Avantek

Transistor Designers 1981 Catalog

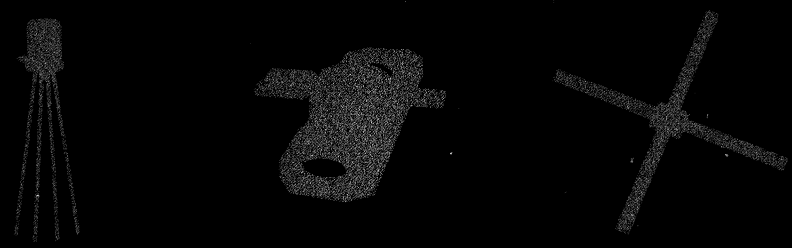


Table of Contents

SILICON BIPOLAR TRANSISTOR SELECTION GUIDE

Low Noise S_i Bipolar Transistors

Part Number	Test f (GHz)	NF_{opt} (dB)	G_{NF} (dB)	f_{max} (GHz)	MAX P_T (MW)	Package	Page
AT-0017A	.06	1.0	25	3	400	TO-72	15
AT-0045	.5	1.4	13	4	400	TO-72	19
AT-1845A	1	2.0	14	10	400	100 mil	23
AT-2645A	2	2.8	11	10	400	70 mil	27
AT-2845A	2	2.8	11	10	400	100 mil	31
AT-4641	4	3.0	8	14	400	70 mil	35
AT-4841	4	3.0	8	14	400	100 mil	39
AT-4680	4	2.8	8.8	15	120	70 mil	43
AT-4880	4	2.8	8.8	15	120	100 mil	47
AT-4690	4	2.8	9.5	16	200	70 mil	51
AT-4890	4	2.8	9.5	16	200	100 mil	55

General Purpose S_i Bipolar Transistors

Part Number	Test f(GHz)	NF_{opt} (dB)	G_{NF} (dB)	f_{max} (GHz)	MAX P_T (MW)	Package	Page
AT-0017	.06	1.3	25	3	400	TO-72	59
AT-0017A	.06	1.0	25	3	400	TO-72	59
AT-0025	.5	2.2	12	3.5	400	TO-72	63
AT-0025A	.5	1.9	12	3.5	400	TO-72	63
AT-1825	1	2.7	13	6.5	400	100 mil	67
AT-1845	1	2.3	14	10	400	100 mil	71
AT-2645	2	3.2	10	10	400	70 mil	75
AT-2845	2	3.2	10	10	400	100 mil	79
AT-4642	4	3.6	7	13	400	70 mil	83
AT-4842	4	3.6	7	13	400	100 mil	87

Linear Power S_i Bipolar Transistors

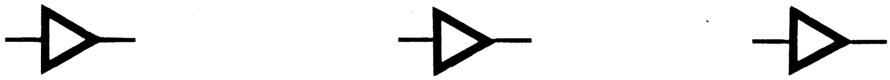
Part Number	Test f(GHz)	$P_{1\,dB}$ (dB)	G_{1dB} (dB)	f_{max} (GHz)	MAX P_T (MW)	Package	Page
AT-2615	2	22	8	8	1000	70 mil	91
AT-2815	2	22	8	8	1000	100 mil	95
AT-7510	4	27.5	9.5	13	2250	180 mil Flange	103

S_i Bipolar Oscillator Transistors

Common base and common collector versions available on special request

RECOMMENDED TRANSISTORS FOR CLASS-A AMPLIFIER APPLICATIONS

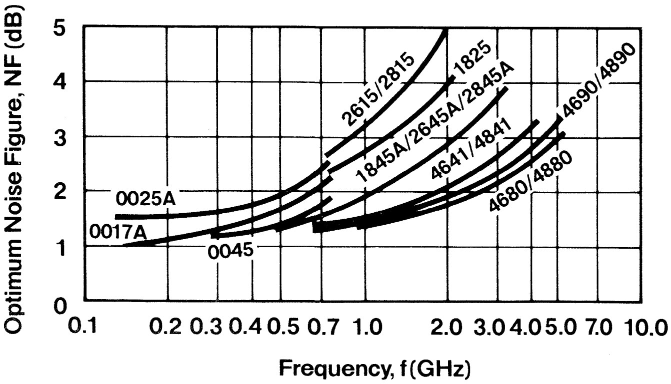
S_i Bipolar Transistors



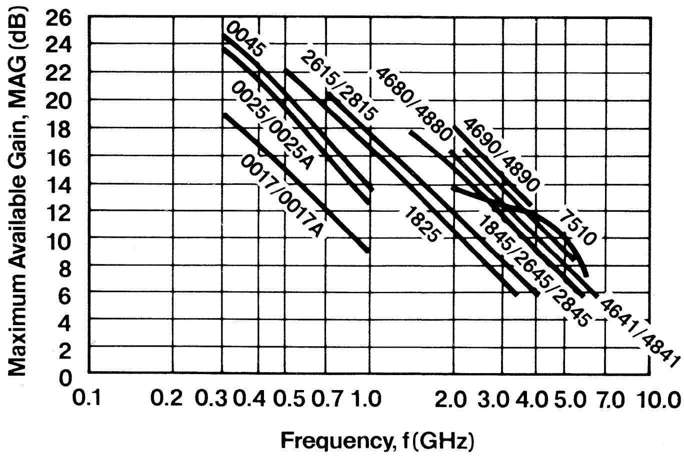
Frequency	Low Noise Amplifier Stages	Intermediate Amplifier Stages	Driver/Output Amplifier Stages
60 MHz	AT-0045 AT-0017A	AT-0025/0025A AT-0017A AT-0017	AT-0017
500 MHz	AT-0045/1845A/2645A AT-0017A	AT-0025/0025A/1825 AT-0017A AT0017	AT-0017A AT-0017/2615/2815
1 GHz	AT-1845A/2645A/2845A AT-4641/4841 AT-4690/4890 AT-4680/4880	AT-1845/2645/2845	AT-7510 AT-2615/2815
2 GHz	AT-4641/4841 AT-4690/4890 AT-4680/4880	AT-1845/2645/2845 AT-4642/4842	AT-7510 AT-2615/2815
4 GHz	AT-4690/4890 AT-4680/4880	AT-4642/4842	AT-7510

S_i BIPOLAR TRANSISTORS

Typical Tuned Noise Figure (NF_{opt}) vs Frequency



Typical Maximum Available Gain (MAG) vs Frequency S_i Bipolar Transistors



GaAs FET SELECTION GUIDE

Low Noise GaAs FETs

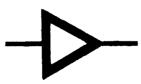
Part Number	Test f(GHz)	NF_{opt} (dB)	G_{NF} (dB)	G_{max} (dB)	MAX P_T (MW)	Package	Page
AT-8110	4	1.3	12	14	500	70 mil	107
AT-8060	6	1.9	11	15	200	50 mil	111
	12	25	8	10	200	50 mil	
AT-8061	18	3.0	5	7	200	(chip)	111
AT-8040	12	2.0	9	11	120	50 mil	117
AT-8041	18	2.5	6	8	120	(chip)	117

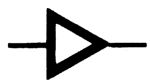
Linear Power GaAs FETs

Part Number	Test f(GHz)	P_{1dB} (dBm)	G_{1dB} (dB)	G_{max} (dB)	MAX P_T (MW)	Package	Page
AT-8160	4	26	11	12.0	2.4	100 mil flange	123
	8	24.5	6.5	8.0	2.4	100 mil flange	
AT-8161	12	23	5.0	6.5	2.4	(chip)	127
AT-8150	4	29	11	12	4.0	100 mil flange	131
	8	28	7.5	9.5	4.0	100 mil flange	
AT-8151	12	27	4	5.5	4.0	(chip)	135
AT-8140	4	31.5	9	10.0	7.0	100 mil flange	139
	8	29.0	4	6.0	7.0	100 mil flange	

RECOMMENDED TRANSISTORS FOR CLASS-A AMPLIFIER APPLICATIONS

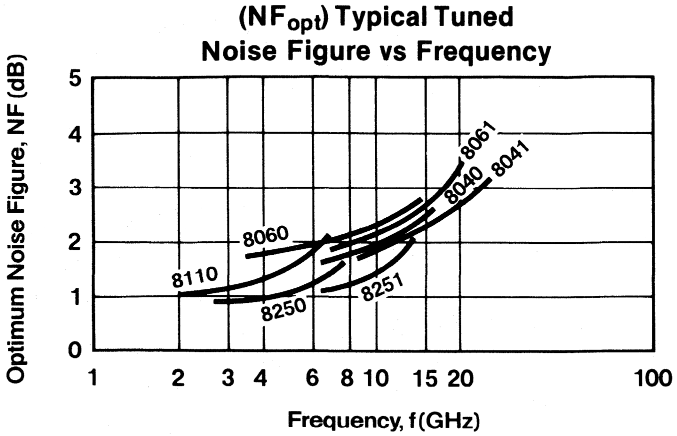
GaAs FETs

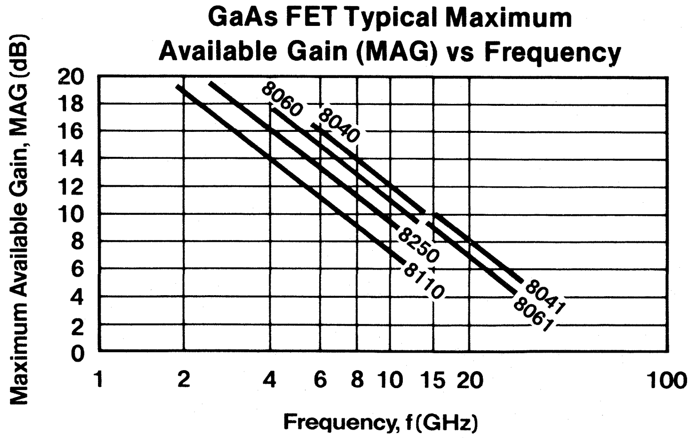




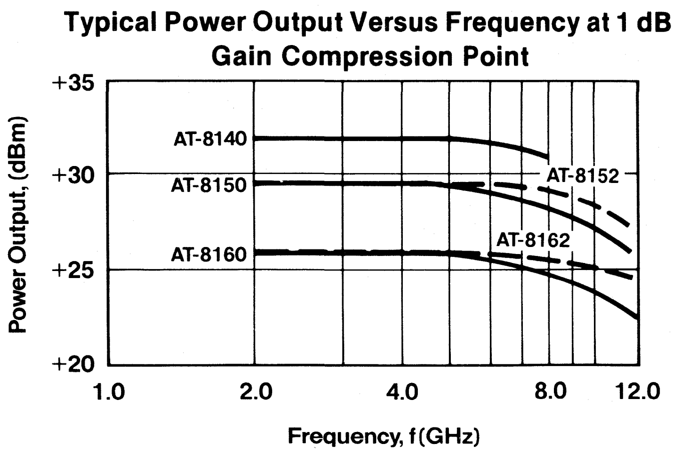
Frequency	Low Noise Amplifier Stages	Intermediate Amplifier Stages	Driver/Output Amplifier Stages
2 GHz	AT-8110/AT-8250	AT-8110/8160	AT-8150/8140
4 GHz	AT-8110/AT-8250	AT-8110/8160	AT-8150/8140
8 GHz	AT-8060	AT-8160	AT-8150
12 GHz	AT-8060	AT-8162	AT-8152
18 GHz	AT-8040	AT-8040/8060	AT-8060/AT-8162

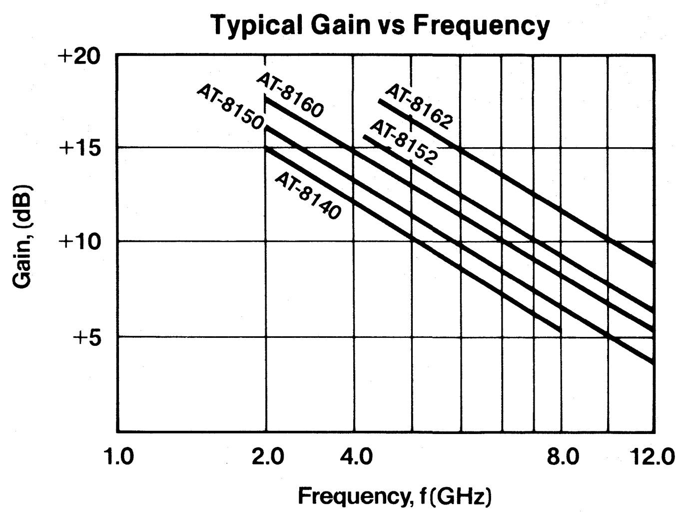
LOW NOISE GaAs FETs

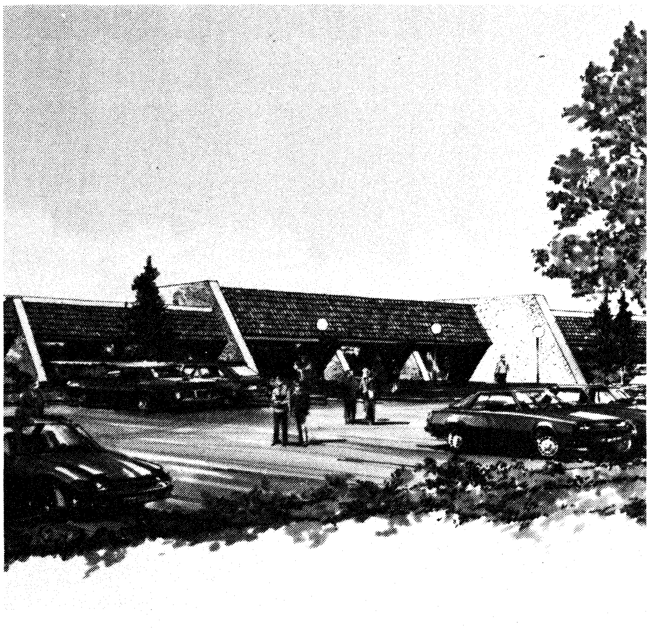




LINEAR POWER GaAs FETs





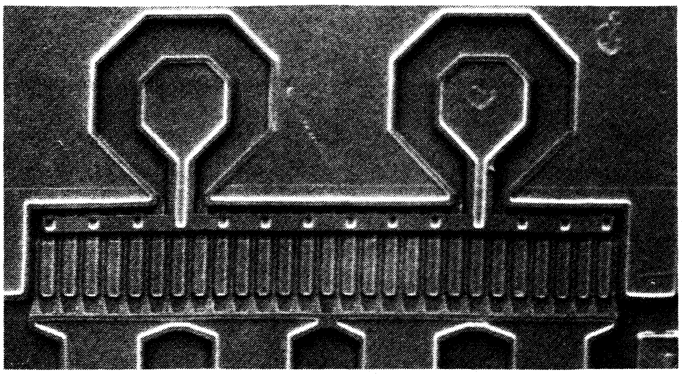


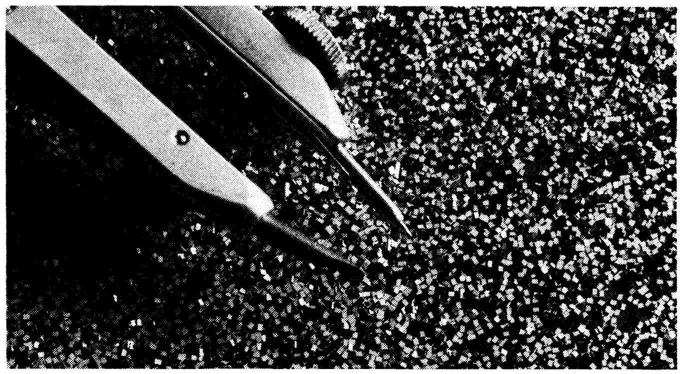
Avantek . . .

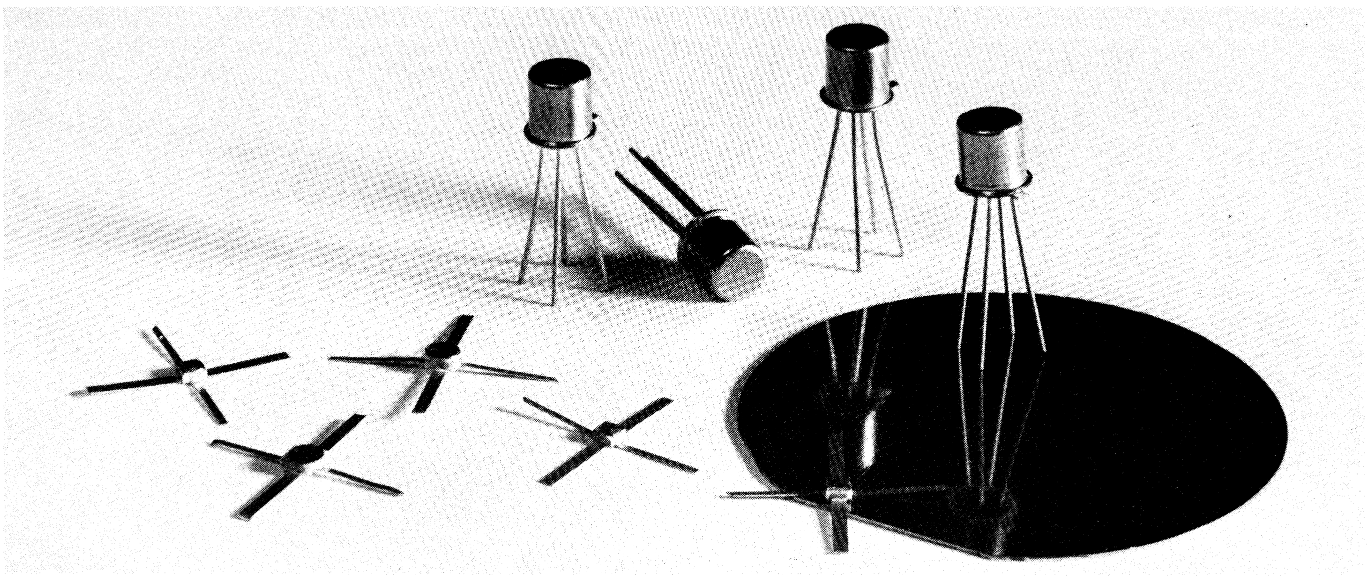
tomorrow's semiconductors today.

Avantek, Inc. supplies state-of-the-art microwave semiconductors, amplifiers, oscillators, modular components and equipment for commercial, telecommunications, military and aerospace applications. We operate from 208,000 sq. ft. facility in Santa Clara, California—the heart of the west coast semiconductor and microwave industry, and supply customers throughout the world. Our second Santa Clara Valley facility, now in the final stages of construction, will add an additional 80,000 square feet early in 1981.

Our microwave components combine unique performance features with uniformity and unparalleled reliability, a reputation that can be traced in large part to the quality and reliability of the microwave transistors that we use. These transistors are Avantek transistors.







The Avantek Transistor Capability

Avantek was founded in late 1965 to product VHF, UHF and microwave solid-state amplifiers for both civilian and military applications. Soon after our formation, it became apparent that advances in solid-state microwave technology were hampered by the limited and sporadic availability of premium-performance microwave transistors. Device suppliers simply were not able to keep pace with the progress made by Avantek circuit designers. Consequently, by the spring of 1968 Avantek added the staff and facilities to design gold metallized microwave bipolar transistors and to fabricate these transistors in quantities that met the growing demand for our products.

From 1968 to the present, we have continuously upgraded our microwave transitor capabilities and facilities. By 1974 we were producing arsenic-doped bipolar transistors with extremely low noise figures and high gain, and had begun quantity production of GaAs FETs. By 1976, we added ion implantation capabilities and were producing GaAs FETs with 0.5 μm gate lengths. In 1977, we adopted a new gold metal system that provides thicker, more uniform metallization on both bipolar and GaAs FET devices. During 1980 we received a patent for our unique gate process which is one of the keys to the success of Avantek's GaAs FETs. In 1980 we introduced our first power GaAs FETs to the marketplace and these have set new standards of industry performance in reliability, efficiency and gain.

Today, the Avantek transistor R & D staff, made up of noted experts in semiconductor technology, works with a completely-equipped prototyping and test facility—independent of our transistor production area. In addition to the applied research that leads to new kinds of microwave transistors, the R & D group continuously reviews all existing production devices for updating with improved manufacturing techniques to upgrade uniformity and performance.

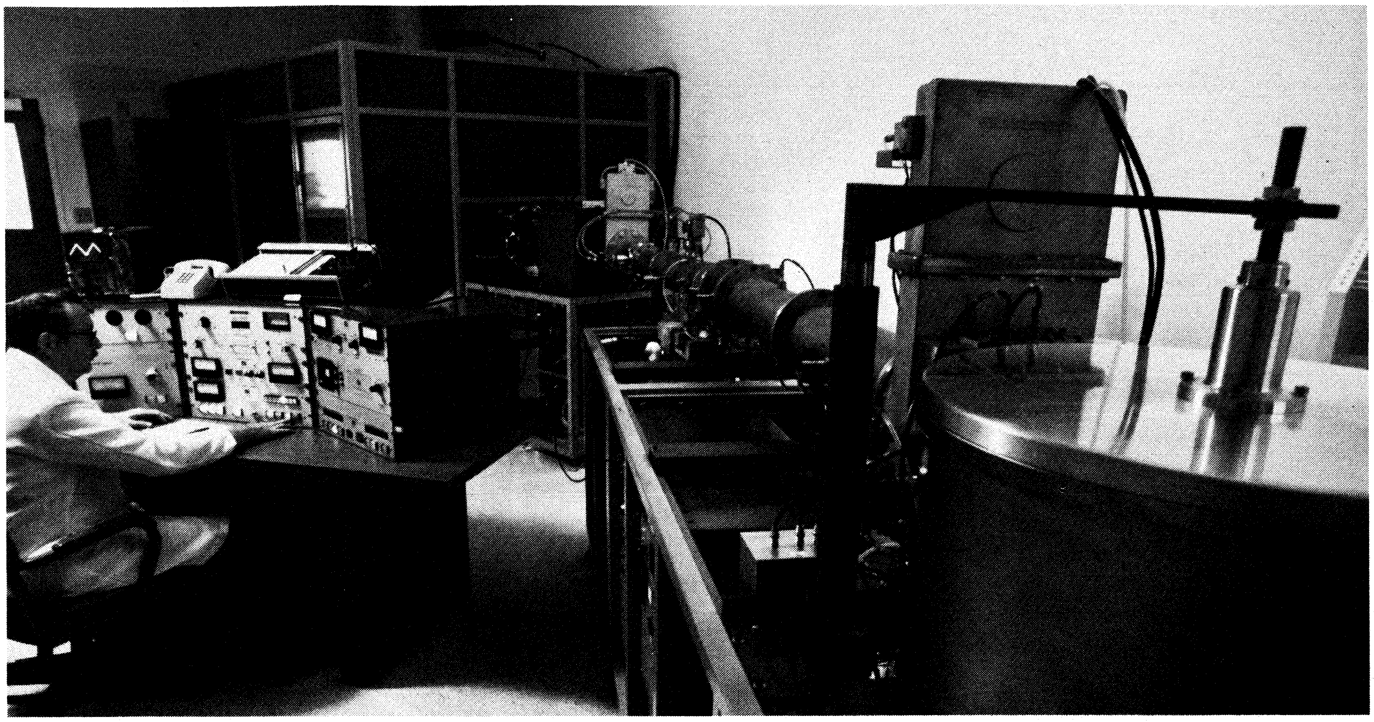
The Avantek transistor production facility is designed and equipped specifically for the efficient quantity production of high performance microwave transistors. To prevent the subtle variations in performance caused by almost undetectable contamination, our production areas are equipped with specially engineered utilities and water treatment and laminar flow hoods are used extensively.

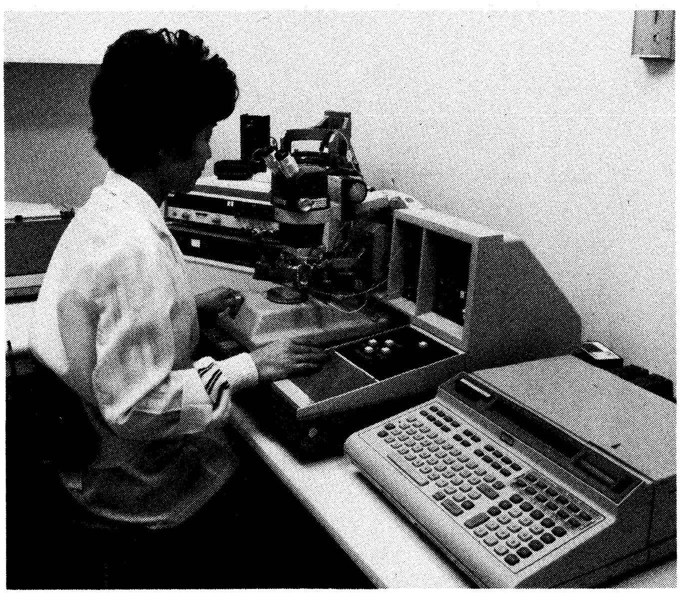
Uniform Performance and Reliability

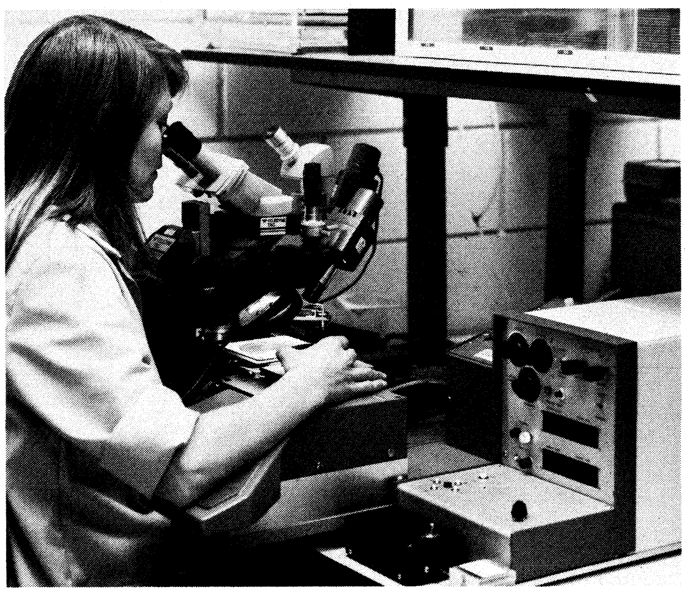
Avantek transistors have proven histories of performance and reliability in some of the most critical microwave applications. They are extensively used in military communications, radar and ECM equipment; marine radar and communications equipment; and in equipment presently operating aboard orbiting spacecraft.

Transistors from Avantek are both designed and tested to provide extremely uniform DC and RF operating characteristics from wafer to wafer. This is particularly important to the user who requires relatively small quantities of transistors over relatively long periods of time. Many users have commented that this uniformity has enabled them to optimize their circuit designs and obtain additional "free" gain by minimizing feedback or stabilization circuitry. Users have also found that Avantek transistors offer uniform noise figures over a wide frequency range and a wide range of bias current levels. These characteristics make wideband amplifiers perform better and can improve the dynamic range of almost any circuit design.

Avantek packaged transistors have been qualified and shipped for use in 1980's-era communications satellites, phased-array radar systems and military electronics equipment now being built.







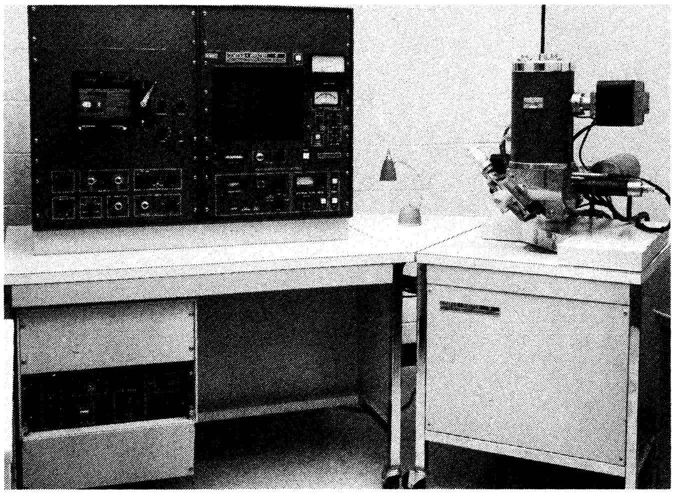
Customer Support

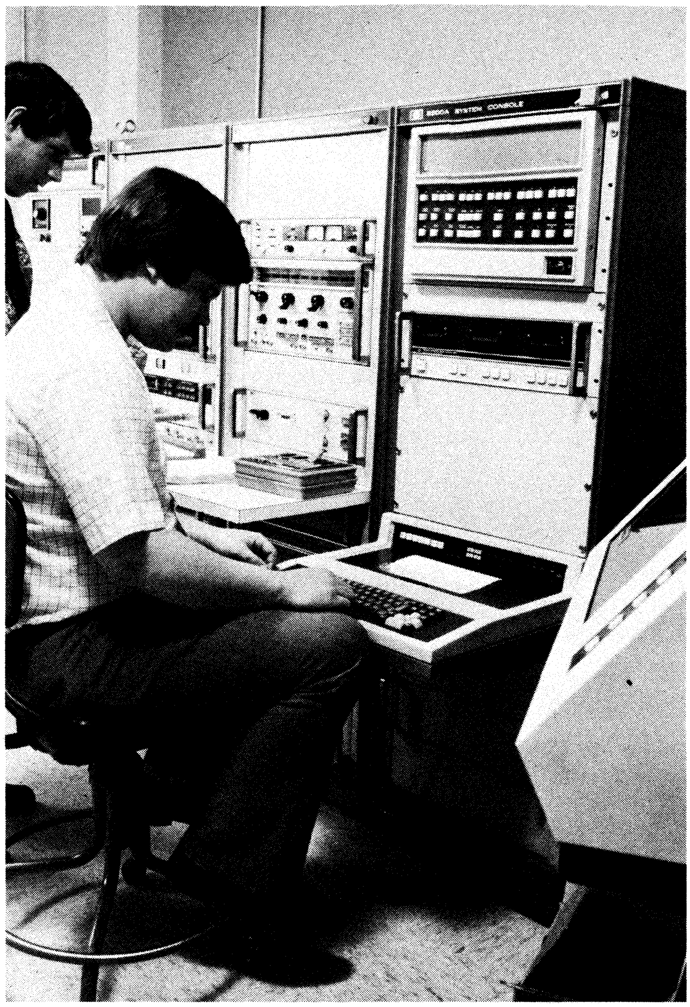
Our goal is to ship every customer's order, regardless of quantity, from stock.

To assure quick order turn-around, we must maintain a large inventory of finished transistor chips and packaged transistors—our inventory is presently in excess of 4.5 million chips. Our policy is to produce enough stock to meet the expected first year's shipments before we introduce a new transistor chip.

We support transistor users with information and assistance as well. Our technical experts are professionals, familiar with both transistor technology and with microwave applications. They can answer your questions regarding the use of Avantek transistors in your application and can provide valuable advice on the design techniques that improve transistor performance and reliability. Our three-volume *Transistor Primer* series provides excellent background information.

COMPACT computer programs are available to assist in design with many of our products.





To Assure Reliability

All Avantek transistors regardless of price, frequency range or package type, are 100% tested for RF and DC performance before capping. Both TO-72 and microstripline packaged are dry nitrogen-filled, hermetically welded and 100% leak tested to verify hermeticity.

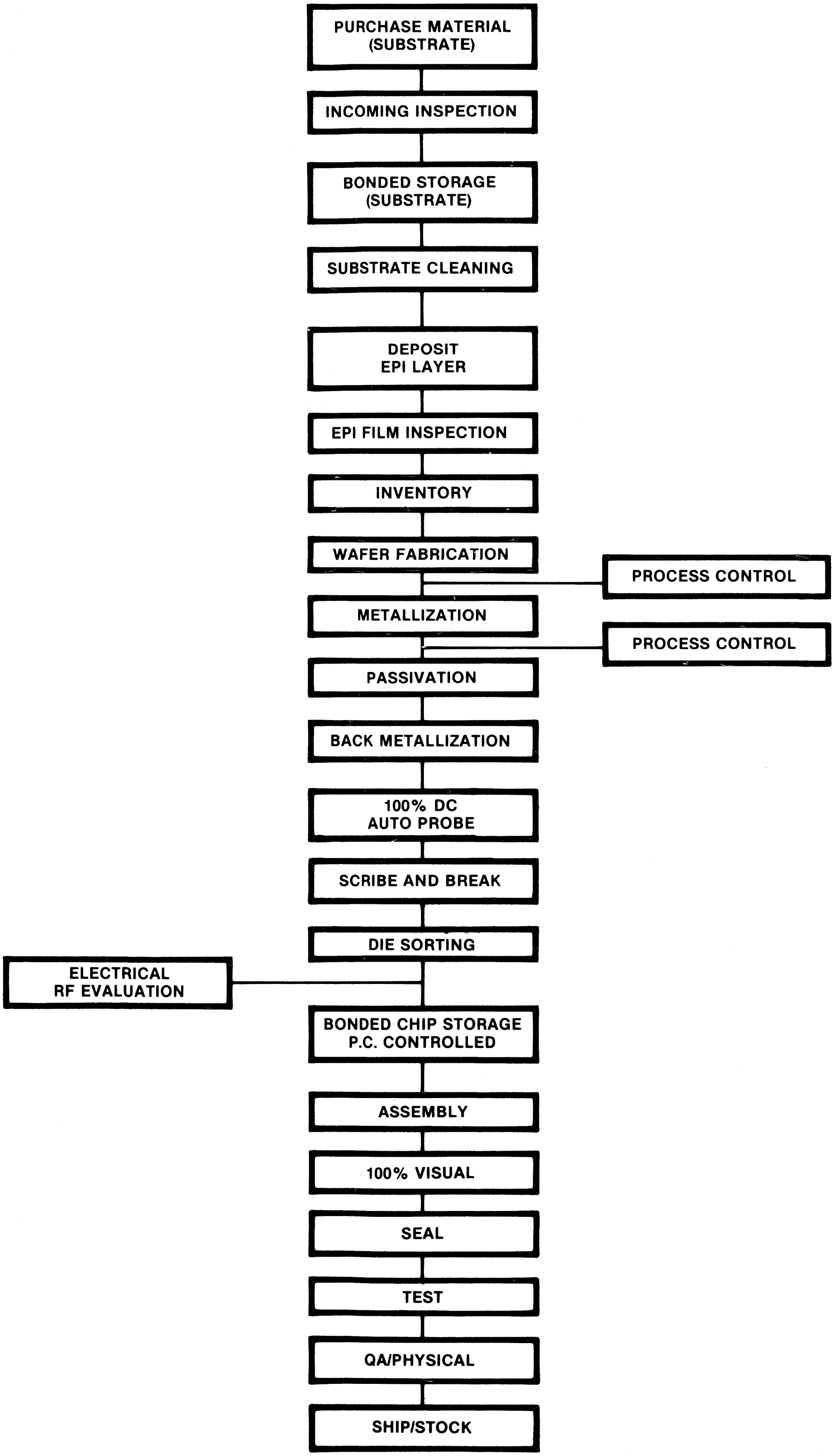
All processing and manufacturing steps are monitored by Avantek Quality Assurance group, which operates independently from transistor production management and reports directly to a vice-president. Using rigid quality control standards based on the requirements of MIL-Q-9858A, MIL-S-19500 and the comprehensive Avantek Quality Assurance Standard Workmanship Manual, our QA/QC group can qualify transistors for virtually any commercial, military or space system.

The combination of gold metallization, hermetic packaging, 100% testing and a carefully-implemented QA/QC procedure assures that Avantek transistors will be reliable, consistent and offer full guaranteed performance under difficult operating conditions.

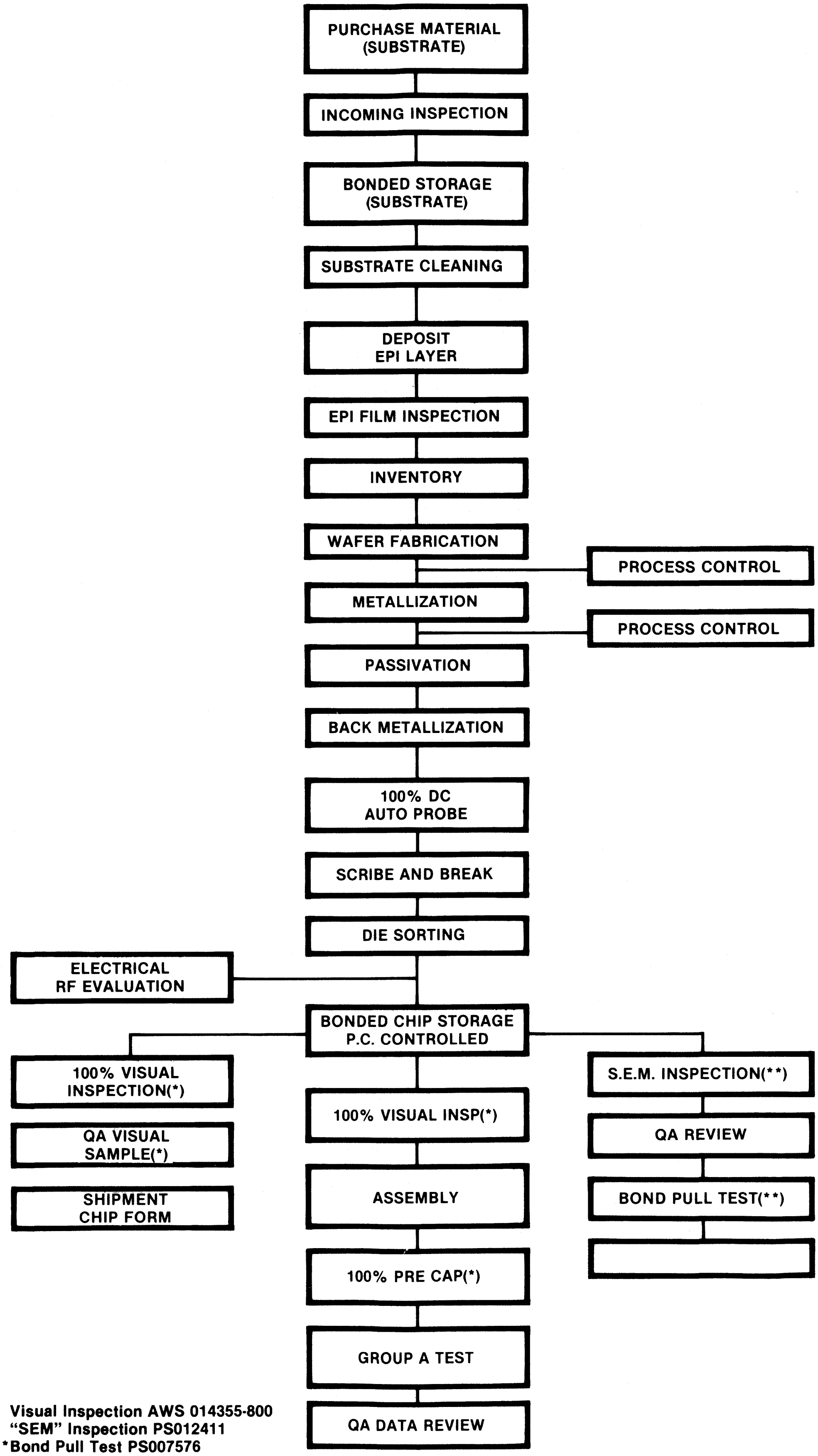
High Reliability Screening

Every Avantek transistor, both bipolar and GaAs FET, can be thought of as a prime commercial grade product, regardless of price. For applications requiring a further assurance of reliability, we offer "R" series high-reliability screening, similar to JANTXV levels. Group B, C and D testing is also available. This screening program, based on MIL-STD-750 methods and conditions, includes burn-in and testing. Each "R" Series transistor is shipped with a screening completion checkoff sheet.

MICROWAVE TRANSISTOR STANDARD LINE



MICROWAVE TRANSISTOR HIGH RELIABILITY LINE



* Visual Inspection AWS 014355-800
** "SEM" Inspection PS012411
***Bond Pull Test PS007576

STANDARD AVANTEK TRANSISTOR "R" SERIES SCREENING COMPLETION CHECK-OFF SHEET

AVANTEK DEVICE TYPE ____________

AVANTEK CSO NO. ____________

Test or Inspection	Test or Inspection	Responsible Person	Initial	Date	Comments
100% Internal Visual (Pre Cap)	AWS 014355-800 Avantek Specification				
Stabilization Bake	Non-Operating 24 hrs. Min., T = 200 °C				
Temp Cycling	Mil-Std-750, 1051, Cond. C, 10 Cycles Min				
Constant Acceleration	Mil-Std-750 2006, 20,000 G's Y_1 plane				
Fine Leak Test Gross Leak Test	Mil-Std-750 1071 Cond. H 1071 Cond. C Step 1				
DC Pre-Test	Avantek Data Sheet				
Burn-In	Mil-Std-750 1039, Cond. B Ta = 25 °C Time-168 hrs., Bias Conditions: V = _____ I = _____				
Post Test	Avantek Data Sheet				
Visual	Mil-Std-750, 2071				
Labeling	Mark Devices with Yellow Dot				
QA	Final Inspection				

FEATURES

- 1.0 dB Noise Figure at 60 MHz
- 25 dB Gain @ NF
- Very Wide Dynamic Range
- Gold Metal System
- Hermetic TO-72 Package
- Phosphorous Emitter

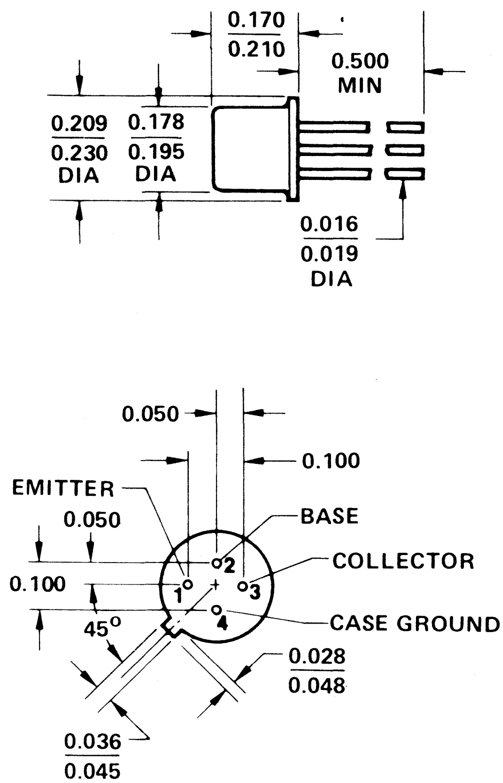
DESCRIPTION

The AT-0017A is designed for low noise figure, high gain, small signal amplification at frequencies through approximately 400 MHz. It maintains a low noise figure at high collector current levels for wide dynamic range, and its linear transducer gain vs. collector current characteristic assures low intermodulation distortion.

This transistor is widely used in front-end amplifiers in VHF receiving systems, in both wide and narrow-band IF systems and in instrumentation and EW amplifiers.

It is fabricated with an etchless gold metal system that produces films of 1 μm thickness and extremely uniform coverage. The TO-72 package is filled with a dry, inert atmosphere and hermetically welded to assure long-term protection from moisture and corrosive gases.

OUTLINE DRAWING TO-72 PACKAGE



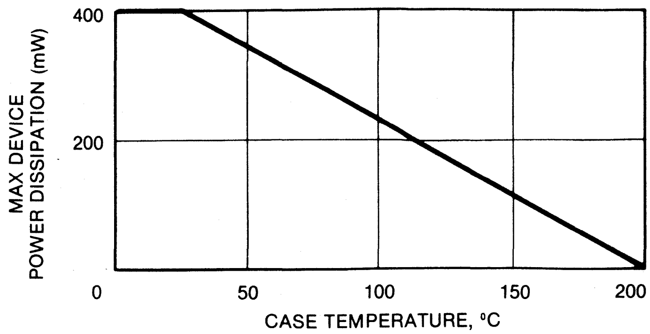
COMMON EMITTER OPERATING CHARACTERISTICS ($T_A = 25°C$)

Parameters	Symbols	Test Conditions	AT-0017A Min	AT-0017A Typ	AT-0017A Max
Spot Noise Figure, AT-0017A	NF_{opt}	$V_{CB} = 10V$, $I_C = 5$ mA, f = 60 MHz		1.0	1.2 dB
Gain at Optimum Noise Figure	G_{NF}	$V_{CB} = 10V$, $I_C = 5$ mA, f = 60 MHz		25 dB	

MAXIMUM RATINGS ($T_A = 25°C$)

Parameter	Symbol	Unit
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)	400 mW
Junction Temperature	T_j	200°
Storage Temperature Range	T_{STG}	−65 to 200°C

POWER DERATING CURVE

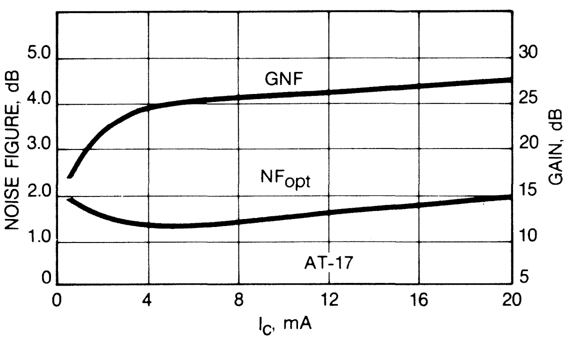


ELECTRICAL CHARACTERISTICS ($T_A = 25°C$)

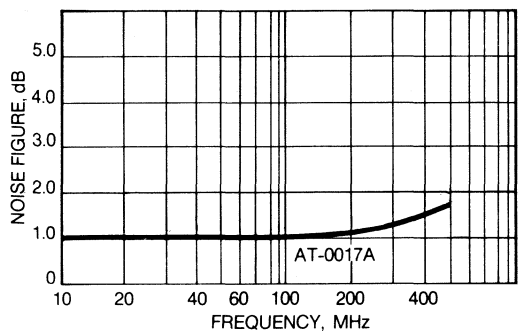
Parameters	Symbols	Test Conditions	Min	Typ	Max
Collector-Base Breakdown Voltage	$V_{(BR)}CBO$	$I_C = 10\ \mu A$	20V		
Emitter-Base Breakdown Voltage	$V_{(BR)}EBO$	$I_E = 10\ \mu A$	3V		
Collector-Emitter Breakdown Voltage	$V_{(BR)}CEO$	$I_C = 100\ \mu A$	12V		
Collector Cutoff Current	I_{CBO}	$V_{CB}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

TYPICAL PERFORMANCE CURVES ($T_A = 25°C$)

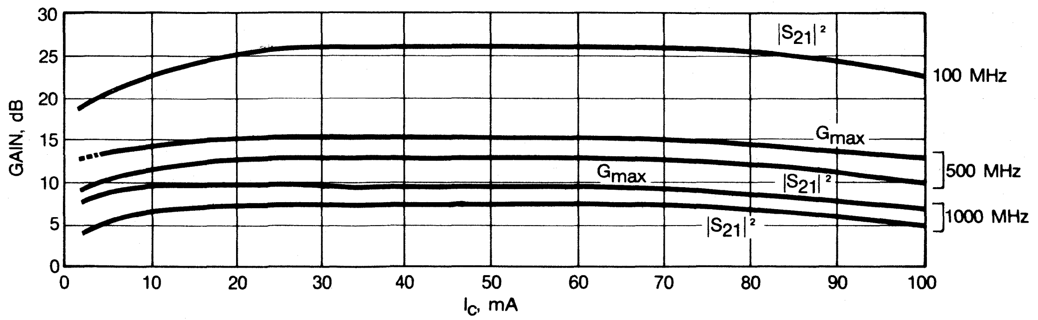
MAXIMUM SPOT NOISE FIGURE (NF_{opt}) AND ASSOCIATED GAIN (G_{NF}) VS. COLLECTOR CURRENT $V_{CB} = 10V$, f = 60 MHz



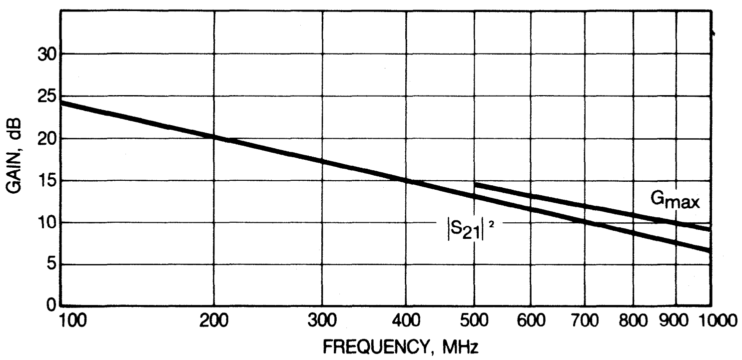
TYPICAL SPOT NOISE FIGURE (NF_{opt}) VS. FREQUENCY V_{CB} = 10V I_C = 5 mA



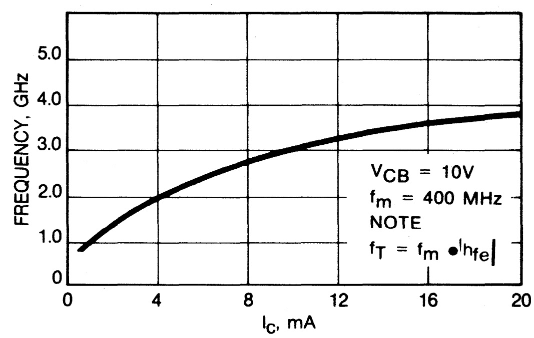
MAXIMUM AVAILABLE GAIN (G_{max}) AND INSERTION POWER GAIN ($|S_{21}|^2$) VS. COLLECTOR CURRENT AND FREQUENCY V_{CE} = 10V



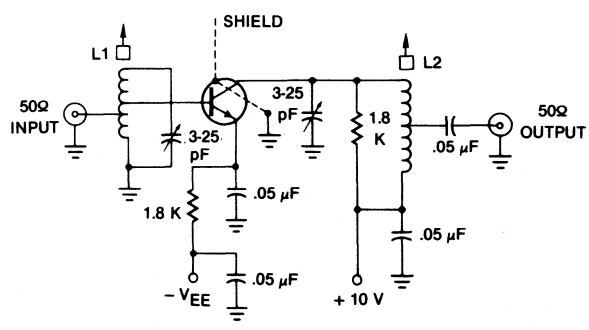
MAXIMUM AVAILABLE GAIN (G_{max}) AND INSERTION POWER GAIN ($|S_{21}|^2$) VS. FREQUENCY V_{CE} = 10V, I_C = 10 mA



TRANSITION FREQUENCY (F_T) VS. COLLECTOR CURRENT



PARAMETER MEASUREMENT INFORMATION



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

Bias = 10.00 Volts, 5.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
100.00	.634	−64.0	9.911	136.0	.043	62.8	.819	−23.7
200.00	.522	−104.2	6.856	113.5	.062	53.6	.654	−31.5
300.00	.470	−130.0	5.016	100.4	.073	52.1	.564	−35.0
400.00	.445	−147.9	3.982	91.1	.082	53.7	.509	−37.5
500.00	.435	−161.5	3.233	81.8	.092	55.5	.463	−41.1
600.00	.438	−172.2	2.753	76.3	.102	57.3	.433	−46.0
700.00	.438	179.6	2.436	70.2	.112	60.5	.430	−52.3
800.00	.441	171.9	2.145	64.9	.128	62.5	.439	−58.0
900.00	.441	165.0	1.964	61.0	.141	63.8	.452	−62.4
1000.00	.447	158.7	1.794	55.6	.156	64.9	.459	−65.7

Bias = 10.00 Volts, 15.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
100.00	.420	−83.1	15.528	124.0	.035	63.6	.662	−33.3
200.00	.347	−122.8	9.459	104.8	.054	62.4	.477	−38.7
300.00	.327	−145.2	6.657	94.5	.070	65.8	.397	−39.4
400.00	.317	−161.2	5.182	87.1	.088	66.1	.349	−40.1
500.00	.318	−172.6	4.188	80.4	.103	66.4	.306	−42.7
600.00	.324	178.6	3.537	74.8	.120	65.9	.279	−47.5
700.00	.326	172.0	3.107	69.8	.137	66.7	.274	−54.9
800.00	.331	165.8	2.736	65.1	.156	65.3	.285	−61.5
900.00	.332	159.8	2.496	61.1	.174	64.7	.300	−65.2
1000.00	.336	153.8	2.275	56.5	.191	63.4	.310	−67.2

CHIP CODE M10

Low Noise
Bipolar Transistor

FEATURES

- **1.3 dB Noise Figure at 500 MHz**
- **17 dB G_{max}**
- **Wide Dynamic Range**
- **Gold Metal System**
- **Hermetic TO-72 Package**
- **Phosphorous Emitter**

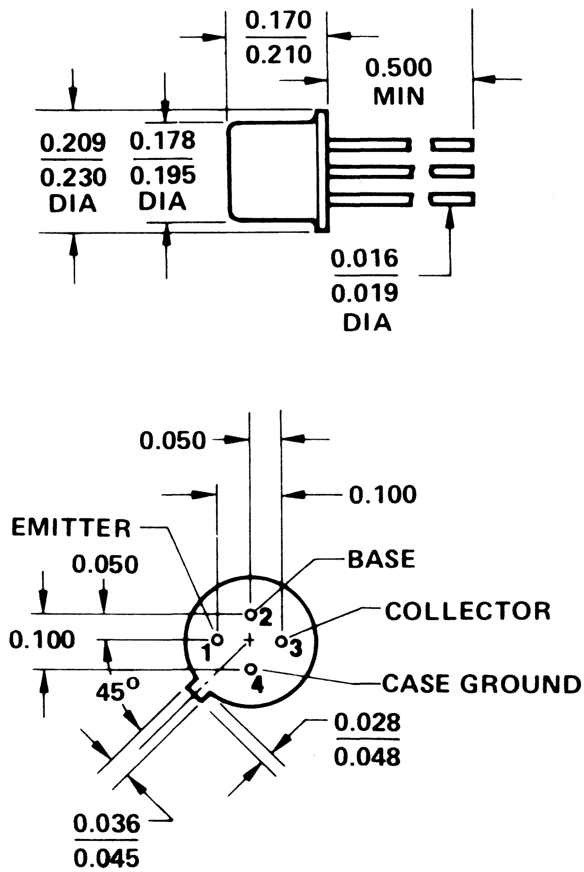
DESCRIPTION

The Avantek AT-0045 is designed for ultra-low noise figure, very high gain/amplification at frequencies up to 1 GHz. It maintains its low noise figure at high collector current levels for wide dynamic range and its linear transducer gain vs. collector current characteristic assures low intermodulation distortion.

This transistor is an excellent choice for use in front-end amplifiers in UHF receiving systems in both wide- and narrow-band IF systems and in wideband instrument and EW amplifiers.

The AT-0045 transistor chip is fabricated with an etchless gold metal system that produces films of 1 μm thickness and extremely uniform coverage. The TO-72 package is filled with a dry, inert atmosphere and hermetically welded to assure long-term protection from moisture and corrosive gases.

OUTLINE DRAWING TO-72 PACKAGE



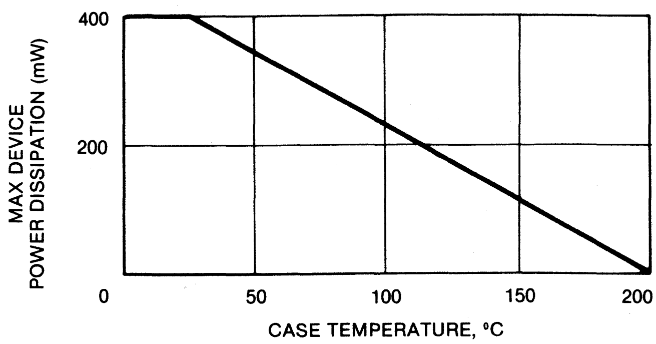
COMMON EMITTER OPERATING CHARACTERISTICS ($T_A = 25°C$)

Parameters	Symbols	Test Conditions	AT-0045 Typ	Max
Spot Noise Figure	NF	$V_{CB} = 10V$, $I_C = 3$ mA, f = .5 GHz	1.3	1.5 dB
		$V_{CB} = 10V$, $I_C = 3$ mA, f = 1.0 GHz	2.5 dB	
Maximum Available Gain	G_{max}	$V_{CB} = 10V$, $I_C = 10$ mA, f = .5 GHz	17 dB	
		$V_{CB} = 10V$, $I_C = 10$ mA, f = 1.0 GHz	11 dB	

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}	15V
Collector Current	I_C	50 mA
Continuous Dissipation	P_T (T_A = 25°C)	400 mW
Junction Temperature	T_j	200°C
Storage Temperature Range	T_{STG}	− 65 to 200°C

POWER DERATING CURVE

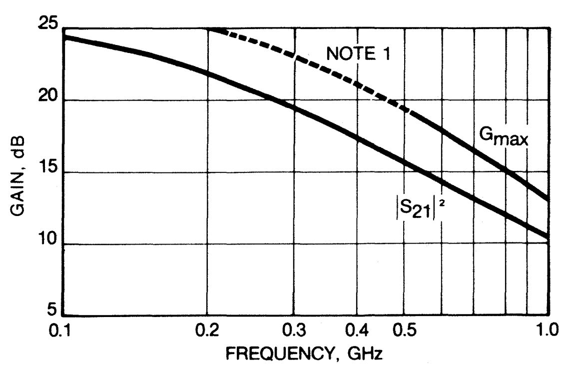


ELECTRICAL CHARACTERISTICS ($T_A = 25°C$)

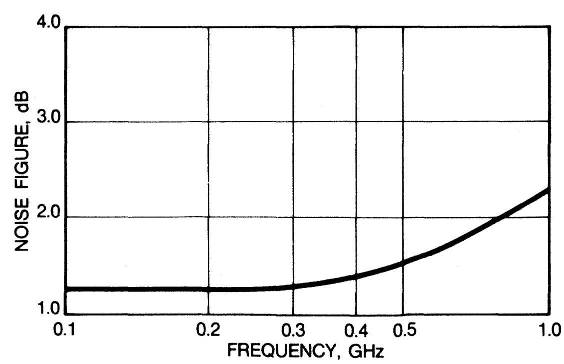
Parameters	Symbols	Test Conditions	Min	Typ	Max
Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E = 10\ \mu A$	3V		
Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C = 10\ \mu A$	20V		
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C = 100\ \mu A$	15V		
Collector Cutoff Current	I_{CBO}	$V_{CB} = 10V$			20 nA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = 3V$			10 μA
Forward Current Transfer Ratio	h_{FE}	$I_C = 10$ mA, $V_{CE} = 10V$	30	75	
Collector-Base Capacitance	C_{cb}	$V_{CB} = 10V$			.5 pF

TYPICAL PERFORMANCE CURVES ($T_A = 25°C$)

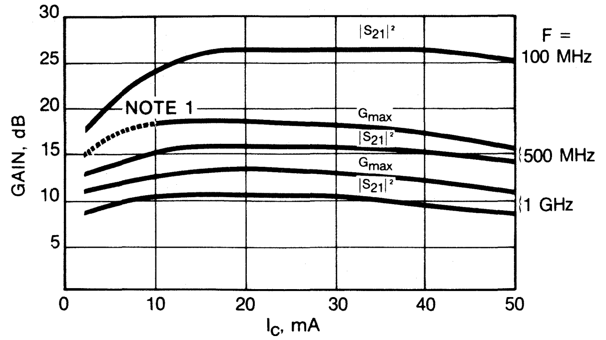
MAXIMUM AVAILABLE GAIN (G_{max}) AND INSERTION POWER GAIN ($|S_{21}|^2$) VS. FREQUENCY V_{CE} = 10V, I_c = 10mA



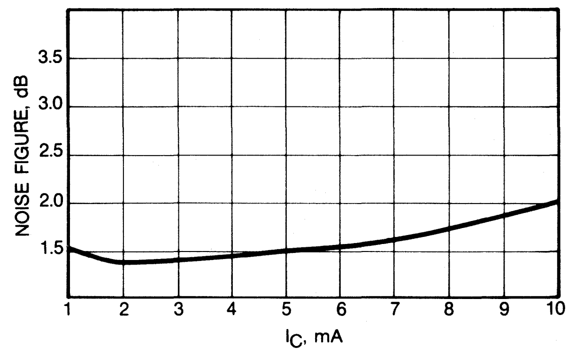
SPOT NOISE FIGURE (NF_{opt}) VS. FREQUENCY V_{CE} = 10V, I_c = 3mA



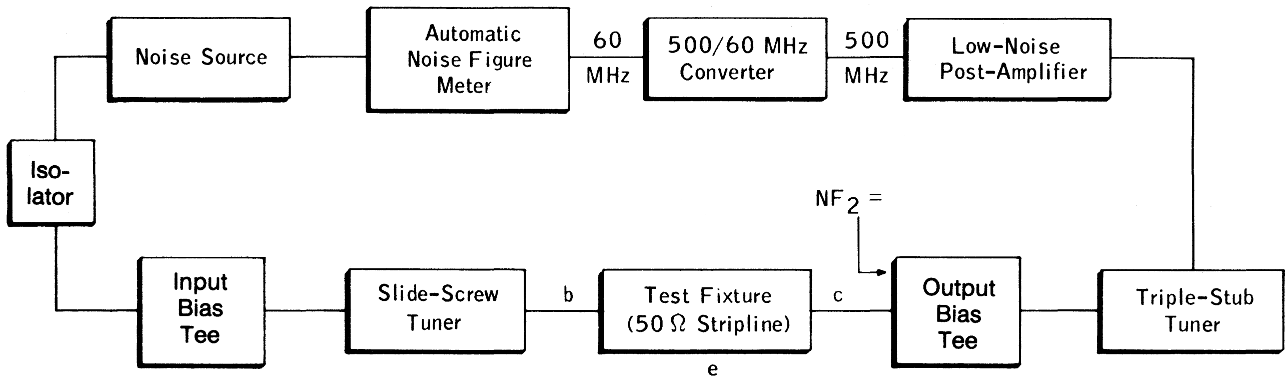
MAXIMUM AVAILABLE GAIN (G_{max}) AND INSERTION POWER GAIN ($|S_{21}|^2$) VS. COLLECTOR CURRENT AND FREQUENCY
V_{CE} = 10V



SPOT NOISE FIGURE (NF_{opt}) VS. COLLECTOR CURRENT
F = 500 MHz, V_{CE} = 10V



500 MHz NF SETUP (See Notes 2 and 3)



NOTES

1. The dotted line indicates a frequency or current range where the transistor is potentially unstable and G_{max} is undefined.
2. Bias blocks (or other bias insertion components) must be broad-band to prevent spurious oscillations.
3. Loss between the noise source and the device under test (I_L) and the second stage noise contribution (NF_2) are accounted for as follows:

$$NF_1 = NF_{MTR} - I_L - \frac{NF_2 - 1}{G_1}$$

where:
NF_1 = Noise figure of device under test.
G_1 = Gain of device under test.
NF_{MTR} = Uncorrected system noise figure from NF meter.

TYPICAL SCATTERING PARAMETERS

Bias = 10.00 Volts, 3.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
100.00	.869	−19.0	7.870	158.3	.019	79.3	.964	−8.8
200.00	.772	−35.0	6.989	141.9	.037	71.4	.909	−15.5
300.00	.667	−48.1	6.076	128.6	.048	68.2	.846	−20.6
400.00	.562	−58.8	5.269	117.6	.059	64.6	.788	−24.3
500.00	.476	−67.9	4.547	108.1	.066	61.6	.732	−27.4
600.00	.408	−75.5	4.013	101.2	.074	60.4	.696	−30.6
700.00	.354	−81.4	3.618	94.8	.083	60.8	.683	−34.3
800.00	.315	−86.9	3.229	88.2	.092	61.6	.686	−37.8
900.00	.280	−91.4	2.963	83.3	.099	62.5	.686	−40.7
1000.00	.250	−95.9	2.700	77.9	.104	63.0	.686	−42.3

Bias = 10.00 Volts, 10.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
100.00	.650	−28.2	16.768	142.2	.017	76.5	.881	−13.6
200.00	.488	−44.0	12.243	122.1	.030	73.9	.775	−18.3
300.00	.379	−52.3	9.271	109.8	.042	75.3	.710	−20.7
400.00	.303	−56.5	7.421	101.0	.052	73.6	.666	−22.0
500.00	.250	−60.0	6.073	94.2	.062	72.1	.625	−23.7
600.00	.213	−61.9	5.182	89.3	.072	71.4	.600	−26.4
700.00	.188	−63.0	4.567	84.6	.083	71.8	.594	−30.2
800.00	.172	−64.7	4.025	80.0	.095	72.0	.602	−34.0
900.00	.158	−64.7	3.649	76.4	.104	70.7	.611	−36.9
1000.00	.143	−65.4	3.296	71.2	.114	70.4	.618	−38.7

CHIP CODE M14

AT-1845A

Low Noise
Bipolar Transistor

FEATURES

- 2.0 dB Noise Figure at 2 GHz
- 11.0 dB Gain at NF
- Hermetic 100 Mil Microstrip Package
- Gold Metal System
- Phosphorous Emitter

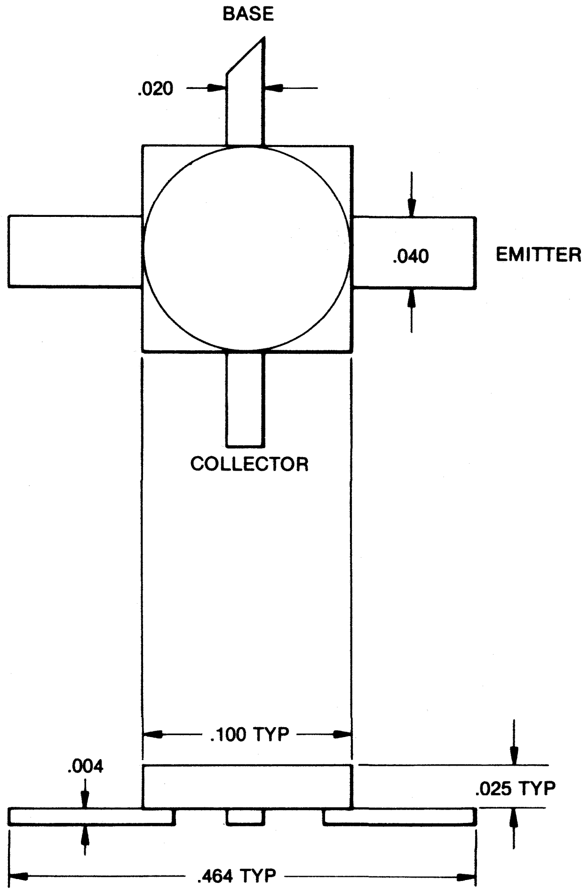
DESCRIPTION

The Avantek AT-1845A is designed for low noise figure, high gain small signal amplification at frequencies up to 4 GHz. It is a particularly cost effective choice for amplifiers in the 500 MHz through 2500 MHz frequency range where low noise figure, high gain and wide dynamic range are required. This transistor is widely used in tuned front-end and signal processing amplifiers in radar, telemetry and point-to-point communications receivers as well as in wideband amplifiers for instrumentation and EW applications.

This transistor features an etchless gold metal system that produces conductive films of 1 μm thickness and extremely uniform coverage. A dielectric layer protects the transistor chips from scratching or contamination before they are packaged.

The 100 Mil metal/ceramic package is easy to install in conventional printed circuits or hybrid thin or thick film circuits and will withstand handling, soldering and welding processes. Each package is filled with a dry, inert atmosphere and hermetically sealed to assure long-term protection from humidity and corrosive gases.

