

ATF-34143

Low Noise Pseudomorphic HEMT in a Surface Mount Plastic Package



Data Sheet

Description

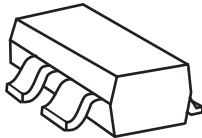
Avago's ATF-34143 is a high dynamic range, low noise PHEMT housed in a 4-lead SC-70 (SOT-343) surface mount plastic package.

Based on its featured performance, ATF-34143 is ideal for the first stage of base station LNA due to the excellent combination of low noise figure and high linearity^[1]. The device is also suitable for applications in Wireless LAN, WLL/RLL, MMDS, and other systems requiring super low noise figure with good intercept in the 450 MHz to 10 GHz frequency range.

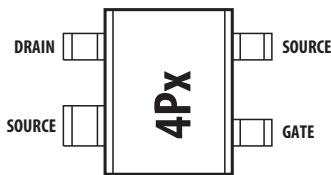
Note:

1. From the same PHEMT FET family, the larger geometry ATF-33143 may also be considered either for the higher linearity performance or easier circuit design for stability in the lower frequency bands (800–900 MHz).

Surface Mount Package - SOT-343



Pin Connections and Package Marking



Note: Top View. Package marking provides orientation and identification.

"4P" = Device code

"x" = Date code character. A new character is assigned for each month, year.

Features

- Lead-free Option Available
- Low Noise Figure
- Excellent Uniformity in Product Specifications
- 800 micron Gate Width
- Low Cost Surface Mount Small Plastic Package SOT-343 (4 lead SC-70)
- Tape-and-Reel Packaging Option Available

Specifications

1.9 GHz; 4V, 60 mA (Typ.)

- 0.5 dB Noise Figure
- 17.5 dB Associated Gain
- 20 dBm Output Power at 1 dB Gain Compression
- 31.5 dBm Output 3rd Order Intercept

Applications

- Tower Mounted Amplifier and Low Noise Amplifier for GSM/TDMA/CDMA Base Stations
- LNA for Wireless LAN, WLL/RLL and MMDS Applications
- General Purpose Discrete PHEMT for other Ultra Low Noise Applications



Attention: Observe precautions for handling electrostatic sensitive devices.

ESD Machine Model (Class A)
ESD Human Body Model (Class 0)
Refer to Avago Application Note A004R:
Electrostatic Discharge Damage and Control.

ATF-34143 Absolute Maximum Ratings^[1]

| Symbol | Parameter | Units | Absolute Maximum |
|---------------|--|-------|--------------------------|
| V_{DS} | Drain - Source Voltage ^[2] | V | 5.5 |
| V_{GS} | Gate - Source Voltage ^[2] | V | -5 |
| V_{GD} | Gate Drain Voltage ^[2] | V | -5 |
| I_D | Drain Current ^[2] | mA | I_{dss} ^[3] |
| P_{diss} | Total Power Dissipation ^[4] | mW | 725 |
| $P_{in\ max}$ | RF Input Power | dBm | 17 |
| T_{CH} | Channel Temperature | °C | 160 |
| T_{STG} | Storage Temperature | °C | -65 to 160 |
| θ_{jc} | Thermal Resistance ^[5] | °C/W | 165 |

Notes:

1. Operation of this device above any one of these parameters may cause permanent damage.
2. Assumes DC quiescent conditions.
3. $V_{GS} = 0$ volts.
4. Source lead temperature is 25°C. Derate 6 mW/°C for $T_L > 40$ °C.
5. Thermal resistance measured using 150°C Liquid Crystal Measurement method.
6. Under large signal conditions, V_{GS} may swing positive and the drain current may exceed I_{dss} . These conditions are acceptable as long as the maximum P_{diss} and $P_{in\ max}$ ratings are not exceeded.

Product Consistency Distribution Charts^[7]

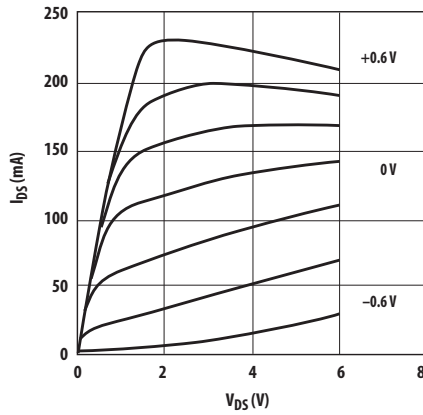


Figure 1. Typical/Pulsed I-V Curves^[6].
($V_{GS} = -0.2V$ per step)

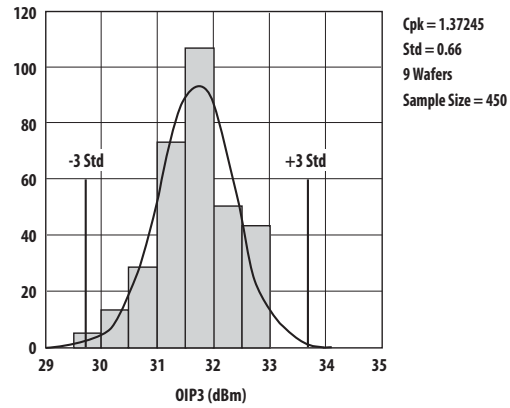


Figure 2. OIP3 @ 2 GHz, 4V, 60 mA.
LSL=29.0, Nominal=31.8, USL=35.0

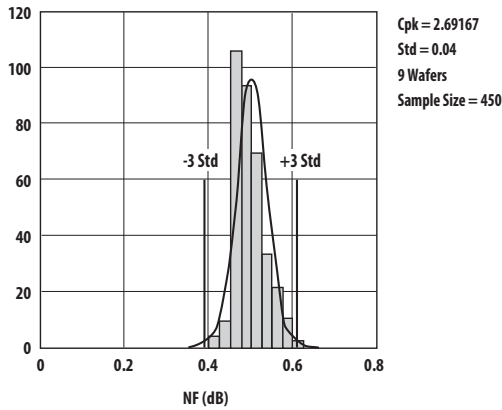


Figure 3. NF @ 2 GHz, 4V, 60 mA.
LSL=0.1, Nominal=0.47, USL=0.8

Notes:

7. Distribution data sample size is 450 samples taken from 9 different wafers. Future wafers allocated to this product may have nominal values anywhere within the upper and lower spec limits.
8. Measurements made on production test board. This circuit represents a trade-off between an optimal noise match and a realizable match based on production test requirements. Circuit losses have been de-embedded from actual measurements.

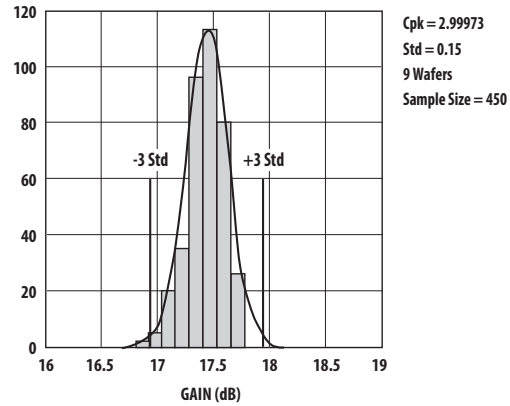


Figure 4. Gain @ 2 GHz, 4V, 60 mA.
LSL=16.0, Nominal=17.5, USL=19.0

ATF-34143 Electrical Specifications

$T_A = 25^\circ\text{C}$, RF parameters measured in a test circuit for a typical device

