EW 2 ASSIGNMENT 2

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DIGITAL NOISE GENERATION

By way of pseudo number generation using linear shift registers and then conversion to analog by filtering the output using a low-pass filter , thus converting it to analog .

A **linear feedback shift register** (LFSR) is a shift register whose input bit is a linear function of its previous state.

The most commonly used linear function of single bits is XOR. Thus, an LFSR is most often a shift register whose input bit is driven by the exclusive-or (XOR) of some bits of the overall shift register value.

The initial value of the LFSR is called the seed, and because the operation of the register is deterministic, the stream of values produced by the register is completely determined by its current (or previous) state. Likewise, because

the register has a finite number of possible states, it must eventually enter a repeating cycle. However, an LFSR with a well-chosen feedback function can produce a sequence of bits which appears random and which has a very long cycle.

The bit positions that affect the next state are called the taps.

SEED SELECTION

For any positive seed the LFSR would work correctly , but for a zero value of seed the LFSR linear map function would repeatedly produce “0000” . Thus it is imperative to choose a non zero seed . It is also

BITS TO BE CHOSEN

The bits to be chosen had a direct impact on the length of the sequence generated thus if correctly chosen the taps would produce longest possible sequence . I had chosen 1st and 2nd bits for linear map, thus it is very

important to get a right linear map function or the bits to be operated upon .

This we had achieved using CD4035 shift register and XOR IC only whereas the clock had been provided by 555 timer circuit .

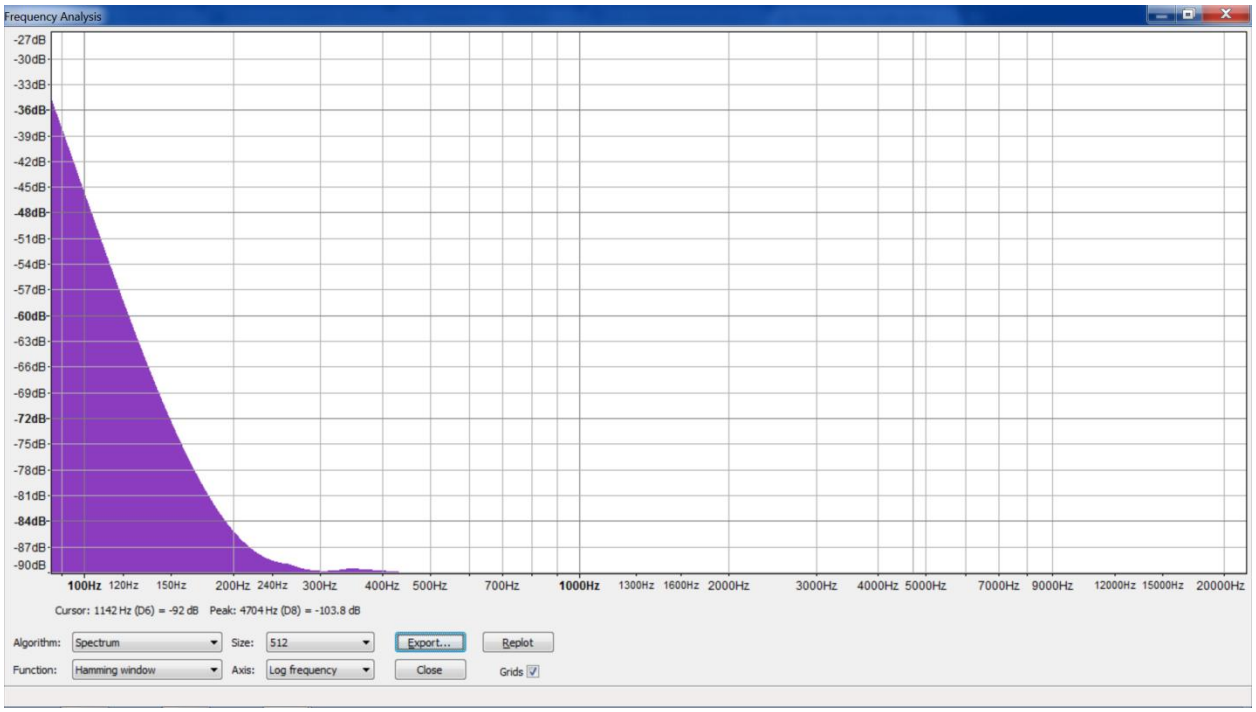
LPF FREQUENCY CUTOFF

I had kept the cutoff of the filter at around 5 Kilohertz for optimal shape of the power spectrum shaping because the frequencies higher than this fc was not of sufficient frequency magnitude .

