# VMMK-1225
## 0.5 to 26 GHz Low Noise E-PHEMT in a Wafer Scale Package

## Data Sheet

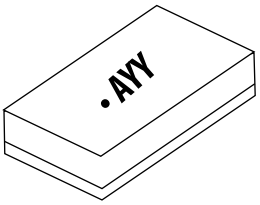
Lead (Pb) Free
RoHS 6 fully compliant

### Description

Avago Technologies has combined it's industry leading E-pHEMT technology with a revolutionary chip scale package. The VMMK-1225 can produce an LNA with high dynamic range, high gain and low noise figure that operates off of a single position DC power supply. The GaAsCap wafer scale sub-miniature leadless package is small and ultra thin, yet can be handled and placed with standard 0402 pick and place assembly.

The use of 0.25 micron gates allow a ultra low noise figure (below 1dB from 500 MHz to 12 GHz) with respectable associated gain. With a flat transconductance over bias and frequency the VMMK-1225 provides excellent linearity of over 22 dBm and power over 10 dBm at one dB compression. This product is easy to use since it requires only positive DC voltages for bias and low matching coefficients for simple impedance matching to 50 Ω systems. The VMMK-1225 is intended for any 500MHz to 26.5GHz application including 802.11abgn WLAN, WiMax, BWA 802.16 & 802.20 and military applications.

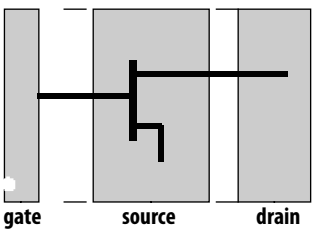
### WLP 0402, 1mm x 0.5mm x 0.25 mm





Pin Connections (Top View)

Notes: Top view package marking provides orientation




Notes:
"A" = Device Code
"YY" = Year Code

### Features

- Sub-miniature 0402 (1mm x 0.5mm) Surface Mount Leadless Package
- Low height (0.25mm)
- Frequency Range DC to 26.5 GHz
- Enhancement Mode[1]
- 0.25 micron gate length
- Tape and Reel packaging option available

### Specifications

- 0.87dB Fmin
- 11dB Ga
- +23 dBm output 3rd order intercept
- +8 dBm output power

### Applications

- 2.4 GHz, 3.5GHz, 5-6GHz WLAN and WiMax notebook computer, access point and mobile wireless applications
- DBS 10 to 13 GHz receivers
- VSAT and SATCOM 13 to 18 GHz systems
- 802.16 & 802.20 BWA systems
- WLL and MMDS Transceivers
- General purpose discrete E-pHEMT for other ultra low noise applications

Notes:
1. The Avago enhancement mode pHEMT devices do not require a negative gate bias voltage as they are "normally off". They can help simplify the design and reduce the cost of receivers and transmitters in many applications from 500 MHz to 18 GHz

**Attention: Observe precautions for handling electrostatic sensitive devices.**
ESD Machine Model = 20 V (class A)
ESD Human Body Model = 100 V (Class 0)
*Refer to Avago Application Note A004R: Electrostatic Discharge, Damage and Control.*

## VMMK-1225 Absolute Maximum Ratings

| Sym | Parameters/Condition | Unit | Max |
|---|---|---|---|
| Vds | Drain-Source Voltage[2] | V | 5 |
| Vgs | Gate-Source Voltage[2] | V | -5 to 1 |
| Vgd | Gate-Drain Voltage[2] | V | -5 to 1 |
| Ids | Drain Current[2] | mA | 50 |
| Igs | Gate Current | mA | 0.8 |
| Pdn | Total Power Dissipation[3] | mW | 250 |
| Pin | RF CW Input Power Max | dBm | 10 |
| Tch | Max channel temperature | C | +150 |
| θjc | Thermal Resistance[4] | C/W | 200 |

Notes:
1. Operation in excess of any of these conditions may result in permanent damage to this device.
2. Assumes DC quiescent conditions
3. Ambient operational temperature $T_A$=25 °C unless otherwise noted.
4. Thermal resistance measured using 150 °C Liquid Crystal Measurement Method
5. The device can handle + 10 dBm RF input power provided Igs is limited to 1 mA

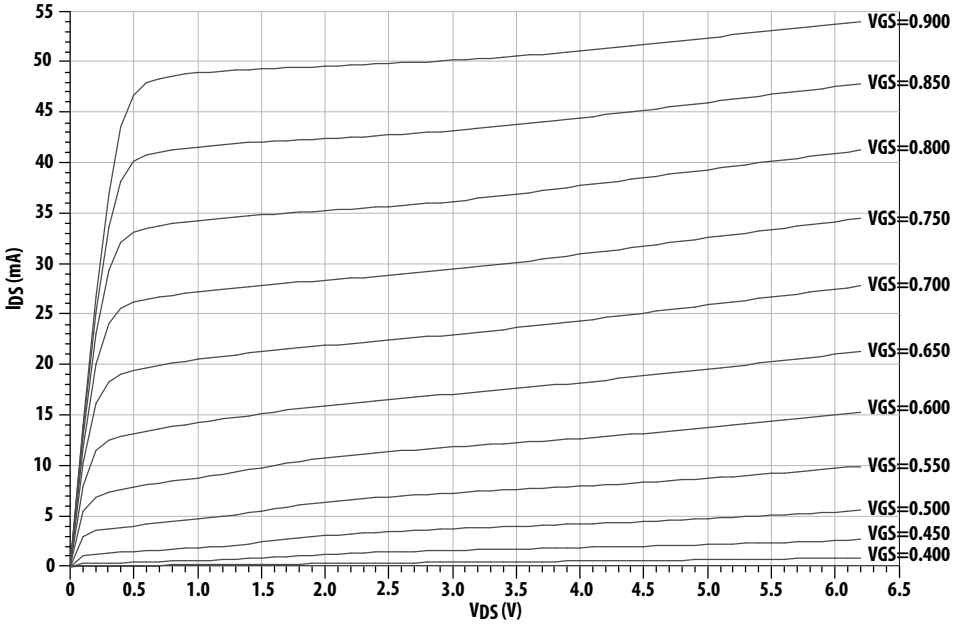



**Figure 1. Typical I-V Curves. (VGS=0.05 V per step)**

## VMMK-1225 RF Specifications (on board) [6,7]

$T_A$ = 25°C, Freq = 12 GHz, Vds = 2V & Ids = 20mA (unless otherwise specified)

| Sym | Parameters/Condition | Units | Min | Typ. | Max |
|---|---|---|---|---|---|
| Vgs | Gate Voltage | V | 0.58 | 0.68 | 0.78 |
| Igs | Gate Current | uA | | 2.0 | |
| Gm | Transconductance | mS | | 120 | |
| Ga | Associated Gain | dB | 8.7 | 11 | 12.2 |
| NF | Noise Figure | dB | | 1.0 | 2.3 |
| Fmin | Noise Figure min | dB | | 0.87 | |
| P-1dB | 1dB Compressed Output Power | dBm | | +8 | |
| OIP3 | Output 3rd Order Intercept Point | dBm | | +23 | |

Notes:
6. Specifications are derived from measurements in a test circuit.
7. All tested parameters guaranteed with measurement accuracy ± 0.5 dB for gain.

## Product Consistency Distribution Charts [1]

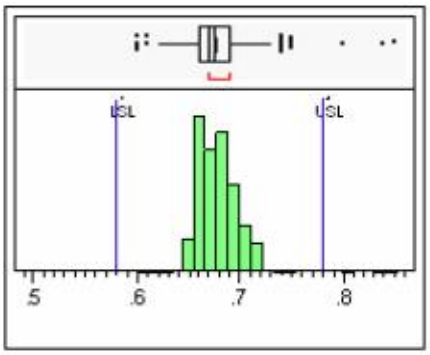



Figure 2. Gate Voltage @ Vds = 2V & Ids = 20mA, LSL=0.58, Nominal=0.67, USL=0.78, CPK=1.957

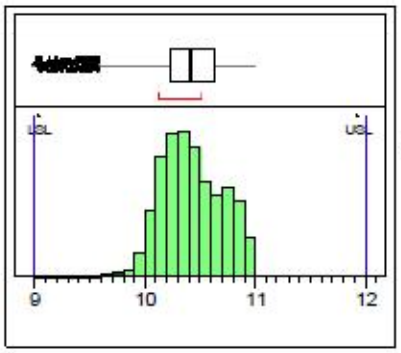



Figure 3. Gain @ 12 GHz, LSL=8.7, Nominal=10.4, USL=12.2, CPK=1.7

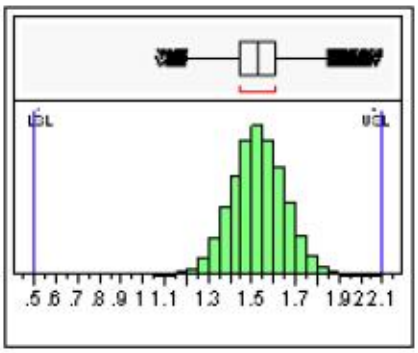



Figure 4. NF @ 12 GHz, Nominal=1.52, USL=2.3,CPK=1.55

Note:
1. Distribution data based at least 500 part sample size from two wafers during initial characterization of this product. Future wafers allocated to this product may have nominal values anywhere between upper and lower limits.

