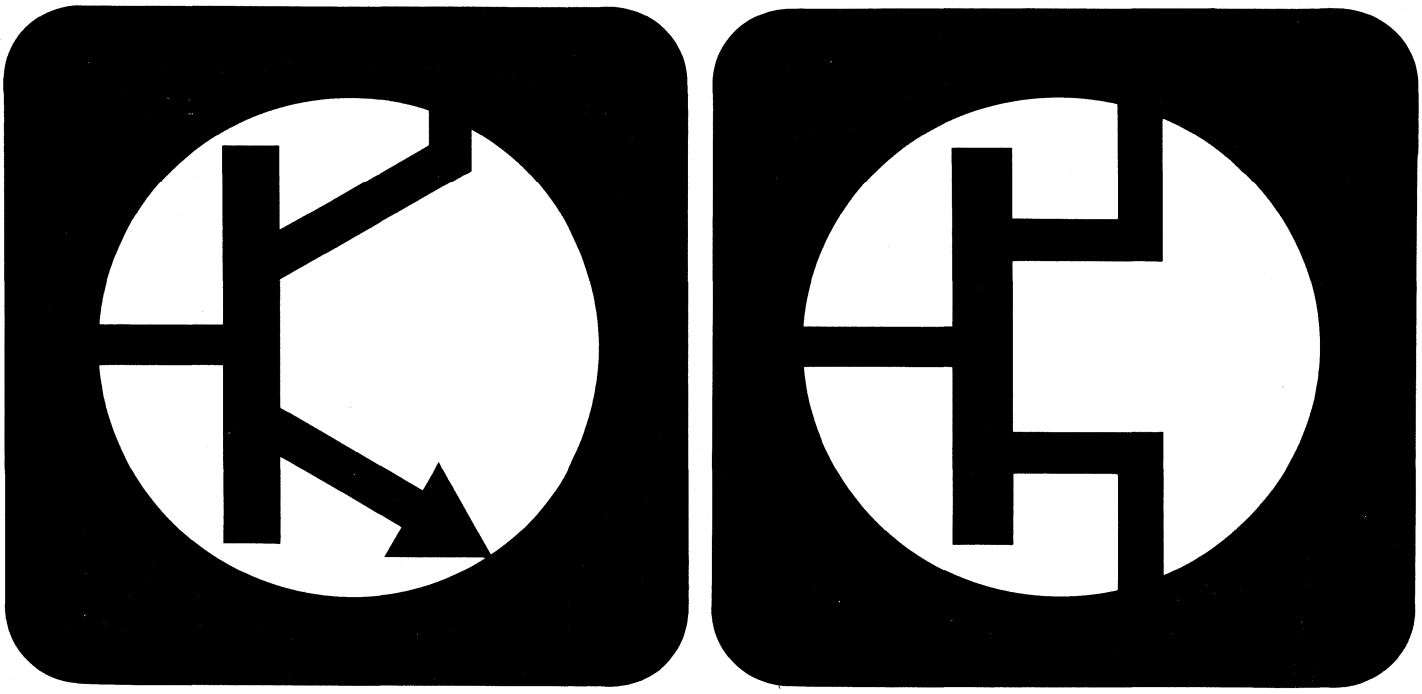


transistor data book

Avantek

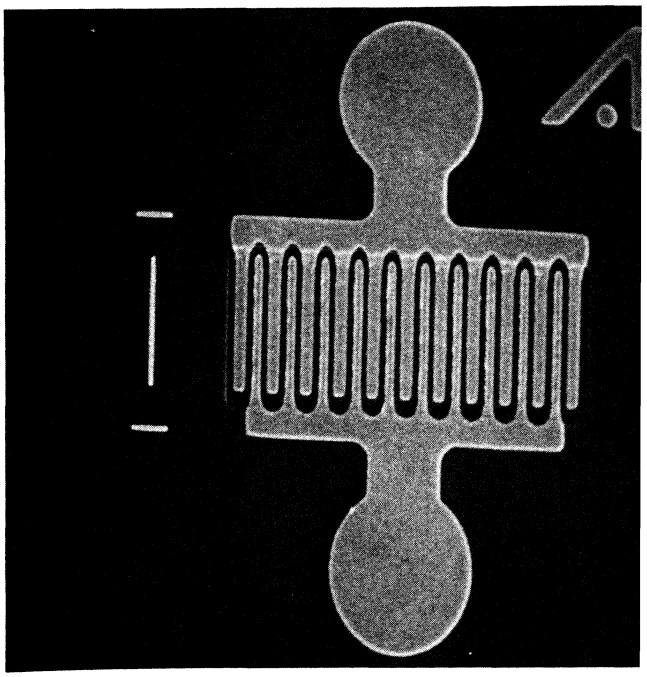
INTRODUCTION

Avantek... *years ahead today.*

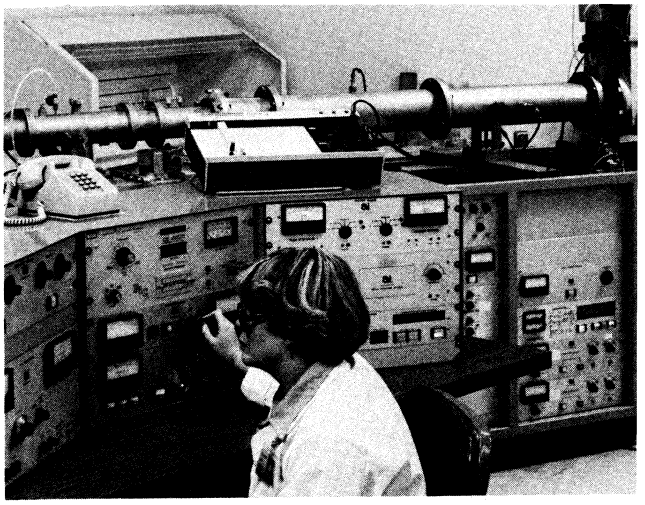
Avantek, Inc., is a leading supplier of state-of-the-art microwave semiconductors, amplifiers, oscillators, modular components and equipment for commercial, telecommunications, military and aerospace applications. Today, we operate from a 208,000 sq. ft. facility in Santa Clara, California — the heart of the west coast semiconductor and microwave industry, and supply customers throughout the world.

We are proud of our reputation for microwave products that 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.

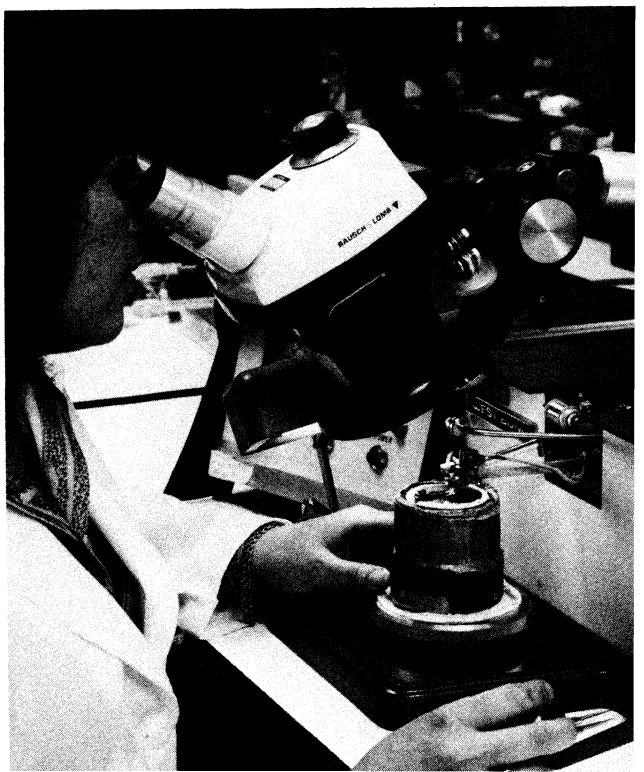
THE AVANTEK TRANSISTOR CAPABILITY



Avantek was founded in late 1965 to produce 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.

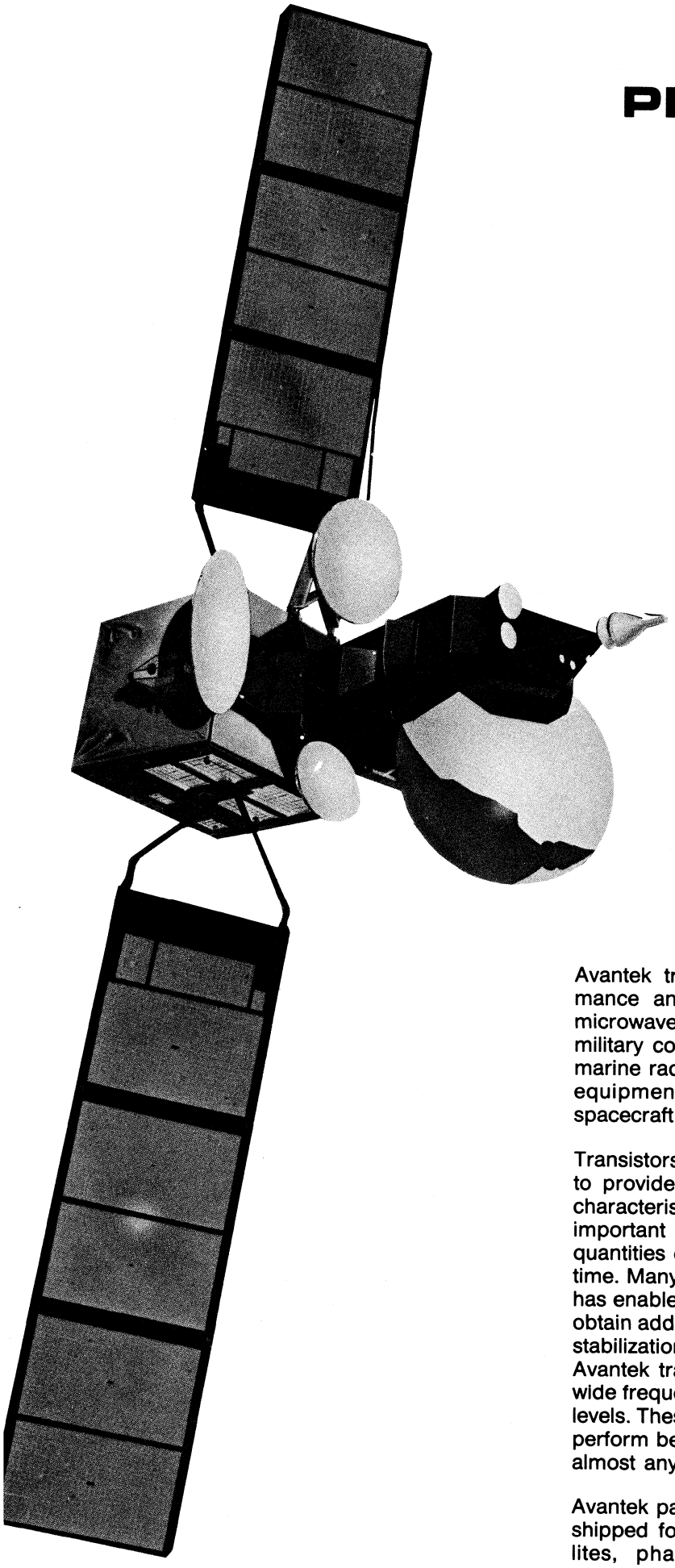


From 1968 to the present, we have continuously upgraded our microwave transistor capabilities and facilities. By 1974 we were producing arsenic-doped bipolar transistors with extremely low noise figures and high gain, and had begun quantity production of GaAs FETs. By 1976, we added ion implantation capabilities and were producing GaAs FET's 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.



Today, the Avantek transistor R & D staff, made up of many noted experts in semiconductor physics, works with one of the industry's most completely-equipped prototyping and test facilities — 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 performance.

The Avantek transistor production facility is designed and equipped specifically for the efficient quantity production of high performance microwave transistors. Our production equipment includes high-vacuum sputtering systems to assure adherence and purity of metal films. 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.

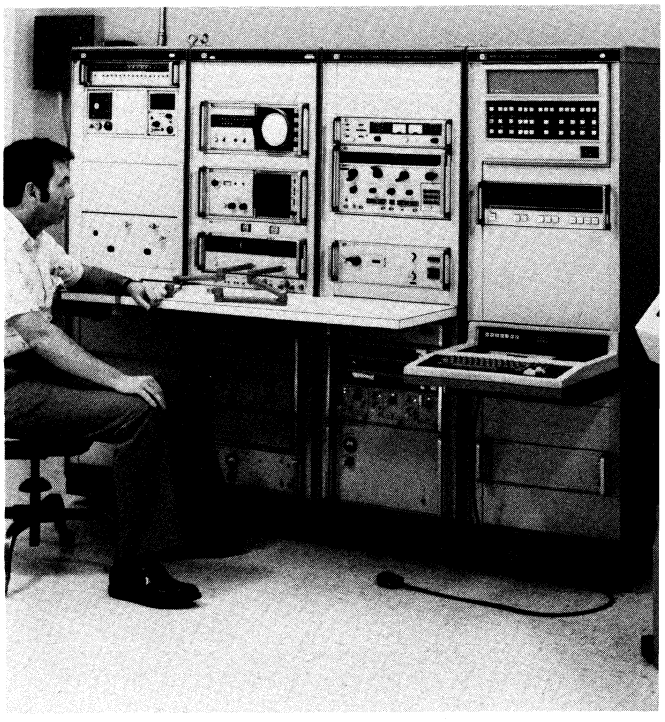
USER SUPPORT

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

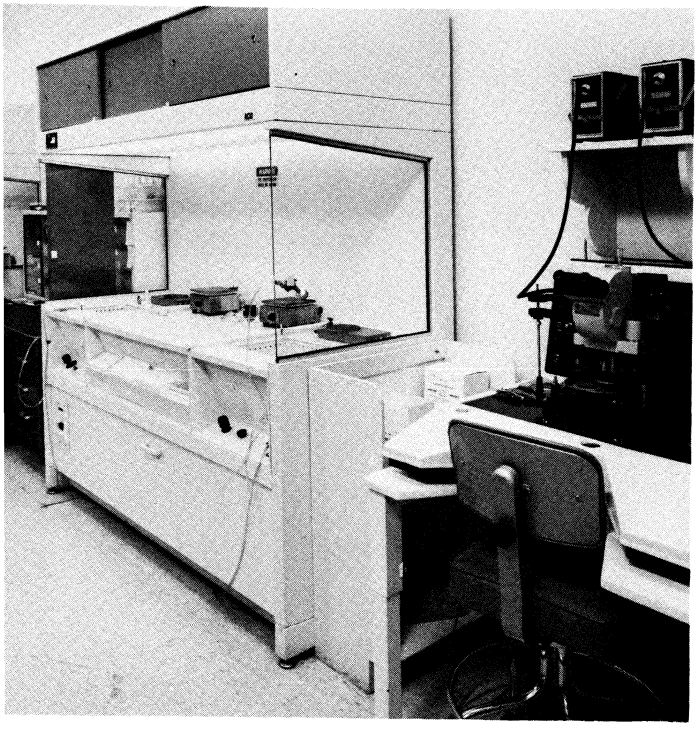
To assure quick order turn-around, we must maintain a large inventory of finished transistor chips and packaged transistors — our inventory is presently in excess of 4.5 million chips. Our policy is to produce enough stock to meet the expected first year's shipments before we introduce a new transistor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

The performance parameters of Avantek AT-3850, AT-4641, AT-4680, AT-4690 and the AT-8050/8051 have been entered in the COMPACT computer program to assist those of you who use computer-aided design.



AVANTEK TRANSISTOR TECHNOLOGY



All Avantek transistors are fabricated with a gold and refractory metal system with proven excellence in junction/contact performance, corrosion resistance, bond strength and freedom from current-induced metal migration under high current and temperature conditions. The presently-used Avantek gold-based metallization produces uniform films in the 1 μm thickness range and assures complete coverage of abrupt contours on the chip surface. Even GaAs FET gate structures with their extremely close telerances, are gold metallized to eliminate the corrosion, intermetallic growth and burn-out problems associated with some metal systems.

Avantek uses a self-aligning nitride/oxide process to define the locations of active regions of bipolar transistors. This self-aligning definition layer eliminates the performance variations caused by minor misalignments of the photo masks during processing. It allows us to produce transistors with a precise 0.5 μm and 1.0 μm geometries in large quantities with excellent yields.

Other processes available to the Avantek transistor production department include ion implantation, the capability to produce diffused ballast resistors on multi-cell power transistors, and the choice of either arsenic or phosphorous doping for bipolar transistor emitters.

TO ASSURE RELIABILITY

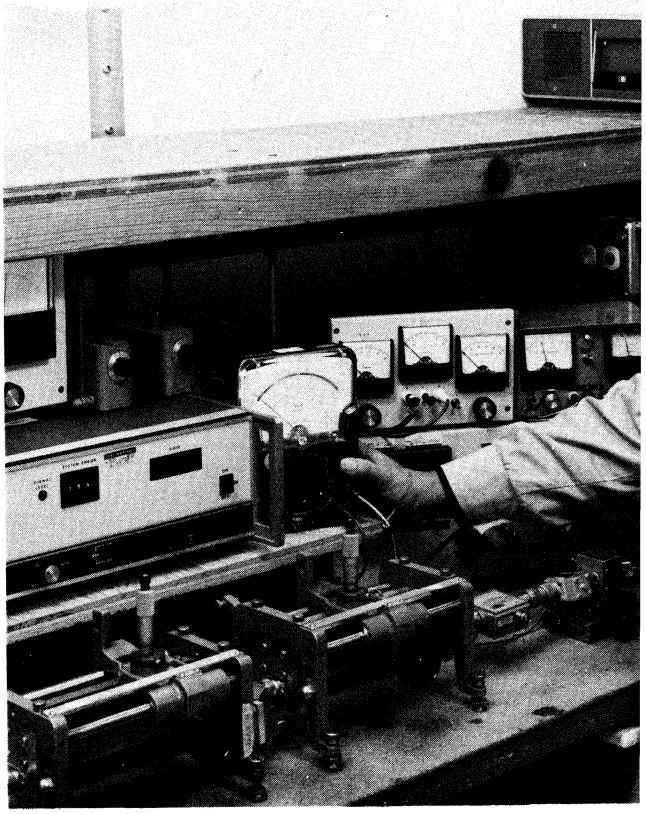
All Avantek transistors regardless of price, frequency range or package type, are 100% tested for RF and DC performance before capping. Both TO-72 and microstripline packaged are dry nitrogen-filled, hermetically welded and 100% leak tested to verify hermeticity.

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.

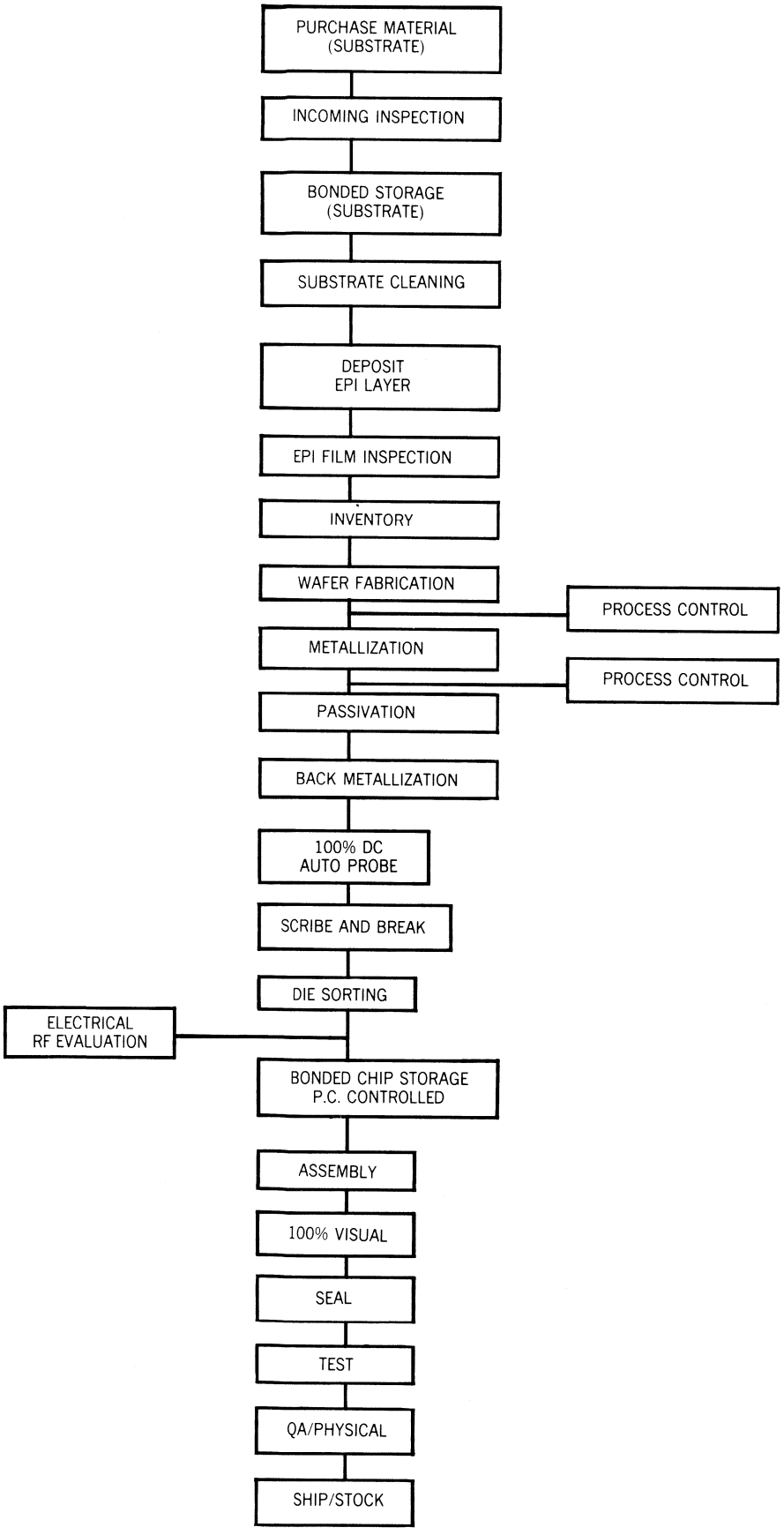
The combination of gold metallization, hermetic packaging, 100% testing and a carefully-implemented QA/QC procedure assures that Avantek transistors will be reliable, consistent and offer full guaranteed performance under difficult operating conditions.

