

Znane programy i urządzenia do pomiaru NF

Pomiary metodą współczynnika Y

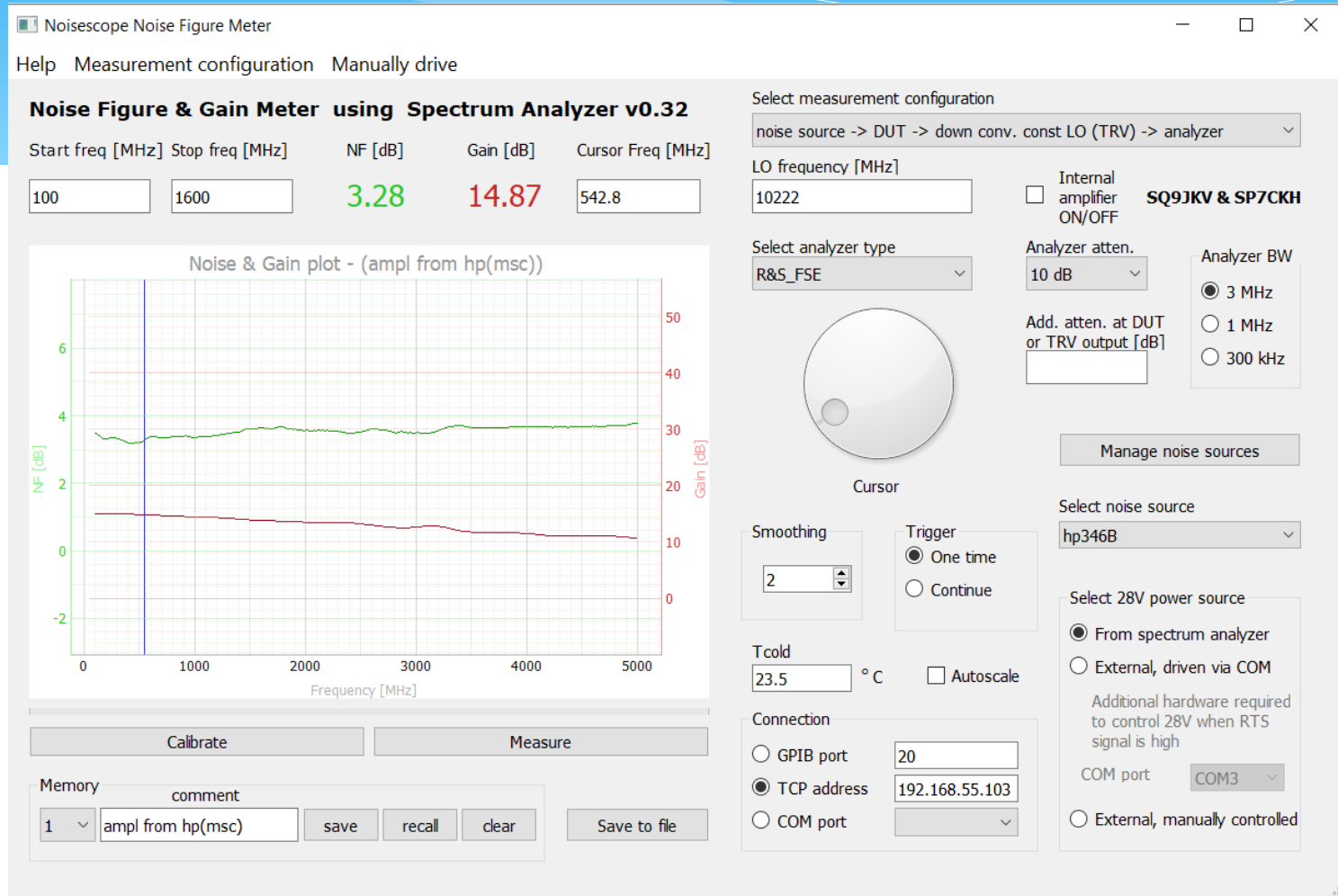
- CANFI – używa popularnego układu RTL SDR
- Miernik SQ4AVS i SP9QZO – rozwiązanie sprzętowe tylko w zakresie dołączanych filtrów
- Program Mario Hellmich wykorzystujący GNU Octave i analizator widma