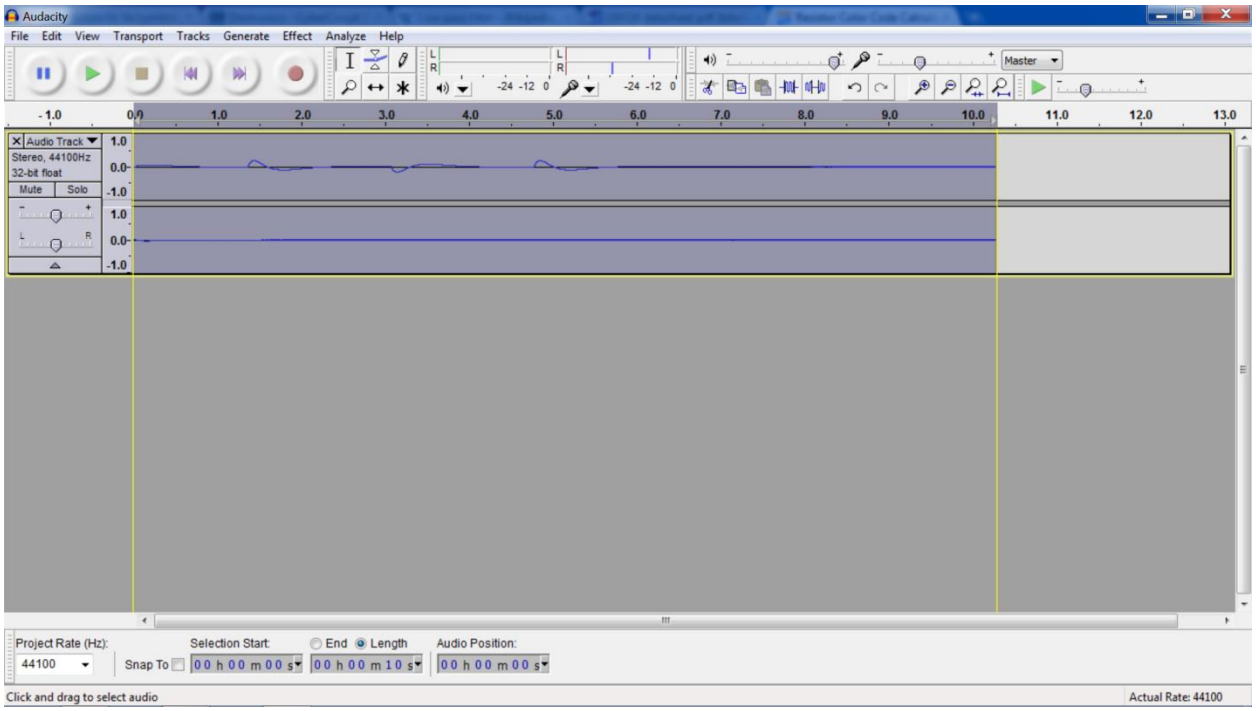
CONCLUSION

The pseudo random generator do not produce true random outputs which is clearly said in the theory of LFSR’s , similarly it is very important to take a appropriate seed , the taps to be selected and for best random sequence generated the choice of linear map function .

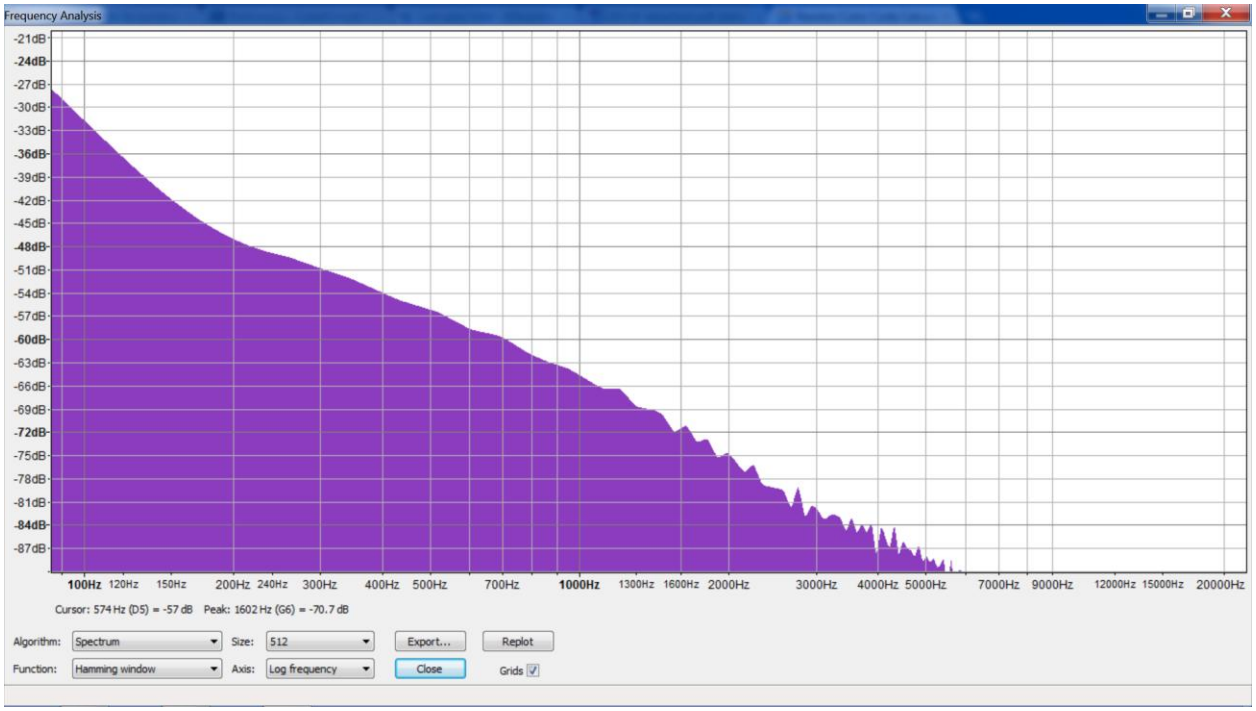
SPECTRUM(SLOW CLOCKED)



