

## Noise Figure Testing at the 2010 International EME Conference By Al Ward W5LUA September 18, 2010

The noise figure workshop was organized by Tommy WD5AGO, Chuck AF8Z and myself. We had the luxury of 4 noise figure test sets. The first system was supplied by WD5AGO and consisted of an Eaton 2075 with an HP346 noise source and calibrated 10 dB attenuator to supply a nominal 5 dB ENR. The second system was supplied by W5LUA and consisted of an HP8970B and HP8971C test set. The noise source was an HP346A with a nominal 5 dB ENR. For 24 GHz testing we used an HP346C noise source with an isolator. The third test set was an Agilent 8973A supplied by W5LUA with an N4000A supplied by Dominique HB9BBD. The fourth test set was an E4440 spectrum analyzer with the noise figure personality card supplied by Agilent Technologies. Having the various test sets available provided some interesting results.

Due to the competitive nature at these events, the decision was made to test three 1296 MHz LNAs, one each from Tommy WD5AGO, Sam G4DDK, and Dominique HB9BBD on the Eaton 2075, the 8970B and 8973A and review the data. The results are as follows.

Test Set	G4DDK	WD5AGO	HB9BBD
Eaton 2075, HP346 + 10 dB pad	0.15 dB	0.16 dB	0.23 dB
8970B + HP346A	0.19 dB	0.22 dB	0.19 dB
8973A + N4000A	0.24 dB	0.25 dB	0.22 dB

It is interesting to note that Sam's LNA measured the lowest noise figure when measured on the Eaton 2075. Both Sam and Dominique's measured the lowest noise figure on the 8970B and Dominique's measured the lowest noise figure on the 8973A. Even though all noise sources have greater than 30 dB return loss, it appears that each LNA may optimize differently when subjected to different noise sources. As a check, I did measure the 346A noise source and it has 35.25 dB return loss in the "off" state and 35.41 dB in the "on" state. The difference in the reflection coefficient from the "off" to the "on" state is .003 at 1296 MHz. The Agilent spec is less than .01 for the 346A and the N4000A. It was decided to continue the testing of the 1296 MHz LNAs with the 8973A and N4000A.

After the conference was over, I decided to run my own tests where I would compare the HP8970, N8973A and the E4440 with the same HP346A noise source. All 3 instruments were corrected for the ambient temperature. The 8970B and the E4440 measured a 1296 MHz LNA to within 0.02 dB of each other on noise figure where the 8973A measured about 0.08dB higher than the 8970. I have heard differing stories over the years about why the 8973 does appear to measure higher and supposedly more accurate noise figures than the older 8970 but it was most interesting that the recent E4440 with the noise figure personality module measured very close to the older 8970 when using the same noise source.

**2010 EME Conference, DFW, Tx Team: WD5AGO, W5LUA, and AF8Z**  
**Equipment: (HP8970B - HP346A), (Eaton 2075 - HP346b+10dB), (HP8973A- w/HB9BBD N4000A)**

50 MHz	(8970)	Call	Design	Device	NF dB	Gain dB
		WA2ODO	WA2ODO	NE334S01	0.16	22.5
		WA3QPX	WA2ODO		0.28	21.6
		K4SME	DEMI KIT	FDP-750	0.37	18
144 MHz	(2075)	Call	Design	Device	NF dB	Gain dB
		WA2ODO	WA2ODO	NE334S01	0.09	26
		WA2ODO	WA2ODO	NE334S01	0.1	24
		WA2ODO	WA2ODO	NE334S01	0.12	20
		K4SME	DEMI KIT	FDP750	0.25	18
		AD6IW	AD6IW	MMIC	0.34	24
		K0YW	HB	MGF1302	0.43	23
		AD6IW	AD6IW	MMIC	1.5	25
		K0YW	HB - WA6LET	U310	2.5	11.7
CONVERTER		KA2UPW	DEMI KIT		8	-7
222 MHz	(8970)	Call	Design	Device	NF dB	Gain dB
		WA2ODO	WA2ODO	NE334S01	0.15	21.8
		K4SME	demikit	FDP-750	0.42	17.7
432 MHz	(2075)	Call	Design	Device	NF dB	Gain dB
		WD5AGO	HB Cavity (new device)	NE334S01 - GAL74	0.22	41
		WA2ODO	WA2ODO	NE334S01	0.26	21.2
		WA2ODO	WA2ODO	NE334S01	0.29	21
		WD5AGO	AGO CAVITY	ATF35143 - GALA	0.32	38
		OK1DFC	AGO CAVITY	ATF35143 - GALA	0.37	37
		WA2ODO	WA2ODO	NE334S01	0.37	22
		WD5AGO	NRAO "1985"	MGF1412 X 2	0.45	37
		K4SME	DEMI KIT	FDP750	0.51	18
		AD6IW	AD6IW	MMIC	0.54	22
CONVERTER		K4SME	DEMI KIT	FDP750	0.64	19.5
		VE6TA	-	MGF1302	0.7	20
		K0DSP	Pauldon	MG1402	1.73	2
		K3JNZ	KA0Y		2.46	10
CONVERTER		KA2UPW	HAMTRONICS		6.3	15.1
902 MHz	(8970)	Call	Design	Device	NF dB	Gain dB
		KL6M	HB	atf 54143	0.45	18.9
		K4SNE	DEMI KIT	FDP-750	0.55	17.7
		WA2ODO	WA2ODO	ATF 334S01	0.75	14.05

