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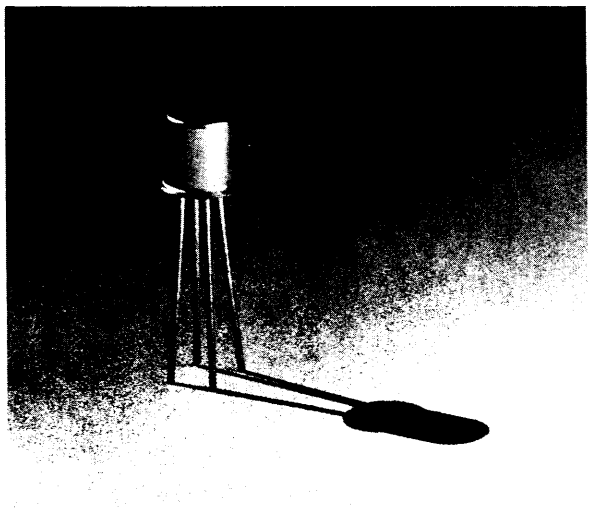
Avantek

TRANSISTOR DATA SHEET

AT-0017A

VHF TRANSISTOR

Silicon Planar UHF Transistor NPN Epitaxial



FEATURES

- **Very Low Noise Figure**
- **Wide Dynamic Range**
- **High Power Gain**

DESCRIPTION

AT-0017A transistors are designed primarily for small ultra-low noise amplifier applications. Their exceptional noise figure versus collector current characteristics make them ideally suited for applications where high dynamic range is required.

COMMON EMITTER OPERATING CHARACTERISTICS (T_A = 25°C)

Parameters	Symbols	Test Conditions	Min	Typ	Max
Spot Noise Figure	NF	V_{CB} = 10V, I_C = 5 mA, f = 60 MHz			1.2 dB
Power Gain	G_{pe}	V_{CB} = 10V, I_C = 5 mA, f = 60 MHz (see figure 1)		25 dB	

ELECTRICAL CHARACTERISTICS (T_A = 25°C)

Parameters	Symbols	Test Conditions	Min	Typ	Max
Collector-Base Breakdown Voltage	$V_{(BR)}CBO$	I_E = 0, I_C = 10 μA	20V		
Emitter-Base Breakdown Voltage	$V_{(BR)}EBO$	I_E = 10 μA, I_C = 0	3V		
Collector-Emitter Breakdown Voltage	$V_{(BR)}CEO$	I_C = 100 μA, I_B = 0	12V		
Collector Cutoff Current	I_{CBO}	V_{CB} = 10V, I_E = 0		10 nA	
Forward Current Transfer Ratio	h_{FE}	V_{CE} = 10V, I_C = 5 mA	20	75	
Current-Gain Transition Frequency	f_T	V_{CB} = 10V, I_C = 15 mA		3.5 GHz	
Collector-Base Capacitance	C_{cb}	V_{CB} = 10V, I_E = 0		0.8 pF	

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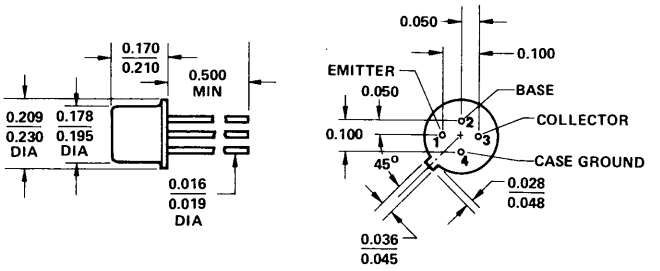
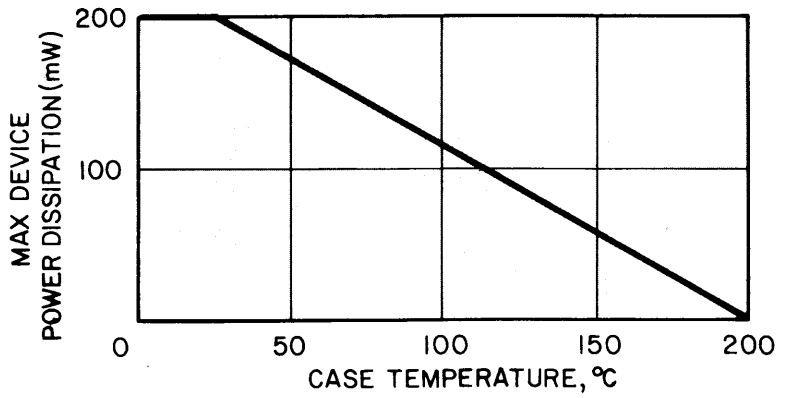
TO-72 PACKAGE



