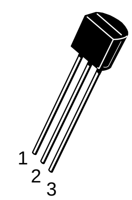
# JFET VHF/UHF Amplifiers

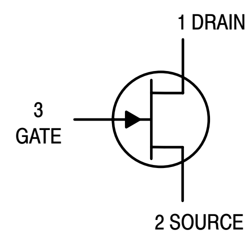
## N–Channel — Depletion

**J308**
**J309**
**J310**

ON Semiconductor Preferred Devices




CASE 29–11, STYLE 5
TO–92 (TO–226AA)




**MAXIMUM RATINGS**

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Drain–Source Voltage | $V_{DS}$ | 25 | Vdc |
| Gate–Source Voltage | $V_{GS}$ | 25 | Vdc |
| Forward Gate Current | $I_{GF}$ | 10 | mAdc |
| Total Device Dissipation @ $T_A$ = 25°C<br>Derate above 25°C | $P_D$ | 350<br>2.8 | mW<br>mW/°C |
| Junction Temperature Range | $T_J$ | –65 to +125 | °C |
| Storage Temperature Range | $T_{stg}$ | –65 to +150 | °C |

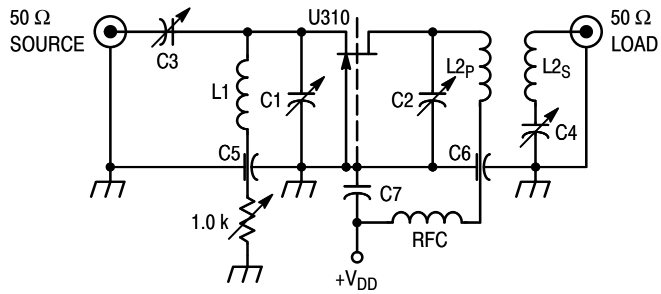
**ELECTRICAL CHARACTERISTICS** ($T_A$ = 25°C unless otherwise noted)

| Characteristic | | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | |
| Gate–Source Breakdown Voltage<br>($I_G$ = –1.0 µAdc, $V_{DS}$ = 0) | | $V_{(BR)GSS}$ | –25 | — | — | Vdc |
| Gate Reverse Current<br>($V_{GS}$ = –15 Vdc, $V_{DS}$ = 0, $T_A$ = 25°C)<br>($V_{GS}$ = –15 Vdc, $V_{DS}$ = 0, $T_A$ = +125°C) | | $I_{GSS}$ | <br>—<br>— | <br>—<br>— | <br>–1.0<br>–1.0 | <br>nAdc<br>µAdc |
| Gate Source Cutoff Voltage<br>($V_{DS}$ = 10 Vdc, $I_D$ = 1.0 nAdc) | <br>J308<br>J309<br>J310 | $V_{GS(off)}$ | <br>–1.0<br>–1.0<br>–2.0 | <br>—<br>—<br>— | <br>–6.5<br>–4.0<br>–6.5 | Vdc |
| **ON CHARACTERISTICS** | | | | | | |
| Zero–Gate–Voltage Drain Current(1)<br>($V_{DS}$ = 10 Vdc, $V_{GS}$ = 0) | <br>J308<br>J309<br>J310 | $I_{DSS}$ | <br>12<br>12<br>24 | <br>—<br>—<br>— | <br>60<br>30<br>60 | mAdc |
| Gate–Source Forward Voltage<br>($V_{DS}$ = 0, $I_G$ = 1.0 mAdc) | | $V_{GS(f)}$ | — | — | 1.0 | Vdc |

| Characteristic | | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **SMALL–SIGNAL CHARACTERISTICS** | | | | | | |
| Common–Source Input Conductance ($V_{DS}$ = 10 Vdc, $I_D$ = 10 mAdc, f = 100 MHz) | J308<br>J309<br>J310 | $Re(y_{is})$ | —<br>—<br>— | 0.7<br>0.7<br>0.5 | —<br>—<br>— | mmhos |
| Common–Source Output Conductance ($V_{DS}$ = 10 Vdc, $I_D$ = 10 mAdc, f = 100 MHz) | | $Re(y_{os})$ | — | 0.25 | — | mmhos |
| Common–Gate Power Gain ($V_{DS}$ = 10 Vdc, $I_D$ = 10 mAdc, f = 100 MHz) | | $G_{pg}$ | — | 16 | — | dB |

1. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 3.0%.

| Characteristic | | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **SMALL–SIGNAL CHARACTERISTICS (continued)** | | | | | | |
| Common–Source Forward Transconductance ($V_{DS}$ = 10 Vdc, $I_D$ = 10 mAdc, f = 100 MHz) | | $Re(y_{fs})$ | — | 12 | — | mmhos |
| Common–Gate Input Conductance ($V_{DS}$ = 10 Vdc, $I_D$ = 10 mAdc, f = 100 MHz) | | $Re(y_{ig})$ | — | 12 | — | mmhos |
| Common–Source Forward Transconductance ($V_{DS}$ = 10 Vdc, $I_D$ = 10 mAdc, f = 1.0 kHz) | J308<br>J309<br>J310 | $g_{fs}$ | 8000<br>10000<br>8000 | —<br>—<br>— | 20000<br>20000<br>18000 | μmhos |
| Common–Source Output Conductance ($V_{DS}$ = 10 Vdc, $I_D$ = 10 mAdc, f = 1.0 kHz) | | $g_{os}$ | — | — | 250 | μmhos |
| Common–Gate Forward Transconductance ($V_{DS}$ = 10 Vdc, $I_D$ = 10 mAdc, f = 1.0 kHz) | J308<br>J309<br>J310 | $g_{fg}$ | —<br>—<br>— | 13000<br>13000<br>12000 | —<br>—<br>— | μmhos |
| Common–Gate Output Conductance ($V_{DS}$ = 10 Vdc, $I_D$ = 10 mAdc, f = 1.0 kHz) | J308<br>J309<br>J310 | $g_{og}$ | —<br>—<br>— | 150<br>100<br>150 | —<br>—<br>— | μmhos |
| Gate–Drain Capacitance ($V_{DS}$ = 0, $V_{GS}$ = –10 Vdc, f = 1.0 MHz) | | $C_{gd}$ | — | 1.8 | 2.5 | pF |
| Gate–Source Capacitance ($V_{DS}$ = 0, $V_{GS}$ = –10 Vdc, f = 1.0 MHz) | | $C_{gs}$ | — | 4.3 | 5.0 | pF |
| **FUNCTIONAL CHARACTERISTICS** | | | | | | |
| Noise Figure ($V_{DS}$ = 10 Vdc, $I_D$ = 10 mAdc, f = 450 MHz) | | NF | — | 1.5 | — | dB |
| Equivalent Short–Circuit Input Noise Voltage ($V_{DS}$ = 10 Vdc, $I_D$ = 10 mAdc, f = 100 Hz) | | $\bar{e}_n$ | — | 10 | — | $nV/\sqrt{Hz}$ |




C1 = C2 = 0.8 – 10 pF, JFD #MVM010W.
C3 = C4 = 8.35 pF Erie #539–002D.
C5 = C6 = 5000 pF Erie (2443–000).
C7 = 1000 pF, Allen Bradley #FA5C.
RFC = 0.33 μH Miller #9230–30.
L1 = One Turn #16 Cu, 1/4″ I.D. (Air Core).
$L2_P$ = One Turn #16 Cu, 1/4″ I.D. (Air Core).
$L2_S$ = One Turn #16 Cu, 1/4″ I.D. (Air Core).