1296 MHz	Eaton 2075	Call	Design	Device	NF dB	Gain dB
	<b>HP346+10dB pad</b>	G4DDK	G4DDK	MGF4919	0.15	
	<b>WD5AGO System</b>	WD5AGO	WD5AGO	MGF4919- MGA61584	0.16	
		HB9BBD	HB9BBD	NE32484A	0.23	
<b>1296 MHz</b>		HB9BBD	HB9BBD	NE32484A	0.19	
<b>8970B</b>	<b>346A</b>	G4DDK	G4DDK	MGF4919	0.19	
	<b>W5LUA System</b>	WD5AGO	WD5AGO	MGF4919- MGA61584	0.22	
<b>1296 MHz</b>	<b>8973A</b>	HB9BBD	HB9BBD	NE32484A	0.22	
	<b>N4000A</b>	G4DDK	G4DDK	MGF4919	0.24	
		WD5AGO	WD5AGO	MGF4919- MGA61584	0.25	
<b>1296 MHz</b>	<b>8973A</b>	HB9BBD	HB9BBD	NE32484A	0.22	39
	<b>N4000A</b>	G4DDK	G4DDK	MGF4919	0.24	36
		WD5AGO	WD5AGO	MGF4919- MGA61584	0.25	39
		K6JEY	G4DDK	MGF4919	0.26	39
		WD5AGO	AGO (Old Ref. 0.20 dB)	NE32584 - ATF21184	0.27	36
		K6HLH	G4DDK	MGF4919	0.27	36
		K6JEY	K6JEY	FHX26	0.28	39
		N2UO	HB	MGF4919	0.28	37
		G4DDK	G4DDK	NE325	0.31	38
		WA2ODO	WA2ODO	NE334S01	0.34	10.6
		N8CQ	LUCKY - CNK		0.35	35
		G3LTF	HB	FHX35LG	0.36	38
		WB2BYP	W7CNK	ATF36077	0.42	34
		K0YW	AGO	ATF36077	0.43	30
		N8CQ	CNK		0.45	34
		WA6MGZ	AGO	NE325	0.47	32
		WB2BYP	Demi		0.47	18
		K0YW	AGO	ATF36077	0.48	29
		K0DSP	DEMI KIT	ATF36077	0.53	21
		KL6M	HB CNK	ATF36077/2086	0.56	33
		WA2ODO	WA2ODO	NE334S01	0.57	12
		K0YW	W7JF	ATF10136	0.65	26
		K0YW	AGO (Old w/relay)	ATF36077	0.7	30
		K6HLH	K6HLH	36077	2.8	13
Converter		KA2UPW	DEMI		3.6	21.1

2304 MHz ( all rest HP)	Call	Design	Device	NF dB	Gain dB
<b>HP8970 and HP8971 HP346A</b>	G4DDK	G4DDK	MGF4919	0.27	29
	N0UU	G4DDK	MGF4919	0.3	25.9
	G4DDK	G4DDK	MGF4919	0.31	29.2
	WD5AGO	WD5AGO	MGF4919 - FHC40	0.32	31.9
	WD5AGO	WD5AGO	NE3511 - ATF36163	0.35	32.9
	K0YW	AGO	ATF36077	0.55	30.9
	K0DSP	Demi	ATF36077	0.55	18.2
	KL6M	W6PQL	ATF54143	0.72	14.7
	W7CS	GASFET		1.03	28.2
<b>3400 MHz</b>	<b>Call</b>	<b>Design</b>	<b>Device</b>	<b>NF dB</b>	<b>Gain dB</b>
	G4DDK	G4DDK	MGF4919	0.45	25.9
	WD5AGO	WD5AGO	NE325 - MGA651	0.55	28
	WD5AGO	WD5AGO	MGF4919	0.56	27.5
	KL7UW		ATF36077	0.58	31.5
	G3LTF	W5LUA	ATF36077	0.6	14.7
	WA6PY	Inb WA6PY		0.65	42.9
	KL6M	W6PQL	54143	2.05	12.8
	VE6TA	W6PQL		NG	
<b>5760 MHz</b>	<b>Call</b>	<b>Design</b>	<b>Device</b>	<b>NF dB</b>	<b>Gain dB</b>
	G3LTF	W5LUA	ATF36077	0.6	10.6
	WD5AGO	AGO-LUA	ATF36077 - FHC40	0.73	25.8
	WD5AGO	AGO-LUA	NE32584 - FHC40	0.77	25.5
	WA6PY	WA6PY	ATF36077	1.02	27.9
<b>10368 MHz</b>	<b>Call</b>	<b>Design</b>	<b>Device</b>	<b>NF dB</b>	<b>Gain dB</b>
	AD6IW	AD6IW		1.02	26.7
	K6HLH	DEMI	ATF36077	2	9.56
	W1GHZ	AML AMPLIFIER		4.34	21.1
<b>24 GHZ</b>	<b>Call</b>	<b>Design</b>	<b>Device</b>	<b>NF dB</b>	<b>Gain dB</b>
<b>HP346C &amp; Isolator</b>	W5LUA	HB		2.25	13.8
	W1GHZ	COMM SOLUTIONS	CS00138-01A	3.42	22.1
	WA6PY	AML		4.35	14
	W1GHZ	AML	0440-120	5.38	12.3
	W1GHZ	AML	0420-117	6.62	15