

# JFET VHF/UHF Amplifiers

## N-Channel — Depletion

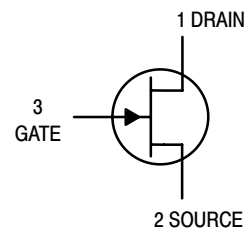
**J308**  
**J309**  
**J310**

ON Semiconductor Preferred Devices

### 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 @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	350 2.8	mW mW/°C
Junction Temperature Range	$T_J$	-65 to +125	°C
Storage Temperature Range	$T_{stg}$	-65 to +150	°C

**CASE 29–11, STYLE 5**  
**TO–92 (TO–226AA)**



### ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

Gate–Source Breakdown Voltage ( $I_G = -1.0 \mu\text{Adc}$ , $V_{DS} = 0$ )	$V_{(BR)GSS}$	-25	—	—	Vdc
Gate Reverse Current ( $V_{GS} = -15 \text{ Vdc}$ , $V_{DS} = 0$ , $T_A = 25^\circ\text{C}$ ) ( $V_{GS} = -15 \text{ Vdc}$ , $V_{DS} = 0$ , $T_A = +125^\circ\text{C}$ )	$I_{GSS}$	— —	— —	-1.0 -1.0	nAdc $\mu\text{Adc}$
Gate Source Cutoff Voltage ( $V_{DS} = 10 \text{ Vdc}$ , $I_D = 1.0 \text{ nAdc}$ )	$V_{GS(off)}$	-1.0 -1.0 -2.0	— — —	-6.5 -4.0 -6.5	Vdc

### ON CHARACTERISTICS

Zero–Gate–Voltage Drain Current <sup>(1)</sup> ( $V_{DS} = 10 \text{ Vdc}$ , $V_{GS} = 0$ )	$I_{DSS}$	12 12 24	— — —	60 30 60	mAdc
Gate–Source Forward Voltage ( $V_{DS} = 0$ , $I_G = 1.0 \text{ mAdc}$ )	$V_{GS(f)}$	—	—	1.0	Vdc

# J308 J309 J310

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

1. Pulse Test: Pulse Width  $\leq 300 \mu\text{s}$ , Duty Cycle  $\leq 3.0\%$ .

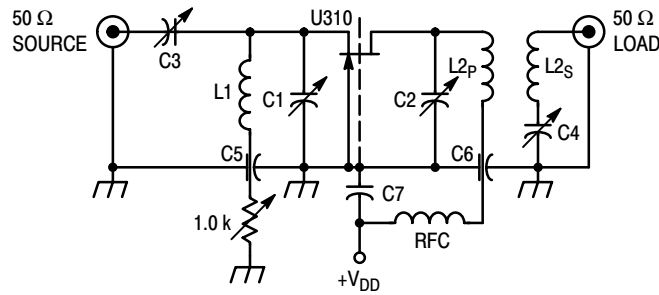
## SMALL-SIGNAL CHARACTERISTICS (continued)

Common-Source Forward Transconductance ( $V_{DS} = 10 \text{ Vdc}$ , $I_D = 10 \text{ mAdc}$ , $f = 100 \text{ MHz}$ )		$\text{Re}(y_{fs})$	—	12	—	mmhos
Common-Gate Input Conductance ( $V_{DS} = 10 \text{ Vdc}$ , $I_D = 10 \text{ mAdc}$ , $f = 100 \text{ MHz}$ )		$\text{Re}(y_{ig})$	—	12	—	mmhos
Common-Source Forward Transconductance ( $V_{DS} = 10 \text{ Vdc}$ , $I_D = 10 \text{ mAdc}$ , $f = 1.0 \text{ kHz}$ )	J308 J309 J310	$g_{fs}$	8000 10000 8000	— — —	20000 20000 18000	$\mu\text{mhos}$
Common-Source Output Conductance ( $V_{DS} = 10 \text{ Vdc}$ , $I_D = 10 \text{ mAdc}$ , $f = 1.0 \text{ kHz}$ )		$g_{os}$	—	—	250	$\mu\text{mhos}$
Common-Gate Forward Transconductance ( $V_{DS} = 10 \text{ Vdc}$ , $I_D = 10 \text{ mAdc}$ , $f = 1.0 \text{ kHz}$ )	J308 J309 J310	$g_{fg}$	— — —	13000 13000 12000	— — —	$\mu\text{mhos}$
Common-Gate Output Conductance ( $V_{DS} = 10 \text{ Vdc}$ , $I_D = 10 \text{ mAdc}$ , $f = 1.0 \text{ kHz}$ )	J308 J309 J310	$g_{og}$	— — —	150 100 150	— — —	$\mu\text{mhos}$
Gate-Drain Capacitance ( $V_{DS} = 0$ , $V_{GS} = -10 \text{ Vdc}$ , $f = 1.0 \text{ MHz}$ )		$C_{gd}$	—	1.8	2.5	pF
Gate-Source Capacitance ( $V_{DS} = 0$ , $V_{GS} = -10 \text{ Vdc}$ , $f = 1.0 \text{ MHz}$ )		$C_{gs}$	—	4.3	5.0	pF

