Proc. Annual Symposium on Research & Industrial Training, 02(2015) 69-73
Department of Electronics – Wayamba University of Sri Lanka

DESIGNING A PORTABLE SIGNAL TO NOISE RATIO (SNR) DETECTOR

M.M.S.N Mudannayake*, G.A.K.S. Perera

Department of Electronics, Wayamba University of Sri Lanka, Kuliyapitiya, Sri Lanka
*salani756@gmail.com**

ABSTRACT

High speed internet access network is enabled by Sri Lanka Telecom PLC (SLT) in island wide for the customers. The speed and quality of a broadband line depends on several factors. One of the most important factors is noise which affects the speed and the quality of broadband line. Signal-to-Noise Ratio (SNR) is a measurement that is related with noise. SNR compares the level of a desired signal to the level of background noise. Most of the times, technical assistants reach the customer premises and then resolve faults in megalines. SNR value of that particular line is an important factor when resolving troubleshoot in a broadband line. An instrument is available in SLT for SNR detection which is expensive and complicated. Due to this reason, it is used in rarely by people who are in the field. The main objective of the project is implementing a low cost SNR detector for broadband line with the facility of portability. Benefits of this device can be gained by people who are in the field without any discomfort.

Keywords: Signal-to-Noise Ratio, Broadband Line

1. INTRODUCTION

Sri Lanka Telecom PLC (SLT) is the largest telecommunication service provider in Sri Lanka. SLT provides both voice and data service to the customer. There are several factors that affect the speed and the quality of a broadband line in SLT. The most important factor is noise. SLT is always attentive for maintenance and tries to provide a good quality service for their customers. Most of the times, technical assistants reach the customer premises and then resolve the reported faults. When resolving a troubleshoot in a broadband line, one of an important factor is Signal-to-Noise Ratio (SNR) value of that particular line. Usually, they use two options to find SNR value in a line. One method is calling the Network Operation

Center (NOC) over the phone and gets the value. The other method is logging in to the router and checking SNR value. Already there exists SNR testers in SLT, which are expensive and complicated. Due to above drawbacks, most of the technical assistants not prefer to use SNR testers. The goal of this project is to develop a device to detect SNR value in a high frequency line as a simple, low cost implementation with the facility of portability to outcome the above drawbacks. Filtering techniques and microcontrollers have been used to input signal analyzing and calculations. This is used to get SNR value of a broadband line at any point in copper transmission medium with high frequency signal. Public Switched Telephone Network (PSTN) and Asynchronous Digital Subscriber Line (ADSL) operate at different frequencies. They can be carried through the same wire at the same time when the operating conditions are correct. Voice calls operate within a narrow frequency range and ADSL operates between 25.875 kHz and 1.1 MHz. Following figure (1) shows frequency allocation for PSTN and ADSL in SLT.

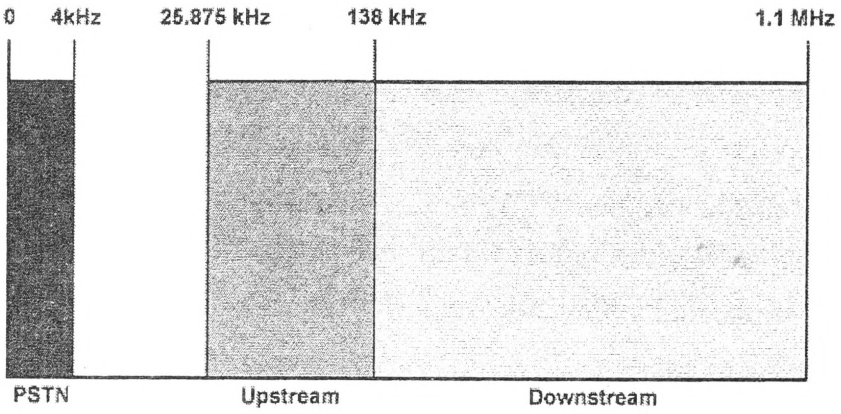

Figure 1: Frequency allocation for PSTN and ADSL

Filtering techniques have been used to separate both signal and noise. Filters are networks that process signals in a frequency-dependent manner. Band pass filters have been used for filtering specific bandwidth and band reject filters have been used for rejecting a particular band width.

