



### FH1 Noise Parameter Information

It should be noted that the  $I_{DSS}$ , or saturation drain-source current, of the WJ Communications' FH1 GaAs MESFETs directly affect the noise figure of the device. ie. A device with 180 mA for  $I_{DSS}$  has a higher noise figure than a 120mA  $I_{DSS}$  device.

In addition, an application circuit using the FH1 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 referred 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 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 FH1 with respect to the biasing condition when measured at 1900 MHz..

**FH1 Typical Performance vs.  $I_{DS}$**

% $I_{DSS}$	$I_{DS}$ (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 FH1 used in this configuration are for LNA's in 2.5G and 3G mobile infrastructure where high linearity is required.

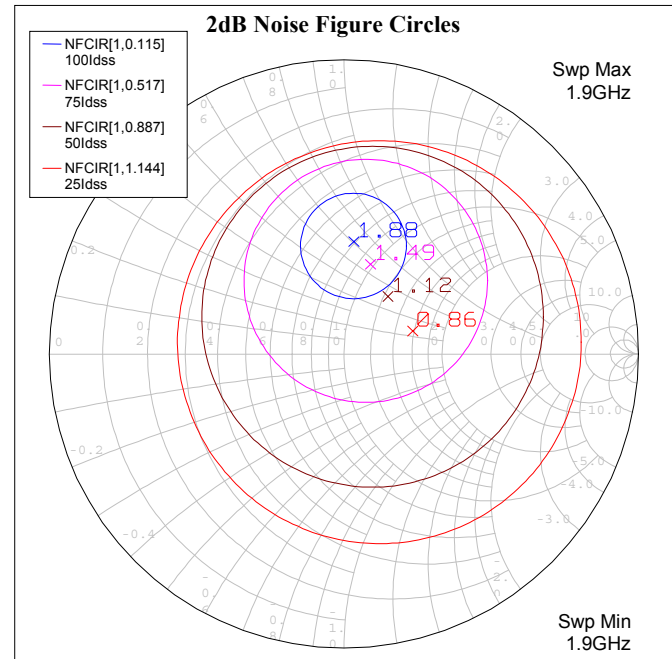


Figure 1. 2 dB Noise Figure Circles for the FH1 as a function of % $I_{DSS}$  (frequency=1.9 GHz). The minimum noise figure for each bias is indicated by an X.

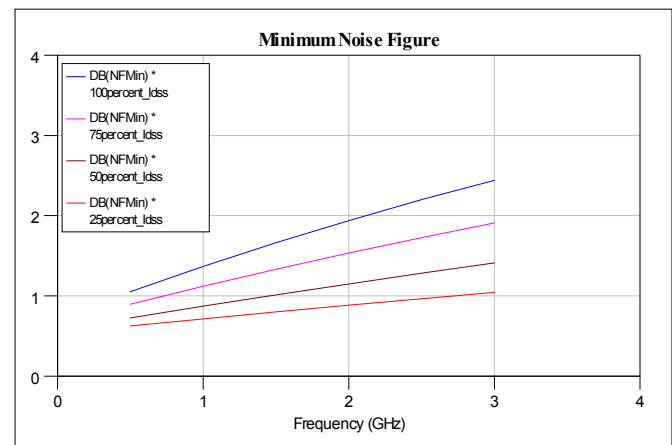


Figure 2. Minimum noise figure for the FH1 as a function of bias.



**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 0.0663 -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