HIGH RELIABILITY SCREENING

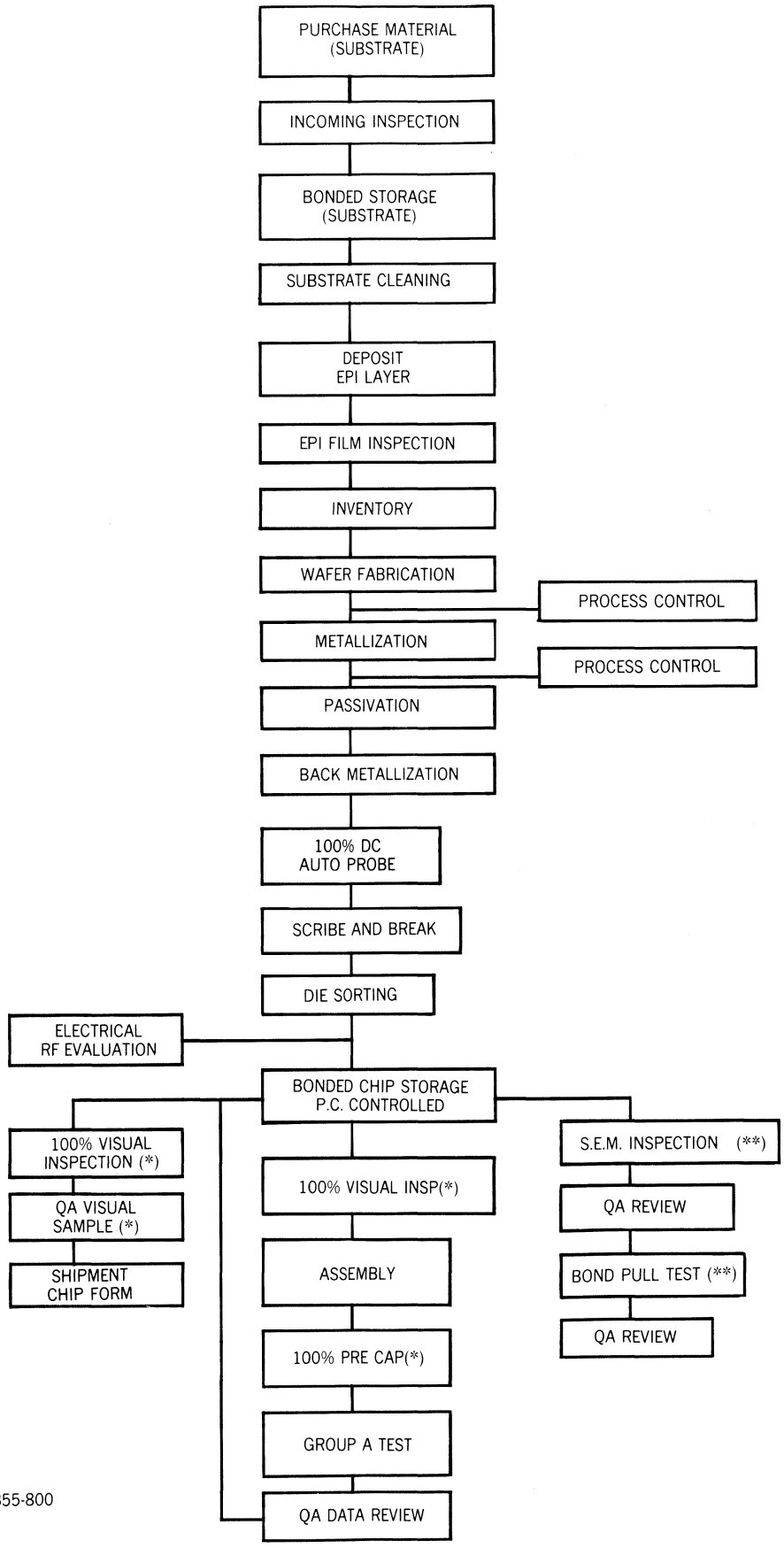
Every Avantek transistor, both bipolar and GaAs FET, can be thought of as a prime commercial grade product, regardless of price. For applications requiring a further assurance of reliability, we offer "R" series high-reliability screening. This screening program, based on MIL-STD-750 methods and conditions, 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
** Still Inspection PS012411
** Bond Pull Test PS007516

DATA SECTION

1

VHF/UHF Gold Metallized Silicon Planar Epitaxial NPN Transistors

AT-0017
AT-0017A
AT-0025
AT-0025A
AT-0045
AT-1825

These Avantek NPN bipolar transistors offer an excellent price to performance ratio as low noise amplifiers in HF, VHF, UHF and low microwave frequency range. They combine a wide dynamic range with the very linear S_{21} vs. I_C characteristics required for intermodulation-free operation in receiving and IF systems. Their high F_T also makes them very useful as oscillators.

All transistors in this category, with the exception of the AT-1825, are packaged in the easy to use TO-72 package. The AT-1825 is packaged in a ceramic/metal microstripline package.

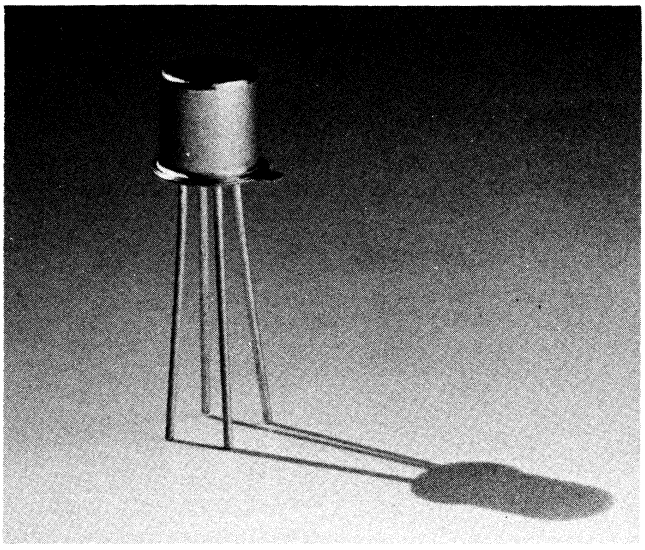
Avantek

TRANSISTOR DATA SHEET

AT-0017/AT-0017A
VHF Transistors
Silicon Planar
NPN Epitaxial

FEATURES

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



DESCRIPTION

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

These transistors are widely used as front-end amplifiers in VHF receiving systems, in both wide and narrow-band IF systems and in instrumentation and EW amplifiers. They also work well as VHF-UHF oscillators due to their high gain and f_T.

Both transistors 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. The AT-0017 and AT-0017A will both withstand normal handling, installation and soldering procedures.

ADDITIONAL HIGH RELIABILITY SCREENING AVAILABLE

All Avantek transistors are fine leak tested and 100% tested for both DC and RF parameters after packaging. For critical military and aerospace programs that require an additional assurance of reliability, the Avantek "R" Series qualification program is available. "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.

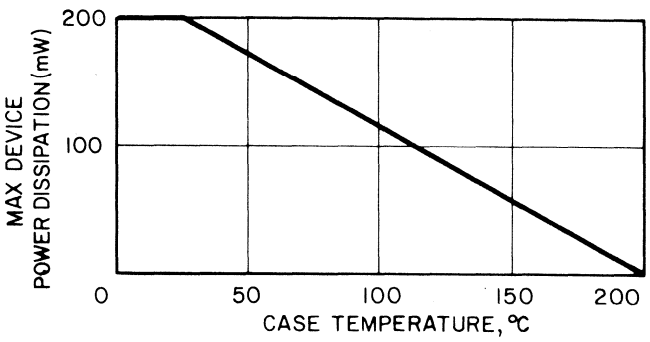
COMMON EMITTER OPERATING CHARACTERISTICS (T_A = 25°C)

Parameters	Symbols	Test Conditions	Min	Typ	Max
Spot Noise Figure, AT-0017	NF_{opt}	V_{CB} = 10V, I_C = 5 mA, f = 60 MHz			1.5 dB
Spot Noise Figure, AT-0017A	NF_{opt}	V_{CB} = 10V, I_C = 5 mA, f = 60 MHz			1.2 dB
Gain at Optimum Noise Figure	G_{NF}	V_{CB} = 10V, I_C = 5 mA, f = 60 MHz (see figure 1)		25 dB	

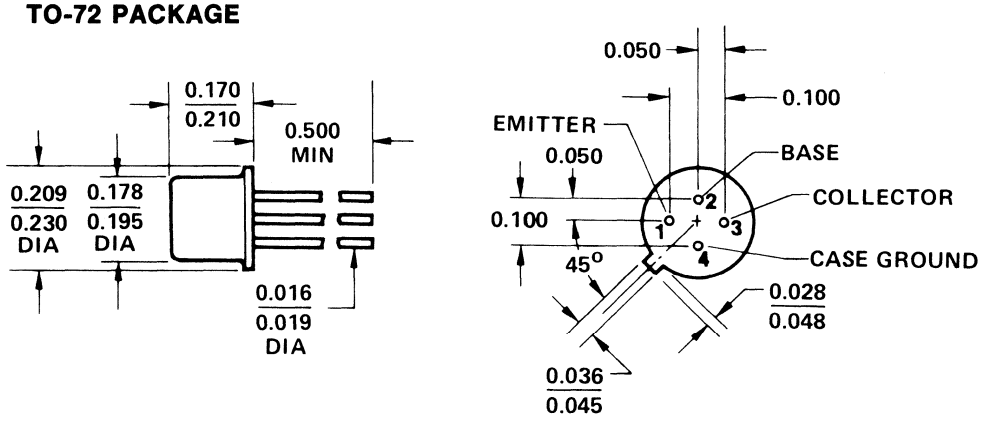
MAXIMUM RATINGS (T_A = 25°C)

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

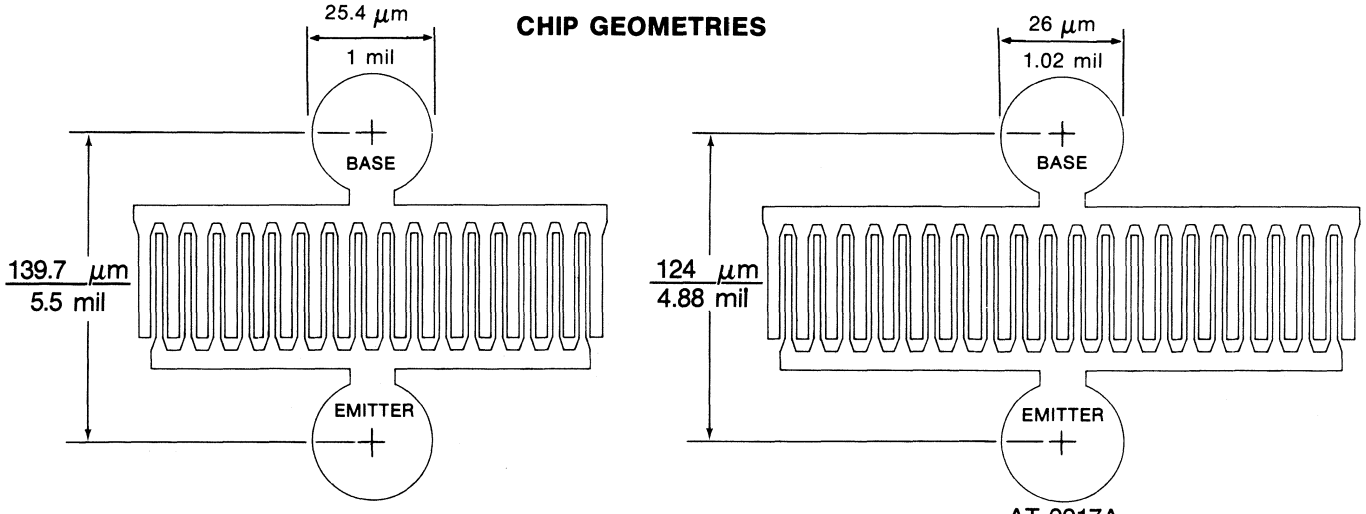
POWER DERATING CURVE



OUTLINE DRAWING TO-72 PACKAGE



CHIP GEOMETRIES



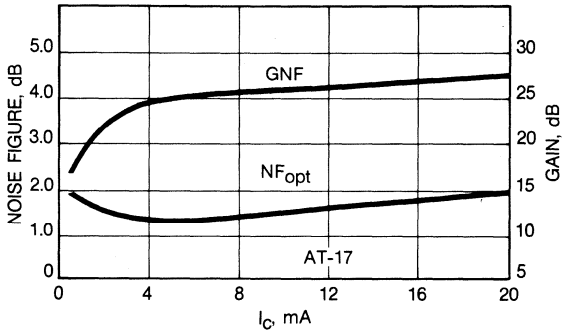
AT-0017
OVERALL CHIP SIZE
10 x 10 mil
254 x 254 μM

AT-0017A
OVERALL CHIP SIZE
10 x 10 mil
254 x 254 μM

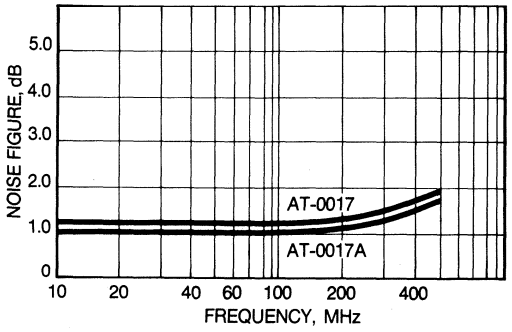
ELECTRICAL CHARACTERISTICS (T_A = 25°C)

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

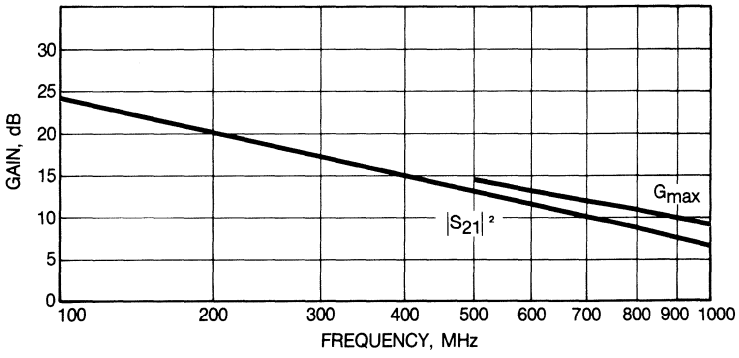
SPOT NOISE FIGURE (NF_{opt}) AND ASSOCIATED GAIN (G_{NF}) VS. COLLECTOR CURRENT V_{CB} = 10V, f = 60 MHz



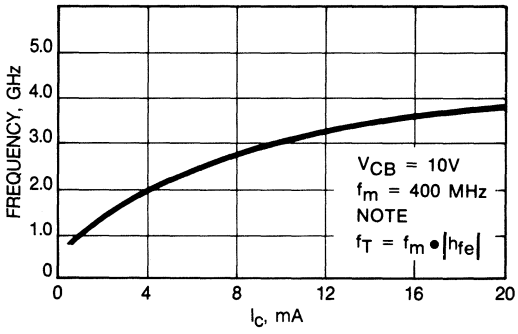
SPOT NOISE FIGURE (NF_{opt}) VS. FREQUENCY V_{CB} = 10V I_C = 5 mA



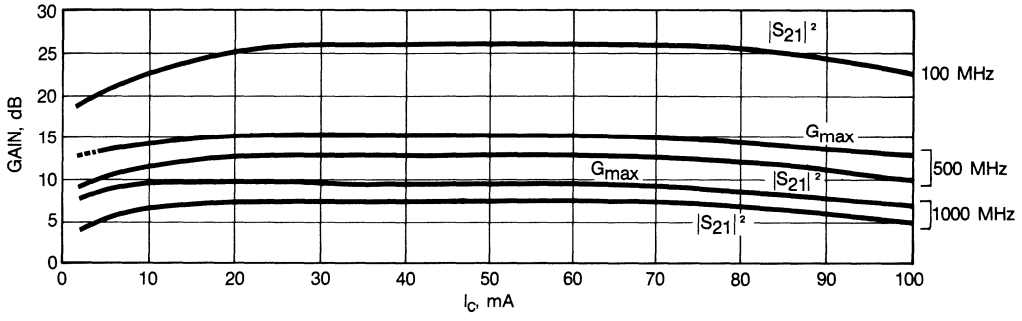
MAXIMUM AVAILABLE GAIN (G_{max}) AND INSERTION POWER GAIN ($|S_{21}|^2$) VS. FREQUENCY V_{CE} = 10V, I_C = 10 mA



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

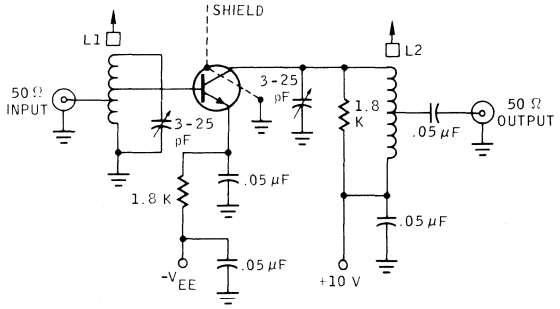


Figure 1 - Power Gain and Noise Figure Test Circuit (60 MHz)

Notes:

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

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

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

AT-0017 **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

AT-0017 **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

AT-0017A **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

AT-0017A **BIAS= 10.00 VOLTS, 15.00 MA**

S -- MAGN AND ANGLES:

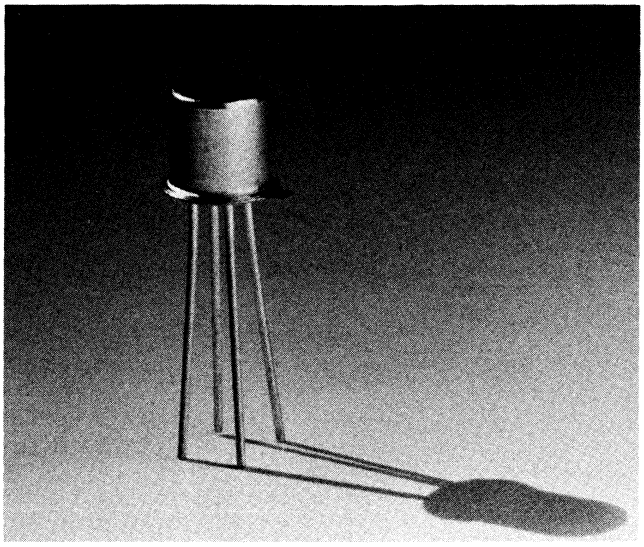
FREQ	11		21		12		22	
100.00	.420	-83.1	15.528	124.0	.035	63.6	.662	-33.3
200.00	.347	-122.8	9.459	104.8	.054	62.4	.477	-38.7
300.00	.327	-145.2	6.657	94.5	.070	65.8	.397	-39.4
400.00	.317	-161.2	5.182	87.1	.088	66.1	.349	-40.1
500.00	.318	-172.6	4.188	80.4	.103	66.4	.306	-42.7
600.00	.324	178.6	3.537	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

Avantek

TRANSISTOR DATA SHEET

AT-0025
AT-0025A

UHF Transistors
Silicon Planar
NPN Epitaxial



FEATURES

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

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.

