

## 20-33GHz Medium Power Amplifier

### GaAs Monolithic Microwave IC

#### Description

The CHA3092 is a high gain broadband four-stage monolithic medium power amplifier. It is designed for a wide range of applications, from military to commercial communication systems. The backside of the chip is both RF and DC grounds. This helps simplify the assembly process.

A B.I.T. ( Build In Test ) monitors a DC voltage that is representative of the microwave output power.

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

It is available in chip form.

#### Main Features

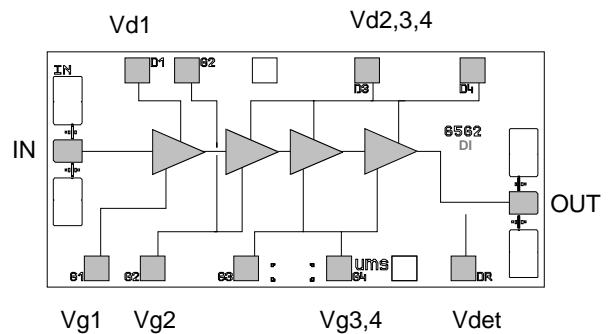
- Broadband performances : 20-33GHz
- 20dBm output power.
- 22dB  $\pm$ 1.0dB gain
- Very good broadband input matching
- On chip output power level DC detector
- Low DC power consumption, 300mA @ 3.5V
- Chip size : 0.88 X 1.72 X 0.10 mm

#### Main Characteristics

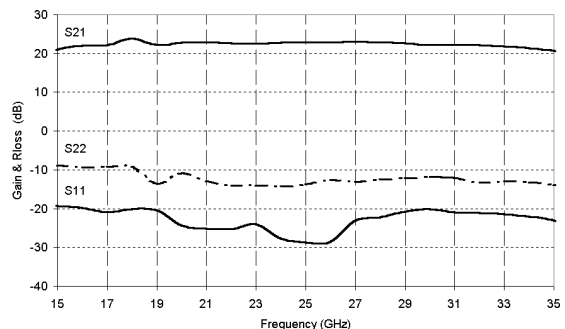
Tamb. = 25°C

Symbol	Parameter	Min	Typ	Max	Unit
Fop	Operating frequency range	20		33	GHz
G	Small signal gain	20	22		dB
P03	Output power at 3dB gain compression	20	23		dBm
Id_small signal	Bias current		300	400	mA

ESD Protection : Electrostatic discharge sensitive device. Observe handling precautions !



Typical on wafer measurements :



Input Rloss : solid line & output Rloss : dash line.

## Electrical Characteristics for Broadband Operation

Tamb = +25°C, Vd1,2,3,4 = 3.5V recommended

Symbol	Parameter	Min	Typ	Max	Unit
Fop	Operating frequency range (1)	20		33	GHz
G	Small signal gain (1)	20	22		dB
ΔG	Small signal gain flatness (1)		±1.0		dB
Is	Reverse isolation (1)		50		dB
P1dB	Pulsed output power at 1dB compression (1)	18	20		dBm
P03	Output power at 3dB gain compression	20	23		dBm
IP3	3 <sup>rd</sup> order intercept point		29		dBm
PAE	Power added efficiency at saturation		10		%
VSWRin	Input VSWR (1)			2.0:1	
VSWRout	Output VSWR (1)			3.0:1	
NF	Noise figure			10.0	dB
Vdet	Detected voltage: at 26GHz @ Pout=20dBm (2)		1		V
Id_small signal	Bias current		300	400	mA

(1) These values are representative for pulsed on-wafer measurements that are made without bonding wires at the RF ports. In the case of a jig or a module CW mode operation, the typical output power may be around 2dB less.

(2) Voltage across an external 10kOhm parallel resistor connected to the voltage detector pad.

## Absolute Maximum Ratings

Tamb. = 25°C (1)

Symbol	Parameter	Values	Unit
Vds	Drain bias voltage_small signal (2)	4.0	V
Ids	Drain bias current_small signal	400	mA
Vgs	Gate bias voltage	-2 to +0.4	V
Vdg	Negative Drain Gate voltage (= Vds – Vgs)	+5	V
Pin	Maximum continuous input power (2) Maximum peak input power overdrive (3)	+4 +15	dBm dBm
Ta	Operating temperature range	-40 to +85	°C
Tstg	Storage temperature range	-55 to +155	°C

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

(2) 3.5V recommended for up to a max of 3dB gain compression.

(3) Duration < 1s.