## FUNCTIONAL CHARACTERISTICS

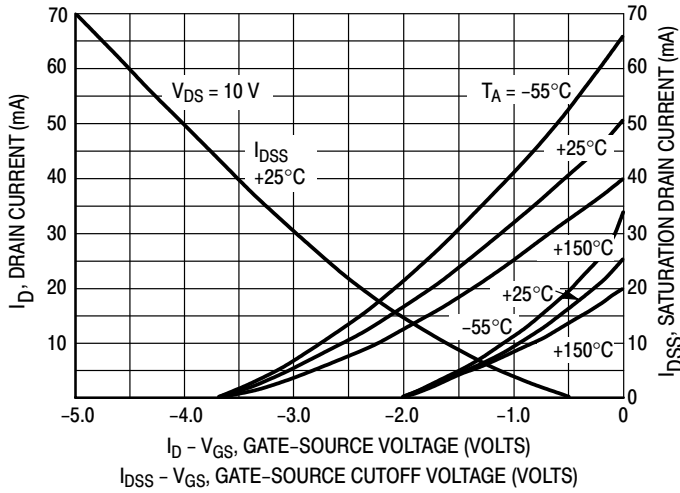
Noise Figure ( $V_{DS} = 10 \text{ Vdc}$ , $I_D = 10 \text{ mAdc}$ , $f = 450 \text{ MHz}$ )	NF	—	1.5	—	dB
Equivalent Short-Circuit Input Noise Voltage ( $V_{DS} = 10 \text{ Vdc}$ , $I_D = 10 \text{ mAdc}$ , $f = 100 \text{ Hz}$ )	$\bar{e}_n$	—	10	—	$\text{nV}/\sqrt{\text{Hz}}$

# J308 J309 J310

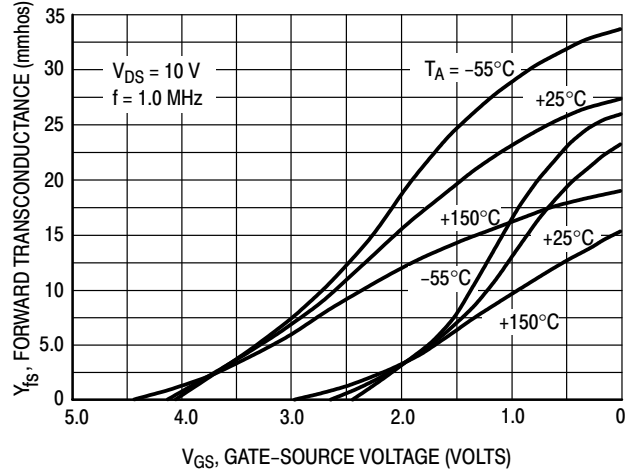


C1 = C2 = 0.8 – 10 pF, JFD #MVM010W.  
 C3 = C4 = 8.35 pF Erie #539-002D.  
 C5 = C6 = 5000 pF Erie (2443-000).  
 C7 = 1000 pF, Allen Bradley #FA5C.  
 RFC = 0.33 μH Miller #9230-30.  
 L1 = One Turn #16 Cu, 1/4" I.D. (Air Core).  
 L2<sub>P</sub> = One Turn #16 Cu, 1/4" I.D. (Air Core).  
 L2<sub>S</sub> = One Turn #16 Cu, 1/4" I.D. (Air Core).