ADDITIONAL HIGH RELIABILITY SCREENING AVAILABLE

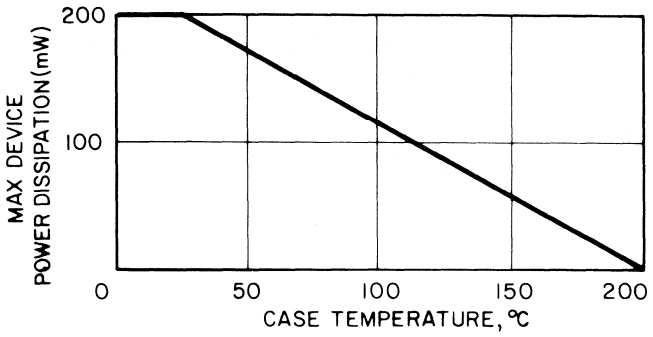
All Avantek transistors are fine leak tested and 100% tested for both DC and RF parameters after packaging. For critical military and aerospace programs that require an additional assurance of reliability, the Avantek "R" Series qualification program is available. "R" Series transistors are identical to their commercial counterparts, but are subjected to an additional burn-in period and screened using MIL-STD-750 procedures.

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	

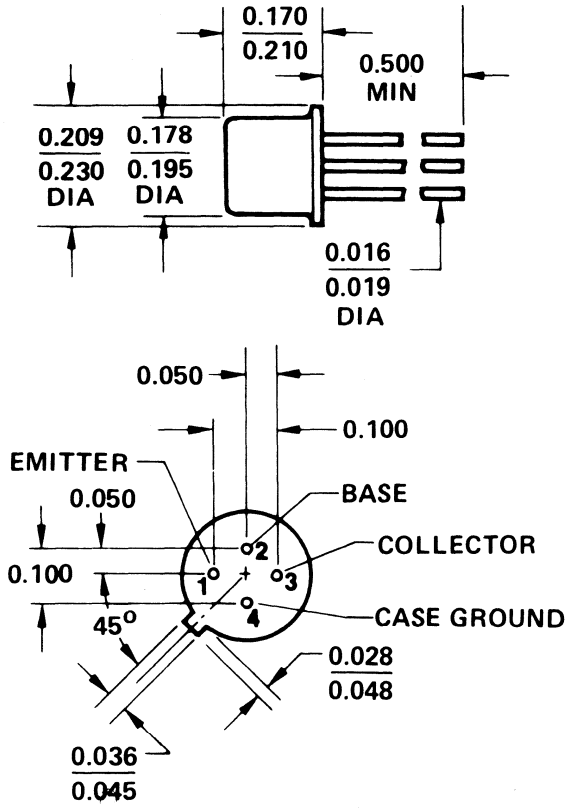
MAXIMUM RATINGS (T_A = 25°C)

Parameter	Symbol	Limit
Reverse Emitter Base Voltage	V_{CB}	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)	200 mW
Junction Temperature	T_j	200°C
Storage Temperature Range	T_{STG}	−65 to 200°C

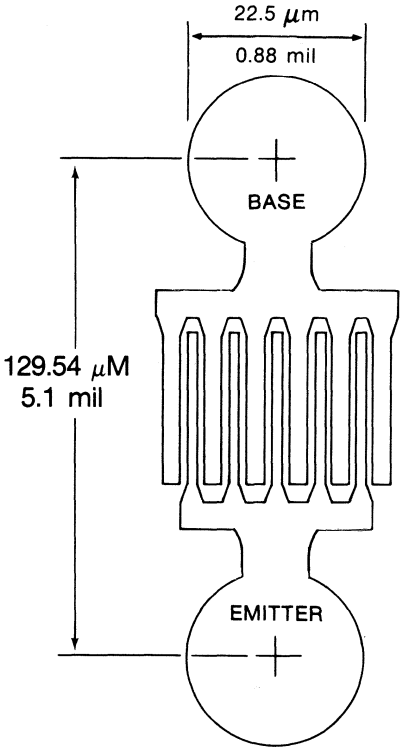
POWER DERATING CURVE



OUTLINE DRAWING
TO-72 PACKAGE



CHIP GEOMETRY

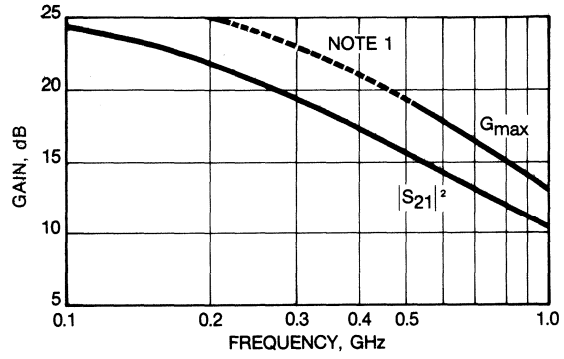


OVERALL CHIP SIZE
10 x 10 MIL
254 x 254 μM

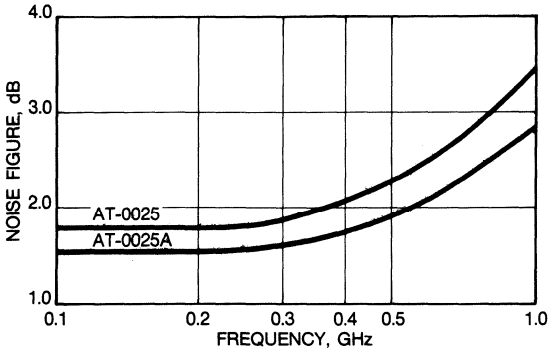
ELECTRICAL CHARACTERISTICS (T_A = 25°C)

Parameters	Symbols	Test Conditions	Min	Typ	Max
Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	I_E = 10μA, I_c = 0	3V		
Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	I_C = 0, I_C = 10μA	20V		
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C = 100μA, I_B = 0	15V		
Collector Cutoff Current	I_{CBO}	I_E = 0, V_{CB} = 10V			20 nA
Emitter Cutoff Current	I_{EBO}	I_C = 0, V_{EB} = 3V			10 μA
Forward Current Transfer Ratio	h_{FE}	I_C = 10 mA, V_{CE} = 10V	30	75	
Current-Gain Transition Frequency	f_T	I_C = 10 mA, V_{CE} = 10V		3.5 GHz	
Collector-Base Capacitance	C_{cb}	I_E = 0, V_{CB} = 10V			.5 pF

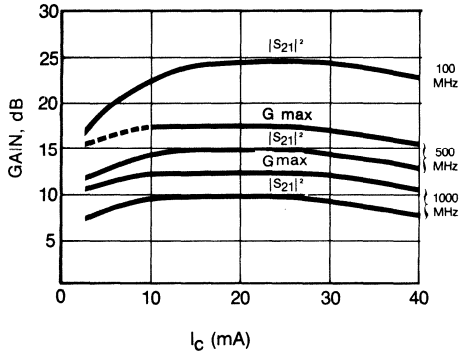
MAXIMUM AVAILABLE GAIN (G_{max}) AND INSERTION POWER GAIN ($|S_{21}|^2$) VS. FREQUENCY
V_{CE} = 10V, I_C = 10 mA



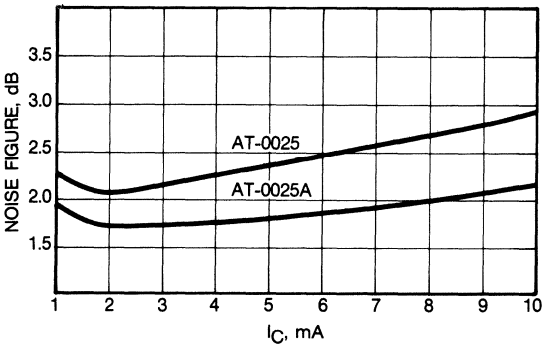
SPOT NOISE FIGURE (NF_{opt}) VS. FREQUENCY
V_{CE} = 10V, I_C = 3mA



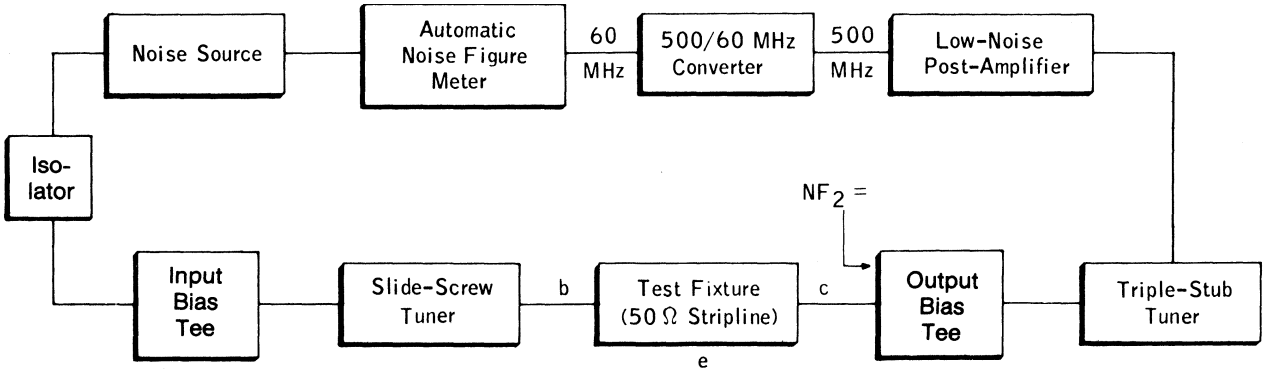
MAXIMUM AVAILABLE GAIN (G_{max}) AND INSERTION POWER GAIN ($|S_{21}|^2$) VS. COLLECTOR CURRENT AND FREQUENCY
V_{CE} = 10V



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.

AT-0025

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

AT-0025

BIAS= 10.00 VOLTS, 10.00 MA

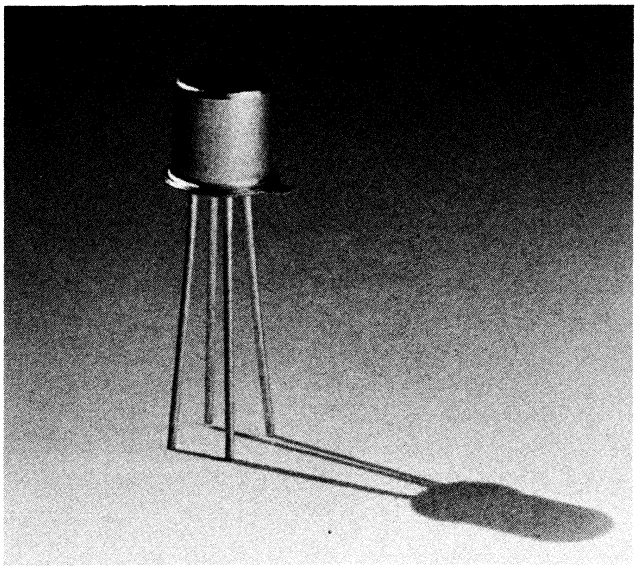
S -- MAGN AND ANGLES:

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

Avantek

TRANSISTOR DATA SHEET

AT-0045
UHF Transistor
Silicon Planar
NPN Epitaxial



FEATURES

- **1.5 dB Noise Figure at 500 MHz**
- **17 dB G_{max}**
- **Wide Dynamic Range**
- **3.5 GHz f_T**
- **Gold Metal System**
- **Hermetic TO-72 Package**

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 is also widely used as a UHF oscillator.

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. It will withstand all normal handling, installation and soldering procedures.

ADDITIONAL HIGH RELIABILITY SCREENING AVAILABLE

All Avantek transistors are 100% fine leak tested, and are 100% tested for both DC and RF parameters after packaging and leak testing. Additional assurance of reliability is available for critical military and aerospace applications in the form of the Avantek "R" series high reliability screening program. Avantek "R" series transistors are produced in exactly the same way as the commercial grade versions, but are given an additional burn-in and screened using MIL-STD-750 procedures.

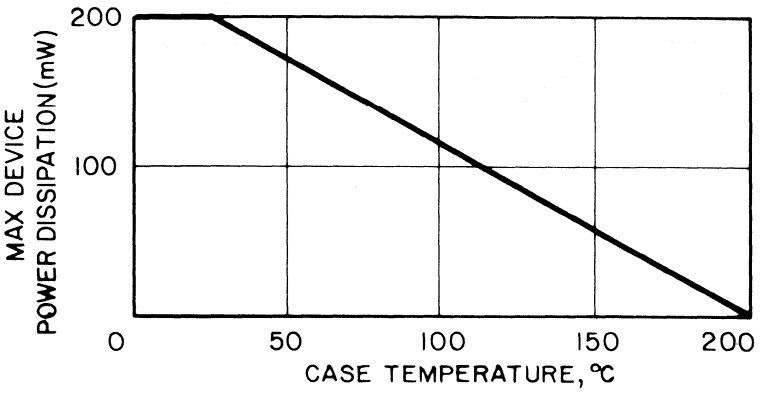
COMMON EMITTER OPERATING CHARACTERISTICS (T_A = 25°C)

Parameters	Symbols	Test Conditions	Typ	Max
Spot Noise Figure	NF	V_{CB} = 10V, I_C = 3 mA, f = .5 GHz		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 = 10mA, f = .5 GHz	17 dB	
		V_{CB} = 10V, I_C = 10mA, f = 1.0 GHz	11 dB	

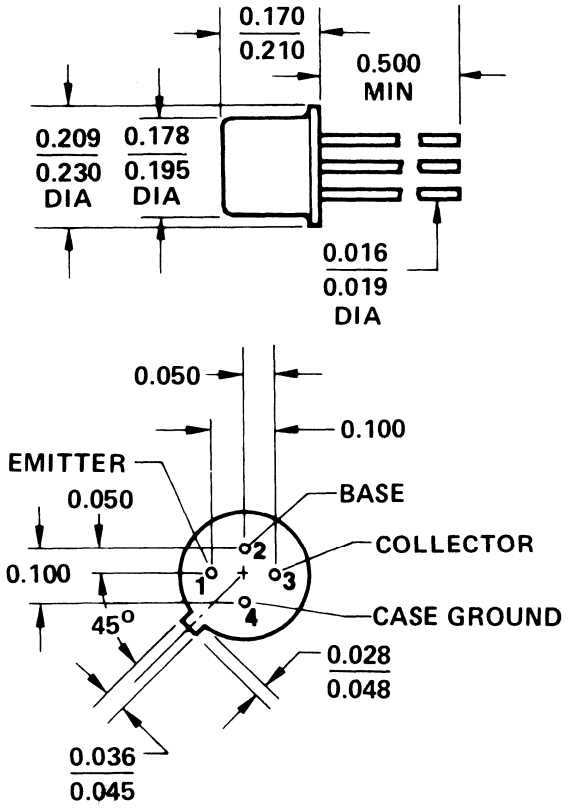
MAXIMUM RATINGS (T_A = 25°C)

Parameter	Symbol	Limit
Reverse Emitter Base Voltage	V_{CB}	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)	200 mW
Junction Temperature	T_j	200°C
Storage Temperature Range	T_{STG}	−65 to 200°C

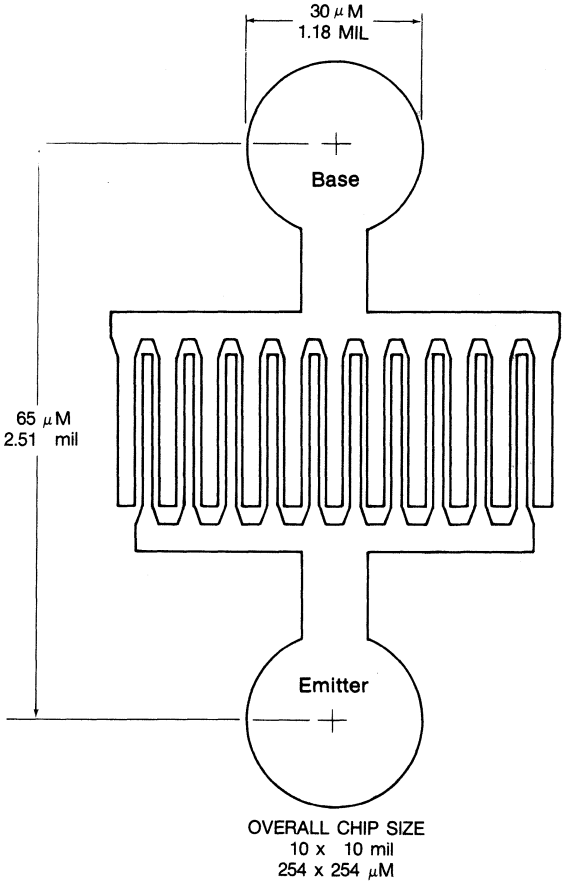
POWER DERATING CURVE



OUTLINE DRAWING
TO-72 PACKAGE



CHIP GEOMETRIES

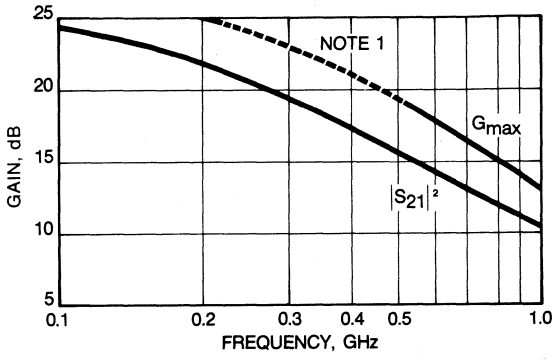


OVERALL CHIP SIZE
10 x 10 mil
254 x 254 μM

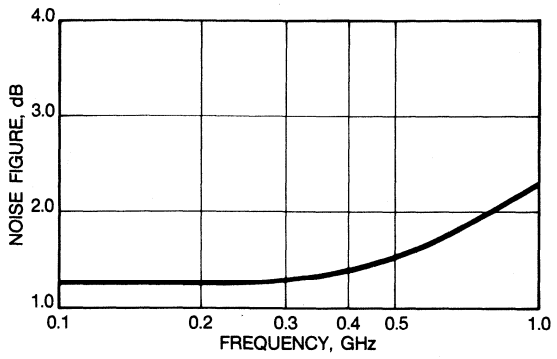
ELECTRICAL CHARACTERISTICS (T_A = 25°C)

Parameters	Symbols	Test Conditions	Min	Typ	Max
Emitter-Base Breakdown Voltage	$V_{(BR)EBO}$	I_E = 10μA, I_c = 0	3V		
Collector-Base Breakdown Voltage	$V_{(BR)CBO}$	I_E = 0, I_C = 10μA	20V		
Collector-Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C = 100μA, I_B = 0	15V		
Collector Cutoff Current	I_{CBO}	I_E = 0, V_{CB} = 10V			20nA
Emitter Cutoff Current	I_{EBO}	I_C = 0, V_{CB} = 3V			10μA
Forward Current Transfer Ratio	h_{FE}	I_C = 10 mA, V_{CE} = 10V	30	75	
Current-Gain Transition Frequency	f_T	I_C = 10 mA, V_{CE} = 10V		3.5 GHz	
Collector-Base Capacitance	C_{cb}	I_E = 0, V_{CB} = 10V			.5 pF

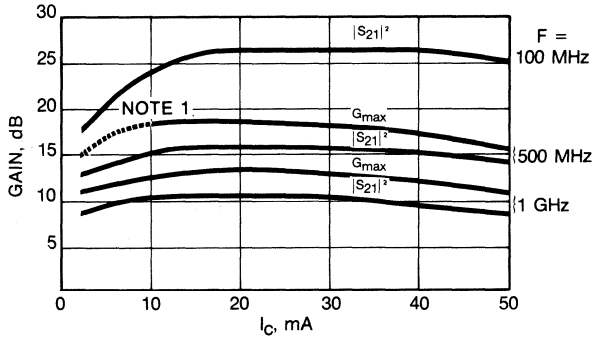
MAXIMUM AVAILABLE GAIN (G_{max}) AND INSERTION POWER GAIN ($|S_{21}|^2$) VS. FREQUENCY
V_{CE} = 10V, I_C = 10mA



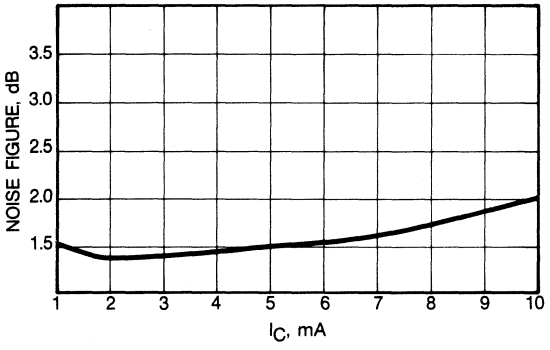
SPOT NOISE FIGURE (NF_{opt}) VS. FREQUENCY
V_{CE} = 10V, I_C = 3mA



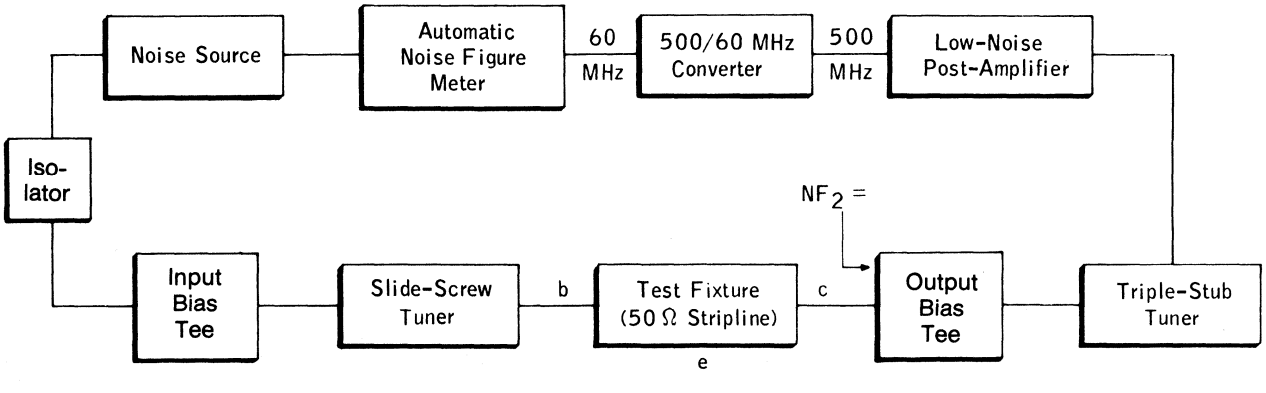
MAXIMUM AVAILABLE GAIN (G_{max}) AND INSERTION POWER GAIN ($|S_{21}|^2$) VS. COLLECTOR CURRENT AND FREQUENCY
V_{CE} = 10V



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.

