Weekly Report ('04 Winter) # 2.2
"White noise of Demodulator2"

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1 Noise investigations for improvement of the demodulator

1.1 Experiment and Result

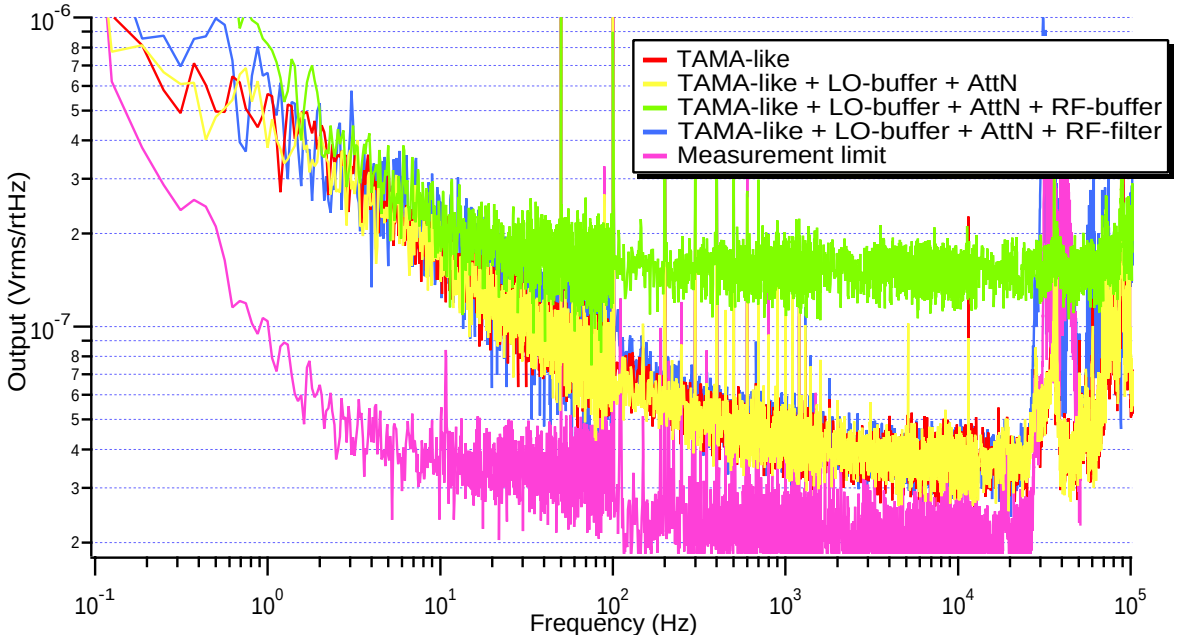

Figure 1: Noise improvement.

Figure 1 shows noise spectra of demodulator output with various configurations. A sinusoidal wave at 15.235Mhz with the amplitude of 2.55V was used as the LO input for each measurement, while the RF input was terminated by a 50 Ω register. The black line shows the noise level of the demodulator that is currently used

for TAMA300. The red line shows the noise level of the newly-built demodulator, but with all of the new features removed. In order to confirm which component causes the dominant noise contribution, each features of the new demodulator is added one by one. An AD811 was used for an RF buffer except "TAMA-like + RF-buffer(CLC425)".

It is concluded that an buffer at the RF port of the mixer causes the significant noise source of the newly built demodulator. Figure 1 shows that the addition of buffers and attenuator at the LO input as well as the filter at an RF input hardly changes the noise level. On the other hand, an addition of the buffer at the RF port clearly makes the noise level worse.

1.2 Considerration

Conversion gain is needs to estimate a noise level of the AD811. Figure 2 show about the conversion gain. Red values are gain of each component. Blue values show measurement values. When a sinusoidal wave at 15.235MHz with the amplitude of -12.13dBVrms was used as the RF, the demodulator output was -4.379dBVrms. The measured conversion gain by voltage ratio was 2.441 from (1)

$$\frac{-4.379[\mathrm{dBVrms/rtHz}]}{-12.13[\mathrm{dBVrms/rtHz}]} = \frac{0.6042[\mathrm{V/rtHz}]}{0.2475[\mathrm{V/rtHz}]} = 2.4412 \tag{1}$$

This conversion gain is close to the other it from (2).

$$(-0.5 + (-4.8) + (-0.02) + 13.34)\,[\mathrm{dB}] = 8.02[\mathrm{dB}] = 2.5177 \tag{2}$$

A noise level of only an AD811 was -160dBm when RF input was terminated by a 50Ω register (c.f. Voltage noise density of a AD811 is said -163.3dB by Analog Devices, Inc). Estimation of a noise level of a AD811 for the demodulator is 5.5×10^{-9}[Vrms] from (3).

$$-160[\mathrm{dBm}] \times 2.44 = 2.24 \times 10^{-9}[\mathrm{Vrms/rtHz}] \times 2.44 = 5.47 \times 10^{-9}[\mathrm{Vrms/rtHz}] \tag{3}$$

It is difficult to say that the cause of noise is RF-buffer because the estimation is lower than measurement result.

