Modular multilevel converter performance improvement for electric vehicle charging system

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***Abstract* - The Multilevel Modular Converter (MMC) represents a technology that generates high voltage and power. The multilevel modular converter (MMC) for electric car applications was studied in this research, with its advantages such as high modularity, error tolerance capability, and multifunctional power integration (motor drive and charger). However, during MMC operation, certain harmonics will be introduced into the cell currents, reducing battery life. The imitation results confirm the accuracy of the proposed method and composition. This allows for successive testing and evaluation, so they are important tools when MMC is introduced into the power system. The hybrid MMC topology is also suggested in this work, which protects the car from being affected by the injectable mode. The imitation results confirm the validity and effectiveness of the proposed method and the hybrid topology.**

***Index Terms* - Modular Multilevel Converter; Cell Current; Electric Vehicle.**

1.INTRODUCTION

The use of motor vehicles is increasing every day. Since cars are powered by fossil fuels like gasoline and diesel which cause air pollution in global warming and related problems. Aside from mineral oil, it is no longer a reliable source of energy as it breaks down quickly. Here comes the role of hybrid electric vehicles that run on less fuel compared to conventional vehicles [1] [3]. In the electrical part, we use a converter, electric car, and battery. Both an IC engine and an electric car can also be used, and this can reduce fuel dependency. An electric car can be charged with electricity. Relying on electricity generated by renewable resources has far greater benefits than non-renewable energy sources. The main advantage of hybrid electric vehicles is therefore that they affect the dependence on fuel and the environment. The electrical power level and energy capacity of this type of CMM can be increased by connecting a series of powerheads to each arm. As described in [4] the arm inductor can be evenly distributed across the arm to form the substrate without touching the equal circuit of the entire converter.

The modular multilevel converter (MMC) was read continuously after lifting and widely accepted with high voltage direct current (HVDC) and motor drive applications. As electrification progresses, the MMC survey of electric vehicle (EV) applications was carried out in terms of control strategies [1] - [3], and performance evaluations were also carried out. Several MMC-specific features such as high density, error-tolerant power, and high-quality rendering make it a promising candidate for EV applications. Additionally, the ability to combine engine drive, state-of-charge battery equalizer, and built-in charger functions make the MMC highly competitive when used in EVs. In the MMC, due to the interaction between the current arm and the switching function, certain low-order harmonics that flow through the battery cells are incorporated. These current harmonics cause additional losses after the subsequent increase in operating temperature, resulting in negative energy dissipation and ultimately accelerating battery aging [4]. As the introduced harmonic waves are extremely low, requirements for filtering devices to filter out these harmonics will be in high demand.

The simulation in the three-phase MMC model was performed in the MATLAB/Simulink environment, confirming the method and the performance of the hybrid topology. In [5] - [6] Changing the commercial MMC power sensor is not allowed, especially if it has already been used in some active projects. Furthermore, potential growth is introduced into the system through this method. In general, no effective diagnostic algorithm is presented in the existing literature based on MMC, where multiple open-circuit IGBT errors appear simultaneously in one arm [7].

Therefore, a significant reduction in the DC source calculation can be significantly reduced. Furthermore, using a voltage series power measurement process, the power is automatically controlled to the required value and an increase in power is obtained. The properties revealed in them can be expanded to produce higher levels of output power. The H-bridge machine has to withstand high pressure, so the amount of stopping power is increased. The typical structure revealed uses the modified H-bridge and SC concept to increase the power level [9] [10].

2 DC-DC CONVERTERS

The DC-DC converter in a hybrid car is used to combine components in an electric car to increase power levels. To work better than the system, the power converter must have a reliable, light, and low volume. And so only an electric car can achieve high performance. The importance of using DC-DC converters in hybrid electric vehicles can be explained as follows: At least one DC/DC converter is required to connect the system. An integrating DC/DC converter is required to use constructive deceleration. Power flow can be controlled by changing the rate of the converter. As mentioned earlier, it needs to have a converter with features like low weight, high efficiency, low volume, optical electromagnetic interface, low ripple current, better power flow control, etc.

3 CONTROL OF THE MMC

In a DC connector, one converter controls DC power while the other controls DC. Motor switch converters can be used to obtain the desired combination of current and electrical power. Active power circuits can control active power or DC power supply, while active power circuits can control active power or AC. This control structure is designed for the front converter which operates within the AC grid and can be used in high power applications, ie electric charging vehicles. Includes independent control modes used to control DC bus voltage power, submodule capacitors voltage, output voltages, and rotary circuits. A simple equivalent balance (PI) controller is adopted to control the DC bus voltage as an external loop and provides an active power reference to the current output controller which acts as an internal loop. In addition to active power, the reference to active power can be added to control the level of active power in the grid. Outputs and rotary cycles are adjusted using closed controls, which generate control commands in a balanced resonant control system.

4 OUTLINES

This article describes the operational process of the MMC. Continued modeling of figures is shown. The MMC modeling method was then introduced into the electromagnetic transients simulation system. This method also applies to MMCs with multiple subtitles. The MMC control system is finally being discussed. This section includes block diagrams of current controls, active power, and AC voltage power controls.

