

## General Description

The **VWA 5001135 AA** is a low noise amplifier MMIC operating in the frequency range 8 to 12GHz.

The device has a linear gain of 19dB and a typical noise figure of 1.0dB. Typical operating supply current is only 28mA with supply voltage at +3V and -3V.

It is manufactured on a PHEMT Technology and is especially suited for radar and for telecommunication applications.

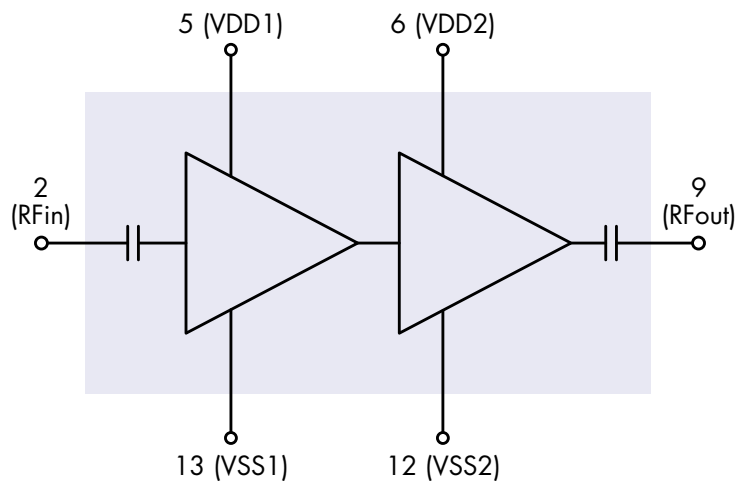
## Features

- Operating frequency range: 8 to 12GHz
- Gain: 18dB
- Noise figure: 1.0dB
- Gain Flatness: +/- 0.7dB
- Input Return Loss: -10dB typ.
- Output Return Loss: -12dB typ.
- Power supply: 28 mA @ VDD = 3V, VSS = -3V
- Die Size: 1.4 x 1.4 x 0.1mm

## Applications

- Radar
- Test and measurement
- Telecommunications

## Functional Block Diagram & Pins Assignment



Pin number	Function
2	RF in
5	VDD1
6	VDD2
9	RF out
12	VSS2
13	VSS1

## Electrical Specifications

**Operating conditions unless otherwise noted:**

- VDD = VDD1 = VDD2 = +3V
- VSS = VSS1 = VSS2 = -3V
- ID = IDD1+IDD2 = 28mA
- T<sub>amb</sub> = +25°C

Symbol	Parameter	Min	Typ	Max	Unit
F	Frequency range	8		12	GHz
G	Linear gain		18		dB
ΔG	Small signal gain flatness		+/-0.7		dB
NF	Noise Figure		1.0		dB
OP1dB	Output power at 1dB compression		7		dBm
Psat	Saturated Output Power		9		dBm
S11	Input Return loss		-10		dB
S22	Output Return loss		-12		dB
VDD1_2	Operating supply voltage		+3		V
VSS1_2			-3		V
IDD	Supply current		28		mA

## Absolute Maximum Ratings

Symbol	Maximum Ratings	Min	Max	Unit
VDD1_2	Voltage Supple		+4	V
VSS1_2		-6	-0.5	V
Pin	CW Input Power		+10	dBm
Tst	Storage temperature	-55	+125	°C
Top	Operating temperature	-40	+85	°C
Tch	Channel temperature		+150	°C

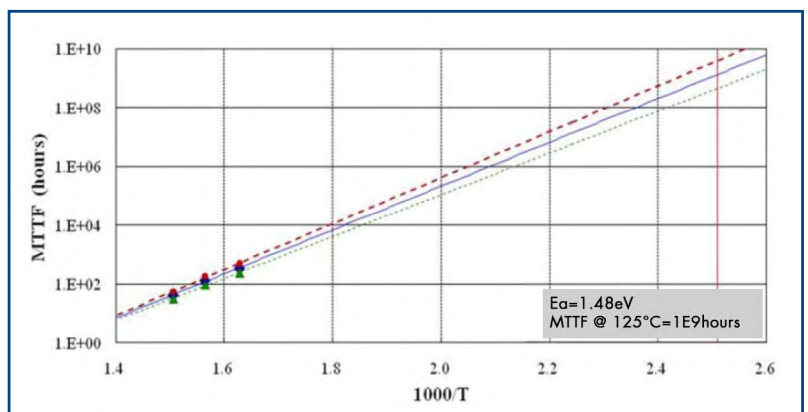
Operation of this device above any of these parameters may cause permanent damage.

