JFET VHF/UHF Amplifiers

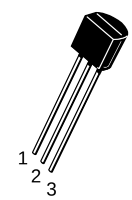
N–Channel — Depletion

J308
J309
J310

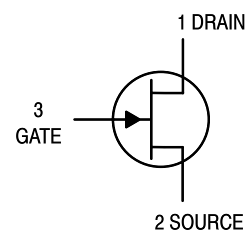
ON Semiconductor Preferred Devices

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°C Derate above 25°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)



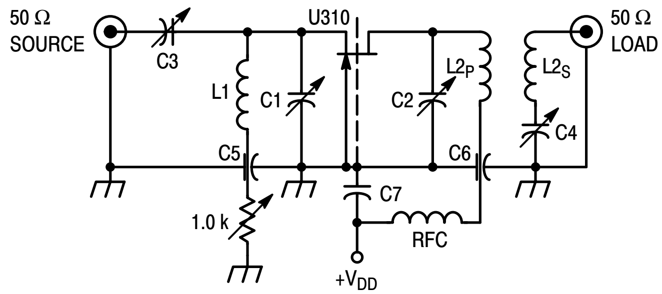
ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Characteristic		Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Gate–Source Breakdown Voltage (I_G = –1.0 µAdc, V_{DS} = 0)		$V_{(BR)GSS}$	–25	—	—	Vdc
Gate Reverse Current (V_{GS} = –15 Vdc, V_{DS} = 0, T_A = 25°C) (V_{GS} = –15 Vdc, V_{DS} = 0, T_A = +125°C)		I_{GSS}	 — —	 — —	 –1.0 –1.0	 nAdc µAdc
Gate Source Cutoff Voltage (V_{DS} = 10 Vdc, I_D = 1.0 nAdc)	 J308 J309 J310	$V_{GS(off)}$	 –1.0 –1.0 –2.0	 — — —	 –6.5 –4.0 –6.5	Vdc
ON CHARACTERISTICS						
Zero–Gate–Voltage Drain Current(1) (V_{DS} = 10 Vdc, V_{GS} = 0)	 J308 J309 J310	I_{DSS}	 12 12 24	 — — —	 60 30 60	mAdc
Gate–Source Forward Voltage (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 J309 J310	$Re(y_{is})$	— — —	0.7 0.7 0.5	— — —	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 J309 J310	g_{fs}	8000 10000 8000	— — —	20000 20000 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 J309 J310	g_{fg}	— — —	13000 13000 12000	— — —	μmhos
Common–Gate Output Conductance (V_{DS} = 10 Vdc, I_D = 10 mAdc, f = 1.0 kHz)	J308 J309 J310	g_{og}	— — —	150 100 150	— — —	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)		$\overline{e}_n$	—	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

