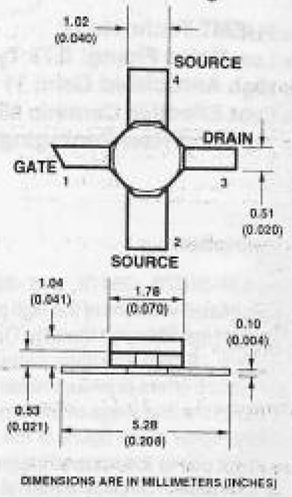
HEWLETT PACKARD

# ATF-35076, -35176, -35376
# 2-18 GHz Low Noise Pseudomorphic HEMT

## Features

- PHEMT Technology
- Low Noise Figure: 0.75 Typical at 12 GHz
- High Associated Gain: 11 dB Typical at 12 GHz
- Cost Effective Ceramic Microstrip Package
- Tape-and-Reel Packaging Option Available[1]

### 76 Package




## Description

The ATF-35076, -35176, and -35376 are noise performance differentiated versions of the high performance ATF-35 Pseudomorphic High Electron Mobility Transistor (PHEMT), housed in the Style 76 cost effective, ceramic microstrip package. The ATF-35076 offers premium noise figure and is an ideal choice for use in the first stage of extremely low noise cascades. The slightly higher noise figure of the ATF-35176 makes it appropriate for use in the second stage of premium cascades or as the first stage in amplifiers that have less critical noise requirements. The moderate noise performance of the ATF-35376 makes this part suitable for second stage use in low noise cascades. Although developed for use in Ku band DBS systems, these devices are also appropriate for use in C band TVRO LNAs or other low noise amplifiers operating in the 2 to 18 GHz frequency range.

These GaAs PHEMT devices have a nominal 0.25 micron gate length with a total gate periphery of 200 microns. Proven gold based metallization systems and nitride passivation assure rugged, reliable devices.

### Typical Noise Parameters: $V_{DS}$ = 1.5 V, $I_{DS}$ = 10 mA

| FREQ GHz | ATF-35076 $NF_O$ dB | ATF-35176 $NF_O$ dB | ATF-35376 $NF_O$ dB | $\Gamma_{OPT}$ MAG | $\Gamma_{OPT}$ ANG | $R_N/Z_O$ - |
|---|---|---|---|---|---|---|
| 2.0 | .13 | .14 | .17 | .82 | 23 | .23 |
| 4.0 | .25 | .28 | .33 | .74 | 43 | .19 |
| 6.0 | .38 | .43 | .50 | .62 | 69 | .13 |
| 8.0 | .50 | .57 | .67 | .57 | 89 | .10 |
| 10.0 | .63 | .71 | .83 | .51 | 115 | .07 |
| 12.0 | .75 | .85 | 1.00 | .44 | 140 | .05 |
| 14.0 | .88 | .99 | 1.17 | .42 | 164 | .04 |

$\Gamma_{OPT}$ and $R_N/Z_O$ apply equally to the ATF-35076, ATF-35176, and ATF-35376.