## VMMK-1225 Typical Performance Curve

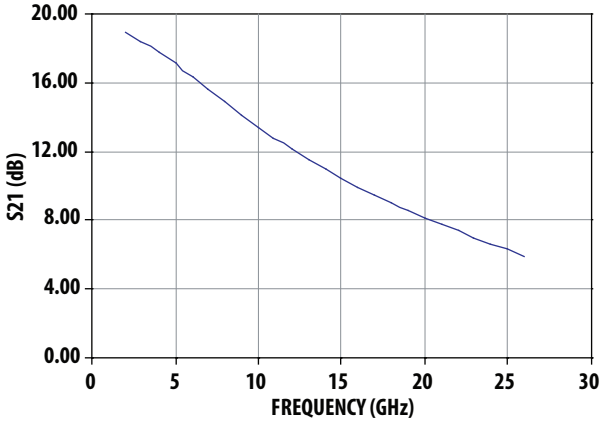



Figure 5. S21 vs. Frequency at 2V, 20mA

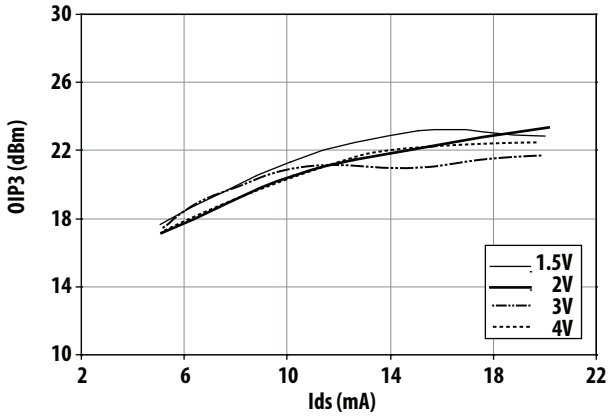



Figure 6. OIP3 and Ids at 12 GHz

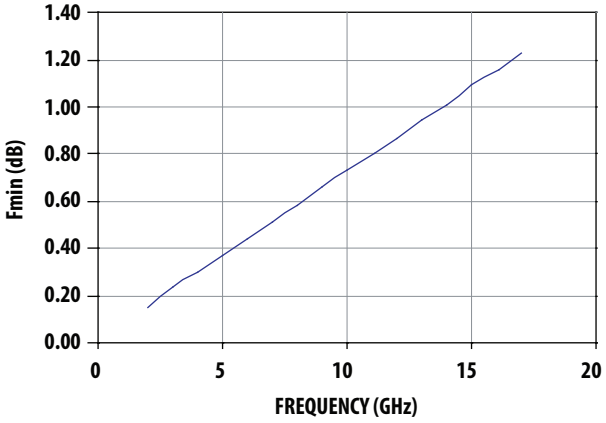



Figure 7. Fmin vs. Frequency at 2V, 20mA

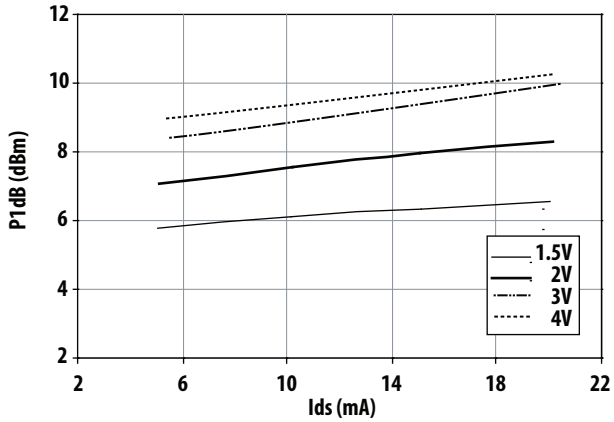



Figure 8. P1dB vs. Ids at 12 GHz

## VMMK-1225 Typical Performance Curve

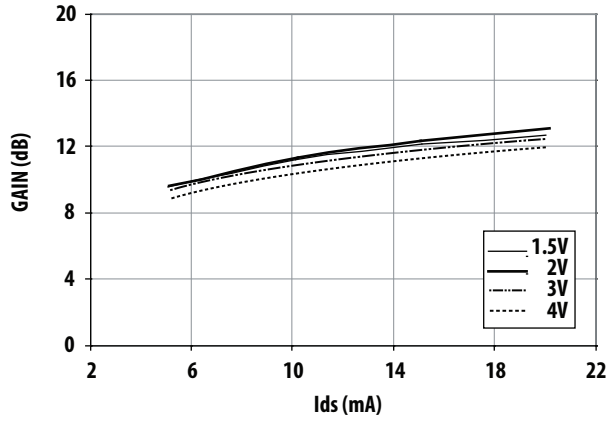



Figure 9. Gain vs. Ids at 12 GHz

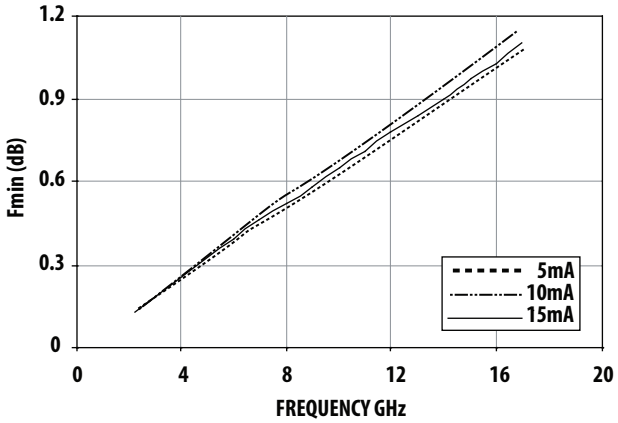



Figure 10. NFmin vs. Frequency at 2V

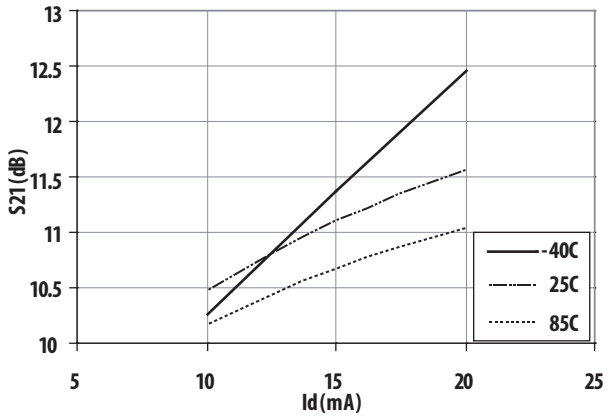



Figure 11. S21 vs. Ids at 12 GHz over temp at 2V

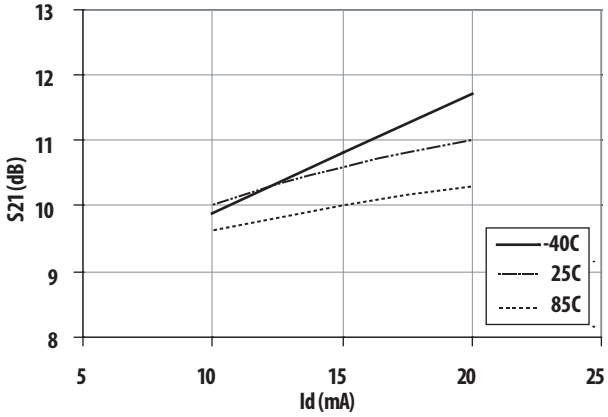



Figure 12. S21 vs. Ids at 12 GHz over temp at 3V

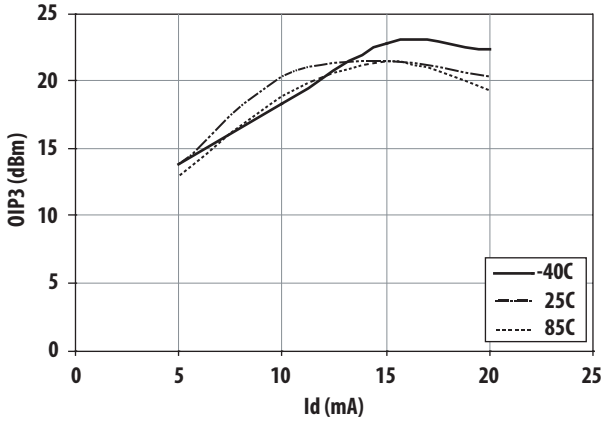



Figure 13. OIP3 vs. Ids at 12 GHz over temp at 2V

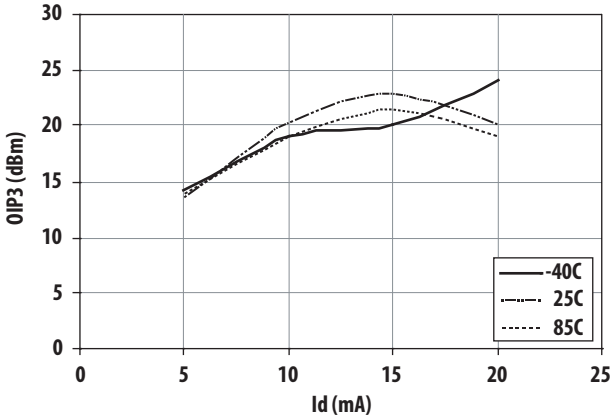



Figure 14. OIP3 vs. Ids at 12 GHz over temp at 3V

**VMMK-1225 Typical Scattering Parameters and Noise Parameters, $T_A$=25°C, Vds=2V, Ids=20mA [1]**

| Freq | S11 | | S21 | | | S12 | | S22 | | MSG/MAG |
|---|---|---|---|---|---|---|---|---|---|---|
| GHz | Mag. | Ang. | dB | Mag. | Ang. | Mag. | Ang. | Mag. | Ang. | dB |
| 2 | 0.95 | -42.72 | 19.01 | 8.92 | 148.51 | 0.03 | 62.56 | 0.78 | -22.76 | 33.45 |
| 3 | 0.92 | -62.66 | 18.46 | 8.38 | 134.49 | 0.05 | 50.55 | 0.74 | -33.18 | 30.07 |
| 4 | 0.88 | -81.48 | 17.82 | 7.78 | 121.19 | 0.06 | 39.47 | 0.69 | -42.88 | 27.08 |
| 5 | 0.85 | -98.49 | 17.11 | 7.17 | 109.28 | 0.07 | 29.48 | 0.65 | -51.36 | 24.89 |
| 6 | 0.81 | -114.47 | 16.36 | 6.58 | 98.09 | 0.07 | 20.68 | 0.60 | -59.27 | 23.06 |
| 7 | 0.79 | -129.09 | 15.64 | 6.05 | 87.68 | 0.08 | 12.23 | 0.56 | -66.63 | 21.51 |
| 8 | 0.77 | -142.63 | 14.91 | 5.56 | 77.86 | 0.08 | 4.59 | 0.53 | -73.61 | 20.20 |
| 9 | 0.75 | -155.20 | 14.16 | 5.11 | 68.55 | 0.08 | -2.42 | 0.50 | -80.46 | 19.02 |
| 10 | 0.74 | -166.71 | 13.47 | 4.71 | 59.82 | 0.08 | -8.97 | 0.47 | -86.77 | 18.01 |
| 11 | 0.73 | -177.38 | 12.81 | 4.37 | 51.64 | 0.08 | -15.21 | 0.45 | -92.81 | 17.11 |
| 12 | 0.73 | 172.73 | 12.17 | 4.06 | 43.68 | 0.08 | -20.51 | 0.43 | -98.99 | 16.34 |