OUTLINE DRAWING 100 MIL PACKAGE



TOLERANCES: ±.010/±.02

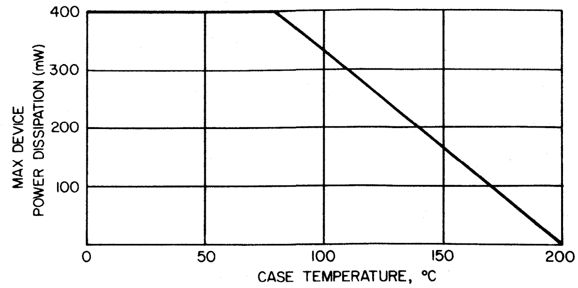
COMMON EMITTER OPERATING CHARACTERISTICS ($T_A = 25°C$)

Parameter	Symbol	Test Cond $V_{CE} I_C$	Freq GHz	Min	AT-1845A Typ	Max
Spot Noise Figure	NF_{opt}	10V 5 mA	1		2.0 dB	2.2 dB
Spot Noise Figure	NF_{opt}	10V 5 mA	2		2.8 dB	
Spot Noise Figure	NF_{opt}	10V 5 mA	4		5.0 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	1		14.0 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	2		11.0 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	4		7.0 dB	
Max Available Power Gain	G_{max}	10V 15 mA	2		15.0 dB	
Max Available Power Gain	G_{max}	10V 15 mA	4		9.0 dB	

MAXIMUM RATINGS ($T_A = 25°C$)

Parameter	Symbol	Limit
Reverse Emitter Base Voltage	V_{EB}	3.0V
Reverse Collector Base Voltage	V_{CB}	20.0V
Open Base Collector-Emitter Voltage	V_{CEO}	12.0V
Collector Current	I_C	50 mA
Continuous Dissipation	P_T (T_{case} = 25°C)	400 mW
Junction Temperature	T_j	200°C
Storage Temperature Range	T_{STG}	– 65 to 200°C
Thermal Resistance	θ_{jc}	300°C/watt

POWER DERATING CURVE

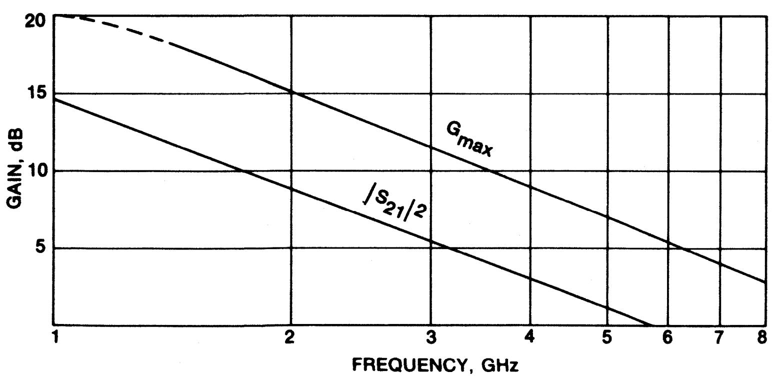


ELECTRICAL CHARACTERISTICS ($T_A = 25°C$)

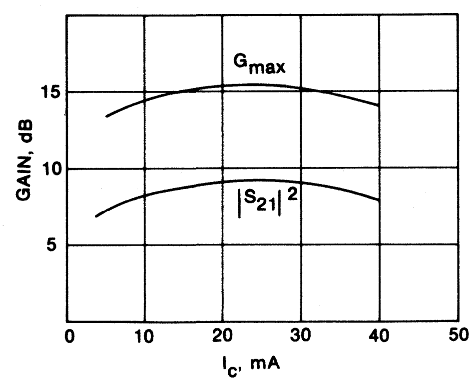
Parameter	Symbol	Test Conditions	Freq.	Min	Typ	Max
Collector-Base Breakdown	$V_{(BR)}CBO$	$I_C = 10\ \mu A$		20V		
Emitter-Base Breakdown	$V_{(BR)}EBO$	$I_E = 10\ \mu A$		3.0V		
Collector-Emitter Breakdown	$V_{(BR)}CEO$	$I_C = 100\ \mu A$		12V		
Collector Cutoff Current	I_{CBO}	$V_{CB} = 10V$				20 nA
Forward Current Transfer Ratio	h_{FE}	$V_{CE} = 10V$, $I_C = 15$ mA		20	75	
Collector-Base Capacitance	C_{cb}	$V_{CB} = 10V$				0.5 pF

TYPICAL PERFORMANCE CURVES ($T_A = 25°C$)

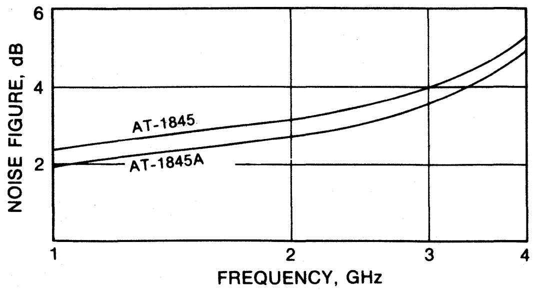
Maximum Available Gain, $|S_{21E}|^2$ vs. Frequency,
V_{CE} = 10V I_C = 15 mA



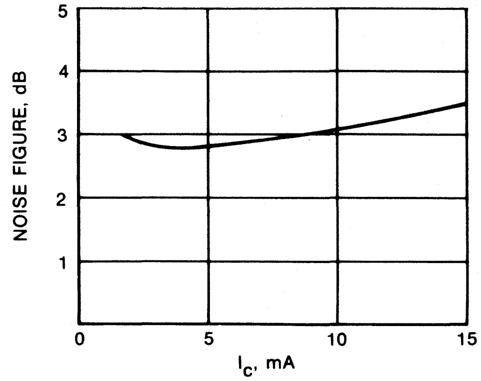
Maximum Available Gain, $|S_{21E}|^2$
vs. Collector Current,
F = 2 GHz, V_{CE} = 10V



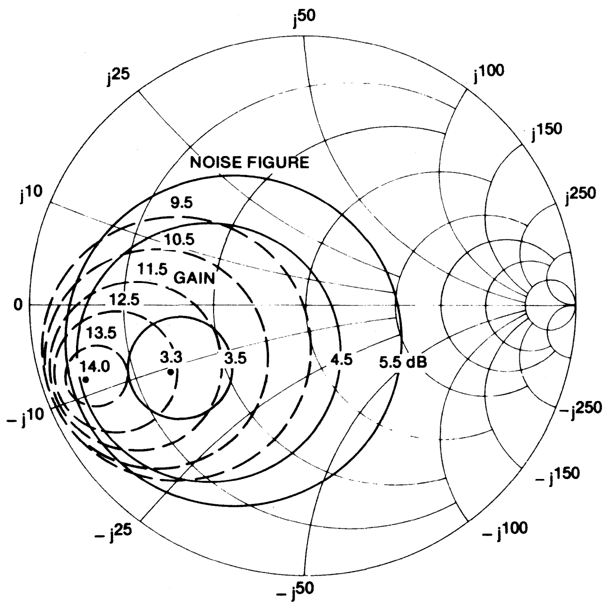
Spot Noise Figure vs. Frequency
V_{CE} = 10V, I_C = 5mA



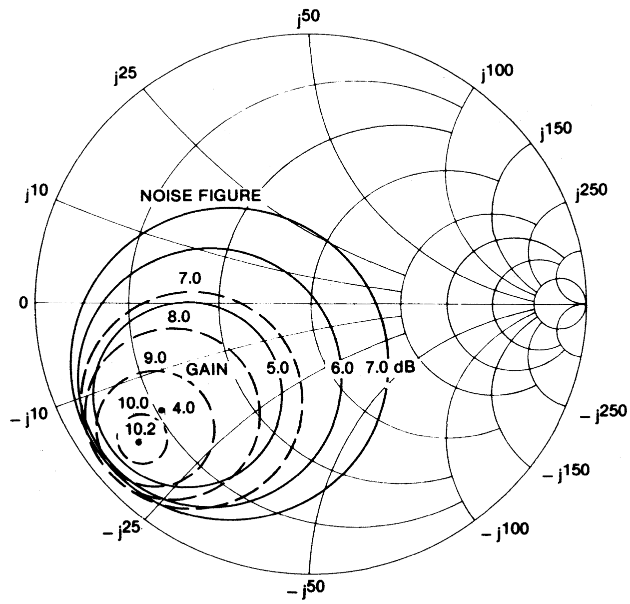
Spot Noise Figure vs. Collector Current
F = 2 GHz, V_{CE} = 10V



TYPICAL CONTOURS OF CONSTANT GAIN AND NOISE FIGURE, AT-2645



Frequency = 2 GHz, 10V 5mA



Frequency = 3GHz, 10V 5mA

TYPICAL SCATTERING PARAMETERS

Bias = 10.00 Volts, 5.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.679	−117.8	7.663	107.6	.045	39.1	.710	−28.9
1000.00	.650	−159.4	4.390	80.7	.054	28.3	.603	−35.9
1500.00	.654	177.3	3.031	61.9	.059	26.4	.571	−44.7
2000.00	.655	162.1	2.286	45.8	.064	23.7	.569	−54.6
2500.00	.662	148.4	1.853	31.1	.070	23.3	.561	−66.3
3000.00	.674	136.1	1.544	16.6	.078	21.8	.565	−80.0
3500.00	.688	124.5	1.329	2.4	.085	21.2	.577	−93.8
4000.00	.711	114.2	1.167	−10.1	.094	21.1	.580	−103.3
4500.00	.721	104.1	1.036	−24.7	.105	18.0	.596	−118.7
5000.00	.736	94.5	.915	−36.3	.119	13.9	.616	−133.9
5500.00	.732	85.0	.796	−47.8	.132	9.7	.631	−149.2
6000.00	.784	75.3	.747	−58.1	.153	5.3	.697	−163.6

Bias = 10.00 Volts, 15.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.617	−148.6	10.509	96.1	.029	41.3	.551	−30.3
1000.00	.626	−177.5	5.544	74.6	.039	42.2	.479	−34.2
1500.00	.645	165.4	3.755	58.3	.049	42.2	.464	−42.8
2000.00	.651	153.7	2.803	44.0	.058	40.7	.465	−52.2
2500.00	.662	142.1	2.265	30.1	.068	38.1	.462	−64.0
3000.00	.680	131.2	1.876	16.8	.079	34.4	.467	−77.6
3500.00	.696	120.4	1.611	3.3	.090	31.2	.479	−91.8
4000.00	.721	110.8	1.413	−8.7	.100	29.2	.482	−101.4
4500.00	.733	101.0	1.255	−21.7	.112	24.4	.502	−116.8
5000.00	.748	91.8	1.117	−34.1	.127	18.9	.523	−132.4
5500.00	.745	82.6	.977	−45.4	.141	13.6	.544	−147.6
6000.00	.801	73.0	.926	−55.8	.164	8.5	.609	−161.9

CHIP CODE M14

AT-2645A

Low Noise
Bipolar Transistor

FEATURES

- **2.8 dB Noise Figure at 2 GHz**
- **11.0 dB Gain at NF**
- **Hermetic 70 Mil Microstrip Package**
- **Gold Metal System**
- **Phosphorous Emitter**

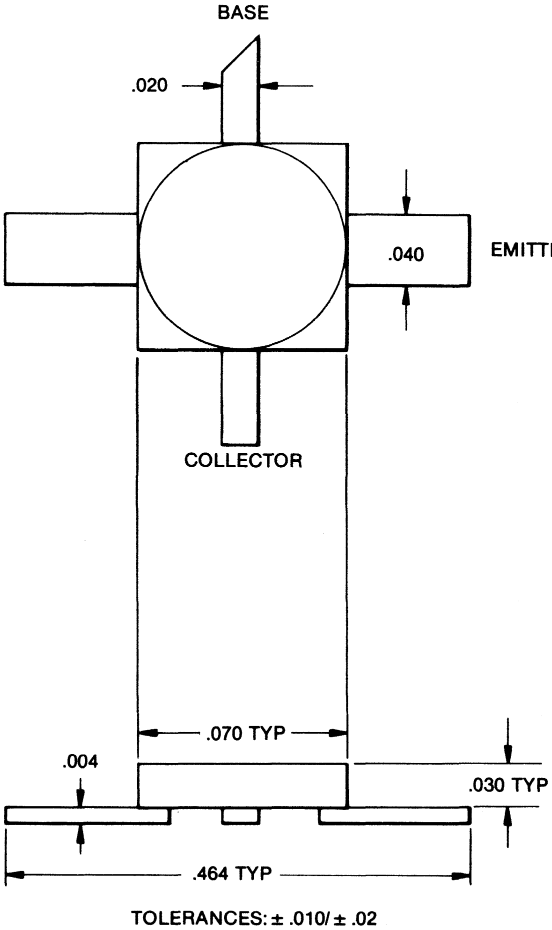
DESCRIPTION

The Avantek AT-2645A is designed for low noise figure, high gain small signal amplification at frequencies up to 4 GHz. It is a particularly cost effective choice for amplifiers in the 500 MHz through 2500 MHz frequency range where low noise figure, high gain and wide dynamic range are required. This transistor is widely used in tuned front-end and signal processing amplifiers in radar, telemetry and point-to-point communications receivers as well as in wideband amplifiers for instrumentation and EW applications.

This transistor features an etchless gold metal system that produces conductive films of 1 μm thickness and extremely uniform coverage. A dielectric layer protects the transistor chip from scratching or contamination before they are packaged.

The 70 Mil metal/ceramic package is easy to install in conventional printed circuits or hybrid thin or thick film circuits and will withstand handling, soldering and welding processes. Each package is filled with a dry, inert atmosphere and hermetically sealed to assure long-term protection from humidity and corrosive gases.

OUTLINE DRAWING 70 MIL PACKAGE



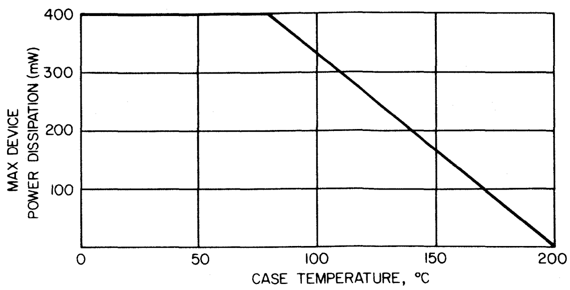
COMMON EMITTER OPERATING CHARACTERISTICS ($T_A = 25°C$)

Parameter	Symbol	Test Cond $V_{CE}I_C$	Freq GHz	Min	AT-2645A Typ	Max
Spot Noise Figure	NF_{opt}	10V 5 mA	1		2.0 dB	
Spot Noise Figure	NF_{opt}	10V 5 mA	2		2.8 dB	3.0 dB
Spot Noise Figure	NF_{opt}	10V 5 mA	4		5.0 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	1		14.0 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	2		11.0 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	4		7.0 dB	
Max Available Power Gain	G_{max}	10V 15 mA	2		15.0 dB	
Max Available Power Gain	G_{max}	10V 15 mA	4		9.0 dB	

MAXIMUM RATINGS ($T_A = 25°C$)

Parameter	Symbol	Limit
Reverse Emitter Base Voltage	V_{EB}	3.0V
Reverse Collector Base Voltage	V_{CB}	20.0V
Open Base Collector-Emitter Voltage	V_{CEO}	12.0V
Collector Current	I_C	50 mA
Continuous Dissipation	P_T (T_{case} = 25°C)	400 mW
Junction Temperature	T_j	200°C
Storage Temperature Range	T_{STG}	– 65 to 200°C
Thermal Resistance	θ_{jc}	300°C/watt

POWER DERATING CURVE

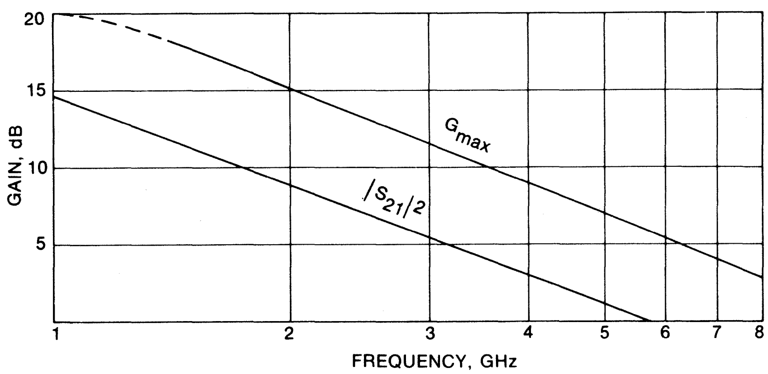


ELECTRICAL CHARACTERISTICS ($T_A = 25°C$)

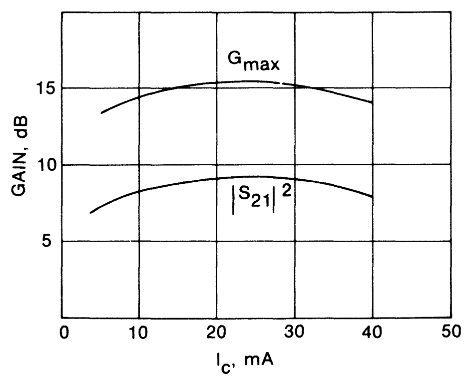
Parameter	Symbol	Test Conditions	Freq.	Min	Typ	Max
Collector-Base Breakdown	$V_{(BR)}CBO$	$I_C = 10\ \mu A$		20V		
Emitter-Base Breakdown	$V_{(BR)}EBO$	$I_E = 10\ \mu A$		3.0V		
Collector-Emitter Breakdown	$V_{(BR)}CEO$	$I_C = 100\ \mu A$		12V		
Collector Cutoff Current	I_{CBO}	$V_{CB} = 10V$				20 nA
Forward Current Transfer Ratio	h_{FE}	$V_{CE} = 10V$, $I_C = 15$ mA		20	75	
Collector-Base Capacitance	C_{cb}	$V_{CB} = 10V$				0.5 pF

TYPICAL CONTOURS OF CONSTANT GAIN AND NOISE FIGURE, AT2645

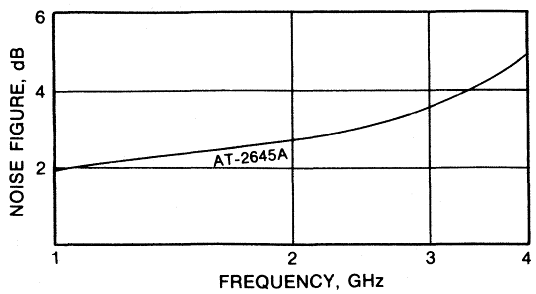
Maximum Available Gain, $|S_{21E}|^2$ vs. Frequency, V_{CE} = 10V I_C = 15 mA



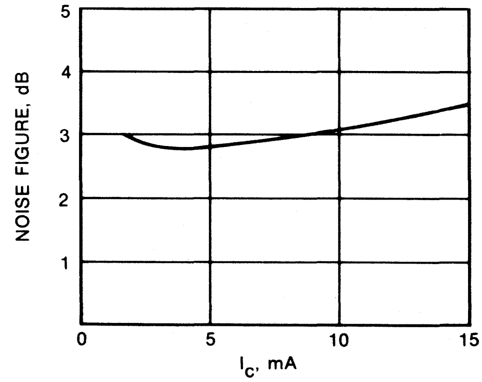
Maximum Available Gain, $|S_{21E}|^2$ vs. Collector Current, F = 2 GHz, V_{CE} = 10V



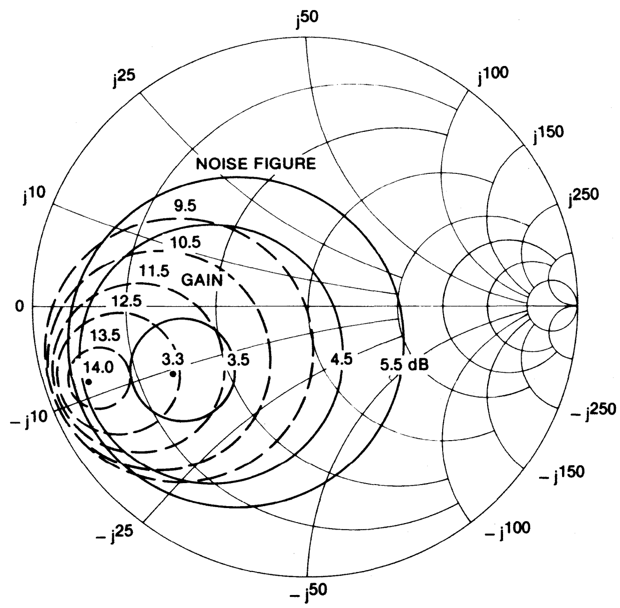
Spot Noise Figure vs. Frequency
V_{CE} = 10V, I_C = 5mA



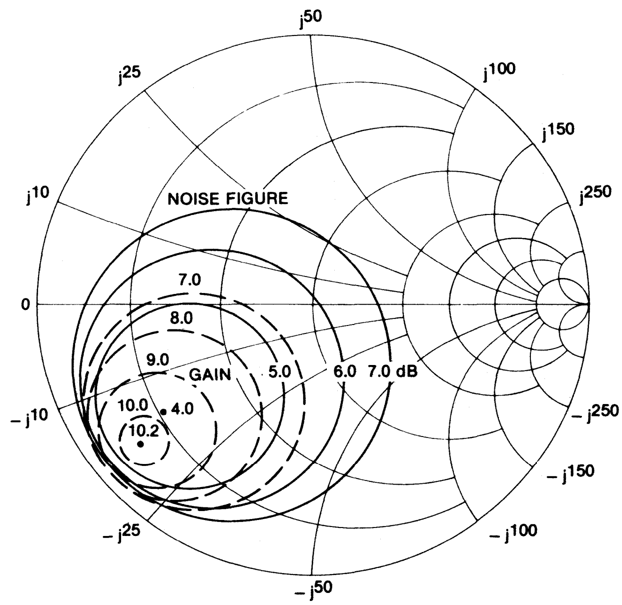
Spot Noise Figure vs. Collector Current
F = 2 GHz, V_{CE} = 10V



TYPICAL CONTOURS OF CONSTANT GAIN AND NOISE FIGURE



Frequency = 2 GHz, 10V 5mA



Frequency = 3 GHz, 10V 5mA

TYPICAL SCATTERING PARAMETERS

Bias = 10.00 Volts, 5.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.734	−100.5	7.262	116.3	.052	42.4	.771	−27.9
1000.00	.687	−144.9	4.445	88.3	.064	26.6	.638	−36.2
1500.00	.677	−169.8	3.133	69.4	.068	21.3	.592	−44.4
2000.00	.671	173.6	2.382	53.6	.071	16.5	.581	−52.6
2500.00	.670	159.8	1.941	39.5	.074	14.5	.568	−63.0
3000.00	.676	147.9	1.623	25.5	.080	12.6	.567	−75.0
3500.00	.684	136.9	1.412	12.1	.084	12.3	.576	−86.9
4000.00	.700	126.4	1.243	−.9	.088	10.8	.586	−98.4
4500.00	.704	117.0	1.102	−14.4	.095	9.2	.593	−111.5
5000.00	.714	108.3	.983	−25.4	.104	6.4	.610	−125.2
5500.00	.707	100.1	.866	−36.4	.112	4.4	.626	−139.0
6000.00	.741	91.5	.811	−46.1	.126	1.6	.685	−152.0

Bias = 10.00 Volts, 15.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.669	−124.9	10.009	106.9	.039	38.8	.642	−32.3
1000.00	.662	−161.7	5.627	82.6	.047	31.1	.521	−36.6
1500.00	.671	178.1	3.867	65.6	.053	30.1	.488	−43.6
2000.00	.671	164.9	2.904	51.4	.059	28.1	.481	−51.3
2500.00	.657	153.0	2.352	37.8	.066	27.1	.474	−61.3
3000.00	.686	142.1	1.952	25.0	.073	24.5	.475	−73.2
3500.00	.696	131.8	1.691	12.2	.081	23.5	.485	−85.1
4000.00	.715	122.5	1.482	−.2	.087	21.4	.497	−96.7
4500.00	.721	113.7	1.314	−12.3	.096	18.5	.508	−109.7
5000.00	.731	105.3	1.171	−23.2	.107	15.0	.527	−123.8
5500.00	.726	97.3	1.037	−34.8	.117	11.8	.550	−137.6
6000.00	.762	88.7	.973	−44.5	.132	8.2	.610	−150.5

CHIP CODE M14

AT-2845A

Low Noise
Bipolar Transistor

FEATURES

- **2.8 dB Noise Figure at 2 GHz**
- **11.0 dB Gain at NF**
- **Hermetic 100 Mil Microstrip Package**
- **Gold Metal System**
- **Phosphorous Emitter**

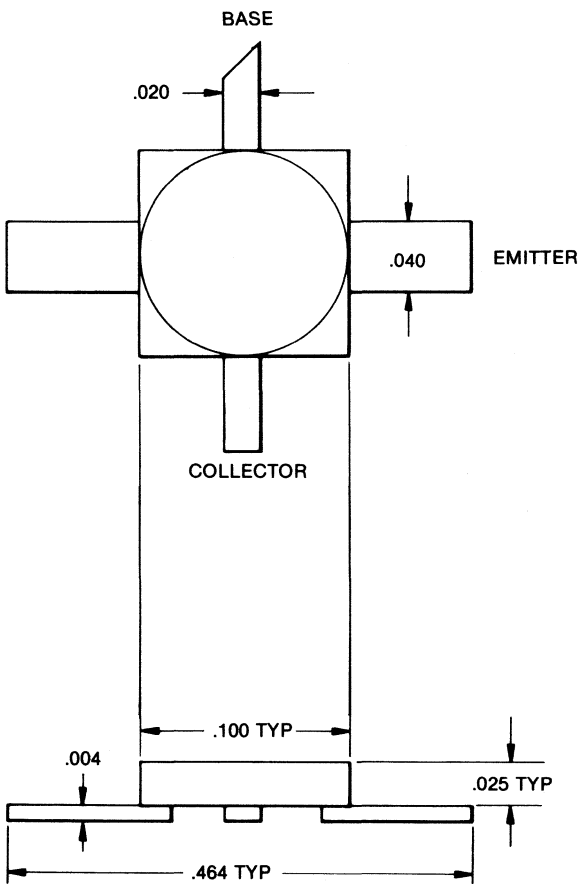
DESCRIPTION

The Avantek AT-2845A is designed for low noise figure, high gain small signal amplification at frequencies up to 4 GHz. It is a particularly cost effective choice for amplifiers in the 500 MHz through 2500 MHz frequency range where low noise figure, high gain and wide dynamic range are required. This transistor is widely used in tuned front-end and signal processing amplifiers in radar, telemetry and point-to-point communications receivers as well as in wideband amplifiers for instrumentation and EW applications.

This transistor features an etchless gold metal system that produces conductive films of 1 μm thickness and extremely uniform coverage. A dielectric layer protects the transistor chip from scratching or contamination before they are packaged.

The 100 Mil metal/ceramic package is easy to install in conventional printed circuits or hybrid thin or thick film circuits and will withstand handling, soldering and welding processes. Each package is filled with a dry, inert atmosphere and hermetically sealed to assure long-term protection from humidity and corrosive gases.

OUTLINE DRAWING 100 MIL PACKAGE



TOLERANCES: ± .010/ ± .02

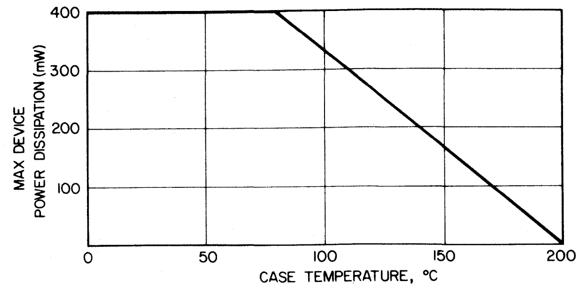
COMMON EMITTER OPERATING CHARACTERISTICS ($T_A = 25°C$)

Parameter	Symbol	Test Cond $V_{CE} I_C$	Freq GHz	Min	AT-2845A Typ	Max
Spot Noise Figure	NF_{opt}	10V 5 mA	1		2.0 dB	
Spot Noise Figure	NF_{opt}	10V 5 mA	2		2.8 dB	3.0 dB
Spot Noise Figure	NF_{opt}	10V 5 mA	4		5.0 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	1		14.0 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	2		11.0 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	4		7.0 dB	
Max Available Power Gain	G_{max}	10V 15 mA	2		15.0 dB	
Max Available Power Gain	G_{max}	10V 15 mA	4		9.0 dB	

MAXIMUM RATINGS ($T_A = 25°C$)

Parameter	Symbol	Limit
Reverse Emitter Base Voltage	V_{EB}	3.0V
Reverse Collector Base Voltage	V_{CB}	20.0V
Open Base Collector-Emitter Voltage	V_{CEO}	12.0V
Collector Current	I_C	50 mA
Continuous Dissipation	P_T (T_{case} = 25°C)	400 mW
Junction Temperature	T_j	200°C
Storage Temperature Range	T_{STG}	– 65 to 200°C
Thermal Resistance	θ_{jc}	300°C/watt

POWER DERATING CURVE

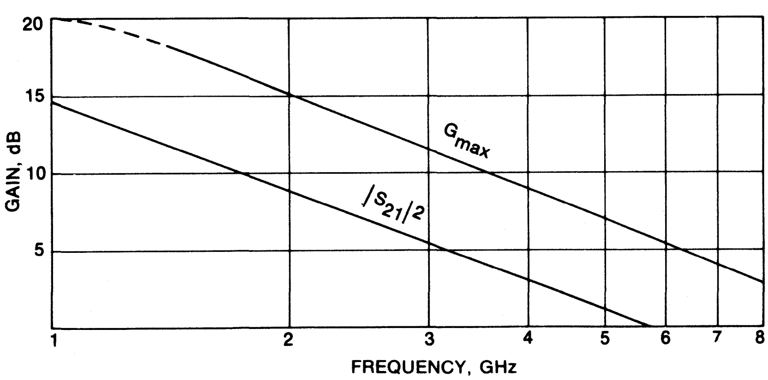


ELECTRICAL CHARACTERISTICS ($T_A = 25°C$)

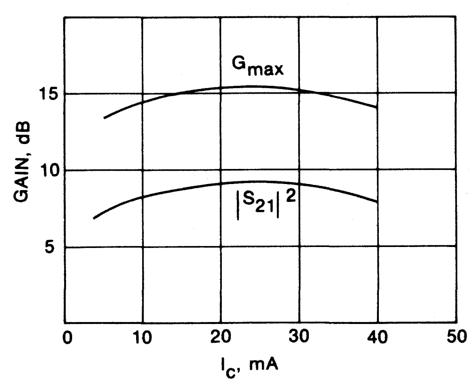
Parameter	Symbol	Test Conditions	Freq.	Min	Typ	Max
Collector-Base Breakdown	$V_{(BR)}CBO$	$I_C = 10\ \mu A$		20V		
Emitter-Base Breakdown	$V_{(BR)}EBO$	$I_E = 10\ \mu A$		3.0V		
Collector-Emitter Breakdown	$V_{(BR)}CEO$	$I_C = 100\ \mu A$		12V		
Collector Cutoff Current	I_{CBO}	$V_{CB} = 10V$				20 nA
Forward Current Transfer Ratio	h_{FE}	$V_{CE} = 10V$, $I_C = 15$ mA		20	75	
Collector-Base Capacitance	C_{cb}	$V_{CB} = 10V$				0.5 pF

TYPICAL PERFORMANCE CURVES ($_A = 25°C$)

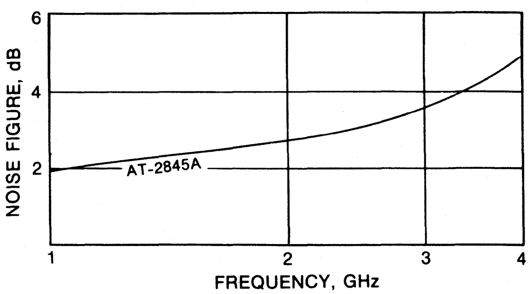
Maximum Available Gain, $|S_{21E}|^2$ vs. Frequency, V_{CE} = 10V I_C = 15 mA



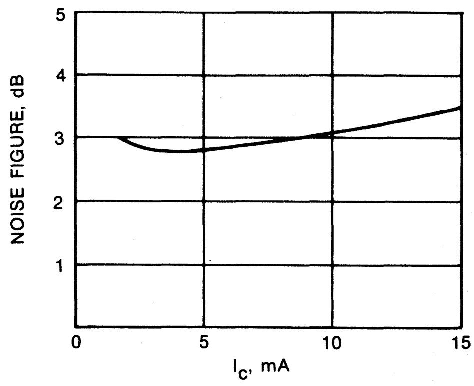
Maximum Available Gain, $|S_{21E}|^2$ vs. Collector Current, F = 2 GHz, V_{CE} = 10V



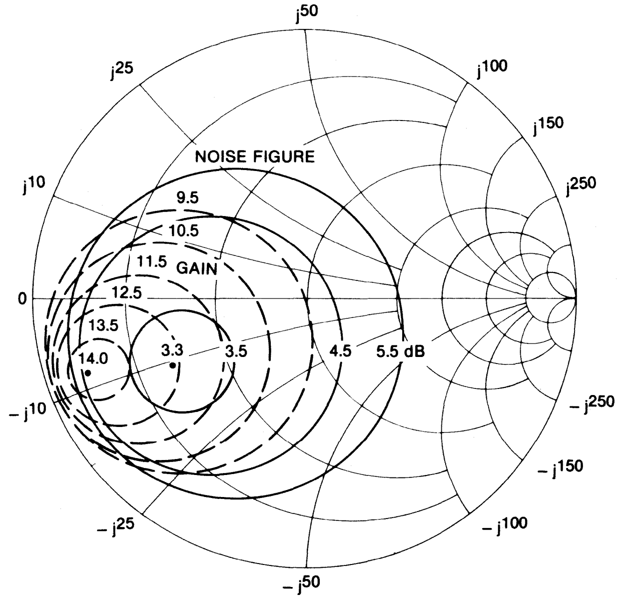
Spot Noise Figure vs. Frequency
V_{CE} = 10V, I_C = 5mA



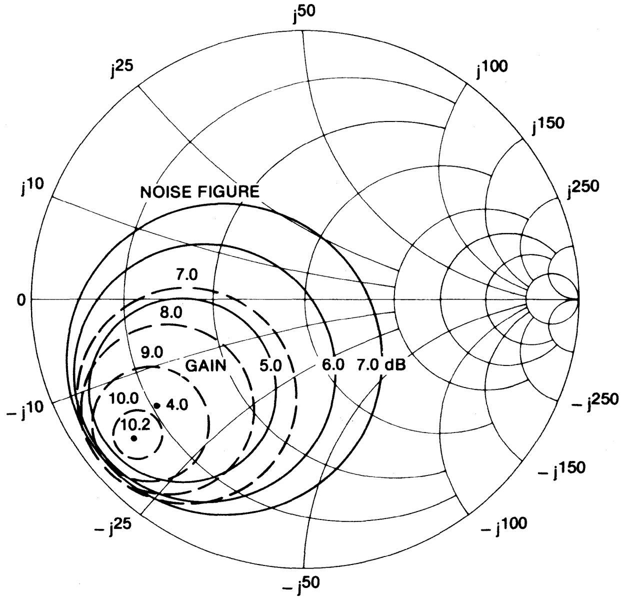
Spot Noise Figure vs. Collector Current
F = 2 GHz, V_{CE} = 10V



TYPICAL CONTOURS OF CONSTANT GAIN AND NOISE FIGURE



Frequency = 2 GHz, 10V 5 mA



Frequency = 3 GHz, 10V 5mA

TYPICAL SCATTERING PARAMETERS

Bias = 10.00 Volts, 5.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.679	−117.8	7.663	107.6	.045	39.1	.710	−28.9
1000.00	.650	−159.4	4.390	80.7	.054	28.3	.603	−35.9
1500.00	.654	177.3	3.031	61.9	.059	26.4	.571	−44.7
2000.00	.655	162.1	2.286	45.8	.064	23.7	.569	−54.6
2500.00	.662	148.4	1.853	31.1	.070	23.3	.561	−66.3
3000.00	.674	136.1	1.544	16.6	.078	21.8	.565	−80.0
3500.00	.688	124.5	1.329	2.4	.085	21.2	.577	−93.8
4000.00	.711	114.2	1.167	−10.1	.094	21.1	.580	−103.3
4500.00	.721	104.1	1.036	−24.7	.105	18.0	.596	−118.7
5000.00	.736	94.5	.915	−36.3	.119	13.9	.616	−133.9
5500.00	.732	85.0	.796	−47.8	.132	9.7	.631	−149.2
6000.00	.784	75.3	.747	−58.1	.153	5.3	.697	−163.6

Bias = 10.00 Volts, 15.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.617	−148.6	10.509	96.1	.029	41.3	.551	−30.3
1000.00	.626	−177.5	5.544	74.6	.039	42.2	.479	−34.2
1500.00	.645	165.4	3.755	58.3	.049	42.2	.464	−42.8
2000.00	.651	153.7	2.803	44.0	.058	40.7	.465	−52.2
2500.00	.662	142.1	2.265	30.1	.068	38.1	.462	−64.0
3000.00	.680	131.2	1.876	16.8	.079	34.4	.467	−77.6
3500.00	.696	120.4	1.611	3.3	.090	31.2	.479	−91.8
4000.00	.721	110.8	1.413	−8.7	.100	29.2	.482	−101.4
4500.00	.733	101.0	1.255	−21.7	.112	24.4	.502	−116.8
5000.00	.748	91.8	1.117	−34.1	.127	18.9	.523	−132.4
5500.00	.745	82.6	.977	−45.4	.141	13.6	.544	−147.6
6000.00	.801	73.0	.926	−55.8	.164	8.5	.609	−161.9

CHIP CODE M14

AT-4641

Low Noise
Bipolar Transistor

FEATURES

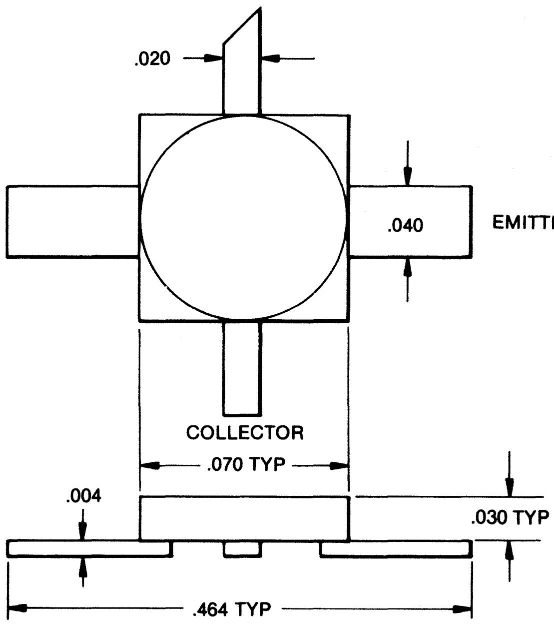
- 3.0 dB Noise Figure at 4 GHz
- 8 dB Gain at NF
- Hermetic 70 Mil Microstrip Package
- Gold Metal System
- Arsenic Emitter

DESCRIPTION

The Avantek AT-4641 is a silicon bipolar transistor designed for small signal amplification at frequencies up to 6 GHz. Arsenic-doped, 1-micron emitter structures give this transistor a low noise figure with high associated gain. The metal system used is gold based, etchless and deposits a metal film of uniform 1 micron thickness to minimize current density. A silicon dioxide layer protects the transistor chip from scratching or contamination during handling and packaging for improved performance and reliability.

The 70 mil square ceramic/metal microstripline package is hermetically sealed while flooded with a dry, inert atmosphere to assure long-term protection from humidity and corrosive gases.

OUTLING DRAWING 70 MIL PACKAGE



TOLERANCES: ± .010/± .02

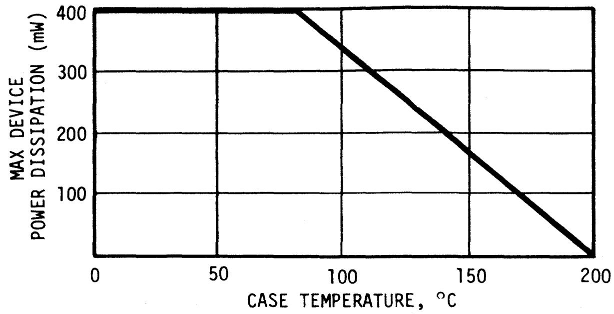
COMMON EMITTER OPERATING CHARACTERISTICS ($T_A = 25°C$)

Parameter	Symbol	Test Cond $V_{CE} I_C$	Freq GHz	Min	AT-4641 Typ	Max
Spot Noise Figure	NF_{opt}	10V 5 mA	4		3.0 dB	3.5 dB
Spot Noise Figure	NF_{opt}	10V 5 mA	2		2.3 dB	
Spot Noise Figure	NF_{opt}	10V 5 mA	1		1.5 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	4		8 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	2		11 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	1		16.0 dB	
Max Available Power Gain	G_{max}	10V 15 mA	4	8 dB	9.5 dB	
Max Available Power Gain	G_{max}	10V 15 mA	2		15.5 dB	

MAXIMUM RATINGS ($T_A = 25°C$)

Parameter	Symbol	Limit
Reverse Emitter Base Voltage	V_{EB}	1.5V
Reverse Collector Base Voltage	V_{CB}	20.0V
Open Base Collector-Emitter Voltage	V_{CEO}	12.0V
Collector Current	I_C	50 mA
Continuous Dissipation	P_T (T_{case} = 25°C)	400 mW
Junction Temperature	T_j	200°C
Storage Temperature Range	T_{STG}	– 65 to 200°C
Thermal Resistance	θ_{jc}	300°C/watt

POWER DERATING CURVE



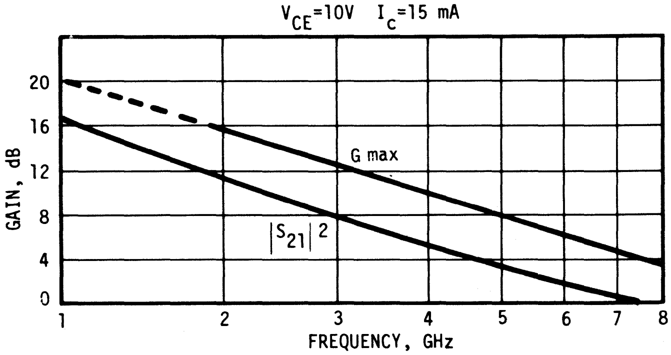
ELECTRICAL CHARACTERISTICS ($T_A = 25°C$)

Parameter	Symbol	Test Conditions	Freq.	Min	Typ	Max
Collector-Base Breakdown	$V_{(BR)}CBO$	$I_C = 10\ \mu A$		20V		
Emitter-Base Breakdown	$V_{(BR)}EBO$	$I_E = 10\ \mu A$		1.5V		
Collector-Emitter Breakdown	$V_{(BR)}CEO$	$I_C = 100\ \mu A$		12V		
Collector Cutoff Current	I_{CBO}	$V_{CB} = 10V$				20 nA
Forward Current Transfer Ratio	h_{FE}	$V_{CE} = 10V, I_C = 15$ mA		20	75	
Collector-Base Capacitance	C_{cb}	$V_{CB} = 10V$				0.5 pF

TYPICAL PERFORMANCE CURVES

G_{MAX}, $|S_{21}|^2$ VS FREQUENCY

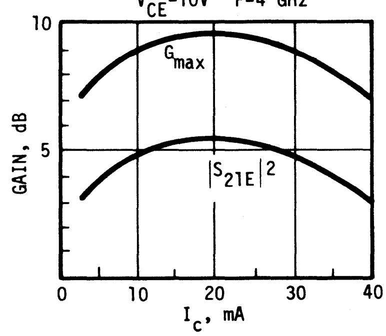
V_{CE}=10V I_c=15 mA



MAXIMUM AVAILABLE GAIN,

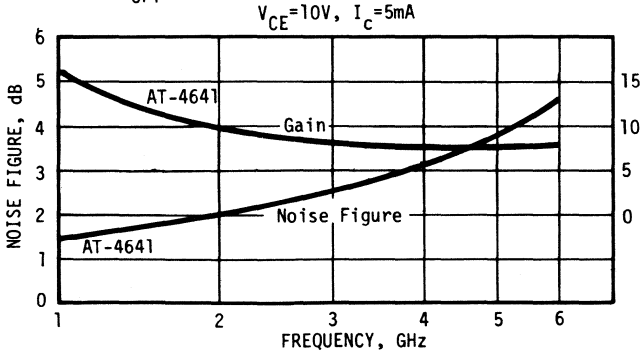
$|S_{21E}|^2$ VS COLLECTOR CURRENT

V_{CE}=10V F=4 GHz



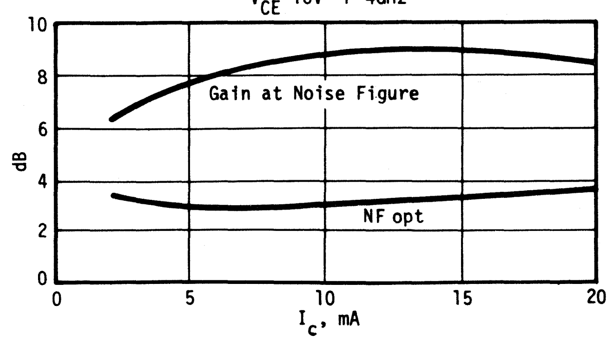
NF_{OPT} AND GAIN AT NOISE FIGURE VS FREQUENCY

V_{CE}=10V, I_c=5mA

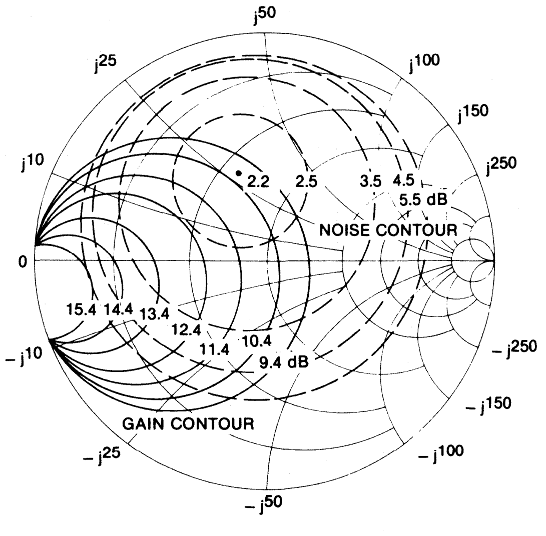


NF_{OPT} AND GAIN AT NOISE FIGURE VS COLLECTOR CURRENT

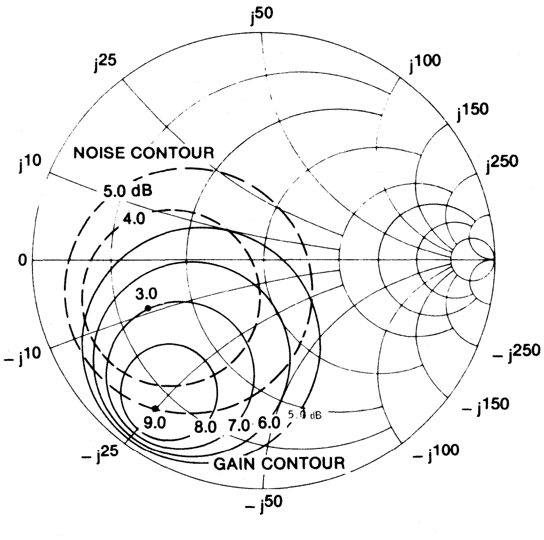
V_{CE}=10V F=4GHz



TYPICAL CONTOURS OF CONSTANT GAIN AND NOISE FIGURE



Frequency = 2 GHz, 10V 5 mA See Note 1



Frequency = 4 GHz, 10V 5mA

Note 1

The AT-4641 is potentially unstable at 2 GHz at $V_{CE} = 10$ V, $I_C = 5$ mA. The 15.4 dB gain contour represents the maximum stable gain of the device defined as $G_{MSG} = |\frac{S_{21}}{S_{22}}|$. By presenting the input with an impedance lying outside of this gain contour, the output impedance of the device is positive and may be conjugately matched to realize the specified gain.

TYPICAL SCATTERING PARAMETERS

Bias = 10.00 Volts, 5.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.653	−102.2	8.887	117.2	.044	42.7	.762	−32.4
1000.00	.629	−149.0	5.554	86.3	.054	25.8	.617	−45.5
2000.00	.618	167.1	2.961	48.4	.065	13.8	.562	−67.6
3000.00	.615	139.0	2.026	17.2	.076	4.5	.572	−92.5
4000.00	.617	114.8	1.534	−11.9	.089	−4.6	.594	−115.2
5000.00	.605	92.7	1.235	−37.7	.106	−15.5	.625	−141.9
6000.00	.586	72.0	1.016	−63.0	.122	−26.9	.683	−166.3
7000.00	.519	48.3	.858	−88.3	.141	−42.9	.749	172.6
8000.00	.439	14.4	.753	−113.4	.170	−59.6	.797	158.9

TYPICAL SCATTERING PARAMETERS (CONTINUED)

Bias = 10.00 Volts, 10.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.571	−131.4	12.403	107.9	.032	43.7	.629	−38.2
1000.00	.592	−168.4	7.034	80.8	.040	35.0	.494	−47.9
2000.00	.600	156.4	3.637	46.8	.057	27.8	.459	−68.2
3000.00	.598	131.6	2.466	17.4	.075	17.7	.476	−92.6
4000.00	.598	109.0	1.864	−10.4	.095	4.8	.502	−114.8
5000.00	.587	88.1	1.510	−35.4	.117	−9.6	.540	−140.9
6000.00	.560	67.9	1.254	−60.6	.135	−24.5	.607	−165.1
7000.00	.488	44.2	1.063	−86.1	.156	−42.5	.690	174.4
8000.00	.407	10.6	.932	−111.6	.181	−61.1	.749	160.6

Bias = 10.00 Volts, 15.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.565	−140.0	13.221	105.1	.028	44.4	.589	−39.3
1000.00	.590	−173.5	7.341	79.3	.037	38.0	.465	−48.0
2000.00	.599	153.6	3.779	46.2	.056	32.1	.437	−67.8
3000.00	.599	130.0	2.556	17.5	.076	20.3	.454	−92.3
4000.00	.600	107.6	1.934	−10.0	.096	−6.7	.483	−114.6
5000.00	.586	87.0	1.566	−34.9	.118	−7.6	.524	−140.9
6000.00	.560	66.9	1.302	−60.0	.137	−23.5	.592	−164.8
7000.00	.487	42.9	1.105	−85.7	.159	−42.0	.675	174.9
8000.00	.403	9.5	.972	−111.1	.185	−60.4	.738	160.9

Bias = 10.00 Volts, 20.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.565	−150.9	14.035	101.4	.025	47.1	.541	−39.6
1000.00	.591	−179.5	7.612	77.2	.033	43.1	.434	−47.2
2000.00	.602	150.6	3.882	45.4	.054	36.7	.415	−67.3
3000.00	.602	127.8	2.624	17.1	.076	23.9	.437	−92.1
4000.00	.604	105.9	1.985	−9.8	.097	−9.8	.465	−114.6
5000.00	.590	85.4	1.605	−34.8	.120	−6.3	.508	−140.8
6000.00	.562	65.4	1.335	−59.7	.139	−22.1	.577	−164.5
7000.00	.488	41.2	1.135	−85.1	.161	−41.4	.663	175.1
8000.00	.407	7.4	1.000	−111.0	.188	−60.7	.728	161.2

Bias = 10.00 Volts, 30.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.580	−161.2	13.700	97.4	.021	49.1	.510	−36.8
1000.00	.604	−175.0	7.278	75.2	.031	49.2	.433	−44.1
2000.00	.616	148.0	3.704	44.1	.052	40.6	.425	−65.9
3000.00	.615	125.9	2.506	16.2	.075	27.4	.447	−91.5
4000.00	.619	104.4	1.895	−10.7	.096	12.4	.475	−114.4
5000.00	.604	83.9	1.530	−35.4	.120	−3.5	.515	−141.1
6000.00	.580	63.7	1.272	−60.4	.140	−19.8	.585	−165.1
7000.00	.507	38.9	1.082	−85.9	.165	−38.8	.668	174.6
8000.00	.429	4.8	.953	−111.4	.193	−58.7	.732	160.7

CHIP CODE M4

AT-4841

Low Noise
Bipolar Transistor

FEATURES

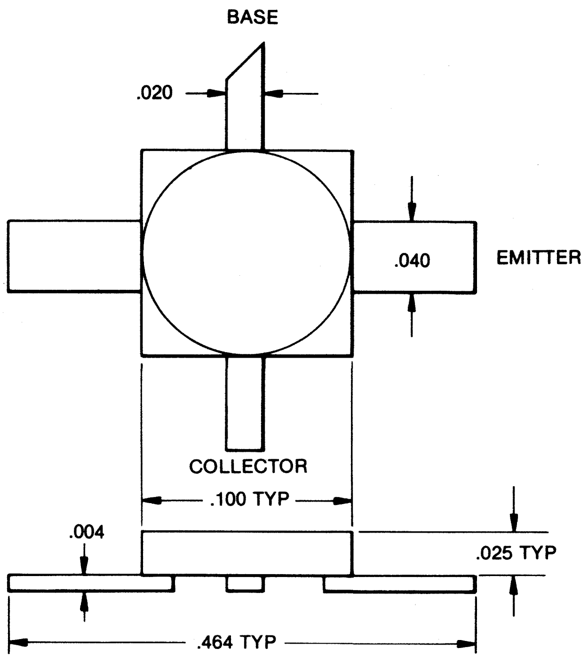
- **3.0 dB Noise Figure at 4 GHz**
- **8 dB Gain at NF**
- **Hermetic 100 Mil Microstrip Package**
- **Gold Metal System**
- **Arsenic Emitter**

DESCRIPTION

The Avantek AT-4841 is a silicon bipolar transistor designed for small signal amplification at frequencies up to 6 GHz. Arsenic-doped, 1-micron emitter structures give this transistor a low noise figure with high associated gain. The metal system used is gold based, etchless and deposits a metal film of uniform 1 micron thickness to minimize current density. A silicon dioxide layer protects the transistor chip from scratching or contamination during handling and packaging for improved performance and reliability.

The 100 mil square ceramic/metal microstriping package is hermetically sealed while flooded with a dry, inert atmosphere to assure long-term protection from humidity and corrosive gases.

OUTLINE DRAWING 100 MIL PACKAGE



TOLERANCES: ± .010/ ± .02

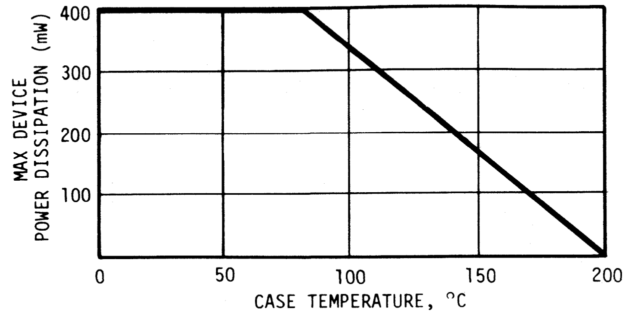
COMMON EMITTER OPERATING CHARACTERISTICS ($T_A = 25°C$)

Parameter	Symbol	Test Cond $V_{CE} I_C$	Freq GHz	AT-4841 Min	Typ	Max
Spot Noise Figure	NF_{opt}	10V 5 mA	4		3.0 dB	3.5 dB
Spot Noise Figure	NF_{opt}	10V 5 mA	2		2.3 dB	
Spot Noise Figure	NF_{opt}	10V 5 mA	1		1.5 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	4		8 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	2		11 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	1		16.0 dB	
Max Available Power Gain	G_{max}	10V 15 mA	4	8 dB	9.5 dB	
Max Available Power Gain	G_{max}	10V 15 mA	2		15.5 dB	

MAXIMUM RATINGS ($T_A = 25°C$)

Parameter	Symbol	Limit
Reverse Emitter Base Voltage	V_{EB}	1.5V
Reverse Collector Base Voltage	V_{CB}	20.0V
Open Base Collector-Emitter Voltage	V_{CEO}	12.0V
Collector Current	I_C	50 mA
Continuous Dissipation	P_T (T_{case} = 25°C)	400 mW
Junction Temperature	T_j	200°C
Storage Temperature Range	T_{STG}	– 65 to 200°C
Thermal Resistance	θ_{jc}	300°C/watt

POWER DERATING CURVE

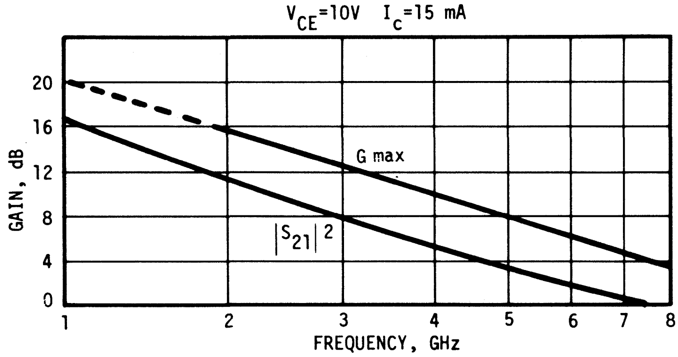


ELECTRICAL CHARACTERISTICS ($T_A = 25°C$)

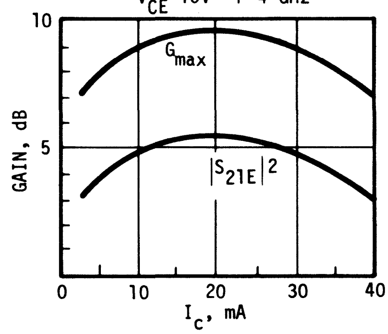
Parameter	Symbol	Test Conditions	Freq.	Min	Typ	Max
Collector-Base Breakdown	$V_{(BR)}CBO$	$I_C = 10\ \mu A$		20V		
Emitter-Base Breakdown	$V_{(BR)}EBO$	$I_E = 10\ \mu A$		1.5V		
Collector-Emitter Breakdown	$V_{(BR)}CEO$	$I_C = 100\ \mu A$		12V		
Collector Cutoff Current	I_{CBO}	$V_{CB} = 10V$				20 nA
Forward Current Transfer Ratio	h_{FE}	$V_{CE} = 10V, I_C = 15$ mA		20	75	
Collector-Base Capacitance	C_{cb}	$V_{CB} = 10V$				0.5 pF

TYPICAL PERFORMANCE CURVES

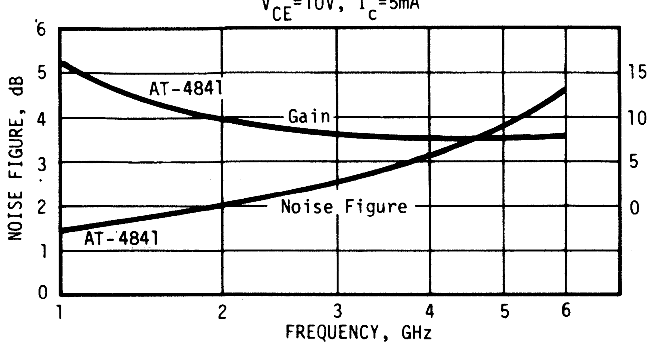
G_{MAX}, $|S_{21}|^2$ VS FREQUENCY
V_{CE}=10V I_c=15 mA



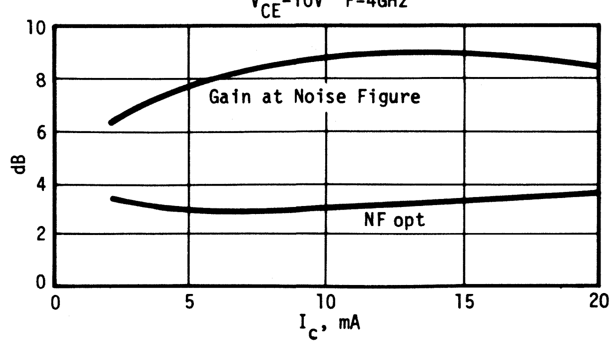
MAXIMUM AVAILABLE GAIN,
$|S_{21E}|^2$ VS COLLECTOR CURRENT
V_{CE}=10V F=4 GHz



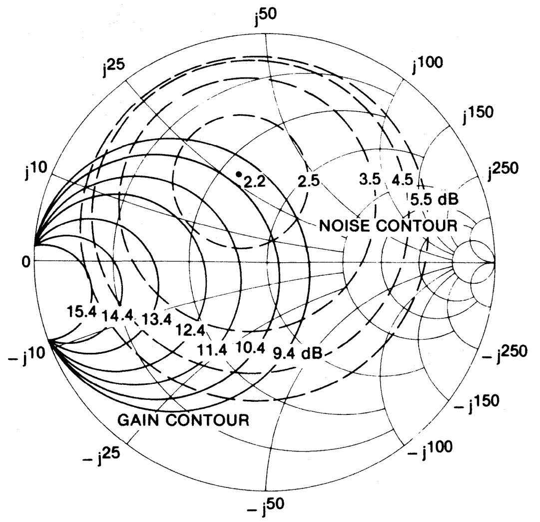
NF_{OPT} AND GAIN AT NOISE FIGURE VS FREQUENCY
V_{CE}=10V, I_c=5mA



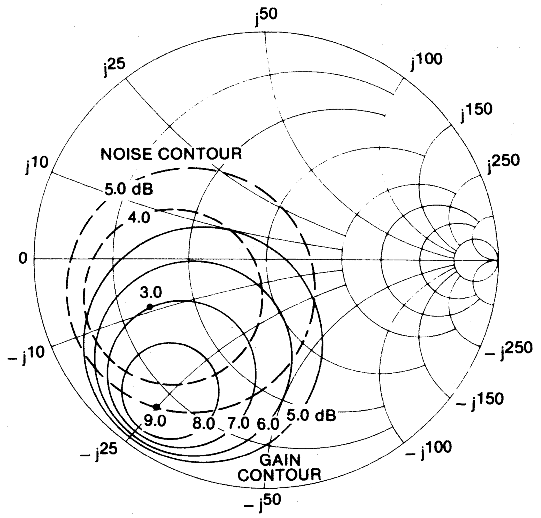
NF_{OPT} AND GAIN AT NOISE FIGURE VS COLLECTOR CURRENT
V_{CE}=10V F=4GHz



TYPICAL CONTOURS OF CONSTANT GAIN AND NOISE FIGURE



Frequency = 2 GHz, 10V 5 mA See Note 1



Frequency = 4 GHz, 10V 5mA

Note 1

The 15.4 dB gain contour represents the maximum stable gain of the device defined as $G_{MSG} = \left|\frac{S_{21}}{S_{22}}\right|$. By presenting the input with an impedance lying outside of this gain contour, the output impedance of the device is positive and may be conjugately matched to realize the specified gain.

TYPICAL SCATTERING PARAMETERS

Bias = 10.00 Volts, 5.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.653	– 102.2	8.887	117.2	.044	42.7	.762	– 32.4
1000.00	.629	– 149.0	5.554	86.3	.054	25.8	.617	– 45.5
2000.00	.618	167.1	2.961	48.4	.065	13.8	.562	– 67.6
3000.00	.615	139.0	2.026	17.2	.076	4.5	.572	– 92.5
4000.00	.617	114.8	1.534	– 11.9	.089	– 4.6	.594	– 115.2
5000.00	.605	92.7	1.235	– 37.7	.106	– 15.5	.625	– 141.9
6000.00	.586	72.0	1.016	– 63.0	.122	– 26.9	.683	– 166.3
7000.00	.519	48.3	.858	– 88.3	.141	– 42.9	.749	172.6
8000.00	.439	14.4	.753	– 113.4	.170	– 59.6	.797	158.9

TYPICAL SCATTERING PARAMETERS (CONTINUED)

Bias = 10.00 Volts, 10.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.571	−131.4	12.403	107.9	.032	43.7	.629	−38.2
1000.00	.592	−168.4	7.034	80.8	.040	35.0	.494	−47.9
2000.00	.600	156.4	3.637	46.8	.057	27.8	.459	−68.2
3000.00	.598	131.6	2.466	17.4	.075	17.7	.476	−92.6
4000.00	.598	109.0	1.864	−10.4	.095	4.8	.502	−114.8
5000.00	.587	88.1	1.510	−35.4	.117	−9.6	.540	−140.9
6000.00	.560	67.9	1.254	−60.6	.135	−24.5	.607	−165.1
7000.00	.488	44.2	1.063	−86.1	.156	−42.5	.690	174.4
8000.00	.407	10.6	.932	−111.6	.181	−61.1	.749	160.6

Bias = 10.00 Volts, 15.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.565	−140.0	13.221	105.1	.028	44.4	.589	−39.3
1000.00	.590	−173.5	7.341	79.3	.037	38.0	.465	−48.0
2000.00	.599	153.6	3.779	46.2	.056	32.1	.437	−67.8
3000.00	.599	130.0	2.556	17.5	.076	20.3	.454	−92.3
4000.00	.600	107.6	1.934	−10.0	.096	−6.7	.483	−114.6
5000.00	.586	87.0	1.566	−34.9	.118	−7.6	.524	−140.9
6000.00	.560	66.9	1.302	−60.0	.137	−23.5	.592	−164.8
7000.00	.487	42.9	1.105	−85.7	.159	−42.0	.675	174.9
8000.00	.403	9.5	.972	−111.1	.185	−60.4	.738	160.9

Bias = 10.00 Volts, 20.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.565	−150.9	14.035	101.4	.025	47.1	.541	−39.6
1000.00	.591	−179.5	7.612	77.2	.033	43.1	.434	−47.2
2000.00	.602	150.6	3.882	45.4	.054	36.7	.415	−67.3
3000.00	.602	127.8	2.624	17.1	.076	23.9	.437	−92.1
4000.00	.604	105.9	1.985	−9.8	.097	−9.8	.465	−114.6
5000.00	.590	85.4	1.605	−34.8	.120	−6.3	.508	−140.8
6000.00	.562	65.4	1.335	−59.7	.139	−22.1	.577	−164.5
7000.00	.488	41.2	1.135	−85.1	.161	−41.4	.663	175.1
8000.00	.407	7.4	1.000	−111.0	.188	−60.7	.728	161.2

Bias = 10.00 Volts, 30.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.580	−161.2	13.700	97.4	.021	49.1	.510	−36.8
1000.00	.604	−175.0	7.278	75.2	.031	49.2	.433	−44.1
2000.00	.616	148.0	3.704	44.1	.052	40.6	.425	−65.9
3000.00	.615	125.9	2.506	16.2	.075	27.4	.447	−91.5
4000.00	.619	104.4	1.895	−10.7	.096	12.4	.475	−114.4
5000.00	.604	83.9	1.530	−35.4	.120	−3.5	.515	−141.1
6000.00	.580	63.7	1.272	−60.4	.140	−19.8	.585	−165.1
7000.00	.507	38.9	1.082	−85.9	.165	−38.8	.668	174.6
8000.00	.429	4.8	.953	−111.4	.193	−58.7	.732	160.7

CHIP CODE M4

Low Noise
Bipolar Transistor

FEATURES

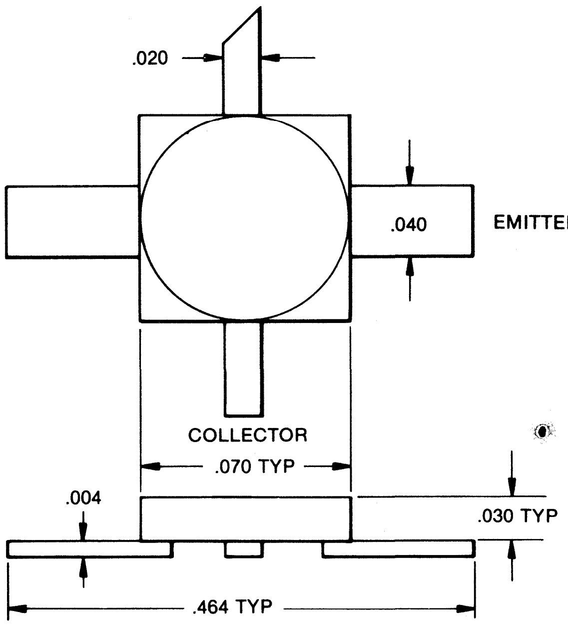
- **Low Noise Figure—NF_{opt} = 2.8 dB @ 4 GHz, Max.**
- **High Associated Gain—G_{NF} = 8.8 dB @ 4 GHz**
- **Hermetic 70 Mil Microstrip Package**
- **Gold Metal System**
- **Arsenic Emitter**

DESCRIPTION

The Aventek AT-4680 is a silicon bipolar transistor designed for small signal amplification at frequencies up to 6 GHz. Arsenic-doped, 0.5 micron emitter structures give this transistor very low noise figures and high associated gains. The metal system used in the AT-4680 transistor chip is gold based, etchless and deposits a metal film of uniform 1 micron thickness to minimize current density. A silicon dioxide layer protects the surface of the chips from scratching or contamination during handling and packaging for improved performance and reliability.

The 70 mil square ceramic-metal microstripline package is hermetically sealed while flooded with a dry, inert atmosphere to assure long-term protection from humidity and corrosive gases.

