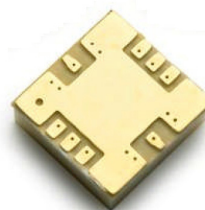


# AMMP-6232

18 to 32 GHz GaAs High Linearity LNA  
in SMT Package



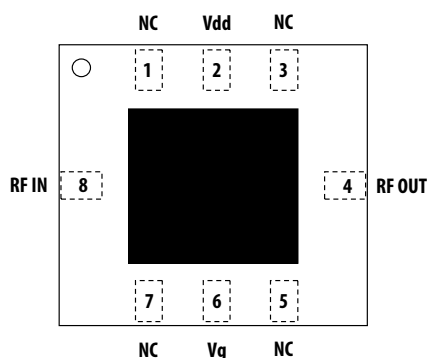
## Data Sheet



### Description

Avago's AMMP-6232 is an easy-to-use broadband, high gain, high linearity Low Noise Amplifier in a surface mount package. The wide band and unconditionally stable performance makes this MMIC ideal as a primary or sub-sequential low noise block or a transmitter driver. The MMIC has 4 gain stages and requires a 4V, 138mA power supply for optimal performance. Since this MMIC covers several bands, it can reduce part inventory and increase volume purchase options. The MMIC is fabricated using PHEMT technology. The surface mount package eliminates the need of "chip & wire" assembly for lower cost. This MMIC is fully SMT compatible with backside grounding and I/Os.

### Package Diagram



Note:

1. This MMIC uses depletion mode pHEMT devices.
2. Negative voltage is used for the gate bias

### Features

- Surface Mount Package, 5.0 x 5.0 x 1.25 mm
- Unconditionally Stable
- 50Ω Input and Output Match

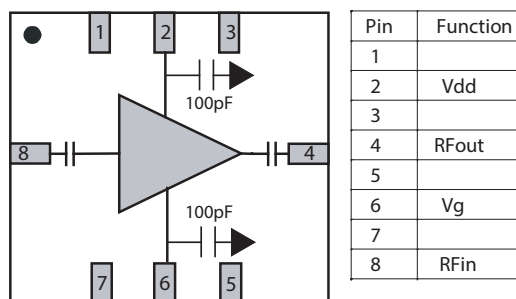
### Specifications (Vdd = 4.0V, Idd = 138mA)

- RF Frequencies: 18 - 32 GHz
- High Output IP3: 29dBm
- High Small-Signal Gain: 23dB
- Typical Noise Figure: 3dB

### Applications

- Microwave Radio systems
- Satellite VSAT, DBS Up/Down Link
- LMDS & Pt-Pt mmW Long Haul
- Broadband Wireless Access (including 802.16 and 802.20 WiMax)
- WLL and MMDS loops

### Functional Block Diagram



Top view

Package base: GND



**Attention: Observe precautions for handling electrostatic sensitive devices.**

ESD Machine Model (Class A) = 60V  
ESD Human Body Model (Class 1A) = 250V  
Refer to Avago Application Note A004R:  
Electrostatic Discharge, Damage and Control.

Note: MSL Rating = Level 2A

## Electrical Specifications

1. Small/Large -signal data measured in a fully de-embedded test fixture form  $T_A = 25^{\circ}\text{C}$ .
2. Pre-assembly into package performance verified 100% on-wafer per AMMC-6220 published specifications.
3. This final package part performance is verified by a functional test correlated to actual performance at one or more frequencies.
4. Specifications are derived from measurements in a  $50\ \Omega$  test environment. Aspects of the amplifier performance may be improved over a more narrow bandwidth by application of additional conjugate, linearity, or low noise ( $\Gamma_{\text{opt}}$ ) matching.
5. All tested parameters guaranteed with measurement accuracy  $\pm 1.5\ \text{dB}$  for gain and  $\pm 0.4\ \text{dB}$  for NF

