

## 20-30GHz Low Noise Amplifier

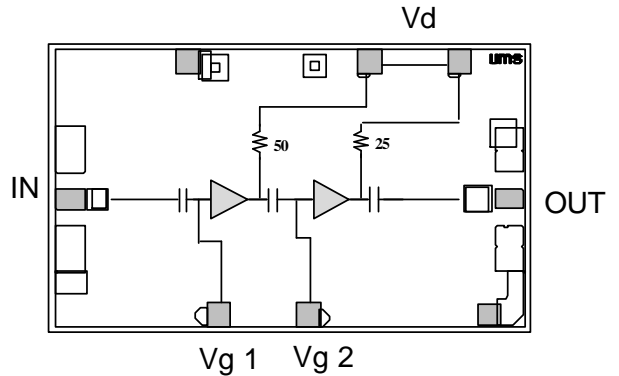
### GaAs Monolithic Microwave IC

#### Description

The CHA2093 is a two-stage wide band monolithic low noise amplifier.

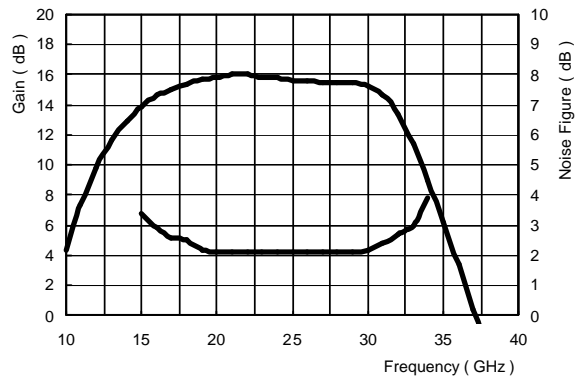
The circuit is manufactured with a standard HEMT process : 0.25 $\mu$ m gate length, via holes through the substrate, air bridges and electron beam gate lithography.

It is supplied in chip form.



#### Main Features

- | Broad band performance 20-30GHz
- | 2.2dB noise figure, 20-30GHz
- | 15dB gain,  $\pm 0.5$ dB gain flatness
- | Low DC power consumption, 50mA
- | 20dBm 3rd order intercept point
- | Chip size : 1.67 x 1.03 x 0.1mm



*On wafer typical measurements.*

#### Main Characteristics

Tamb = +25°C

Symbol	Parameter	Min	Typ	Max	Unit
NF	Noise figure, 20-30GHz		2.2	3.0	dB
G	Gain	13	15		dB
$\Delta$ G	Gain flatness		$\pm 0.5$	$\pm 1.0$	dB

ESD Protections : Electrostatic discharge sensitive device observe handling precautions !

## Electrical Characteristics

Tamb = +25°C, Vd = +4V Id=45mA

Symbol	Parameter	Min	Typ	Max	Unit
Fop	Operating frequency range	20		30	Ghz
G	Gain (1)	13	15		dB
ΔG	Gain flatness (1)		± 0.5	± 1.0	dB
NF	Noise figure (1)		2.2	3.0	dB
VSWRin	Input VSWR (1)			3.0:1	
VSWRout	Ouput VSWR (1)			3.0:1	
IP3	3rd order intercept point		20		dBm
P1dB	Output power at 1dB gain compression		13		dBm
Id	Drain bias current		50		mA

(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.

## Absolute Maximum Ratings (1)

Tamb = +25°C

Symbol	Parameter	Values	Unit
Vd	Drain bias voltage	5.0	V
Pin	Maximum peak input power overdrive (2)	+10	dBm
Top	Operating temperature range	-40 to +85	°C
Tstg	Storage temperature range	-55 to +125	°C

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

(2) Duration < 1s.