MAXIMUM RATINGS (T_A = 25°C)

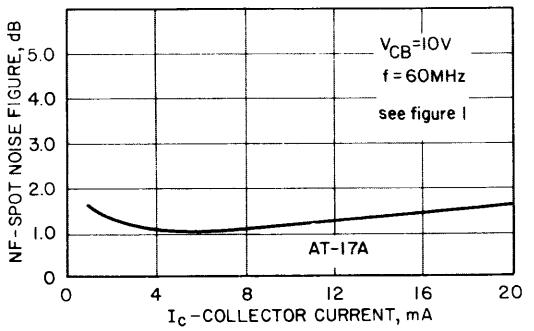
Parameter	Symbol	Limit
Reverse Emitter Base Voltage	V_{EB}	3V
Reverse Collector Base Voltage	V_{CB}	20V
Open Base Collector-Emitter Voltage	V_{CEO}	12V
Collector Current	I_C	100 mA
Continuous Dissipation	P_T (T_A = 25°C)	200 mW
Junction Temperature	T_j	200°C
Storage Temperature Range	T_{STG}	-65 to 200°C

POWER DERATING CURVE

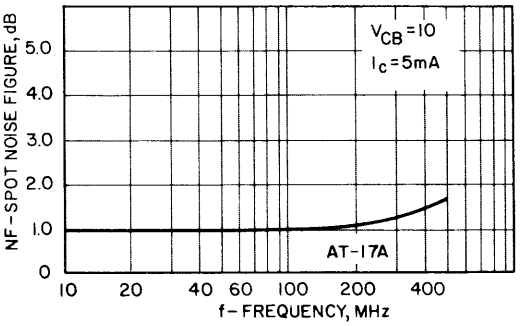


TYPICAL CHARACTERISTICS (T_A = 25° C)

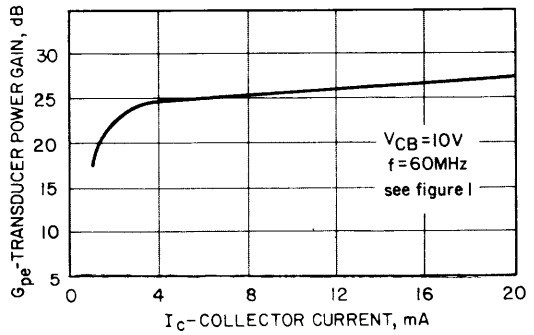
SPOT NOISE FIGURE
VS
COLLECTOR CURRENT



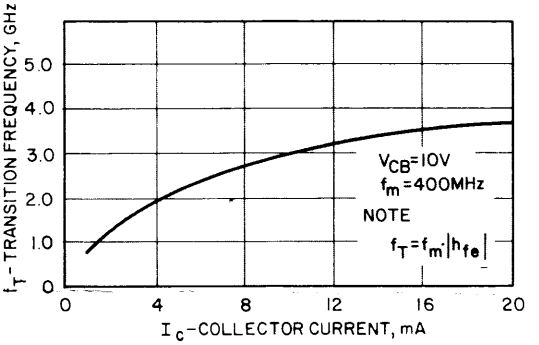
SPOT NOISE FIGURE
VS
FREQUENCY



TRANSDUCER POWER GAIN
VS
COLLECTOR CURRENT



TRANSITION FREQUENCY
VS
COLLECTOR CURRENT



PARAMETER MEASUREMENT INFORMATION

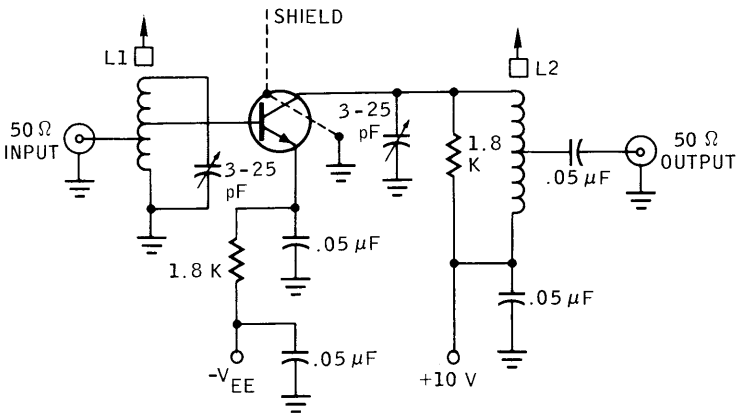


Figure 1 - Power Gain and Noise Figure Test Circuit (60 MHz)