| 13 | 0.73 | 163.36 | 11.58 | 3.79 | 36.07 | 0.08 | -25.92 | 0.42 | -104.88 | 15.64 |
| 14 | 0.72 | 154.49 | 11.00 | 3.55 | 28.75 | 0.08 | -31.20 | 0.40 | -110.71 | 15.00 |
| 15 | 0.72 | 146.17 | 10.48 | 3.34 | 21.67 | 0.07 | -35.48 | 0.40 | -116.24 | 14.43 |
| 16 | 0.73 | 137.93 | 9.99 | 3.16 | 14.53 | 0.07 | -39.63 | 0.39 | -121.82 | 13.96 |
| 17 | 0.73 | 129.96 | 9.52 | 2.99 | 7.56 | 0.07 | -43.76 | 0.38 | -127.93 | 13.52 |
| 18 | 0.73 | 122.52 | 9.05 | 2.83 | 0.89 | 0.07 | -47.66 | 0.38 | -133.93 | 13.09 |
| 19 | 0.74 | 114.96 | 8.61 | 2.69 | -5.89 | 0.07 | -51.22 | 0.38 | -139.67 | 12.70 |
| 20 | 0.74 | 107.64 | 8.19 | 2.57 | -12.53 | 0.07 | -54.78 | 0.38 | -145.51 | 12.36 |
| 21 | 0.75 | 100.69 | 7.77 | 2.44 | -19.05 | 0.06 | -58.37 | 0.38 | -151.20 | 12.05 |
| 22 | 0.76 | 93.20 | 7.38 | 2.34 | -25.66 | 0.06 | -62.24 | 0.37 | -156.42 | 11.72 |
| 23 | 0.76 | 86.08 | 7.01 | 2.24 | -32.37 | 0.06 | -65.41 | 0.37 | -162.46 | 11.42 |
| 24 | 0.77 | 79.35 | 6.66 | 2.15 | -38.72 | 0.06 | -69.57 | 0.38 | -168.85 | 11.26 |
| 25 | 0.78 | 72.88 | 6.31 | 2.07 | -45.30 | 0.06 | -72.63 | 0.38 | -175.43 | 10.99 |
| 26 | 0.78 | 66.18 | 5.94 | 1.98 | -51.81 | 0.06 | -76.40 | 0.38 | 178.40 | 10.70 |

**Typical Noise Parameters**

| Freq | Fmin | Γ opt | Γ opt | Rn/50 | Ga |
|---|---|---|---|---|---|
| GHz | dB | Mag. | Ang. | | dB |
| 2 | 0.15 | 0.78 | 16.80 | 0.19 | 21.31 |
| 3 | 0.23 | 0.707 | 24 | 0.19 | 19.92 |
| 4 | 0.3 | 0.637 | 31.7 | 0.18 | 18.63 |
| 5 | 0.37 | 0.573 | 40 | 0.17 | 17.45 |
| 6 | 0.44 | 0.515 | 48.8 | 0.16 | 16.37 |
| 7 | 0.51 | 0.462 | 58.2 | 0.15 | 15.41 |
| 8 | 0.58 | 0.415 | 68.1 | 0.14 | 14.55 |
| 9 | 0.66 | 0.373 | 78.6 | 0.13 | 13.79 |
| 10 | 0.73 | 0.338 | 89.7 | 0.12 | 13.15 |
| 11 | 0.8 | 0.308 | 101.3 | 0.11 | 12.61 |
| 12 | 0.87 | 0.284 | 113.5 | 0.1 | 12.17 |
| 13 | 0.94 | 0.265 | 126.2 | 0.09 | 11.85 |
| 14 | 1.01 | 0.252 | 139.5 | 0.09 | 11.63 |
| 15 | 1.09 | 0.245 | 153.4 | 0.08 | 11.52 |
| 16 | 1.16 | 0.244 | 167.8 | 0.08 | 11.51 |
| 17 | 1.23 | 0.248 | -177.3 | 0.08 | 11.62 |

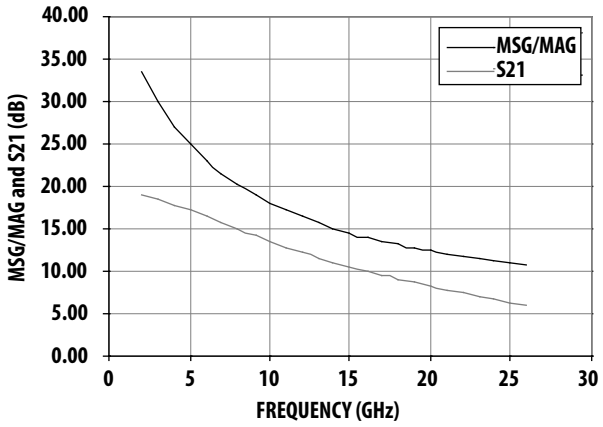



**Figure 15. MSG/MAG and S21 vs Frequency at 2V 20mA**

Note:
1. S-parameters are measured in 50 Ohm test environment.