| Symbol | Parameters and Test Conditions | Units | Min. | Typ. ^[2] | Max. |
|-----------------|---|---------------|-------|---------------------|-------|
| $I_{dss}^{[1]}$ | Saturated Drain Current $V_{DS} = 1.5\text{ V}, V_{GS} = 0\text{ V}$ | mA | 90 | 118 | 145 |
| $V_p^{[1]}$ | Pinchoff Voltage $V_{DS} = 1.5\text{ V}, I_{DS} = 10\% \text{ of } I_{dss}$ | V | -0.65 | -0.5 | -0.35 |
| I_d | Quiescent Bias Current $V_{GS} = -0.34\text{ V}, V_{DS} = 4\text{ V}$ | mA | — | 60 | — |
| $g_m^{[1]}$ | Transconductance $V_{DS} = 1.5\text{ V}, g_m = I_{dss}/V_p$ | mmho | 180 | 230 | — |
| I_{GDO} | Gate to Drain Leakage Current $V_{GD} = 5\text{ V}$ | μA | — | — | 500 |
| I_{gss} | Gate Leakage Current $V_{GD} = V_{GS} = -4\text{ V}$ | μA | — | 30 | 300 |
| NF | Noise Figure $f = 2\text{ GHz}$ $V_{DS} = 4\text{ V}, I_{DS} = 60\text{ mA}$ $V_{DS} = 4\text{ V}, I_{DS} = 30\text{ mA}$ | dB | — | 0.5 | 0.8 |
| | | | | 0.5 | — |
| G_a | Associated Gain $f = 2\text{ GHz}$ $V_{DS} = 4\text{ V}, I_{DS} = 60\text{ mA}$ $V_{DS} = 4\text{ V}, I_{DS} = 30\text{ mA}$ | dB | 16 | 17.5 | 19 |
| | | | | 17 | — |
| OIP3 | Output 3 rd Order Intercept Point ^[3] $f = 2\text{ GHz}$ $+5\text{ dBm } P_{out}/\text{Tone}$ $V_{DS} = 4\text{ V}, I_{DS} = 60\text{ mA}$ $V_{DS} = 4\text{ V}, I_{DS} = 30\text{ mA}$ | dBm | 29 | 31.5 | — |
| | | | | 30 | — |
| P_{1dB} | 1 dB Compressed Intercept Point ^[3] $f = 2\text{ GHz}$ $V_{DS} = 4\text{ V}, I_{DS} = 60\text{ mA}$ $V_{DS} = 4\text{ V}, I_{DS} = 30\text{ mA}$ | dBm | — | 20 | — |
| | | | | 19 | — |
| | $f = 900\text{ MHz}$ $V_{DS} = 4\text{ V}, I_{DS} = 60\text{ mA}$ | dBm | — | 21.5 | — |
| | | | | 31 | — |
| | $f = 900\text{ MHz}$ $V_{DS} = 4\text{ V}, I_{DS} = 60\text{ mA}$ | dBm | — | 18.5 | — |
| | | | | — | — |

Notes:

1. Guaranteed at wafer probe level
2. Typical value determined from a sample size of 450 parts from 9 wafers.
3. Using production test board.

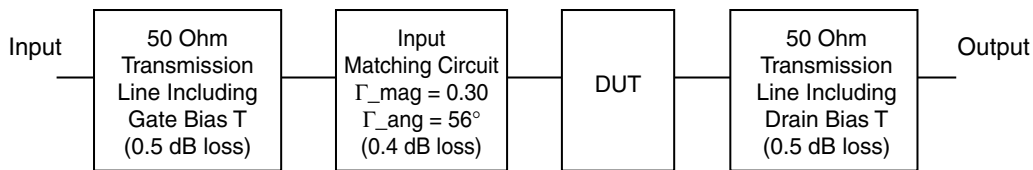


Figure 5. Block diagram of 2 GHz production test board used for Noise Figure, Associated Gain, P1dB, and OIP3 measurements. This circuit represents a trade-off between an optimal noise match and associated impedance matching circuit losses. Circuit losses have been de-embedded from actual measurements.

ATF-34143 Typical Performance Curves

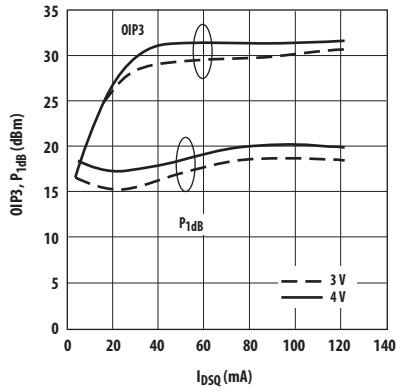


Figure 6. OIP3 and P_{1dB} vs. I_{DSQ} and V_{DS} Tuned for NF @ 4 V, 60 mA at 2 GHz. [1,2]

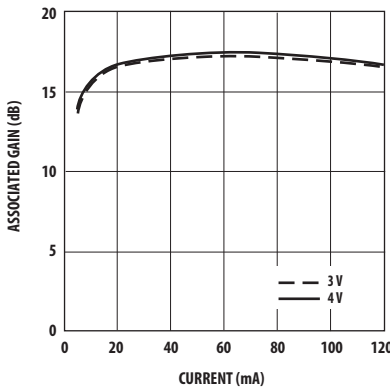


Figure 7. Associated Gain vs. Current (I_d) and Voltage (V_D) at 2 GHz. [1,2]

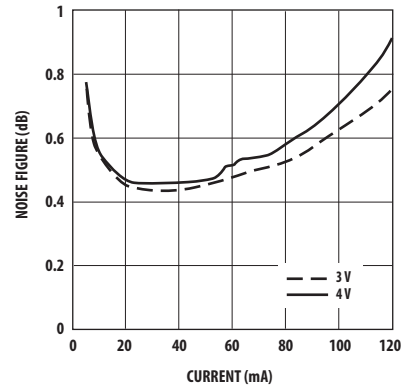


Figure 8. Noise Figure vs. Current (I_d) and Voltage (V_{DS}) at 2 GHz. [1,2]

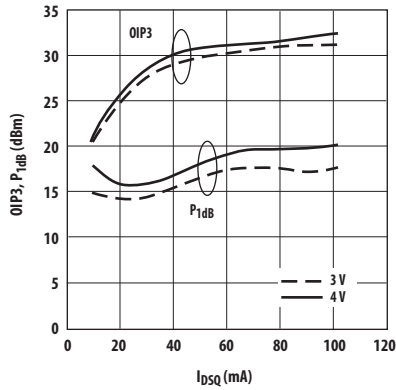


Figure 9. OIP3 and P_{1dB} vs. I_{DSQ} and V_{DS} Tuned for NF @ 4 V, 60 mA at 900 MHz. [1,2]

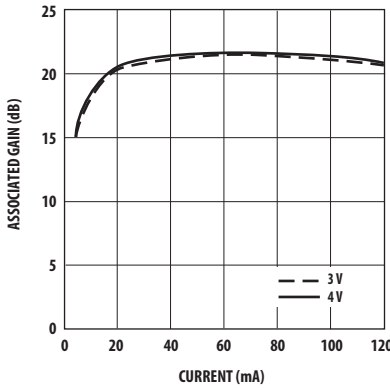


Figure 10. Associated Gain vs. Current (I_d) and Voltage (V_D) at 900 MHz. [1,2]

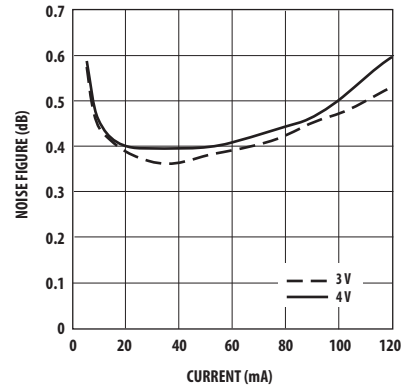


Figure 11. Noise Figure vs. Current (I_d) and Voltage (V_{DS}) at 900 MHz. [1,2]

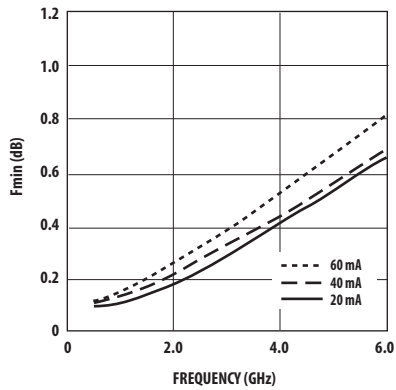


Figure 12. F_{min} vs. Frequency and Current at 4 V.

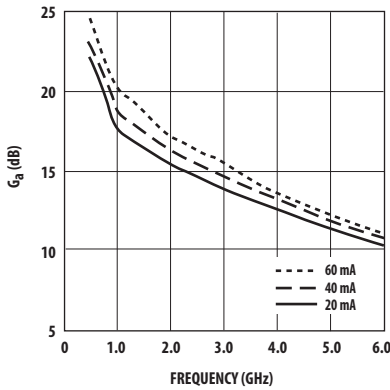


Figure 13. Associated Gain vs. Frequency and Current at 4 V.

Notes:

1. Measurements made on a fixed toned production test board that was tuned for optimal gain match with reasonable noise figure at 4V, 60 mA bias. This circuit represents a trade-off between optimal noise match, maximum gain match, and a realizable match based on production test board requirements. Circuit losses have been de-embedded from actual measurements.
2. P_{1dB} measurements are performed with passive biasing. Quiescent drain current, I_{DSQ} , is set with zero RF drive applied. As P_{1dB} is approached, the drain current may increase or decrease depending on frequency and dc bias point. At lower values of I_{DSQ} the device is running closer to class B as power output approaches P_{1dB} . This results in higher PAE (power added efficiency) when compared to a device that is driven by a constant current source as is typically done with active biasing. As an example, at a $V_{DS} = 4$ V and $I_{DSQ} = 10$ mA, I_d increases to 62 mA as a P_{1dB} of +19 dBm is approached.