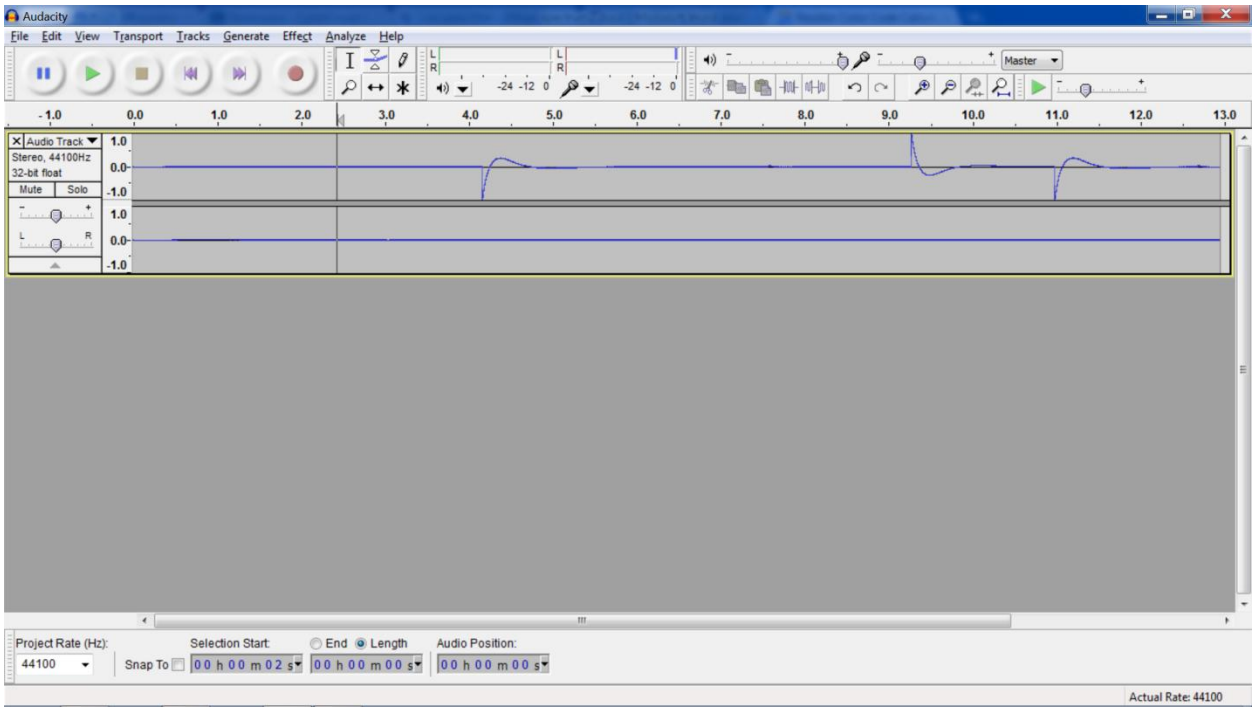
TIME DOMAIN(SLOW CLOCKED)



SPECTRUM (FAST CLOCKED)



TIME DOMAIN(FAST CLOCKED)



BIT STREAM GENERATED(XOR 2nd and 3rd bits0)

“1010”

“1101”

“1110”

“0111”

“0011”

“1001”

“0100”

“1010”

BIT STREAM GENERATED(XOR 1st and 2nd bits0)

“1010”

“1101”

“1110”

“1111”

“0111”

“0011”

“0001”

“1000”

“0100”

“0010”

“1001”