**Figure 1. 450 MHz Common–Gate Amplifier Test Circuit**

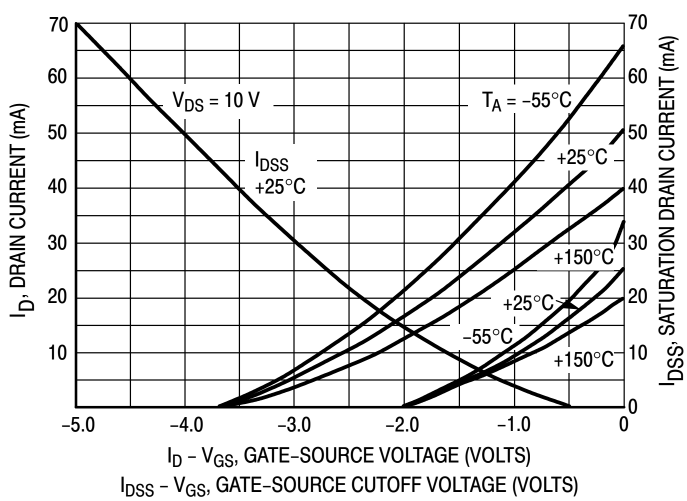



**Figure 2. Drain Current and Transfer Characteristics versus Gate–Source Voltage**

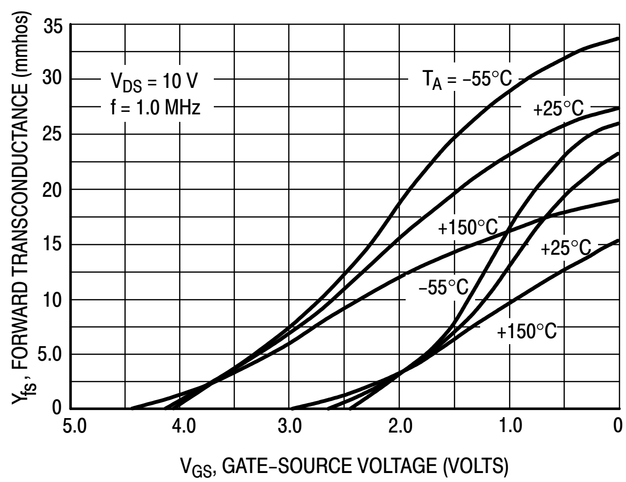



**Figure 3. Forward Transconductance versus Gate–Source Voltage**

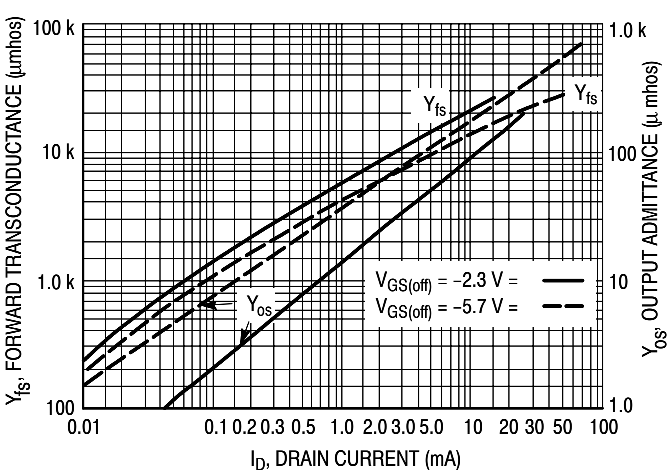



