NOISE and ITS GENERATION

INTRODUCTION :

Noise is inevitably present in electrical circuits. Noise analysis and its reduction is important to study.

AIM :

To generate an electrical noise and to analyse its spectrum(frequency composition).

DIGITAL NOISE GENERATOR :

INTRODUCTION :

The noise generator is based on the use of shift registers and logic gates. It is source for the band limited noise that can be used for measuring its characteristics.

DETAILS OF NOISE GENERATOR :

A digital circuit can generate periodic sequences consisting of an random pattern of bits called a Pseudorandom bit sequence(PRBS). Our PRBS circuit employs serial-in-parallel-out(SIPO) shift register. An exclusive OR operation of mth and nth bits is then performed, where m,n are appropriately selected.

There is also need to provide a periodic pulse train, called clock to shift register. The bits move forward within the register when a clock transition occurs. An input sequence(SEED) is also required to initialise the registers.

The suitable outputs from the SIPO shift register are then fed into XOR gates. The resultant output is sequence of bits which shows randomness within a period T, before the output deterministically repeats itself. The maximum number of states that can be generated through this approach is 2^k, k being overall number of output bits in shift register.

The complete circuit consists of :

1. SIPO shift register
2. XOR gate for implementing the maximal length shift register sequence.

For PRBS generation, We have used one 4 bit shift register (part number 4035). The sequence required to initialise the shift register is parallely loaded into shift register. In our case the SEED was 1100. The attainment of the maximal length sequence depends on selecting suitable taps, feeding them into XOR gates and routing the output through the feedback path into the shift register input. In the 4 bit shift register the maximal length is attained by selection the 3^{rd} and 4^{th} bits of shift register. The output of the noise generator is unipolar. The noise generator can be used in variety of applications such as generation of band-limited white noise.

SEED : 1100

The selected seed can be any sequence other than 0000 because “0000” always produces 0000 as output.

BITS for feeding XOR gate : 3rd and 4th bits.

SEQUENCE OBSERVED :

1100 → 0110 → 1011 → 0101 → 1010 → 1101 → 1110 → 1111 → 0111 → 0011 → 0001→ 1000 → 0100 → 0010 → 1001 → 1100

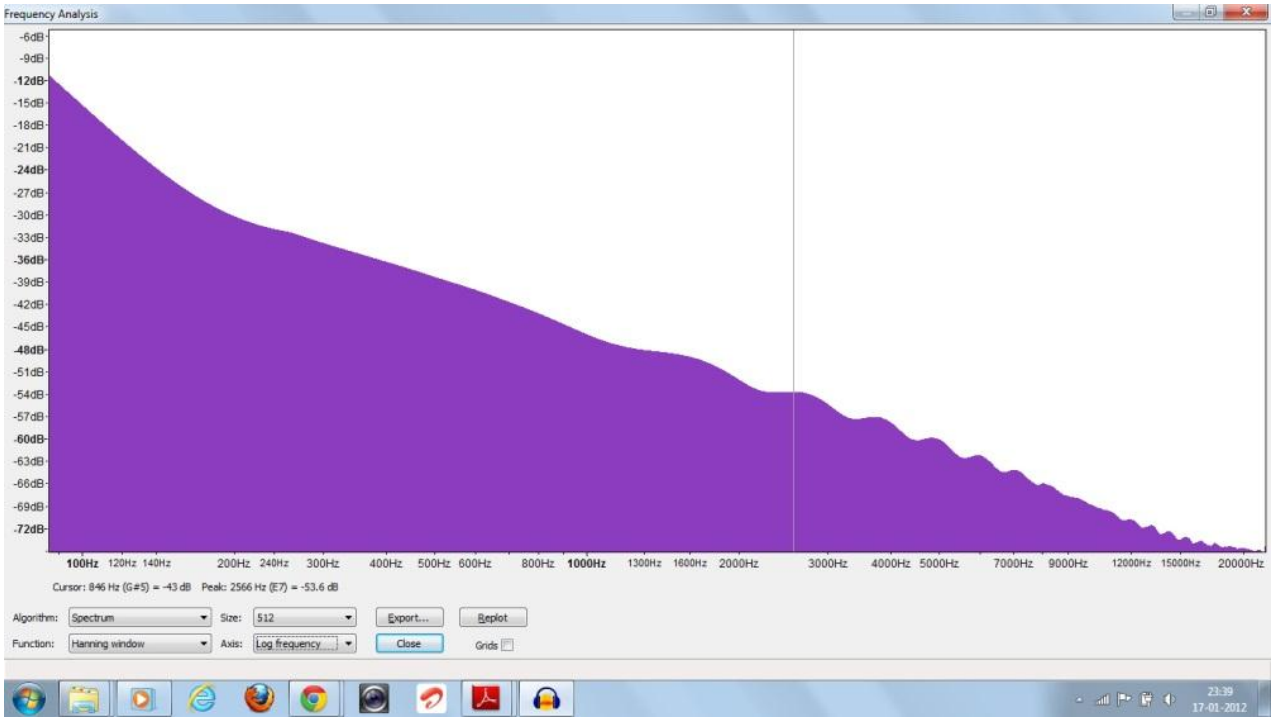
We observe that we get maximal length sequence when we choose 3rd and 4th bits to feed to XOR gate.

