

2–18 GHz Ultra Low Noise Pseudomorphic HEMT

Technical Data

Features

- **PHEMT Technology**
- **Ultra-Low Noise Figure:**
0.5 dB Typical at 12 GHz
0.3 dB Typical at 4 GHz
- **High Associated Gain:**
12 dB Typical at 12 GHz
17 dB Typical at 4 GHz
- **Low Parasitic Ceramic Microstrip Package**
- **Tape-and-Reel Packing Option Available**

Applications

- **12 GHz DBS LNB (Low Noise Block)**
- **4 GHz TVRO LNB (Low Noise Block)**
- **Ultra-Sensitive Low Noise Amplifiers**

Note: 1. See Noise Parameter Table.

Description

Hewlett-Packard's ATF-36077 is an ultra-low-noise Pseudomorphic High Electron Mobility Transistor (PHEMT), packaged in a low parasitic, surface-mountable ceramic package. Properly matched, this transistor will provide typical 12 GHz noise figures of 0.5 dB, or typical 4 GHz noise figures of 0.3 dB. Additionally, the ATF-36077 has very low noise resistance, reducing the sensitivity of noise performance to variations in input impedance match, making the design of broadband low noise amplifiers much easier. The premium sensitivity of the ATF-36077 makes this device the ideal choice for use in the first stage of extremely low noise cascades.

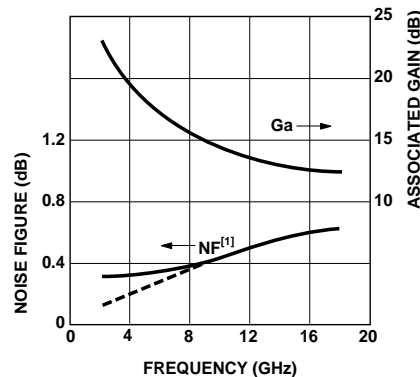
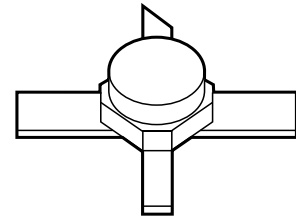


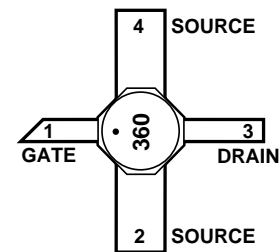
Figure 1. ATF-36077 Optimum Noise Figure and Associated Gain vs. Frequency for $V_{DS} = 1.5$ V, $I_D = 10$ mA.

ATF-36077

77 Package



Pin Configuration



The repeatable performance and consistency make it appropriate for use in Ku-band Direct Broadcast Satellite (DBS) Television systems, C-band Television Receive Only (TVRO) LNAs, or other low noise amplifiers operating in the 2-18 GHz frequency range.

This GaAs PHEMT device has a nominal 0.2 micron gate length with a total gate periphery (width) of 200 microns. Proven gold based metalization systems and nitride passivation assure rugged, reliable devices.

ATF-36077 Absolute Maximum Ratings

| Symbol | Parameter | Units | Absolute Maximum ^[1] |
|---------------------|--|-------|---------------------------------|
| V _{DS} | Drain – Source Voltage | V | +3 |
| V _{GS} | Gate – Source Voltage | V | -3 |
| V _{GD} | Gate-Drain Voltage | V | -3.5 |
| I _D | Drain Current | mA | I _{dss} |
| P _T | Total Power Dissipation ^[3] | mW | 180 |
| P _{in max} | RF Input Power | dBm | +10 |
| T _{ch} | Channel Temperature | °C | 150 |
| T _{STG} | Storage Temperature | °C | -65 to 150 |

Thermal Resistance^[2,3]:

$$\theta_{ch-c} = 60^{\circ}\text{C}/\text{W}$$

Notes:

1. Operation of this device above any one of these parameters may cause permanent damage.
2. Measured at P_{diss} = 15 mW and T_{ch} = 100°C.
3. Derate at 16.7 mW/°C for T_C > 139°C.

ATF-36077 Electrical Specifications,

T_C = 25°C, Z_O = 50 Ω, V_{ds} = 1.5 V, I_{ds} = 10 mA, (unless otherwise noted).

| Symbol | Parameters and Test Conditions | Units | Min. | Typ. | Max. |
|-------------------|--|-------|------|-------|-------|
| NF | Noise Figure ^[1] f = 12.0 GHz | dB | | 0.5 | 0.6 |
| G _A | Gain at NF ^[1] f = 12.0 GHz | dB | 11.0 | 12.0 | |
| g _m | Transconductance V _{DS} = 1.5 V, V _{GS} = 0 V | mS | 50 | 55 | |
| I _{dss} | Saturated Drain Current V _{DS} = 1.5 V, V _{GS} = 0 V | mA | 15 | 25 | 45 |
| V _{p10%} | Pinch-off Voltage V _{DS} = 1.5 V, I _{DS} = 10% of I _{dss} | V | -1.0 | -0.35 | -0.15 |

