CHA2090-99F

17-24GHz Low Noise Amplifier

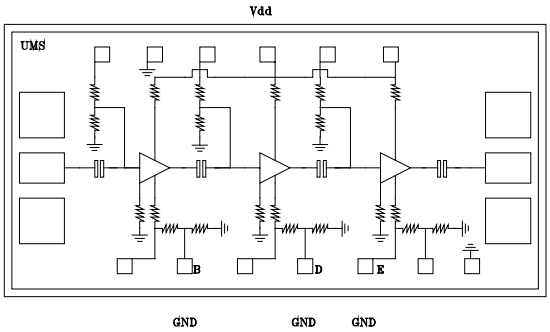
GaAs Monolithic Microwave IC

Description

The CHA2090-99F is a wide band Low Noise Monolithic Amplifier which integrates three amplification stages that produces 23dB gain associated to 2dB Noise Figure.

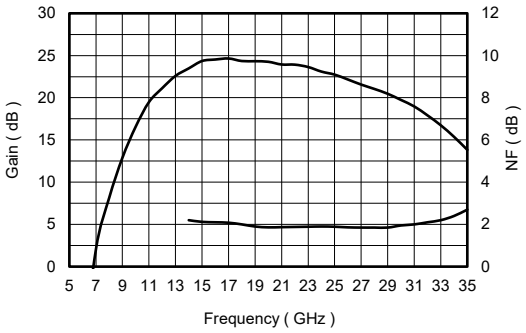
It is designed for a wide range of applications, from military to commercial communication systems. The circuit is manufactured with a pHEMT process.

It is available in chip form.



Main Features

- Broadband performance 17-24GHz
- 2.0dB Noise Figure
- 23dB gain, ± 1dB gain flatness
- Low DC power consumption, 55mA
- Chip size: 2.17 x 1.27 x 0.1mm



On wafer typical measurement

Main Characteristics

$T_{backside}$ = +25°C, Vd = 4.5V, Pads B,D,E = GND

Symbol	Parameter	Min	Typ	Max	Unit
Freq	Frequency range	17		24	GHz
Gain	Linear Gain	19	23		dB
NF	Noise Figure		2.0	3.0	dB
VSWRin	Input VSWR		2:1		
VSWRout	Output VSWR		2:1		

United Monolithic Semiconductors S.A.S.
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Specifications

$T_{backside}$ = +25°C, Vd = 4.5V, Pads B, D, E = GND

Symbol	Parameter	Min	Typ	Max	Unit
Freq	Frequency range	17		24	GHz
Gain	Linear Gain	19	23		dB
NF	Noise Figure		2.0	3.0	dB
P1dB	Output power at 1dB gain compression		10		dBm
VSWRin	Input VSWR(1)		2:1		
VSWRout	Output VSWR(1)		2:1		
Vd	Drain supply voltage(2)		4.5		V

(1) These values are representative of on-wafer measurements that are made without bonding wires at the RF ports. When the chip is attached with typical 0.15nH input and output bonding wires, the indicated parameter values should be improved.

(2) See chip biasing option page 9/10.

These values are representative of onboard measurements as defined on the drawing in paragraph "Evaluation board".

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Absolute Maximum Ratings (1)

$T_{backside}$ = 25°C

Symbol	Parameter	Values	Unit
Vd	Drain bias voltage	5.5	V
Pin	Maximum peak input power	+15	dBm
Tj	Maximum junction temperature	175	°C

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

Recommended Operating Range

Symbol	Parameter	Values	Unit
Vd	Drain bias voltage	4 to 5	V
Idq	Quiescent current	55	mA
Vg	Gate bias voltage	-3.0 to +0.10	V
Pin	Maximum peak input power	+6	dBm
Tj	Maximum junction temperature	175	°C

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Temperature Range

$T_{backside}$	Operating temperature range	-40 to +85	°C
Tstg	Storage temperature range	-55 to +150	°C

"Power ON" sequence

1. Bias LNA gate voltage at Vg close to Vpinch-off (Typically: Vg ≈ -3.0V)
2. Apply Vd bias voltage (Typically: Vd = 4.5V)
3. Increase gate voltage Vg up to quiescent bias drain current Idq
4. Apply RF signal