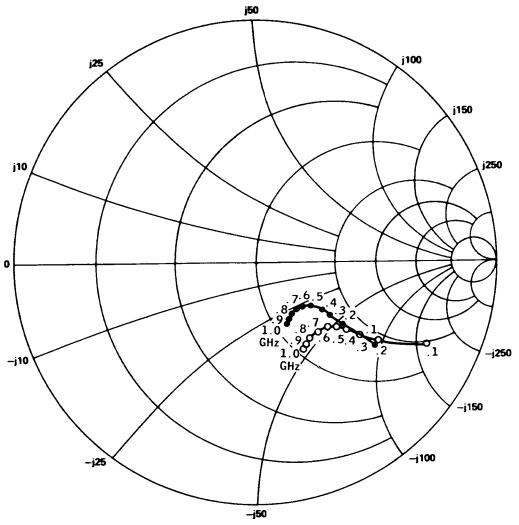
Notes:

L1 and L2 wound on 3/8 in. OD Miller (or equivalent) Ceramic Forms with Blue-Coded Powdered Iron Cores

L1: 0.6 in. Long, 6 Turns #14 Solid Copper Wire; Input Tap @ 2-1/8 Turns, Base Tap @ 2-5/8 Turns

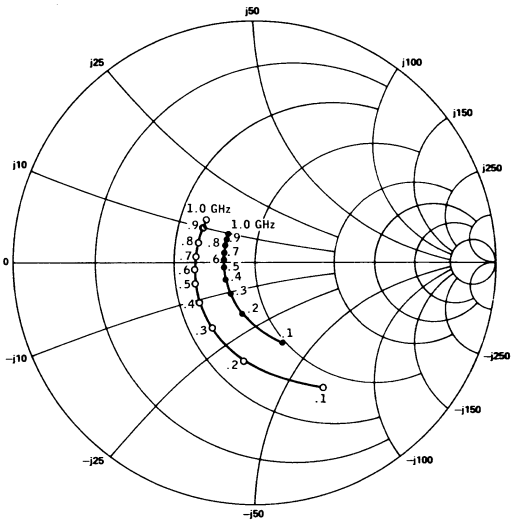
L2: 0.7 in. Long, 7-1/2 Turns #14 Solid Copper Wire; Tapped @ 1-7/8 Turns.

TYPICAL SCATTERING PARAMETERS



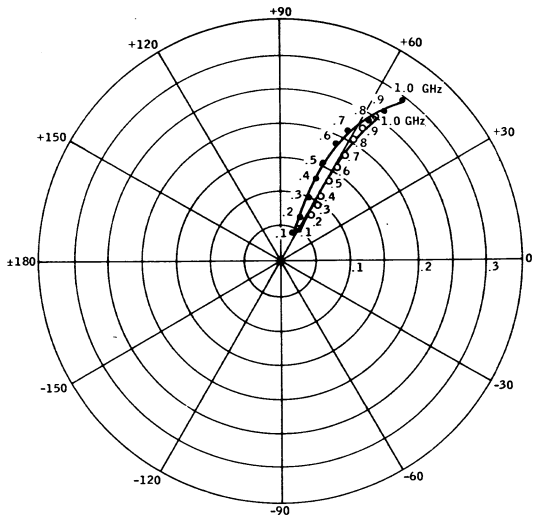
Output Impedance and
Output Reflection Coefficient, S_{22e}

V_{CB} = 10V ○ I_C = 5 mA ● I_C =15 mA



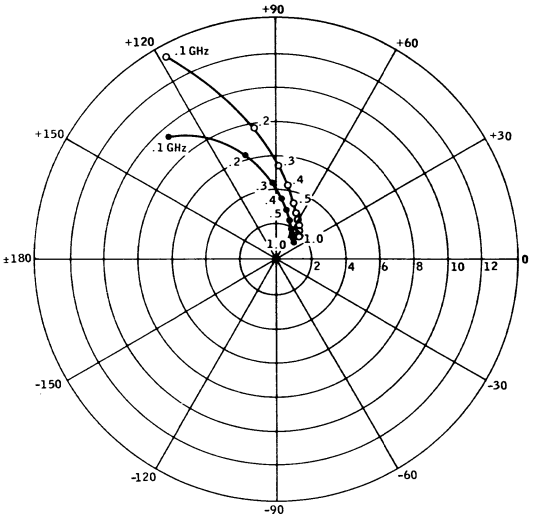
Input Impedance and
Input Reflection Coefficient, S_{11e}