## MTTF (Provided by Foundry)

The values shown here are calculated, only to be used as a guideline and represent reliability information under V<sub>ds</sub>=+5V and drain current of 267mA/mm.

0.15μm Low noise pHEMT  
(PL15-10) / MTTF Test Arrhenius Plot

- ..... 10% failure line : MTF @ 125C=4.7E8
- 50% failure line : MTF @ 125C=1E9
- - - - 90% failure line : MTF @ 125C=4.1E9



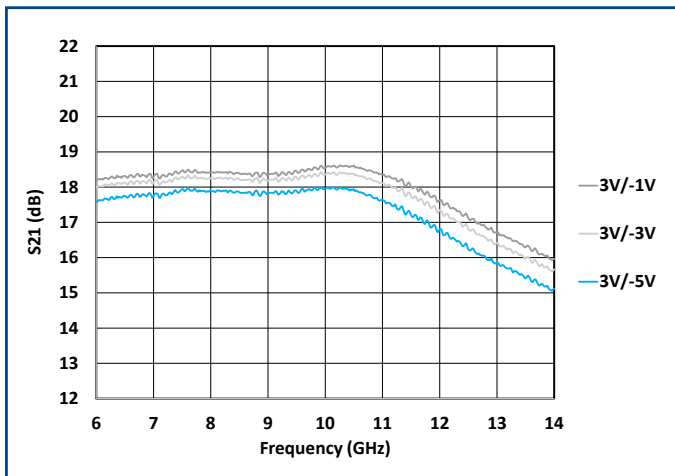
**Typical performances (Board measurements)**

Measurement conditions otherwise noted:

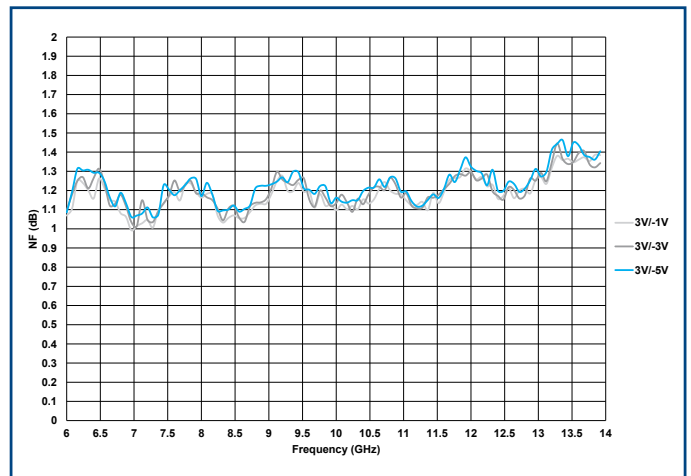
- VDD = VDD1 = VDD2 = +3V
- VSS = VSS1 = VSS2 = -3V
- Typically, ID = IDD1 + IDD2 = 28mA
- T<sub>amb</sub> = +25°C