Low Pass Filter(LPF) :

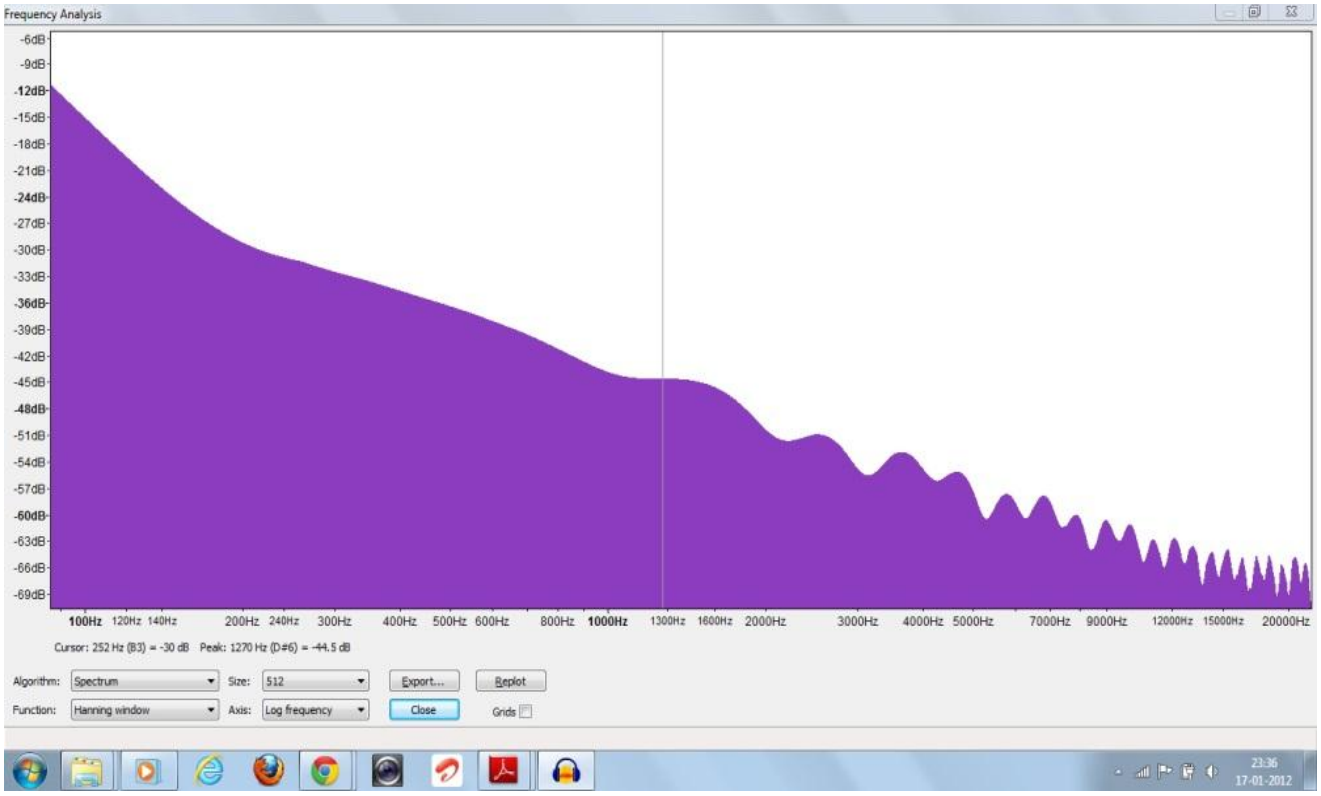
When the 4th output bit of the pseudorandom bit generator is fed into low pass RC filter, the output approximates band limited white noise.