**Table 1. RF Electrical Characteristics**

$T_A = 25^{\circ}\text{C}$ ,  $V_{\text{dd}} = 4.0\text{V}$ ,  $I_{\text{dd}} = 135\text{mA}$ ,  $Z_0 = 50\ \Omega$

| Parameter                                    | Min | Typ. | Max | Unit | Comment                         |
|--|-----|------|-----|------|---------------------------------|
| Small Signal Gain, Gain                      | 19  | 23   |     | dB   | Test Frequency = 20, 26, 29 GHz |
| Noise Figure into $50\ \Omega$ , NF          |     | 3    | 4.5 | dB   | Test Frequency = 20, 26, 29 GHz |
| Output Power at 1 dB Gain Compression, P-1dB |     | 18   |     | dBm  |                                 |
| Output Power at 3 dB Gain Compression, Psat  |     | 20   |     | dBm  |                                 |
| Output Third Order Intercept Point, OIP3     |     | 29   |     | dBm  |                                 |
| Isolation, Iso                               |     | -45  |     | dB   |                                 |
| Input Return Loss, RLin                      |     | -10  |     | dB   |                                 |
| Output Return Loss, RLout                    |     | -10  |     | dB   |                                 |

**Table 2. Recommended Operating Range**

1. Ambient operational temperature  $T_A = 25^{\circ}\text{C}$  unless otherwise noted.
2. Channel-to-backside Thermal Resistance ( $T_{\text{channel}}$  ( $T_c$ ) =  $34^{\circ}\text{C}$ ) as measured using infrared microscopy. Thermal Resistance at backside temperature ( $T_b$ ) =  $25^{\circ}\text{C}$  calculated from measured data.

| Description                           | Min. | Typical | Max. | Unit | Comments   |
|---------------------------------------|------|---------|------|------|--|
| Drain Supply Current, $I_{\text{dd}}$ |      | 135     | 150  | mA   | $V_d = 4.5\text{V}$ , Under any RF power drive and temperature |
| Drain Supply Voltage, $V_d$           | 3    | 4       | 5    | V    |  |
| Gate Bias Current, $I_g$              |      | 0.1     |      | mA   |  |
| Gate Bias Voltage, $V_g$              | -1.1 | -0.95   | -0.8 | V    |  |

**Table 3. Thermal Properties**

| Parameter                         | Test Conditions   | Value                                    |
|-----------------------------------|---|--|
| Thermal Resistance, $\theta_{jc}$ | Channel-to-backside Thermal Resistance $T_{channel}(T_c)=34^{\circ}\text{C}$<br>Thermal Resistance at backside temperature $T_b=25^{\circ}\text{C}$ | $\theta_{ch-b} = 35.1^{\circ}\text{C/W}$ |

**Absolute Minimum and Maximum Ratings****Table 4. Minimum and Maximum Ratings**

| Description                    | Pin | Min. | Max. | Unit               | Comments          |
|--------------------------------|-----|------|------|--------------------|-------------------|
| Drain to Ground Supply Voltage | Vdd |      | 5.5  | V                  |                   |
| Gate-Drain Voltage             | Vgd |      | -8   | V                  |                   |
| Drain Current                  | Idd |      | 200  | mA                 |                   |
| Gate Bias Voltage              | Vg  |      | +0.8 | V                  |                   |
| Gate Bias Current              | Ig  |      | 1    | mA                 |                   |
| RF CW Input Power              | Pin |      | 10   | dBm                |                   |
| Channel Temperature            |     |      | +150 | $^{\circ}\text{C}$ |                   |
| Storage Temperature            |     | -65  | +150 | $^{\circ}\text{C}$ |                   |
| Maximum Assembly Temperature   |     |      | +260 | $^{\circ}\text{C}$ | 20 second maximum |

Notes:

1. Operation in excess of any one of these conditions may result in permanent damage to this device.

## AMMP-6232 Typical Performance [1, 2]

( $T_A = 25^\circ\text{C}$ ,  $V_{dd}=4\text{V}$ ,  $I_{dd}=138\text{mA}$ ,  $Z_{in} = Z_{out} = 50\ \Omega$  unless noted)