**VDD = +3V, VSS = -5V to -1V**

**Small signal Gain (dB)**

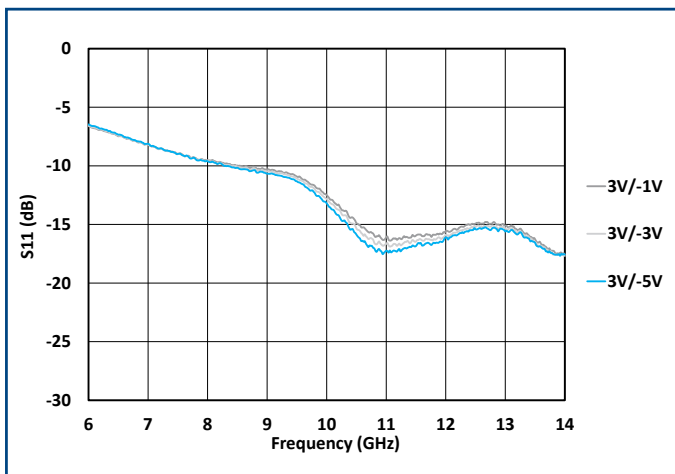


**Noise Figure (dB)\***

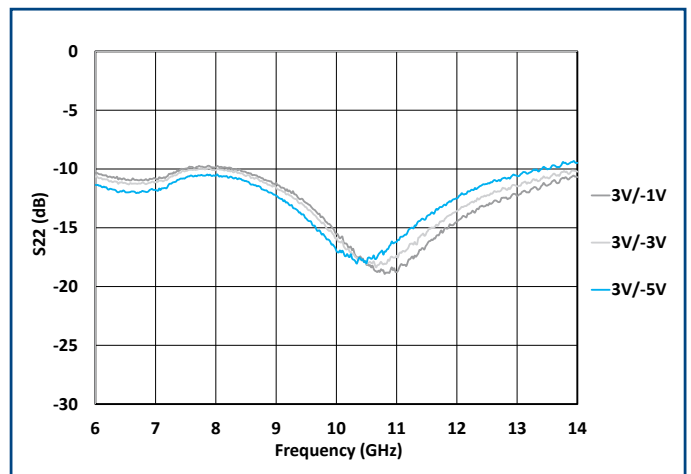


\*Measurement accuracy for noise figure is +/- 0.2 dB.

**Input Return Loss (dB)**

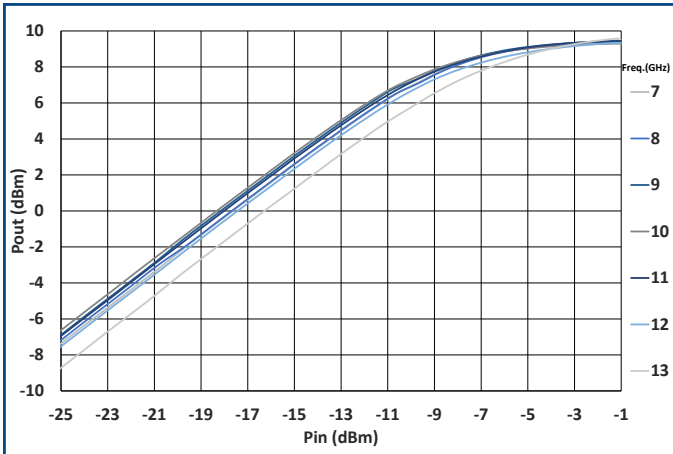


**Output Return Loss (dB)**

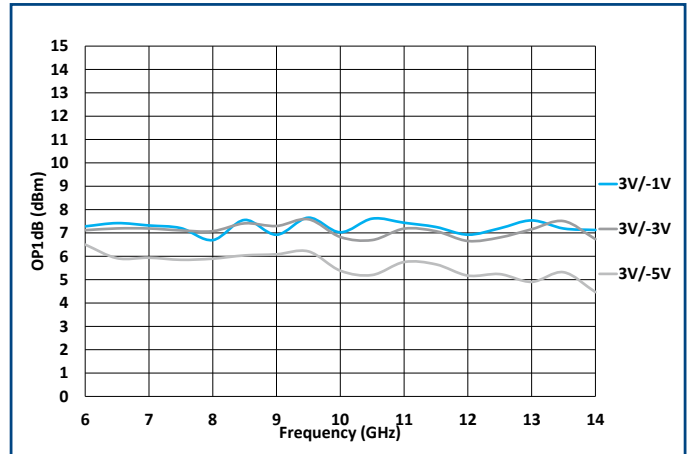


Typical performances (Board measurements)

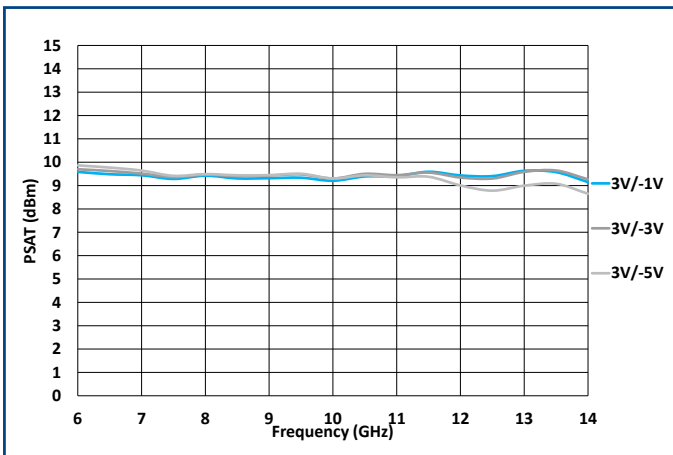
Output power VS Input Power  
@ VDD= 3V, VSS=-3V