Plots of Spectrum with different cut-off frequencies: (auto-correlation)

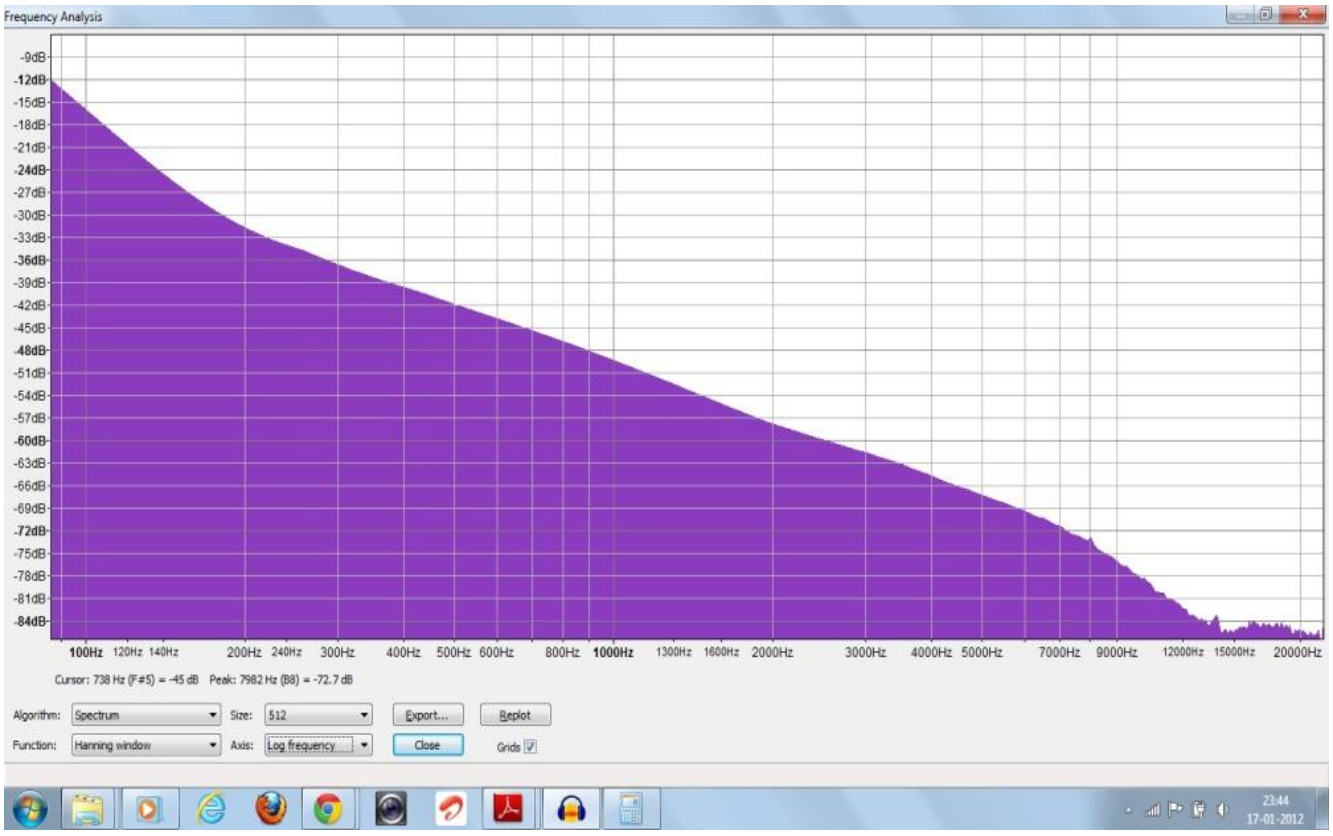
With cut-off frequency : 160 hz.



