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A COMPARATIVE STUDY ON THE OPERATION AND OUTPUT WAVE FORMS OF AN SG3524 DC-DC CONVERTER

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ABSTRACT

The SG3524 is a famous integrated circuit for designing DC-DC converters. The SG3524 is a versatile integrated circuit that can generate the gate pulses of switch mode DC-DC converters and the following experiment's single-phase square wave inverter operation. This paper presents these converters' operation and output waveforms using the SG3524 as the pulse-width modulator (PWM) controller. The circuit diagrams, switch modes, pick-to-pick voltage, average voltage, frequency, Duty Cycle, and Rise Time of the converter are explained. The output waveforms of the converters are simulated using PSpice software and verified by experimental measurements using an oscilloscope. The results show that the SG3524 can provide stable and efficient DC-DC conversion for different Duty cycles. This paper offers to change the duty cycle and output Squire wave to provide DC-DC converters using the SG3524 IC.

Keywords: SG3524, DC-DC Converter, Oscilloscope, Resistor, Capacitor, Potentiometer.

I. INTRODUCTION

Power electronic devices called switched-mode DC-DC converters use switching action to change one electrical voltage level into another [1]. These converters are widely used in personal computers, computer peripherals, communication, medical electronics, and adapters of consumer electrical products to supply various levels of DC voltages because of their excellent efficiency and small size [1,2]. Today, even onboard power supplies are distributed, using regulated converters for both supply conversion and load conversion [3,4].

A switching regulator in single-ended or push-pull mode can be created using the integrated switching regulator circuit SG3524. A pulse width modulator, oscillator, voltage reference, error amplifier, overload protection circuit, output drivers, etc. are among the built-in circuitries found inside the SG3524. This inverter circuit's brain, the SG3524, can rectify its output voltage in response to variations in the output load. while the output load changes, the output voltage also changes (voltage decreases while the output load increases, and vice versa) in a non-PWM inverter. However, the output voltage of a PWM inverter is constant throughout a range of output loads.[5]

An oscilloscope is an electrical test equipment that visually shows changing voltages of one or more signals as a function of time. It is also known as a scope or O-scope. Their main objective is to record electrical signal information for debugging, analysis, or characterization. Once the waveform has been shown, several characteristics can be examined, including amplitude, frequency, rising time, time interval, distortion, etc. At first, calculating these numbers involved physically comparing the waveform to scales included in the instrument's screen. [6]

A capacitor is a component of electronics that stores electrical power in an electric field by building up electric charges on two closely spaced surfaces isolated from one another. It has two terminals as well as a passively electrical component. Capacitance refers to a capacitor's effect. While there is some capacitance between any two adjacent electrical cables in a circuit, a capacitor is a component that increases capacitance. Initially, the condenser was also referred to as the capacitor [7]

A resistor is an element or component that controls how much power is supplied to electrical or electronic components while reducing the electrical current. Additionally, it protects these items from damage brought on by an overabundance of electricity. [8]

A three-terminal resistor with a sliding or revolving contact that creates a variable voltage divider is called a potentiometer. It functions as a variable resistance or rheostat if only the wiper and the other end of the connector are used. [9]

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II. METHODOLOGY

In this experiment, SG3524 will generate the gate pulses of switch mode DC-DC converters and the following experiment's single-phase square wave inverter operation. Also, three charge pump circuits will be constructed for isolated gate drive of switch mode DC-DC converter experiments, and the square wave inverter experiment will be cloned in the next phase. IC 3524 has a feedback voltage control facility for pulse width modulation as necessary for the voltage control of an SMPS or an inverter. Constant voltage output regulation is used in present power supplies for microcomputer TVs, VCRs, and other electronic equipment.

III. MODELING AND ANALYSIS

The use of IC 3524 was set on the breadboard. IC 3524 is an SMPS power supply controller chip that can also be used for square wave inverter control. The control circuit can be used for the management of choppers as well. Construct the control circuit and observe the waveforms of pin 12 or 13 (out 1) with the variation of the potentiometer knob. Keep this circuit intact on the breadboard for later experiments.