2. EXPERIMENTAL

SNR is defined as the power ratio between a signal (meaningful information) and the background noise (unwanted signal). SNR is often used to measure the quality of a system. It is given in decibel (dB).

$$\text{SNR (dB)} = 10 \log \left(\frac{\text{Signal Power}}{\text{Noise Power}} \right) \quad \text{---------- (1)}$$

This can be written equivalently using amplitude ratios as;

$$\text{SNR (dB)} = 20 \log \left(\frac{\text{Amplitude of the Signal}}{\text{Amplitude of the Noise}} \right) \quad \text{---------- (2)}$$

The frequencies of both ADSL and PSTN transmit in a single wire. Then, it is separated while transmitting through filters. Microcontroller detects separated signals as "Noise" and "Signal" and SNR value is calculated according to the equation(2).

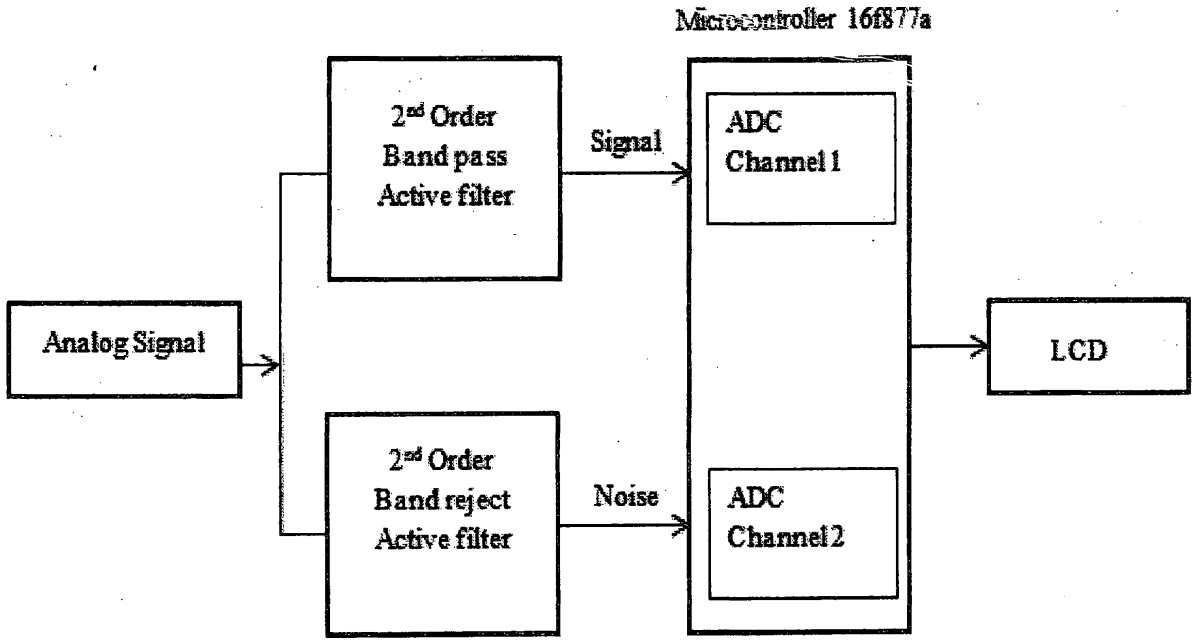

Figure 2: Block diagram of the system

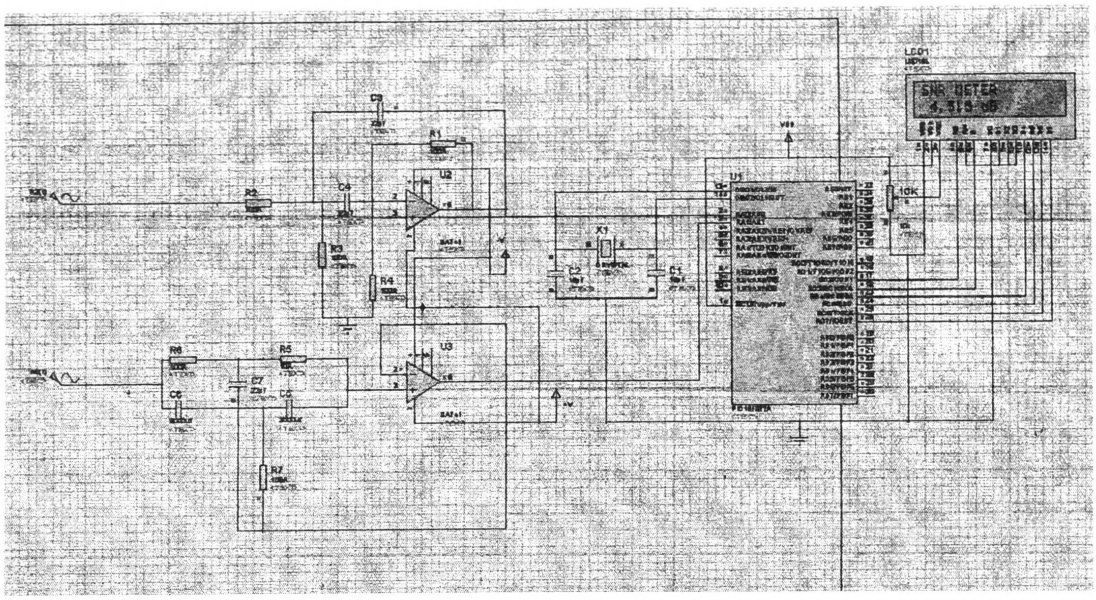

Figure 3: Circuit diagram of the system

3.0 RESULTS AND DISCUSSION

3.1 Results

All the separate circuits have been tested individually before simulation and then integrated as a whole circuit. Results were observed using different sinusoidal signals with different frequencies and amplitudes for two inputs. Results are given below. SNR values were calculated as per equation (2).

Table 1: SNR values for different sinusoidal signals

Input as signal with 10 kHz (V)	Input as noise with 15 kHz (V)	SNR value on LCD (dB)	Calculated value (dB)
48.5	45.5	0.58	0.61
46.0	42.0	0.75	0.79
45.5	39.5	1.18	1.23
44.0	35.0	2.01	1.99
43.5	32.5	2.50	2.53
42.0	30.0	2.89	2.92
41.5	26.5	3.82	3.90

3.2 Discussion