**Figure 4. Common–Source Output Admittance and Forward Transconductance versus Drain Current**

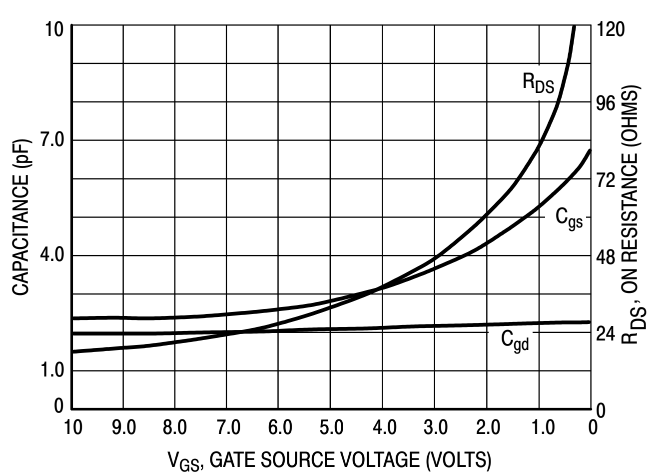



**Figure 5. On Resistance and Junction Capacitance versus Gate–Source Voltage**

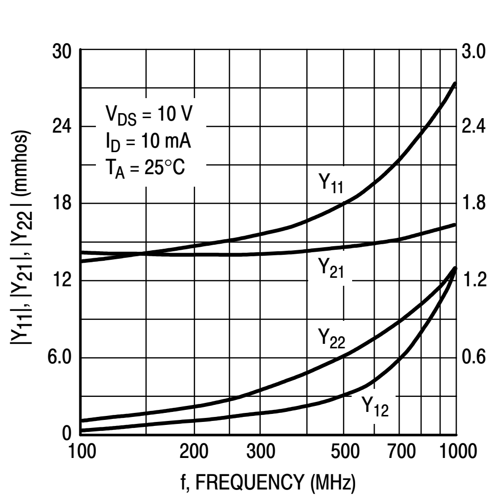



**Figure 6. Common−Gate Y Parameter Magnitude versus Frequency**

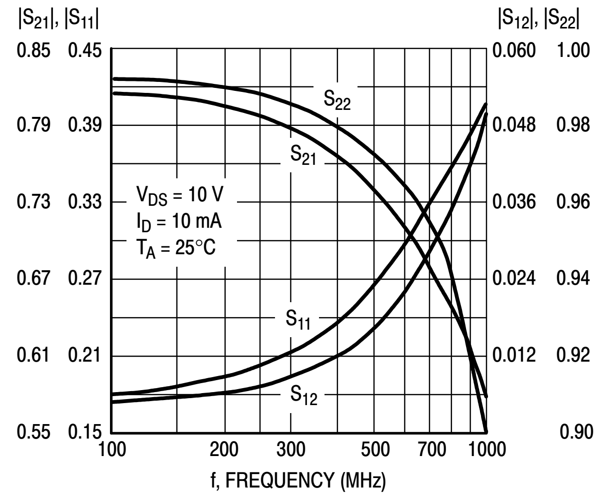



**Figure 7. Common−Gate S Parameter Magnitude versus Frequency**

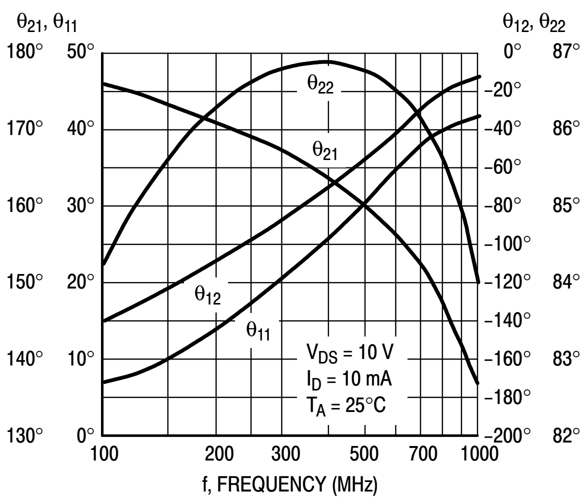