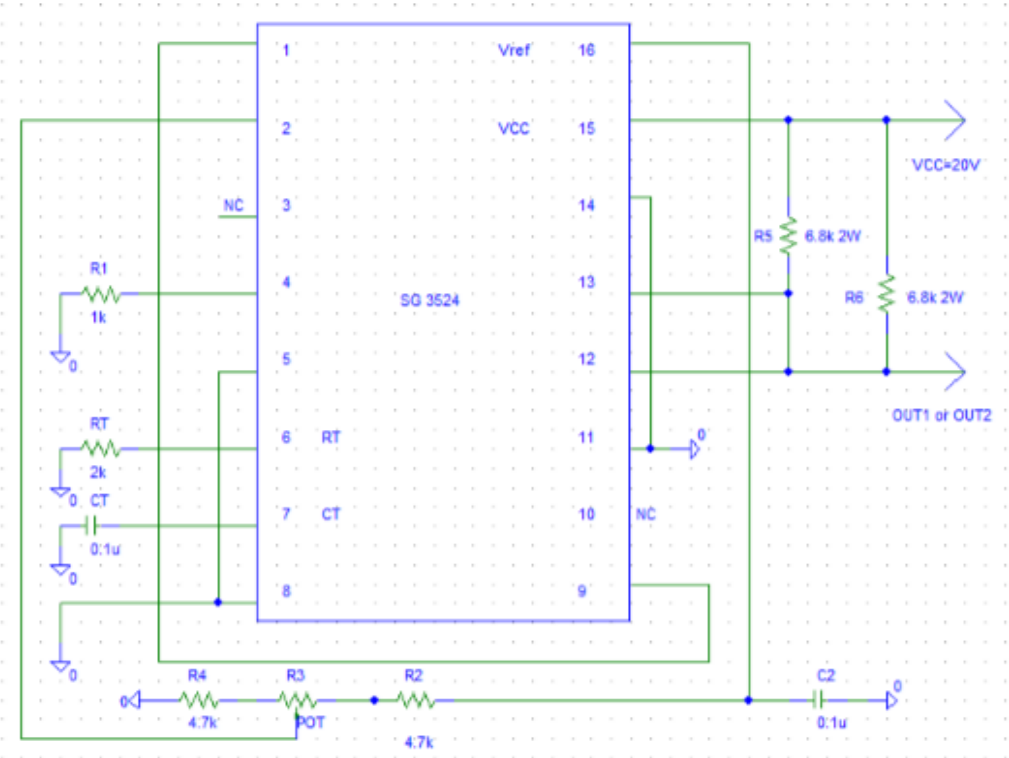

Figure 1: Control Circuit for DC-DC Converter.

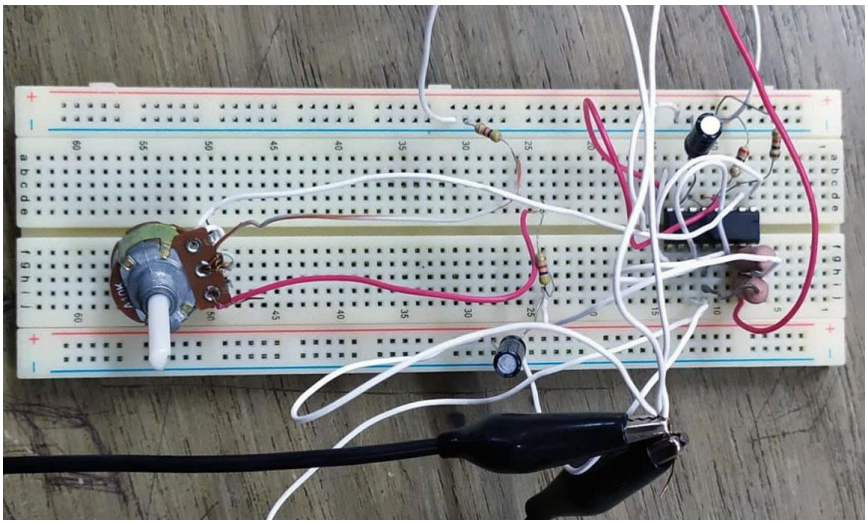

Figure 2: Assembled Circuit on bread board.

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Figure 3: DC power supply.

IV. RESULTS AND DISCUSSION

As the duty cycle changes, the change in rise time can be observed.