OUTLINE DRAWING 70 MIL PACKAGE



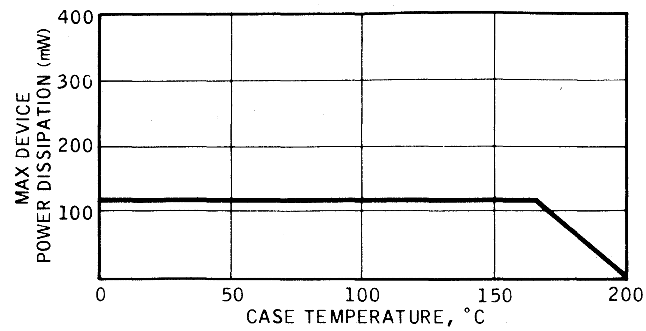
COMMON EMITTER OPERATING CHARACTERISTICS (T_A = 25°C)

Parameter	Symbol	Test Cond $V_{CE}I_C$	Freq GHz	Min	AT-4680 Typ	Max
Spot Noise Figure	NF_{opt}	10V 3 mA	4		2.8 dB	3.0 dB
Spot Noise Figure	NF_{opt}	10V 3 mA	2		1.8 dB	
Spot Noise Figure	NF_{opt}	10V 3 mA	1		1.4 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 3 mA	4	8.5 dB	8.8 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 3 mA	2		13.6 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 3 mA	1		17.7 dB	
Max Available Power Gain	G_{max}	10V 6 mA	4		12.0 dB	
Max Available Power Gain	G_{max}	10V 6 mA	2		18.0 dB	

MAXIMUM RATINGS ($T_A = 25°C$)

Parameter	Symbol	Limit
Reverse Emitter Base Voltage	V_{EB}	2.0V
Reverse Collector Base Voltage	V_{CB}	20.0V
Open Base Collector-Emitter Voltage	V_{CEO}	14.0V
Collector Current	I_C	50 mA
Continuous Dissipation	P_T (T_{case} = 25°C)	120 mW
Junction Temperature	T_j	200°C
Storage Temperature Range	T_{STG}	– 65 to 200°C
Thermal Resistance	θ_{jc}	300°C/watt

POWER DERATING CURVE

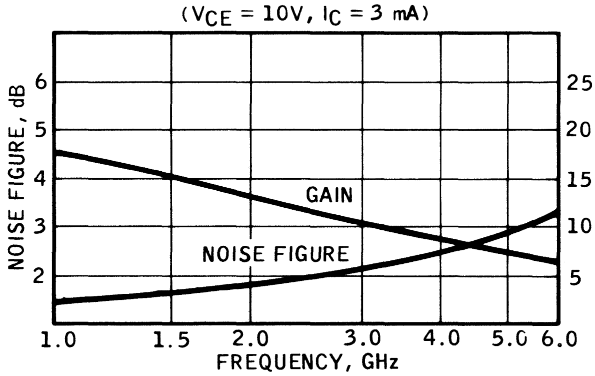


ELECTRICAL CHARACTERISTICS ($T_A = 25°C$)

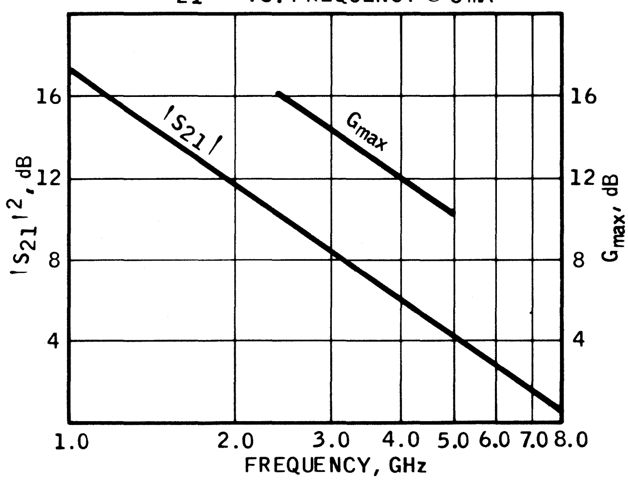
Parameter	Symbol	Test Conditions	Freq.	Min	Typ	Max
Collector-Base Breakdown	$V_{(BR)}CBO$	$I_C = 10\ \mu A$		20V		
Emitter-Base Breakdown	$V_{(BR)}EBO$	$I_E = 10\ \mu A$		2.0V		
Collector-Emitter Breakdown	$V_{(BR)}CEO$	$I_C = 100\ \mu A$		12V		
Collector Cutoff Current	I_{CBO}	$V_{CB} = 10V$				20 nA
Forward Current Transfer Ratio	h_{FE}	$V_{CE} = 10V$, $I_C = 6$ mA		20	150	
Collector-Base Capacitance	C_{cb}	$V_{CB} = 10V$				0.5 pF

TYPICAL PERFORMANCE CURVES

NF_{OPT} AND G_{NF} VS. FREQUENCY
(V_{CE} = 10V, I_C = 3 mA)

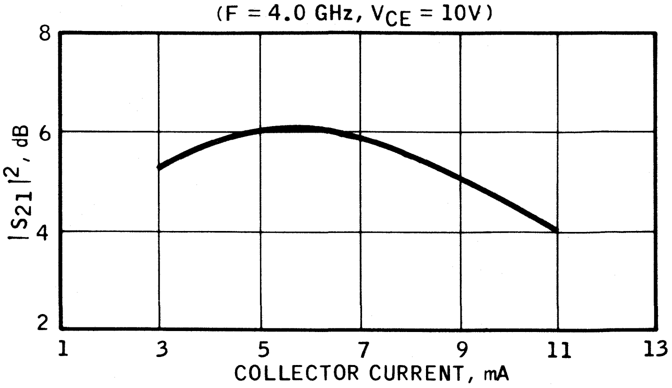


G_{max} VS. FREQUENCY @ 6 mA
$|S_{21}|^2$ VS. FREQUENCY @ 6 mA



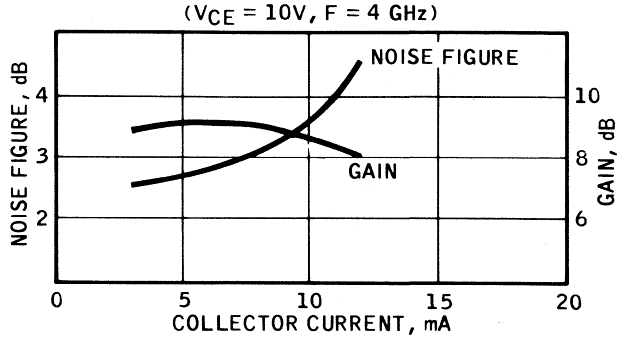
$|S_{21}|^2$ VS. CURRENT

(F = 4.0 GHz, V_{CE} = 10V)

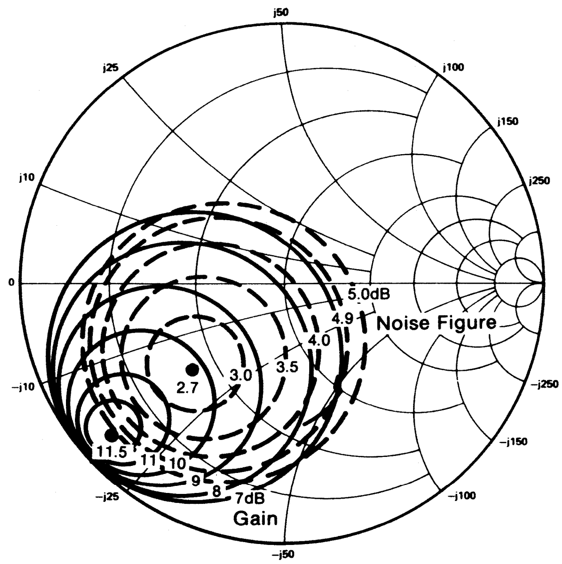


NF_{OPT} AND G_{NF} VS. I_C

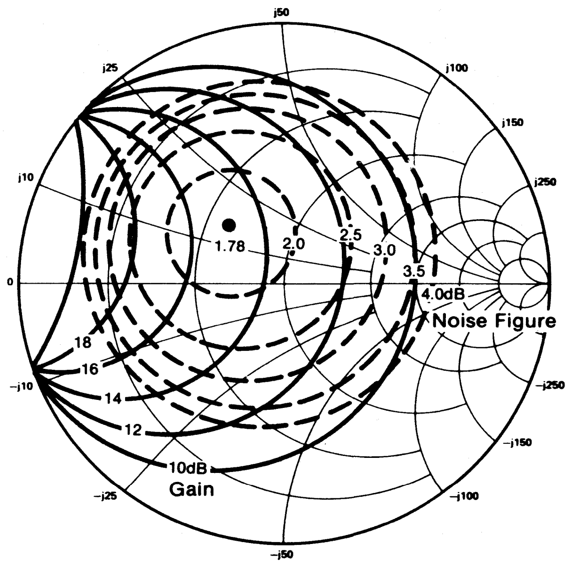
(V_{CE} = 10V, F = 4 GHz)



TYPICAL CONTOURS OF CONSTANT GAIN AND NOISE FIGURE



(V_{CE} = 10V, I_C = 3 mA, F = 4 GHz)



(V_{CE} = 10V, I_C = 3 mA, F = 2.0 GHz)

TYPICAL SCATTERING PARAMETERS

Bias = 10.00 Volts, 3.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.726	−57.8	6.874	137.0	.041	59.0	.913	−22.4
1000.00	.625	−103.6	5.339	105.2	.060	37.8	.786	−38.0
2000.00	.530	−162.6	3.260	63.8	.073	18.6	.682	−59.2
3000.00	.515	159.2	2.314	31.5	.079	10.6	.653	−80.2
4000.00	.525	129.7	1.778	3.3	.088	5.7	.656	−99.8
5000.00	.535	105.3	1.452	−21.6	.103	1.2	.667	−123.7
6000.00	.541	84.4	1.194	−45.4	.120	−6.1	.705	−147.4
7000.00	.510	63.6	1.005	−68.6	.142	−16.7	.761	168.2
8000.00	.463	38.9	.874	−89.7	.170	−29.2	.812	178.4

Bias = 10.00 Volts, 5.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.634	−74.0	9.002	129.7	.036	55.5	.866	−24.9
1000.00	.560	−123.1	6.347	98.2	.049	37.4	.725	−38.6
2000.00	.514	−178.4	3.622	59.4	.060	24.9	.639	−57.8
3000.00	.516	147.7	2.518	28.9	.071	21.4	.621	−78.9
4000.00	.532	121.0	1.919	1.7	.087	16.1	.630	−98.8
5000.00	.547	98.0	1.567	−22.6	.107	8.6	.645	−122.8
6000.00	.551	78.3	1.287	−45.8	.129	−.7	.685	−146.3
7000.00	.521	57.7	1.085	−69.0	.153	−13.4	.746	−167.1
8000.00	.475	32.6	.941	−90.3	.182	−27.0	.801	179.3

Bias = 10.00 Volts, 9.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.539	−104.0	10.514	118.3	.028	50.4	.800	−25.5
1000.00	.525	−150.6	6.558	88.9	.037	39.1	.680	−35.9
2000.00	.528	164.6	3.527	53.3	.050	36.1	.634	−54.6
3000.00	.539	136.3	2.413	24.4	.066	33.4	.633	−76.6
4000.00	.560	112.1	1.827	−2.1	.087	26.6	.648	−97.3
5000.00	.575	91.0	1.485	−25.8	.113	16.3	.665	−121.8
6000.00	.581	71.7	1.214	−49.1	.137	5.2	.701	−146.0
7000.00	.551	51.1	1.019	−71.9	.164	−8.9	.759	−167.3
8000.00	.510	25.2	.873	−93.0	.196	−23.8	.817	179.1

Bias = 10.00 Volts, 12.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.526	−121.4	9.513	111.6	.025	47.8	.788	−23.0
1000.00	.531	−163.0	5.576	83.9	.031	43.0	.705	−32.3
2000.00	.544	157.9	2.934	50.0	.046	41.8	.683	−52.9
3000.00	.558	131.5	2.008	21.5	.065	38.5	.683	−75.9
4000.00	.578	108.3	1.518	−5.1	.088	−30.7	.697	−97.8
5000.00	.593	87.8	1.227	−28.9	.116	−20.0	.711	−122.8
6000.00	.599	68.9	.998	−51.8	.141	7.7	.745	−147.5
7000.00	.568	47.9	.824	−74.2	.169	−7.3	.793	168.9
8000.00	.530	21.9	.702	−95.0	.202	−23.0	.840	177.2

CHIP CODE M12

AT-4880

Low Noise
Bipolar Transistor

FEATURES

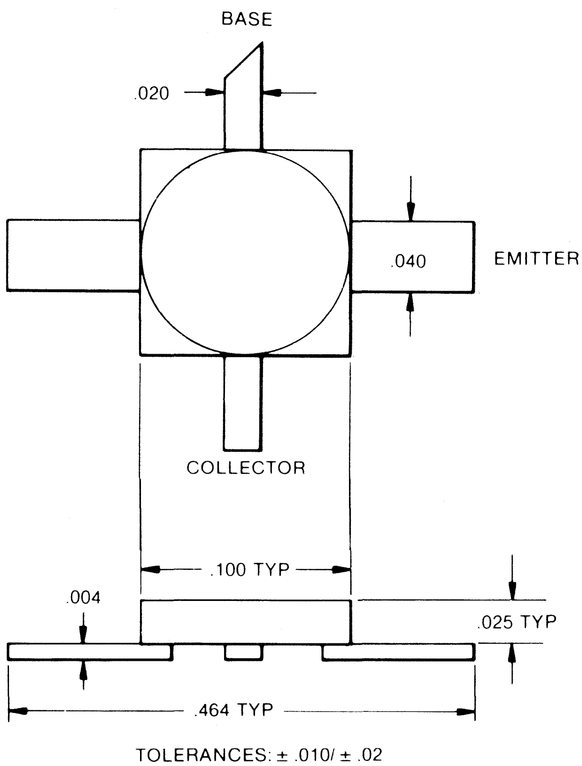
- Low Noise Figure—NF_{opt} = 2.8 dB @ 4 GHz, Max.
- High Associated Gain—G_{NF} = 8.8 dB 0 4 GHz
- Hermetic 100 Mil Microstrip Package
- Gold Metal System
- Arsenic Emitter

DESCRIPTION

The Avantek AT-4880 is a silicon bipolar transistor designed for small signal amplification at frequencies up to 6 GHz. Arsenic-doped, 0.5 micron emitter structures give this transistor a very low noise figure and high associated gain. The metal system used in the AT-4880 transistor chip is gold based, etchless and deposits a metal film of uniform 1 micron thickness to minimize current density. A silicon dioxide layer protects the surface of the chips from scratching or contamination during handling and packaging for improved performance and reliability.

The 100 mil square ceramic-metal microstripline package is hermetically sealed while flooded with a dry, inert atmosphere to assure long-term protection from humidity and corrosive gases.

OUTLINE DRAWING 100 MIL PACKAGE



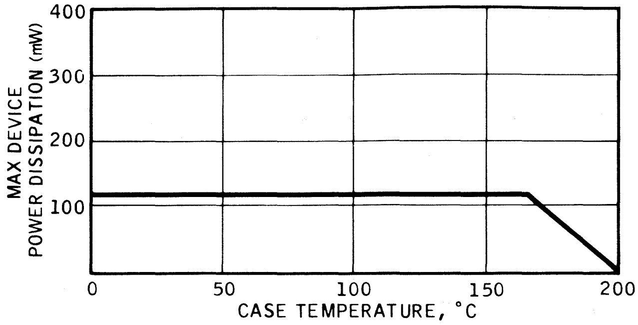
COMMON EMITTER OPERATING CHARACTERISTICS (T_A = 25°C)

Parameter	Symbol	Test Cond $V_{CE}I_C$	Freq GHz	Min	AT-4880 Typ	Max
Spot Noise Figure	NF_{opt}	10V 3 mA	4		2.8 dB	3.0 dB
Spot Noise Figure	NF_{opt}	10V 3 mA	2		1.8 dB	
Spot Noise Figure	NF_{opt}	10V 3 mA	1		1.4 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 3 mA	4	8.5 dB	8.8 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 3 mA	2		13.6 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 3 mA	1		17.7 dB	
Max Available Power Gain	G_{max}	10V 6 mA	4		12.0 dB	
Max Available Power Gain	G_{max}	10V 6 mA	2		18.0 dB	

MAXIMUM RATINGS ($T_A = 25°C$)

Parameter	Symbol	Limit
Reverse Emitter Base Voltage	V_{EB}	2.0V
Reverse Collector Base Voltage	V_{CB}	20.0V
Open Base Collector-Emitter Voltage	V_{CEO}	14.0V
Collector Current	I_C	50 mA
Continuous Dissipation	P_T (T_{case} = 25°C)	120 mW
Junction Temperature	T_j	200°C
Storage Temperature Range	T_{STG}	– 65 to 200°C
Thermal Resistance	θ_{jc}	300°C/watt

POWER DERATING CURVE

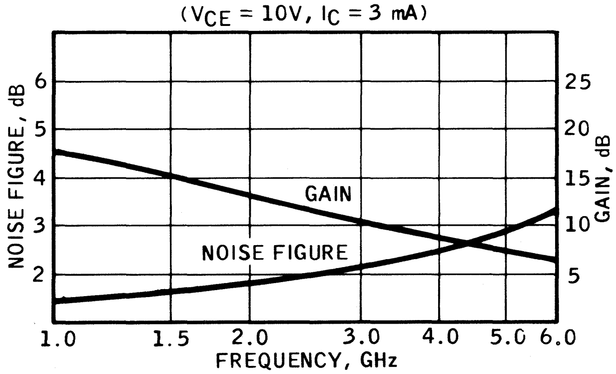


ELECTRICAL CHARACTERISTICS ($T_A = 25°C$)

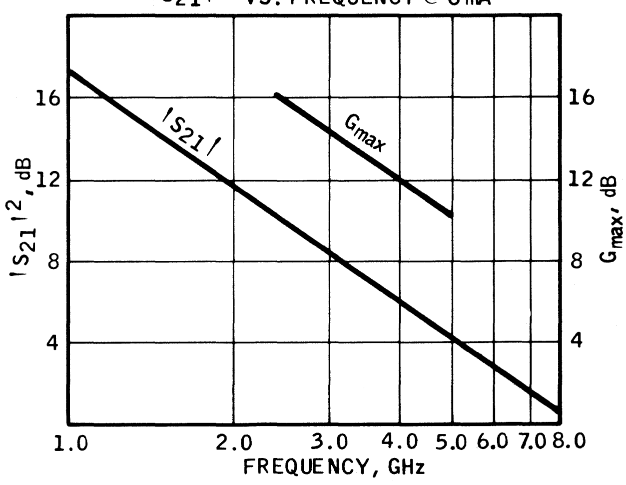
Parameter	Symbol	Test Conditions	Freq.	Min	Typ	Max
Collector-Base Breakdown	$V_{(BR)}CBO$	$I_C = 10\ \mu A$		20V		
Emitter-Base Breakdown	$V_{(BR)}EBO$	$I_E = 10\ \mu A$		2.0V		
Collector-Emitter Breakdown	$V_{(BR)}CEO$	$I_C = 100\ \mu A$		12V		
Collector Cutoff Current	I_{CBO}	$V_{CB} = 10V$				20 nA
Forward Current Transfer Ratio	h_{FE}	$V_{CE} = 10V$, $I_C = 6$ mA		20	150	
Collector-Base Capacitance	C_{cb}	$V_{CB} = 10V$				0.5 pF

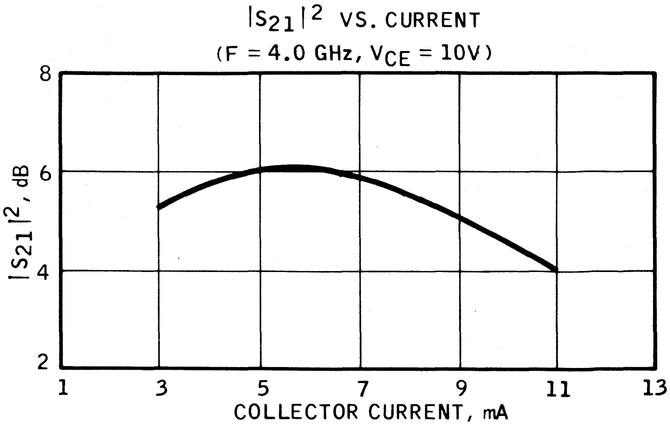
TYPICAL PERFORMANCE CURVES

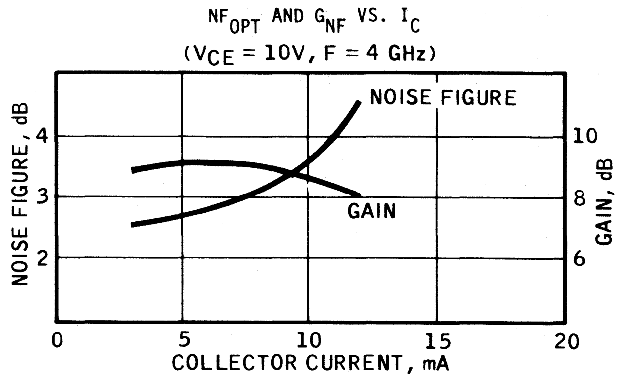
NF_{OPT} AND G_{NF} VS. FREQUENCY (V_{CE} = 10V, I_C = 3 mA)



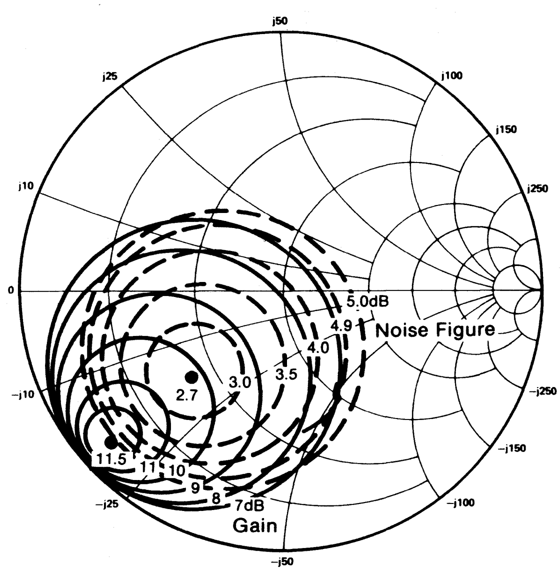
G_{max} VS. FREQUENCY @ 6 mA
$|S_{21}|^2$ VS. FREQUENCY @ 6 mA



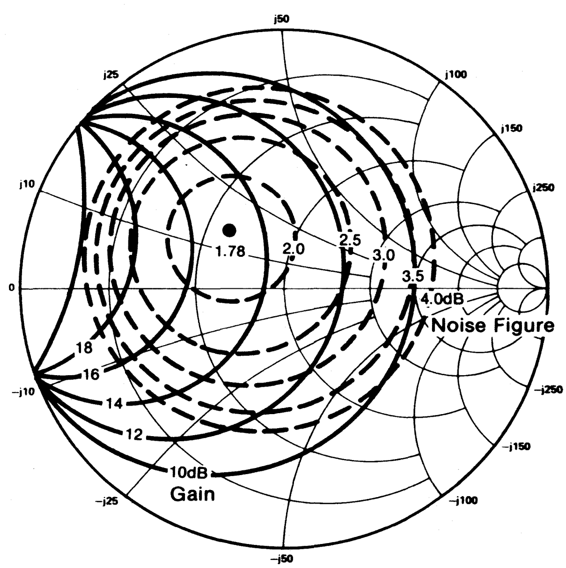




TYPICAL CONTOURS OF CONSTANT GAIN AND NOISE FIGURE



(V_{CE} = 10V, I_C = 3 mA, F = 4 GHz)



(V_{CE} = 10V, I_C = 3 mA, F = 2.0 GHz)

TYPICAL SCATTERING PARAMETERS

Bias = 10.00 Volts, 3.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.726	−57.8	6.874	137.0	.041	59.0	.913	−22.4
1000.00	.625	−103.6	5.339	105.2	.060	37.8	.786	−38.0
2000.00	.530	−162.6	3.260	63.8	.073	18.6	.682	−59.2
3000.00	.515	159.2	2.314	31.5	.079	10.6	.653	−80.2
4000.00	.525	129.7	1.778	3.3	.088	5.7	.656	−99.8
5000.00	.535	105.3	1.452	−21.6	.103	1.2	.667	−123.7
6000.00	.541	84.4	1.194	−45.4	.120	−6.1	.705	−147.4
7000.00	.510	63.6	1.005	−68.6	.142	−16.7	.761	168.2
8000.00	.463	38.9	.874	−89.7	.170	−29.2	.812	178.4

Bias = 10.00 Volts, 5.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.634	−74.0	9.002	129.7	.036	55.5	.866	−24.9
1000.00	.560	−123.1	6.347	98.2	.049	37.4	.725	−38.6
2000.00	.514	−178.4	3.622	59.4	.060	24.9	.639	−57.8
3000.00	.516	147.7	2.518	28.9	.071	21.4	.621	−78.9
4000.00	.532	121.0	1.919	1.7	.087	16.1	.630	−98.8
5000.00	.547	98.0	1.567	−22.6	.107	8.6	.645	−122.8
6000.00	.551	78.3	1.287	−45.8	.129	−.7	.685	−146.3
7000.00	.521	57.7	1.085	−69.0	.153	−13.4	.746	−167.1
8000.00	.475	32.6	.941	−90.3	.182	−27.0	.801	179.3

Bias = 10.00 Volts, 9.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.539	−104.0	10.514	118.3	.028	50.4	.800	−25.5
1000.00	.525	−150.6	6.558	88.9	.037	39.1	.680	−35.9
2000.00	.528	164.6	3.527	53.3	.050	36.1	.634	−54.6
3000.00	.539	136.3	2.413	24.4	.066	33.4	.633	−76.6
4000.00	.560	112.1	1.827	−2.1	.087	26.6	.648	−97.3
5000.00	.575	91.0	1.485	−25.8	.113	16.3	.665	−121.8
6000.00	.581	71.7	1.214	−49.1	.137	5.2	.701	−146.0
7000.00	.551	51.1	1.019	−71.9	.164	−8.9	.759	−167.3
8000.00	.510	25.2	.873	−93.0	.196	−23.8	.817	179.1

Bias = 10.00 Volts, 12.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.526	−121.4	9.513	111.6	.025	47.8	.788	−23.0
1000.00	.531	−163.0	5.576	83.9	.031	43.0	.705	−32.3
2000.00	.544	157.9	2.934	50.0	.046	41.8	.683	−52.9
3000.00	.558	131.5	2.008	21.5	.065	38.5	.683	−75.9
4000.00	.578	108.3	1.518	−5.1	.088	−30.7	.697	−97.8
5000.00	.593	87.8	1.227	−28.9	.116	−20.0	.711	−122.8
6000.00	.599	68.9	.998	−51.8	.141	7.7	.745	−147.5
7000.00	.568	47.9	.824	−74.2	.169	−7.3	.793	168.9
8000.00	.530	21.9	.702	−95.0	.202	−23.0	.840	177.2

CHIP CODE M12

AT-4690

Low Noise
Bipolar Transistor

FEATURES

- **NF Flat Within 0.8 dB for $I_C = 2.5$ to 20 mA**
- **Low Noise Figure—$NF_{opt} = 2.8$ dB @ 4 GHz**
- **High Associated Gain—$G_{NF} = 9.5$ dB**
- **Hermetic 70 Mil Microstrip Package**
- **Arsenic Emitter**

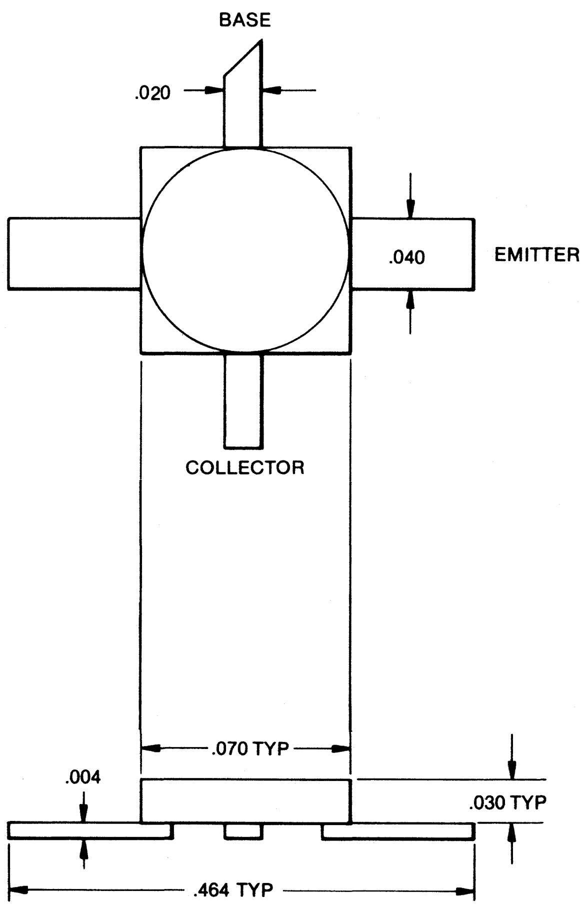
DESCRIPTION

The Avantek AT-4690 is a silicon bipolar transistor designed for small signal amplification at frequencies of up to 6 GHz. An important feature of this transistor is its flat noise figure vs. collector current characteristic which permits them to be used at collector currents from 2.5 mA to 20 mA with only 0.8 dB (approx.) change in noise figure. This characteristic allows the amplifier designer to obtain a larger output power per amplification stage, while still minimizing the second (and subsequent) stage noise figure contribution.

Avantek uses a highly reliable gold-based metal system on the AT-4690 transistor that combines excellent adherence, junction performance and corrosion resistance with high bond strength and freedom from current-induced metal transport (metal migration). An arsenic-doped 0.5 micron emitter structure helps provide low noise figures and high associated gain and a silicon dioxide layer protects the chip from contamination or scratching during fabrication.

The 70 mil square ceramic/metal stripline package is hermetically sealed while flooded with a dry, inert atmosphere to assure long-term protection from humidity and corrosive gases.

OUTLINE DRAWING 70 MIL PACKAGE



TOLERANCES: ÷ .010/± .02

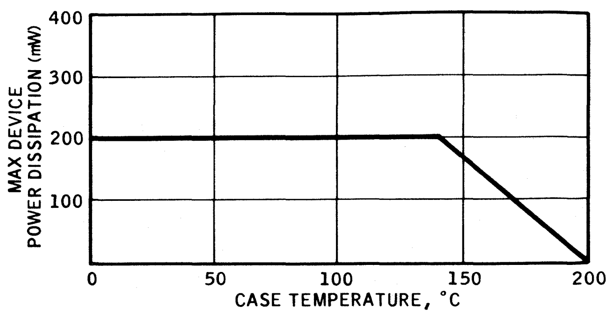
COMMON EMITTER OPERATING CHARACTERISTICS ($T_A = 25°C$)

Parameter	Symbol	Test Cond $V_{CE} I_C$	Freq GHz	AT-4690 Min	Typ	Max
Spot Noise Figure	NF_{opt}	10V 5 mA	4		2.8 dB	3.0 dB
Spot Noise Figure	NF_{opt}	10V 5 mA	2		2.0 dB	
Spot Noise Figure	NF_{opt}	10V 5 mA	1		1.6 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	4	8.5 dB	9.5 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	2	12 dB	13 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	1		17.5 dB	
Max Available Power Gain	G_{max}	10V 15 mA	4	12 dB	13.2 dB	
Max Available Power Gain	G_{max}	10V 15 mA	2		16.2 dB	

MAXIMUM RATINGS ($T_A = 25°C$)

Parameter	Symbol	Limit
Reverse Emitter Base Voltage	V_{EB}	1.5V
Reverse Collector Base Voltage	V_{CB}	2.0V
Open Base Collector-Emitter Voltage	V_{CEO}	14V
Collector Current	I_C	50 mA
Continuous Dissipation	P_T (T_{case} = 25°C)	200 mW
Junction Temperature	T_j	200°C
Storage Temperature Range	T_{STG}	– 65 to 200°C
Thermal Resistance	θ_{jc}	300°C/watt

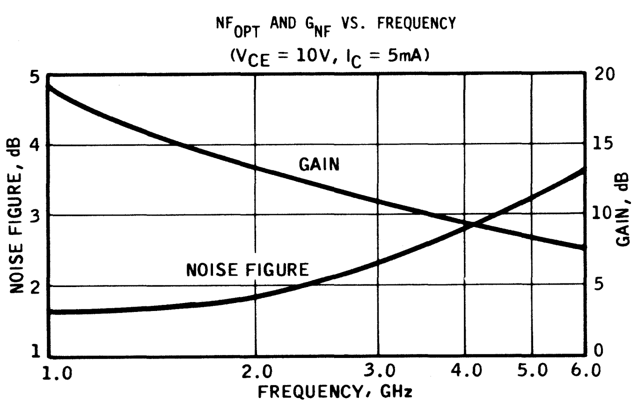
POWER DERATING CURVE

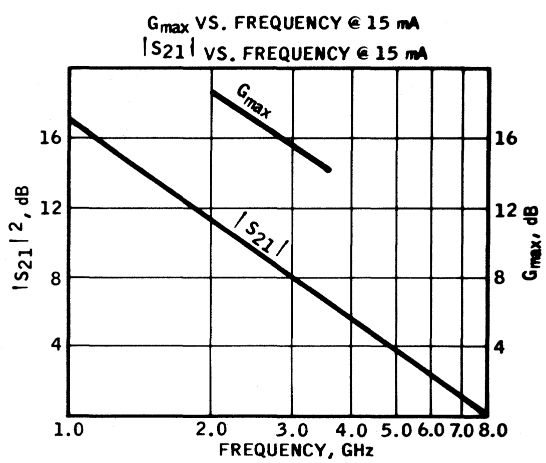


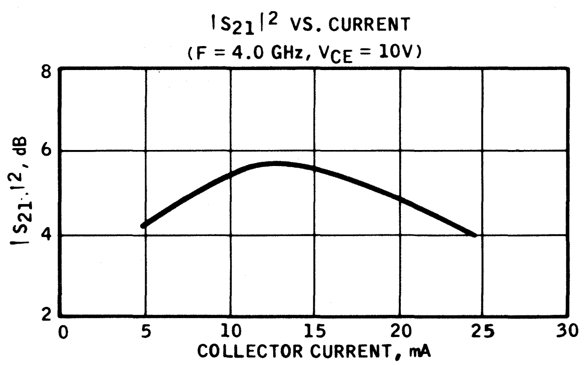
ELECTRICAL CHARACTERISTICS ($T_A = 25°C$)

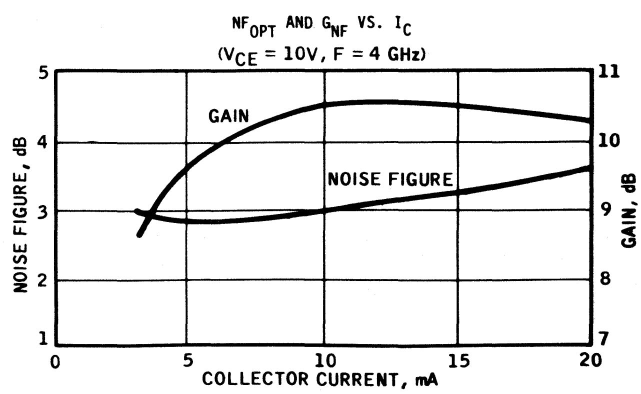
Parameter	Symbol	Test Conditions	Min	Typ	Max
Collector-Base Breakdown	$V_{(BR)}CBO$	$I_C = 10\ \mu A$	20V		
Emitter-Base Breakdown	$V_{(BR)}EBO$	$I_E = 10\ \mu A$	2.0V		
Collector-Emitter Breakdown	$V_{(BR)}CEO$	$I_C = 100\ \mu A$	14V		
Collector Cutoff Current	I_{CBO}	$V_{CB} = 10V$			20 nA
Forward Current Transfer Ratio	h_{FE}	$V_{CE} = 10V, I_C = 15\ mA$	20	150	
Collector-Base Capacitance	C_{cb}	$V_{CB} = 10V$			0.5 pF

TYPICAL PERFORMANCE CURVES

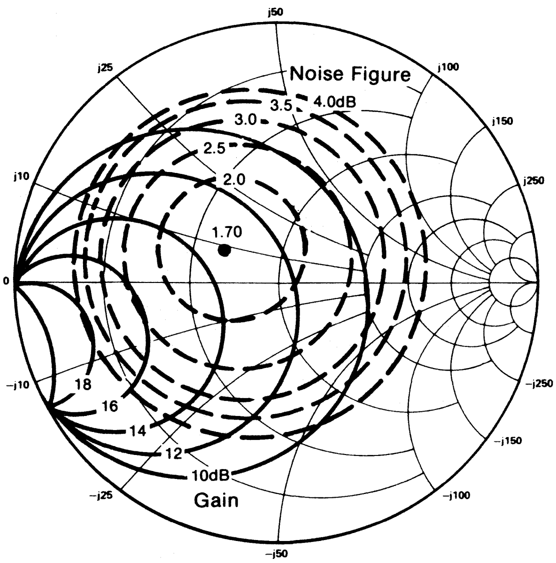




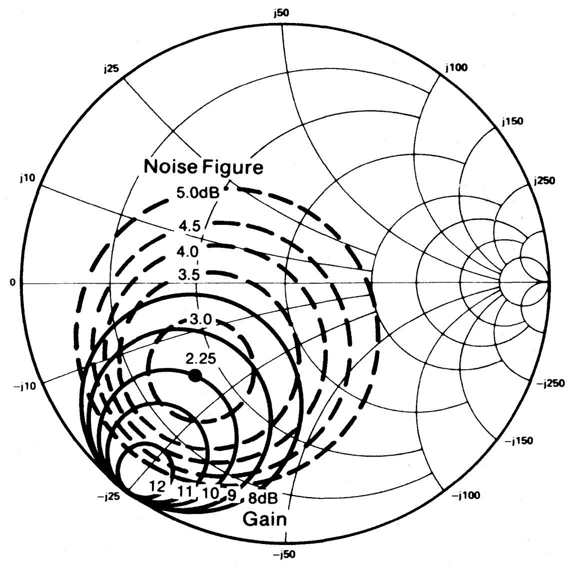




TYPICAL CONTOURS OF CONSTANT GAIN AND NOISE FIGURE



(Frequency = 2 GHz 10V, 5 mA)



(Frequency = 4 GHz 10V, 5 mA)

TYPICAL SCATTERING PARAMETERS

Bias = 10.00 Volts, 5.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.710	−98.3	9.158	117.2	.036	42.9	.800	−28.0
1000.00	.665	−144.6	5.715	86.3	.045	25.0	.681	−40.8
2000.00	.646	172.0	3.042	47.9	.051	13.5	.642	−64.0
3000.00	.644	145.1	2.066	16.2	.058	7.7	.655	−90.1
4000.00	.648	122.2	1.547	−13.2	.068	1.0	.679	−114.0
5000.00	.640	102.4	1.218	−39.4	.081	−7.3	.711	−141.8
6000.00	.626	84.1	.972	−64.9	.094	−17.4	.759	−166.4
7000.00	.573	64.9	.797	−89.8	.111	−30.5	.818	172.7
8000.00	.489	38.8	.686	−113.7	.136	−46.3	.859	158.8

Bias = 10.00 Volts, 10.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.636	−128.4	12.382	106.1	.026	40.2	.687	−30.0
1000.00	.636	−165.4	6.946	79.4	.032	33.3	.594	−39.8
2000.00	.640	160.3	3.569	45.2	.042	28.9	.580	−62.5
3000.00	.641	137.1	2.398	15.6	.056	21.5	.599	−88.7
4000.00	.646	116.1	1.789	−12.7	.071	12.2	.627	−113.0
5000.00	.637	97.3	1.417	−38.0	.088	.0	.664	−140.5
6000.00	.620	79.8	1.142	−63.3	.104	−13.1	.721	−165.6
7000.00	.559	60.2	.936	−88.1	.121	−29.2	.790	173.6
8000.00	.469	34.3	.809	−112.4	.145	−46.5	.838	160.1

TYPICAL SCATTERING PARAMETERS (CONTINUED)

Bias = 10.00 Volts, 15.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.628	−137.4	12.973	102.9	.023	38.7	.659	−29.8
1000.00	.637	−170.8	7.117	77.6	.028	35.9	.577	−39.1
2000.00	.645	157.5	3.628	44.3	.041	32.2	.571	−62.2
3000.00	.644	135.2	2.433	15.1	.055	25.6	.591	−88.4
4000.00	.651	114.7	1.815	−12.9	.072	14.7	.619	−112.6
5000.00	.642	95.7	1.437	−38.0	.090	1.9	.655	−140.3
6000.00	.623	78.3	1.156	−63.1	.105	−11.2	.716	−165.5
7000.00	.564	58.7	.950	−87.8	.123	−27.7	.784	173.8
8000.00	.475	32.4	.816	−112.4	.147	−45.6	.834	160.4

Bias = 10.00 Volts, 20.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.636	−150.2	12.750	98.2	.020	43.0	.638	−27.5
1000.00	.651	−178.0	6.815	74.9	.024	41.3	.581	−37.1
2000.00	.660	154.1	3.453	42.7	.039	38.3	.581	−61.2
3000.00	.661	132.5	2.316	13.9	.054	30.9	.603	−88.0
4000.00	.668	112.6	1.723	−14.0	.072	19.7	.631	−112.8
5000.00	.661	94.2	1.358	−39.1	.090	5.9	.669	−140.7
6000.00	.645	76.3	1.091	−64.0	.107	−8.4	.723	−165.5
7000.00	.585	56.1	.898	−88.7	.126	−25.2	.787	173.7
8000.00	.497	28.8	.773	−113.0	.153	−43.7	.834	159.7

Bias = 10.00 Volts, 25.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.644	−156.6	11.450	95.9	.018	42.7	.650	−25.0
1000.00	.661	−178.6	6.085	74.0	.023	43.3	.608	−35.6
2000.00	.672	152.3	3.115	42.4	.037	40.4	.608	−61.1
3000.00	.675	131.4	2.088	13.3	.053	33.1	.627	−88.4
4000.00	.683	111.5	1.557	−14.8	.070	21.5	.652	−113.5
5000.00	.676	93.0	1.228	−40.0	.090	8.5	.689	−141.5
6000.00	.664	74.9	.986	−64.8	.107	−6.3	.739	−166.4
7000.00	.605	54.3	.807	−89.4	.128	−22.9	.798	172.7
8000.00	.521	25.8	.692	−113.5	.157	−42.1	.843	159.0

CHIP CODE M11

AT-4890

Low Noise
Bipolar Transistor

FEATURES

- **NF Flat Within 0.8 dB for I_C = 2.5 to 20 mA**
- **Low Noise Figure—NF_{opt} = 2.8 dB @ 4 GHz**
- **High Associated Gain—G_{NF} = 9.5 dB**
- **Hermetic 100 Mil Microstrip Package**
- **Arsenic Emitter**

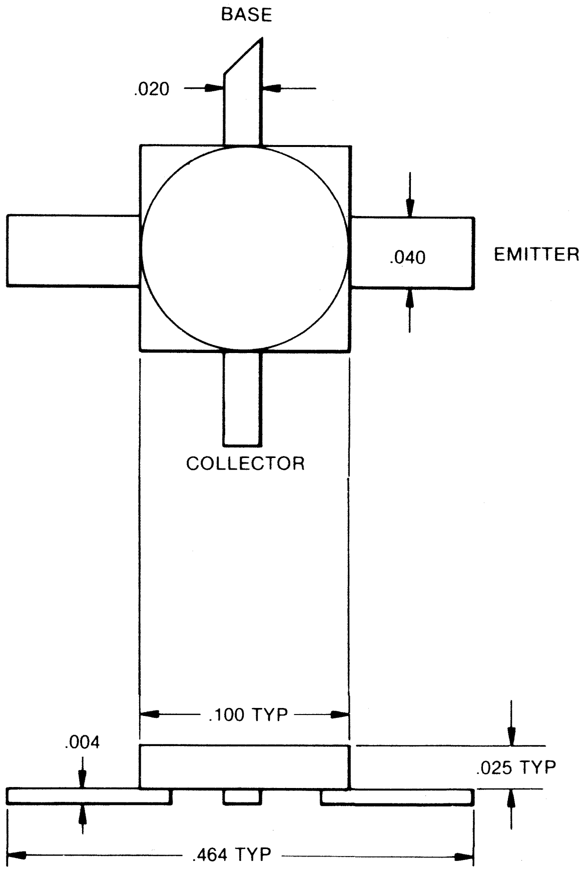
DESCRIPTION

The Avantek AT-4890 silicon bipolar transistor is designed for small signal amplification at frequencies up to 6 GHz. An important feature of this transistor is its flat noise figure vs. collector current characteristic which permits it to be used at collector currents from 2.5 mA to 20 mA with only 0.8 dB (approx.) change in noise figure. This characteristic allows the amplifier designer to obtain a larger output power per amplification stage, while still minimizing the second (and subsequent) stage noise figure contribution.

Avantek uses a highly reliable gold-based metal system on the 4890 transistor that combines excellent adherence, junction performance and corrosion resistance with high bond strength and freedom from current-induced metal transport (metal migration). An arsenic-doped 0.5 micron emitter structure helps provide low noise figures and high associated gain and a silicon dioxide layer protects the chip from contamination or scratching during fabrication.

The 100 mil square ceramic/metal stripline package is hermetically sealed while flooded with a dry, inert atmosphere to assure long-term protection from humidity and corrosive gases.

OUTLINE DRAWING 100 MIL PACKAGE



TOLERANCES: ± .010/ ± .02

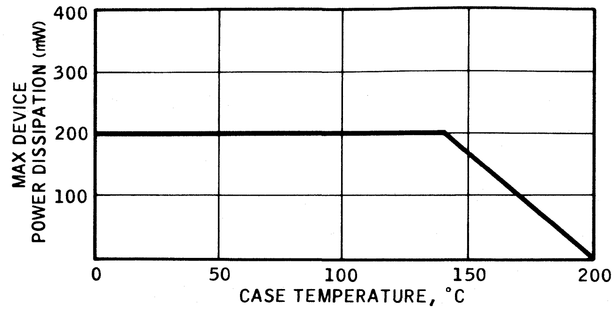
COMMON EMITTER OPERATING CHARACTERISTICS (T_A = 25°C)

Parameter	Symbol	Test Cond V_{CE} I_C	Freq GHz	AT-4890 Min	AT-4890 Typ	AT-4890 Max
Spot Noise Figure	NF_{opt}	10V 5 mA	4		2.8 dB	3.0 dB
Spot Noise Figure	NF_{opt}	10V 5 mA	2		2.0 dB	
Spot Noise Figure	NF_{opt}	10V 5 mA	1		1.6 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	4	8.5 dB	9.5 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	2	12 dB	13 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	1		17.5 dB	
Max Available Power Gain	G_{max}	10V 15 mA	4	12 dB	13.2 dB	
Max Available Power Gain	G_{max}	10V 15 mA	2		16.2 dB	

MAXIMUM RATINGS ($T_A = 25°C$)

Parameter	Symbol	Limit
Reverse Emitter Base Voltage	V_{EB}	1.5V
Reverse Collector Base Voltage	V_{CB}	20.0V
Open Base Collector-Emitter Voltage	V_{CEO}	14V
Collector Current	I_C	50 mA
Continuous Dissipation	P_T ($T_{case} =$ 25°C)	200 mW
Junction Temperature	T_j	200°C
Storage Temperature Range	T_{STG}	– 65 to 200°C
Thermal Resistance	θ_{jc}	300°C/watt

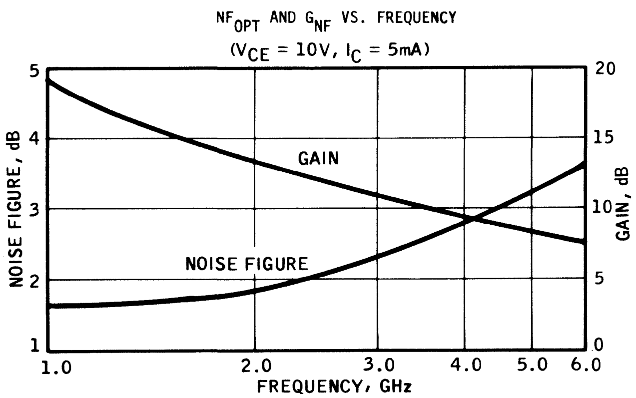
POWER DERATING CURVE

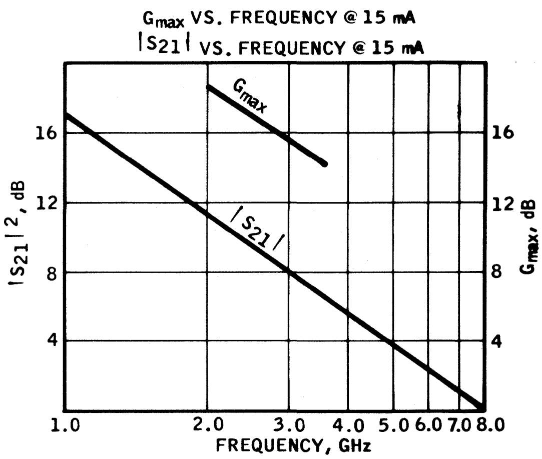


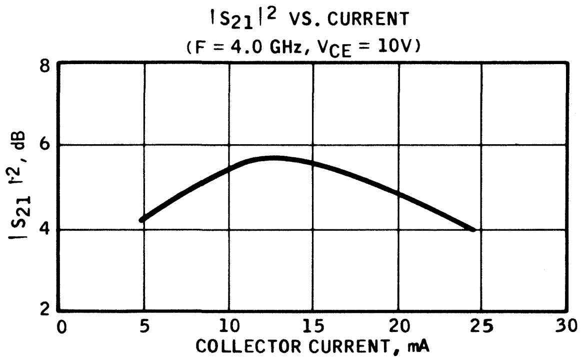
ELECTRICAL CHARACTERISTICS ($T_A = 25°C$)

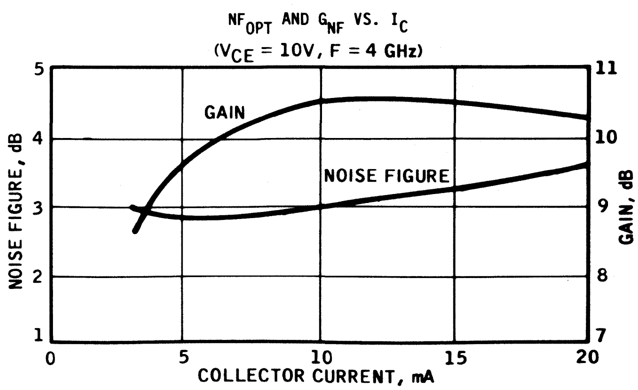
Parameter	Symbol	Test Conditions	Min	Typ	Max
Collector-Base Breakdown	$V_{(BR)}CBO$	$I_C = 10\ \mu A$	20V		
Emitter-Base Breakdown	$V_{(BR)}EBO$	$I_E = 10\ \mu A$	2.0V		
Collector-Emitter Breakdown	$V_{(BR)}CEO$	$I_C = 100\ \mu A$	14V		
Collector Cutoff Current	I_{CBO}	$V_{CB} = 10V$			20 nA
Forward Current Transfer Ratio	h_{FE}	$V_{CE} = 10V$, $I_C = 15$ mA	20	150	
Collector-Base Capacitance	C_{cb}	$V_{CB} = 10V$			0.5 pF

TYPICAL PERFORMANCE CURVES

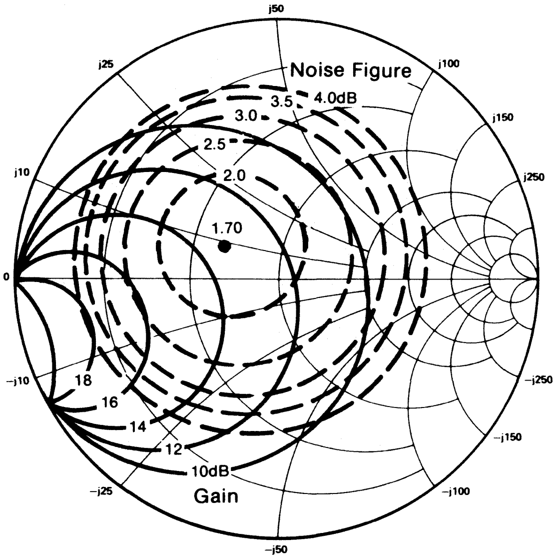




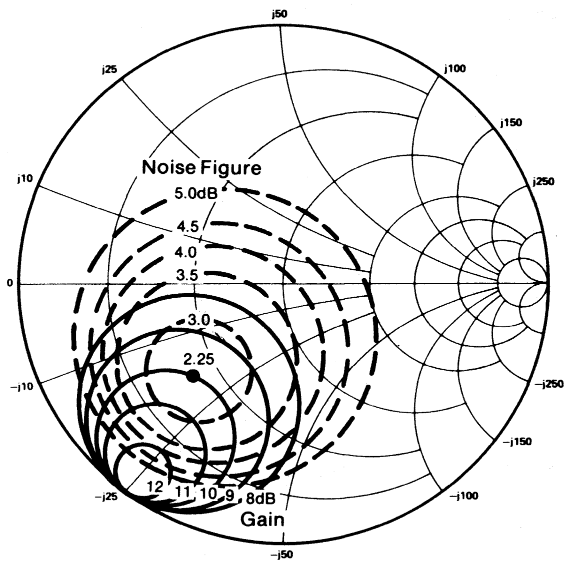




TYPICAL CONTOURS OF CONSTANT GAIN AND NOISE FIGURE



(Frequency = 2 GHz 10V, 5 mA)



(Frequency = 4 GHz 10V, 5 mA)

TYPICAL SCATTERING PARAMETERS

Bias = 10.00 Volts, 5.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.710	−98.3	9.158	117.2	.036	42.9	.800	−28.0
1000.00	.665	−144.6	5.715	86.3	.045	25.0	.681	−40.8
2000.00	.646	172.0	3.042	47.9	.051	13.5	.642	−64.0
3000.00	.644	145.1	2.066	16.2	.058	7.7	.655	−90.1
4000.00	.648	122.2	1.547	−13.2	.068	1.0	.679	−114.0
5000.00	.640	102.4	1.218	−39.4	.081	−7.3	.711	−141.8
6000.00	.626	84.1	.972	−64.9	.094	−17.4	.759	−166.4
7000.00	.573	64.9	.797	−89.8	.111	−30.5	.818	172.7
8000.00	.489	38.8	.686	−113.7	.136	−46.3	.859	158.8

Bias = 10.00 Volts, 10.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.636	−128.4	12.382	106.1	.026	40.2	.687	−30.0
1000.00	.636	−165.4	6.946	79.4	.032	33.3	.594	−39.8
2000.00	.640	160.3	3.569	45.2	.042	28.9	.580	−62.5
3000.00	.641	137.1	2.398	15.6	.056	21.5	.599	−88.7
4000.00	.646	116.1	1.789	−12.7	.071	12.2	.627	−113.0
5000.00	.637	97.3	1.417	−38.0	.088	.0	.664	−140.5
6000.00	.620	79.8	1.142	−63.3	.104	−13.1	.721	−165.6
7000.00	.559	60.2	.936	−88.1	.121	−29.2	.790	173.6
8000.00	.469	34.3	.809	−112.4	.145	−46.5	.838	160.1

TYPICAL SCATTERING PARAMETERS (CONTINUED)

Bias = 10.00 Volts, 15.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.628	−137.4	12.973	102.9	.023	38.7	.659	−29.8
1000.00	.637	−170.8	7.117	77.6	.028	35.9	.577	−39.1
2000.00	.645	157.5	3.628	44.3	.041	32.2	.571	−62.2
3000.00	.644	135.2	2.433	15.1	.055	25.6	.591	−88.4
4000.00	.651	114.7	1.815	−12.9	.072	14.7	.619	−112.6
5000.00	.642	95.7	1.437	−38.0	.090	1.9	.655	−140.3
6000.00	.623	78.3	1.156	−63.1	.105	−11.2	.716	−165.5
7000.00	.564	58.7	.950	−87.8	.123	−27.7	.784	173.8
8000.00	.475	32.4	.816	−112.4	.147	−45.6	.834	160.4

Bias = 10.00 Volts, 20.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.636	−150.2	12.750	98.2	.020	43.0	.638	−27.5
1000.00	.651	−178.0	6.815	74.9	.024	41.3	.581	−37.1
2000.00	.660	154.1	3.453	42.7	.039	38.3	.581	−61.2
3000.00	.661	132.5	2.316	13.9	.054	30.9	.603	−88.0
4000.00	.668	112.6	1.723	−14.0	.072	19.7	.631	−112.8
5000.00	.661	94.2	1.358	−39.1	.090	5.9	.669	−140.7
6000.00	.645	76.3	1.091	−64.0	.107	−8.4	.723	−165.5
7000.00	.585	56.1	.898	−88.7	.126	−25.2	.787	173.7
8000.00	.497	28.8	.773	−113.0	.153	−43.7	.834	159.7

Bias = 10.00 Volts, 25.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.644	−156.6	11.450	95.9	.018	42.7	.650	−25.0
1000.00	.661	−178.6	6.085	74.0	.023	43.3	.608	−35.6
2000.00	.672	152.3	3.115	42.4	.037	40.4	.608	−61.1
3000.00	.675	131.4	2.088	13.3	.053	33.1	.627	−88.4
4000.00	.683	111.5	1.557	−14.8	.070	21.5	.652	−113.5
5000.00	.676	93.0	1.228	−40.0	.090	8.5	.689	−141.5
6000.00	.664	74.9	.986	−64.8	.107	−6.3	.739	−166.4
7000.00	.605	54.3	.807	−89.4	.128	−22.9	.798	172.7
8000.00	.521	25.8	.692	−113.5	.157	−42.1	.843	159.0

CHIP CODE M11

General Purpose
Bipolar Transistor

FEATURES

- **1.2 dB Noise Figure at 60 MHz**
- **25 dB Gain @ NF**
- **Very Wide Dynamic Range**
- **Gold Metal System**
- **Hermetic TO-72 Package**
- **Phosphorous Emitter**

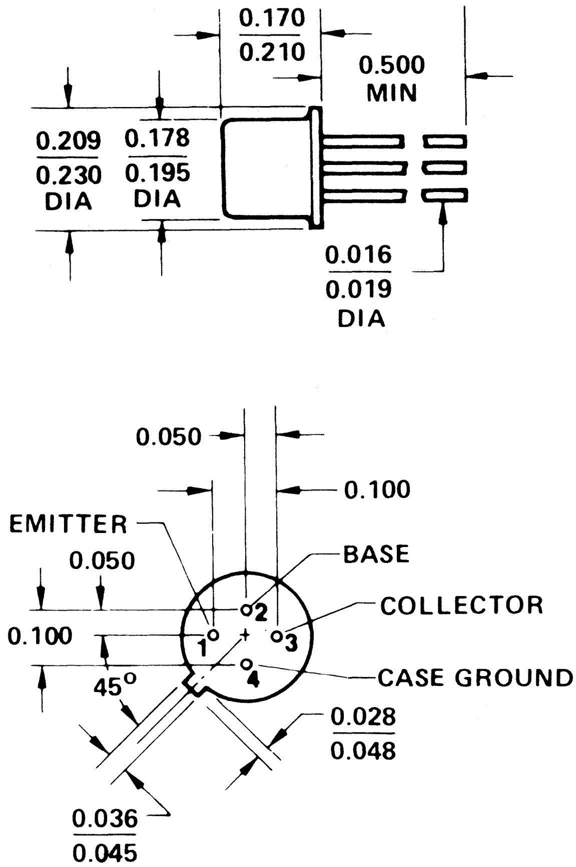
DESCRIPTION

The AT-0017 is designed for low noise figure, high gain, small signal amplification at frequencies through approximately 400 MHz. It maintains a low noise figure at high collector current levels for wide dynamic range, and its linear transducer gain vs. collector current characteristic assures low intermodulation distortion.

This transistor is widely used in front-end amplifiers in VHF receiving systems, in both wide and narrow-band IF systems and in instrumentation and EW amplifiers. It also works well for VHF-UHF oscillators due to its high gain and f_T.

The AT-0017 is fabricated with an etchless gold metal system that produces films of 1 μm thickness and extremely uniform coverage. The TO-72 package is filled with a dry, inert atmosphere and hermetically welded to assure longterm protection from moisture and corrosive gases. The AT-0017 will withstand normal handling, installation and soldering procedures.

OUTLINE DRAWING TO-72 PACKAGE



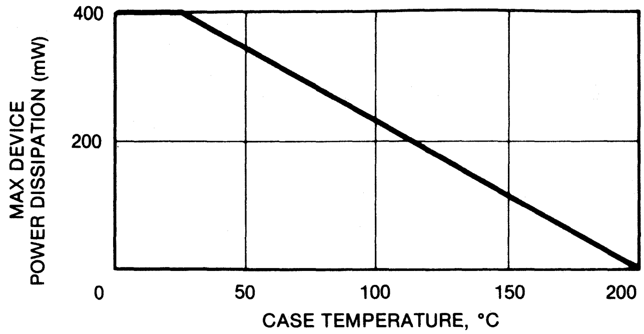
COMMON EMITTER OPERATING CHARACTERISTICS ($T_A = 25°C$)

Parameter	Symbol	Test Conditions	Min	AT-0017 Typ	Max
Spot Noise Figure, AT-0017	NF_{opt}	$V_{CB} = 10V, I_C = 5$ mA, f = 60 MHz			1.5 dB
Gain at Optimum Noise Figure	G_{NF}	$V_{CB} = 10V, I_C = 5$ mA, f = 60 MHz		25 dB	

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_{case} = 25°C)	400 mW
Junction Temperature	T_j	200°C
Storage Temperature Range	T_{STG}	− 65 to 200°C

POWER DERATING CURVE



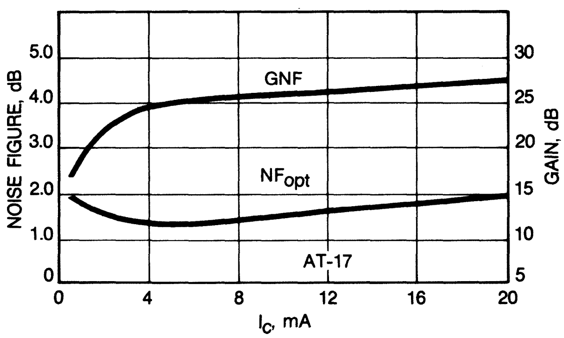
ELECTRICAL CHARACTERISTICS ($T_A = 25°C$)

Parameter	Symbols	Test Conditions	Min	Typ	Max
Collector-Base Breakdown	$V_{(BR)}CBO$	$I_C = 10\ \mu A$	20V		
Emitter-Base Breakdown	$V_{(BR)}EBO$	$I_E = 10\ \mu A$	3V		
Collector-Emitter Breakdown	$V_{(BR)}CEO$	$I_C = 100\ \mu A$	12V		
Collector Cutoff Current	I_{CBO}	$V_{CB} = 10V$		10 nA	
Forward Current Transfer Ratio	h_{FE}	$V_{CE} = 10V$, $I_C = 5$ mA	20	75	
Collector-Base Capacitance	C_{cb}	$V_{CB} = 10V$, $I_E = 0$		0.8 pF	

TYPICAL PERFORMANCE CURVES ($T_A = 25°C$)

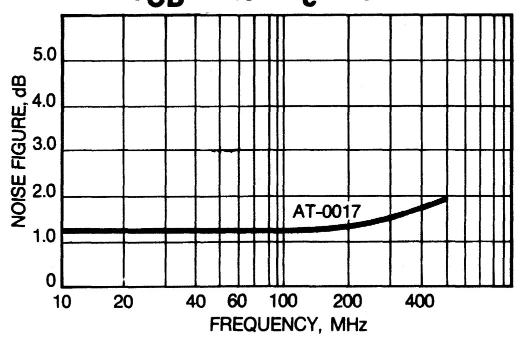
SPOT NOISE FIGURE (NF_{opt}) AND ASSOCIATED GAIN (G_{NF}) VS. COLLECTOR CURRENT

V_{CB} = 10V, f = 60 MHz

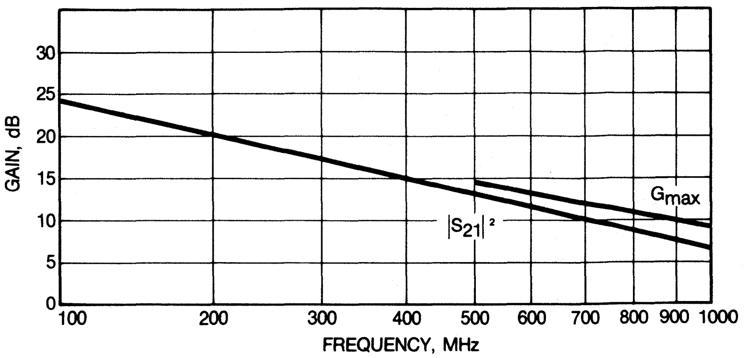


SPOT NOISE FIGURE (NF_{opt}) VS. FREQUENCY

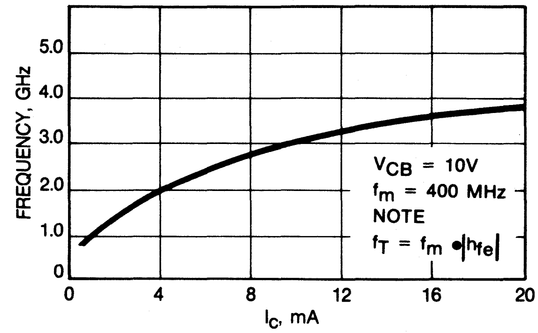
V_{CB} = 10V I_C = 5 mA



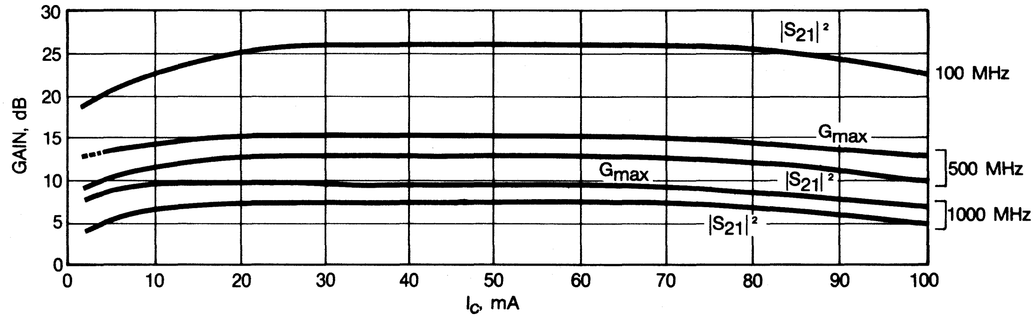
MAXIMUM AVAILABLE GAIN (G_{max}) AND INSERTION POWER GAIN ($|S_{21}|^2$) VS. FREQUENCY V_{CE} = 10V, I_C = 10 mA



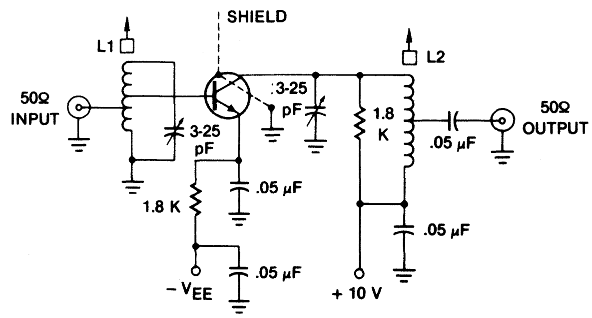
TRANSITION FREQUENCY (F_T) VS. COLLECTOR CURRENT



MAXIMUM AVAILABLE GAIN (G_{max}) AND INSERTION POWER GAIN ($|S_{21}|^2$) VS. COLLECTOR CURRENT AND FREQUENCY V_{CE} = 10V



PARAMETER MEASUREMENT INFORMATION



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

Bias = 10.00 Volts, 5.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
100.00	.611	−54.5	9.982	139.2	.046	65.9	.828	−24.7
200.00	.483	−91.7	7.140	116.8	.070	58.2	.649	−34.4
300.00	.414	−117.1	5.315	103.5	.085	56.0	.539	−38.6
400.00	.377	−136.1	4.242	93.8	.099	55.5	.469	−40.8
500.00	.360	−151.0	3.466	84.6	.112	56.8	.413	−43.7
600.00	.356	−162.6	2.959	78.9	.123	57.2	.375	−48.0
700.00	.354	−171.7	2.621	73.0	.138	58.4	.363	−53.6
800.00	.355	−179.7	2.317	67.6	.155	59.1	.371	−59.1
900.00	.352	173.2	2.121	63.8	.170	59.8	.380	−62.8
1000.00	.354	166.5	1.942	58.7	.186	59.8	.384	−64.9

Bias = 10.00 Volts, 15.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
100.00	.387	−74.4	15.491	125.7	.037	67.0	.663	−34.9
200.00	.298	−113.0	9.571	106.3	.059	66.0	.464	−41.8
300.00	.267	−136.5	6.778	95.9	.079	67.2	.369	−42.7
400.00	.253	−154.2	5.281	88.5	.100	67.5	.314	−42.3
500.00	.251	−166.4	4.283	81.9	.118	66.7	.265	−44.0
600.00	.256	−175.7	3.626	77.1	.137	66.2	.233	−48.4
700.00	.258	177.4	3.175	71.4	.157	65.4	.226	−55.7
800.00	.262	170.8	2.807	66.9	.178	64.4	.233	−61.6
900.00	.262	165.2	2.558	63.0	.199	63.5	.248	−64.6
1000.00	.265	159.1	2.338	58.6	.217	61.7	.255	−65.5

CHIP CODE M1

AT-0025/AT-0025A

General Purpose
Bipolar Transistor

FEATURES

- **2.0 dB Noise Figure at 500 MHz**
- **17 dB G_{max}**
- **Wide Dynamic Range**
- **Gold Metal System**
- **Hermetic TO-72 Package**
- **Phosphorous Emitter**

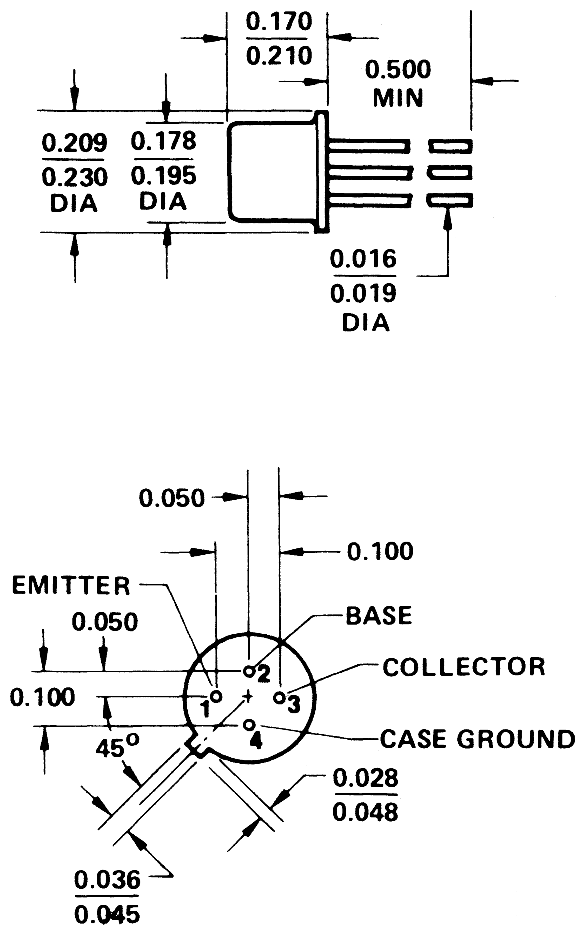
DESCRIPTION

The Avantek AT-0025 and AT-0025A are designed to provide economical low noise figure, high gain, small signal amplification at frequencies up to 1 GHz. They maintain their low noise figure at high collector current levels for wide dynamic range and their flat linear transducer gain vs. collector current characteristic assures low intermodulation distortion.