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

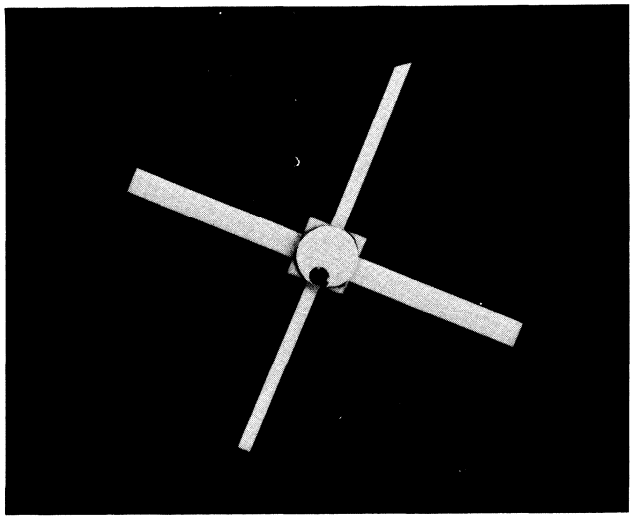
Avantek

TRANSISTOR DATA SHEET

AT-1825
Microwave Transistor
Silicon Planar
NPN Epitaxial

FEATURES

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



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.

ADDITIONAL HIGH RELIABILITY SCREENING AVAILABLE

All Avantek transistors are 100% fine leak tested, and are 100% tested for both DC and RF parameters after packaging and leak testing. Additional assurance of reliability is available for critical military and aerospace applications in the form of the Avantek "R" series high reliability screening program. Avantek "R" series transistors are produced in exactly the same way as the commercial grade versions, but are given an additional burn-in and screened using MIL-STD-750 procedures.

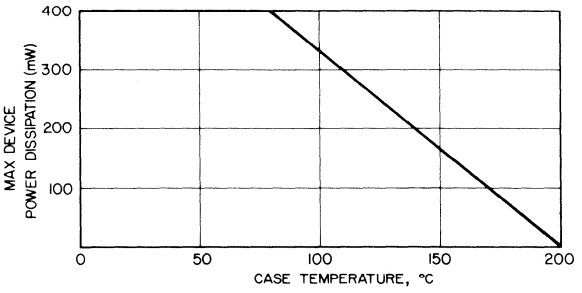
COMMON EMITTER OPERATING CHARACTERISTICS (T_A = 25°C)

Parameter	Symbol	Test Cond V_{CE} I_C	Freq GHz	Min	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	

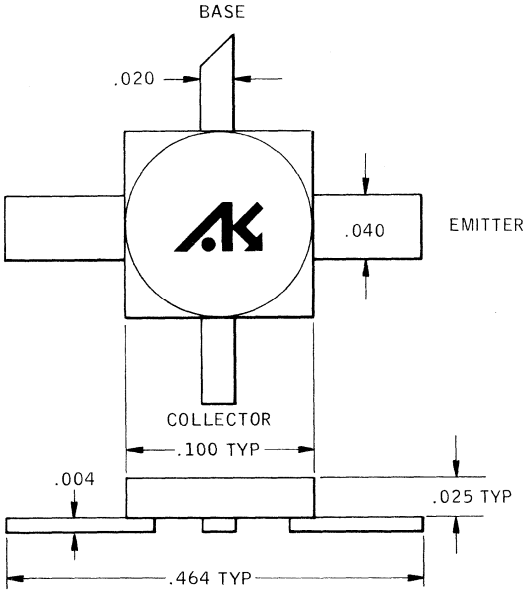
MAXIMUM RATINGS (T_A = 25°C)

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	θjc	300°C/watt

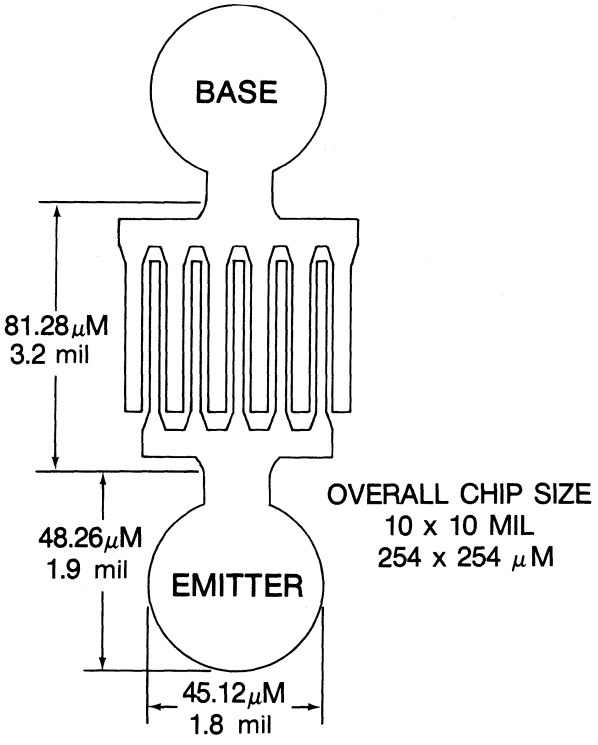
POWER DERATING CURVE



OUTLINE DRAWING
100 MIL PACKAGE



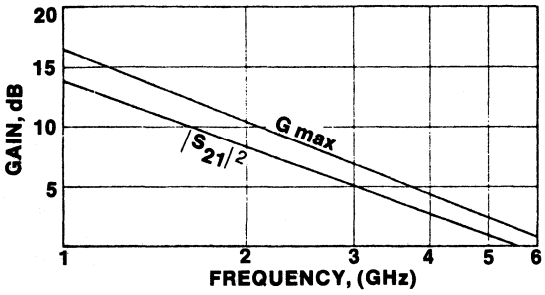
CHIP GEOMETRY



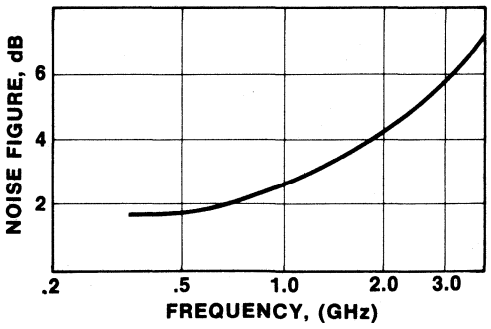
ELECTRICAL CHARACTERISTICS (T_A = 25°C)

Parameter	Symbol	Test Conditions	Min	Typ	Max
Collector-Base Breakdown	$V_{(BR)CBO}$	I_E = 0, I_C = 10μA	20V		
Emitter-Base Breakdown	$V_{(BR)EBO}$	I_E = 10μA, I_C = 0	3V		
Collector-Emitter Breakdown	$V_{(BR)CEO}$	I_C = 100μA, I_B = 0	12V		
Collector Cutoff Current	I_{CBO}	V_{CB} = 10V, I_E = 0			20 nA
Forward Current Transfer Radio	h_{FE}	V_{CE} = 10V, I_C = 15 mA	20	75	
Short Circuit Gain-Bandwidth	f_T	V_{CE} = 10V, I_C = 15 mA		5.0 GHz	
Collector-Base Capacitance	C_{cb}	V_{CB} = 10V, I_E = 0			0.5 pF

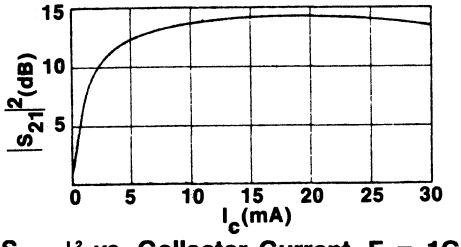
TYPICAL PERFORMANCE CURVES (T_A = 25°C)



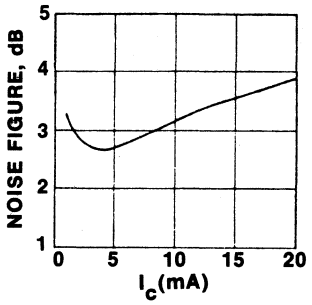
Maximum Available Gain, $|S_{21E}|^2$ vs. Frequency
V_{CE} = 10V, I_C = 15mA



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

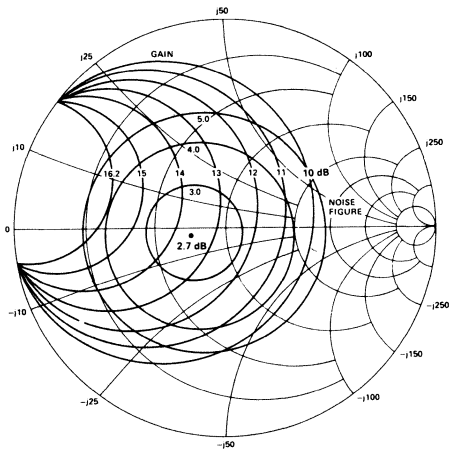


$|S_{21E}|^2$ vs. Collector Current, F = 1GHz
V_{CE} = 10V

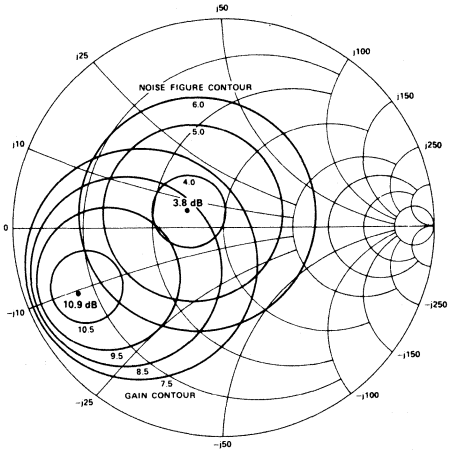


Spot Noise Figure vs. Collector Current,
F = 1 GHz, V_{CE} = 10V

TYPICAL CONTOURS OF CONSTANT GAIN AND NOISE FIGURE



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



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

Note 1

The AT-1825 is potentially unstable at 1 GHz at V_{CE} = 10V, IC = 5mA. The 16.2 dB gain contour represents the maximum stable gain of the device defined as $G_{MSG} = \left|\frac{S_{21}}{S_{12}}\right|$. 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.

AT-1825

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

REF PLANES = 2.51 2.51 5.02

AT-1825

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

REF PLANES = 2.51 2.51 5.02

DATA SECTION

2

Gold Metallized, Low Noise Figure Small Signal Microwave Transistors

Silicon Planar Epitaxial NPN Transistors
- AT-1845/AT-1845A
- AT-2645/AT-2645A
- AT-4641/4841
- AT-4642/4842
- AT-4680/4880
- AT-4690/4890

Gallium Arsenide Schottky-Barrier GaAs MESFET

AT-8050/8051

These Avantek microwave transistors are designed for low noise, small signal amplification in the 1 GHz through 6 GHz frequency range. They are packaged in well proven 70 and 100 mil hermetic ceramic/metal microstripline packages for direct application on microstrip PC boards. The AT-8050 GaAs FET is supplied in unpackaged chip form for use in thin- or thick-film hybrid circuitry. These transistors are widely used in both wide and narrowband small signal amplifiers and as oscillators in commercial and telecommunications equipment. "R" Series versions are suitable for rigorous military applications.

Avantek microwave transistors are designed and tested to assure extremely uniform DC and RF operating parameters from lot to lot.

Avantek

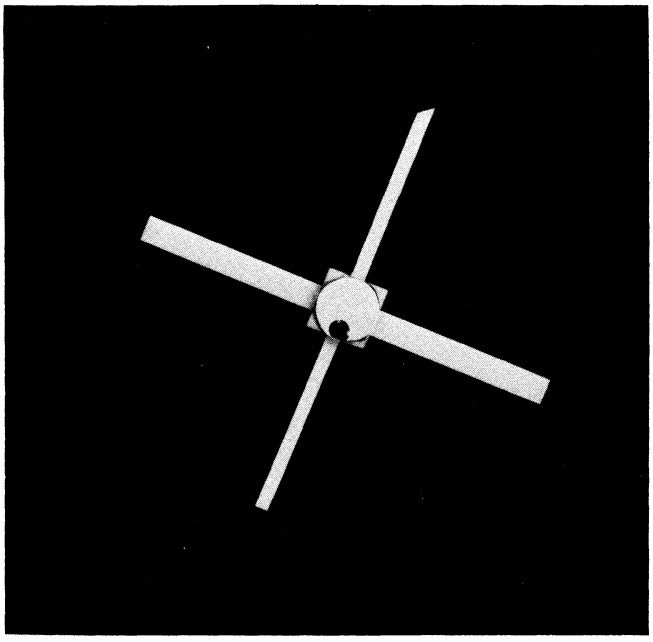
TRANSISTOR DATA SHEET

AT-1845/2645
AT-1845A/2645A

Microwave Transistors
Silicon Planar
NPN Epitaxial

FEATURES

- **2.8 dB Noise Figure at 2 GHz**
- **11.0 dB Gain at NF**
- **Hermetic 70 and 100 Mil Microstrip Packages**
- **Gold Metal System**



DESCRIPTION

The Avantek AT-2645/2645A (compact 70 mil microstrip package), and AT-1845/1845A (economical 100 mil package) are designed for low noise figure, high gain small signal amplification at frequencies up to 4 GHz. They are 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. These transistors are 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 family of transistors 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.

Both the 70 and 100 Mil metal/ceramic packages are 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.

ADDITIONAL HIGH RELIABILITY SCREENING AVAILABLE

All Avantek transistors are 100% fine leak tested and are 100% tested for both DC and RF parameters after packaging. An additional assurance of long term reliability is available for critical military and aerospace programs with transistors screened in the Avantek "R" series high reliability program. All Avantek transistors are available in "R" series qualified versions. These "R" series transistors are given the same comprehensive testing as their commercial counterparts, but then undergo an additional burn-in period and are screened using MIL-STD-750 procedures.

COMMON EMITTER OPERATING CHARACTERISTICS (T_A = 25°C)

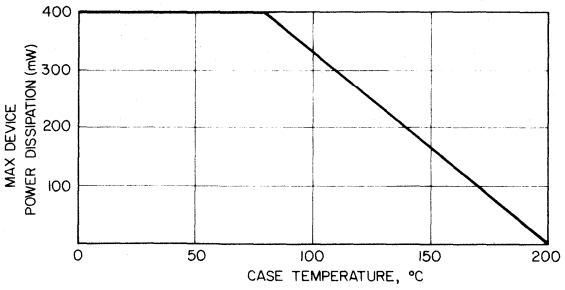
Parameter	Symbol	Test Cond V_{CE} I_C	Freq GHz	AT-1845/2645 Min	AT-1845/2645 Typ	AT-1845/2645 Max	AT-1845A/2645A Min	AT-1845A/2645A Typ	AT-1845A/2645A Max	Note
Spot Noise Figure	NF_{opt}	10 V 5 mA	1		2.3 dB	2.5 dB		2.0 dB	2.2 dB	1
Spot Noise Figure	NF_{opt}	10V 5 mA	2		3.2 dB	3.5 dB		2.8 dB	3.0 dB	2
Spot Noise Figure	NF_{opt}	10V 5 mA	4		5.5 dB			5.0 dB		2
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	1		14.0 dB			14.0 dB		1
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	2		11.0 dB			11.0 dB		2
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	4		7.0 dB			7.0 dB		2
Max Available Power Gain	G_{max}	10V 15 mA	1							1
MaxAvailable Power Gain	G_{max}	10V 15 mA	2		15.0 dB			15.0 dB		2
Max Available Power Gain	G_{max}	10V 15 mA	4		9.0 dB			9.0 dB		2

NOTES: (1) Measured on AT-1845/1845A
(2) Measured on AT-2645/2645A

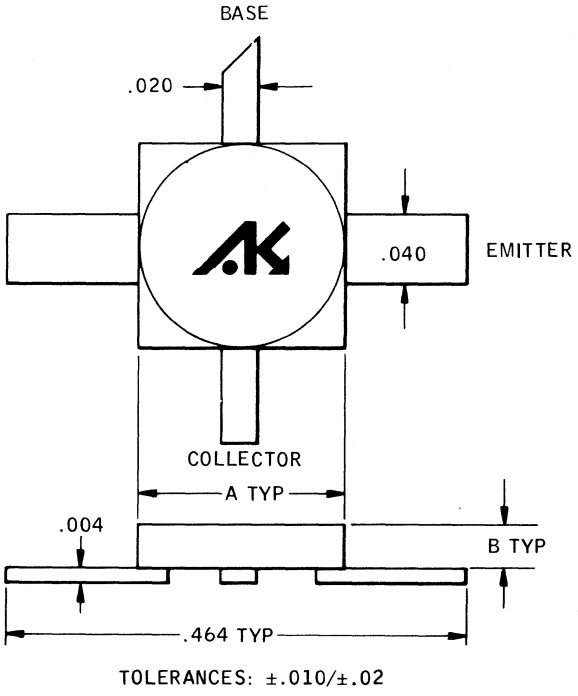
MAXIMUM RATINGS (T_A = 25°C)

