EV CHARGER POWER QUALITY IMPROVED WITH BRIDGE-LESS CUK CONVERTER USING FUZZY LOGIC CONTROLLER

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Abstract—
Using a Bridgeless Cuk converters with a fuzzy logic controller, this research provides a novel configuration for enhancing the voltage stability of an EV charger by minimizing the THD of the source current provided to the EV charger. A fuzzy-logic controller is often utilized to control converters (switches gating signals). This EV charger uses fewer switches per switching cycle than a traditional EV charger's diode bridge rectifier, allowing for faster charging times. Since the suggested converters are used, an EV charger's efficiency is enhanced. Moreover, the conductance of inactive switches and the undesirable capacitive coupling loop are both eliminated in the current BL Cuk converter. Electrical isolation between the converter and flyback converter is ensured by synchronizing the directives charging method that maintains a constant current and voltage. The proposed charger uses AC mains electricity to keep the supply current THD below IEC standard limits by drawing power from the main supply.

Keywords: BL (bridgeless) Cuk converter, flyback converter, battery charger, fuzzy logic controller, THD.
DOINumber:10.48047/nq.2022.20.22.NQ10258 NeuroQuantology2022;20(22):2676-2680

I. INTRODUCTION

When more conventional fuels are used to power vehicles and other forms of transportation, there is a corresponding increase in the amount of pollution that is harmful to people and other forms of life. As a consequence of this, battery-powered electric vehicles (BEVs), also known as rechargeable electric vehicles, are gaining ground on conventional gasoline-powered automobiles in the race to develop current modes of transportation that are sustainable and kind to the environment. When it comes to the process of charging an electric vehicle, the most essential component is either an onboard or an offboard AC converter charger (EV). Throughout the research that has been done on electric vehicle (EV) charging, many unidirectional and bidirectional designs have been investigated. Conventional diode bridge rectifier electric vehicle (EV) chargers have the ability to lower the input power factor (PF) and increase the total harmonic distortion (THD), with the latter number reaching as high as 54.9%. Waves that were recorded make it abundantly evident that the typical diode rectifier type electric vehicle (EV) charger in question does not perform to the standards established by the IEC.

II. METHODOLOGY

A. EXISTING SYSTEM

Neuroquantology | December 2022 | Volume 20 | Issue 22 |PAGE 2676-2680|DOI: 10.48047/NQ.2022.20.22.NQ10258

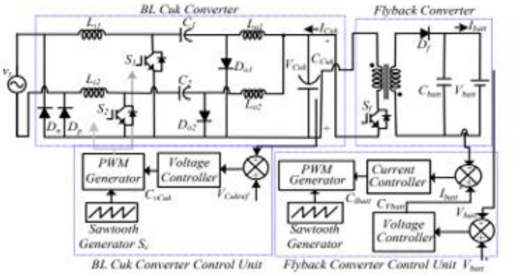

Fig. 1. The BL Cuk Converter as the Base of an EV Charger Arrangement.

As shown in Figure 1, the BL Cuk converter is the primary component of an electric vehicle (EV) charger arrangement. The supply voltage to the converter is denoted by the symbol vs in this equation.

B. PROPOSED SYSTEM

Block Diagram:

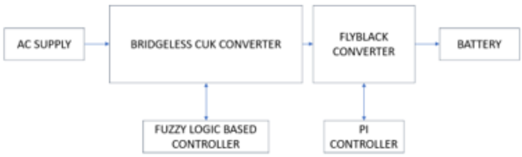

Fig.2 The suggested system is shown schematically.

Alternating current is supplied to the bridgeless Cuk converter, as indicated in the block diagram, and the Flyback converter is used to supply the battery with the bridgeless Cuk converter's output. In order to ensure the most efficient functioning of converters, fuzzy logic-based controllers and PI controllers are used.

