Vectrawave
RF & Millimeter Wave MMIC Design

DC to 28GHz
Medium Power Amplifier

VM014D

General Description

The VM014D is a distributed amplifier designed on a 0.15µm pHEMT process. The device is capable of output voltage up to 8Vpp and has more than +23dBm of output power at saturation regime, up to 28GHz.

It provides more than +21dBm of output power at 1dB of gain compression, up to 20GHz. The linear gain is of 16dB from DC to 28GHz, with an excellent group delay. The design has been optimized to provide high efficiency. The supply current is as low as 200mA when operating with VD= +9V.

This device needs an RF Output external biastee to bias the drain and an RF Input external DC-Block.

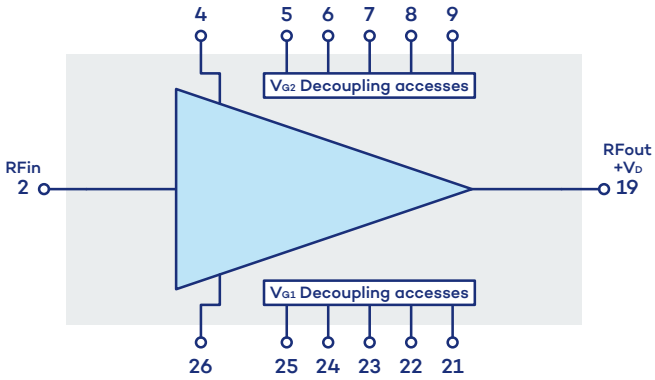
Features

Distributed amplifier pHEMT GaAs MMIC	
Wide band	**DC – 28GHz**
Flat group delay	**up to 32Gbps**
50ΩRF Single ended input and output	
DC coupled In, DC coupled Out	
High P1dB	**>+20dBm DC to 20GHz**
High Output P_{SAT}	**>+21dBm DC to 28GHz**
Small signal gain	**>16dB typ. DC to 28GHz**
Power supply	**200mA @ +9V**
Chip size	**3.02 x 1.77 x 0.1 (mm)**

Applications

- Wide Band Low Noise Amplifier
- Radar / ECM / ECCM
- Test and measurement
- E2O driver up to 32Gbps
- SONET / SDH.
- Broadband / datalink communication

Pins Assignement & Functional Block Diagram



Function	Pin number
RF in	2
V_{G2}	4
V_{G2} Decoupling access	5 / 6 / 7 / 8 / 9
RF out & V_D	19
V_{G1} Decoupling access	21 / 22 / 23 / 24 / 25
V_{G1}	26
Gnd	1 / 2 / 18 / 20

Electrical Specifications

Test conditions: unless otherwise noted
- T_{amb} = +25°C
- V_D = +9V
- V_G =+2V

Symbol	Parameter	Min	Typ	Max	Unit
F	Frequency range	DC		28	GHz
NF	Simulated Noise figure		4.5		dB
G	Small signal gain		16		dB
ΔG	Small signal gain flatness		+/-1		dB
S11	Input return loss		-12		dB
S22	Output return loss		-12		dB
P1dB	Output power @1dB compression	20	21		dBm
P_{SAT}	Saturated output power		23		dBm
I_D	Drain current		200		mA

Environmental parameters

Symbol	Parameter	Min	Max	Unit
Tst	Storage temperature	-55	+85	°C
Top	Operating temperature	-40	+85	°C

Absolute Maximum Ratings

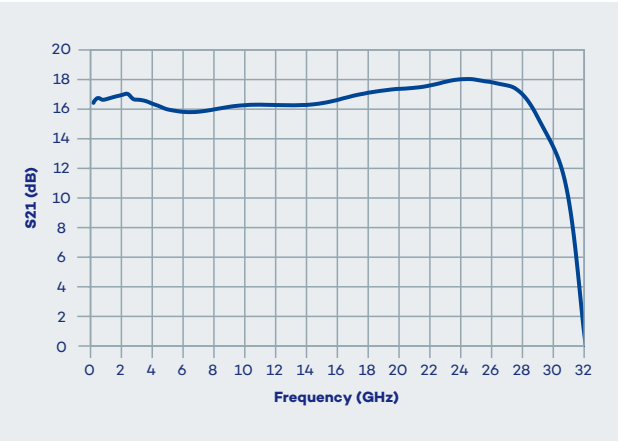
Symbol	Parameter	Min	Max	Unit
V_D	Drain voltage		9.5	V
V_{G2}	Gate control input access for second stage	-1	V_D/2	V
V_{G1}	Gate control input access for first stage	-1.5	0.15	V
Pin	RF input power		+20	dBm
Pcw	Continuous power dissipation		2	W
Tprocess	Temperature process max 20 seconds		+325	°C

