

# 0.5–6 GHz Low Noise Gallium Arsenide FET

## Technical Data

**ATF-21170**

### Features

- **Low Noise Figure:**  
0.9 dB Typical at 4 GHz
- **High Associated Gain:**  
13.0 dB Typical at 4 GHz
- **High Output Power:**  
23.0 dBm Typical  $P_{1\text{ dB}}$  at 4 GHz
- **Hermetic Gold-Ceramic Microstrip Package**

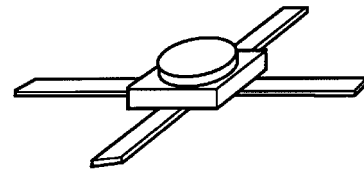
### Description

The ATF-21170 is a high performance gallium arsenide Schottky-barrier-gate field effect transistor

housed in a hermetic, high reliability package. This device is designed for use in low noise or medium power amplifier applications in the 0.5-6 GHz frequency range.

This GaAs FET device has a nominal 0.3 micron gate length with a total gate periphery of 750 microns. Proven gold based metallization systems and nitride passivation assure a rugged, reliable device.

### 70 mil Package



### Electrical Specifications, $T_A = 25^\circ\text{C}$

Symbol	Parameters and Test Conditions	Units	Min.	Typ.	Max.	
NF <sub>O</sub>	Optimum Noise Figure: $V_{DS} = 3\text{ V}$ , $I_{DS} = 20\text{ mA}$	$f = 2.0\text{ GHz}$	dB		0.6	1.1
		$f = 4.0\text{ GHz}$	dB		0.9	
		$f = 6.0\text{ GHz}$	dB		1.2	
G <sub>A</sub>	Gain @ NF <sub>O</sub> : $V_{DS} = 3\text{ V}$ , $I_{DS} = 20\text{ mA}$	$f = 2.0\text{ GHz}$	dB	12.0	16.0	
		$f = 4.0\text{ GHz}$	dB		13.0	
		$f = 6.0\text{ GHz}$	dB		10.0	
P <sub>1 dB</sub>	Power Output @ 1 dB Gain Compression: $V_{DS} = 5\text{ V}$ , $I_{DS} = 80\text{ mA}$	$f = 4.0\text{ GHz}$	dBm		23.0	
G <sub>1 dB</sub>	1 dB Compressed Gain: $V_{DS} = 5\text{ V}$ , $I_{DS} = 80\text{ mA}$	$f = 4.0\text{ GHz}$	dB		13.0	
g <sub>m</sub>	Transconductance: $V_{DS} = 3\text{ V}$ , $V_{GS} = 0\text{ V}$		mmho	70	120	
I <sub>DSS</sub>	Saturated Drain Current: $V_{DS} = 3\text{ V}$ , $V_{GS} = 0\text{ V}$		mA	80	120	200
V <sub>P</sub>	Pinch-off Voltage: $V_{DS} = 3\text{ V}$ , $I_{DS} = 1\text{ mA}$		V	-3.0	-1.5	-0.8

## ATF-21170 Absolute Maximum Ratings

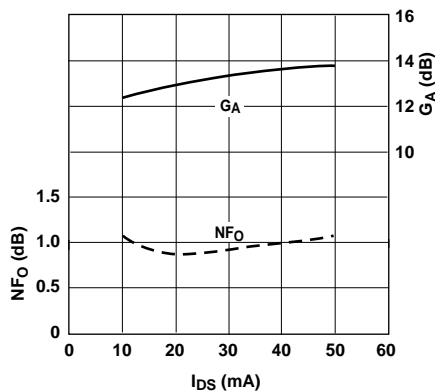
Symbol	Parameter	Units	Absolute Maximum <sup>[1]</sup>
$V_{DS}$	Drain-Source Voltage	V	+7
$V_{GS}$	Gate-Source Voltage	V	-4
$V_{GD}$	Gate-Drain Voltage	V	-8
$I_{DS}$	Drain Current	mA	$I_{DSS}$
$P_T$	Power Dissipation <sup>[2,3]</sup>	mW	600
$T_{CH}$	Channel Temperature	°C	175
$T_{STG}$	Storage Temperature	°C	-65 to +175