P1dB vs Frequency



Psat vs Frequency



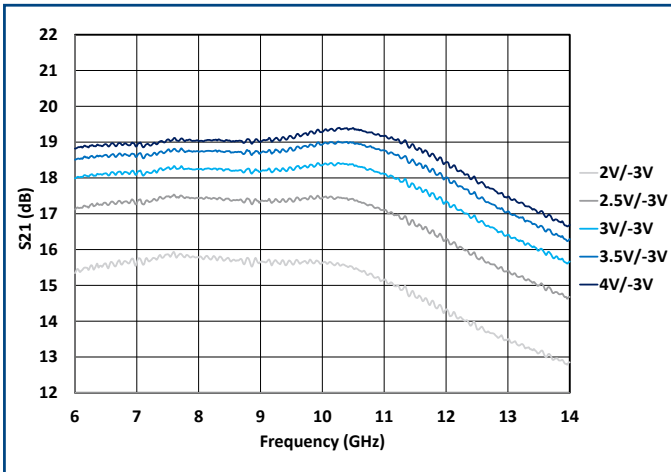
IDD vs VSS

VDD	VSS	IDD
3V	-1V	31mA
3V	-3V	28mA
3V	-5V	24mA

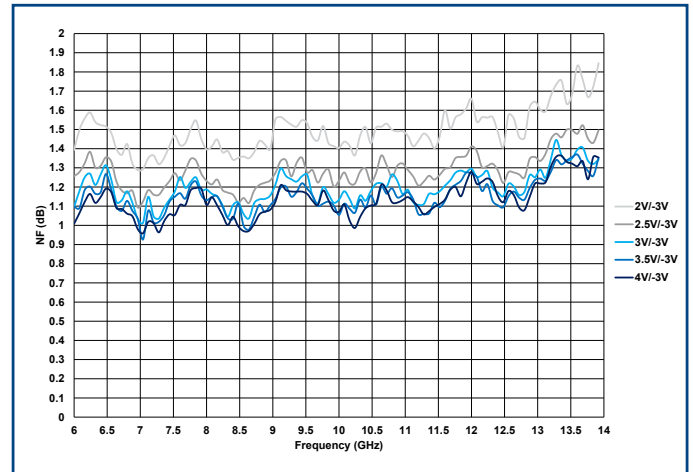
Typical performances (Board measurements)

VDD = +2V to +4V, VSS = -3V

Small signal Gain (dB)

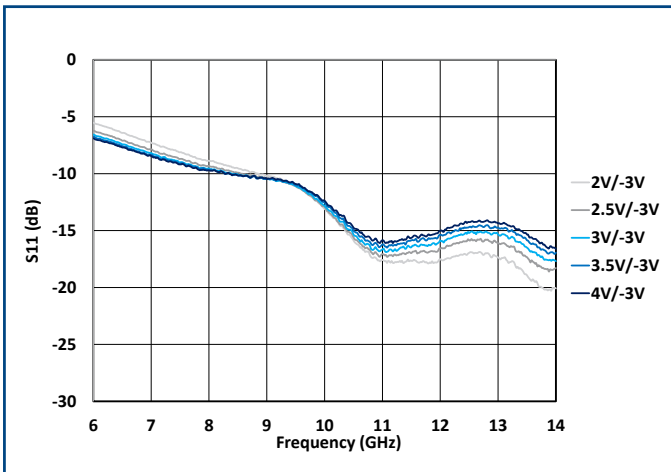


Noise Figure (dB)\*

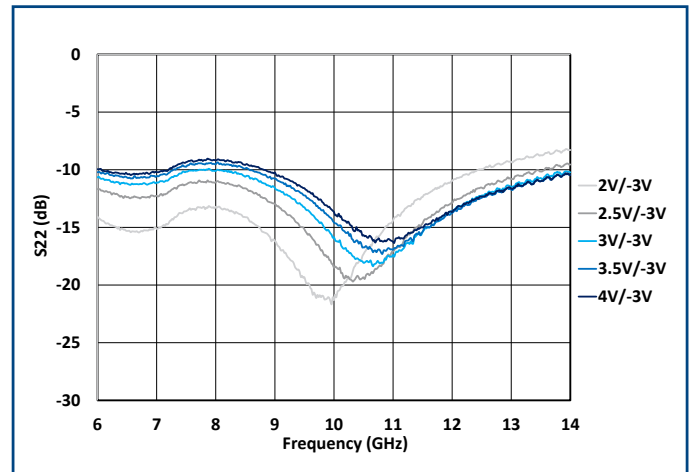


\*Measurement accuracy for noise figure is +/- 0.2 dB.