5 SIMULATIONS

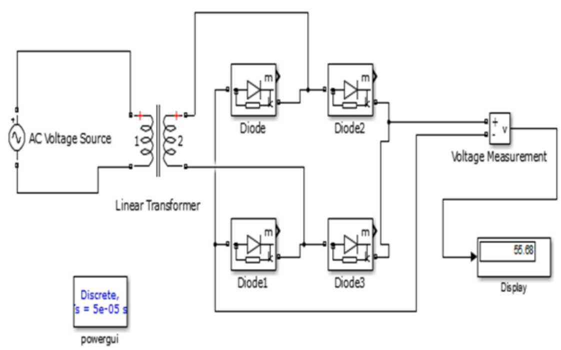

Figure 1 Power supply by linear transformer

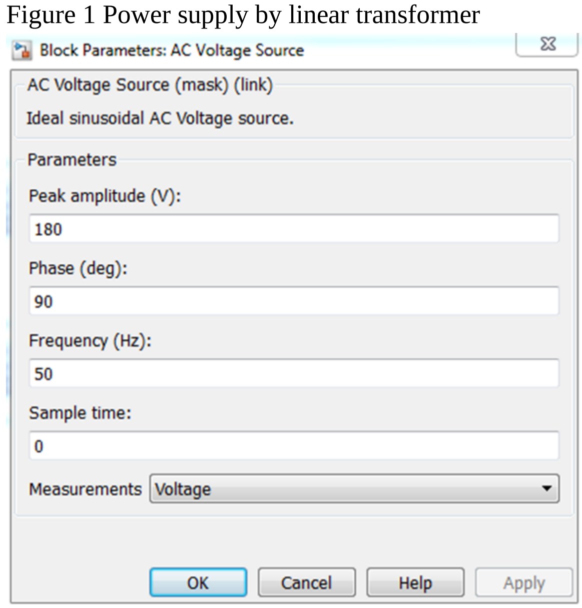

Figure 2 Input A.C. Voltage for linear transformer

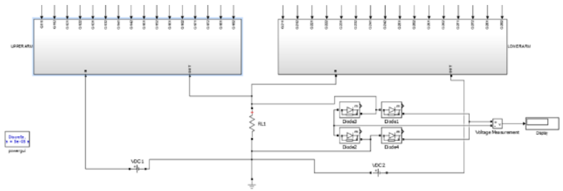

Figure 3 Output D.C. Voltage by Modular Multilevel Converter

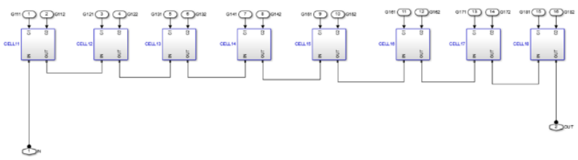

Figure 4 D.C. Voltage by Modular Multilevel Converter (Upper arm)

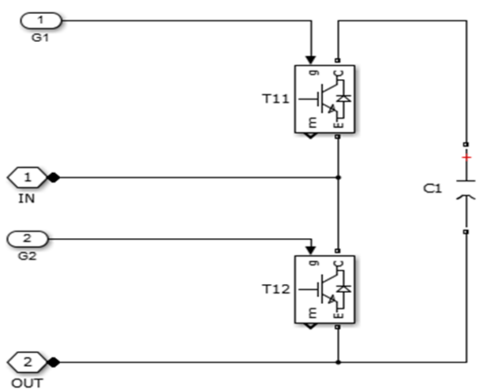

Figure 5 Implements an ideal IGBT, Gto, or Mosfet and antiparallel diode in the Upper arm

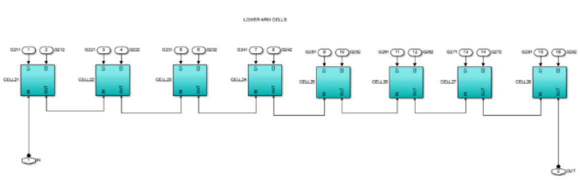

Figure 6 D.C. Voltage by Modular Multilevel Converter (Lower arm)

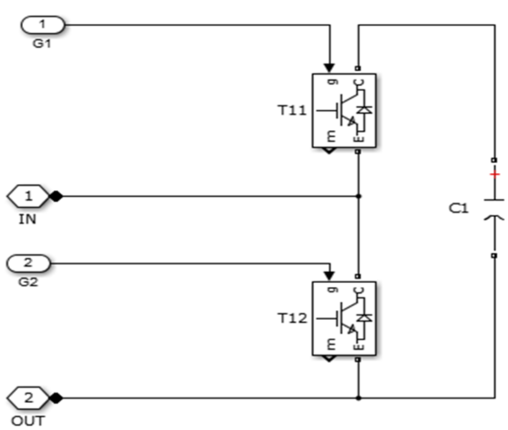

Figure 7 Implements an ideal IGBT, Gto, or Mosfet and antiparallel diode in the Lower arm

6 CONCLUSION

The region that allows us to do this is called the full-wave rectifier. A single-phase converter and multi-level module modification module were developed in MATLAB / SIMULINK. The input of the single-phase transformer model and the multi-level converter model were 180 VAC and 55.68 VDC in both VDC1 and VDC2 inputs, respectively. The output of the single-phase transformer model and modular multilevel converter model was 55.68 VDC and 54.15 VDC, respectively. The input of the single-phase transformer model and the multi-level converter model were 200VAC and 47.91 VDC in both VDC1 and VDC2 inputs, respectively. The output of the single-phase transformer model and modular multilevel converter model was 47.91 VDC and 46.37 VDC, respectively. The input of the single-phase transformer model and the multi-level converter model were 220 VAC and 52.98 VDC in both VDC1 and VDC2 inputs, respectively. The stable output of the single-phase transformer model and modular multilevel converter model was 52.98 VDC and 51.44 VDC, respectively.

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