ATF-34143 Typical Performance Curves, continued

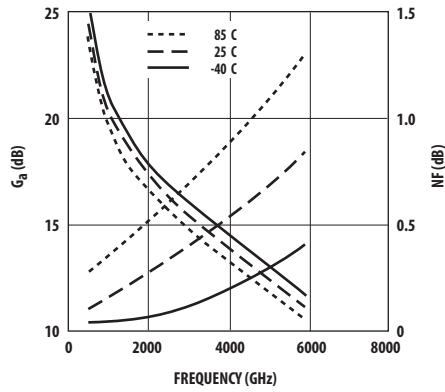


Figure 14. F_{min} and G_a vs. Frequency and Temperature at $V_{DS} = 4V$, $I_{DS} = 60$ mA.

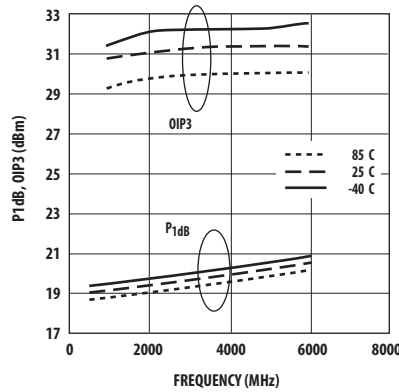


Figure 15. P_{1dB} , $IP3$ vs. Frequency and Temperature at $V_{DS} = 4V$, $I_{DS} = 60$ mA. [1]

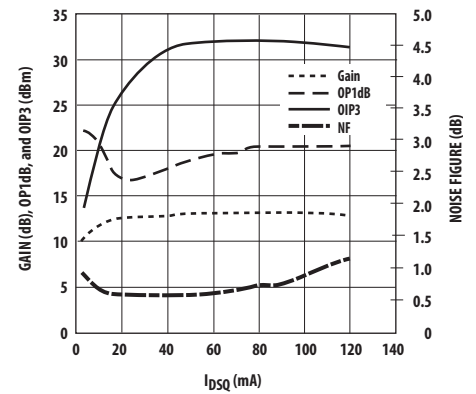


Figure 16. NF, Gain, OP1dB and OIP3 vs. I_{DSQ} at 4 V and 3.9 GHz Tuned for Noise Figure. [1]

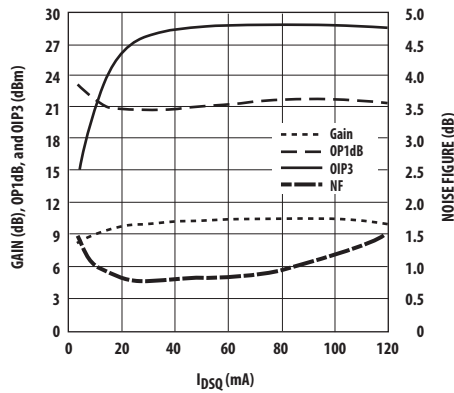


Figure 17. NF, Gain, OP1dB and OIP3 vs. I_{DSQ} at 4 V and 5.8 GHz Tuned for Noise Figure. [1]

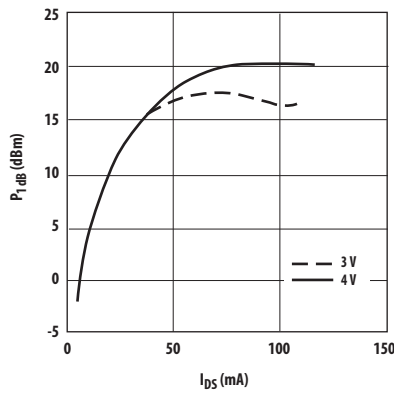


Figure 18. P_{1dB} vs. I_{DSQ} Active Bias Tuned for NF @ 4V, 60 mA at 2 GHz.

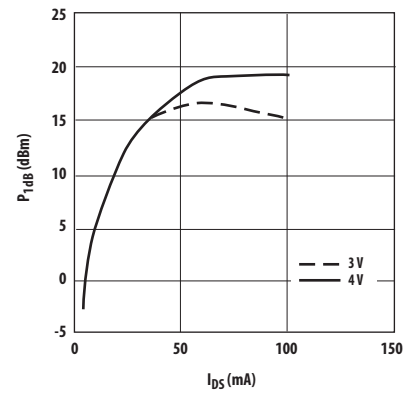


Figure 19. P_{1dB} vs. I_{DSQ} Active Bias Tuned for min NF @ 4V, 60 mA at 900 MHz.

Note:

- P_{1dB} measurements are performed with passive biasing. Quiescent drain current, I_{DSQ} , is set with zero RF drive applied. As P_{1dB} is approached, the drain current may increase or decrease depending on frequency and dc bias point. At lower values of I_{DSQ} the device is running closer to class B as power output approaches P_{1dB} . This results in higher PAE (power added efficiency) when compared to a device that is driven by a constant current source as is typically done with active biasing. As an example, at a $V_{DS} = 4V$ and $I_{DSQ} = 10$ mA, I_d increases to 62 mA as a P_{1dB} of +19 dBm is approached.

ATF-34143 Power Parameters tuned for Power, $V_{DS} = 4\text{ V}$, $I_{DSQ} = 120\text{ mA}$

| Freq (GHz) | P_{1dB} (dBm) | I_d (mA) | G_{1dB} (dB) | PAE_{1dB} (%) | P_{3dBm} (dBm) | I_d (mA) | PAE_{3dB} (%) | Gamma Out_mag (Mag) | Gamma Out_ang (Degrees) |
|------------|-----------------|------------|----------------|-----------------|------------------|------------|-----------------|---------------------|-------------------------|
| 0.9 | 20.9 | 114 | 25.7 | 27 | 22.8 | 108 | 44 | 0.34 | 136 |
| 1.5 | 21.7 | 115 | 21.9 | 32 | 23.1 | 95 | 53 | 0.31 | 152 |
| 1.8 | 21.3 | 111 | 20.5 | 30 | 23.0 | 105 | 47 | 0.30 | 164 |
| 2 | 22.0 | 106 | 19.5 | 37 | 23.7 | 115 | 50 | 0.28 | 171 |
| 4 | 22.7 | 110 | 12.7 | 40 | 23.6 | 111 | 47 | 0.26 | -135 |
| 6 | 23.3 | 115 | 9.2 | 41 | 24.2 | 121 | 44 | 0.24 | -66 |

ATF-34143 Power Parameters tuned for Power, $V_{DS} = 4\text{ V}$, $I_{DSQ} = 60\text{ mA}$

| Freq (GHz) | P_{1dB} (dBm) | I_d (mA) | G_{1dB} (dB) | PAE_{1dB} (%) | P_{3dBm} (dBm) | I_d (mA) | PAE_{3dB} (%) | Gamma Out_mag (Mag) | Gamma Out_ang (Degrees) |
|------------|-----------------|------------|----------------|-----------------|------------------|------------|-----------------|---------------------|-------------------------|
| 0.9 | 18.2 | 75 | 27.5 | 22 | 20.5 | 78 | 36 | 0.48 | 102 |
| 1.5 | 18.7 | 58 | 24.5 | 32 | 20.8 | 59 | 51 | 0.45 | 117 |
| 1.8 | 18.8 | 57 | 23.0 | 33 | 21.1 | 71 | 45 | 0.42 | 126 |
| 2 | 18.8 | 59 | 22.2 | 32 | 21.9 | 81 | 47 | 0.40 | 131 |
| 4 | 20.2 | 66 | 13.9 | 38 | 22.0 | 77 | 48 | 0.25 | -162 |
| 6 | 21.2 | 79 | 9.9 | 37 | 23.5 | 102 | 46 | 0.18 | -77 |

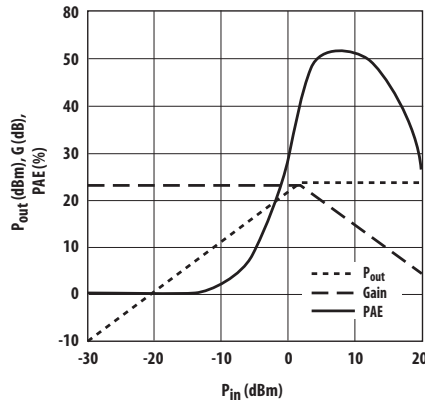


Figure 20. Swept Power Tuned for Power at 2 GHz, $V_{DS} = 4\text{ V}$, $I_{DSQ} = 120\text{ mA}$.

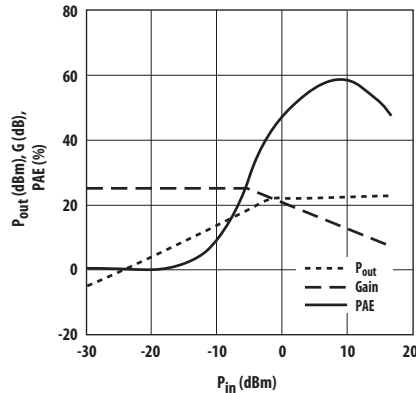


Figure 21. Swept Power Tuned for Power at 2 GHz, $V_{DS} = 4\text{ V}$, $I_{DSQ} = 60\text{ mA}$.

