

GENERATION OF SIGNALS USING LABVIEW FOR MAGNETIC COILS WITH POWER AMPLIFIERS

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ABSTRACT

Design and implementation of a power amplifier to control the magnetic coils using LabVIEW (Laboratory Virtual Instrumentation Engineering Workbench) for displaying different waveforms is presented. A power amplifier is used to give supply voltages to the magnetic coils. A LabVIEW based program using Data Acquisition (DAQ) is generated for supplying various input signals to the power amplifier, thereby controlling the magnetic coils from the software itself. The various output signals such as sine, square, pulse, staircase, triangular, sawtooth waveforms are generated and the output characteristics of power amplifier is obtained. The generated waveform and its parameters are displayed simultaneously on the front panel of the LabVIEW program and on the screen of the oscilloscope. The virtual instrument created in LabVIEW allows testing and controlling these signals using power amplifier.

Keyword: - Lab View, Power Amplifier, Data Acquisition (DAQ), Virtual Instruments.

I. INTRODUCTION

The generation of continuous monitoring of signals in experiments or research is evidently. The main objective of the work is to control the magnetic coils using the hardware component such as power amplifier and the software application realized with Lab VIEW graphical programming. Through Lab VIEW programs various signals are generated to drive the magnetic coils using power amplifier. This is intended to be used to study the scattering properties of a magnetic sample placed in between the poles of an electromagnet (magnetic coils). Also, this can be used as a system to generate signals for the communication circuits, experiments regarding analog, digital modulations, optics, medical field etc. One of the main parts of the work is software programming the Virtual Instruments (VI) used for the control and user interface. The control system consists of a data acquisition card using Lab VIEW. The user interface is programmed as virtual instruments. By employing a Lab VIEW virtual instrument which control the module can obtain an optimal balance between its flexibility of use and price. Therefore, both the execution of the experiment as well as studying the characteristics of the sample and the processing of measured data are achieved by virtual instrumentation.

II. HARDWARE COMPONENT

Power operational amplifiers (POA) are developed for application purposes in which the power of low-level signals can be increased that drive low impedances or reactive loads. They dissipate excess energy as heat, sustain relatively high supply voltages and deliver extensive current. The devices have impedances range 10 to 100 times lower than small-signal operational amplifiers and can dissipate more power and deliver high amounts

of current. The power operational amplifier used is OPA541 and is capable of operation from power supplies up to +/-40 Volts and delivering continuous output currents up to 5Amperes. This can be operated from unbalanced power supplies or a single power supply. The current limit circuitry is user-programmed with a single external resistor thereby protecting the amplifier and load from worst conditions. The OPA541 uses a single current-limit resistor to set both the positive and negative current limits. The advantages of power amplifier over conventional amplifiers are reduced part counts, high reliability, and design simplicity. The total cost of power amplifier is less including design time, logistics, and production costs.

Fig. 1 shows the circuit diagram of power operational amplifier, OPA541.

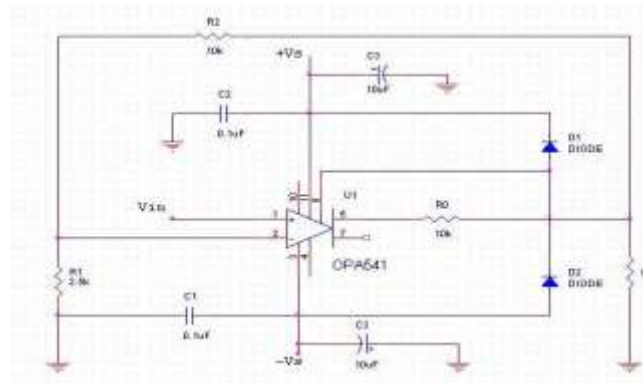


Fig. 1: Power Operational Amplifier

The design for the circuit is as follows:

Gain of the circuit, $A_v = 1 + R_2 / R_1$ (1)

Where, R_1 and R_2 are resistors and C_1 , C_2 and C_3 are capacitors.