**Figure 8. Common−Gate Y Parameter Phase−Angle versus Frequency**

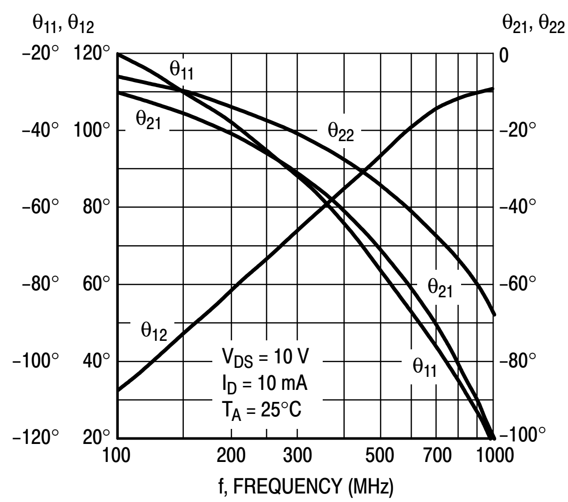



**Figure 9. S Parameter Phase−Angle versus Frequency**

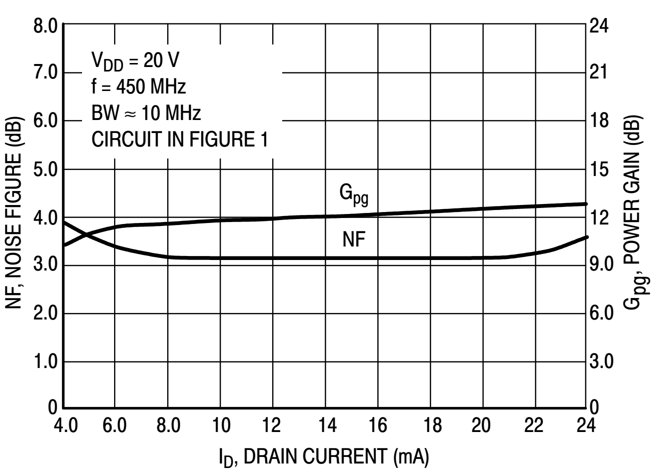



**Figure 10. Noise Figure and Power Gain versus Drain Current**

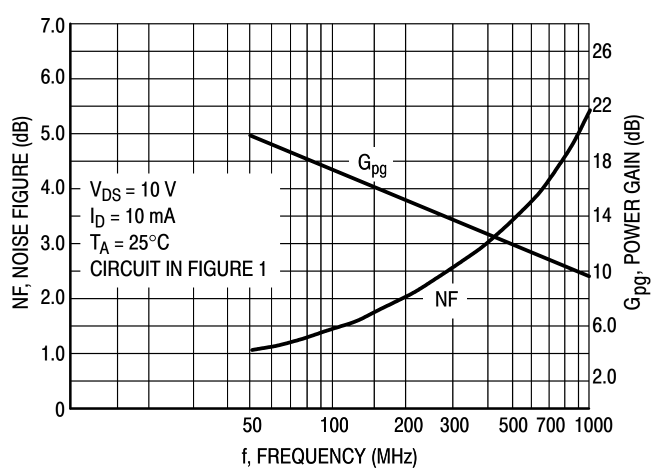
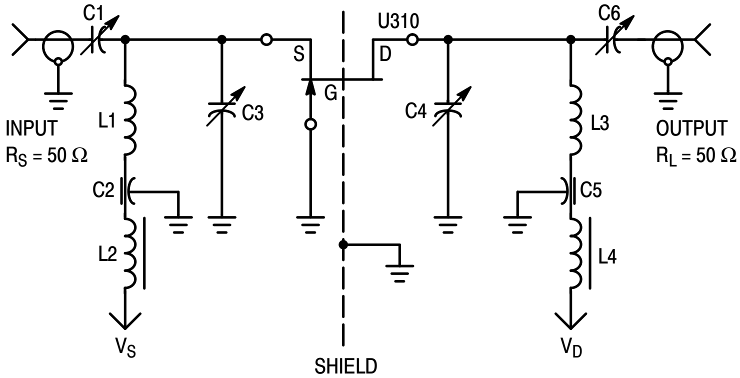