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

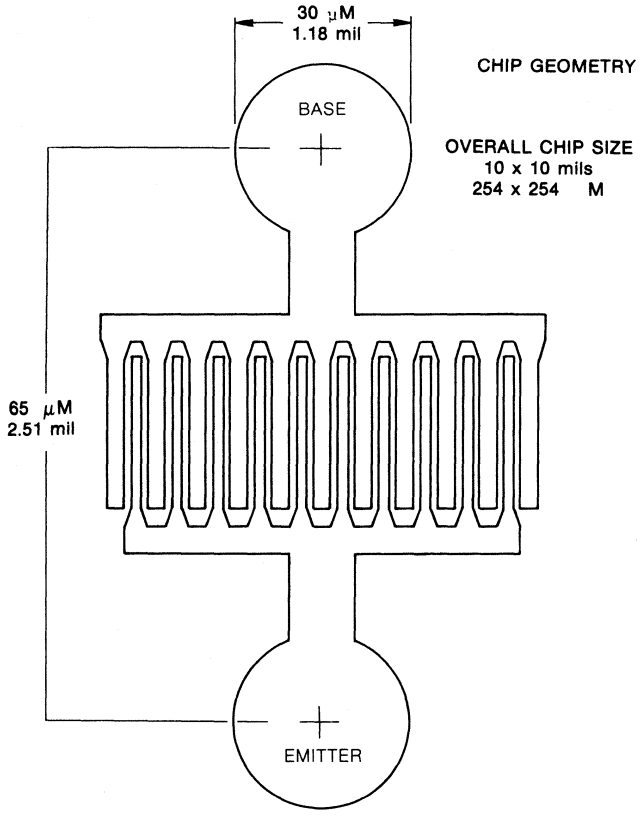
POWER DERATING CURVE



OUTLINE DRAWING
70/100 MIL PACKAGE



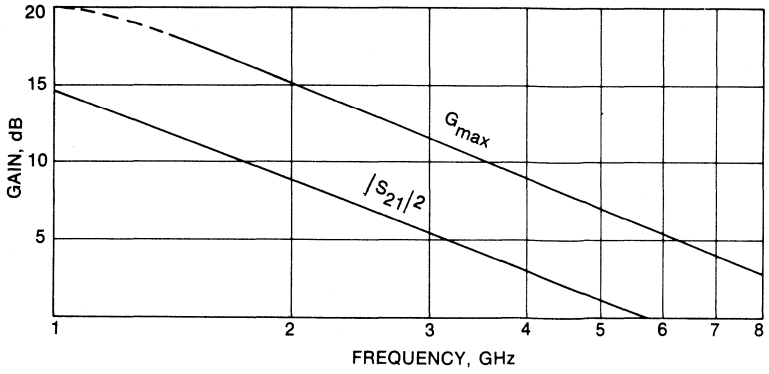
DIMENSION	AT-2645 AT-2645A	AT-1845 AT-1845A
A	.070	.100
B	.030	.025



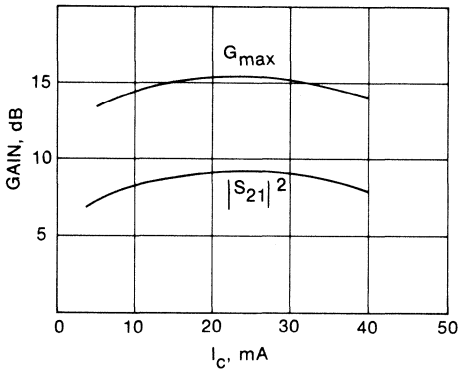
ELECTRICAL CHARACTERISTICS (T_A = 25°C)

Parameter	Symbol	Test Conditions	Freq.	Min	Typ	Max
Collector-Base Breakdown	$V_{(BR)CBO}$	I_E = 0, I_C = 10µA		20V		
Emitter-Base Breakdown	$V_{(BR)EBO}$	I_E = 10µA, I_C = 0		3.0V		
Collector-Emitter Breakdown	$V_{(BR)CEO}$	I_C = 100µA, I_B = 0		12V		
Collector Cutoff Current	I_{CBO}	V_{CB} = 10V, I_E = 0				20 nA
Forward Current Transfer Ratio	h_{FE}	V_{CE} = 10V, I_C = 15 mA		20	75	
Short Circuit Gain-Bandwidth	f_T	V_{CE} = 10V, I_C = 15 mA			5.5 GHz	
Maximum Frequency of Oscillation	f_{max}	V_{CE} = 10V, I_C = 15 mA			10.0 GHz	
Collector-Base Capacitance	C_{cb}	V_{CB} = 10V, I_E = 0				0.5 pF

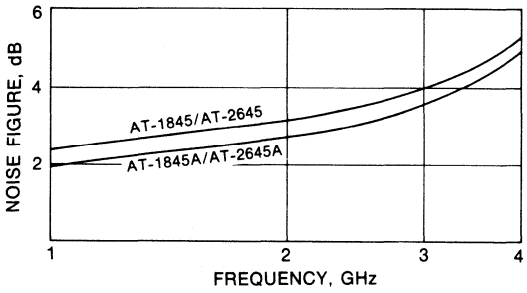
Typical Performance Curves (T_A = 25°C)



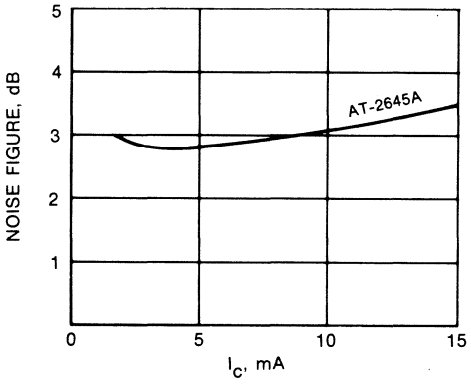
Maximum Available Gain, $|S_{21E}|^2$ vs. Frequency, V_{CE} = 10V I_C = 15 mA



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

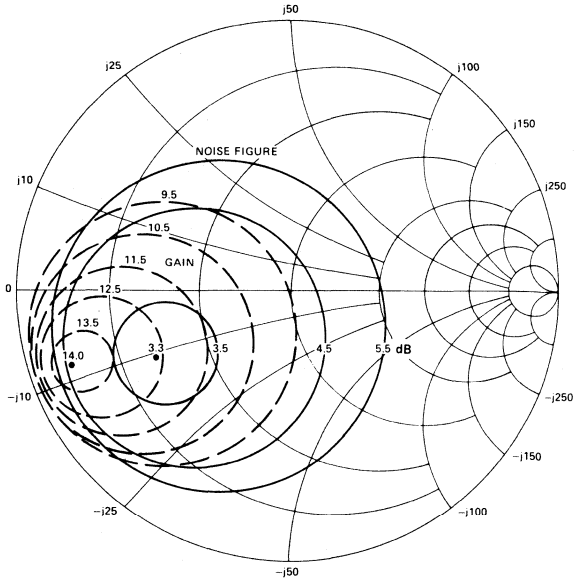


Spot Noise Figure vs. Frequency V_{CE} = 10V, I_C = 5mA

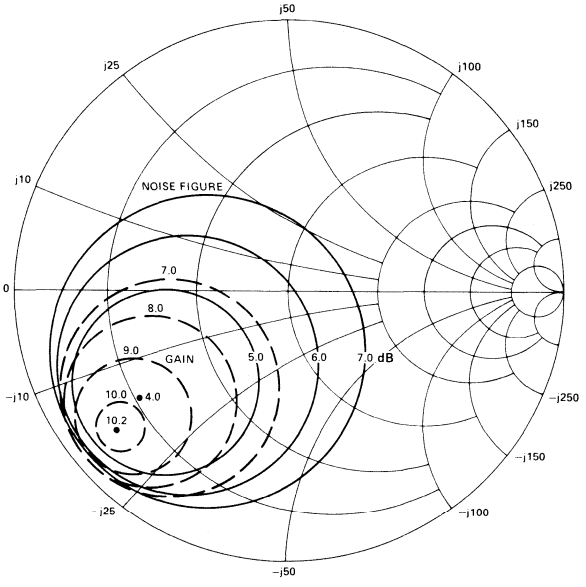


Spot Noise Figure vs. Collector Current F = 2 GHz, V_{CE} = 10V

Typical Contours of Constant Gain and Noise Figure, AT-2645



Frequency = 2 GHz, 10V 5mA



Frequency = 3 GHz, 10V 5mA

AT-1845

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

AT-1845

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

AT-2645

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

AT-2645

BIAS= 10.00 VOLTS, 15.00 MA

S -- MAGN AND ANGLES:

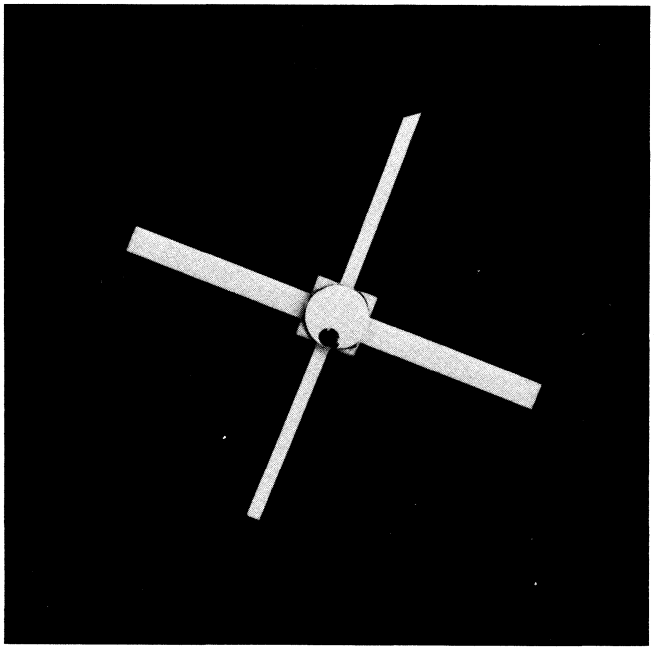
FREQ	11		21		12		22	
500.00	.669	-124.9	10.009	106.9	.039	38.8	.642	-32.3
1000.00	.662	-161.7	5.627	82.6	.047	31.1	.521	-36.6
1500.00	.671	178.1	3.867	65.6	.053	30.1	.488	-43.6
2000.00	.671	164.9	2.904	51.4	.059	28.1	.481	-51.3
2500.00	.675	153.0	2.352	37.8	.066	27.1	.474	-61.3
3000.00	.686	142.1	1.952	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

Avantek

TRANSISTOR DATA SHEET

AT-4641/4841
AT-4642/4842
Microwave Transistors

Silicon Planar
Arsenic Emitter
NPN Epitaxial



FEATURES

- **Noise Figure as Low as 3.5 dB @ 4 GHz**
- **Associated Gain as High as 8.0 dB**
- **Hermetic Ceramic/Metal 70 and 100 Mil Packages**
- **1 μm Thick, Uniform Gold Metallization**

DESCRIPTION

The Avantek AT-4641 and AT-4642 (70 mil package) and equivalent AT-4841 and AT-4842 (100 mil package) are silicon bipolar transistors designed for small signal amplification at frequencies up to 6 GHz. Arsenic-doped, 1-micron emitter structures give these transistors low noise figures with high associated gain. The metal system used in AT-4641/4841 Series transistors 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 chips from scratching or contamination during handling and packaging for improved performance and reliability.

Both the 70 mil and 100 mil square ceramic/metal microstripline packages are hermetically sealed while flooded with a dry, inert atmosphere to assure long-term protection from humidity and corrosive gases.

ADDITIONAL HIGH RELIABILITY SCREENING AVAILABLE

All Avantek transistors are 100% fine leak tested and are 100% tested for both DC and RF parameters after packaging. An additional assurance of long term reliability is available for critical military and aerospace programs with transistors screened in the Avantek "R" series high reliability program. All Avantek transistors are available in "R" series qualified versions. These "R" series transistors are given the same comprehensive testing as their commercial counterparts, but then undergo an additional burn-in period and are screened using MIL-STD-750 procedures. Each "R" series transistor is shipped with individual documentation.

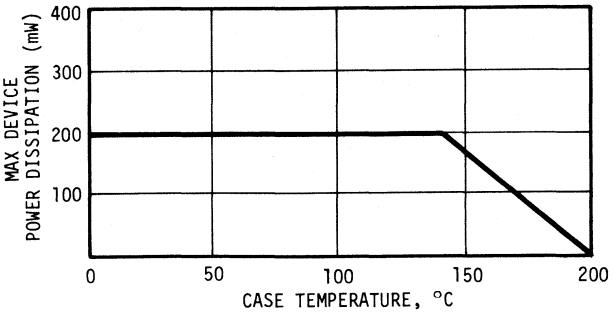
COMMON EMITTER OPERATING CHARACTERISTICS (T_A = 25°C)

Parameter	Symbol	Test Cond V_{CE} I_C	Freq GHz	AT-4642/-4842 Min	AT-4642/-4842 Typ	AT-4642/-4842 Max	AT-4641/-4841 Min	AT-4641/-4841 Typ	AT-4641/-4841 Max
Spot Noise Figure	NF_{opt}	10V 5 mA	4		3.6 dB	4.0 dB		3.0 dB	3.5 dB
Spot Noise Figure	NF_{opt}	10V 5 mA	2		2.5 dB			2.3 dB	
Spot Noise Figure	NF_{opt}	10V 5 mA	1		1.8 dB			1.5 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	4		7.0 dB			8 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	2		10.0 dB			11 dB	
Gain at Optimum Noise Figure	G_{NF}	10V 5 mA	1		14.5 dB			16.0 dB	
Max Available Power Gain	G_{max}	10V 15 mA	4	8 dB	9.0 dB		8 dB	9.5 dB	
Max Available Power Gain	G_{max}	10V 15 mA	2		14.5 dB			15.5 dB	

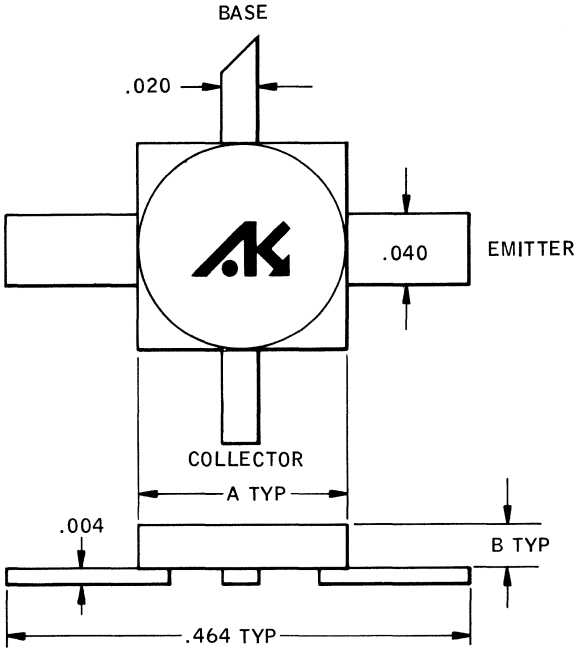
MAXIMUM RATINGS (T_A = 25°C)

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)	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

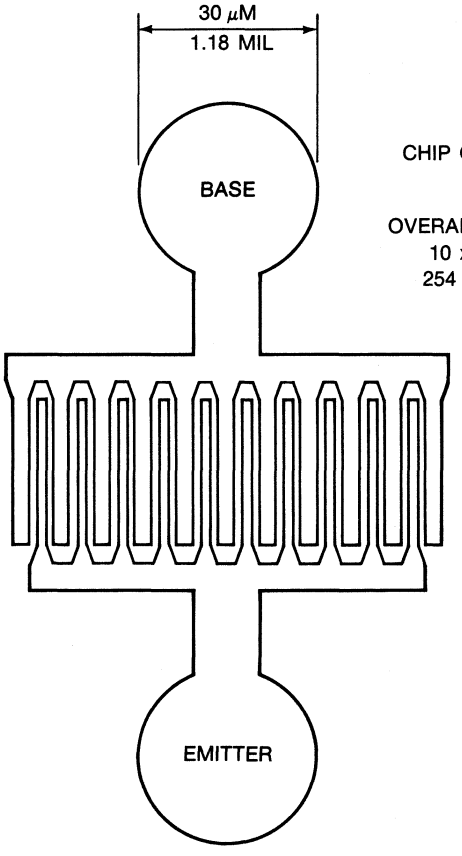


OUTLINE DRAWING



TOLERANCES: ±.010/±.02

DIMENSION	AT-4641 AT-4642	AT-4841 AT-4842
A	.070	.100
B	.030	.025



CHIP GEOMETRY

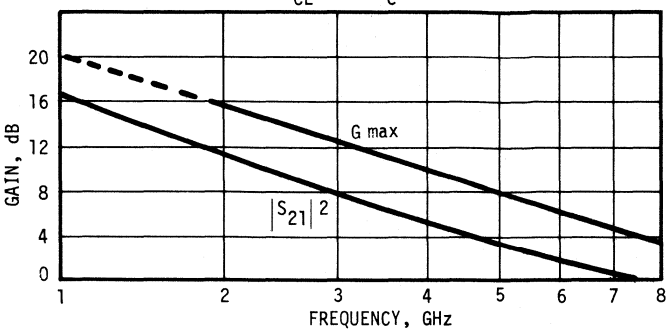
OVERALL CHIP SIZE
10 x 10 MIL
254 x 254 μM

ELECTRICAL CHARACTERISTICS (T_A = 25°C)

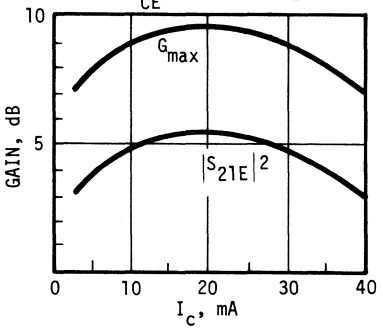
Parameter	Symbol	Test Conditions	Freq	Min	Typ	Max
Collector-Base Breakdown	$V_{(BR)}CBO$	I_E = 0, I_C = 10 μA		20V		
Emitter-Base Breakdown	$V_{(BR)}EBO$	I_E = 10 μA, I_C = 0		1.5V		
Collector-Emitter Breakdown	$V_{(BR)}CEO$	I_C = 100 μA , I_B = 0		12V		
Collector Cutoff Current	I_{CBO}	V_{CB} = 10V, I_E = 0				20 nA
Forward Current Transfer Ratio	h_{FE}	V_{CE} = 10V, I_C = 15 mA		20	75	
Short Circuit Gain-Bandwidth	f_T	V_{CE} = 10V, I_C = 15 mA			8 GHz	
Maximum Frequency of Oscillation	f_{max}	V_{CE} = 10V, I_C = 15 mA			14 GHz	
Collector-Base Capacitance	C_{cb}	V_{CB} = 10V, I_E = 0				0.5 pF

TYPICAL PERFORMANCE CURVES

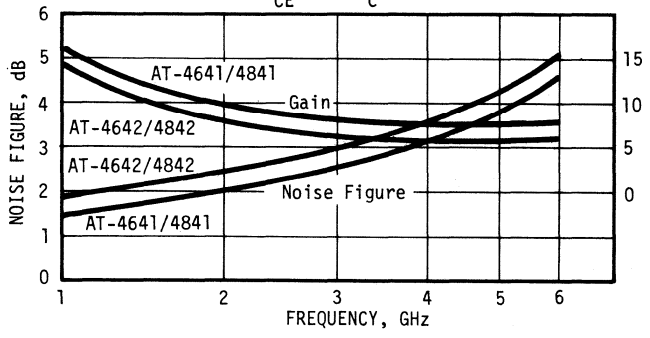
G_{MAX}, $|S_{21}|^2$ VS FREQUENCY
V_{CE}=10V I_C=15 mA



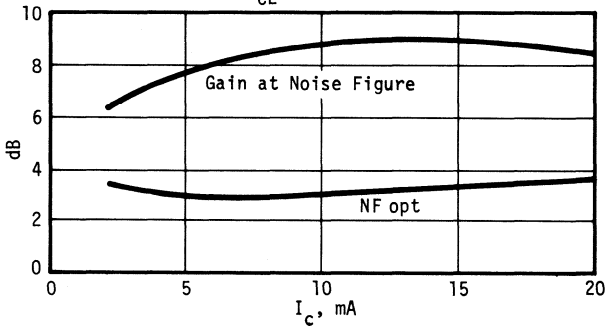
MAXIMUM AVAILABLE GAIN,
$|S_{21E}|^2$ VS COLLECTOR CURRENT
V_{CE}=10V F=4 GHz



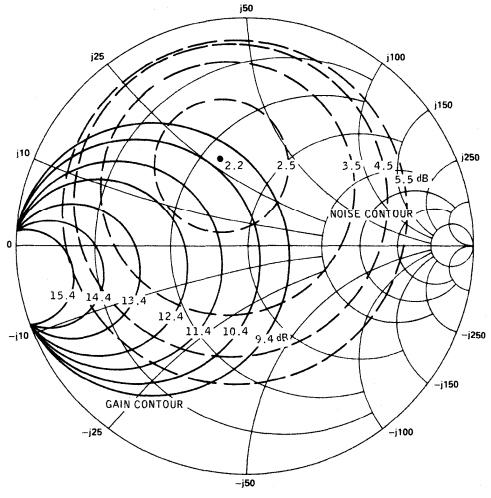
NF_{OPT} AND GAIN AT NOISE FIGURE VS FREQUENCY
V_{CE}=10V, I_C=5mA



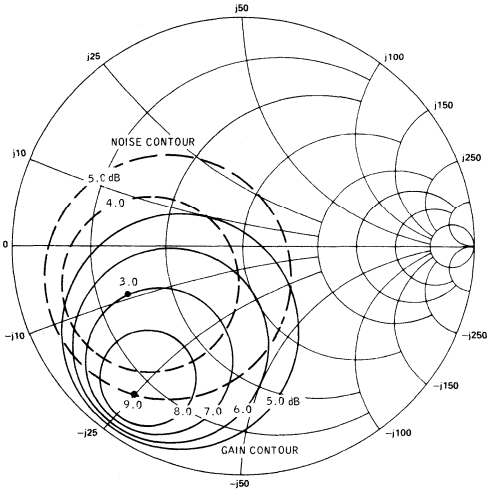
NF_{OPT} AND GAIN AT NOISE FIGURE VS COLLECTOR CURRENT
V_{CE}=10V F=4GHz



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} = 10 V, I_C = 5 mA. 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