Take, $C_1 = C_2 = 0.1\mu F$ and $C_3 = 10\mu F$.

Let, $A_v = 20$, Select, $R_2 = 10 K\Omega$.

Therefore, $R_1 = 2.5 K\Omega$.

III. SOFTWARE SECTION

Lab VIEW (Laboratory Virtual Instrumentation Engineering Workbench) is a graphical programming environment for data analysis, presentation, acquisition and control. A diagrammatic view of how the data flows through the program is present and no text-based code like any other programming language [1]. Data acquisition (DAQ) is the process of sampling of real world physical conditions and converting the resulting samples into digital values. Data acquisition and data acquisition systems (DAS) involve the conversion of analog waveforms into digital values for processing [2]. The main components of data acquisition systems include: i) sensors that convert physical parameters to electrical signals. ii) Signal conditioning circuitry to convert sensor signals into a form that can be converted to digital values. iii) analog-to-digital converters (ADC), which convert conditioned sensor signals to digital values iv) the DAQ boards which are multi function plug-n-play, analog and digital input/output boards consisting of a onboard timer, 12 bit analog to digital converter with 8 channel input, 2 digital to analog converters (DAC) and 24 Transistor- Transistor Logic (TTL) level logic inputs. There are several ways in which the data can be exchanged between instruments and a computer. One way to measure signals and transfer the data into a computer is by using a Data Acquisition

board. A DAQ card contains ADC and DAC that allows input and output of analog and digital signals in addition to digital input/output channels [3].