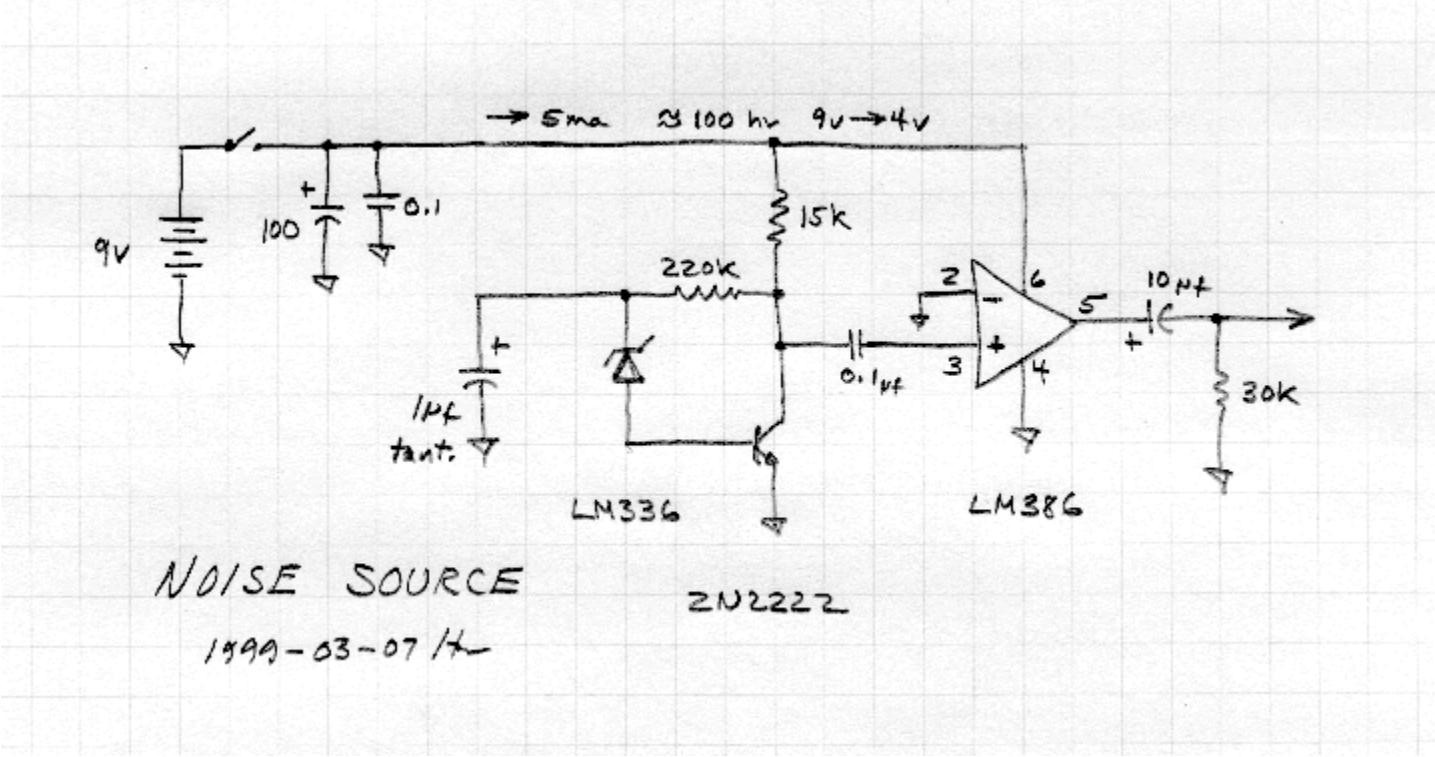
“1100”

“0110”

“1011”

“0101”

ANALOG NOISE GENERATION(CURRENT TO VOLTAGE)



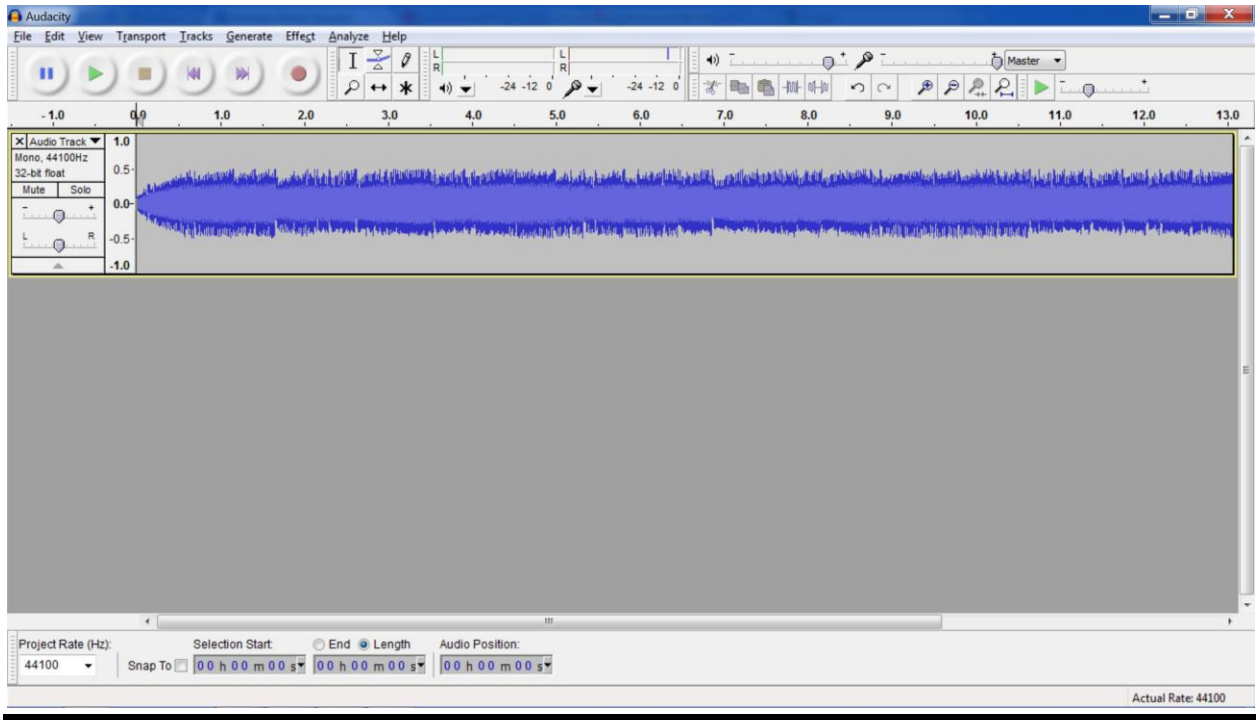
THE first part of circuit uses a Low Pass filter and a High Pass filter , then it biases the 6.8 v zener diode in breakdown region , the current flowing(SHOT NOISE) through it is applied to 2N2222A transistor which converts it accordingly to voltage thus this noise is amplified by the LM386 audio amplifier which is then further

modified by applying a High Pass Filter using a simple RC network .