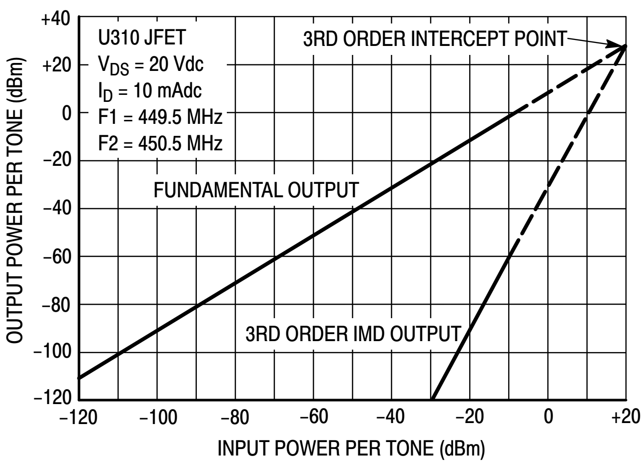

**Figure 11. Noise Figure and Power Gain versus Frequency**




$B_W$ (3 dB) – 36.5 MHz
$I_D$ – 10 mAdc
$V_{DS}$ – 20 Vdc
Device case grounded
IM test tones – f1 = 449.5 MHz, f2 = 450.5 MHz
C1 = 1–10 pF Johanson Air variable trimmer.
C2, C5 = 100 pF feed thru button capacitor.
C3, C4, C6 = 0.5–6 pF Johanson Air variable trimmer.
L1 = 1/8″ x 1/32″ x 1–5/8″ copper bar.
L2, L4 = Ferroxcube Vk200 choke.
L3 = 1/8″ x 1/32″ x 1–7/8″ copper bar.

**Figure 12. 450 MHz IMD Evaluation Amplifier**

Amplifier power gain and IMD products are a function of the load impedance. For the amplifier design shown above with C4 and C6 adjusted to reflect a load to the drain resulting in a nominal power gain of 9 dB, the 3rd order intercept point (IP) value is 29 dBm. Adjusting C4, C6 to provide larger load values will result in higher gain, smaller bandwidth and lower IP values. For example, a nominal gain of 13 dB can be achieved with an intercept point of 19 dBm.

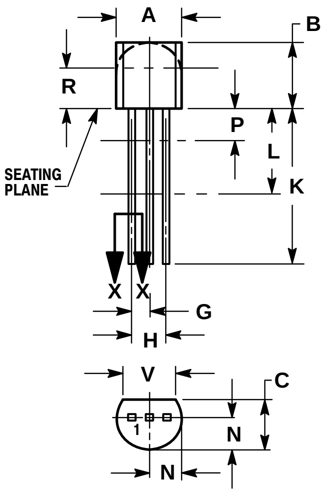


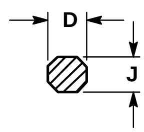

Example of intercept point plot use:
Assume two in–band signals of –20 dBm at the amplifier input. They will result in a 3rd order IMD signal at the output of –90 dBm. Also, each signal level at the output will be –11 dBm, showing an amplifier gain of 9.0 dB and an intermodulation ratio (IMR) capability of 79 dB. The gain and IMR values apply only for signal levels below comparison.

**Figure 13. Two Tone 3rd Order Intercept Point**

## PACKAGE DIMENSIONS

### TO–92 (TO–226AA)
### CASE 29–11
### ISSUE AL




SECTION X–X

NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
4. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 0.175 | 0.205 | 4.45 | 5.20 |
| B | 0.170 | 0.210 | 4.32 | 5.33 |
| C | 0.125 | 0.165 | 3.18 | 4.19 |
| D | 0.016 | 0.021 | 0.407 | 0.533 |
| G | 0.045 | 0.055 | 1.15 | 1.39 |
| H | 0.095 | 0.105 | 2.42 | 2.66 |
| J | 0.015 | 0.020 | 0.39 | 0.50 |
| K | 0.500 | --- | 12.70 | --- |
| L | 0.250 | --- | 6.35 | --- |
| N | 0.080 | 0.105 | 2.04 | 2.66 |
| P | --- | 0.100 | --- | 2.54 |
| R | 0.115 | --- | 2.93 | --- |
| V | 0.135 | --- | 3.43 | --- |

STYLE 5:
PIN 1. DRAIN
2. SOURCE
3. GATE

# Notes

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