These transistors offer a cost-effective choice for use in front-end amplifiers in VHF-UHF receivers, in both wide and narrow-band IF systems and in wideband instrumentation and EW amplifiers. Their combination of high power gain and high f_T also makes them very useful as VHF, UHF and microwave oscillators.

The AT-0025 and AT-0025A transistor chips are fabricated with an etchless gold metal system that produces films of 1 μm thickness and extremely uniform coverage. The TO-72 package is filled with a dry, inert atmosphere and hermetically welded to assure long-term protection from moisture and corrosive gases. It will withstand all normal handling, installation and soldering procedures.

OUTLINE DRAWING TO-72 PACKAGE



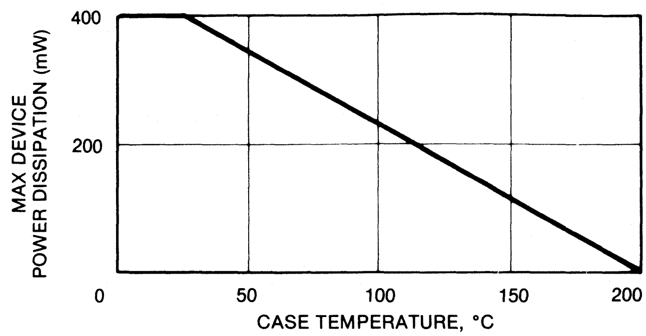
COMMON EMITTER OPERATING CHARACTERISTICS ($T_A = 25°C$)

Parameters	Symbols	Test Conditions	AT-0025 Typ	AT-0025 Max	AT-0025A Typ	AT-0025A Max
Spot Noise Figure	NF	V_{CB} = 10V, I_C = 3 mA, f = .5 GHz		2.5 dB		2.0 dB
		V_{CB} = 10V, I_C = 3 mA, f = 1.0 GHz	3.5 dB		3.0 dB	
Maximum Available Gain	G_{max}	V_{CB} = 10V, I_C = 10 mA, f = .5 GHz	17 dB		17 dB	
		V_{CB} = 10V, I_C = 10 mA, F = 1.0 GHz	11 dB		11 dB	

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}	15V
Collector Current	I_C	50 mA
Continuous Dissipation	P_T (T_{case} = 25°C)	400 mW
Junction Temperature	T_j	200°C
Storage Temperature Range	T_{STG}	– 65 to 200°C

POWER DERATING CURVE

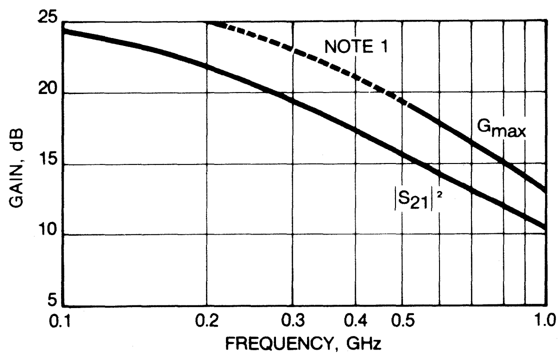


ELECTRICAL CHARACTERISTICS ($T_A = 25°C$)

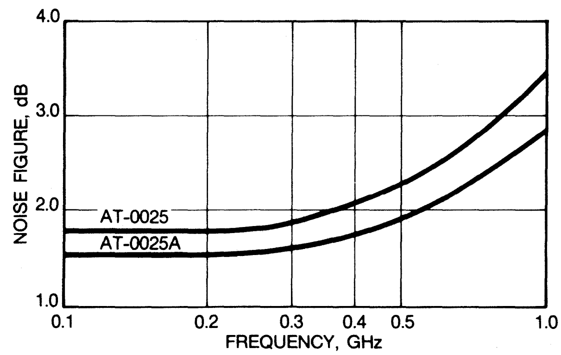
Parameter	Symbols	Test Conditions	Min	Typ	Max
Emitter-Base Breakdown Voltage	$V_{(BR)}EBO$	$I_E = 10\ \mu A$	3V		
Collector-Base Breakdown Voltage	$V_{(BR)}CBO$	$I_C = 10\ \mu A$	20V		
Collector-Emitter Breakdown Voltage	$V_{(BR)}CEO$	$I_C = 100\ \mu A$	15V		
Collector Cutoff Current	I_{CBO}	$V_{CB} = 10V$			20 nA
Emitter Cutoff Current	I_{EBO}	$V_{EB} = 3V$			10 μA
Forward Current Transfer Ratio	h_{FE}	$I_C = 10mA$, $V_{CE} = 10V$	30	75	
Collector-Base Capacitance	C_{cb}	$I_E = 0$, $V_{CB} = 10V$			.5 pF

TYPICAL PERFORMANCE CURVES ($T_A = 25°C$)

MAXIMUM AVAILABLE GAIN (G_{max}) AND INSERTION POWER GAIN ($|S_{21}|^2$) VS. FREQUENCY
V_{CE} = 10V, I_c = 10 mA

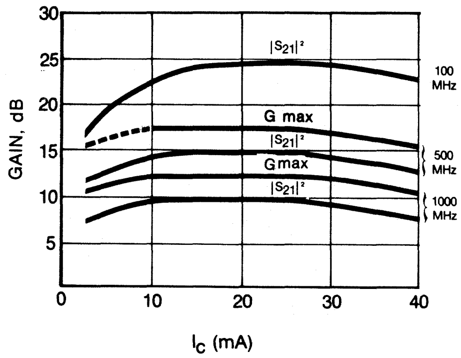


SPOT NOISE FIGURE (NF_{opt}) VS. FREQUENCY
V_{CE} = 10V, I_c = 3mA



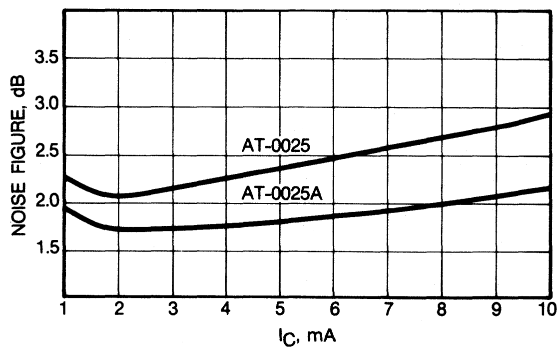
MAXIMUM AVAILABLE GAIN (G_{max}) AND INSERTION POWER GAIN ($|S_{21}|^2$) VS. COLLECTOR CURRENT AND FREQUENCY

V_{CE} = 10V

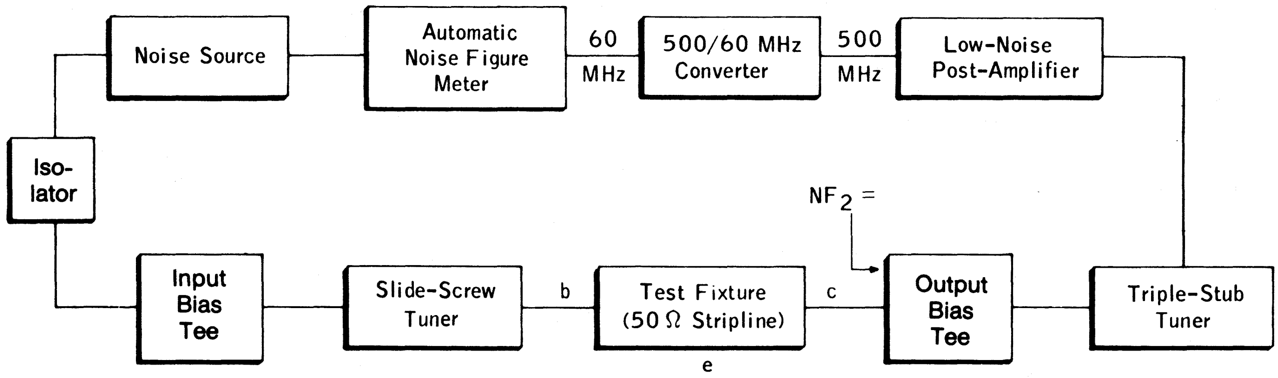


SPOT NOISE FIGURE (NF_{opt}) VS. COLLECTOR CURRENT

F = 500 MHz, V_{CE} = 10V



500 MHz NF SETUP (See Notes 2 and 3)



NOTES

1. The dotted line indicates a frequency or current range where the transistor is potentially unstable and G_{max} is undefined.
2. Bias blocks (or other bias insertion components) must be broad-band to prevent spurious oscillations.
3. Loss between the noise source and the device under test (I_L) and the second stage noise contribution (NF_2) are accounted for as follows:

$$NF_1 = NF_{MTR} - I_L - \frac{NF_2 - 1}{G_1}$$

where:

NF_1 = Noise figure of device under test.
G_1 = Gain of device under test.
NF_{MTR} = Uncorrected system noise figure from NF meter.

SECTION 3

TYPICAL SCATTERING PARAMETERS

Bias = 10.00 Volts, 3.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
100.00	.753	−20.7	7.304	157.1	.019	81.5	.963	−9.1
200.00	.660	−37.5	6.403	140.1	.036	72.0	.908	−15.6
300.00	.557	−51.6	5.501	126.2	.049	68.8	.846	−20.4
400.00	.462	−62.9	4.742	115.1	.060	65.0	.790	−24.0
500.00	.385	−72.6	4.069	105.5	.067	63.5	.734	−27.0
600.00	.324	−81.3	3.576	97.8	.075	63.3	.700	−30.1
700.00	.277	−88.3	3.224	91.4	.084	63.3	.685	−34.0
800.00	.242	−94.3	2.876	85.3	.094	64.2	.689	−37.4
900.00	.211	−100.1	2.644	80.5	.102	65.4	.691	−40.3
1000.00	.184	−106.1	2.413	74.9	.108	65.4	.691	−42.3

Bias = 10.00 Volts, 10.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
100.00	.504	−26.3	14.470	143.3	.017	80.1	.896	−13.3
200.00	.385	−42.3	10.707	123.0	.031	74.6	.789	−18.5
300.00	.300	−51.0	8.174	110.4	.043	76.0	.722	−21.0
400.00	.237	−55.4	6.575	101.6	.054	74.7	.675	−22.4
500.00	.193	−59.0	5.398	94.1	.064	73.3	.634	−24.2
600.00	.160	−61.5	4.630	89.0	.076	72.6	.606	−27.0
700.00	.138	−62.5	4.086	83.9	.088	73.2	.600	−30.7
800.00	.123	−64.8	3.598	78.6	.100	73.1	.606	−34.4
900.00	.111	−64.7	3.276	74.7	.112	72.6	.615	−37.4
1000.00	.098	−64.7	2.964	69.9	.120	71.6	.622	−39.2

CHIP CODE M2

AT-1825

General Purpose
Bipolar Transistor

FEATURES

- **2.7 dB Noise Figure at 1 GHz**
- **13 dB Gain at NF**
- **Hermetic 100 Mil Microstrip Package**
- **Gold Metal System**
- **Phosphorous Emitter**

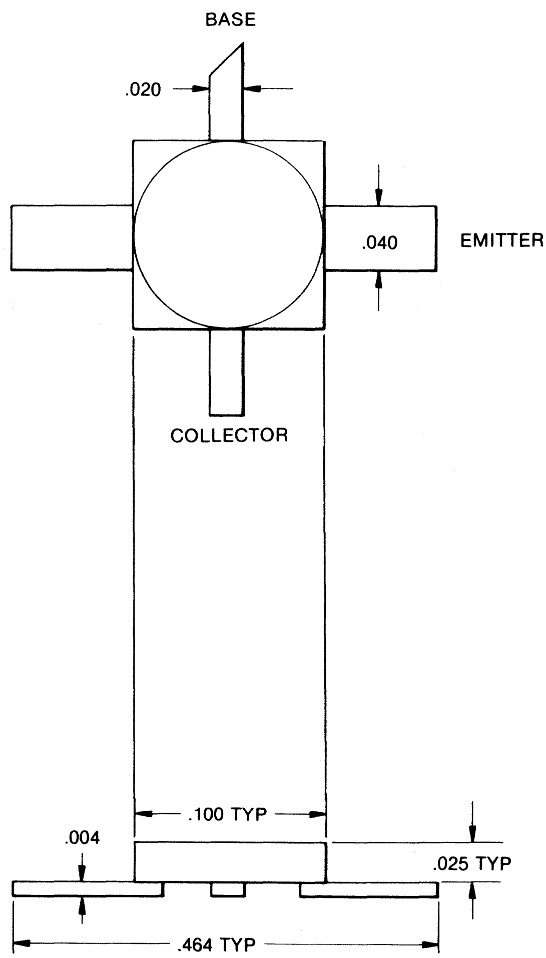
DESCRIPTION

The Avantek AT-1825, packaged in an economical 100 mil microstrip package, is designed for low noise figure, small signal amplification at frequencies up to 4 GHz. It is particularly useful as a high-performance amplifier in the 500 MHz to 1 GHz frequency range, where it offers an excellent combination of noise figure, high gain and very wide dynamic range. This transistor is widely used in tuned front-end, signal processing and IF amplifiers for radar, telemetry and communications receivers as well as in wideband amplifiers for instruments and EW systems.

The AT-1825 features an etchless gold metal system that produces films of 1 μm thickness with extremely uniform coverage. A dielectric layer protects the surface of the transistor chip from scratching or contamination before packaging.

It is easy to install the 100 mil metal/ceramic package in conventional printed circuits or hybrid thin or thick film circuits and the package will withstand handling, soldering and welding processes. Each package is filled with a dry, inert atmosphere and hermetically sealed to assure long-term protection from humidity and corrosive gases.

OUTLINE DRAWING 100 MIL PACKAGE



TOLERANCES: ± .010/ ± .02

COMMON EMITTER OPERATING CHARACTERISTICS ($T_A = 25°C$)

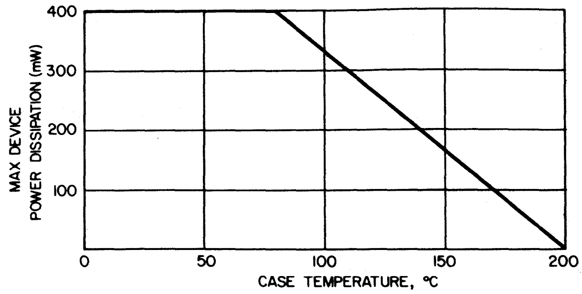
Parameter	Symbol	Test Cond $V_{CE} I_C$	Freq GHz	Min	AT-1825 Typ	Max
Spot Noise Figure	NF_{opt}	10V 5 mA	1		2.7 dB	3.0 dB
Spot Noise Figure	NF_{opt}	10V 5 mA	2		4.0 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	1		13.0 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	2		8.5 dB	
Max Available Power Gain	G_{max}	10V 15 mA	1		16.0 dB	
Max Available Power Gain	G_{max}	10V 15 mA	2		11.0 dB	

SECTION 3

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	50 mA
Continuous Dissipation	P_T (T_{case} = 25°C)	400 mW
Junction Temperature	T_j	200°C
Storage Temperature Range	T_{STG}	− 65 to 200°C
Thermal Resistance	θ_{jc}	300°C/watt

POWER DERATING CURVE

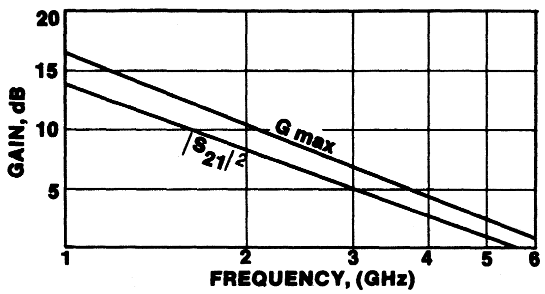


ELECTRICAL CHARACTERISTICS ($T_A = 25°C$)

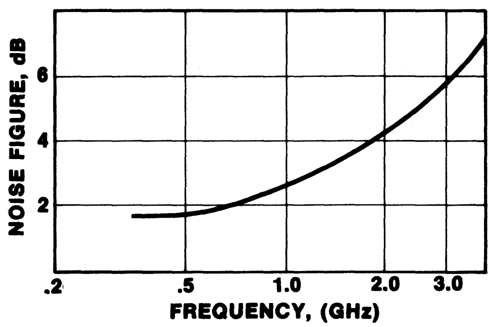
Parameter	Symbol	Test Conditions	Min	Typ	Max
Collector-Base Breakdown	$V_{(BR)}CBO$	$I_C = 10\ \mu A$	20V		
Emitter-Base Breakdown	$V_{(BR)}EBO$	$I_E = 10\ \mu A$	3V		
Collector-Emitter Breakdown	$V_{(BR)}CEO$	$I_C = 100\ \mu A$	12V		
Collector Cutoff Current	I_{CBO}	$V_{CB} = 10V$			20 nA
Forward Current Transfer Ratio	h_{FE}	$V_{CE} = 10V$, $I_C = 15$ mA	20	75	

TYPICAL PERFORMANCE CURVES ($T_A = 25°C$)

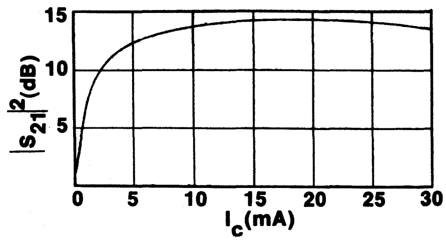
Maximum Available Gain, $|S_{21E}|^2$ vs. Frequency
V_{CE} = 10V, I_C = 15mA



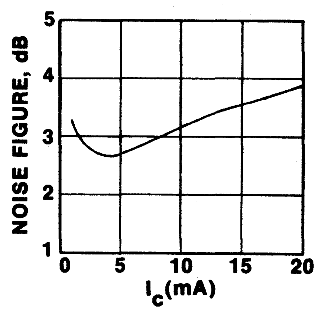
Spot Noise Figure vs. Frequency
V_{CE} = 10V, I_C = 5mA



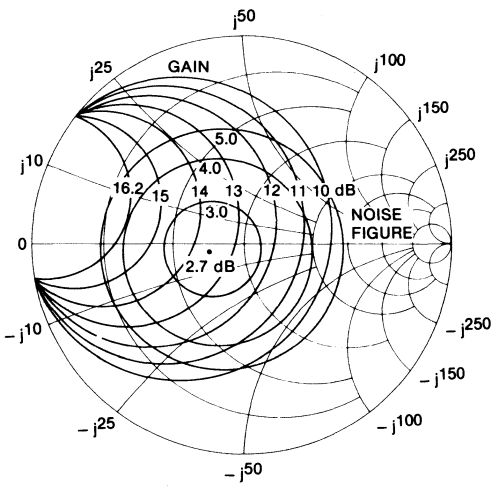
$|S_{21E}|^2$ vs. Collector Current, F = 1GHz V_{CE} = 10V



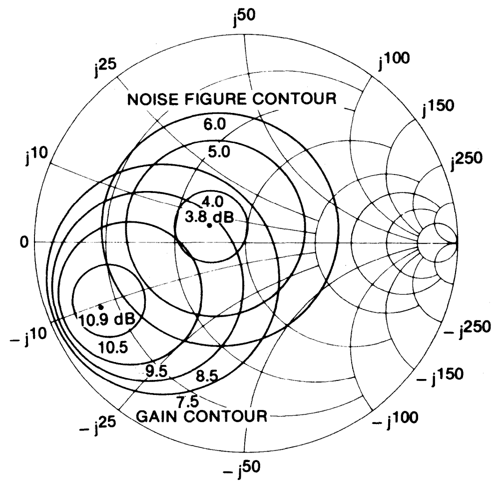
Spot Noise Figure vs. Collector Current, F = 1 GHz, V_{CE} = 10V



TYPICAL CONTOURS OF CONSTANT GAIN AND NOISE FIGURE



Frequency = 1 GHz, Bias V_{CE} = 10V, I_C = 5 mA
See Note 1



Frequency = 2 GHz, Bias V_{CE} = 10V, I_C = 5 mA

Note 1

The AT-1825 is potentially unstable at 1 GHz at V_{CE} = 10V, IC = 5 mA. The 16.2 dB gain contour represents the maximum stable gain of the device defined as $G_{MSG} = |\frac{S_{21}}{S_{12}}|$. By presenting the input with an impedance lying outside of this gain contour, the output impedance of the device is positive and may be conjugately matched to realize the specified gain.

TYPICAL SCATTERING PARAMETERS

Bias = 10.00 Volts, 5.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.575	−110.0	6.753	107.3	.059	42.4	.672	−34.6
1000.00	.518	−152.3	3.872	80.4	.075	32.9	.544	−42.9
1500.00	.510	−176.1	2.680	61.7	.089	29.2	.508	−53.2
2000.00	.513	−168.0	2.031	45.5	.101	23.9	.500	−64.0
2500.00	.518	−154.7	1.655	31.0	.113	18.8	.494	−77.1
3000.00	.529	142.3	1.388	16.7	.125	12.8	.502	−92.3
3500.00	.542	131.1	1.198	2.9	.135	7.7	.514	−106.8
4000.00	.561	121.0	1.062	−10.5	.143	3.8	.524	−117.6
4500.00	.569	111.3	.947	−23.2	.152	−2.7	.544	−132.8
5000.00	.581	102.0	.845	−34.3	.162	−8.3	.568	−148.2
5500.00	.578	93.3	.744	−45.0	.168	−13.1	.588	−162.8
6000.00	.613	84.3	.704	−54.6	.182	−18.3	.654	−176.2

Bias = 10.00 Volts, 15.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.504	−137.5	9.128	98.5	.042	44.5	.512	−40.2
1000.00	.501	−169.8	4.897	76.1	.059	42.5	.407	−45.2
1500.00	.516	171.7	3.329	59.7	.076	39.2	.382	−54.4
2000.00	.526	159.2	2.501	45.2	.091	34.0	.378	−64.5
2500.00	.536	147.5	2.024	31.7	.104	28.4	.376	−77.7
3000.00	.551	136.4	1.692	18.3	.118	21.9	.385	−92.8
3500.00	.564	125.8	1.461	5.2	.130	17.0	.400	−107.8
4000.00	.585	116.3	1.290	−6.6	.140	12.1	.410	−118.6
4500.00	.592	106.7	1.153	−20.1	.152	−5.8	.433	−133.8
5000.00	.603	97.8	1.036	−30.9	.164	−.8	.461	−149.2
5500.00	.598	89.1	.918	−41.5	.174	−6.0	.487	−163.4
6000.00	.634	80.1	.873	−51.2	.191	−11.6	.554	−176.3

CHIP CODE M2

AT-1845

General Purpose
Bipolar Transistor

FEATURES

- **2.3 dB Noise Figure at 1 GHz**
- **14.0 dB Gain at NF**
- **Hermetic 100 Mil Microstrip Package**
- **Gold Metal System**
- **Phosphorous Emitter**

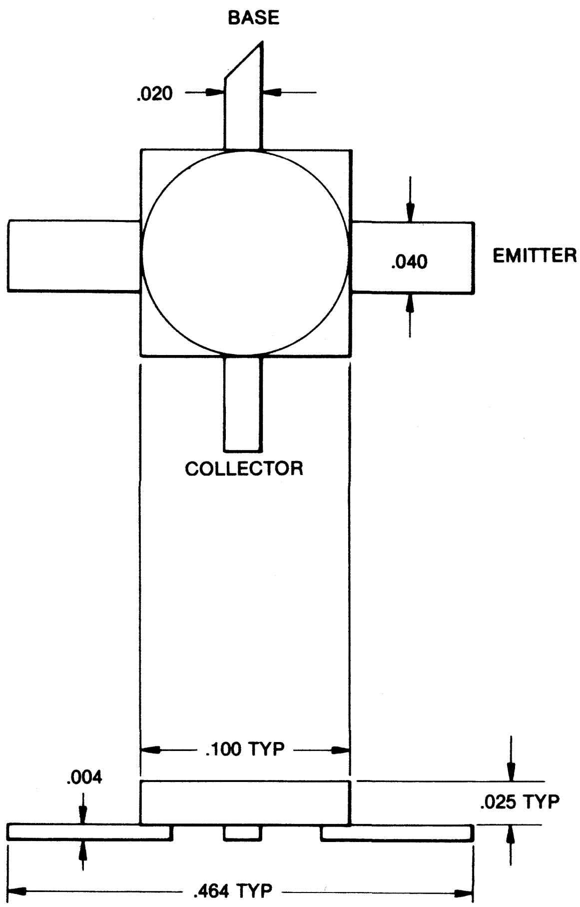
DESCRIPTION

The Avantek AT-1845 is designed for low noise figure, high gain small signal amplification at frequencies up to 4 GHz. It is a particularly cost effective choice for amplifiers in the 500 MHz through 2500 MHz frequency range where low noise figure, high gain and wide dynamic range are required. This transistor is widely used in tuned front-end and signal processing amplifiers in radar, telemetry and point-to point communications receivers as well as in wideband amplifiers for instrumentation and EW applications.

This transistor features an etchless gold metal system that produces conductive films of 1 μm thickness and extremely uniform coverage. A dielectric layer protects the transistor chip from scratching or contamination before they are packaged.

The 100 Mil metal/ceramic package is easy to install in conventional printed circuits or hybrid thin or thick film circuits and will withstand handling, soldering and welding processes. Each package is filled with a dry, inert atmosphere and hermetically sealed to assure long-term protection from humidity and corrosive gases.

OUTLINE DRAWING 100 MIL PACKAGE



TOLERANCES: ± .010/± .02

SECTION 3

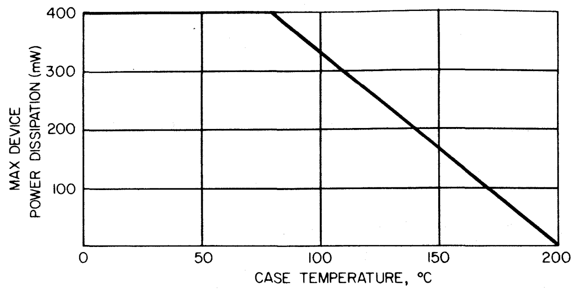
COMMON EMITTER OPERATING CHARACTERISTICS ($T_A = 25°C$)

Parameter	Symbol	Test Cond $V_{CE}I_C$	Freq GHz	Min	AT-1845 Typ	Max
Spot Noise Figure	NF_{opt}	10V 5 mA	1		2.3 dB	2.5 dB
Spot Noise Figure	NF_{opt}	10V 5 mA	2		3.2 dB	
Spot Noise Figure	NF_{opt}	10V 5 mA	4		5.5 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	1		14.0 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	2		11.0 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	4		7.0 dB	
Max Available Power Gain	G_{max}	10V 15 mA	2		15.0 dB	
Max Available Power Gain	G_{max}	10V 15 mA	4		9.0 dB	

MAXIMUM RATINGS ($T_A = 25°C$)

Parameter	Symbol	Limit
Reverse Emitter Base Voltage	V_{EB}	3.0V
Reverse Collector Base Voltage	V_{CB}	20.0V
Open Base Collector-Emitter Voltage	V_{CEO}	12.0V
Collector Current	I_C	50 mA
Continuous Dissipation	P_T (T_{case} = 25°C)	400 mW
Junction Temperature	T_j	200°C
Storage Temperature Range	T_{STG}	– 65 to 200°C
Thermal Resistance	θ_{jc}	300°C/watt

POWER DERATING CURVE

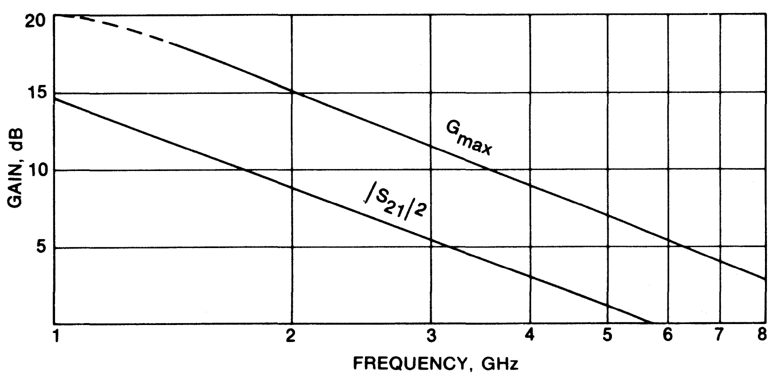


ELECTRICAL CHARACTERISTICS ($T_A = 25°C$)

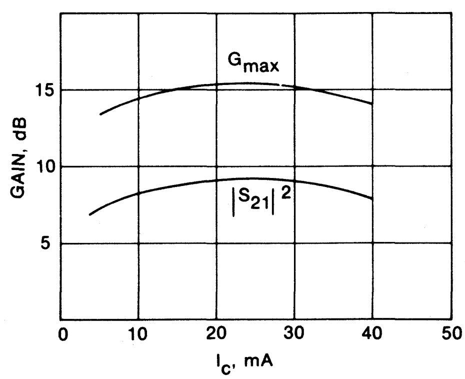
Parameter	Symbol	Test Conditions	Freq.	Min	Typ	Max
Collector-Base Breakdown	$V_{(BR)}CBO$	$I_C = 10\ \mu A$		20V		
Emitter-Base Breakdown	$V_{(BR)}EBO$	$I_E = 10\ \mu A$		3.0V		
Collector-Emitter Breakdown	$V_{(BR)}CEO$	$I_C = 100\ \mu A$		12V		
Collector Cutoff Current	I_{CBO}	$V_{CB} = 10V$				20 nA
Forward Current Transfer Ratio	h_{FE}	$V_{CE} = 10V$, $I_C = 15$ mA		20	75	

TYPICAL PERFORMANCE CURVES ($T_A = 25°C$)

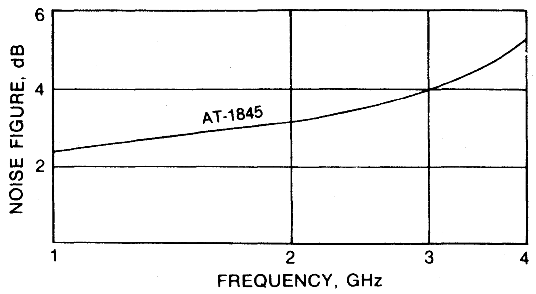
Maximum Available Gain, $|S_{21E}|^2$ vs. Frequency,
V_{CE} = 10V I_C = 15 mA



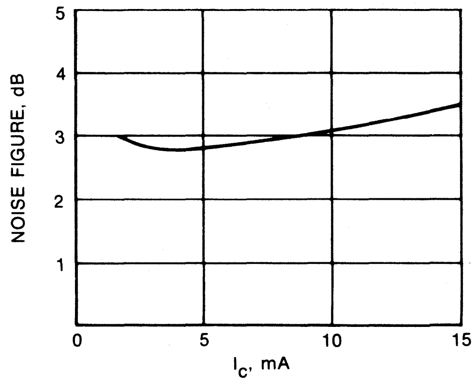
Maximum Available Gain, $|S_{21E}|^2$
vs. Collector Current,
F = 2 GHz, V_{CE} = 10V



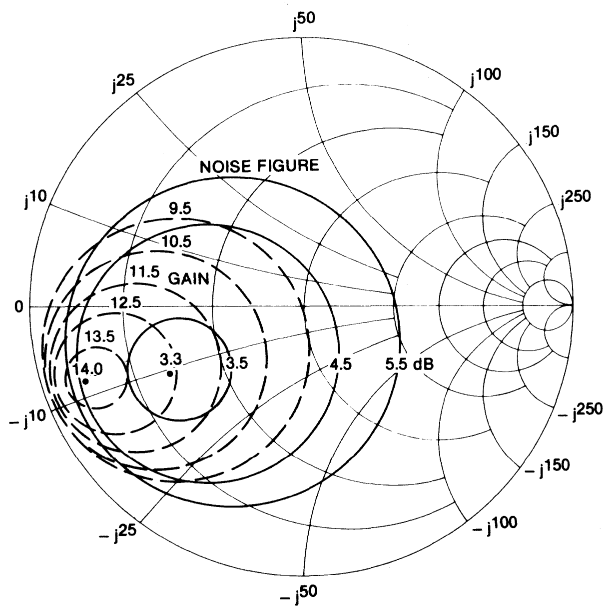
Spot Noise Figure vs. Frequency
V_{CE} = 10V, I_C = 5mA



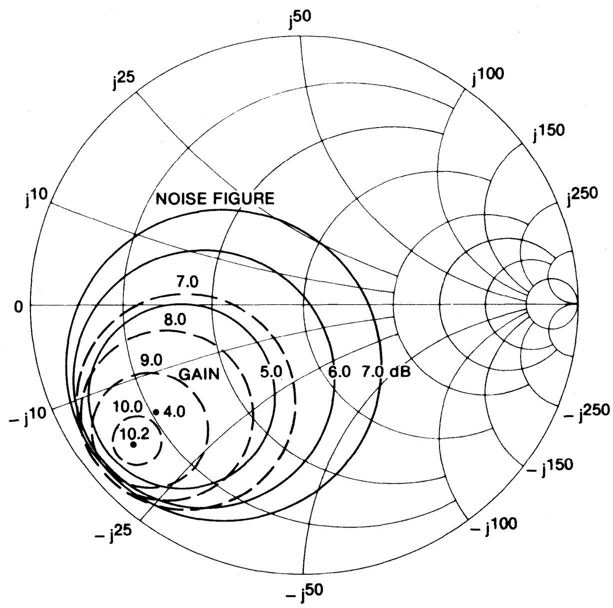
Spot Noise Figure vs. Collector Current
F = 2 GHz, V_{CE} = 10V



TYPICAL CONTOURS OF CONSTANT GAIN AND NOISE FIGURE, AT-2645



Frequency = 2 GHz, 10V 5 mA



Frequency = 3 GHz, 10V 5 mA

TYPICAL SCATTERING PARAMETERS

Bias = 10.00 Volts, 5.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.679	−117.8	7.663	107.6	.045	39.1	.710	−28.9
1000.00	.650	−159.4	4.390	80.7	.054	28.3	.603	−35.9
1500.00	.654	177.3	3.031	61.9	.059	26.4	.571	−44.7
2000.00	.655	162.1	2.286	45.8	.064	23.7	.569	−54.6
2500.00	.662	148.4	1.853	31.1	.070	23.3	.561	−66.3
3000.00	.674	136.1	1.544	16.6	.078	21.8	.565	−80.0
3500.00	.688	124.5	1.329	2.4	.085	21.2	.577	−93.8
4000.00	.711	114.2	1.167	−10.1	.094	21.1	.580	−103.3
4500.00	.721	104.1	1.036	−24.7	.105	−18.0	.596	−118.7
5000.00	.736	94.5	.915	−36.3	.119	13.9	.616	−133.9
5500.00	.732	85.0	.796	−47.8	.132	−9.7	.631	−149.2
6000.00	.784	75.3	.747	−58.1	.153	−5.3	.697	−163.6

Bias = 10.00 Volts, 15.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.617	−148.6	10.509	96.1	.029	41.3	.551	−30.3
1000.00	.626	−177.5	5.544	74.6	.039	42.2	.479	−34.2
1500.00	.645	165.4	3.755	58.3	.049	42.2	.464	−42.8
2000.00	.651	153.7	2.803	44.0	.058	40.7	.465	−52.2
2500.00	.662	142.1	2.265	30.1	.068	38.1	.462	−64.0
3000.00	.680	−131.2	1.876	16.8	.079	34.4	.467	−77.6
3500.00	.696	120.4	1.611	3.3	.090	31.2	.479	−91.8
4000.00	.721	110.8	1.413	−8.7	.100	29.2	.482	−101.4
4500.00	.733	101.0	1.255	− 21.7	.112	24.4	.502	−116.8
5000.00	.748	91.8	1.117	−34.1	.127	18.9	.523	−132.4
5500.00	.745	82.6	.977	−45.4	.141	13.6	.544	−147.6
6000.00	.801	73.0	.926	−55.8	.164	8.5	.609	−161.9

CHIP CODE M14

General Purpose
Bipolar Transistor

FEATURES

- **3.2 dB Noise Figure at 2 GHz**
- **11.0 dB Gain at NF**
- **Hermetic 70 Mil Microstrip Package**
- **Gold Metal System**
- **Phosphorous Emitter**

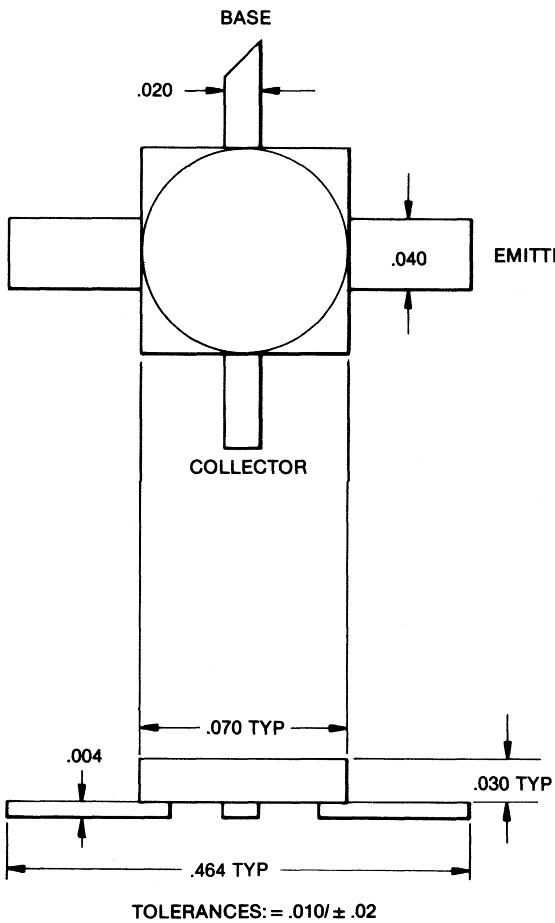
DESCRIPTION

The Avantek AT-2645 is designed for low noise figure, high gain small signal amplification at frequencies up to 4 GHz. It is a particularly cost effective choice for amplifiers in the 500 MHz through 2500 MHz frequency range where low noise figure, high gain and wide dynamic range are required. This transistor is widely used in tuned front-end and signal processing amplifiers in radar, telemetry and point-to-point communications receivers as well as in wideband amplifiers for instrumentation and EW applications.

This transistor features an etchless gold metal system that produces conductive films of 1 μm thickness and extremely uniform coverage. A dielectric layer protects the transistor chip from scratching or contamination before they are packaged.

The 70 Mil metal/ceramic package is easy to install in conventional printed circuits or hybrid thin or thick film circuits and will withstand handling, soldering and welding processes. Each package is filled with a dry, intert atmosphere and hermetically sealed to assure long-term protection from humidity and corrosive gases.

OUTLINE DRAWING 70 MIL PACKAGE



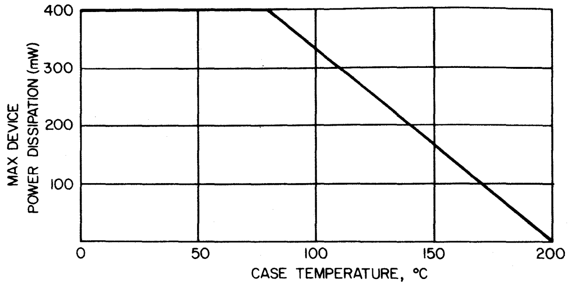
COMMON EMITTER OPERATING CHARACTERISTICS ($T_A = 25°C$)

Parameter	Symbol	Test Cond $V_{CE}I_C$	Freq GHz	Min	AT-2645 Typ	Max
Spot Noise Figure	NF_{opt}	10V 5 mA	1		2.3 dB	
Spot Noise Figure	NF_{opt}	10V 5 mA	2		3.2 dB	3.5 dB
Spot Noise Figure	NF_{opt}	10V 5 mA	4		5.5 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	1		14.0 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	2		11.0 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	4		7.0 dB	
Max Available Power Gain	G_{max}	10V 15 mA	2		15.0 dB	
Max Available Power Gain	G_{max}	10V 15 mA	4		9.0 dB	

MAXIMUM RATINGS ($T_A = 25°C$)

Parameter	Symbol	Limit
Reverse Emitter Base Voltage	V_{EB}	3.0V
Reverse Collector Base Voltage	V_{CB}	20.0V
Open Base Collector-Emitter Voltage	V_{CEO}	12.0V
Collector Current	I_C	50 mA
Continuous Dissipation	P_T (T_{case} = 25°C)	400 mW
Junction Temperature	T_j	200°C
Storage Temperature Range	T_{STG}	– 65 to 200°C
Thermal Resistance	θ_{jc}	300°C/watt

POWER DERATING CURVE

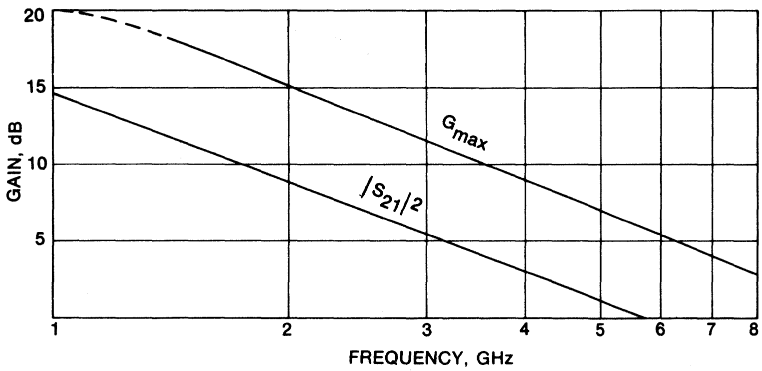


ELECTRICAL CHARACTERISTICS ($T_A = 25°C$)

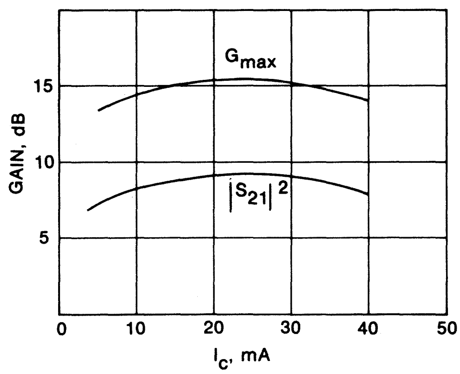
Parameter	Symbol	Test Conditions	Freq.	Min	Typ	Max
Collector-Base Breakdown	$V_{(BR)}CBO$	$I_C = 10\ \mu A$		20V		
Emitter-Base Breakdown	$V_{(BR)}EBO$	$I_E = 10\ \mu A$		3.0V		
Collector-Emitter Breakdown	$V_{(BR)}CEO$	$I_C = 100\ \mu A$		12V		
Collector Cutoff Current	I_{CBO}	$V_{CB} = 10V$				20 nA
Forward Current Transfer Ratio	h_{FE}	$V_{CE} = 10V$, $I_C = 15$ mA		20	75	
Collector-Base Capacitance	C_{cb}	$V_{CB} = 10V$, $I_E = 0$				0.5 pF

TYPICAL PERFORMANCE CURVES ($T_A = 25°C$)

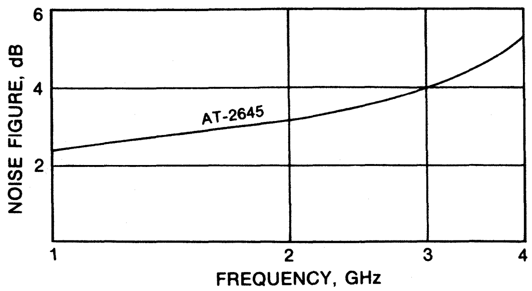
Maximum Available Gain, $|S_{21E}|^2$ vs. Frequency, V_{CE} = 10V I_C = 15 mA



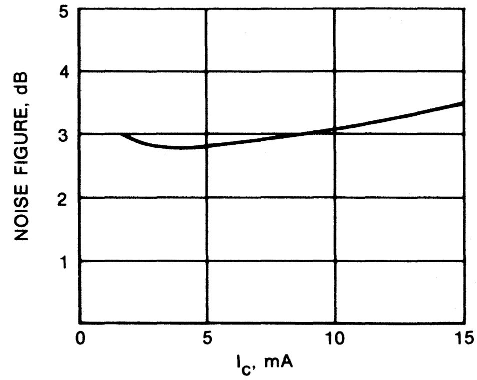
Maximum Available Gain, $|S_{21E}|^2$ vs. Collector Current, F = 2 GHz, V_{CE} = 10V



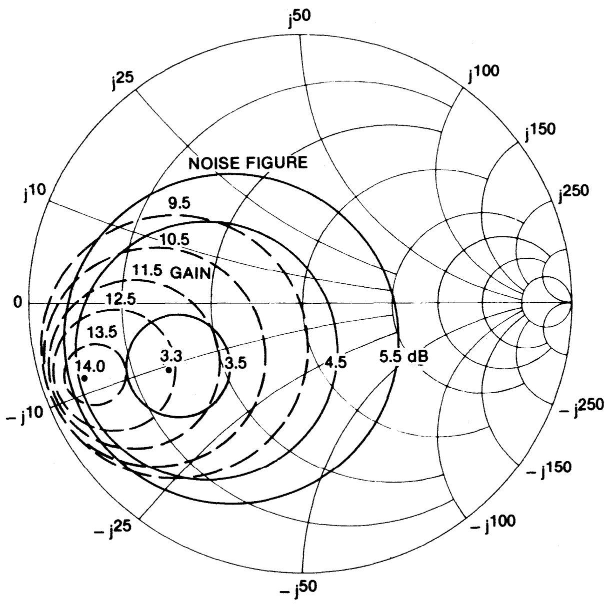
Spot Noise Figure vs. Frequency
V_{CE} = 10V, I_C = 5mA



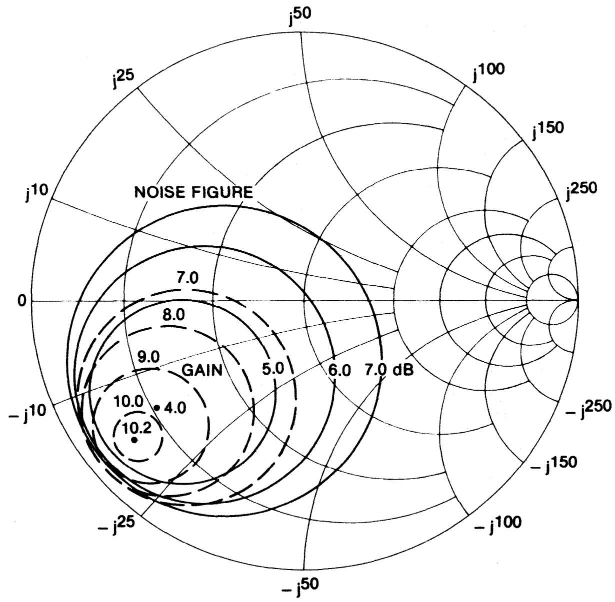
Spot Noise Figure vs. Collector Current
F = 2 GHz, V_{CE} = 10V



TYPICAL CONTOURS OF CONSTANT GAIN AND NOISE FIGURE, AT-2645



Frequency = 2 GHz, 10V 5 mA



Frequency = 3 GHz, 10V 5 mA

SECTION 3

TYPICAL SCATTERING PARAMETERS

Bias = 10.00 Volts, 5.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.734	−100.5	7.262	116.3	.052	42.4	.771	−27.9
1000.00	.687	−144.9	4.445	88.3	.064	26.6	.638	−36.2
1500.00	.677	−169.8	3.133	69.4	.068	21.3	.592	−44.4
2000.00	.671	173.6	2.382	53.6	.071	16.5	.581	−52.6
2500.00	.670	159.8	1.941	39.5	.074	14.5	.568	−63.0
3000.00	.676	147.9	1.623	25.5	.080	12.6	.567	−75.0
3500.00	.684	136.9	1.412	12.1	.084	12.3	.576	−86.9
4000.00	.700	126.4	1.243	.9	.088	10.8	.586	−98.4
4500.00	.704	117.0	1.102	−14.4	.095	9.2	.593	−111.5
5000.00	.714	108.3	.983	−25.4	.104	6.4	.610	−125.2
5500.00	.707	100.1	.866	−36.4	.112	4.4	.626	−139.0
6000.00	.741	91.5	.811	−46.1	.126	1.6	.685	−152.0

Bias = 10.00 Volts, 15.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.669	−124.9	10.009	106.9	.039	38.8	.642	−32.3
1000.00	.662	−161.7	5.627	82.6	.047	31.1	.521	−36.6
1500.00	.671	178.1	3.867	65.6	.053	30.1	.488	−43.6
2000.00	.671	164.9	2.904	51.4	.059	28.1	.481	−51.3
2500.00	.675	153.0	2.352	37.8	.066	27.1	.474	−61.3
3000.00	.686	142.1	1.952	25.0	.073	24.5	.475	−73.2
3500.00	.696	131.8	1.691	12.2	.081	23.5	.485	−85.1
4000.00	.715	122.5	1.482	−.2	.087	21.4	.497	−96.7
4500.00	.721	113.7	1.314	−12.3	.096	18.5	.508	−109.7
5000.00	.731	105.3	1.171	−23.2	.107	15.0	.527	−123.8
5500.00	.726	97.3	1.037	−34.8	.117	11.8	.550	−137.6
6000.00	.762	88.7	.973	−44.5	.132	8.2	.610	−150.5

CHIP CODE M14

AT-2845

General Purpose
Bipolar Transistor

FEATURES

- **3.2 dB Noise Figure at 2 GHz**
- **11.0 dB Gain at NF**
- **Hermetic 100 Mil Microstrip Package**
- **Gold Metal System**
- **Phosphorous Emitter**

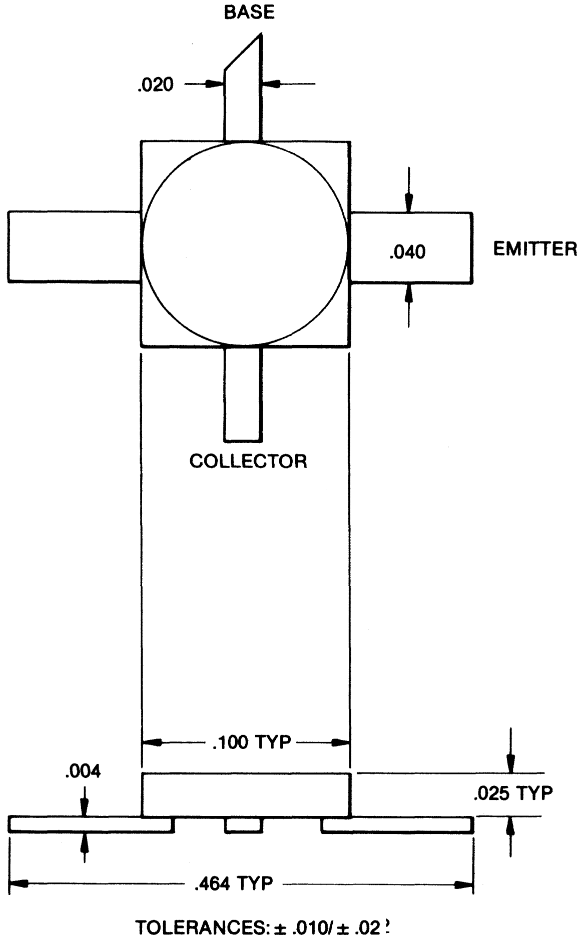
DESCRIPTION

The Avantek AT-2845 is designed for low noise figure, high gain small signal amplification at frequencies up to 4 GHz. It is a particularly cost effective choice for amplifiers in the 500 MHz through 2500 MHz frequency range where low noise figure, high gain and wide dynamic range are required. This transistor is widely used in tuned front-end and signal procesing amplifiers in radar, telemetry and point-to-point communications receivers as well as in wideband amplifiers for instrumentation and EW applications.

This transistor features an etchless gold metal system that produces conductive films of 1 μm thickness and extremely uniform coverage. A dielectric layer protects the transistor chip from scratching or contamination before they are packaged.

The 100 Mil metal/ceramic package is easy to install in conventional printed circuits or hybrid thin or thick film circuits and will withstand handling, soldering and welding processes. Each package is filled with a dry, inert atmosphere and hermetically sealed to assure long-term protection from humidity and corrosive gases.

OUTLINE DRAWING 100 MIL PACKAGE



SECTION 3

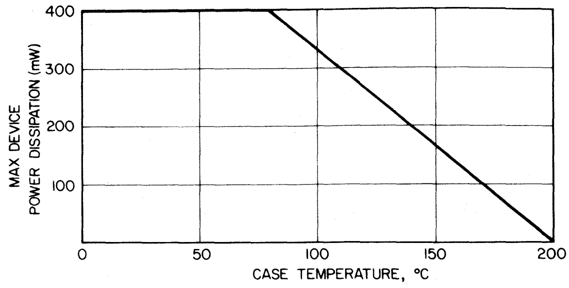
COMMON EMITTER OPERATING CHARACTERISTICS ($T_A = 25°C$)

Parameter	Symbol	Test Cond $V_{CE} I_C$	Freq GHz	Min	AT-2845 Typ	Max
Spot Noise Figure	NF_{opt}	10V 5 mA	1		2.3 dB	
Spot Noise Figure	NF_{opt}	10V 5 mA	2		3.2 dB	3.5 dB
Spot Noise Figure	NF_{opt}	10V 5 mA	4		5.5 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	1		14.0 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	2		11.0 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	4		7.0 dB	
Max Available Power Gain	G_{max}	10V 15 mA	2		15.0 dB	
Max Available Power Gain	G_{max}	10V 15 mA	4		9.0 dB	

MAXIMUM RATINGS ($T_A = 25°C$)

Parameter	Symbol	Limit
Reverse Emitter Base Voltage	V_{EB}	3.0V
Reverse Collector Base Voltage	V_{CB}	20.0V
Open Base Collector-Emitter Voltage	V_{CEO}	12.0V
Collector Current	I_C	50 mA
Continuous Dissipation	P_T (T_{case} = 25°C)	400 mW
Junction Temperature	T_j	200°C
Storage Temperature Range	T_{STG}	−65 to 200°C
Thermal Resistance	θ_{jc}	300°C/watt

POWER DERATING CURVE

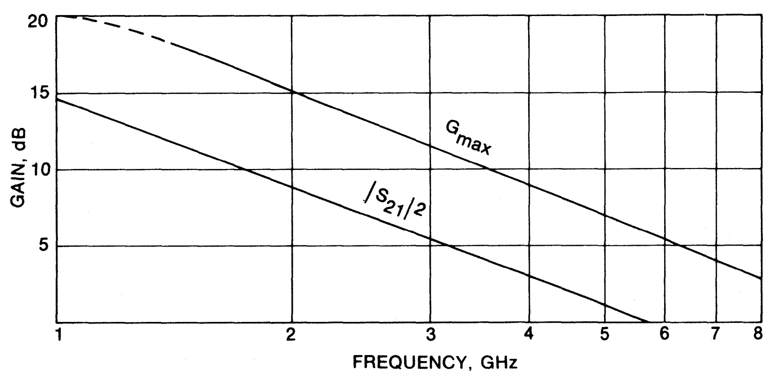


ELECTRICAL CHARACTERISTICS ($T_A = 25°C$)

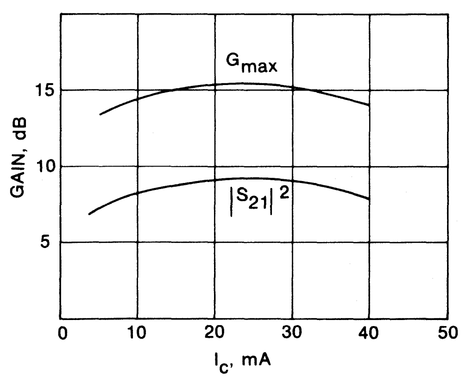
Parameter	Symbol	Test Conditions	Freq.	Min	Typ	Max
Collector-Base Breakdown	$V_{(BR)}CBO$	$I_C = 10\ \mu A$		20V		
Emitter-Base Breakdown	$V_{(BR)}EBO$	$I_E = 10\ \mu A$		3.0V		
Collector-Emitter Breakdown	$V_{(BR)}CEO$	$I_C = 100\ \mu A$		12V		
Collector Cutoff Current	I_{CBO}	$V_{CB} = 10V$				20 nA
Forward Current Transfer Ratio	h_{FE}	$V_{CE} = 10V$, $I_C = 15$ mA		20	75	
Collector-Base Capacitance	C_{cb}	$V_{CB} = 10V$, $I_E = 0$				0.5 pF

TYPICAL PERFORMANCE CURVES ($T_A = 25°C$)

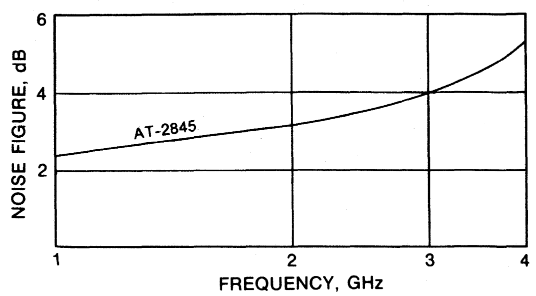
Maximum Available Gain, $|S_{21E}|^2$ vs. Frequency, V_{CE} = 10V I_C = 15 mA



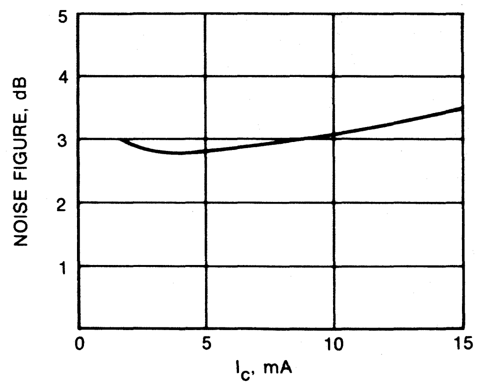
Maximum Available Gain, $|S_{21E}|^2$ vs. Collector Current, F = 2 GHz, V_{CE} = 10V



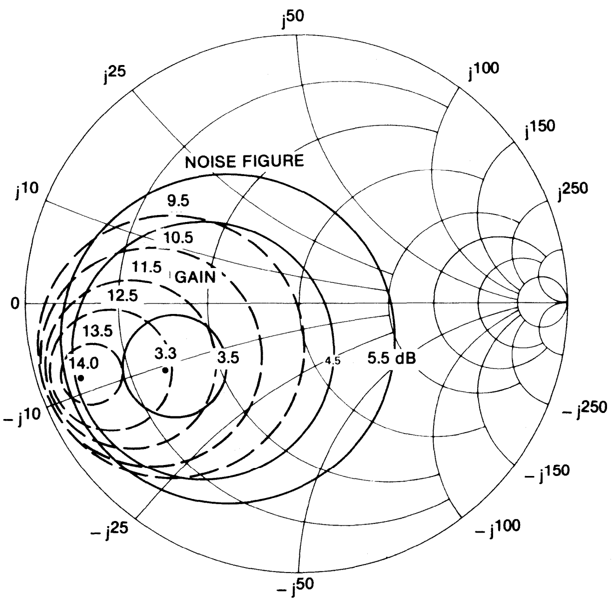
Spot Noise Figure vs. Frequency
V_{CE} = 10V, I_C = 5mA



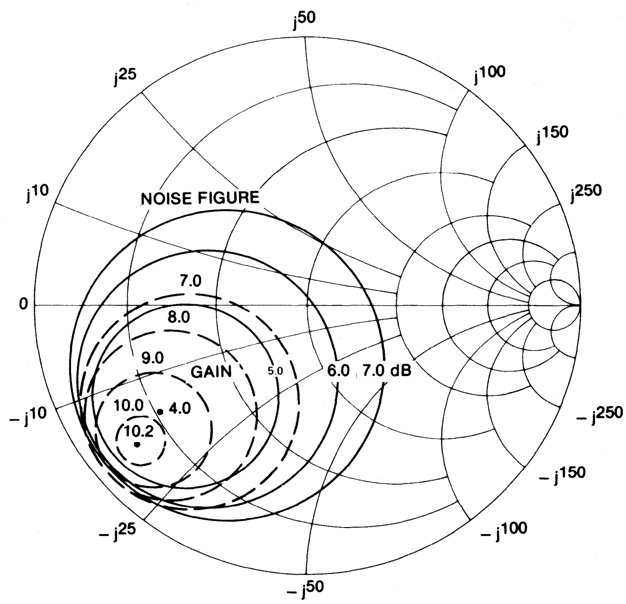
Spot Noise Figure vs. Collector Current
F = 2 GHz, V_{CE} = 10V



TYPICAL CONTOURS OF CONSTANT GAIN AND NOISE FIGURE, AT-2645



Frequency = 2 GHz, 10V 5 mA



Frequency = 3 GHz, 10V 5 mA

TYPICAL SCATTERING PARAMETERS

S—MAGN AND ANGLES

Bias = 10.00 Volts, 5.00 mA

FREQ	11		21		12		22	
500.00	.679	−117.8	7.663	107.6	.045	39.1	.710	−28.9
1000.00	.650	−159.4	4.390	80.7	.054	28.3	.603	−35.9
1500.00	.654	177.3	3.031	61.9	.059	26.4	.571	−44.7
2000.00	.655	162.1	2.286	45.8	.064	23.7	.569	−54.6
2500.00	.662	148.4	1.853	31.1	.070	23.3	.561	−66.3
3000.00	.674	136.1	1.544	16.6	.078	21.8	.565	−80.0
3500.00	.688	124.5	1.329	2.4	.085	21.2	.577	−93.8
4000.00	.711	114.2	1.167	−10.1	.094	21.1	.580	−103.3
4500.00	.721	104.1	1.036	−24.7	.105	18.0	.596	−118.7
5000.00	.736	94.5	.915	−36.3	.119	13.9	.616	−133.9
5500.00	.732	85.0	.796	−47.8	.132	9.7	.631	−149.2
6000.00	.784	75.3	.747	−58.1	.153	5.3	.697	−163.6

S—MAGN AND ANGLES

Bias = 10.00 Volts, 15.00 mA

FREQ	11		21		12		22	
500.00	.617	−148.6	10.509	96.1	.029	41.3	.551	−30.3
1000.00	.626	−177.5	5.544	74.6	.039	42.2	.479	−34.2
1500.00	.645	165.4	3.755	58.3	.049	42.2	.464	−42.8
2000.00	.651	153.7	2.803	44.0	.058	40.7	.465	−52.2
2500.00	.662	142.1	2.265	30.1	.068	38.1	.462	−64.0
3000.00	.680	131.2	1.876	16.8	.079	34.4	.467	−77.6
3500.00	.696	120.4	1.611	3.3	.090	31.2	.479	−91.8
4000.00	.721	110.8	1.413	−8.7	.100	29.2	.482	−101.4
4500.00	.733	101.0	1.255	−21.7	.112	24.4	.502	−116.8
5000.00	.748	91.8	1.117	−34.1	.127	18.9	.523	−132.4
5500.00	.745	82.6	.977	−45.4	.141	13.6	.544	−147.6
6000.00	.801	73.0	.926	−55.8	.164	8.5	.609	−161.9

CHIP CODE M14

General Purpose
Bipolar Transistors

FEATURES

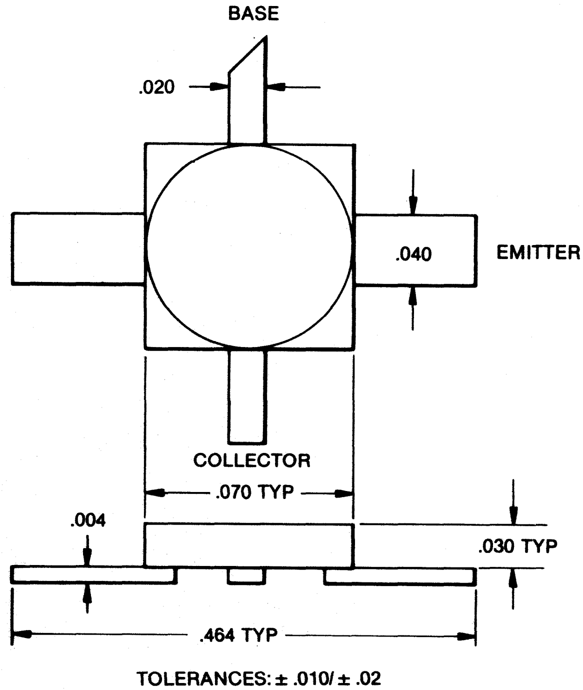
- **3.6 dB Noise Figure at 4 GHz**
- **7 dB Gain at NF**
- **Hermetic 70 Mil Microstrip Package**
- **Gold Metal System**
- **Arsenic Emitter**

DESCRIPTION

The Avantek AT-4642 is a silicon bipolar transistor designed for small signal amplification at frequencies up to 6 GHz. Arsenic-doped, 1-micron emitter structures give this transistor low noise figure with high associated gain. The metal system used is gold based, etchless and deposits a metal film of uniform 1 micron thickness to minimize current density. A silicon dioxide layer protects the transistor chip from scratching or contamination during handling and packaging for improved performance and reliability.

The 70 mil square ceramic/metal microstripline package is hermetically sealed while flooded with a dry, inert atmosphere to assure long-term protection from humidity and corrosive gases.

