

# ATF-52189

## High Linearity Mode<sup>[1]</sup> Enhancement

### Pseudomorphic HEMT in SOT 89 Package



## Data Sheet

### Description

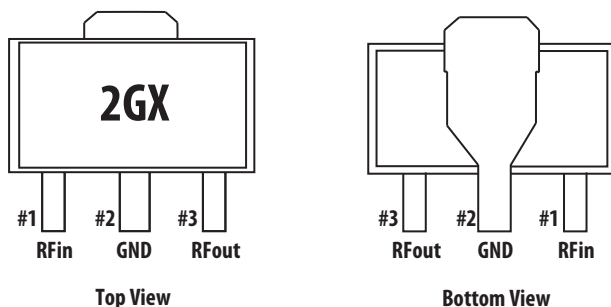
Avago Technologies's ATF-52189 is a single-voltage high linearity, low noise E-pHEMT FET packaged in a low cost surface mount SOT89 package. The device is ideal as a medium-power, high-linearity amplifier. Its operating frequency range is from 50 MHz to 6 GHz.

ATF-52189 is ideally suited for Cellular/PCS and WCDMA wireless infrastructure, WLAN, WLL and MMDS application, and general purpose discrete E-pHEMT amplifiers which require medium power and high linearity. All devices are 100% RF and DC tested.

#### Notes:

1. Enhancement mode technology employs a single positive  $V_{gs}$ , eliminating the need of negative gate voltage associated with conventional depletion mode devices.
2. Refer to reliability datasheet for detailed MTTF data
3. Conform to JEDEC reference outline MO229 for DRP-N
4. Linearity Figure of Merit (LFOM) is OIP3 divided by DC bias power

### Pin Connections and Package Marking



#### Notes:

Package marking provides orientation and identification:  
"2G" = Device Code  
"x" = Month code indicates the month of manufacture.

### Features

- Single voltage operation
- High Linearity and P1dB
- Low Noise Figure
- Excellent uniformity in product specifications
- SOT 89 standard package
- Point MTTF > 300 years<sup>[2]</sup>
- MSL-2 and lead-free
- Tape-and-Reel packaging option available

### Specifications

2 GHz, 4.5V, 280 mA (Typ.)

- 42 dBm Output IP3
- 27 dBm Output Power at 1dB gain compression
- 1.50 dB Noise Figure
- 16.0 dB Gain
- 55% PAE at P1dB
- LFOM<sup>[3]</sup> 12.5 dB

### Applications

- Front-end LNA Q2 and Q3, Driver or Pre-driver Amplifier for Cellular/PCS and WCDMA wireless infrastructure
- Driver Amplifier for WLAN, WLL/RLL and MMDS applications
- General purpose discrete E-pHEMT for other high linearity applications

## ATF-52189 Absolute Maximum Ratings<sup>[1]</sup>

| Symbol         | Parameter                              | Units | Absolute Maximum |
|----------------|----------------------------------------|-------|------------------|
| $V_{ds}$       | Drain–Source Voltage <sup>[2]</sup>    | V     | 7                |
| $V_{gs}$       | Gate–Source Voltage <sup>[2]</sup>     | V     | -5 to 1.0        |
| $V_{gd}$       | Gate Drain Voltage <sup>[2]</sup>      | V     | -5 to 1.0        |
| $I_{ds}$       | Drain Current <sup>[2]</sup>           | mA    | 500              |
| $I_{gs}$       | Gate Current                           | mA    | 46               |
| $P_{diss}$     | Total Power Dissipation <sup>[3]</sup> | W     | 1.5              |
| $P_{in\ max.}$ | RF Input Power                         | dBm   | +27              |
| $T_{ch}$       | Channel Temperature                    | °C    | 150              |
| $T_{stg}$      | Storage Temperature                    | °C    | -65 to 150       |

## Thermal Resistance<sup>[2,4]</sup>

$$\theta_{ch-b} = 52^{\circ}\text{C/W}$$

### Notes:

1. Operation of this device above any one of these parameters may cause permanent damage.
2. Assuming DC quiescent conditions.
3. Board (package belly) temperature  $T_B$  is 25°C. Derate 19.25 mW/°C for  $T_B > 72^{\circ}\text{C}$ .
4. Channel-to-board thermal resistance measured using 150°C Liquid Crystal Measurement method.

## ATF-52189 Electrical Specifications

$T_A = 25^{\circ}\text{C}$ , DC bias for RF parameters is  $V_{ds} = 4.5\text{V}$  and  $I_{ds} = 200\text{ mA}$  unless otherwise specified.

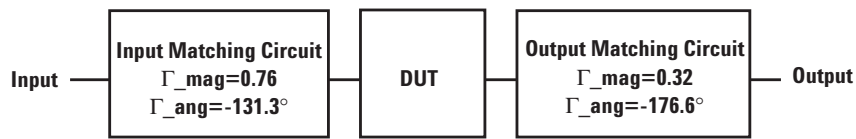
| Symbol    | Parameters and Test Conditions                                                                                                                                                    | Units             | Min.           | Typ.                 | Max.           |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|----------------|----------------------|----------------|
| $V_{gs}$  | Operational Gate Voltage<br>$V_{ds} = 4.5\text{V}$ , $I_{ds} = 200\text{ mA}$                                                                                                     | V                 | —              | 0.62                 | —              |
| $V_{th}$  | Threshold Voltage<br>$V_{ds} = 4.5\text{V}$ , $I_{ds} = 16\text{ mA}$                                                                                                             | V                 | —              | 0.28                 | —              |
| $I_{ds}$  | Drain to Source Current<br>$V_{ds} = 4.5\text{V}$ , $V_{gs} = 0\text{V}$                                                                                                          | μA                | —              | 14.8                 | —              |
| $G_m$     | Transconductance<br>$V_{ds} = 4.5\text{V}$ , $G_m = \Delta I_{ds} / \Delta V_{gs}$ ;<br>$\Delta V_{gs} = V_{gs1} - V_{gs2}$<br>$V_{gs1} = 0.55\text{V}$ , $V_{gs2} = 0.5\text{V}$ | mmho              | —              | 1300                 | —              |
| $I_{gss}$ | Gate Leakage Current<br>$V_{ds} = 0\text{V}$ , $V_{gs} = -4\text{V}$                                                                                                              | μA                | -20.0          | 0.49                 | —              |
| NF        | Noise Figure<br>$f = 2\text{ GHz}$<br>$f = 900\text{ MHz}$                                                                                                                        | dB<br>dB          | —<br>—         | 1.50<br>1.25         | —<br>—         |
| G         | Gain <sup>[1]</sup><br>$f = 2\text{ GHz}$<br>$f = 900\text{ MHz}$                                                                                                                 | dB<br>dB          | 14.8<br>—      | 16.0<br>16.5         | 17.8<br>—      |
| OIP3      | Output 3 <sup>rd</sup> Order Intercept Point <sup>[1]</sup><br>$f = 2\text{ GHz}$<br>$f = 900\text{ MHz}$                                                                         | dBm<br>dBm        | 38.5<br>—      | 42.0<br>42.0         | —<br>—         |
| P1dB      | Output 1dB Compressed <sup>[1]</sup><br>$f = 2\text{ GHz}$<br>$f = 900\text{ MHz}$                                                                                                | dBm<br>dBm        | 25.5<br>—      | 27.0<br>27.2         | —<br>—         |
| PAE       | Power Added Efficiency<br>$f = 2\text{ GHz}$<br>$f = 900\text{ MHz}$                                                                                                              | %<br>%            | 40.0<br>—      | 55.0<br>50.0         | —<br>—         |
| NF        | Noise Figure<br>$f=900\text{ MHz}$<br>$f=2.0\text{ GHz}$<br>$f=2.4\text{ GHz}$                                                                                                    | dB<br>dB<br>dB    | —<br>—<br>—    | 1.25<br>1.50<br>1.60 | —<br>—<br>—    |
| G         | Gain <sup>[1]</sup><br>$f=900\text{ MHz}$<br>$f=2.0\text{ GHz}$<br>$f=2.4\text{ GHz}$                                                                                             | dB<br>dB<br>dB    | —<br>14.8<br>— | 16.5<br>16.0<br>13.5 | —<br>17.8<br>— |
| OIP3      | Output 3rd Order Intercept Point <sup>[1]</sup><br>$f=900\text{ MHz}$<br>$f=2.0\text{ GHz}$<br>$f=2.4\text{ GHz}$                                                                 | dBm<br>dBm<br>dBm | —<br>38.5<br>— | 42.0<br>42.0<br>41.0 | —<br>—<br>—    |
| P1dB      | Output 1dB Compressed <sup>[1]</sup><br>$f=900\text{ MHz}$<br>$f=2.0\text{ GHz}$<br>$f=2.4\text{ GHz}$                                                                            | dBm<br>dBm<br>dBm | —<br>25.5<br>— | 27.2<br>27.0<br>26.0 | —<br>—<br>—    |

continued on next page

| Symbol | Parameters and Test Conditions                        | Units              | Min. | Typ.  | Max. |
|--------|-------------------------------------------------------|--------------------|------|-------|------|
| PAE    | Power Added Efficiency                                | f=900 MHz          | —    | 50.0  | —    |
|        |                                                       | f=2.0 GHz          | 40.0 | 55.0  | —    |
|        |                                                       | f=2.4 GHz          | —    | 52.0  | —    |
| ACLR   | Adjacent Channel Leakage Power Ratio <sup>[1,2]</sup> | Offset BW = 5 MHz  | —    | -58.0 | —    |
|        |                                                       | Offset BW = 10 MHz | —    | -66.0 | —    |

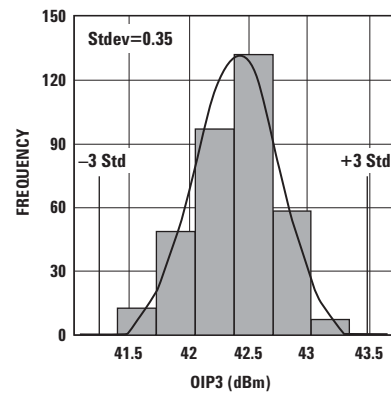
**Notes:**

- Measurements at 2 GHz obtained using production test board described in Figure 1.
- ACLR test spec is based on 3GPP TS 25.141 V5.3.1 (2002-06)
  - Test Model 1
  - Active Channels: PCCPCH + SCH + CPICH + PICH + SCCPCH + 64 DPCH (SF=128)
  - Freq = 2140 MHz
  - Pin = -8 dBm
  - Channel Integrate Bandwidth = 3.84 MHz

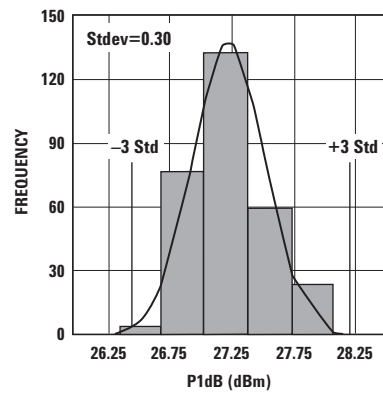


**Figure 1. Block diagram of the 2 GHz production test board used for NF, Gain, OIP3, P1dB, PAE and ACLR measurements. This circuit achieves a trade-off between optimal OIP3, P1dB and VSWR. Circuit losses have been de-embedded from actual measurements.**

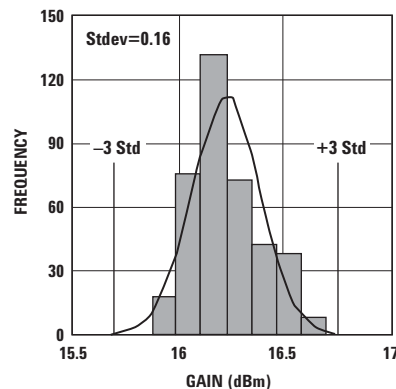
**Product Consistency Distribution Charts<sup>[1,2]</sup>**



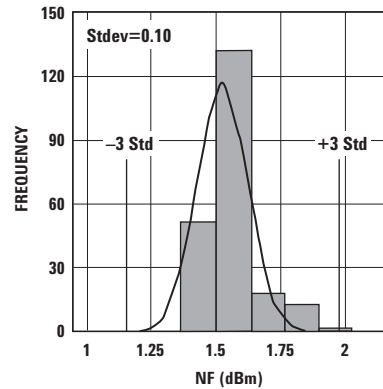
**Figure 2. OIP3 @ 2 GHz, 4.5V/200 mA.**  
LSL = 38.5 dBm, Nominal = 42.4 dBm.