## Typical Results

### Chip Typical Response ( On wafer Sij ) :

Tamb = +25°C

Bias Conditions : Vd = +4V Id=45mA

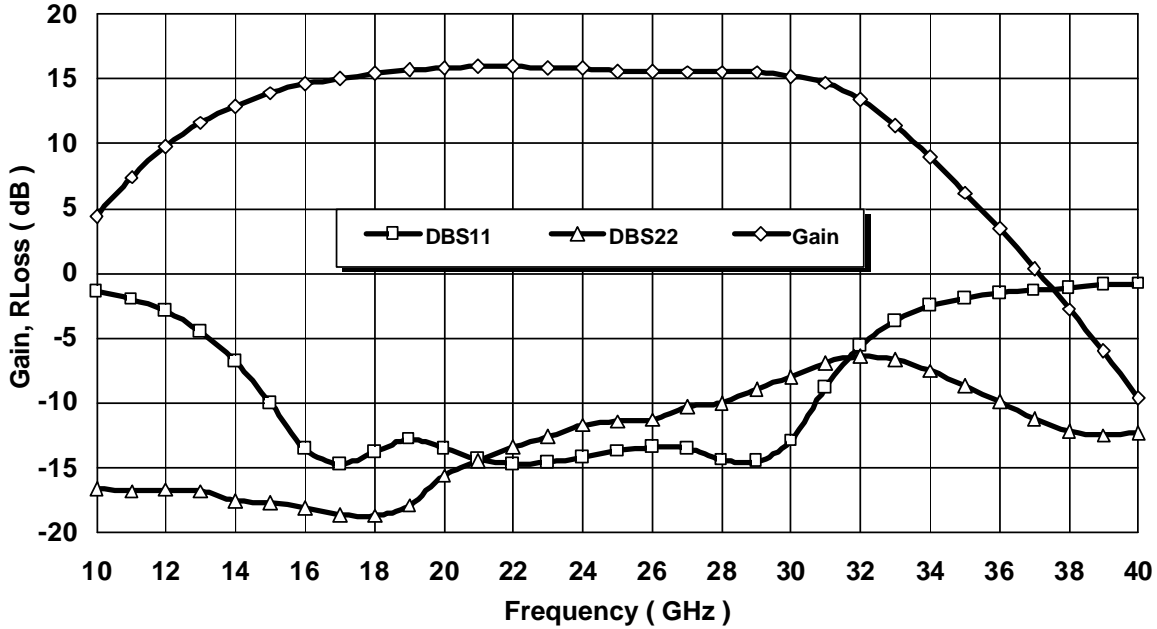
Freq GHz	MS11 dB	PS11 °	MS12 dB	PS12 °	MS21 dB	PS21 °	MS22 dB	PS22 °
10	-1.36	140	-62.29	-138.5	4.35	51.6	-16.6	151.6
11	-1.98	121.9	-58.39	-130.1	7.36	27.2	-16.75	145.1
12	-2.93	101.1	-53.05	-130.3	9.77	0.8	-16.67	137.9
13	-4.5	77.7	-49.08	-146.8	11.61	-26.2	-16.77	129.8
14	-6.8	50.1	-46.97	-163.9	12.9	-53.2	-17.47	122.7
15	-10.02	16.4	-44.52	173.2	13.86	-78.7	-17.67	122.2
16	-13.47	-30	-42.23	160.2	14.55	-103.5	-18.06	118.4
17	-14.68	-86	-40.43	138.2	15	-127	-18.55	118.4
18	-13.76	-131	-39.41	126.2	15.36	-149.8	-18.7	125.4
19	-12.83	-159.2	-38	104.7	15.69	-171.8	-17.9	131.3
20	-13.51	177.8	-36.01	92.4	15.79	165.6	-15.62	131.1
21	-14.3	170.9	-34.99	63.7	15.96	144.3	-14.48	127
22	-14.74	167.2	-34.53	46.8	15.98	122.3	-13.4	120.5
23	-14.63	168	-34.46	24.6	15.84	102.1	-12.6	116.3
24	-14.15	163.4	-33.67	6.3	15.75	80.9	-11.67	107.1
25	-13.71	155.8	-33.27	-7.6	15.6	60.2	-11.4	100.6
26	-13.42	145.5	-32.65	-29.3	15.55	40.3	-11.3	96.1
27	-13.54	124.4	-32.6	-51.5	15.46	18.6	-10.33	91.6
28	-14.43	100.2	-32.49	-68.3	15.48	-2.8	-9.98	85.7
29	-14.48	56.9	-31.69	-88.8	15.48	-27.3	-8.88	80.2
30	-12.87	5.6	-31.87	-115.7	15.24	-53	-7.99	70.5
31	-8.84	-37.4	-31.22	-140.4	14.69	-82.2	-6.86	58.1
32	-5.55	-73.3	-31.23	-171	13.43	-112.8	-6.35	40.1
33	-3.72	-101.3	-32.96	159.7	11.43	-141.9	-6.69	20.4
34	-2.5	-123.2	-34.73	134.8	9.01	-168.7	-7.51	1.5
35	-1.88	-141.2	-35.69	121.6	6.2	167.5	-8.65	-17
36	-1.52	-155.7	-35.69	98	3.35	145.9	-9.92	-36.6
37	-1.32	-167.5	-37.95	72.2	0.36	125.7	-11.17	-56.5
38	-1.07	-177.6	-38.15	56.8	-2.78	107.4	-12.15	-78.9
39	-0.93	172.6	-43.41	86.9	-6.02	89	-12.5	-103.1
40	-0.82	164.7	-43.1	76.9	-9.59	71.9	-12.27	-127.3
41	-0.68	157.2	-43.1	44.4	-13.6	55.3	-11.82	-148.5
42	-0.52	149.5	-43.23	39.6	-18.24	40.2	-10.89	-166.3
43	-0.5	142	-44.08	24	-24.6	27.2	-9.87	-179.6
44	-0.41	135.3	-45.8	21	-35.19	30.1	-8.91	167.4
45	-0.37	128.4	-45.05	18.1	-37.14	126.8	-8.04	156.2