OUTLINE DRAWING 70 MIL PACKAGE



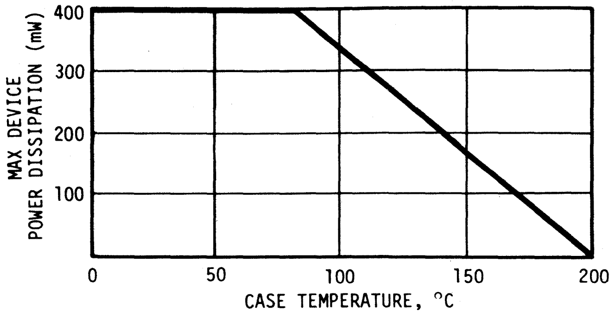
COMMON EMITTER OPERATING CHARACTERISTICS ($T_A = 25°C$)

Parameter	Symbol	Test Cond $V_{CE}I_C$	Freq GHz	AT-4642 Min	AT-4642 Typ	AT-4642 Max
Spot Noise Figure	NF_{opt}	10V 5 mA	4		3.6 dB	4.0 dB
Spot Noise Figure	NF_{opt}	10V 5 mA	2		2.5 dB	
Spot Noise Figure	NF_{opt}	10V 5 mA	1		1.8 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	4		7.0 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	2		10.0 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	1		14.5 dB	
Max Available Power Gain	G_{max}	10V 15 mA	4	8 dB	9.0 dB	
Max Available Power Gain	G_{max}	10V 15 mA	2		14.5 dB	

MAXIMUM RATINGS ($T_A = 25°C$)

Parameter	Symbol	Limit
Reverse Emitter Base Voltage	V_{EB}	1.5V
Reverse Collector Base Voltage	V_{CB}	20.0V
Open Base Collector-Emitter Voltage	V_{CEO}	12.0V
Collector Current	I_C	50 mA
Continuous Dissipation	P_T (T_{case} = 25°C)	400 mW
Junction Temperature	T_j	200°C
Storage Temperature Range	T_{STG}	− 65 to 200°C
Thermal Resistance	θ_{jc}	300°C/watt

POWER DERATING CURVE

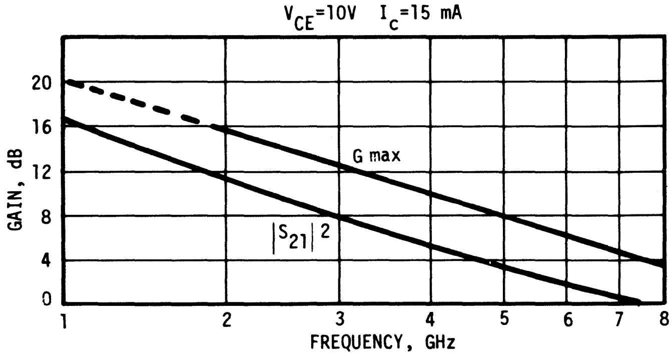


ELECTRICAL CHARACTERISTICS ($T_A = 25°C$)

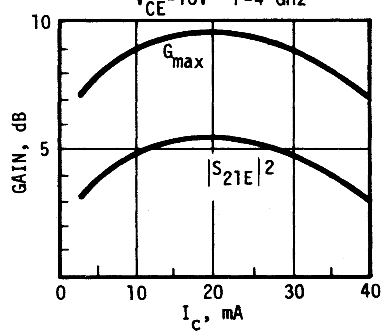
Parameter	Symbol	Test Conditions	Freq.	Min	Typ	Max
Collector-Base Breakdown	$V_{(BR)}CBO$	$I_C = 10\ \mu A$		20V		
Emitter-Base Breakdown	$V_{(BR)}EBO$	$I_E = 10\ \mu A$		1.5V		
Collector-Emitter Breakdown	$V_{(BR)}CEO$	$I_C = 100\ \mu A$		12V		
Collector Cutoff Current	I_{CBO}	$V_{CB} = 10V$				20 nA
Forward Current Transfer Ratio	h_{FE}	$V_{CE} = 10V$, $I_C = 15$ mA		20	75	
Collector-Base Capacitance	C_{cb}	$V_{CB} = 10V$, $I_E = 0$				0.5 pF

TYPICAL PERFORMANCE CURVES

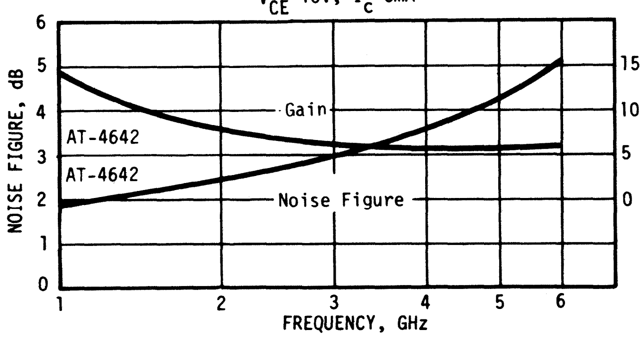
G_{MAX}, $|S_{21}|^2$ VS FREQUENCY
V_{CE}=10V I_c=15 mA



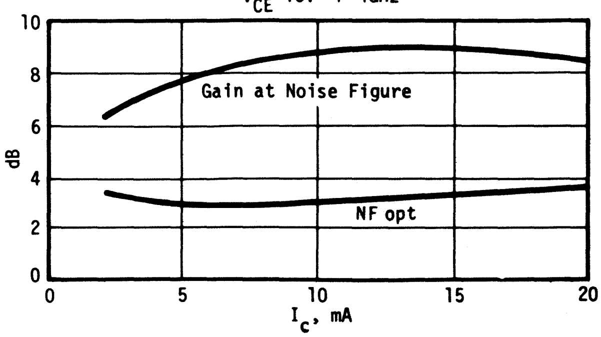
MAXIMUM AVAILABLE GAIN,
$|S_{21E}|^2$ VS COLLECTOR CURRENT
V_{CE}=10V F=4 GHz



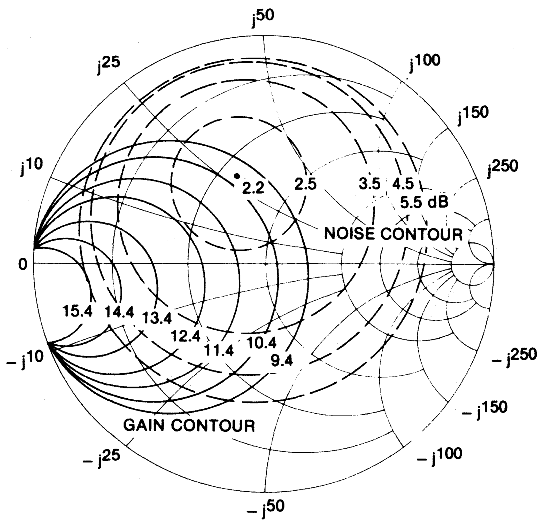
NF_{OPT} AND GAIN AT NOISE FIGURE VS FREQUENCY
V_{CE}=10V, I_c=5mA



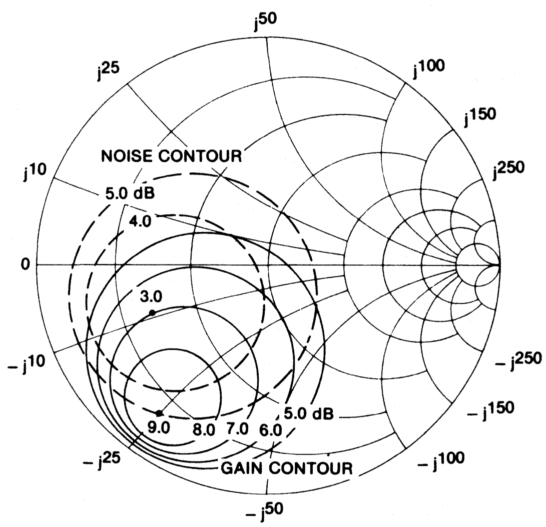
NF_{OPT} AND GAIN AT NOISE FIGURE VS COLLECTOR CURRENT
V_{CE}=10V F=4GHz



TYPICAL CONTOURS OF CONSTANT GAIN AND NOISE FIGURE



Frequency = 2 GHz, 10V 5 mA See Note 1



Frequency = 4 GHz, 10V 5 mA

Note 1

The AT-4641 is potentially unstable at 2 GHz at $V_{CE} = 10V$, $I_C = 5$ mA. The 15.4 dB gain contour represents the maximum stable gain of the device defined as $G_{MSG} = |\frac{S_{21}}{S_{22}}|$. By presenting the input with an impedance lying outside of this gain. contour, the output impedance of the device is positve and may be conjugately matched to realize the specified gain.

TYPICAL SCATTERING PARAMETERS

Bias = 10.00 Volts, 5.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.653	−102.2	8.887	117.2	.044	42.7	.762	−32.4
1000.00	.629	−149.0	5.554	86.3	.054	25.8	.617	−45.5
2000.00	.618	167.1	2.961	48.4	.065	13.8	.562	−67.6
3000.00	.615	139.0	2.026	17.2	.076	4.5	.572	−92.5
4000.00	.617	114.8	1.534	−11.9	.089	−4.6	.594	−115.2
5000.00	.605	92.7	1.235	−37.7	.106	−15.5	.625	−141.9
6000.00	.586	72.0	1.016	−63.0	.122	−26.9	.683	−166.3
7000.00	.519	48.3	.858	−88.3	.141	−42.9	.749	172.6
8000.00	.439	14.4	.753	−113.4	.170	−59.6	.797	158.9

SECTION 3

TYPICAL SCATTERING PARAMETERS (CONTINUED)

Bias = 10.00 Volts, 10.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.571	– 131.4	12.403	107.9	.032	43.7	.629	– 38.2
1000.00	.592	– 168.4	7.034	80.8	.040	35.0	.494	– 47.9
2000.00	.600	156.4	3.637	46.8	.057	27.8	.459	– 68.2
3000.00	.598	131.6	2.466	17.4	.075	17.7	.476	– 92.6
4000.00	.598	109.0	1.864	– 10.4	.095	4.8	.502	– 114.8
5000.00	.587	88.1	1.510	– 35.4	.117	– 9.6	.540	– 140.9
6000.00	.560	67.9	1.254	– 60.6	.135	– 24.5	.607	– 165.1
7000.00	.488	44.2	1.063	– 86.1	.156	– 42.5	.690	174.4
8000.00	.407	10.6	.932	– 111.6	.181	– 61.1	.749	160.6

Bias = 10.00 Volts, 15.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.565	– 140.0	13.221	105.1	.028	44.4	.589	– 39.3
1000.00	.590	– 173.5	7.341	79.3	.037	38.0	.465	– 48.0
2000.00	.599	153.6	3.779	46.2	.056	32.1	.437	– 67.8
3000.00	.599	130.0	2.556	17.5	.076	20.3	.454	– 92.3
4000.00	.600	107.6	1.934	– 10.0	.096	– 6.7	.483	– 114.6
5000.00	.586	87.0	1.566	– 34.9	.118	– 7.6	.524	– 140.9
6000.00	.560	66.9	1.302	– 60.0	.137	– 23.5	.592	– 164.8
7000.00	.487	42.9	1.105	– 85.7	.159	– 42.0	.675	174.9
8000.00	.403	9.5	.972	– 111.1	.185	– 60.4	.738	160.9

Bias = 10.00 Volts, 20.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.565	– 150.9	14.035	101.4	.025	47.1	.541	– 39.6
1000.00	.591	– 179.5	7.612	77.2	.033	43.1	.434	– 47.2
2000.00	.602	150.6	3.882	45.4	.054	36.7	.415	– 67.3
3000.00	.602	127.8	2.624	17.1	.076	23.9	.437	– 92.1
4000.00	.604	105.9	1.985	9.8	.097	– 9.8	.465	– 114.6
5000.00	.590	85.4	1.605	– 34.8	.120	– 6.3	.508	– 140.8
6000.00	.562	65.4	1.335	– 59.7	.139	– 22.1	.577	– 164.5
7000.00	.488	41.2	1.135	– 85.1	.161	– 41.4	.663	175.1
8000.00	.407	7.4	1.000	– 111.0	.188	– 60.7	.728	161.2

Bias = 10.00 Volts, 30.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.580	– 161.2	13.700	97.4	.021	49.1	.510	– 36.8
1000.00	.604	175.0	7.278	75.2	.031	49.2	.433	– 44.1
2000.00	.616	148.0	3.704	44.1	.052	40.6	.425	– 65.9
3000.00	.615	125.9	2.506	16.2	.075	27.4	.447	– 91.5
4000.00	.619	104.4	1.895	– 10.7	.096	12.4	.475	– 114.4
5000.00	.604	83.9	1.530	– 35.4	.120	– 3.5	.515	– 141.1
6000.00	.580	63.7	1.272	– 60.4	.140	– 19.8	.585	– 165.1
7000.00	.507	38.9	1.082	– 85.9	.165	– 38.8	.668	174.6
8000.00	.429	4.8	.953	– 111.4	.193	– 58.7	.732	160.7

CHIP CODE M4

General Purpose
Bipolar Transistors

FEATURES

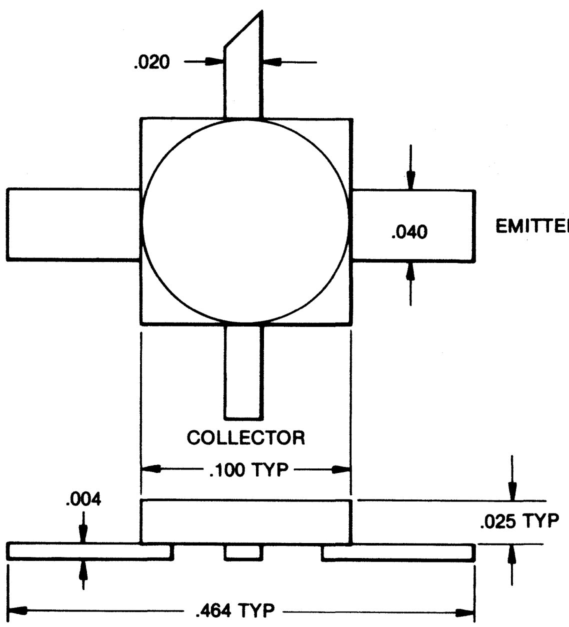
- 3.6 dB Noise Figure at 4 GHz
- 7 dB Gain at NF
- Hermetic 100 Mil Microstrip Package
- Gold Metal System
- Arsenic Emitter

DESCRIPTION

The Avantek AT-4842 is a silicon bipolar transistor designed for small signal amplification at frequencies up to 6 GHz. Arsenic-doped, 1-micron emitter structures give this transistor a low noise figure with high associated gain. The metal system used is gold based, etchless and deposits a metal film of uniform 1 micron thickness to minimize current density. A silicon dioxide layer protects the transistor chip from scratching or contamination during handling and packaging for improved performance and reliability.

The 100 mil square ceramic/metal microstripline package is hermetically sealed while flooded with a dry, inert atmosphere to assure long-term protection from humidity and corrosive gases.

OUTLINE DRAWING 100 MIL PACKAGE



TOLERANCES: ± .010/ ± .02

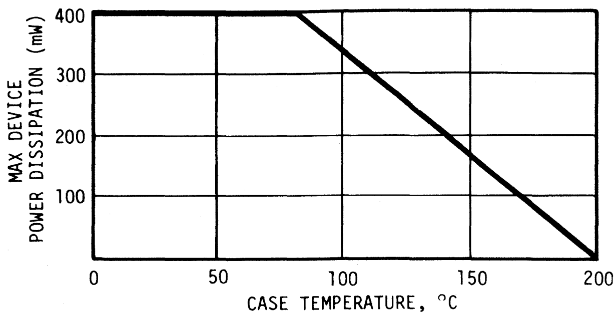
COMMON EMITTER OPERATING CHARACTERISTICS ($T_A = 25°C$)

Parameter	Symbol	Test Cond $V_{CE}I_C$	Freq GHz	Min	AT-4842 Typ	Max
Spot Noise Figure	NF_{opt}	10V 5 mA	4		3.6 dB	4.0 dB
Spot Noise Figure	NF_{opt}	10V 5 mA	2		2.5 dB	
Spot Noise Figure	NF_{opt}	10V 5 mA	1		1.8 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	4		7.0 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	2		10.0 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	1		14.5 dB	
Max Available Power Gain	G_{max}	10V 15 mA	4	8 dB	9.0 dB	
Max Available Power Gain	G_{max}	10V 15 mA	2		14.5 dB	

MAXIMUM RATINGS ($T_A = 25°C$)

Parameter	Symbol	Limit
Reverse Emitter Base Voltage	V_{EB}	1.5V
Reverse Collector Base Voltage	V_{CB}	20.0V
Open Base Collector-Emitter Voltage	V_{CEO}	12.0V
Collector Current	I_C	50 mA
Continuous Dissipation	P_T (T_{case} = 25°C)	400 mW
Junction Temperature	T_j	200°C
Storage Temperature Range	T_{STG}	– 65 to 200°C
Thermal Resistance	θ_{jc}	300°C/watt

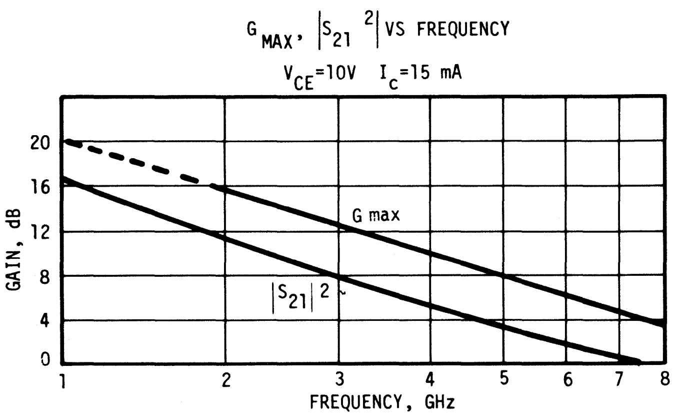
POWER DERATING CURVE

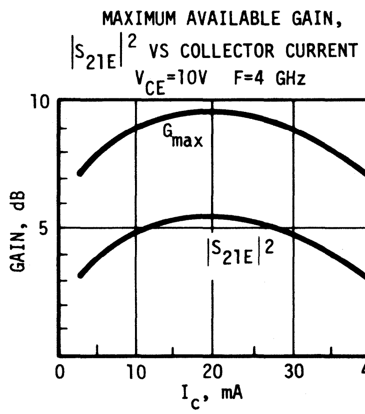


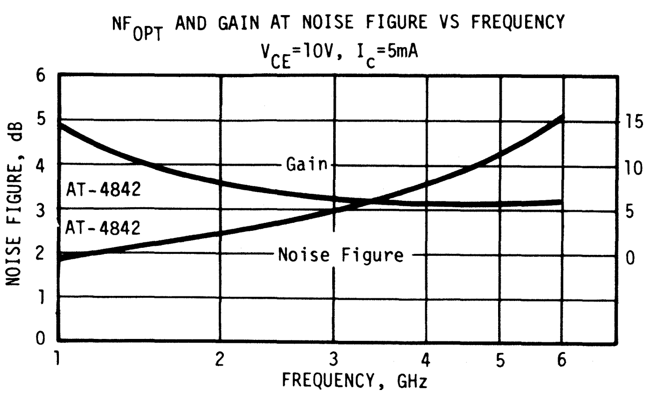
ELECTRICAL CHARACTERISTICS ($T_A = 25°C$)

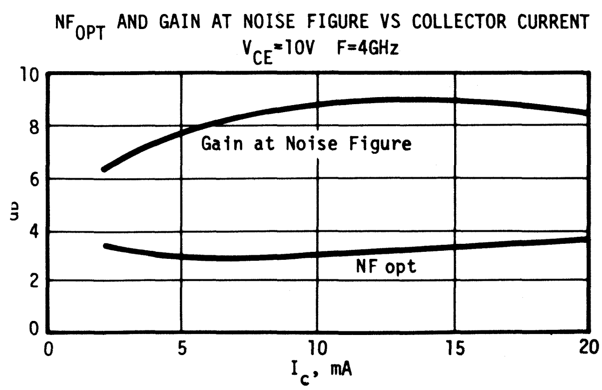
Parameter	Symbol	Test Conditions	Freq.	Min	Typ	Max
Collector-Base Breakdown	$V_{(BR)}CBO$	$I_C = 10\ \mu A$		20V		
Emitter-Base Breakdown	$V_{(BR)}EBO$	$I_E = 10\ \mu A$		1.5V		
Collector-Emitter Breakdown	$V_{(BR)}CEO$	$I_C = 100\ \mu A$		12V		
Collector Cutoff Current	I_{CBO}	$V_{CB} = 10V$				20 nA
Forward Current Transfer Ratio	h_{FE}	$V_{CE} = 10V$, $I_C = 15$ mA		20	75	
Collector-Base Capacitance	C_{cb}	$V_{CB} = 10V$, $I_E = 0$				0.5 pF

TYPICAL PERFORMANCE CURVES

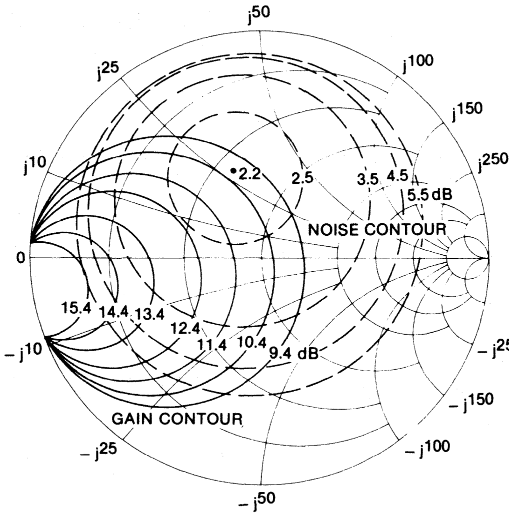




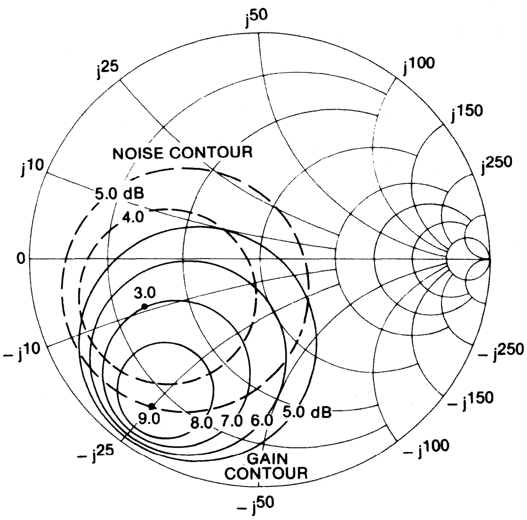




TYPICAL CONTOURS OF CONSTANT GAIN AND NOISE FIGURE



Frequency = 2 GHz, 10V 5 mA See Note 1



Frequency = 4 GHz, 10V 5 mA

Note 1

The 15.4 dB gain contour represents the maximum stable gain of the device defined as $G_{MSG} = |\frac{S_{21}}{S_{22}}|$.

By presenting the input with an impedance lying outside of this gain contour, the output impedance of the device is positive and may be conjugately matched to realize the specified gain.

TYPICAL SCATTERING PARAMETERS

Bias = 10.00 Volts, 5.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.653	– 102.2	8.887	117.2	.044	42.7	.762	– 32.4
1000.00	.629	– 149.0	5.554	86.3	.054	25.8	.617	– 45.5
2000.00	.618	167.1	2.961	48.4	.065	13.8	.562	– 67.6
3000.00	.615	139.0	2.026	17.2	.076	4.5	.572	– 92.5
4000.00	.617	114.8	1.534	– 11.9	.089	– 4.6	.594	– 115.2
5000.00	.605	92.7	1.235	– 37.7	.106	– 15.5	.625	– 141.9
6000.00	.586	72.0	1.016	– 63.0	.122	– 26.9	.683	– 166.3
7000.00	.519	48.3	.858	– 88.3	.141	– 42.9	.749	172.6
8000.00	.439	14.4	.753	– 113.4	.170	– 59.6	.797	158.9

TYPICAL SCATTERING PARAMETERS (CONTINUED)

Bias = 10.00 Volts, 10.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.571	−131.4	12.403	107.9	.032	43.7	.629	−38.2
1000.00	.592	−168.4	7.034	80.8	.040	35.0	.494	−47.9
2000.00	.600	156.4	3.637	46.8	.057	27.8	.459	−68.2
3000.00	.598	131.6	2.466	17.4	.075	17.7	.476	−92.6
4000.00	.598	109.0	1.864	−10.4	.095	4.8	.502	−114.8
5000.00	.587	88.1	1.510	−35.4	.117	−9.6	.540	−140.9
6000.00	.560	67.9	1.254	−60.6	.135	−24.5	.607	−165.1
7000.00	.488	44.2	1.063	−86.1	.156	−42.5	.690	174.4
8000.00	.407	10.6	.932	−111.6	.181	−61.1	.749	160.6

Bias = 10.00 Volts, 15.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.565	−140.0	13.221	105.1	.028	44.4	.589	−39.3
1000.00	.590	−173.5	7.341	79.3	.037	38.0	.465	−48.0
2000.00	.599	153.6	3.779	46.2	.056	32.1	.437	−67.8
3000.00	.599	130.0	2.556	17.5	.076	20.3	.454	−92.3
4000.00	.600	107.6	1.934	−10.0	.096	−6.7	.483	−114.6
5000.00	.586	87.0	1.566	−34.9	.118	−7.6	.524	−140.9
6000.00	.560	66.9	1.302	−60.0	.137	−23.5	.592	−164.8
7000.00	.487	42.9	1.105	−85.7	.159	−42.0	.675	174.9
8000.00	.403	9.5	.972	−111.1	.185	−60.4	.738	160.9

Bias = 10.00 Volts, 20.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.565	−150.9	14.035	101.4	.025	47.1	.541	−39.6
1000.00	.591	−179.5	7.612	77.2	.033	43.1	.434	−47.2
2000.00	.602	150.6	3.882	45.4	.054	36.7	.415	−67.3
3000.00	.602	127.8	2.624	17.1	.076	23.9	.437	−92.1
4000.00	.604	105.9	1.985	−9.8	.097	9.8	.465	−114.6
5000.00	.590	85.4	1.605	−34.8	.120	−6.3	.508	−140.8
6000.00	.562	65.4	1.335	−59.7	.139	−22.1	.577	−164.5
7000.00	.488	41.2	1.135	−85.1	.161	−41.4	.663	175.1
8000.00	.407	7.4	1.000	−111.0	.188	−60.7	.728	161.2

Bias = 10.00 Volts, 30.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.580	−161.2	13.700	97.4	.021	49.1	.510	−36.8
1000.00	.604	175.0	7.278	75.2	.031	49.2	.433	−44.1
2000.00	.616	148.0	3.704	44.1	.052	40.6	.425	−65.9
3000.00	.615	125.9	2.506	16.2	.075	27.4	.447	−91.5
4000.00	.619	104.4	1.895	−10.7	.096	12.4	.475	−114.4
5000.00	.604	83.9	1.530	−35.4	.120	−3.5	.515	−141.1
6000.00	.580	63.7	1.272	−60.4	.140	−19.8	.585	−165.1
7000.00	.507	38.9	1.082	−85.9	.165	−38.8	.668	174.6
8000.00	.429	4.8	.953	−111.4	.193	−58.7	.732	160.7

CHIP CODE M4

AT-2615

Linear Power
Bipolar Transistor

FEATURES

- $+22$ dBm Output Power at 2 GHz
- 10 dB G_{max}
- 1 W Maximum P_T
- Gold Metal System
- Hermetic 70 Mil Package
- Phosphorous Emitter

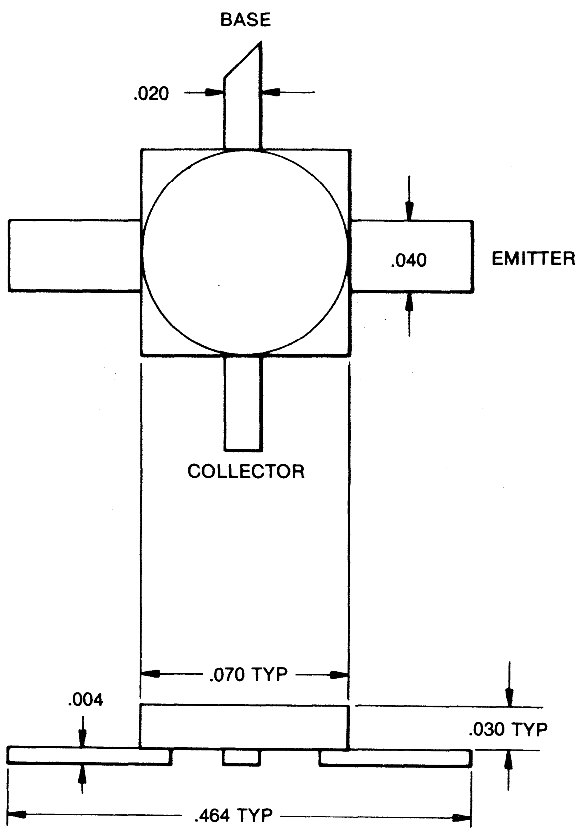
DESCRIPTION

The Avantek® AT-2615 is a silicon bipolar transistor designed for use as an intermediate power linear amplifier at frequencies through 3 GHz. It combines high gain and the capability to safely handle large collector current levels.

This transistor is an excellent choice for both wide and narrow band driver and output stages in communications, EW and instrumentation power amplifiers. It is widely applied as a driver for high power amplifiers in satellite uplink and point-to-point communications transmitters operating in the .5 to 3 GHz frequency range.

Avantek's proven gold metal system, which produces extremely uniform metallization of 1 μm thickness, minimizes current density to help prevent burn-out and metal migration. The package has a low thermal resistance which effectively carries heat away from the transistor junction. As a further assurance of long term reliability, the package is filled with a dry, inert atmosphere and hermetically sealed for protection against moisture and corrosive gases.

OUTLINE DRAWING 70 MIL PACKAGE



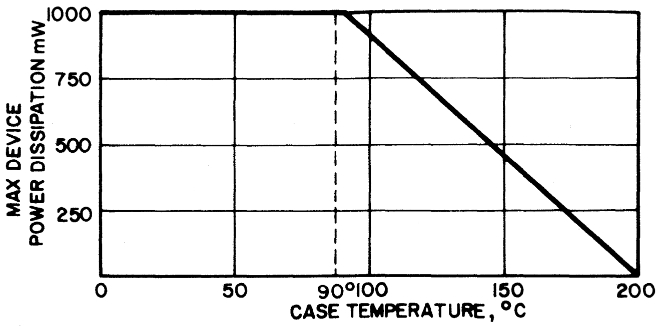
COMMON EMITTER OPERATING CHARACTERISTICS ($T_A = 25°C$)

Parameters	Symbols	Test Conditions	Freq.	AT-2615 Min	AT-2615 Typ	AT-2615 Max	Units
Spot Noise Figure	NF	$V_{CB} = 10V, I_C = 10$ mA	2 GHz		5.0		dB
		$V_{CB} = 10V, I_C = 10$ mA	4 GHz		8.0		dB
Maximum Available Gain	G_{max}	$V_{CB} = 10V, I_C = 35$ mA	2 GHz	7.0	10.0		dB
		$V_{CB} = 10V, I_C = 10$ mA	2 GHz		7.5		dB
		$V_{CB} = 10V, I_C = 35$ mA	4 GHz		5.0		dB
Insertion Power Gain	$\|S_{21}\|^2$	$V_{CB} = 10V, I_C = 35$ mA	2 GHz		5.0		dB

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}	15V
Collector Current	I_C	200 mA
Continuous Dissipation	P_T (T_{case} = 25°C)	1 watt
Junction Temperature	T_j	200°C
Storage Temperature Range	T_{STG}	– 65 to 200°C
Thermal Resistance	θ_{jc}	120°C/watt

POWER DERATING CURVE



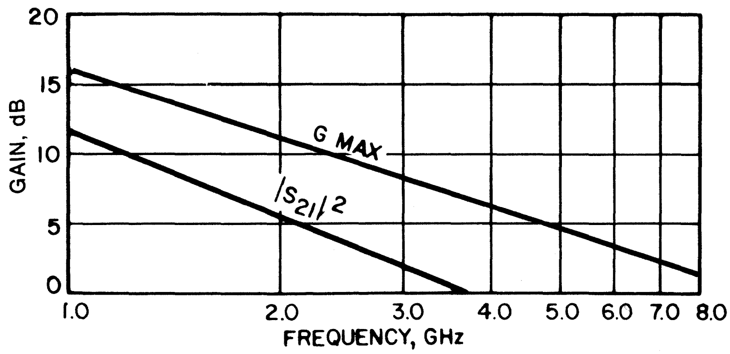
ELECTRICAL CHARACTERISTICS ($T_A = 25°C$)

Parameters	Symbols	Test Conditions	Min	Typ	Max	Units
Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	$I_C = 10\ \mu A$	20			V
Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	$I_E = 10\ \mu A$	3			V
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	$I_C = 100\ \mu A$	15			V
Collector Cutoff Current	I_{CBO}	$V_{CB} = 10V$			20	nA
Forward Current Transfer Ratio	h_{FE}	$V_{CE} = 10V, I_C = 35$ mA	20	50		
Collector-Base Capacitance	C_{cb}	$V_{CB} = 10V$		1.0		pF

TYPICAL PERFORMANCE CURVES ($T_A = 25°C$)

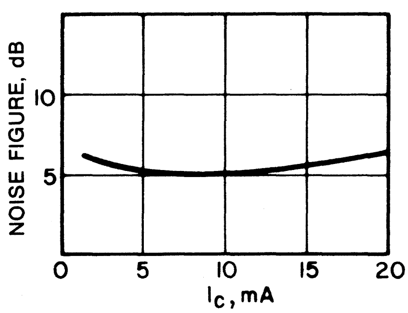
Maximum Available Gain (G_{max}) and Insertion Power Gain ($|S_{21}|^2$) vs. Frequency

V_{CE}=10 V I_C=35 mA



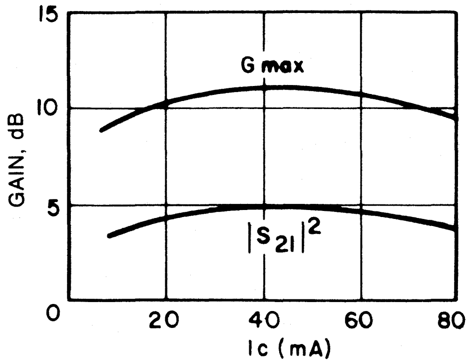
Spot Noise Figure vs Collector Current

V_{CE} = 10V Frequency = 2 GHz



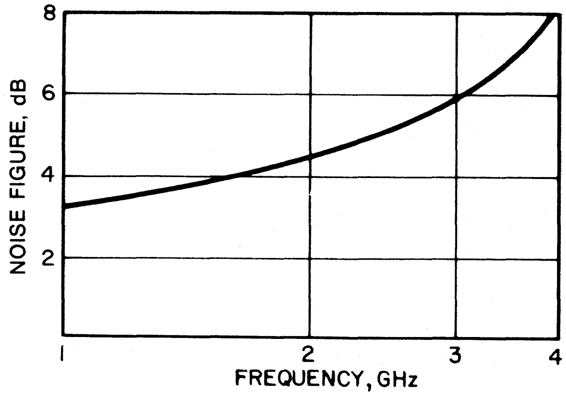
Maximum Available Gain (G_{max}) and Insertion Power Gain ($|S_{21}|^2$) vs. Collector Current

f=2 GHz V_{CE}=10V



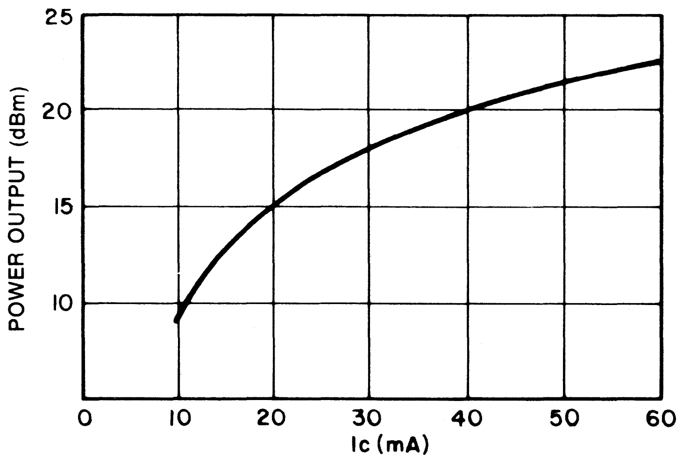
Spot Noise Figure vs Frequency

V_{CE} = 10V I_C = 10 mA



Power Output at 1 dB Gain Compression vs Collector Current

V_{CB} = 10V f = 2 GHz



SECTION 4

TYPICAL SCATTERING PARAMETERS

Bias = 10.00 Volts, 10.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.775	−166.6	6.232	88.0	.041	27.3	.370	−49.3
1000.00	.796	173.6	3.186	68.4	.048	29.7	.324	−58.5
1500.00	.803	160.4	2.141	51.9	.056	32.3	.336	−74.0
2000.00	.798	151.2	1.578	37.4	.065	32.3	.361	−88.6
2500.00	.799	141.6	1.262	23.2	.075	32.0	.391	−105.4
3000.00	.806	132.2	1.030	8.8	.086	28.9	.438	−121.0
3500.00	.815	123.2	.865	−4.1	.098	26.7	.481	−134.7
4000.00	.829	115.2	.734	−16.8	.108	23.8	.528	−147.3

Bias = 10.00 Volts, 35.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.784	−178.5	7.700	84.6	.026	44.1	.221	−67.5
1000.00	.790	167.5	3.879	67.8	.039	50.3	.186	−76.4
1500.00	.807	156.5	2.600	53.2	.052	49.7	.205	−90.4
2000.00	.803	148.5	1.918	40.1	.065	46.7	.232	−103.0
2500.00	.803	139.4	1.536	26.7	.078	42.3	.268	−117.7
3000.00	.812	130.3	1.261	13.8	.091	37.1	.318	−130.9
3500.00	.819	121.6	1.067	.4	.104	33.0	.362	−142.5
4000.00	.835	113.9	.913	−11.8	.115	28.4	.413	−153.5

CHIP CODE M1

AT-2815

Linear Power
Bipolar Transistor

FEATURES

- +22 dBm Output Power at 2 GHz
- 10 dB G_{max}
- 1W Maximum P_T
- Gold Metal System
- Hermetic 100 Mil Package
- Phosphorous Emitter

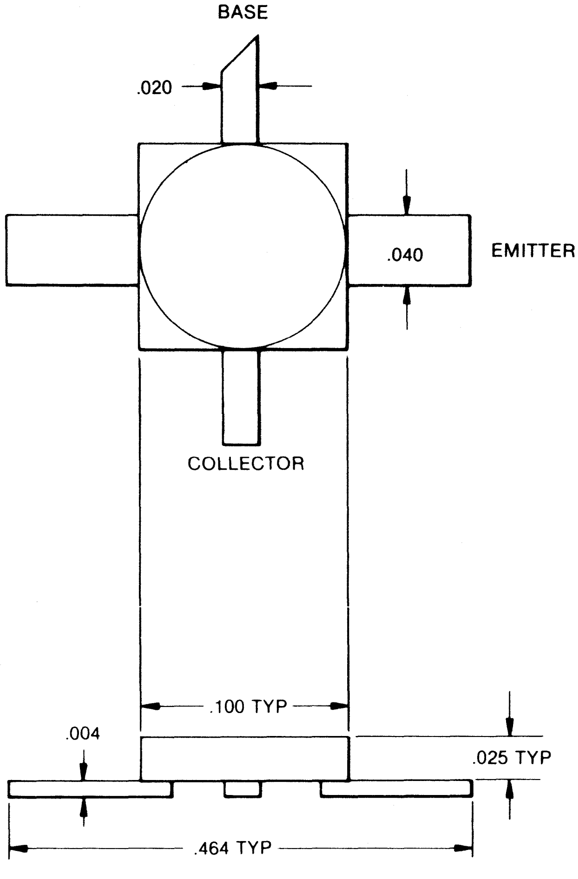
DESCRIPTION

The Avantek® AT-2815 is a silicon bipolar transistor designed for use as an intermediate power linear amplifier at frequencies through 3 GHz. It combines high gain and the capability to safely handle large collector current levels.

This transistor is an excellent choice for both wide and narrow band driver and output stages in communications, EW and intrumentation power amplifiers. It is widely applied as a driver for high power amplifiers in satellite uplink and point-to-point communications transmitters operating in the .5 to 3 GHz frequency range.

Avantek's proven gold metal system, which produces extremely uniform metallization of 1 μm thickness, minimizes current density to help prevent burn-out and metal migration. The package has a low thermal resistance which effectively carries heat away from the transistor junction. As a further assurance of long term reliability, the package is filled with a dry, inert atmosphere and hermetically sealed for protection against moisture and corrosive gases.

OUTLINE DRAWING 100 MIL PACKAGE



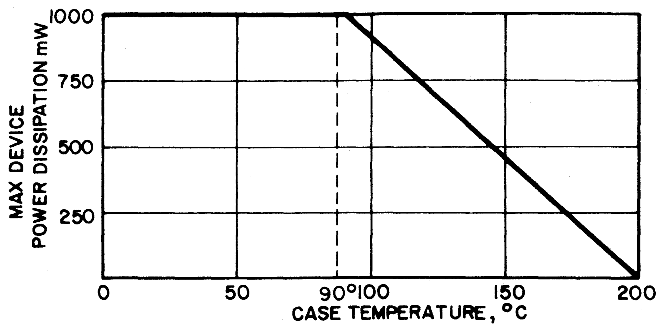
COMMON EMITTER OPERATING CHARACTERISTICS ($T_A = 25°C$)

Parameters	Symbols	Test Conditions	Freq.	AT-2815 Min	AT-2815 Typ	AT-2815 Max	Units
Spot Noise Figure	NF	$V_{CB} = 10V, I_C = 10$ mA	2 GHz		5.0		dB
		$V_{CB} = 10V, I_C = 10$ mA	4 GHz		8.0		dB
Maximum Available Gain	G_{max}	$V_{CB} = 10V, I_C = 35$ mA	2 GHz	7.0	10.0		dB
		$V_{CB} = 10V, I_C = 10$ mA	2 GHz		7.5		dB
		$V_{CB} = 10V, I_C = 35$ mA	4 GHz		5.0		dB
Insertion Power Gain	$\|S_{21}\|^2$	$V_{CB} = 10V, I_C = 35$ mA	2 GHz		5.0		dB

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}	15V
Collector Current	I_C	200 mA
Continuous Dissipation	P_T (T_{case} = 25°C)	1 watt
Junction Temperature	T_j	200°C
Storage Temperature Range	T_{STG}	− 65 to 200°C
Thermal Resistance	θ_{jc}	120°C/watt

POWER DERATING CURVE



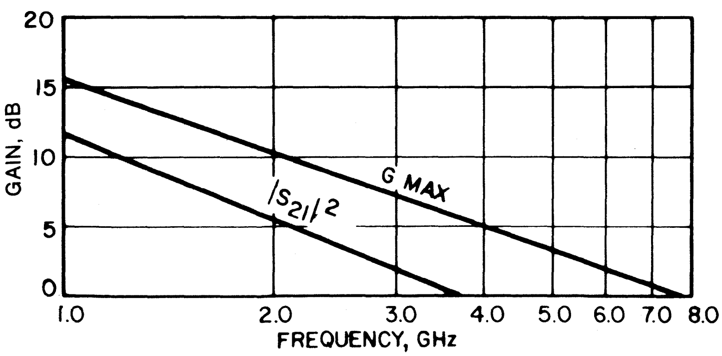
ELECTRICAL CHARACTERISTICS ($T_A = 25°C$)

Parameters	Symbols	Test Conditions	Min	Typ	Max	Units
Collector-Base Breakdown Voltage	$V_{(BR)}CBO$	$I_C = 10\ \mu A$	20			V
Emitter-Base Breakdown Voltage	$V_{(BR)}EBO$	$I_E = 10\ \mu A$	3			V
Collector-Emitter Breakdown Voltage	$V_{(BR)}CEO$	$I_C = 100\ \mu A$	15			V
Collector Cutoff Current	I_{CBO}	$V_{CB} = 10V$			20	nA
Forward Current Transfer Ratio	h_{FE}	$V_{CE} = 10V$, $I_C = 35$ mA	20	50		
Collector-Base Capacitance	C_{cb}	$V_{CB} = 10V$		1.0		pF

TYPICAL PERFORMANCE CURVES ($T_A = 25°C$)

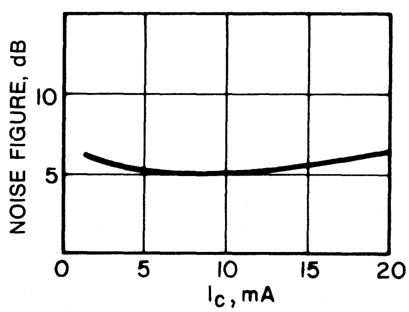
Maximum Available Gain (G_{max}) and Insertion Power Gain ($|S_{21}|^2$) vs. Frequency

V_{CE}=10 V I_C=35 mA



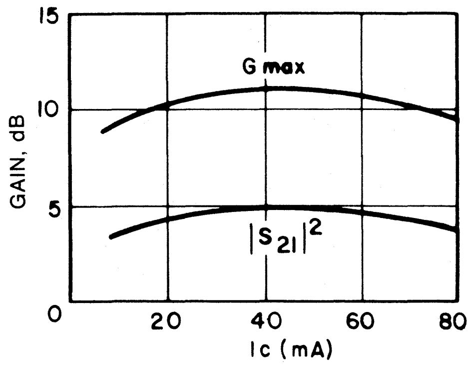
Spot Noise Figure vs Collector Current

V_{CE} = 10V Frequency = 2 GHz



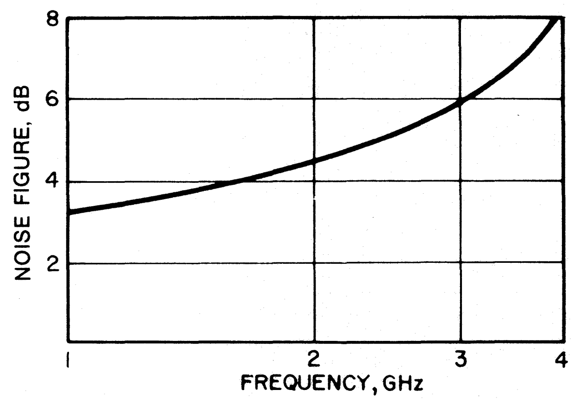
Maximum Available Gain (G_{max}) and Insertion Power Gain ($|S_{21}|^2$) vs. Collector Current

f=2 GHz V_{CE}=10V



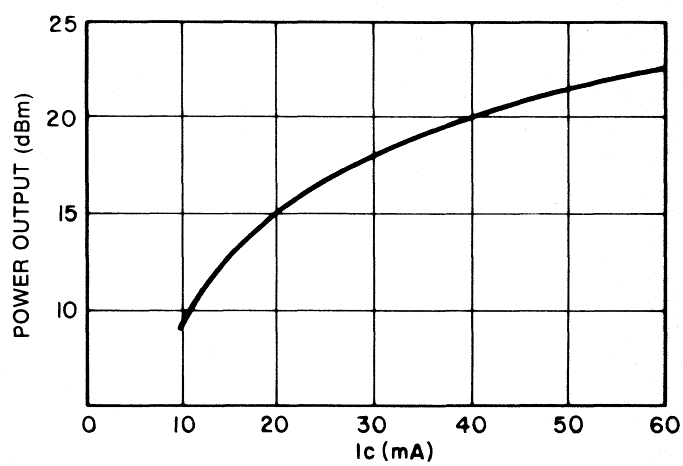
Spot Noise Figure vs Frequency

V_{CE} = 10V I_C = 10 mA



Power Output at 1 dB Gain Compression vs Collector Current

V_{CB} = 10V f = 2 GHz



SECTION 4

TYPICAL SCATTERING PARAMETERS

Bias = 10.00 Volts, 10.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.775	−166.6	6.232	88.0	.041	27.3	.370	−49.3
1000.00	.796	−173.6	3.186	68.4	.048	29.7	.324	−58.5
1500.00	.803	−160.4	2.141	51.9	.056	32.3	.336	−74.0
2000.00	.798	151.2	1.578	37.4	.065	32.3	.361	−88.6
2500.00	.799	141.6	1.262	23.2	.075	32.0	.391	−105.4
3000.00	.806	132.2	1.030	8.8	.086	28.9	.438	−121.0
3500.00	.815	123.2	.865	−4.1	.098	26.7	.481	−134.7
4000.00	.829	115.2	.734	−16.8	.108	23.8	.528	−147.3

Bias = 10.00 Volts, 35.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.784	−178.5	7.700	84.6	.026	44.1	.221	−67.5
1000.00	.790	167.5	3.879	67.8	.039	50.3	.186	−76.4
1500.00	.807	156.5	2.600	53.2	.052	49.7	.205	−90.4
2000.00	.803	148.5	1.918	40.1	.065	46.7	.232	−103.0
2500.00	.803	139.4	1.536	26.7	.078	42.3	.268	−117.7
3000.00	.812	130.3	1.261	13.8	.091	37.1	.318	−130.9
3500.00	.819	121.6	1.067	.4	.104	33.0	.362	−142.5
4000.00	.835	113.9	.913	−11.8	.115	28.4	.413	−153.5

CHIP CODE M1

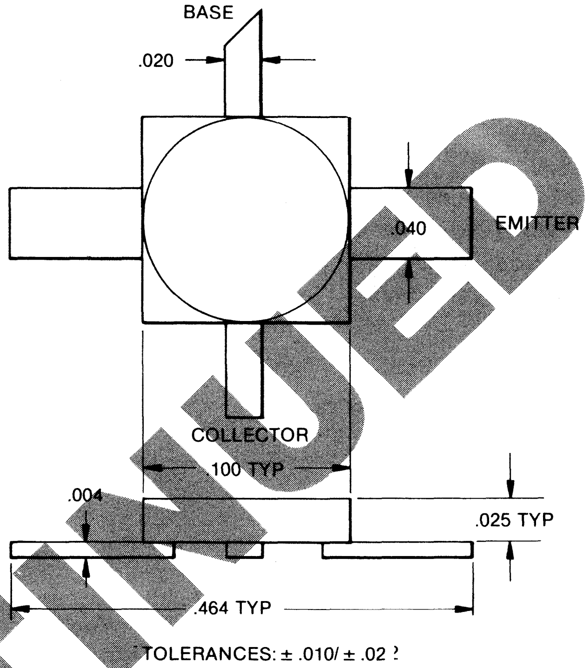
AT-3850

Linear Power
Bipolar Transistor

FEATURES

- **At 2 GHz:**
  - **Output Power = 100 mW**
  - **Noise Figure = 3.5 dB**
  - **G_{max} = 13 dB**
- **Diffused Emitter Ballast Resistors**
- **Gold Metal System**
- **700 mW Maximum P_T**
- **Hermetic 100 Mil Microstrip Package**
- **Phosphorous Emitter**

OUTLINE DRAWING 100 MIL PACKAGE



DESCRIPTION

The Avantek AT-3850 silicon bipolar transistor is an intermediate power, high gain amplifier for applications through approximately 3 GHz. It combines low-resistance platinum silicide contacts with an advanced gold metallization system that offers an extremely uniform conductor more than 1 micron thick. This combination prevents performance degradation or failure due to excessive contact heating, excessive current density or metal migration.

A two cell, 10 × 15 mil. multi-emitter transistor chip is used with the distribution of current through the emitter fingers controlled by diffused emitter ballast resistors. Unlike deposited metal resistors, the junction characteristics of the diffused resistors serves to self-limit the emitter current by providing a finite, limited number of

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

Parameters	Symbols	Typical Values	Freq.	Test Conditions
Spot Noise Figure	NF	2.5 dB	1 GHz	V_{CB} = 10V, I_C = 10 mA
		3.5 dB	2 GHz	
		4.8 dB	3 GHz	
		6.1 dB	4 GHz	
Maximum Available Gain	G_{max}	13.0 dB	2 GHz	V_{CB} = 10V, I_C = 35 mA
		10.0 dB	3 GHz	
		(9.0 dB min.)	3 GHz	
Insertion Power Gain	$\|S_{21}\|^2$	13.5 dB	1 GHz	V_{CB} = 10V, I_C = 35 mA
		7.5 dB	2 GHz	
		4.0 dB	3 GHz	
		1.8 dB	4 GHz	
Power Output (at 1 dB Gain Compression)	$P_o(-1\ dB)$	+ 20 dBm	2 GHz	V_{CB} = 10V, I_C = 35 mA
		+ 20 dBm	3 GHz	
		+ 19 dBm	4 GHz	
Power Output (saturated)	$P_o(sat)$	+ 23 dBm	2 GHz	
		+ 23 dBm	3 GHz	
		+ 22 dBm	4 GHz	

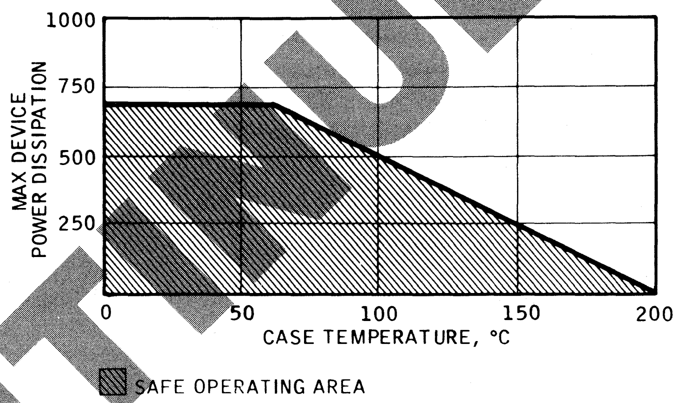
charge carriers. In addition, the inherent well-matched resistance of the diffused resistors offers unit-to-unit uniformity and batch-to-batch reproduceability.

The AT-3850 transistor chip is protected by a layer of silicon dioxide which prevents scratching or contamination during handling and packaging. It is packaged in the proven 100 mil. square ceramic stripline package. This package is filled with an inert atmosphere, hermetically sealed and fine leak tested to protect the transistor chip from humidity of corrosive atmospheric gases.

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}	15V
Collector Current	I_C	100 mA
Continuous Dissipation	P_T (T_{case} = 25°C)	700 mW
Junction Temperature	T_j	200°C
Storage Temperature Range	T_{STG}	– 65 to 200°C
Thermal Resistance	θ_{jc}	300°C/watt

POWER DERATING CURVE

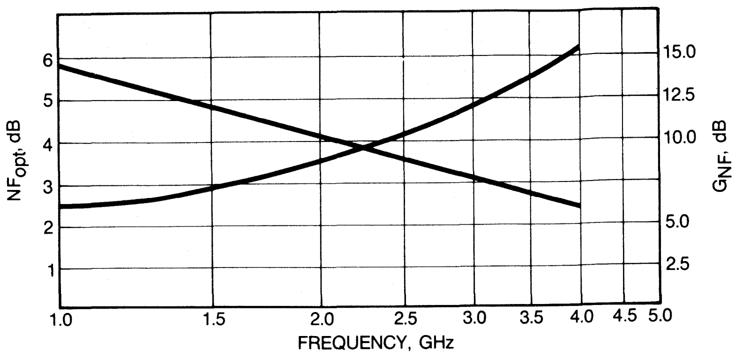


ELECTRICAL CHARACTERISTICS ($T_A = 25°C$)

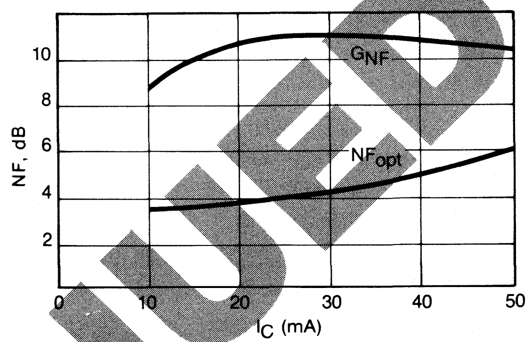
Parameters	Symbols	Test Conditions	Min	Typ	Max	Units
Collector-Base Breakdown Voltage	$V_{(BR)}CBO$	$I_C = 10\ \mu A$	20			V
Emitter-Base Breakdown Voltage	$V_{(BR)}EBO$	$I_E = 10\ \mu A$	3			V
Collector-Emitter Breakdown Voltage	$V_{(BR)}CEO$	$I_C = 100\ \mu A$	15			V
Collector Cutoff Current	I_{CBO}	$V_{CB} = 10V$			40	nA
Forward Current Transfer Ratio	h_{FE}	$V_{CE} = 10V$, $I_C = 35$ mA	20	50		
Collector-Base Capacitance	C_{cb}	$V_{CB} = 10V$		1.0		pF

TYPICAL PERFORMANCE CURVES ($T_A = 25°C$)

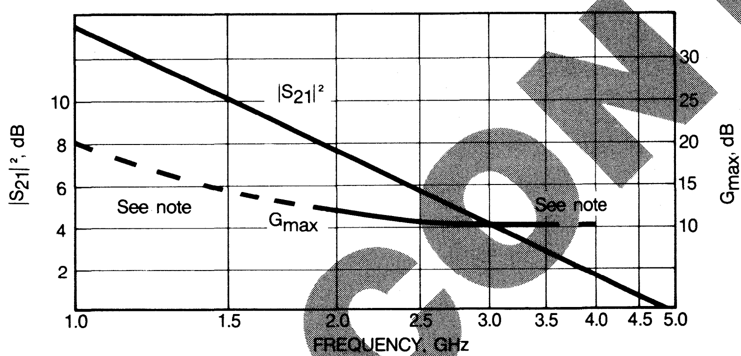
OPTIMUM NOISE FIGURE (NF_{opt}) and ASSOCIATED GAIN (G_{NF}) vs. FREQUENCY V_{CE} = 10V, I_C = 10 mA



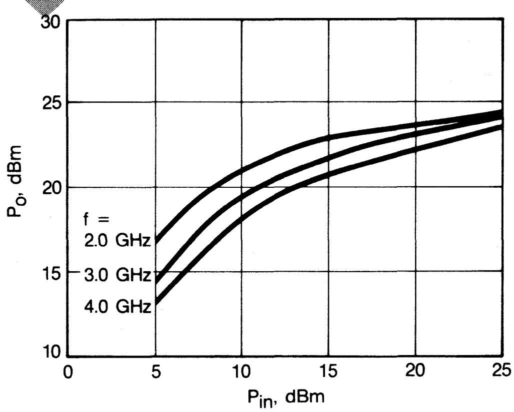
OPTIMUM NOISE FIGURE (NF_{opt}) and ASSOCIATED GAIN (G_{NF}) vs. COLLECTOR CURRENT F = 2 GHz, V_{CE} = 10V



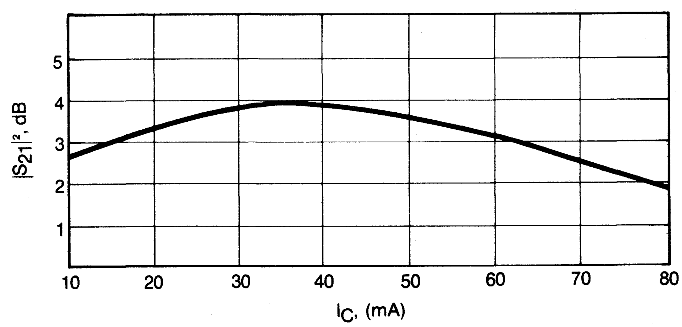
MAXIMUM AVAILABLE GAIN (G_{max}) and INSERTION POWER GAIN ($|S_{21}|^2$) vs. FREQUENCY V_{CE} = 10V, I_C = 35 mA



OUTPUT POWER vs. INPUT POWER V_{CE} = 10V, I_C = 35 mA



INSERTION POWER GAIN ($|S_{21}|^2$) vs. COLLECTOR CURRENT F = 3 GHz, V_{CE} = 8V



TYPICAL SCATTERING PARAMETERS

Bias = 10.00 Volts, 10.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.716	−147.3	7.048	98.7	.046	30.1	.585	−41.1
1000.00	.750	−178.7	3.815	72.4	.050	22.9	.485	−52.2
1500.00	.774	162.5	2.595	52.8	.052	25.7	.471	−67.0
2000.00	.776	149.7	1.932	35.6	.056	30.0	.478	−82.2
2500.00	.783	137.2	1.547	19.8	.065	34.0	.489	−99.9
3000.00	.797	125.2	1.269	4.5	.079	34.3	.522	−118.1
3500.00	.809	113.7	1.063	−11.3	.097	32.5	.554	−134.9
4000.00	.829	103.3	.912	−25.0	.115	29.6	.578	−149.0
4500.00	.837	93.0	.786	−37.8	.134	22.5	.617	−165.6
5000.00	.844	83.4	.673	−48.3	.153	14.8	.656	178.4
5500.00	.828	73.4	.566	−58.9	.169	6.6	.681	163.6
6000.00	.907	64.2	.534	−67.1	.197	−.3	.771	151.5

Bias = 10.00 Volts, 35.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
500.00	.702	−156.5	8.713	96.1	.039	33.2	.478	−50.0
1000.00	.738	176.5	4.632	71.7	.045	31.0	.368	−59.3
1500.00	.764	159.5	3.138	53.1	.052	33.6	.352	−72.5
2000.00	.768	147.8	2.335	36.6	.059	35.9	.357	−86.3
2500.00	.775	135.9	1.869	21.2	.070	36.7	.372	−103.3
3000.00	.791	124.4	1.540	6.1	.084	34.7	.409	−120.6
3500.00	.806	113.2	1.296	−8.7	.100	31.8	.444	−136.9
4000.00	.827	103.0	1.118	−23.6	.117	28.5	.473	−150.4
4500.00	.836	92.9	.973	−36.7	.134	21.8	.519	−166.3
5000.00	.845	83.3	.838	−48.2	.152	14.3	.567	178.2
5500.00	.832	73.4	.711	−59.5	.168	6.6	.601	164.0
6000.00	.913	64.2	.672	−68.9	.196	−.0	.694	152.4

CHIP CODE M8

AT-7510

Linear Power
Bipolar Transistor

FEATURES

- At 4 GHz, Typical:
  - Sat. Output Power = +29 dBm
  - P_{1dB} = +27.5 dBm
  - Associated Gain = 8.0 dB
- Diffused Emitter Ballast Resistor
- Gold Metal System
- 2.2 W Maximum P_T
- Hermetic Beryllia/Metal Stripline Package
- Arsenic Emitter

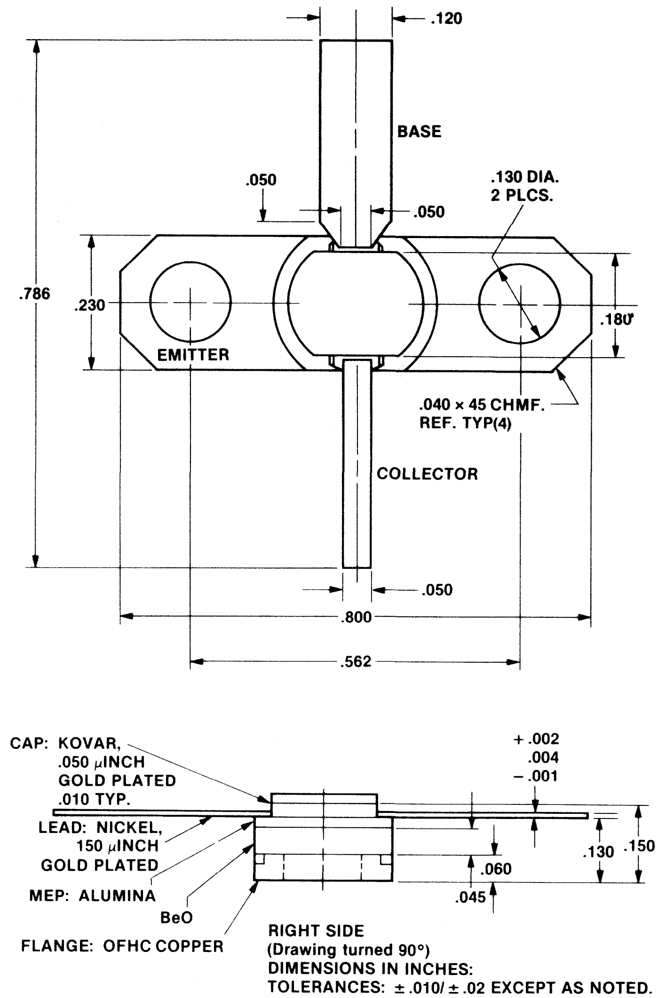
DESCRIPTION

The AT-7510 silicon bipolar transistor is a medium power, high gain amplifier for applications through 4 GHz. It combines low resistance platinum silicide contacts with an advanced gold metal system that produces an extremely uniform conductor more than 1 μm thick with excellent step coverage.

This combination prevents performance degradation or failure from excessive contact heating, excessive current density or metal migration under high power, high temperature operation.

A multi-emitter geometry is used with the current distribution through the emitter fingers controlled by diffused ballast resistors. Unlike deposited metal resistors, the junction characteristics of the diffused resistors serves to self-limit the emitter current by providing a finite number of charge carriers. In addition, the inherently well-matched resistance of diffused resistors assures unit-to-unit uniformity and batch reproduceability. Depletion rings are included to prevent base-to-collector breakdown at high operating voltages.

OUTLINE DRAWING



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

Parameter	Symbol	Test V_{CB}	Cond I_C	Freq GHz	AT-7510 Values Min	Typ	Max
Power Output (@ 1 dB Gain Compression)	Po (− dB)	+15V	110 mA	2	—	+29 dBm	—
		+15V	110 mA	4	+25.5 dBm	+27.5 dBm	—
Power Output, Saturated (@ 3 dB Gain Compression)	Po (sat)	+15V	110 mA	4	—	+29 dBm	—
Associated 1 dB Compressed Gain	G (−1 dB)	+15V	110 mA	2	—	11.5 dB	—
		+15V	110 mA	4	7.0 dB	9.5 dB	—
Power Added Efficiency (@ 1 dB Gain Compression)	η	+15V	110 mA	2	—	40%	—
		+15V	110 mA	4	—	35%	—

The AT-7510 is packaged in a metal/beryllia microstrip package specifically designed for low thermal resistance and equipped with a highly-conductive copper mounting flange for maximum transfer of heat to radiator or circuit board. To assure the long term reliability of the AT-7510 under severe environmental conditions the package is filled with a dry, inert atmosphere, hermetically sealed and leak tested.