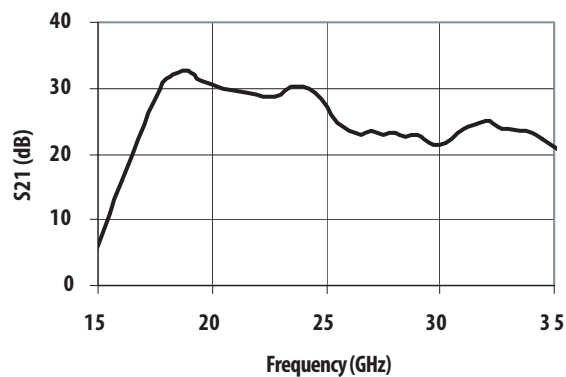


Figure 1. Small-signal Gain

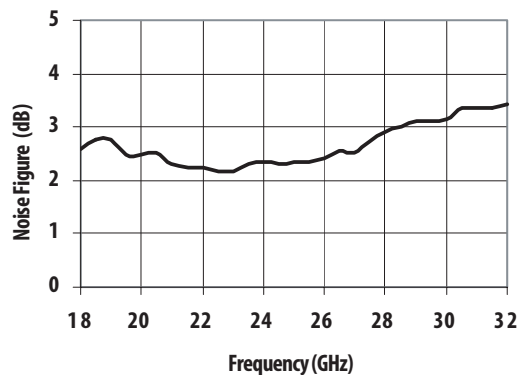


Figure 2. Noise Figure

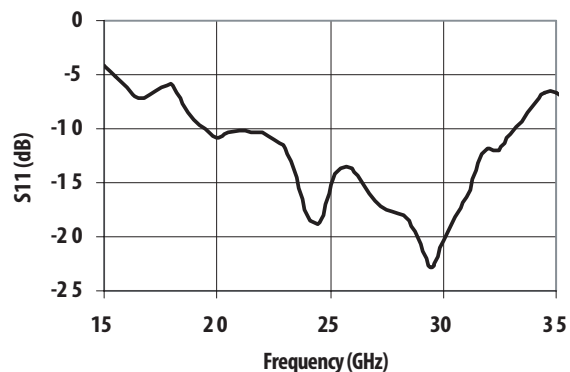


Figure 3. Input Return Loss

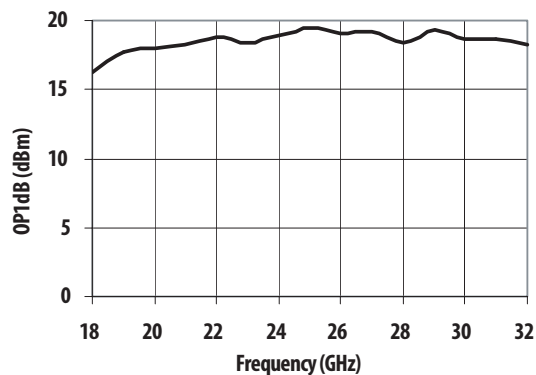


Figure 4. Output P-1dB

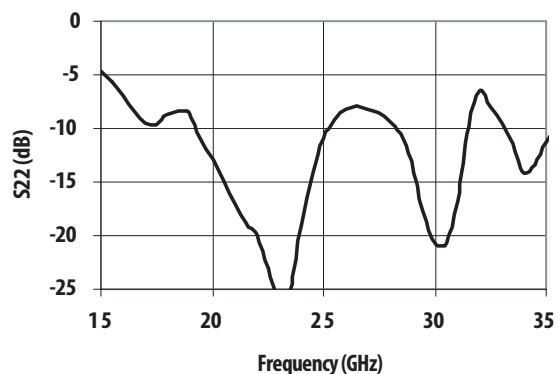


Figure 5. Output Return Loss

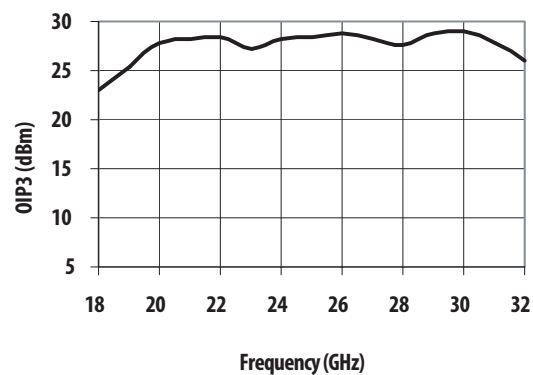


Figure 6. Output IP3

Note:

1. S-parameters are measured on R&D Eval Board as shown in Figure 20. Effects of connectors and board traces are included in results.
2. Noise Figure is measured on R&D Eval Board as shown in Figure 20, and with a 3dB pad at the input. Board and Connector losses are already de-embedded from the data.

## AMMP-6232 Typical Performance (cont.)

( $T_A = 25^\circ\text{C}$ ,  $V_{dd}=4\text{V}$ ,  $I_{dd}=138\text{mA}$ ,  $Z_{in} = Z_{out} = 50\ \Omega$  unless noted)

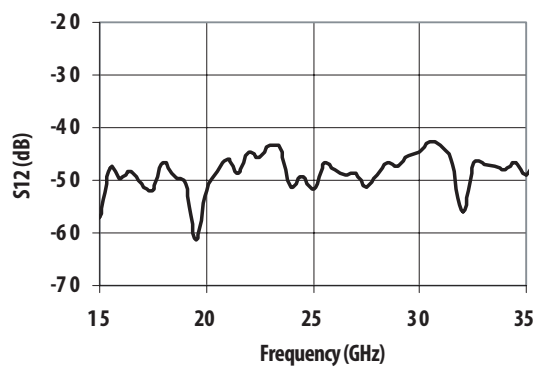


Figure 7. Isolation

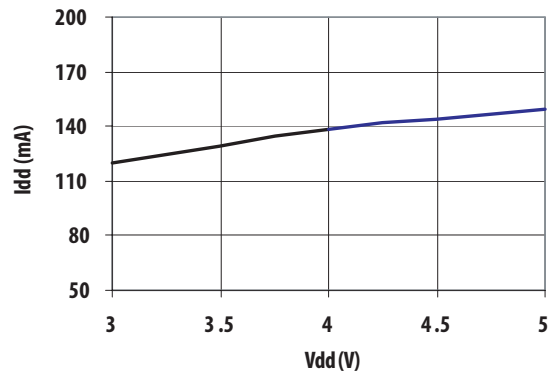


Figure 8. Total Current

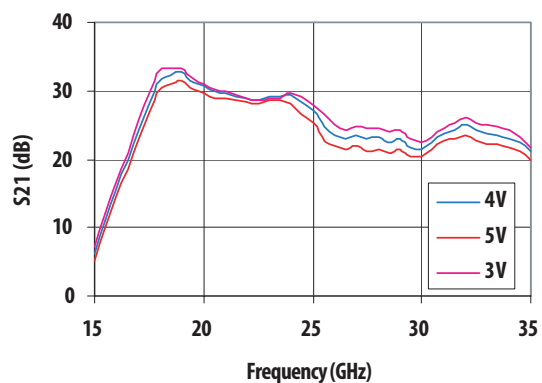


Figure 9. Gain over Vdd

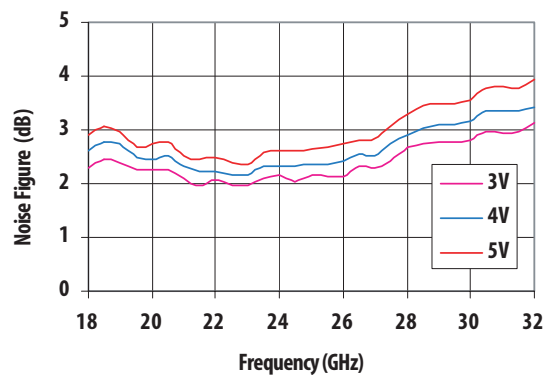


Figure 10. Noise Figure over Vdd

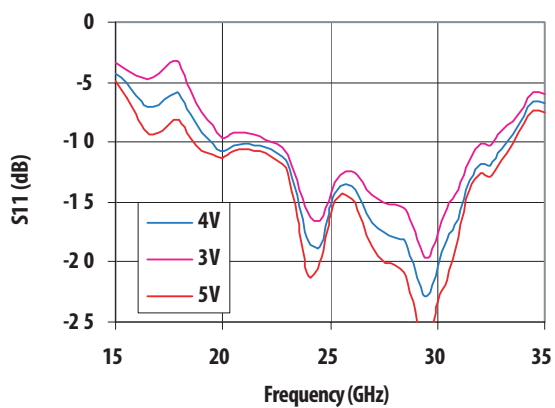


Figure 11. Input Return Loss Over Vdd

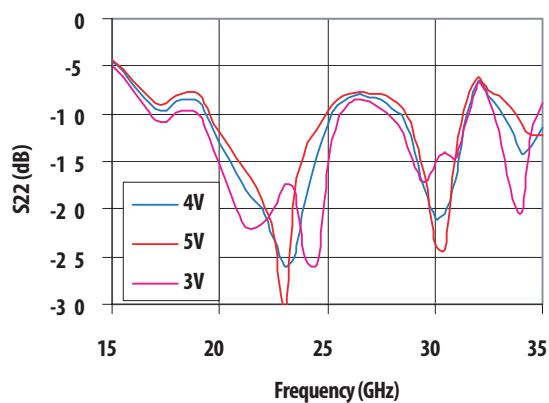


Figure 12. Output Return Loss Over Vdd

## AMMP-6232 Typical Performance (cont.)

( $T_A = 25^\circ\text{C}$ ,  $V_{dd}=4\text{V}$ ,  $I_{dd}=138\text{mA}$ ,  $Z_{in} = Z_{out} = 50\ \Omega$  unless noted)