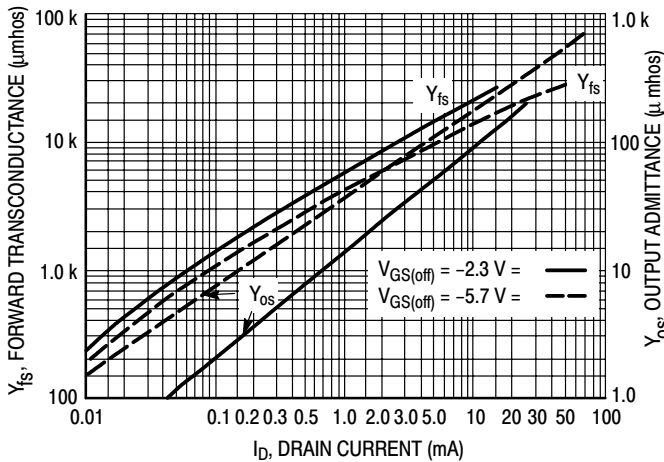
**Figure 1. 450 MHz Common-Gate Amplifier Test Circuit**



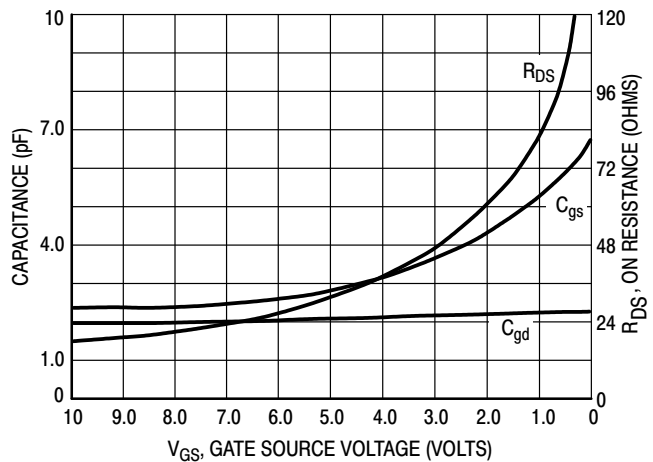
**Figure 2. Drain Current and Transfer Characteristics versus Gate-Source Voltage**



