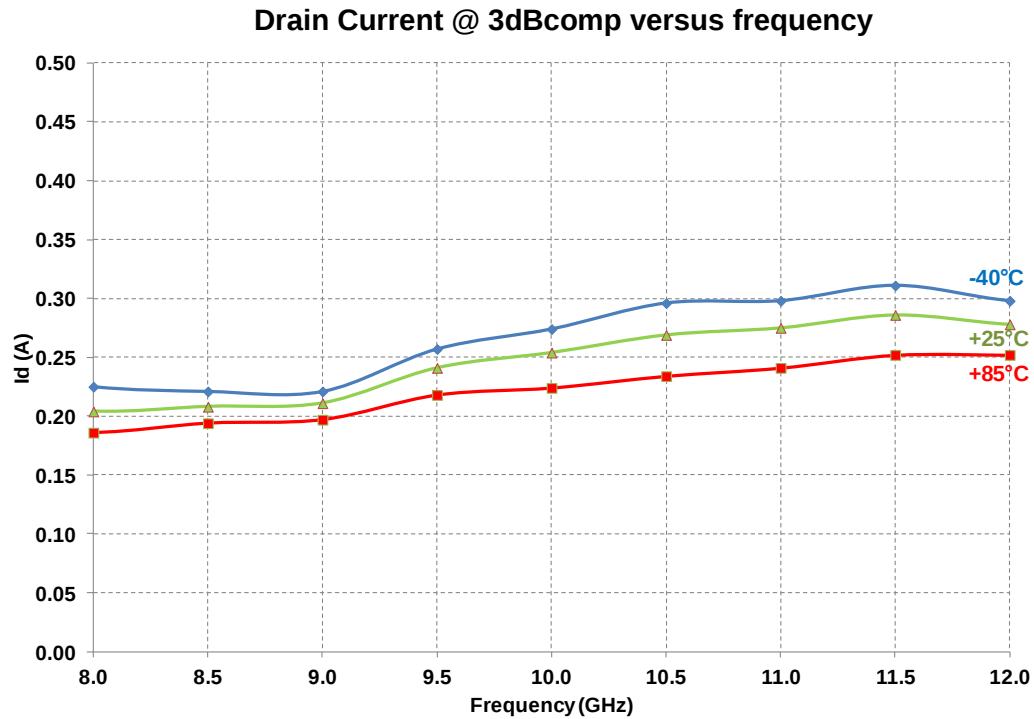
Vd =8V, Id (Quiescent) =190mA

Output Power @ 3dB comp versus frequency**Power added efficiency @ 3dBcomp versus frequency**