Typical Results

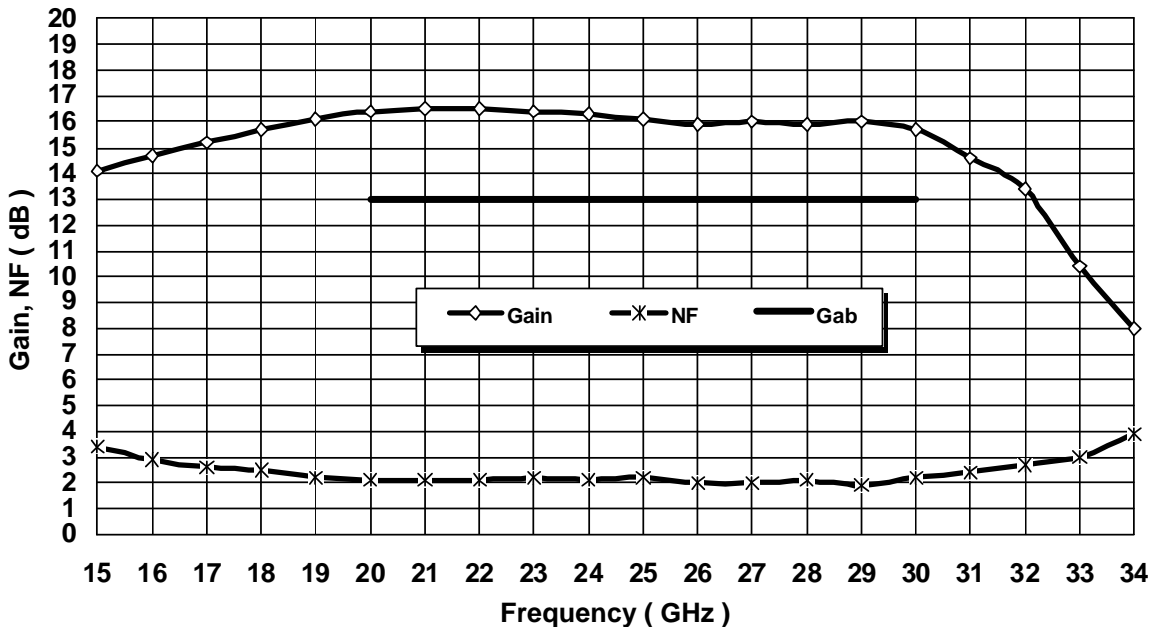
Chip Typical Response ( On wafer Sij ) :

Tamb = +25°C

Vd = 4V ; Id = 45mA



Typical Gain and Matching measurements on wafer.