**Figure 3. P1dB @ 2 GHz, 4.5V, 200 mA.**  
LSL = 25.5 dBm, Nominal = 27.1 dBm.



**Figure 4. Gain @ 2 GHz, 4.5V, 200 mA.**  
LSL = 14.8 dBm, Nominal = 16.1 dBm,  
USL = 17.8 dB.



**Figure 5. NF @ 2 GHz, 4.5V, 200 mA.**  
Nominal = 1.5 dBm.

**Notes:**

- Distribution data sample size is 500 samples taken from 3 different wafers. Future wafers allocated to this product may have nominal values anywhere between the upper and lower limits.
- Measurements are made on production test board, which represents a trade-off between optimal OIP3, P1dB and VSWR. Circuit losses have been de-embedded from actual measurements.

### Gamma Load and Source at Optimum OIP3 and P1dB Tuning Conditions

The device's optimum OIP3 and P1dB measurements were determined using a Maury Load Pull System at 4.5V, 200 mA quiescent bias.

#### Typical Gammas at Optimum OIP3<sup>[1]</sup>

| Freq<br>(GHz) | Gamma Source |           | Gamma Load |           | OIP3<br>(dBm) | Gain<br>(dB) | P1dB<br>(dBm) | PAE<br>(%) |
|---------------|--------------|-----------|------------|-----------|---------------|--------------|---------------|------------|
|               | Mag          | Ang (deg) | Mag        | Ang (deg) |               |              |               |            |
| 0.9           | 0.7511       | -132.82   | 0.6444     | -157.38   | 42.0          | 16.5         | 27.2          | 49.7       |
| 2.0           | 0.7577       | -131.31   | 0.3236     | -176.55   | 42.0          | 15.7         | 26.8          | 54.9       |
| 2.4           | 0.7625       | -128.49   | 0.2665     | -148.09   | 41.0          | 13.6         | 26.5          | 49.5       |
| 3.9           | 0.7432       | -94.91    | 0.4125     | -98.27    | 40.0          | 10.8         | 27.3          | 49.1       |

#### Typical Gammas at Optimum P1dB<sup>[1]</sup>

| Freq<br>(GHz) | Gamma Source |           | Gamma Load |           | OIP3<br>(dBm) | Gain<br>(dB) | P1dB<br>(dBm) | PAE<br>(%) |
|---------------|--------------|-----------|------------|-----------|---------------|--------------|---------------|------------|
|               | Mag          | Ang (deg) | Mag        | Ang (deg) |               |              |               |            |
| 0.9           | 0.7786       | 139.82    | 0.5494     | -177.76   | 38.6          | 17.3         | 28.4          | 58.3       |
| 2.0           | 0.7052       | -168.54   | 0.6981     | -165.37   | 37.5          | 14.8         | 29.0          | 48.6       |
| 2.4           | 0.7117       | -161.45   | 0.6624     | -159.44   | 37.3          | 12.0         | 29.3          | 48.2       |
| 3.9           | 0.3379       | -100.92   | 0.6151     | -126.28   | 37.0          | 9.1          | 28.0          | 46.2       |

#### Note:

1. Typical describes additional product performance information that is not covered by the product warranty.

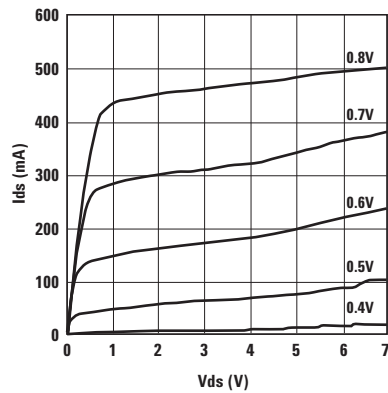


Figure 6. Typical IV Curve.

**ATF-52189 Typical Performance Curves (at 25°C unless specified otherwise)**  
**Tuned for Optimal OIP3 at  $V_d = 4.5V$ ,  $I_{ds} = 200\text{ mA}$ .**

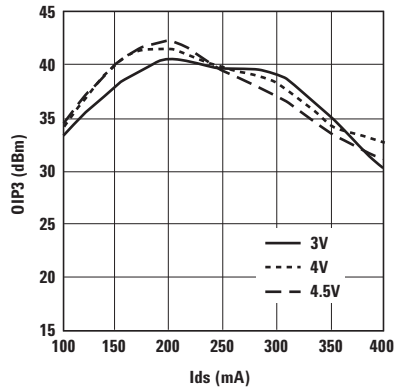


Figure 7. OIP3 vs.  $I_{ds}$  and  $V_{ds}$  at 900 MHz.

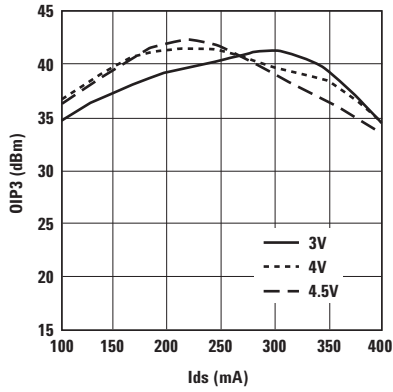


Figure 8. OIP3 vs.  $I_{ds}$  and  $V_{ds}$  at 2 GHz.

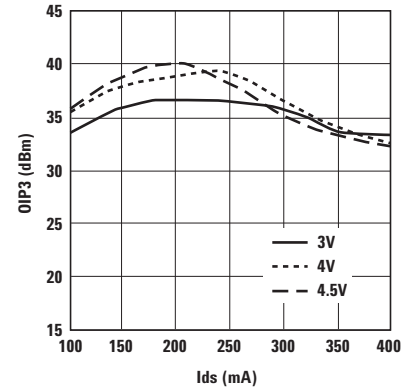


Figure 9. OIP3 vs.  $I_{ds}$  and  $V_{ds}$  at 3.9 GHz.

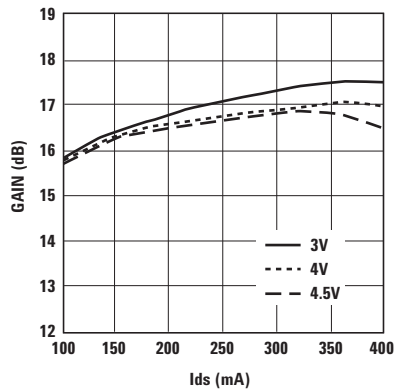


Figure 10. Small Signal Gain vs.  $I_{ds}$  and  $V_{ds}$  at 900 MHz.

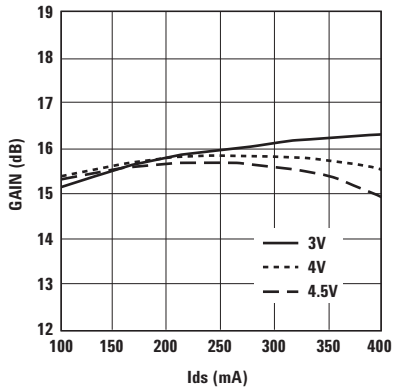


Figure 11. Small Signal Gain vs.  $I_{ds}$  and  $V_{ds}$  at 2 GHz.

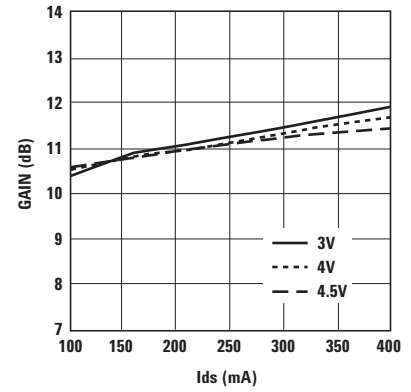


Figure 12. Small Signal Gain vs.  $I_{ds}$  and  $V_{ds}$  at 3.9 GHz.

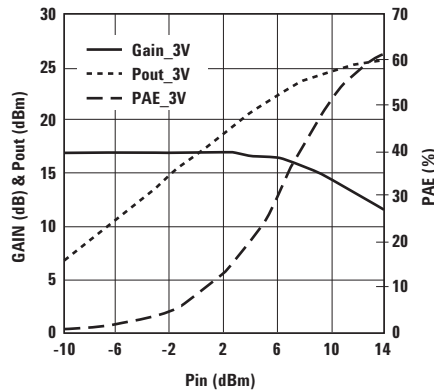


Figure 13. Small Signal Gain/Pout/PAE vs.  $P_{in}$  at  $V_{ds} = 3V$  and Frequency = 900 MHz.

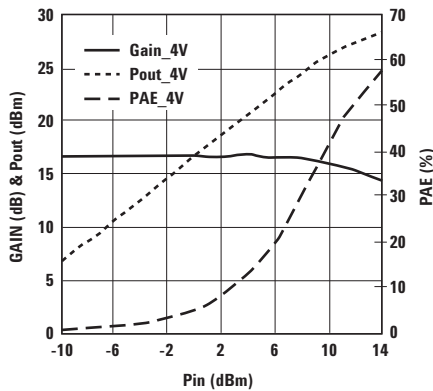


Figure 14. Small Signal Gain/Pout/PAE vs.  $P_{in}$  at  $V_{ds} = 4V$  and Frequency = 900 MHz.

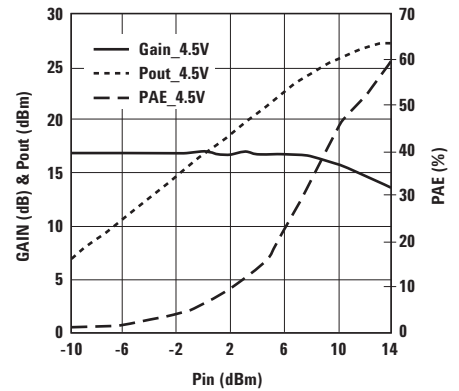
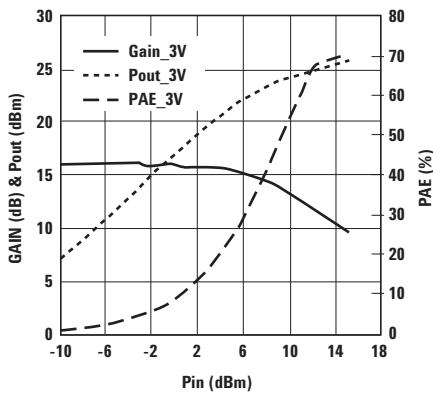


Figure 15. Small Signal Gain/Pout/PAE vs.  $P_{in}$  at  $V_{ds} = 4.5V$  and Frequency = 900 MHz.

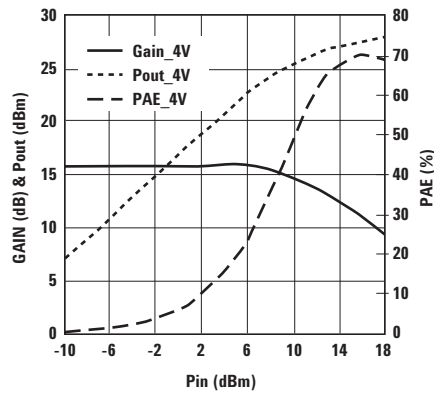
**Note:**

Bias current for the above charts are quiescent conditions. Actual level may increase depending on amount of RF drive.

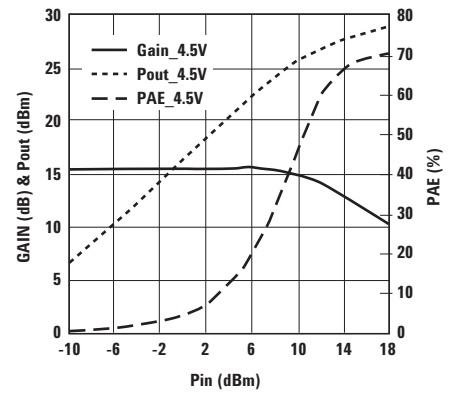
**ATF-52189 Typical Performance Curves** (at 25°C unless specified otherwise), continued  
**Tuned for Optimal OIP3 at  $V_d = 4.5V$ ,  $I_{ds} = 200\text{ mA}$ .**



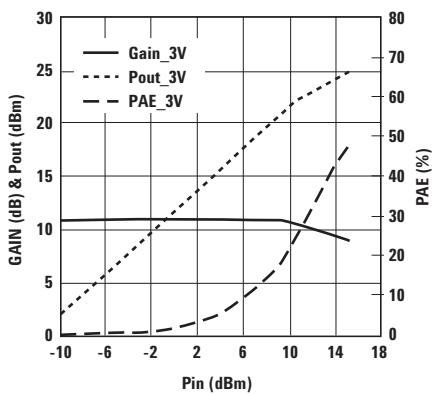
**Figure 16.** Small Signal Gain/Pout/PAE vs. Pin at  $V_{ds} = 3V$  and Frequency = 2 GHz.



