Design and Fabrication of a Simple Waveform Generator

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Abstract
A simple and economical wave form generator is designed with the help of PSIM software and the hardware is fabricated in laboratory and tested satisfactorily. The waveform generator uses a 220V, 50 Hz AC supply as its input and gives a square wave, triangular wave, saw tooth wave (all 50 Hz) and a DC signal as its output signals. In absence of high quality function generator, the fabricated model which is economical as well as simple can be used as an alternative. However, this fabricated model can be modified further to perform frequency modulation.

Keywords
Waveform Generator, PSIM, Hardware Simulation

I. Introduction
Waveforms are electrical signals that convey information about the behaviors or attributes of some phenomenon. Waveform generator is that electronics device which is used to generate different kinds of waveforms like sine waves, square waves, triangular waves. Waveform generators are used for circuit analysis, design and development very often. They are generally used in designing, testing, troubleshooting, and repairing electronic or electro acoustic devices because they allow us to obtain various waveforms from a single device making the design compact and economical. In the proposed work a very simple and economical waveform generator is both designed and fabricated. “Simple” because the circuit operation is very easy to design and fabricate using easily available components “Economical” because the circuits elements which we have used are very cheap and as a whole the waveform generator will cost very less.

II. Design of Proposed Waveform Generator
The function generator, which is used to generate different waveforms, can be designed and developed with the help of the following schematic diagram shown in fig. 1.

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Fig. 1: Schematic Diagram of the Function Generator
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The above scheme is simulated in PSIM software, which is very user friendly, using the already available electronics and electrical components in the PSIM library. The designed PSIM model is shown in fig. 2.

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Fig. 2: Designed PSIM Model
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After the design phase the simulated model is tested and the obtained waveforms are shown in fig. 3.

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Fig. 3: Obtained Waveforms in PSIM
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III. Hardware Fabrication of the Proposed Model
After satisfactory design of the proposed waveform generator, it is fabricated with the help of ICs which do not possess the capability to handle a high voltage supply like 230V-50Hz. So a 230V – 9V, centre tap step down transformer is used to make the readily available voltage source (230V-50Hz) compatible with the hardware circuit. The transformer used is centre tapped (9V-0-9V) so that we can get two 9V AC supply which are complementary to each other, i.e. 180 degrees out of phase with each other, as is required in our case.

The Square wave generator is used to generate a square wave pulse of 50Hz which will be required in the subsequent Saw-tooth generator block for generating saw-tooth signal. The Square wave generator is designed with the help of a LM-339 comparator chip. The output obtained from center tap transformer is sine wave with a 180degree phase shift. This sinusoidal wave is taken as an input to the comparator to get a square wave as an output, as we are using a center tap transformer we will get two square waves which are 180 degree phase shift, as the sine waves are also 180degree phase shifted.

The saw-tooth and the triangular waveforms are designed with the help of an Op-amp chip LM324 which contains four similar Op-amps. The square pulses falls on a base terminal of transistors and the transistors behaves as a switch. The transistors are located at the feedback portion of integrators, i.e. parallel to feedback capacitor, because the switching action of transistor will make the capacitor discharge very fast so we get a saw tooth waveform. There will be two saw tooth waveforms for two transformer outputs, so we will
add these two waves using an adder circuit. The normal integrator will give a triangular wave form. The DC waveform is designed with the help of DAC converter. When two square waves displaced from each other by 90 degrees are passed through an OR gate we get a digital DC signal, which can be converted to analog DC signal with the help of a DAC converter. The fabricated model and the hardware setup in the laboratory are shown in fig. 4 and fig. 5 respectively.

![Fabricated Hardware Model](image1)

![Laboratory Setup of the Hardware Model](image2)

After the fabrication the developed model was tested and the waveforms were observed on Digital Storage Oscilloscope. The waveforms obtained are shown in figs. 6, 7 and 8.

![Obtained Square Waveform](image3)

![Obtained Square and Saw-Tooth Waveforms](image4)

![Obtained Triangular Waveform](image5)

**IV. Conclusion**

The design of the proposed function generator in PSIM gave good results while the testing of the proposed function generator and
the waveforms observed on the DSO shows that the waveforms obtained were satisfactory. However, the DC signal could not be realized on hardware. Economical optimization in any electrical or electronics device is of great importance and huge amount of research goes into making the design economical and compact as well as user friendly. The function generator allows us to generate different waveforms of different magnitude from the same device rather than using different devices for different waveforms. Hence the developed function generator will help us to make electrical circuit design economical and compact and will help to carry out simple academic works satisfactorily and economically in the laboratory at constant amplitude and frequency even if a novel function generator with variable amplitude and variable frequency is unavailable.

V. Future Scope of the Proposed Work

The proposed waveform generator can generate waves of constant frequency and constant amplitude, so this waveform generator can be modified to a function generator if the proposed waveform generator can vary the frequency as well as the amplitude and we could also add PWM (pulse width modulator) circuit which can give a new dimension to the proposed waveform generator.

References