

Wideband, Microwave, 0.5W

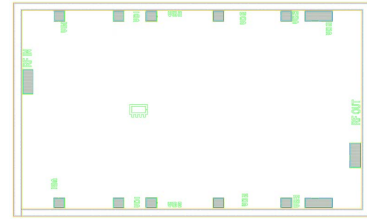
# Monolithic Amplifier Die

**AVM-273HP-D+**

50Ω    13 to 26.5GHz

## The Big Deal

- Wideband 13 to 26.5 GHz
- Output power up to +27dBm
- Excellent directivity, 58 dB typ. @ 20 GHz
- Unconditionally stable
- Excellent gain flatness,  $\pm 1.1$  dB
- Sequencing and DC Control module (VCM-1+) is available



## Product Overview

Mini-Circuits AVM-273HP-D+ is a three stage balanced, wideband monolithic amplifier die delivering up to 0.5W power and operating over 13 to 26.5 GHz. It is designed using PHEMT technology and is unconditionally stable. Its outstanding isolation enables it to be used as a wideband isolation amplifier or buffer amplifier in a variety of microwave systems including point to point radios, military EW and radar, DBS, and VSAT.

## Key Features

Feature	Advantages
Wideband	Wide frequency coverage up to 26.5 GHz supports many microwave applications.
Pout up to +27 dBm	Can be used as a low-cost driver for high power amplifiers.
Excellent active directivity, 58 dB @ 20 GHz (directivity = isolation – gain)	Can be used as an inter-stage isolation amplifier, minimizing interaction of adjacent components.
Voltage Sequencing and DC control module (VCM-1+) - sold separately	Provides correct voltage sequence and DC control, as well as reverse polarity protection replacing over 20 discrete components and greatly simplifying circuit design.
Unpackaged Die	Enables user to integrate amplifier directly into hybrids.



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# Monolithic Amplifier Die

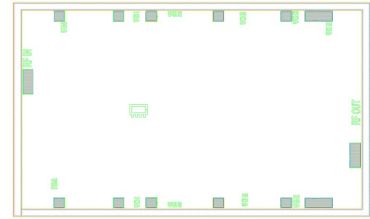
AVM-273HP-D+

## Product Features

- Gain, 13 dB typ.
- Output Power, up to +27 dBm typ.
- Excellent directivity, 58 dB typ. at 20 GHz
- Unconditionally Stable

## Typical Applications

- Point to Point Radio
- Military EW and Radar
- DBS
- VSAT
- Wideband Isolation amplifier



### +RoHS Compliant

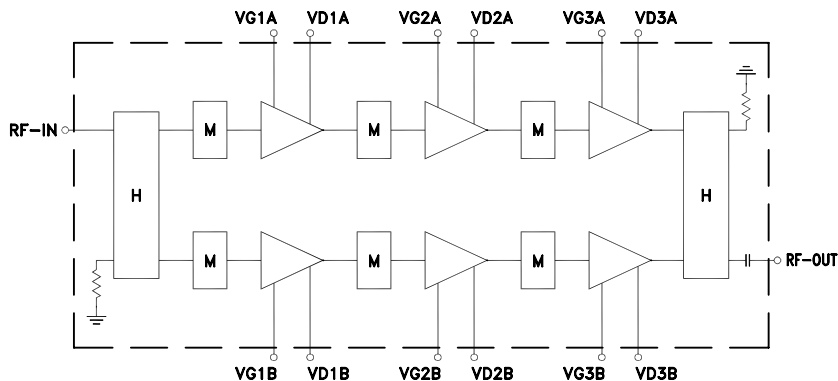
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Ordering Information: Refer to Last Page

## General Description

The AVM-273HP-D+ is a three stage balanced wideband monolithic amplifier die delivering up to 0.5W power operating over 13 to 26.5 GHz. It is manufactured using PHEMT technology and is unconditionally stable. Its outstanding isolation enables it to be used as a wideband isolation amplifier or buffer amplifier in a variety of microwave systems.