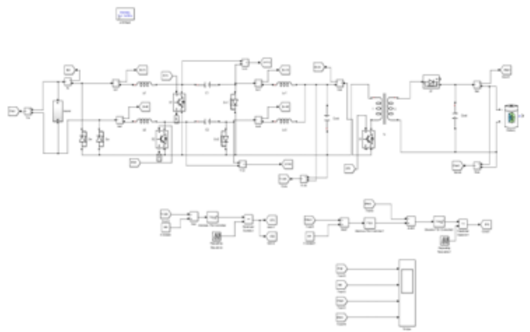

Fig.3. The Suggested BL Cuk Converter-Based Electric Vehicle Charging System.

The fuzzy logic controller design for the BL Cuk converter may be shown in Figure 3. The PI controller that can be seen in the figure is the component that exercises control over the flyback converter. It is possible to show that this system operates in two unique ways.

Additionally, the switch S1 is triggered and conducts the supply current through it.The inductor Li1 gets charged as shown in above figure. During the operation of the circuit, the capacitor C1 discharges while the inductor Lo1 becomes charged. At the same time, the capacitor Ccuk also becomes charged. The flyback converter is then connected to the output voltage across the Ccuk.

Mode-II [switch OFF period, DCukTs ≤ t ≤ D1Ts]:When the supply voltage Vs experiences a positive half cycle, the diode DP becomes forward biased and starts conducting.The switch S1 is turned off due to the charging& discharging of the inductors and the capacitors in the mode-1,the polarities of them gets reversed. Hence the diode Do1 gets forward biased and it starts to conduct. As shown in the figure, the inductors Li1, L01 discharges & the capacitors Ci,Ccuk gets charged.

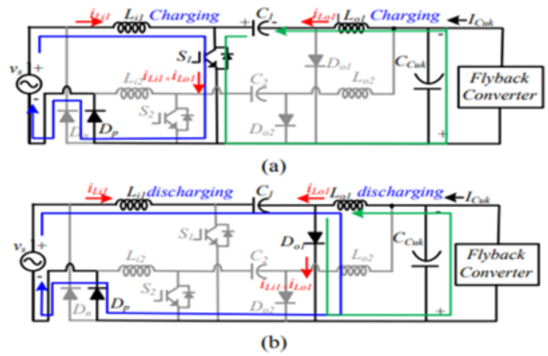

Fig4. The circuit operation of an EV charger with a BL Cuk converter. (a) Mode-I and (b) Mode-II.

The Li1, S1, Dp, L01 (Li1, L01 are charging) are in conduction during the positive half cycle of the input voltage and the capacitors C1 discharges &CCukcharges, whose output is fed to the flyback converter & then to the battery. The Li1, D01, Dp, L01 are in conduction (Li1, L01 are discharging) and the capacitors C1 charges &Ccuk gets charged, whose output is fed to the flyback converter & then to the battery.

III. RESULTS AND DISCUSSION

The efficiency of the suggested model was tested by simulation.

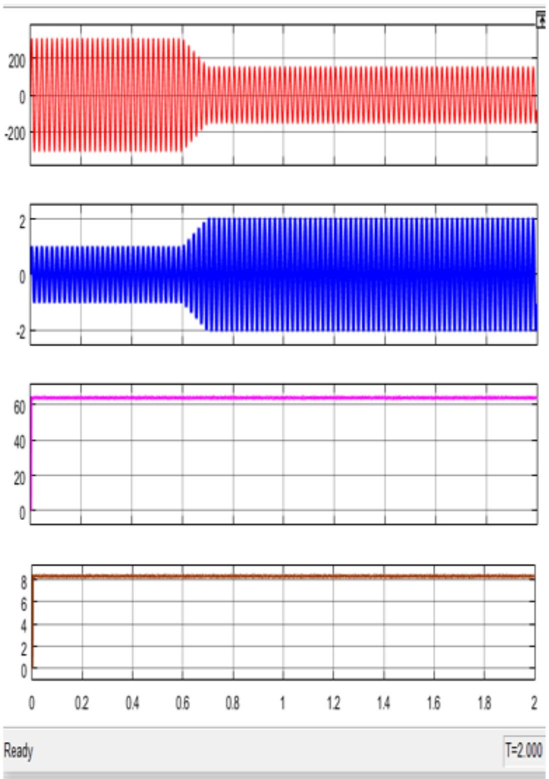

Fig.5.Simulation results of input voltage & input current during voltage sag condition.