MAXIMUM RATINGS ($T_A = 25°C$)

Parameter	Symbol	Limit
Collector-Base Voltage	V_{CBO}	40V
Collector-Emitter Voltage	V_{CEO}	30V
Emitter-Base Voltage	V_{EBO}	2.0V
DC Collector Current	I_C	150 mA
Total Device Dissipation	P_T	2.25W
Junction Temperature*	T_j	200°C
Thermal Resistance	θ_{jc}	40°C/watt
Storage Temperature Range	T_{STG}	−65° to 200°C
Lead Temperature (Soldering 10 seconds each lead)	—	+250°C

See: *POWER DERATING CURVE*

POWER DERATING CURVE

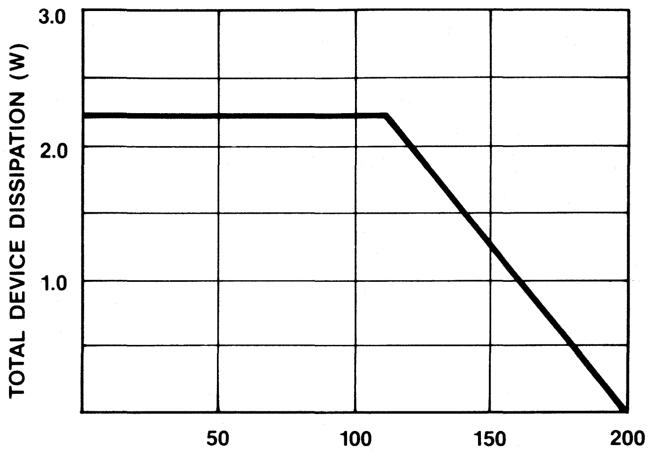


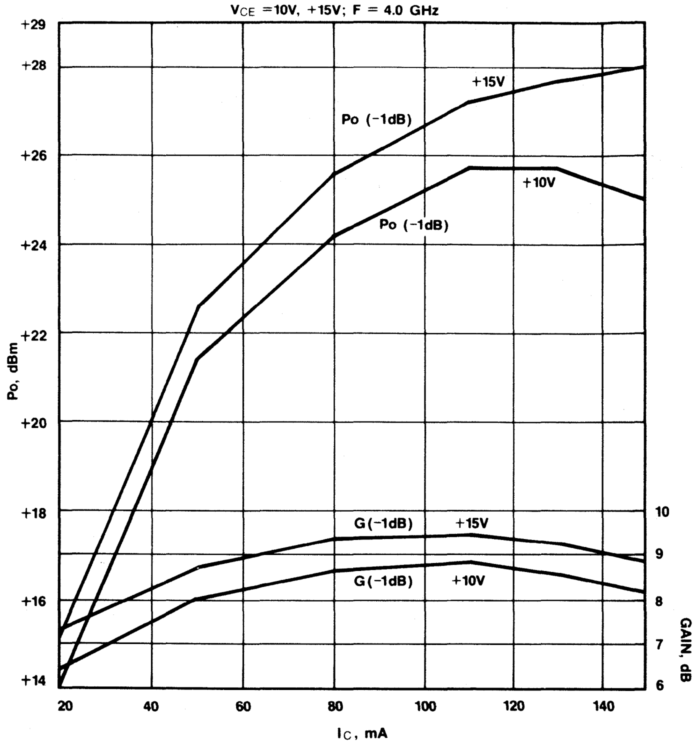
FIGURE 1. MAXIMUM POWER DISSIPATION CURVE FOR $\theta_{jc} = 40°$ C/W, $T_{jmax} = 200°C$

ELECTRICAL CHARACTERISTICS ($T_A = 25°C$)

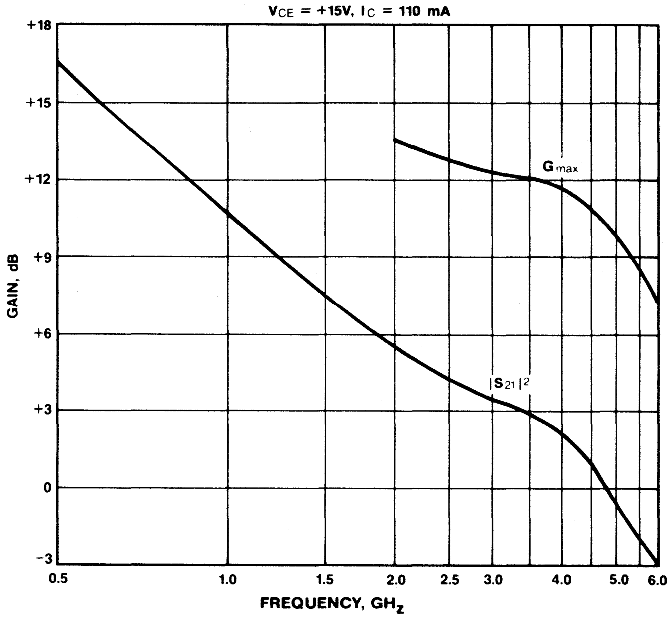
Parameter	Symbol	Test Conditions	Values Min	Values Typ	Values Max	Units
Collector-Base Breakdown Voltage	$V_{(BR)}CBO$	$I_C = 100\ \mu A$	40	—	—	V
Collector-Emitter Breakdown Voltage	$V_{(BR)}CEO$	$I_C = 500\ \mu A$	22	—	—	V
Emitter-Base Breakdown Voltage	$V_{(BR)}EBO$	$I_B = 100\ \mu A$	2.0	—	—	V
Emitter-Base Leakage Current	I_{EBO}	$V_{EB} = 1V$	—	—	5.0	μA
Collector-Emitter Leakage Current	I_{CES}	$V_{CE} = 32V$	—	—	200	μA
Collector-Base Leakage Current	I_{CBO}	$V_{CB} = 20V$	—	—	100	μA
Forward Current Transfer Ratio	h_{fe}	$V_{CB} = 15V$, $I_C = 110$ mA	15	30	100	—

TYPICAL PERFORMANCE CURVES

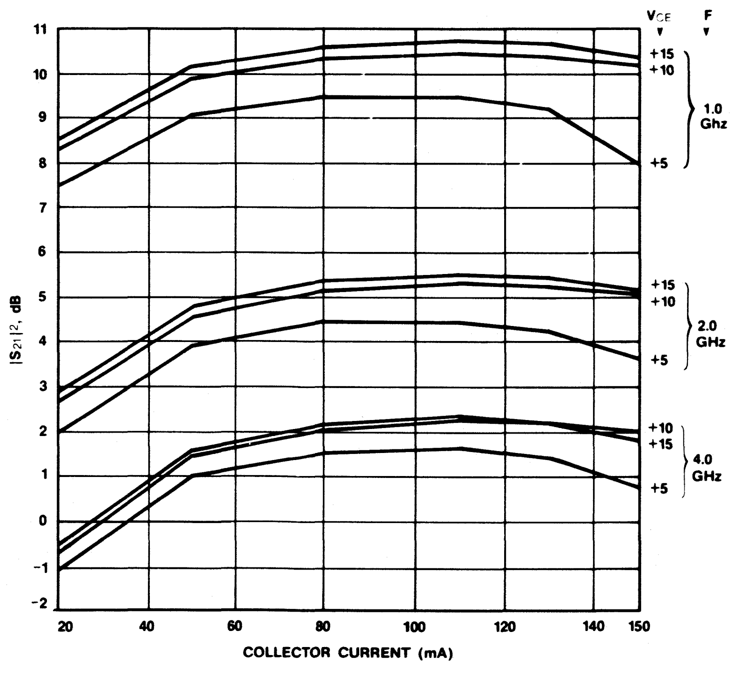
POWER OUTPUT @ 1 dB GAIN COMPRESSION [$P_o(-1\ dB)$] AND ASSOCIATED GAIN [G(−1 dB)] VS. COLLECTOR CURRENT



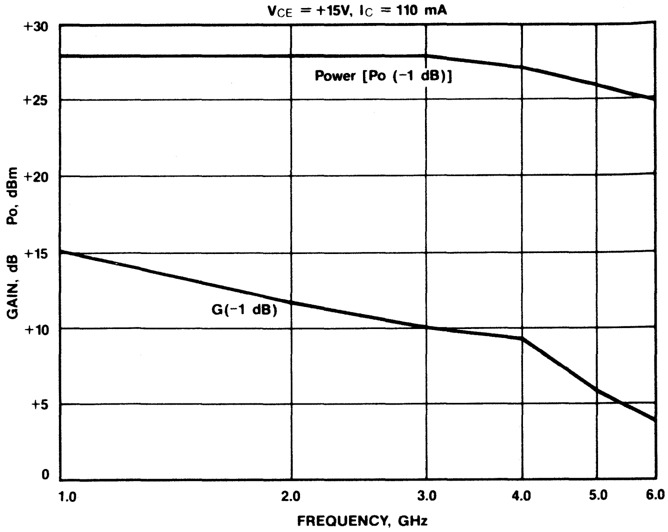
MAXIMUM AVAILABLE GAIN (G_{Max}) AND INSERTION POWER GAIN ($|S_{21}|^2$) VS. FREQUENCY



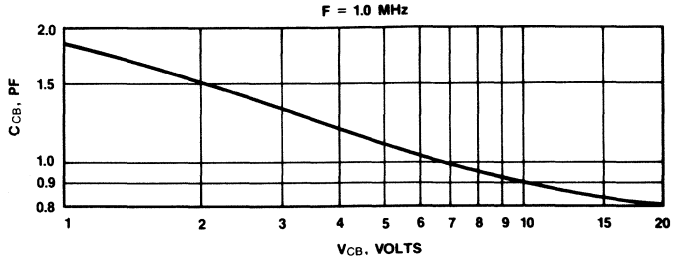
INSERTION POWER GAIN ($|S_{21}|^2$) dB VS. COLLECTOR CURRENT, COLLECTOR-EMITTER VOLTAGE AND FREQUENCY



POWER OUTPUT @ 1 dB GAIN COMPRESSION [P_o(−1 dB)] AND ASSOCIATED GAIN [G(−1 dB)] VS. FREQUENCY



COLLECTOR-BASE CAPACITANCE (EMITTER GROUNDED) VS. COLLECTOR-BASE VOLTAGE



TYPICAL SCATTERING PARAMETERS

V_{CE} = 10.00 VOLTS, I_C = 50.00 MA

S—MAGN AND ANGLES

FREQ	S_{11}		S_{21}		S_{12}		S_{22}	
500.00	.757	−173.4	6.251	83.4	.037	21.4	.459	−96.2
1000.00	.778	−168.3	3.315	52.0	.040	15.2	.459	−119.9
1500.00	.773	154.6	2.339	24.9	.044	14.8	.537	−125.9
2000.00	.717	142.9	1.871	−.5	.051	10.5	.615	−150.2
2500.00	.636	129.1	1.668	−28.2	.058	.6	.707	−163.3
3000.00	.492	117.4	1.558	−59.3	.062	−18.1	.800	−176.4
3500.00	.306	124.4	1.453	−96.5	.050	−45.9	.890	−168.0
4000.00	.381	157.7	1.206	−137.4	.021	−90.3	.938	−151.4
4500.00	.603	150.3	.912	−177.3	.023	103.7	.911	134.2
5000.00	.746	131.6	.682	147.6	.056	66.0	.866	−119.1
5500.00	.814	112.8	.547	115.9	.083	42.1	.818	104.8
600.00	.847	91.8	.488	84.8	.105	20.0	.770	89.4

V_{CE} = 15.00 VOLTS, I_C = 110.00 MA

S—MAGN AND ANGLES

FREQ	S_{11}		S_{21}		S_{12}		22	
500.00	.754	−172.6	6.945	82.6	.037	20.3	.423	−100.6
1000.00	.769	168.7	3.686	52.3	.040	15.2	.423	−122.5
1500.00	.761	155.2	2.610	26.0	.045	13.6	.500	−136.4
2000.00	.704	144.0	2.101	.3	.051	8.6	.582	−149.4
2500.00	.623	131.0	1.869	−27.1	.057	−2.6	.681	−161.9
3000.00	.491	121.1	1.740	58.0	.059	−20.6	.782	−174.6
3500.00	.337	128.2	1.617	94.6	.047	−47.7	.880	−169.4
4000.00	.405	154.0	1.351	−134.3	.017	−93.2	.933	−152.4
4500.00	.602	148.0	1.037	−173.2	.023	102.5	.902	−134.9
5000.00	.741	130.5	.783	−151.9	.056	67.0	.854	−119.7
5500.00	.809	112.1	.629	120.4	.083	42.9	.799	−105.5
6000.00	.843	91.2	.557	89.4	.105	21.2	.747	−90.9

CHIP CODE M200

AT-8110/AT-8111

2-6 GHz Small Signal
Ultra-Low Noise
Gallium Arsenide FET
Revised June, 1980

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

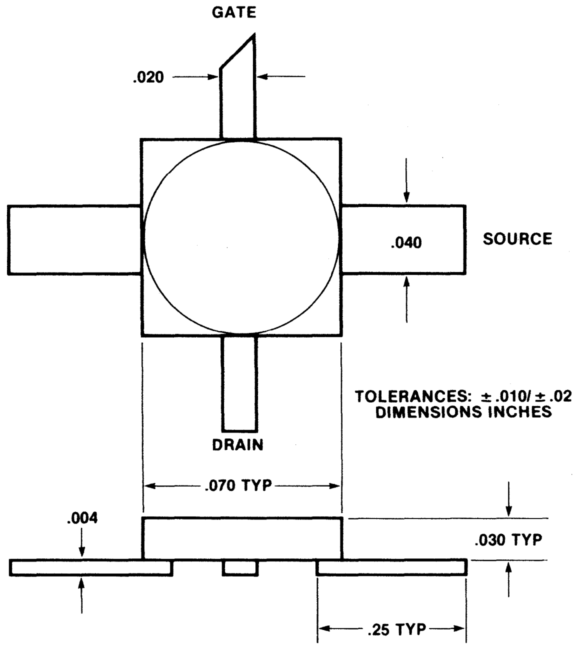
DESCRIPTION

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 narrow-band 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 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.

OUTLINE DRAWING PACKAGED VERSION



AVANTEK 70 mil FET PACKAGE

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

PARAMETER	SYMBOL	VALUE	FREQUENCY	TEST CONDITION
Spot Noise Figure	NF_{opt}	1.3 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*	$P_{O(-)}$	+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 power

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 ultraminiature 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.

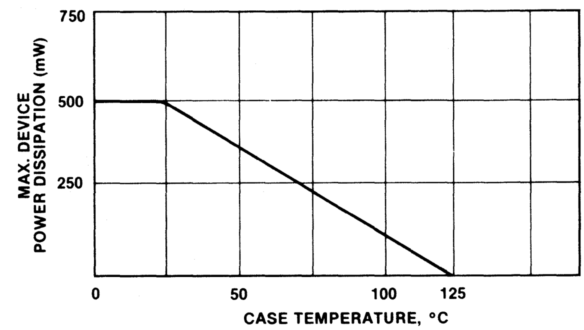
The AT-8111 is an unpackaged 15 x 19 mil chip suitable for MIC thin-film and thick-film hybrid circuits. It's gold metal system provides excellent bond strength and assures compatibility with the wire bonding techniques used in hybrid circuit fabrication. An optional PGA (polycrystalline gallium arsenide) 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.

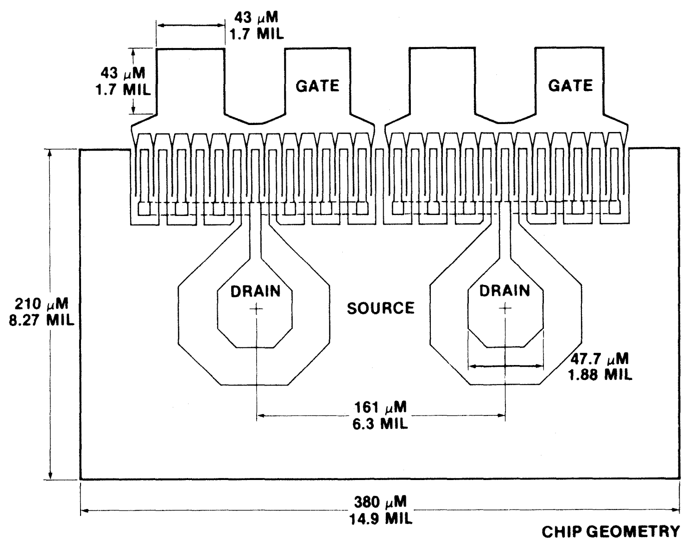
ABSOLUTE MAXIMUM RATINGS (T_A = 25°C)

Parameter	Symbol	Limit
Drain-Source Voltage	V_{DS}	+7V
Gate-Source Voltage	V_{GS}	−5V
Drain Current	I_D	120 mA
Continuous Dissipation	P_T (T_{case} = 25°C)	500 mW
Channel Temperature	T_{ch}	125°C
Storage Temperature (AT-8110)	T_{stg}	−65°C to +125°C
Thermal Resistance	Θ_{CC}	175°C/W pkgd. device 100°C/W chip device

POWER DERATING CURVE



OUTLINE DRAWINGS UNPACKAGED CHIP



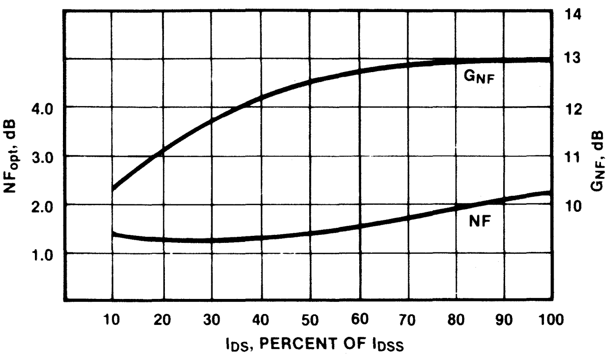
CHIP GEOMETRY
OVERALL
CHIP SIZE
15 x 19 MIL
381 x 482.6 μM

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

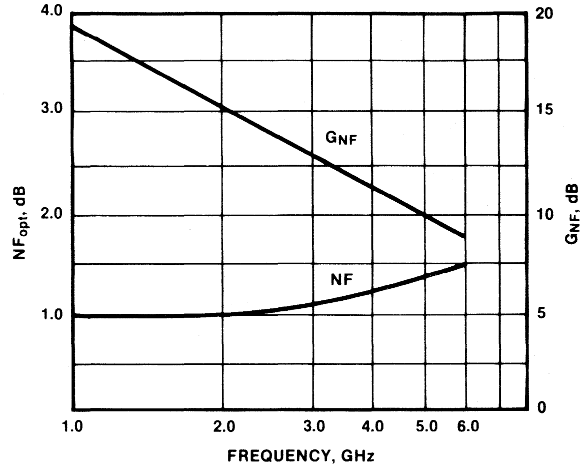
TYPICAL PERFORMANCE CURVES

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

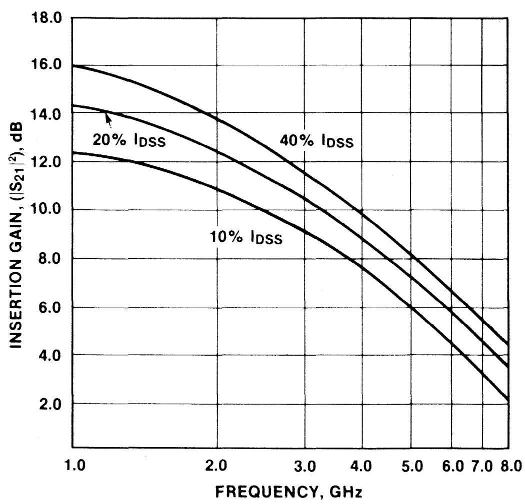


Note: Source admittance for the AT-8110 optimum noise figure at 4.0 GHz, $V_{DS} = 3V$, $I_{DS} = 20$ mA is approximately (23-j24) mmho.

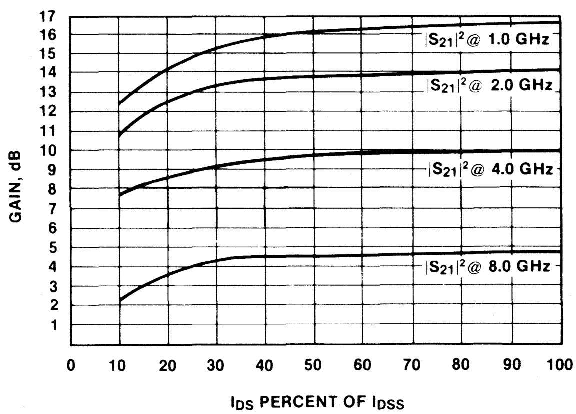
SPOT NOISE FIGURE (NF_{opt}) AND ASSOCIATED GAIN (G_{NF}) VS. FREQUENCY $V_{DS} = 3V$, $I_{DS} = 20$ MA



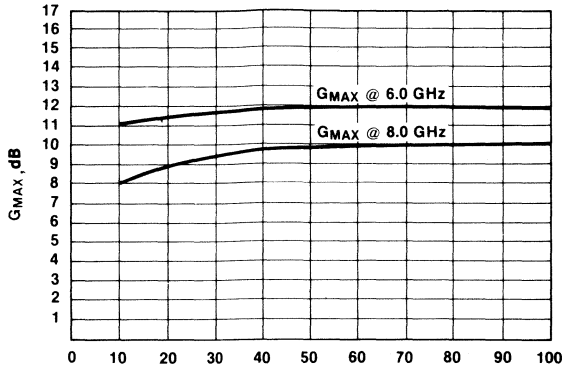
INSERTION POWER GAIN ($|S_{21}|^2$) VS. FREQUENCY AND I_{DS} @$V_{DS} = 3V$



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



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



TYPICAL SCATTERING PARAMETERS

AT-8110

S—MAGN AND ANGLES — **Bias = 3.00 Volts, 20.00 mA**

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

S—MAGN AND ANGLES — **Bias = 5.00 Volts, 50.00 mA**

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	.359	−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

CHIP CODE M110

AT-8060/AT-8061

6-18 GHz, Small Signal
Gallium Arsenide FET
Revised December, 1979

Features

- 3.3 dB NF, 5.0 dB Gain @ 18 GHz*
- 2.5 dB NF, 9.0 dB Gain @ 12 GHz*
- 1.9 dB NF, 11.0 dB Gain @ 6 GHz*
- +10 dBm P_0 (1 dB G.C.P.) @ 12 GHz
- Excellent Gain and Noise Flatness vs. I_{ds}
- Wide Dynamic Range
- All Gold-Based Metallization
- High Performance 50 mil package or chip form

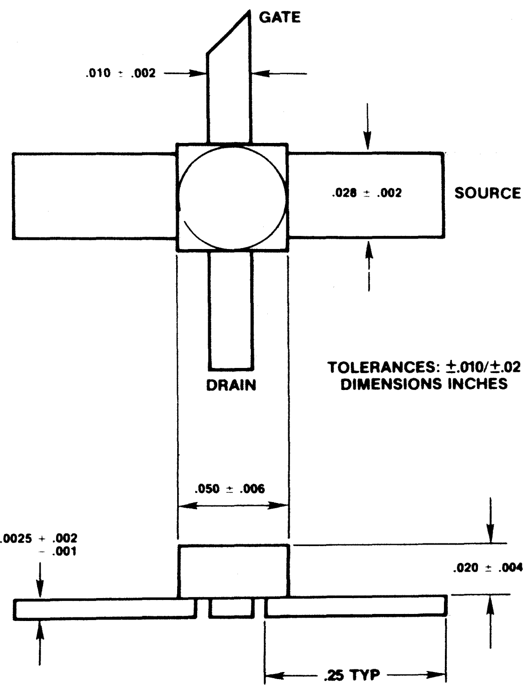
DESCRIPTION

The AT-8060/AT-8061 is gallium arsenide, n-channel metal semiconductor field effect transistor (GaAs FET) with a 0.5 μm-length Schottky barrier gate. It is designed for high gain, low noise amplification in both narrowband communications and radar amplifiers and in wideband electronic defense applications in the 6 to 18 GHz frequency range.

Among the performance features of this GaAs FET are the particularly flat curves for insertion power gain (S_{21}^2), maximum available gain (G_{max}) and noise figure vs. drain current, from relatively low bias levels through I_{DSS}. This simplifies the bias requirements of amplifier stages using the AT-8060/AT-8061.

All metallization, including the gate, in the AT-8060/-8061 uses a system of gold and refractory metals. This eliminates the corrosion, intermetallic growth and burn-out problems associated with other GaAs FET metal systems helping to assure long term reliability under severe operating conditions.

OUTLINE DRAWING: PACKAGED VERSION



AVANTEK 50 mil FET PACKAGE

SECTION 5

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

PARAMETER	SYMBOL		VALUE	FREQUENCY	TEST CONDITION
Spot Noise Figure	NF_{opt}	*BOTH*	1.9 dB	6.0 GHz	$V_{DS} = 3V$, $I_{DS} = 10.0$ mA
		AT-8060	2.8 dB (3.5 dB max.)	12.0 GHz	" " "
		AT-8061	2.5 dB (3.2 dB max.)	12.0 GHz	" " "
		AT-8061	3.3 dB	18.0 GHz	" " "
Gain at Optimum Noise Figure	G_{NF}	*BOTH*	11.0 dB	6.0 GHz	" " "
		AT-8060	8.0 dB (6.5 dB min.)	12.0 GHz	" " "
		AT-8061	9.0 dB (7.5 dB min.)	12.0 GHz	" " "
		AT-8061	5.0 dB	18.0 GHz	" " "
Maximum Available Gain	G_{max}	*AT-8061*	12.0 dB	12.0 GHz	$V_{DS} = 3V$, $I_{DS} = 40.0$ mA
Output Power at 1 dB Gain Compression*	$P_{O(-1)}$	*BOTH*	+10.0 dBm	12.0 GHz	$V_{DS} = 5V$, $I_{DS} = 40.0$ mA

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

The AT-8060 version, recommended for operation through 12 GHz, is packaged in a unique 50 mil square metal-ceramic stripline package. The package's small dimensions and careful optimization minimizes parasitic reactances, and it is particularly compatible with the dimensions of microstripline circuitry at 12 GHz. As a further assurance of reliability, the package is filled with dry nitrogen and hermetically sealed to fully protect the GaAs FET chip from contamination, corrosive gasses or moisture, Each AT-8060 is leak tested before shipment to verify its hermetic seal.

For microwave hybrid construction at frequencies up to 18 GHz, the AT-8061 version is available as an unpackaged 10 x 14 mil chip. Its gold metal system provides excellent bond strength and assures compatibility with the wirebonding techniques used in thin or thick film hybrid circuit construction.

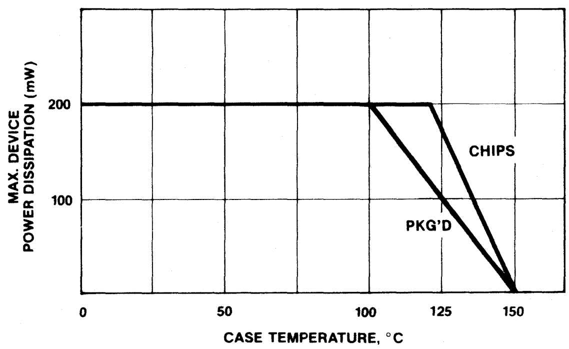
All Avantek transistors, both silicon bipolar and GaAs FET types, are 100% tested for both DC and RF parameters after packaging and leak-testing.

For critical military and aerospace programs that require an added assurance of reliability the AT-8060 may be qualified under the Avantek "R" Series program. "R" Series transistors are identical to their commercial counterparts, but are subjected to an additional burn-in period and screened using MIL-STD-750 procedures.

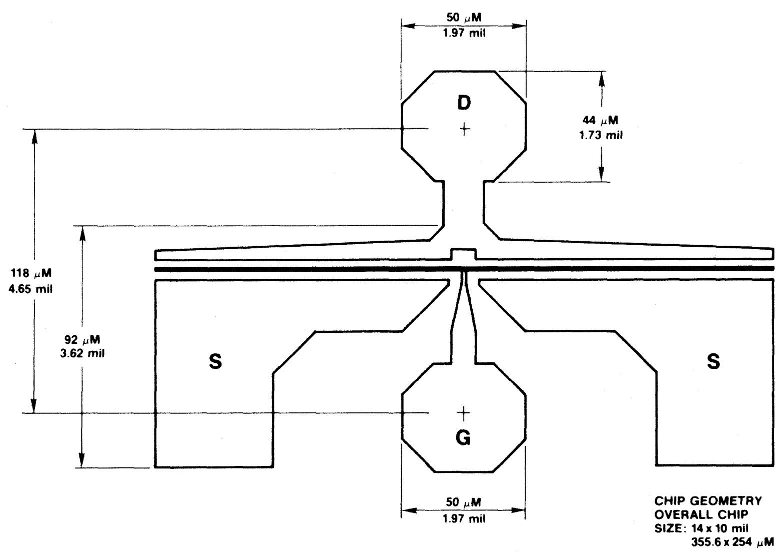
ABSOLUTE MAXIMUM RATINGS ($T_A = 25°C$)

Parameter	Symbol	Limit
Drain-Source Voltage	V_{DS}	+5V
Gate-Source Voltage	V_{GS}	−4V
Drain Current	I_D	50 mA
Continuous Dissipation	P_T ($T_{case} = 25°C$)	200 mW
Channel Temperature	T_{ch}	150°C
Storage Temperature (AT-8110)	T_{stg}	−65°C to +150°C
Thermal Resistance	Θ_{CC}	250°C/W pkgd. device 150°C/W chip device

POWER DERATING CURVE (AT-8060)



OUTLINE DRAWING: UNPACKAGED VERSION

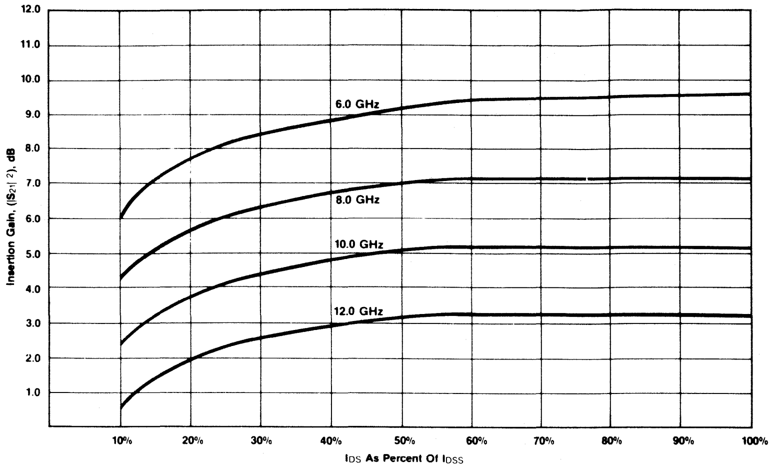


TYPICAL DC CHARACTERISTICS ($T_A = 25°C$)

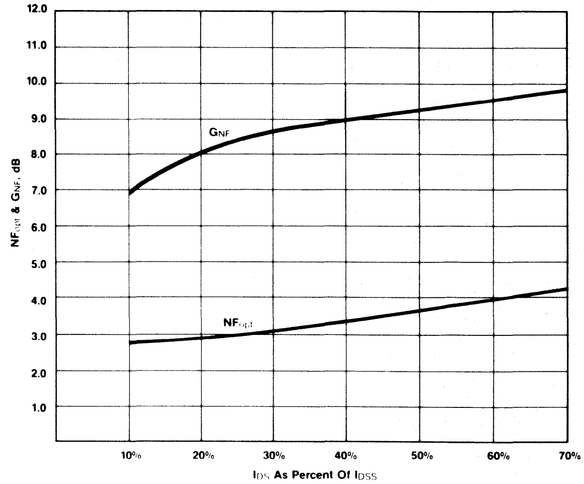
Parameter	Symbol	Value	Test Conditions
Transconductance	G_M	30 mmho	$V_{DS} = 3V$, $V_{GS} = 0V$
Saturated Drain Current	I_{DSS}	50 mA	$V_{DS} = 3V$
Pinchoff Voltage	V_P	−2V	$V_{DS} = 3V$, $I_{DS} = 1$ mA

TYPICAL PERFORMANCE CURVES AT-8060

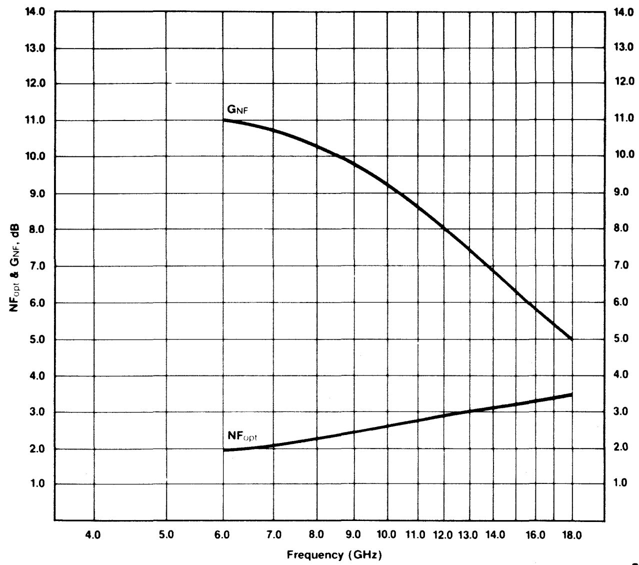
AT-8060
Insertion Power Gain ($|S_{21}|^2$) vs. I_{DS} and Frequency @ V_{DS} = 3V



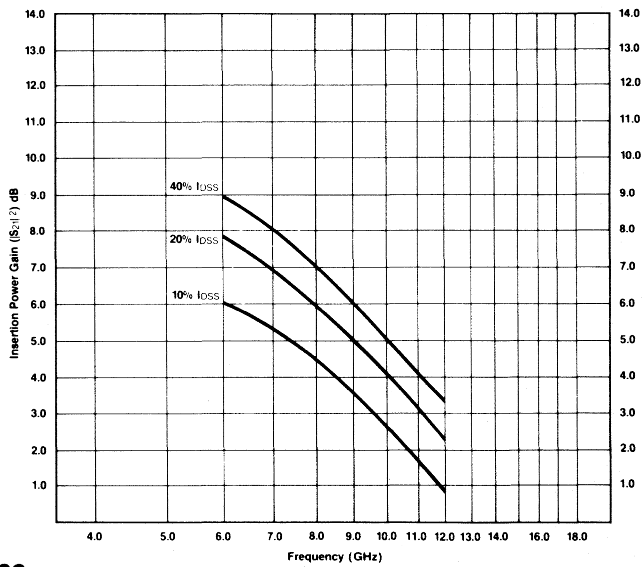
AT-8060
Spot Noise Figure (NF_{opt}) And Associated Gain (G_{NF}) vs. I_{DS}
V_{DS} = +3V, Freq = 12.0 GHz



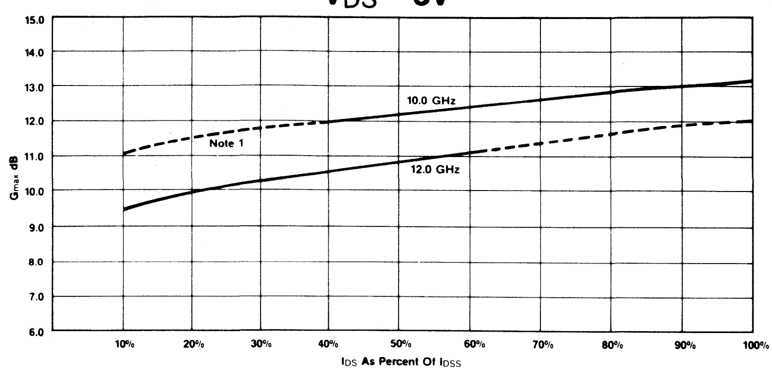
AT-8060
Spot Noise Figure (NF_{opt}) And Associated Gain (G_{NF}) vs. Frequency
V_{DS} = +3 Volts I_{DS} = 20% I_{DS} (≈10 mA)



AT-8060
Insertion Power Gain ($|S_{21}|^2$) vs. Frequency And I_{DS} @ 3 Volts V_{DS}
V_{DS} = 3V



AT-8060
Maximum Available Gain (G_{max}) vs. I_{DS}
V_{DS} = 3V

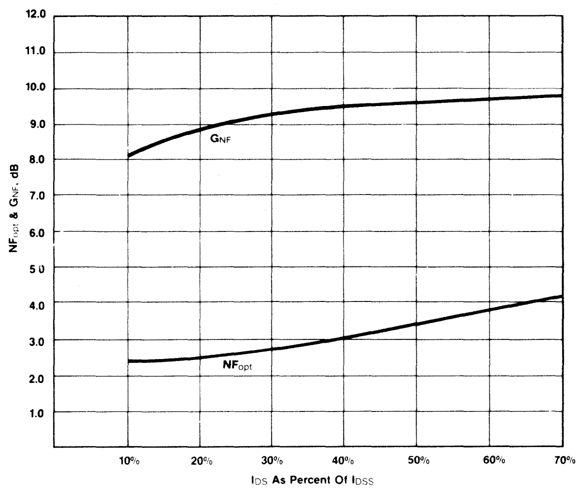


Note 1: Dashed line indicates area of potential instability.

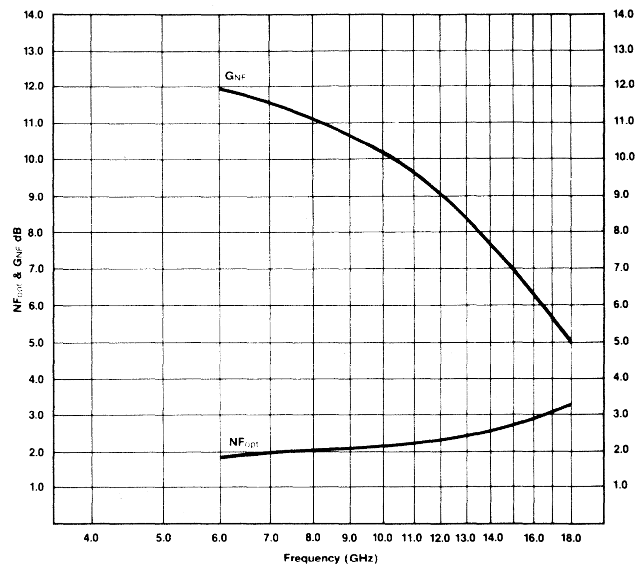
SECTION 5

TYPICAL PERFORMANCE CURVES AT-8061

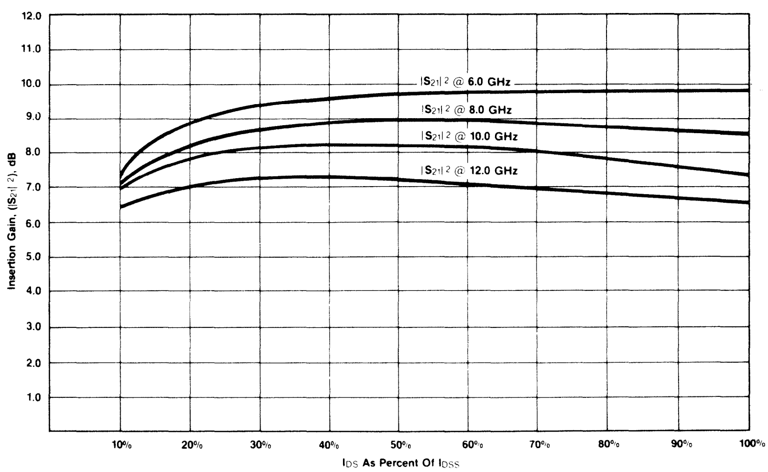
AT-8061
Spot Noise Figure (NF_{opt}) And Associated Gain (G_{NF}) vs. I_{DS}
V_{DS} = +3V, Freq = 12.0 GHz



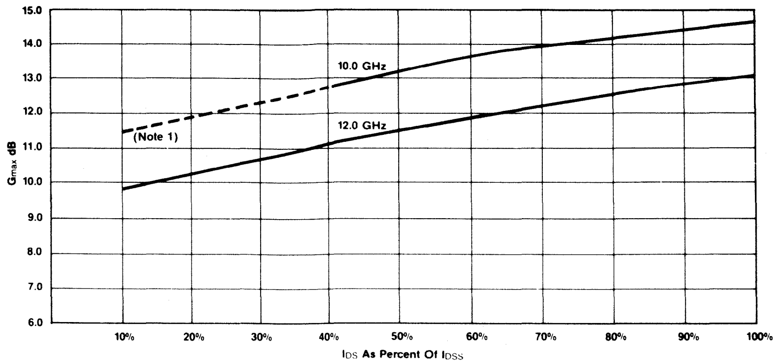
AT-8061
Spot Noise Figure (NF_{opt}) And Associated Gain (G_{NF}) vs. Frequency
V_{DS} = 3V I_{DS} = 20% I_{DSS} (≈ 10 mA)



AT-8061
Insertion Power Gain ($|S_{21}|^2$) vs. I_{DS} and Frequency
V_{DS} = 3V

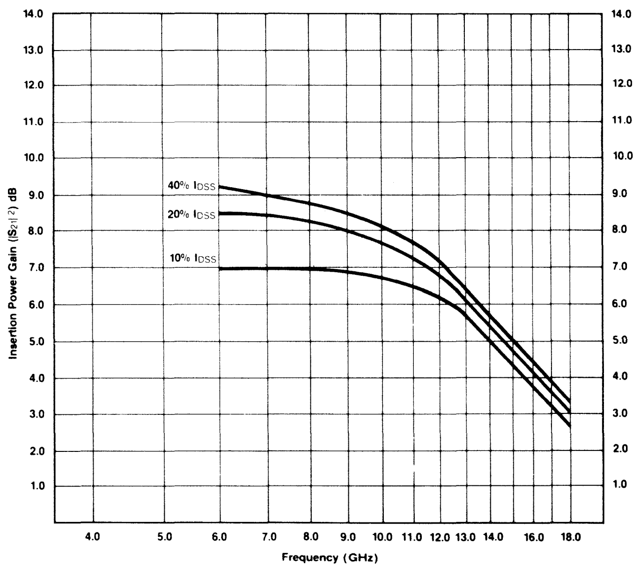


AT-8061
Maximum Available Gain (G_{max}) vs. I_{DS}
V_{DS} = 3V



Note 1: Dashed line indicates area of potential instability.

AT-8061
Insertion Power Gain ($|S_{21}|^2$)
vs. Frequency And I_{DS} At V_{DS} = 3V



TYPICAL SCATTERING PARAMETERS

AT-8060

Bias = 3.0 Volts, 10.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
6000.00	.773	− 146.4	2.464	51.5	.094	− 8.9	.631	− 84.7
7000.00	.753	− 171.8	2.247	30.3	.100	− 25.8	.592	− 102.9
8000.00	.729	166.2	1.993	10.4	.097	− 40.4	.586	− 121.2
9000.00	.722	149.1	1.783	− 8.7	.094	− 53.9	.591	− 138.5
10000.00	.709	134.2	1.615	− 24.1	.088	− 63.7	.611	− 153.3
11000.00	.720	120.1	1.443	− 40.5	.085	− 72.4	.642	− 167.6
12000.00	.704	108.5	1.314	− 54.7	.085	− 78.8	.659	179.5
13000.00	.697	98.0	1.209	− 69.1	.085	− 88.3	.674	167.3
14000.00	.691	89.0	1.153	− 82.4	.083	− 95.5	.711	157.3
15000.00	.645	79.9	1.084	− 97.8	.082	− 102.8	.729	145.9
16000.00	.621	70.4	1.078	− 107.3	.086	− 109.3	.764	137.9
17000.00	.558	58.7	1.044	− 123.7	.092	− 118.4	.784	128.8
17999.99	.417	36.8	1.030	− 142.5	.099	− 127.3	.797	119.9

TYPICAL SCATTERING PARAMETERS (CONTINUED)

AT-8060

Bias = 3.0 Volts, 40.0 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
6000.00	.729	−168.3	3.009	42.3	.049	−.8	.670	−78.0
7000.00	.710	168.0	2.633	22.6	.050	−12.1	.636	−94.7
8000.00	.705	148.1	2.316	4.0	.050	−22.1	.638	−112.8
9000.00	.706	132.1	2.057	−15.0	.049	−30.2	.645	−130.3
10000.00	.692	117.9	1.852	−29.9	.047	−33.1	.666	−145.8
11000.00	.702	104.8	1.647	−46.0	.051	−37.4	.697	−160.8
12000.00	.684	93.4	1.496	−60.5	.057	−43.2	.712	−174.2
13000.00	.670	82.3	1.387	−74.7	.059	−50.8	.724	173.2
14000.00	.650	73.1	1.313	−88.6	.064	−57.3	.763	162.8
15000.00	.587	62.4	1.234	−104.0	.067	−65.0	.782	150.6
16000.00	.542	51.8	1.217	−114.0	.077	−72.1	.813	143.3
17000.00	.459	35.9	1.172	−130.9	.086	−84.0	.842	133.8
17999.99	.318	3.9	1.124	−151.2	.097	−96.6	.859	123.5

AT-8061

Bias = 3.0 Volts, 10.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
6000.00	.781	−71.8	2.682	119.8	.080	64.8	.681	−8.3
7000.00	.713	−85.0	2.593	110.7	.089	59.8	.631	−10.3
8000.00	.678	−99.3	2.531	102.1	.094	57.9	.596	−11.9
9000.00	.633	−114.6	2.491	90.2	.102	52.5	.559	−13.2
10000.00	.587	−134.1	2.426	81.1	.107	48.6	.506	−15.0
11000.00	.575	−153.1	2.361	70.2	.110	43.5	.438	−18.7
12000.00	.576	−174.9	2.214	57.4	.113	36.2	.363	−23.3
13000.00	.596	169.3	2.019	47.9	.115	32.2	.296	−28.4
14000.00	.641	156.4	1.913	38.4	.113	25.7	.234	−33.3
15000.00	.667	144.9	1.748	28.0	.114	20.9	.168	−50.8
16000.00	.699	137.8	1.662	19.9	.124	16.4	.136	−77.8
17000.00	.704	125.9	1.523	8.0	.128	11.6	.127	−103.9
17999.99	.704	112.4	1.431	−4.0	.128	5.7	.124	−132.2

AT-8061

Bias = 3.0 Volts, 40.00 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
6000.00	.687	−96.8	2.993	108.6	.037	80.3	.754	−1.8
7000.00	.613	−112.4	2.767	100.6	.040	83.4	.722	−2.5
8000.00	.595	−128.2	2.645	91.9	.043	88.3	.710	−3.0
9000.00	.561	−145.5	2.503	81.5	.049	88.4	.703	−3.5
10000.00	.552	−164.1	2.378	73.5	.054	90.8	.686	−5.0
11000.00	.564	178.5	2.275	63.6	.060	89.1	.648	−8.2
12000.00	.589	161.8	2.110	52.5	.066	84.9	.610	−12.9
13000.00	.624	150.9	1.925	44.6	.074	82.8	.572	−18.8
14000.00	.687	142.1	1.864	36.3	.077	78.3	.535	−24.3
15000.00	.706	133.1	1.716	25.9	.085	71.7	.474	−37.7
16000.00	.746	128.6	1.657	18.6	.097	65.0	.451	−50.1
17000.00	.761	117.9	1.527	6.5	.109	58.1	.429	−65.6
17999.99	.757	105.4	1.437	−5.2	.112	49.1	.404	−80.1

CHIP CODE M106

AT-8040/AT-8041

10-26 GHz, Small Signal
Gallium Arsenide FET
Tenative, December, 1980

FEATURES

- **2.8 dB NF, 7.0 dB Gain @ 18 GHz***
- **2.0 dB NF, 10 dB Gain @ 12 GHz***
- **1.7 dB NF, 13 dB Gain @ 6 GHz***
- **+8 dBm P_o (1 dB G.C.P.) @ 12 GHz**
- **Excellent Gain and Noise Flatness vs. I_{ds}**
- **Wide Dynamic Range**
- **All Gold-Based Metallization**
- **High Performance 50 mil package or chip form**

DESCRIPTION

The AT-8040/AT-8041 is gallium arsenide, n-channel metal semiconductor field effect transistor (GaAs FET) with a 0.5 μm-length Schottky barrier gate. It is designed for high gain, low noise amplification in both narrowband communications and radar amplifiers and in wideband electronic defense applications in the 10 to 26 GHz frequency range.

Among the performance features of this GaAs FET are the particularly flat curves for insertion power gain (S_{21}^2), maximum available gain (G_{max}) and noise figure vs. drain current, from relatively low bais levels through I_{DSS}. This simplifies the bias requirements of amplifier stages using the AT-8040/AT-8041.

All metallization, including the gate, in the AT-8040/AT-8041 uses a system of gold and refractory metals. This eliminates the corrosion, intermetallic growth and burn-out problems associated with other GaAs FET metal systems helping to assure long term reliability under severe operating conditions.

The AT-8040 version, recommended for operation through 15 GHz, is packaged in a unique 50 mil square metal-ceramic stripline package. The package's small dimensions and careful optimization minimizes parasitic reactances, and it is particularly compatible with the dimensions of microstripline circuitry at 12 GHz. As a further assurance of reliability, the package is filled with dry nitrogen and hermetically sealed to fully protect the GaAs FET chip from contamination, corrosive gasses or moisture. Each AT-8040 is leak tested before shipment to verify its hermetic seal.

For microwave hybrid construction at frequencies up to 26 GHz, the AT-8041 version is available as an unpackaged 10×14 mil chip. Its gold metal system provides excellent bond strength and assures compatibility with the wirebonding techniques used in thin or thick film hybrid circuit construction.

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

PARAMETER	SYMBOL		VALUE	FREQUENCY	TEST CONDITION
Spot Noise Figure	NF_{opt}	*BOTH*	1.7 dB	6.0 GHz	$V_{DS} = 3V$, $I_{DS} = 8.0$ mA
		AT-8040	2.4 dB	12.0 GHz	" " "
		AT-8041	2.0 dB	12.0 GHz	" " "
		AT-8041	2.8 dB	18.0 GHz	" " "
Gain at Optimum Noise Figure	G_{NF}	*BOTH*	13 dB	6.0 GHz	" " "
		AT-8040	9 dB	12.0 GHz	" " "
		AT-8041	10 dB	12.0 GHz	" " "
		AT-8041	7 dB	18.0 GHz	" " "
Maximum Available Gain	G_{max}	*AT-8041*	14 dB	12.0 GHz	$V_{DS} = 3V$, $I_{DS} = 30.0$ mA
Output Power at 1 dB Gain Compression*	$P_o(-1)$	*BOTH*	+ 8 dBm	12.0 GHz	$V_{DS} = 5V$, $I_{DS} = 30.0$ mA

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

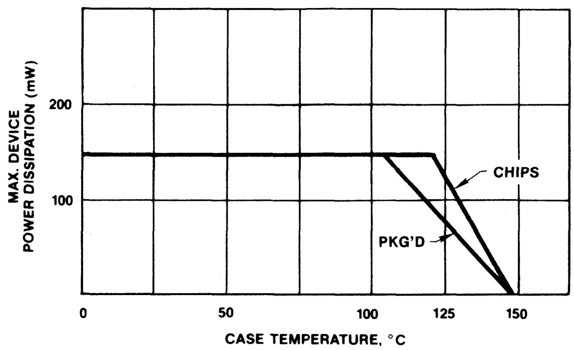
All Avantek transistors, both silicon bipolar and GaAs FET types, are 100% tested for both DC and RF parameters after packaging and leak-testing.

For critical military and aerospace programs that require an added assurance of reliability the AT-8040 may be qualified under the Avantek "R" Series program. "R" Series transistors are identical to their commercial counterparts, but are subjected to an additional burn-in period and screened using MIL-STD-750 procedures.

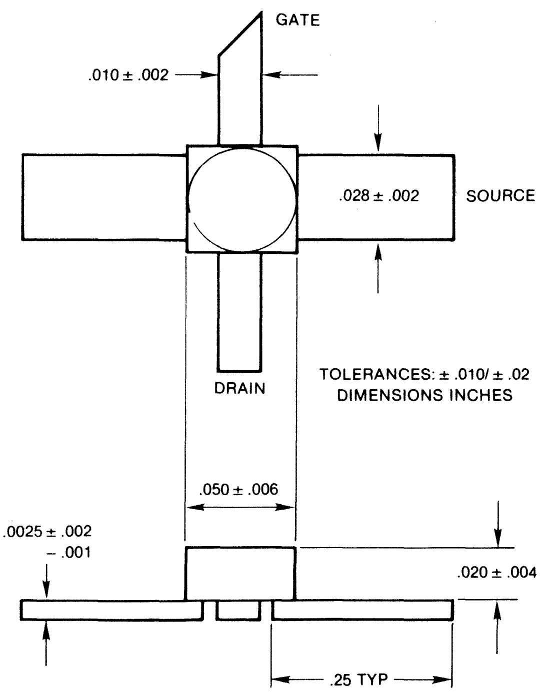
ABSOLUTE MAXIMUM RATINGS ($T_A = 25°C$)

Parameter	Symbol	Limit
Drain-Source Voltage	V_{DS}	+5V
Gate-Source Voltage	V_{GS}	−4V
Drain Current	I_{DSO}	50 mA
Continuous Dissipation	P_T ($T_{case} = 25°C$)	150 mW
Channel Temperature	T_{ch}	150°C
Storage Temperature	T_{stg}	−65 to 150°C
Thermal Resistance (AT-8040)	Θ_{jc}	300°C/watt pkgd. device 200°C/watt chip device

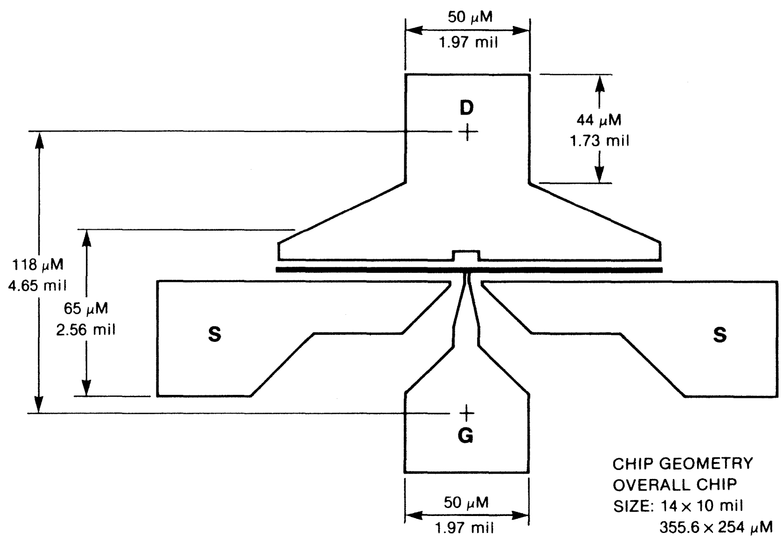
POWER DERATING CURVE (AT-8040)



OUTLINE DRAWING: PACKAGED VERSION



OUTLINE DRAWING: UNPACKAGED VERSION

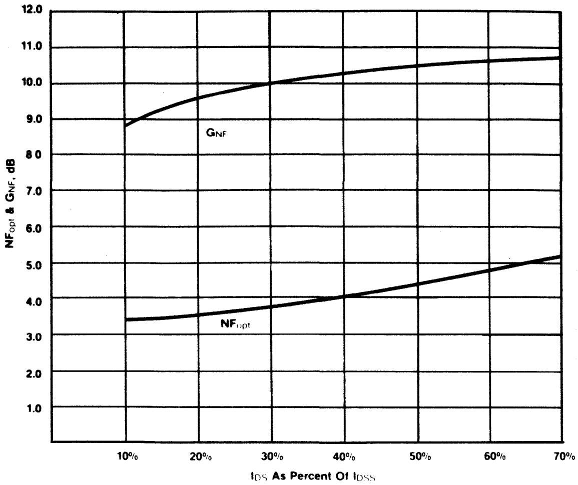


TYPICAL DC CHARACTERISTICS ($T_A = 25°C$)

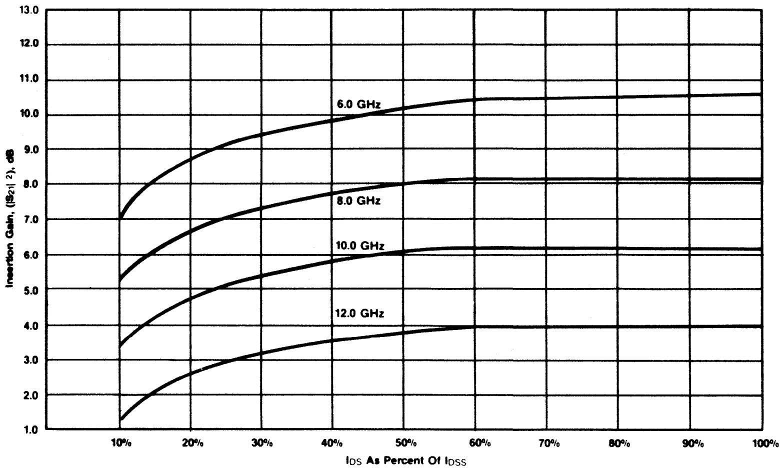
Parameter	Symbol	Value	Test Conditions
Transconductance	G_M	20 mmho	$V_{DS} = 3V$, $V_{GS} = 0V$
Saturated Drain Current	I_{DSS}	30 mA	$V_{DS} = 3V$
Pinchoff Voltage	V_p	−2V	$V_{DS} = 3V$, $I_{DS} = 1$ mA

TYPICAL PERFORMANCE CURVES AT-8040

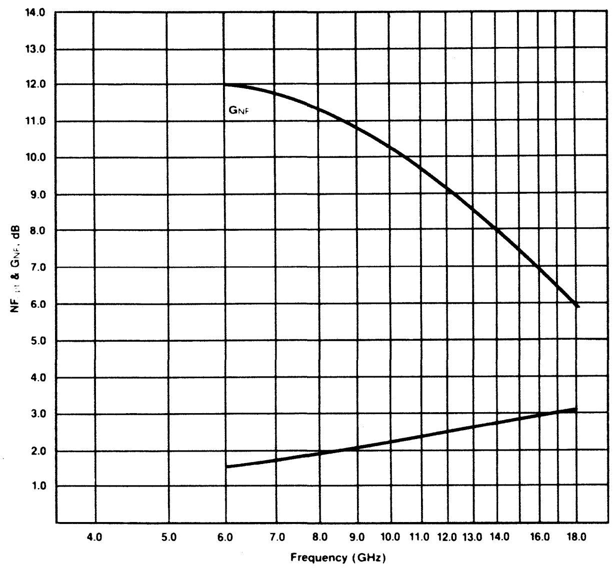
SPOT NOISE FIGURE (NF_{opt}) AND ASSOCIATED GAIN (G_{NF}) VS. I_{DS}
V_{DS} = +3V, FREQ = 12.0 GHz



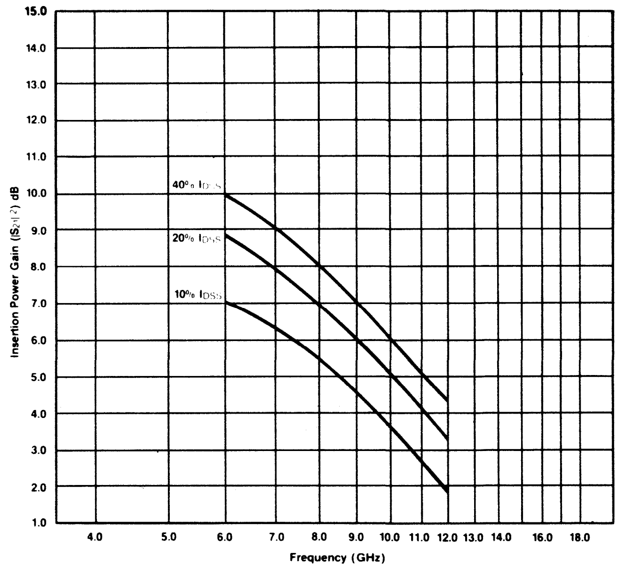
INSERTION POWER GAIN ($|S_{21}|^2$) VS. I_{DS} AND FREQUENCY
@ V_{DS} = 3V



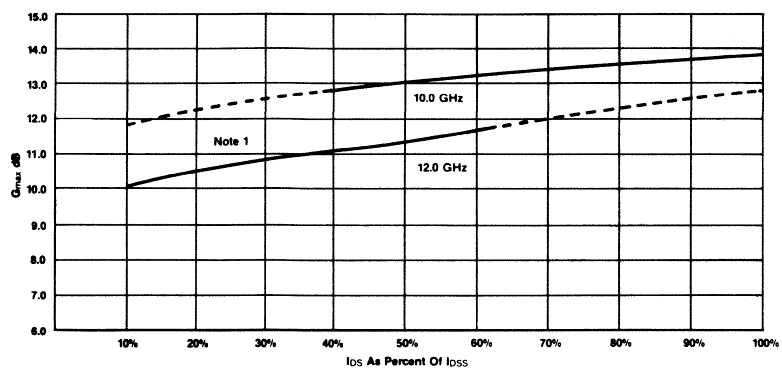
SPOT NOISE FIGURE (NF_{opt}) AND ASSOCIATED GAIN (G_{NF}) VS. FREQUENCY
V_{DS} = +3 VOLTS I_{DS} = 20% I_{DS} (≅10 mA)



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



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

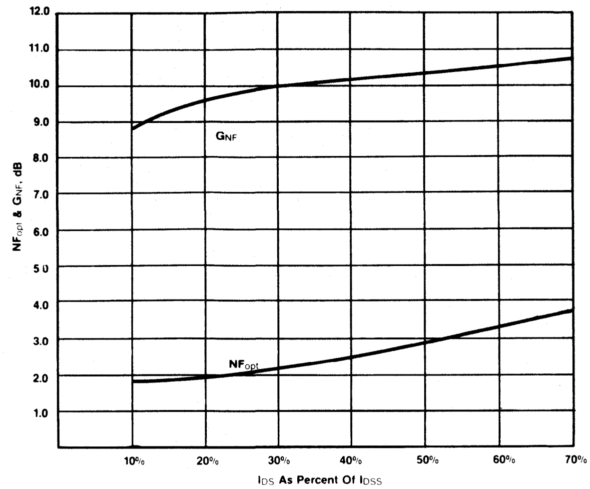


Note 1: Dashed line indicates area of potential instability.

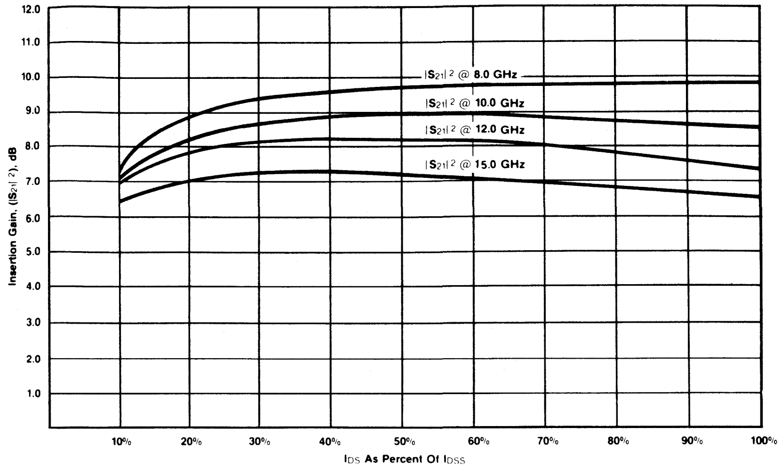
SECTION 5

TYPICAL PERFORMANCE CURVES AT-8041

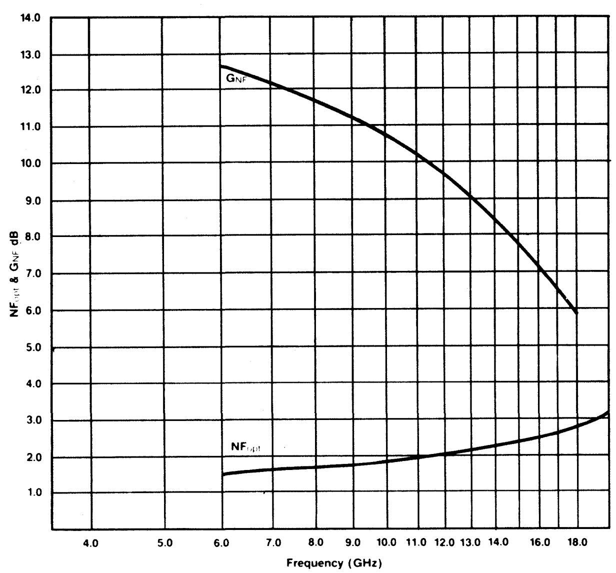
SPOT NOISE FIGURE (NF_{opt}) AND ASSOCIATED GAIN (G_{NF}) VS. I_{DS} V_{DS} = +3V, FREQ = 12.0 GHz



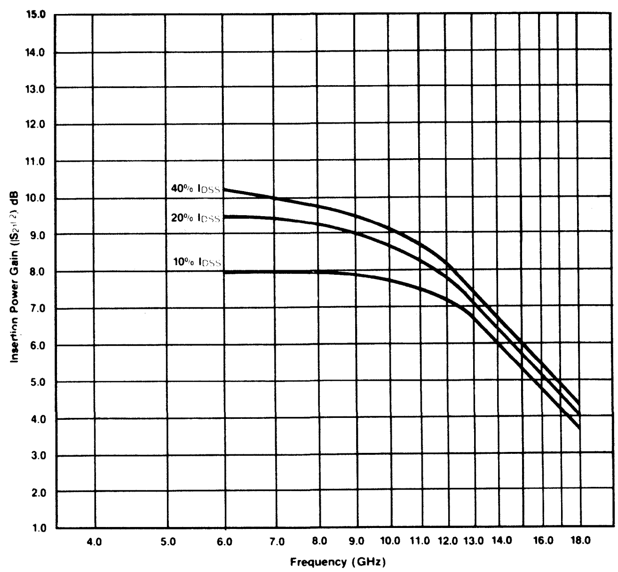
INSERTION POWER GAIN ($|S_{21}|^2$) VS. I_{DS} AND FREQUENCY @ V_{DS} = 3V



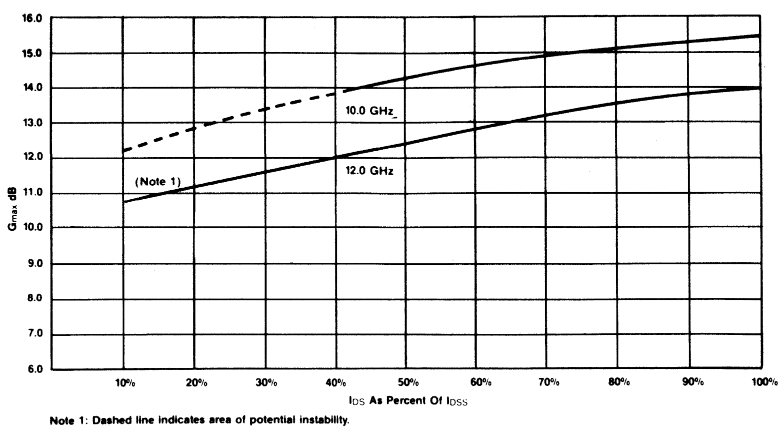
SPOT NOISE FIGURE (NF_{opt}) AND ASSOCIATED GAIN (G_{NF}) VS. FREQUENCY V_{DS} = +3 VOLTS I_{DS} = 20% I_{DS} (≅10 mA)



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



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



Note 1: Dashed line indicates area of potential instability.

TYPICAL SCATTERING PARAMETERS

Bias = 3.0V, 8 mA

AT-8041
S—MAGN AND ANGLES

FREQ	11		21		12		22	
6000	.83	−38°	3.90	132°	.048	63°	.87	−12°
7000	.79	−49.5	4.00	124	.048	60	.86	−14.5
8000	.68	−65	4.15	115	.051	56	.84	−17.
9000	.63	−79	4.40	107	.055	52	.83	−20
10000	.64	−88	4.50	99	.064	48	.81	−22
11000	.63	−96	4.50	89	.073	41	.79	−24.5
12000	.62	−104	4.50	78	.082	35	.76	−27
13000	.57	−114	4.65	68	.091	27	.73	−29
14000	.54	−124	4.50	60	.095	20	.70	−30.5
15000	.47	−147	4.30	50	.102	14	.66	−31.5
16000	.41	−172	4.10	39	.109	8	.63	−36
17000	.40	169	3.70	31	.117	2	.60	−37
18000	.42	146	3.30	23	.120	−4	.58	−39
19000	.45	131	2.90	15	.125	−10	.55	−40
20000	.50	120	2.60	5	.129	−14	.53	−41

AT-8041

Bias = 3.0V, 30 mA

S—MAGN AND ANGLES

FREQ	11		21		12		22	
6000	.73	−58°	4.31	122°	.039	80°	.85	−11°
7000	.69	−71	4.35	114	.039	77	.84	−14
8000	.60	−89	4.40	106	.040	73	.82	−16
9000	.57	−105	4.53	98	.043	70	.80	−20
10000	.60	−116	4.60	91	.044	66	.79	−21
11000	.60	−126	4.75	81	.047	62	.77	−23
12000	.62	−131	4.80	71	.050	58	.75	−26
13000	.58	−138	4.78	61	.061	55	.74	−28
14000	.56	−145	4.62	54	.063	51	.67	−30
15000	.50	−155	4.41	44	.072	48	.64	−31
16000	.47	171	4.20	34	.077	44	.60	−33
17000	.48	157	3.75	26	.081	42	.58	−35
18000	.49	136	3.35	17	.088	40	.56	−36
19000	.53	123	2.91	11	.096	37	.52	−37
20000	.55	114	2.60	2	.110	33°	.50	−39

CHIP CODE M104

SECTION 5

AT-8160

0.25 Watt, 2-10 GHz
Gallium Arsenide FET
December, 1980

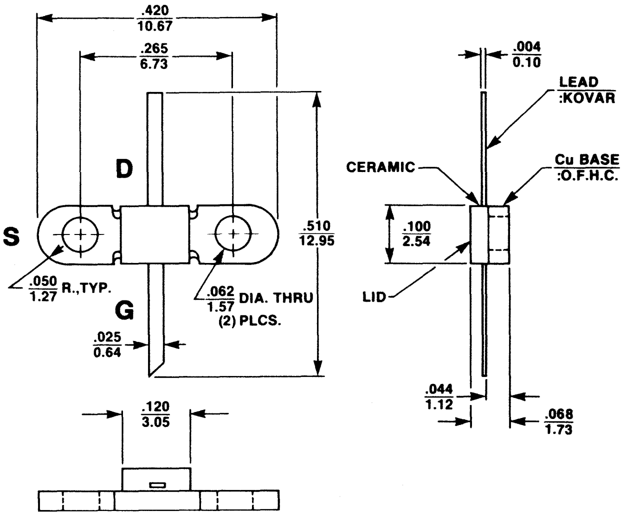
FEATURES

- **+24 dBm Min. Power Output at 4 GHz**
- **10 dB Min. Associated Gain (G_P)**
- **Up to 35% Power Added Efficiency**
- **Gold-Based Metallization**
- **Optimized Power Epitaxy and Doping**
- **"Right-Side-Up" Chip Permits Visual Inspection**
- **Hermetic Copper-Flange Stripline Package**

DESCRIPTION

The Avantek® AT-8160 is a gallium arsenide Schottky-gate field effect transistor designed for medium power, linear amplification in the 2 to 10 GHz frequency range. This rugged, reliable device is suitable for a wide variety of applications such as communications and radar equipment operating in the space, airborne, military and commercial environments.