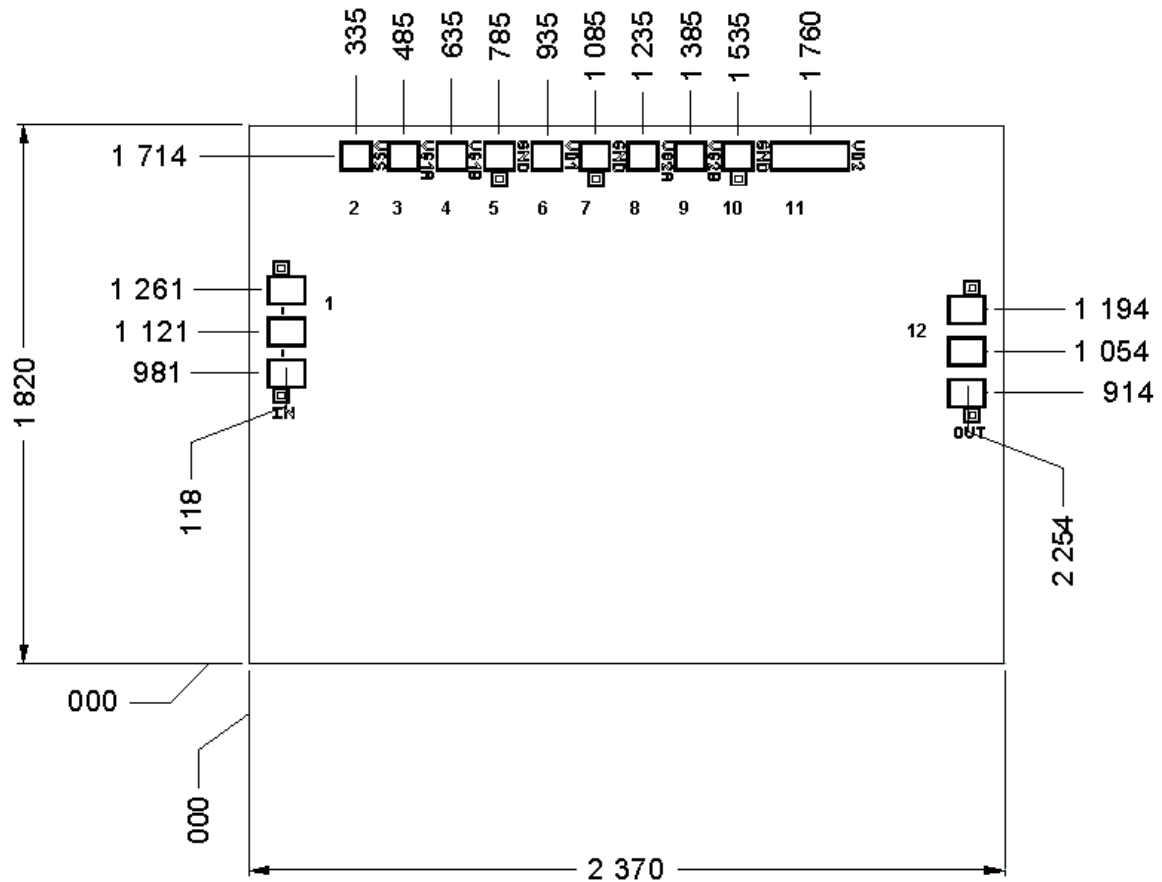
Typical on Jig Measurements (CW mode)

Tamb= -40°C/+25°C/+85°C;