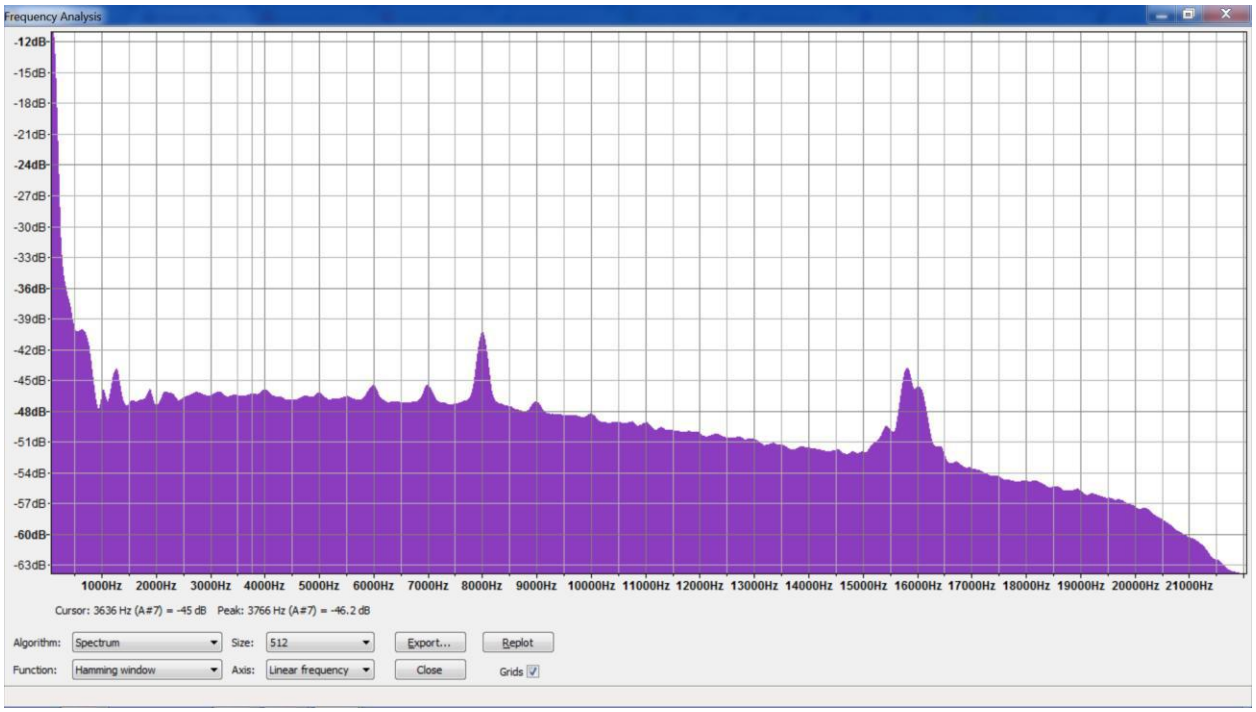
CUTOFF OF HPF

The cutoff I had initially set for 500 hertz then I changed it two 2 Kilohertz this had been done so as to obtain a flatband power-spectrum just as in the case of White noise , I had also used the gain control factor of LM 386 IC and increased it to about 2 decibel so that the mid frequencies are more flattened .

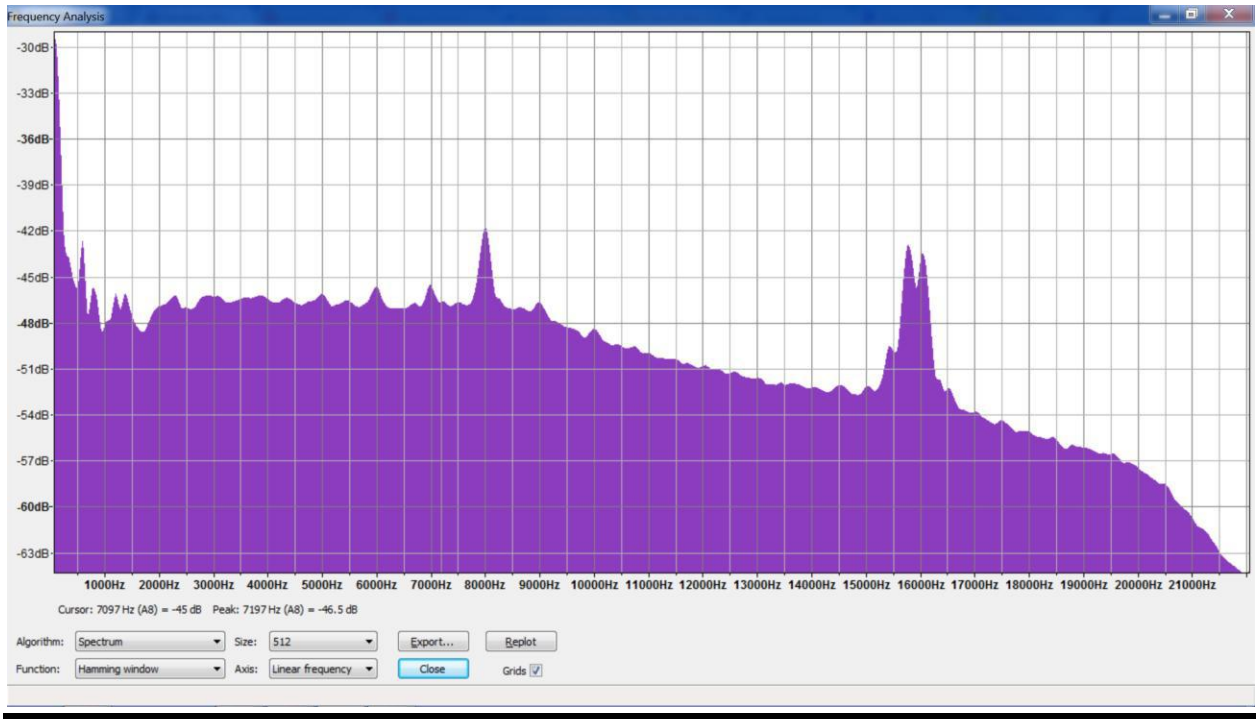
TIME DOMAIN(NORMAL)



