ISSN 2278-3091
Volume 7, No.6, November - December 2018
International Journal of Advanced Trends in Computer Science and Engineering
Available Online at http://www.warse.org/IJATCSE/static/pdf/file/ijatcse10762018.pdf
https://doi.org/10.30534/ijatcse/2018/10762018

Analysis and Detection of Correlation photon pairs using shot noise Detection

[1]S.V.R.Kondala Rao, [2]R.J. Kumar, [3]R.Rajasekhar, [4]B Vijay Kiran
[1,2,3,4] Department of ECE, Godavari Institute of Engineering & Technology, Rajahmundry, A.P., India.

ABSTRACT
Profound advancements in quantum optics create necessity to analyze and detect correlated photon pairs. Technologies so far developed to support quantum optics are done mainly to offer new possibilities towards experimental tests dealing with basic principles of quantum mechanics. Dynamic range amplifier is designed for detection of shot noise current obtained due to squeezing or entanglement in laser. The amplification of the Ac current (shot noise current) and DC current is done using this enhanced amplifier with the available input power. The performance of the system is notable from the significant increase in amplifier gain over a wide range of frequency. Therefore this design is tested for various input powers and it is concluded that it plays a very important role for a wide variety of applications, especially in weak signal detection.

Keywords: DC Amplifier, JFET Buffer, Impedance matching, Impedance amplifier

1. INTRODUCTION

The optical noise dimension at the limit sensitivity of shot noise with photo detector is a vital portion of numerous quantum optics evaluations, particularly in non-classical-light generation [1], quantum information and CV (continuous variable) quantum teleportation [2].The noise of quantum is typically measured through heterodyne detection or BHD (balanced homodyne detection), and can be usually compared with the shot-noise level of coherent light at the same power [4]. The thermal noise of resistors, dark current of the photodiode, and the noise of voltage and current in the op amps are the main providers towards electronic noise when no light is incident on the photodiode that sets a strong restriction to the quantum noise's dimension [3].

Firstly, a Trans impedance amplifier was investigated for utilize as the low- noise front-end electronics to a single photodiode-based shadow-sensor, with the shadow of the illuminated fiber falling over one vertically orientated edge of the rectangular sensor. In this method, a lateral vibration of the silica fiber's shadow changed the photocurrent flowing through the PD (photodiode).

With modem strong-state gadgets and coordinated circuits, it will be probable to recognize amplifiers that show a greatly gain of high voltage. Certainly, a gain of nearly whatever desired magnitude might be got by cascading phases [6]. This may appear will suggest that an arbitrary small signal might make amplified to whatever preferred level. This will be not valid due to there is constantly a border to the smallest signal that might be amplified. This breaking point is resolved toward electronic noise. Whether a signal is so little that it is covered by the noise in an amplifier, it is unthinkable to improve the indicator by amplification.

The noise will be available in the whole electronic circuits. It will be created by the irregular movement of electrons in a resistive material, by the irregular grouping of electrons and holes in a semiconductor, and when electrons and holes diffuse through a possibility boundary. The hypothetical groundwork to the study of noise lies in the regions of semiconductor gadget physics and likelihood hypothesis [9].

2. THERMAL NOISE

A voltage noise is also known as thermal noise is produced when energy of thermal causes free electrons to transfer inadvertently in a resistive material. It is also mentioned to as Johnson noise. Nyquist utilized a thermodynamic argument to display that the open-circuit RMS thermal noise voltage across a resistor.

The thermal noise is exhibit in all circuit components holding resistance. The noise is free of the resistance composition. It will be demonstrated the same path in thin film resistors, in integrated circuit monolithic, and in discrete-circuit resistors [8]. A carbon composition resistor produces the same quantity of thermal noise like a same value of the metal film resistor. Though, an extra noise component known as flicker noise might be exist in the carbon composition resistor. It effects from the variable contact among the carbon particles of the resistive material. This noise may be available just when a direct current streams in the resistor [5].

In any type of circuit are comprising capacitors, resistors, and inductors, here only the resistors are used produce the thermal noise. The inductor should be showed as a distinct resistor [6]. The voltage of open-circuit RMS thermal noise is produced by the network in the frequency band from $f1$ to $f2$ is shown in below equation (1)

$$V_t = \left[4KT \int_{f1}^{f_2} \mathrm{Re}(z)\, df \right]^{1/2} \quad (1)$$

3. SCHEMATIC OF AMPLIFIER

A weak signal detection deals with major problem of electronic noise due to the presence of BJT and experience the thermal noise by very high feedback resistance. So, most of the applications where high SNR place a major role it is better to not use BJT.Shot noise current to the OPAMP is estimated to be pico amperes. Non inverting node is grounded so it is self-biased voltage enter into this node is zero. Current from emitter resister is enters the OPAMP. Feedback capacitor used to maintain stability .The value of capacitor depends [7] on the total capacitance and feedback resistor is given by the equation.

$$C_f = \sqrt{\frac{C_T}{2\pi R_f (GBW)}} \quad (2)$$

Where C_f is feedback capacitance and C_T is the total capacitance.

