

## 20-40GHz Medium Power Amplifier

### GaAs Monolithic Microwave IC

#### Description

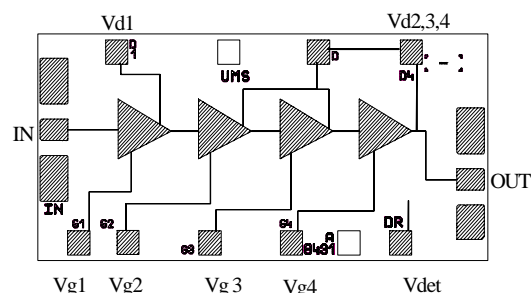
The CHA3093c is a high gain broadband four-stage monolithic medium power amplifier. It is designed for a wide range of applications, from military to commercial communication systems. The backside of the chip is both RF and DC grounded. This helps simplify the assembly process.

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

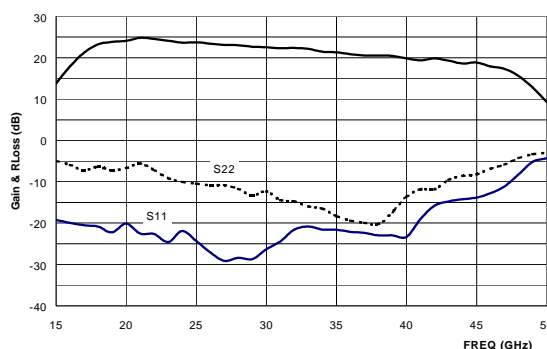
The circuit is manufactured with a PM-HEMT process, 0.15µm gate length, via holes through the substrate, air bridges and electron beam gate lithography. It is available in chip form.

#### Main Features

- Broadband performances : 20-40GHz
- 20dBm output power.
- 22dB gain
- Very good broadband input matching
- On chip output power level DC detector
- Low DC power consumption, 330mA @ 3.5V
- Chip size : 0.83 X 1.72 X 0.10 mm



Typical on wafer measurements :



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

#### Main Characteristics

Tamb. = 25°C

	Parameter	Min	Typ	Max	Unit
Fop	Operating frequency range	20		40	GHz
G	Small signal gain	18	20		dB
P03	Output power at 3dB gain compression	20	22		dBm
Id	Bias current		330	400	mA

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

**Electrical Characteristics for Broadband Operation**T<sub>amb</sub> = +25°C, V<sub>d1,2,3,4</sub> = 3.5V I<sub>d</sub>=330mA

Symbol	Parameter	Min	Typ	Max	Unit
F <sub>op</sub>	Operating frequency range (1)	20		40	GHz
G	Small signal gain [ 20GHz to 35GHz](1)	20	22		dB
G	Small signal gain (1)	18			dB
ΔG	Small signal gain flatness (1) (Any 1GHz BW)		±0.5		dB
I <sub>s</sub>	Reverse isolation (1)		50		dB
P <sub>1dB</sub>	Pulsed output power at 1dB gain compression (1)	18	20		dBm
P <sub>3dB</sub>	Pulsed output power at 3dB gain compression (1)	20	22		dBm
IP <sub>3</sub>	3 <sup>rd</sup> order intercept point		29		dBm
PAE	Power added efficiency at saturation		10		%
V <sub>SWRin</sub>	Input VSWR (1)		1.2:1	2.0:1	
V <sub>SWRout</sub>	Output VSWR (1)		2.0:1	3.0:1	
NF	Noise figure		8.0	10.0	dB
V <sub>det</sub>	Detected voltage : at 25GHz @ P <sub>out</sub> =20dBm (2) Detected voltage : at 38GHz @ P <sub>out</sub> =20dBm (2)		0.65 0.45		V V
I <sub>d</sub>	Bias current (small signal)		330	400	mA

(1) These values are representative for pulsed on-wafer measurements that are made without bonding wires at the RF ports.

(2) 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 (1)**

Symbol	Parameter	Values	Unit
V <sub>ds</sub>	Drain bias voltage_small signal (2)	4.0	V
I <sub>ds</sub>	Drain bias current_small signal	470	mA
V <sub>gs</sub>	Gate bias voltage	-2 to +0.4	V
V <sub>dg</sub>	Drain Gate voltage (V <sub>ds</sub> – V <sub>gs</sub> )	+5	V
P <sub>in</sub>	Maximum continuous input power (2) Maximum peak input power overdrive (3)	+4 (@ 20GHz) -1 (@ 40GHz) +15	dBm dBm
T <sub>a</sub>	Operating temperature range	-40 to +85	°C
T <sub>stg</sub>	Storage temperature range	-55 to +125	°C

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

(2) Duration &lt; 1s.

