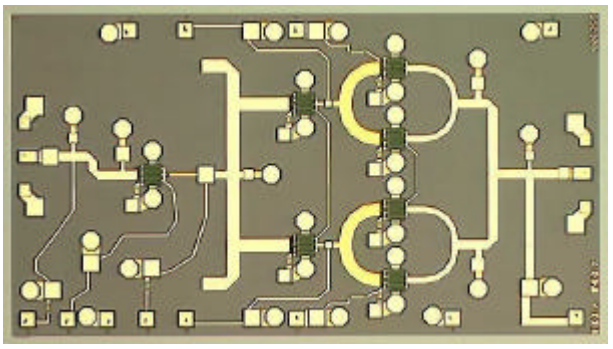
HEMT MMIC 0.5W POWER AMPLIFIER, 24GHz



Features

- Gain; 19dB typical @ 24GHz
- P-1dB; 29dBm typical @ 24GHz
- 20% PAE
- 0.20 um pHEMT technology

Description

The P35-5133-000-200 is a high performance 24GHz Gallium Arsenide power amplifier, capable of output powers in excess of 0.5 Watt. It is intended for use in point-to-point digital radio and point-to- multipoint communications.

The die is fabricated using Caswell Technology's 0.20um gate length, Power HEMT process (H40P) and is fully protected using Silicon Nitride passivation for excellent performance and reliability.

Electrical Performance

Ambient Temperature 22±3° C, Z_O = 50Ω, Vdd = 5V,Vg1 to Vg3 Set for Typical Drain Current. U.O.S

Parameter	Conditions	Min	Typ	Max	Units
Small Signal Gain	23 – 25GHz	-	19	-	dB
Gain Flatness	23 – 25GHz	-	± 0.5	± 1.0	dB
Input Return Loss	23 – 25GHz	-	6	-	dB
Output Return Loss	23 – 25GHz	-	10	-	dB
P-1dB Output Power	23 – 25GHz				
	Vdd=5V	-	29	-	dBm
Drain Voltage Vdd	-	-	5	7	Volts
Gate Voltage Vgg	-	-	-0.4	-	Volts
First Stage Current	Set Vg1	-	90	-	mA
Second Stage Current	Set Vg2	-	180	-	mA
Third Stage Current	Set Vg3	-	360	-	mA
Thermal Resistance	-	-	22	-	°C/W