FREQUENCY DOMAIN(NORMAL)



FREQUENCY DOMAIN(FILTER OPERATED AND GAIN ENABLED)



CONCLUSION

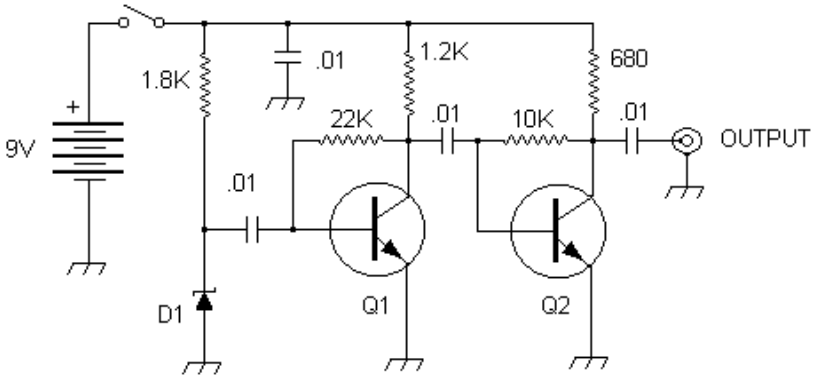
The design of this analog noise generation was far better and random in the true sense that I can manipulate several factors from the amplitude of the noise recorded , number of samples taken , frequency shaping of the plot (This experiment towards WHITE NOISE) , the signals had been generated from true SHOT NOISE of the ZENER DIODE in the breakdown region .

ANALOG NOISE GENERATION(PART 2)

In the second part I had generated noise using the zener diode voltage and amplified it using two

coupled transistors which had been coupled together and biased at sufficient voltage there was also a low capacitor value placed to filter high frequency ripples .