With cut-off frequency : 1590 hz



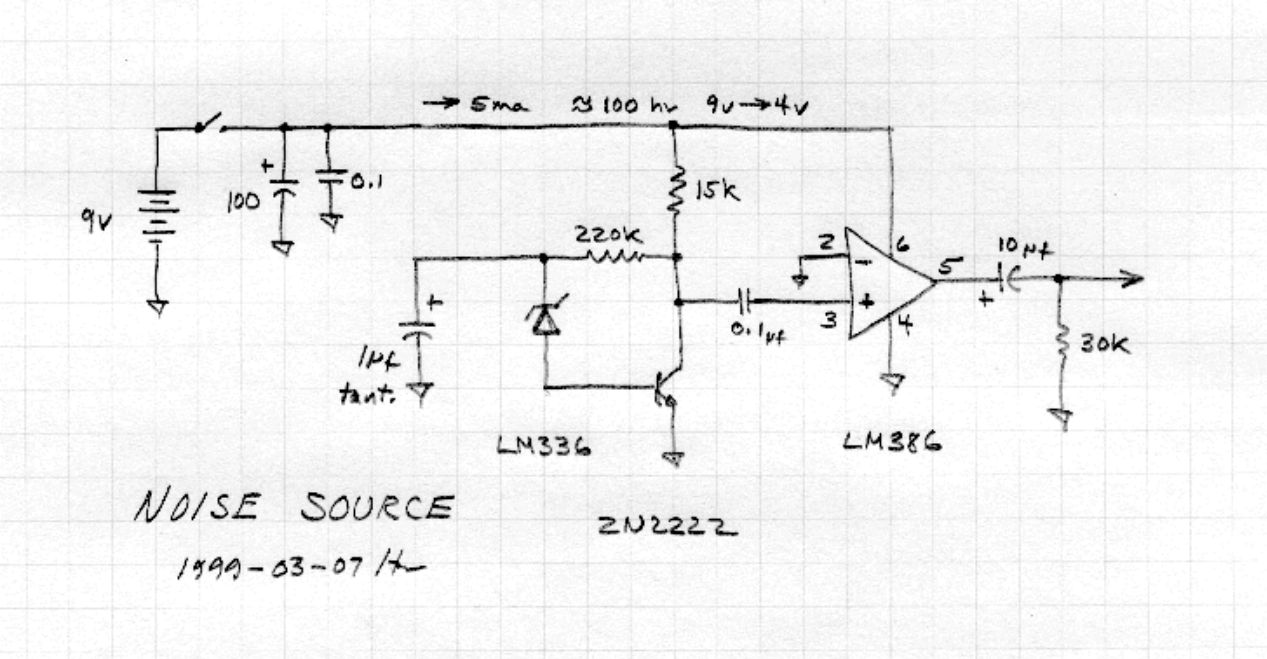
With cut-off frequency : 16hz



Conclusion :

The noise generated through Pseudorandom numbers is band limited spectrum.