AT-4841 (M4)

S -- MAGN AND ANGLES: BIAS= 10.00 VOLTS, 5.00 MA

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

S -- MAGN AND ANGLES: BIAS= 10.00 VOLTS, 10.00 MA

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

S -- MAGN AND ANGLES: BIAS= 10.00 VOLTS, 15.00 MA

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

S -- MAGN AND ANGLES: BIAS= 10.00 VOLTS, 20.00 MA

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

S -- MAGN AND ANGLES: BIAS= 10.00 VOLTS, 30.00 MA

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

S -- MAGN AND ANGLES: BIAS= 10.00 VOLTS, 40.00 MA

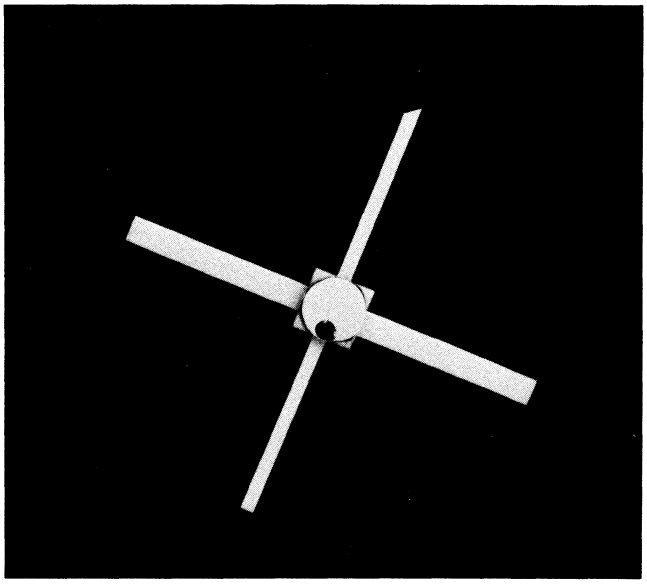
FREQ	11		21		12		22	
500.00	.614	-170.2	10.506	95.3	.019	50.3	.548	-29.5
1000.00	.632	170.4	5.678	75.3	.028	51.9	.495	-40.3
2000.00	.645	145.7	2.969	44.1	.049	44.5	.485	-65.5
3000.00	.645	124.1	2.029	15.5	.071	30.6	.503	-92.1
4000.00	.653	102.9	1.535	-12.1	.093	15.8	.528	-116.0
5000.00	.640	82.6	1.240	-36.8	.119	.1	.563	-143.1
6000.00	.619	61.4	1.030	-61.6	.140	-15.6	.624	-167.2
7000.00	.552	35.6	.875	-86.9	.166	-35.1	.699	172.4
8000.00	.483	-.1	.770	-112.0	.199	-55.5	.751	158.5

Avantek

TRANSISTOR DATA SHEET

AT-4680/AT-4880 Microwave Transistors

Silicon Planar Arsenic Emitter NPN Epitaxial



FEATURES

- **Low Noise Figure — NF_{opt} = 2.8 dB @ 4 GHz, Max.**
- **High Associated Gain — G_{NF} = 8.5 dB @ 4 GHz**
- **Hermetic Ceramic/Metal Stripline Package**
- **Gold Metallization**

DESCRIPTION

The Avantek AT-4680 (70 mil package) and equivalent AT-4880 (100 mil package) are silicon bipolar transistors designed for small signal amplification at frequencies up to 6 GHz. Arsenic-doped, 0.5 micron emitter structures give these transistors very low noise figures and high associated gains. The metal system used in the AT-4680/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.

Both the 70 mil and 100 mil square ceramic-metal microstripline packages are hermetically sealed while flooded with a dry, inert atmosphere to assure long-term protection from humidity and corrosive gases.

ADDITIONAL HIGH RELIABILITY SCREENING AVAILABLE

All Avantek transistors are 100% fine leak tested and are 100% tested for both DC and RF parameters after packaging. An additional assurance of long term reliability is available for critical military and aerospace programs with transistors screened in the Avantek "R" series high reliability program. All Avantek transistors are available in "R" series qualified versions. These "R" series transistors are given the same comprehensive testing as their commercial counterparts, but then undergo an additional burn-in period and are screened using MIL-STD-750 procedures. Each "R" series transistor is shipped with individual documentation.

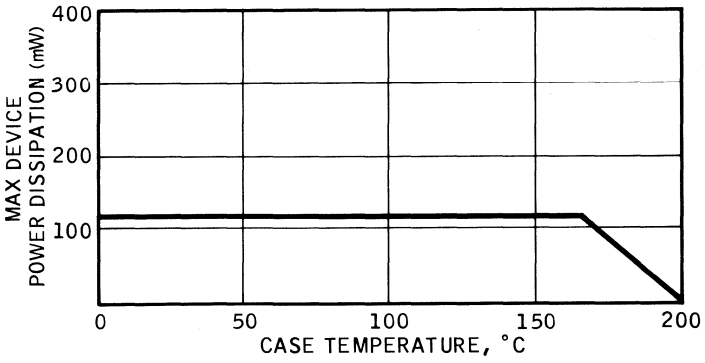
COMMON EMITTER OPERATING CHARACTERISTICS (T_A = 25°C)

Parameter	Symbol	Test Cond V_{CE} I_C	Freq GHz	Min	Typ	Max
Spot Noise Figure	NF_{opt}	10V 3 mA	4		2.6 dB	2.8 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	

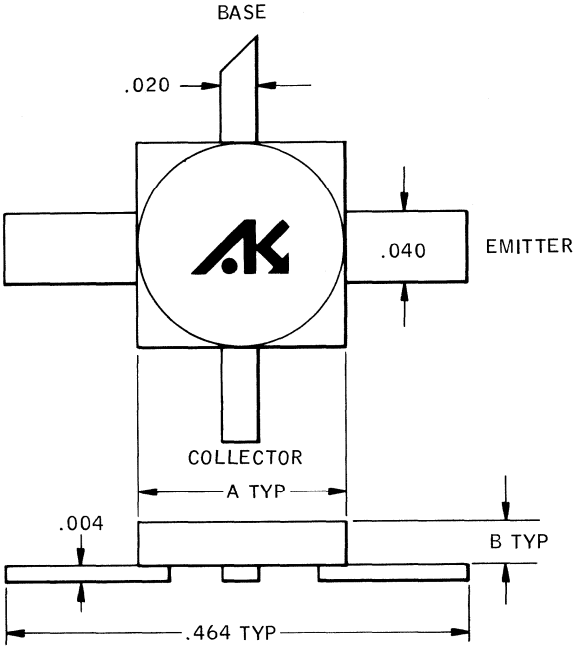
MAXIMUM RATINGS (T_A = 25°C)

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

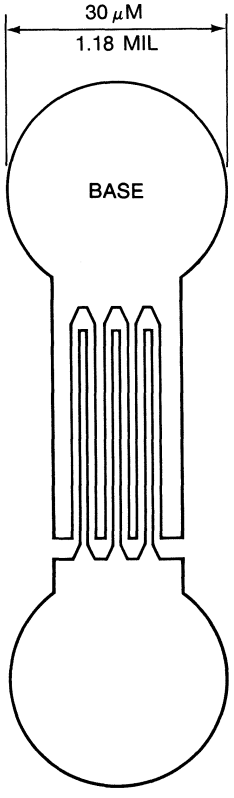


OUTLINE DRAWING



TOLERANCES: ±.010/±.02

DIMENSION	AT-4680	AT-4880
A	.070	.100
B	.030	.025



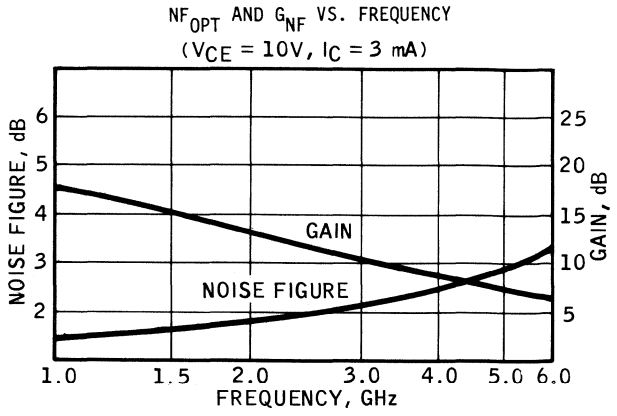
CHIP GEOMETRY

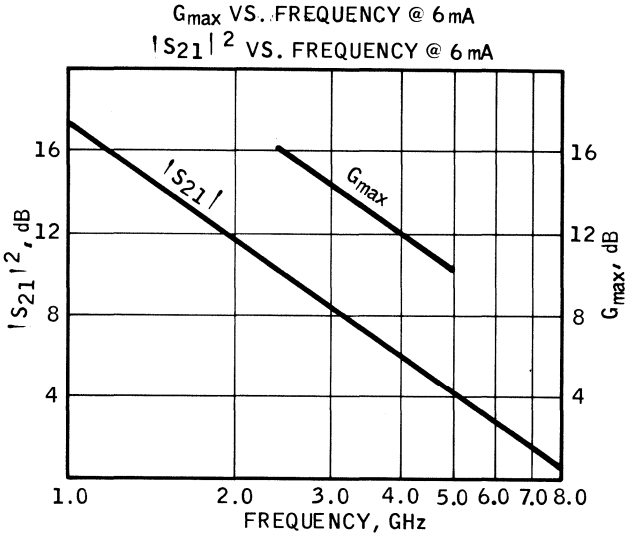
OVERALL CHIP SIZE
10 x 10 MIL
254 x 254 μM

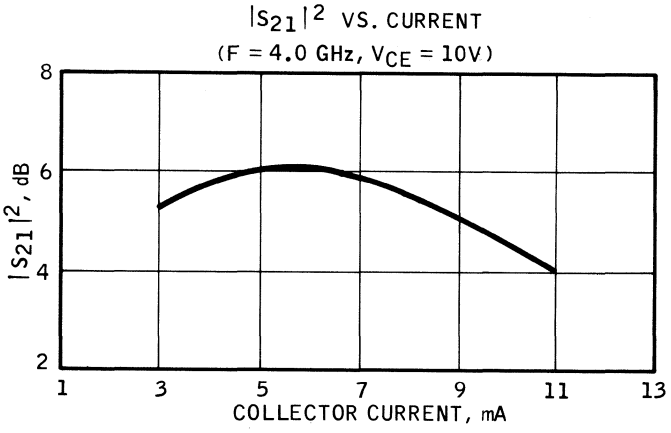
ELECTRICAL CHARACTERISTICS (T_A = 25°C)

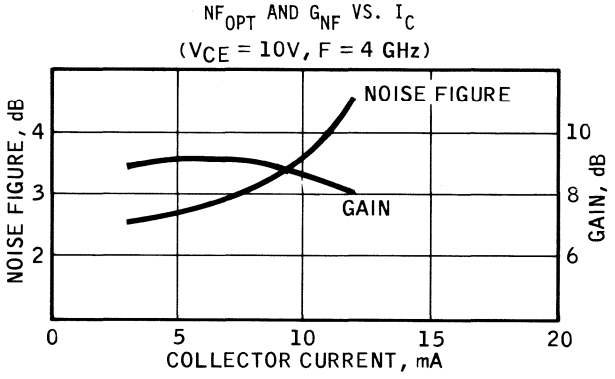
Parameter	Symbol	Test Conditions	Freq	Min	Typ	Max
Collector-Base Breakdown	$V_{(BR)CBO}$	I_E = 0, I_C = 10 μA		20V		
Emitter-Base Breakdown	$V_{(BR)EBO}$	I_E = 10 μA, I_C = 0		2.0V		
Collector-Emitter Breakdown	$V_{(BR)CEO}$	I_C = 100 μA, I_B = 0		12V		
Collector Cutoff Current	I_{CBO}	V_{CB} = 10V, I_E = 0				20 nA
Forward Current Transfer Ratio	h_{FE}	V_{CE} = 10V, I_C = 6 mA		20	150	
Short Circuit Gain-Bandwidth	f_T	V_{CE} = 10V, I_C = 6 mA			8.5 GHz	
Maximum Frequency of Oscillation	f_{max}	V_{CE} = 10V, I_C = 6 mA			15 GHz	
Collector-Base Capacitance	C_{cb}	V_{CB} = 10V, I_E = 0				0.5 pF

TYPICAL PERFORMANCE CURVES

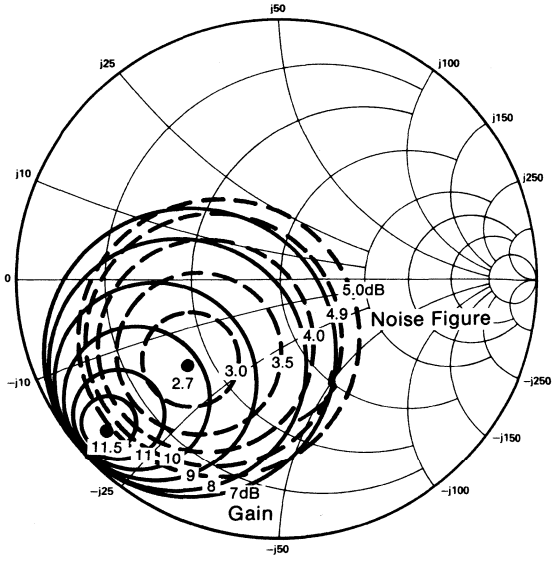




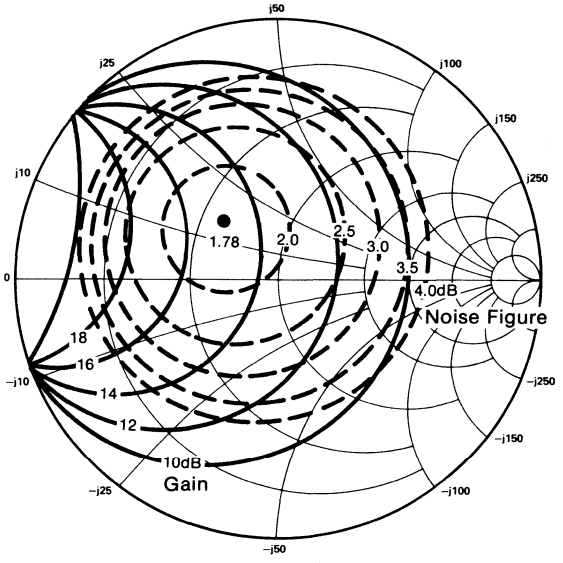




TYPICAL CONTOURS OF CONSTANT GAIN AND NOISE FIGURE



(VCE = 10V, IC = 3 mA, F = 4 GHz)



(VCE = 10V, IC = 3 mA, F = 2.0 GHz)

TYPICAL SCATTERING PARAMETERS

AT-4880 (M12)

S -- MAGN AND ANGLES: BIAS= 10.00 VOLTS, 3.00 MA

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

S -- MAGN AND ANGLES: BIAS= 10.00 VOLTS, 5.00 MA

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

S -- MAGN AND ANGLES: BIAS= 10.00 VOLTS, 9.00 MA

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

S -- MAGN AND ANGLES: BIAS= 10.00 VOLTS, 12.00 MA

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

S -- MAGN AND ANGLES: BIAS= 10.00 VOLTS, 15.00 MA

FREQ	11		21		12		22	
500.00	.553	-145.7	6.981	101.7	.019	46.1	.800	-18.4
1000.00	.570	-177.7	3.816	77.2	.026	48.5	.761	-28.7
2000.00	.589	149.9	1.984	44.3	.042	50.5	.760	-51.8
3000.00	.600	125.8	1.352	15.8	.063	47.1	.759	-76.3
4000.00	.622	103.5	1.017	-11.1	.089	37.7	.773	-98.8
5000.00	.633	83.4	.807	-34.4	.121	25.5	.785	-125.0
6000.00	.638	64.5	.640	-56.9	.149	12.1	.805	-150.2
7000.00	.607	43.2	.513	-77.1	.179	-4.1	.843	-171.9
8000.00	.573	16.5	.420	-94.7	.215	-20.7	.878	174.1

S -- MAGN AND ANGLES: BIAS= 10.00 VOLTS, 20.00 MA

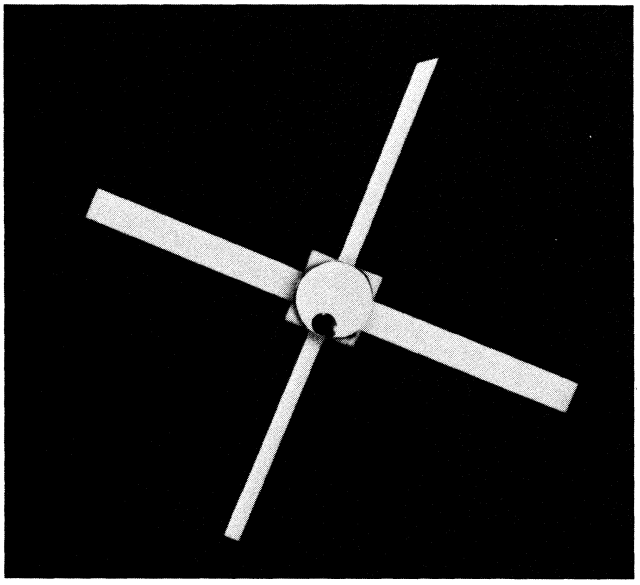
FREQ	11		21		12		22	
500.00	.642	-168.6	4.104	90.0	.014	44.8	.823	-15.2
1000.00	.659	169.7	2.138	67.2	.020	54.8	.811	-26.9
2000.00	.679	143.1	1.073	32.2	.036	61.2	.820	-51.5
3000.00	.692	120.0	.694	2.4	.059	58.0	.825	-77.5
4000.00	.711	98.5	.485	-24.2	.091	47.9	.838	-101.1
5000.00	.714	78.1	.341	-42.6	.128	32.7	.841	-128.6
6000.00	.712	58.9	.241	-55.1	.162	17.2	.851	-154.4
7000.00	.679	36.4	.187	-57.6	.195	-1.1	.870	-176.3
8000.00	.645	9.2	.180	-55.6	.237	-19.1	.880	169.7

Avantek

TRANSISTOR DATA SHEET

AT-4690/AT-4890
Microwave Transistor

Silicon Planar
Arsenic Emitter
NPN Epitaxial



FEATURES

- **NF Flat Within 0.8 dB for I_C = 2.5 to 20 mA**
- **Low Noise Figure — NF_{opt} = 3.0 dB @ 4 GHz**
- **High Associated Gain — G_{NF} = 9.5 dB**
- **Hermetic Ceramic/Metal Stripline Package**
- **High Reliability**

DESCRIPTION

The Avantek AT-4690 (70 mil package) and equivalent AT-4890 (100 mil package) are silicon bipolar transistors designed for small signal amplification at frequencies of up to 6 GHz. An important feature of these transistors is their 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-4690/4890 transistors 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.

Both the 70 mil and 100 mil square ceramic/metal stripline packages are hermetically sealed while flooded with a dry, inert atmosphere to assure long-term protection from humidity and corrosive gases.

PACKAGING, TESTING AND SCREENING FOR RELIABILITY

All Avantek transistors are 100% fine leak tested, and are 100% tested for both DC and RF parameters after packaging and leak testing. Additional assurance of reliability is available for critical military and aerospace applications in the form of the Avantek "R" series high reliability screening program. Avantek "R" series transistors are produced in exactly the same way as the commercial grade versions, but are given an additional burn-in and screened using MIL-STD-750 procedures. Each "R" series device is shipped with individual documentation.