### Electrical Specifications, $T_A$ = 25°C

| Symbol | Parameters and Test Conditions | | Product | Unit | Min. | Typ. | Max. |
|---|---|---|---|---|---|---|---|
| $NF_O$ | Optimum Noise Figure: $V_{DS}$ = 1.5 V, $I_{DS}$ = 10 mA | f = 4.0 GHz | ATF-35076 | dB | | 0.25 | |
| | | f = 12 GHz | | dB | | 0.75 | 0.80 |
| $G_A$ | Gain @ $NF_O$: $V_{DS}$ = 1.5 V, $I_{DS}$ = 10 mA | f = 4.0 GHz | | dB | | 16.0 | |
| | | f = 12 GHz | | dB | 10.0 | 11.0 | |
| $NF_O$ | Optimum Noise Figure: $V_{DS}$ = 1.5 V, $I_{DS}$ = 10 mA | f = 4.0 GHz | ATF-35176 | dB | | 0.30 | |
| | | f = 12 GHz | | dB | | 0.85 | 0.90 |
| $G_A$ | Gain @ $NF_O$: $V_{DS}$ = 1.5 V, $I_{DS}$ = 10 mA | f = 4.0 GHz | | dB | | 16.0 | |
| | | f = 12 GHz | | dB | 10.0 | 11.0 | |
| $NF_O$ | Optimum Noise Figure: $V_{DS}$ = 1.5 V, $I_{DS}$ = 10 mA | f = 4.0 GHz | ATF-35376 | dB | | 0.40 | |
| | | f = 12 GHz | | dB | | 1.0 | 1.2 |
| $G_A$ | Gain @ $NF_O$: $V_{DS}$ = 1.5 V, $I_{DS}$ = 10 mA | f = 4.0 GHz | | dB | | 15.0 | |
| | | f = 12 GHz | | dB | 9.5 | 10.0 | |
| $g_m$ | Transconductance: $V_{DS}$ = 1.5 V, $V_{GS}$ = 0 V | | | mS | 40 | 65 | |
| $I_{dss}$ | Saturated Drain Current: $V_{DS}$ = 1.5 V, $V_{GS}$ = 0 V | | | mA | 20 | 50 | 70 |
| $V_P$ | Pinchoff Voltage: $V_{DS}$ = 1.5 V, $I_{DS}$ = 1 mA | | | V | -2.0 | -0.4 | |

## Absolute Maximum Ratings

| Parameter | Symbol | Absolute Maximum[1] |
|---|---|---|
| Drain-Source Voltage | $V_{DS}$ | +4 V |
| Gate-Source Voltage | $V_{GS}$ | -3 V |
| Drain Current | $I_D$ | $I_{dss}$ |
| Total Power Dissipation [2,3] | $P_T$ | 225 mW |
| RF Input Power | $P_{IN\,max}$ | +10 dBm |
| Channel Temperature | $T_{CH}$ | 150°C |
| Storage Temperature | $T_{STG}$ | -65 to 150°C |

Thermal Resistance 2: $\theta_{jc}$=325 °C/W; $T_{CH}$=150°C
Liquid Crystal Measurement: 1 µm Spot Size 4

**Notes:**
1. Operation of this device above any one of these limits may cause permanent damage.
2. $T_{case}$ = 25°C
3. Derate at 3.2 mW/ °C for $T_C$>102°C
4. The small spot size of this technique results in a higher, though more accurate determination of $\theta_{jc}$ than alternate methods.

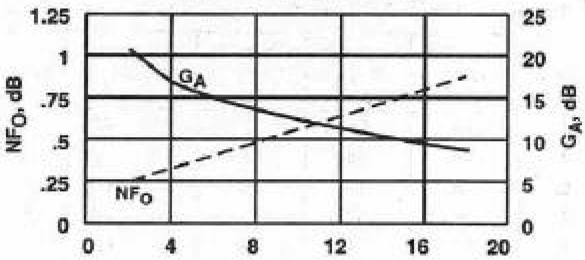
## Part Number Order Information

| Part Number | Devices Per Reel | Reel Size |
|---|---|---|
| ATF-35076-TR1 | 1000 | 7" |
| ATF-35076-TR2 | 4000 | 13" |
| ATF-35076-STR | 1 | strip |
| ATF-35176-TR1 | 1000 | 7" |
| ATF-35176-TR2 | 4000 | 13" |
| ATF-35176-STR | 1 | strip |
| ATF-35376-TR1 | 1000 | 7" |
| ATF-35376-TR2 | 4000 | 13" |
| ATF-35376-STR | 1 | strip |

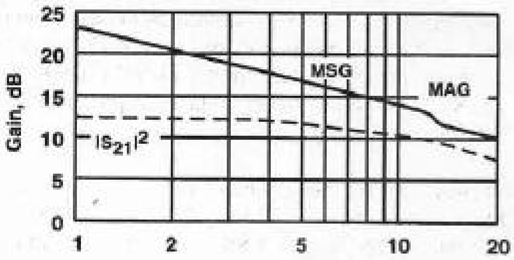
For more information, see "Tape and Reel Packaging for Semiconductor Devices", page 14-14.