**VMMK-1225 Typical Scattering Parameters and Noise Parameters, $T_A$=25°C, Vds=1.5V, Ids=20mA [1]**

| Freq | S11 | | S21 | | S12 | | S22 | | MSG/MAG |
|---|---|---|---|---|---|---|---|---|---|
| GHz | Mag. | Ang. | dB | Mag. | Ang. | Mag. | Ang. | Mag. | Ang. | dB |
| 2 | 0.95 | -41.45 | 19.16 | 9.07 | 149.23 | 0.04 | 63.03 | 0.75 | -25.07 | 35.71 |
| 3 | 0.92 | -60.81 | 18.64 | 8.55 | 135.54 | 0.05 | 51.14 | 0.71 | -36.68 | 32.36 |
| 4 | 0.88 | -79.22 | 18.03 | 7.97 | 122.51 | 0.06 | 40.08 | 0.66 | -47.70 | 29.32 |
| 5 | 0.85 | -95.99 | 17.35 | 7.37 | 110.76 | 0.07 | 30.08 | 0.62 | -57.44 | 27.04 |
| 6 | 0.82 | -111.80 | 16.64 | 6.80 | 99.69 | 0.08 | 20.91 | 0.57 | -66.62 | 25.10 |
| 7 | 0.79 | -126.35 | 15.94 | 6.26 | 89.35 | 0.09 | 12.49 | 0.53 | -75.19 | 23.45 |
| 8 | 0.77 | -139.88 | 15.23 | 5.77 | 79.62 | 0.09 | 4.67 | 0.49 | -83.31 | 22.05 |
| 9 | 0.75 | -152.58 | 14.50 | 5.31 | 70.33 | 0.09 | -2.71 | 0.46 | -91.35 | 20.76 |
| 10 | 0.74 | -164.13 | 13.82 | 4.91 | 61.64 | 0.09 | -9.42 | 0.43 | -98.74 | 19.66 |
| 11 | 0.73 | -174.92 | 13.16 | 4.55 | 53.54 | 0.09 | -15.86 | 0.41 | -105.72 | 18.68 |
| 12 | 0.72 | 175.03 | 12.54 | 4.24 | 45.64 | 0.09 | -21.52 | 0.38 | -112.70 | 17.84 |
| 13 | 0.72 | 165.58 | 11.95 | 3.96 | 38.11 | 0.09 | -27.32 | 0.37 | -119.39 | 17.08 |
| 14 | 0.72 | 156.60 | 11.38 | 3.71 | 30.88 | 0.09 | -32.92 | 0.35 | -125.81 | 16.37 |
| 15 | 0.71 | 148.19 | 10.86 | 3.49 | 23.83 | 0.09 | -37.75 | 0.34 | -131.85 | 15.76 |
| 16 | 0.72 | 139.78 | 10.37 | 3.30 | 16.76 | 0.09 | -42.36 | 0.33 | -138.18 | 15.26 |
| 17 | 0.72 | 131.83 | 9.89 | 3.12 | 9.84 | 0.08 | -47.16 | 0.33 | -144.56 | 14.79 |
| 18 | 0.72 | 124.31 | 9.42 | 2.96 | 3.32 | 0.08 | -51.18 | 0.32 | -150.78 | 14.34 |
| 19 | 0.73 | 116.48 | 8.97 | 2.81 | -3.41 | 0.08 | -55.89 | 0.32 | -157.20 | 13.95 |
| 20 | 0.73 | 109.16 | 8.55 | 2.68 | -9.91 | 0.08 | -60.43 | 0.32 | -163.11 | 13.60 |
| 21 | 0.74 | 102.09 | 8.15 | 2.55 | -16.35 | 0.08 | -64.86 | 0.32 | -169.12 | 13.28 |
| 22 | 0.75 | 94.51 | 7.76 | 2.44 | -22.84 | 0.08 | -69.11 | 0.31 | -174.70 | 12.90 |
| 23 | 0.75 | 87.43 | 7.38 | 2.34 | -29.48 | 0.07 | -73.28 | 0.31 | 178.98 | 12.59 |
| 24 | 0.76 | 80.52 | 7.03 | 2.25 | -35.76 | 0.07 | -77.84 | 0.31 | 172.70 | 12.42 |
| 25 | 0.76 | 74.22 | 6.67 | 2.16 | -42.19 | 0.07 | -82.02 | 0.32 | 166.48 | 12.14 |
| 26 | 0.77 | 67.45 | 6.31 | 2.07 | -48.60 | 0.07 | -86.38 | 0.32 | 159.81 | 11.88 |

**Typical Noise Parameters**

| Freq | Fmin | Γ opt | Γ opt | Rn/50 | Ga |
|---|---|---|---|---|---|
| GHz | dB | Mag. | Ang. | | dB |
| 2 | 0.15 | 0.81 | 16.80 | 0.18 | 21.28 |
| 3 | 0.21 | 0.734 | 24 | 0.18 | 19.91 |
| 4 | 0.28 | 0.665 | 31.8 | 0.17 | 18.65 |
| 5 | 0.34 | 0.601 | 40 | 0.17 | 17.49 |
| 6 | 0.41 | 0.543 | 48.8 | 0.16 | 16.43 |
| 7 | 0.47 | 0.49 | 58.2 | 0.15 | 15.48 |
| 8 | 0.54 | 0.442 | 68 | 0.14 | 14.64 |
| 9 | 0.6 | 0.4 | 78.4 | 0.13 | 13.9 |
| 10 | 0.67 | 0.363 | 89.3 | 0.12 | 13.27 |
| 11 | 0.73 | 0.332 | 100.7 | 0.11 | 12.74 |
| 12 | 0.8 | 0.307 | 112.6 | 0.1 | 12.32 |
| 13 | 0.86 | 0.286 | 125.1 | 0.09 | 12 |
| 14 | 0.93 | 0.272 | 138.1 | 0.08 | 11.79 |
| 15 | 0.99 | 0.262 | 151.6 | 0.08 | 11.68 |
| 16 | 1.06 | 0.259 | 165.6 | 0.08 | 11.68 |
| 17 | 1.12 | 0.26 | -179.8 | 0.08 | 11.79 |

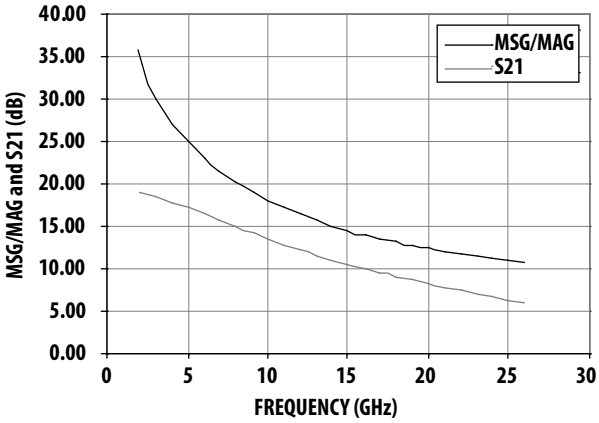



**Figure 16. MSG/MAG and S21 vs Frequency at 1.5V 20mA**

Note:
1. S-parameters are measured in 50 Ohm test environment.