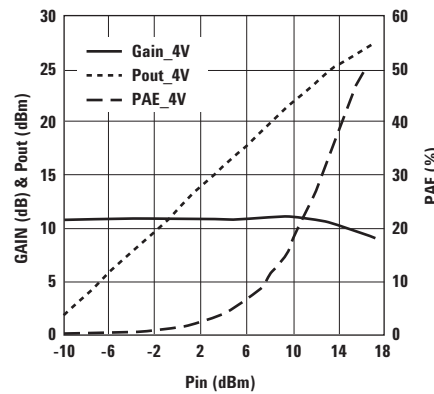
**Figure 17.** Small Signal Gain/Pout/PAE vs. Pin at  $V_{ds} = 4V$  and Frequency = 2 GHz.



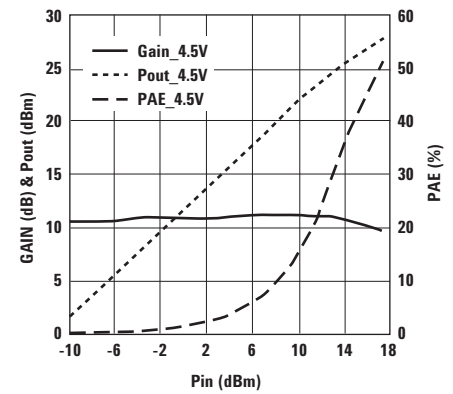
**Figure 18.** Small Signal Gain/Pout/PAE vs. Pin at  $V_{ds} = 4.5V$  and Frequency = 2 GHz.



**Figure 19.** Small Signal Gain/Pout/PAE vs. Pin at  $V_{ds} = 3V$  and Frequency = 3.9 GHz.



**Figure 20.** Small Signal Gain/Pout/PAE vs. Pin at  $V_{ds} = 4V$  and Frequency = 3.9 GHz.

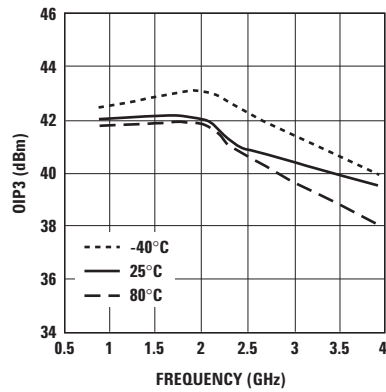


**Figure 21.** Small Signal Gain/Pout/PAE vs. Pin at  $V_{ds} = 4.5V$  and Frequency = 3.9 GHz.

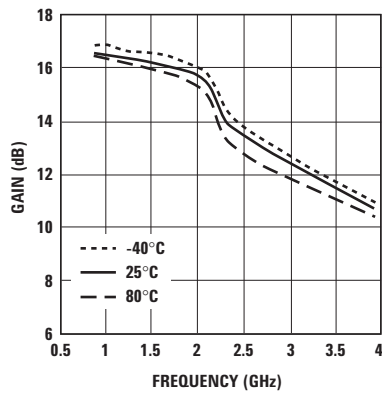
**Note:**

Bias current for the above charts are quiescent conditions. Actual level may increase depending on amount of RF drive.

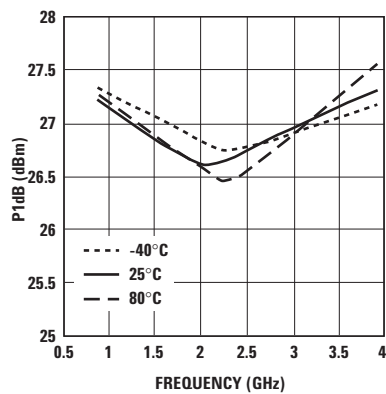
**ATF-52189 Typical Performance Curves, continued**  
**Tuned for Optimal OIP3 at  $V_d = 4.5V$ ,  $I_{ds} = 200\text{ mA}$ , Over Temperature and Frequency**



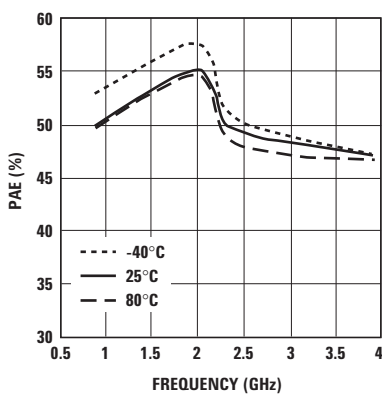
**Figure 22. OIP3 vs. Temperature and Frequency at optimum OIP3.**



**Figure 23. Gain vs. Temperature and Frequency at optimum OIP3.**



**Figure 24. P1dB vs. Temperature and Frequency at optimum OIP3.**



**Figure 25. PAE vs. Temperature and Frequency at optimum OIP3.**

**Note:**

Bias current for the above charts are quiescent conditions. Actual level may increase depending on amount of RF drive.

**ATF-52189 Typical Performance Curves, (at 25°C unless specified otherwise)  
Tuned for Optimal P1dB at  $V_d = 4.5V$ ,  $I_{ds} = 200\text{ mA}$ .**

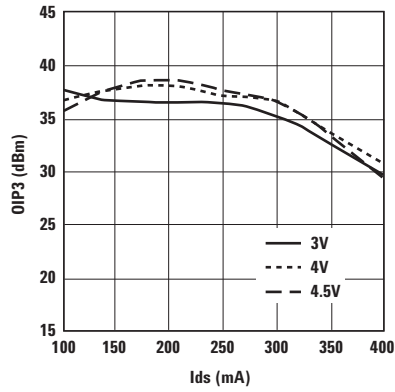


Figure 26. OIP3 vs  $I_{ds}$  and  $V_{ds}$  at 900 MHz.

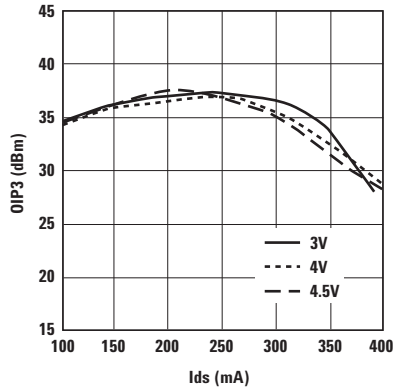


Figure 27. OIP3 vs  $I_{ds}$  and  $V_{ds}$  at 2 GHz.

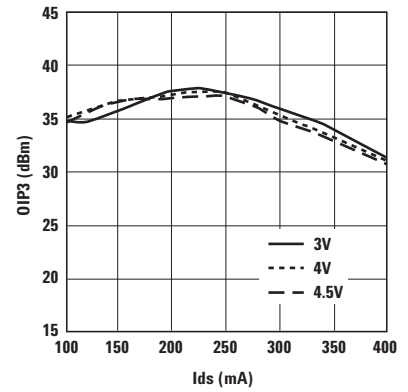


Figure 28. OIP3 vs  $I_{ds}$  and  $V_{ds}$  at 3.9 GHz.

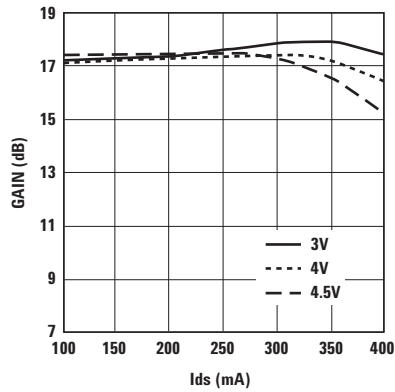


Figure 29. Small Signal Gain vs.  $I_{ds}$  and  $V_{ds}$  at 900 MHz.

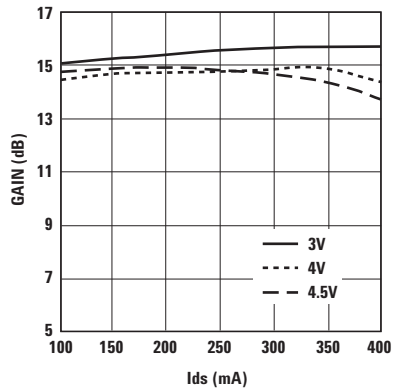


Figure 30. Small Signal Gain vs.  $I_{ds}$  and  $V_{ds}$  at 2 GHz.

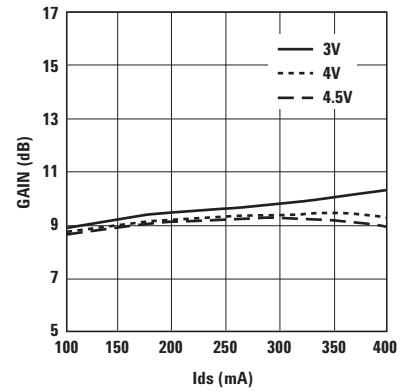


Figure 31. Small Signal Gain vs.  $I_{ds}$  and  $V_{ds}$  at 3.9 GHz.

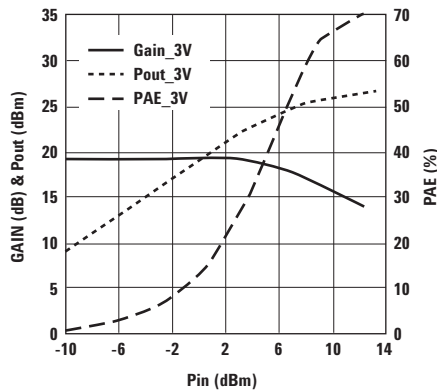


Figure 32. Small Signal Gain/Pout/PAE vs.  $P_{in}$  at  $V_{ds} = 3V$  and Frequency = 900 MHz.

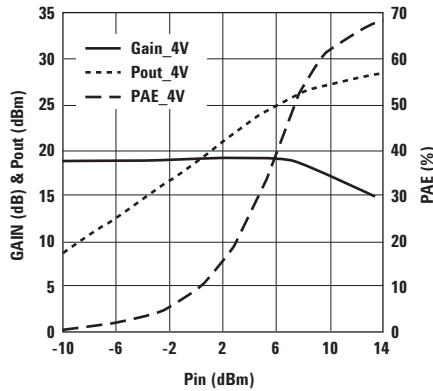


Figure 33. Small Signal Gain/Pout/PAE vs.  $P_{in}$  at  $V_{ds} = 4V$  and Frequency = 900 MHz.

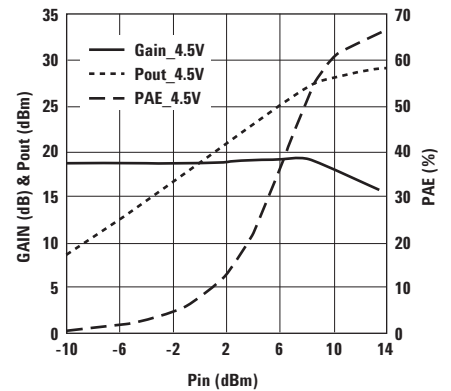
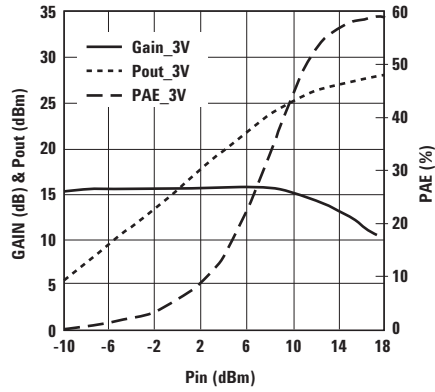


Figure 34. Small Signal Gain/Pout/PAE vs.  $P_{in}$  at  $V_{ds} = 4.5V$  and Frequency = 900 MHz.

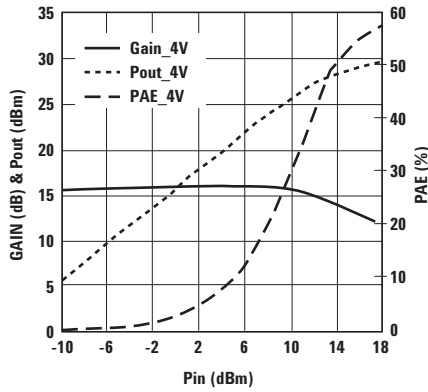
**Note:**

Bias current for the above charts are quiescent conditions. Actual level may increase depending on amount of RF drive.