V_{CB} = 10 V ○ I_C = 5 mA ● I_C =15 mA



Reverse Transfer Coefficient, S_{12e}

V_{CB} = 10 V ○ I_C = 5 mA ● I_C =15 mA



Forward Transfer Coefficient, S_{21e}

V_{CB} = 10 V ○ I_C = 5 mA ● I_C =15 mA

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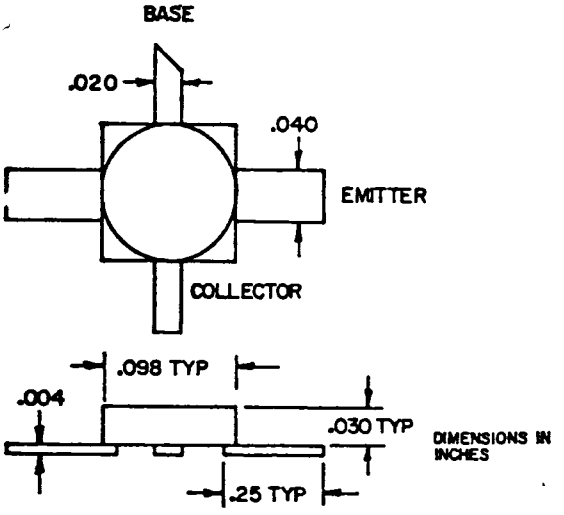
AT-0817

VHF TRANSISTOR

Silicon Planar VHF Transistor NPN Epitaxial



FEATURES

- Very Low Noise Figure
- Wide Dynamic Range
- High Power Gain

DESCRIPTION

AT-0817 transistors are designed primarily for small-signal, ultra-low-noise amplifier applications in the VHF frequency range.

OPERATING CHARACTERISTICS (T_A = 25°C)

PARAMETERS	SYMBOLS	TEST CONDITIONS	MIN	TYP	MAX
Spot Noise Figure	NF	V_{CB} = 10V, I_C = 5 mA, f = .5 GHz			1.7 dB
Power Gain	G_{pe}	V_{CB} = 10V, I_C = 5 mA, f = .5 GHz		17 dB	

MAXIMUM RATINGS (T_A = 25°C)

Reverse Emitter-Base Voltage	V_{EB}				3V
Reverse Collector-Base Voltage	V_{CB}				20V
Open-Base Collector-Emitter Voltage	V_{CEO}				12V
Collector Current	I_c				100 mA
Continuous Dissipation (see Note)	P_T	$T_A \leq 25°C$			200 mW
Linear Derating Factor	K_{JA}	$T_A > 25°C$	1.14 mW/°C		
Junction Temperature	T_J				200°C
Storage Temperature	T_{stg}		-65°C		200°C

ELECTRICAL CHARACTERISTICS (T_A = 25°C)

Collector-Base Breakdown Voltage	$V_{(BR)}CBO$	I_C = 0, I_C = 10 μA	20V		
Emitter-Base Breakdown Voltage	$V_{(BR)}EBO$	I_E = 10 μA, I_C = 0	3V		
Collector-Emitter Breakdown Voltage	$V_{(BR)}CEO$	I_C = 100 μA, I_B = 0	12V		
Collector Cutoff Current	I_{CBO}	V_{CB} = 10V, I_E = 0		10 nA	
Forward Current Transfer Ratio	h_{FE}	V_{CE} = 10V, I_C = 5 mA	20	75	
Current-Gain Transition Frequency	f_T	V_{CB} = 10V, I_C = 15 mA		3.5 GHz	
Collector-Base Capacitance	C_{cb}	V_{CB} = 10V, I_E = 0		0.8 pF	

NOTE: Derate linearly to 200°C free-air temperature at the rate of 1.14 mW/°C.