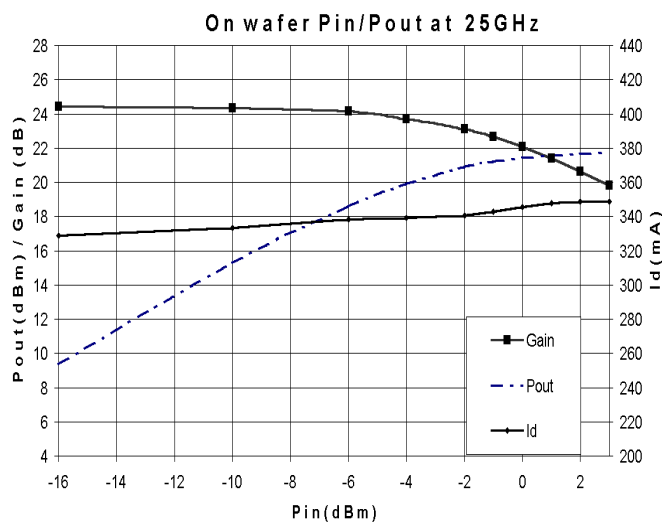
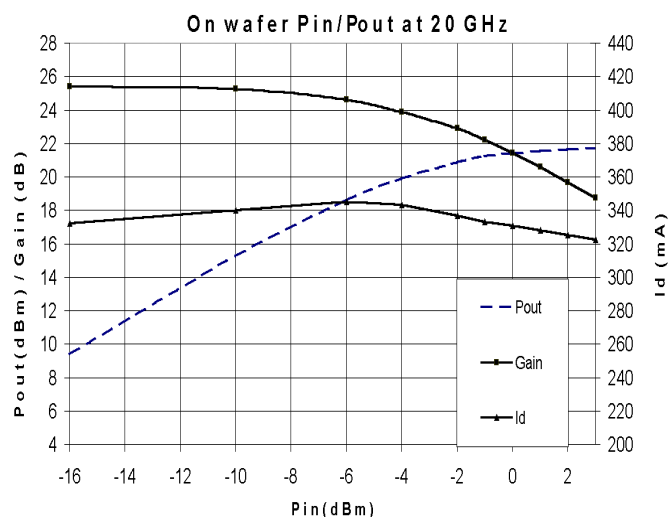
**Typical Scattering Parameters ( On wafer Sij measurements )**

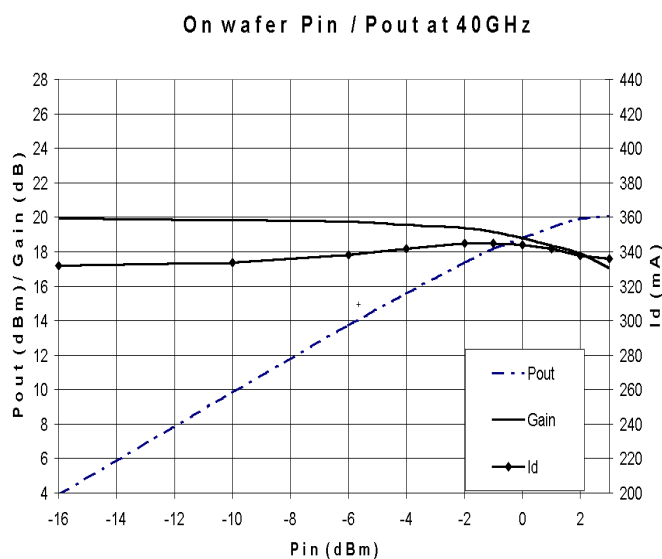
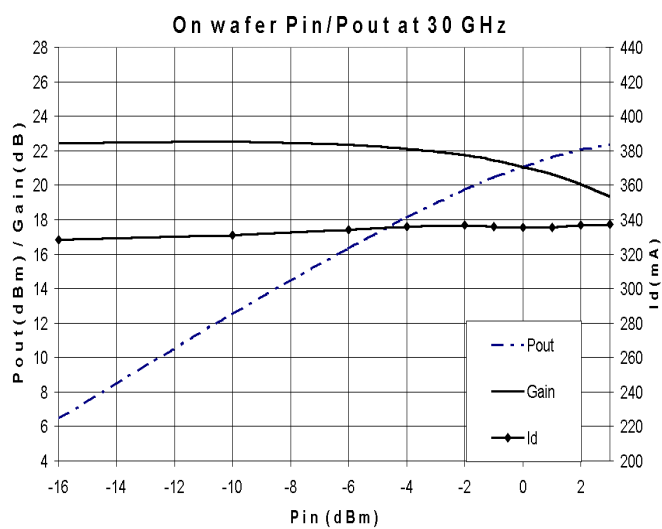
Bias Conditions : Vd1,2,3,4 = 3.5 Volt, Vg1=Vg2,3,4 for Id total = 330 mA.

