FH101 Noise Parameter Information

It should be noted that the I_{DSS}, or saturation drain-source current, of the WJ Communications' FH101 GaAs MESFETs directly affect the noise figure of the device. ie. A device with 180 mA for Idss has a higher noise figure than a 120mA Idss device.

In addition, an application circuit using the FH101 can be optimized for noise figure by having the proper optimum noise impedance at the source of device and also by operating the device at a bias point with lower I_{DS}. The operating current, often refered to as a percentage of I_{DSS} (such as 50% I_{DSS}), can be controlled by applying a negative bias to the gate of the device. The optimum noise match can be simulated using any standard simulation software, such as ADS or Microwave Office, using the noise parameters at the end of this application note. When applied as the source impedance that the device "sees" out of the input, the minimum noise figure will be achieved at the given operating bias condition.

The trade-off with operating the device at a lower bias condition is that linearity characteristics for the device are reduced, namely IP3 and P1dB. In addition, a negative supply is required to induce a negative voltage at the gate for the FET. The following table shows the typical OIP3 for the FH101 with respect to the biasing condition when measured at 1900 MHz..

FH101 Typical Performance vs. Ids

% Idss	Ids (mA)	IP3 (dBm)	min NF (dB)
100	140	36	1.88
75	105	32	1.49
50	70	27	1.12
25	35	22	0.86

Typical applications for the FH101 used in this configuration are for LNA's in 2.5G and 3G mobile infrastructure where high linearity is required.

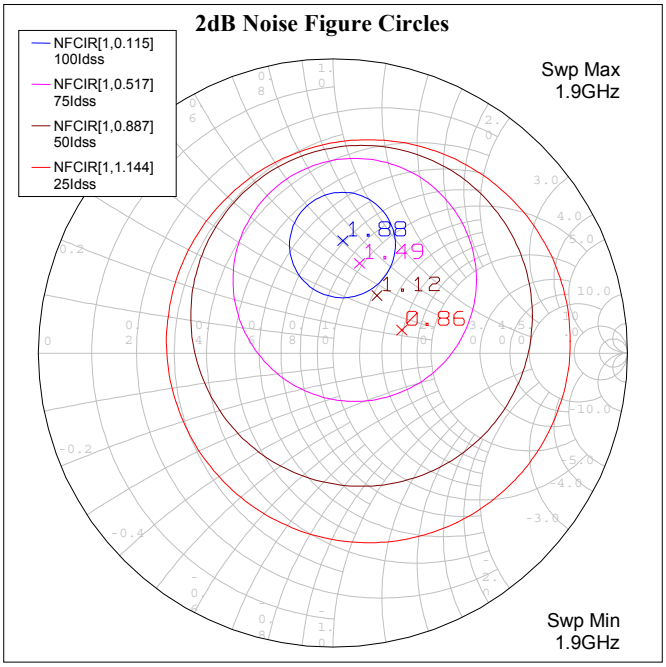

Figure 1. 2 dB Noise Figure Circles for the FH101 as a function of %Idss (frequency=1.9 GHz). The minimum noise figure for each bias is indicated by an X.

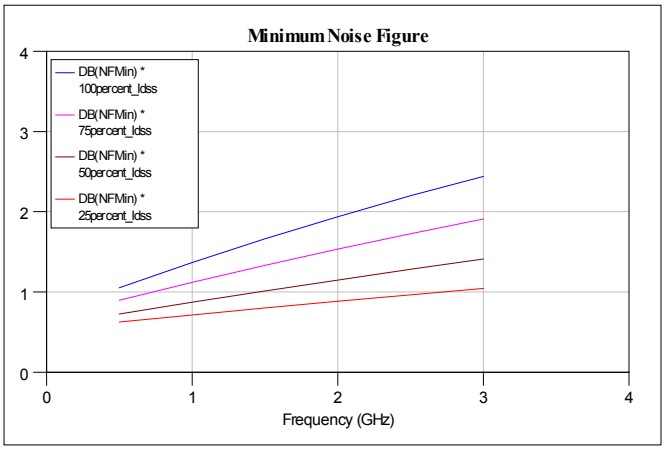

Figure 2. Minimum noise figure for the FH101 as a function of bias.