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

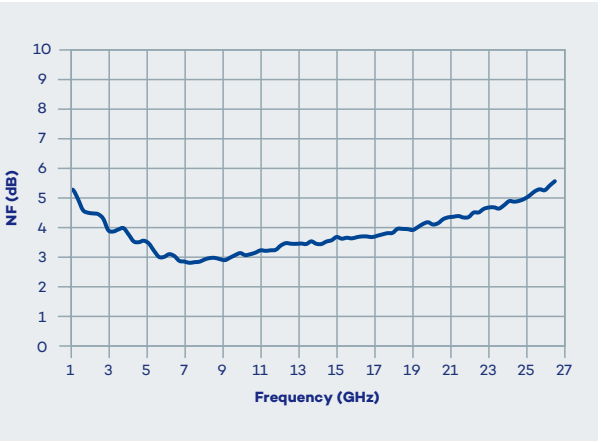
Typical Performance
(Test Under Probes)

Measured assembly: see assembly diagram (except for RF Input and RF Output pads)
- T_{amb} = +25°C
- V_D = +9V
- V_{G1} = 0V, V_{G2} = +2V
- I_D = 200mA

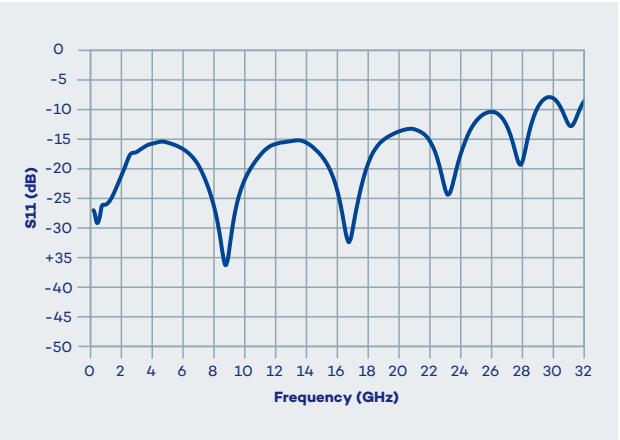
Small Signal Gain



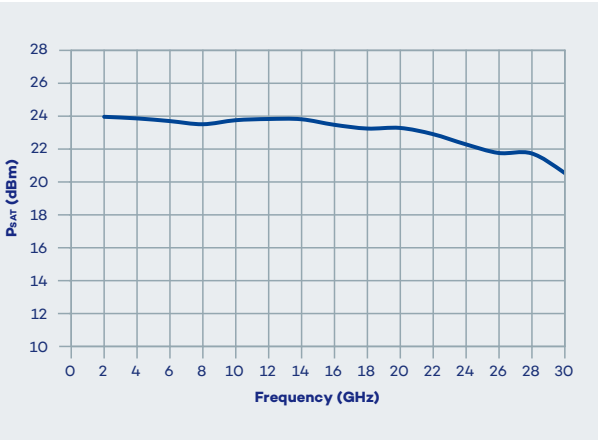
Noise Figure



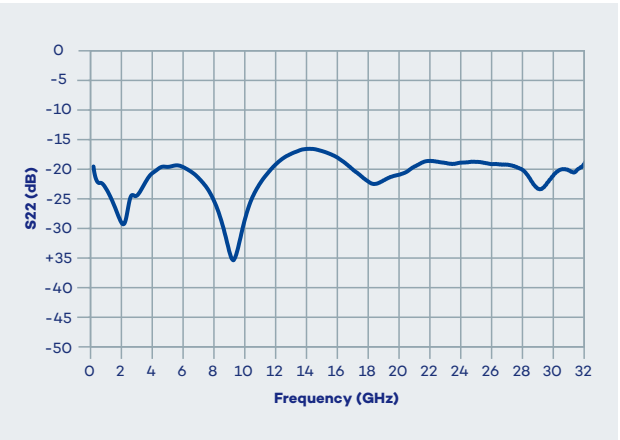
Input Return Loss



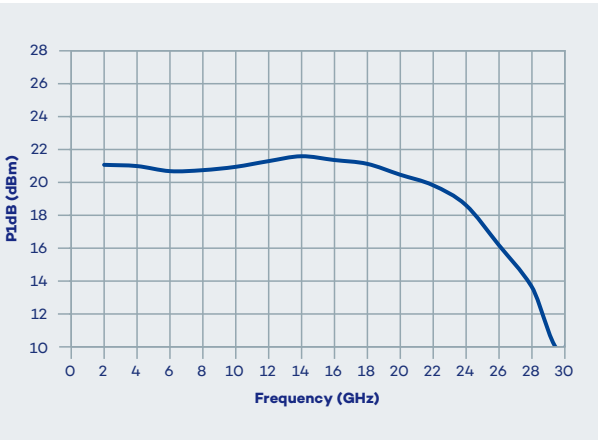
Saturated Output Power



Output Return Loss



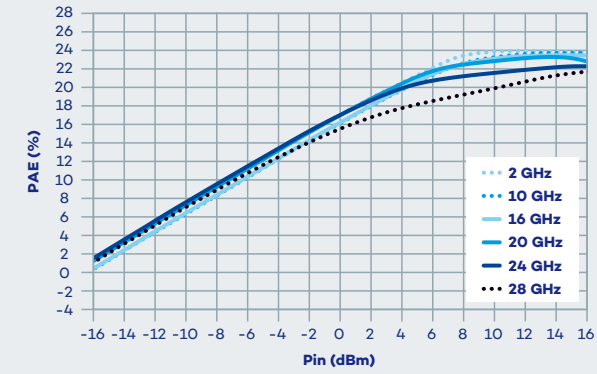
Output P1dB



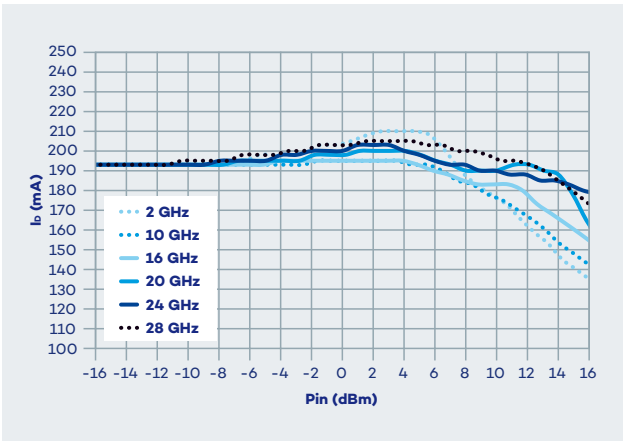
Typical Performance
(Test Under Probes)

Measured assembly: see assembly diagram (except for RF Input and RF Output pads)
- T_{amb} = +25°C
- V_D = +9V
- V_{G1} = 0V, V_{G2} = +2V
- I_D = 200mA

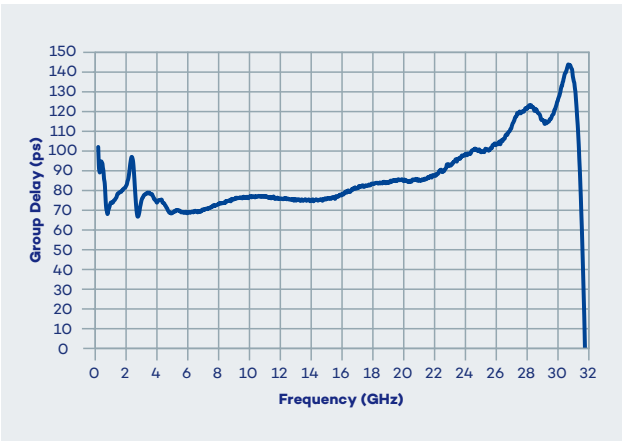
Output Power vs Input Power for various Frequency



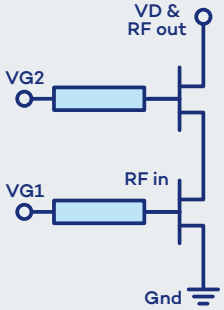
Drain Current vs Input Power for various Frequency



Group Delay



Pin description

Pin number	Name	Description	Electrical interface
2	RF in	Amplifier input, this access is DC coupled and internally matched to 50 Ohms	
4	V_{G2}	Gate control input access for second stage distributed amplifier structure. Apply +2.5V for nominal biasing conditions.	
5, 6, 7, 8, 9	D0 to D4	Decoupling accesses. These 5 accesses must be connected to a same MIM 100pF or 1000pF capacitor, with a low serial inductance bonding wire.	
19	RF out	RF Amplifier output, this access is DC coupled and internally matched to 50 Ohms . It is also used to bias the drain current (ID), by using a wide bandwidth external Bias-T structure.	
26	V_{G1}	Gate control input access for first stage distributed amplifier structure. Must be connected to a MIM 100pF or 1000pF capacitor, with a low serial inductance bonding wire. It can also be directly connected to the ground reference plane.	
21, 22, 23, 24, 25	G0 to G4	V_{G1} decoupling accesses. This 5 accesses must be connected to V_{G1}	
Die Bottom	Gnd	Die must be connected to RF and DC Ground	