Notes:

- P_{1dB} measurements are performed with passive biasing. Quiescent drain current, I_{DSQ} is set with zero RF drive applied. As P_{1dB} is approached, the drain current may increase or decrease depending on frequency and dc bias point. At lower values of I_{DSQ} the device is running closer to class B as power output approaches P_{1dB} . This results in higher PAE (power added efficiency) when compared to a device that is driven by a constant current source as is typically done with active biasing. As an example, at a $V_{DS} = 4\text{ V}$ and $I_{DSQ} = 10\text{ mA}$, I_d increases to 62 mA as a P_{1dB} of +19 dBm is approached.
- $PAE(\%) = ((P_{out} - P_{in})/P_{dc}) \times 100$
- Gamma out is the reflection coefficient of the matching circuit presented to the output of the device.

ATF-34143 Typical Scattering Parameters, $V_{DS} = 3\text{ V}$, $I_{DS} = 20\text{ mA}$

| Freq. GHz | S_{11} | | | S_{21} | | | S_{12} | | | S_{22} | | MSG/MAG dB |
|-----------|----------|------|-------|----------|------|--------|----------|------|------|----------|-------|------------|
| | Mag. | Ang. | dB | Mag. | Ang. | dB | Mag. | Ang. | Mag. | Ang. | | |
| 0.5 | 0.96 | -37 | 20.07 | 10.079 | 153 | -29.12 | 0.035 | 68 | 0.40 | -35 | 24.59 | |
| 0.8 | 0.91 | -60 | 19.68 | 9.642 | 137 | -26.02 | 0.050 | 56 | 0.34 | -56 | 22.85 | |
| 1.0 | 0.87 | -76 | 18.96 | 8.867 | 126 | -24.29 | 0.061 | 48 | 0.32 | -71 | 21.62 | |
| 1.5 | 0.81 | -104 | 17.43 | 7.443 | 106 | -22.27 | 0.077 | 34 | 0.29 | -98 | 19.85 | |
| 1.8 | 0.78 | -115 | 16.70 | 6.843 | 98 | -21.62 | 0.083 | 28 | 0.28 | -110 | 19.16 | |
| 2.0 | 0.75 | -126 | 16.00 | 6.306 | 90 | -21.11 | 0.088 | 23 | 0.26 | -120 | 18.55 | |
| 2.5 | 0.72 | -145 | 14.71 | 5.438 | 75 | -20.45 | 0.095 | 15 | 0.25 | -140 | 17.58 | |
| 3.0 | 0.69 | -162 | 13.56 | 4.762 | 62 | -19.83 | 0.102 | 7 | 0.23 | -156 | 16.69 | |
| 4.0 | 0.65 | 166 | 11.61 | 3.806 | 38 | -19.09 | 0.111 | -8 | 0.22 | 174 | 15.35 | |
| 5.0 | 0.64 | 139 | 10.01 | 3.165 | 16 | -18.49 | 0.119 | -21 | 0.22 | 146 | 14.25 | |
| 6.0 | 0.65 | 114 | 8.65 | 2.706 | -5 | -18.06 | 0.125 | -35 | 0.23 | 118 | 13.35 | |
| 7.0 | 0.66 | 89 | 7.33 | 2.326 | -27 | -17.79 | 0.129 | -49 | 0.25 | 91 | 10.91 | |
| 8.0 | 0.69 | 67 | 6.09 | 2.017 | -47 | -17.52 | 0.133 | -62 | 0.29 | 67 | 9.71 | |
| 9.0 | 0.72 | 48 | 4.90 | 1.758 | -66 | -17.39 | 0.135 | -75 | 0.34 | 46 | 8.79 | |
| 10.0 | 0.75 | 30 | 3.91 | 1.568 | -86 | -17.08 | 0.140 | -88 | 0.39 | 28 | 8.31 | |
| 11.0 | 0.77 | 10 | 2.88 | 1.393 | -105 | -16.95 | 0.142 | -103 | 0.43 | 10 | 7.56 | |
| 12.0 | 0.80 | -10 | 1.74 | 1.222 | -126 | -16.95 | 0.142 | -118 | 0.47 | -10 | 6.83 | |
| 13.0 | 0.83 | -29 | 0.38 | 1.045 | -145 | -17.39 | 0.135 | -133 | 0.53 | -28 | 6.18 | |
| 14.0 | 0.85 | -44 | -0.96 | 0.895 | -161 | -17.86 | 0.128 | -145 | 0.58 | -42 | 5.62 | |
| 15.0 | 0.86 | -55 | -2.06 | 0.789 | -177 | -18.13 | 0.124 | -156 | 0.62 | -57 | 5.04 | |
| 16.0 | 0.85 | -72 | -3.09 | 0.701 | 166 | -18.13 | 0.124 | -168 | 0.65 | -70 | 3.86 | |
| 17.0 | 0.85 | -88 | -4.22 | 0.615 | 149 | -18.06 | 0.125 | 177 | 0.68 | -85 | 3.00 | |
| 18.0 | 0.88 | -101 | -5.71 | 0.518 | 133 | -18.94 | 0.113 | 165 | 0.71 | -103 | 2.52 | |

ATF-34143 Typical Noise Parameters

$V_{DS} = 3\text{ V}$, $I_{DS} = 20\text{ mA}$

| Freq. GHz | F_{min} dB | Γ_{opt} | | $R_{n/50}$ - | G_a dB |
|-----------|--------------|----------------|------|--------------|----------|
| | | Mag. | Ang. | | |
| 0.5 | 0.10 | 0.90 | 13 | 0.16 | 21.8 |
| 0.9 | 0.11 | 0.85 | 27 | 0.14 | 18.3 |
| 1.0 | 0.11 | 0.84 | 31 | 0.13 | 17.8 |
| 1.5 | 0.14 | 0.77 | 48 | 0.11 | 16.4 |
| 1.8 | 0.17 | 0.74 | 57 | 0.10 | 16.0 |
| 2.0 | 0.19 | 0.71 | 66 | 0.09 | 15.6 |
| 2.5 | 0.23 | 0.65 | 83 | 0.07 | 14.8 |
| 3.0 | 0.29 | 0.59 | 102 | 0.06 | 14.0 |
| 4.0 | 0.42 | 0.51 | 138 | 0.03 | 12.6 |
| 5.0 | 0.54 | 0.45 | 174 | 0.03 | 11.4 |
| 6.0 | 0.67 | 0.42 | -151 | 0.05 | 10.3 |
| 7.0 | 0.79 | 0.42 | -118 | 0.10 | 9.4 |
| 8.0 | 0.92 | 0.45 | -88 | 0.18 | 8.6 |
| 9.0 | 1.04 | 0.51 | -63 | 0.30 | 8.0 |
| 10.0 | 1.16 | 0.61 | -43 | 0.46 | 7.5 |

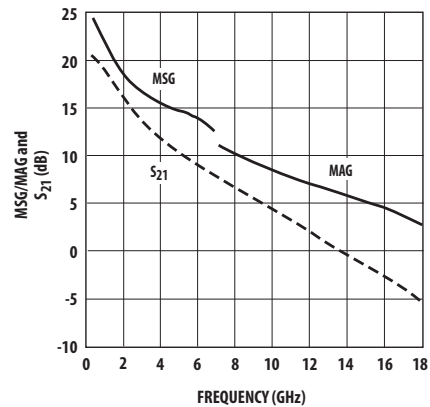


Figure 23. MSG/MAG and $|S_{21}|^2$ vs. Frequency at 3 V, 20 mA.

Notes:

1. F_{min} values at 2 GHz and higher are based on measurements while the F_{min} s 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. The parameters include the effect of four plated through via holes connecting source landing pads on top of the test carrier to the microstrip ground plane on the bottom side of the carrier. Two 0.020 inch diameter via holes are placed within 0.010 inch from each source lead contact point, one via on each side of that point.