S- and Noise Parameter files for the data presented above.

```
! 782E IDSS=191MA IDS=191 VGS=-0
! 23-SEP-97 15:04
! Frequency S11 S21 S12 S22
# GHZ S RI R 50
0.500 0.6572 -0.5379 -8.9512 5.1846 0.0075 0.0154 0.3427 -0.0385
1.000 0.3122 -0.7437 -6.0681 5.8462 0.0168 0.0234 0.3100 -0.1183
1.500 0.0283 -0.7927 -4.0288 5.8037 0.0246 0.0263 0.2670 -0.1596
2.000 -0.1843 -0.7685 -2.5896 5.3975 0.0300 0.0273 0.2360 -0.1818
2.500 -0.3377 -0.7153 -1.5981 4.8801 0.0345 0.0281 0.2030 -0.2029
3.000 -0.4467 -0.6580 -0.9146 4.3657 0.0377 0.0288 0.1745 -0.2182
3.500 -0.5244 -0.5983 -0.4583 3.8992 0.0408 0.0287 0.1496 -0.2273
4.000 -0.5801 -0.5454 -0.1433 3.5114 0.0432 0.0283 0.1302 -0.2293
4.500 -0.6216 -0.5002 0.0983 3.1781 0.0447 0.0278 0.1200 -0.2382
5.000 -0.6550 -0.4592 0.2872 2.8835 0.0455 0.0278 0.1016 -0.2474
5.500 -0.6812 -0.4243 0.4296 2.6300 0.0463 0.0279 0.0916 -0.2555
6.000 -0.7018 -0.3928 0.5441 2.4033 0.0468 0.0279 0.0764 -0.2688
6.500 -0.7195 -0.3663 0.6326 2.2003 0.0469 0.0281 0.0629 -0.2751
7.000 -0.7330 -0.3403 0.7018 2.0144 0.0467 0.0287 0.0500 -0.2894
7.500 -0.7451 -0.3164 0.7554 1.8489 0.0467 0.0295 0.0305 -0.2962
8.000 -0.7550 -0.2967 0.7962 1.6982 0.0465 0.0302 0.0195 -0.3052
8.500 -0.7634 -0.2766 0.8279 1.5620 0.0464 0.0310 -0.0009 -0.3144
9.000 -0.7712 -0.2578 0.8539 1.4381 0.0460 0.0317 -0.0126 -0.3175
9.500 -0.7741 -0.2404 0.8688 1.3203 0.0453 0.0324 -0.0287 -0.3285
10.000 -0.7797 -0.2247 0.8813 1.2161 0.0444 0.0335 -0.0491 -0.3294

2.000    1.9393   0.3911   88.8941   0.3231
4.000    2.8947   0.5709  131.1117   0.3212
6.000    3.8133   0.6691  148.0883   0.3026
8.000    4.7406   0.7183  157.3196   0.2918
10.000    5.7574   0.7391  163.7815   0.2861


! 782E IDSS=191MA IDS=142 VGS=-.36 HD01
! 23-SEP-97 15:06
! SRITABLE TWO_PORT 20
# GHZ S RI R 50
0.500 0.6660 -0.5273 -9.2476 5.2168 0.0078 0.0163 0.3112 -0.0409
1.000 0.3299 -0.7349 -6.3503 5.9365 0.0175 0.0249 0.2753 -0.1232
1.500 0.0501 -0.7889 -4.2776 5.9407 0.0258 0.0282 0.2281 -0.1639
2.000 -0.1621 -0.7692 -2.7949 5.5603 0.0318 0.0294 0.1946 -0.1837
2.500 -0.3171 -0.7191 -1.7605 5.0530 0.0367 0.0303 0.1593 -0.2023
3.000 -0.4277 -0.6638 -1.0427 4.5386 0.0403 0.0309 0.1300 -0.2144