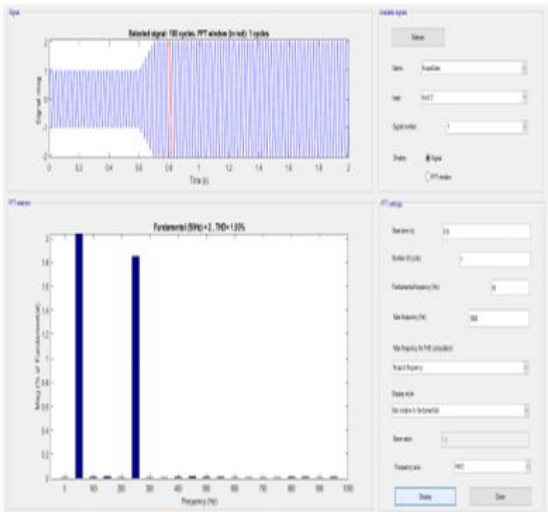

Fig.6. During the voltage sag, grid current and THD.

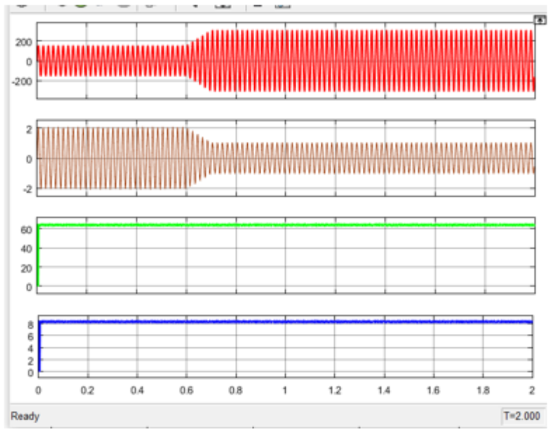

Fig.7. Simulation results of input voltage & input current during voltage swell condition.

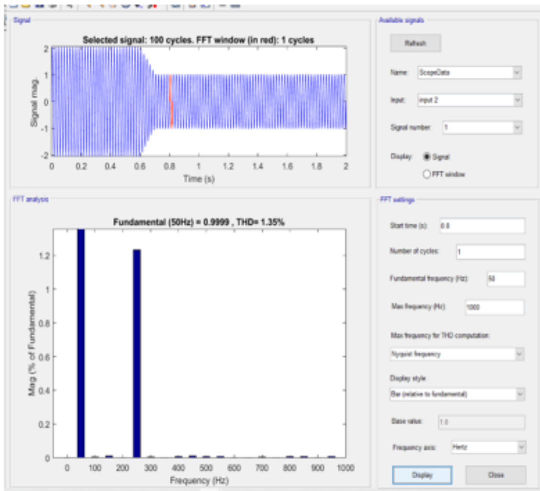

Fig.8. Voltage swells increase the grid current and THD.

IV. Comparison between existing & proposed system

S.No.	THD during voltage sag (Using PI Controller)	THD during voltage swell (Using PI Controller)	THD during voltage sag (Using Fuzzy logic Controller)	THD during voltage swell (Using Fuzzy logic Controller)
1	3.27%	3.29%	1.93%	1.35%

V. Conclusion

Fuzzy logics controls are used in the cutting-edge BL Cuk converters in order to improve the power efficiency of the electric vehicle chargers by lowering the amount of total harmonic distortion in the provided current (THD). The Power Quality analysis for the indicated chargers is carried out in compliance with the criteria established by the IEC, and it takes into account income voltages ranging from 0 to 240V. As a consequence of putting into action the recommended configuration, an improved alternative to the existing devices is produced.

VI. References

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