Input Return Loss (dB)

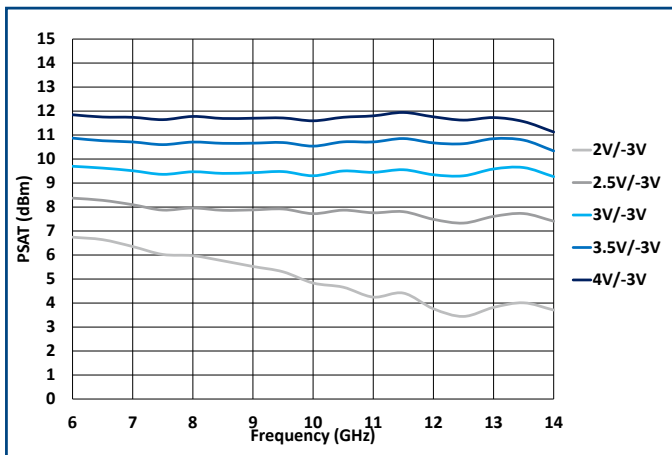


Output Return Loss (dB)

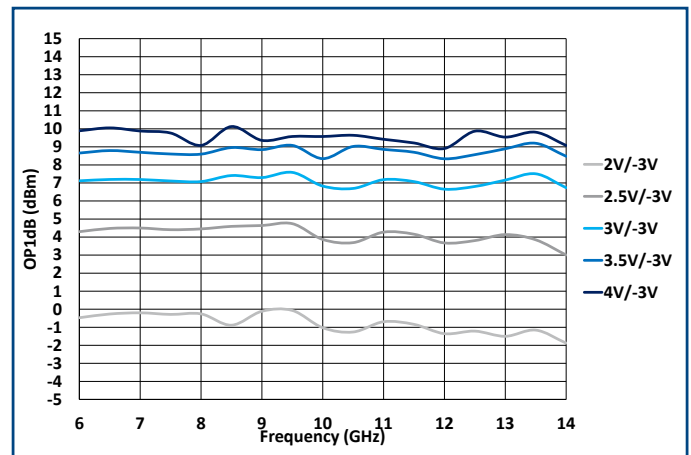


## Typical performances (Board measurements)

**Psat vs Frequency**



**P1dB vs Frequency**



**IDD vs VDD**

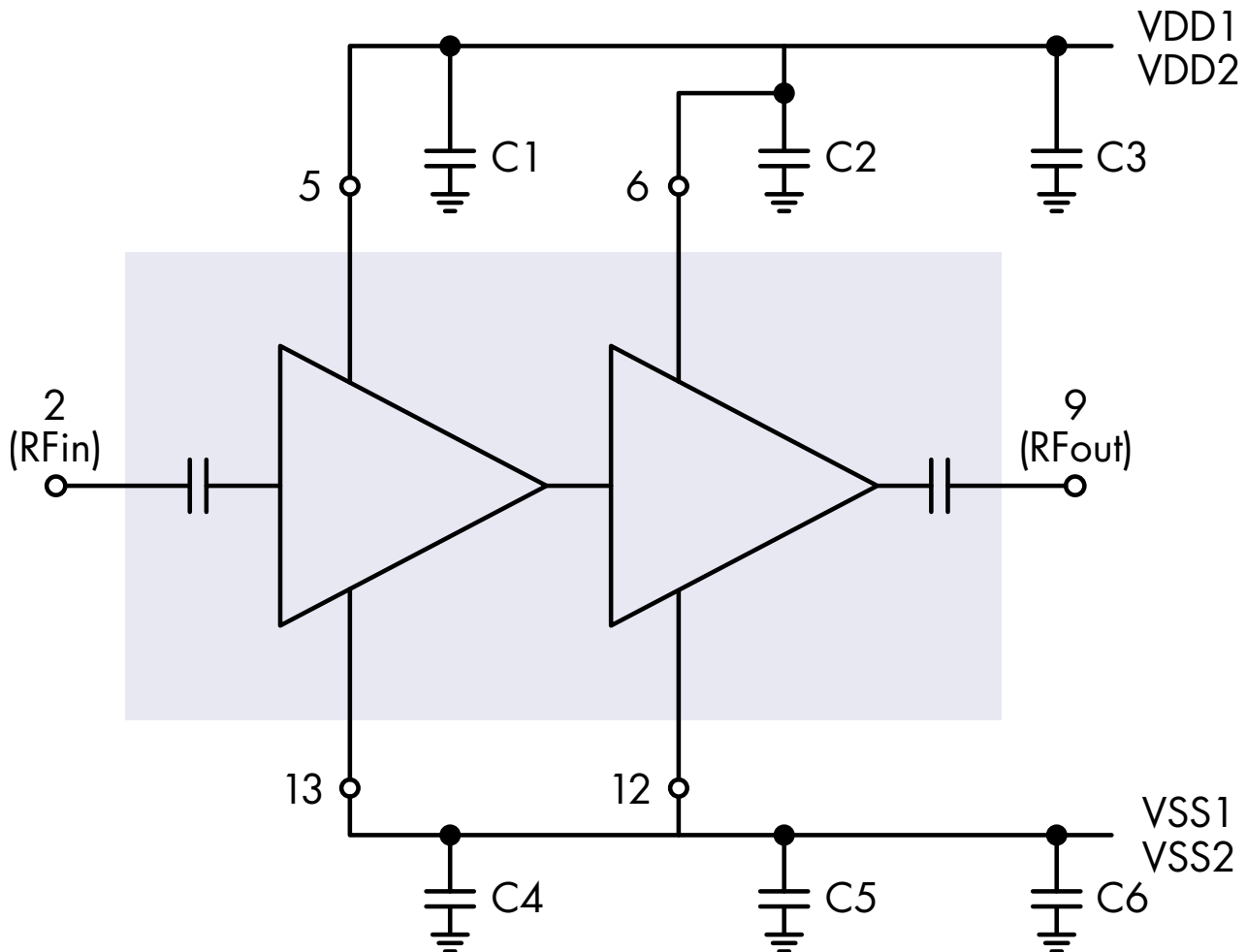
VDD	VSS	IDD
2V	-3V	31mA
2.5V	-3V	28mA
3V	-3V	24mA
3.5V	-3V	24mA
4V	-3V	24mA

## Pin description

Pin number	Name	Description	Electrical interface
2	RFIn	AC coupled, amplifier input access. Internally matched 50 Ohms.	
9	RFout	AC coupled amplifier output access. Internally matched 50 Ohms.	
5, 6	VDD1, VDD2	1 <sup>st</sup> stage and 2 <sup>nd</sup> stage drain biasing access	
13, 12	VSS1, VSS2	1 <sup>st</sup> stage and 2 <sup>nd</sup> stage gate biasing access	
Die bottom	GND	Die Bottom must be connected to RF and DC Ground	

## Application circuit

- C1, C2, C4, C5 = 100 pF MIM capacitor (close to the die)
- C3, C6 = 1  $\mu$ F SMD capacitor 0402