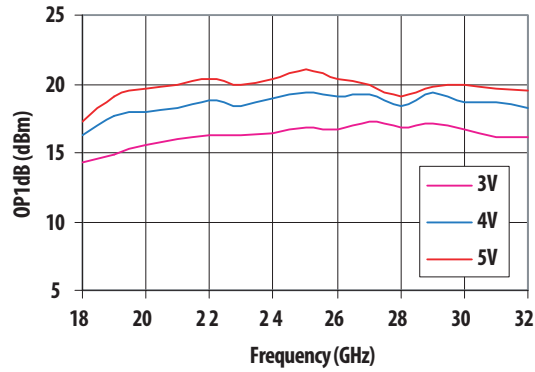


Figure 13. Output P-1dB over Vdd

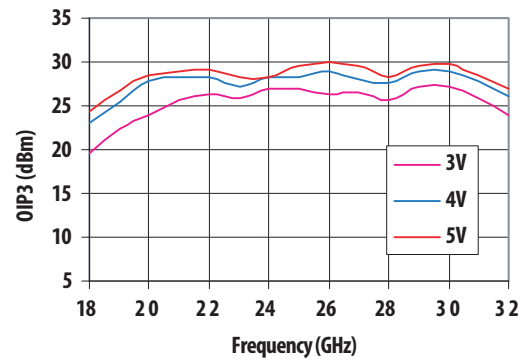


Figure 14. Output IP3 Over Vdd

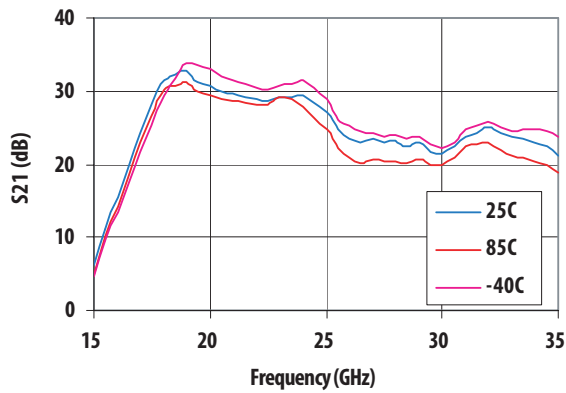


Figure 15. Gain over Temp

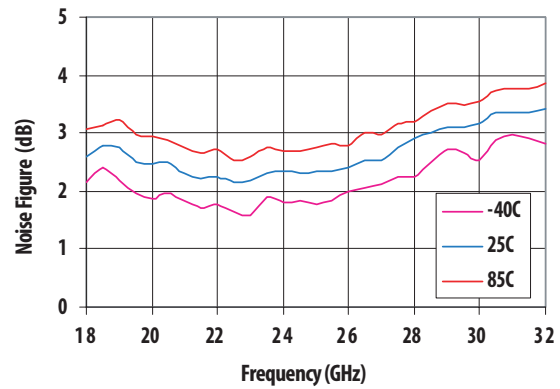


Figure 16. Noise Figure over Temp

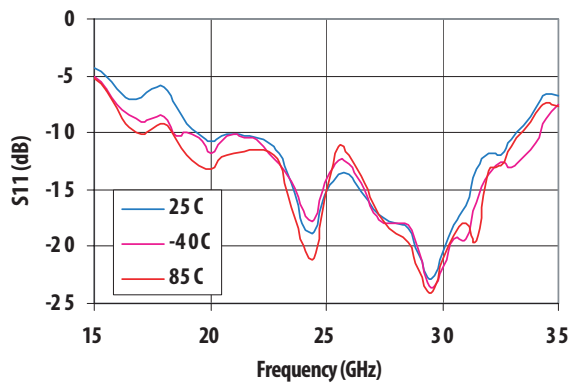


Figure 17. Input Return Loss Over Temp