"Power OFF" sequence

1. Turn off RF signal
2. Bias LNA gate voltage at Vg close to Vpinch-off (Typically: Vg ≈ -3.0V)
3. Check that quiescent bias drain current Idq is close to 0mA
4. Turn Vd bias voltage to 0V
5. Check that quiescent bias drain current Idq is close to 0mA
6. Turn Vg bias voltage to 0V

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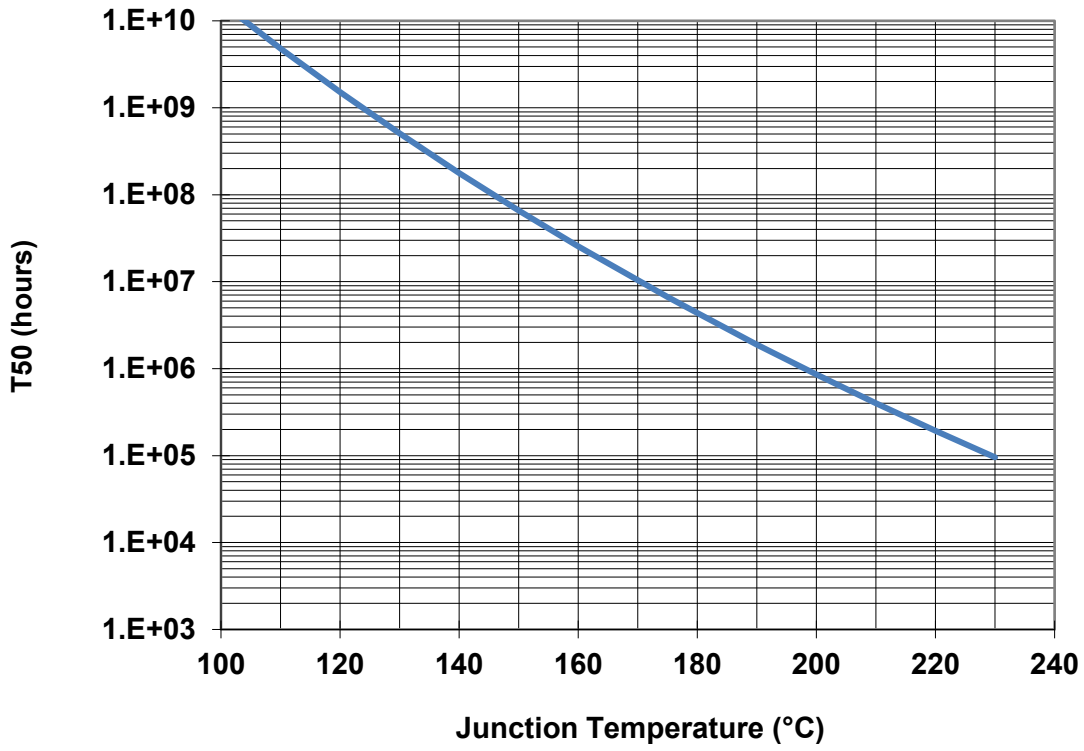
Device thermal performances

All the figures given in this section are obtained assuming that the chip device is only cooled down by conduction through the package thermal pad (no convection mode considered).
The temperature is monitored at the chip back-side interface ($T_{backside}$).
The system maximum temperature must be adjusted in order to guarantee that $T_{junction}$ remains below the maximum value specified in the Absolute Maximum Ratings table.
So, the system PCB must be designed to comply with this requirement.