## Biasing procedure

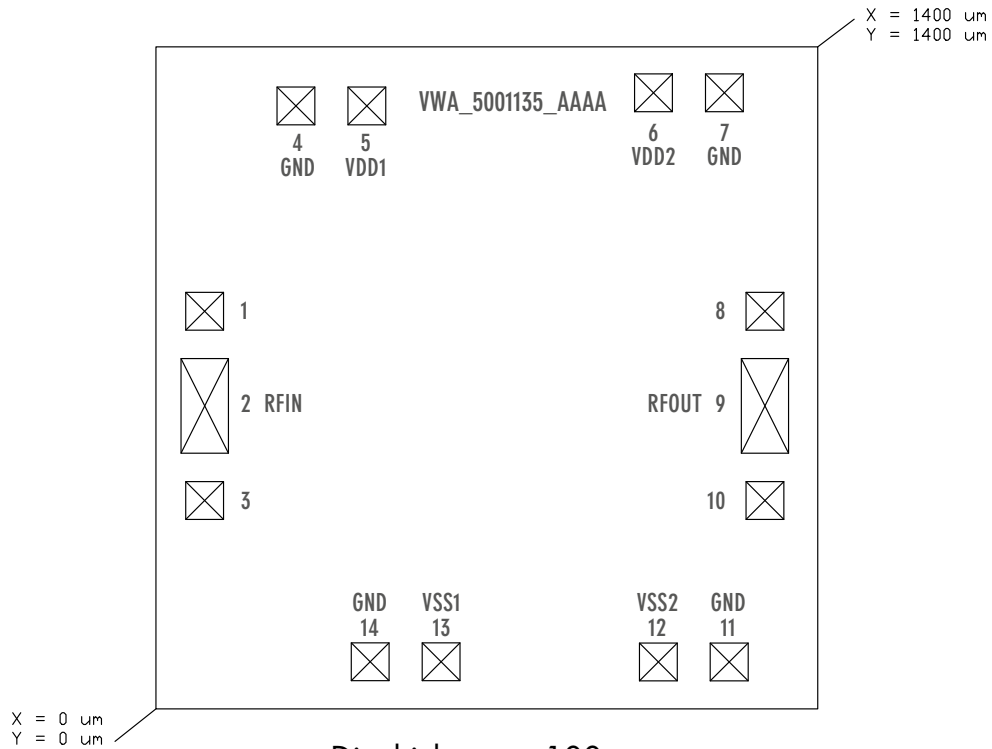
### Switch on

1. Set VSS1, VSS2 to -3V
2. Set VDD1, VDD2 to +3V.
3. Turn RFin ON

### Switch off

1. Turn RFin OFF
2. Decrease VDD1, VDD2 to 0V
3. Decrease VSS1, VSS2 to 0V.

## Die Layout



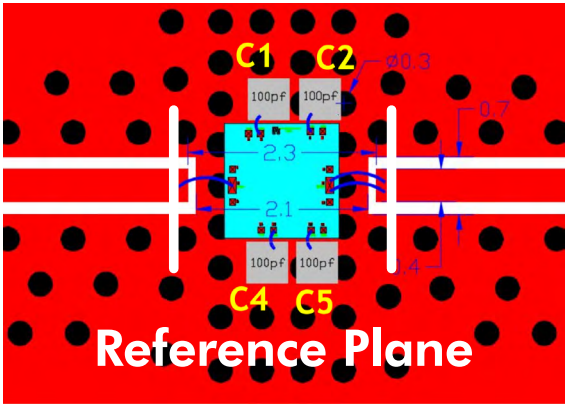
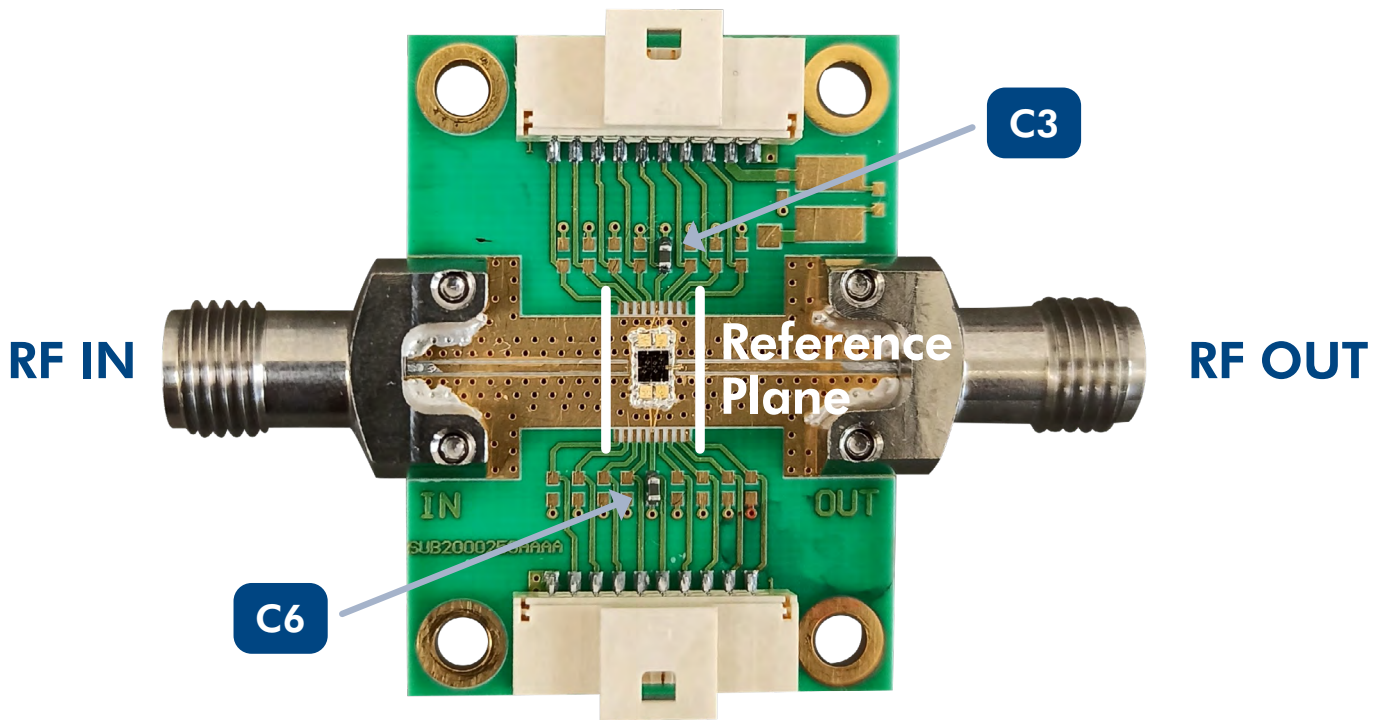
Die thickness = 100 $\mu\text{m}$   
Die bottom must be connected to ground (RF and DC)