ANALOG NOISE GENERATION :



The above circuit is used to generate the noise.

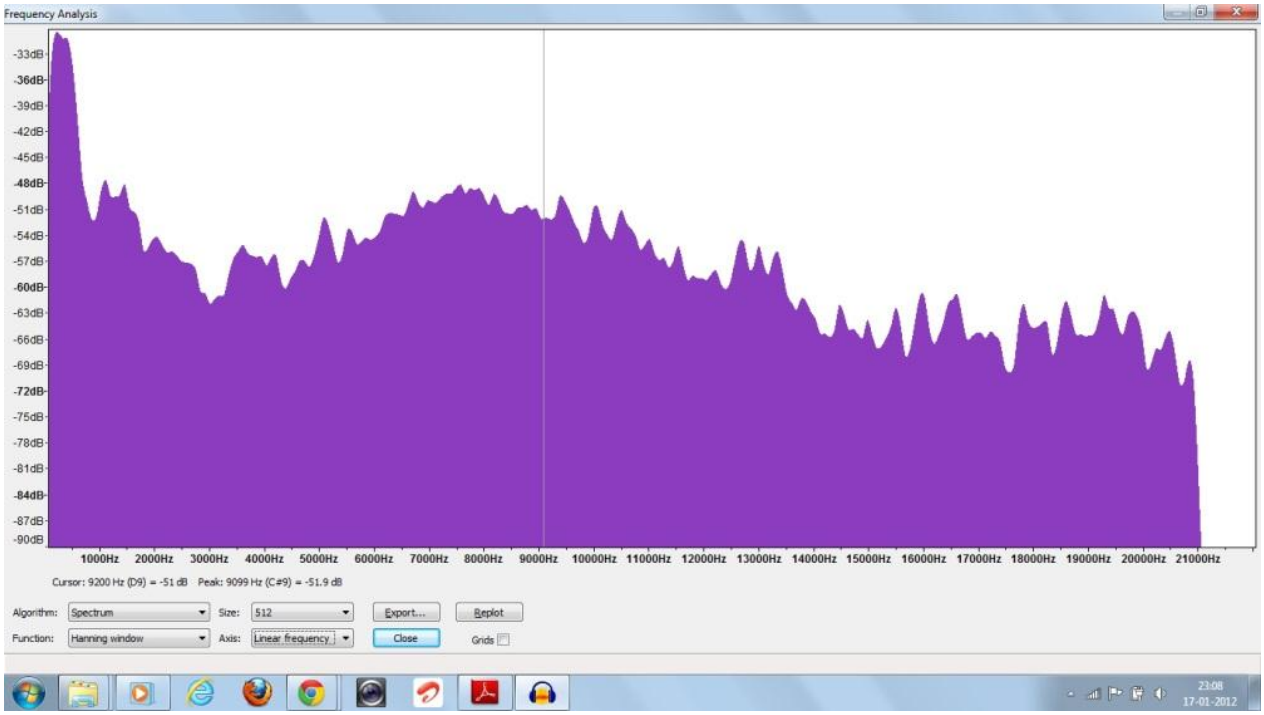
The circuit consists of :

1. The high pass and low pass filters
2. Zener diode(6.8 V) biased in breakdown region.
3. Transistor to amplify(also converts current to voltage).
4. Audio Amplifier(LM 386).

The two filters that are built cut-off the high and low frequency components. The noise produced in Zener diode(Shot noise due to random carrier movement) is very weak. So it is amplified by the transistor. Here the current signal is converted to voltage signal which are further amplified by the audio amplifier(LM 386). The amplified signal is then passes through a high pass filter.