**Typical Scattering Parameters ( On wafer Sij measurements )**

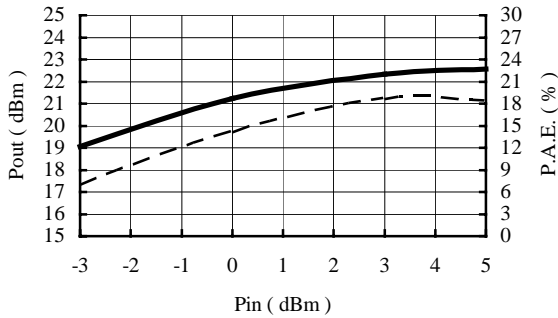
Bias Conditions : Vd1,2,3,4 = 3.5 Volt, Vg1,2,3,4 = -0.15 Volt, Id = 300 mA.

Freq. GHz	S11 dB	S11 /°	S12 dB	S12 /°	S21 dB	S21 /°	S22 dB	S22 /°
10	-17.1	134.5	-62.3	-143	4.8	144.2	-5.2	-173.7
11	-17.6	138.2	-62.8	137	9	112.4	-6.3	179.4
12	-18.1	140.3	-78.5	-31	13	78.1	-7.3	173.5
13	-18.9	138	-59.9	157.3	16.5	41.6	-8.2	168.7
14	-19	141.5	-62.4	126.9	19.1	2.9	-9.1	170.5
15	-19.2	138	-65.1	-160.1	21.1	-35.2	-8.7	171.3
16	-19.8	137.8	-64.3	157.5	22.1	-74.3	-9.3	165.6
17	-20.9	138.8	-60.3	-178.9	22.3	-110.1	-9.2	162.4
18	-20.1	146.2	-67.6	138.4	23.9	-137	-9.1	145.5
19	-20.4	131.7	-54.2	100.1	22.3	-175.3	-13.6	161.1
20	-24.3	126.9	-58.8	3.5	22.8	163.8	-10.9	154.2
21	-25.1	144.6	-62.5	-138.8	22.8	134.4	-12.7	148.6
22	-25.2	148	-60.5	156	22.7	109.3	-14	155.7
23	-24	157.7	-55.6	142.2	22.6	87.4	-13.9	154.7
24	-27.7	157.3	-63.7	135.9	22.9	61.6	-14.3	160.8
25	-28.7	-178.8	-57.1	126.6	22.8	36.7	-13.8	170.2
26	-28.5	-161.1	-55.7	96.9	22.9	15.5	-12.6	167.1
27	-23	-151.3	-66	72.7	23	-10.2	-13.1	161.9
28	-22.1	-157.5	-59.1	125.1	22.8	-33.6	-12.5	162.5
29	-20.7	-167.6	-56.6	85.1	22.7	-57.2	-12.1	158.2
30	-20	-175.2	-57	106.5	22.3	-80.4	-11.8	149.7
31	-20.8	171.5	-57	97.8	22.2	-101.9	-11.9	144.9
32	-21.1	168	-52	77.7	22.2	-125.3	-13.2	130.1
33	-21.3	166.5	-52.5	62.7	21.9	-150.2	-13	134.1
34	-22	155.6	-51.2	75	21.4	-174.1	-13.1	124
35	-23	140.2	-52.7	76.7	20.8	164.1	-13.8	113.6

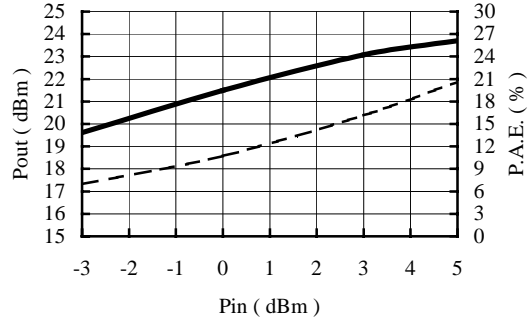
## Typical On wafer Power Measurements

Bias Conditions :  $V_{d1,2,3,4} = 3.5$  Volt,  $V_{g1,2,3,4} = -0.15$  Volt,  $I_d = 300$  mA.