**VMMK-1225 Typical Scattering Parameters and Noise Parameters, $T_A$=25°C, Vds=3V, Ids=20mA [1]**

| Freq | S11 | | S21 | | S12 | | S22 | | MSG/MAG |
|---|---|---|---|---|---|---|---|---|---|
| GHz | Mag. | Ang. | dB | Mag. | Ang. | Mag. | Ang. | Mag. | Ang. | dB |
| 2 | 0.95 | -44.16 | 18.65 | 8.56 | 147.52 | 0.03 | 62.38 | 0.80 | -20.48 | 33.25 |
| 3 | 0.92 | -64.98 | 18.10 | 8.03 | 132.99 | 0.04 | 49.96 | 0.76 | -29.83 | 29.80 |
| 4 | 0.87 | -84.86 | 17.43 | 7.44 | 119.11 | 0.05 | 38.25 | 0.71 | -38.52 | 26.77 |
| 5 | 0.84 | -103.02 | 16.69 | 6.83 | 106.61 | 0.06 | 28.18 | 0.67 | -46.15 | 24.51 |
| 6 | 0.81 | -119.88 | 15.89 | 6.23 | 94.91 | 0.06 | 19.19 | 0.63 | -53.21 | 22.66 |
| 7 | 0.78 | -135.19 | 15.11 | 5.69 | 84.12 | 0.07 | 10.75 | 0.59 | -59.80 | 21.11 |
| 8 | 0.76 | -149.25 | 14.32 | 5.20 | 74.00 | 0.07 | 3.23 | 0.56 | -66.03 | 19.78 |
| 9 | 0.75 | -161.91 | 13.51 | 4.74 | 64.50 | 0.07 | -3.86 | 0.53 | -72.27 | 18.59 |
| 10 | 0.74 | -173.16 | 12.77 | 4.35 | 55.73 | 0.07 | -9.95 | 0.52 | -78.27 | 17.60 |
| 11 | 0.74 | 176.55 | 12.05 | 4.01 | 47.51 | 0.07 | -15.58 | 0.50 | -84.02 | 16.71 |
| 12 | 0.74 | 167.27 | 11.39 | 3.71 | 39.54 | 0.06 | -20.57 | 0.49 | -90.13 | 15.98 |
| 13 | 0.74 | 158.74 | 10.77 | 3.46 | 32.00 | 0.06 | -25.46 | 0.48 | -96.11 | 15.29 |
| 14 | 0.74 | 150.81 | 10.19 | 3.23 | 24.84 | 0.06 | -29.82 | 0.47 | -101.79 | 14.67 |
| 15 | 0.73 | 143.18 | 9.66 | 3.04 | 17.76 | 0.06 | -33.52 | 0.47 | -107.60 | 14.12 |
| 16 | 0.74 | 135.70 | 9.16 | 2.87 | 10.68 | 0.06 | -36.60 | 0.47 | -113.31 | 13.64 |
| 17 | 0.74 | 128.49 | 8.71 | 2.73 | 3.81 | 0.06 | -39.53 | 0.47 | -118.80 | 13.23 |
| 18 | 0.74 | 121.25 | 8.27 | 2.59 | -2.90 | 0.05 | -42.17 | 0.47 | -124.55 | 12.80 |
| 19 | 0.74 | 113.89 | 7.85 | 2.47 | -9.79 | 0.05 | -44.68 | 0.48 | -130.27 | 12.44 |
| 20 | 0.75 | 106.67 | 7.46 | 2.36 | -16.52 | 0.05 | -47.26 | 0.48 | -136.04 | 12.11 |
| 21 | 0.75 | 99.29 | 7.07 | 2.26 | -23.30 | 0.05 | -50.61 | 0.48 | -141.26 | 11.78 |
| 22 | 0.75 | 91.51 | 6.72 | 2.17 | -30.13 | 0.05 | -52.95 | 0.49 | -146.30 | 11.46 |
| 23 | 0.75 | 83.74 | 6.37 | 2.08 | -37.20 | 0.05 | -55.09 | 0.49 | -151.70 | 11.13 |
| 24 | 0.76 | 75.90 | 6.04 | 2.00 | -43.95 | 0.05 | -58.00 | 0.49 | -157.00 | 10.91 |
| 25 | 0.76 | 68.74 | 5.69 | 1.93 | -50.88 | 0.05 | -60.53 | 0.49 | -163.41 | 10.67 |
| 26 | 0.77 | 61.14 | 5.33 | 1.85 | -57.76 | 0.05 | -63.55 | 0.49 | -168.90 | 10.37 |

**Typical Noise Parameters**

| Freq | Fmin | Γ opt | Γ opt | Rn/50 | Ga |
|---|---|---|---|---|---|
| GHz | dB | Mag. | Ang. | | dB |
| 2 | 0.14 | 0.783 | 16.4 | 0.19 | 20.73 |
| 3 | 0.21 | 0.704 | 23.4 | 0.18 | 19.33 |
| 4 | 0.29 | 0.632 | 30.9 | 0.18 | 18.03 |
| 5 | 0.37 | 0.565 | 39.1 | 0.17 | 16.85 |
| 6 | 0.45 | 0.505 | 48 | 0.16 | 15.77 |
| 7 | 0.53 | 0.45 | 57.4 | 0.15 | 14.81 |
| 8 | 0.61 | 0.402 | 67.6 | 0.14 | 13.95 |
| 9 | 0.68 | 0.359 | 78.3 | 0.13 | 13.21 |
| 10 | 0.76 | 0.322 | 89.7 | 0.12 | 12.57 |
| 11 | 0.84 | 0.291 | 101.7 | 0.11 | 12.04 |
| 12 | 0.92 | 0.266 | 114.3 | 0.11 | 11.62 |
| 13 | 1 | 0.247 | 127.6 | 0.1 | 11.31 |
| 14 | 1.08 | 0.234 | 141.5 | 0.09 | 11.12 |
| 15 | 1.15 | 0.227 | 156 | 0.09 | 11.03 |
| 16 | 1.23 | 0.226 | 171.2 | 0.09 | 11.05 |
| 17 | 1.31 | 0.231 | -173 | 0.09 | 11.18 |

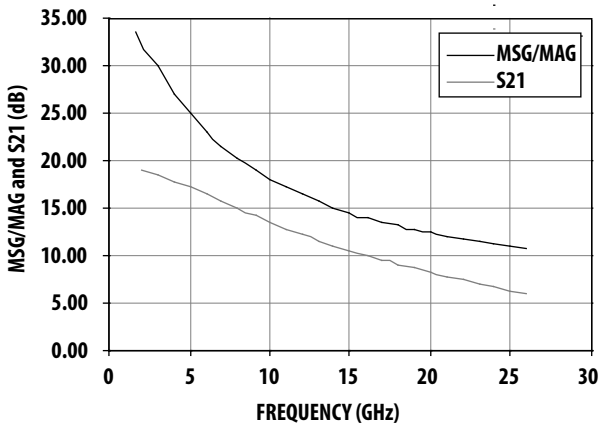



**Figure 17. MSG/MAG and S21 vs Frequency at 3V 20mA**

Note:
1. S-parameters are measured in 50 Ohm test environment.