The spectrum observed

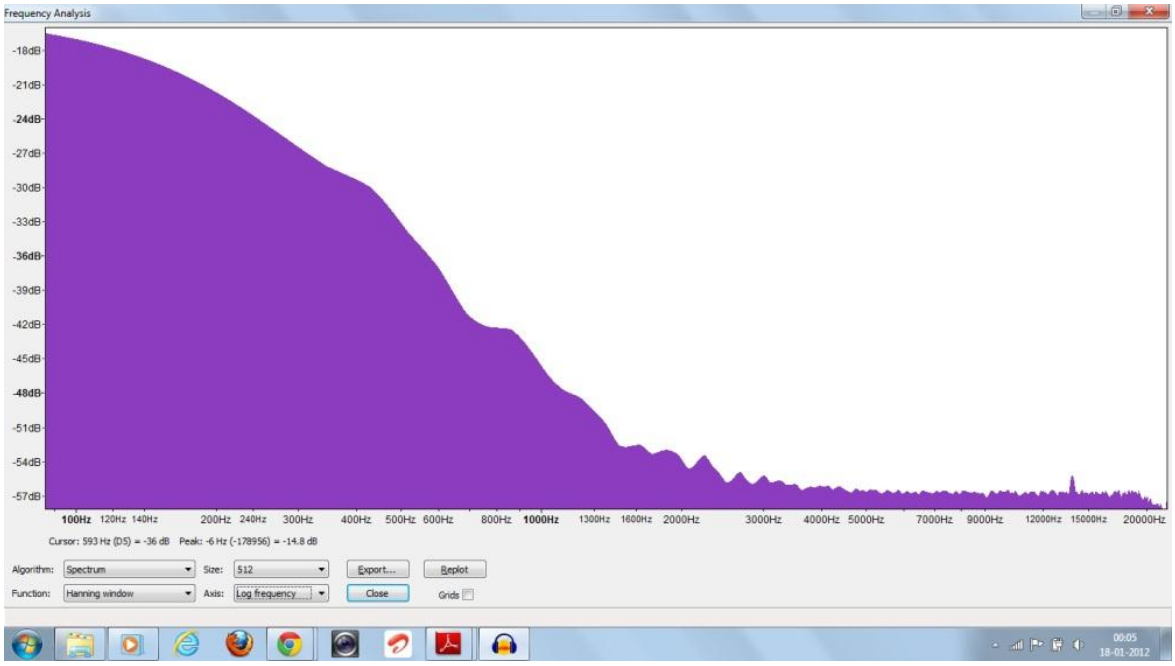
CUT-OFF : 2000 hz.



The above picture is in linear frequency axis.