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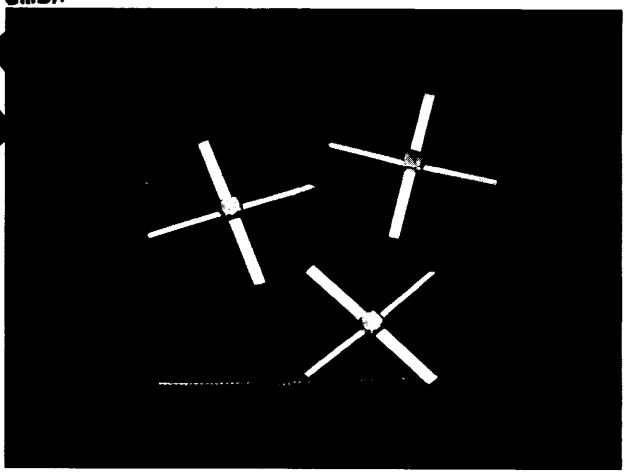
TRANSISTOR DATA SHEET

AT-8110/-8111
2-6 GHz Small Signal Ultra-Low Noise Gallium Arsenide FET

UPDATE

FEATURES

- 1.3 dB NF, 11 dB Gain @ 4 GHz
- 1.7 dB NF, 9 dB Gain @ 6 GHz
- +17 dBm Linear P_O @ 4 GHz
- Excellent 50 ohm Input Match
- All Gold-based Metallization
- Hermetic 70 mil Package or Chip Form
- Very Wide Dynamic Range



DESCRIPTION

The AT-8110/-8111 is a gallium arsenide metal-semiconductor field effect transistor with Schottky-barrier gate electrodes, particularly designed for simplified input matching, high gain, low noise figure and wide dynamic range in the 2 to 6 GHz frequency range. It is ideal for narrowband communications and radar amplifiers as well as for wideband EW applications.

This unique GaAs FET combines a half-micron gate length for low noise figure with a 28 gate geometry that provides a close-to-perfect 50 ohm input impedance match and 50 ohm noise match at 4 GHz. This means that the input circuit of a moderate-bandwidth amplifier using the AT-8110/-8111 will normally consist of a single, simple transmission line element. The result is a fast and easy input circuit design and reduced input circuit losses for a significant decrease in overall *amplifier* noise figure.

In addition to its excellent input characteristics, the AT-8110/-8111 features a 1.3 dB noise figure at 4 GHz with 12 dB associated gain and + 17 dBm linear output power capability (at 1 dB gain compression point). The addition of high power capability to a low noise figure transistor permits an extremely wide dynamic range amplifier front end and excellent amplifier linearity over a wide input signal range. This makes the AT-8110/-8111 capable of cross- and intermodulation-free operation in communications LNA, radar preamplifier and EW amplifier applications.

The AT-8110/-8111, like all Avantek transistors, features a metal system that combines gold and refractory metals throughout, even the gate is gold metallized. This eleminates the corrosion, intermetallic growth (metal migration) and burn-out problems associated with some other metal systems used in GaAs FET fabrication — thus helping to assure excellent long-term reliability.

The AT-8110 version is packaged in the ultra-miniature 70 mil square metal-ceramic microstrip package. The package is filled with a dry, inert atmosphere and hermetically sealed to fully protect the GaAs FET chip from contamination, corrosive gasses and moisture. Each packaged transistor is leak tested before shipment to verify the true hermeticity of its package.

TYPICAL COMMON SOURCE OPERATING CHARACTERISTICS (T_A = 25°C)

PARAMETER	SYMBOL	VALUE	FREQUENCY	TEST CONDITION
Spot Noise Figure	NF_{opt}	1.3 dB (1.5 dB max)	4.0 GHz	V_{DS} = 3V, I_{DS} = 20 mA
		1.7 dB	6.0 GHz	V_{DS} = 3V, I_{DS} = 20 mA
Gain at Optimum Noise Figure	G_{NF}	12 dB (11 dB min)	4.0 GHz	V_{DS} = 3V, I_{DS} = 20 mA
		9 dB	6.0 GHz	V_{DS} = 3V, I_{DS} = 20 mA
Output Power at 1 dB Gain Compression *	$P_{O(-1)}$	+ 17 dBm	4.0 GHz	V_{DS} = 5V, I_{DS} = 50 mA

* Measured with a 50 ohm input source impedance and the output circuit tuned for maximum output power.