Notes

1. All parameters measured on wafer

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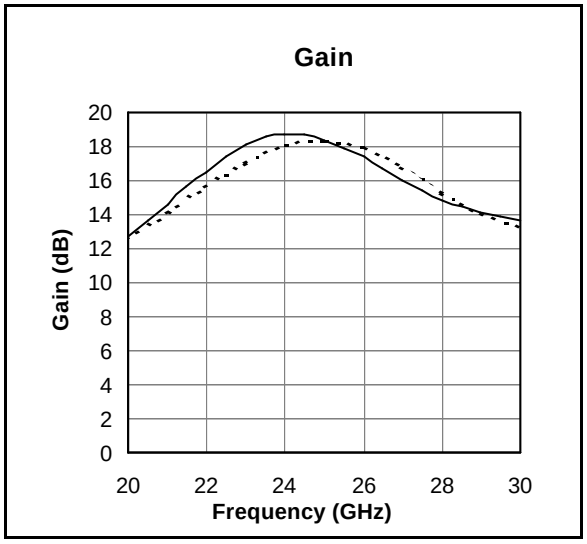
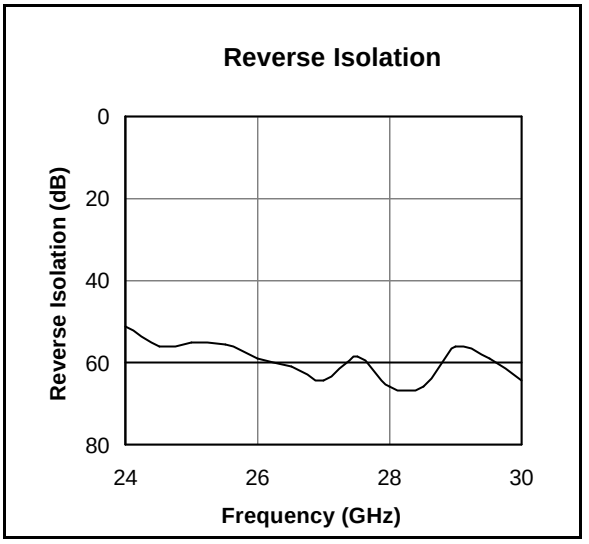
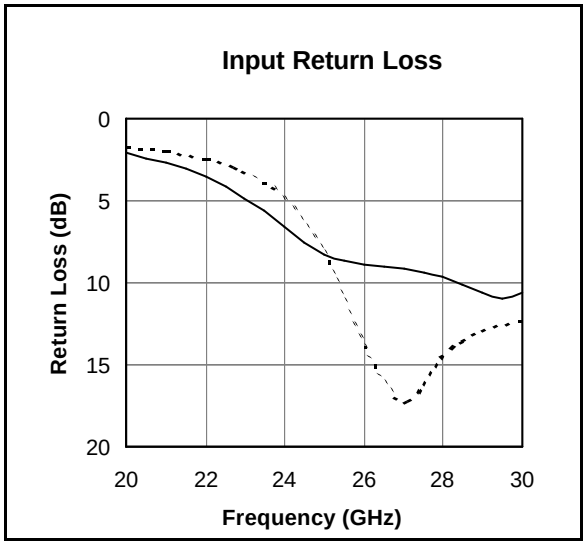
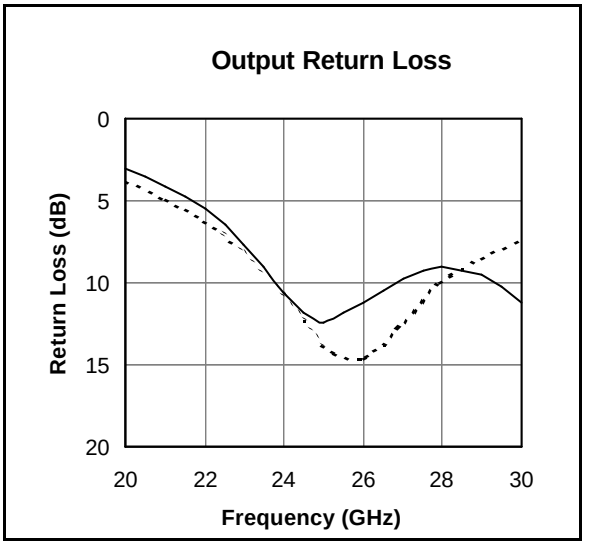
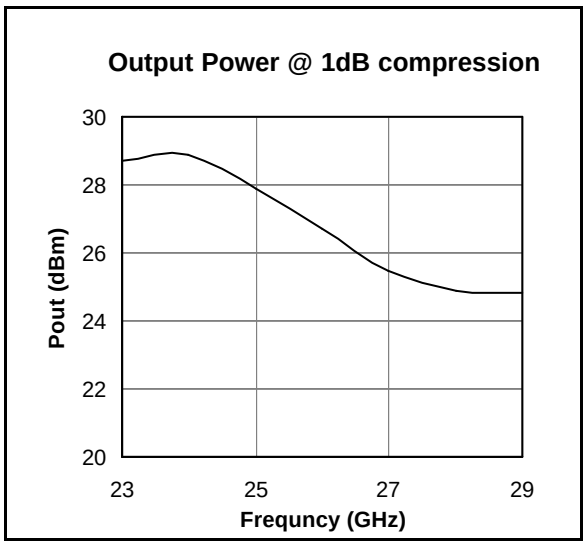
Typical RFOW Performance (----- With Bondwires)