3.500 -0.5069 -0.6051 -0.5605 4.0640 0.0437 0.0308 0.1046 -0.2209
4.000 -0.5640 -0.5524 -0.2264 3.6686 0.0464 0.0304 0.0840 -0.2196
4.500 -0.6065 -0.5076 0.0306 3.3276 0.0481 0.0299 0.0747 -0.2253
5.000 -0.6408 -0.4664 0.2323 3.0255 0.0492 0.0298 0.0563 -0.2313
5.500 -0.6677 -0.4317 0.3851 2.7659 0.0502 0.0298 0.0477 -0.2364
6.000 -0.6887 -0.4001 0.5084 2.5319 0.0510 0.0298 0.0332 -0.2471
6.500 -0.7072 -0.3731 0.6049 2.3239 0.0512 0.0299 0.0211 -0.2502
7.000 -0.7209 -0.3468 0.6796 2.1321 0.0512 0.0304 0.0106 -0.2628
7.500 -0.7334 -0.3229 0.7399 1.9609 0.0514 0.0312 -0.0081 -0.2670
8.000 -0.7437 -0.3032 0.7855 1.8052 0.0515 0.0318 -0.0163 -0.2744
8.500 -0.7524 -0.2830 0.8213 1.6641 0.0515 0.0325 -0.0355 -0.2817
9.000 -0.7602 -0.2640 0.8514 1.5362 0.0514 0.0332 -0.0447 -0.2825
9.500 -0.7631 -0.2467 0.8687 1.4139 0.0507 0.0338 -0.0581 -0.2929
10.000 -0.7686 -0.2306 0.8845 1.3061 0.0501 0.0348 -0.0775 -0.2916

2.000    1.5330   0.3251   78.0662   0.2502
4.000    2.2569   0.5122  126.6991   0.2464
6.000    2.9627   0.6235  144.6107   0.2373
8.000    3.6414   0.6937  154.6169   0.2206
10.000    4.3556   0.7332  161.7025   0.2005


! 782E IDSS=191MA IDS=95 VGS=-.7
! 23-SEP-97 15:09
! SRITABLE TWO_PORT 20
# GHZ S RI R 50
0.500 0.6825 -0.5082 -9.5376 5.1943 0.0082 0.0174 0.2993 -0.0473
1.000 0.3627 -0.7187 -6.6814 5.9775 0.0184 0.0269 0.2585 -0.1338
1.500 0.0901 -0.7819 -4.5967 6.0579 0.0274 0.0307 0.2058 -0.1759
2.000 -0.1216 -0.7709 -3.0710 5.7310 0.0342 0.0321 0.1670 -0.1946
2.500 -0.2792 -0.7267 -1.9866 5.2495 0.0397 0.0331 0.1284 -0.2105
3.000 -0.3931 -0.6751 -1.2219 4.7439 0.0438 0.0337 0.0961 -0.2205
3.500 -0.4758 -0.6180 -0.7041 4.2668 0.0476 0.0336 0.0688 -0.2230
4.000 -0.5355 -0.5659 -0.3424 3.8633 0.0508 0.0330 0.0471 -0.2193
4.500 -0.5800 -0.5212 -0.0637 3.5165 0.0528 0.0324 0.0361 -0.2210
5.000 -0.6165 -0.4804 0.1570 3.2063 0.0542 0.0321 0.0190 -0.2234
5.500 -0.6446 -0.4451 0.3240 2.9365 0.0555 0.0320 0.0095 -0.2264
6.000 -0.6671 -0.4135 0.4606 2.6976 0.0565 0.0318 -0.0035 -0.2326
6.500 -0.6865 -0.3859 0.5684 2.4808 0.0570 0.0317 -0.0146 -0.2346
7.000 -0.7013 -0.3593 0.6532 2.2825 0.0572 0.0321 -0.0247 -0.2434
7.500 -0.7143 -0.3349 0.7207 2.1038 0.0575 0.0327 -0.0404 -0.2460