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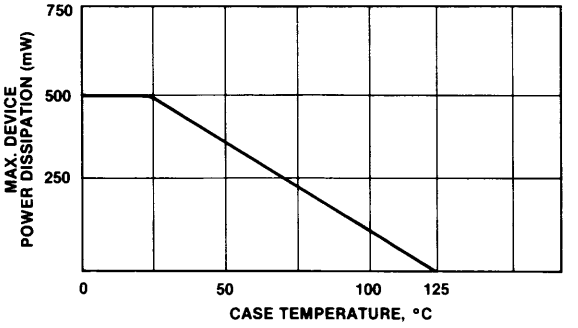
The AT-8111 is an unpackaged 15 x 19 mil chip suitable for MIC thin-film and thick-film hybrid circuits. It's gold metal system provides excellent bond strength and assures compatibility with the wire bonding techniques used in hybrid circuit fabrication. An optional PGA (polycrystalline gallium arsenide) protective layer is available on the AT-8111 chip to protect the surface from damage or contamination during handling. The PGA layer is also opaque which prevents variations in operating parameters caused by light impingement during amplifier tuning.

Avantek transistors, including the AT-8110/-8111, are 100% tested for both DC and RF parameters after packaging and leak testing.

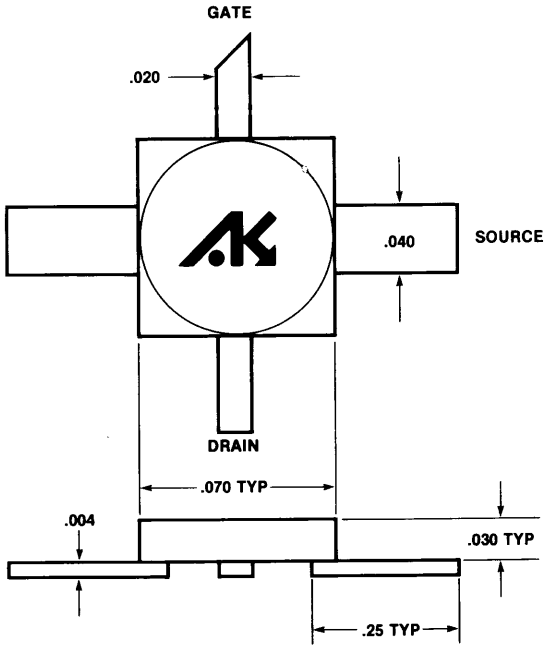
ABSOLUTE MAXIMUM RATINGS (T_A = 25°C)

Parameter	Symbol	Limit
Drain-Source Voltage	V_{DS}	+7V
Gate-Source Voltage	V_{GS}	−5V
Drain Current	I_D	120 mA
Continuous Dissipation (T_{case} = 25°C)	P_T	500 mW
Channel Temperature	T_{ch}	125°C
Storage Temperature (AT-8110)	T_{stg}	−65° to +125°C
Thermal Resistance	Θ_{CC}	200°C/W