ATF-34143 Typical Scattering Parameters, $V_{DS} = 3\text{ V}$, $I_{DS} = 40\text{ mA}$

| Freq. GHz | S_{11} | | | S_{21} | | | S_{12} | | S_{22} | | MSG/MAG dB |
|-----------|----------|------|-------|----------|------|--------|----------|------|----------|------|------------|
| | Mag. | Ang. | dB | Mag. | Ang. | dB | Mag. | Ang. | Mag. | Ang. | |
| 0.5 | 0.96 | -40 | 21.32 | 11.645 | 151 | -30.46 | 0.030 | 68 | 0.29 | -43 | 25.89 |
| 0.8 | 0.89 | -64 | 20.79 | 10.950 | 135 | -27.33 | 0.043 | 56 | 0.24 | -70 | 24.06 |
| 1.0 | 0.85 | -81 | 19.96 | 9.956 | 124 | -25.68 | 0.052 | 49 | 0.24 | -88 | 22.82 |
| 1.5 | 0.79 | -109 | 18.29 | 8.209 | 104 | -23.61 | 0.066 | 36 | 0.23 | -118 | 20.95 |
| 1.8 | 0.76 | -121 | 17.50 | 7.495 | 96 | -22.97 | 0.071 | 32 | 0.23 | -130 | 20.24 |
| 2.0 | 0.74 | -131 | 16.75 | 6.876 | 88 | -22.38 | 0.076 | 27 | 0.22 | -141 | 19.57 |
| 2.5 | 0.70 | -150 | 15.39 | 5.880 | 74 | -21.51 | 0.084 | 19 | 0.22 | -160 | 18.45 |
| 3.0 | 0.67 | -167 | 14.19 | 5.120 | 61 | -20.92 | 0.090 | 12 | 0.22 | -176 | 17.55 |
| 4.0 | 0.64 | 162 | 12.18 | 4.063 | 38 | -19.83 | 0.102 | -1 | 0.21 | 157 | 16.00 |
| 5.0 | 0.64 | 135 | 10.54 | 3.365 | 16 | -19.02 | 0.112 | -14 | 0.22 | 131 | 14.78 |
| 6.0 | 0.65 | 111 | 9.15 | 2.867 | -5 | -18.34 | 0.121 | -28 | 0.24 | 105 | 12.91 |
| 7.0 | 0.66 | 87 | 7.80 | 2.454 | -26 | -17.86 | 0.128 | -42 | 0.28 | 81 | 11.03 |
| 8.0 | 0.69 | 65 | 6.55 | 2.125 | -46 | -17.46 | 0.134 | -55 | 0.32 | 60 | 9.93 |
| 9.0 | 0.73 | 46 | 5.33 | 1.848 | -65 | -17.20 | 0.138 | -69 | 0.37 | 40 | 9.07 |
| 10.0 | 0.76 | 28 | 4.33 | 1.647 | -84 | -16.83 | 0.144 | -84 | 0.41 | 23 | 8.59 |
| 11.0 | 0.78 | 9 | 3.30 | 1.462 | -104 | -16.65 | 0.147 | -99 | 0.45 | 5 | 7.84 |
| 12.0 | 0.80 | -11 | 2.15 | 1.281 | -123 | -16.65 | 0.147 | -114 | 0.50 | -14 | 7.15 |
| 13.0 | 0.83 | -30 | 0.79 | 1.095 | -142 | -17.08 | 0.140 | -130 | 0.55 | -31 | 6.50 |
| 14.0 | 0.86 | -44 | -0.53 | 0.941 | -158 | -17.52 | 0.133 | -142 | 0.60 | -45 | 5.96 |
| 15.0 | 0.87 | -56 | -1.61 | 0.831 | -174 | -17.72 | 0.130 | -154 | 0.64 | -59 | 5.39 |
| 16.0 | 0.86 | -72 | -2.60 | 0.741 | 169 | -17.72 | 0.130 | -166 | 0.66 | -73 | 4.21 |
| 17.0 | 0.86 | -88 | -3.72 | 0.652 | 153 | -17.79 | 0.129 | 179 | 0.69 | -88 | 3.43 |
| 18.0 | 0.88 | -102 | -5.15 | 0.553 | 137 | -18.64 | 0.117 | 166 | 0.72 | -105 | 2.95 |

ATF-34143 Typical Noise Parameters

$V_{DS} = 3\text{ V}$, $I_{DS} = 40\text{ mA}$

| Freq. GHz | F_{min} dB | Γ_{opt} | | $R_{n/50}$ - | G_a dB |
|-----------|--------------|----------------|------|--------------|----------|
| | | Mag. | Ang. | | |
| 0.5 | 0.10 | 0.87 | 13 | 0.16 | 23.0 |
| 0.9 | 0.13 | 0.82 | 28 | 0.13 | 19.6 |
| 1.0 | 0.14 | 0.80 | 32 | 0.13 | 19.2 |
| 1.5 | 0.17 | 0.73 | 50 | 0.1 | 17.7 |
| 1.8 | 0.21 | 0.70 | 61 | 0.09 | 17.1 |
| 2.0 | 0.23 | 0.66 | 68 | 0.08 | 16.7 |
| 2.5 | 0.29 | 0.60 | 87 | 0.06 | 15.8 |
| 3.0 | 0.35 | 0.54 | 106 | 0.05 | 14.9 |
| 4.0 | 0.47 | 0.46 | 144 | 0.03 | 13.4 |
| 5.0 | 0.6 | 0.41 | -178 | 0.03 | 12.1 |
| 6.0 | 0.72 | 0.39 | -142 | 0.06 | 10.9 |
| 7.0 | 0.85 | 0.41 | -109 | 0.12 | 9.9 |
| 8.0 | 0.97 | 0.45 | -80 | 0.21 | 9.1 |
| 9.0 | 1.09 | 0.52 | -56 | 0.34 | 8.4 |
| 10.0 | 1.22 | 0.61 | -39 | 0.50 | 8.0 |

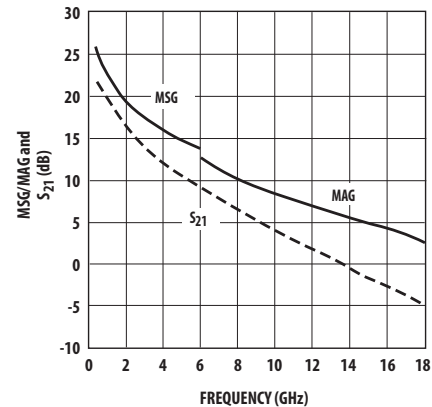


Figure 24. MSG/MAG and $|S_{21}|^2$ vs. Frequency at 3 V, 40 mA.

Notes:

1. F_{min} values at 2 GHz and higher are based on measurements while the F_{min} s 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. The parameters include the effect of four plated through via holes connecting source landing pads on top of the test carrier to the microstrip ground plane on the bottom side of the carrier. Two 0.020 inch diameter via holes are placed within 0.010 inch from each source lead contact point, one via on each side of that point.

ATF-34143 Typical Scattering Parameters, $V_{DS} = 4\text{ V}$, $I_{DS} = 40\text{ mA}$

| Freq. GHz | S_{11} | | | S_{21} | | | S_{12} | | | S_{22} | | MSG/MAG dB |
|--------------|----------|---------|-------|----------|------|------|----------|------|------|----------|-------|---------------|
| | Mag. | Ang. | dB | Mag. | Ang. | dB | Mag. | Ang. | Mag. | Ang. | | |
| 0.5 | 0.95 | -40 | 21.56 | 11.973 | 151 | 0.03 | 0.030 | 68 | 0.33 | -39 | 26.01 | |
| 0.8 | 0.89 | -65 | 21.02 | 11.252 | 135 | 0.04 | 0.042 | 56 | 0.27 | -63 | 24.28 | |
| 1.0 | 0.85 | -82 | 20.19 | 10.217 | 123 | 0.05 | 0.051 | 48 | 0.26 | -80 | 23.02 | |
| 1.5 | 0.78 | -109 | 18.49 | 8.405 | 104 | 0.06 | 0.064 | 36 | 0.24 | -109 | 21.18 | |
| 1.8 | 0.73 | -131 | 16.93 | 7.024 | 87 | 0.07 | 0.074 | 27 | 0.22 | -131 | 20.46 | |
| 2.0 | 0.70 | -150 | 15.57 | 6.002 | 73 | 0.08 | 0.081 | 19 | 0.21 | -150 | 19.77 | |
| 2.5 | 0.67 | -167 | 14.36 | 5.223 | 61 | 0.09 | 0.087 | 12 | 0.20 | -167 | 18.70 | |
| 3.0 | 0.64 | 162 | 12.34 | 4.141 | 37 | 0.10 | 0.098 | -1 | 0.19 | 165 | 17.75 | |
| 4.0 | 0.63 | 135 | 10.70 | 3.428 | 16 | 0.11 | 0.108 | -13 | 0.20 | 138 | 16.26 | |
| 5.0 | 0.64 | 111 | 9.32 | 2.923 | -6 | 0.12 | 0.117 | -27 | 0.21 | 111 | 15.02 | |
| 6.0 | 0.66 | 87 | 7.98 | 2.506 | -26 | 0.12 | 0.124 | -41 | 0.24 | 86 | 12.93 | |
| 7.0 | 0.69 | 65 | 6.74 | 2.173 | -46 | 0.13 | 0.130 | -54 | 0.29 | 63 | 11.14 | |
| 8.0 | 0.72 | 47 | 5.55 | 1.894 | -65 | 0.13 | 0.134 | -68 | 0.34 | 42 | 10.09 | |
| 9.0 | 0.76 | 28 | 4.55 | 1.689 | -85 | 0.14 | 0.141 | -82 | 0.38 | 26 | 9.24 | |
| 10.0 | 0.78 | 9 | 3.53 | 1.501 | -104 | 0.15 | 0.145 | -97 | 0.42 | 8 | 8.79 | |
| 11.0 | 0.80 | -11 | 2.39 | 1.317 | -124 | 0.15 | 0.145 | -113 | 0.47 | -11 | 8.09 | |
| 12.0 | 0.84 | -29 | 1.02 | 1.125 | -143 | 0.14 | 0.140 | -128 | 0.53 | -29 | 7.35 | |
| 13.0 | 0.86 | -44 | -0.30 | 0.966 | -160 | 0.13 | 0.133 | -141 | 0.58 | -43 | 6.76 | |
| 14.0 | 0.87 | -56 | -1.38 | 0.853 | -176 | 0.13 | 0.130 | -152 | 0.62 | -58 | 6.19 | |
| 15.0 | 0.86 | -72 | -2.40 | 0.759 | 167 | 0.13 | 0.131 | -165 | 0.65 | -71 | 5.62 | |
| 16.0 | 0.86 | -88 | -3.53 | 0.666 | 151 | 0.13 | 0.130 | -180 | 0.68 | -86 | 4.43 | |
| 17.0 | 0.89 | -102 | -4.99 | 0.563 | 134 | 0.12 | 0.119 | 168 | 0.71 | -103 | 3.60 | |
| 18.0 | 0.89 | -101.85 | -4.99 | 0.563 | 134 | 0.12 | 0.119 | 168 | 0.71 | -103 | 3.15 | |

