Low noise broadband amplifier based on SPF5189Z

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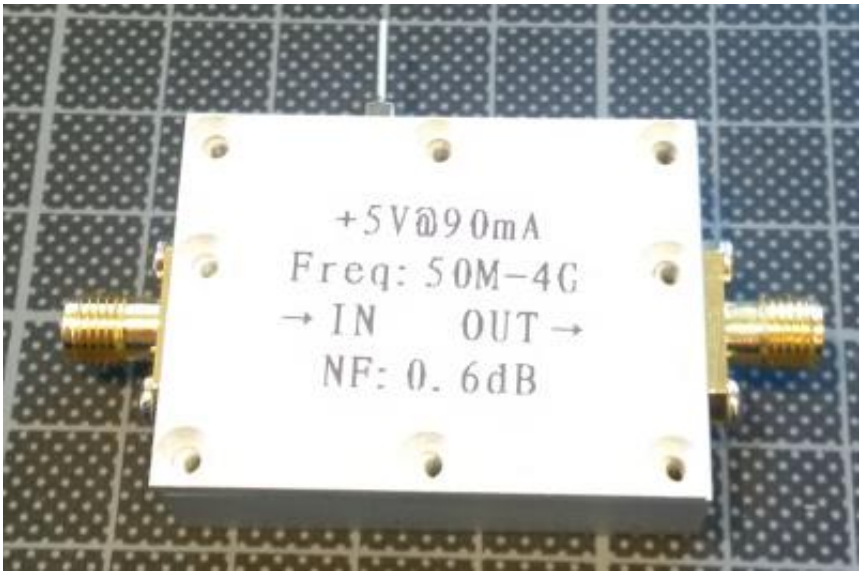
Matthias DD1US

Hello,

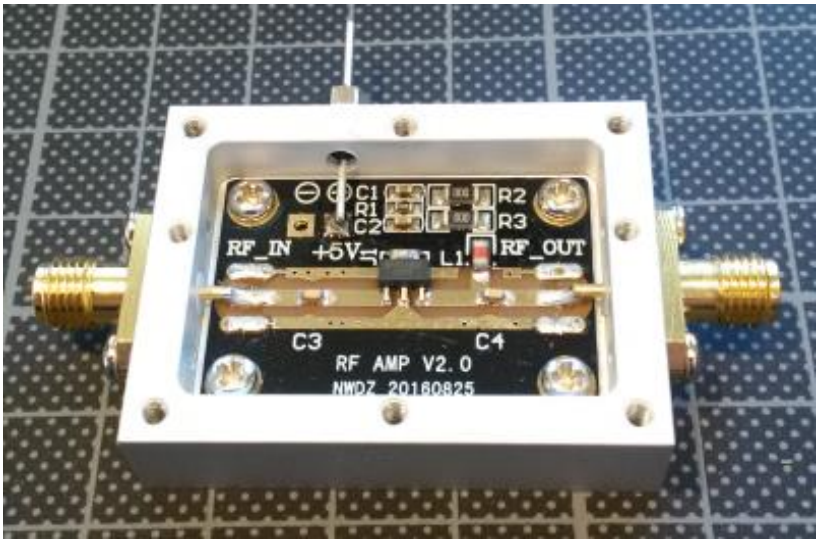
Recently I bought a broadband low noise amplifier from a Chinese vendor. The amplifier is mounted in a nice milled aluminium case and I was astonished that the price including shipping from China to Germany was less than 15 Euros. The amplifier is advertised to to cover a frequency range of 40MHz to 4 GHz and to feature a noise figure of 0.6dB. The supply voltage is +5V and the current consumption is 90 mA.

The amplifier was properly packed in a ESD-protection bag.

I opened the amplifier to see what's inside.



The dimensions of the amplifier are 7cm x 4.5cm x 1.2cm.