Freq	S11		S12		S21		S22	
	mod	pha	mod	pha	mod	pha	mod	pha
GHz	dB	°	dB	°	dB	°	dB	°
2,00	-9,77	166,10	-79,63	85,41	-44,50	11,25	-0,06	-16,47
4,00	-9,97	159,94	-78,88	19,46	-45,28	64,07	-0,17	-32,94
6,00	-10,97	144,60	-63,16	-150,36	-32,41	-15,70	-0,26	-48,70
8,00	-12,23	141,58	-67,81	-92,96	-30,97	-73,10	-0,19	-66,41
10,00	-13,30	132,93	-76,00	168,10	-39,55	-81,72	-0,32	-86,37
12,00	-14,19	127,48	-69,79	162,87	-12,99	-8,19	-0,95	-109,99
14,00	-15,25	119,12	-68,09	-141,61	4,59	-92,82	-3,13	-134,29
16,00	-16,90	109,51	-56,64	151,79	14,64	166,69	-6,28	-148,92
18,00	-18,45	101,39	-77,66	-40,17	20,56	66,78	-12,44	-152,39
20,00	-18,27	99,66	-54,79	30,38	23,06	-25,87	-11,02	-127,42
21,00	-20,55	75,06	-69,47	-61,55	23,87	-67,24	-8,60	-138,79
22,00	-20,72	49,52	-57,54	-51,49	24,20	-106,39	-7,90	-148,31
23,00	-29,56	58,15	-54,03	-168,51	23,40	-146,58	-10,21	-167,46
24,00	-23,58	58,28	-56,11	107,75	22,98	-173,95	-10,20	-161,72
25,00	-21,33	29,56	-54,05	67,67	22,93	156,61	-10,87	-166,58
26,00	-21,32	-8,76	-62,57	-37,46	23,05	125,30	-11,82	179,69
27,00	-22,06	-29,59	-63,41	-139,56	22,56	96,27	-13,75	179,91
28,00	-22,21	-31,27	-56,43	165,63	21,93	70,69	-13,72	-176,79
29,00	-19,66	-44,67	-59,88	138,12	22,19	43,16	-13,95	168,88
30,00	-17,80	-56,40	-58,46	132,33	21,80	16,81	-15,15	167,61
31,00	-17,46	-61,68	-56,48	154,53	21,36	-6,65	-15,78	157,73
32,00	-15,16	-70,64	-52,06	105,41	21,50	-31,90	-15,57	137,58
33,00	-15,09	-83,96	-56,43	63,48	20,88	-56,82	-20,24	133,08
34,00	-14,57	-89,19	-59,91	89,24	20,82	-81,12	-19,36	132,46
35,00	-13,80	-92,45	-54,72	94,43	20,70	-104,79	-18,36	101,23
36,00	-13,55	-97,98	-54,97	59,43	20,47	-129,10	-20,65	80,50
37,00	-12,80	-102,27	-54,75	93,32	20,11	-154,27	-17,69	61,37
38,00	-12,55	-108,34	-54,06	58,24	19,72	-177,11	-18,18	37,45
39,00	-12,64	-110,41	-53,05	50,25	19,84	159,83	-15,31	24,91
40,00	-12,53	-108,87	-50,99	30,11	19,49	133,90	-13,49	5,75
41,00	-11,23	-110,01	-52,73	3,78	19,40	108,31	-11,73	-9,23
42,00	-10,73	-118,61	-56,04	22,66	18,88	81,37	-11,60	-21,67
43,00	-10,79	-124,01	-56,86	-6,86	18,38	56,83	-10,29	-23,61
44,00	-10,93	-121,39	-52,92	-31,58	18,36	32,20	-8,52	-33,55
45,00	-10,92	-125,62	-52,23	-85,31	18,33	-0,36	-7,30	-45,47
46,00	-11,37	-121,74	-60,67	-166,71	17,03	-37,26	-7,39	-51,37
48,00	-8,41	-103,89	-53,21	-121,20	13,67	-104,46	-4,69	-68,35
50,00	-5,96	-119,91	-58,10	116,39	6,60	-158,83	-3,75	-85,06
52,00	-3,89	-131,50	-52,69	160,04	-0,07	156,43	-3,23	-99,24
54,00	-2,88	-146,98	-60,21	15,97	-7,50	118,68	-2,74	-112,94
56,00	-2,21	-160,52	-52,63	159,63	-16,29	95,16	-2,57	-124,78
58,00	-2,02	-173,49	-55,84	-175,77	-29,86	112,18	-2,56	-135,15
60,00	-1,87	175,37	-49,76	95,59	-23,82	170,18	-2,53	-145,16