ATF-34143 Typical Noise Parameters

$V_{DS} = 4\text{ V}$, $I_{DS} = 40\text{ mA}$

| Freq. GHz | F_{min} dB | Γ_{opt} | | $R_{n/50}$ - | G_a dB |
|--------------|-----------------|----------------|------|-----------------|-------------|
| | | Mag. | Ang. | | |
| 0.5 | 0.10 | 0.87 | 13 | 0.16 | 22.8 |
| 0.9 | 0.13 | 0.82 | 27 | 0.14 | 19.4 |
| 1.0 | 0.14 | 0.80 | 31 | 0.13 | 18.9 |
| 1.5 | 0.17 | 0.73 | 49 | 0.11 | 17.4 |
| 1.8 | 0.20 | 0.70 | 60 | 0.10 | 16.9 |
| 2.0 | 0.22 | 0.66 | 67 | 0.09 | 16.4 |
| 2.5 | 0.28 | 0.60 | 85 | 0.07 | 15.6 |
| 3.0 | 0.34 | 0.54 | 104 | 0.05 | 14.8 |
| 4.0 | 0.45 | 0.45 | 142 | 0.03 | 13.3 |
| 5.0 | 0.57 | 0.40 | 180 | 0.03 | 12.0 |
| 6.0 | 0.69 | 0.38 | -144 | 0.05 | 10.9 |
| 7.0 | 0.81 | 0.39 | -111 | 0.11 | 9.9 |
| 8.0 | 0.94 | 0.43 | -82 | 0.20 | 9.1 |
| 9.0 | 1.06 | 0.51 | -57 | 0.32 | 8.5 |
| 10.0 | 1.19 | 0.62 | -40 | 0.47 | 8.1 |

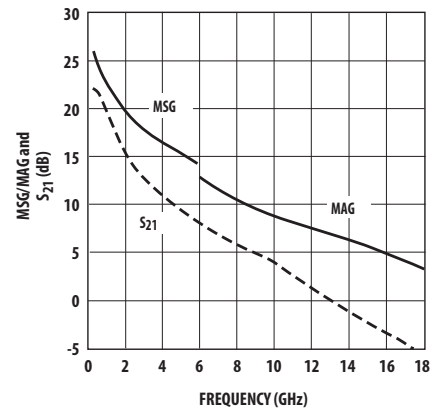


Figure 25. MSG/MAG and $|S_{21}|^2$ vs. Frequency at 4 V, 40 mA.

Notes:

1. F_{min} values at 2 GHz and higher are based on measurements while the F_{min} s 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. The parameters include the effect of four plated through via holes connecting source landing pads on top of the test carrier to the microstrip ground plane on the bottom side of the carrier. Two 0.020 inch diameter via holes are placed within 0.010 inch from each source lead contact point, one via on each side of that point.

ATF-34143 Typical Scattering Parameters, $V_{DS} = 4\text{ V}$, $I_{DS} = 60\text{ mA}$

| Freq. GHz | S_{11} | | | S_{21} | | | S_{12} | | | S_{22} | | | MSG/MAG dB |
|--------------|----------|---------|-------|----------|------|--------|----------|------|------|----------|-------|----|---------------|
| | Mag. | Ang. | dB | Mag. | Ang. | dB | Mag. | Ang. | dB | Mag. | Ang. | dB | |
| 0.5 | 0.95 | -41 | 21.91 | 12.454 | 150 | -31.06 | 0.028 | 68 | 0.29 | -41 | 26.48 | | |
| 0.8 | 0.89 | -65 | 21.33 | 11.654 | 134 | -28.18 | 0.039 | 57 | 0.24 | -67 | 24.75 | | |
| 1.0 | 0.85 | -83 | 20.46 | 10.549 | 123 | -26.56 | 0.047 | 49 | 0.23 | -84 | 23.51 | | |
| 1.5 | 0.78 | -111 | 18.74 | 8.646 | 103 | -24.44 | 0.060 | 38 | 0.21 | -114 | 21.59 | | |
| 1.8 | 0.75 | -122 | 17.92 | 7.873 | 95 | -23.74 | 0.065 | 33 | 0.21 | -125 | 20.83 | | |
| 2.0 | 0.73 | -133 | 17.16 | 7.207 | 87 | -23.22 | 0.069 | 29 | 0.20 | -136 | 20.19 | | |
| 2.5 | 0.69 | -151 | 15.78 | 6.149 | 73 | -22.38 | 0.076 | 22 | 0.19 | -155 | 19.08 | | |
| 3.0 | 0.67 | -168 | 14.56 | 5.345 | 60 | -21.62 | 0.083 | 15 | 0.19 | -171 | 18.09 | | |
| 4.0 | 0.64 | 161 | 12.53 | 4.232 | 37 | -20.54 | 0.094 | 3 | 0.18 | 162 | 16.53 | | |
| 5.0 | 0.63 | 134 | 10.88 | 3.501 | 16 | -19.58 | 0.105 | -10 | 0.19 | 135 | 15.23 | | |
| 6.0 | 0.64 | 111 | 9.49 | 2.983 | -5 | -18.79 | 0.115 | -24 | 0.21 | 109 | 12.89 | | |
| 7.0 | 0.66 | 86 | 8.15 | 2.557 | -26 | -18.27 | 0.122 | -38 | 0.24 | 84 | 11.22 | | |
| 8.0 | 0.69 | 65 | 6.92 | 2.217 | -46 | -17.79 | 0.129 | -51 | 0.28 | 62 | 10.21 | | |
| 9.0 | 0.73 | 46 | 5.72 | 1.932 | -65 | -17.46 | 0.134 | -65 | 0.33 | 42 | 9.36 | | |
| 10.0 | 0.76 | 28 | 4.73 | 1.723 | -84 | -16.95 | 0.142 | -79 | 0.38 | 25 | 8.94 | | |
| 11.0 | 0.78 | 9 | 3.70 | 1.531 | -104 | -16.71 | 0.146 | -94 | 0.42 | 7 | 8.23 | | |
| 12.0 | 0.81 | -11 | 2.57 | 1.344 | -124 | -16.71 | 0.146 | -111 | 0.47 | -12 | 7.56 | | |
| 13.0 | 0.84 | -30 | 1.20 | 1.148 | -143 | -17.02 | 0.141 | -126 | 0.52 | -29 | 6.94 | | |
| 14.0 | 0.86 | -44 | -0.12 | 0.986 | -159 | -17.46 | 0.134 | -139 | 0.58 | -43 | 6.37 | | |
| 15.0 | 0.87 | -56 | -1.21 | 0.870 | -175 | -17.59 | 0.132 | -150 | 0.62 | -58 | 5.78 | | |
| 16.0 | 0.86 | -72 | -2.21 | 0.775 | 168 | -17.59 | 0.132 | -163 | 0.65 | -71 | 4.60 | | |
| 17.0 | 0.86 | -88 | -3.35 | 0.680 | 151 | -17.65 | 0.131 | -178 | 0.68 | -86 | 3.79 | | |
| 18.0 | 0.89 | -101.99 | -4.81 | 0.575 | 135 | -18.42 | 0.120 | 169 | 0.71 | -104 | 3.33 | | |