IV. PROGRAMMING USING LABVIEW

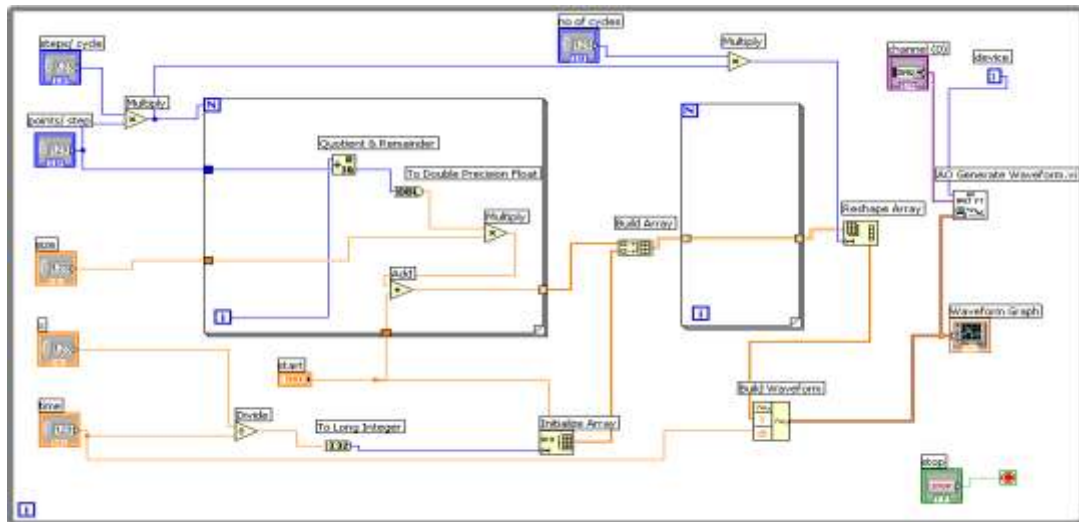


Fig. 2(a): block diagram of the staircase voltage

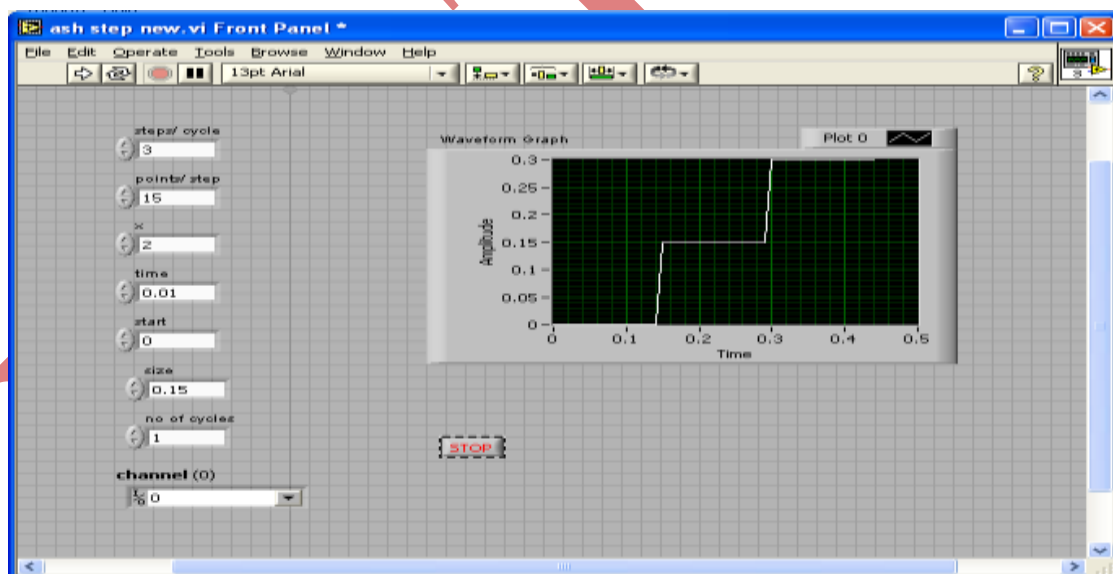


Fig. 2(b): front panel of the staircase voltage

Fig. 2(a) and Fig. 2(b) shows the block diagram and front panel of a LabVIEW program for staircase voltage. While programming in LabVIEW software, we can monitor the required waveform using waveform graph as shown in the block diagram. The waveform can be continuously monitored by placing the program inside a loop. The required output of staircase voltage can be seen in the front panel itself.