**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**

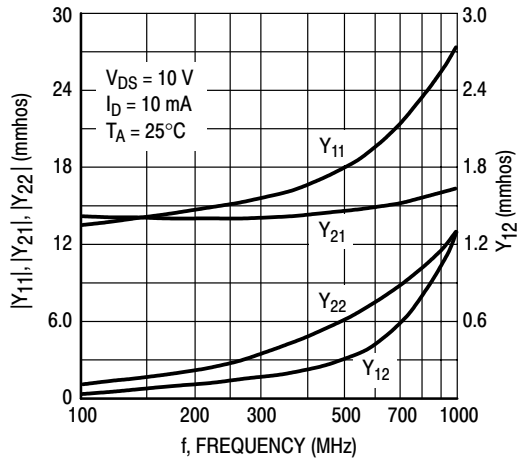


Figure 6. Common-Gate Y Parameter Magnitude versus Frequency

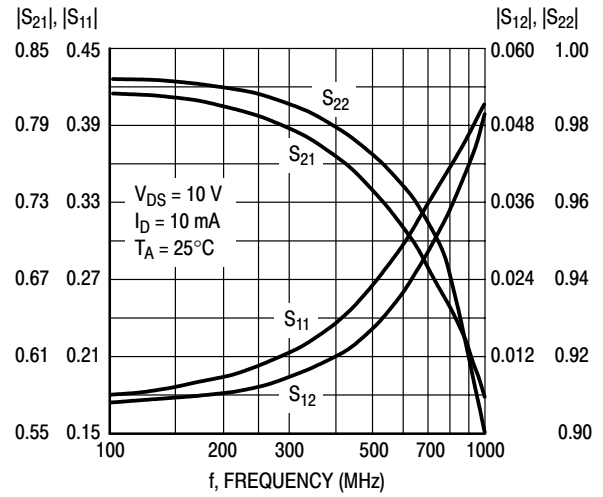


Figure 7. Common-Gate S Parameter Magnitude versus Frequency

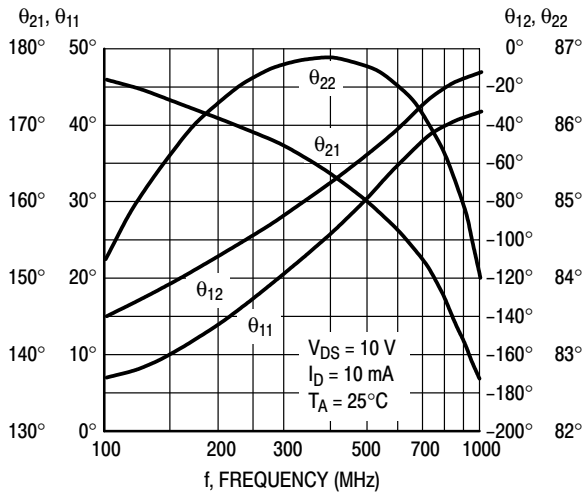


Figure 8. Common-Gate Y Parameter Phase-Angle versus Frequency

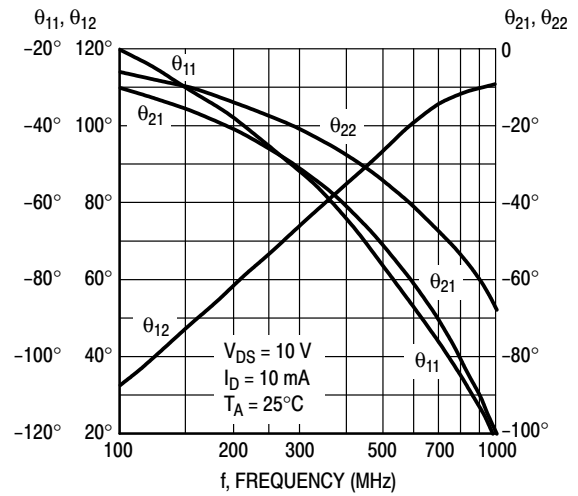


Figure 9. S Parameter Phase-Angle versus Frequency

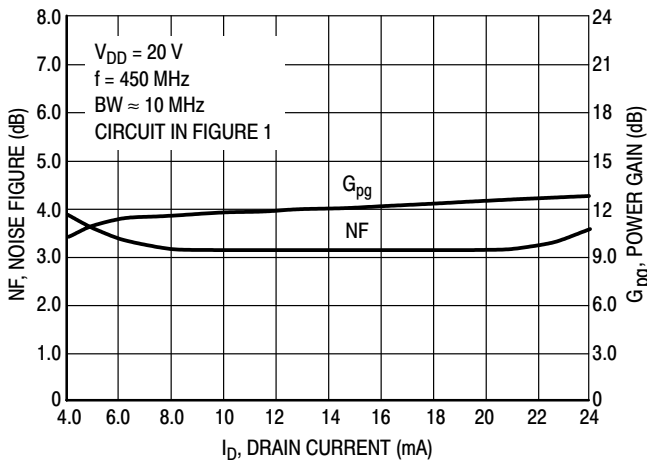


Figure 10. Noise Figure and Power Gain versus Drain Current

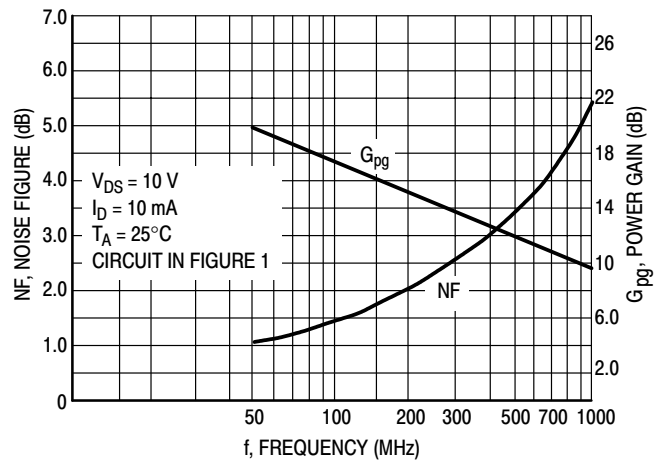
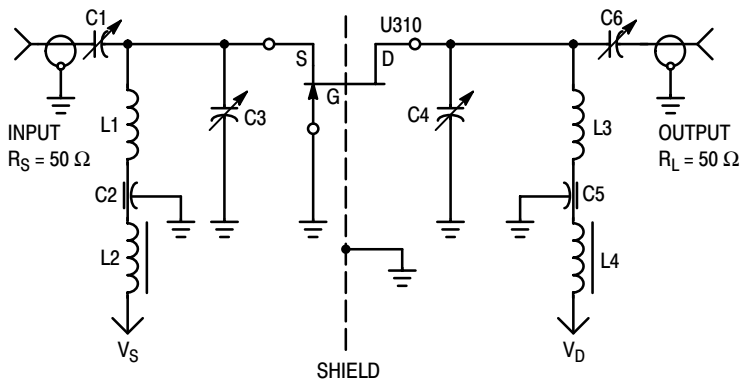


Figure 11. Noise Figure and Power Gain versus Frequency

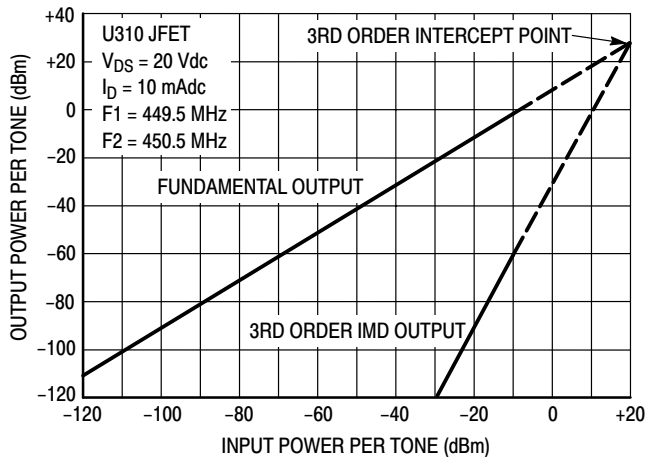
## J308 J309 J310



$B_W$  (3 dB) – 36.5 MHz  
 $I_D$  – 10 mAdc  
 $V_{DS}$  – 20 Vdc  
 Device case grounded  
 IM test tones –  $f_1 = 449.5$  MHz,  $f_2 = 450.5$  MHz  
 $C_1 = 1$ –10 pF Johanson Air variable trimmer.  
 $C_2, C_5 = 100$  pF feed thru button capacitor.  
 $C_3, C_4, C_6 = 0.5$ –6 pF Johanson Air variable trimmer.  
 $L_1 = 1/8'' \times 1/32'' \times 1$ –5/8'' copper bar.  