Note:

1. Measured in a fixed tuned environment with Γ source = 0.54 at 156°; Γ load = 0.48 at 167°.

ATF-36077 Characterization Information,

T_C = 25°C, Z_O = 50 Ω, V_{ds} = 1.5 V, I_{ds} = 10 mA, (unless otherwise noted).

| Symbol | Parameters and Test Conditions | Units | Typ. | |
|----------------------|---|-------------------------|--------------------|------|
| NF | Noise Figure (Tuned Circuit) | f = 4 GHz | 0.3 ^[2] | |
| | | f = 12 GHz | 0.5 | |
| G _A | Gain at Noise Figure (Tuned Circuit) | f = 4 GHz | 17 | |
| | | f = 12 GHz | 12 | |
| S _{12 off} | Reverse Isolation f = 12 GHz, V _{DS} = 1.5 V, V _{GS} = -2 V | dB | 14 | |
| P _{1dB} | Output Power at 1 dB Gain Compression | f = 4 GHz | 5 | |
| | | f = 12 GHz | 5 | |
| V _{GS10 mA} | Gate to Source Voltage for I _{DS} = 10 mA | V _{DS} = 1.5 V | V | -0.2 |

Note:

2. See noise parameter table.

ATF-36077 Typical Scattering Parameters,

Common Source, $Z_0 = 50 \Omega$, $V_{DS} = 1.5 \text{ V}$, $I_D = 10 \text{ mA}$

| Freq. GHz | S_{11} | | dB | S_{21} | | dB | S_{12} | | S_{22} | |
|--------------|----------|------|-------|----------|------|--------|----------|------|----------|------|
| | Mag. | Ang. | | Mag. | Ang. | | Mag. | Ang. | Mag. | Ang. |
| 1.0 | 0.99 | -17 | 14.00 | 5.010 | 163 | -36.08 | 0.016 | 78 | 0.60 | -14 |
| 2.0 | 0.97 | -33 | 13.81 | 4.904 | 147 | -30.33 | 0.030 | 66 | 0.59 | -28 |
| 3.0 | 0.94 | -49 | 13.53 | 4.745 | 132 | -27.25 | 0.043 | 54 | 0.57 | -41 |
| 4.0 | 0.90 | -65 | 13.17 | 4.556 | 116 | -25.32 | 0.054 | 43 | 0.55 | -54 |
| 5.0 | 0.86 | -79 | 12.78 | 4.357 | 102 | -24.04 | 0.063 | 33 | 0.53 | -66 |
| 6.0 | 0.82 | -93 | 12.39 | 4.162 | 88 | -23.17 | 0.069 | 24 | 0.50 | -78 |
| 7.0 | 0.78 | -107 | 12.00 | 3.981 | 75 | -22.58 | 0.074 | 16 | 0.48 | -89 |
| 8.0 | 0.75 | -120 | 11.64 | 3.820 | 62 | -22.17 | 0.078 | 8 | 0.46 | -99 |
| 9.0 | 0.72 | -133 | 11.32 | 3.682 | 49 | -21.90 | 0.080 | 1 | 0.44 | -109 |
| 10.0 | 0.69 | -146 | 11.04 | 3.566 | 37 | -21.71 | 0.082 | -6 | 0.42 | -119 |
| 11.0 | 0.66 | -159 | 10.81 | 3.473 | 25 | -21.57 | 0.083 | -13 | 0.40 | -129 |
| 12.0 | 0.63 | -172 | 10.63 | 3.401 | 13 | -21.44 | 0.085 | -19 | 0.38 | -139 |
| 13.0 | 0.61 | 175 | 10.50 | 3.349 | 1 | -21.32 | 0.086 | -25 | 0.37 | -149 |
| 14.0 | 0.60 | 161 | 10.41 | 3.315 | -12 | -21.19 | 0.087 | -32 | 0.35 | -160 |
| 15.0 | 0.58 | 147 | 10.36 | 3.296 | -24 | -21.04 | 0.089 | -39 | 0.33 | -171 |
| 16.0 | 0.57 | 131 | 10.34 | 3.289 | -37 | -20.87 | 0.091 | -47 | 0.31 | 177 |
| 17.0 | 0.56 | 114 | 10.34 | 3.289 | -50 | -20.69 | 0.092 | -55 | 0.29 | 164 |
| 18.0 | 0.57 | 97 | 10.35 | 3.291 | -64 | -20.53 | 0.094 | -65 | 0.26 | 148 |