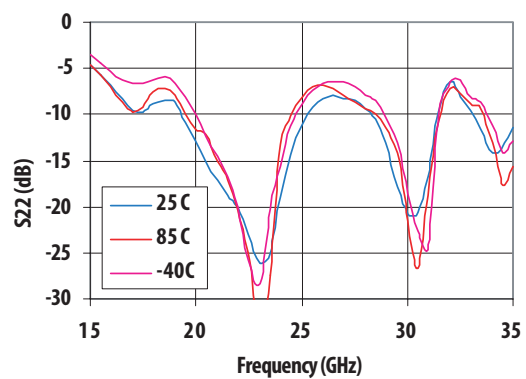
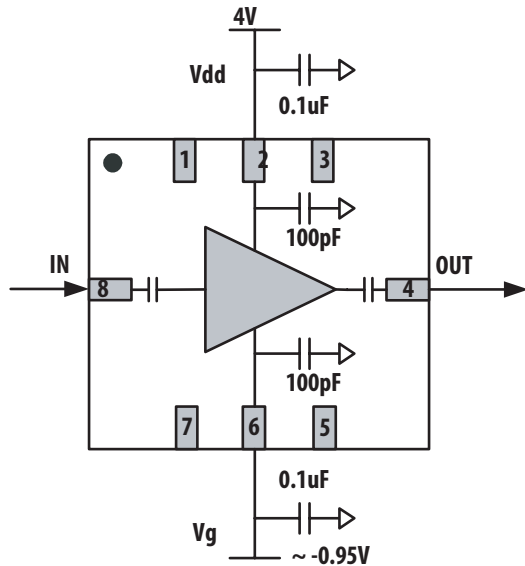


Figure 18. Output Return Loss Over Temp

## AMMP-6232 Application and Usage



Top View

Package base: GND

Figure 19. Usage of the AMMP-6232

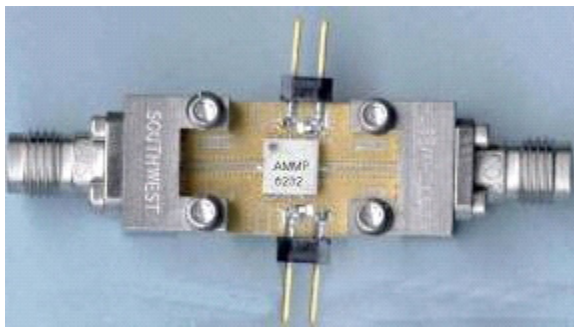


Figure 20. Evaluation/Test Board (available to qualified customer request)