C1
R1
C2
R2
R3
RF_IN
+5V
L1
RF_OUT
C3
C4
RF AMP V2.0
NWDZ 20160825


R1
C2
R3
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+5V
L1
RF_OUT
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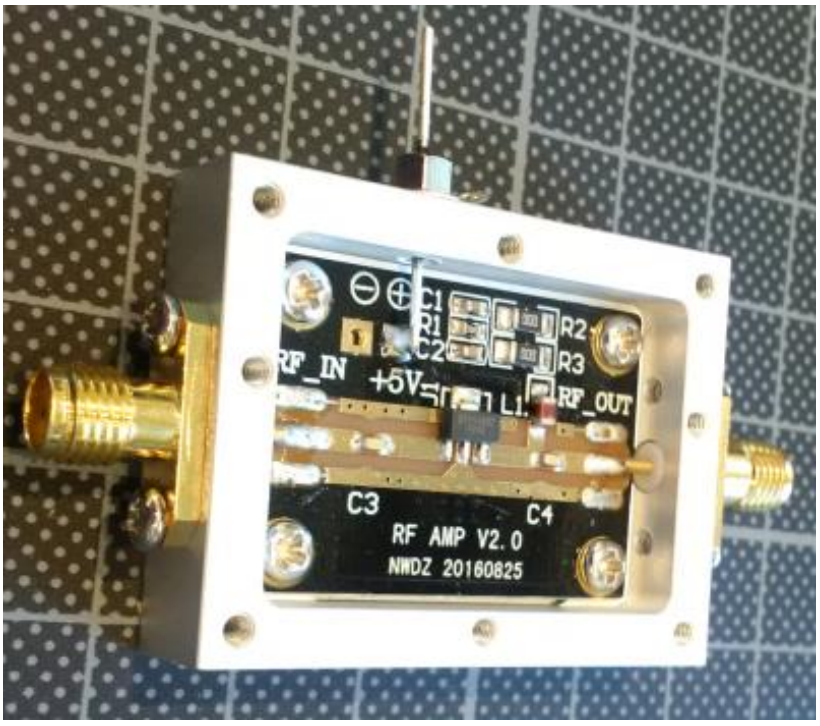
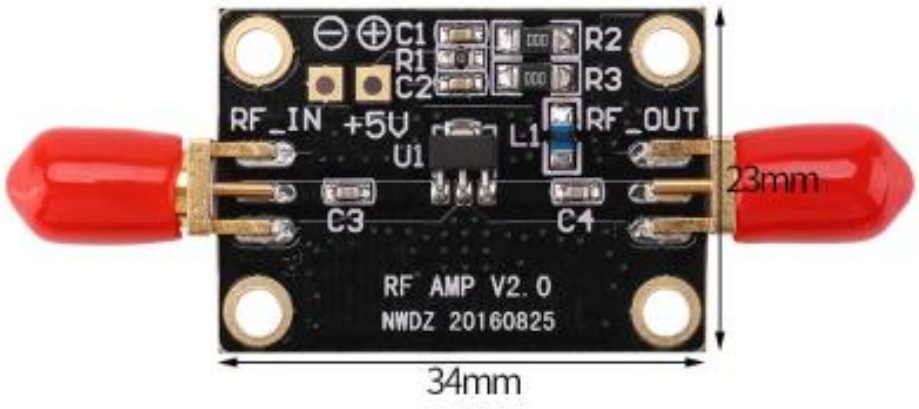
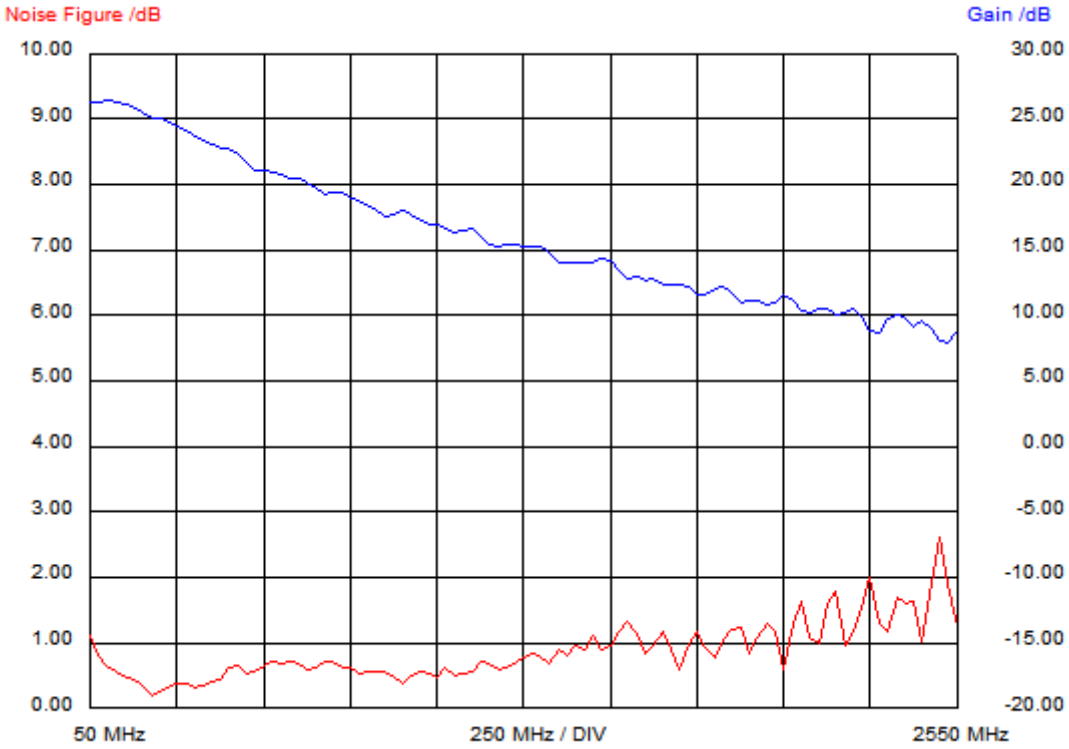