This GaAs FET incorporates a chip (available in unpackaged form as the AT-8161) with a two-cell, 1.25-millimeter gate periphery structure with air-bridge interconnects between drain pads. It is supplied in the Avantek 100 mil FET flange package—a rugged, hermetic package with low parasitic reactance and minimum thermal resistance.



AVANTEK 100 MIL FET FLANGE PACKAGE
(Dimensions in inches / mm)

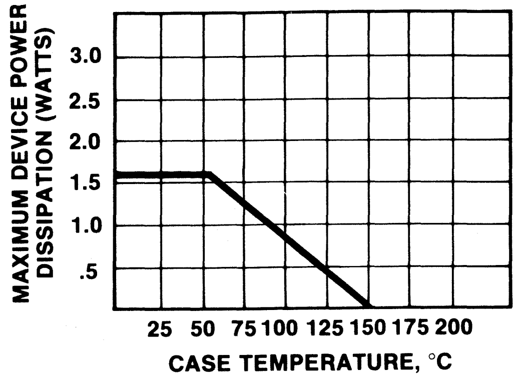
ELECTRICAL SPECIFICATIONS, $T_A = 25°C$

Symbol	Parameters and Test Conditions	Freq.	Units	Min.	Typ.	Max.
$P_{O\,(-1\,dB)}$	Output Power at 1 dB Gain Compression, $V_{DS} = 9V$, $I_{DS} = 50\%\ I_{DSS}$, Tuned for maximum output power at input level producing 1 dB gain compression.	4 GHz 8 GHz	dBm	24.0	26.0 24.5	
G_P	Associated Small Signal Gain, $V_{DS} = 9V$, $I_{DS} = 50\%\ I_{DSS}$.	4 GHz 8 GHz	dB	10.0	11.0 7.5	
G_{max}	Maximum Available Gain, $V_{DS} = 9V$, $I_{DS} = 50\%\ I_{DSS}$	8 GHz	dB		9.5	
g_m	Transconductance: $V_{DS} = 3V$, $I_{DS} = I_{DSS}$		mmho		120	
I_{DSS}	Saturated Drain Current: $V_{DS} = 3V$, $V_{gs} = 0$		mA		250	
V_P	Pinchoff Voltage: $V_{DS} = 3V$, $I_{DS} = 5.0$ mA		V		−3.0	

MAXIMUM RATINGS (T_A = 25°C)

Parameter	Symbol	Recommended max. for continuous operation	Absolute max.
Drain-Source Voltage	V_{DS}	+9V	+11V
Gate-Source Voltage	V_{GS}	−5V	−7V
Drain Current	I_{DS}	175 mA	I_{DSS}
Continuous Dissipation	P_T (T_{case} = 25°C)	1.6 W	2.4 W
Channel Temperature	T_{ch}	+150°C	+300°C
Storage Temperature	T_{stg}	−65° to +150°C	+250°C

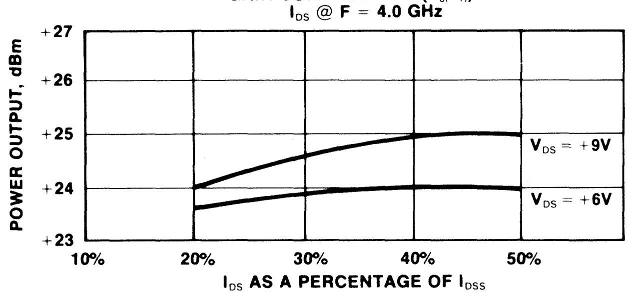
POWER DERATING CURVE



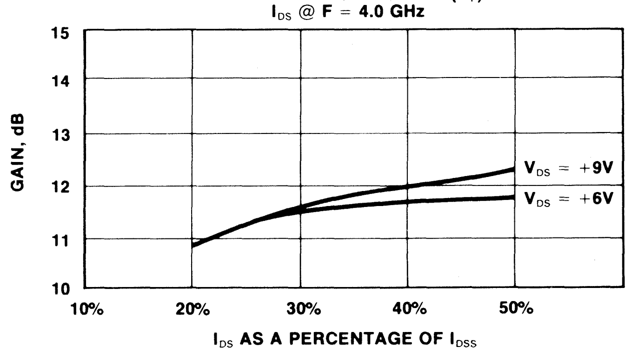
Thermal Resistance	Θ_{jc}	60°C/W

TYPICAL PERFORMANCE CURVES (T_A = 25°C)

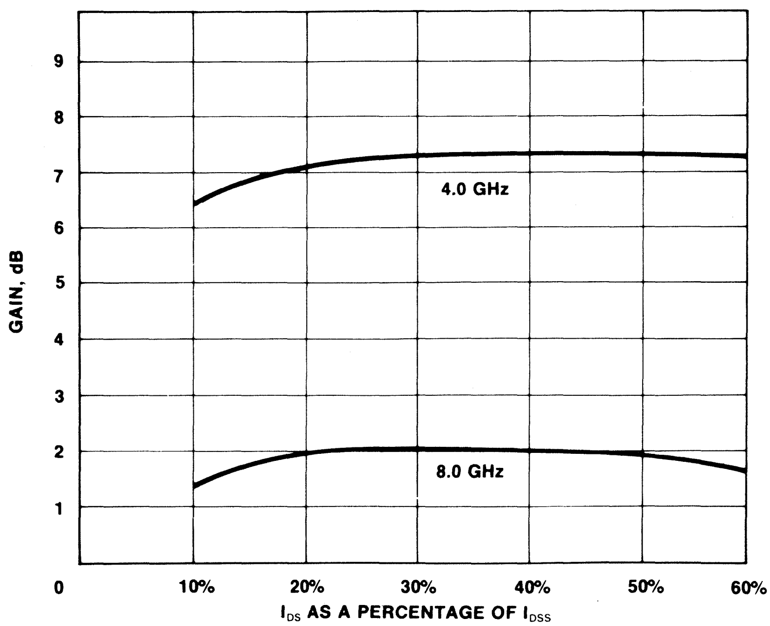
POWER OUTPUT AT 1 dB GAIN COMPRESSION ($P_{0(-1)}$) vs. I_{DS} @ F = 4.0 GHz



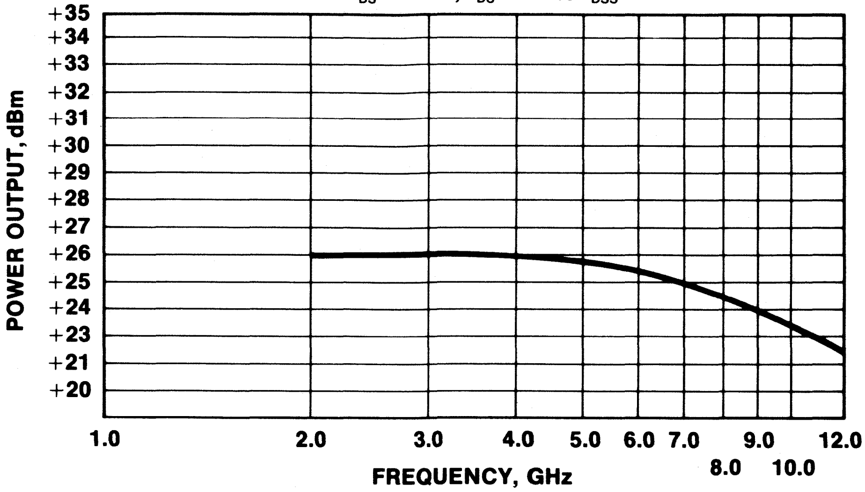
SMALL SIGNAL POWER GAIN (G_P) vs. I_{DS} @ F = 4.0 GHz



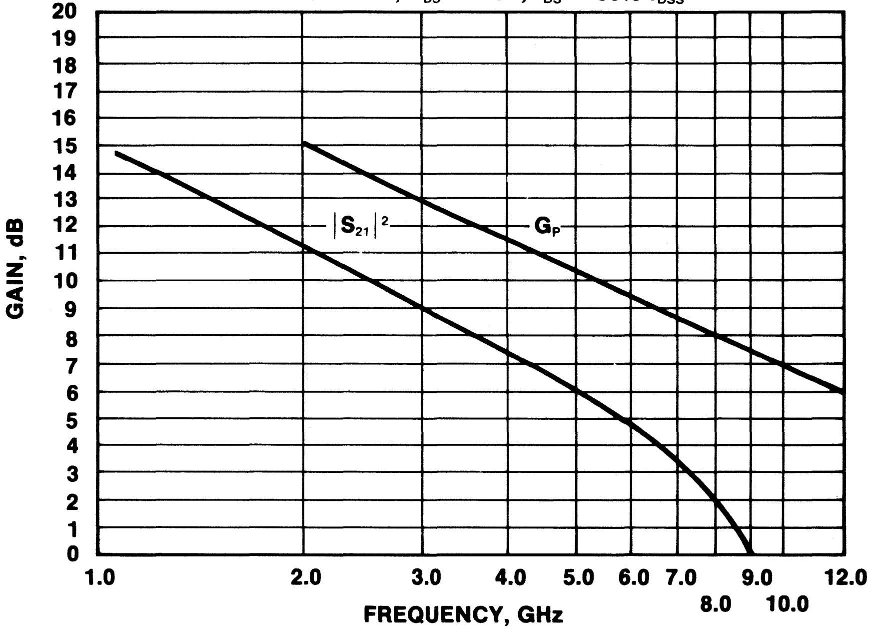
INSERTION POWER GAIN ($|S_{21}|^2$) vs. I_{DS} @ F = 4.0 and 8.0 GHz, V_{DS} = +9V



POWER OUTPUT AT 1 dB
GAIN COMPRESSION ($P_{0\,(-1)}$) vs. FREQUENCY
V_{DS} = +9V, I_{DS} = 50% I_{DSS}



SMALL SIGNAL POWER GAIN (G_P) AND
INSERTION POWER GAIN ($|S_{21}|^2$) vs.
FREQUENCY, V_{DS} = +9V, I_{DS} = 50% I_{DSS}



SECTION 6

TYPICAL SCATTERING PARAMETERS, COMMON SOURCE

S — MAGN AND ANGLES: AT-8160 BIAS = 6.00 VOLTS, 145.00 MA

FREQ.	11		21		12		22	
1000.00	.877	−72.4	5.794	129.4	.045	48.8	.397	−45.1
2000.00	.805	−108.8	3.985	102.0	.058	35.8	.380	−66.7
3000.00	.770	−128.1	2.972	84.7	.065	29.2	.394	−77.6
4000.00	.758	−140.0	2.485	71.1	.070	32.3	.427	−83.6
5000.00	.707	−156.8	2.148	56.9	.072	27.9	.431	−92.4
6000.00	.691	−178.9	2.003	40.4	.080	28.0	.424	−100.9
7000.00	.704	154.6	1.740	21.9	.084	26.3	.384	−118.1
8000.00	.768	139.5	1.413	4.4	.087	20.0	.390	−145.4
9000.00	.787	136.1	1.122	−6.6	.088	20.2	.474	−161.2
10000.00	.769	139.3	1.005	−13.3	.086	21.8	.552	−164.1
11000.00	.743	135.0	1.007	−20.9	.109	23.7	.592	−163.5
12000.00	.674	116.1	1.059	−35.4	.140	15.1	.597	−166.3
13000.00	.657	84.0	1.054	−54.5	.168	1.1	.605	−177.3

S — MAGN AND ANGLES: AT-8160 BIAS = 9.00 VOLTS, 135.00 MA

FREQ.	11		21		12		22	
1000.00	.883	−72.9	5.522	127.8	.041	48.1	.505	−35.7
2000.00	.814	−109.5	3.771	99.5	.051	34.9	.479	−54.1
3000.00	.781	−128.9	2.788	81.4	.056	28.8	.491	−65.3
4000.00	.772	−141.1	2.323	67.1	.059	35.1	.523	−73.4
5000.00	.721	−158.1	1.996	52.4	.059	33.1	.525	−82.5
6000.00	.709	179.6	1.859	35.6	.066	37.0	.527	−90.5
7000.00	.722	153.3	1.624	16.6	.074	38.3	.493	−104.3
8000.00	.785	138.6	1.322	−1.8	.080	31.9	.485	−130.3
9000.00	.803	135.2	1.036	−14.2	.086	31.1	.556	−149.7
10000.00	.784	138.1	.918	−21.4	.085	33.6	.636	−155.9
11000.00	.761	133.0	.901	−29.4	.112	34.2	.683	−157.3
12000.00	.692	113.2	.937	−44.3	.146	24.3	.695	−161.0
13000.00	.675	80.7	.921	−63.8	.180	9.5	.716	−171.7

CHIP CODE M116

AT-8161

0.25 Watt, 2-15 GHz
Gallium Arsenide FET Chip
December, 1980

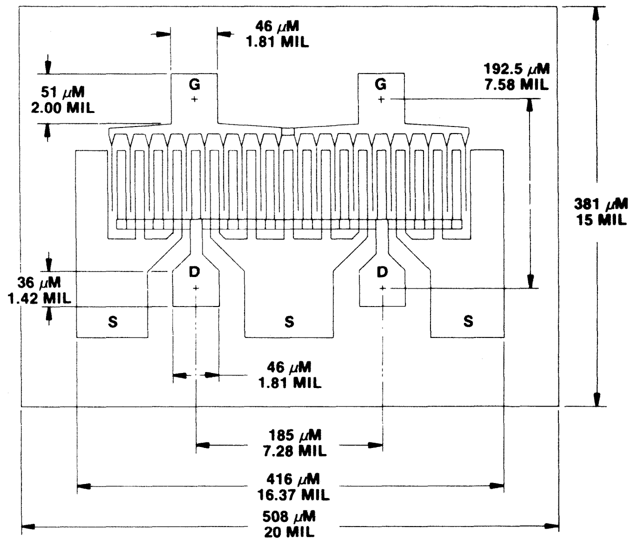
FEATURES

- **+24 dBm Min. Power Output at 4 GHz**
- **10 dB Min. Associated Gain (G_P)**
- **Up to 35% Power Added Efficiency**
- **Gold-Based Metallization**
- **Optimized Power Epitaxy and Doping**
- **Suitable for Broadband Applications**
- **Optimum Thermal and Electrical Design**
- **Large Bonding Pads**

DESCRIPTION

The Avantek® AT-8161 is an unpackaged gallium arsenide Schottky-gate field effect transistor chip designed for medium power, linear amplification in the 2 to 15 GHz frequency range. This rugged, reliable device is suitable for a wide variety of applications such as communications and radar equipment operating in the space, airborne, military and commercial environments.

This GaAs FET chip (also available in packaged form as the AT-8160) has a two-cell, 1.25-millimeter gate periphery structure with airbridge interconnects between drain pads. All metal surfaces are gold plated for ease of bonding and die attach. Large bonding pads facilitate bonding into hybrid integrated circuits.



THICKNESS = 4.5 ± .5 MILS
114 ± 13 μM

ELECTRICAL SPECIFICATIONS, T_A = 25°C

Symbol	Parameters and Test Conditions	Freq.	Units	Min.*	Typ.	Max.
$P_{0\,(-1\,dB)}$	Output Power at 1 dB Gain Compression, V_{DS} = 9V, I_{DS} = 50% I_{DSS}, Tuned for maximum output power at input level producing 1 dB gain compression.	4 GHz 8 GHz 12 GHz	dBm	24.0	26.0 25.0 24.0	
G_P	Associated Small Signal Gain, V_{DS} = 9V, I_{DS} = 50% I_{DSS},	4 GHz 8 GHz 12 GHz	dB	10.0	12.0 8.5 5.0	
G_{max}	Maximum Available Gain, V_{DS} = 9V, I_{DS} = 50% I_{DSS}	8 GHz	dB		10.5	
g_m	Transconductance: V_{DS} = 3V, I_{DS} = I_{DSS}		mmho		120	
I_{DSS}	Saturated Drain Current: V_{DS} = 3V, V_{gs} = 0		mA		250	
V_P	Pinchoff Voltage: V_{DS} = 3V, I_{DS} = 5.0 mA		V		−3.0	

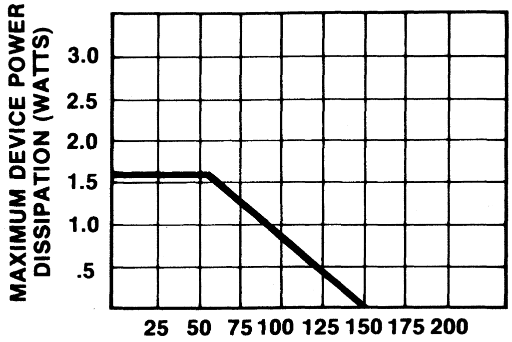
*(Measured in Avantek's 100 MIL FET flange package.)

SECTION 6

MAXIMUM RATINGS (T_A = 25°C)

Parameter	Symbol	Recommended max. for continuous operation	Absolute max.
Drain-Source Voltage	V_{DS}	+9V	+11V
Gate-Source Voltage	V_{GS}	−5V	−7V
Drain Current	I_{DS}	175 mA	I_{DSS}
Continuous Dissipation	P_T (T_{case} = 25°C)	1.6 W	2.4 W
Channel Temperature	T_{ch}	+150°C	+300°C
Storage Temperature	T_{stg}	−65° to +150°C	+250°C

POWER DERATING CURVE

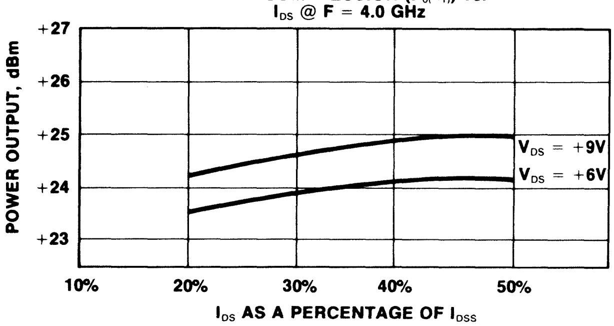


Thermal Resistance	Θ_{jc}	60°C/W

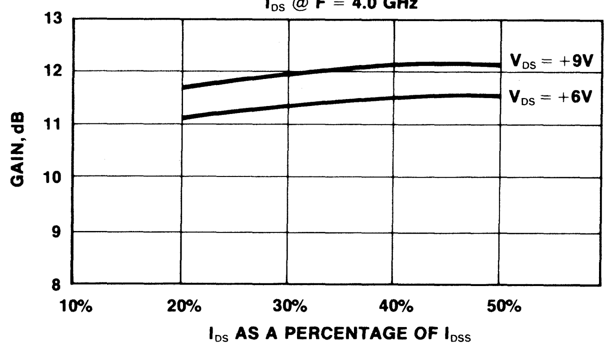
Note: The indicated thermal resistance (θ_{jc}) and power derating curve apply to this GaAs FET chip when installed in the Avantek 100-mil FET flange package. The actual thermal characteristics of this unpackaged device will depend on the type and quality of bond and characteristics of the surface to which it is bonded.

TYPICAL PERFORMANCE CURVES (T_A = 25°C)

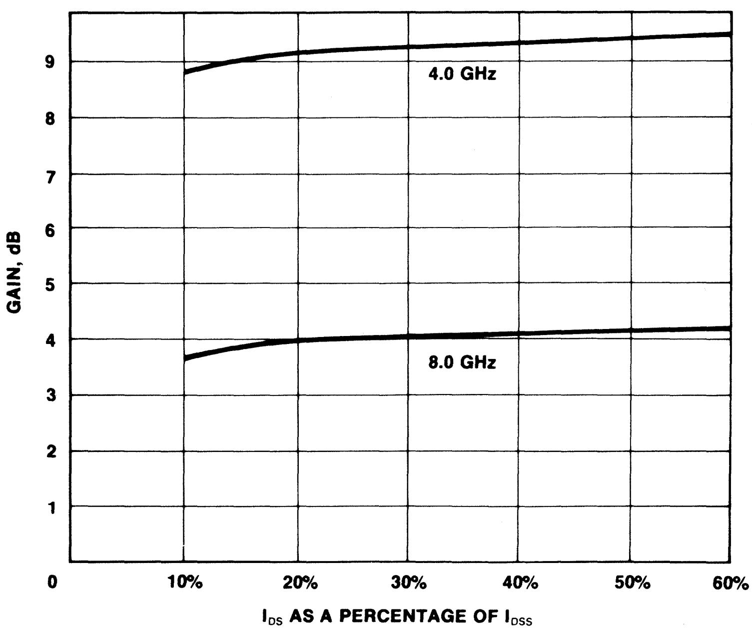
POWER OUTPUT AT 1 dB GAIN COMPRESSION ($P_{0(-1)}$) vs. I_{DS} @ F = 4.0 GHz



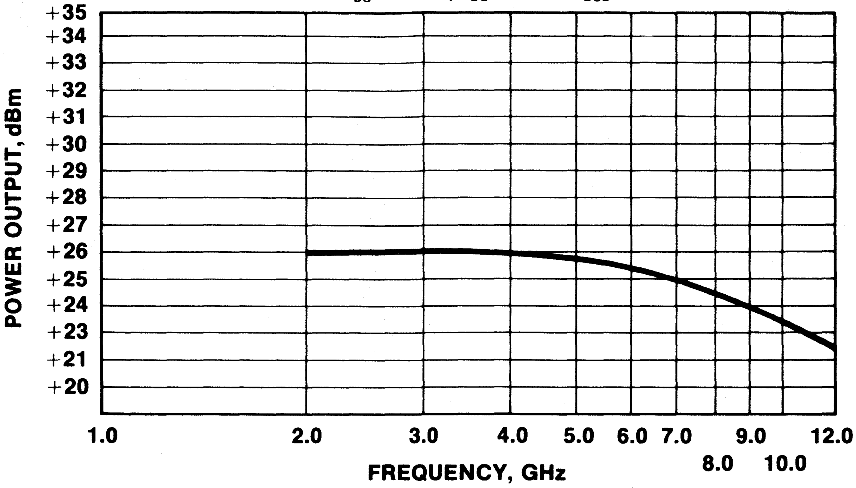
SMALL SIGNAL POWER GAIN (G_P) vs. I_{DS} @ F = 4.0 GHz



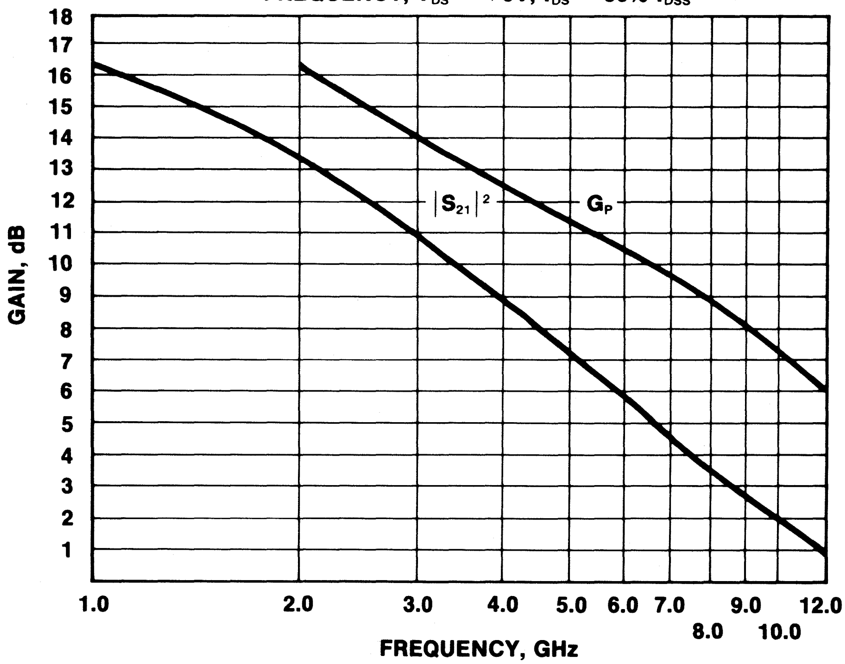
INSERTION POWER GAIN ($|S_{21}|^2$) vs. I_{DS} @ F = 4.0 and 8.0 GHz, V_{DS} = +9V



POWER OUTPUT AT 1 dB GAIN COMPRESSION ($P_{0\,(-1)}$) vs. FREQUENCY V_{DS} = +9V, I_{DS} = 50% I_{DSS}



SMALL SIGNAL POWER GAIN (G_P) AND INSERTION POWER GAIN ($|S_{21}|^2$) vs. FREQUENCY, V_{DS} = +9V, I_{DS} = 50% I_{DSS}



SECTION 6

TYPICAL SCATTERING PARAMETERS, COMMON SOURCE *

S — MAGN AND ANGLES: AT-8161 BIAS = 6.00 VOLTS, 125.00 MA

FREQ.	11		21		12		22	
1000.00	.908	−58.9	6.484	140.0	.032	59.3	.509	−19.8
2000.00	.829	−96.9	4.793	115.0	.045	48.3	.444	−30.5
3000.00	.796	−121.6	3.598	97.9	.049	44.9	.415	−38.5
4000.00	.783	−138.0	2.914	85.9	.050	48.8	.395	−44.1
5000.00	.776	−149.9	2.391	74.7	.050	55.4	.380	−52.4
6000.00	.802	−159.2	2.074	65.4	.054	62.8	.384	−62.2
7000.00	.794	−164.6	1.789	57.2	.059	70.9	.384	−73.6
8000.00	.808	−171.1	1.629	47.8	.068	74.9	.403	−83.7
9000.00	.814	−179.9	1.485	37.7	.079	74.9	.420	−95.2
10000.00	.820	170.3	1.317	26.3	.086	73.9	.438	−110.0
11000.00	.847	161.8	1.154	15.5	.094	69.7	.467	−127.2
12000.00	.868	155.5	.979	4.2	.096	64.3	.517	−143.6

S — MAGN AND ANGLES: AT-8161 BIAS = 8.00 VOLTS, 150.00 MA

FREQ.	11		21		12		22	
1000.00	.892	−58.7	6.307	139.6	.035	58.4	.480	−29.9
2000.00	.815	−95.5	4.637	115.4	.049	49.2	.424	−46.1
3000.00	.787	−118.2	3.485	98.9	.054	47.6	.398	−60.1
4000.00	.772	−133.0	2.821	87.4	.056	52.4	.375	−72.0
5000.00	.759	−143.9	2.301	77.1	.057	59.0	.363	−84.0
6000.00	.781	−152.2	1.966	67.8	.063	65.7	.354	−95.3
7000.00	.779	−156.1	1.674	61.0	.069	73.7	.387	−102.2
8000.00	.790	−160.3	1.514	53.7	.079	78.2	.431	−103.5
9000.00	.787	−166.7	1.382	46.0	.090	79.4	.455	−107.7
10000.00	.789	−173.9	1.242	37.7	.100	80.2	.460	−115.3
11000.00	.816	−178.4	1.121	30.5	.112	78.5	.462	−126.6
12000.00	.832	177.3	1.039	21.7	.123	74.4	.487	−139.4

CHIP CODE M116

*(S-parameters include bond wire inductance and are measured in Avantek's standard 50 ohm test carrier.)

AT-8150

0.5 Watt, 2-10 GHz
Gallium Arsenide FET
December, 1980

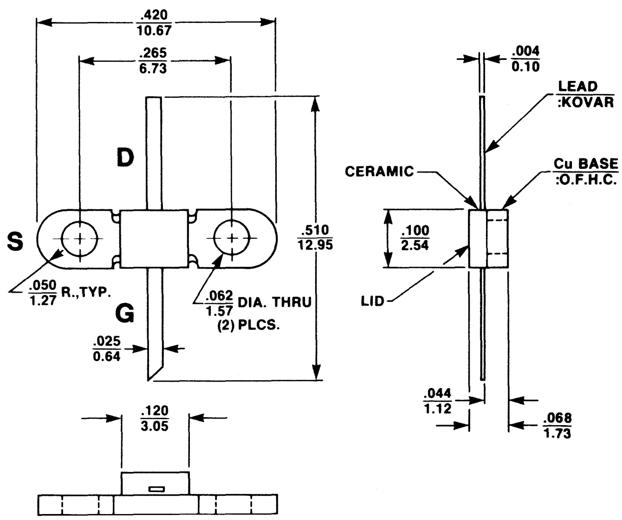
FEATURES

- +27 dBm Min. Power Output at 4 GHz
- 8 dB Min. Associated Gain (G_P)
- Up to 35% Power Added Efficiency
- Gold-Based Metallization
- Optimized Power Epitaxy and Doping
- "Right-Side-Up" Chip Permits Visual Inspection
- Hermetic Copper-Flange Stripline Package

DESCRIPTION

The Avantek® AT-8150 is a gallium arsenide Schottky-gate field effect transistor designed for medium power, linear amplification in the 2 to 10 GHz frequency range. This rugged, reliable device is suitable for a wide variety of applications such as communications and radar equipment operating in the space, airborne, military and commercial environments.

This GaAs FET incorporates a chip (available in unpackaged form as the AT-8151) with a four-cell, 2.5-millimeter gate periphery structure with air-bridge interconnects between drain pads. It is supplied in the Avantek 100 mil FET flange package—a rugged, hermetic package with low parasitic reactance and minimum thermal resistance.



AVANTEK 100 MIL FET FLANGE PACKAGE (Dimensions in inches / mm)

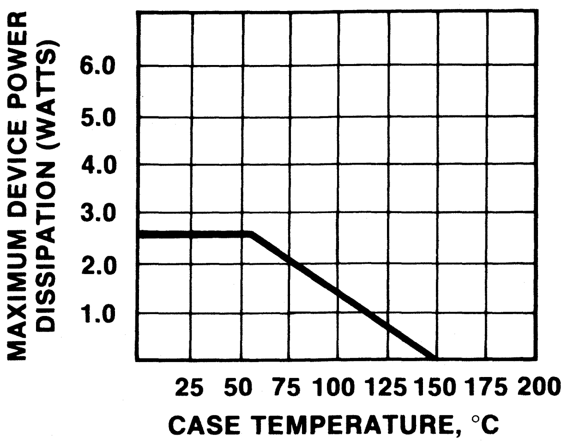
ELECTRICAL SPECIFICATIONS, $T_A = 25°C$

Symbol	Parameters and Test Conditions	Freq.	Units	Min.	Typ.	Max.
$P_{O(-1\,dB)}$	Output Power at 1 dB Gain Compression, $V_{DS} = 9V$, $I_{DS} = 50\%\ I_{DSS}$, Tuned for maximum output power at input level producing 1 dB gain compression.	4 GHz 8 GHz	dBm	27.0	29.0 28.0	
G_P	Associated Small Signal Gain, $V_{DS} = 9V$, $I_{DS} = 50\%\ I_{DSS}$,	4 GHz 8 GHz	dB	9.5	11.0 6.5	
G_{max}	Maximum Available Gain, $V_{DS} = 9V$, $I_{DS} = 50\%\ I_{DSS}$	8 GHz	dB	8.5		
g_m	Transconductance: $V_{DS} = 3V$, $I_{DS} = I_{DSS}$		mmho		225	
I_{DSS}	Saturated Drain Current: $V_{DS} = 3V$, $V_{gs} = 0$		mA		500	
V_P	Pinchoff Voltage: $V_{DS} = 3V$, $I_{DS} = 5.0$ mA		V		−3.0	

MAXIMUM RATINGS (T_A = 25°C)

Parameter	Symbol	Recommended max. for continuous operation	Absolute max.
Drain-Source Voltage	V_{DS}	+9V	+14V
Gate-Source Voltage	V_{GS}	−5V	−7V
Drain Current	I_{DS}	300 mA	I_{DSS}
Continuous Dissipation	P_T (T_{case} = 25°C)	2.7 W	4.0 W
Channel Temperature	T_{ch}	+150°C	+300°C
Storage Temperature	T_{stg}	−65° to +150°C	+300°C

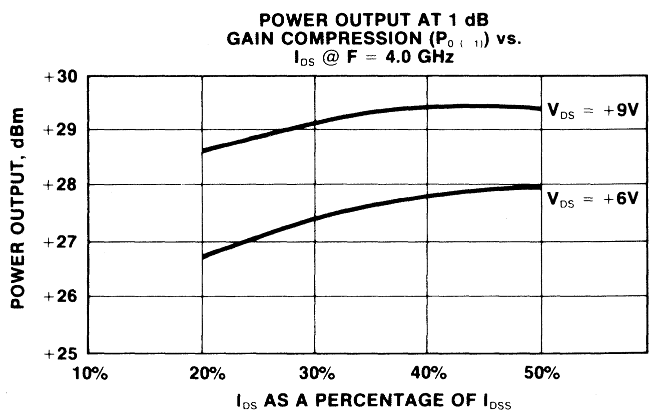
POWER DERATING CURVE

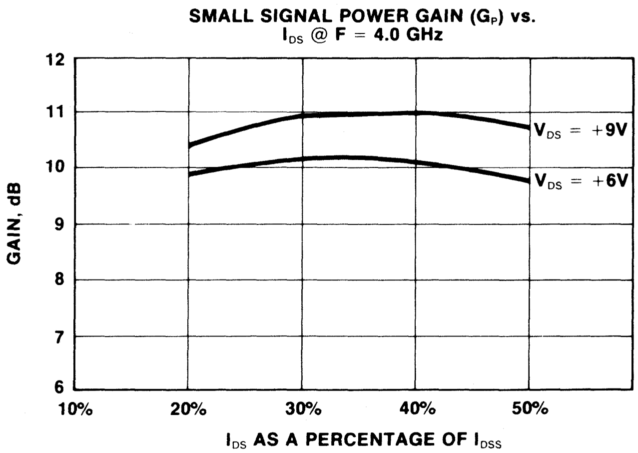


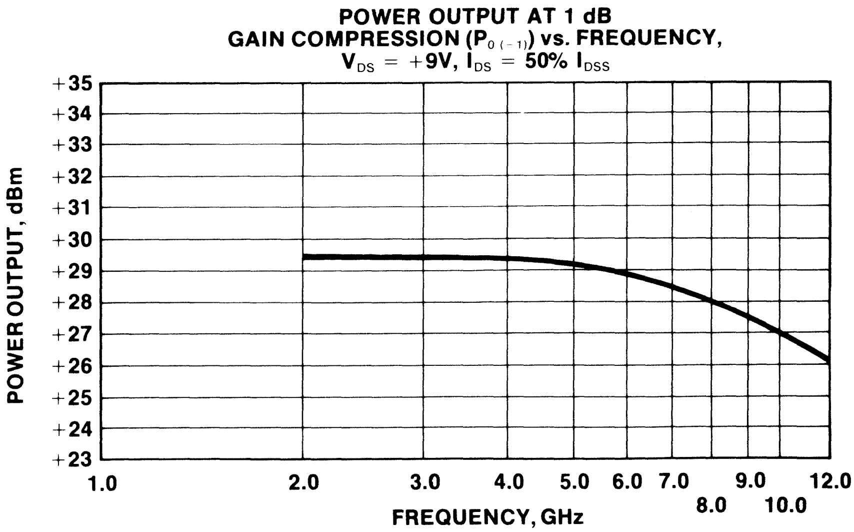
Thermal Resistance	Θ_{jc}	35°C/W

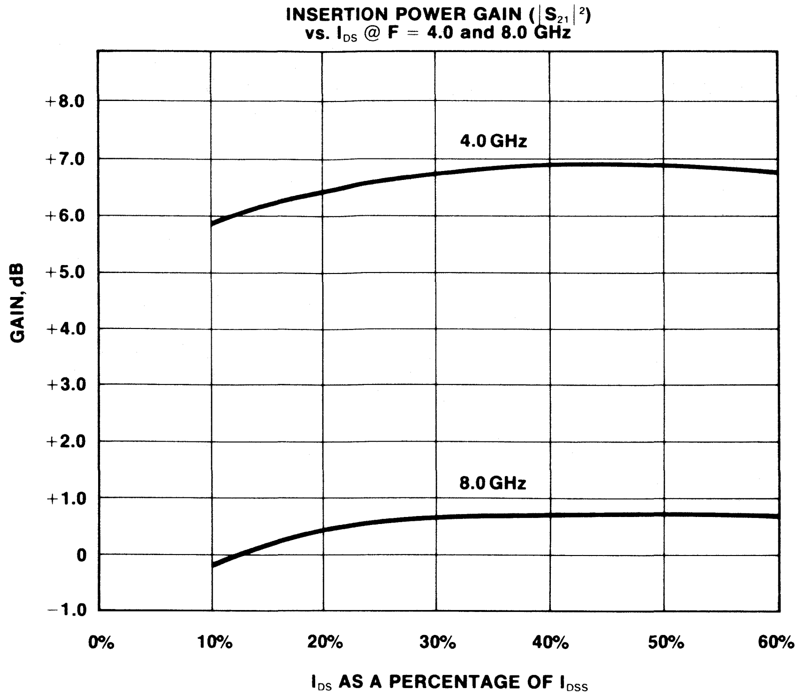
Note: The indicated thermal resistance (θ_{jc}) and power derating curve apply to this GaAs FET chip when installed in the Avantek 100-mil FET flange package. The actual thermal characteristics of this unpackaged device will depend on the type and quality of bond and characteristics of the surface to which it is bonded.

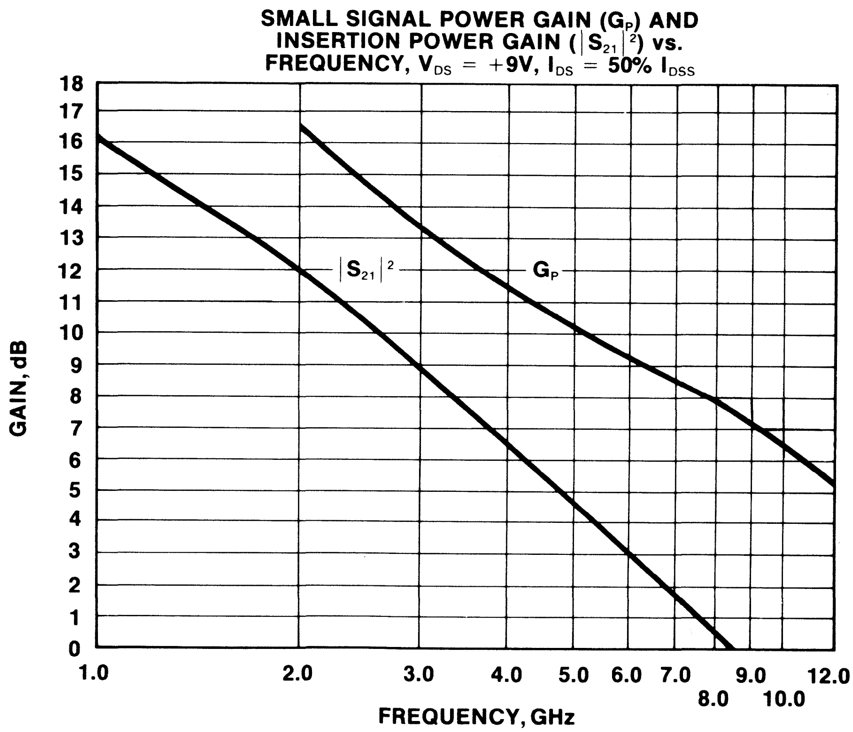
TYPICAL PERFORMANCE CURVES (T_A = 25°C)








INSERTION POWER GAIN (|S21|²) vs. IDS @ F = 4.0 and 8.0 GHz
GAIN, dB
+8.0
+7.0
+6.0
+5.0
+4.0
+3.0
+2.0
+1.0
0
−1.0
4.0 GHz
8.0 GHz
0%
10%
20%
30%
40%
50%
60%
IDS AS A PERCENTAGE OF IDSS


SMALL SIGNAL POWER GAIN (GP) AND INSERTION POWER GAIN (|S21|²) vs. FREQUENCY, VDS = +9V, IDS = 50% IDSS
GAIN, dB
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
|S21|²
GP
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
12.0
FREQUENCY, GHz

SECTION 6

TYPICAL SCATTERING PARAMETERS, COMMON SOURCE

S — MAGN AND ANGLES: AT-8150 BIAS = 9.00 VOLTS, 275.00 MA

FREQ.	11		21		12		22	
1000.00	.818	−96.7	5.987	115.4	.033	46.7	.211	−83.8
2000.00	.786	−129.1	3.672	89.0	.042	49.6	.276	−100.9
3000.00	.756	−143.7	2.626	71.9	.050	63.3	.325	−107.5
4000.00	.747	−154.8	2.171	57.4	.073	75.4	.377	−113.7
5000.00	.699	−171.4	1.861	40.3	.124	79.5	.413	−123.4
6000.00	.715	164.9	1.660	21.9	.160	67.8	.434	−141.9
7000.00	.778	137.9	1.336	−.7	.180	52.5	.523	−167.5
8000.00	.835	125.0	.945	−16.3	.188	32.8	.610	164.9
9000.00	.862	124.9	.687	−23.4	.189	39.9	.708	158.7
10000.00	.858	127.7	.582	−24.9	.233	40.8	.755	156.4
11000.00	.828	123.7	.537	−26.0	.314	37.0	.762	150.1
12000.00	.794	108.6	.533	−33.6	.452	22.1	.768	133.7
13000.00	.780	81.5	.484	−42.1	.561	−1.6	.838	103.8

CHIP CODE M115

AT-8151

0.5 Watt, 2-15 GHz
Gallium Arsenide FET Chip
December, 1980

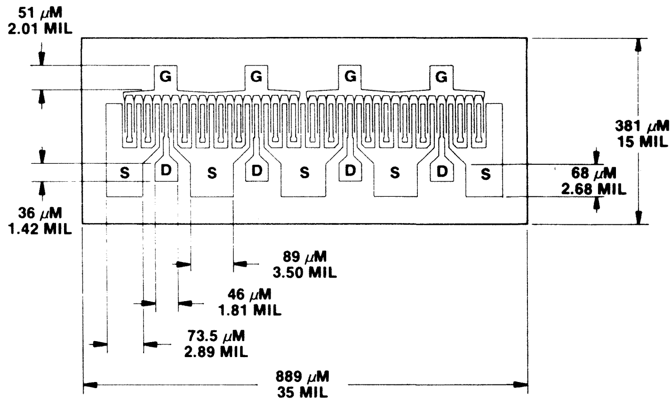
FEATURES

- +27 dBm Min. Power Output at 4 GHz
- 9 dB Min. Associated Gain (G_P)
- Up to 35% Power Added Efficiency
- Gold-Based Metallization
- Optimized Power Epitaxy and Doping
- Suitable for Broadband Applications
- Optimum Thermal and Electrical Design
- Large Bonding Pads

DESCRIPTION

The Avantek® AT-8151 is an unpackaged gallium arsenide Schottky-gate field effect transistor chip designed for medium power, linear amplification in the 2 to 15 GHz frequency range. This rugged, reliable device is suitable for a wide variety of applications such as communications and radar equipment operating in the space, airborne, military and commercial environments.

This GaAs FET chip (also available in packaged form as the AT-8150) has a four-cell, 2.5-millimeter gate periphery structure with airbridge interconnects between drain pads. All metal surfaces are gold plated for ease of bonding and die attach. Large bonding pads facilitate bonding into hybrid integrated circuits.



THICKNESS = 4.5 ± .5 MILS
114 ± 13 µM

ELECTRICAL SPECIFICATIONS, $T_A = 25°C$

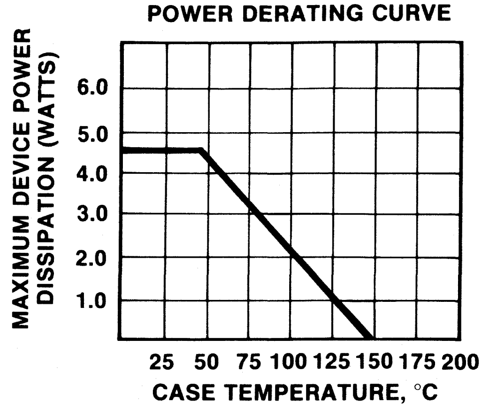
Symbol	Parameters and Test Conditions	Freq.	Units	Min.*	Typ.	Max.
$P_{0\,(-1\,dB)}$	Output Power at 1 dB Gain Compression, $V_{DS} = 9V$, $I_{DS} = 50\%\ I_{DSS}$, Tuned for maximum output power at input level producing 1 dB gain compression.	4 GHz 8 GHz	dBm	27.0	29.0 28.0	
G_P	Associated Small Signal Gain, $V_{DS} = 9V$, $I_{DS} = 50\%\ I_{DSS}$,	4 GHz 8 GHz	dB	9.5	11.0 7.5	
G_{max}	Maximum Available Gain, $V_{DS} = 9V$, $I_{DS} = 50\%\ I_{DSS}$	8 GHz	dB		9.5	
g_m	Transconductance: $V_{DS} = 3V$, $I_{DS} = I_{DSS}$		mmho		225	
I_{DSS}	Saturated Drain Current: $V_{DS} = 3V$, $V_{gs} = 0$		mA		500	
V_P	Pinchoff Voltage: $V_{DS} = 3V$, $I_{DS} = 5.0$ mA		V		−3.0	

*(Measured in Avantek's 100 MIL FET flange package.)

MAXIMUM RATINGS (T_A = 25°C)

Parameter	Symbol	Recommended max. for continuous operation	Absolute max.
Drain-Source Voltage	V_{DS}	+9V	+14V
Gate-Source Voltage	V_{GS}	−5V	−7V
Drain Current	I_{DS}	500 mA	I_{DSS}
Continuous Dissipation	P_T (T_{case} = 25°C)	4.5 W	7.0 W
Channel Temperature	T_{ch}	150°C	300°C
Storage Temperature	T_{stg}	−65° to +150°C	250°C

POWER DERATING CURVE

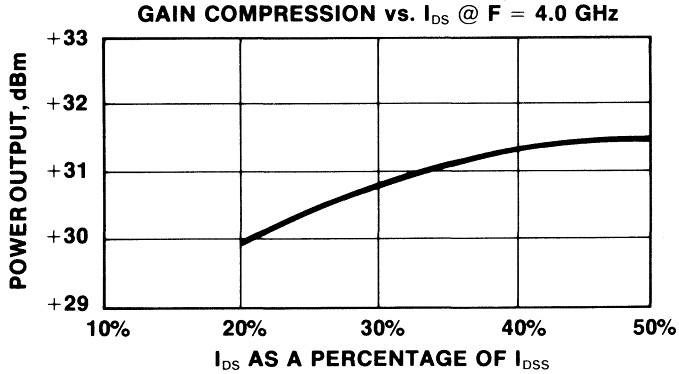


Thermal Resistance	Θ_{jc}	23°C/W

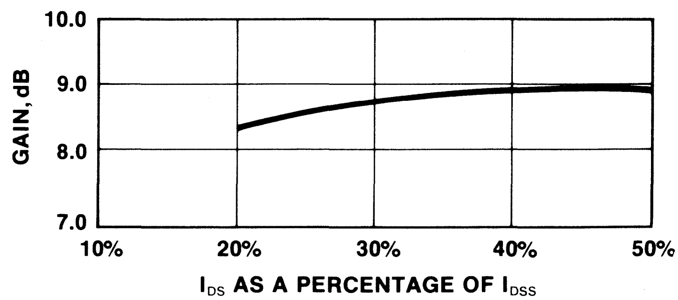
Note: The indicated thermal resistance (θ_{jc}) and power derating curve apply to this GaAs FET chip when installed in the Avantek 100-mil FET flange package. The actual thermal characteristics of this unpackaged device will depend on the type and quality of bond and characteristics of the surface to which it is bonded.

TYPICAL PERFORMANCE CURVES (T_A = 25°C)

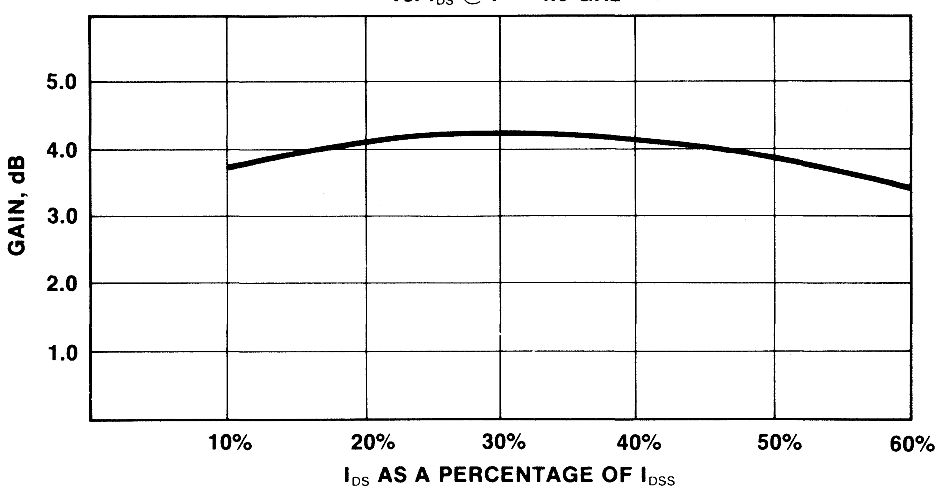
POWER OUTPUT AT 1 dB GAIN COMPRESSION vs. I_{DS} @ F = 4.0 GHz



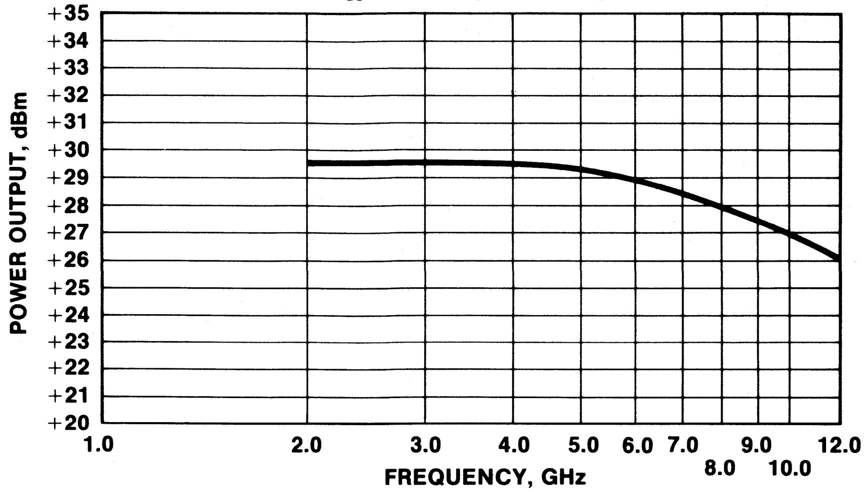
SMALL SIGNAL POWER GAIN (G_P) vs. I_{DS} @ F = 4.0 GHz



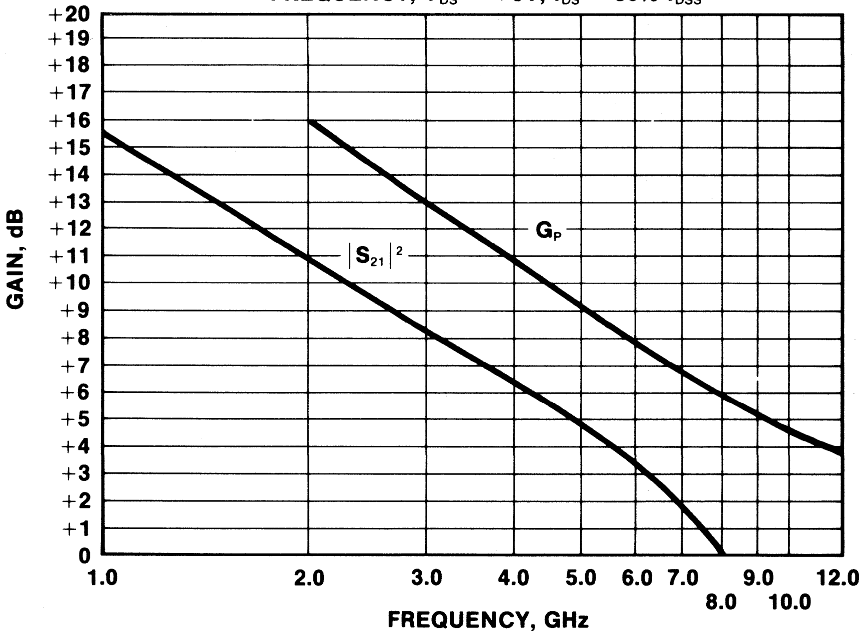
INSERTION POWER GAIN ($|S_{21}|^2$) vs. I_{DS} @ F = 4.0 GHz



POWER OUTPUT AT 1 dB GAIN COMPRESSION ($P_{0(-1)}$) vs. FREQUENCY, V_{DS} = +9V, I_{DS} = 50% I_{DSS}



SMALL SIGNAL POWER GAIN (G_P) AND INSERTION POWER GAIN ($|S_{21}|^2$) vs. FREQUENCY, V_{DS} = +9V, I_{DS} = 50% I_{DSS}



TYPICAL SCATTERING PARAMETERS, COMMON SOURCE*

S — MAGN AND ANGLES: AT-8151 BIAS = 6.00 VOLTS, 275.00 MA

FREQ.	11		21		12		22	
1000.00	.862	−101.1	7.317	120.0	.035	43.3	.188	−106.4
2000.00	.842	−133.1	4.343	97.6	.040	40.1	.226	−124.2
3000.00	.841	−146.3	2.962	85.2	.042	45.5	.273	−129.7
4000.00	.849	−153.3	2.278	76.7	.045	55.2	.327	−132.0
5000.00	.848	−157.7	1.808	69.1	.047	65.3	.378	−134.3
6000.00	.867	−161.2	1.506	61.9	.053	71.6	.445	−135.0
7000.00	.861	−161.9	1.258	57.0	.059	79.7	.495	−133.2
8000.00	.874	−163.1	1.118	51.7	.068	83.9	.542	−130.9
9000.00	.875	−164.8	1.006	45.9	.076	85.6	.572	−131.6
10000.00	.873	−167.2	.901	39.9	.084	86.7	.586	−135.6
11000.00	.886	−170.0	.816	33.8	.091	84.8	.601	−142.3
12000.00	.895	−174.0	.737	25.9	.095	81.2	.633	−150.4

S — MAGN AND ANGLES: AT-8151 BIAS = 9.00 VOLTS, 260.00 MA

FREQ.	11		21		12		22	
1000.00	.867	−101.6	7.378	118.3	.032	42.3	.218	−66.4
2000.00	.847	−133.4	4.340	95.2	.036	39.6	.224	−88.0
3000.00	.846	−146.5	2.945	82.0	.037	46.5	.272	−100.2
4000.00	.856	−153.4	2.260	72.7	.039	59.1	.331	−108.5
5000.00	.857	−157.7	1.780	64.1	.041	71.7	.388	−114.7
6000.00	.877	−161.2	1.475	56.2	.049	79.3	.469	−119.4
7000.00	.871	−162.0	1.217	50.6	.056	87.6	.528	−120.8
8000.00	.884	−163.3	1.068	44.7	.066	91.7	.584	−120.1
9000.00	.887	−165.1	.955	38.6	.076	93.5	.623	−121.9
10000.00	.884	−167.6	.848	31.9	.085	94.2	.644	−126.6
11000.00	.896	−170.6	.762	25.1	.094	91.5	.659	−133.9
12000.00	.904	−174.5	.680	16.7	.099	87.0	.690	−142.8

CHIP CODE M115

*(S-parameters include bond wire inductance and are measured in Avantek's standard 50 ohm test carrier.)

AT-8140

One Watt, 2-8 GHz
Gallium Arsenide FET
December, 1980

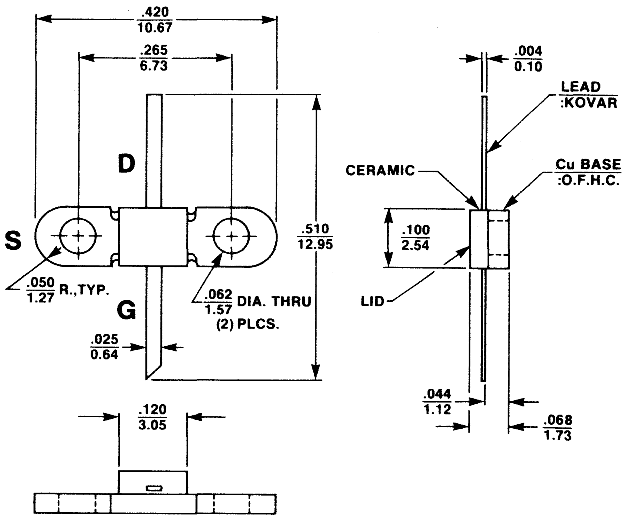
FEATURES

- +30 dBm Min. Power Output at 4 GHz
- 8 dB Min. Associated Gain (G_P)
- Up to 35% Power Added Efficiency
- Gold-Based Metallization
- Optimized Power Epitaxy and Doping
- "Right-Side-Up" Chip Permits Visual Inspection
- Hermetic Copper-Flange Stripline Package

DESCRIPTION

The Avantek® AT-8140 is a gallium arsenide Schottky-gate field effect transistor designed for medium power, linear amplification in the 2 to 8 GHz frequency range. This rugged, reliable device is suitable for a wide variety of applications such as communications and radar equipment operating in the space, airborne, military and commercial environments.

This GaAs FET incorporates a chip (available in unpackaged form as the AT-8141) with a four-cell, 5-millimeter gate periphery structure with airbridge interconnects between source pads. It is supplied in the Avantek 100 mil FET flange package—a rugged, hermetic package with low parasitic reactance and minimum thermal resistance.



AVANTEK 100 MIL FET FLANGE PACKAGE
(Dimensions in inches / mm)

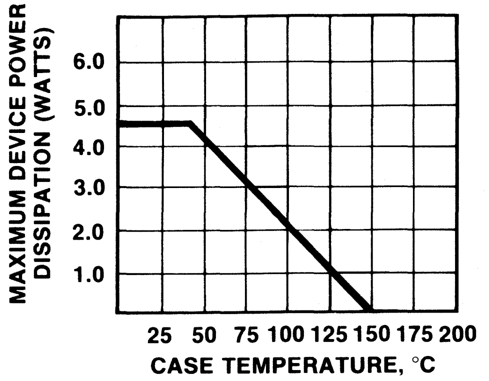
ELECTRICAL SPECIFICATIONS, $T_A = 25°C$

Symbol	Parameters and Test Conditions	Freq.	Units	Min.	Typ.	Max.
$P_{0\,(-1\,dB)}$	Output Power at 1 dB Gain Compression, $V_{DS} = 9V$, $I_{DS} = 50\%\ I_{DSS}$, Tuned for maximum output power at input level producing 1 dB gain compression.	4 GHz 8 GHz	dBm	30.0	31.5 30.0	
G_P	Associated Small Signal Gain, $V_{DS} = 9V$, $I_{DS} = 50\%\ I_{DSS}$,	4 GHz 8 GHz	dB	8.0	9.0 4.0	
G_{max}	Maximum Available Gain, $V_{DS} = 9V$, $I_{DS} = 50\%\ I_{DSS}$	8 GHz	dB		6	
g_m	Transconductance: $V_{DS} = 3V$, $I_{DS} = I_{DSS}$		mmho		450	
I_{DSS}	Saturated Drain Current: $V_{DS} = 3V$, $V_{gs} = 0$		mA		1000	
V_P	Pinchoff Voltage: $V_{DS} = 3V$, $I_{DS} = 5.0$ mA		V		−3.0	

MAXIMUM RATINGS (T_A = 25°C)

Parameter	Symbol	Recommended max. for continuous operation	Absolute max.
Drain-Source Voltage	V_{DS}	+9V	+14V
Gate-Source Voltage	V_{GS}	−5V	−7V
Drain Current	I_{DS}	500 mA	I_{DSS}
Continuous Dissipation	P_T (T_{case} = 25°C)	4.5 W	7.0 W
Channel Temperature	T_{ch}	150°C	300°C
Storage Temperature	T_{stg}	−65° to +150°C	250°C

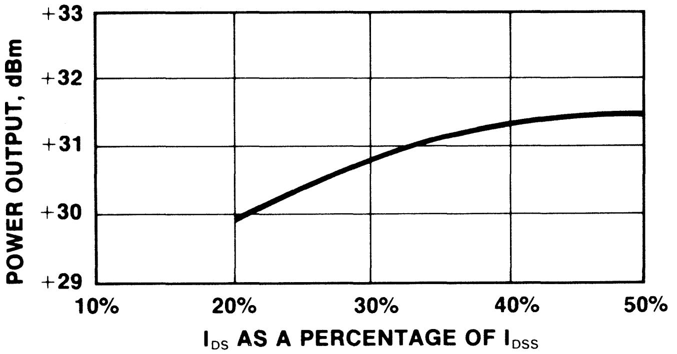
POWER DERATING CURVE



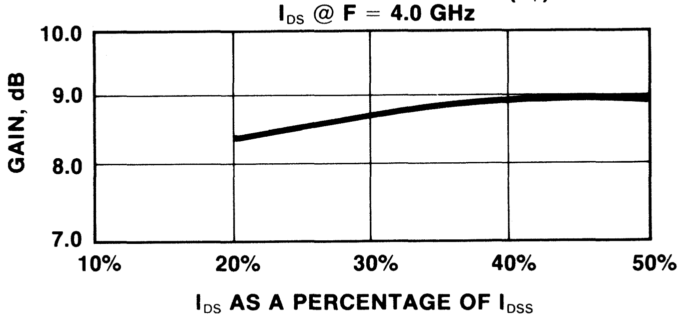
Thermal Resistance	Θ_{jc}	23°C/W

TYPICAL PERFORMANCE CURVES (T_A = 25°C)

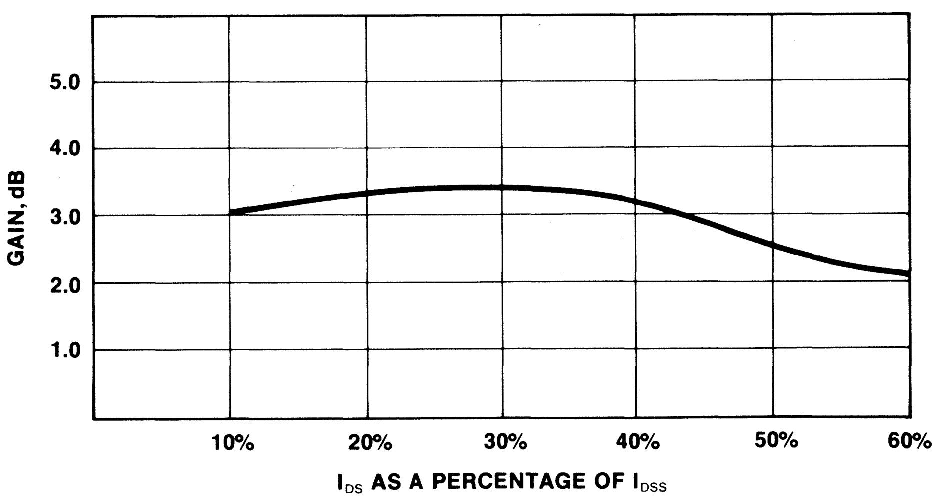
POWER OUTPUT AT 1 dB GAIN COMPRESSION vs. I_{DS} @ F = 4.0 GHz



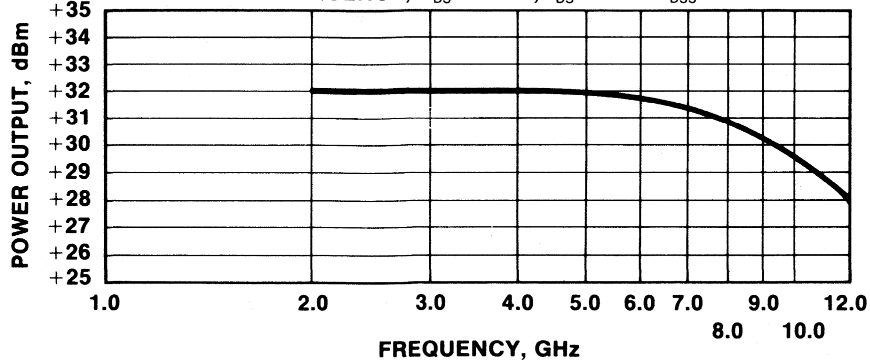
SMALL SIGNAL POWER GAIN (G_P) vs. I_{DS} @ F = 4.0 GHz



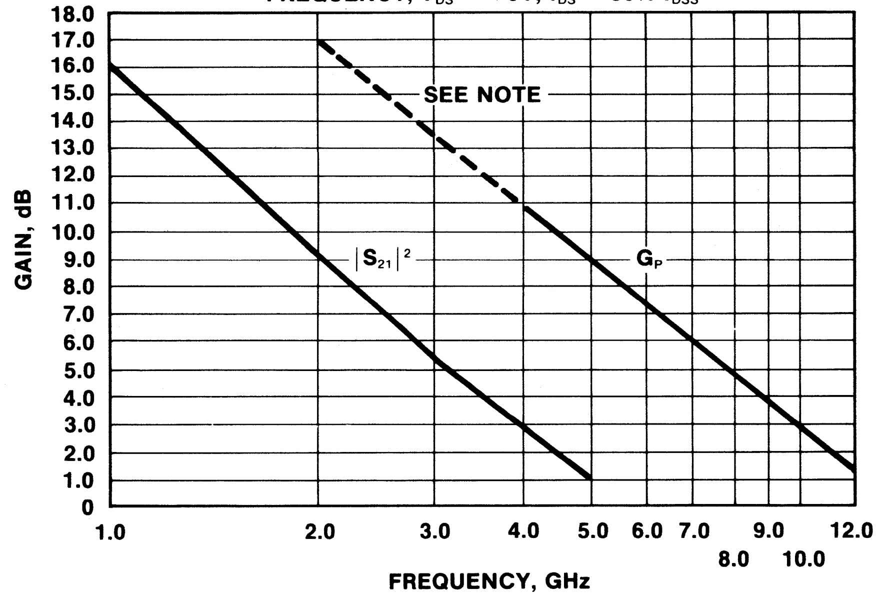
INSERTION POWER GAIN ($|S_{21}|^2$) vs. I_{DS} @ F = 4.0 GHz



POWER OUTPUT AT 1 dB GAIN COMPRESSION ($P_{0(1)}$) vs. FREQUENCY, V_{DS} = +9V, I_{DS} = 50% I_{DSS}



SMALL SIGNAL POWER GAIN (G_P) AND INSERTION POWER GAIN ($|S_{21}|^2$) vs. FREQUENCY, V_{DS} = +9V, I_{DS} = 50% I_{DSS}



NOTE: DASHED LINE INDICATES AREA OF POTENTIAL INSTABILITY.