## Simplified Schematic



Notes:

H - 90° Hybrid

M - Matching Network



**Electrical Specifications <sup>(1)</sup> at 25°C, Zo=50Ω, (refer to characterization circuit, Fig.1)**

Parameter	Condition (GHz)	Min.	Typ.	Max.	Units.
Frequency Range		13.0		26.5	GHz
DC Voltage (VD1 to VD3 (A)&(B)) ⚠			5.0		V
DC Voltage (VG1 to VG3 (A)&(B)) ⚠			-0.8		V
DC Current (ID1+ID2+ID3; (A)&(B))		525	561	590	mA
DC Current (IG1+IG2+IG3; (A)&(B))			0.5		mA
Gain	13.0	—	13.6		dB
	14.0	—	12.8		
	15.0	—	12.6		
	16.0	—	12.9		
	17.0	—	13.5		
	18.0	—	13.9		
	20.0	—	14.1		
	24.0	—	12.2		
Input Return Loss	13.0		21.7		dB
	14.0		21.0		
	15.0		20.7		
	16.0		15.5		
	17.0		14.4		
	18.0		12.7		
	20.0		13.0		
	24.0		18.6		
Output Return Loss	13.0		24.8		dB
	14.0		20.6		
	15.0		18.4		
	16.0		16.7		
	17.0		14.4		
	18.0		12.2		
	20.0		14.1		
	24.0		12.8		
Directivity (Isolation- Gain)	13.0		54		dB
	14.0		54		
	15.0		54		
	16.0		54		
	17.0		54		
	18.0		54		
	20.0		54		
	24.0		54		
Output Power @ 1 dB compression	13.0		23.8		dBm
	14.0		25.1		
	15.0		25.8		
	16.0		26.6		
	17.0		27.2		
	18.0		26.9		
	20.0		27.3		
	24.0		26.9		
OIP3	13.0		30.8		dBm
	14.0		33.1		
	15.0		33.7		
	16.0		34.8		
	17.0		34.4		
	18.0		34.8		
	20.0		33.2		
	24.0		31.3		
Noise Figure	13.0		10.8		dB
	14.0		10.5		
	15.0		10.2		
	16.0		9.8		
	17.0		9.6		
	18.0		9.4		
	20.0		9.4		
	24.0		9.4		
DC Current Variation vs. Voltage			0.135		mA/mV
Thermal Resistance at Tj=87°C			16.3		°C/W

1. Measured on Mini-Circuits Die characterization Test Board . See Characterization Test Circuit (Fig. 1), See cautionary note. ⚠

**Absolute Maximum Ratings<sup>(2)</sup>**

Operating Temperature <sup>(3)</sup>	-40°C to 85°C
Channel Temperature	136°C
DC Voltage-Drain @ VG=-0.8V <sup>(4)</sup>	+6 V
DC Voltage-Gate @ VD=+5V <sup>(5)</sup>	-6 V
Power Dissipation	3.1 W
DC Current	620 mA
Input Power (CW)	16 dBm
DC Voltage on RF-OUT PADS (@VD=5V & VG=-0.8V)	+10V

Notes:

- Permanent damage may occur if any of these limits are exceeded. These maximum ratings are not intended for continuous normal operation. Measured in industry standard 5x5x1mm package.
- Defined with reference to ground pad temperature.
- VG=VG1, VG2, VG3 (A&B)
- VD= VD1, VD2, VD3 (A&B)

**Bias Sequence and Conditions**

**NOTE:** to prevent damage to the AVM-273HP-D+, and to ensure proper operation, all bias voltages must be applied in the following sequence for both Power On and for Power Off:

**Power ON**

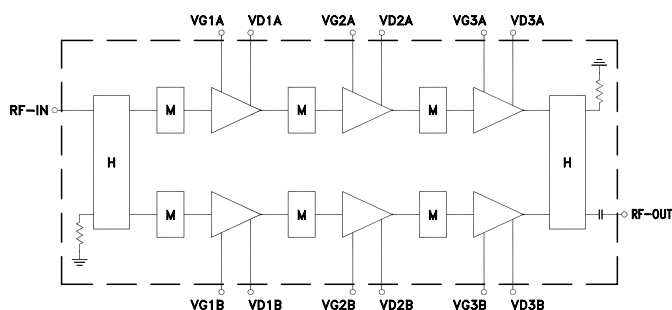
- Connect all Vg wires together (to ensure all stages are biased simultaneously).
- Connect all Vd wires together (to ensure all stages are biased simultaneously).
- Set Vg to -2V, apply Vg
- Set Vd to +5V, apply Vd
- Adjust Vg until the desired  $I_{dd}$  is reached (the typical Vg is around -0.8V).
- Apply RF signal.

**Power OFF**

- Turn OFF RF signal
- Set Vg to -2.0V
- Turn OFF Vd (Vd to 0V)
- Turn OFF Vg (Vg to 0V)

**ALTERNATELY** – VCM-1+ module provide voltage sequencing and DC control automatically.

Following these requirements are required for proper operation and are a condition of Mini-Circuits Warranty.