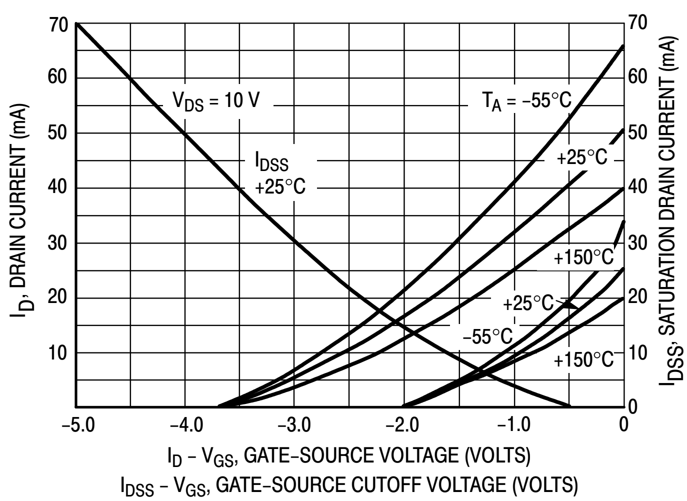


Figure 2. Drain Current and Transfer Characteristics versus Gate–Source Voltage

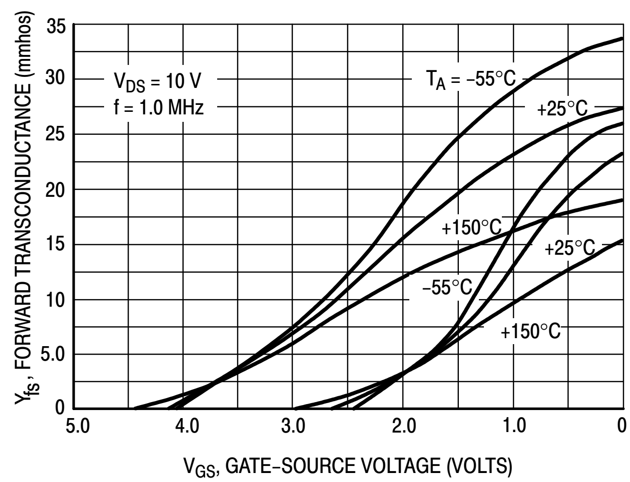


Figure 3. Forward Transconductance versus Gate–Source Voltage

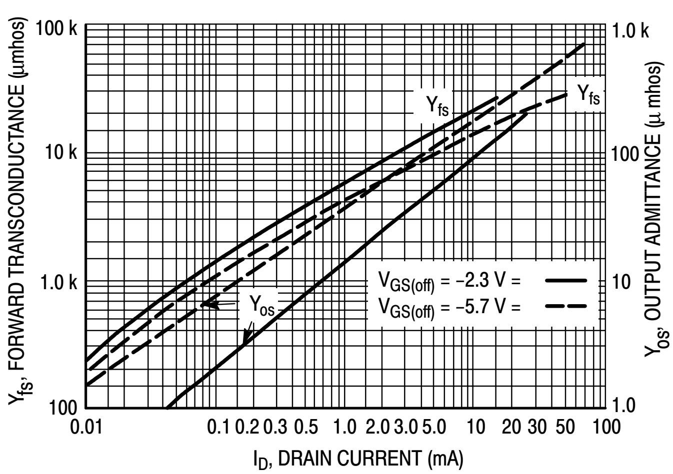


Figure 4. Common–Source Output Admittance and Forward Transconductance versus Drain Current