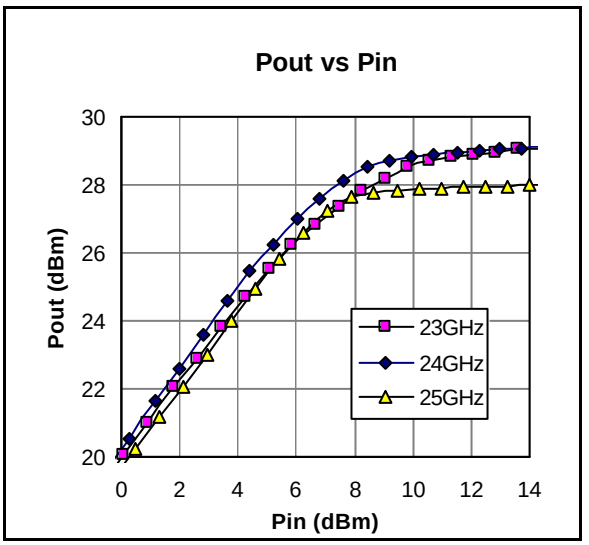












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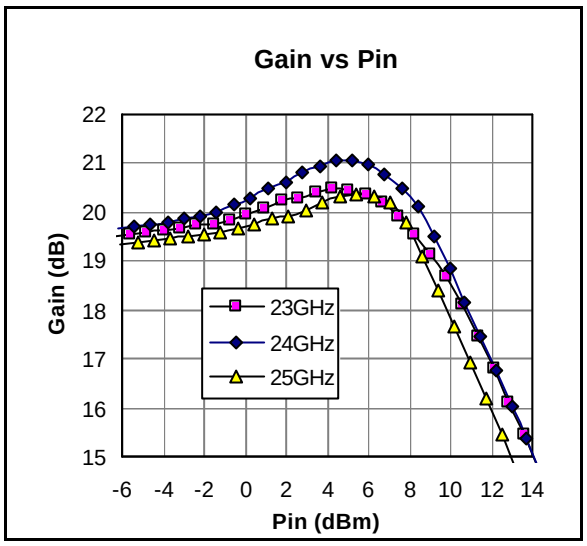
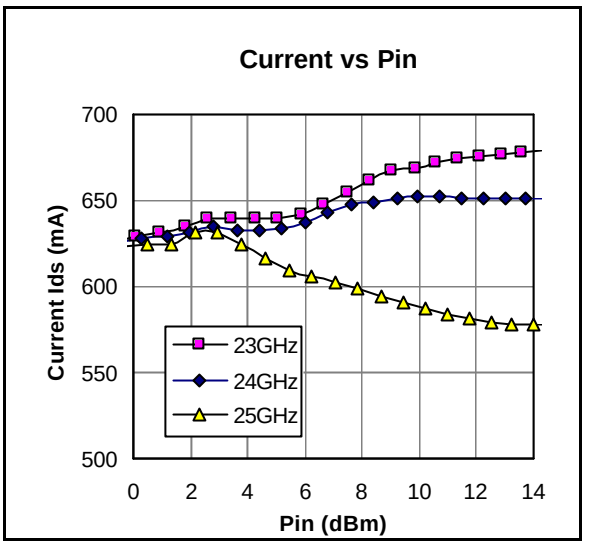
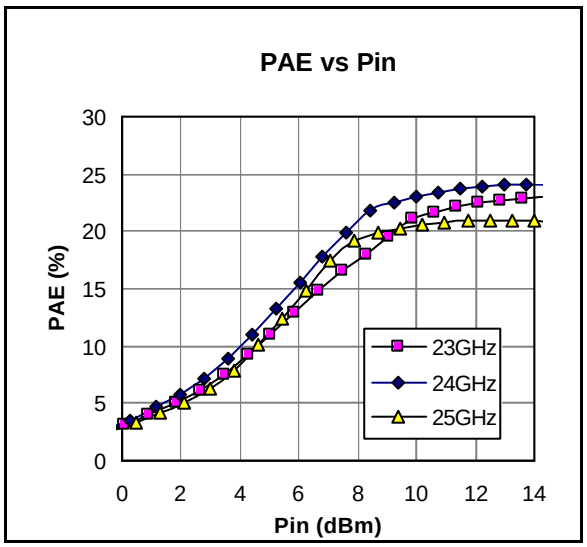
Typical RFOW Performance







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Typical S-parameters (RFOW)