Parameter	Biasing conditions	Tjunction (°C)	RTH (°C/W)	T50 (hours)
RTH (1) Thermal Resistance (Junction to Case)	Vd= 4.5V Idq= 55mA Pdiss= 0.2475W	116	130	4E+09

(1) Assuming 85°C $T_{backside}$



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Typical Scattering Parameters (on Wafer)

$T_{backside}$ = +25°C, Vd = 4.5V, Id = 55mA

Frequency	S11	PhS11	S12	PhS12	S21	PhS21	S22	PhS22
	mod	*pha*	*mod*	*pha*	*mod*	*pha*	*mod*	*pha*
GHz	dB	deg	dB	deg	dB	deg	dB	deg
1.000	-0.53	-20.8	-89.62	-92.0	-41.76	-148.5	-0.72	-23.8
2.000	-0.06	-39.0	-97.43	26.6	-48.17	170.5	-0.30	-50.3
3.000	-0.10	-58.5	-87.21	-23.0	-52.46	74.5	-0.33	-75.6
4.000	-0.16	-77.4	-84.87	-135.7	-61.22	154.8	-0.49	-101.9
5.000	-0.23	-96.5	-83.35	120.1	-35.86	-69.1	-0.89	-129.8
6.000	-0.34	-115.2	-66.23	84.2	-12.12	-123.6	-1.77	-159.0
7.000	-0.35	-134.1	-72.40	-58.1	1.34	145.9	-3.35	168.8
8.000	-0.45	-154.1	-73.93	-13.6	7.48	75.4	-6.63	141.1
9.000	-0.52	-175.4	-72.23	-7.1	11.96	18.3	-9.34	119.1
10.000	-0.75	160.3	-66.01	-34.2	15.54	-28.2	-13.97	85.5
11.000	-1.21	132.1	-60.26	-60.3	18.30	-72.2	-22.57	53.2
12.000	-2.33	97.8	-56.60	-94.9	19.92	-116.5	-39.69	-60.4
13.000	-4.60	57.2	-53.53	-135.9	21.36	-163.1	-30.19	-133.1
14.000	-8.86	8.5	-52.43	-173.4	22.49	149.3	-25.30	-127.8
15.000	-16.48	-40.4	-52.50	157.8	23.60	100.6	-21.56	-134.5
16.000	-24.70	-70.2	-52.26	135.4	23.89	62.2	-19.34	-144.1
17.000	**-27.75**	**-80.6**	**-52.62**	**108.9**	**24.01**	**28.4**	**-17.60**	**-158.0**
18.000	**-23.51**	**-87.4**	**-51.36**	**100.6**	**23.66**	**-1.9**	**-16.51**	**-172.3**
19.000	**-21.41**	**-95.7**	**-51.27**	**60.6**	**23.52**	**-30.5**	**-16.34**	**163.7**
20.000	**-18.63**	**-107.0**	**-54.07**	**52.8**	**23.46**	**-57.8**	**-17.75**	**149.6**
21.000	**-16.77**	**-115.6**	**-55.06**	**30.3**	**23.11**	**-84.4**	**-19.33**	**131.6**
22.000	**-14.95**	**-123.2**	**-57.35**	**23.7**	**23.14**	**-111.0**	**-22.26**	**113.9**
23.000	**-13.73**	**-132.0**	**-59.54**	**8.0**	**22.82**	**-137.3**	**-25.44**	**89.1**
24.000	**-12.59**	**-138.8**	**-60.85**	**32.3**	**22.36**	**-162.8**	**-29.95**	**43.8**
25.000	-11.60	-144.7	-62.07	49.5	22.01	171.8	-28.26	-24.5
26.000	-10.61	-149.8	-54.29	40.2	21.46	147.9	-22.90	-58.9
27.000	-9.34	-154.5	-55.03	23.9	20.91	125.0	-19.22	-84.3
28.000	-7.89	-160.6	-52.05	-11.6	20.49	102.3	-17.12	-102.6
29.000	-6.63	-171.3	-60.41	-22.1	20.06	78.5	-16.20	-114.2
30.000	-5.86	179.9	-56.56	23.2	19.50	55.4	-14.73	-123.1
31.000	-4.83	172.0	-52.73	-13.7	19.03	31.5	-13.72	-137.5
32.000	-3.95	161.7	-54.11	-40.7	18.31	6.9	-13.60	-147.0
33.000	-3.18	151.2	-54.59	-51.2	17.51	-17.5	-13.61	-155.8
34.000	-2.61	140.2	-55.15	-37.9	16.54	-42.3	-14.22	-161.4
35.000	-2.15	129.3	-51.68	-92.2	15.35	-66.8	-14.94	-161.8
36.000	-1.77	117.9	-57.64	-111.2	13.94	-91.0	-15.31	-154.5
37.000	-1.65	106.7	-60.87	-68.5	12.41	-114.4	-13.87	-143.9
38.000	-1.64	95.9	-53.10	-33.4	10.67	-137.5	-11.60	-140.4
39.000	-1.65	85.9	-47.45	-99.7	8.76	-159.6	-9.18	-143.5
40.000	-1.76	75.2	-46.80	-137.0	6.70	178.9	-7.06	-151.0