ATF-34143 Typical Noise Parameters

$V_{DS} = 4\text{ V}$, $I_{DS} = 60\text{ mA}$

| Freq. GHz | F_{min} dB | Γ_{opt} | | $R_{n/50}$ - | G_a dB |
|--------------|-----------------|----------------|------|-----------------|-------------|
| | | Mag. | Ang. | | |
| 0.5 | 0.11 | 0.84 | 15 | 0.14 | 24.5 |
| 0.9 | 0.14 | 0.78 | 30 | 0.12 | 20.7 |
| 1.0 | 0.15 | 0.77 | 34 | 0.12 | 20.2 |
| 1.5 | 0.20 | 0.69 | 53 | 0.10 | 18.5 |
| 1.8 | 0.23 | 0.66 | 62 | 0.10 | 17.7 |
| 2.0 | 0.26 | 0.62 | 72 | 0.09 | 17.2 |
| 2.5 | 0.33 | 0.55 | 91 | 0.07 | 16.3 |
| 3.0 | 0.39 | 0.50 | 111 | 0.05 | 15.4 |
| 4.0 | 0.53 | 0.43 | 149 | 0.03 | 13.7 |
| 5.0 | 0.67 | 0.39 | -173 | 0.04 | 12.3 |
| 6.0 | 0.81 | 0.39 | -137 | 0.07 | 11.1 |
| 7.0 | 0.96 | 0.42 | -104 | 0.14 | 10.0 |
| 8.0 | 1.10 | 0.47 | -76 | 0.26 | 9.2 |
| 9.0 | 1.25 | 0.54 | -53 | 0.41 | 8.6 |
| 10.0 | 1.39 | 0.62 | -37 | 0.60 | 8.2 |

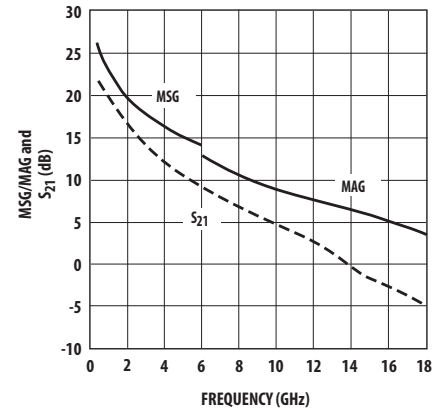


Figure 26. MSG/MAG and $|S_{21}|^2$ vs. Frequency at 4 V, 60 mA.

Notes:

1. F_{min} values at 2 GHz and higher are based on measurements while the F_{min} s 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. The parameters include the effect of four plated through via holes connecting source landing pads on top of the test carrier to the microstrip ground plane on the bottom side of the carrier. Two 0.020 inch diameter via holes are placed within 0.010 inch from each source lead contact point, one via on each side of that point.

Noise Parameter Applications Information

F_{min} values at 2 GHz and higher are based on measurements while the F_{min} s 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. F_{min} represents the true minimum noise figure of the device when the device is presented with an impedance matching network that transforms the source impedance, typically 50Ω , to an impedance represented by the reflection coefficient Γ_o . The designer must design a matching network that will present Γ_o to the device with minimal associated circuit losses. The noise figure of the completed amplifier is equal to the noise figure of the device plus the losses of the matching network preceding the device. The noise figure of the device is equal to F_{min} only when the device is presented with Γ_o . If the reflection coefficient of the matching network is other than Γ_o , then the noise figure of the device will be greater than F_{min} based on the following equation.

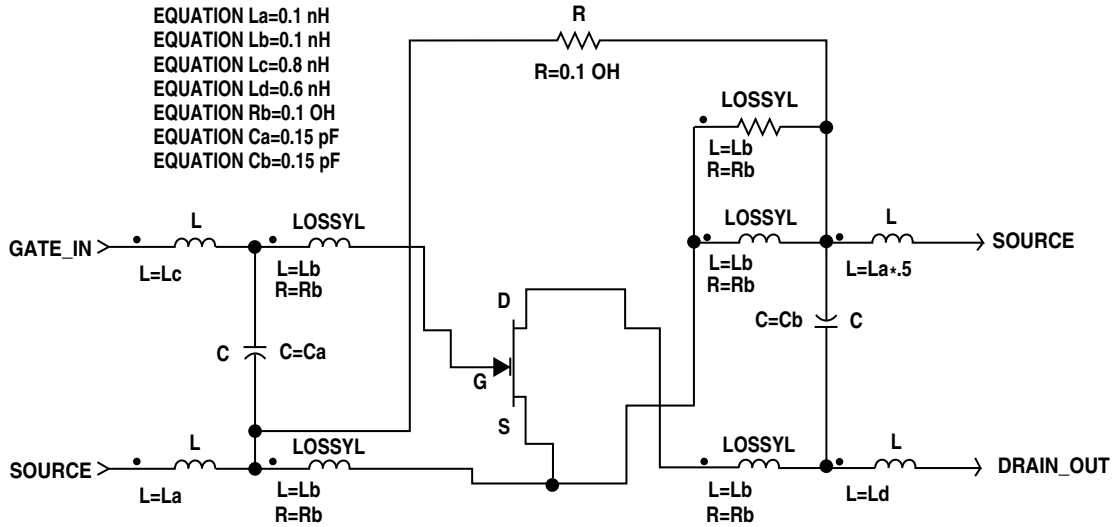
$$NF = F_{min} + 4 \frac{R_n}{Z_o} \frac{|\Gamma_s - \Gamma_o|^2}{(1 + |\Gamma_o|^2)(1 - |\Gamma_s|^2)}$$

Where R_n/Z_o is the normalized noise resistance, Γ_o is the optimum reflection coefficient required to produce F_{min} and Γ_s is the reflection coefficient of the source impedance actually presented to the device. The losses of the matching networks are non-zero and they will also add

to the noise figure of the device creating a higher amplifier noise figure. The losses of the matching networks are related to the Q of the components and associated printed circuit board loss. Γ_o is typically fairly low at higher frequencies and increases as frequency is lowered. Larger gate width devices will typically have a lower Γ_o as compared to narrower gate width devices.

Typically for FETs, the higher Γ_o usually infers that an impedance much higher than 50Ω is required for the device to produce F_{min} . At VHF frequencies and even lower L Band frequencies, the required impedance can be in the vicinity of several thousand ohms. Matching to such a high impedance requires very hi-Q components in order to minimize circuit losses. As an example at 900 MHz, when airwound coils ($Q > 100$) are used for matching networks, the loss can still be up to 0.25 dB which will add directly to the noise figure of the device. Using multilayer molded inductors with Qs in the 30 to 50 range results in additional loss over the airwound coil. Losses as high as 0.5 dB or greater add to the typical 0.15 dB F_{min} of the device creating an amplifier noise figure of nearly 0.65 dB. A discussion concerning calculated and measured circuit losses and their effect on amplifier noise figure is covered in Avago Application 1085.

ATF-34143 SC-70 4 Lead, High Frequency Nonlinear Model
Optimized for 0.1–6.0 GHz



This model can be used as a design tool. It has been tested on MDS for various specifications. However, for more precise and accurate design, please refer to the measured

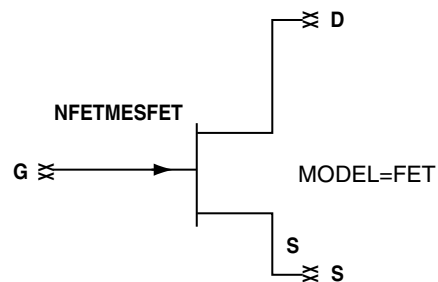
data in this data sheet. For future improvements Avago reserves the right to change these models without prior notice.

ATF-34143 Die Model

| * STATZ MESFET MODEL * | | | | |
|------------------------|------------|------------|-----------|-----------|
| MODEL = FET | | | | |
| IDS model | Gate model | Parasitics | Breakdown | Noise |
| NFET=yes | DELTA=.2 | RG=1 | GSFWD=1 | FNC=01e+6 |
| PFET= | GSCAP=3 | RD=Rd | GSREV=0 | R=.17 |
| IDSMOD=3 | CGS=cgs pF | RS=Rs | GDFWD=1 | P=.65 |
| VTO=-0.95 | GDCAP=3 | LG=Lg nH | GDREV=0 | C=.2 |
| BETA= Beta | GCD=Cgd pF | LD=Ld nH | VJR=1 | |
| LAMBDA=0.09 | | LS=Ls nH | IS=1 nA | |
| ALPHA=4.0 | | CDS=Cds pF | IR=1 nA | |
| B=0.8 | | CRF=.1 | IMAX=.1 | |
| TNOM=27 | | RC=Rc | XTI= | |
| IDSTC= | | | N= | |
| VBI=.7 | | | EG= | |

Model scal factors (W=FET width in microns)

EQUATION Cds=0.01*W/200
 EQUATION Beta=0.06*W/200
 EQUATION Rd=200/W
 EQUATION Rs=.5*200/W
 EQUATION Cgs=0.2*W/200
 EQUATION Cgd=0.04*W/200
 EQUATION Lg=0.03*200/W
 EQUATION Ld=0.03*200/W
 EQUATION Ls=0.01*200/W
 EQUATION Rc=500*200/W