Frequency	S11		S21		S12		S22	
(GHz)	Mag	Angle	Mag	Angle	Mag	Angle	Mag	Angle
20.00	0.79	165.1	4.30	54.8	0.001	103.0	0.71	-123.1
20.50	0.76	156.0	4.82	35.2	0.003	91.3	0.67	-127.2
21.00	0.73	146.2	5.39	14.8	0.003	67.6	0.62	-131.3
21.50	0.70	135.0	6.02	-6.7	0.002	53.2	0.58	-135.4
22.00	0.67	121.8	6.71	-29.6	0.003	54.1	0.53	-139.4
22.50	0.62	106.8	7.38	-53.8	0.003	37.7	0.47	-143.2
23.00	0.57	89.4	8.00	-79.3	0.003	27.9	0.42	-146.0
23.50	0.52	69.6	8.46	-106.0	0.003	-2.5	0.35	-147.8
24.00	0.47	46.3	8.64	-133.5	0.003	-36.0	0.29	-145.5
24.50	0.42	21.6	8.57	-160.8	0.002	-46.1	0.26	-138.3
25.00	0.39	-3.8	8.27	171.9	0.002	-53.7	0.24	-127.8
25.50	0.37	-27.9	7.83	145.8	0.002	-81.3	0.26	-120.8
26.00	0.36	-50.3	7.39	120.2	0.001	-127.2	0.27	-117.4
26.50	0.35	-68.5	6.85	95.0	0.001	-124.6	0.30	-117.5
27.00	0.35	-84.7	6.35	70.5	0.001	141.8	0.33	-120.4
27.50	0.34	-97.4	5.91	46.5	0.001	124.2	0.34	-125.8
28.00	0.33	-107.1	5.54	23.0	0.001	22.8	0.35	-133.5
28.50	0.31	-115.6	5.29	-1.1	0.001	122.9	0.35	-142.3
29.00	0.30	-120.9	5.10	-26.5	0.002	83.1	0.33	-153.0
29.50	0.28	-122.7	4.95	-53.2	0.001	31.4	0.31	-167.9
30.00	0.30	-124.2	4.84	-82.1	0.001	4.5	0.28	173.9

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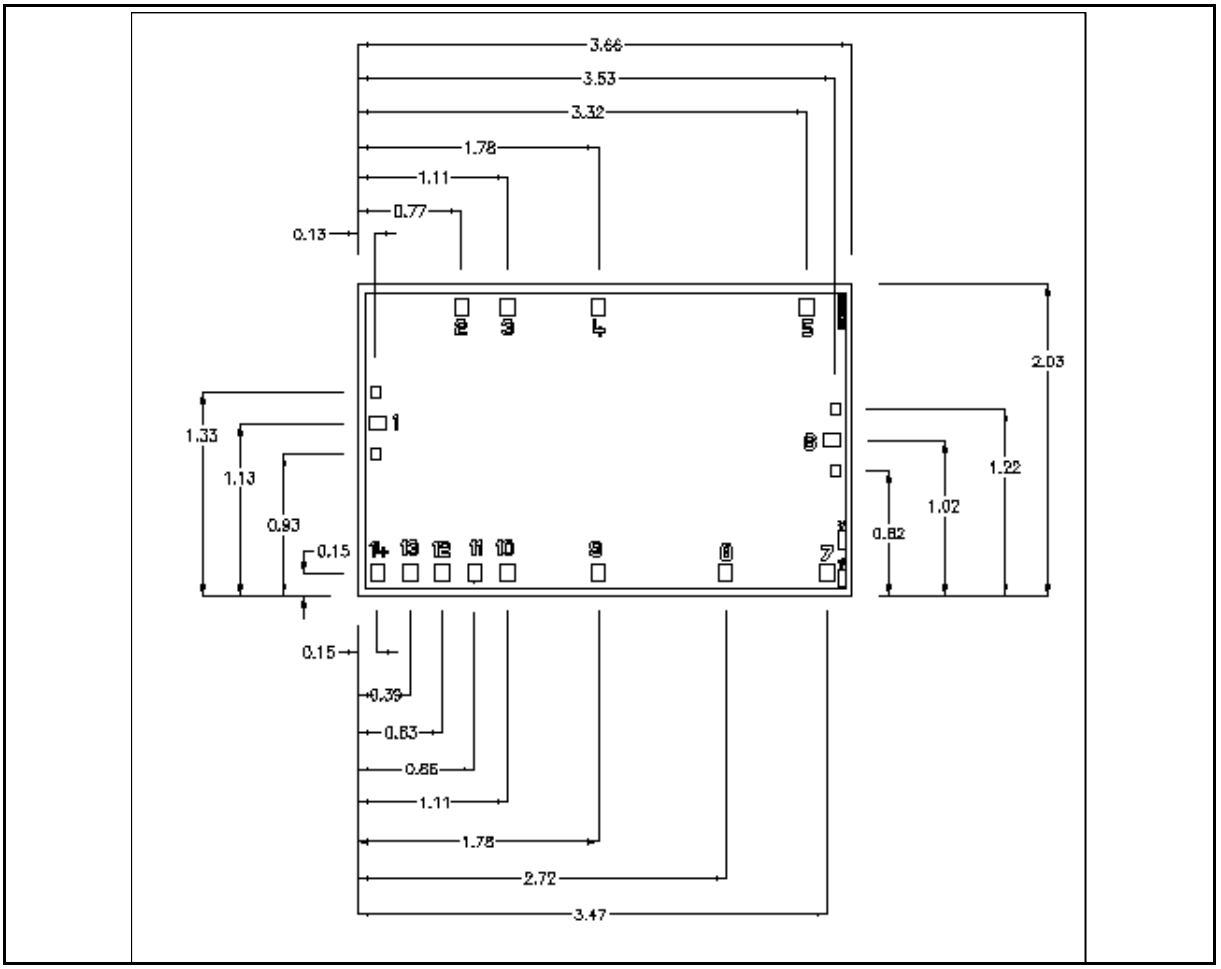
Chip Outline