Ogólne wskazówki do pomiaru NF

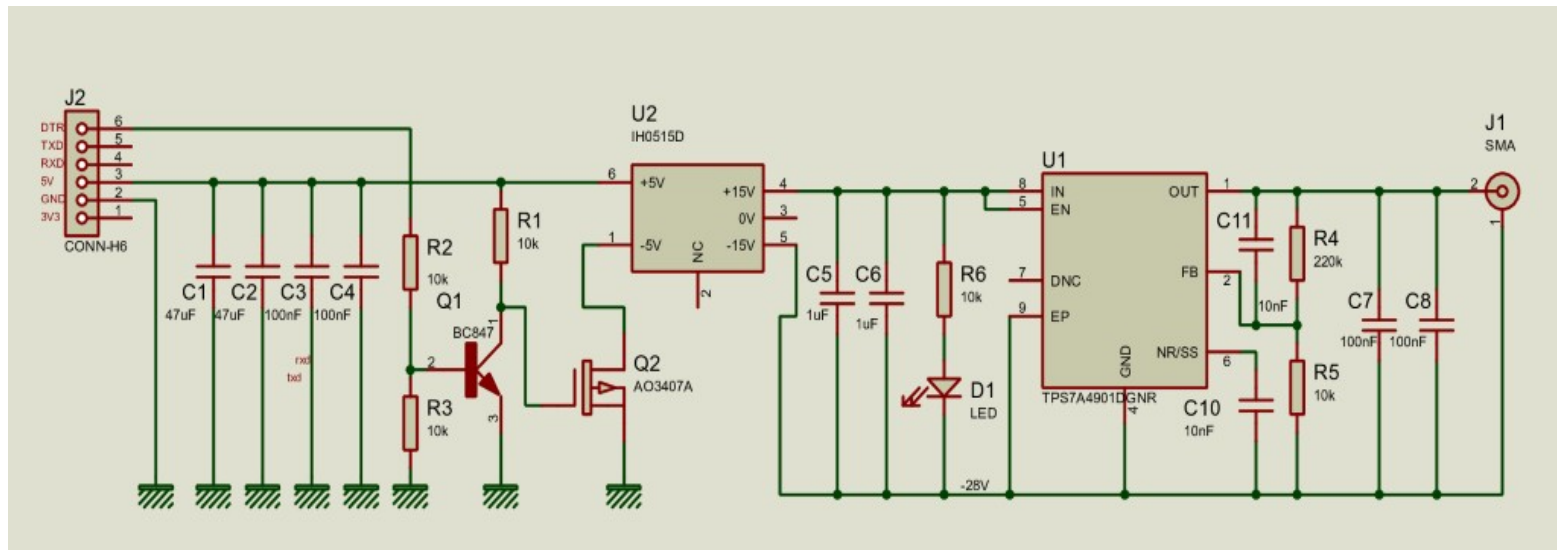
Dobór wzmacniacza, BW sys i ENR źródła szumów

- Dobór wzmacniacza wstępnego, właściwe ekranowanie
- $BW_{ampl} > BW_{sys}$
- $ENR_{dB} > NF_{dBSA} + 3dB$
- $ENR_{dB} > NF_{dBDUT} + 5dB$
- $NF_{dBDUT} + GAIN_{dBDUT} > NF_{dBSA} + 1dB$