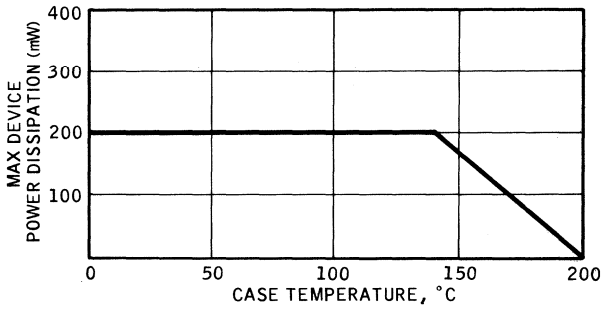
COMMON EMITTER OPERATING CHARACTERISTICS (T_A = 25°C)

Parameter	Symbol	Test Cond V_{CE} I_C	Freq GHz	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	

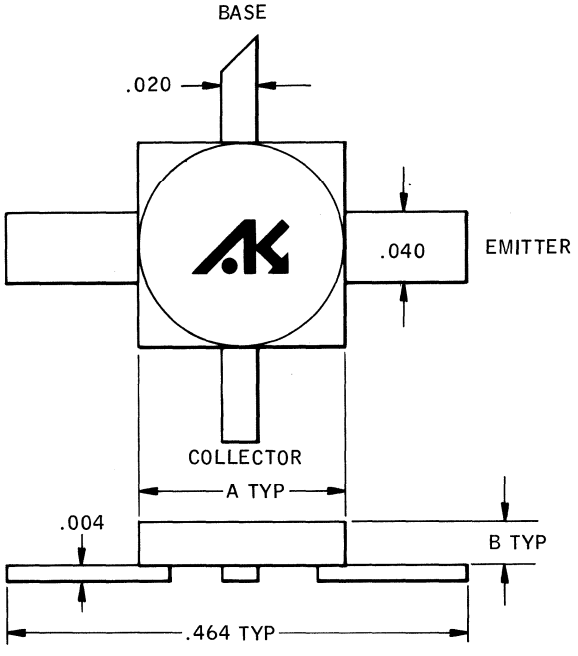
MAXIMUM RATINGS (T_A = 25°C)

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

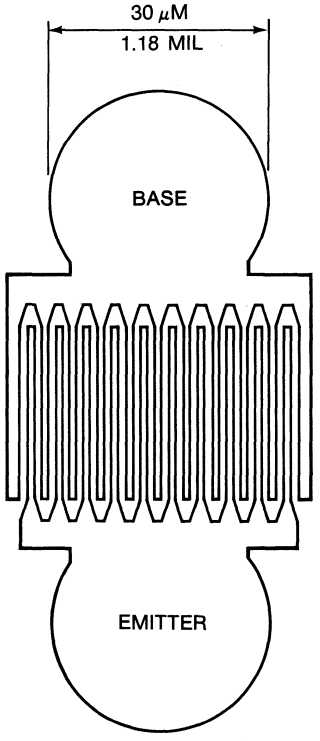


OUTLINE DRAWING



TOLERANCES: ±.010/±.02

DIMENSION	AT-4690	AT-4890
A	.070	.100
B	.030	.025



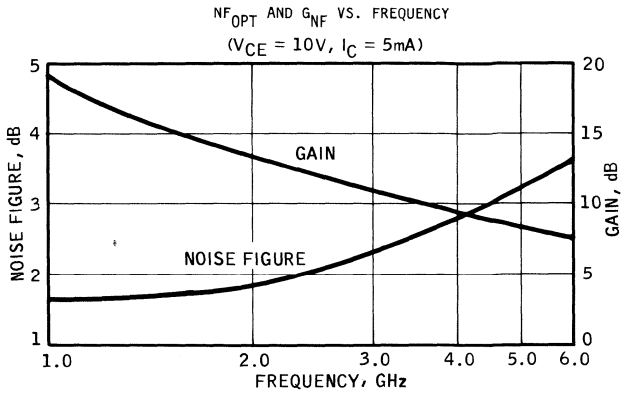
CHIP GEOMETRY

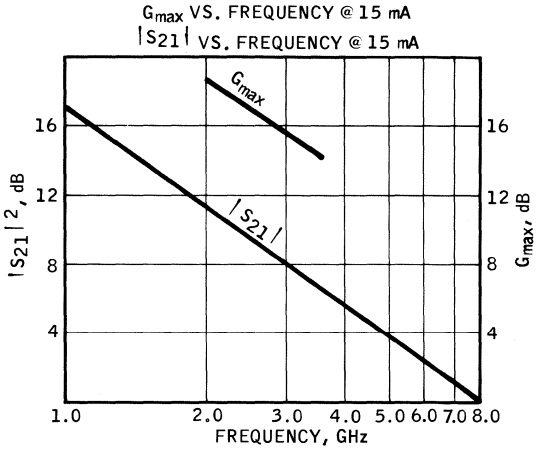
OVERALL CHIP SIZE
10 x 10 MIL
254 x 254 μM

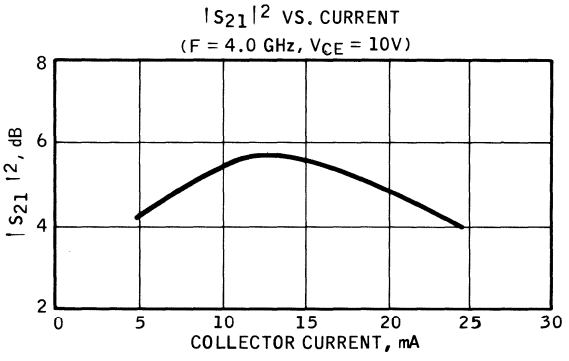
ELECTRICAL CHARACTERISTICS (T_A = 25°C)

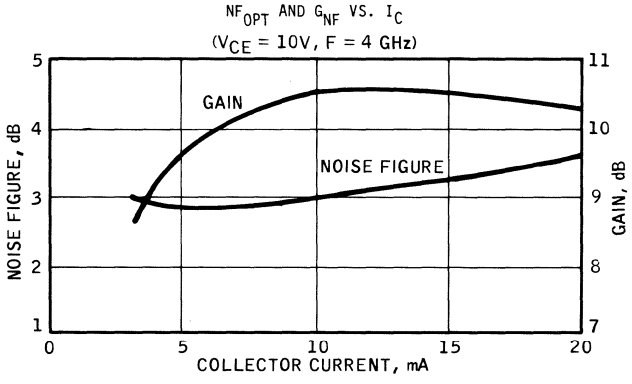
Parameter	Symbol	Test Conditions	Min	Typ	Max
Collector-Base Breakdown	$V_{(BR)CBO}$	I_E = 0, I_C = 10 μA	20V		
Emitter-Base Breakdown	$V_{(BR)EBO}$	I_E = 10 μA, I_C = 0	2.0V		
Collector-Emitter Breakdown	$V_{(BR)CEO}$	I_C = 100 μA, I_B = 0	14V		
Collector Cutoff Current	I_{CBO}	V_{CB} = 10V, I_E = 0			20 nA
Forward Current Transfer Ratio	h_{FE}	V_{CE} = 10V, I_C = 15 mA	20	150	
Short Circuit Gain-Bandwidth	f_T	V_{CE} = 10V, I_C = 15 mA		8.5 GHz	
Maximum Frequency of Oscillation	f_{max}	V_{CE} = 10V, I_C = 15 mA		15 GHz	
Collector-Base Capacitance	C_{cb}	V_{CB} = 10V, I_E = 0			0.5 pF

TYPICAL PERFORMANCE CURVES

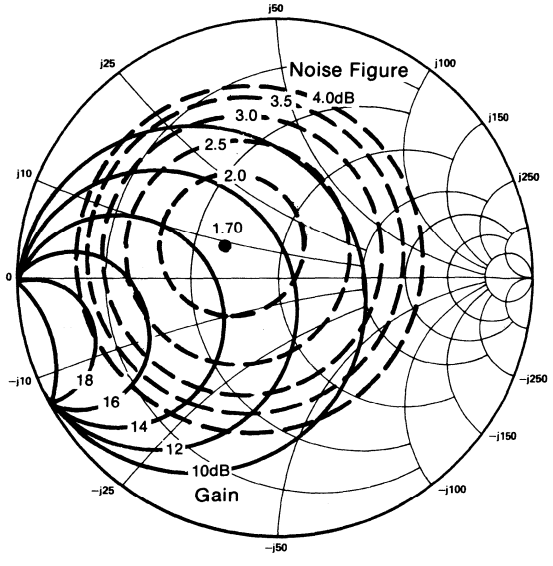




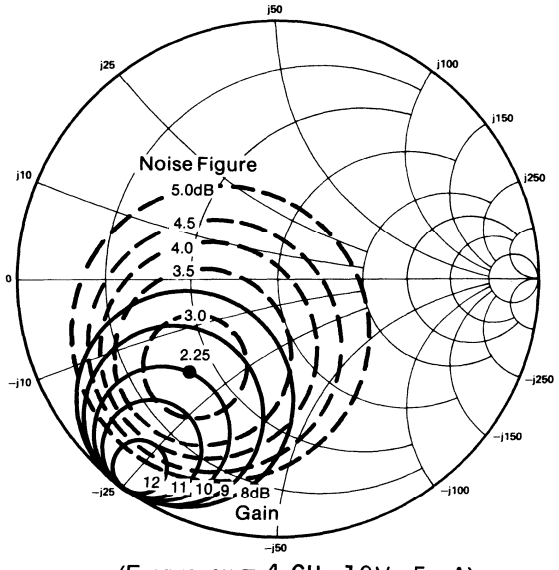




TYPICAL CONTOURS OF CONSTANT GAIN AND NOISE FIGURE



(Frequency = 2 GHz 10V, 5 mA)



(Frequency = 4 GHz 10V, 5 mA)

TYPICAL SCATTERING PARAMETERS

AT-4890 (M11)

S -- MAGN AND ANGLES: BIAS= 10.00 VOLTS, 5.00 MA

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

S -- MAGN AND ANGLES: BIAS= 10.00 VOLTS, 10.00 MA

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

S -- MAGN AND ANGLES: BIAS= 10.00 VOLTS, 15.00 MA

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

S -- MAGN AND ANGLES: BIAS= 10.00 VOLTS, 20.00 MA

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

S -- MAGN AND ANGLES: BIAS= 10.00 VOLTS, 25.00 MA

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

S -- MAGN AND ANGLES: BIAS= 10.00 VOLTS, 30.00 MA

FREQ	11		21		12		22	
500.00	.683	-167.7	7.881	92.5	.014	40.6	.702	-20.7
1000.00	.696	172.7	4.221	73.2	.020	49.1	.675	-33.7
2000.00	.712	149.2	2.210	41.4	.034	45.9	.674	-61.3
3000.00	.715	128.9	1.501	11.6	.049	39.1	.689	-89.7
4000.00	.725	109.0	1.122	-16.8	.069	27.8	.711	-115.2
5000.00	.719	90.4	.874	-42.2	.091	13.9	.735	-144.0
6000.00	.711	71.8	.693	-66.6	.110	-1.1	.778	-168.9
7000.00	.658	49.9	.561	-90.0	.135	-18.0	.823	170.3
8000.00	.586	19.1	.478	-112.9	.169	-38.1	.857	156.5

Avantek

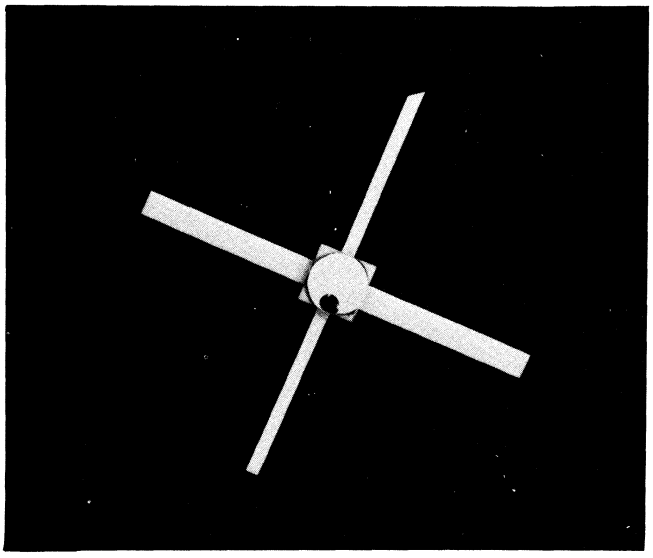
TRANSISTOR DATA SHEET

AT-8050/AT-8051

6 GHz Small Signal Gallium Arsenide FET

FEATURES

- **1.8 dB NF, 11 dB Gain @ 4 GHz**
- **2.2 dB NF, 9 dB Gain @ 6 GHz**
- **+10 dBm Linear P_0 @ 4 GHz**
- **All Gold-Based Metallization**
- **Ultra-Miniature Hermetic Package**
- **Available As Unpackaged Chip**
- **PGA Scratch Protection Option**



DESCRIPTION

The AT-8050/-8051 is a gallium arsenide metal-semiconductor field effect transistor with Schottky-barrier gate electrode. It features a sub-micron gate length and a four gate electrode geometry that combines low noise figure performance at 6 GHz and above with a moderate input impedance at lower frequencies. Its skeleton contact structure minimizes parasitic capacitance for improved broadband performance. The AT-8050/-8051 is an excellent choice for a wide variety of narrowband and broadband high performance amplification applications.

All metallization, including the gate, in the AT-8050/-8051 uses a system of gold and refractory metals. This eliminates the corrosion, inter-metallic growth and burn-out problems associated with some other metal systems, helping to assure long term reliability.

The AT-8050 version is packaged in the ultra-miniature 70 mil square metal-ceramic microstripline package. The package is filled with dry nitrogen and hermetically sealed to fully protect the GaAs FET chip from contamination, corrosive gases or moisture. Each transistor is leak tested before shipment to verify its hermetic seal.

The AT-8051 is an unpackaged 10 x 13 mil chip suitable for MIC thin-film and thick-film hybrid circuits. Its gold metal system provides excellent bond strength and assures compatability with the wirebonding techniques used in hybrid circuit construction. An optional PGA (polycrystalline gallium arsenide) protective layer is available to protect the surface of the AT-8051 chip from damage or contamination during handling. The PGA layer is also opaque, which prevents variations in operating parameters caused by light impingement during tuning procedures. All GaAs FETs are light sensitive.

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

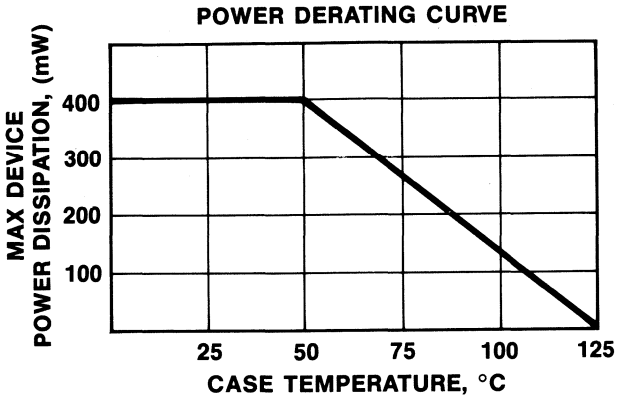
TYPICAL COMMON SOURCE OPERATING CHARACTERISTICS (T_A = 25°C)

Parameter	Symbol	Value	Frequency	Test Condition
Spot Noise Figure	NF_{opt}	1.8 dB (2.0 max)	4.0 GHz	V_{DS} = 3V, I_{DS} = 15 mA
		2.2 dB	6.0 GHz	V_{DS} = 3V, I_{DS} = 15 mA
Gain at Optimum Noise Figure	G_{NF}	11 dB	4.0 GHz	V_{DS} = 3V, I_{DS} = 15 mA
		9 dB	6.0 GHz	V_{DS} = 3V, I_{DS} = 15 mA
Output Power at 1 dB Gain Compression*	$P_{0(-1\,dB)}$	+10 dBm	4.0 GHz	V_{DS} = 5V, I_{DS} = 50 mA

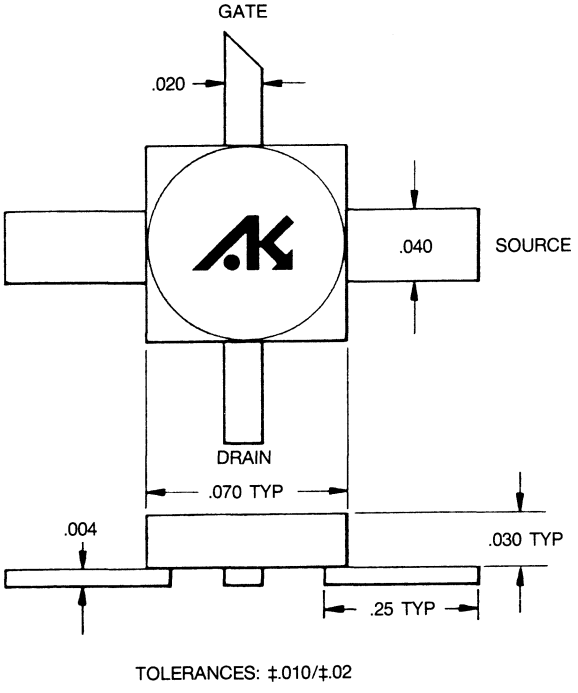
*Measured with a 50 ohm input source impedance and the output circuit tuned for maximum output power

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C)

	Symbol	Ratings	Unit
Drain to Source Voltage	V_{DS}	5	V
Gate to Source Voltage	V_{GS}	-8	V
Drain Current	I_D	100	mA
Thermal Resistance	O_{jc}	200	°c/W
Channel Temperature	T_{ch}	125	°C
Continuous Dissipation	(T_{case}=25°C)	400	mW
Storage Temperature	T_{stg}	-65° to +125°C	

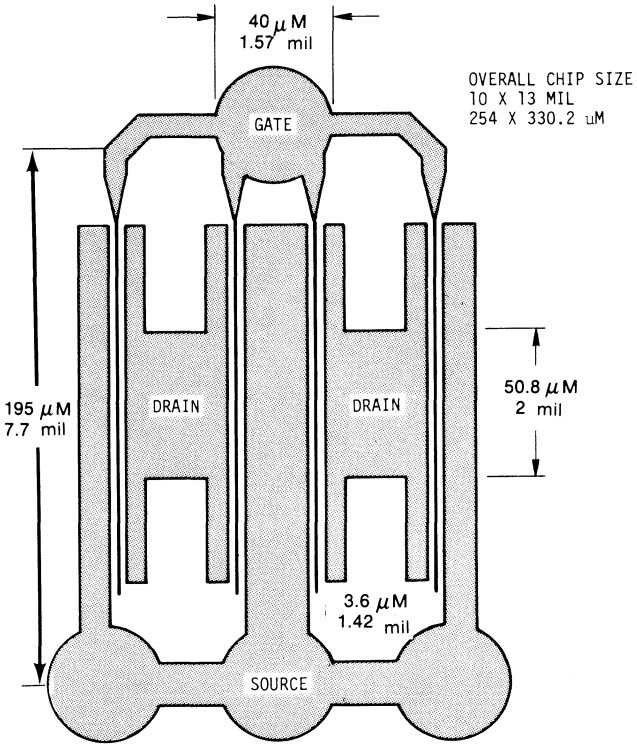


OUTLINE DRAWING: PACKAGED VERSION 70 MIL PACKAGE



TOLERANCES: ±.010/±.02

OUTLINE DRAWING: UNPACKAGED CHIP

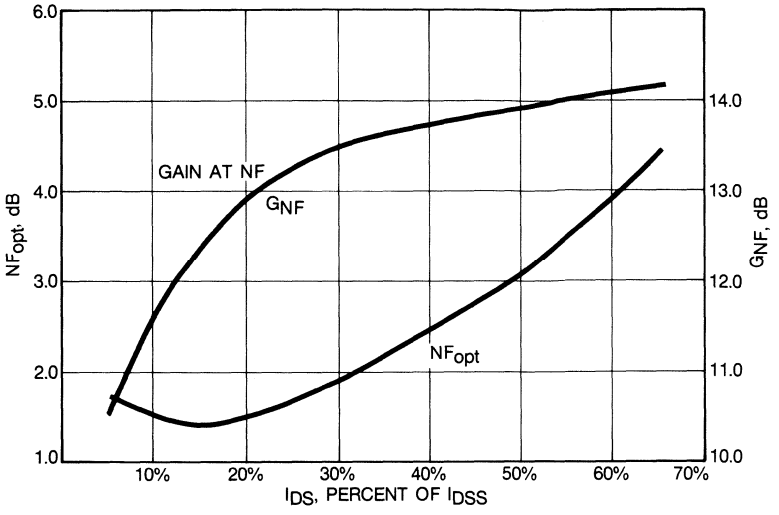


TYPICAL DC CHARACTERISTICS (T_A = 25°C)