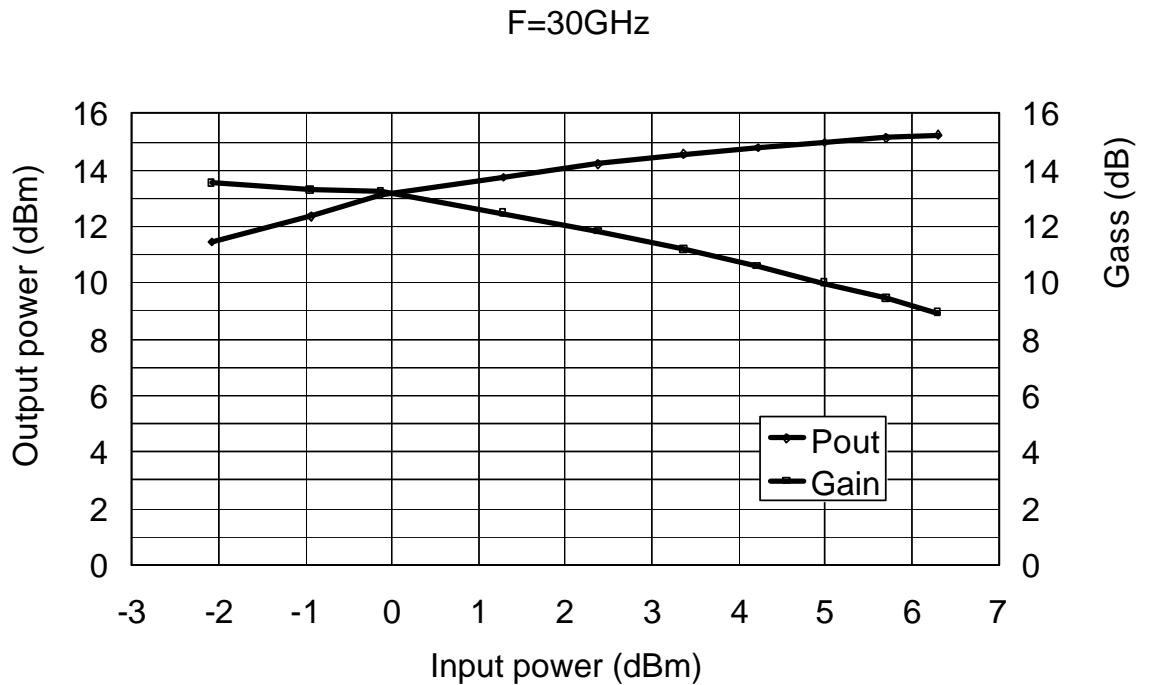
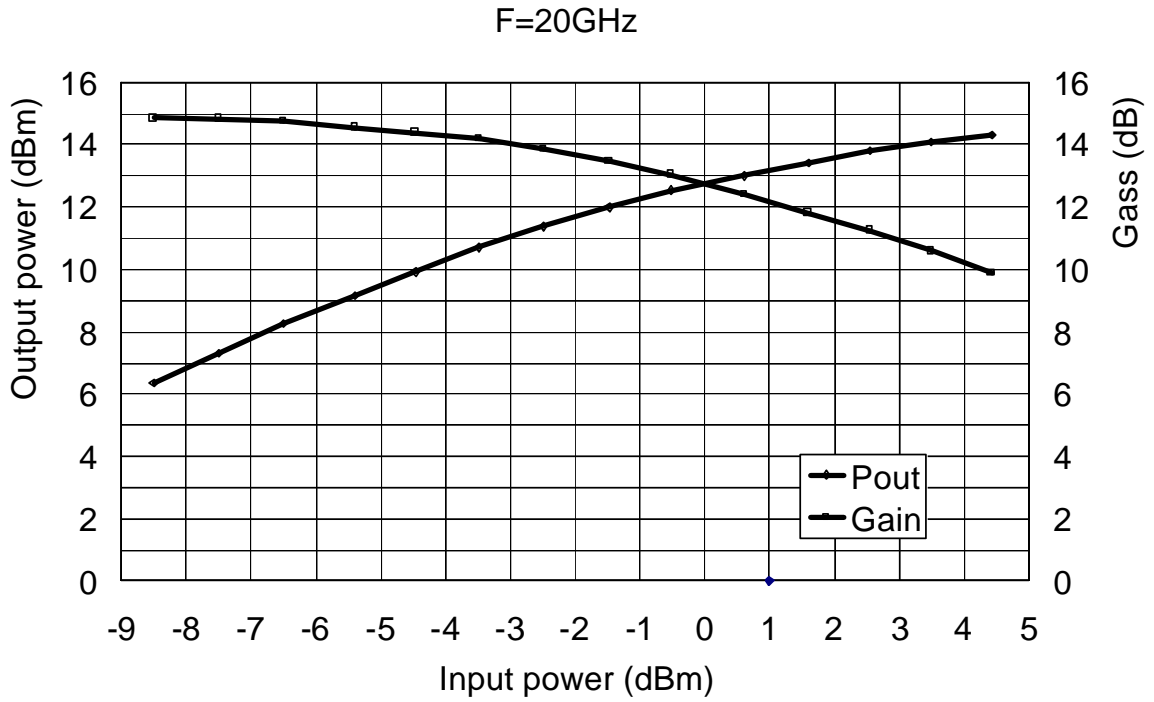


Typical Gain and Noise Figure measurements on wafer.