**VMMK-1225 Typical Scattering Parameters and Noise Parameters, $T_A$=25°C, Vds=4V, Ids=20mA [1]**

| Freq | S11 | | | S21 | | S12 | | S22 | | MSG/MAG |
|---|---|---|---|---|---|---|---|---|---|---|
| GHz | Mag. | Ang. | dB | Mag. | Ang. | Mag. | Ang. | Mag. | Ang. | dB |
| 2 | 0.95 | -45.53 | 18.45 | 8.37 | 146.63 | 0.03 | 61.48 | 0.81 | -19.63 | 33.11 |
| 3 | 0.91 | -66.85 | 17.86 | 7.82 | 131.81 | 0.04 | 49.37 | 0.77 | -28.48 | 29.56 |
| 4 | 0.87 | -87.06 | 17.16 | 7.21 | 117.72 | 0.05 | 37.71 | 0.73 | -36.59 | 26.53 |
| 5 | 0.83 | -105.43 | 16.37 | 6.59 | 105.08 | 0.05 | 27.63 | 0.69 | -43.74 | 24.25 |
| 6 | 0.80 | -122.38 | 15.55 | 5.99 | 93.35 | 0.06 | 18.64 | 0.65 | -50.37 | 22.41 |
| 7 | 0.78 | -137.72 | 14.73 | 5.45 | 82.50 | 0.06 | 10.37 | 0.62 | -56.59 | 20.86 |
| 8 | 0.76 | -151.66 | 13.93 | 4.97 | 72.41 | 0.06 | 3.27 | 0.59 | -62.52 | 19.54 |
| 9 | 0.75 | -164.20 | 13.11 | 4.52 | 62.92 | 0.06 | -3.88 | 0.56 | -68.53 | 18.35 |
| 10 | 0.74 | -175.38 | 12.36 | 4.15 | 54.12 | 0.06 | -9.86 | 0.55 | -74.35 | 17.39 |
| 11 | 0.74 | 174.53 | 11.64 | 3.82 | 45.87 | 0.06 | -14.98 | 0.53 | -80.07 | 16.51 |
| 12 | 0.74 | 165.32 | 10.97 | 3.54 | 37.88 | 0.06 | -19.88 | 0.52 | -86.09 | 15.78 |
| 13 | 0.74 | 156.90 | 10.34 | 3.29 | 30.28 | 0.06 | -23.98 | 0.52 | -92.05 | 15.09 |
| 14 | 0.74 | 149.09 | 9.76 | 3.08 | 23.07 | 0.06 | -28.30 | 0.51 | -97.69 | 14.48 |
| 15 | 0.74 | 141.52 | 9.23 | 2.89 | 15.94 | 0.05 | -31.31 | 0.51 | -103.56 | 13.94 |
| 16 | 0.74 | 134.12 | 8.72 | 2.73 | 8.83 | 0.05 | -34.13 | 0.51 | -109.35 | 13.46 |
| 17 | 0.74 | 126.90 | 8.27 | 2.59 | 1.87 | 0.05 | -35.42 | 0.51 | -114.79 | 13.05 |
| 18 | 0.74 | 119.69 | 7.82 | 2.46 | -4.91 | 0.05 | -38.50 | 0.51 | -120.61 | 12.65 |
| 19 | 0.74 | 112.42 | 7.40 | 2.34 | -11.91 | 0.05 | -40.30 | 0.52 | -126.46 | 12.27 |
| 20 | 0.75 | 105.25 | 7.00 | 2.24 | -18.68 | 0.05 | -42.50 | 0.52 | -132.13 | 11.94 |
| 21 | 0.75 | 97.82 | 6.61 | 2.14 | -25.52 | 0.05 | -43.80 | 0.53 | -137.49 | 11.61 |
| 22 | 0.75 | 90.09 | 6.24 | 2.05 | -32.42 | 0.05 | -46.17 | 0.53 | -142.61 | 11.28 |
| 23 | 0.75 | 82.38 | 5.88 | 1.97 | -39.51 | 0.05 | -48.45 | 0.53 | -148.08 | 10.95 |
| 24 | 0.76 | 74.56 | 5.55 | 1.89 | -46.30 | 0.05 | -50.37 | 0.53 | -153.35 | 10.73 |
| 25 | 0.77 | 67.45 | 5.20 | 1.82 | -53.32 | 0.04 | -52.43 | 0.53 | -159.71 | 10.48 |
| 26 | 0.77 | 59.93 | 4.83 | 1.74 | -60.23 | 0.05 | -55.25 | 0.53 | -165.19 | 10.18 |

**Typical Noise Parameters**

| Freq | Fmin | Γ opt | Γ opt | Rn/50 | Ga |
|---|---|---|---|---|---|
| GHz | dB | Mag. | Ang. | | dB |
| 2 | 0.14 | 0.78 | 16.40 | 0.20 | 20.28 |
| 3 | 0.22 | 0.697 | 23.2 | 0.19 | 18.95 |
| 4 | 0.3 | 0.625 | 30.7 | 0.19 | 17.71 |
| 5 | 0.37 | 0.558 | 38.9 | 0.18 | 16.58 |
| 6 | 0.45 | 0.498 | 47.7 | 0.17 | 15.55 |
| 7 | 0.53 | 0.443 | 57.3 | 0.16 | 14.63 |
| 8 | 0.6 | 0.395 | 67.5 | 0.15 | 13.81 |
| 9 | 0.68 | 0.352 | 78.4 | 0.14 | 13.09 |
| 10 | 0.75 | 0.316 | 89.9 | 0.13 | 12.47 |
| 11 | 0.83 | 0.286 | 102.1 | 0.12 | 11.96 |
| 12 | 0.91 | 0.261 | 115 | 0.11 | 11.55 |
| 13 | 0.98 | 0.243 | 128.6 | 0.1 | 11.24 |
| 14 | 1.06 | 0.231 | 142.9 | 0.1 | 11.03 |
| 15 | 1.14 | 0.224 | 157.8 | 0.09 | 10.93 |
| 16 | 1.21 | 0.224 | 173.4 | 0.09 | 10.94 |
| 17 | 1.29 | 0.23 | -170.3 | 0.09 | 11.04 |

Note:
1. S-parameters are measured in 50 Ohm test environment.

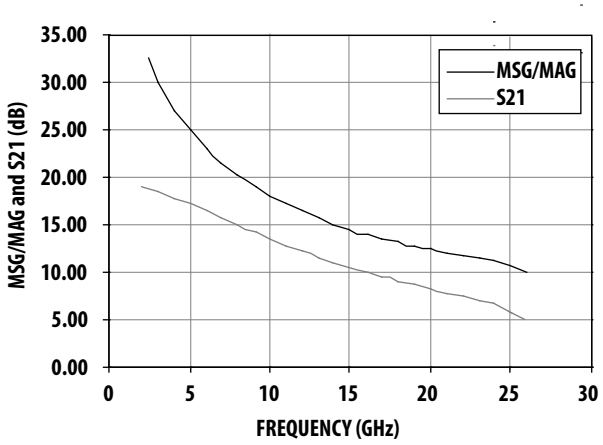



**Figure 18. MSG/MAG and S21 vs Frequency at 4V 20mA**

## Small Signal Model Parameters

| Parameter | Value | Parameter | Value | Parameter | Value | Parameter | Value |
|---|---|---|---|---|---|---|---|
| Vd (V) | 1.5 | Vd (V) | 1.5 | Vd (V) | 1.5 | Vd (V) | 1.5 |
| Id (mA) | 5 | Id (mA) | 10 | Id (mA) | 15 | Id (mA) | 20 |
| Gm | 0.07549 | Gm | 0.10852 | Gm | 0.1276 | Gm | 0.128 |
| Tau | 0.001914 | Tau | 0.00212 | tau | 0.002061 | tau | 0.001952 |
| Cgs | 0.3008 | Cgs | 0.3596 | Cgs | 0.393 | Cgs | 0.3943 |
| Rgs | 0 | Rgs | 0.05267 | Rgs | 1.682 | Rgs | 1.989 |
| Cgd | 0.04174 | Cgd | 0.0376 | Cgd | 0.0337 | Cgd | 0.03377 |
| Cds | 0.1093 | Cds | 0.10984 | Cds | 0.109 | Cds | 0.1082 |
| Rds | 540.40 | Rds | 374.20 | Rds | 348.00 | Rds | 341.90 |

| Parameter | Value | Parameter | Value | Parameter | Value | Parameter | Value |
|---|---|---|---|---|---|---|---|
| Vd (V) | 2 | Vd (V) | 2 | Vd (V) | 2 | Vd (V) | 2 |
| Id (mA) | 5 | Id (mA) | 10 | Id (mA) | 15 | Id (mA) | 20 |
| Gm | 0.07357 | Gm | 0.1063 | Gm | 0.1243 | Gm | 0.1357 |
| Tau | 0.00206 | Tau | 0.00206 | tau | 0.002 | tau | 0.002034 |
| Cgs | 0.3266 | Cgs | 0.3973 | Cgs | 0.4458 | Cgs | 0.4758 |
| Rgs | 0.4454 | Rgs | 1.598 | Rgs | 1.9394 | Rgs | 2.282 |
| Cgd | 0.03642 | Cgd | 0.0323 | Cgd | 0.0289 | Cgd | 0.0256 |
| Cds | 0.1081 | Cds | 0.1075 | Cds | 0.1075 | Cds | 0.1072 |
| Rds | 631.10 | Rds | 444.90 | Rds | 408.90 | Rds | 418.70 |