**Simplified Schematic and Pad Description**

Notes:

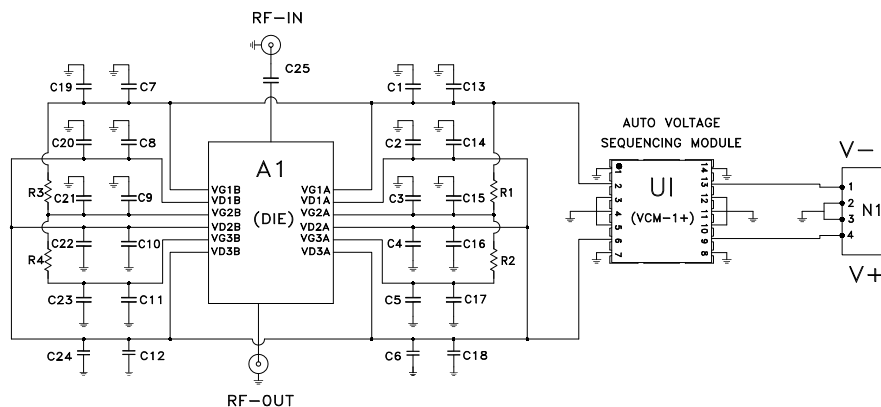
H - 90° Hybrid  
M - Matching Network



Pad Function	Description (See Application Circuit)
RF-In	RF Input
RF-Out	RF-Output (DC blocked)
VG1 A	Gate Voltage of first stage amplifier (Top)
VG2 A	Gate Voltage of second stage amplifier (Top)
VG3 A	Gate Voltage of third stage amplifier (Top)
VD1 A	Drain Voltage of first stage amplifier (Top)
VD2 A	Drain Voltage of second stage amplifier (Top)
VD3 A	Drain Voltage of third stage amplifier (Top)

Pad Function	Description (See Application Circuit)
VG1 B	Gate Voltage of first stage amplifier (Bottom)
VG2 B	Gate Voltage of second stage amplifier (Bottom)
VG3 B	Gate Voltage of third stage amplifier (Bottom)
VD1 B	Drain Voltage of first stage amplifier (Bottom)
VD2 B	Drain Voltage of second stage amplifier (Bottom)
VD3 B	Drain Voltage of third stage amplifier (Bottom)

## Characterization Test Circuit



COMPONENT	VALUE/ PART NUMBER	SIZE
A1	AVM-273HP-D+	-
U1	VCM-1+	-
N1	CONN VERTICAL HEADER 4 POS	-
C1, C6, C7, C12-C24	0.1 uF	.04 X .02
C2-C5, C8-C11	470 pF	.02 X .01
C25	0.1 uF	.04 X .02
R1-R4	0 Ohm	.08 X .05

**Fig. 1 Schematic of Test & Application Circuit**

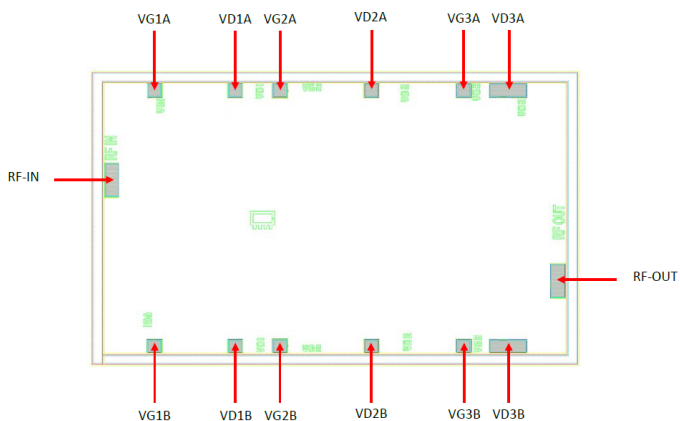
Test board used for characterization incorporates Current stabilization, automatic voltage sequencing, reverse voltage protection circuitry. Gain, Output power at 1dB compression (P1dB), Noise Figure, Output IP3 (OIP3) are measured using Agilent's N5247A PNA-X microwave network analyzer.