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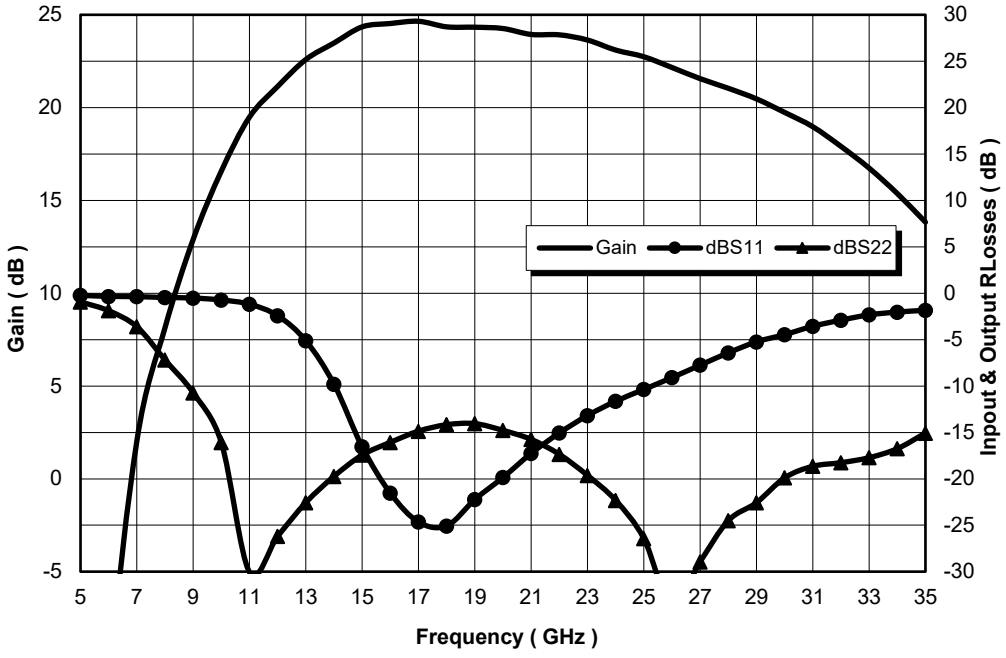
Typical on Wafer Measurements