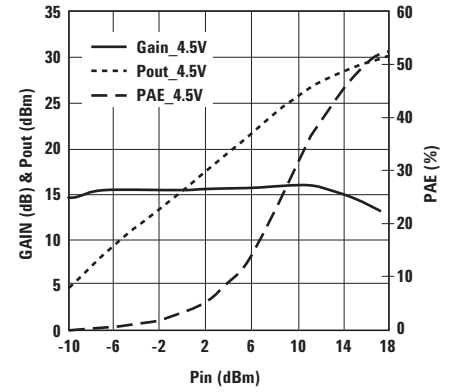
**ATF-52189 Typical Performance Curves** (at 25°C unless specified otherwise), continued  
**Tuned for Optimal P1dB at  $V_d = 4.5V$ ,  $I_{ds} = 200\text{ mA}$ .**



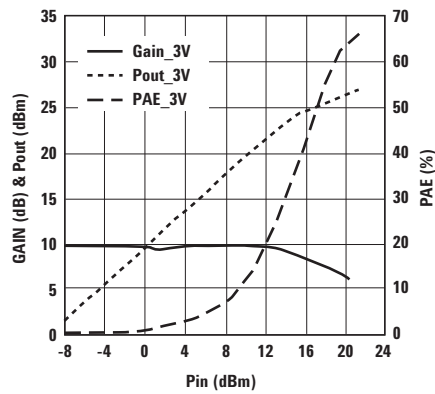
**Figure 35.** Small Signal Gain/Pout/PAE vs. Pin at  $V_d = 3V$  and Frequency = 2 GHz.



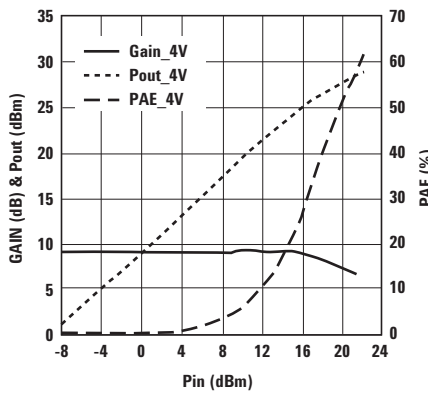
**Figure 36.** Small Signal Gain/Pout/PAE vs. Pin at  $V_d = 4V$  and Frequency = 2 GHz.



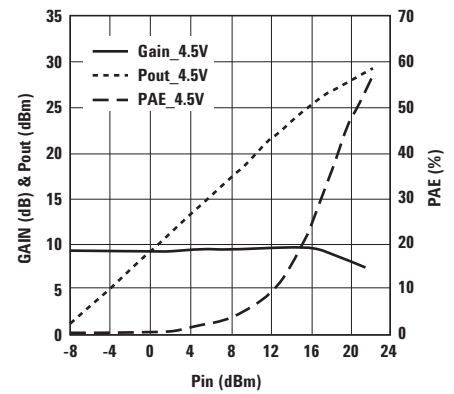
**Figure 37.** Small Signal Gain/Pout/PAE vs. Pin at  $V_d = 4.5V$  and Frequency = 2 GHz.



**Figure 38.** Small Signal Gain/Pout/PAE vs. Pin at  $V_d = 3V$  and Frequency = 3.9 GHz.



**Figure 39.** Small Signal Gain/Pout/PAE vs. Pin at  $V_d = 4V$  and Frequency = 3.9 GHz.



**Figure 40.** Small Signal Gain/Pout/PAE vs. Pin at  $V_d = 4.5V$  and Frequency = 3.9 GHz.

**Note:**

Bias current for the above charts are quiescent conditions. Actual level may increase depending on amount of RF drive.

# ATF-52189 Typical Performance Curves, continued

Tuned for Optimal P1dB at  $V_d = 4.5V$ ,  $I_{ds} = 200\text{ mA}$ , Over Temperature and Frequency.

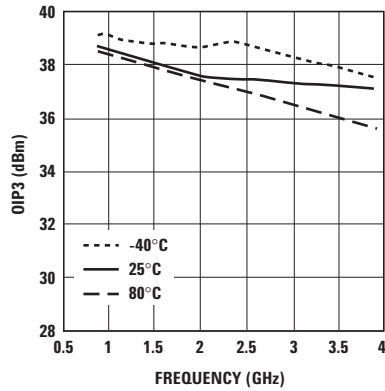


Figure 41. OIP3 vs. Temperature and Frequency at optimum P1dB.

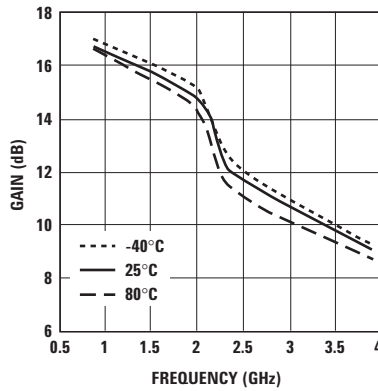


Figure 42. Gain vs. Temperature and Frequency at optimum P1dB.

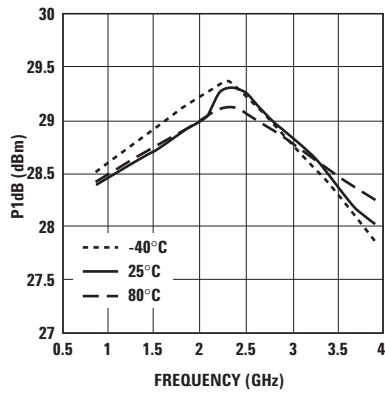


Figure 43. P1dB vs. Temperature and Frequency at optimum P1dB.

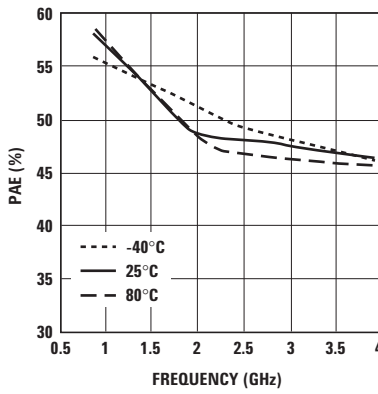
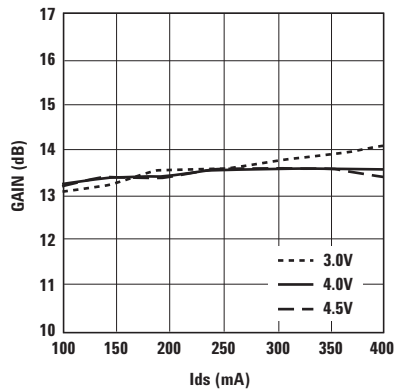


Figure 44. PAE vs. Temperature and Frequency at optimum P1dB.

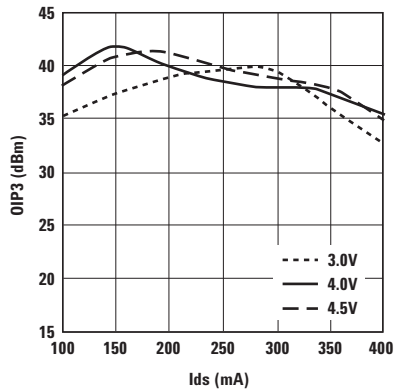
## Note:

Bias current for the above charts are quiescent conditions. Actual level may increase depending on amount of RF drive.

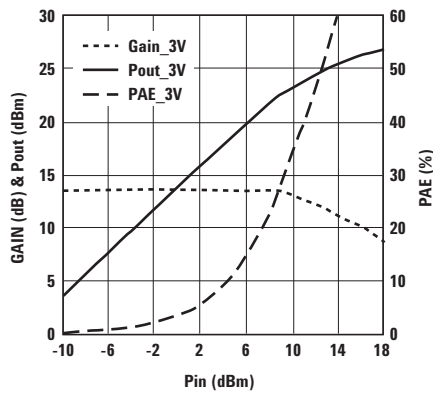
**ATF-52189 Typical Performance Curves (at 25°C unless specified otherwise), continued**  
**Tuned for Optimal OIP3 at  $V_d = 4.5V$ ,  $I_{ds} = 200\text{ mA}$ .**



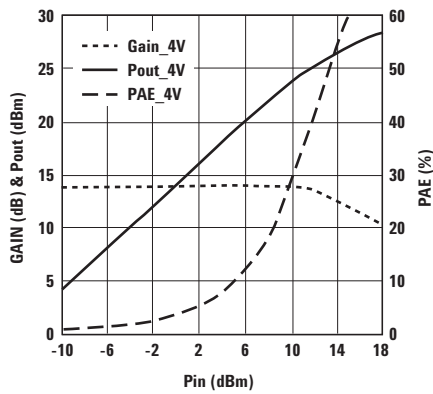
**Figure 45. OIP3 vs.  $I_{ds}$  and  $V_{ds}$  at 2.4 GHz.**



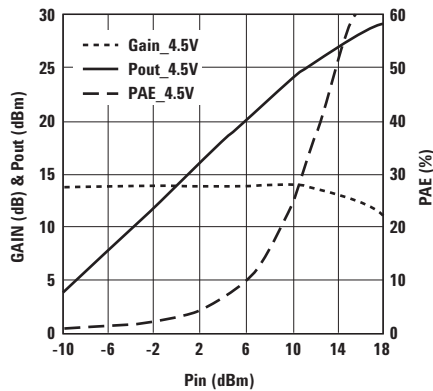
**Figure 46. Small Signal Gain vs.  $I_{ds}$  and  $V_{ds}$  at 2.4 GHz.**



**Figure 47. Small Signal Gain/Pout/PAE vs.  $P_{in}$  at  $V_{ds}$  3V and Freq = 2.4 GHz.**



**Figure 48. Small Signal Gain/Pout/PAE vs.  $P_{in}$  at  $V_{ds}$  4V and Freq = 2.4 GHz.**



**Figure 49. Small Signal Gain/Pout/PAE vs.  $P_{in}$  at  $V_{ds}$  4.5V and Freq = 2.4 GHz.**

**Note:**

Bias current for the above charts are quiescent conditions. Actual level may increase depending on amount of RF drive.

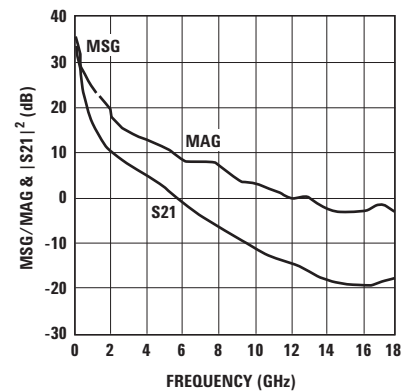
**ATF-52189 Typical Scattering and Noise Parameters at 25°C,  $V_{DS} = 4.5V$ ,  $I_{DS} = 280$  mA**