Conditions:

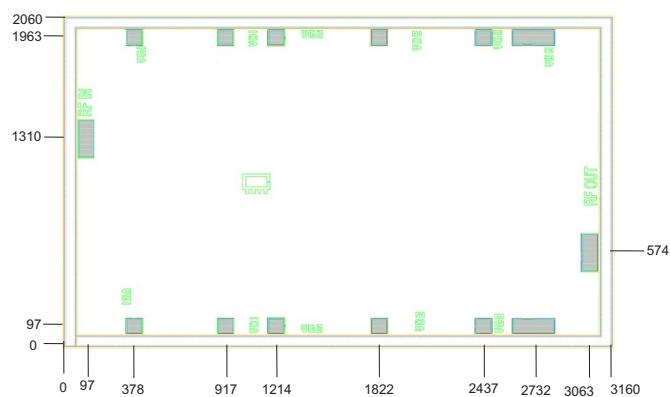
1. Gain: Pin=-25 dBm
2. Output IP3 (OIP3): Two tones, spaced 1 MHz apart, 0 dBm/tone at output.
3. V+ set to +6.1V to account for 1.1V drop in bias circuit resulting in +5V at drain (VD1 to VD3 (A&B))
4. V- is set to -5V to realize proper gate voltage (-0.8V typ.)

**NOTE 1:** The voltage sequencing and DC control circuit is available as a self-contained, surface mount module, see page 8

## Die Layout



**Fig 2. Die Layout**

Bonding Pad Position  
(Dimensions in  $\mu\text{m}$ , Typical)

**Fig 3. Bonding Pad Positions**

## Critical Dimensions

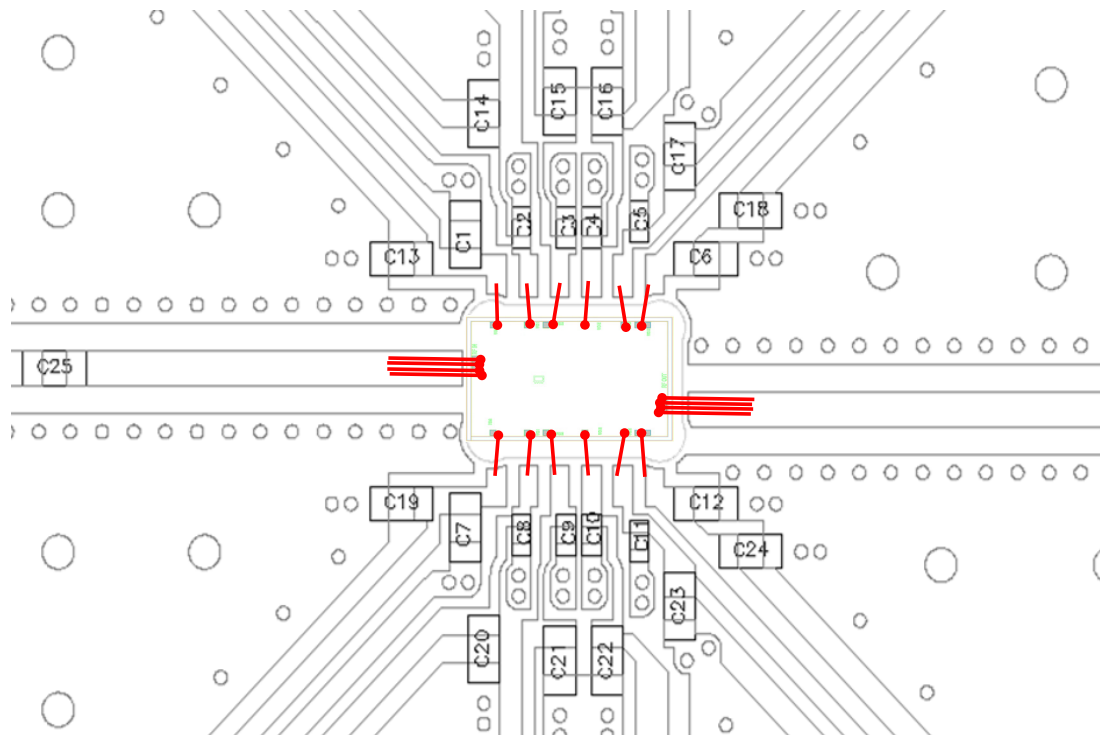
Parameter	Values
Die Thickness, $\mu\text{m}$	100
Die Width, $\mu\text{m}$	3160
Die Length, $\mu\text{m}$	2060
Bond Pad Size-RF IN, RF OUT, $\mu\text{m}$	100 x 250
Bond Pad Size - VD3, $\mu\text{m}$	250 x 100
Bond Pad Size - VD, VG, $\mu\text{m}$	100 x 100