2 Next Week

- Replacement of the buffer AD811 by CLC425 or AD8099.
- Dividing the ground plate.

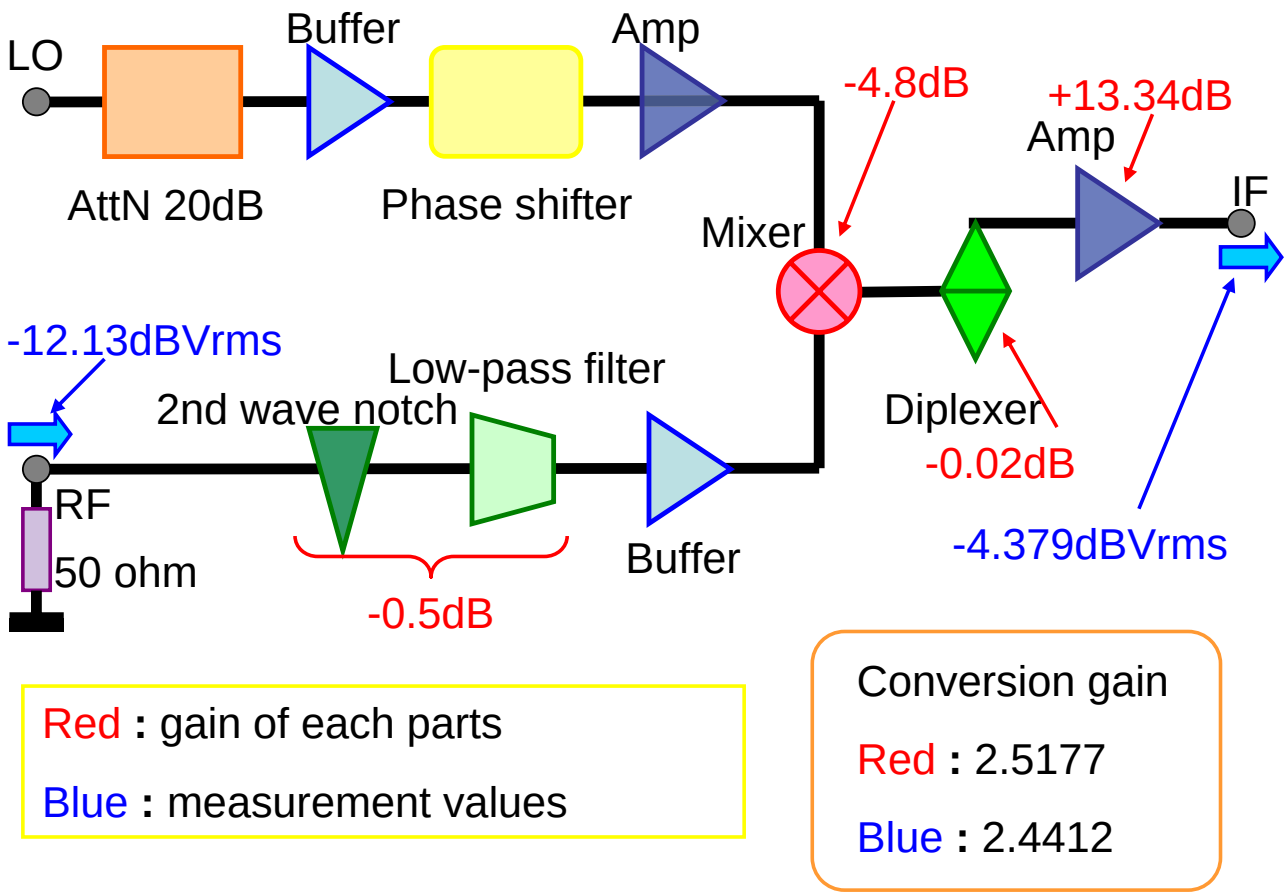

Figure 2: Conversion gain.