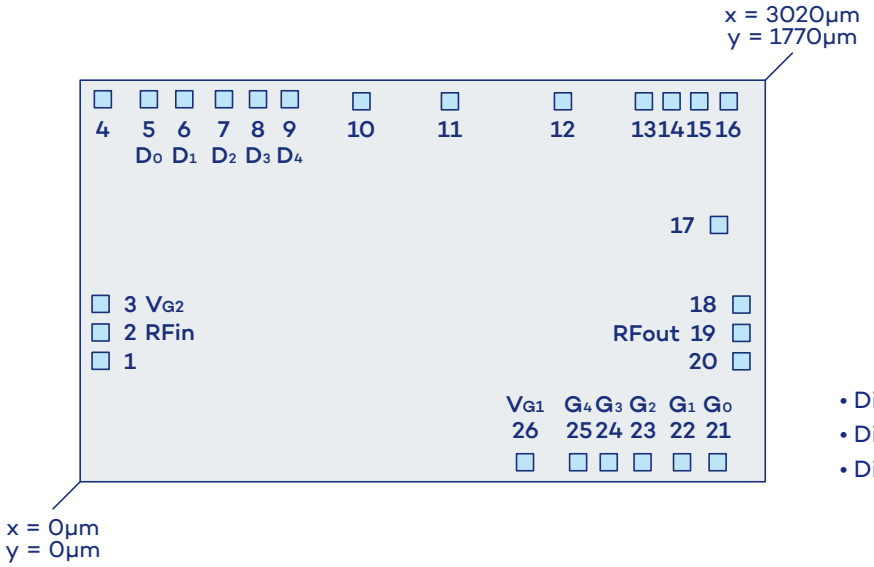
Bias-up procedure

1. Apply V_D = +9V
2. Apply V_{G2} = +2V
3. Turn on RF signal

Bias-down procedure

1. Turn off RF signal
2. Reduce V_{G2} = 0V
3. Reduce V_D = 0V

Die Layout & Pin Out



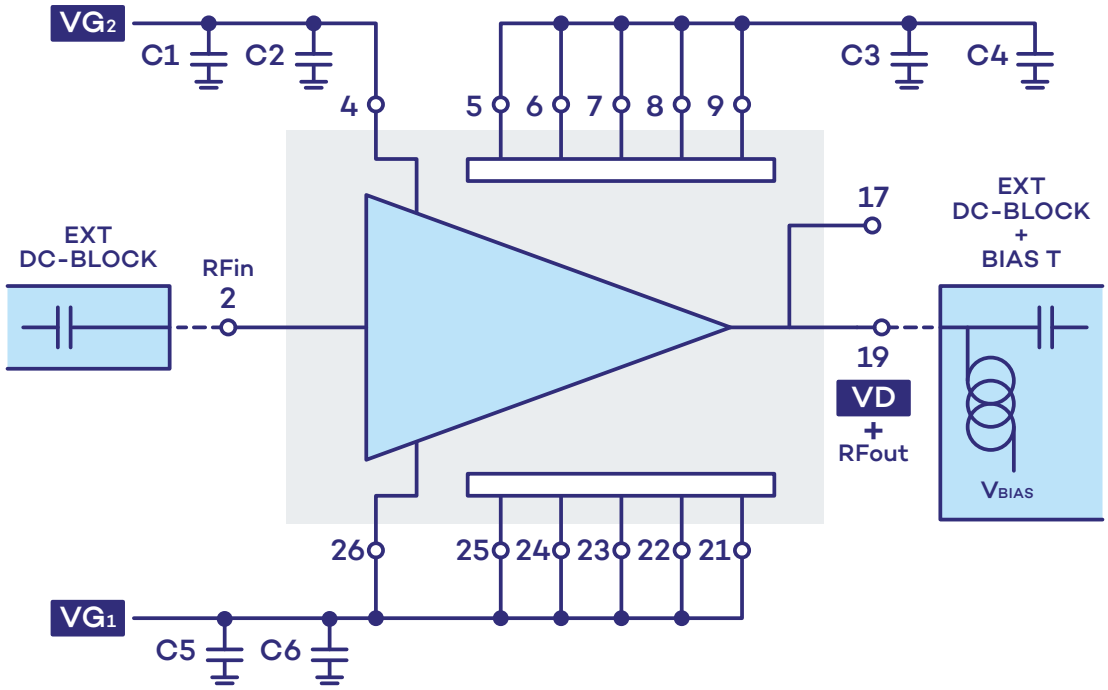
- Die size = 3020µm x 1770µm
- Die thickness = 100µm
- Die size tolerance = 50µm