Die size:	3.66 x 2.03mm
RF bond pads (1 & 6):	80 x 120µm
All other bond pads:	120µm x 120µm
Die Thickness:	100µm

Pad Details

Pad	Function
1	RF Input
2	Gnd
3	Vd2
4	Vg3
5	Gnd
6	RF Output
7	Vd3
8	Gnd
9	Vg3
10	Vd2
11	Vg2
12	Gnd
13	Vd1
14	Vg1

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Handling and Assembly Information

Gallium Arsenide (GaAs) devices are susceptible to electrostatic and mechanical damage. Dice are supplied in antistatic containers, which should be opened in cleanroom conditions at an appropriately grounded anti-static workstation. Devices need careful handling using correctly designed collets, vacuum pickups or, with care, sharp tweezers.

GaAs Products from Caswell Technology's H40P Foundry process are 100µm thick and have through GaAs vias to enable grounding to the circuit. Windows in the surface passivation above the bond pads are provided to allow wire bonding to the die.

The surface to which the die are to be attached should be cleaned with a proprietary de-greasing cleaner.

Eutectic mounting should be used and entails the use of a gold-tin (AuSn) preform, approximately 0.001″ thick, placed between the die and the attachment surface. The preferred method of mounting is the use of a machine such as a Mullins 8-140 die bonder. This utilises a heated collet and workstation with a facility for applying a scrubbing action to ensure total wetting and avoid the formation of voids. Dry nitrogen gas is directed across the work piece.

The gold-tin eutectic (80% Au 20% Sn) has a melting point of approximately 280°C (Note: Gold Germanium with a higher melting temperature should be avoided, in particular for MMICs). The work station temperature should be 310°C ± 10°C. The collet should be heated, and the die pre-heated to avoid excessive thermal shock. The strength of the bonding formed by this method will result in fracture of the die, rather than the bond under die strength testing.

The P35-5133-000-200 amplifier die has gold bond pads. The recommended wire bonding procedure uses 25µm (0.001") 99.99% pure gold wire with 0.5-2% elongation. Thermo-compression wedge bonding is preferred though thermosonic wire bonding may be used providing the ultrasonic content of the bond is minimised. A work station temperature of 260°C ± 10°C with a wedge tip temperature of 120°C ± 10°C is recommended. The wedge force should be 45 ± 5 grams. Bonds should be made from the bond pads on the die to the package or substrate.