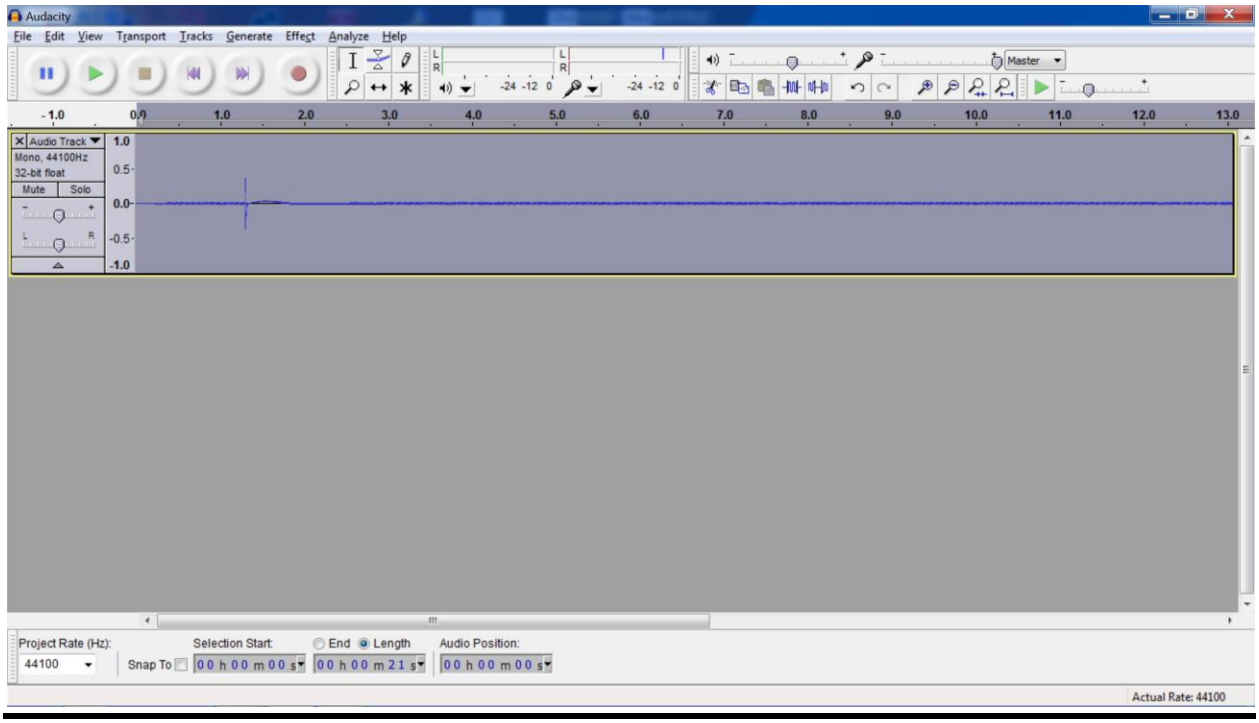
HF NOISE GENERATOR

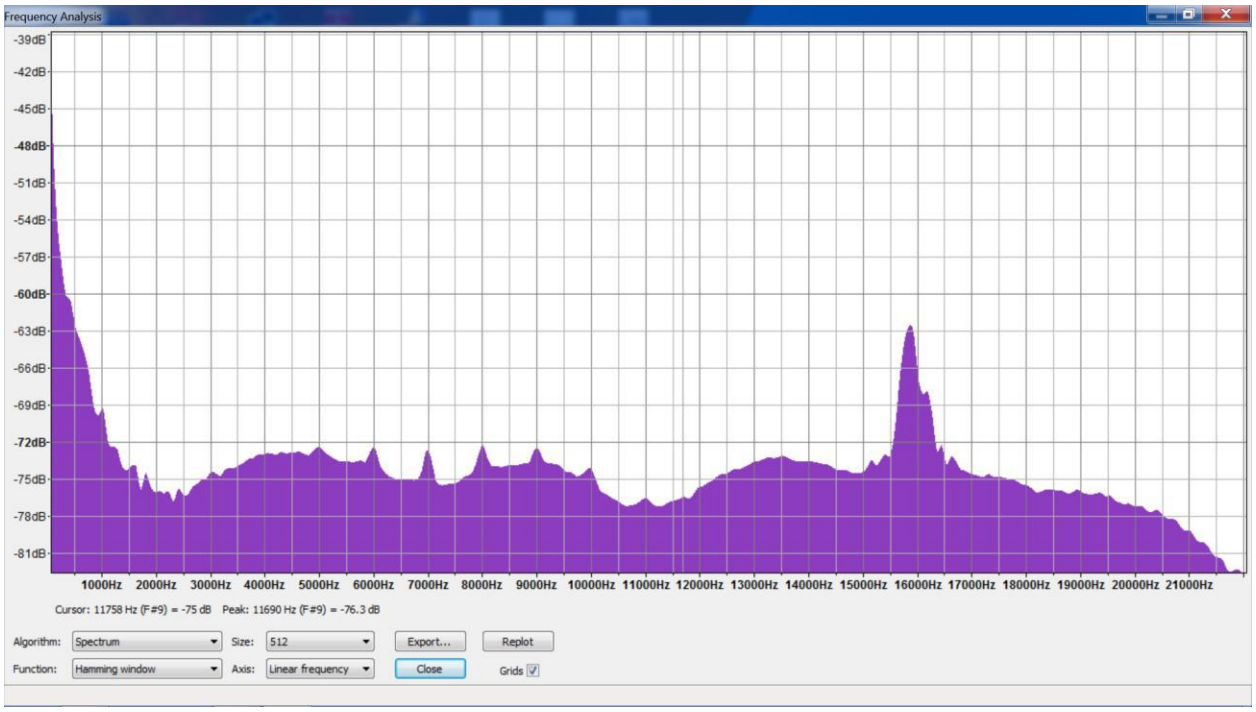


D1 = 6.8 V 1 Watt Zener Diode
Q1, Q2 = 2N2222 or equal.

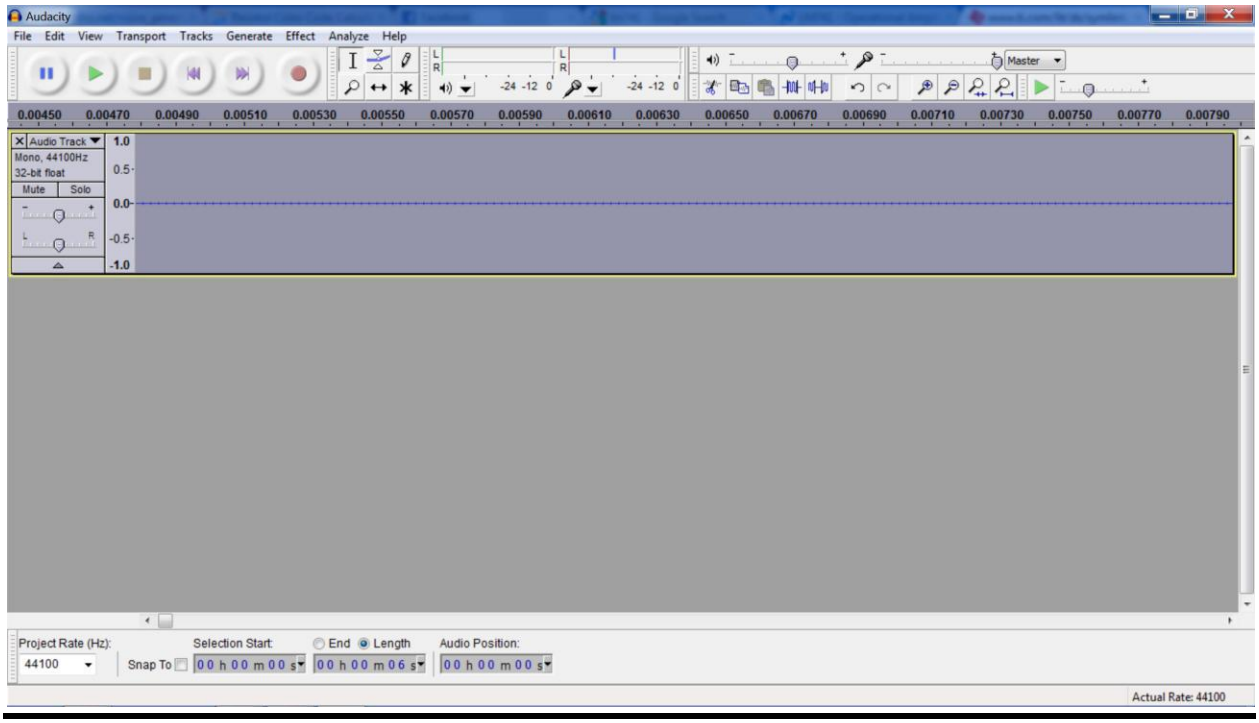
Capacitor Values in ufd
Resistor Values in ohms
Resistors 1/4 watt.