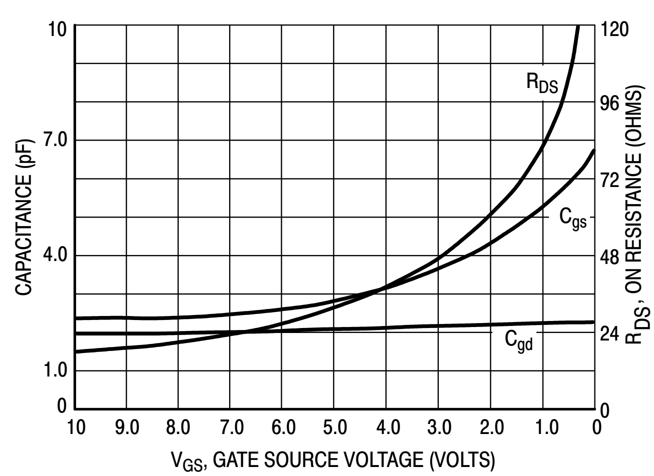


Figure 5. On Resistance and Junction Capacitance versus Gate–Source Voltage

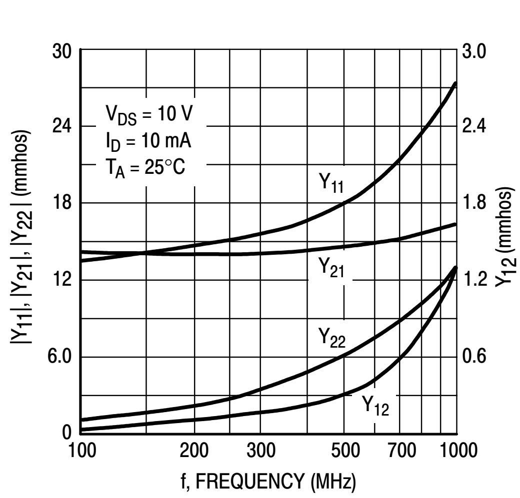


Figure 6. Common–Gate Y Parameter Magnitude versus Frequency

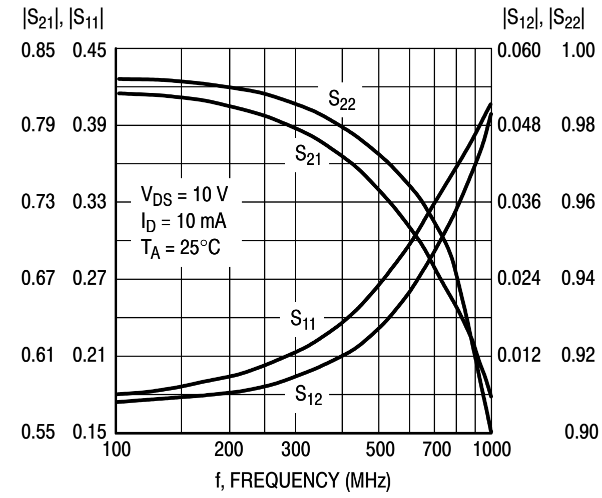


Figure 7. Common–Gate S Parameter Magnitude versus Frequency

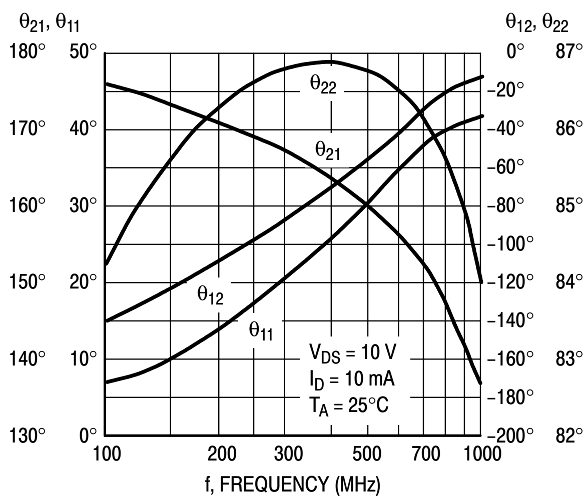


Figure 8. Common–Gate Y Parameter Phase–Angle versus Frequency

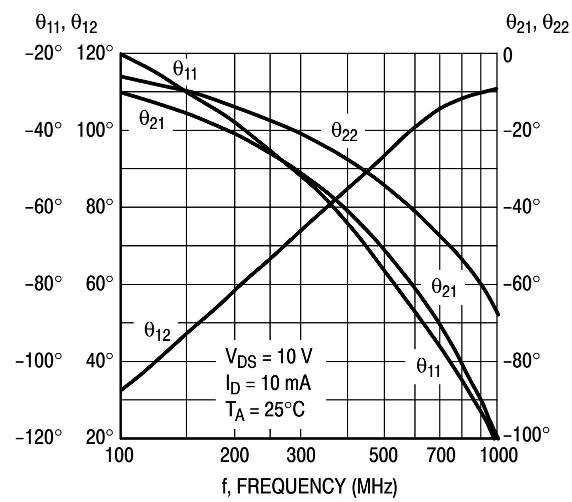


Figure 9. S Parameter Phase–Angle versus Frequency

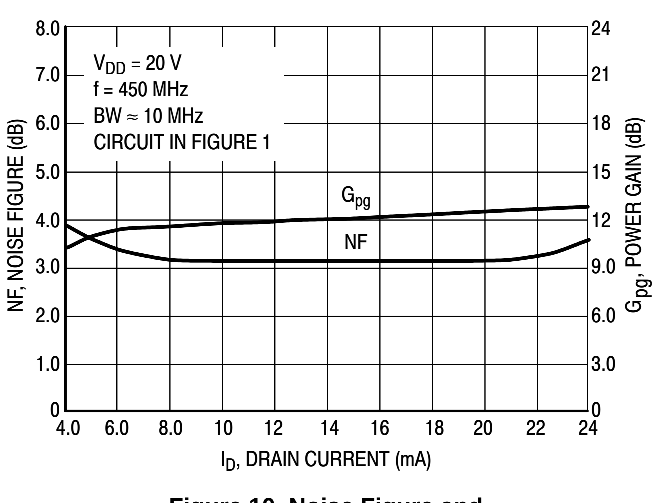


Figure 10. Noise Figure and Power Gain versus Drain Current

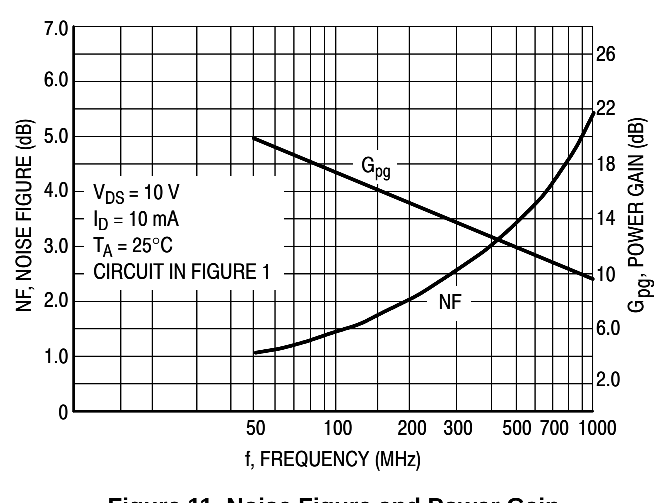