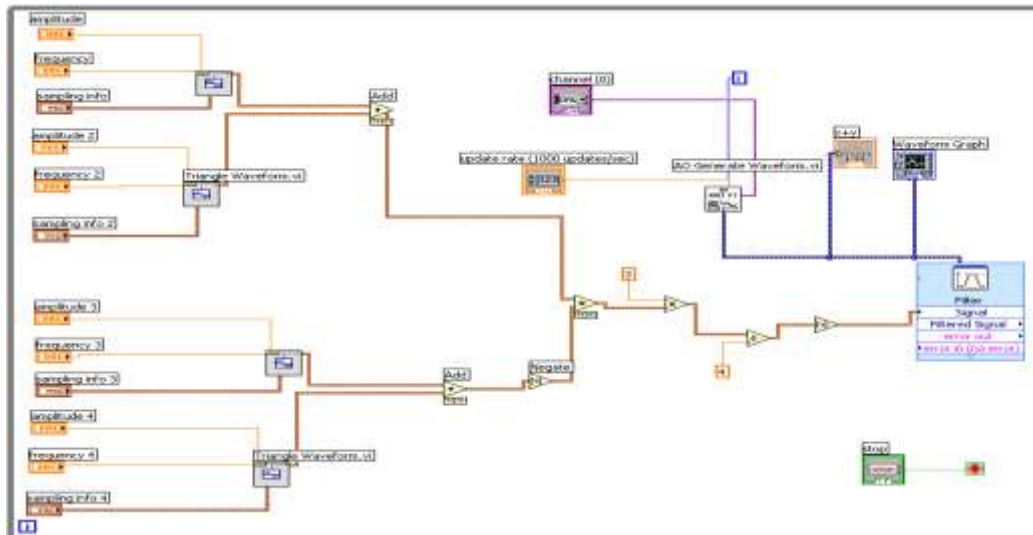


Fig. 3(a): block diagram of sawtooth voltage

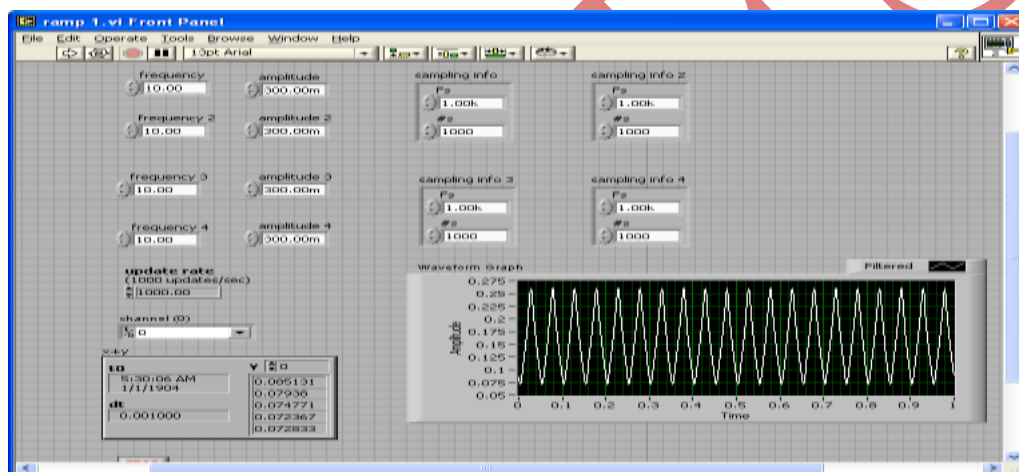


Fig. 3(b): front panel of sawtooth voltage

Fig. 3(a) and Fig. 3(b) shows the block diagram and front panel of a LabVIEW program for sawtooth waveform.