Ekran główny programu



Przykład konwertera USB – 28 V



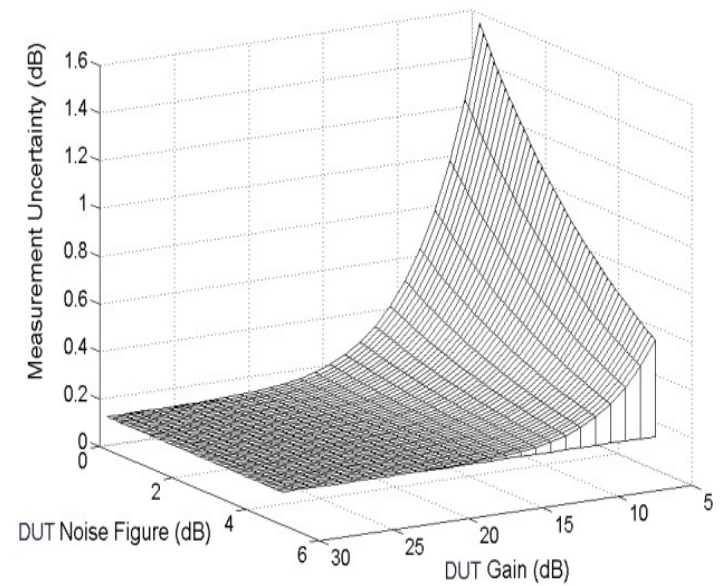
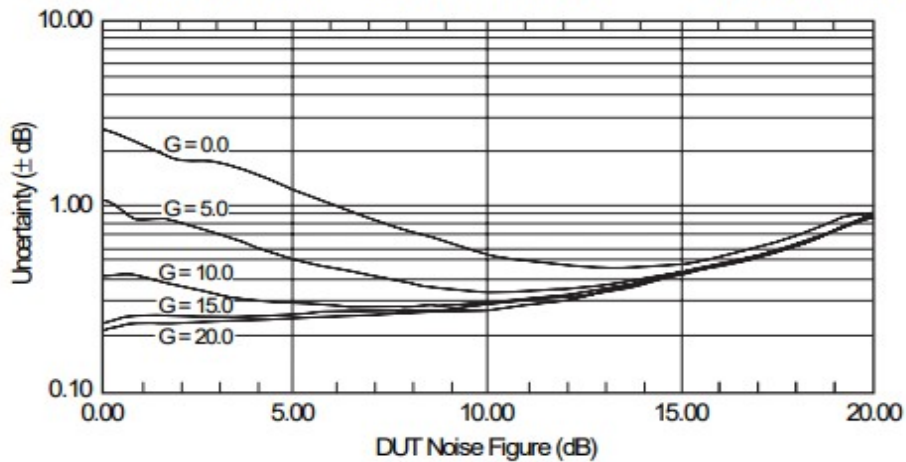
Uwagi ogólne

- Wygrzanie sprzętu przed pomiarem , sprawdzenie zera
- Dynamika urządzeń - dodatkowe tłumiki
- Pomiar wzmocnienia nie zależy od ENR
- Pomiar filtrów, tłumików
- Uwaga na poziom mocy!
- $-174 + 100 + 15 + 40 + 40 = +21 !$

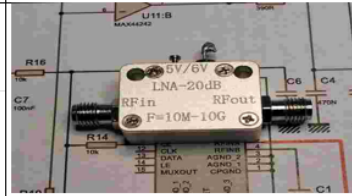
Błędy pomiaru

TYPICAL NOISE FIGURE MEASUREMENT UNCERTAINTY

Noise Source ENR = 15.00 (dB) System Input SWR = 1.70
Noise Source ENR Error = 0.10 (dB) System Noise Figure = 8.00 (dB)
Noise Source SWR = 1.25
Noise Source RHO Delta = 0.050 Amplitude Jitter = ± 0.00 (dB) DUT Input SWR = 1.50
DUT Output SWR = 1.50