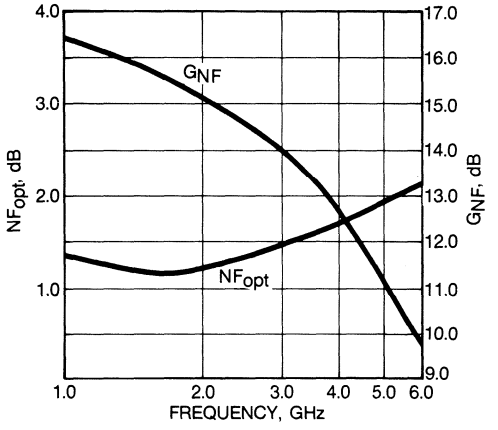
Parameter	Symbol	Value	Test Condition
Transconductance	G_M	30 mmho[1]	V_{DS} = 3V, V_{GS} = OV
Saturated Drain Current	I_{DSS}	70 mA	V_{DS} = 3V
Pinchoff Voltage	V_P	-3V	V_{DS} = 3V, I_{DS} = 1 mA

Note 1: Minimum G_M = 20 mmho

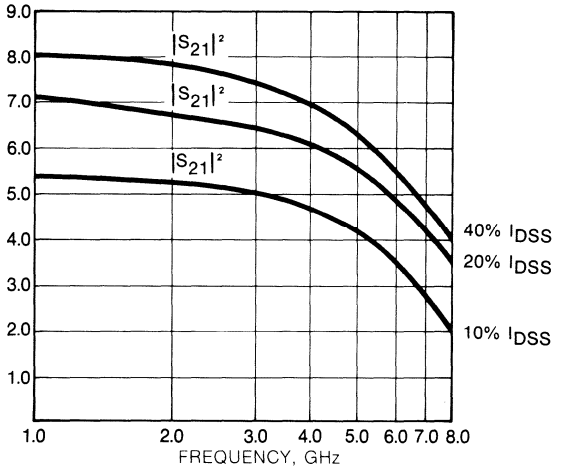
SPOT NOISE FIGURE (NF_{opt}) AND ASSOCIATED GAIN (G_{NF}) VS. I_{DS} AT V_{DS} = 3V, f = 4 GHz



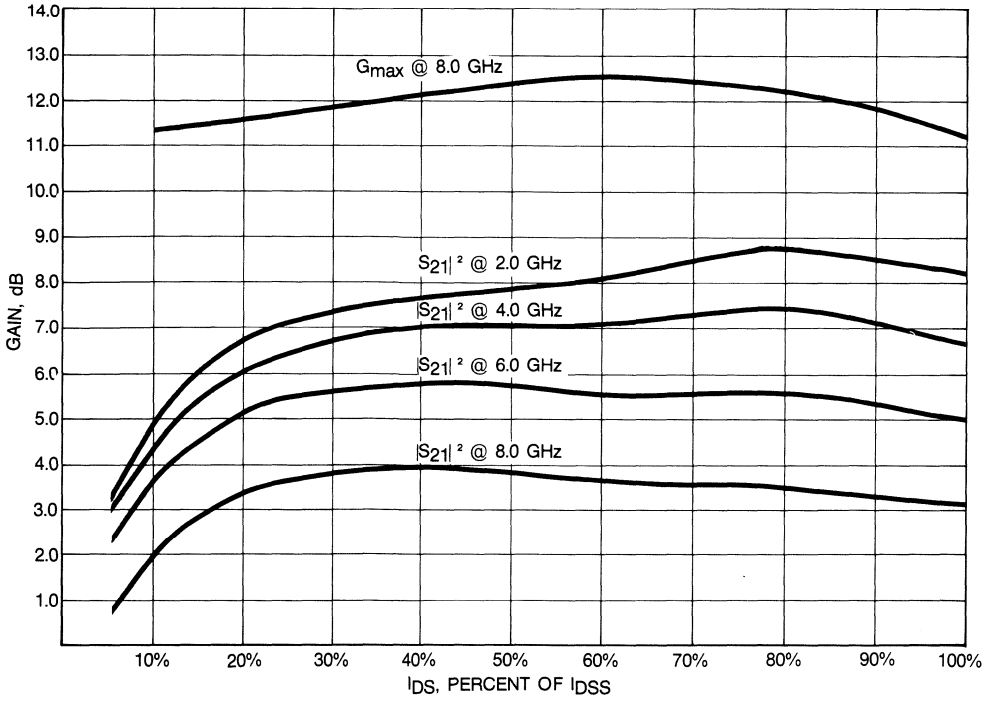
SPOT NOISE FIGURE (NF_{opt}) AND ASSOCIATED GAIN (G_{NF}) VS. FREQUENCY V_{DS} = 3V, I_{DS} = 15 mA



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



INSERTION POWER GAIN ($|S_{21}|^2$) AND MAXIMUM AVAILABLE GAIN (G_{max}) vs. I_{DS} V_{DS} = 3V



BIAS= 3.00 VOLTS, 15.00 MA

S -- MAGN AND ANGLES:

FREQ	11		21		12		22	
500.00	.998	-15.1	2.722	164.9	.011	82.1	.679	-9.9
1000.00	.984	-29.4	2.695	151.4	.020	72.0	.669	-18.7
1500.00	.964	-44.0	2.683	138.4	.029	61.9	.659	-28.5
2000.00	.956	-58.1	2.649	125.0	.038	52.0	.657	-37.8
2500.00	.924	-72.6	2.581	112.0	.046	42.3	.639	-47.3
3000.00	.897	-87.7	2.522	98.3	.052	32.6	.625	-57.8
3500.00	.878	-102.0	2.467	84.9	.058	23.8	.613	-68.4
4000.00	.841	-114.9	2.383	72.2	.061	15.1	.601	-78.4
4500.00	.821	-128.9	2.310	58.7	.064	6.5	.585	-88.8
5000.00	.794	-143.7	2.198	45.4	.067	-2.1	.573	-100.4
5500.00	.775	-157.1	2.105	32.0	.067	-8.8	.569	-111.9
6000.00	.767	-169.8	2.003	21.1	.067	-15.4	.580	-124.1
6500.00	.752	179.3	1.875	9.8	.066	-21.2	.590	-134.9
7000.00	.739	169.1	1.765	-1.0	.065	-26.0	.606	-144.7
7500.00	.735	159.3	1.685	-11.6	.065	-30.2	.620	-154.3
8000.00	.724	150.9	1.611	-21.9	.064	-34.9	.637	-163.3

BIAS= 5.00 VOLTS, 50.00 MA

S -- MAGN AND ANGLES:

FREQ	11		21		12		22	
500.00	.995	-16.0	2.495	162.4	.007	86.0	.832	-12.0
1000.00	.981	-31.1	2.428	147.1	.013	76.1	.811	-22.6
1500.00	.962	-46.4	2.377	132.8	.019	69.1	.790	-34.0
2000.00	.953	-61.2	2.307	117.9	.024	60.8	.774	-44.8
2500.00	.925	-76.3	2.209	104.0	.029	55.3	.740	-55.8
3000.00	.905	-92.3	2.124	89.2	.034	48.3	.711	-67.2
3500.00	.891	-107.0	2.036	75.5	.039	42.6	.689	-78.3
4000.00	.862	-120.7	1.937	62.2	.043	37.6	.662	-88.5
4500.00	.846	-135.3	1.840	48.4	.047	31.5	.636	-99.3
5000.00	.827	-150.7	1.730	34.6	.050	25.8	.620	-111.0
5500.00	.813	-164.5	1.638	21.7	.054	20.8	.614	-122.5
6000.00	.811	-177.5	1.530	10.3	.058	16.5	.618	-135.0
6500.00	.798	171.3	1.411	-.9	.062	11.6	.620	-145.9
7000.00	.786	160.3	1.315	-11.6	.066	6.6	.625	-155.0
7500.00	.784	150.2	1.248	-22.5	.070	2.0	.634	-164.2
8000.00	.771	141.2	1.186	-32.8	.075	-3.5	.644	-172.7

DATA SECTION

3

Gold Metallized, Medium Power Silicon Planar Epitaxial NPN Transistors

AT-3850

These Avantek transistors provide high gain, medium power linear amplification at frequencies through approximately 4 GHz. They are specifically designed and packaged to minimize junction temperature during operation to prevent thermally-induced performance degradation and to assure long operating lives.

Their linear S_{21} vs. I_C characteristics make these Avantek medium power transistors excellent for application as ultra-linear driver amplifiers and microwave oscillators.

Avantek

TRANSISTOR DATA SHEET

AT-3850

3 GHz Medium Powe NPN Epitaxial Silicon Planar Transis

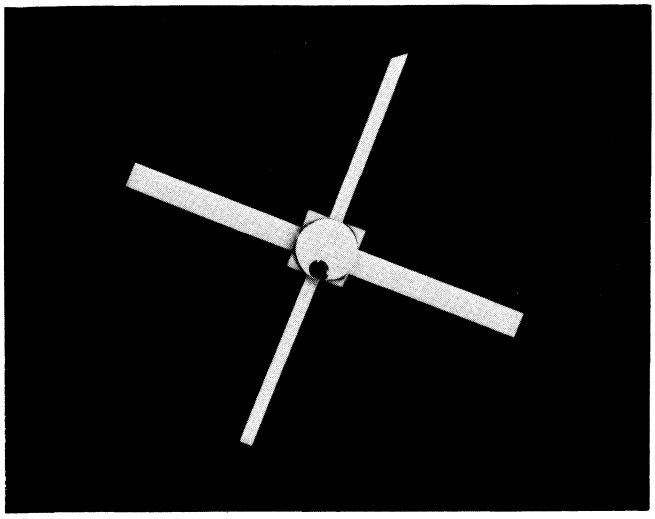
FEATURES

- **At 2 GHz:**
  - **Output Power = 100 mW**
  - **Noise Figure = 3.5 dB**
  - **G_{max} = 13 dB**
- **Diffused Emitter Ballast Resistors**
- **Platinum Silicide Contacts**
- **1 Micron Thickness Gold Metallization**
- **700 mW Continuous Power Dissipation**
- **(T_C = 25°C)**
- **Hermetic Ceramic/Metal Stripline 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 x 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 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 or corrosive atmospheric gases.

ADDITIONAL HIGH RELIABILITY SCREENING AVAILABLE

All Avantek transistors are fine leak tested and 100% tested for both DC and RF parameters after packaging. For critical military and aerospace programs that require an additional assurance of reliability, the Avantek "R" Series qualification program is available. "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.

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

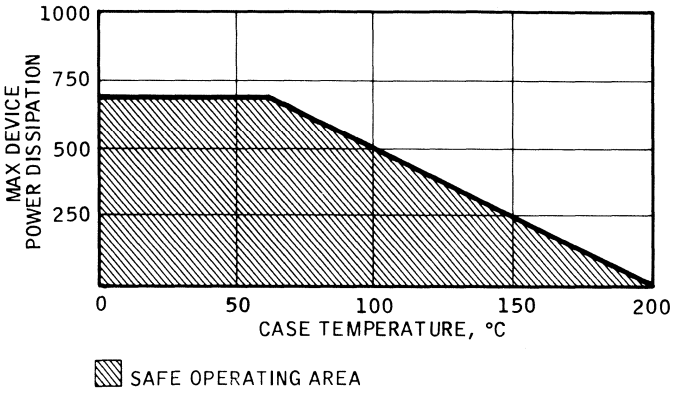
Parameters	Symbols	Typical Values	Freq.	Test Conditions
Spot Noise Figure	NF	2.5 dB	1 GHz	V_{CB} = 10V, I_C = 10 mA
		3.5 dB	2 GHz	
		4.8 dB	3 GHz	
		6.1 dB	4 GHz	
Maximum Available Gain	G_{max}	13.0 dB	2 GHz	V_{CB} = 10V, I_C = 35 mA
		10.0 dB	3 GHz	
		(9.0 dB min.)	3 GHz	
Insertion Power Gain	$\|S_{21}\|^2$	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	

MAXIMUM RATINGS (T_A = 25°C)

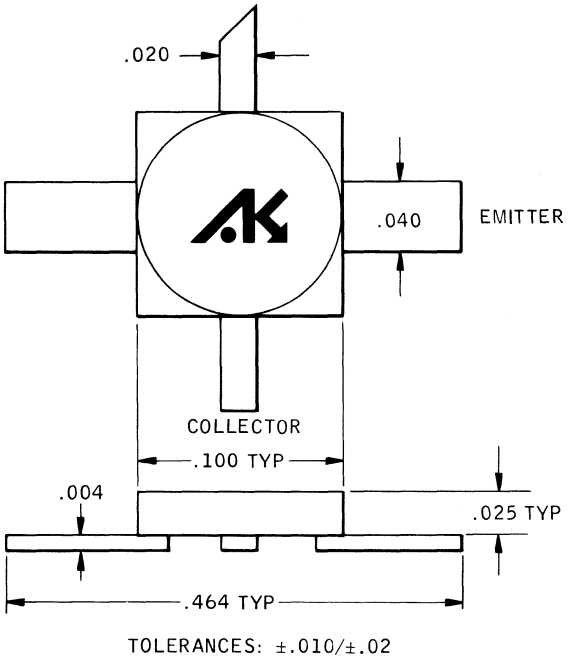
Parameter	Symbol	Limit
Reverse Emitter Base Voltage	V_{EB}	3V
Reverse Collector Base Voltage	V_{CB}	20V
Open Base Collector-Emitter Voltage	V_{CEO}	15V
Collector Current	I_C	100mA
Continuous Dissipation	P_T (T case) = 25°C)	700mW
Junction Temperature	T_j	200°C
Storage Temperature Range	T_{STG}	−65 to 200°C
Thermal Resistance	θjc	200°C/watt

POWER DERATING CURVE

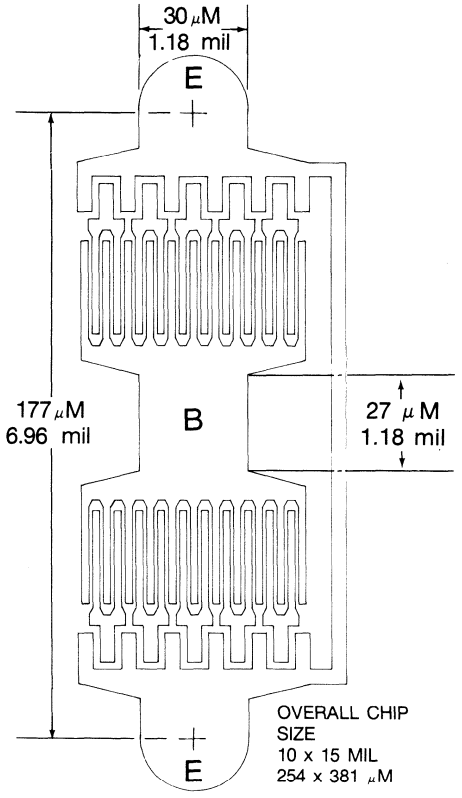
AT-3850



OUTLINE DRAWING
100 MIL PACKAGE



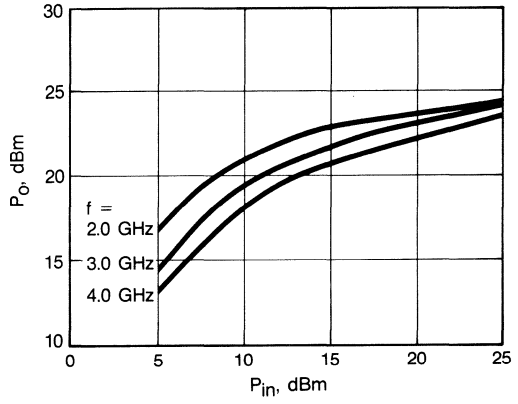
CHIP GEOMETRY



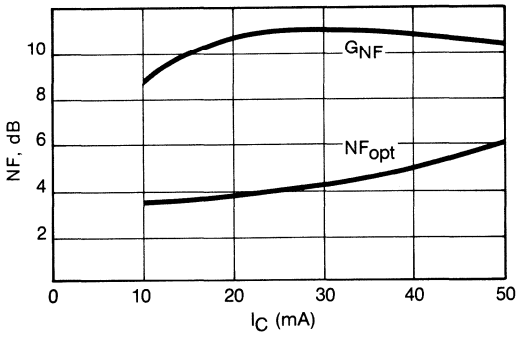
ELECTRICAL CHARACTERISTICS (T_A = 25° C)

Parameters	Symbols	Test Conditions	Min	Typ	Max	Units
Collector-Base Breakdown Voltage	$V_{(BR)}CBO$	I_E = 0, I_C = 10μA	20			V
Emitter-Base Breakdown Voltage	$V_{(BR)}EBO$	I_E = 10μA, I_C = 0	3			V
Collector-Emitter Breakdown Voltage	$V_{(BR)}CEO$	I_C = 100μA, I_B = 0	15			V
Collector Cutoff Current	I_{CBO}	V_{CB} = 10V, I_E = 0			40	nA
Forward Current Transfer Ratio	h_{FE}	V_{CE} = 10V, I_C = 35 mA	20	50		
Short Circuit Gain-Bandwidth	f_T	V_{CE} = 10V, I_C = 35 mA		4.5		GHz
Maximum Frequency of Oscillation	f_{max}	V_{CE} = 10V, I_C = 35 mA		8		GHz
Collector-Base Capacitance	C_{cb}	V_{CB} = 10V, I_E = 0		1.0		pF
Collector-Base Time Constant	r_bC_{cb}	V_{CB} = 10V, I_C = 35 mA		1.5		pS

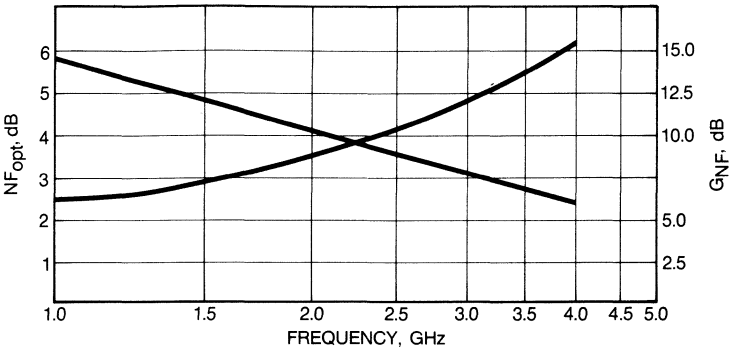
OUTPUT POWER vs. INPUT POWER
V_{CE} = 10V, I_C = 35 mA



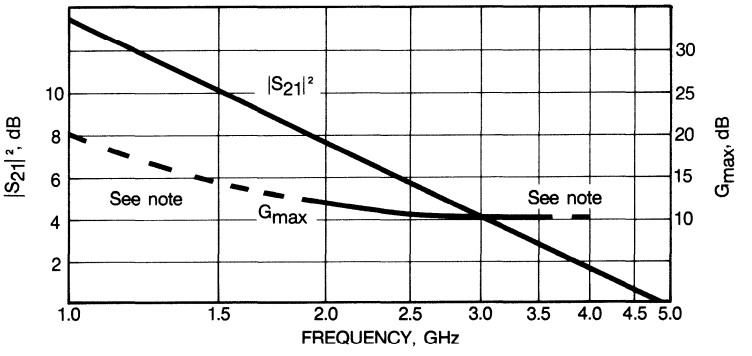
OPTIMUM NOISE FIGURE (NF_{opt})
and ASSOCIATED GAIN (G_{NF})
vs. COLLECTOR CURRENT
F = 2 GHz, V_{CE} = 10V



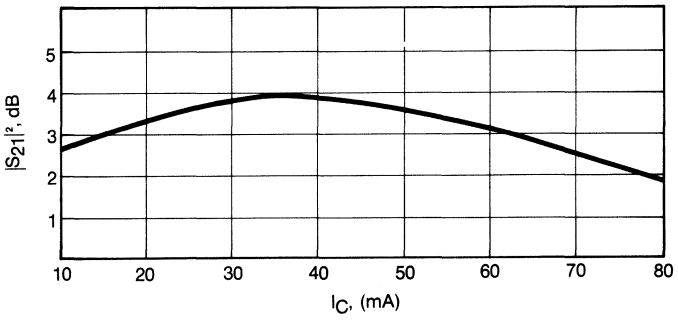
OPTIMUM NOISE FIGURE (NF_{opt})
and ASSOCIATED GAIN (G_{NF}) vs. FREQUENCY
V_{CE} = 10V, I_C = 10 mA



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



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



NOTE

1. The dotted line indicates a frequency or current range where the transistor is potentially unstable and G_{max} is undefined.

AT-3850

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

AT-3850

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