$T_{backside}$ = +25°C, Vd = 4.5V, Id = 55mA

Gain & Noise Figure vs. Frequency



Gain & Input and Output Loss vs. Frequency

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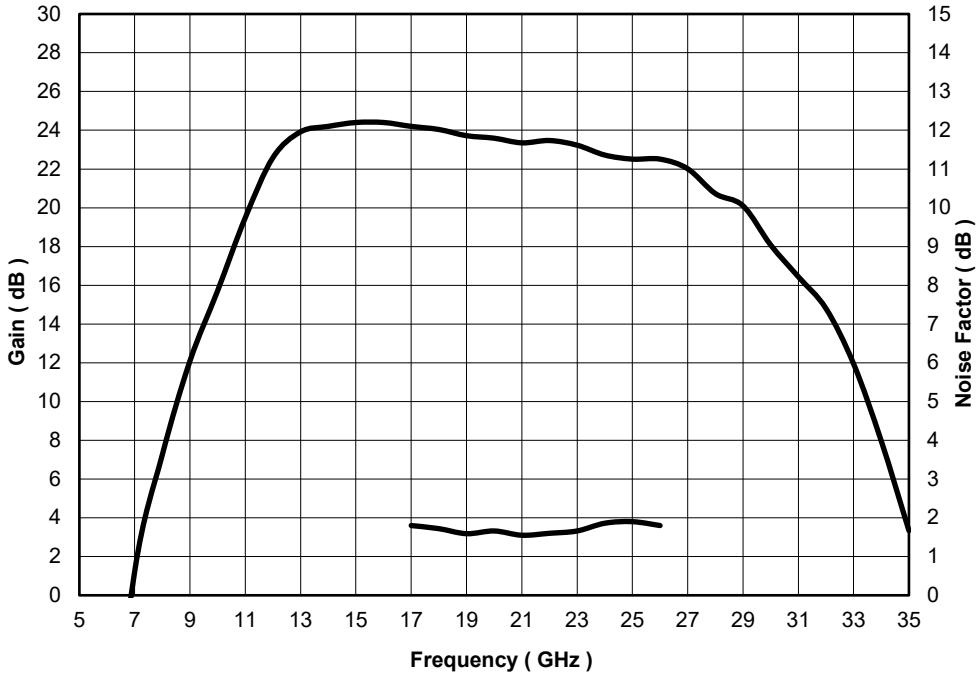
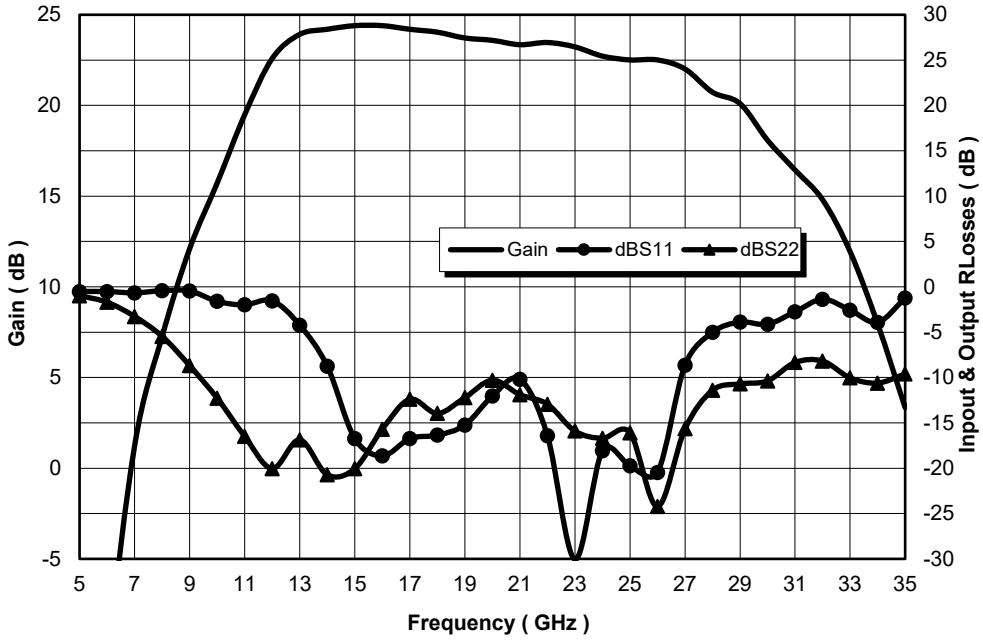
Typical on Evaluation Board Measurements