ATF-36077 Typical “Off” Scattering Parameters,

Common Source, $Z_0 = 50 \Omega$, $V_{DS} = 1.5 \text{ V}$, $I_D = 0 \text{ mA}$, $V_{GS} = -2 \text{ V}$

| Freq. GHz | S_{11} | | dB | S_{21} | | dB | S_{21} | | S_{22} | |
|--------------|----------|------|-------|----------|------|-------|----------|------|----------|------|
| | Mag. | Ang. | | Mag. | Ang. | | Mag. | Ang. | Mag. | Ang. |
| 11.0 | 0.96 | -139 | -14.2 | 0.19 | -43 | -14.2 | 0.19 | -43 | 0.97 | -125 |
| 12.0 | 0.95 | -152 | -14.0 | 0.20 | -56 | -14.0 | 0.20 | -56 | 0.97 | -137 |
| 13.0 | 0.94 | -166 | -13.8 | 0.20 | -69 | -13.8 | 0.20 | -68 | 0.96 | -149 |

ATF-36077 Typical Noise Parameters,

Common Source, $Z_0 = 50 \Omega$, $V_{DS} = 1.5 \text{ V}$, $I_D = 10 \text{ mA}$

| Freq. GHz | $F_{min}^{[1]}$ dB | Γ_{opt} | | R_n/Z_0 - |
|--------------|-----------------------|----------------|------|----------------|
| | | Mag. | Ang. | |
| 1 | 0.30 | 0.95 | 12 | 0.40 |
| 2 | 0.30 | 0.90 | 25 | 0.20 |
| 4 | 0.30 | 0.81 | 51 | 0.17 |
| 6 | 0.30 | 0.73 | 76 | 0.13 |
| 8 | 0.37 | 0.66 | 102 | 0.09 |
| 10 | 0.44 | 0.60 | 129 | 0.05 |
| 12 | 0.50 | 0.54 | 156 | 0.03 |
| 14 | 0.56 | 0.48 | -174 | 0.02 |
| 16 | 0.61 | 0.43 | -139 | 0.05 |
| 18 | 0.65 | 0.39 | -100 | 0.09 |

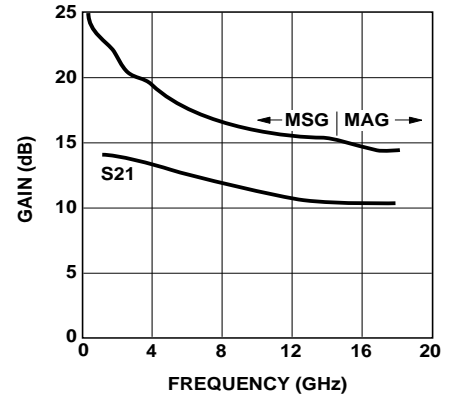
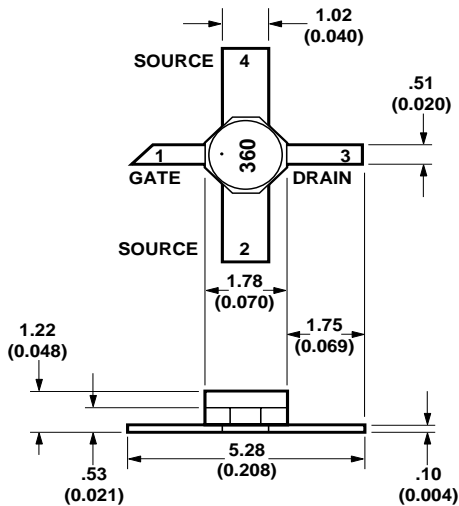


Figure 2. Maximum Available Gain, Maximum Stable Gain and Insertion Power Gain vs. Frequency. $V_{DS} = 1.5 \text{ V}$, $I_D = 10 \text{ mA}$.

Note:

- The F_{min} values at 2, 4, and 6 GHz have been adjusted to reflect expected circuit losses that will be encountered when matching to the optimum reflection coefficient (Γ_{opt}) at these frequencies. The theoretical F_{min} values for these frequencies are: 0.10 dB at 2 GHz, 0.20 dB at 4 GHz, and 0.29 dB at 6 GHz. Noise parameters are derived from associated s parameters, packaged device measurements at 12 GHz, and die level measurements from 6 to 18 GHz.

77 Package Dimensions



TYPICAL DIMENSIONS ARE IN MILLIMETERS (INCHES).

Part Number Ordering Information

| Part Number | No. of Devices | Container |
|------------------------------|----------------|-----------|
| ATF-36077-TR1 ^[2] | 1000 | 7" Reel |
| ATF-36077-STR | 10 | strip |

Note:

- For more information, see "Tape and Reel Packaging for Semiconductor Devices," in "Communications Components" Designer's Catalog.