## Typical On wafer Power CW Measurements

Bias Conditions :  $V_{d1,2,3,4} = 3.5$  Volt,  $V_{g1,2,3,4}$  for  $I_d = 330$  mA

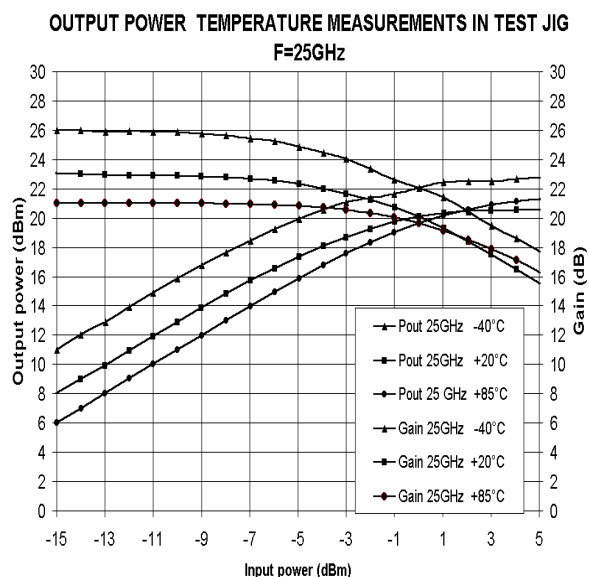
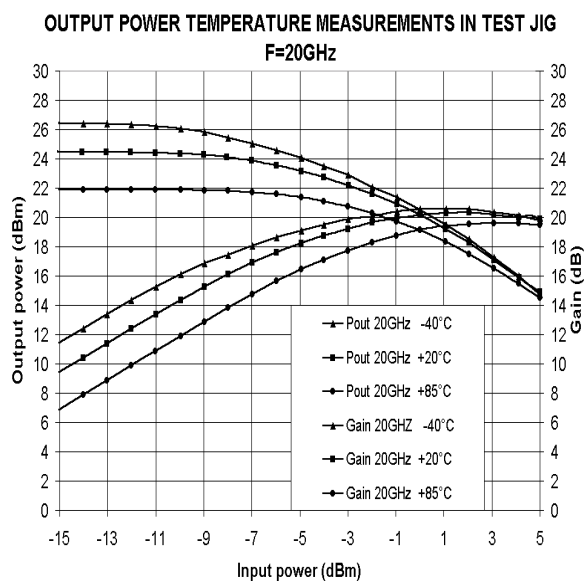




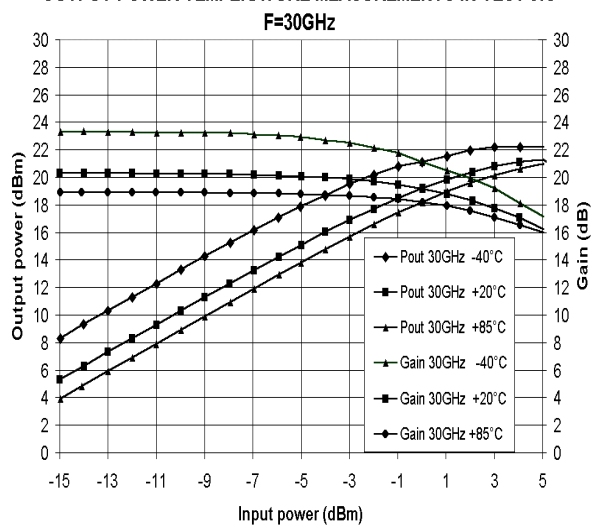
## Typical IN TEST JIG Power Measurements in temperature

Note : Jig losses included (1 dB)