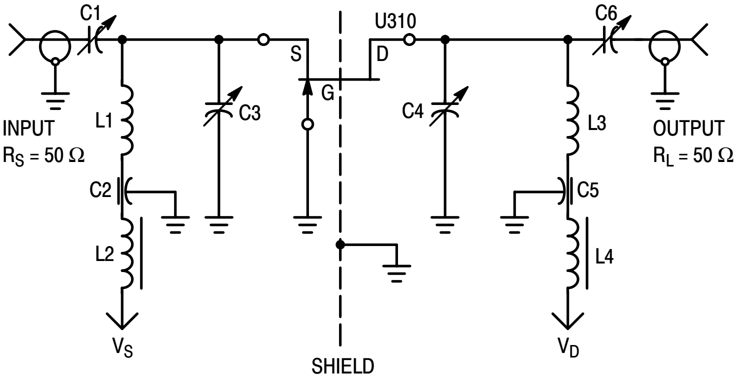


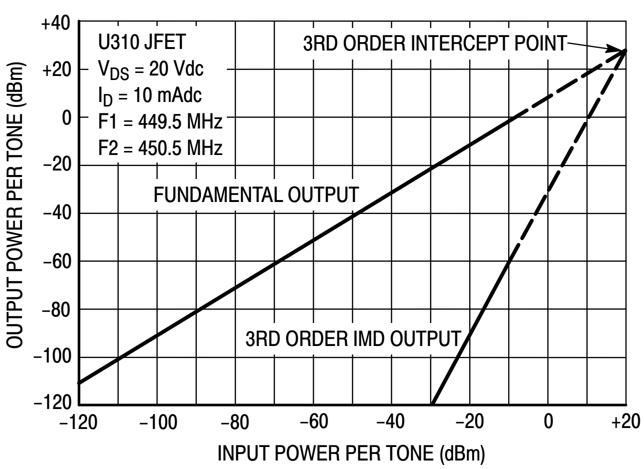
Figure 11. Noise Figure and Power Gain versus Frequency



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.

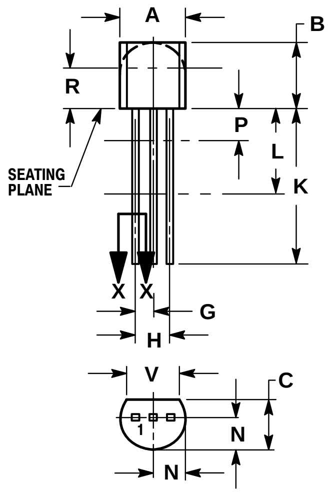


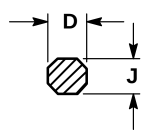
Example of intercept point plot use:
Assume two in–band signals of –20 dBm at the amplifier input. They will result in a 3rd order IMD signal at the output of –90 dBm. Also, each signal level at the output will be –11 dBm, showing an amplifier gain of 9.0 dB and an intermodulation ratio (IMR) capability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