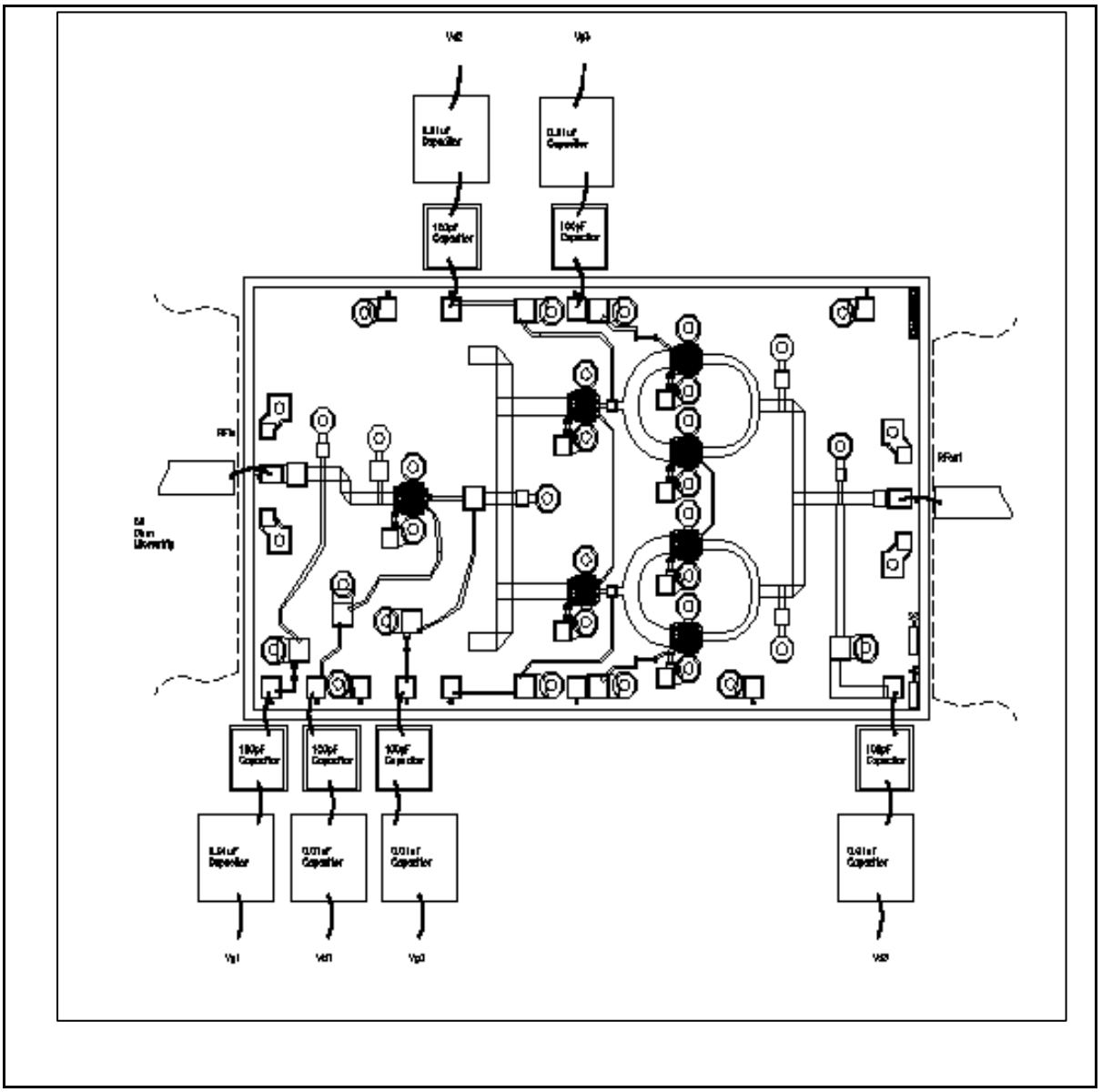
The RF bond pads at the input and output are 80µm x 120µm; all other bond pads are 120µm x 120µm.

The P35-5133-000-200 has been designed to include the inductance of a single 0.2mm length, 25µm bond wire at both the input and output, facilitating the integration of the die into a 50Ω environment.

Operating and Biasing of the P35-5133-000-200

The P35-5133-000-200 is a three-stage amplifier. The drain bias for all three stages (Vd1, Vd2 & Vd3) should be set to 5.0 volts. The gate voltages (Vg1, Vg2 & Vg3) are typically set to -0.3V. The separate drain and gate voltage supplies for all three stages can be combined into single supplies (Vdd & Vgg). DC bias supplies should be decoupled to ground using 100pF chip capacitors placed close to the chip with short bondwires to the amplifier bond pad, larger 0.01uF capacitors should be used to decouple the supplies further, as indicated on the bonding diagram.

Typical bonding detail



Absolute maximum Ratings

Max Vdd	+7V
Max Vgg	-2V
Max channel temperature	150°C
Storage temperature	-65°C to +150°C

Ordering Information

P35-5133-000-200

This is a pre production specification, sample parts available 1999 Quarter 3.

Prototype samples are devices which have determined to be a potential product but which have not completed all pre-production and production release requirements. Samples can be supplied for customer evaluation purposes only but are not stocked. Further devices may not be the same.

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