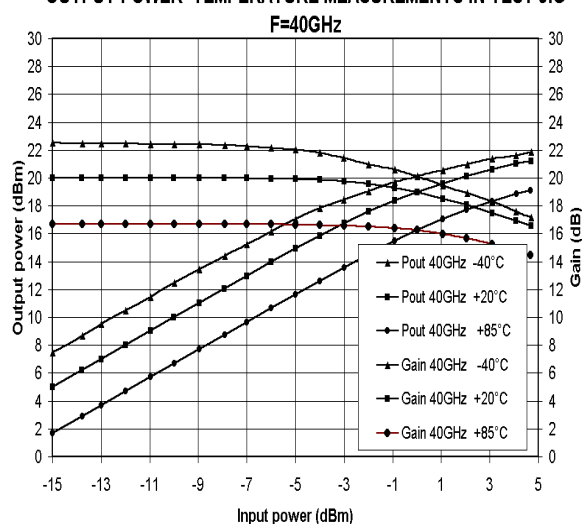
Bias Conditions :  $V_{d1,2,3,4} = 3.5$  Volt,  $V_{g1,2,3,4}$  for  $I_d = 330$  mA



OUTPUT POWER TEMPERATURE MEASUREMENTS IN TEST JIG

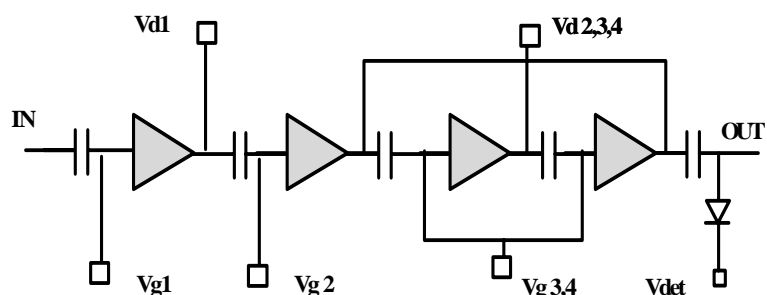


OUTPUT POWER TEMPERATURE MEASUREMENTS IN TEST JIG



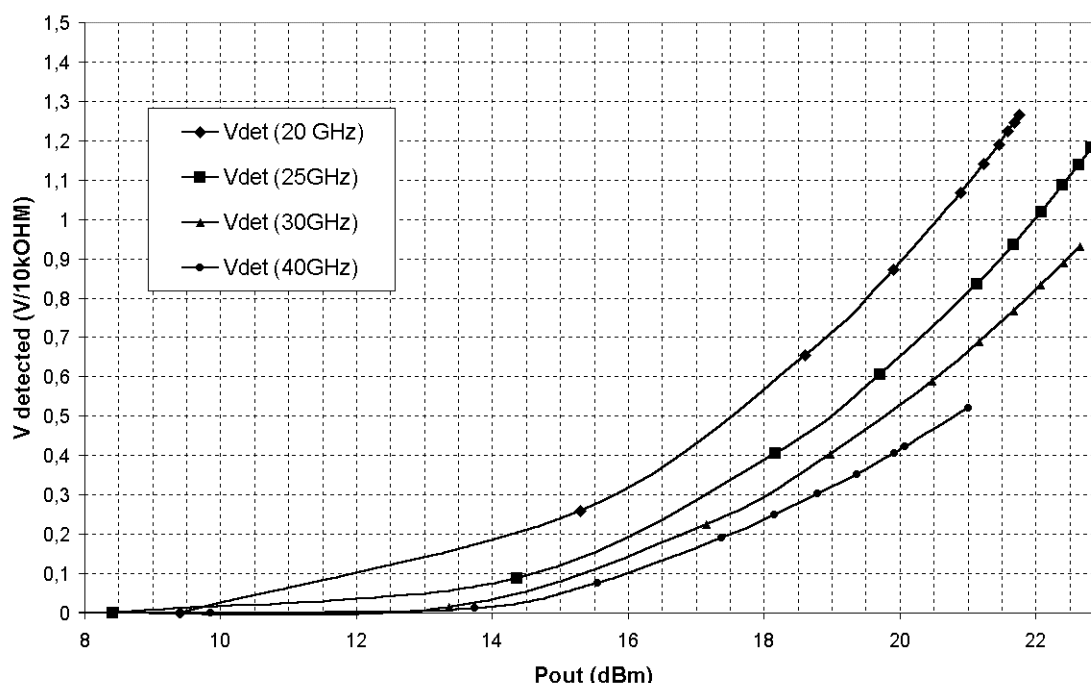
## Typical Bias Tuning

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.