## Typical Performance, $T_A$ = 25°C, (Unless otherwise noted)

**Noise Figure and Associated Gain vs. Frequency (ATF-35076)**
**$V_{DS}$ = 1.5 V, $I_{DS}$ = 10 mA**




**Insertion Power Gain, Maximum Available Gain and Maximum Stable Gain vs. Frequency**
**$V_{DS}$ = 1.5 V, $I_{DS}$ = 10 mA**




## Typical Scattering Parameters: Common Source, $Z_o$ = 50 Ω

$T_A$ = 25°C, $V_{DS}$ = 1.5 V, $I_{DS}$ = 10 mA

| Freq. GHz | $S_{11}$ Mag | $S_{11}$ Ang | $S_{21}$ dB | $S_{21}$ Mag | $S_{21}$ Ang | $S_{12}$ dB | $S_{12}$ Mag | $S_{12}$ Ang | $S_{22}$ Mag | $S_{22}$ Ang |
|---|---|---|---|---|---|---|---|---|---|---|
| 2.0 | .98 | -31 | 12.69 | 4.10 | 149 | -29.11 | .035 | 67 | .49 | -24 |
| 3.0 | .95 | -43 | 12.13 | 4.04 | 137 | -25.85 | .051 | 59 | .47 | -33 |
| 4.0 | .92 | -60 | 12.06 | 4.01 | 122 | -23.48 | .067 | 48 | .45 | -45 |
| 5.0 | .88 | -76 | 11.84 | 3.91 | 106 | -21.94 | .080 | 36 | .41 | -58 |
| 6.0 | .83 | -92 | 11.51 | 3.76 | 91 | -20.82 | .091 | 26 | .38 | -70 |
| 7.0 | .79 | -108 | 11.22 | 3.64 | 77 | -20.00 | .100 | 16 | .35 | -83 |
| 8.0 | .76 | -119 | 10.95 | 3.53 | 67 | -19.33 | .108 | 10 | .32 | -90 |
| 9.0 | .73 | -134 | 10.66 | 3.41 | 53 | -18.86 | .114 | 0 | .29 | -102 |
| 10.0 | .70 | -149 | 10.32 | 3.28 | 39 | -18.42 | .120 | -10 | .27 | -114 |
| 11.0 | .66 | -164 | 10.01 | 3.17 | 26 | -18.20 | .123 | -20 | .24 | -127 |
| 12.0 | .63 | -179 | 9.75 | 3.07 | 13 | -17.86 | .128 | -29 | .22 | -139 |
| 13.0 | .61 | 166 | 9.57 | 3.01 | 09 | -17.79 | .129 | -39 | .20 | -150 |
| 14.0 | .60 | 155 | 9.37 | 2.94 | -83 | -17.65 | .131 | -43 | .16 | -158 |
| 15.0 | .59 | 140 | 9.17 | 2.88 | -22 | -17.52 | .133 | -54 | .14 | -170 |
| 16.0 | .57 | 124 | 8.91 | 2.79 | -35 | -17.46 | .134 | -65 | .11 | 178 |
| 17.0 | .55 | 108 | 8.82 | 2.76 | -50 | -17.20 | .138 | -76 | .07 | 166 |
| 18.0 | .54 | 88 | 8.77 | 2.75 | -64 | -17.02 | .141 | -89 | .04 | 131 |

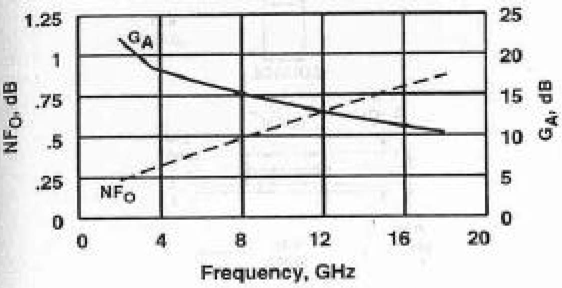
The above S parameter description applies equally to the ATF-35076, -35176, and -35376.