| Freq<br>(GHz) | S11   |        |        | S21    |        |        | S12   |        |       | S22    |       | MSG/MAG<br>dB |
|---------------|-------|--------|--------|--------|--------|--------|-------|--------|-------|--------|-------|---------------|
|               | Mag.  | Ang.   | (dB)   | Mag.   | Ang.   | (dB)   | Mag.  | Ang.   | Mag.  | Ang.   |       |               |
| 0.1           | 0.544 | -91.7  | 31.93  | 39.502 | 144.2  | -39.17 | 0.011 | 52.6   | 0.289 | -99.7  | 35.55 |               |
| 0.2           | 0.704 | -128.0 | 29.23  | 28.943 | 122.7  | -35.39 | 0.017 | 40.4   | 0.397 | -130.4 | 32.31 |               |
| 0.3           | 0.777 | -146.6 | 26.78  | 21.823 | 109.6  | -33.98 | 0.020 | 33.2   | 0.446 | -145.8 | 30.38 |               |
| 0.4           | 0.813 | -158.4 | 24.74  | 17.257 | 100.6  | -33.15 | 0.022 | 28.6   | 0.470 | -155.3 | 28.95 |               |
| 0.5           | 0.856 | -171.5 | 21.75  | 12.238 | 93.9   | -33.98 | 0.020 | 26.1   | 0.551 | -170.8 | 27.87 |               |
| 0.6           | 0.866 | -176.8 | 20.26  | 10.303 | 89.3   | -33.56 | 0.021 | 25.4   | 0.559 | -174.5 | 26.91 |               |
| 0.7           | 0.872 | 178.8  | 19.00  | 8.913  | 85.4   | -33.56 | 0.021 | 25.1   | 0.562 | -177.5 | 26.28 |               |
| 0.8           | 0.874 | 175.1  | 17.92  | 7.866  | 81.8   | -33.15 | 0.022 | 25.0   | 0.564 | 179.8  | 25.53 |               |
| 0.9           | 0.876 | 171.6  | 16.96  | 7.050  | 78.4   | -32.77 | 0.023 | 25.0   | 0.564 | 177.4  | 24.86 |               |
| 1.0           | 0.880 | 168.4  | 16.08  | 6.366  | 75.3   | -32.40 | 0.024 | 25.0   | 0.563 | 175.2  | 24.24 |               |
| 1.5           | 0.881 | 154.5  | 12.74  | 4.333  | 61.0   | -31.06 | 0.028 | 24.2   | 0.558 | 165.5  | 21.90 |               |
| 2.0           | 0.882 | 141.6  | 10.39  | 3.309  | 47.5   | -29.63 | 0.033 | 21.5   | 0.549 | 156.5  | 18.26 |               |
| 2.5           | 0.879 | 128.6  | 8.63   | 2.702  | 34.1   | -28.18 | 0.039 | 16.7   | 0.542 | 147.4  | 16.05 |               |
| 3.0           | 0.874 | 115.1  | 7.31   | 2.320  | 20.5   | -27.26 | 0.043 | 9.6    | 0.543 | 138.9  | 14.47 |               |
| 3.5           | 0.882 | 105.8  | 6.39   | 2.087  | 9.7    | -26.92 | 0.045 | 3.3    | 0.560 | 130.4  | 13.83 |               |
| 4.0           | 0.889 | 96.5   | 5.36   | 1.853  | -1.2   | -26.60 | 0.047 | -3.1   | 0.578 | 121.8  | 13.09 |               |
| 5.0           | 0.903 | 77.9   | 2.83   | 1.385  | -22.8  | -25.98 | 0.050 | -15.7  | 0.613 | 104.8  | 11.24 |               |
| 6.0           | 0.918 | 59.3   | -0.75  | 0.918  | -44.5  | -25.41 | 0.054 | -28.4  | 0.648 | 87.7   | 8.51  |               |
| 7.0           | 0.948 | 43.4   | -3.31  | 0.683  | -63.8  | -26.02 | 0.050 | -39.9  | 0.687 | 74.6   | 8.14  |               |
| 8.0           | 0.960 | 31.6   | -5.68  | 0.520  | -81.4  | -26.74 | 0.046 | -51.6  | 0.729 | 61.0   | 7.41  |               |
| 9.0           | 0.941 | 23.4   | -8.20  | 0.389  | -96.9  | -28.18 | 0.039 | -63.8  | 0.773 | 47.8   | 4.33  |               |
| 10.0          | 0.946 | 14.0   | -10.29 | 0.306  | -112.0 | -29.63 | 0.033 | -80.6  | 0.805 | 36.5   | 3.52  |               |
| 11.0          | 0.937 | 3.1    | -12.11 | 0.248  | -128.9 | -32.77 | 0.023 | -113.1 | 0.825 | 26.9   | 2.11  |               |
| 12.0          | 0.914 | -3.8   | -13.68 | 0.207  | -143.7 | -37.72 | 0.013 | -154.6 | 0.843 | 16.9   | -0.19 |               |
| 13.0          | 0.951 | -15.1  | -15.70 | 0.164  | -163.9 | -37.08 | 0.014 | 106.3  | 0.842 | 7.7    | 0.27  |               |
| 14.0          | 0.948 | -19.8  | -17.79 | 0.129  | -172.6 | -37.72 | 0.013 | 51.0   | 0.849 | 1.1    | -2.38 |               |
| 15.0          | 0.939 | -21.2  | -18.56 | 0.118  | 179.7  | -41.94 | 0.008 | 60.4   | 0.879 | -4.4   | -2.87 |               |
| 16.0          | 0.948 | -24.7  | -18.94 | 0.113  | 171.7  | -46.02 | 0.005 | 71.8   | 0.876 | -8.4   | -2.64 |               |
| 17.0          | 0.947 | -33.0  | -17.99 | 0.126  | 157.7  | -38.42 | 0.012 | 123.0  | 0.884 | -13.3  | -1.07 |               |
| 18.0          | 0.903 | -45.1  | -17.14 | 0.139  | 140.5  | -33.98 | 0.020 | 114.5  | 0.859 | -21.3  | -3.66 |               |

| Freq<br>GHz | Fmin<br>dB | Gamma Opt<br>Mag | Ang    | Rn/50 | Ga<br>dB |
|-------------|------------|------------------|--------|-------|----------|
| 0.5         | 1.45       | 0.704            | -175.0 | 0.23  | 21.63    |
| 1.0         | 1.60       | 0.706            | -162.6 | 0.15  | 18.91    |
| 2.0         | 1.90       | 0.727            | -137.5 | 0.10  | 16.10    |
| 3.0         | 2.20       | 0.763            | -112.8 | 0.14  | 12.97    |
| 4.0         | 2.46       | 0.804            | -91.9  | 0.27  | 11.03    |
| 5.0         | 2.79       | 0.855            | -68.9  | 0.61  | 9.62     |
| 6.0         | 3.09       | 0.896            | -51.5  | 0.81  | 8.46     |
| 7.0         | 3.39       | 0.923            | -38.6  | 1.02  | 7.62     |
| 8.0         | 3.69       | 0.930            | -31.0  | 1.42  | 6.50     |

**Notes:**

1.  $F_{min}$  values at 2 GHz and higher are based on measurements while the  $F_{min}$  below 2 GHz have been extrapolated. The  $F_{min}$  values are based on a set of 16 noise figure measurements made at 16 different impedances using an ATN NP5 test system. From these measurements a true  $F_{min}$  is calculated. Refer to the noise parameter application section for more information.
2. S and noise parameters are measured on a microstrip line made on 0.025 inch thick alumina carrier. The input reference plane is at the end of the gate lead. The output reference plane is at the end of the drain lead.



**Figure 50. MSG/MAG &  $|S21|^2$  vs. Frequency at 4.5V/280 mA.**

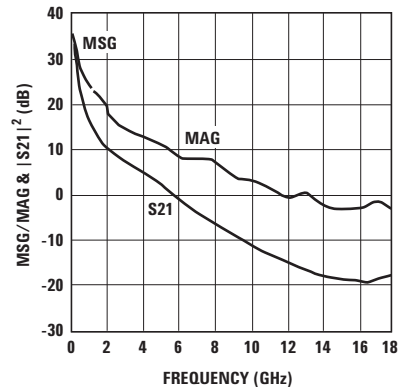
**ATF-52189 Typical Scattering and Noise Parameters at 25°C,  $V_{DS} = 4.5V$ ,  $I_{DS} = 200$  mA**

| Freq<br>(GHz) | S11   |        |        | S21    |        |        | S12   |        |       | S22    |       | MSG/MAG<br>dB |
|---------------|-------|--------|--------|--------|--------|--------|-------|--------|-------|--------|-------|---------------|
|               | Mag.  | Ang.   | (dB)   | Mag.   | Ang.   | (dB)   | Mag.  | Ang.   | Mag.  | Ang.   |       |               |
| 0.1           | 0.848 | -84.4  | 33.58  | 47.752 | 136.0  | -37.08 | 0.014 | 51.6   | 0.360 | -104.6 | 35.33 |               |
| 0.2           | 0.856 | -124.7 | 30.01  | 31.649 | 114.6  | -34.42 | 0.019 | 35.9   | 0.442 | -136.7 | 32.22 |               |
| 0.3           | 0.863 | -144.9 | 27.16  | 22.811 | 102.9  | -33.15 | 0.022 | 28.7   | 0.473 | -151.3 | 30.16 |               |
| 0.4           | 0.868 | -157.3 | 24.94  | 17.656 | 95.1   | -32.77 | 0.023 | 24.7   | 0.487 | -159.9 | 28.85 |               |
| 0.5           | 0.882 | -170.8 | 21.81  | 12.320 | 89.4   | -33.56 | 0.021 | 22.5   | 0.562 | -173.9 | 27.68 |               |
| 0.6           | 0.885 | -176.3 | 20.27  | 10.315 | 85.5   | -33.56 | 0.021 | 22.2   | 0.567 | -177.2 | 26.91 |               |
| 0.7           | 0.886 | 179.2  | 18.98  | 8.894  | 82.0   | -33.15 | 0.022 | 22.1   | 0.568 | -179.8 | 26.07 |               |
| 0.8           | 0.886 | 175.4  | 17.88  | 7.831  | 78.8   | -32.77 | 0.023 | 22.1   | 0.568 | 177.7  | 25.32 |               |
| 0.9           | 0.885 | 171.9  | 16.91  | 7.007  | 75.8   | -32.40 | 0.024 | 22.3   | 0.567 | 175.6  | 24.65 |               |
| 1.0           | 0.887 | 168.6  | 16.01  | 6.320  | 72.9   | -32.40 | 0.024 | 22.4   | 0.566 | 173.6  | 24.21 |               |
| 1.5           | 0.886 | 154.7  | 12.65  | 4.291  | 59.3   | -30.75 | 0.029 | 22.1   | 0.560 | 164.3  | 21.70 |               |
| 2.0           | 0.886 | 141.7  | 10.29  | 3.271  | 46.3   | -29.37 | 0.034 | 19.7   | 0.549 | 155.6  | 18.69 |               |
| 2.5           | 0.881 | 128.7  | 8.52   | 2.668  | 33.1   | -28.18 | 0.039 | 15.0   | 0.543 | 146.6  | 16.11 |               |
| 3.0           | 0.879 | 116.3  | 7.28   | 2.312  | 20.4   | -27.38 | 0.043 | 8.7    | 0.548 | 138.1  | 14.68 |               |
| 3.5           | 0.885 | 106.8  | 6.33   | 2.073  | 9.5    | -27.01 | 0.045 | 2.5    | 0.564 | 129.6  | 13.97 |               |
| 4.0           | 0.891 | 97.4   | 5.27   | 1.835  | -1.4   | -26.65 | 0.047 | -3.8   | 0.580 | 121.0  | 13.15 |               |
| 5.0           | 0.903 | 78.4   | 2.66   | 1.358  | -23.2  | -25.98 | 0.050 | -16.3  | 0.613 | 104.0  | 11.08 |               |
| 6.0           | 0.915 | 59.5   | -1.10  | 0.881  | -45.0  | -25.35 | 0.054 | -28.8  | 0.645 | 86.9   | 8.05  |               |
| 7.0           | 0.948 | 43.4   | -3.44  | 0.673  | -64.1  | -26.02 | 0.050 | -40.5  | 0.686 | 74.4   | 8.04  |               |
| 8.0           | 0.960 | 31.6   | -5.78  | 0.514  | -81.8  | -26.74 | 0.046 | -52.4  | 0.729 | 60.9   | 7.37  |               |
| 9.0           | 0.941 | 23.4   | -8.34  | 0.383  | -97.0  | -28.18 | 0.039 | -64.2  | 0.772 | 47.7   | 4.20  |               |
| 10.0          | 0.945 | 14.0   | -10.40 | 0.302  | -112.0 | -29.63 | 0.033 | -80.8  | 0.805 | 36.5   | 3.35  |               |
| 11.0          | 0.938 | 3.0    | -12.32 | 0.242  | -129.2 | -33.15 | 0.022 | -113.9 | 0.826 | 26.8   | 1.99  |               |
| 12.0          | 0.914 | -3.7   | -13.89 | 0.202  | -144.1 | -38.42 | 0.012 | -156.0 | 0.843 | 16.9   | -0.42 |               |
| 13.0          | 0.953 | -15.1  | -15.86 | 0.161  | -164.5 | -37.72 | 0.013 | 98.9   | 0.843 | 7.7    | 0.22  |               |
| 14.0          | 0.946 | -19.8  | -17.92 | 0.127  | -172.6 | -39.17 | 0.011 | 49.2   | 0.849 | 1.0    | -2.67 |               |
| 15.0          | 0.939 | -21.2  | -18.64 | 0.117  | 178.8  | -43.10 | 0.007 | 72.1   | 0.877 | -4.5   | -2.97 |               |
| 16.0          | 0.948 | -24.7  | -19.17 | 0.110  | 170.6  | -44.44 | 0.006 | 76.0   | 0.874 | -8.4   | -2.92 |               |
| 17.0          | 0.947 | -33.1  | -18.13 | 0.124  | 157.2  | -38.42 | 0.012 | 119.6  | 0.883 | -13.2  | -1.28 |               |
| 18.0          | 0.900 | -45.1  | -17.27 | 0.137  | 140.4  | -33.98 | 0.020 | 115.7  | 0.859 | -21.3  | -3.92 |               |

| Freq<br>GHz | Fmin<br>dB | Gamma Opt |        | Rn/50 | Ga<br>dB |
|-------------|------------|-----------|--------|-------|----------|
|             |            | Mag       | Ang    |       |          |
| 0.5         | 0.92       | 0.409     | 177.1  | 0.15  | 19.38    |
| 1.0         | 1.02       | 0.480     | -169.1 | 0.10  | 17.52    |
| 2.0         | 1.21       | 0.602     | -141.8 | 0.08  | 15.64    |
| 3.0         | 1.41       | 0.700     | -115.6 | 0.12  | 12.74    |
| 4.0         | 1.59       | 0.772     | -93.6  | 0.23  | 11.05    |
| 5.0         | 1.81       | 0.841     | -69.9  | 0.54  | 9.72     |
| 6.0         | 2.01       | 0.891     | -52.2  | 0.70  | 8.62     |
| 7.0         | 2.21       | 0.931     | -39.1  | 0.98  | 7.78     |
| 8.0         | 2.41       | 0.965     | -31.5  | 1.33  | 6.72     |

**Notes:**

1.  $F_{min}$  values at 2 GHz and higher are based on measurements while the  $F_{min}$  below 2 GHz have been extrapolated. The  $F_{min}$  values are based on a set of 16 noise figure measurements made at 16 different impedances using an ATN NP5 test system. From these measurements a true  $F_{min}$  is calculated. Refer to the noise parameter application section for more information.
2. S and noise parameters are measured on a microstrip line made on 0.025 inch thick alumina carrier. The input reference plane is at the end of the gate lead. The output reference plane is at the end of the drain lead.