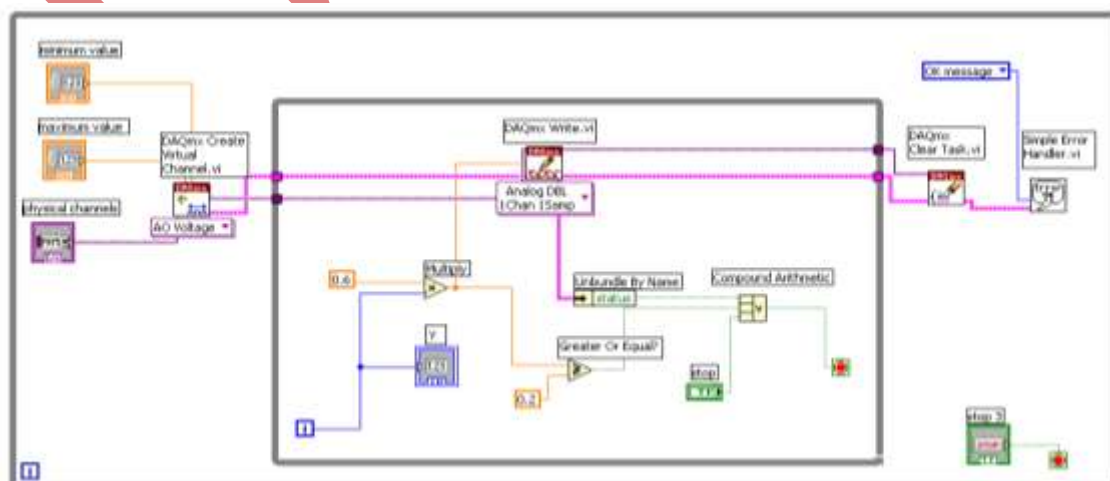


Fig. 4(a): block diagram of pulse voltage

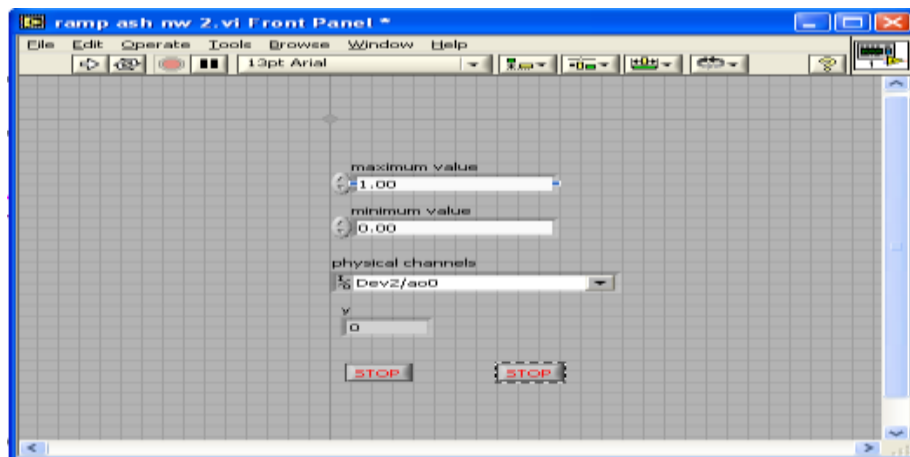


Fig. 4(b): front panel of pulse voltage

Fig. 4(a) and Fig. 4(b) shows the block diagram and front panel of a LabVIEW program for pulse voltage.

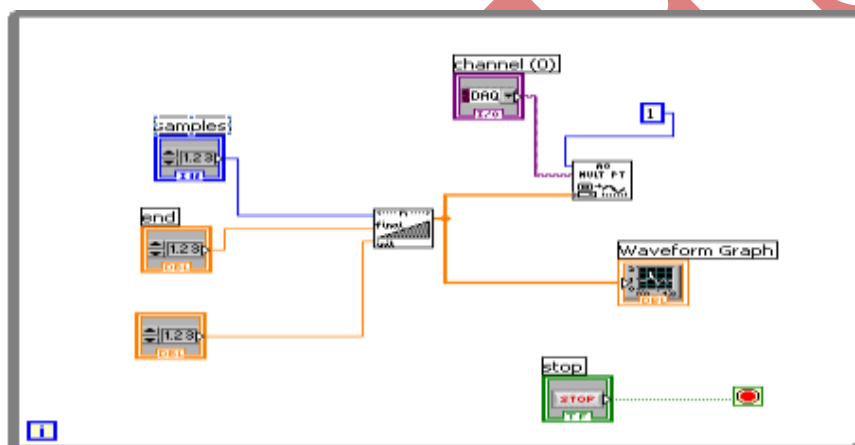


Fig. 5(a): block diagram of ramp voltage

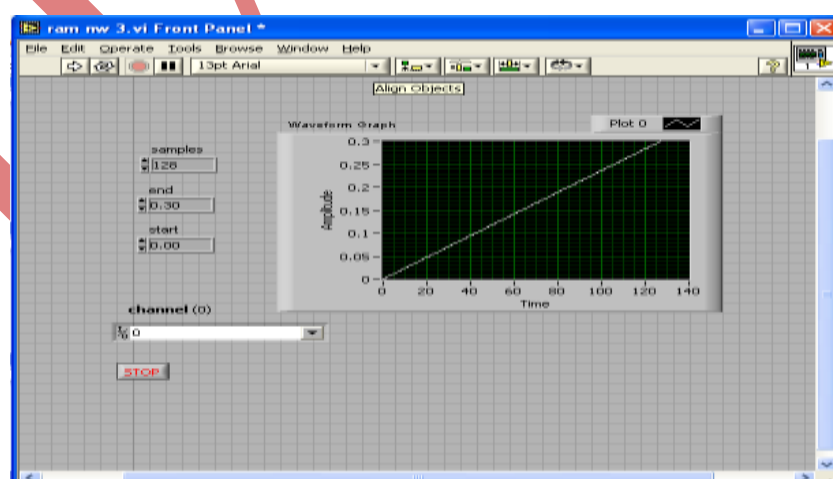


Fig. 5(b): front panel of ramp voltage

Fig. 5(a) and Fig. 5(b) shows the block diagram and front panel of a LabVIEW program for ramp voltage.