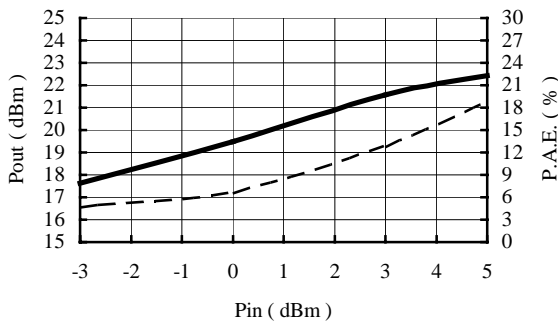
On wafer Pin / Pout at 20 GHz



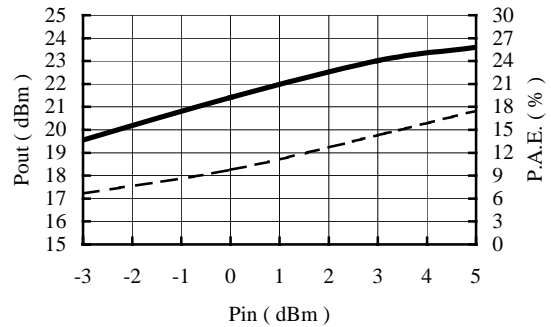
On wafer Pin / Pout at 26 GHz



On wafer Pin / Pout at 22 GHz



On wafer Pin / Pout at 28 GHz

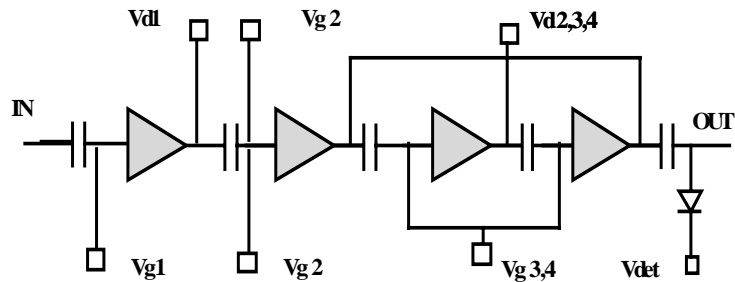


### Notes :

- 1- Test conditions :  
 $V_{d1,2,3,4} = 3.5$  Volt,  $V_{g1,2,3,4} = -0.15$  Volt.
- 2- Power measurements are typical ( solid lines ).  
P.A.E. is representative of on wafer measurements on a typical circuit ( Dotted lines ).

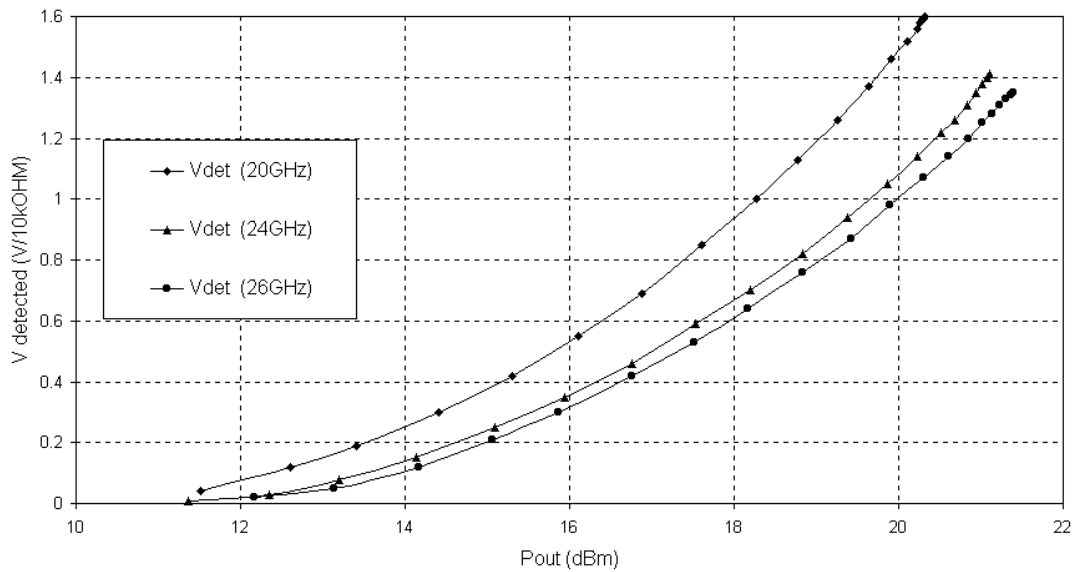
### Typical Bias Tuning

The circuit schematic is given below :