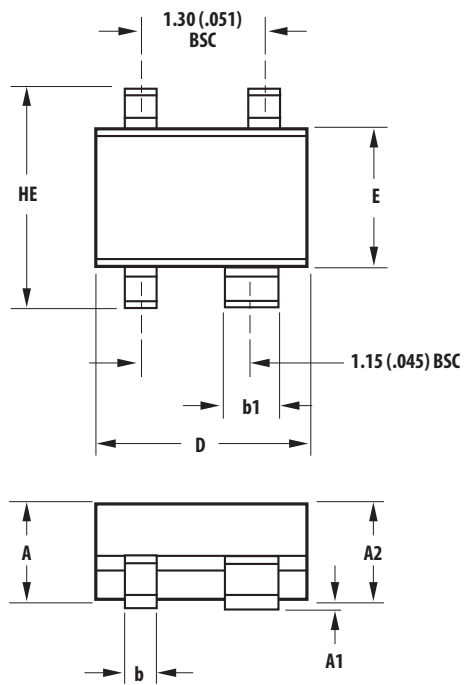


W=800 μm

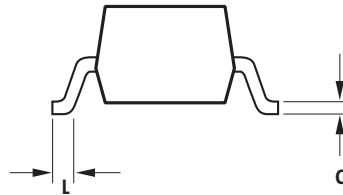
Part Number Ordering Information

| Part Number | No. of Devices | Container |
|----------------|----------------|----------------|
| ATF-34143-TR1G | 3000 | 7" Reel |
| ATF-34143-TR2G | 10000 | 13" Reel |
| ATF-34143-BLKG | 100 | antistatic bag |

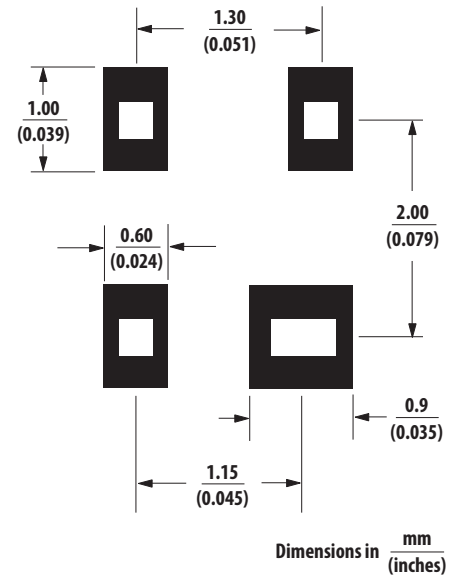
Package Dimensions SC-70 4L/SOT-343



| SYMBOL | DIMENSIONS (mm) | |
|--------|-----------------|------|
| | MIN. | MAX. |
| E | 1.15 | 1.35 |
| D | 1.85 | 2.25 |
| HE | 1.80 | 2.40 |
| A | 0.80 | 1.10 |
| A2 | 0.80 | 1.00 |
| A1 | 0.00 | 0.10 |
| b | 0.15 | 0.40 |
| b1 | 0.55 | 0.70 |
| c | 0.10 | 0.20 |
| L | 0.10 | 0.46 |



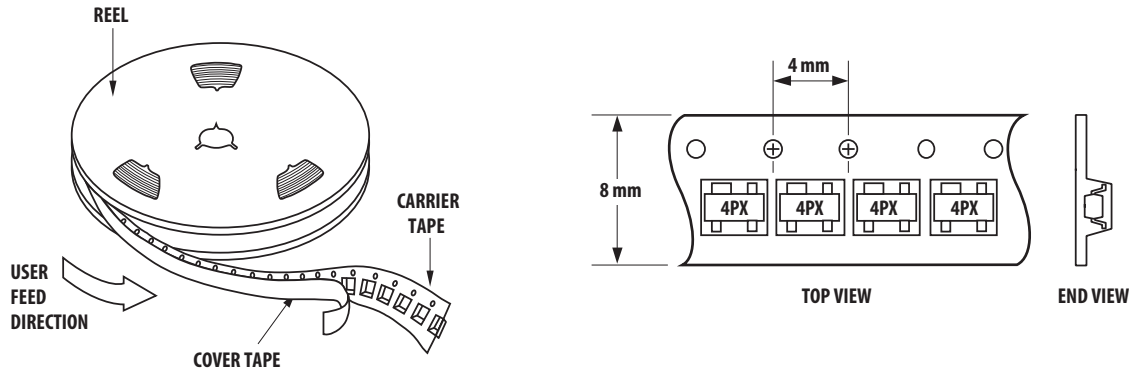
Recommended PCB Pad Layout for Avago's SC70 4L/SOT-343 Products



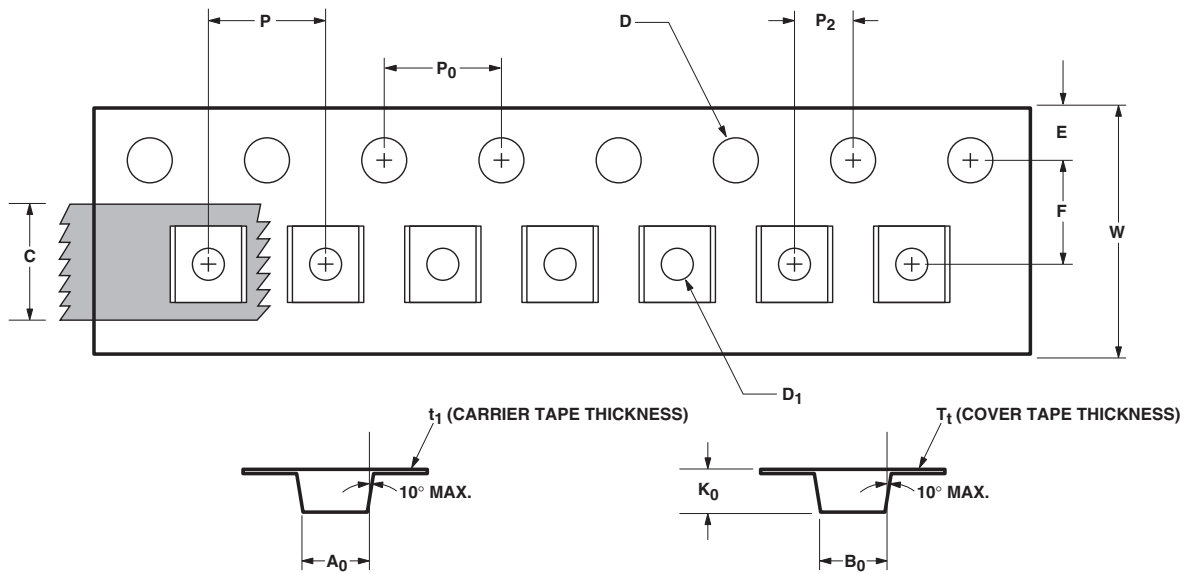
NOTES:

1. All dimensions are in mm.
2. Dimensions are inclusive of plating.
3. Dimensions are exclusive of mold flash & metal burr.
4. All specifications comply to EIAJ SC70.
5. Die is facing up for mold and facing down for trim/form, ie: reverse trim/form.
6. Package surface to be mirror finish.

Device Orientation



Tape Dimensions for Outline 4T



| | DESCRIPTION | SYMBOL | SIZE (mm) | SIZE (INCHES) |
|--------------|--|----------------|--------------------|-----------------|
| CAVITY | LENGTH | A ₀ | 2.40 ± 0.10 | 0.094 ± 0.004 |
| | WIDTH | B ₀ | 2.40 ± 0.10 | 0.094 ± 0.004 |
| | DEPTH | K ₀ | 1.20 ± 0.10 | 0.047 ± 0.004 |
| | PITCH | P | 4.00 ± 0.10 | 0.157 ± 0.004 |
| | BOTTOM HOLE DIAMETER | D ₁ | 1.00 + 0.25 | 0.039 + 0.010 |
| PERFORATION | DIAMETER | D | 1.55 ± 0.10 | 0.061 + 0.002 |
| | PITCH | P ₀ | 4.00 ± 0.10 | 0.157 ± 0.004 |
| | POSITION | E | 1.75 ± 0.10 | 0.069 ± 0.004 |
| CARRIER TAPE | WIDTH | W | 8.00 + 0.30 - 0.10 | 0.315 + 0.012 |
| | THICKNESS | t ₁ | 0.254 ± 0.02 | 0.0100 ± 0.0008 |
| COVER TAPE | WIDTH | C | 5.40 ± 0.10 | 0.205 + 0.004 |
| | TAPE THICKNESS | T _t | 0.062 ± 0.001 | 0.0025 ± 0.0004 |
| DISTANCE | CAVITY TO PERFORATION (WIDTH DIRECTION) | F | 3.50 ± 0.05 | 0.138 ± 0.002 |
| | CAVITY TO PERFORATION (LENGTH DIRECTION) | P ₂ | 2.00 ± 0.05 | 0.079 ± 0.002 |

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

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