V. RESULTS

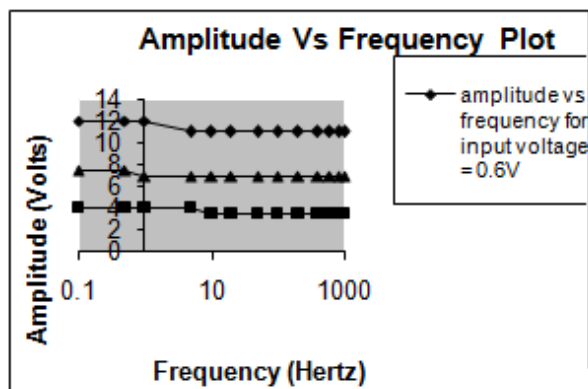


Fig. 6: Amplitude Verses Frequency Plot

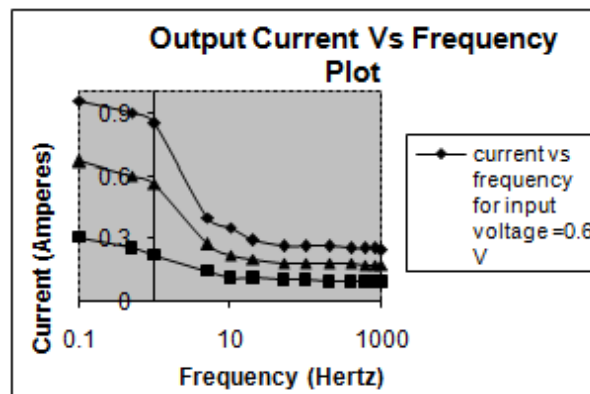


Fig. 7: Current Verses Frequency Plot

Fig. 6 shows the output characteristics of power amplifier with amplitude versus frequency curve for different input voltages such as 0.6V, 0.4V and 0.2V. The amplifier output voltage ranges from 0 to 14V and the frequency ranges from 0.1 to 1000 Hz. Fig. 7 shows the output characteristics of power amplifier with current versus frequency curve for different input voltages such as 0.6V, 0.4V and 0.2V. The current ranges from 0 to 0.9A and the frequency ranges from 0.1 to 1000 Hz.

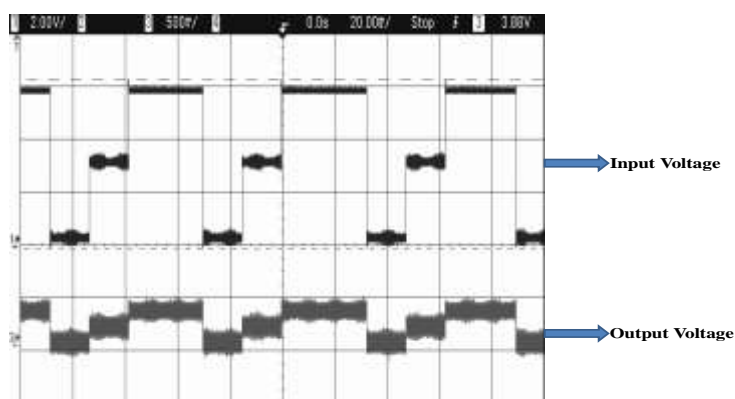


Fig. 8: Output Waveform of Labview Program by Giving Staircase Voltage as Input.