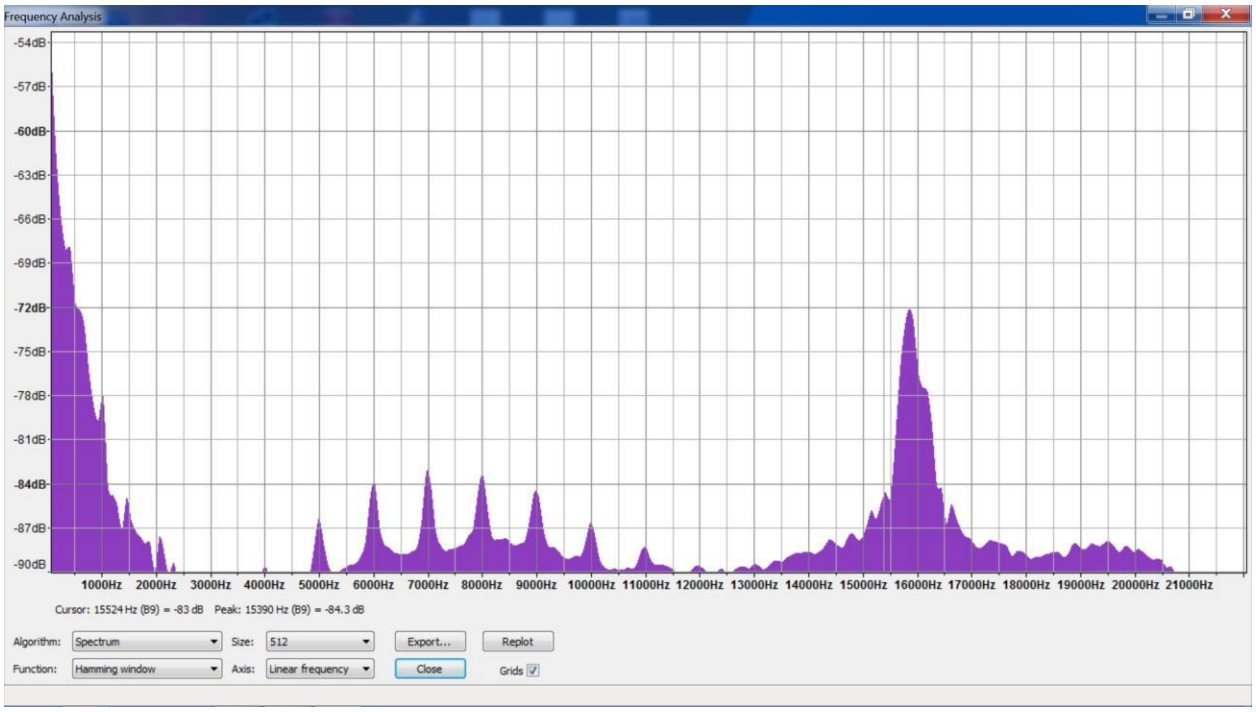
TIME DOMAIN+ FREQUENCY DOMAIN(NORMAL OPERATION)





TIME DOMAIN + FREQUENCY DOMAIN(HPF FILTER)


Audacity
File Edit View Transport Tracks Generate Effect Analyze Help
Master
Audio Track
Mono, 44100Hz
32-bit float
Mute Solo
Project Rate (Hz):
44100
Snap To
Selection Start:
End
Length
Audio Position:
Actual Rate: 44100


Frequency Analysis
-54dB
-57dB
-60dB
-63dB
-66dB
-69dB
-72dB
-75dB
-78dB
-81dB
-84dB
-87dB
-90dB
1000Hz 2000Hz 3000Hz 4000Hz 5000Hz 6000Hz 7000Hz 8000Hz 9000Hz 10000Hz 11000Hz 12000Hz 13000Hz 14000Hz 15000Hz 16000Hz 17000Hz 18000Hz 19000Hz 20000Hz 21000Hz
Cursor: 15524 Hz (B9) = -83 dB Peak: 15390 Hz (B9) = -84.3 dB
Algorithm: Spectrum
Function: Hamming window
Size: 512
Axis: Linear frequency
Export...
Replot
Close
Grids

CONCLUSION

I preferred the first circuit of analog noise generation since the circuit behaved randomly that is on operation of two things normal or with High Pass filter.