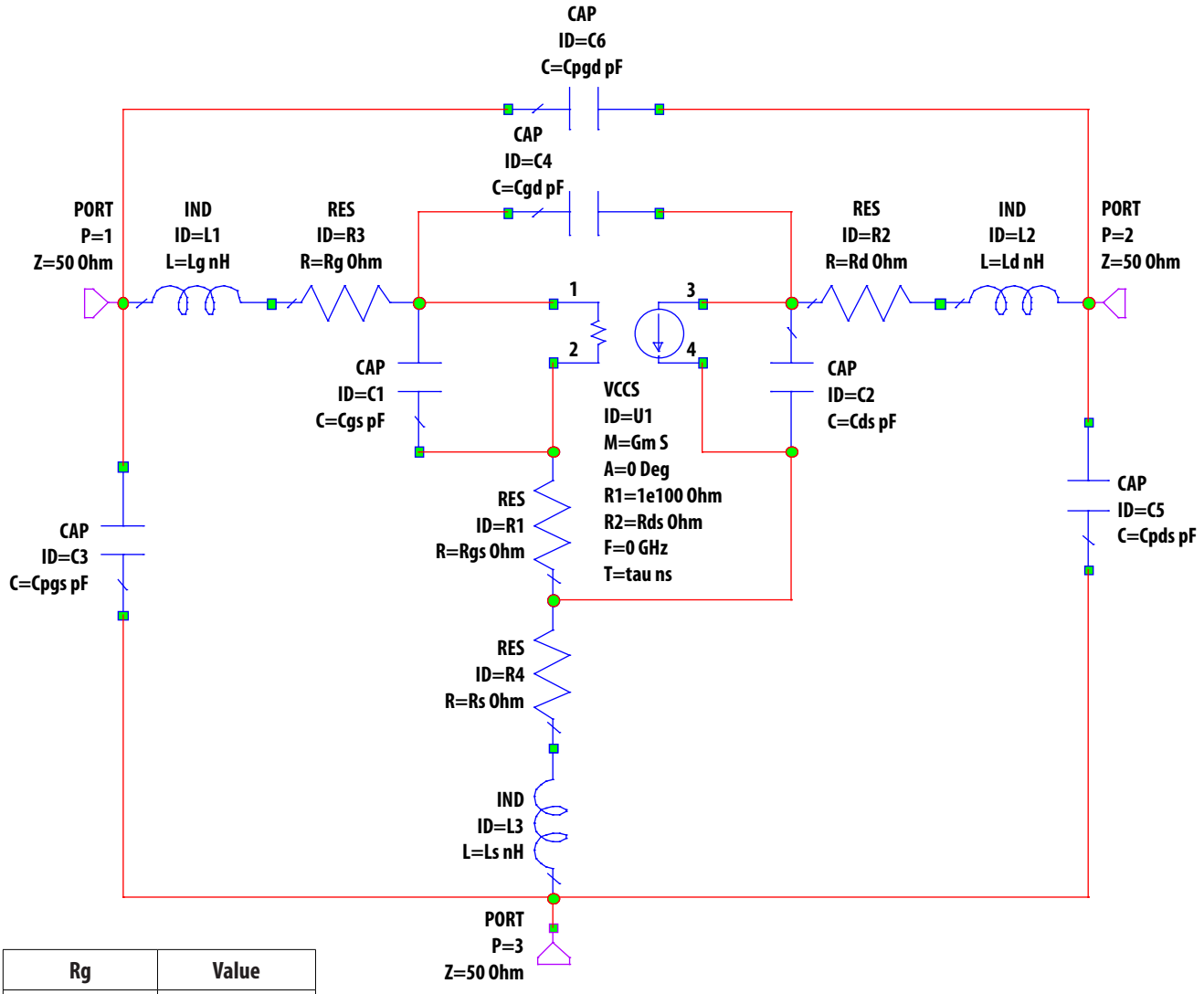
| Parameter | Value | Parameter | Value | Parameter | Value | Parameter | Value |
|---|---|---|---|---|---|---|---|
| Vd (V) | 3 | Vd (V) | 3 | Vd (V) | 3 | Vd (V) | 3 |
| Id (mA) | 5 | Id (mA) | 10 | Id (mA) | 15 | Id (mA) | 20 |
| Gm | 0.0718 | Gm | 0.1023 | Gm | 0.1196 | Gm | 0.1305 |
| tau | 0.002319 | tau | 0.00224 | tau | 0.00226 | tau | 0.002248 |
| Cgs | 0.3761 | Cgs | 0.4662 | Cgs | 0.5227 | Cgs | 0.555 |
| Rgs | 1.106 | Rgs | 1.801 | Rgs | 2.023 | Rgs | 2.15 |
| Cgd | 0.0293 | Cgd | 0.02623 | Cgd | 0.02397 | Cgd | 0.022 |
| Cds | 0.1071 | Cds | 0.1065 | Cds | 0.1067 | Cds | 0.1064 |
| Rds | 785.70 | Rds | 556.80 | Rds | 494.10 | Rds | 479.90 |

| Parameter | Value | Parameter | Value | Parameter | Value | Parameter | Value |
|---|---|---|---|---|---|---|---|
| Vd (V) | 3 | Vd (V) | 3 | Vd (V) | 3 | Vd (V) | 3 |
| Id (mA) | 5 | Id (mA) | 10 | Id (mA) | 15 | Id (mA) | 20 |
| Gm | 0.06983 | Gm | 0.1005 | Gm | 0.5649 | Gm | 0.1269 |
| tau | 0.002544 | tau | 0.002389 | tau | 0.002383 | tau | 0.002368 |
| Cgs | 0.4077 | Cgs | 0.51068 | Cgs | 0.5649 | Cgs | 0.595 |
| Rgs | 1.341 | Rgs | 1.879 | Rgs | 1.912 | Rgs | 1.883 |
| Cgd | 0.02604 | Cgd | 0.02355 | Cgd | 0.02197 | Cgd | 0.0208 |
| Cds | 0.1062 | Cds | 0.10589 | Cds | 0.1057 | Cds | 0.1058 |
| Rds | 887.00 | Rds | 627.00 | Rds | 552.20 | Rds | 517.10 |

## S Parameter Measurements

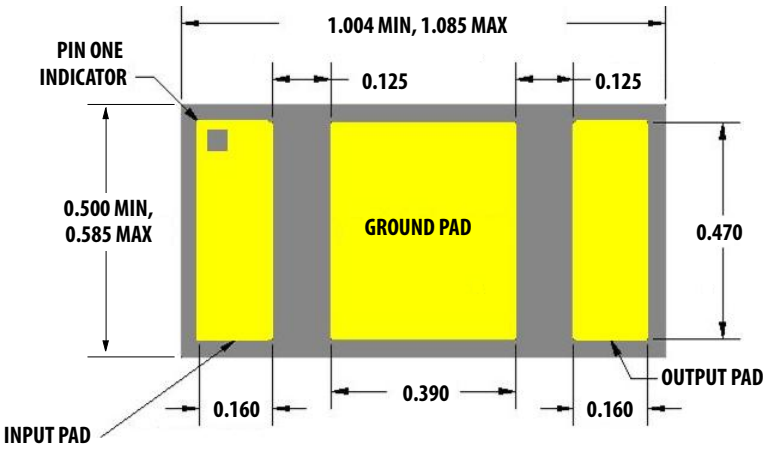
The S-parameters are measured on a .016 inch thick RO4003 printed circuit test board, using G-S-G (ground signal ground) probes. Coplanar waveguide is used to provide a smooth transition from the probes to the device under test. The presence of the ground plane on top of the test board results in excellent grounding at the device under test. A combination of SOLT (Short - Open - Load - Thru) and TRL (Thru - Reflect - Line) calibration techniques are used to correct for the effects of the test board, resulting in accurate device S-parameters. The reference plane for the S Parameters is at the edge of the package.

## VMMK-1225 ADS Model



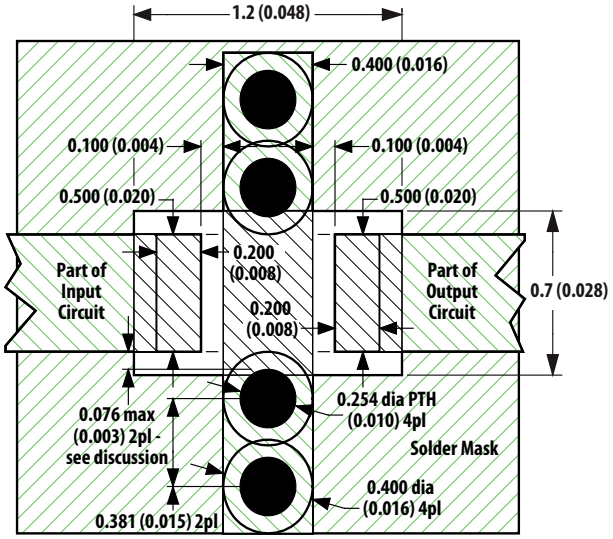

| Rg | Value |
|---|---|
| Rg | 4.532 |
| Rd | 1.9 |
| RsG | 1.72 |
| C pgs | 0.0475 |
| C pds | 0.0392 |
| C pgd | 0.003935 |
| Ls | 0.000303 |
| Lg | 0.3492 |
| Ld | 0.2772 |

## Outline Drawing




Notes:
1. • indicates pin 1
2. Dimensions are in millimeters
3. Pad Material is minimum 5.0 um thick Au

## Suggested PCB Material and Land Pattern




Notes:
1. 0.010" Rogers RO4350

## Recommended SMT Attachment

The VMMK Packaged Devices are compatible with high volume surface mount PCB assembly processes.