**Thermal Resistance:**  $\theta_{jc} = 250^\circ\text{C/W}$ ;  $T_{CH} = 150^\circ\text{C}$   
**Liquid Crystal Measurement:**  $1\ \mu\text{m}$  Spot Size<sup>[4]</sup>

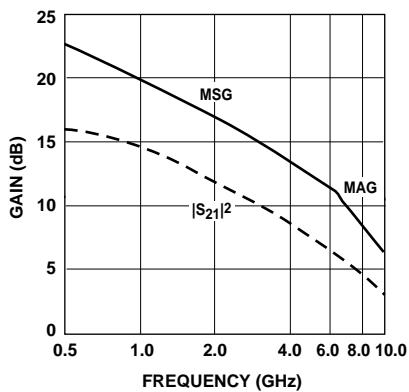
## ATF-21170 Noise Parameters: $V_{DS} = 3\ \text{V}$ , $I_{DS} = 20\ \text{mA}$

Freq. GHz	$N_{F0}$ dB	$\Gamma_{opt}$		$R_N/50$
		Mag	Ang	
0.5	0.4	.93	17	.90
1.0	0.5	.85	35	.70
2.0	0.6	.70	70	.46
4.0	0.9	.59	148	.14
8.0	1.2	.54	-177	.09

## ATF-21170 Typical Performance, $T_A = 25^\circ\text{C}$



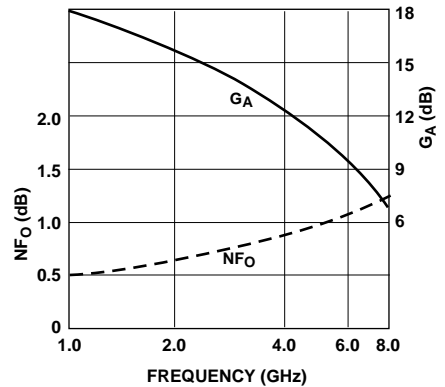
**Figure 2. Optimum Noise Figure and Associated Gain vs.  $I_{DS}$ .**  
 $V_{DS} = 3\ \text{V}$ ,  $f = 4.0\ \text{GHz}$ .



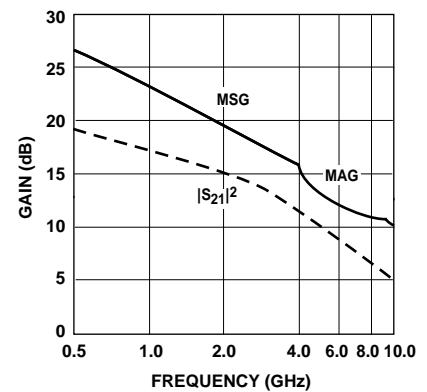
**Figure 3. Insertion Power Gain, Maximum Available Gain and Maximum Stable Gain vs. Frequency.**  
 $V_{DS} = 3\ \text{V}$ ,  $I_{DS} = 20\ \text{mA}$ .

### Notes:

- Permanent damage may occur if any of these limits are exceeded.
- $T_{CASE}$  TEMPERATURE =  $25^\circ\text{C}$ .
- Derate at  $4\ \text{mW}/^\circ\text{C}$  for  $T_{CASE} > 25^\circ\text{C}$ .
- The small spot size of this technique results in a higher, though more accurate determination of  $\theta_{jc}$  than do alternate methods. See MEASUREMENTS section for more information.



**Figure 1. Optimum Noise Figure and Associated Gain vs. Frequency.**  
 $V_{DS} = 3\ \text{V}$ ,  $I_{DS} = 20\ \text{mA}$ ,  $T_A = 25^\circ\text{C}$ .



**Figure 4. Insertion Power Gain, Maximum Available Gain and Maximum Stable Gain vs. Frequency.**  
 $V_{DS} = 5\ \text{V}$ ,  $I_{DS} = 80\ \text{mA}$ .