$T_{backside}$ = +25°C, Vd = 4.5V, Id = 55mA



Gain & Noise Figure vs. Frequency



Gain & Input and Output Loss vs. Frequency

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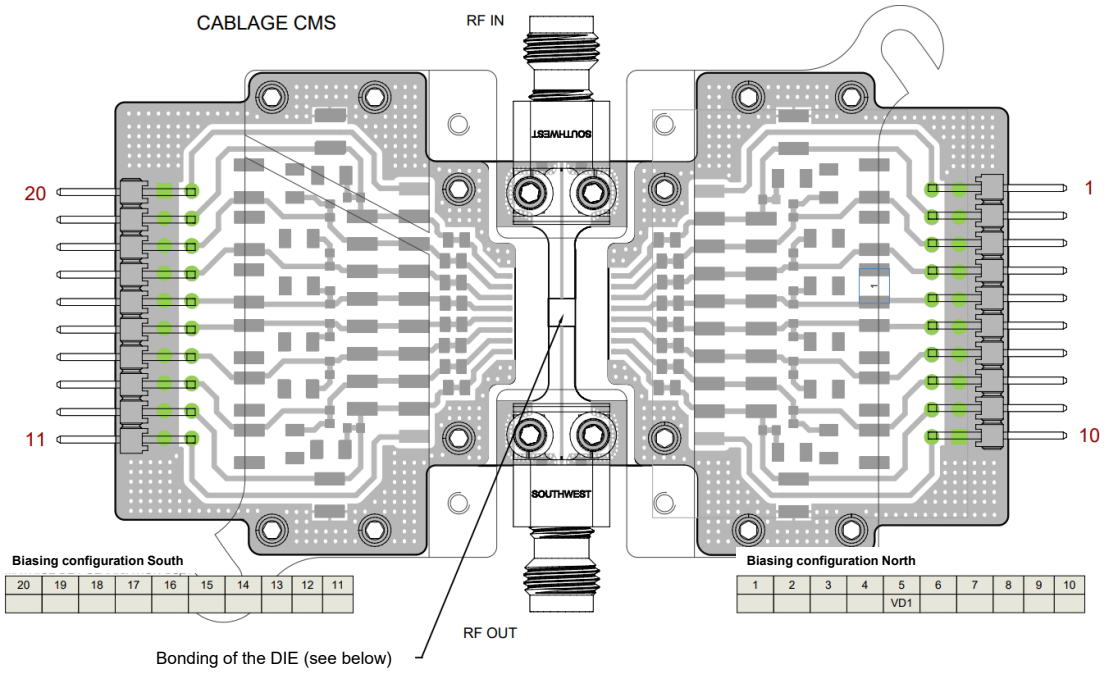
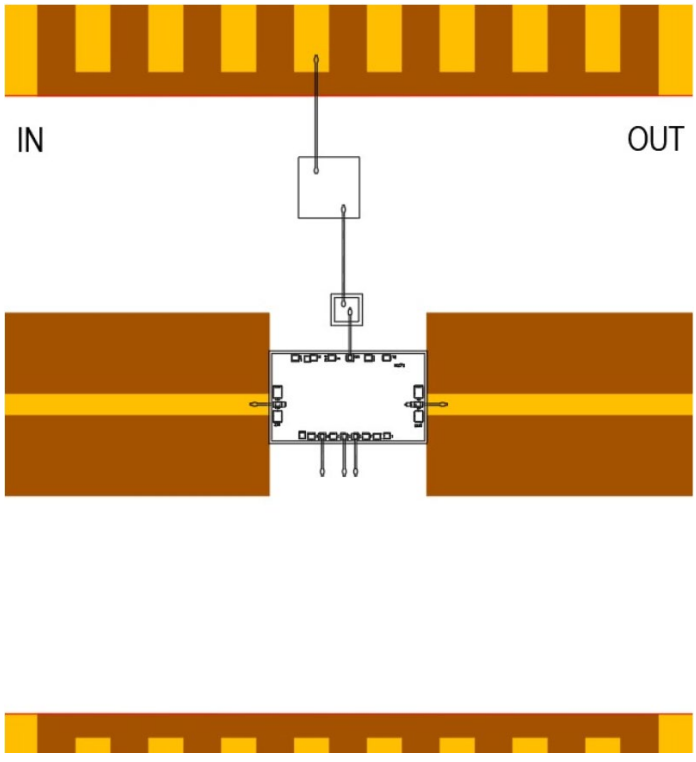
Evaluation board