C1
R1
C2
R2
R3
RF_IN
+5V
L1
RF_OUT
C3
C4
RF AMP V2.0
NWDZ 20160825

The amplifier is based on SPF5189Z, a GaAs MMIC from Quorvo. The datasheet values of this MMIC correspond well with the specified value of the amplifier. There is no voltage regulator inside, thus the supply voltage should be 5V ±250mV. The measured current consumption is 90mA @5V. The output power at 1dB compression point is about 22-23dBm.

The same amplifier board without the aluminium encasing can be purchased on Ebay for less than 8 Euros.



Next, I measured the gain and noise figure in the frequency range 50 MHz to 2550 MHz.



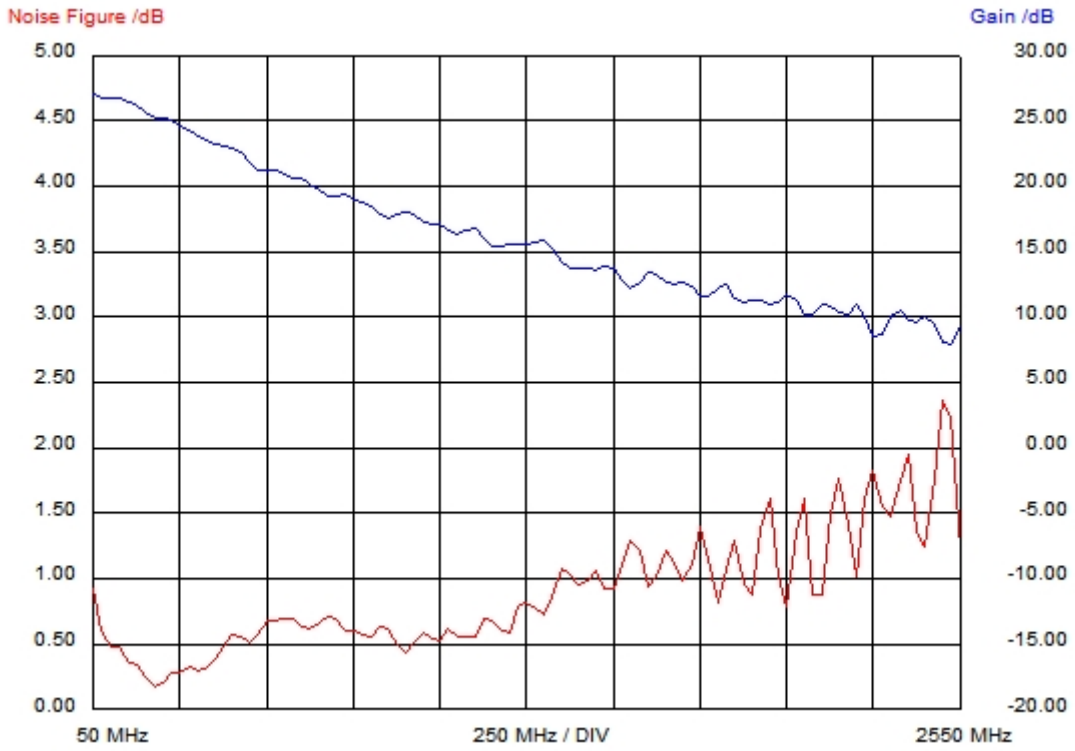
As can be seen the LNA features a maximum gain of about 26 dB below 150 MHz. The gain drops to 23 dB at 400 MHz and 20 dB at 700 MHz. At 1300 MHz the gain is down to about 13 dB and at 2400 MHz it is below 10 dB. A minimum noise figure of 0.2 dB is achieved at 225 MHz. The noise figure at 145 MHz is below 0.5 dB and at 435 MHz below 0.6 dB. At 1300 MHz the noise figure is still below 0.8dB.