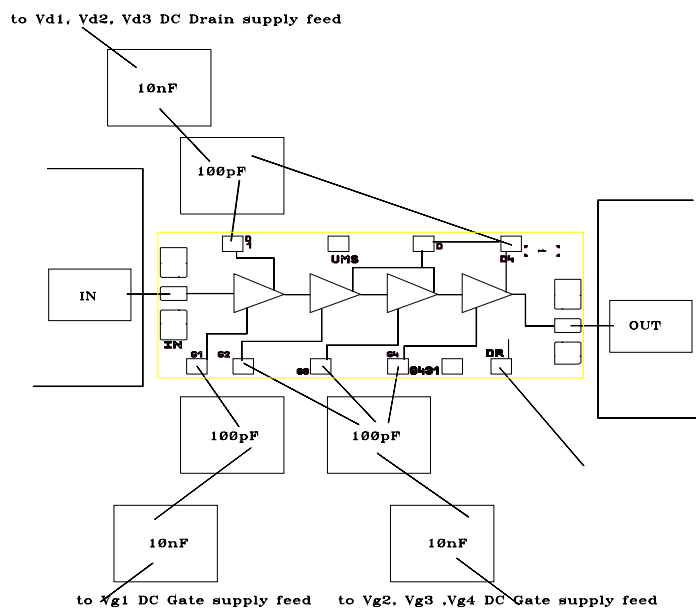
An additional pad is provided for monitoring the output power, using the Build In Test. This access, when connected to an external resistor of 10 kOhm ( typical value ) provides a DC voltage which follows the output power level.



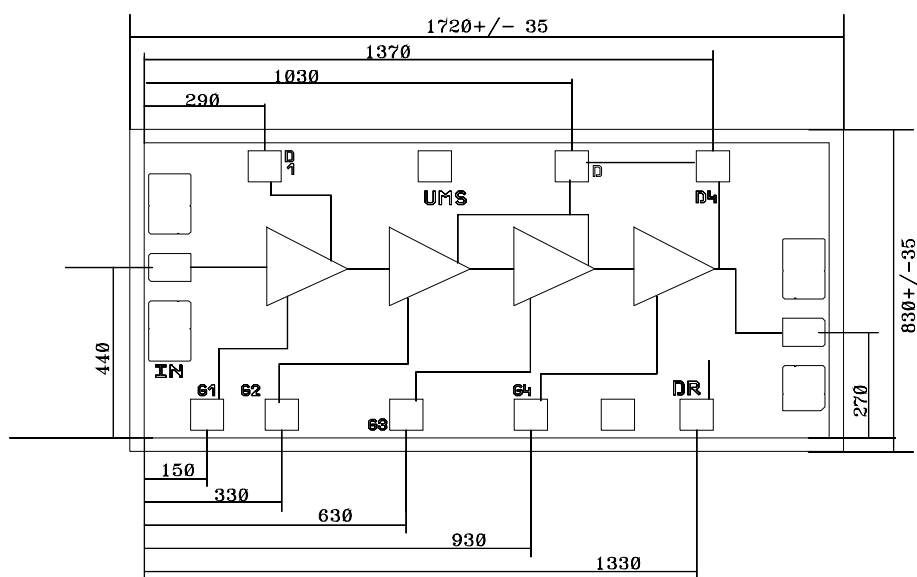
On wafer power measurements versus output power



## Chip Assembly and Mechanical Data

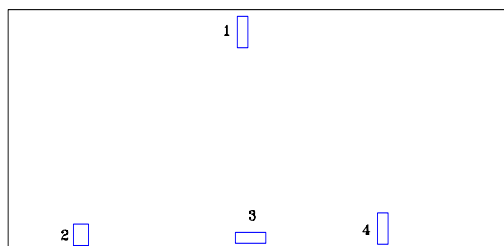


Note : Supply feed should be capacitively bypassed. 25 $\mu$ m diameter gold wire is recommended



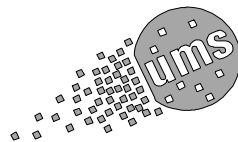
### Bonding pad positions.

( Chip thickness : 100 $\mu$ m.all dimensions are in micrometers)



Number	Size (x,y) $\mu$ m	Center position (x,y) $\mu$ m (Referred to bottom left origin)
1	34 / 98	773 / 689
2	48 / 68	68 / 34
3	98 / 34	800 / 43
4	34 / 98	1237 / 73

### Pickup Pillow



## Ordering Information

Chip form : CHA3093c99F/00

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