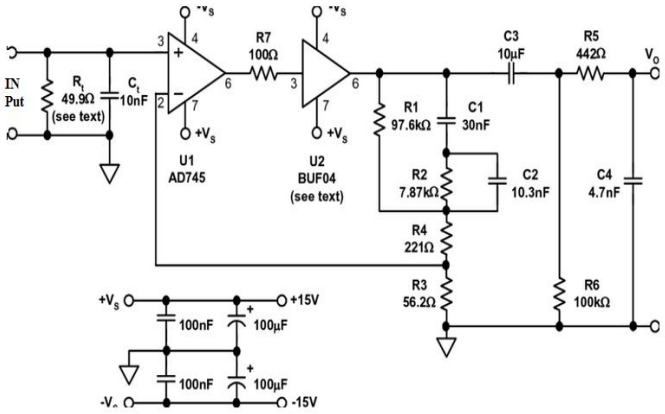

Figure 1: weak signal detection amplifier with low input noise signal

As mentioned above the feedback capacitance is used to stabilized the overall dynamic response of the amplifier . Without the feedback capacitance the circuit is not stabilized. The thermal noise is reduced by using low resistance with the op amp .The part of the output voltage is converted and given back as input to the op amp 2 from figure 1. The two op amps are connected back to back to rise the overall gain of the amplifier. When the given input signal is increased the output also increased in such a condition weak noise dominates electronic noise. In order to achieve the better amplification with low input there is trade between electronic noise and weak signal. Evolutionally, the AC coupling capacitance C3 must be greater and An 100 nF might have been chosen with high frequency impedance showed up. The inductances and parasitic capacitances must be minimized and avoided under the paradigm of the high-frequency trans impedance amplifiers. The audio frequency and DC photocurrents voyaged through resistor R15 and inductor L1. The voltage created crosswise over Rb was then amplified with no swaying to give a DC voltage utilized for phase locking and arrangement.

4. EXPERIMENTAL RESULT

From the graph given below it is observed that, when the input power given to the amplifier increase the electronic noise is difficult to split from the shot noise. However, the presence of thermal noise in the feedback resistance is replaced by back to back connection of op amp and overall stabilization of amplifier is obtained. And noise voltages measurement also designate that noise voltages of total output might be incompletely reduced by the feedback impedance's low pass effect at 2.0MHz as in figure 2.

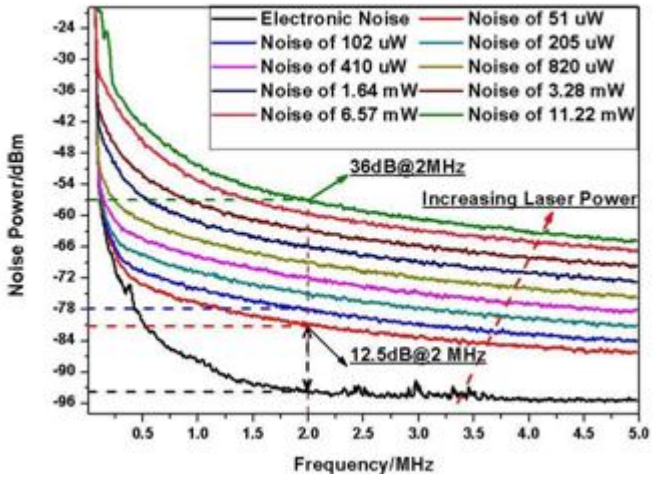

Figure 2: output graph obtained for various input power using ADS tool

5. CONCLUSION

In conclusion, we have designed a high gain, low-noise amplifier with low resistance feedback with low thermal noise and the group of inductance and capacitance (L-C) that is appropriate for calculating the shot noise from laser in the power range of microwatt. The deliberated photo detector had a large gain for the shot noise current with no effect of large DC current. When illuminated by 50 μW input power, the electronic noise is easily distinguished from the available shot noise or white noise The developed weak signal detection amplifier can be used as photo detector and input noise source should be replaced with photo diode and laser might be simply constructed using accessible components.

REFERENCES

[1] H. J. Zhou, W. H. Yang, Z. X. Li, X. F. Li, and Y. H. Zheng, "A bootstrapped, low-noise, and high-gain photo detector for shot noise measurement," Rev. Sci. Instrum.,

vol. 85, no. 1, pp. 013111-1–013111-5, Jan.2014. https://doi.org/10.1063/1.4862295

[2] M. B. Gray, D. A. Shaddock, C. C. Harb, and H. Bachor, "Photo detector designs for low-noise, broadband, and high-power applications," Rev. Sci. Instrum., vol. 69, no. 11, pp. 3755–3762, Nov.1998. https://doi.org/10.1063/1.1149175

[3] D. Nordin and K. Hyyppä, "Single-stage photodiode op-amp solution suited for a self-mixing FMCW system," IEEE Trans. Instrum. Meas., vol. 52, no. 6, pp. 1820–1824, Dec.2003. https://doi.org/10.1109/TIM.2003.820454

[4] Design Considerations for a Trans impedance Amplifier(SNOA515A–February 2008–Revised May2013)

[5] T. Y. Lin, R. J. Green, and P. B. O'Connor, "A gain and bandwidth enhanced trans impedance preamplifier for Fourier-transform ion cyclotron resonance mass spectrometry," Rev. Sci. Instrum., vol. 82, no. 12, pp. 124101– 124108, Dec.2011. https://doi.org/10.1063/1.3660778

[6] W. Marshall Leach, "Fundamentals of low noise circuit design ", IEEE, vol. 82. no**.** 10, october1994..

[7] Papa Rao Nalajala, Rotala Umarani, Naroju Mounika,"Design Of Intelligent Road Traffic Control System For Ambulance Using Rf And Gsm Technology", International Journal Of Advanced Trends In Computer Science And Engineering, Vol.5 , No.1, Pages : 70-73, (2016)

[8] H. Vahlbruch, S. Chelkowski, K. Danzmann, and R. Schnabel, New J. Phys. **9**, 371(2007). https://doi.org/10.1088/1367-2630/9/10/371

[9] Apoorva Deshpande, Ramnaresh Sharma," Multilevel Ensemble Classifier using Normalized Feature based Intrusion Detection System", International Journal of Advanced Trends in Computer Science and Engineering, Volume 7, No.5, Pp-72-76,2018