Here is a table of the measurement data:

Frequency	Gain /dB	NF /dB	Frequency	Gain /dB	NF /dB
50 MHz	26.36	1.10	475 MHz	22.35	0.64
75 MHz	26.35	0.79	500 MHz	21.72	0.52
100 MHz	26.49	0.61	525 MHz	21.14	0.56
125 MHz	26.32	0.57	550 MHz	21.02	0.66
150 MHz	26.17	0.45	575 MHz	20.97	0.72
175 MHz	25.90	0.44	600 MHz	20.74	0.67
200 MHz	25.50	0.34	625 MHz	20.53	0.72
225 MHz	25.10	0.20	650 MHz	20.49	0.68
250 MHz	25.10	0.26	675 MHz	20.19	0.60
275 MHz	24.80	0.30	700 MHz	19.67	0.62
300 MHz	24.48	0.37	725 MHz	19.19	0.72
325 MHz	24.08	0.36	750 MHz	19.33	0.71
350 MHz	23.67	0.30	775 MHz	19.32	0.62
375 MHz	23.31	0.34	800 MHz	18.97	0.63
400 MHz	23.06	0.41	825 MHz	18.71	0.52
425 MHz	22.81	0.45	850 MHz	18.37	0.55
450 MHz	22.73	0.61	875 MHz	18.07	0.56