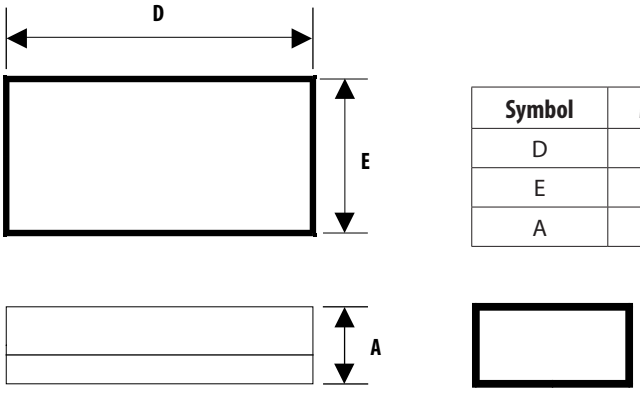
## Manual Assembly for Prototypes

1. Follow ESD precautions while handling packages.
2. Handling should be along the edges with tweezers or from topside if using a vacuum collet.
3. Recommended attachment is solder paste. Please see Figure 14 for recommended solder reflow profile. Conductive epoxy is not recommended. Hand soldering is not recommended.
4. Apply solder paste using either a stencil printer or dot placement. The volume of solder paste will be dependent on PCB and component layout and should be controlled to ensure consistent mechanical and electrical performance. Excessive solder will degrade RF performance.
5. Follow solder paste and vendor's recommendations when developing a solder reflow profile. A standard profile will have a steady ramp up from room temperature to the pre-heat temp to avoid damage due to thermal shock.
6. Packages have been qualified to withstand a peak temperature of 260ºC for 20 to 40 sec. Verify that the profile will not expose device beyond these limits.
7. Clean off flux per vendor's recommendations.
8. Clean the module with Acetone. Rinse with alcohol. Allow the module to dry before testing.

## Part Number Ordering Information

| Part Number | No. of Devices | Container |
|---|---|---|
| VMMK-1225-BLKG | 100 | antistatic bag |
| VMMK-1225-TR1G | 5000 | 7″ Reel |

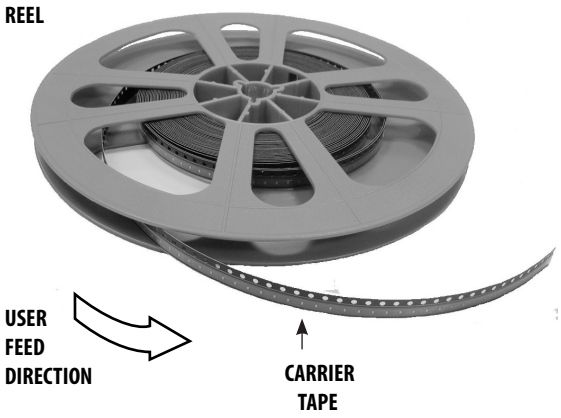
## Package Dimension Outline

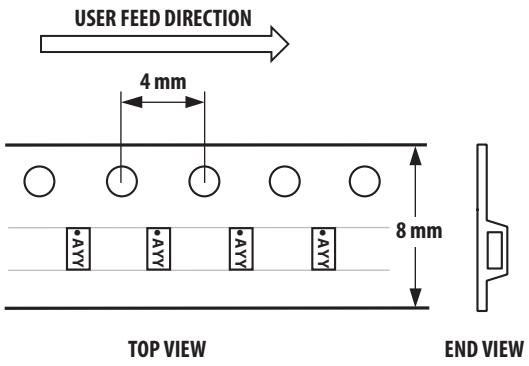


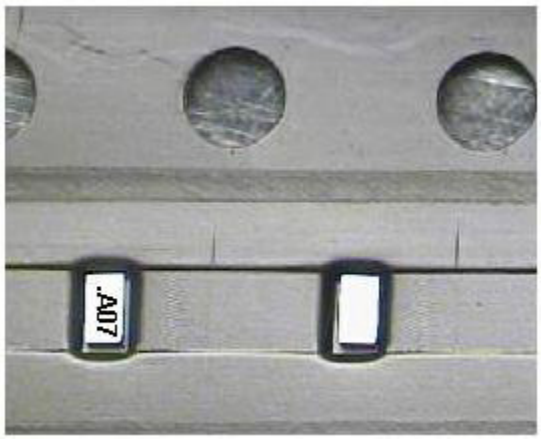

| Symbol | Min (mm) | Max (mm) |
|---|---|---|
| D | 1.004 | 1.085 |
| E | 0.500 | 0.585 |
| A | 0.225 | 0.275 |

Notes:
All dimensions are in mm

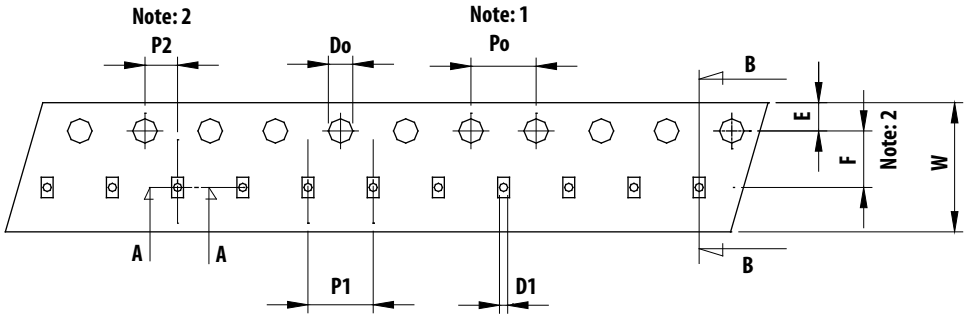
## Device Orientation

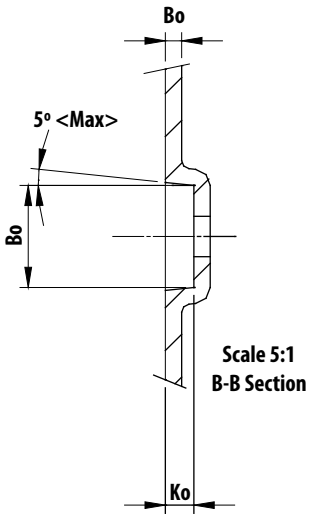


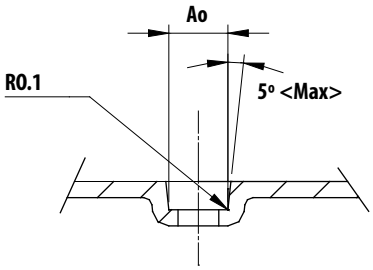




Notes:
"A" = Device Code
"YY" = Month Code




Scale 5:1
B-B Section




Scale 5:1
A-A Section

**Ao = 0.73± 0.05 mm**

**Bc = 1.26± 0.05 mm**

**Ko = 0.35 $^{+0.05}_{+0}$ mm**

| Symbol | Parameter and Test Condition |
|---|---|
| K1 | - |
| Po | 4.0± 0.10 |
| P1 | 4.0± 0.10 |
| P2 | 2.0± 0.05 |
| Do | 1.55± 0.05 |
| D1 | 0.5± 0.05 |
| E | 1.75± 0.10 |
| F | 3.50± 0.05 |
| Po | 40.0± 0.10 |
| W | 8.0± 0.20 |
| T | 0.20± 0.02 |

**Unit: mm**

Notice:
1. 10 sprocket hole pitch cumulative tolerance is ±0.1 mm
2. Pocket position relative to sprocket hole measured as true position of pocket not pocket hole
3. Ao & Bo measured on a place 0.3mm above the bottom of the pocket to top surface of the carrier
4. Ko measured from a plane on the inside bottom of the pocket to the top surface of the carrier
5. Carrier camber shall be not than 1mm per 100mm through a length of 250mm

For product information and a complete list of distributors, please go to our web site: **www.avagotech.com**


AV02-1082EN - January 9, 2014