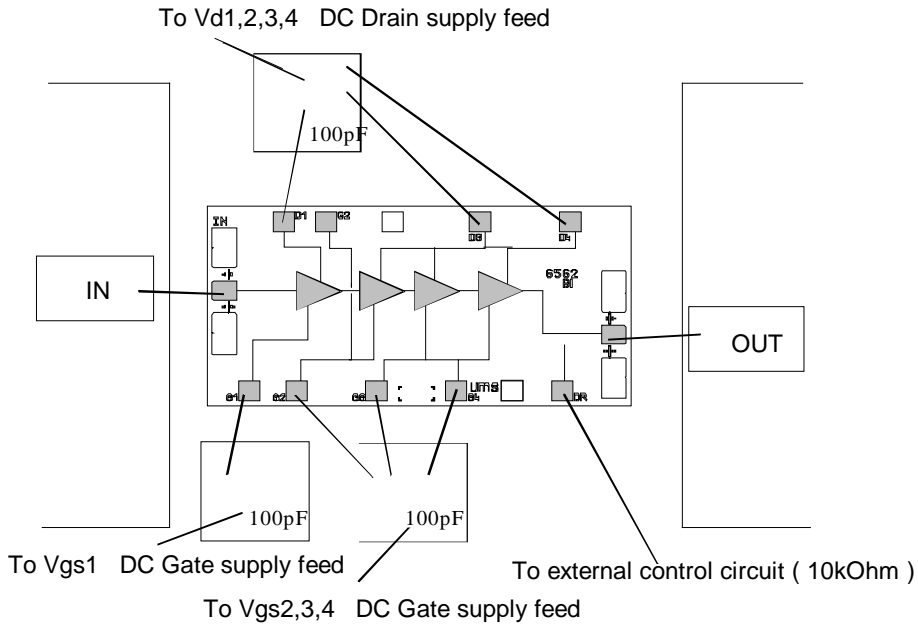
For medium power operation, the four drain biases are connected altogether. In a same way, all the gate biases are connected together at the same power supply, tuned to drive a small signal operating current of 300mA. A separate access to the gate voltages of the two first stages ( Vg1,2 ) is provided in order to be able to tune the first stages for the application, as a lower noise amplifier or a multiplier. An additional pad is provided for monitoring the output power, using the Build In Test. This access, when connected to an external resistor of 10 kOhm ( typical value ) provides a DC voltage which follows the output power level.

Note : In order to minimize the chip to chip performance spread, it is recommended to bias the chip at fixed drain current Id rather than at fixed Vg voltage.  
 In addition, to prevent unwanted self-biasing of the gates under gain compression, it is preferable to minimize as much as possible the source resistance of the Vg power supply.

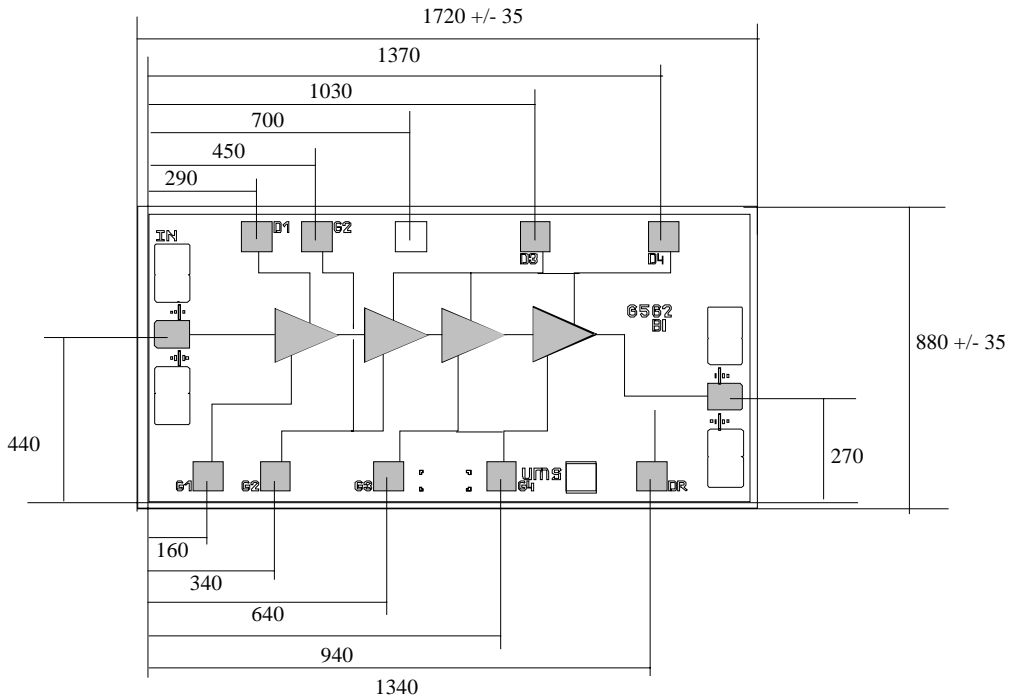


Typical Test Jig Measurements versus Output Power

Chip Assembly and Mechanical Data



Note : Supply feed should be capacitively bypassed. 25µm diameter gold wire is recommended.



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

## Ordering Information

Chip form : CHA3092-99F/00

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