## ATF-35 Series Pseudomorphic HEMT

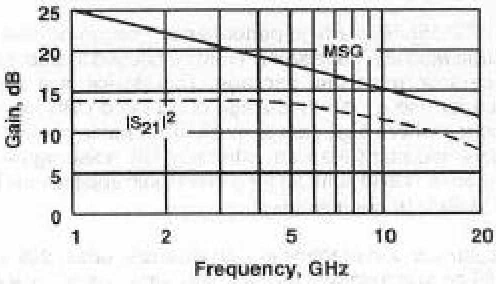
For the ATF-35 Series PHEMTs, increasing I ds from 10 mA to 20 mA has the effect of increasing gain at 12 GHz by approximately 1 dB without significantly altering noise performance. Designers having the flexibility to operate at this higher bias current may want to take advantage of this feature. 20 mA S parameter data follows. Since device capacitances vary little with bias current, the 10 mA noise parameters may also be used to describe 20 mA noise performance.

## Typical Performance, $T_A$ = 25°C, (Unless otherwise noted)

**Noise Figure and Associated Gain vs. Frequency (ATF-35076) $V_{DS}$ = 1.5 V, $I_{DS}$ = 20 mA**




**Insertion Power Gain and Maximum Stable Gain vs. Frequency $V_{DS}$ = 1.5 V, $I_{DS}$ = 20 mA**




## Typical Scattering Parameters: Common Source, $Z_o$ = 50 Ω $T_A$ = 25°C, $V_{DS}$ = 1.5 V, $I_{DS}$ = 20 mA

| Freq. | $S_{11}$ | | $S_{21}$ | | | $S_{12}$ | | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|---|---|
| GHz | Mag | Ang | dB | Mag | Ang | dB | Mag | Ang | Mag | Ang |
| 2.0 | .97 | -33 | 13.89 | 4.95 | 147 | -29.62 | .033 | 68 | .41 | -24 |
| 3.0 | .95 | -45 | 13.76 | 4.88 | 135 | -26.56 | .047 | 60 | .40 | -33 |
| 4.0 | .91 | -62 | 13.57 | 4.77 | 119 | -24.44 | .060 | 50 | .37 | -45 |
| 5.0 | .86 | -79 | 13.20 | 4.57 | 103 | -22.73 | .073 | 38 | .33 | -57 |
| 6.0 | .80 | -95 | 12.75 | 4.34 | 88 | -21.72 | .082 | 28 | .30 | -69 |
| 7.0 | .76 | -110 | 12.34 | 4.14 | 74 | -20.82 | .091 | 19 | .27 | -82 |
| 8.0 | .74 | -121 | 12.07 | 4.01 | 65 | -20.09 | .099 | 14 | .24 | -90 |
| 9.0 | .71 | -135 | 11.75 | 3.87 | 51 | -19.66 | .104 | 5 | .22 | -102 |
| 10.0 | .67 | -150 | 11.35 | 3.70 | 37 | -19.17 | .110 | -5 | .20 | -113 |
| 11.0 | .62 | -164 | 10.95 | 3.53 | 24 | -18.86 | .114 | -14 | .17 | -123 |
| 12.0 | .59 | -178 | 10.63 | 3.40 | 11 | -18.42 | .120 | -23 | .15 | -138 |
| 13.0 | .57 | 167 | 10.47 | 3.34 | -2 | -18.20 | .123 | -33 | .14 | -152 |
| 14.0 | .56 | 156 | 10.32 | 3.28 | -9 | -17.99 | .126 | -37 | .12 | -164 |
| 15.0 | .54 | 140 | 10.10 | 3.20 | -23 | -17.92 | .127 | -47 | .10 | -173 |
| 16.0 | .52 | 125 | 9.82 | 3.10 | -37 | -17.65 | .131 | -58 | .06 | -179 |
| 17.0 | .49 | 107 | 9.70 | 3.05 | -51 | -17.39 | .135 | -70 | .03 | 165 |
| 18.0 | .50 | 88 | 9.72 | 3.06 | -66 | -17.08 | .140 | -82 | .03 | 53 |

The above S parameter description applies equally to the ATF-35076, -35176, and -35376.