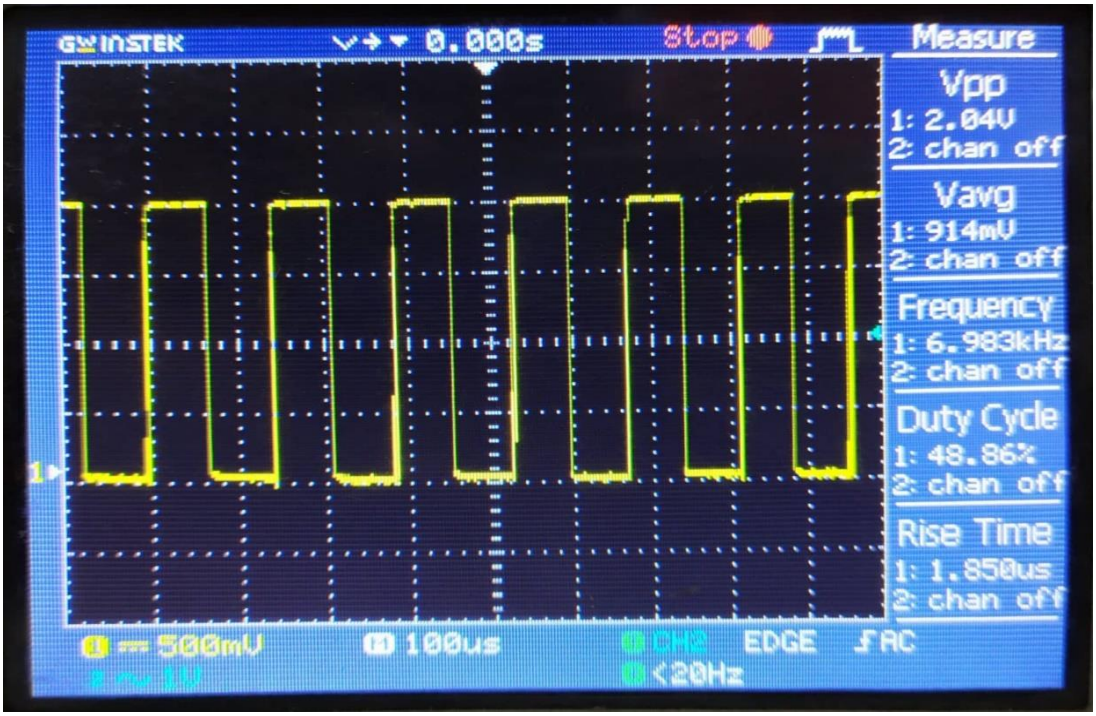

Figure 4: The output is taken with duty cycle less 50%

When the duty cycle is below 50%, the rise time is 1.850us, which can be seen through the oscilloscope.

Table 1. The output is taken with duty cycle less 50%

SL	Vpp	Vavg	Frequency	Duty Cycle	Rise Time
1	2.04V	914mV	6.983KHz	48.86%	1.850us

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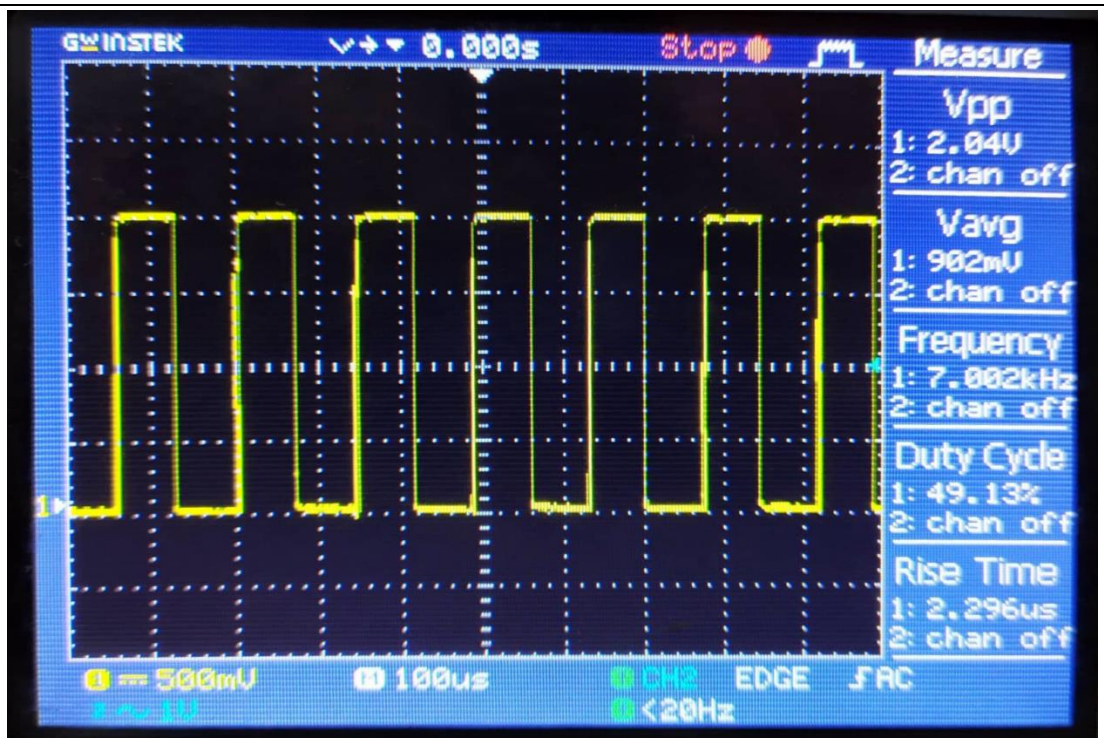

Figure 5: The output is taken with duty cycle equals 50%

When the duty cycle equals 50%, the rise time is 2.296us, which can be seen through the oscilloscope.