8.000 -0.7249 -0.3151 0.7744 1.9412 0.0578 0.0332 -0.0491 -0.2516
8.500 -0.7342 -0.2945 0.8153 1.7935 0.0580 0.0337 -0.0650 -0.2557
9.000 -0.7423 -0.2746 0.8499 1.6589 0.0580 0.0342 -0.0734 -0.2564
9.500 -0.7453 -0.2571 0.8721 1.5313 0.0576 0.0347 -0.0849 -0.2636
10.000 -0.7513 -0.2410 0.8912 1.4185 0.0572 0.0356 -0.1015 -0.2623

2.000    1.1503   0.2483   58.1931   0.1855
4.000    1.6601   0.4302  118.7030   0.1863
6.000    2.1518   0.5505  139.4448   0.1805
8.000    2.6644   0.6326  150.3960   0.1703
10.000    3.1822   0.6943  157.7794   0.1537
! ENDTABLE

! 782E IDSS=191MA IDS=47 VGS=-1.05 HD01
! 23-SEP-97 15:14
! SRITABLE TWO_PORT 20
# GHZ S RI R 50
0.500 0.7326 -0.4570 -8.6655 4.3252 0.0086 0.0193 0.3220 -0.0497
1.000 0.4578 -0.6765 -6.3757 5.1138 0.0196 0.0307 0.2826 -0.1435
1.500 0.2053 -0.7675 -4.6152 5.3672 0.0301 0.0361 0.2261 -0.1933
2.000 -0.0051 -0.7832 -3.2388 5.2322 0.0386 0.0382 0.1815 -0.2166
2.500 -0.1710 -0.7579 -2.2041 4.9109 0.0458 0.0394 0.1358 -0.2349
3.000 -0.2963 -0.7184 -1.4434 4.5208 0.0512 0.0400 0.0983 -0.2438
3.500 -0.3904 -0.6671 -0.9055 4.1196 0.0564 0.0395 0.0663 -0.2463
4.000 -0.4603 -0.6179 -0.5214 3.7687 0.0607 0.0383 0.0400 -0.2397
4.500 -0.5127 -0.5739 -0.2214 3.4548 0.0635 0.0370 0.0270 -0.2399
5.000 -0.5565 -0.5326 0.0194 3.1709 0.0656 0.0361 0.0061 -0.2394
5.500 -0.5906 -0.4966 0.2028 2.9191 0.0674 0.0353 -0.0037 -0.2395
6.000 -0.6179 -0.4634 0.3547 2.6930 0.0688 0.0343 -0.0194 -0.2446
6.500 -0.6418 -0.4347 0.4761 2.4871 0.0695 0.0335 -0.0309 -0.2424
7.000 -0.6597 -0.4065 0.5715 2.2947 0.0698 0.0333 -0.0411 -0.2506
7.500 -0.6761 -0.3802 0.6505 2.1218 0.0703 0.0333 -0.0587 -0.2495
8.000 -0.6892 -0.3589 0.7129 1.9626 0.0707 0.0332 -0.0654 -0.2539
8.500 -0.7005 -0.3365 0.7618 1.8171 0.0709 0.0332 -0.0833 -0.2563
9.000 -0.7110 -0.3158 0.8038 1.6844 0.0710 0.0331 -0.0899 -0.2539
9.500 -0.7151 -0.2965 0.8311 1.5577 0.0704 0.0332 -0.1017 -0.2615
10.000 -0.7228 -0.2785 0.8562 1.4455 0.0699 0.0336 -0.1181 -0.2563

2.000    0.8827   0.2415   23.3733   0.1501
4.000    1.2028   0.3351   98.2729   0.1608
6.000    1.4957   0.4576  125.4862   0.1560
8.000    1.8075   0.5672  139.1802   0.1431
10.000    2.2839   0.5883  148.1550   0.1523
! ENDTABLE
```