**Figure 51. MSG/MAG &  $|S21|^2$  vs. Frequency at 4.5V/200 mA.**

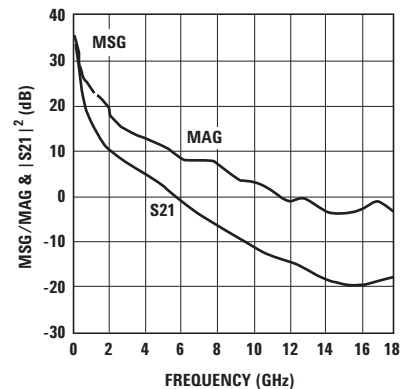
**ATF-52189 Typical Scattering and Noise Parameters at 25°C,  $V_{DS} = 4.5V$ ,  $I_{DS} = 120\text{ mA}$**

| Freq<br>(GHz) | S11   |        |        | S21    |        |        | S12   |        | S22   |        | MSG/MAG<br>dB |
|---------------|-------|--------|--------|--------|--------|--------|-------|--------|-------|--------|---------------|
|               | Mag.  | Ang.   | (dB)   | Mag.   | Ang.   | (dB)   | Mag.  | Ang.   | Mag.  | Ang.   |               |
| 0.1           | 0.926 | -80.9  | 33.47  | 47.170 | 135.8  | -35.92 | 0.016 | 51.6   | 0.389 | -96.0  | 34.70         |
| 0.2           | 0.891 | -121.5 | 29.88  | 31.192 | 114.3  | -33.15 | 0.022 | 34.6   | 0.447 | -131.4 | 31.52         |
| 0.3           | 0.882 | -142.5 | 27.03  | 22.457 | 102.7  | -32.04 | 0.025 | 26.7   | 0.471 | -147.6 | 29.53         |
| 0.4           | 0.879 | -155.4 | 24.79  | 17.360 | 94.8   | -31.70 | 0.026 | 22.2   | 0.482 | -157.0 | 28.25         |
| 0.5           | 0.885 | -169.7 | 21.67  | 12.120 | 88.9   | -32.77 | 0.023 | 19.7   | 0.551 | -172.5 | 27.22         |
| 0.6           | 0.886 | -175.4 | 20.13  | 10.145 | 85.0   | -32.40 | 0.024 | 19.0   | 0.555 | -176.0 | 26.26         |
| 0.7           | 0.886 | -180.0 | 18.83  | 8.743  | 81.6   | -32.40 | 0.024 | 18.6   | 0.557 | -178.8 | 25.61         |
| 0.8           | 0.886 | 176.1  | 17.72  | 7.695  | 78.4   | -32.04 | 0.025 | 18.5   | 0.557 | 178.7  | 24.88         |
| 0.9           | 0.885 | 172.5  | 16.76  | 6.883  | 75.3   | -31.70 | 0.026 | 18.4   | 0.555 | 176.5  | 24.23         |
| 1.0           | 0.887 | 169.3  | 15.86  | 6.209  | 72.4   | -31.70 | 0.026 | 18.3   | 0.554 | 174.4  | 23.78         |
| 1.5           | 0.884 | 155.1  | 12.49  | 4.212  | 58.8   | -30.46 | 0.030 | 17.8   | 0.548 | 165.1  | 21.47         |
| 2.0           | 0.884 | 142.1  | 10.13  | 3.210  | 45.7   | -29.12 | 0.035 | 15.6   | 0.538 | 156.3  | 19.17         |
| 2.5           | 0.880 | 129.1  | 8.36   | 2.618  | 32.5   | -27.96 | 0.040 | 11.2   | 0.532 | 147.4  | 16.16         |
| 3.0           | 0.875 | 115.5  | 7.03   | 2.246  | 18.9   | -27.08 | 0.044 | 4.9    | 0.532 | 139.0  | 14.43         |
| 3.5           | 0.882 | 106.2  | 6.10   | 2.018  | 8.1    | -26.80 | 0.046 | -1.1   | 0.549 | 130.5  | 13.76         |
| 4.0           | 0.889 | 96.8   | 5.06   | 1.791  | -2.8   | -26.54 | 0.047 | -7.1   | 0.567 | 122.0  | 12.99         |
| 5.0           | 0.903 | 78.1   | 2.52   | 1.337  | -24.5  | -26.04 | 0.050 | -19.0  | 0.603 | 105.1  | 11.06         |
| 6.0           | 0.917 | 59.4   | -1.09  | 0.882  | -46.2  | -25.56 | 0.053 | -31.0  | 0.638 | 88.1   | 8.23          |
| 7.0           | 0.947 | 43.5   | -3.64  | 0.658  | -65.5  | -26.20 | 0.049 | -42.2  | 0.681 | 75.1   | 7.89          |
| 8.0           | 0.959 | 31.7   | -6.00  | 0.501  | -83.3  | -26.74 | 0.046 | -53.9  | 0.725 | 61.6   | 7.19          |
| 9.0           | 0.941 | 23.4   | -8.64  | 0.370  | -98.9  | -28.40 | 0.038 | -65.8  | 0.770 | 48.2   | 4.00          |
| 10.0          | 0.946 | 14.1   | -10.69 | 0.292  | -114.3 | -29.63 | 0.033 | -82.9  | 0.805 | 36.9   | 3.26          |
| 11.0          | 0.936 | 3.1    | -12.54 | 0.236  | -131.4 | -33.15 | 0.022 | -116.4 | 0.826 | 27.2   | 1.71          |
| 12.0          | 0.914 | -3.7   | -14.24 | 0.194  | -146.0 | -37.72 | 0.013 | -159.1 | 0.843 | 17.2   | -0.74         |
| 13.0          | 0.951 | -14.9  | -16.25 | 0.154  | -166.9 | -37.72 | 0.013 | 104.3  | 0.843 | 8.0    | -0.35         |
| 14.0          | 0.948 | -19.8  | -18.34 | 0.121  | -175.3 | -39.17 | 0.011 | 56.9   | 0.850 | 1.2    | -2.88         |
| 15.0          | 0.937 | -21.1  | -19.02 | 0.112  | 176.1  | -40.92 | 0.009 | 79.5   | 0.877 | -4.2   | -3.46         |
| 16.0          | 0.949 | -24.5  | -19.66 | 0.104  | 167.9  | -43.10 | 0.007 | 74.4   | 0.878 | -8.2   | -3.21         |
| 17.0          | 0.947 | -32.9  | -18.56 | 0.118  | 154.7  | -37.72 | 0.013 | 117.9  | 0.887 | -13.1  | -1.56         |
| 18.0          | 0.906 | -45.1  | -17.79 | 0.129  | 138.1  | -33.56 | 0.021 | 111.8  | 0.862 | -21.1  | -4.11         |

| Freq<br>GHz | Fmin<br>dB | Gamma Opt<br>Mag | Ang    | Rn/50 | Ga<br>dB |
|-------------|------------|------------------|--------|-------|----------|
| 0.5         | 0.67       | 0.263            | 166.7  | 0.14  | 19.36    |
| 1.0         | 0.76       | 0.361            | -177.3 | 0.08  | 17.64    |
| 2.0         | 0.95       | 0.524            | -146.8 | 0.06  | 15.04    |
| 3.0         | 1.13       | 0.652            | -118.4 | 0.12  | 12.27    |
| 4.0         | 1.30       | 0.741            | -95.3  | 0.15  | 10.83    |
| 5.0         | 1.50       | 0.826            | -70.9  | 0.30  | 9.62     |
| 6.0         | 1.68       | 0.887            | -52.9  | 0.54  | 8.48     |
| 7.0         | 1.86       | 0.939            | -39.7  | 0.69  | 7.85     |
| 8.0         | 1.88       | 0.989            | -31.8  | 0.97  | 4.25     |

**Notes:**

1.  $F_{min}$  values at 2 GHz and higher are based on measurements while the  $F_{min}$  below 2 GHz have been extrapolated. The  $F_{min}$  values are based on a set of 16 noise figure measurements made at 16 different impedances using an ATN NP5 test system. From these measurements a true  $F_{min}$  is calculated. Refer to the noise parameter application section for more information.
2. S and noise parameters are measured on a microstrip line made on 0.025 inch thick alumina carrier. The input reference plane is at the end of the gate lead. The output reference plane is at the end of the drain lead.



**Figure 52. MSG/MAG &  $|S21|^2$  vs. Frequency at 4.5V/120 mA.**

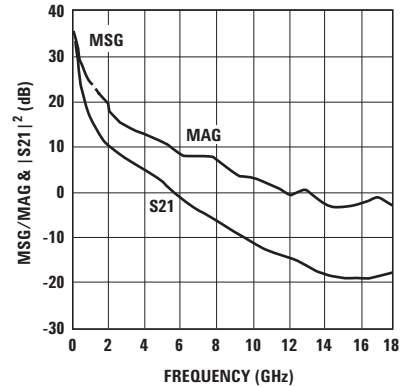
**ATF-52189 Typical Scattering and Noise Parameters at 25°C,  $V_{DS} = 4.0V$ ,  $I_{DS} = 200$  mA**