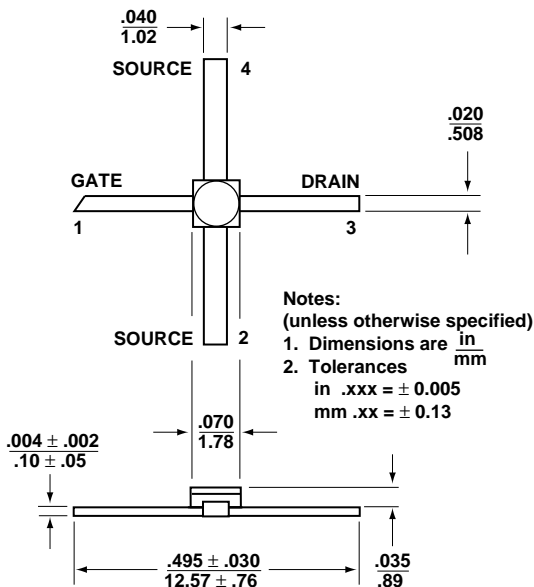
**Typical Scattering Parameters, Common Emitter,  $Z_0 = 50 \Omega$ ,  $T_A = 25^\circ\text{C}$ ,  $V_{DS} = 3 \text{ V}$ ,  $I_{DS} = 20 \text{ mA}$** 

Freq. GHz	$S_{11}$		dB	$S_{21}$		dB	$S_{12}$		$S_{22}$	
	Mag.	Ang.		Mag.	Ang.		Mag.	Ang.	Mag.	Ang.
0.5	.96	-31	15.5	5.93	157	-29.4	.034	72	.46	-23
1.0	.91	-55	14.2	5.14	137	-24.3	.061	56	.42	-42
2.0	.82	-95	12.1	4.05	106	-20.4	.096	36	.39	-70
3.0	.74	-123	10.2	3.23	82	-19.5	.106	21	.35	-91
4.0	.70	-147	8.8	2.74	61	-18.7	.116	9	.33	-109
5.0	.65	-170	7.3	2.33	41	-18.2	.123	-1	.30	-127
6.0	.64	167	6.3	2.07	22	-17.7	.131	-10	.29	-145
7.0	.65	146	5.4	1.86	4	-17.5	.134	-17	.26	-167
8.0	.66	126	4.5	1.67	-13	-17.0	.141	-28	.26	164
9.0	.66	107	3.4	1.48	-30	-16.6	.148	-39	.26	140
10.0	.67	87	2.2	1.29	-47	-16.2	.155	-50	.25	114

**Typical Scattering Parameters, Common Emitter,  $Z_0 = 50 \Omega$ ,  $T_A = 25^\circ\text{C}$ ,  $V_{DS} = 5 \text{ V}$ ,  $I_{DS} = 80 \text{ mA}$** 

Freq. GHz	$S_{11}$		dB	$S_{21}$		dB	$S_{12}$		$S_{22}$	
	Mag.	Ang.		Mag.	Ang.		Mag.	Ang.	Mag.	Ang.
0.5	.95	-43	18.3	8.24	149	-32.4	.024	67	.49	-17
1.0	.89	-64	17.4	7.28	133	-29.9	.032	59	.46	-26
2.0	.78	-106	14.6	5.36	101	-25.2	.055	44	.40	-45
3.0	.69	-133	12.4	4.18	79	-23.4	.068	34	.38	-60
4.0	.64	-160	10.7	3.42	56	-22.7	.073	31	.36	-81
5.0	.60	175	9.1	2.85	37	-21.7	.082	24	.35	-100
6.0	.61	154	7.9	2.47	18	-20.4	.095	19	.33	-115
7.0	.61	136	6.9	2.22	2	-19.3	.108	12	.31	-132
8.0	.63	120	6.2	2.05	-14	-17.9	.127	7	.27	-152
9.0	.64	102	5.3	1.85	-32	-16.6	.148	0	.27	-179
10.0	.64	86	4.5	1.68	-48	-15.3	.172	-13	.29	165

A model for this device is available in the DEVICE MODELS section.

**70 mil Package Dimensions**




*www.hp.com/go/rf*

For technical assistance or the location of your nearest Hewlett-Packard sales office, distributor or representative call:

**Americas/Canada:** 1-800-235-0312 or 408-654-8675

**Far East/Australasia:** Call your local HP sales office.

**Japan:** (81 3) 3335-8152

**Europe:** Call your local HP sales office.

Data subject to change.  
Copyright © 1998 Hewlett-Packard Co.

Obsoletes 5965-8718E  
Printed in U.S.A. 5966-4979E (5/98)