SECTION 6

TYPICAL SCATTERING PARAMETERS, COMMON SOURCE

S — MAGN AND ANGLES: AT-8140 BIAS = 6.00 VOLTS, 490.00 MA

FREQ.	11		21		12		22	
1000.00	.863	−140.0	4.753	100.7	.033	38.5	.411	−166.2
2000.00	.863	−158.2	2.630	82.9	.041	45.6	.431	−165.0
3000.00	.849	−166.1	1.873	70.7	.052	54.1	.432	−163.0
4000.00	.862	−174.7	1.413	57.9	.071	58.7	.448	−163.2
5000.00	.815	171.3	1.121	42.5	.094	52.4	.442	−167.1
6000.00	.839	151.4	.966	26.6	.113	46.8	.451	−175.4
7000.00	.856	133.0	.919	9.0	.126	42.1	.512	168.4
8000.00	.885	127.1	.677	−2.5	.134	37.6	.597	155.8
9000.00	.899	129.6	.531	−4.1	.151	39.2	.669	152.1
10000.00	.879	134.0	.496	−2.0	.205	39.5	.685	152.2
11000.00	.791	127.8	.582	−2.1	.355	26.7	.613	145.5
12000.00	.444	128.3	.785	−23.9	.573	−24.9	.344	147.1
13000.00	.658	123.2	.701	−51.8	.330	−78.5	.475	160.3

S — MAGN AND ANGLES: AT-8140 BIAS = 9.00 VOLTS, 415.00 MA

FREQ.	11		21		12		22	
1000.00	.859	−139.9	4.923	98.9	.032	36.6	.309	−156.6
2000.00	.862	−157.9	2.690	79.7	.039	43.9	.349	−152.9
3000.00	.849	−165.8	1.892	66.4	.048	53.7	.378	−149.1
4000.00	.865	−174.3	1.564	52.9	.064	61.1	.416	−147.9
5000.00	.820	171.6	1.301	36.8	.089	55.7	.429	−152.6
6000.00	.844	151.7	1.138	20.5	.108	49.9	.446	−161.1
7000.00	.860	133.3	.898	2.2	.124	45.0	.510	−179.4
8000.00	.887	127.2	.652	−10.2	.134	38.6	.597	164.6
9000.00	.897	129.7	.501	−12.4	.152	37.5	.674	158.5
10000.00	.867	134.6	.463	−10.6	.199	33.6	.688	158.0
11000.00	.773	132.5	.528	−12.2	.294	16.2	.608	155.7
12000.00	.623	130.1	.637	−29.3	.354	−20.5	.491	159.2
13000.00	.667	113.6	.637	−53.9	.266	−54.4	.528	156.9

CHIP CODE M114

AT-8141

One Watt, 2-10 GHz
Gallium arsenide FET Chip
December, 1980

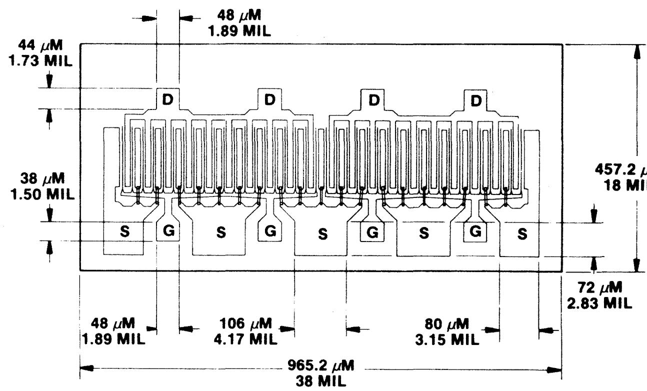
FEATURES

- **+30 dBm Min. Power Output at 4 GHz**
- **8 dB Min. Associated Gain (G_P)**
- **Up to 35% Power Added Efficiency**
- **Gold-Based Metallization**
- **Optimized Power Epitaxy and Doping**
- **Suitable for Broadband Applications**
- **Optimum Thermal and Electrical Design**
- **Large Bonding Pads**

DESCRIPTION

The Avantek® AT-8141 is an unpackaged gallium arsenide Schottky-gate field effect transistor chip designed for medium power, linear amplification in the 2 to 10 GHz frequency range. This rugged, reliable device is suitable for a wide variety of applications such as communications and radar equipment operating in the space, airborne, military and commercial environments.

This GaAs FET chip (also available in packaged form as the AT-8140) has a four-cell, 5-millimeter gate periphery structure with airbridge interconnects between source pads. All metal surfaces are gold plated for ease of bonding and die attach. Large bonding pads facilitate bonding into hybrid integrated circuits.



THICKNESS = 4.5 ± .5 MILS
114 ± 12 μM

ELECTRICAL SPECIFICATIONS, T_A = 25°C

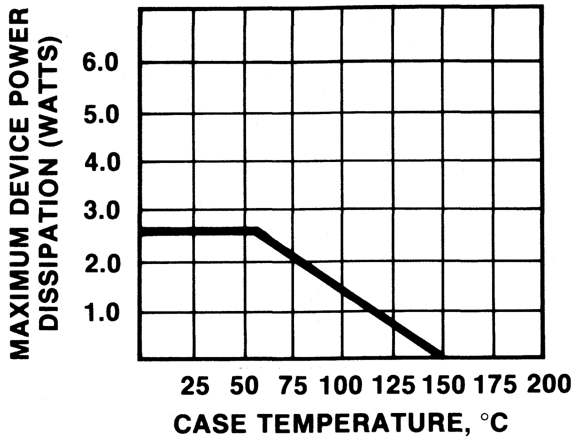
Symbol	Parameters and Test Conditions	Freq.	Units	Min.*	Typ.	Max.
$P_{0\ (-1\ dB)}$	Output Power at 1 dB Gain Compression, V_{DS} = 9V, I_{DS} = 50% I_{DSS}, Tuned for maximum output power at input level producing 1 dB gain compression.	4 GHz 8 GHz	dBm	30.0	31.5 30.0	
G_P	Associated Small Signal Gain, V_{DS} = 9V, I_{DS} = 50% I_{DSS},	4 GHz 8 GHz	dB	8.0	9.0 6.0	
G_{max}	Maximum Available Gain, V_{DS} = 9V, I_{DS} = 50% I_{DSS}	8 GHz	dB		8.0	
g_m	Transconductance: V_{DS} = 3V, I_{DS} = I_{DSS}		mmho		450	
I_{DSS}	Saturated Drain Current: V_{DS} = 3V, V_{gs} = 0		mA		1000	
V_P	Pinchoff Voltage: V_{DS} = 3V, I_{DS} = 5.0 mA		V		−3.0	

*(Measured in Avantek's 100 MIL FET flange package.)

MAXIMUM RATINGS (T_A = 25°C)

Parameter	Symbol	Recommended max. for continuous operation	Absolute max.
Drain-Source Voltage	V_{DS}	+9V	+14V
Gate-Source Voltage	V_{GS}	−5V	−7V
Drain Current	I_{DS}	300 mA	I_{DSS}
Continuous Dissipation	P_T (T_{case} = 25°C)	2.7 W	4.0 W
Channel Temperature	T_{ch}	+150°C	+300°C
Storage Temperature	T_{stg}	−65° to +150°C	+250°C

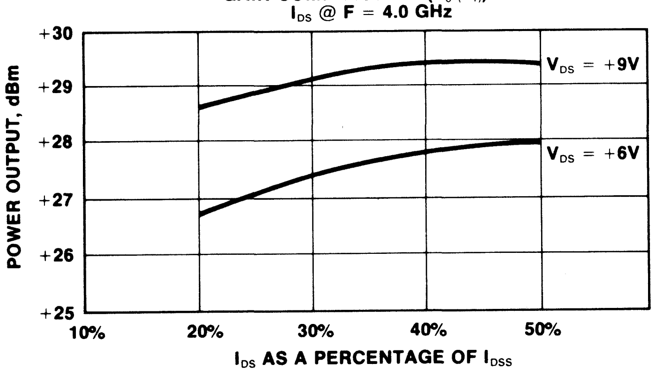
POWER DERATING CURVE



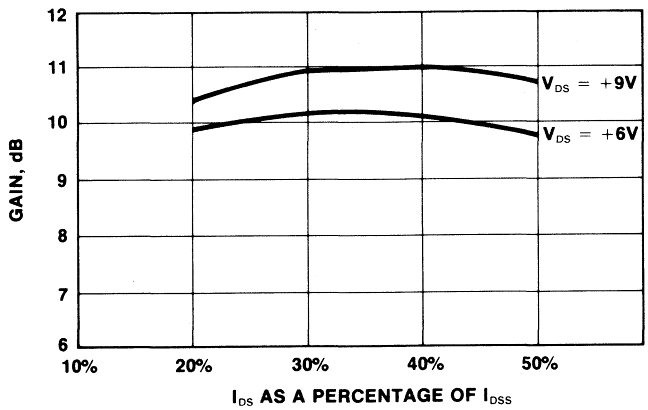
Thermal Resistance Θ_{jc} 35°C/W

TYPICAL PERFORMANCE CURVES (T_A = 25°C)

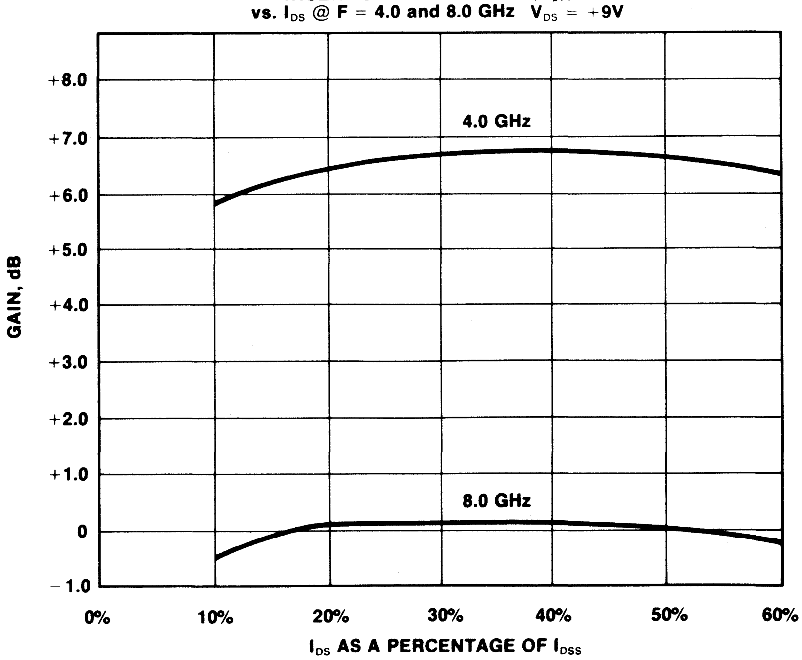
POWER OUTPUT AT 1 dB GAIN COMPRESSION ($P_{0\ (-1)}$) vs. I_{DS} @ F = 4.0 GHz



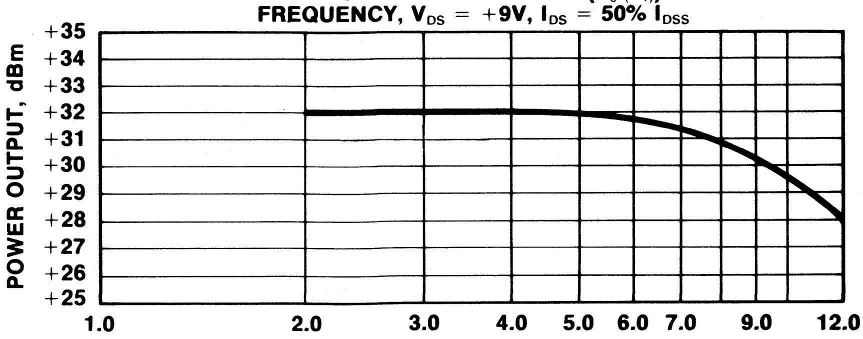
SMALL SIGNAL POWER GAIN (G_P) vs. I_{DS} @ F = 4.0 GHz



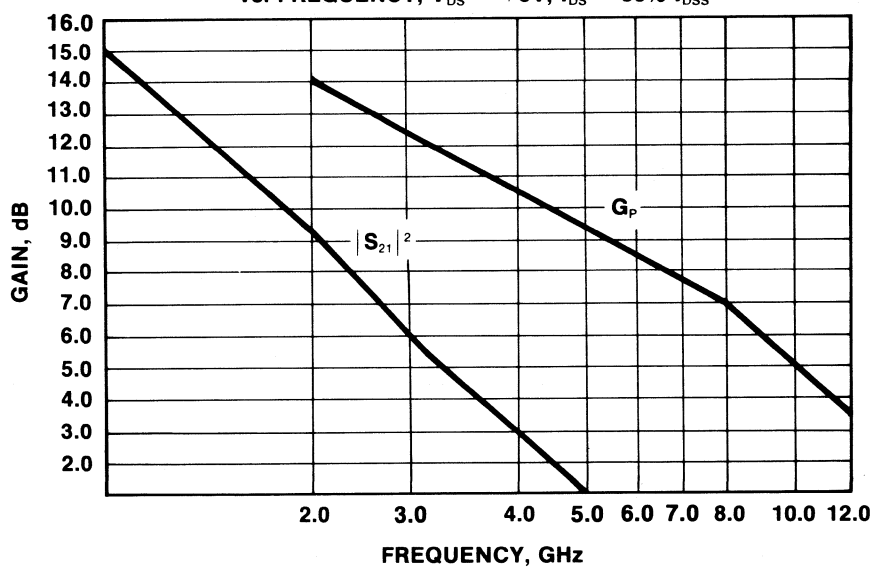
INSERTION POWER GAIN ($|S_{21}|^2$) vs. I_{DS} @ F = 4.0 and 8.0 GHz V_{DS} = +9V



POWER OUTPUT
AT 1 dB GAIN COMPRESSION ($P_{O(-1)}$) vs.
FREQUENCY, V_{DS} = +9V, I_{DS} = 50% I_{DSS}



SMALL SIGNAL POWER GAIN (G_P) AND
INSERTION POWER GAIN ($|S_{21}|^2$)
vs. FREQUENCY, V_{DS} = +9V, I_{DS} = 50% I_{DSS}



SECTION 6

TYPICAL SCATTERING PARAMETERS, COMMON SOURCE *

S — MAGN AND ANGLES: AT-8141 BIAS = 9.00 VOLTS, 425.00 MA

FREQ.	11		21		12		22	
1000.00	.879	−91.2	5.563	101.3	.028	40.9	.227	−52.3
2000.00	.841	−136.0	2.933	83.1	.034	49.4	.182	−83.2
3000.00	.846	−157.9	1.891	73.9	.040	61.2	.207	−97.3
4000.00	.858	−168.5	1.440	66.7	.047	72.4	.228	−106.6
5000.00	.851	−174.8	1.128	58.8	.056	80.8	.254	−111.8
6000.00	.882	−179.6	.924	52.5	.065	84.0	.284	−115.6
7000.00	.843	−179.6	.764	49.9	.074	90.7	.326	−123.9
8000.00	.838	172.4	.694	45.8	.086	92.6	.347	−127.6
9000.00	.856	160.1	.619	42.0	.097	94.0	.383	−137.9
10000.00	.835	145.0	.577	36.6	.111	95.6	.399	−148.4
11000.00	.778	129.2	.530	30.9	.129	92.3	.433	−160.0
12000.00	.845	116.5	.494	21.4	.137	84.8	.480	−177.7
13000.00	.796	108.6	.403	15.0	.136	81.6	.524	157.6

CHIP CODE M114

*(S-parameters include bond wire inductance and are measured in Avantek's standard 50 ohm test carrier.)

AVANTEK CASCADABLE AMPLIFIERS

Whether your RF, IF, AGC, buffering or isolation application involves a single frequency, a single modulated carrier or a multi-octave bandwidth, Avantek's unique modular "building block" approach offers a superior alternative to designing and building your own discrete component amplifier. Avantek® modular amplifiers and accessories can save you time and money, and may even improve your system performance.

Beginning with a handful of thin-film cascadable amplifier modules introduced in 1970, the Avantek modular amplifier family has grown in both numbers and performance each year since. Today there are more than 90 modules to choose from, and each new module that is introduced further extends the performance capabilities of the family—through lower noise figure, higher gain, more power output or wider frequency coverage. Since each amplifier module can be cascaded without affecting its individual performance, these 90-plus gain blocks may be combined to meet practically any system specifications.

Designed by experts, tested and qualified by experts and produced using efficient, high volume, automated production and testing techniques, Avantek modular components offer *more performance per dollar* than ever before.

Today's linear or digital system designer would never consider building an operational amplifier or flip-flop with separate components—because equal or better performance is now available in reliable, cost-effective *integrated circuit* form. In the same way, an RF designer should not be faced with designing and taming an IF gain stage—one that could well break into oscillation with changes in load impedance or ambient temperature—because the same or better performance is available *right now* from reliable, cost-effective hybrid *integrated circuit* modules.

Designed to be unconditionally stable regardless of source or load conditions, Avantek MICamp® thin-film modular amplifiers, related amplifier modules and accessory components, are cascadable in a conventional 50-ohm microstrip circuit without loss of gain, output power capability or operating bandwidth. A patented[1] feedback network, in conjunction with consistent Avantek-produced microwave transistors insures predictable, stable and repeatable performance. They are suitable for an almost unlimited range of applications at frequencies up to 2300 MHz.

[1]Pat. No. Re. 29844

All a designer need do is mount these amplifier modules on a 50-ohm microstrip PC board, assure good RF and thermal grounding and supply the DC bias voltage—they are "ready-to-go," trouble-free gain blocks.

There is no need to go through the design of bias circuitry, feedback loops or impedance matching networks nor to perform complex stability plots. There is no need to order, evaluate, test and stock the many components that go to make up a discrete-component amplifier. Each modular amplifier is complete and includes stable DC biasing circuitry and internal power supply decoupling.* Each module will operate at its full output power rating in most normal installations without special heat dissipation provisions. Truly, they are "install-and-forget" components.

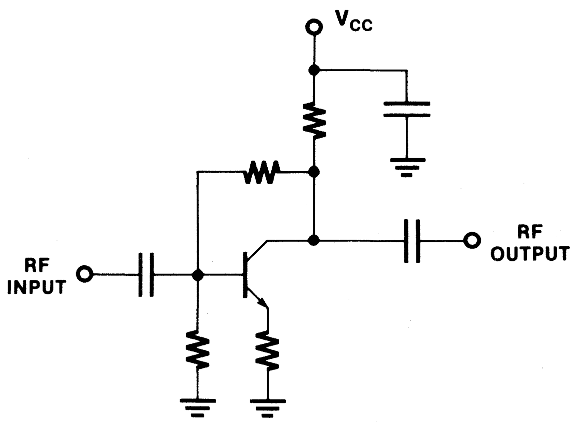
Selecting a Modular Amplifier Family for Your Application

Avantek offers three distinct series of thin-film, wideband, cascadable modular amplifiers. Each module is manufactured on the same assembly line, uses the same proven thin-film hybrid construction, is hermetically packaged and undergoes the same quality assurance procedure—but each of the three modular amplifier series offers its own special advantages.

The *GPD Series* general purpose amplifier modules have been specifically designed for applications which require the highest performance-to-cost ratio or for which the size of the module is an important consideration. Supplied in the TO-12 metal/glass hermetic "transistor" package, GPD Series amplifiers are extremely compact. Most versions are equipped with internal coupling and bypass capacitors—these are available with up to 5-1000 MHz guaranteed frequency coverage. Some versions, the GPD "60" Series, are used with external user-supplied coupling and bypass capacitors to allow their low-frequency roll-off to be set virtually as low as required—down to a few hundred Hz, if necessary. Noise figures of GPD Series modules are as low as 3.2 dB, their gains are as high as 30 dB, and up to +15 dBm of linear (1 dB gain compression) output power is available. In 100-499 quantities, these general purpose modules can cost as little as 30¢ per dB of gain.

*See description of GPD "60" series modules.

Figure 1. **Basic circuit of single-stage GPD Series amplifier module.**



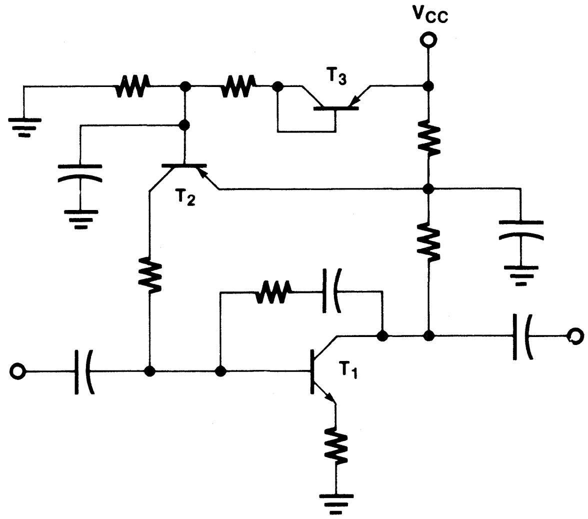
The primary difference between the GPD Series module and the "premium" UTO Series module is that the GPD Series design uses a simplified passive biasing circuit (see figure 1). In this design, the collector feedback resistor serves the dual purpose of providing base bias to the RF transistor as well as collector-to-base shunt feedback. In addition, relatively simple input and output matching networks are used to permit the GPD amplifier circuit to be fabricated on a very small ceramic substrate. The result is that the GPD Series module has slightly higher noise figure, slightly less gain and more performance variation over temperature than the larger TO-8 module—but its excellent performance has been proven in literally hundreds of commercial and military applications.

The *UTO Series* of cascadable amplifier modules has been designed specifically for the best possible performance and highest reliability under the most difficult operating conditions. They can be characterized as having very stable and repeatable performance over a wide range of frequencies, operating temperatures and supply voltages.

Supplied in the TO-8 metal/glass hermetic package, UTO Series modules cover the 1 to 2300 MHz frequency range. They offer noise figures as low as 2.0 dB, as much as 31 dB of gain and linear (1 dB gain compression) output power capabilities as high as +33 dBm. Most UTO Series modules operate from +15 VDC power sources—special versions are optimized for high efficiency operation at +5 VDC and others for higher output power using +24 VDC bias. Various modules incorporate silicon bipolar transistors, GaAs field effect transistors and VMOS FETs.

Since they are the "premium" modules, both the input and output circuit of each UTO Series module is optimized for the best 50-ohm impedance match. In the actively-biased UTO Series amplifier (see figure 2), one low-frequency PNP transistor (T_2) controls the quiescent current for the RF transistor (T_1), while a second low-frequency transistor (T_3) is sometimes used to assure base-to-emitter voltage tracking over a wide temperature range. Modules with +13 dBm or greater output power ratings usually incorporate a ferrite RF choke for power supply decoupling.

Figure 2. **Basic circuit of a typical single-stage UTO Series amplifier module. T_1 is the RF transistor, while T_2 and T_3 are part of the active biasing circuit.**



The *UDP and FDP Series* amplifier modules are packaged in special RF dual-inline metal/glass hermetic packages. They cover the 5 to 2000 MHz frequency range and offer noise figures as low as 3.5 dB, up to +18 dBm of linear (1 dB gain compression) output power with up to *44 dB gain.*

Essentially, UDP and FDP Series modules consist of the same type of thin-film circuits used in the high-performance UTO Series amplifiers—optimized for best match and cascaded. This provides the user with a complete multi-stage cascade—the equivalent of two or three TO-8 modules—in a single, compact package. This helps reduce the number of components that are used in a system even further and, with even fewer connections to be made, can provide an even higher system reliability.

Figure 3. **Summary of the performance of the Avantek thin-film modular amplifier families.**

TYPICAL PERFORMANCE SUMMARY CHART

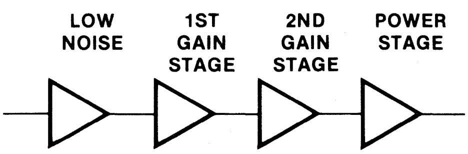
Frequency Range (MHz)	Noise Figure (dB)	Single Module Gain (dB)	Power Output (dBm)	Product Type
5-200	3.5 (201)	30 (201)	+9 (202)	GPD-200 Series
0.1-300	6.0	13	+6	GPD-300 Series
0.1-400	3.2	13	+15	GPD-400 Series
0.1-1000	6.0	12	+14	GPD-1000 Series
10-100	4.5	9	+33	UTO-161 VMOS
30-200	2.0	16	−1	UTO-514
5-500	2.5 (511)	31 (524)	+27 (561)	UTO-500 Series
5-1000	3.0 (1011)	24 (1021)	+22 (1004)	UTO-1000 Series
5-1500	4.0 (1524)	28 (1521)	+10 (1521)	UTO-1500 Series
1-2000	4.0	10	+16	UTO-2000 Series
500-2000	5.0	9	+19	UTO-GaAs FET 2000 Series
2000-2300	5.0	14	+14	UTO-2300 Series
5-500	3.5	44	+17	DIP 500 Series
5-1000	5.5	37	+13	DIP 1000 Series
1000-2000	5.5	24	+8	DIP 2000 Series
10-500	5.5	34	+18	FDP 500 Series

( ) Model #

Cascading Modular Amplifiers

With over 90 Avantek thin-film amplifier modules from which to choose, it is simple to design a cascade offering practically any required combination of performance characteristics.

Figure 4. **Typical cascade of amplifier modules.**



In most cases, the first module is selected to provide the required cascade noise figure and the final module to provide the necessary cascade output power. If additional gain is required, intermediate modules are included—taking care to assure that the power output of each intermediate module is high enough to sufficiently drive the following stage, yet not so high that it will cause saturation. The entire cascade design process is very straightforward, with quite accurate results possible by simply using a few "rules of thumb," as listed below:

1. **Bandwidth** — Since cascading does not affect the bandwidth of the individual modules, the overall bandwidth of a cascade will be defined by the module having the *smallest* bandwidth. Note, though, that the bandwidths specified for each modular amplifier is the guaranteed operating frequency range, and the modules will provide significant amounts of gain at much lower and usually much higher frequencies.

2. **Gain** — The minimum gain of a cascade will be the sum of the minimum gains of each of the cascaded modules *so long as none of the modules are driven into saturation* by signal levels applied to the cascade.

3. **Gain flatness** — The following table provides a conservative estimate of the overall gain flatness of a cascade, based on the number and type of modules used.

Figure 5. **Approximate gain flatness of cascades of Avantek modular amplifiers.**

UTO Series	Bandpass Flatness in dB, No. of Gain Stages: 2 ea	3	4
500	±1.0	±1.5	±2.0
1000	±1.0	±1.5	±2.0
1500	±1.0	±1.5	±2.0
2000	±1.5	±2.0	±2.5

4. **Noise figure** — The noise figure of a cascade can be calculated from the usual equation

$$F_C = F_1 + \frac{F_2 - 1}{G_1} + \frac{F_3 - 1}{G_1G_2} + \ldots \frac{F_N - 1}{G_1G_2 \ldots G_{N-1}}$$

Where F_1 and F_N are the noise figures (in numeric form, $F = \log^{-1}\frac{NF_{dB}}{10}$) of the 1st and Nth stages respectively and G_1 and G_N are the gains (in numeric form, $G = \log^{-1}\frac{G_{dB}}{10}$) of the 1st and Nth stages. As a general rule, the noise figure contribution of subsequent stages will be rather small if the gain of the first module is greater than approximately 15 dB.

5. **Power Output** — In the usual cascade, when the amplifier modules are arranged in order of ascending output power, the minimum output power of the cascade will be no worse than 1 dB less than the guaranteed output power of the last module alone. To ensure full rated output power, each module in the cascade should have an output power that is approximately *5 dB greater* than

the input compression point (guaranteed output power *minus* module gain) of the following module.

6. Bias — While guaranteed specifications only apply at the specified supply voltage (±1%), lower voltages may be applied to the amplifier modules to help optimize their performance for a specific application. For example, the specifications of 6 dB noise figure, 7 dB gain and +14.2 dBm output power of the UTO-1503 only apply at +24 VDC (±1%) bias voltage. At +12 VDC, the module noise figure will be reduced to approximately 5.1 dB (at 800 MHz) with approximately 6.5 dB gain and +7 dBm output power (1 dB gain compression).

When several modular amplifiers, requiring different input voltages, are to be cascaded, they may be powered from a single supply capable of supplying the *highest* required voltage and the *total* required current. Since the current consumption of modules remains fairly constant, the lower voltage modules may then be supplied through series dropping resistors ($R = \frac{V_{supply} - V_{module}}{I_{module}}$).

When such dropping resistors are used, it is recommended that a 0.1 μf capacitor be installed (with the shortest possible leads) between the module power terminal and ground to assure adequate RF bypassing.

How Avantek Thin-Film Amplifier Modules Are Made

Avantek thin-film cascadable amplifier modules are the product of advanced thin-film fabrication technology, using high-vacuum RF sputtering to deposit both the resistive and conductor metallizations on precision ceramic substrates.

All circuit conductors, including all inductors except for ferrite RF chokes, are thin-film gold. All resistors are thin-film tantalum nitride, heat-treated for long-term stability and minimum drift with temperature — and laser trimming of these resistors brings their tolerance within ±2% for consistent performance. Avantek-designed and produced RF transistor chips are used throughout to help assure uniform phase, gain and VSWR characteristics from lot to lot. In fact, an entire wafer containing thousands of individual transistors is allocated specifically to each individual product.

All thin-film modular products are packaged in dry-nitrogen filled, hermetically welded packages. Each module is both gross and fine-leak tested as a final assurance of long-term reliability regardless of the operating environment.

Advantages of Modular Amplifiers

There are many benefits to the designer who elects to use modular amplifiers in a system design. Some examples are:

Saves time — Modular components save substantial amounts of time throughout the design and manufacturing process. It takes time to order and receive components — and certain components are subject to long shipment delays — as well as to design and fabricate a printed circuit board. It takes additional time to analyze the performance of an amplifier circuit, to make modifications and to repeat the steps until the amplifier works as it should. A modification to an already-designed receiver or other RF system — for example a reduction in RF gain and increase in subsequent IF gain — can often result in a lengthy redesign program.

With the "building block" approach, the gain stages are ready for immediate evaluation. In fact, if it will take too long for your own PC shop or supplier to produce the necessary microstrip boards to install the modules, Avantek can provide evaluation boards with your module order. All that's required is to plug the module into a system, and the system is ready to test. If gain, noise figure or output power requirements change, you can simply substitute another modular amplifier — all modules have identical pin-out arrangements.

All modules are unconditionally stable, and are guaranteed over a wide temperature range to assure that they will operate properly under field conditions.

Reduces Parts Count — In a discrete amplifier design transistor, capacitor, resistor and inductor must be ordered, tested and stocked. Each of these components must be separately inserted in the circuit board and soldered — and each soldered connection presents the possibility of a faulty connection or a damaged component due to overheating. With the modular design approach only the complete module need be purchased and stocked, and only four soldered connections need be made. Because the amplifier modules are broadband, most can be used in more than one socket within the system for a further reduction in ordering, testing and stocking problems.

Solves the Stability Problem — One of the hardest parts of designing an RF amplifier is to insure that it will not break into oscillation under some combination of bias, termination impedance or temperature conditions. Since the designers of Avantek cascadable amplifier modules have no way of knowing exactly how they are to be used, each amplifier is designed to be *unconditionally* stable for all combinations of input and output impedance, frequency and temperature.

Provides Wideband 50-ohm Impedance Match — Each amplifier is well matched at both input and output terminals to a 50 ohm impedance over a very wide frequency range. This can be particularly important when the amplifier is combined with components such as mixers, filters and switches which are significantly affected by the terminating impedance.

Stable Over Temperature — Transistor characteristics vary substantially from unit to unit, so designing an amplifier circuit that assures constant collector current can present a real problem. Linear stabilization techniques may be used, or a temperature compensating circuit added to an amplifier — but combining good gain vs. temperature characteristics with the desired RF performance is not always easy. With the Avantek family of modular amplifiers gain variations are reduced and, in the case of the UTO Series, active temperature compensation is part of the bias circuit. The performance of these modules is guaranteed over temperature, and their typical performance curves show just how little their performance actually does change as the temperature varies. A most important consideration is that since thin-film circuit fabrication assures very precise control of both resistor and conductor geometries, all performance characteristics of these modular amplifiers are highly consistent and repeatable from unit to unit.

Reduces the Size and Weight of Your System — Using modular amplifiers can substantially reduce both the size and weight of your design. The GPD Series amplifiers, in the TO-12 transistor package, offer the highest performance per volume — for example a GPD-201 requires only 6.4×10^{-3} sq. inches of board space per dB of gain.

Increases System Reliability — A quality product must have the quality built in. Avantek's MICamp thin-film amplifiers are no exception. Their designs are conservative, normally* requiring no external heat sinking other than the microstrip ground plane.

Most important, thin-film hybrid construction techniques assure that each amplifier will be extremely reliable. Each amplifier will pass the rigorous environmental screening of MIL-STD-883B without prior qualification. Because the package is hermetically sealed and both gross and fine-leak tested prior to shipment, moisture or corrosive gas intrusion is never a problem. Typical calculated mean time before failure (MTBF) calculations for a standard UTO Series amplifier at 65°C is 159 years and, since they contain fewer components and connections, the MTBF of a GPD Series module can be even higher.

Applications

These modular amplifiers are ideal for RF and IF gain stages in receivers and are particularly well suited for application as IF amplifiers following microwave mixers. They can also be used in conjunction with Avantek UTF Series thin-film PIN-diode voltage-controlled attenuators to produce a wide-dynamic range AGC amplifier; or cascaded with Avantek UTL Series thin-film limiters to provide an extremely constant output with a wide input signal power level range. With their excellent 50-ohm impedance match over multi-octave bandwidths—regardless of source or load impedance—Avantek modular amplifiers are widely used as active isolators and buffer amplifiers.

*Some higher powered units may require additional heat sinking.

LOW COST TO-12 PACKAGED CASCADABLE AMPLIFIERS

Guaranteed Specifications @ 25°C

Model	Frequency Response (MHz) Minimum	Gain (dB) Minimum	Noise Figure (dB) Typical	Reverse Isolation (dB) Typical	Power Output for 1 dB Gain Compression (dBm) Typical	Gain Flatness (± dB) Typical	Intercept Point for IM Products (dBm)	VSWR (50Ω) Typical In	VSWR (50Ω) Typical Out	Input Power (± 1% Reg.) Volts DC	Input Power (± 1% Reg.) Current mA Typ.	Model	Price 1-99 ea ($)	Price 100-499 ea ($)
GPD-201	5-200	30	3.5	28	+ 5	1.0	+ 14	2.0	2.0	+ 15	30	201	28.75	25.30
GPD-202	5-200	25	5.5	28	+ 9	1.0	+ 20	2.0	2.0	+ 15	60	202	28.00	24.64
GPD-251	5-200	25	4.0	28	+ 1	1.0	+ 11	2.0	2.0	+ 5	30	251	28.75	25.30
GPD-252	5-400	14	5.0	21	0	1.0	+ 11	2.0	2.0	+ 5	10	252	28.00	16.17
GPD-401/461[6]	5-400	13	4.5	20	− 2	1.0	+ 8	2.0	2.0	+ 15	10	401/461	17.50/5.90	15.75/5.31
GPD-411	5-400	12	3.2	18	− 6	1.0	+ 4	2.0	2.0	+ 15	7	411	21.00	18.90
GPD-402/462[6]	5-400	13	6.0	20	+ 6	1.0	+ 18	2.0	2.0	+ 15	24	402/462	17.00/6.30	15.30/5.67
GPD-403/463[6]	5-400	9	7.5	20	+ 15	1.0	+ 26	2.0	2.0	+ 24	65	403/463	19.50/7.50	17.55/6.75
GPD-404.464[6]	5-400	9	7.5	20	+ 15	1.0	+ 26	2.0	2.0	+ 15	70	404/464	18.25/7.05	16.43/6.35
GPD-1001/1061[6]	5-1000	12	6.0	18	0	1.0	+ 10	2.0	2.0	+ 15	15	1001/1061	22.50/8.50	20.25/7.65
GPD-1002/1062[6]	5-100	12	7.0	18	+ 6	1.0	+ 16	2.0	2.0	+ 15	27	1002/1062	22.00/9.10	19.80/8.19
GPD-1003/1063[6]	5-1000	10	8.0	18	+ 14	1.0	+ 24	2.0	2.0	+ 15	55	1003/1063	23.25/10.50	20.93/9.45

HIGH PERFORMANCE TO-8 PACKAGED CASCADABLE AMPLIFIERS

Guaranteed Specifications: 0° to 50°C (A), − 54° to + 85°C (B)

Model	Frequency Response (MHz) Minimum	Gain (dB) Minimum A	Gain (dB) Minimum B	Noise Figure (dB) Maximum A	Noise Figure (dB) Maximum B	Power Output at 1 dB Gain Compression (dBm) Minimum A	Power Output at 1 dB Gain Compression (dBm) Minimum B	Gain Flatness (± dB) Maximum A	Gain Flatness (± dB) Maximum B	Typical Intercept Point for IM Products (dBm)	VSWR (50 ohms) Maximum In	VSWR (50 ohms) Maximum Out	Iput Power (± 1% Reg.) Volts DC	Iput Power (± 1% Reg.) Current mA Typ.	"R" Series Burn-in Case Temperature (°C)	Case Drawing	Price 1-9 ea ($)
UTO-161[4] (VMOS)	**10-100**	**8.0**	**8.0**	**6.0**	**6.0**	**+ 31** **+ 33**	**+ 30** **+ 32**	**1.0**	**1.0**	**+ 43**	**2.0**	**2.0**	**+ 15** **+ 20**	**330** **450**	**+ 71**	**TO-3**	**160**
2 to 500 MHz, Low Noise Versions (Listed in Order of Increasing Noise Figure, Decreasing Gain)																	
UTO-514	30-200	15	14.5	2.0	2.5	− 3	− 4	0.75	1.0	+ 7	2.0	2.0	+ 15	8	125	TO-8U	115
UTO-410	**5-400**	**15**	**15**	**3.0**	**3.5**	**− 2**	**− 3**	**1.0**	**1.0**	**+ 8**	**A = 2.0** **B = 2.2**	**2.0** **2.0**	**+ 15**	**10**	**125**	**TO-8U**	**45**
UTO-416	**5-400**	**14**	**13.5**	**5.5**	**5.5**	**+ 10**	**+ 9.5**	**1.0**	**1.0**	**+ 23**	**2.0**	**2.0**	**+ 15**	**35**	**100**	**TO-8U**	**46**
UTO-421	**5-400**	**27**	**27**	**5.5**	**5.5**	**+ 6**	**+ 5.5**	**1.0**	**1.0**	**+ 18**	**2.0**	**2.0**	**+ 15**	**38**	**125**	**TO-8U**	**55**
UTO-517	5-500	22	21	3.0	3.5	+ 5	+ 4	1.0	1.0	+ 15	2.0	2.0	+ 15	25	125	TO-8U	95
UTO-511	5-500	15	15	2.5	3.0	− 2	− 3	1.0	1.0	+ 8	A = 2.0 B = 2.2	2.0 2.0	+ 15	10	125	TO-8U	75
UTO-543[4]	10-500	10	9	2.5	3.0	+ 6	+ 6	1.0	1.0	+ 22	2.0	2.0	+ 15	25	125	TO-8U	120
UTO-510	5-500	15	15	3.0	3.5	− 2	− 3	1.0	1.0	+ 8	A = 2.0 B = 2.2	2.0 2.0	+ 15	10	125	TO-8U	70
UTO-544[4]	10-500	10	9	3.0	3.5	+ 12	+ 12	1.0	1.0	+ 28	2.0	2.0	+ 15	35	125	TO-8T	125
UTO-524	5-500	30	30	4.0	4.0	+ 14	+ 14	1.0	1.0	+ 27[1] + 34[2]	2.0	2.0	+ 15	70	100	TO-8T	140
UTO-551	5-500	15	14	4.0	4.5	− 5	− 6	1.0	1.0	+ 10	2.0	2.0	+ 5	7	125	TO-8U	80
UTO-501	5-500	14	13.5	4.0	4.5	− 2	− 3	1.0	1.0	+ 11	2.0	2.0	+ 15	10	125	TO-8U	65
UTO-512	5-500	20	19	4.5	5.0	+ 7	+ 7	1.0	1.0	+ 20	2.0	2.0	+ 15	23	125	TO-8U	85
UTO-521	5-500	27	27	5.5	5.5	+ 6	+ 5.5	1.0	1.0	+ 18	2.0	2.0	+ 15	38	125	TO-8U	110
UTO-502	5-500	14	13.5	5.5	6.0	+ 7	+ 7	1.0	1.0	+ 21	2.0	2.0	+ 15	23	125	TO-8U	65
2 to 500 MHz, High Power Versions (Listed in Order of Increasing Power Output, Decreasing Gain)																	
UTO-516	5-500	14	13.5	5.5	5.5	+ 10	+ 9.5	1.0	1.0	+ 23	2.0	2.0	+ 15	35	100	TO-8U	85
UTO-523	5-500	23	23	7.0	7.0	+ 12	+ 12	1.0	1.0	+ 25[1] + 36[2]	2.0	2.0	+ 15	80	100	TO-8U	110
UTO-503	5-500	9	8.5	7.0	7.0	+ 13	+ 13	1.0	1.0	+ 27	2.0	2.0	+ 24	50	100	TO-8U	70
UTO-515	2-500	12	11	7.0	7.5	+ 14	+ 13	0.5	0.7	+ 25	2.0	2.0	+ 15	65	100	TO-8U	80
UTO-533	5-500	16	15	5.5	6.0	+ 14	+ 13	0.7	1.0	+ 28	2.0	2.0	+ 15	53	100	TO-8T	90
UTO-513	5-500	16	15.5	6.0	6.5	+ 14	+ 14	1.0	1.0	+ 27[1] + 36[2]	2.0	2.0	+ 24	50	100	TO-8U	75
UTO-545	10-500	10	10	5.0	5.5	+ 17	+ 16	0.5	0.5	+ 36	2.0	2.0	+ 15	60	100	TO-8T	130

HIGH PERFORMANCE TO-8 PACKAGED CASCADABLE AMPLIFIERS, continued

Guaranteed Specifications: 0° to 50°C (A), −54° to +85°C (B)

Model	Frequency Response (MHz) Minimum	Gain (dB) Minimum A	B	Noise Figure (dB) Maximum A	B	Power Output at 1 dB Gain Compression (dBm) Minimum A	B	Gain Flatness (±dB) Maximum A	B	Typical Intercept Point for IM Products (dBm)	VSWR (50 ohms) Maximum In	Out	Iput Power (±1% Reg.) Volts DC	Current mA Typ.	"R" Series Burn-in Case Temperature (°C)	Case Drawing	Price 1-9 ea ($)
UTO-504	5-500	6	6	11.0	11.0	+17	+17	1.0	1.0	+31	2.0	2.0	+24	100	71	TO-8U	70
UTO-505	10-500	9	9	8.5	9.0	+18	+18	1.0	1.0	+30	2.0	2.0	+15	95	100	TO-8T	90
UTO-507[3]	10-500	14	14	8.5	9.0	+20	+20	1.0	1.0	+35	2.0	2.0	+15	110	71	TO-8T	120
UTO-508[3]	10-500	11.5	11	8.5	9.0	+20	+20	0.7	1.0	+35	2.0	2.0	+24	110	71	TO-8T	175
UTO-546[5]	10-500	10	10	8.0	8.5	+23	+22	0.5	0.5	+38	2.0	2.0	+15	110	71	TO-8T	146
UTO-561[3]	10-500	11	10	9.0	9.5	+26	+25.5	0.7	1.0	+40	2.0	2.0	+15	190	71	TO-8T	125

2 to 1000 MHz (Listed in Order of Increasing Noise Figure, Decreasing Gain)

Model	Frequency Response (MHz) Minimum	Gain A	Gain B	NF A	NF B	Pout A	Pout B	Flatness A	Flatness B	Intercept (dBm)	VSWR In	VSWR Out	Volts DC	Current mA Typ.	Burn-in Case Temp (°C)	Case Drawing	Price ($)
UTO-1012	5-1000	15	14	4.0	4.5	+4	+3	1.0	1.0	+17	2.0	2.0	+15	18	125	TO-8U	105
UTO-1011	2-1000	14	13.5	3.5	4.0	−5	−6	0.7	1.0	+10	2.0	2.2	+15	8	125	TO-8U	105
UTO-1043[4]	10-1000	10	9	4.0	4.5	+6	+6	1.0	1.0	+22	2.0	2.0	+15	25	125	TO-8T	140
UTO-1013	5-1000	15	14	4.5	5.0	+9	+8	1.0	1.0	+20	2.0	2.0	+15	29	125	TO-8U	115
UTO-1044[4]	10-1000	10	9	4.5	5.0	+12	+12	1.0	1.0	+28	2.0	2.0	+15	35	125	TO-8T	150
UTO-1021Δ	5-1000	22	21	4.5	5.0	+12	+11	1.0	1.0	+23	2.0	2.0	+15	85	100	TO-8U	170
UTO-1051	5-1000	10	9	5.0	5.7	−5	−6	1.0	1.0	+10	2.0	2.0	+5	7	125	TO-8U	110
UTO-1001	5-1000	14	13.5	5.0	5.5	−2	−3	1.0	1.0	+11	2.0	2.0	+15	10	125	TO-8U	85
UTO-1002	5-1000	14	13.5	6.5	7.0	+7	+7	1.0	1.0	+21	2.0	2.0	+15	23	125	TO-8U	85
UTO-1003	5-1000	9	8.5	8.0	8.5	+13	+13	1.0	1.0	+27	2.0	2.0	+24	50	100	TO-8U	90
UTO-1033	5-1000	10	9	8.0	8.5	+14	+13	1.0	1.0	+28	2.0	2.0	+15	48	100	TO-8T	115
UTO-1004	10-1000	6	5.5	12.5	12.5	+20	+19	0.7	1.0	+33	2.0	2.0	+15	110	71	TO-8T	110

1 to 1500 MHz (Listed in Order of Increasing Noise Figure, Decreasing Gain)

Model	Frequency Response (MHz) Minimum	Gain A	Gain B	NF A	NF B	Pout A	Pout B	Flatness A	Flatness B	Intercept (dBm)	VSWR In	VSWR Out	Volts DC	Current mA Typ.	Burn-in Case Temp (°C)	Case Drawing	Price ($)
UTO-1524Δ	10-1500	21	20	4.5	5.0	+7	+6	1.5	1.5	+19	2.0	2.0	+15	60	100	TO-8U	185
UTO-1522Δ	5-1500	18	17	5.5	6.0	+11	+10	1.5	1.5	+23	2.0	2.0	+15	85	100	TO-8U	185
UTO-1511	5-1500	10	10	4.5	5.0	−9	+10	0.5	1.0	+1	2.0	2.0	+15	7	125	TO-8U	100
UTO-1501	5-1500	9	8.5	5.5	6.0	−3	−4	0.5	1.0	+10	2.0	2.0	+15	10	125	TO-8U	95
UTO-1502	5-1500	9	8.5	7.5	7.5	+6	+6	0.5	1.0	+19	2.0	2.0	+15	23	125	TO-8U	95
UTO-1504	2-1500	9	8.5	8.0	8.5	+12	+12	1.0	1.0	+27	2.0	2.0	+24	60	100	TO-8U	100
UTO-1521	1-1500	28	26	8.0	8.5	+13	+12	2.0	3.0	+26[1] +36[2]	A=2.2 B=2.5	2.2 2.5	+24	135	100	TO-3	220
UTO-1503	5-1500	6	5.5	9.0	9.0	+12	+12	0.5	1.0	+25	2.0	2.0	+24	50	100	TO-8U	100

1 to 2000 MHz (Listed in Order of Increasing Noise Figure, Decreasing Gain)

Model	Frequency Response (MHz) Minimum	Gain A	Gain B	NF A	NF B	Pout A	Pout B	Flatness A	Flatness B	Intercept (dBm)	VSWR In	VSWR Out	Volts DC	Current mA Typ.	Burn-in Case Temp (°C)	Case Drawing	Price ($)
UTO-2031	1-2000	9	8.5	5.5	5.5	+2	+2	1.0	1.0	+14	2.0	2.0	+15	16	125	TO-8U	115
UTO-2032	1-2000	9	8.5	6.0	6.0	+7	+6.5	1.0	1.0	+17	2.0	2.0	+15	25	125	TO-8U	120
UTO-2033	1-2000	8	7.5	8.5	9.5	+14	+14	1.0	1.0	+25	2.2	2.2	+15	50	71	TO-8T	130

10 to 2000 MHz (Listed in Order of Increasing Noise Figure, Decreasing Gain)

Model	Frequency Response (MHz) Minimum	Gain A	Gain B	NF A	NF B	Pout A	Pout B	Flatness A	Flatness B	Intercept (dBm)	VSWR In	VSWR Out	Volts DC	Current mA Typ.	Burn-in Case Temp (°C)	Case Drawing	Price ($)
UTO-2012Δ FET	**500-2000**	**9**	**8.5**	**5.0**	**5.5**	**+12**	**+11**	**1.0**	**1.0**	**+23**	**2.0**	**2.0**	**+15**	**50**	**71**	**TO-8U**	**195**
UTO-2013Δ FET	**500-2000**	**9**	**8.5**	**5.5**	**6.0**	**+19**	**+18**	**1.0**	**1.0**	**+32**	**2.0**	**2.0**	**+15**	**100**	**71**	**TO-8U**	**295**
UTO-2011	1000-2000	7.5	7.5	5.0	5.5	−3	−4	0.5	1.0	+10	2.0	2.0	+15	12.5	125	TO-8U	115
UTO-2021	10-2000	9	8.5	5.5	5.5	+2	+2	1.0	1.0	+14	2.0	2.0	+15	16	125	TO-8U	115
UTO-2022	10-2000	9	8.5	6.0	6.0	+7	+6.5	1.0	1.0	+17	2.0	2.0	+15	25	125	TO-8U	120
UTO-2001	1000-2000	7.5	6.5	6.0	6.5	−3	−4	0.5	1.0	+10	2.0	2.0	+15	12.5	125	TO-8U	110
UTO-2002	1000-2000	8	7.6	7.0	7.5	+3	+3	0.5	1.0	+16	2.0	2.0	+15	20	125	TO-8U	110
UTO-2003	1000-2000	8	7.5	8.0	8.5	+7	+7	1.0	1.0	+20	2.0	2.0	+15	30	125	TO-8U	100
UTO-2023	10-2000	8	7.5	8.5	9.5	+14	+14	1.0	1.0	+25	2.2	2.2	+15	50	71	TO-8T	130

1700 to 2300 MHz (Listed in Order of Increasing Noise Figure, Decreasing Gain)

Model	Frequency Response (MHz) Minimum	Gain A	Gain B	NF A	NF B	Pout A	Pout B	Flatness A	Flatness B	Intercept (dBm)	VSWR In	VSWR Out	Volts DC	Current mA Typ.	Burn-in Case Temp (°C)	Case Drawing	Price ($)
UTO-2311	1700-2300	8	8	5.0	5.5	−3	−4	0.5	1.0	+10	2.0	2.0	+15	15	125	TO-8U	140
UTO-2302	1700-2300	8	8	6.5	7.0	+3	+2	0.5	1.0	+13	2.0	2.0	+15	18	125	TO-8U	120
UTO-2303	1700-2300	8	8	8.0	8.5	+10	+9	0.5	1.0	+20	2.0	2.0	+15	30	100	TO-8U	125

KEY TO HIGH PERFORMANCE TO-8 PACKAGED CASCADABLE AMPLIFIERS

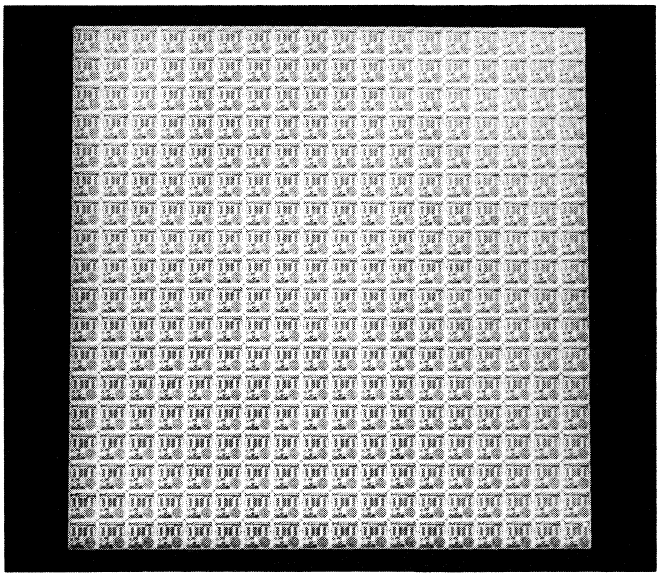
Boldface Listings *are new products.*
For units with 71°C burn-in temperature, B column is −54° to +71°C.
Δ Preliminary, contact factory.
Note 1: Third order intercept point.
Note 2: Second order intercept point.
Note 3: RF input pin is at DC ground.
Note 4: Both RF input and RF output pins are at DC ground.
Note 5: A portion of any DC voltage applied at the RF input pin will appear on the RF output pin (i.e., a resistive DC path exists between pins).
Note 6: The 60 Series same as standard amplifier except three external capacitors are required to establish low frequency roll-off.

The factory can guarantee operation of UTO MICamp modules over −54° to +105°C if so desired. The factory can also guarantee operation of GPD and Dual In Line amplifiers over 0° to +50°C, −54° to +85°C and −54°C to +105°C if so desired.

Most MICamp thin-film modules are available with high reliability screening under the Avantek "R" Series program. The "R" Series devices are conditioned with a full complement of Method 5004.2 screening procedures which provide Class B level reliability assurance. These test procedures, selected from MIL-STD-883, are sufficient to provide this assurance.

Figure 6. Computer-controlled automatic wire bonding speeds up the production of Avantek amplifier modules, as well as assuring consistent wire loops for reproducable performance.

Figure 7. This 3 in. by 3 in. substrate contains all the circuitry for 324 GPD-201 amplifier modules. Each ceramic substrate has dimension of approximately .165 × .165 inches.



Accessory Components

To complement Avantek's line of modular amplifiers other components designed for operation in a 50 ohm microstrip line are available. These include the UTF Series of voltage-controlled PIN-diode attenuators; the UTL Series of limiters and limiting amplifiers and an optimized AGC amplifier. They are all manufactured with the same thin-film technology component quality and inert gas-filled hermetic packaging that is used in the commercial, military and high-reliability screened thin-film amplifier modules.

UTF Series Attenuators

Avantek's UTF Series of thin-film precision, broadband voltage controlled attenuators are specifically designed to provide flexible gain control in a cascade of modular amplifiers such as the UTO Series. With a frequency response of 5 to 2000 MHz they may be placed in any position in an amplifier cascade and the consistent input and output impedance allows several UTF modules to be cascaded for an even wider attenuation range.

The designer can elect to install one near the input (for widest control range) or near the output (for best noise figure).

Long-term stability of the thin-film attenuator means that a UTF attenuator can be used as a "trimmer" to precisely match the performance of two or more amplifier cascades and, with a well-regulated control voltage source, will maintain their gain match without constant adjustment.

UTL Series Limiters

Whether the application be ECM, radar, instrumentation or communication, most sophisticated system designs require some method of either removing amplitude modulation from an FM signal or preventing the overdriving of a detection circuit. Both these functions can be conveniently performed with UTL and UDL limiting amplifier and UTL-1000 limiter modules.

The basic UTL-502 module consists of a thin-film hybrid differential amplifier. Three of these modules are cascaded in a dual-inline package to produce the UDL-502. For their size and cost, Avantek's modular limiters offer exceptional performance characteristics such as flat power output over a very wide dynamic range of RF input.

UTL-502 provides ±.5 dB flat power output over 10 dB range of input power.

UDL-502 provides ±.5 dB flat power output over 30 dB range of input power.

Both the UTL-502 and UDL-502 are also quite suitable for use as pulse amplifiers, offering pulse recovery time of less than 2 nano-seconds.

The UTL-1001 and UTL-1002 (identical except for 470 pf and 6800 pf coupling capacitors, respectively) are thin-film limiters with output levels programmable by the application of voltages in the +5 to +20 V (7 to 10 mA) range. They provide a wide range of limited output levels with input levels as high as +26 dBm and frequencies from 5 or 50 MHz to 1000 MHz. Among the special features of these limiters are input and output VSWR of less than 2.0:1 (unusual in limiters), low insertion loss, excellent second and third harmonic suppression and very low AM-to-PM conversion. At any limiting level setting, the output of a UTL-1001 or -1002 will vary less than ±1.0 dB over a −54° to +100°C ambient temperature range. Recovery from fully-saturating input signals (+20 dBm or greater) is less than 50 nano-seconds.

AGC Series

The Avantek AGC-330 is a unique combination of a thin-film cascadable amplifier and fast response attenuator. Compact and inexpensive, it offers the equivalent of two or three separate TO-8 modules in a single TO-3 package.

Used alone, the AGC-330 can be a complete AGC-controlled IF amplifier, suitable for a variety of extremely compact receivers with intermediate frequencies in the 5 to 300 MHz range. It may also be combined with additional stages of wideband modular amplifier modules, such as the Avantek UTO-500 or GPD Series, to produce a voltage-controlled amplifier with any reasonable amount of gain and power output. Used with modular amplifiers, the AGC-330 will not degrade the frequency response of a cascade.

Since the gain of the AGC-330 (−10 dB to +20 dB) is programmed with a 0 to +5 VDC control voltage, it is simple and practical to design into systems controlled by standard TTL digital logic. It is ideal for computer-controlled test equipment and receiving systems.

The AGC-330 consists of a simplified PIN-diode attenuator sandwiched between an input and output amplifier stage. Both the input and output terminals of the device maintain a constant 50 ohm impedance, with the amplifier stages serving to isolate external components from variations in attenuator impedance.

By using a minimum parts count in the attenuator circuit, and particularly by minimizing reactive components in the control line, the AGC-330 has a very fast response time of less than 1.5 μs and a pulse recovery time of approximately 1 μs. This makes the AGC-330, although a low-cost device, faster than currently available thin-film attenuator modules—ideal for high performance ECM systems as well as low cost receivers.

COMPLEMENTARY COMPONENTS

Guaranteed Specifications: −54 to +100°C

Model	Frequency Range (MHz)	Insertion Loss, Maximum (dB)	Attenuation Minimum (dB)	VSWR Maximum	Control Power (typical)	Input Power (typical)	Case Drawing	Price 1-9 ($)
UTF-025 Attenuator	5-2500	2.5, 5-1000 MHz 3.3, 5-2000 MHz	30, 5-500 MHz 25, 5-2000 MHz	2.0, 5-1000 MHz 2.5, 5-2000 MHz	0 to +15 VDC, 0 to 7 mA	+15 VDC, 15 mA	TO-8F	75

Guaranteed Specifications @ 25°C

Model	Frequency Range (MHz)	Insertion Loss, Maximum (dB)	Attenuation Minimum (dB)	VSWR Maximum	Control Power (typical)	Input Power (typical)	Case Drawing	Price 1-9 ($)
UTF-015 Attenuator	5-1000	2.0, 5-500 MHz 2.5, 500-1000 MHz	15	2.0	0 to −10 VDC, 0 to 7 mA	+15 VDC, 7 mA	TO-8F	80
UTF-040 Attenuator	5-1000	2.0, 5-500 MHz 2.5, 500-1000 MHz	40, 20-250 MHz 35, 10-500 MHz 30, 5-1000 MHz	2.0, 10-500 MHz 2.5, 5-1000 MHz	0 to −10 VDC, 0 to 60 mA	+15 VDC, 10 mA	TO-8F	95

Guaranteed Specifications: −54 to +100°C

Model	Frequency Range MHz Minimum	Input VSWR (P_{in} < +20 dBm) Maximum	Output VSWR (P_{in} < −10 dBm) Maximum	Input Signal Level (dBm) Maximum	Operating Bias Typical	Case Drawing	Price 1-9 ($)
UTL-1001[1] Limiter	50-1000	2.0:1	2.0:1	+26	+15V, 7 mA to +20V, 10 mA	TO-8U	90
UTL-1002[1] Limiter	5-1000	2.0:1	2.0:1	+26	+15V, 7 mA to +20V, 10 mA	TO-8U	110

Limiting and Insertion Loss Characteristics, UTL-1001, -1002 @ 25°C

Bias Voltage	Output Level At Limiting Threshold (1 dB Compression) dBm typ	max	Maximum Output Limiting Level (+20 dBm Input) dBm typ	max	Insertion Loss (500 MHz) dB typ	max	Insertion Loss (1000 MHz) dB typ	max
+20	0 dBm	+2 dBm	0 dBm	+2 dBm	1.6 dB	2.0 dB	2.0 dB	2.5 dB
+15	−2 dBm	0 dBm	−1 dBm	+1 dBm	1.9 dB	2.4 dB	2.5 dB	3.0 dB
+10	−6 dBm	−4 dBm	−4 dBm	−2 dBm	2.5 dB	3.0 dB	3.1 dB	3.7 dB
+5	−13 dBm	—	−9 dBm	—	4.3 dB	—	5.2 dB	—

Guaranteed Specifications @ 25°C

Model	Frequency Response (MHz) Minimum	Limited Output Power (@ +10 dBm Pin) dBm Maximum	Insertion Loss (small signal) (dB) Typical	Output Power Flatness (± dB) Typical	VSWR (typical) Input	VSWR (typical) Output	Second Harmonic (dBc) Typical	Third Harmonic (dBc) Typical	Operating Bias VDC Nominal	Operating Bias Current (mA) Typical	Maximum Recommended Input Power (dBm)	Maximum Recommended Bias (VDC)	Case Drawing	Price 1-9 $
GPL -1001[2] Limiter	5-1000	−4.0 (−8 typ)	5.0	1.0	2.0	2.0	>30	>12	15	5	+26	+20	TO-12	80

Note 1: Both limiters incorporate DC coupled diodes shunting both the input and output pins to ground.
Note 2: Limiter incorporates DC coupled diodes shunted to ground at input pin.

Guaranteed Specifications @ 25°C

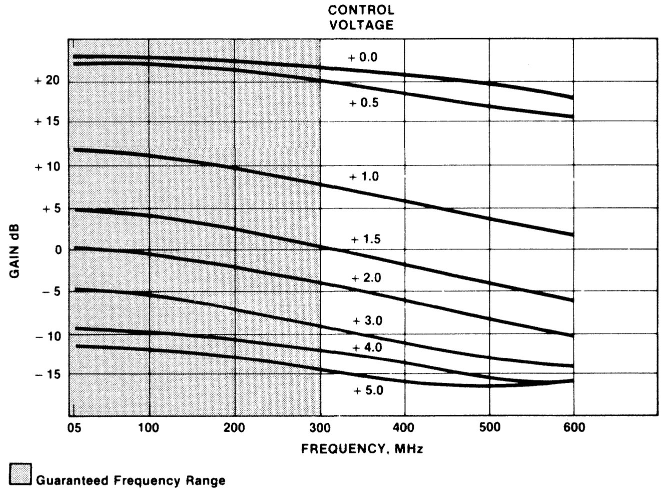
Model	Frequency Response (MHz) Minimum	Small Signal Gain (dB) Minimum	Saturated Flatness (± dB) Maximum	Noise Figure (dB) Max.	VSWR (50Ω) Maximum In	VSWR (50Ω) Maximum Out	Standard Power Output (dBm)	Even Harmonic	Input Power (± 1% Reg.)	Case Drawing	Price $
UTL-502[1] Limiting Amplifier	5-500	7^2	$\pm 0.5^2$	11	2.0	2.0	− 4 (min) − 2 (typ)	15 dB down w/input from − 50 to + 7 dBm	+ 15 VDC and − 15 VDC	TO-8L	195
UDL-502[1] Limiting Amplifier	5-500	30^2	$\pm 0.5^2$	11	2.0	2.0	− 4 (min) − 2 (typ)	15 dB down w/input from − 50 to − 7 dBm	+ 15 VDC and − 15 VDC	DIPL	595

Note 1: Maximum input power + 15 dBm.
Note 2: ± 1.0 dB in linear operating range.

AGC-330 SPECIFICATIONS, 0 to 50°C.

	Typical	Guaranteed
Frequency Range	5-300 MHz	5-300 MHz min.
Response Time	< 1.5 μs	2.0 μs max.
Gain	22 dB	20 dB min. @ $0V_C$
Flatness	± 0.7 dB	± 1.0 dB max.
Attenuation	36 dB	30 dB min.
VSWR (input)	1.7:1	2.0:1 max.
VSWR (output)	1.5:1	2.0:1 max.
Noise Figure	< 4.0 dB	5.0 dB (No AGC)
P_O, 1 dB Compression	+ 1 dBm	0 dBm (No AGC)
Bias Voltage	15 VDC	15 VDC ± 1% Reg
Current	< 25 ma	30 ma max.
Package		4 lead, TO-3
AGC Voltage Range		0-5 VDC

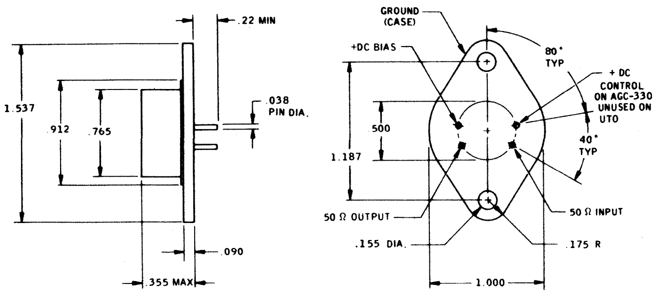
AGC-330 GAIN vs. FREQUENCY



CASE DRAWINGS

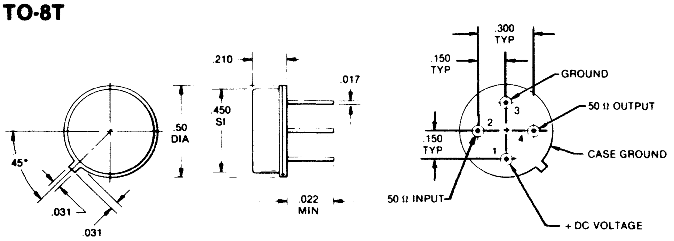
Unless otherwise specified
all dimensions in inches
Tolerances: .XX = .02
.XXX = .01

TO-3



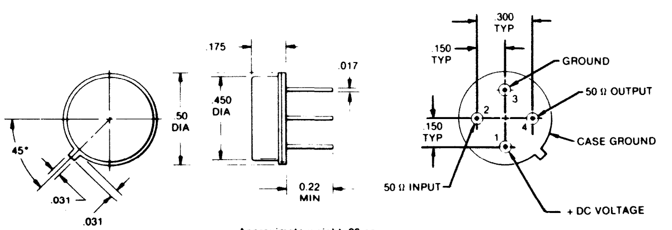
Approximate weight 0.5 oz

TO-8T



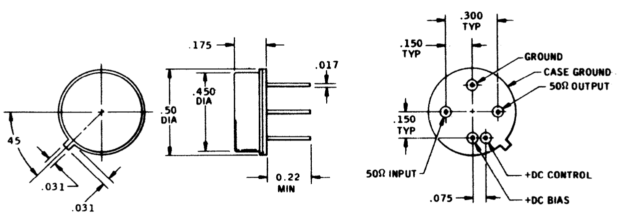
Approximate weight .06 oz.

TO-8U



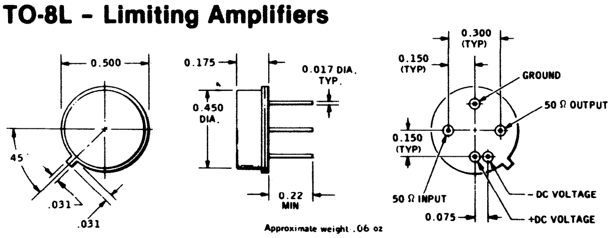
Approximate weight .06 oz.

TO-8F - Attenuators



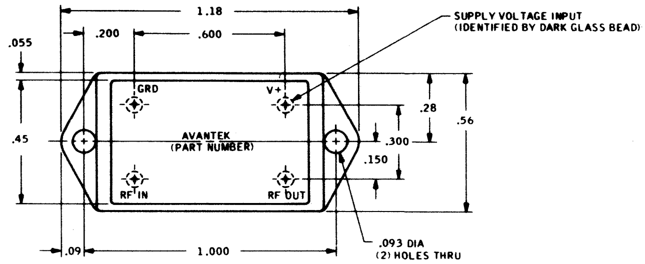
Approximate weight .06 oz

TO-8L - Limiting Amplifiers

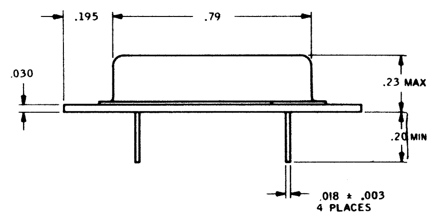


Approximate weight .06 oz

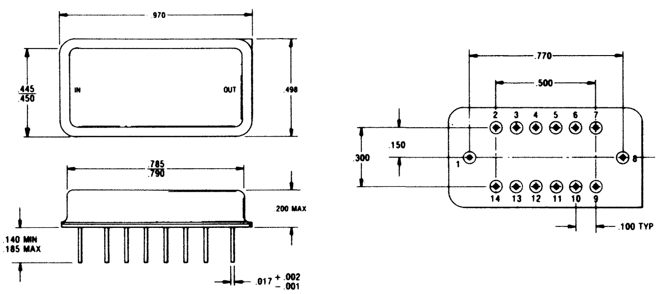
FDP



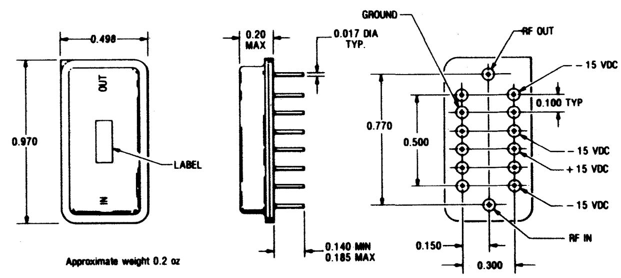
Approximate weight 0.2 oz



DIP

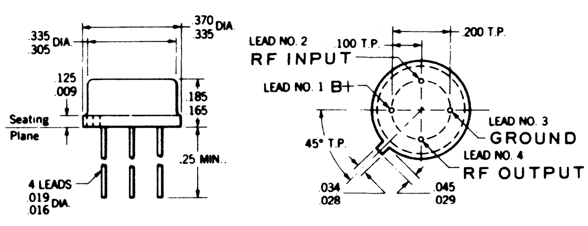


DIPL - Limiting Amplifier



Approximate weight 0.2 oz

TO-12 - GPD Series



SECTION 7