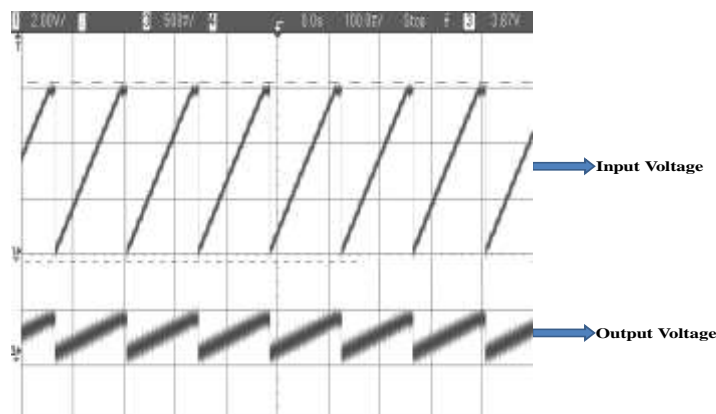


Fig. 9: Output Waveform of Labview Program by Giving Sawtooth Voltage as Input

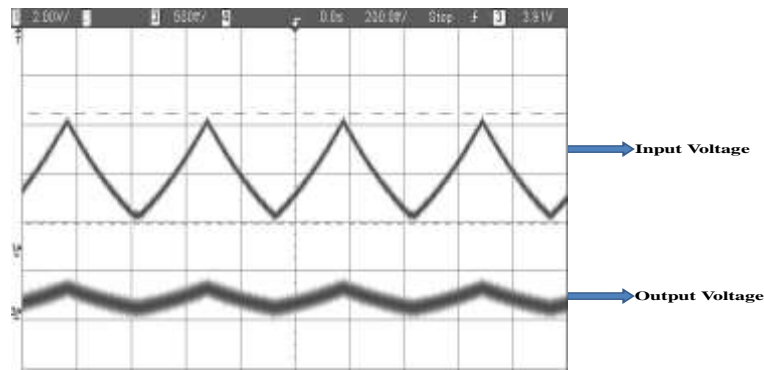


Fig. 10: Output Waveform of Labview Program by Giving Triangular Voltage as Input.

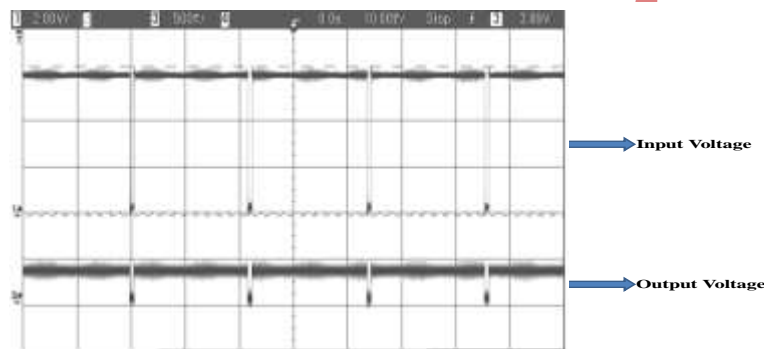


Fig. 11: output waveform of labVIEW program by giving pulse voltage as input.

Fig. 8, fig. 9, fig. 10 and fig. 11 shows the different waveforms obtained such as staircase, sawtooth, triangular and pulse from labVIEW programs. The continuous signals obtained from the labVIEW program are used to drive the power amplifiers and the output signals are observed and saved in oscilloscope.

VI. THEORETICAL RESULTS

Designed and tested the amplifier OPA541 with a function generator and signals generated from LabVIEW program along with data acquisition card. From the readings of the data and from the graphs we have inferred the following results. The power amplifier can be used for – i) the input frequencies range from 0.1 Hertz to 10 Kilo Hertz. ii) the input voltages range from 0.2 peak to peak voltage (Vpp) to 0.6 peak to peak voltage (Vpp).

VII. CONCLUSION

Data acquisition and control of the experimental setup was realized using the software LabVIEW and National Instruments DAQ 6014. LabVIEW has advantages concerning speed of data acquisition and flexibility of measuring procedure. This was used for developing software based “virtual instruments” which analyze the input signals and generate output signals, accordingly which are fed back to the power amplifier. Designed and tested the circuit of power amplifier for integrating it with magnetic coils. Also the various output characteristics of power amplifier is obtained. Thus the magnetic coils for the experiment can be controlled by using the power amplifier by using both hardware and software part. This shows that the experiment can be effectively controlled by using the power amplifier with the help of labVIEW program.

REFERENCES

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