Table 2. The output is taken with duty cycle equals 50%

SL	Vpp	Vavg	Frequency	Duty Cycle	Rise Time
1	2.04V	902mV	7.002KHz	49.13%	2.296us

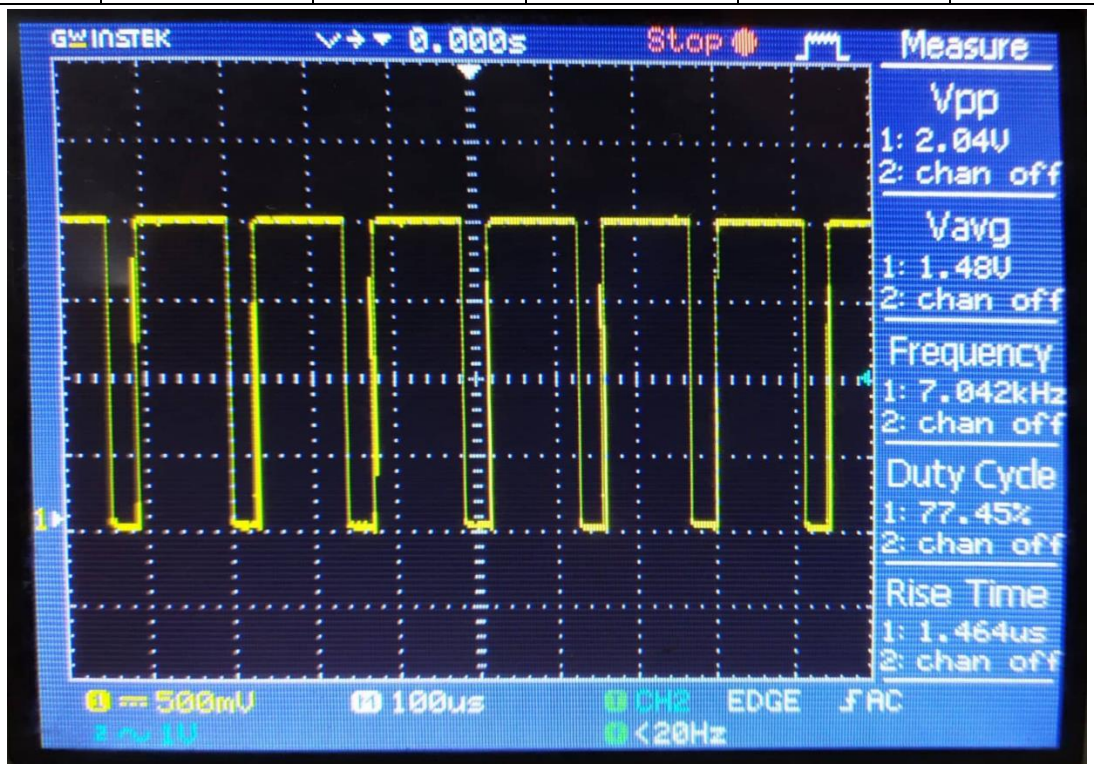

Figure 6: The output is taken with duty cycle above 50%

When the duty cycle above 50%, the rise time is 2.296us, which can be seen through the oscilloscope.

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Table 3. The output is taken with duty cycle above 50%

SL	Vpp	Vavg	Frequency	Duty Cycle	Rise Time
1	2.04V	1.48V	7.042KHz	77.45%	1.464us

IC SG3524 was used in this experiment to generate the gate pulses of single-phase square wave inverter operation. They have constructed three charge pump circuits for isolated gate drive of switch mode DC-DC converter experiments and the square wave inverter. Without any problem, we completed this experiment and got the output wave shape in an oscilloscope.

V. CONCLUSION

The control circuit for the DC-DC converter can be controlled with the help of a potentiometer, whereas the control circuit for the single-phase square wave inverter is fixed. The control circuit for the square wave inverter is biased to provide the necessary commutation delay.

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