## Assembly and Handling Procedure

1. Storage  
Dice should be stored in a dry nitrogen purged desiccators or equivalent.
2. ESD  
MMIC Gallium Arsenide (GaAs) amplifier dice are susceptible to electrostatic and mechanical damage. Die are supplied in antistatic protected material, which should be opened in clean room conditions at an appropriately grounded anti-static workstation. Devices need careful handling using correctly designed collets, vacuum pickup tips or sharp antistatic tweezers to deter ESD damage to dice.
3. Die Attach  
The die mounting surface must be clean and flat. Using conductive silver filled epoxy, recommended epoxies are DieMat DM6030HK-PT/H579 or Ablestik 84-1LMISR4. Apply sufficient epoxy to meet required epoxy bond line thickness, epoxy fillet height and epoxy coverage around total die periphery. Parts shall be cured in a nitrogen filled atmosphere per manufacturer's cure condition. It is recommended to use antistatic die pick up tools only.
4. Wire Bonding  
Bond pad openings in the surface passivation above the bond pads are provided to allow wire bonding to the dice gold bond pads. Thermosonic bonding is used with minimized ultrasonic content. Bond force, time, ultrasonic power and temperature are all critical parameters. Suggested wire is pure gold, 1 mil diameter. Bonds must be made from the bond pads on the die to the package or substrate. All bond wires should be kept as short as low as reasonable to minimize performance degradation due to undesirable series inductance.

## Assembly Diagram



Note: For component values, refer to Figure 1.  
Four 1mil bond wires should be used for RF-IN and RF-OUT.

### Recommended Wire Length, Typical

Wire	Wire Length (mm)	Wire Loop Height (mm)
RF-IN, RF-OUT, VD, VG	0.50	0.15

**Additional Detailed Technical Information***additional information is available on our dash board.*

Performance Data	Data Table	
	Swept Graphs	
	S-Parameter (S2P Files) Data Set with and without port extension(.zip file)	
Case Style	Die	
Die Ordering and packaging information	Quantity, Package	Model No.
	Small, Gel - Pak: 10,50,100 KGD*	AVM-273HP-DG+
	Medium†, Partial wafer: KGD*<360	AVM-273HP-DP+
	Large†, Full Wafer	AVM-273HP-DF+
	†Available upon request contact sales representative	
	Refer to <a href="#">AN-60-067</a>	
Environmental Ratings	ENV-80	

\*Known Good Dice ("KGD") means that the dice in question have been subjected to Mini-Circuits DC test performance criteria and measurement instructions and that the parametric data of such dice fall within a predefined range. While DC testing is not definitive, it does help to provide a higher degree of confidence that dice are capable of meeting typical RF electrical parameters specified by Mini-Circuits.

**ESD Rating\*\***

Human Body Model (HBM): Class 1C (1000 to <2000V) in accordance with ANSI/ESD STM 5.1 - 2001

Machine Model (MM): Class M2 (100 to <200V) in accordance with ANSI/ESD STM5.2-1999

\*\* Measured in 5x5x1 mm package

**Additional Notes**

- Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
- Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
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## VCM-1+



**+RoHS Compliant**  
The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

SEQ	Manufacturer P/N	Description	Manufacturer
Q1,Q2	MMBT3906	PNP Transistor	Fairchild Semiconductor
Q3	MMBT3904	NPN Transistor	Fairchild Semiconductor
Q4	NTS4101PT1G	P-Channel MOSFET	ON Semiconductor
D1	MMSZ5228BT1G	Zener Diode	ON Semiconductor
D2-D4	MBR0520LT1G	Schottky Diode	ON Semiconductor
C26,C27	GRM1555C1H101GA01D	0402 Capacitor, 100 pF, 2%	Murata Electronics
C28,C29	GRM188R71C105KA12D	0603 Capacitor, 1µF	Murata Electronics
R1,R2,R9,R10	RK73H1JTTD1002F	0603 Resistor, 10kΩ	KOA Speer
R3-R5	RK73H2BTTD3R32F	1206 Resistor, 3.32 Ω	KOA Speer
R6	RK73H1JTTD1000F	0603 Resistor, 100 Ω	KOA Speer
R7	RK73H1JTTD1501F	0603 Resistor, 1.5 kΩ	KOA Speer
R8	RK73H1JTTD1001F	0603 Resistor, 1.0 kΩ	KOA Speer
R11	RK73Z2BTTD	1206 Resistor, 0 Ω	KOA Speer