Vd =8V, Id (Quiescent) =190mA



Mechanical data



All dimensions are in micrometers

Chip size = 1820x2370 $\pm$ 35 μ m

Chip thickness = 70 μ m $\pm$ 10 μ m

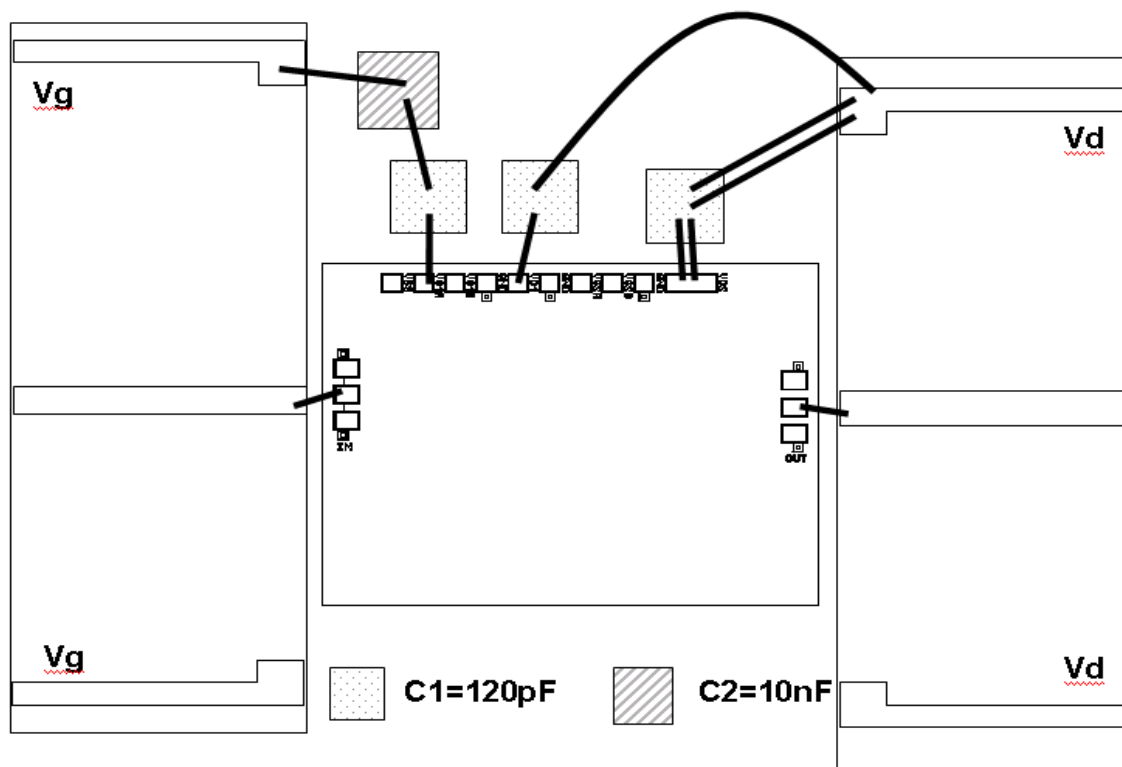
RF pads (1, 12) = 100 x 122 μ m²

DC pads (3, 6, 8, 11) = 100 x 100 μ m²

Chip width and length are given with a tolerance of $\pm$ 35 μ m

Pin number	Pin name	Description
1	IN	Input RF
2, 4, 8, 9	VSS, VG1B, VG2A, VG2B	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.

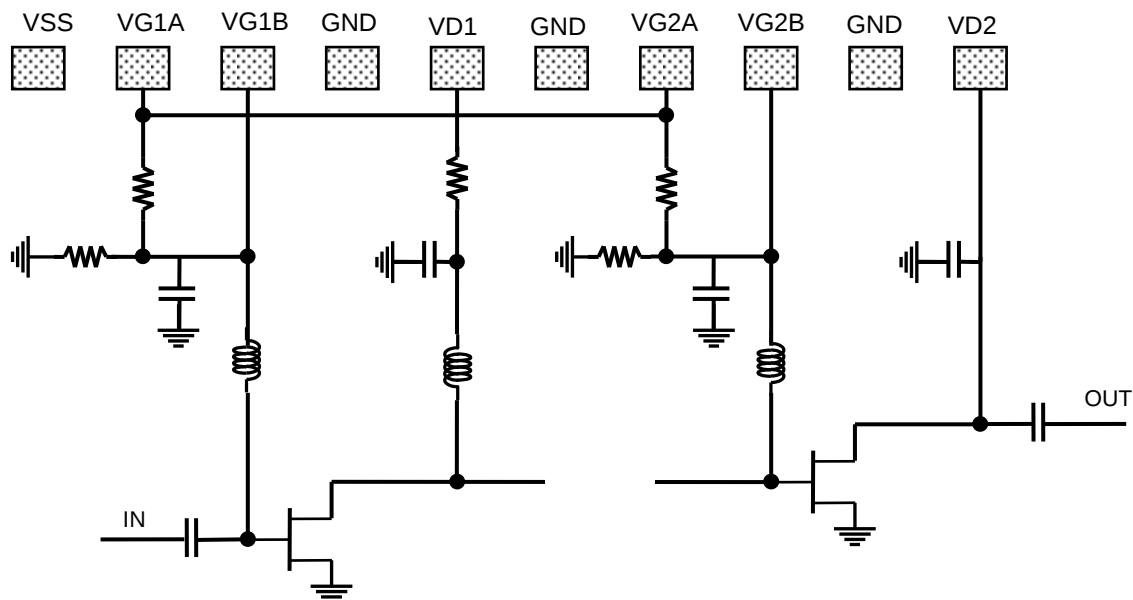
Equivalent RF Wire Bonding: 0.2nH (typical length of 200μm for a 25μm diameter wire).

Bonding recommendations

Port	Connection	External capacitor
IN	Inductance (L _{bonding}) = 0.3nH 1 gold wire with diameter of 25μm	
OUT	Inductance (L _{bonding}) = 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, 190mA



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:

CHA5115-99F/00

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