This portable SNR detector can be used to check SNR value of an analog signal. This is most useful for getting SNR value of a broadband line in Outside Plant Network (OSP). The existing instrument for SNR detection is about two lakhs in rupees and it can be used for many testing in addition to SNR detection. Advantages of this implemented device are user friendly and less complicated, low cost and easy to use for analog signal with fast response. This device can be used without having any expertise knowledge and SNR value can be seen on the LCD in dB.

4. CONCLUSION

This implementation can increase effectiveness of the workers and get accurate SNR value at any point in copper access network. Maximum sampling frequency of PIC16F877A microcontroller is 50 kHz. Therefore, this device can be used for frequencies up to 50 kHz. 10 kHz and 15 kHz signals have been used for testing purposes of the device. The broadband bandwidth in SLT is 25.875 kHz to 1.1 MHz. Hence, the microcontroller used in this project is suitable for a part of bandwidth. To cover the whole range, Field-Programmable Gate Array (FPGA) can be used which is bit expensive than PIC microcontroller. FPGAs are programmable semiconductor devices that are based around a matrix of configurable logic blocks connected through programmable interconnect with up to 300 MHz frequencies.

ACKNOWLEDGMENTS

Authors would like to acknowledge and extend heartfelt gratitude to Department of Electronics, Wayamba University of Sri Lanka.

REFERENCES

[1]. T. Starr, J. M. Cioffi, and P. J. Silverman, *Understanding Digital Subscriber Line Technology*. Prentice Hall Communications Engineering and Emerging Technologies Series, Prentice Hall, New York, 1999. ISBN 0-13-780545-4.

[2]. http://ww1.microchip.com/downloads/en/DeviceDoc/39582b.pdf

[3]. http://www.ehow.com/how_6941285_increase-modem-signal-noise-ratio.html

[4]. http://www.speedguide.net/faq/what-is-considered-good-dsl-noise-margin-snr-355

[5]. http://www.circuitstoday.com/band-pass-filters

Proc. Annual Symposium on Research & Industrial Training, 02(2015) 69-73
Department of Electronics – Wayamba University of Sri Lanka