| Freq<br>(GHz) | S11   |        |        | S21    |        |        | S12   |        | S22   |        | MSG/MAG<br>dB |
|---------------|-------|--------|--------|--------|--------|--------|-------|--------|-------|--------|---------------|
|               | Mag.  | Ang.   | (dB)   | Mag.   | Ang.   | (dB)   | Mag.  | Ang.   | Mag.  | Ang.   |               |
| 0.1           | 0.866 | -84.2  | 33.69  | 48.364 | 135.7  | -37.08 | 0.014 | 51.3   | 0.366 | -106.5 | 35.38         |
| 0.2           | 0.865 | -124.5 | 30.08  | 31.913 | 114.3  | -33.98 | 0.020 | 35.7   | 0.451 | -138.0 | 32.03         |
| 0.3           | 0.868 | -144.8 | 27.22  | 22.964 | 102.7  | -33.15 | 0.022 | 28.6   | 0.483 | -152.3 | 30.19         |
| 0.4           | 0.870 | -157.3 | 24.98  | 17.748 | 94.9   | -32.77 | 0.023 | 24.5   | 0.498 | -160.7 | 28.87         |
| 0.5           | 0.884 | -170.8 | 21.85  | 12.369 | 89.3   | -33.56 | 0.021 | 22.6   | 0.572 | -174.3 | 27.70         |
| 0.6           | 0.886 | -176.3 | 20.30  | 10.356 | 85.4   | -33.56 | 0.021 | 22.3   | 0.577 | -177.5 | 26.93         |
| 0.7           | 0.887 | 179.2  | 19.01  | 8.926  | 82.0   | -33.15 | 0.022 | 22.1   | 0.579 | 179.8  | 26.08         |
| 0.8           | 0.887 | 175.4  | 17.91  | 7.862  | 78.8   | -32.77 | 0.023 | 22.3   | 0.579 | 177.4  | 25.34         |
| 0.9           | 0.886 | 171.9  | 16.94  | 7.033  | 75.8   | -32.40 | 0.024 | 22.4   | 0.578 | 175.2  | 24.67         |
| 1.0           | 0.888 | 168.7  | 16.05  | 6.344  | 72.9   | -32.40 | 0.024 | 22.6   | 0.577 | 173.2  | 24.22         |
| 1.5           | 0.886 | 154.7  | 12.68  | 4.307  | 59.5   | -30.75 | 0.029 | 22.3   | 0.570 | 164.0  | 21.72         |
| 2.0           | 0.885 | 141.7  | 10.33  | 3.284  | 46.5   | -29.37 | 0.034 | 19.7   | 0.560 | 155.1  | 18.68         |
| 2.5           | 0.881 | 128.7  | 8.57   | 2.681  | 33.3   | -28.18 | 0.039 | 15.0   | 0.554 | 146.1  | 16.18         |
| 3.0           | 0.868 | 113.6  | 7.16   | 2.280  | 18.8   | -26.94 | 0.045 | 7.5    | 0.549 | 137.6  | 14.17         |
| 3.5           | 0.876 | 104.5  | 6.24   | 2.051  | 8.3    | -26.66 | 0.046 | 1.3    | 0.566 | 129.1  | 13.55         |
| 4.0           | 0.884 | 95.5   | 5.21   | 1.823  | -2.2   | -26.39 | 0.048 | -4.9   | 0.584 | 120.6  | 12.84         |
| 5.0           | 0.901 | 77.3   | 2.70   | 1.365  | -23.3  | -25.88 | 0.051 | -17.3  | 0.618 | 103.7  | 11.06         |
| 6.0           | 0.917 | 59.2   | -0.84  | 0.908  | -44.3  | -25.40 | 0.054 | -29.7  | 0.653 | 86.7   | 8.44          |
| 7.0           | 0.947 | 43.4   | -3.38  | 0.678  | -63.3  | -26.02 | 0.050 | -40.8  | 0.691 | 73.8   | 8.02          |
| 8.0           | 0.960 | 31.6   | -5.73  | 0.517  | -80.8  | -26.74 | 0.046 | -52.8  | 0.732 | 60.3   | 7.39          |
| 9.0           | 0.941 | 23.4   | -8.27  | 0.386  | -96.1  | -28.18 | 0.039 | -64.6  | 0.774 | 47.2   | 4.27          |
| 10.0          | 0.947 | 14.1   | -10.34 | 0.304  | -111.3 | -29.90 | 0.032 | -80.9  | 0.807 | 36.1   | 3.57          |
| 11.0          | 0.938 | 3.0    | -12.18 | 0.246  | -128.0 | -33.15 | 0.022 | -114.7 | 0.826 | 26.5   | 2.13          |
| 12.0          | 0.914 | -3.7   | -13.85 | 0.203  | -142.4 | -38.42 | 0.012 | -156.1 | 0.844 | 16.7   | -0.36         |
| 13.0          | 0.954 | -15.0  | -15.76 | 0.163  | -162.4 | -37.72 | 0.013 | 100.7  | 0.843 | 7.4    | 0.47          |
| 14.0          | 0.948 | -19.9  | -17.79 | 0.129  | -171.0 | -39.17 | 0.011 | 49.4   | 0.849 | 0.8    | -2.37         |
| 15.0          | 0.937 | -21.1  | -18.49 | 0.119  | -178.9 | -43.10 | 0.007 | 72.7   | 0.876 | -4.6   | -2.98         |
| 16.0          | 0.949 | -24.6  | -18.86 | 0.114  | 173.5  | -44.44 | 0.006 | 78.5   | 0.873 | -8.6   | -2.54         |
| 17.0          | 0.947 | -33.0  | -17.86 | 0.128  | 158.9  | -38.42 | 0.012 | 119.1  | 0.881 | -13.3  | -1.06         |
| 18.0          | 0.902 | -45.1  | -17.20 | 0.138  | 141.5  | -33.98 | 0.020 | 116.4  | 0.856 | -21.4  | -3.85         |

| Freq<br>GHz | Fmin<br>dB | Gamma Opt |        | Rn/50 | Ga<br>dB |
|-------------|------------|-----------|--------|-------|----------|
|             |            | Mag       | Ang    |       |          |
| 0.5         | 0.61       | 0.434     | 175.5  | 0.14  | 19.42    |
| 1.0         | 0.75       | 0.490     | -170.4 | 0.09  | 17.66    |
| 2.0         | 1.03       | 0.595     | -142.6 | 0.08  | 15.68    |
| 3.0         | 1.30       | 0.689     | -116.0 | 0.11  | 12.74    |
| 4.0         | 1.56       | 0.763     | -93.9  | 0.19  | 11.11    |
| 5.0         | 1.86       | 0.837     | -70.1  | 0.55  | 9.71     |
| 6.0         | 2.14       | 0.887     | -52.4  | 0.70  | 8.56     |
| 7.0         | 2.42       | 0.918     | -39.2  | 0.95  | 7.89     |
| 8.0         | 2.70       | 0.929     | -31.4  | 1.34  | 6.79     |

**Notes:**

1.  $F_{min}$  values at 2 GHz and higher are based on measurements while the  $F_{min}$  below 2 GHz have been extrapolated. The  $F_{min}$  values are based on a set of 16 noise figure measurements made at 16 different impedances using an ATN NP5 test system. From these measurements a true  $F_{min}$  is calculated. Refer to the noise parameter application section for more information.
2. S and noise parameters are measured on a microstrip line made on 0.025 inch thick alumina carrier. The input reference plane is at the end of the gate lead. The output reference plane is at the end of the drain lead.



**Figure 53. MSG/MAG &  $|S21|^2$  vs. Frequency at 4.0V/200 mA.**

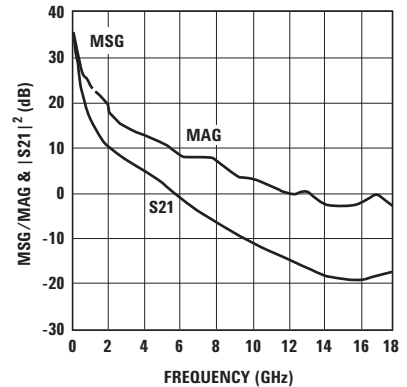
**ATF-52189 Typical Scattering and Noise Parameters at 25°C,  $V_{DS} = 3.0V$ ,  $I_{DS} = 200$  mA**

| Freq<br>(GHz) | S11   |        |        | S21    |        |        | S12   |        |       | S22    |       | MSG/MAG<br>dB |
|---------------|-------|--------|--------|--------|--------|--------|-------|--------|-------|--------|-------|---------------|
|               | Mag.  | Ang.   | (dB)   | Mag.   | Ang.   | (dB)   | Mag.  | Ang.   | Mag.  | Ang.   |       |               |
| 0.1           | 0.880 | -81.4  | 33.44  | 46.976 | 136.0  | -35.92 | 0.016 | 53.2   | 0.374 | -106.9 | 34.68 |               |
| 0.2           | 0.882 | -121.9 | 29.97  | 31.521 | 115.1  | -33.15 | 0.022 | 35.2   | 0.488 | -138.1 | 31.56 |               |
| 0.3           | 0.885 | -143.0 | 27.17  | 22.842 | 103.3  | -32.40 | 0.024 | 26.7   | 0.529 | -152.9 | 29.79 |               |
| 0.4           | 0.886 | -156.1 | 24.96  | 17.691 | 95.3   | -32.04 | 0.025 | 22.1   | 0.545 | -161.6 | 28.50 |               |
| 0.5           | 0.893 | -170.1 | 21.77  | 12.257 | 89.6   | -33.15 | 0.022 | 20.0   | 0.614 | -174.8 | 27.46 |               |
| 0.6           | 0.894 | -175.8 | 20.22  | 10.259 | 85.7   | -32.77 | 0.023 | 19.6   | 0.618 | -178.2 | 26.49 |               |
| 0.7           | 0.893 | 179.6  | 18.93  | 8.842  | 82.3   | -32.77 | 0.023 | 19.7   | 0.619 | 179.1  | 25.85 |               |
| 0.8           | 0.892 | 175.6  | 17.83  | 7.786  | 79.1   | -32.40 | 0.024 | 19.9   | 0.618 | 176.6  | 25.11 |               |
| 0.9           | 0.891 | 172.1  | 16.86  | 6.967  | 76.1   | -32.40 | 0.024 | 20.2   | 0.617 | 174.4  | 24.63 |               |
| 1.0           | 0.893 | 168.8  | 15.96  | 6.281  | 73.3   | -32.04 | 0.025 | 20.5   | 0.616 | 172.3  | 24.00 |               |
| 1.5           | 0.889 | 154.6  | 12.60  | 4.265  | 60.0   | -30.75 | 0.029 | 21.2   | 0.608 | 162.8  | 21.68 |               |
| 2.0           | 0.887 | 141.6  | 10.26  | 3.258  | 47.2   | -29.37 | 0.034 | 19.3   | 0.597 | 153.7  | 18.87 |               |
| 2.5           | 0.882 | 128.6  | 8.50   | 2.660  | 34.2   | -27.96 | 0.040 | 14.6   | 0.591 | 144.5  | 16.25 |               |
| 3.0           | 0.869 | 113.5  | 7.10   | 2.264  | 19.8   | -26.74 | 0.046 | 6.9    | 0.585 | 135.8  | 14.22 |               |
| 3.5           | 0.877 | 104.4  | 6.18   | 2.037  | 9.5    | -26.50 | 0.047 | 0.6    | 0.600 | 127.3  | 13.59 |               |
| 4.0           | 0.885 | 95.4   | 5.16   | 1.811  | -0.9   | -26.27 | 0.049 | -5.7   | 0.616 | 118.8  | 12.87 |               |
| 5.0           | 0.901 | 77.2   | 2.66   | 1.358  | -21.6  | -25.82 | 0.051 | -18.4  | 0.647 | 101.7  | 11.07 |               |
| 6.0           | 0.916 | 59.1   | -0.87  | 0.904  | -42.2  | -25.39 | 0.054 | -31.0  | 0.678 | 84.7   | 8.45  |               |
| 7.0           | 0.947 | 43.2   | -3.36  | 0.679  | -60.8  | -26.02 | 0.050 | -42.3  | 0.711 | 71.9   | 8.06  |               |
| 8.0           | 0.960 | 31.5   | -5.68  | 0.520  | -77.8  | -26.74 | 0.046 | -54.2  | 0.747 | 58.6   | 7.42  |               |
| 9.0           | 0.941 | 23.2   | -8.18  | 0.390  | -92.9  | -28.18 | 0.039 | -66.1  | 0.785 | 45.7   | 4.41  |               |
| 10.0          | 0.945 | 13.9   | -10.20 | 0.309  | -107.4 | -29.90 | 0.032 | -82.6  | 0.813 | 34.8   | 3.57  |               |
| 11.0          | 0.937 | 2.9    | -12.04 | 0.250  | -124.1 | -33.15 | 0.022 | -116.2 | 0.830 | 25.3   | 2.23  |               |
| 12.0          | 0.914 | -4.0   | -13.60 | 0.209  | -137.8 | -38.42 | 0.012 | -158.8 | 0.845 | 15.6   | -0.08 |               |
| 13.0          | 0.953 | -15.3  | -15.55 | 0.167  | -157.2 | -37.72 | 0.013 | 100.1  | 0.843 | 6.5    | 0.64  |               |
| 14.0          | 0.947 | -20.2  | -17.46 | 0.134  | -165.2 | -39.17 | 0.011 | 50.2   | 0.848 | -0.1   | -2.10 |               |
| 15.0          | 0.939 | -21.6  | -18.20 | 0.123  | -173.2 | -43.10 | 0.007 | 73.3   | 0.874 | -5.3   | -2.59 |               |
| 16.0          | 0.949 | -25.0  | -18.49 | 0.119  | 178.6  | -44.44 | 0.006 | 81.7   | 0.870 | -9.2   | -2.23 |               |
| 17.0          | 0.948 | -33.4  | -17.39 | 0.135  | 164.0  | -37.72 | 0.013 | 121.3  | 0.876 | -14.1  | -0.58 |               |
| 18.0          | 0.902 | -45.7  | -16.71 | 0.146  | 147.2  | -33.98 | 0.020 | 117.2  | 0.849 | -22.1  | -3.52 |               |

| Freq<br>GHz | Fmin<br>dB | Gamma Opt |        | Rn/50 | Ga<br>dB |
|-------------|------------|-----------|--------|-------|----------|
|             |            | Mag       | Ang    |       |          |
| 0.5         | 0.75       | 0.341     | 174.7  | 0.11  | 21.18    |
| 1.0         | 0.84       | 0.427     | -171.1 | 0.08  | 19.42    |
| 2.0         | 1.00       | 0.573     | -143.2 | 0.06  | 17.13    |
| 3.0         | 1.17       | 0.688     | -116.6 | 0.11  | 14.59    |
| 4.0         | 1.32       | 0.769     | -94.3  | 0.20  | 10.99    |
| 5.0         | 1.50       | 0.847     | -70.4  | 0.45  | 9.83     |
| 6.0         | 1.67       | 0.903     | -52.6  | 0.66  | 8.48     |
| 7.0         | 1.83       | 0.951     | -39.3  | 0.85  | 7.61     |
| 8.0         | 2.00       | 0.996     | -31.6  | 1.10  | 4.30     |

**Notes:**

1.  $F_{min}$  values at 2 GHz and higher are based on measurements while the  $F_{min}$  below 2 GHz have been extrapolated. The  $F_{min}$  values are based on a set of 16 noise figure measurements made at 16 different impedances using an ATN NP5 test system. From these measurements a true  $F_{min}$  is calculated. Refer to the noise parameter application section for more information.
2. S and noise parameters are measured on a microstrip line made on 0.025 inch thick alumina carrier. The input reference plane is at the end of the gate lead. The output reference plane is at the end of the drain lead.