## Die Pinout

Pad number	Pad center		Size ( $\mu\text{m} \times \mu\text{m}$ )	Name	Function
	X ( $\mu\text{m}$ )	Y ( $\mu\text{m}$ )			
1	103	841	80 x 80	Gnd	
2	103	641	100 x 200	RFin	RF Input
3	103	441	80 x 80	Gnd	
4	296	1275	80 x 80	Gnd	
5	446	1275	80 x 80	VDD1	Drain Bias
6	1053	1303	80 x 80	VDD2	Drain Bias
7	1203	1303	80 x 80	Gnd	
8	1289	841	80 x 80	Gnd	
9	1289	641	100 x 200	RFout	RF Output
10	1289	441	80 x 80	Gnd	
11	1213	990	80 x 80	Gnd	
12	1063	990	80 x 80	VSS1	Gate Bias
13	603	1000	80 x 80	VSS2	Gate Bias
14	453	1000	80 x 80	Gnd	



Board layout



Substrate : RO4350B (  $\epsilon_r = 3.48$  ), 0.254mm thickness.

Measurements on connectorized structure. Small signal gain (S21) and Noise figure are de-embedded at reference plane (see drawing above)

Note: Multiple vias should be employed under die to minimize inductance and thermal resistance

- C1, C2, C4, C5: 100pF MIM capacitor
- RF In: 1 Gold Wire (25 $\mu$ m diameter Au)
- RF Out : 2 Gold Wires (25 $\mu$ m diameter Au)
- C3, C6 : SMD 1 $\mu$ F 0402 capacitor

**Ordering Information**

Product Code	Definition
VWA 5001135 AA	8 to 12GHz – 18dB – 1.0dB NF Low Noise Amplifier

**Associated Material**

Product Code	Definition
Packaged die	Contact factory
Die Evaluation Board (die EVB)	Contact factory
Packaged die Evaluation Board (packaged die EVB)	Contact factory
Mechanical files (DXF)	Contact factory
Measurements files (S2P)	Contact factory

**Product Compliance Information**

**Solderability :**

Use only AuSn (80/20) solder and limit exposure to temperature above 300 °C TO 3-4 minutes, maximum

**ESD Sensitivity Rating :**

Test : Human Body Model (HBM)  
Standard : JEDEC Standard JESD22-A114



**CAUTION ! ESD-Sensitive device**

**RoHS-Compliance :**

This part is compliant with EU 2011/65/ EU RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment).

This product also has the following attributes:

- Lead Free
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A (C15H12Br4O2) Free
- PFOS Free
- SVHC Free

**Contact Information**

For the latest specifications, additional product information, worldwide sales and distribution locations, and information about Vectrawave:

**Vectrawave SA**

5, rue Louis de Broglie  
22 300 Lannion - FRANCE

[www.vectrawave.com](http://www.vectrawave.com)

Email sales: [contact\\_sales@vectrawave.com](mailto:contact_sales@vectrawave.com)

Tel sales: +33 (0)2 57 63 00 20

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