 $L_2, L_4 =$  Ferroxcube Vk200 choke.  
 $L_3 = 1/8'' \times 1/32'' \times 1$ –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  $C_4$  and  $C_6$  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  $C_4, C_6$  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:

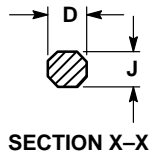
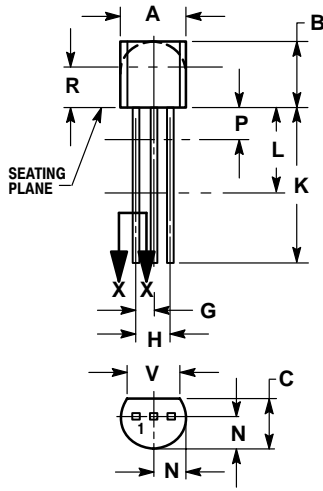
Assume two in-band signals of  $-20$  dBm at the amplifier input. They will result in a 3rd order IMD signal at the output of  $-90$  dBm. Also, each signal level at the output will be  $-11$  dBm, showing an amplifier gain of 9.0 dB and an intermodulation ratio (IMR) capability of 79 dB. The gain and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

Figure 13. Two Tone 3rd Order Intercept Point

# J308 J309 J310

## PACKAGE DIMENSIONS

TO-92 (TO-226AA)  
CASE 29-11  
ISSUE AL




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

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.

DIM	INCHES		MILLIMETERS	
	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	---

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