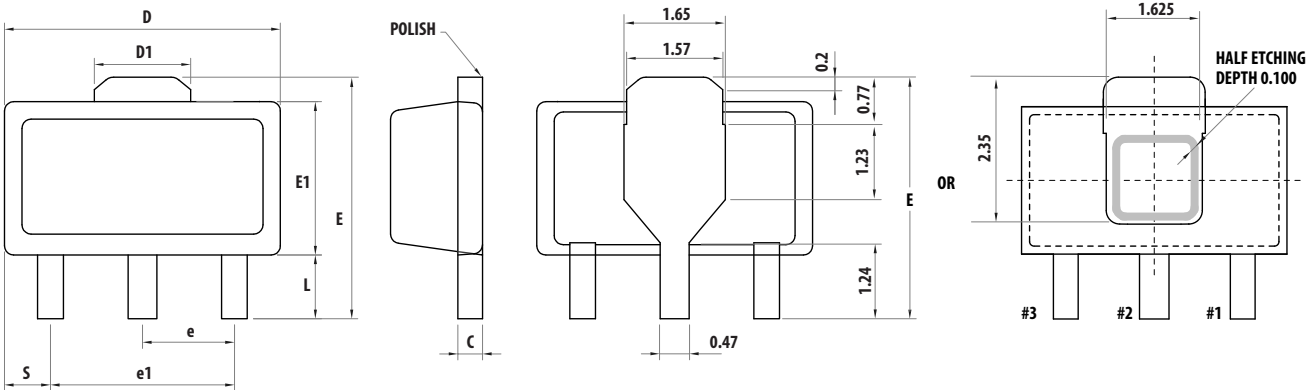


**Figure 54. MSG/MAG &  $|S21|^2$  vs. Frequency at 3.0V/200 mA.**

Device Models, PCB Layout and Stencil Device

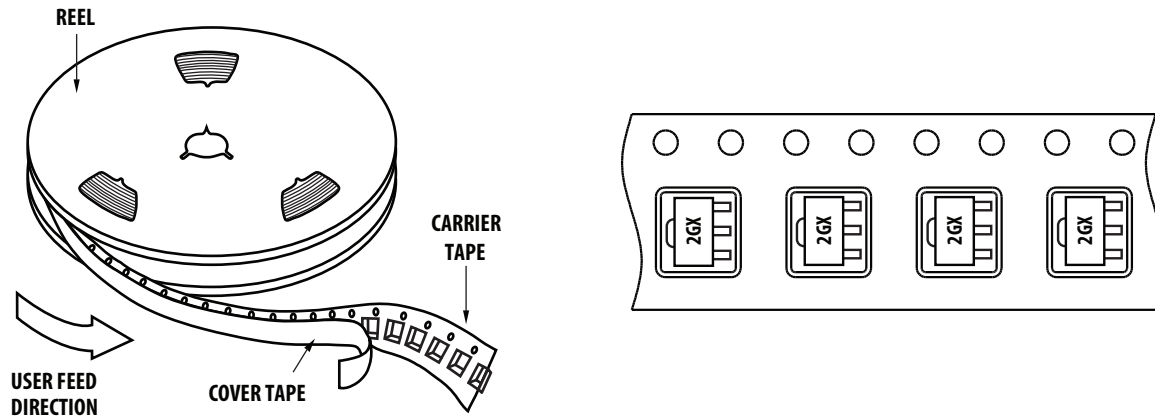
Refer to Avago’s Web Site: [www.avagotech.com/view/rf](http://www.avagotech.com/view/rf)

SOT89 Package Dimensions

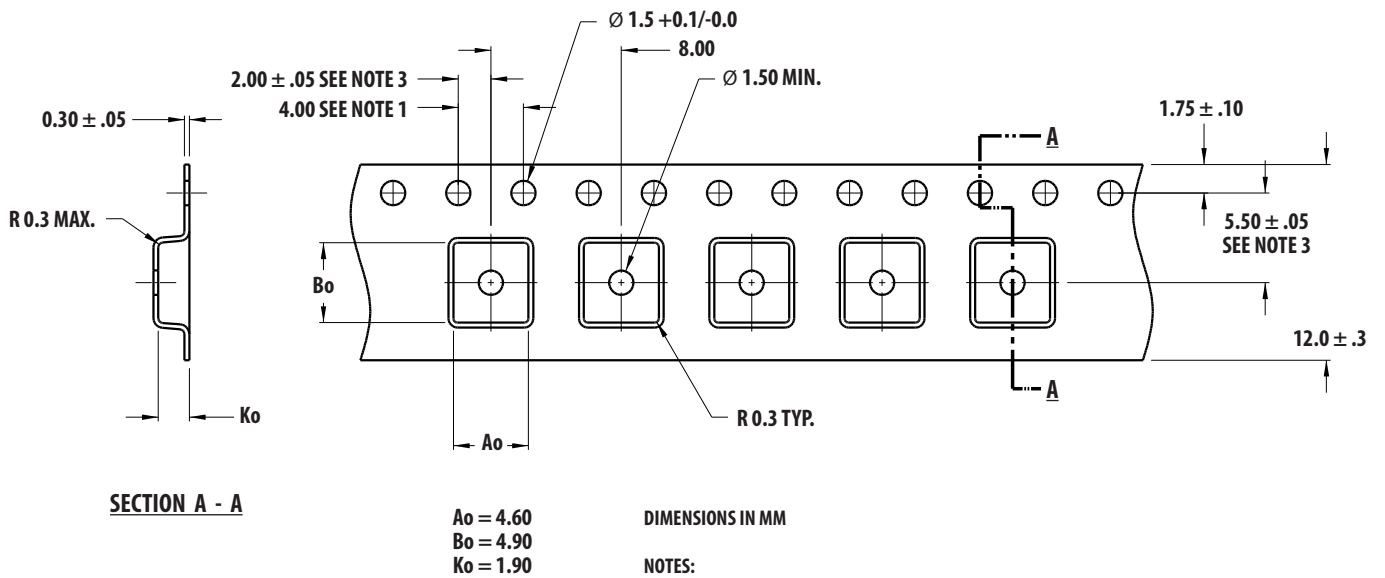


| SYMBOLS | DIMENSIONS IN MILLIMETERS |      |      | DIMENSIONS IN INCHES |       |       |
|---------|---------------------------|------|------|----------------------|-------|-------|
|         | MIN                       | NOM  | MAX  | MIN                  | NOM   | MAX   |
| A       | 1.40                      | 1.50 | 1.60 | 0.055                | 0.059 | 0.063 |
| L       | 0.89                      | 1.04 | 1.20 | 0.0350               | 0.041 | 0.047 |
| b       | 0.36                      | 0.42 | 0.48 | 0.014                | 0.016 | 0.018 |
| b1      | 0.41                      | 0.47 | 0.53 | 0.016                | 0.018 | 0.030 |
| C       | 0.38                      | 0.40 | 0.43 | 0.014                | 0.015 | 0.017 |
| D       | 4.40                      | 4.50 | 4.60 | 0.173                | 0.177 | 0.181 |
| D1      | 1.40                      | 1.60 | 1.75 | 0.055                | 0.062 | 0.069 |
| E       | 3.94                      | -    | 4.25 | 0.155                | -     | 0.167 |
| E1      | 2.40                      | 2.50 | 2.60 | 0.094                | 0.098 | 0.102 |
| e1      | 2.90                      | 3.00 | 3.10 | 0.114                | 0.118 | 0.122 |
| S       | 0.65                      | 0.75 | 0.85 | 0.026                | 0.030 | 0.034 |
| e       | 1.40                      | 1.50 | 1.60 | 0.054                | 0.059 | 0.063 |

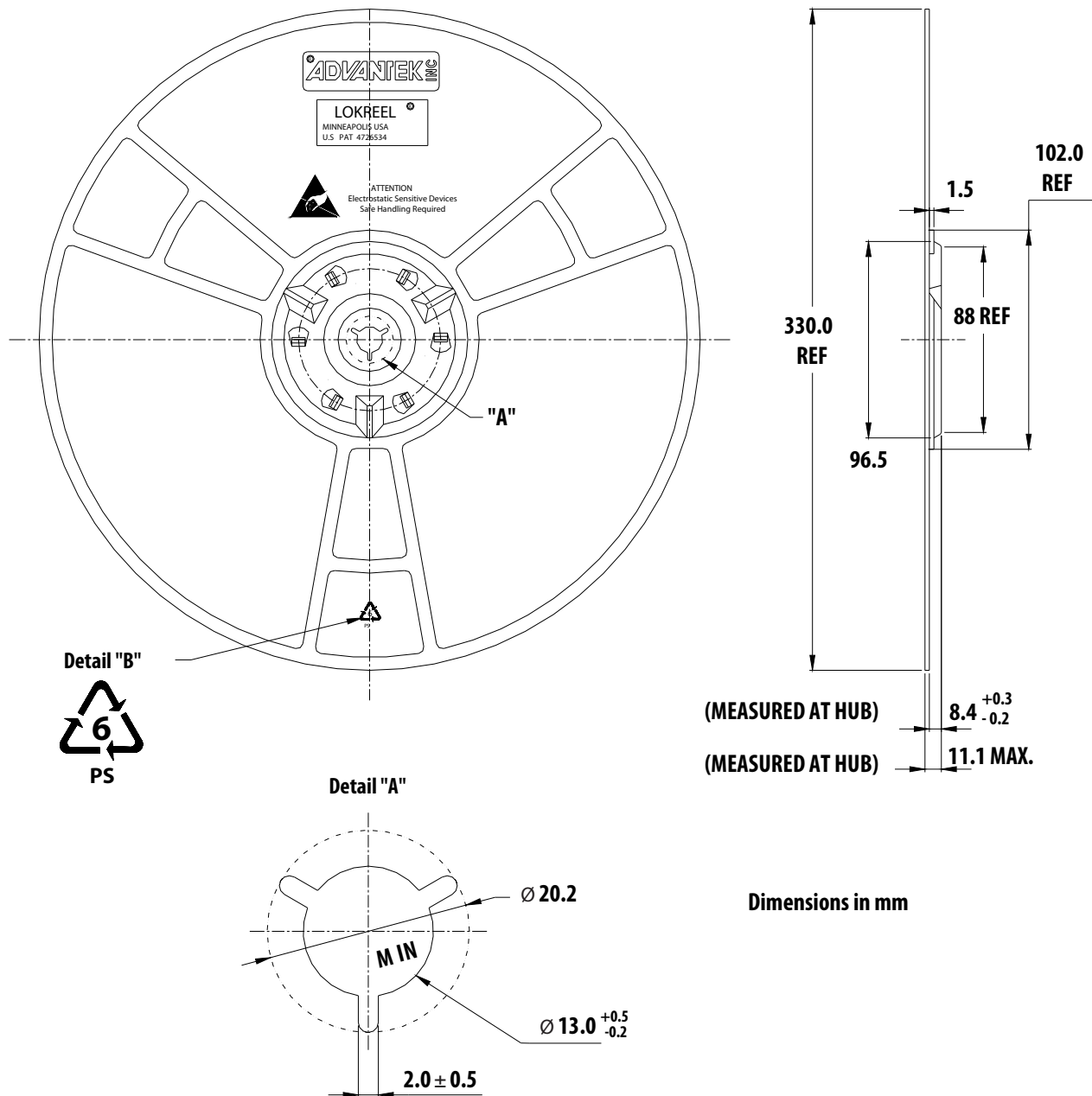
## Device Orientation



## Tape Dimensions



## Reel Dimensions – 13" 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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AV02-0050EN - March 19, 2013

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Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
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- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



#### Как с нами связаться

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