See next page for recommended assembly plan

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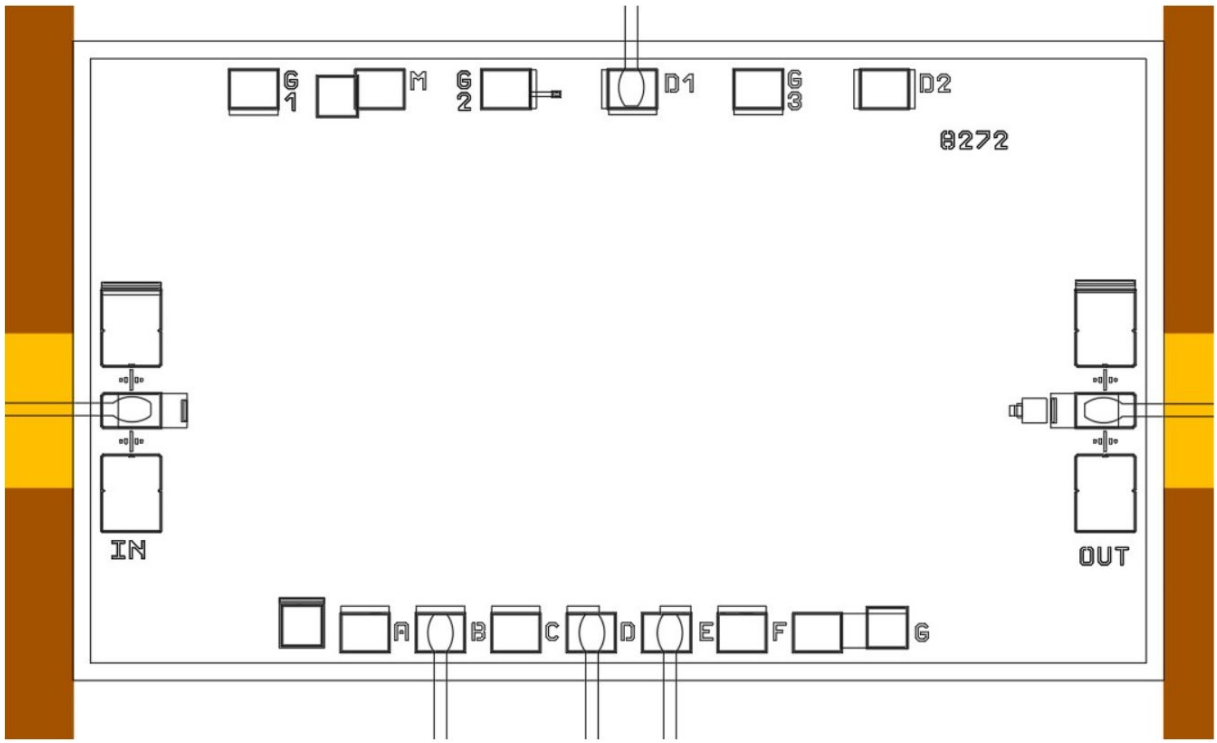
Recommended Assembly Plan (zoom in)



Three levels of decoupling capacitors are recommended. The first and second levels are composed of 120pF and 10nF chip capacitors, the third level is composed of 1µF SMD capacitors. The first level should be as close as possible to the die.
PADS B,D and E are grounded.