Pomiary porównawcze

WZMACNIACZ		Miernik	10MHz		30MHz		100MHz		500MHz		1000MHz		1600MHz	
			NF	GAIN	NF	GAIN	NF	GAIN	NF	GAIN	NF	GAIN	NF	GAIN
SP7CKH		8970B	5.0	30.29	2.33	30.2	2.0	29.73	1.98	30.33	1.92	30.09	2.06	30.01
		8970A	4.5	30.56	2.29	30.31	1.97	29.83	1.97	29.93	1.86	30.15	1.98	30.00
		R&S FSE	3.27	30.39	2.21	29.84	1.99	29.70	1.95	29.80	1.89	29.76	2.03	29.31
		8594E	2.20	29.55	2.25	29.35	2.07	29.56	2.07	29.69	2.07	29.69	2.27	29.27
		Rigol 5065N	2.6	30.0	2.49	30	2.2	29.9	2.2	29.9	2.16	29.8	2.2	29.5
		R&S FSL3	2.8	30.2	2.7	30.1	2.28	29.9	2.2	29.9	2.19	29.9	2.3	29.5
		HP 8563E	2.36	39.7	2.22	29.9	2.09	30.0	2.03	30.2	1.95	30.1	2.02	29.9
WYDZ-LAN		8970b	5.8	41.2	3.3	43.4	1.6	44.6	1.5	44.6	1.2	44.4	1.3	44.3
		8970A	4.98	41.30	2.27	43.36	1.4	44.80	1.11	44.89	1.12	44.81	1.22	44.56
		R&S FSE	3.66	42.22	2.15	43.38	1.43	44.21	1.18	44.28	1.20	44.13	1.28	43.93
		8594E	1.80	43.40	1.61	43.72	1.46	43.87	1.38	43.78	1.37	43.70	1.52	43.4
		Rigol 5065N	3.6	41.3	2.6	42.5	1.6	43.7	1.3	43.7	1.3	43.6	1.4	43.3
		R&S FSL3	2.64	42.5	2.36	42.9	1.61	43.7	1.33	43.8	1.37	43.6	1.49	43.4
		HP 8563E	1.89	43.3	1.82	43.4	1.53	43.7	1.3	43.6	1.30	43.4	1.48	43.0
LNA-20dB		8970b	6.5	20.6	2.8	22.1	1.6	22.6	1.1	22.5	1.2	22.3	1.3	22.2
		8970A	5.13	19.73	3.35	20.81	1.55	21.19	1.01	21.29	1.10	21.04	1.22	21.12
		R&S FSE	3.80	19.44	2.44	19.80	1.56	20.00	1.11	20.25	1.24	19.73	1.29	19.36
		8594E	2.05	20.68	1.79	20.74	1.5	20.94	1.32	20.88	1.35	20.62	1.36	20.33
		Rigol 5065N	4.27	20.4	3.2	20.7	1.6	21.2	1.2	21.2	1.3	20.9	1.3	20.4
		R&S FSL3	3.1	20.7	2.78	20.6	1.81	21.2	1.36	21.3	1.43	21.1	1.57	20.8
		HP 8563E	2.04	22.1	2.07	22.1	1.81	22.1	1.31	22.4	1.19	22.2	1.33	22.1
F=20M-6GHz		8970B	4.5	20.0	3.0	33.8	2.3	35.12	2.2	34.5	2.3	33.6	2.3	32.2
		8970A	-	-	2.95	22.50	2.46	24.99	2.60	24.79	2.81	24.58	2.71	24.87
		R&S FSE	2.93	19.55	2.89	22.99	2.89	24.10	2.57	23.91	2.78	24.12	2.66	24.24
		594E	2.72	23.56	2.47	23.90	2.82	23.99	2.49	23.79	2.68	23.88	2.36	24.12
		Rigol 5065N	2.5	29.9	2.5	33.1	2.36	35.0	2.3	34.4	2.4	33.6	2.4	31.9
		R&S FSL3	2.7	28.9	2.64	33.4	2.5	34.6	2.45	34.0	2.25	33.2	2.7	31.5
		HP 8563E	2.55	34.5	2.48	34.8	2.40	34.9	2.42	34.4	2.45	33.6	2.54	31.8

Pomiary porównawcze c.d.

[illegible]

Literatura

- <https://testworld.com/wp-content/uploads/noise-figure-measurement-accuracy-the-y-factor-method.pdf>
- <https://web.stanford.edu/class/ee133/appnotes/5952-8255E.pdf>
- <https://www.keysight.com/us/en/assets/7018-09368/data-sheets-archived/5091-4800.pdf>
- <https://dl.cdn-anritsu.com/en-en/test-measurement/files/Application-Notes/Application-Note/ms269xa-2830a-017-ef1300.pdf>

Literatura

- https://scdn.rohde-schwarz.com/ur/pws/dl_downloads/dl_application/application_notes/1ma178/1MA178_5e_NoiseFigure.pdf
- https://scdn.rohde-schwarz.com/ur/pws/dl_downloads/dl_application/application_notes/1sl378/1SL378_0e_ColdSrcNF.pdf
- <https://www.repeater-builder.com/tech-info/pdfs/nf-meas-10-hints-an57-3.pdf>https://hparcive.com/Application_Notes/HP-AN-57-1.pdf