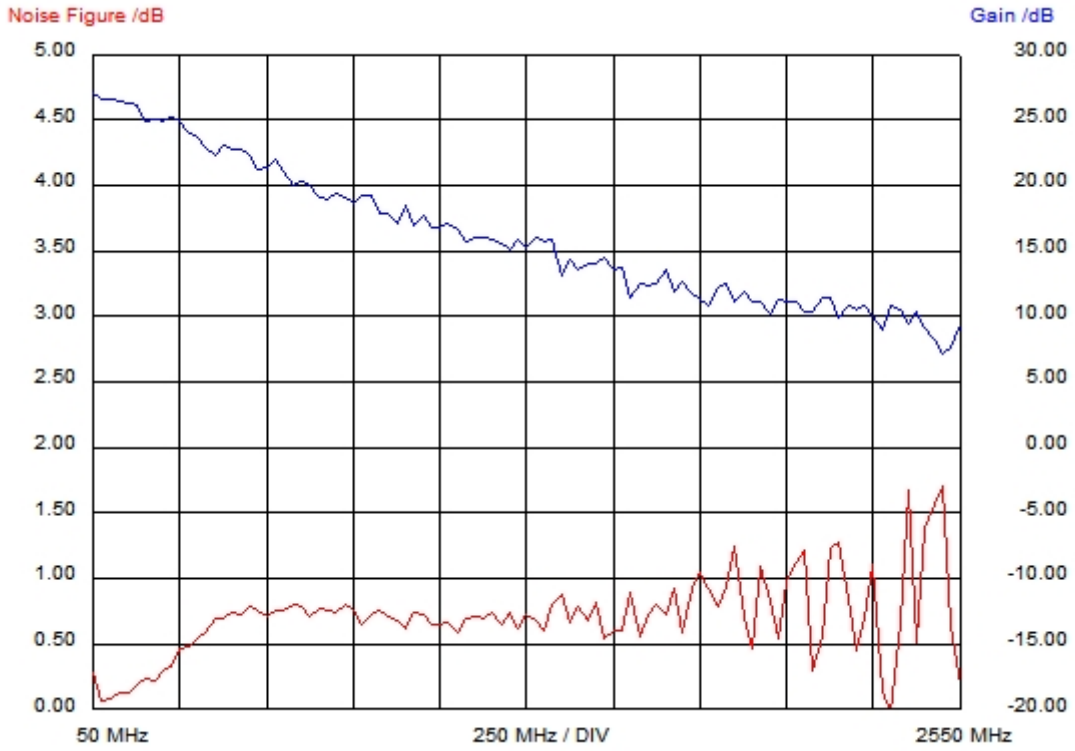
Frequency	Gain /dB	NF /dB	Frequency	Gain /dB	NF /dB
900 MHz	17.57	0.57	1750 MHz	12.36	0.58
925 MHz	17.71	0.47	1775 MHz	12.14	0.99
950 MHz	18.06	0.38	1800 MHz	11.60	1.17
975 MHz	17.73	0.50	1825 MHz	11.54	0.94
1000 MHz	17.20	0.55	1850 MHz	12.04	0.76
1025 MHz	16.91	0.52	1875 MHz	12.26	1.05
1050 MHz	16.90	0.47	1900 MHz	11.68	1.20
1075 MHz	16.58	0.63	1925 MHz	10.97	1.25
1100 MHz	16.32	0.50	1950 MHz	11.10	0.85
1125 MHz	16.52	0.51	1975 MHz	11.17	1.06
1150 MHz	16.63	0.55	2000 MHz	10.88	1.28
1175 MHz	15.98	0.70	2025 MHz	10.91	1.16
1200 MHz	15.38	0.67	2050 MHz	11.54	0.58
1225 MHz	15.33	0.60	2075 MHz	11.12	1.29
1250 MHz	15.41	0.62	2100 MHz	10.31	1.64
1275 MHz	15.35	0.68	2125 MHz	10.23	1.09
1300 MHz	15.18	0.77	2150 MHz	10.59	0.98
1325 MHz	15.19	0.83	2175 MHz	10.59	1.58
1350 MHz	15.32	0.78	2200 MHz	9.98	1.79
1375 MHz	14.78	0.68	2225 MHz	10.23	0.94
1400 MHz	14.09	0.90	2250 MHz	10.60	1.18
1425 MHz	14.02	0.80	2275 MHz	9.90	1.53
1450 MHz	14.09	0.96	2300 MHz	8.77	2.01
1475 MHz	14.08	0.91	2325 MHz	8.74	1.28
1500 MHz	14.01	1.12	2350 MHz	9.75	1.17
1525 MHz	14.31	0.90	2375 MHz	10.08	1.70
1550 MHz	14.18	0.94	2400 MHz	9.70	1.59
1575 MHz	13.39	1.17	2425 MHz	9.11	1.61
1600 MHz	12.77	1.32	2450 MHz	9.59	1.02
1625 MHz	13.00	1.15	2475 MHz	9.05	1.90
1650 MHz	12.74	0.82	2500 MHz	8.08	2.62
1675 MHz	12.80	0.95	2525 MHz	7.92	1.91
1700 MHz	12.32	1.16	2550 MHz	8.79	1.25
1725 MHz	12.36	0.90			

About 4 weeks later I bought another amplifier of the same kind and measured it under the same conditions. Here are the results:



As can be seen the results are almost identical. It looks like that those amplifiers provide reliable results over production.

When measuring the amplifier with a different noise source (ENR approx. 5dB instead of approx. 15dB) the noise figure results are similar but slightly different. As to be expected the gain measurements are identical.



Even though this amplifier is not really useful up to 4 GHz it provides excellent performance in the VHF/UHF range and can certainly be used successfully for terrestrial operation in the 23cm band. Even in 13cm band it can be used with some compromised (lower gain and higher noise figure)

I always appreciate feedback. Please send it to the Email address below.

Best regards

Matthias DD1US

Email: DD1US@AMSAT.ORG
Homepage: http://www.dd1us.de