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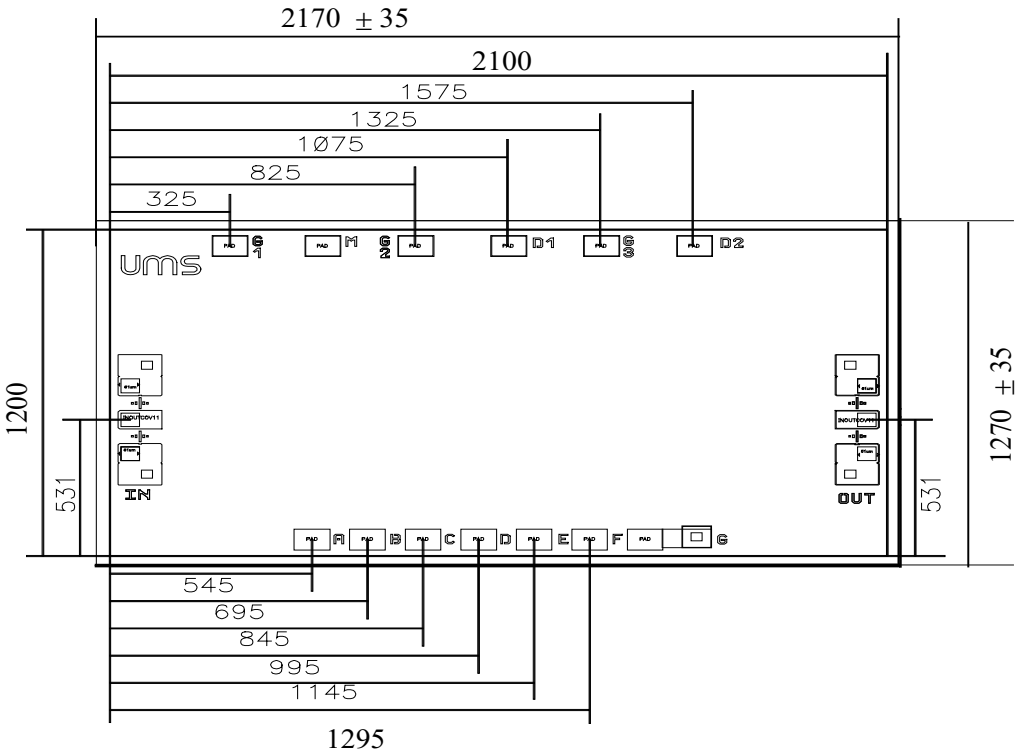
Mechanical Data



Bonding pad positions.
(Chip thickness: 100µm. Pad size: 100x80µm²)
(All dimensions are in micrometers)

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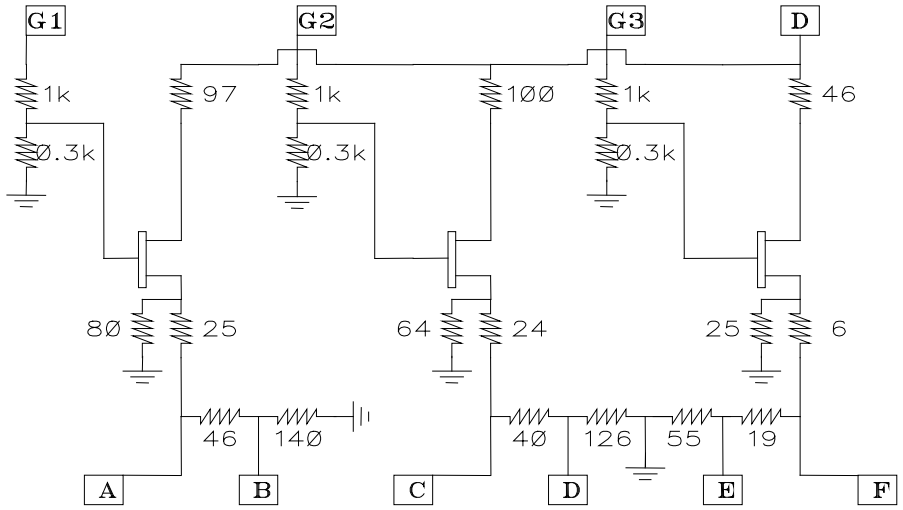
Chip Biasing Options

This chip is self-biased, and flexibility is provided by the access to number of pads. The internal DC electrical schematic is given in order to use these pads in a safe way.



The two requirements are:

- N°1: Not exceed Vds = 3.5V(internal Drain to Source voltage)
- N°2: Not biased in such a way that Vgs becomes positive (internal Gate to Source voltage)

Low Noise and low consumption biasing condition:

- Vd = 4.5V and B, D, E grounded
- All the other pads non connected (NC)
- Id = 55mA and Pout-1dB = 10dBm

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Note

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Recommended reflow process assembly

Refer to the application note AN0001 available at https://www.ums-rf.com for die attach.

Recommended ESD management

Refer to the application note AN0020 available at https://www.ums-rf.com for ESD sensitivity and handling recommendations.

Recommended Evaluation board assembly

Refer to the application note AN0030 available at https://www.ums-rf.com Evaluation board.

Ordering Information

Die form	CHA2090-99F/00
Evaluation board	EVB-CHA2090-99F

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