**Typical Results**

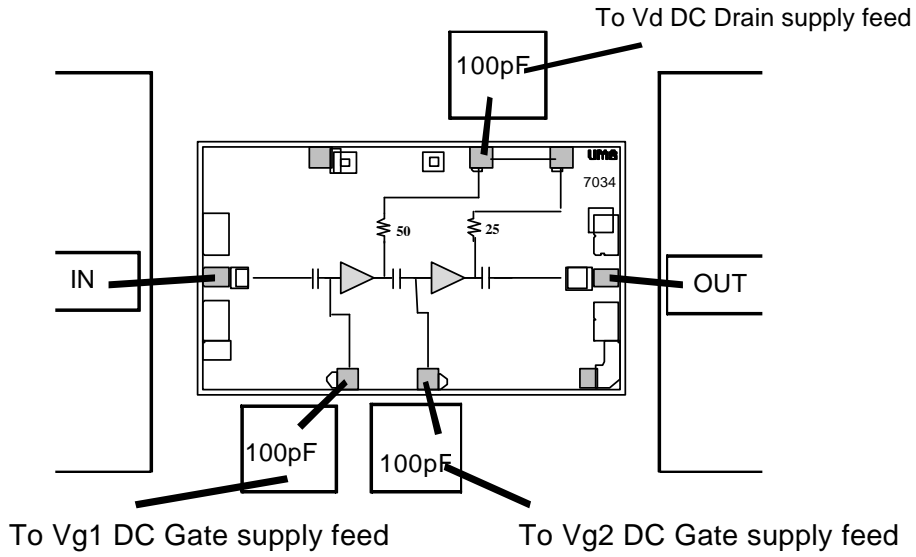
Tamb = +25°C

Vd = 4V ; Id = 45mA

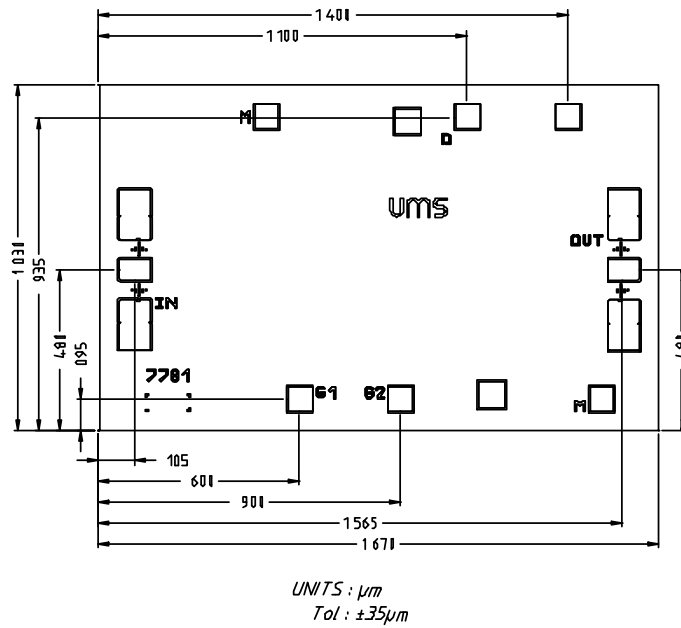


**Typical Output Power and Gain measurements in test jig  
(included losses of the jig)**

Typical Chip Assembly

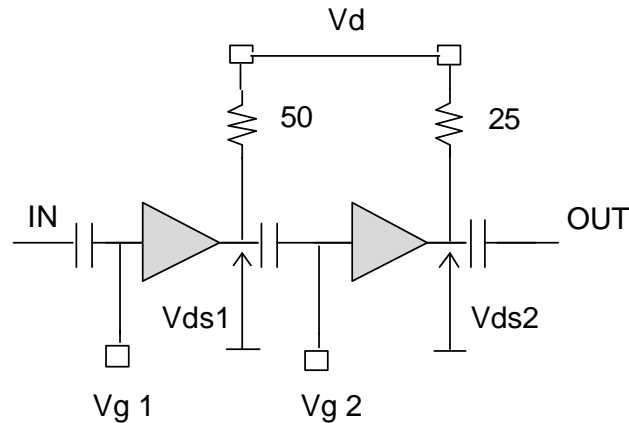


Mechanical data



## Chip Biasing

This chip is a two stage amplifier, 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  $V_{ds} = 3.5V$  ( internal Drain to Source voltage ).
- N°2 : Not biased in such a way that  $V_{gs}$  becomes positive.  
( internal Gate to Source voltage )

We propose two standard biasing :

Low Noise and low consumption :  $V_d = 3.5V$  and  $I_d = 30mA$  (  $V_{g1}=V_{g2}$  )

Low Noise and high output power :  $V_d = 4.0V$  and  $I_d = 45mA$ . A separate access to the gate voltages of the first and the output stage is provided. Nominal bias is obtained for a typical current of 30mA for the output stage and 15 mA for the first stage. The first step to bias the amplifier is to tune the  $V_{g1} = -1V$  and  $V_{g2}$  to drive 30mA for the full amplifier. Then  $V_{g1}$  is reduced to obtain 45 mA of current through the amplifier.

## Ordering Information

Chip form :           CHA2093-99F/00

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