POWER DERATING CURVE

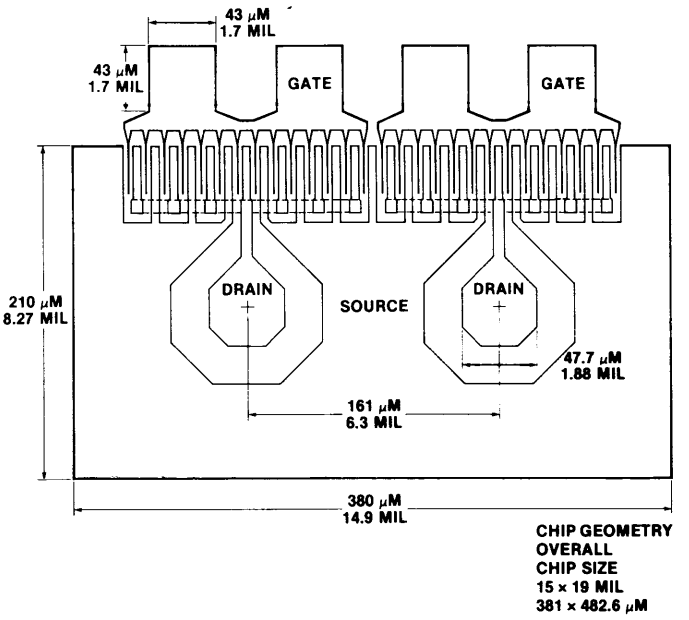


OUTLINE DRAWING: PACKAGED VERSION



TOLERANCES: ±.010/±.02
DIMENSIONS INCHES

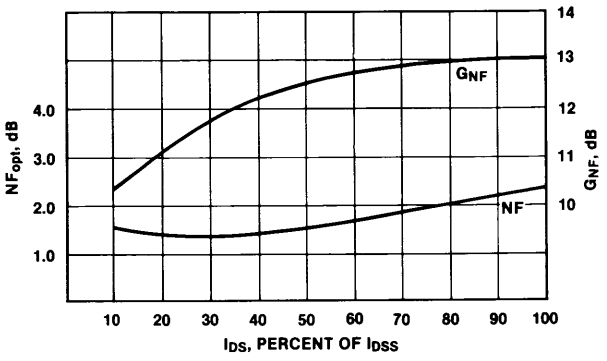
OUTLINE DRAWING: UNPACKAGED CHIP



TYPICAL DC CHARACTERISTICS (T_A = 25°C)

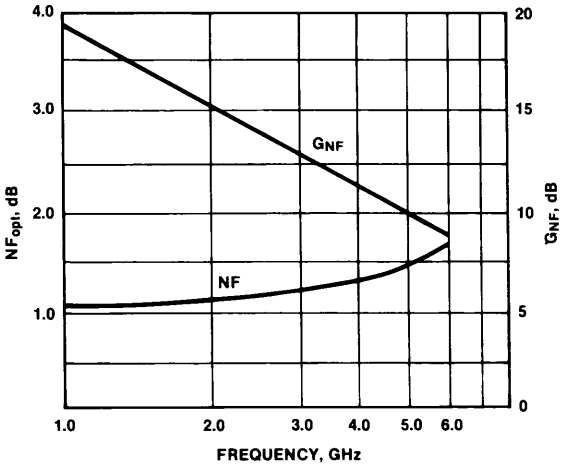
Parameter	Symbol	Value	Test Conditions
Transconductance	G_M	65 mmho (50 mmho min)	V_{DS} = 3V, V_{GS} = 0V
Saturated Drain Current	I_{DSS}	120 mA	V_{DS} = 3V
Pinchoff Voltage	V_P	−2V	V_{DS} = 3V, I_{DS} = 1 mA

SPOT NOISE FIGURE (NF_{opt}) AND ASSOCIATED GAIN (G_{NF}) VS. I_{DS} AT V_{DS} = 3V, f = 4 GHz

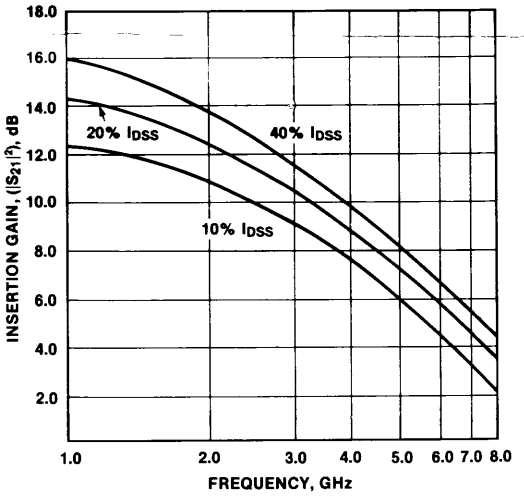


Note: Source admittance for the AT-8110 optimum noise figure at 4.0 GHz, V_{DS} = 3V, I_{DS} = 20 mA is approximately (23-j24) mmho.

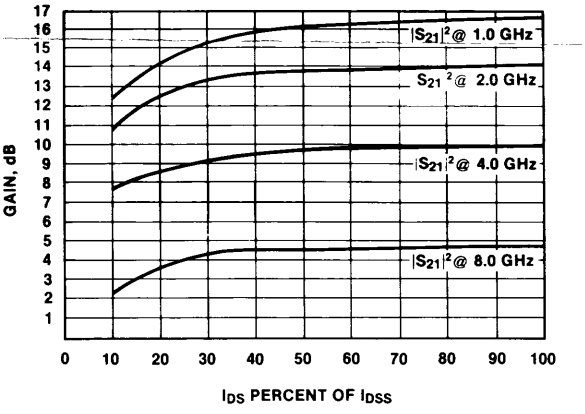
SPOT NOISE FIGURE (NF_{opt}) AND ASSOCIATED GAIN (G_{NF}) VS. FREQUENCY V_{DS} = 3V, I_{DS} = 20 mA