Pad number	Pad center X (µm)	Pad center Y (µm)	Size (µm x µm)	Name	Function
1	90	533	75 x 75	Gnd	
2	90	658	75 x 75	RFin	RF Input
3	90	784	75 x 75	V_{G2}	Gate Bias
4	100	1686	75 x 75	Gnd	
5	303	1686	75 x 75	D0	
6	459	1686	75 x 75	D1	
7	634	1686	75 x 75	D2	
8	784	1686	75 x 75	D3	
9	924	1686	75 x 75	D4	
10	1240	1677	75 x 75	Reserved	
11	1630	1677	75 x 75	Reserved	
12	2128	1677	75 x 75	Reserved	
13	2485	1677	75 x 75	Reserved	
14	2607	1677	75 x 75	Reserved	
15	2729	1677	75 x 75	Reserved	
16	2859	1677	75 x 75	Reserved	
17	2816	1132	75 x 75	Reserved	
18	2915	781	75 x 75	Gnd	
19	2915	656	75 x 75	RFout	RF Output
20	2915	531	75 x 75	Gnd	
21	2810	86	75 x 75	G0	
22	2653	86	75 x 75	G1	
23	2479	86	75 x 75	G2	
24	2330	86	75 x 75	G3	
25	2195	86	75 x 75	G4	
26	1961	86	75 x 75	V_{G1}	Gate Bias

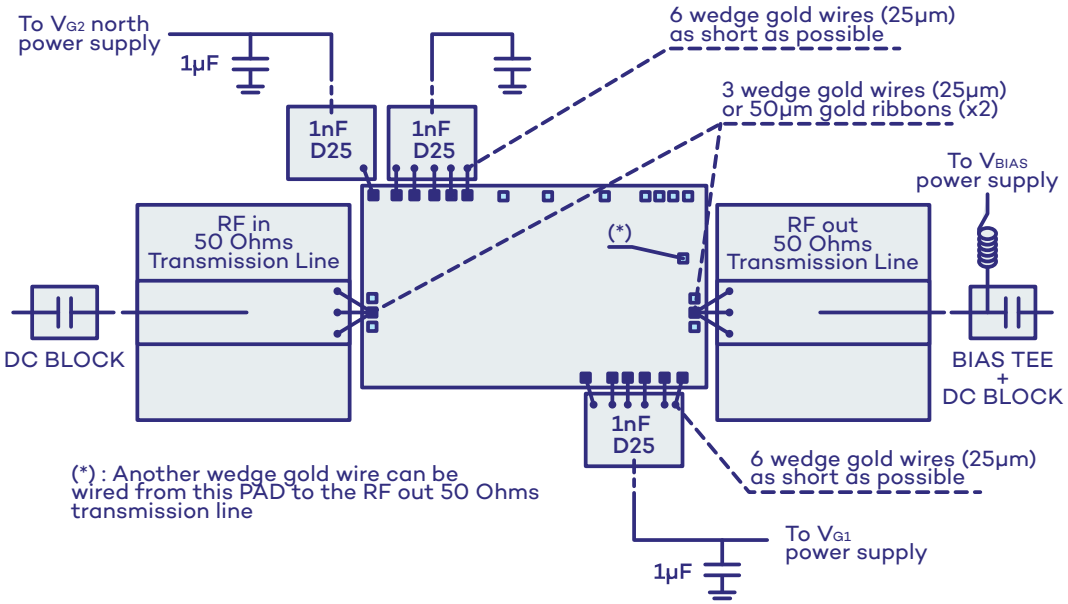
- Die bottom must be connected to ground (RF and DC)

Application circuit

- C1, C4 and C5 = 1µF
- C2, C3 and C6 = 1nF capacitors are MIM type and must be placed as close as possible to the die access.



Typical Assembly Diagram



Ordering information

Product Code	Parameter
VM014D	DC to 28GHz Medium Power Amplifier

Associated Material

- Packaged die
- Die Evaluation Board (die EVB)
- Packaged die Evaluation Board (packaged die EVB)
- Mechanical files (DXF)
- Measurents files (S2P)

Product Compliance Information

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

ESD Sensitivy Rating
Test: Human Body Model (HBM)
Std: JEDEC Standard JESD22-A114

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).

Other attributes
- Lead Free
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A (C15H12Br402) Free
- PFOS Free
- SVHC Free

Contact information

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

vectrawave.com
+33 (0)2 57 63 00 20
sales@vectrawave.com

Vectrawave Device
5, rue de Louis de Broglie
22300 Lannion
France