## Biasing and Operation

The AMMP-6232 is normally biased with a positive drain supply connected to the VDD pin and a negative gate bias through bypass capacitors as shown in Figure 19. The recommended drain supply voltage is 4 V and the gate bias is approximately -0.95V to get the corresponding drain current of 138mA. It is important to have 0.1uF bypass capacitors and the capacitor should be placed as close to the component as possible. Aspects of the amplifier performance may be improved over a narrower bandwidth by application of additional conjugate, linearity, or low noise (Topt) matching.

After adjusting the gate bias to obtain 138mA at Vdd = 4V, the AMMP-6232 can be safely biased at 3V or 5V (while fixing the gate bias) as desired. At 4V, the performance is an optimal compromise between power consumption, gain and power/linearity. It is both applicable to be used as a low noise block or driver. At 3V, the amplifier is ideal as a front end low noise block where linearity is not highly required. At 5V, the amplifier can provide 1 to 2dBm more output power for LO or transmitter driver applications where high output power and linearity are often required.

Refer the Absolute Maximum Ratings table for allowed DC and thermal conditions.

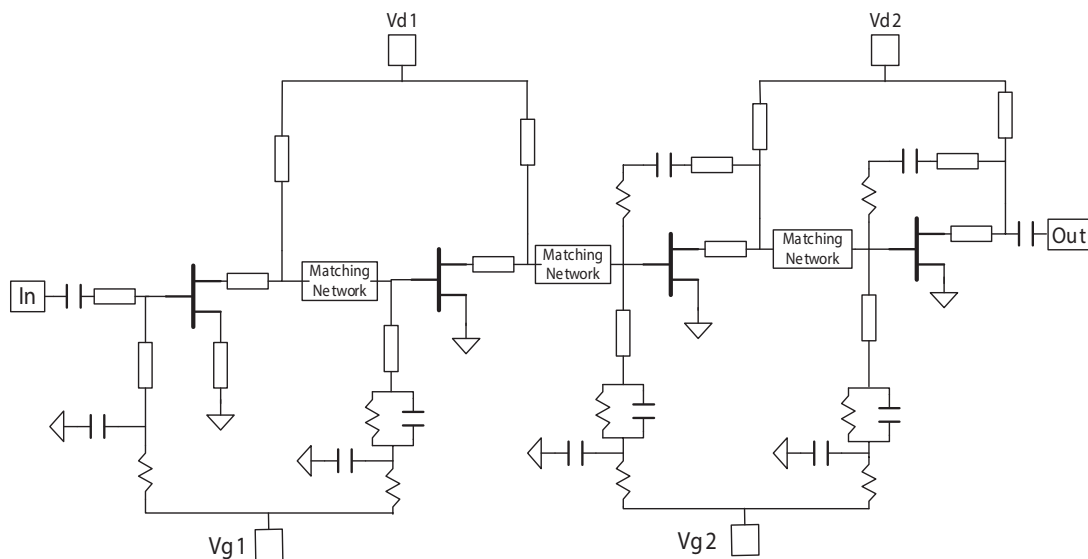


Figure 21. Simplified AMMP-6232 Schematic

## Typical Scattering Parameters

Please refer to <<http://www.avagotech.com>> for typical scattering parameters data.

## Package Dimension, PCB Layout and Tape and Reel information

Please refer to Avago Technologies Application Note 5520, AMxP-xxxx production Assembly Process (Land Pattern A).

## AMMP-6232 Part Number Ordering Information

| Part Number    | Devices Per Container | Container      |
|----------------|-----------------------|----------------|
| AMMP-6232-BLKG | 10                    | Antistatic bag |
| AMMP-6232-TR1G | 100                   | 7" Reel        |
| AMMP-6232-TR2G | 500                   | 7" Reel        |

For product information and a complete list of distributors, please go to our web site: [www.avagotech.com](http://www.avagotech.com)

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AV02-0491EN - July 8, 2013