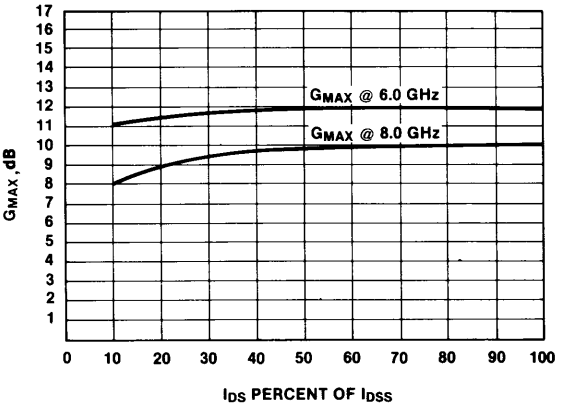
INSERTION POWER GAIN ($|S_{21}|^2$) VS FREQUENCY AND I_{DS} @ V_{DS} = 3V



INSERTION POWER GAIN ($|S_{21}|^2$) VS. I_{DS} V_{DS} = 3V



MAXIMUM AVAILABLE GAIN (G_{max}) VS. I_{DS} V_{DS} = 3V



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AT-8110/-8111

BIAS= 3.00 VOLTS, 20.00 MA

S -- MAGN AND ANGLES:

FREQ	11		21		12		22	
500.00	.924	-30.1	5.488	153.9	.031	60.1	.519	-23.8
1000.00	.877	-56.1	5.070	134.7	.052	48.0	.464	-40.2
1500.00	.834	-80.7	4.571	117.5	.069	36.3	.416	-56.7
2000.00	.797	-102.6	4.062	100.6	.080	24.7	.376	-71.3
2500.00	.774	-122.9	3.640	86.2	.087	14.5	.345	-85.8
3000.00	.758	-140.2	3.247	71.9	.092	5.6	.327	-99.3
3500.00	.737	-155.5	2.924	58.6	.095	-2.3	.307	-110.5
4000.00	.727	-168.4	2.663	47.2	.095	-8.9	.290	-120.6
4500.00	.721	178.9	2.417	35.8	.097	-14.7	.282	-132.3
5000.00	.713	167.1	2.229	24.5	.098	-19.5	.285	-144.7
5500.00	.712	156.4	2.059	14.4	.098	-23.7	.292	-156.4
6000.00	.712	147.1	1.897	5.2	.100	-28.8	.312	-167.7
6500.00	.709	138.8	1.772	-4.2	.101	-32.0	.335	-177.2
7000.00	.709	131.0	1.668	-13.5	.102	-36.3	.358	175.2
7500.00	.701	123.9	1.579	-22.2	.104	-39.9	.384	168.6
8000.00	.686	117.1	1.501	-31.0	.107	-43.5	.396	164.1

BIAS= 5.00 VOLTS, 50.00 MA

S -- MAGN AND ANGLES:

FREQ	11		21		12		22	
500.00	.918	-33.2	6.827	151.9	.023	57.5	.575	-21.2
1000.00	.866	-61.5	6.197	131.6	.037	46.6	.515	-34.2
1500.00	.822	-87.7	5.481	113.8	.048	35.8	.465	-47.2
2000.00	.784	-110.3	4.779	96.7	.055	26.5	.425	-58.5
2500.00	.765	-130.7	4.224	82.0	.059	17.9	.395	-69.9
3000.00	.750	-147.7	3.720	68.2	.062	11.1	.377	-81.2
3500.00	.734	-162.9	3.329	54.9	.064	5.1	.365	-90.5
4000.00	.727	-175.3	3.022	43.5	.064	1.1	.346	-99.2
4500.00	.723	172.4	2.727	32.1	.066	-2.9	.337	-109.6
5000.00	.717	161.0	2.507	21.0	.068	-5.8	.337	-121.0
5500.00	.718	150.6	2.309	10.9	.070	-7.7	.341	-132.7
6000.00	.719	141.5	2.123	1.6	.072	-11.2	.356	-145.0
6500.00	.718	133.5	1.983	-7.8	.076	-13.7	.377	-155.8
7000.00	.717	125.7	1.855	-17.3	.079	-16.5	.403	-164.8
7500.00	.709	118.5	1.751	-26.3	.084	-19.8	.429	-173.4
8000.00	.695	111.7	1.659	-35.2	.089	-22.7	.451	-179.0