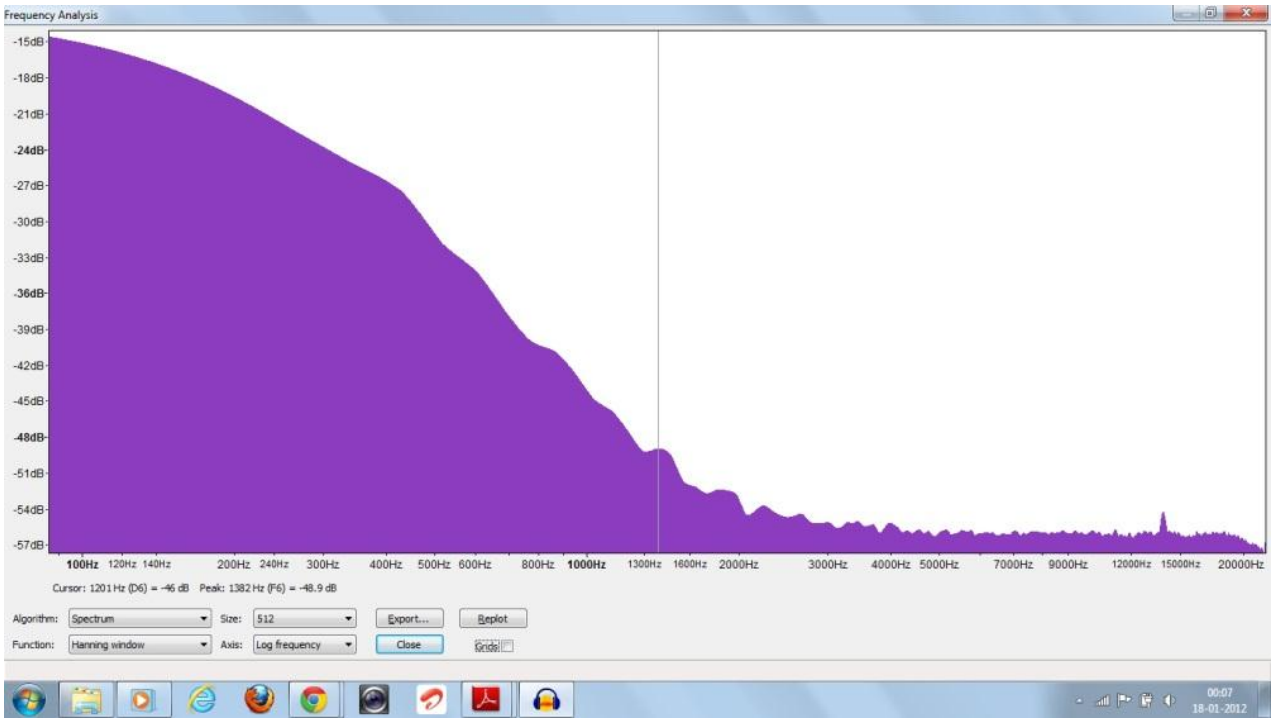
EFFECT OF CHANGE IN THE SUPPLY VOLTAGE :

At voltage : 4.6 Volts



At 7 volts :

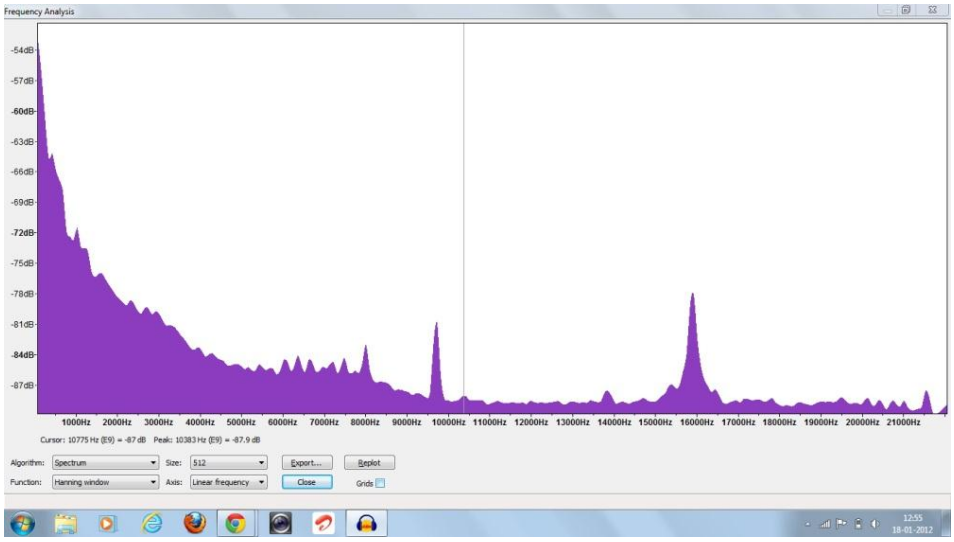
More power



SECOND CIRCUIT :

This circuit uses two transistor to amplify the signal(shot noise).

Spectrum observed is :



CONCLUSION :

The first circuit of analog noise generation gave the nice results than the second one.

This experiment on noise generation gave understanding of power spectral density of white noise.

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